

DISSERTATION

AN EVIDENCE-BASED APPROACH TO EVALUATING THE OUTCOMES OF  
CONSERVATION EDUCATION

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## ABSTRACT

### AN EVIDENCE-BASED APPROACH TO EVALUATING THE OUTCOMES OF CONSERVATION EDUCATION

There is increasing agreement among practitioners and scientists that addressing modern-day conservation challenges demands multi-disciplinary approaches that more effectively integrate social and natural sciences (Erlich & Kennedy, 2005; Mascia, 2003; Saunders, 2003; Schultz, 2011). These challenges stem from anthropogenic causes and threaten both natural systems and human health and wellbeing (Clayton, Litchfield, & Geller, 2013). Although conservation biologists are proficient in identifying priority locations for conservation and understanding threats to biodiversity in those locations (Myers, Mittermeyer, Mittermeyer, Fonseca, & Kent, 2000; Purvis, Gittleman, Cowlishaw, & Mace, 2000), many projects have fallen short of meeting conservation objectives (Jenks, Vaughan, & Butler, 2010; Mascia, 2003; Verissimo, 2013).

Some have asserted that this is due to an overall failure to recognize and consider the social aspects of conservation (Schultz, 2011). For example, social factors in the form of broad-scale changes such as economic development, population growth, demographic changes, technological advancement, and changing public attitudes and beliefs are the very forces behind the primary threats to biodiversity, including habitat loss and degradation, overexploitation, invasive species, pollution and disease (IUCN, 2010). Furthermore, conventional science may be unable to attend to the complex nature of social-ecological systems whereby each level requires a unique set of concepts, theories and methods (Berkes, 2007; Schultz, 2011). Because threats to

biodiversity extend into biodiversity hot spots in developing countries that also contain a large percentage of the world's population living below the poverty line, more tailored conservation approaches that consider these multi-level social aspects are needed moving forward (Myers et al., 2000; Verissimo, 2013), and conservation education can contribute to this need.

This dissertation responds to a need for theoretically-driven and applied approaches to conservation education that address modern-day conservation challenges. The two primary objectives of this dissertation are addressed in the form of two individual articles. First, Article 1 utilizes a systematic review approach to investigate evaluation of conservation education on a global scale in order to better understand 1) the temporal and spatial trends in conservation education program evaluations over the last 25 years (e.g., whether the frequency of program evaluations has changed both within and outside of the United States); 2) patterns that are evident in the types of conservation and/or social issues addressed through these programs; 3) metrics considered to indicate effectiveness of conservation education programs; and 4) which outcomes of these programs are evaluated (e.g., to what extent do evaluations focus on cognitive targets as well as behavioral, social or ecological outcomes) as well as the methods that have been used to draw conclusions about these outcomes. Findings indicated that evaluation of conservation education programs has increased over the last 25 years in countries around the world. Increasingly, conservation education programs are being developed in response to ecological and social issues, yet metrics to indicate effectiveness are rooted in cognition and behavior change. Three primary needs in the field of conservation education program evaluation emerged from this study and can inform the future direction of the field. First, there is a need to think more holistically about the outcomes of conservation education programs. Secondly, there is a need to consider the ways in which these outcomes are evaluated and reported. Finally, there

is a need for longitudinal evaluation, particularly when attempting to capture ecological outcomes that may not be immediately apparent.

Article 2 utilizes an applied, person-centered interview approach to address a need for more rigorous and culturally relevant evaluation of conservation education program outcomes that is focused on benefits beyond rote knowledge gain and considers community perspectives on metrics or indicators of program success in a rural community in Hawai'i. The study upon which this article is based sought to compare past and present learning about nature in terms of knowledge acquisition and the knowledge itself. Secondly, the study aimed to set the stage for the development of a culturally relevant and comprehensive quantitative evaluation instrument that could be used to document long-term outcomes of conservation education programs that seek to facilitate sharing of local environmental knowledge in Hawai'i.

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# EVALUATING THE EFFECTIVENESS OF CONSERVATION EDUCATION: A SYSTEMATIC REVIEW OF A QUARTER CENTURY OF LESSONS LEARNED

## **Introduction**

Improving engagement of stakeholders in conservation through education, communication, and outreach is often viewed as a means to an end of achieving conservation success (Bickford, Posa, Qie, Campos-Arceiz & Kudavidanage, 2013). Many scholars have touted the benefits of such programs in terms of their ability to affect knowledge, attitudes and awareness, thereby promoting conservation of natural resources (Bickford et al., 2013; Padua, 1994; Roczen, Kaiser, Bogner & Wilson, 2014). However, others have raised concerns about the effectiveness of these programs in achieving their goals and have called for regular program evaluation to ensure objectives are met (Heimlich, 2010).

Moving beyond a case-study approach to examine outcomes across multiple studies, comprehensive reviews such as this one can document the importance and limitations of current conservation education program evaluation strategies (Ardoin & Heimlich, 2013). To date, existing reviews on conservation programs have examined ecological (e.g., species conservation or habitat protection), attitudinal, behavioral and economic outcomes of community-based conservation strategies (e.g., Waylen, Fischer, McGowan, Thirgood & Milner-Gulland, 2010). With regard to conservation education specifically, Zelesny (1999) conducted a meta-analysis of 22 studies published between 1971 and 1996, which used quantitative methods to understand outcomes of interventions aimed at improving environmentally responsible behavior. However, no studies to date have explored multiple types of outcomes of conservation education strategies

assessed using both qualitative and quantitative methods aggregated on a broad scale across space and time.

The purpose of this systematic review is to highlight the trends and broad conclusions that can be gleaned from the last 25 years of published literature on conservation education program evaluation in order to contribute to an evidence-based framework for the field. The term ‘conservation education’ is used hereafter to encompass both traditional western approaches to environmental education (e.g., efforts to improve science literacy among school children) in addition to conservation-related programs that take place in the developing world (e.g., programs that address conservation and development needs such as promoting the use of fuel efficient cook stoves to curb deforestation; see DeWan, Green, Xiaohong, & Hayden, 2013).

### *Research questions*

This study was guided by the following research questions:

1. What are the temporal and spatial trends in conservation education program evaluations over the last 25 years (e.g., in what ways has the frequency of program evaluations changed both within and outside of the United States)?
2. Are there patterns that are evident in the types of ecological and/or social issues addressed through these programs?
3. What metrics are considered to indicate effectiveness of conservation education programs<sup>1</sup>?
4. What are the outcomes of these programs (e.g., to what extent do they focus on cognitive targets as well as behavioral, social or ecological outcomes), and what methods are being used to draw conclusions about program outcomes?

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<sup>1</sup> Metrics that are thought to indicate program effectiveness may not be easily operationalized and are therefore not always measured as program outcomes (thus the parsing out of metrics and outcomes in questions 3 and 4).

## **Conceptual Background**

Conservation education aims to foster the development of knowledge, values, attitudes, behaviors and engagement that might lead to a healthier planet. Because it was conceived largely in developed, post-industrialist countries such as the United States, where social needs are better met, its primary focus has related more to conservation and natural resource management issues than to human well-being and livelihoods (Padua, 2010). In the United States, The Environmental Education Act was signed into law in 1970 and defined environmental education (EE) as “The educational process dealing with man’s relationship with his natural and manmade surroundings, and includes the relation of population, conservation, transportation, technology, and urban and regional planning to the total human environment” (P.L., 91-516). This act was later replaced by the National Environmental Education Act of 1990, which situated EE in the United States within the scope of K-12 education (P.L. 101-619). In 1976, the Belgrade charter (UNESCO-UNEP, 1976) set the stage for a more global emphasis on conservation education, which should strive to “develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current environmental problems and the prevention of new ones.”

Given its application globally, the context and setting for issues addressed by conservation education is broad, and program formats for addressing these issues can range from free-choice learning, where participants from a diversity of backgrounds have full control over the learning experience (Dierking & Falk, 1994; Dori & Tal, 2000; Falk, 2005), to more structured programs that take place within institutions (e.g., schools; Salata & Ostergren, 2010) or as overnight adventure-based recreation experiences which seek to facilitate development of

skills in teamwork, collaboration and leadership (Stern, Powell, & Ardoin., 2008). Additionally, metrics indicating success are varied, and should be guided by the program objectives (Mertens & Wilson, 2012). These objectives, as indicated above, may be linked to metrics assessing ecological characteristics (e.g., survival of reintroduced species or reduction in pollutants), changes in human behavior (e.g., human actions toward the environment), social context (e.g., enhancing social capital to facilitate working with others to find solutions to environmental problems) or human cognition toward conservation issues (e.g., changes in knowledge, attitudes or awareness).

Ultimately, a diverse range of methods and theoretical perspectives are needed in addition to collaboration between practitioners and scientists to evaluate program effectiveness because solutions to conservation problems that prove to be useful in one context may not make sense in another. Garnering lessons learned on a broader scale through a systematic review of case studies that have employed rigorous evaluation of successes and failures is therefore critical for ensuring the viability of education, communication, and outreach efforts as a strategy for biodiversity conservation in the future.

#### *Why a systematic review?*

Frequently seen in fields of medicine and public health, a recent surge in literature has justified the need for systematic reviews in conservation (Pullin and Knight 2001; Fazey, Salisbury, Lindemayer, Maindonald, & Douglas, 2004; Pullin et al, 2004; & Sutherland, Pullin, Dolman, & Knight, 2004). The systematic review methodology is an innovative approach that is part of a movement calling for the use of evidence-based science to inform natural resource conservation through objective assessment of intervention effectiveness or impacts (Pullin & Knight, 2009). Guidelines recommend developing an overarching question for the systematic

review that is relevant to practice or policy, generated in collaboration with key decision-makers, and neutral to stakeholder groups (Pullin & Stewart, 2006).

To this end, some have called for utilizing scientific evidence to develop a less biased platform for decision-making (Pullin & Stewart, 2006). Specifically, documenting and substantiating the effectiveness of conservation education, communication, and outreach efforts using scientific evidence could improve their reach by impacting policies and funding (Kuhar et al., 2007; Sutherland et al., 2004). In response to this need, a systematic review of evaluation techniques for conservation education programs can facilitate a better understanding of linkages between issues addressed by the program, metrics indicating program success, and outcomes documented through evaluation. This can contribute to improvement in program evaluations by identifying gaps in evaluation strategies that can be better addressed in the future. Specifically, the focus of this review is placed upon evaluation of programs seeking to address specific issues that aim to generate change in terms of their desired outcomes (Figure 1). Outcomes are defined as “all relative objectives of the proposed management intervention that can be measured reliably with particular consideration given to the most important management outcome and to any other outcome critical to whether the intervention has greater benefits or disadvantages than any other alternatives” (Pullin & Stewart, 2006; p. 1648). These relative objectives or outcomes, described in detail below, can be categorized as cognitive, behavioral, social and/or ecological.

#### *Outcomes of conservation education*

Bloom (1956) described the cognitive domain of learning as ‘what we know’, which is grounded in acquisition of knowledge and skills and would include concepts such as beliefs and attitudes. Emotions, often referred to as the affective domain and applied in the context of connectedness to nature, have also been shown to play an important role in conservation

education (Wagenet, 2009). Researchers in the field of ecopsychology, for example, have linked emotional connection to nature with environmentally responsible behavior, and argue that this affinity should be a key consideration in conservation education strategies (Louv, 2008; Mayer & Frantz, 2004; Nisbet, Zelenski, & Murphy, 2008). Conservation education programs often seek to influence individual cognition and affective outcomes (Clayton, Litchfield, & Geller, 2013; MacKenzie-Mohr, Lee, Schultz, & Kotler, 2012; Padua, 1994) because there is a belief that these will in turn affect behavior change. In other words, justification for this emphasis is tied in large part to the expectation that a knowledgeable and aware citizenry with appreciation and concern for the environment will be more motivated toward and capable of working to solve environmental problems by practicing environmentally responsible behavior such as conserving energy, recycling or carpooling (Price et al., 2009). This is also consistent with prevailing philosophies that conservation education teaches people *how* to think as opposed to *what* to think by facilitating the establishment of an ecological foundation upon which people can base decisions about their opinions (NAAEE, 2014).

Several theoretical frameworks from the field of social psychology have proven especially useful in organizing key concepts that explain behavior at the individual level. In reality, because human behavior results from a complex mix of cognitions as well as broader influences, providing people with information is often not enough to change behavior (Schultz, 2011). The value-attitude-behavior hierarchy is based on the notion that within the individual exists a hierarchy of cognitions that form the basis for human behavior (Homer & Kahle, 1998; Manfreda, Teel, & Henry, 2009; Teel, Dietsch, & Manfreda, 2015). Values, defined as enduring beliefs that typically form during childhood and are shared within a culture (Schwartz, 2006; Rokeach, 1973), comprise the basis for this hierarchy, which also consists of value orientations,

norms (i.e., what other people are doing or what one perceives other people and oneself ought to do, Graefe & Thapa, 1996), attitudes (i.e., positive or negative evaluations of an object, Eagly & Chaiken, 1993), basic beliefs, behavioral intentions, and behaviors. Icek Ajzen (1991) developed the Theory of Planned Behavior, which posits that attitudes, subjective norms and locus of control influence behavioral intentions, which ultimately influence behavior.

This theory has been supported with empirical evidence in several contexts, including the fields of outdoor recreation and an array of conservation-related applications (Ajzen & Driver, 1992; Fishbein & Ajzen, 2011; Manfredo & Larson, 1993; Kouthouris & Spontis, 2005). For example, Kaiser, Hubner & Bogner (2005) found that the Theory of Planned Behavior accounted for 95% of the conservation behavior of university students. Others have explored the utility of the Theory of Planned Behavior in predicting intentions to conserve water (Lam, 1999), engage in energy conservation to mitigate climate change (Clement, Henning & Osbaldiston, 2014) and willingness to pay for park conservation (Lopez-Mosquera, Barcia & Barrena, 2012).

Hungerford and Volk's (1990) seminal paper on affecting behavior change through conservation education prompted widespread thinking on gaps in conventional wisdom that merely providing people with information would lead to changes in awareness or attitudes, and that this in turn would lead to environmental action. In comparison to the frameworks described above, Hungerford and Volk (1990) posit that citizenship behavior is a product of entry-level variables (e.g., knowledge, attitudes and environmental sensitivity), ownership variables (e.g., a personal investment in issues and commitment to issue resolution) and empowerment variables (e.g., locus of control).

Since this time, concepts from these frameworks have also been integrated into conservation education programs and corresponding evaluations as a means to assess the



pathways through which exposure to a communication strategy contributes to behavior change (Manfredo, 2008; Teel et al., 2015). For example, given the theoretical linkages between knowledge, attitudes and conservation-oriented behavior, a program evaluator may choose to develop a scale that measures attitudes toward a specific target behavior in order to estimate the likelihood that an individual may engage in that behavior.

Tied to this area of investigation is a recent surge in literature applying social marketing theory, which has its roots in social psychology and marketing principles, to conservation behavior change (MacKenzie-Mohr et al., 2012). Broadly, application of this theory has proven to be useful in conservation of natural resources through recognition that behavior change is more effectively achieved through community-level initiatives that focus on simultaneously enhancing benefits of desired behaviors and removing barriers, which are consistent with the notion of perceived behavioral control described above (Ajzen, 1991). Application of social marketing theory has also resulted more specifically in natural resource management improvements in indigenous contexts where local leadership and culturally relevant campaign messaging formed the cornerstone of success (Verissimo, 2013). For example, social marketing has been used to bring about increases in the use of fuel-efficient stoves (DeWan et al., 2013) and to improve enforcement of sanctions (Andriamalala, Peabody, Gardner, & Westerman, 2013; Martinez, Green & DeWan, 2013; Saypanya, Hansel, Johnson, Bianchessi, & Sadowsky, 2013).

Although some scholars contend that conservation is a goal that can only be achieved by changing human behavior (Schultz, 2011), this goal is often fraught with challenges due to the array of multi-level and multi-scale interactions affecting behavior within complex social-ecological systems (Ostrom, 2009). Response to these challenges demands recognition that the individual is nested within a broader social-ecological context that both impacts and is impacted

by the individual (Clayton et al., 2013; Manfredi, Teel, Gavin, & Fulton, 2014). This suggests a need to consider broader-level influences on human behavior beyond the individual focus prevalent in many traditional models of behavior change in conservation efforts. While individual cognitive outcomes can lend insight into the outcomes of an educational initiative (e.g., to what extent does participating in a program influence attitudes, awareness or norms), broader social outcomes should also be considered when seeking to understand the full spectrum of effects that can result from conservation education.

By definition, conservation education seeks to influence elements of social development including individual character, leadership and ability to collaborate with others in order to facilitate participation in identifying and solving environmental problems (Jacobson, McDuff & Monroe, 2006). Recently, some have called for the inclusion of longer-term and broader effects of conservation education on communities, such as the development of social capital, as desired and measured outcomes of conservation education programs (Schneller, 2008). This is also in line with Sterling's (2010) notion of the 'resilient learner', which focuses on individual personal growth or social competencies associated with healthy development and life success.

Understanding the extent to which participating in a conservation education program contributes to individual social development within the context of the broader community or social group has the potential to contribute to more thorough documentation of social-ecological outcomes.

While social outcomes are fundamentally a part of the definition of conservation education, the focus on social outcomes has not been fully realized, due in part to challenges in measurement and operationalization of variables of interest but also due to the rise of conservation education from the United States environmental education tradition. For example, measurement of social factors such as community cohesion and empowerment leading to

increased collective capacity for action can be problematic. In recognition of this, some have pointed out the need for further research to develop practical approaches to documentation of these kinds of social outcomes that can be incorporated into evaluation of conservation initiatives (Vanclay, 2010). Further, there is often a disconnect between the timing of the evaluation and the time it would take for such patterns of social benefits to develop (Lane, Lucas, Vanclay, Henry, & Coates 2005).

In addition to the focus on cognitive, behavioral, and broader social effects of conservation education, some have argued for the need to better document ecological outcomes such as reduction in threats to biodiversity and habitat protection or restoration (Ardoin & Heimlich, 2013). Social marketing, for example, as it has been applied in the conservation context, places a strong emphasis on metrics and evaluation with a clear focus on outputs (e.g., specific behavior changes) and how they translate to biodiversity outcomes (Verissimo, 2013). Although the need for improved conservation education strategies to meet conservation goals has been recognized, greater attention to evaluation of these strategies relative to conservation outcomes is essential for ensuring the desired goals can be met.

### *Program evaluation*

By documenting lessons learned through evaluation, learning from past errors and building upon previous successes is more likely (Heimlich, 2010; Verissimo, 2013). Several scholars working in the broad field of program evaluation have advanced working definitions of evaluation. Trochim (1998) pointed out that program evaluation “uses formal methodologies to provide useful empirical evidence in decision-making contexts that are inherently political and involve multiple, often conflicting, stakeholders, where resources are seldom sufficient and where time pressures are salient” (p. 248). A simpler definition was advanced by Alkin (2010),

who stated that evaluation at its most basic level involves appraising or assigning worth to some entity with a goal of systematic valuation. USAID (2009) defined evaluation in a development context in terms of its ability to objectively assess the effects of a program and to explain linkages between program inputs, activities and outcomes. More specifically in the conservation education context, evaluation can help to determine whether educational efforts are effective, leading to program improvement and/or procurement of funding or support (Carleton-Hug & Hug, 2010; Clayton et al., 2013).

Although distinct definitions for research and evaluation have been established, the term ‘evaluation’ is often used interchangeably with ‘research’ in the literature, and a similar suite of methods is used for research and evaluation. For that reason, research and evaluation studies were both included in this review. The primary difference between research and evaluation lies in how the findings are used. Research seeks to draw conclusions (Alkin, 2010), whereas evaluation makes a judgment.

## **Methods**

Books, conference proceedings and journal articles published within the last quarter century (from 1990 through 2014) that focused on evaluating the outcomes of conservation education programs were systematically searched in Web of Science and Education Resources Information Center (ERIC) databases. The search was limited to this time period due to the development of and advancement of the fields of both conservation education and program evaluation and increased attention given to the notion that simply providing information does not lead to meaningful behavior change following the publication of Hungerford and Volk’s seminal paper in 1990. Search terms “environmental education”, “conservation education” and “environmental communication” were used in all possible combinations along with the search

string “outcomes OR evaluation” contained within the abstracts (ERIC) or topics (Web of Science) of publications. In order to elucidate a broad selection of program evaluations, findings were not limited to peer-reviewed literature.

The initial search yielded a total of 160 results from ERIC and 267 results from Web of Science. First, all abstracts were reviewed, and publications that discussed the outcomes of a specific conservation education strategy or intervention were selected for inclusion in analysis. Publications were excluded for the following reasons: (1) the publication did not describe a specific program or intervention (94 publications excluded); (2) the program was not tailored toward public audiences (e.g., programs developed to “train the trainer” or instruct teachers were excluded; 34 publications excluded); (3) the publication described analysis of curriculum content as opposed to implementation of curriculum (53 publications excluded); (4) the program did not fit the definition of conservation education as described above (e.g., the key search terms elucidated several publications that utilized the term “environmental education” in a different context, such as teaching engineering students about the built and natural environment; 54 publications excluded); and (5) the publication did not report the results of an evaluation of intervention outcomes (14 publications excluded). Additionally, publications were excluded if they: (1) consisted of a literature review, theory paper or “best practices” guide (66 publications excluded); (2) introduced an instrument for evaluation, but did not actually utilize the instrument to draw conclusions about program outcomes (14 publications excluded); (3) were not available due to copyright restrictions (9 publications excluded); and (4) were not available in English (3 publications excluded). The process of excluding publications as described above yielded a total of 86 publications for final review. Seven publications were duplicated between the two

databases, which further reduced the number of publications to a total of 79 studies to include in analysis.

Following established guidelines for conducting systematic reviews, data were extracted from each publication and analyzed (Centre for Evidence-Based Conservation, 2008; Littell et al., 2008). In order to investigate the spatial and temporal trends in program evaluations, the studies were grouped into five-year blocks depending on the date of publication. The location of the study was recorded by country. For studies that did not indicate a specific country, continent was recorded. Due to specific policy frameworks for conservation education in the United States (National Environmental Education Act, 1990) and the goal of capturing differences in issues, metrics and outcomes addressed through programs in different locations, studies were further categorized by location based on whether the evaluations took place within or outside of the United States. Data were entered in an Excel database and organized by research question. Then, the exact language used in the publication to describe the details about the program, evaluation methods and program outcomes was recorded. Excerpts were then coded via constant comparative analysis (Coffey & Atkinson, 1996; Glesne, 2006) to identify and categorize key themes.

## **Results**

The following sections detail the results and implications of findings with regard to the four primary research questions. It is important here to note that issues, metrics and outcomes were analyzed separately using the data contained in each publication. For example, a program may have been designed to address endangered species habitat loss and fragmentation (the issue) and deemed successful if stakeholder perspectives toward conservation changed as a result of implementation and the rate of habitat loss decreased (the metrics). The outcome would be what

was actually measured through the evaluation and may or may not be linked to the issue and/or the metric. For instance, using the example above, outcomes in the form of changes in knowledge of species life history and available alternatives to deforestation may have been measured.

#### *Temporal and spatial trends in conservation education program evaluations*

The first research question sought to understand the temporal and spatial trends in conservation education program evaluations over the last 25 years. The final set of 79 studies analyzed in the systematic review represented 37 countries. Results indicated an overall upward trend in the number of program evaluations conducted over the last quarter century. Of the studies included in this analysis, only three were conducted between 1990-1994. Five studies were conducted between 1995-1999. Twelve were conducted between 2000-2004, and 23 were conducted between 2005-2009. Twelve studies were conducted in 2010 alone, yielding a total of 36 studies conducted between 2010-2014.

When further categorized based on program location (i.e., inside the United States vs. outside the United States), results indicated a recent increase in evaluation of international programs, many of which took place in developing countries (see Table 1 for a summary of program locations and study citations). For example, between 1990-1994, only one evaluation study took place outside the United States, whereas between 2010-2014, 27 studies occurred in international locations (Figure 2).

#### *Types of ecological and/or social issues addressed by the programs*

The second research question assessed the extent to which patterns were evident in the types of issues being addressed through the conservation education programs. Issues were categorized as cognitive, behavioral, social or ecological. For example, some programs were

developed to address a need for increased knowledge (e.g., knowledge of local food sources; see Froelich et al., 2013) or awareness (e.g., urban environmental awareness; see Guerro & Abbott, 1990), both considered cognitive issues, while others were developed to address ecological issues such as species or habitat protection (e.g., see Padua, 1994) or reduction in pollutants in stormwater retention ponds (Betts and Alsharif 2014). Still others were developed to address community empowerment and stakeholder involvement in conservation (social issues such as the need for increased stakeholder participation in environmental decision-making; e.g., see Elfin & Scheafer, 2006) or responsible consumer behavior such as purchasing sustainably harvested seafood (behavior issues; e.g., see Kemmerly & Macfarlane, 2009).

Results indicated that a majority of the programs contained in the studies were developed in response to cognitive (30 studies) or ecological (37) issues. Fewer programs were developed in response to social issues (24) or issues of human behavior (13). Fifty-four studies reported on programs that addressed a single issue (e.g., either cognitive, behavioral, social, or ecological), and 25 studies were based on programs addressing two issues.

When the issues were further examined according to date of publication, results indicated that although there were no significant differences in issues that could be explained by year of publication, a recent surge in evaluation studies centered on programs intended to address ecological issues was evident (Figure 3).

Chi-squared analyses indicated that there were significant differences by program location in the number of studies with programs addressing cognitive and ecological issues (Figure 4). For example, 17 studies involved programs that were developed to address cognitive issues in the United States, while 13 studies contained programs developed to address cognitive issues internationally ( $\chi^2 = 9.52, df = 1, p = .003$ ). While only six studies that took place in the



United States had programs that were developed to address ecological issues, 31 studies were based on programs addressing ecological issues internationally ( $\chi^2 = 11.24$ ,  $df = 1$ ,  $p = .001$ ).

There were no significant differences for behavior and social issues by program location in terms of the number of studies reporting on programs with that focus.

#### *Metrics to indicate program effectiveness*

The third research question sought to identify metrics considered to indicate effectiveness of conservation education programs. Indicators or metrics that would point to program success were often mentioned in the publication introduction or description of the program or site but were not always measured directly as program outcomes due to challenges in operationalization. Consistent with the classification scheme applied for other research questions, metrics were categorized as cognitive, social, behavioral or ecological. Cognitive or affective metrics such as knowledge, attitudes, awareness or connection to nature were mentioned most often (64 studies). For example, Guerra and Abbott (1990) noted that metrics of program success for a conservation education program in New York City included changes in knowledge or awareness about natural and urban environments. Similarly, several studies referenced attitudes toward conservation issues as metrics of program success (e.g., attitudes toward endangered species; see Curti & Valdez, 2009). Thirty studies discussed human behavior metrics. For instance, Cincera and Krajhanzl (2013) mentioned that engagement in environmentally responsible behavior such as reducing water consumption and recycling would indicate success of a conservation education program in the Czech Republic. Fourteen studies referenced social metrics, such as improved communication and exchange of information about the environment between practitioners and community members (Curti & Valdez, 2009). Six studies mentioned ecological metrics, such as improvements in stream water nutrient concentrations and changes in species types and

abundance found in an area (Rhodes et al., 2007), success of species reintroduction efforts (Cartwright et al., 2012) or survival of trees planted during a conservation education program at a primary school in Gambia (Paulette & Orr, 2010). Four studies did not have pre-identified metrics or indicators of success, and instead utilized inductive approaches to understand program outcomes (e.g., Pringle et al., 2003). Many of the studies indicated more than one metric; five studies identified three categories of metrics, 29 identified two categories, and 41 identified one category.

#### *Program outcomes and evaluation methods used for outcome assessment*

The final research question explored conservation education program outcomes as well as the methods used to assess those outcomes. Cognitive or affective outcomes were defined as measured changes in knowledge, attitudes, awareness or affect. Social outcomes were defined as improvements in social capital, improved communication within community groups, changes in individual characteristics that impacted association with a group (e.g., leadership skills or character) and empowerment to influence policy and become involved in local environmental issues in locations where programs took place. Social capital, a nonmonetary source of power, can lead to more effective engagement with policymakers and develops through participation in groups (Portes, 1998). Ecological outcomes were defined as positive impacts on the natural or biophysical environment. These included improvements in targets that prevent loss of biodiversity, such as reduction in overconsumption of resources (e.g., Possingham, Bode & Klein, 2015) and improved species survival (e.g., Curti & Valdez, 2009; Dolins, 2010). Ecological outcomes also included enhanced protection of natural resources (e.g., development of a new protected area; see Padua, 2010). Behavioral outcomes were defined as either changes in behavioral intentions or self-reported engagement in target behaviors.

Four studies did not measure cognitive or affective outcomes (e.g., Paulette & Orr, 2010; Cutter-Mackenzie, 2010), and six studies reported cognitive outcomes that were not statistically significant. For example, a program in Florida was found to have little effect on boaters' attitudes, knowledge and behaviors regarding manatees (Morris et al., 2007). A majority of studies (69) measured and reported positive cognitive or affective outcomes (e.g., Stern et al., 2008; Uzun & Saglam, 2007).

Most studies (50) did not measure social outcomes. Twenty studies reported positive social outcomes. For example, some programs resulted in an increased sense of community through improved interaction between members of a community or group (e.g., Ballantyne et al., 2000; D'Amato & Krasny, 2011). Other studies noted participant empowerment, character development and leadership skills (e.g., Padua, 2010; Stern et al., 2011), and several reported improved communication between community members and government officials. Some studies indicated that these social outcomes influenced or had the potential to influence environmental policy (e.g., McDuff & Jacobson, 2000; Pearson et al., 2014). Six studies reported anecdotal social outcomes. For example, Cutter-MacKenzie (2010) speculated that a school-based program in Australia led to student empowerment and commitment, although these weren't measured in the evaluation. Similarly, while not a measured outcome, Dolins and colleagues (2010) noted improved ability for knowledge sharing and transfer within a community in Madagascar. Three studies measured social outcomes but did not find evidence of positive social outcomes. Of these, one reported negative or harmful social outcomes due to a lack of collaboration with key community stakeholders during program development and implementation (Cartwright et al., 2012).

Thirty-five studies indicated changes in behavioral intentions or self-reported behavior. For example, Middlestadt and colleagues (2001) found that after participating in a program about water conservation, youth reported more frequent engagement in behaviors such as taking shorter showers and brushing teeth with the tap off compared to youth who had not participated in the program. Of the studies that reported behavior change, two studies indicated that results did not persist after a seven-week follow up period (Froelich et al., 2013; Gaus & Mueller, 2012). One study discussed anecdotal behavior change that was not measured formally as a part of the evaluation (Betiang, 2010). Two studies did not find evidence of behavioral outcomes (i.e., changes in behavior were not significant; Flowers, 2010; Morris et al., 2007). Forty-one studies did not measure behavioral outcomes.

Most studies (62) did not measure ecological outcomes. Ten studies documented positive ecological outcomes, including successful outplanting of trees (McDuff & Jacobson, 2000), clean up of a nature sanctuary (Elfin and Scheafer 2006), development of a new protected area (Trehwella et al., 2005) and decreases in illegal hunting (Padua, 1994). Further, three studies found anecdotal evidence of positive ecological outcomes. For example, Padua (1994) noted that one year following a program's implementation, anecdotal evidence suggested that local community members became more involved in park conservation by helping to extinguish a forest fire with park employees and rallying to stop illegal logging in a farm near a park in Brazil. Four studies found no evidence of positive ecological outcomes (e.g., no changes in short-term survival of re-introduced animals that could be attributed to program implementation; see Cartwright et al., 2012).

Many of the studies indicated more than one outcome. For example, the only study to report all four categories of outcomes used an inductive approach with no pre-determined

metrics of success and found that participation in an environmental literacy program in an unspecified African country led to increased awareness and knowledge, changes in behavioral intentions (pursuit of conservation-oriented careers for youth), community involvement and influence on environmental policy, and tree planting (McDuff & Jacobson, 2000). Fourteen studies mentioned three categories of outcomes. For example, Betiang (2010) found evidence of ecological outcomes of reduced night hunting and clearing of forests on riverbanks, cognitive outcomes of increased awareness of conservation issues, and social outcomes of improved quality of cultural life and empowerment. Most evaluations (30) identified two categories of outcomes, 28 evaluations identified one category, and five did not identify any outcomes at all.

Of the 79 studies examined, 23 studies used mixed methods, 13 studies used qualitative methods (e.g., participant observation, interviews, document review; see McDuff & Jacobson, 2000), and the majority of studies (40) used quantitative methods. Quantitative methods typically included testing at multiple points in time to measure changes in desired outcomes (e.g., effects of program participation on knowledge, attitudes and behavioral intentions; see Dimopolous et al., 2008). There were no significant differences in methods that could be attributed to year of publication or program location. Twenty-seven studies used a control group (e.g., quasi-experimental design; see Gaus & Mueller, 2012), and 51 did not. Only eleven studies mentioned that the evaluation goals were linked to audience values or developed with stakeholder input. Of these, all but one evaluation took place outside of the United States.

## **Discussion**

The mission of the International Union for the Conservation of Nature (IUCN) is “to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically

sustainable” ([www.iucn.org/about](http://www.iucn.org/about)). Realizing this goal during a time of rapid social and ecological change will require scientifically grounded decision-making to inform development, implementation and evaluation of conservation education strategies around the world. Lessons learned from more comprehensive evaluation of conservation education programs can ensure that program development is responsive to social and ecological needs on the ground. Toward this end, and in response to recent calls for greater development of evidence-based frameworks in the field of conservation (Pullin & Knight, 2009; Pullin & Stewart, 2006), the purpose of this review was to identify the trends and broad conclusions in conservation education program evaluations over the last quarter century. Results indicated that evaluation of conservation education programs has increased over the last 25 years in countries around the world. Increasingly, conservation education programs are being developed in response to ecological and social issues, yet metrics to indicate effectiveness are rooted in cognition and behavior change. Three primary needs in the field of conservation education program evaluation emerged from this study and can inform the future direction of the field.

First, there is a need to think more holistically about the outcomes of conservation education programs. This is in line with trends in the field of conservation as a whole, in which social issues are increasingly being recognized as intertwined with conservation issues, particularly in developing countries (Mascia, 2003). The results of this review indicated a recent jump in the number of evaluations of programs developed to address ecological issues and in the number of program evaluations that have taken place outside of the United States, many of them in developing world contexts. Because the field of conservation education was conceived largely in developed, post-industrialist countries such as the United States, its primary focus has related more to conservation and natural resource management issues than to human well-being and

livelihoods (Padua, 2010). This has led to a disconnect between program issues, metrics and outcomes in addition to evaluation strategies and conservation goals and points to a need for greater collaboration between natural and social scientists.

Developing, implementing and evaluating a conservation education program demands collaboration between parties that often have different goals and objectives. Greater attention should be given to social and ecological outcomes, as opposed to the traditional focus on cognitive measures as indicators of success. Theoretical models highlighting the precursors to environmentally responsible behavior were frequently mentioned in the studies examined in this review and cognitive outcomes (e.g., knowledge, understanding, awareness, attitudes) were reported more than twice as often as ecological outcomes and social outcomes combined. Also, three studies in this review mentioned anecdotal evidence of ecological outcomes even though they were not formally evaluated (Evans, 2005; Kuhar et al., 2007; Padua, 1994). Similarly, five studies included in this review mentioned anecdotal evidence of social outcomes (Cutter-Mackenzie, 2010; Flowers, 2010; Padua, 1994; Schneller, 2008; Sellman & Bogner, 2013). Adopting a narrow view of outcomes that excludes potential outcomes (e.g., social and/or ecological outcomes) limits understanding of the potential impacts of the program and may limit future support for continued conservation education programming. Although most conservation projects incorporate education and outreach in some capacity, the evaluation of outcomes related to these activities is sometimes based on intuition and limited by lack of funding and support, leading to an underestimate of their impact in the scientific literature (Van der Ploeg, 2011).

Secondly, there is a need to consider the ways in which these outcomes are evaluated and reported. Who defines the objectives for program evaluation and how they are defined determines what is evaluated and what methods are used. Although some have indicated that

stakeholder perspectives should be considered and incorporated into evaluation design (Mertens & Wilson, 2012), only eleven publications mentioned that program evaluations were developed with audience or stakeholder input in mind. Although results indicated that a greater proportion of programs that took place outside the United States were developed with stakeholder input compared to those which took place within the United States, there is still room for improvement overall. For the 31 programs that took place outside of the United States without stakeholder input, program evaluators operating under a Western framework may have pre-determined metrics for success that guide measurement of program outcomes. Ultimately, borrowing evaluation strategies rooted in a Western understanding of teaching and learning may limit opportunities for optimal community engagement and support throughout the process and holistic understanding of program outcomes. Additionally, only five out of 79 studies reported no outcomes at all. Sharing results of programs, even when desirable outcomes are not achieved, can help to better inform future practice through lessons learned.

Only 13 studies used qualitative methods, which can lend further insights into program outcomes (Stankey & McCool, 2004) and have been shown to be particularly useful in cultural contexts in which storytelling is a common form of communication (Thomas, Bruyere, Sundaresan, Bouzo, Welden & Trimarco, 2015). Along these lines, though mixed-methods approaches can be helpful in achieving pragmatic research and evaluation goals (Mertens & Wilson, 2012), these designs should be employed thoughtfully and should match the evaluation questions and program objectives.

Third, there is a need for longitudinal evaluation, particularly when attempting to capture ecological outcomes that may not be immediately apparent. Although conservation activities that yield rapid results are often prioritized over education efforts in urgent situations (e.g., critically



endangered species) due to the perception that benefits from these efforts may be slow to accrue and difficult to measure (Trewhella, 2005), there is increasing recognition that incorporating education programs into conservation plans is a necessary strategy for the long-term success of conservation initiatives (Curti & Valdez, 2009). Since many studies examined program impacts immediately following participation, the sustainability of intervention outcomes could not be examined (Gaus & Mueller, 2012). Zint and colleagues (2002) suggest that in order for programs to achieve their full potential, they should seek to provide multiple experiences over time that are coordinated with other interventions. Longitudinal evaluations can facilitate a better understanding of the extent to which outcomes and impacts persist into the future.

### *Limitations*

Although this study provides a starting point for thinking more holistically about conservation education program evaluation, there are several limitations worth noting. First, the distinction between approaches to conservation education within and outside of the United States is ambiguous. Arguably, there are locations within the United States where conservation education is not rooted in a Western understanding of teaching and learning and more strongly emphasizes outcomes of human well-being and livelihood. Conversely, several program evaluations that took place in post-industrialist countries were grouped with those in developing countries and compared with United States evaluations. Secondly, including both qualitative and quantitative evaluation studies in analysis led to difficulties in extracting data for analysis. For this reason, issues, metrics and outcomes were coded and categorized by one coder. This approach may introduce a negligible amount of bias into the results.

Table 1. List of program locations and study citations included in the systematic review

Program location <sup>1,2</sup>	No. studies	References
United States	28	Betts & Alsharif, 2014; Cachelin et al., 2009; D'Amato & Krasny, 2011; Elfin & Scheafer, 2006; Evans, 2005; Fitzgerald, 2000; Flowers, 2010; Guerro & Abbott, 1990; Herman et al., 2013; Hilaire et al., 1998; Hofreiter et al., 2007; Kemmerly & Macfarlane, 2009; Kumler, 2011; Liddicoat & Krasny, 2014; Marynowski & Jacobson, 1999; Morris et al., 2007; Price et al., 2009; Pringle et al., 2003; Salata & Ostergren, 2010; Smith-Sebasto & Semaru, 2004; Stern et al., 2008; Stern et al., 2011; Teisl et al., 2011; Theimer & Ernst, 2012; Wagenet, 2009; Waliczek, 2003; Williamson & Dann, 1999; Zint et al., 2002
Germany	5	Drissner et al., 2010; Ruchter et al., 2010; Liefelaender et al., 2013; Sellman & Bogner, 2013; Seybold et al., 2013
Australia	5	Ballantyne et al., 2010; Cutter-Mackenzie, 2010; Lane et al., 2005; Pearson et al., 2014; Sheehy & Dingle, 2004
Greece	3	Papananagou, 2005; Hovardes & Poirazidis, 2006; Dimopolous et al., 2008
Brazil	3	Padua, 1994; Engles & Jacobson, 2007; Padua, 2010
England	2	Davies et al., 2012; Jensen, 2014
Africa	2	McDuff & Jacobson, 2000; Kuhar et al., 2012
Israel	2	Gorodetsky & Keiny, 1995; Dori & Tal, 2000
Mexico	2	Ruiz-Mallen et al., 2009; Schneller, 2008
New Zealand	2	Kolandi-Matchett et al., 2009; Rhodes et al., 2007
Uganda	2	Kuhar et al., 2007; Kuhar et al., 2010
Bavaria	1	Froelich et al., 2013
Congo	1	Cartwright et al., 2012
Czech Republic	1	Cincera & Krajhanzl, 2013
Ecuador	1	Espinosa & Jacobson, 2012
Gambia	1	Paulette & Orr, 2010
India	1	Roberts, 2009
Japan	1	Sakurai & Jacobson, 2011
Jordan	1	Middlestadt et al., 2001
Madagascar	1	Dolins et al., 2010
Nigeria	1	Betianga, 2010
Ontario	1	Schultz & Joordens, 2014
Panama	1	Curti & Valdez, 2009
Peru, Costa Rica, Tanzania	1	Duerden & Witt, 2010
Portugal	1	Lima et al., 2010
Republic of San Mariano	1	Van der Ploeg et al., 2011
South Africa	1	Ferreira, 2012
Spain	1	Jose-Diaz et al., 2012
Switzerland	1	Bogner, 1999
Taiwan	1	Hsu, 2004
Tanzania	1	Howe, 2001
Turkey	1	Uzun & Saglam, 2007
West Indies	1	Trewhella et al., 2005
Not mentioned	1	Gaus & Mueller, 2012

<sup>1</sup>Continent is noted for publications that did not specify a country location.

<sup>1</sup>One publication (Duerden & Witt, 2010) analyzed results of a program that took place in three countries. These are indicated together above since outcomes for the entire program were reported and analyzed together.

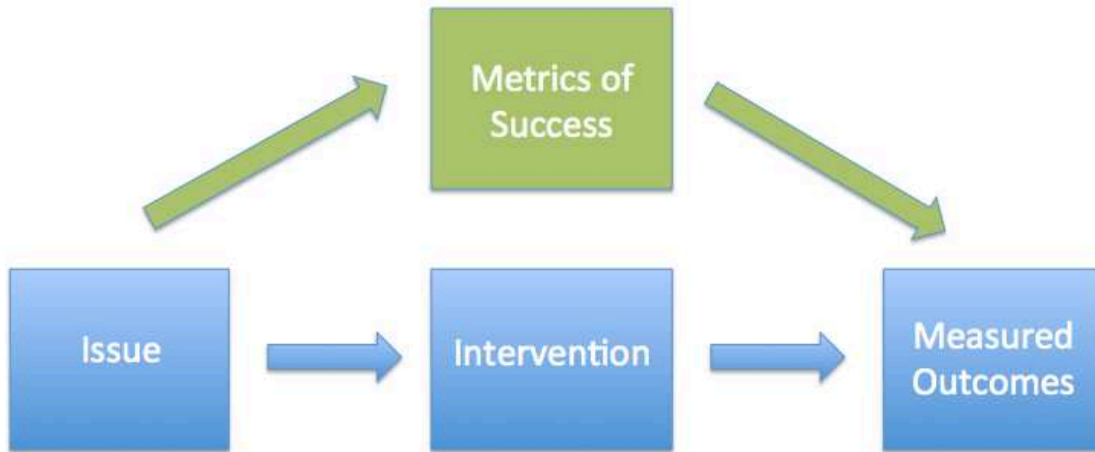


Figure 1. Heuristic model of relationships between issues addressed by programs, ideal metrics or indicators of success, and measured outcomes.

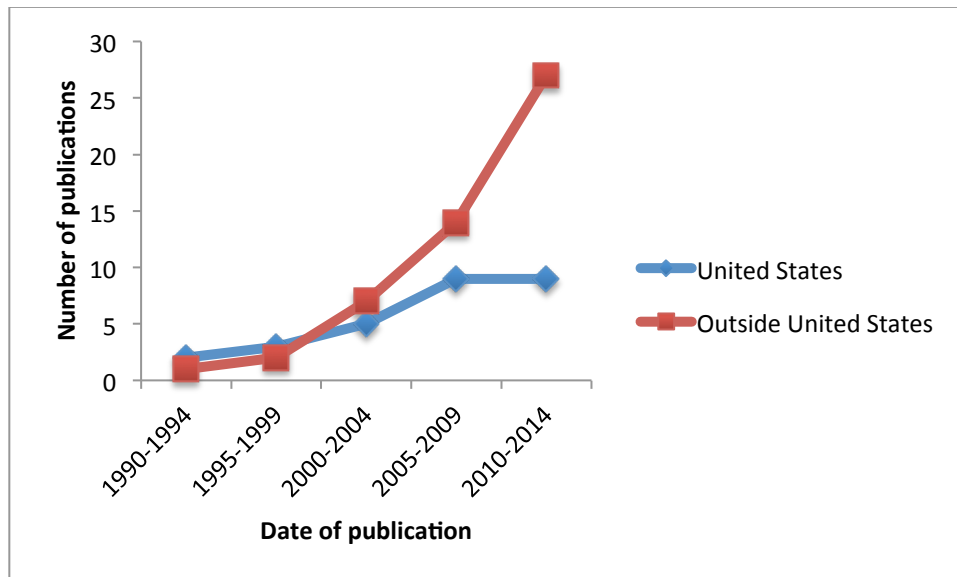


Figure 2. Number of program evaluation studies based on date of publication and program location

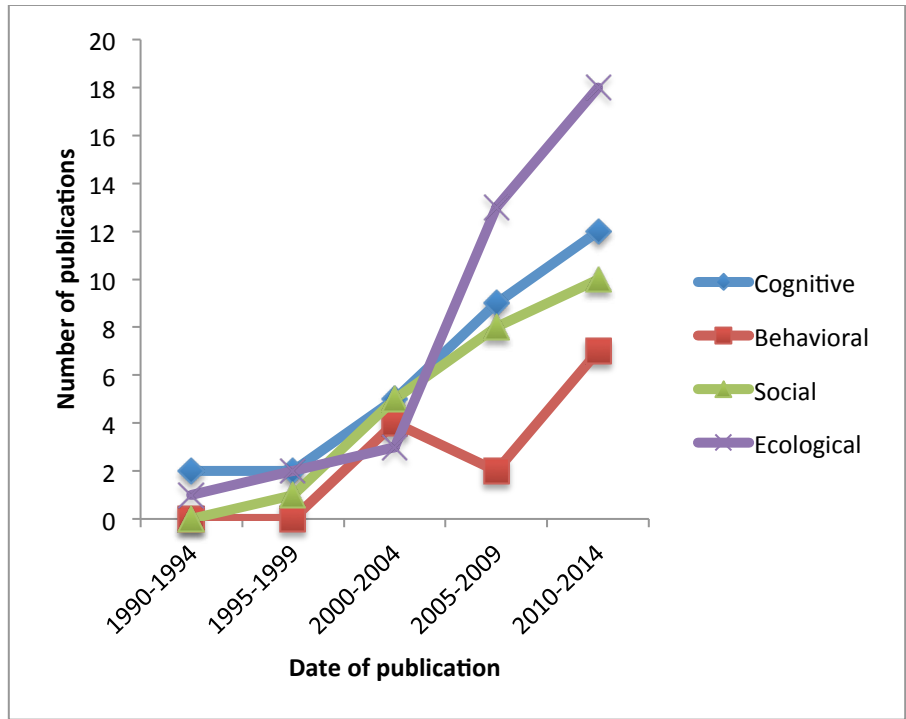


Figure 3. Number of program evaluation studies based on year of publication and type of issue addressed

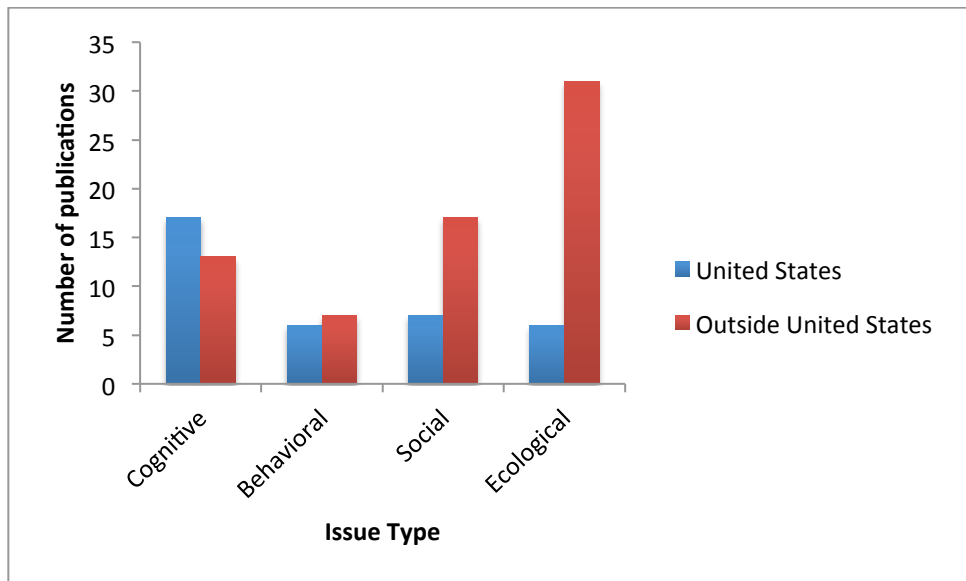


Figure 4. Number of program evaluation studies based on program location and type of issue addressed

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# FACILITATING TRANSMISSION OF LOCAL ENVIRONMENTAL KNOWLEDGE IN HAWAI'I THROUGH CONSERVATION EDUCATION

*“...our problem is not just – the things we see here are not just here, you know. This happens to so many people around the world, whether they’re traditional people or not...and I realize that we’re just a microcosm of a greater ailment to our people, the world...and so when I say all of these things, I do recognize that it’s not just us. It’s everybody”.* Conservation education practitioner, Hawai’i

## **Introduction**

There is increasing agreement among practitioners and scientists that addressing modern-day conservation challenges demands a collaborative approach that more effectively integrates social and natural sciences (Mascia, 2003). Conservation biologists are proficient in identifying priority locations for conservation and understanding threats to biodiversity in those locations (Myers, Mittermeyer, Mittermeyer, Fonseca & Kent, 2000; Purvis, Gittleman, Cowlishaw & Mace, 2000), yet successful efforts to conserve biodiversity have been spotty at best (Jenks, Vaughan & Butler, 2010; Mascia, 2003). Some have argued that this is due to an overall failure to recognize and address the social aspects of conservation (Schultz, 2011) and the inability of conventional science to attend to the complex nature of systems whereby each level requires a unique set of concepts, theories and methods (Berkes, 2008). The broad field of environmental education, communication and outreach can contribute to addressing this need by informing development of tailored programs through a better understanding of target audiences and as such address threats to biodiversity and human livelihoods.

Social science research can also inform evaluation of these programs, which is needed to ensure that objectives have been met (Heimlich, 2010). Without rigorous evaluation beyond simplistic pre- and post-measures that focus on one particular area of the cognitive domain (e.g.,

knowledge), understanding broader impacts of programs on cognitive, social, behavioral and conservation outcomes will be difficult. Specifically, evaluation measures conducted immediately after programs take place may be inadequate to understand the full range of benefits that can result. Establishing clear criteria for program evaluation is necessary for conservation educators who seek funding for future program support and to facilitate better collaboration between formal and informal educators (Heimlich, 2010). As well, situating evaluations within a larger body of theory exploring locally relevant human-environment interactions via social and cultural connections with nature is key to developing robust evaluations that can contribute to a growing body of literature documenting program outcomes.

Some have called for conservation practitioners to consider local knowledge in decision-making, arising from the recognition that those who live near to and depend upon local natural resources desire more participation in decisions that affect their livelihood (Field, Brown & Burdge, 2004). Drawing from the anthropological tradition of the field of human dimensions of natural resources, which incorporates qualitative modes of inquiry to inform cross-cultural research, can more effectively integrate local knowledge into conservation decisions (Manfredo, 2008), including decisions about conservation education programs.

### **Conceptual background**

#### *Clarification of terminology*

Berkes, Colding and Folke (2000) define Traditional Ecological Knowledge (TEK) as a complex arrangement of knowledge, practice and belief that is gained through direct experience and transmitted culturally between generations. TEK evolves over time and facilitates adaptation to changing environmental conditions in response to inherent system uncertainty and unpredictability. Highly localized, TEK incorporates knowledge of ecosystem structure and



function (Berkes, 2008). It is a specific focus within a body of literature on indigenous knowledge, which encompasses more broadly the unique, local knowledge of particular cultural groups or indigenous peoples (i.e., original inhabitants of an area) and recognizes that traditions are dynamic and change over time (Dudgeon & Berkes, 2003). Culture can be defined as “a system of beliefs, values, norms and behaviors that are transmitted through social learning” and shared to some extent both locally and globally (Hrushka, 2009; Kohrt, Hadley & Hrushka, 2009, pp. 230), and ‘knowledge’ refers to a holistic understanding of ways of knowing and interacting with the environment (Dudgeon & Berkes, 2003). In the last few decades, research has emerged that highlights the distinct contributions TEK can make to conservation of biological diversity, both at the species and ecosystem levels (Berkes et al, 2000; Drew & Henne, 2006; Fraser, Coon, Prince, Dion, & Bernatchez, 2006; Gadgil, Berkes & Folke, 1993; Sheil & Lawrence, 2004). However, some have noted that the word ‘tradition’ implies a static state that is rooted in the past and unable to adapt to changing contexts (Stevenson 1996, 1999).

Given the notion that the extent to which an individual self-identifies as ‘indigenous’ in Hawai‘i may not necessarily reflect direct descent from the original inhabitants, I have chosen to use the term ‘local environmental knowledge’ in this manuscript when referring to locally and culturally relevant knowledge about nature that has been and is currently shared with the next generation, recognizing that there is a separate body of literature associated with traditional ecological knowledge, indigenous knowledge, and local environmental knowledge. Although I draw mainly from the TEK literature to frame the findings, I believe that use of the term “local environmental knowledge” is more appropriate for the context of this study and use this term when presenting results.

### *Theoretical perspectives – TEK*

TEK is important and worth studying for several reasons. First, TEK has much to contribute to our understanding of social-ecological systems. Beyond the notion that others may have something to teach us that could advance further scientific understanding, Sillitoe (1998) advocates for “development-oriented indigenous knowledge” that seeks to uncover how this kind of knowledge can contribute to development. This thinking is related to arguments advanced by Lalasz, Kareiva and Marvier (2011), who posit that prioritizing social and environmental justice issues will ultimately lead to more effective conservation of biodiversity. In other words, TEK can contribute to sustainable development, which can in turn result in more effective biodiversity conservation.

Additionally, TEK has the potential to function as a rich source of information about local-level ecosystem functioning within a defined spatial scale over many generations by providing a glimpse into past human-environment relationships (Ellis, 2005; Green, Billy & Tapim, 2010; Ramstad, Nelson, Paine, Beech, Paul, Paul, Allendorf & Daugherty 2006). TEK can lead to enhanced capacity to determine ecosystem health and to maintain, restore or improve ecosystems (Chinn, 2007; Fraser et al., 2006). Incorporation of TEK into site-specific resource management also has implications for both broad-scale conservation of biodiversity (Gadgil et al., 1993) and conservation of specific rare and endangered species (Colding, 1998).

Because social factors in the form of broad-scale changes such as economic development, population growth, demographic changes, technological advancement, and changing public attitudes and beliefs are the very forces behind the primary threats to biodiversity (e.g., habitat loss and degradation, overexploitation, invasive species, pollution and disease; IUCN, 2010), identifying ways in which knowledge has changed in specific locations can help conservation

education practitioners to develop more targeted approaches to communicating with public audiences. In a different vein, some have advocated for the application of biocultural approaches to conservation that seek to incorporate different worldviews and knowledge systems into conservation planning and to tailor conservation interventions to local social-ecological contexts (Gavin, McCarter, Mead, Berkes, Stepp, Peterson & Tang, 2015). Comprehensive evaluation of the successes and failures of conservation education approaches that seek to integrate diverse knowledge systems can contribute to ensuring programs are meeting their goals.

### *Knowledge change*

Changes in TEK have been attributed to the loss of native languages (Cristancho & Vining, 2009; Ellis, 2005) and changes in teaching practices resulting from a widespread move toward standardized Western science education (Chinn, 2007; Cristancho & Vining, 2009; Gruenwald, 2003). Other drivers of TEK change include influx of invasive species and the simultaneous decline of native species due to habitat loss and degradation (Kaneshiro, Chinn, Duin, Hood, Maly & Wilcox, 2005; Pimm, Moulton, Justice, Collar, Bowman & Bond, 1994), which limit opportunities to interact directly with culturally relevant species. Youth conservation education programs that seek to incorporate TEK have been found to contribute to enhanced sense of place (Semken, 2005), increased responsibility toward the environment (Eijck & Roth, 2011), and increased knowledge about locally relevant ecosystem science (Endreny, 2010; Thomas et al., 2014).

### *Effects of cultural connections with nature*

According to the Millennium Ecosystem Assessment (2005), humans benefit from ecosystems in aesthetic, non-material ways, which include spiritual enrichment and reflection (Smith, Case, Smith, Harwell & Summers, 2013) in addition to overall psychological well-being.

Spending time learning about nature also contributes to stress reduction and psychological well-being among youth (Orsega-Smith, Mowen, Payne & Godbey, 2004; Ulrich, Dimberg & Driver, 1991; Wolsko & Lindberg, 2013). In fact, access to nature was found to serve as a buffer for children living under high stress conditions, bolstering resilience to adversity (Wells & Evans, 2003). The restorative emotional benefits of spending time in nature are particularly apparent for children who have experienced specific traumatic events (Louv, 2008). Yet another study found that students' feelings of self-confidence and capacity for moral judgment were associated with engagement in outdoor recreation (Palmberg & Kuru, 2000), and others found that exposure to natural environments contributed to improved outcomes for children with mental disorders such as Attention Deficit Hyperactivity Disorder (Faber-Taylor, Kuo & Sullivan, 2002; Kuo, 2001; Taylor & Kuo, 2006). An important conclusion drawn from these findings is the need for environmentally based curricula and programs that focus on natural elements (Taylor & Kuo, 2006).

Strong, Malina, Blimkie, Daniels, Dishman, Gutin et al. (2005) found a lower risk of chronic illness development in children who were physically active outdoors. Additionally, engaging in outdoor activities has been associated with contributing to a decrease in the nationwide obesity epidemic (Barnowski, Thompson, DuRant, Barhowski & Puhl, 1993; Davison, Edmunds, Wyker, Young, Sarfoh and Sekhobo, 2011; Kruger, Nelson, Klein, McCurdy, Pride & Carrier-Ady, 2010; Wang, 2007; Zimmerman, Christakis & Meltzoff, 2007). This is important given that a sedentary lifestyle has been identified as a global public health problem, accounting for nearly half of the global burden of disease (Louv, 2008).

Recently, a large body of literature has debated issues of culture and education, drawing linkages between adoption of Western models of education and many of the concerns described

above. Some argue that an overall failure to incorporate diverse ways of knowing into teaching and learning is a form of forced acculturation (Aikenhead, 2001; De Beer & Whitlock, 2009), and there has been a movement in some Pacific regions to redevelop curriculum around local contexts and issues (Bajund, 2008; Maclean, 2002). Similarly, conservation education programs that take place outside of the formal school setting can provide place-based, locally-relevant opportunities for participants to acquire local environmental knowledge.

#### *Literature gaps and study justification*

This study contributes to existing gaps in literature in several ways. First, it contributes to a small but growing body of literature that explores intergenerational variation in local environmental knowledge in Oceania. Secondly, although others have studied the drivers of TEK variation and change in transmission pathways in Oceania (McCarter, 2014), Hawai'i's geographical position in Oceania juxtaposed with its political position within the United States makes it a unique case. Finally, it represents an approach that can help to develop more comprehensive evaluation strategies for conservation education programs that seek to incorporate local environmental knowledge.

Understanding challenges and opportunities in knowledge change from the perspectives of community elders and conservation education practitioners and the potential social and ecological benefits of integrating local environmental knowledge into conservation education programs can help to develop more effective and meaningful metrics of success for education and outreach strategies. Integrating information about local cultural values and human relationships with the natural world into conservation education program evaluation efforts can ensure that these efforts are successful. Linking elder and practitioner perspectives on TEK is an important first step in measuring outcomes of an effective program.

A comparison of past and present local environmental knowledge in Hawai'i is timely for two primary reasons. First, understanding how cultural knowledge might be changing intergenerationally may lead to more effective conservation of biological diversity. TEK of endangered species, for example, has the potential to contribute to exchange of knowledge between local groups and scientists as well as provide ways for local groups to share responsibility for conservation with scientists (Berkes, 2008). The endangered 'Alalā (*Corvus hawaiiensis*) has mainly been recognized for its important role in seed dispersal of native plants (Culliney, Pejchar, Switzer, & Ruiz-Guitierrez, 2012), though limited research has indicated that the 'Alalā may also hold significance in Hawai'ian culture (Teel & Bruyere, 2010; Walters, 2006). Currently, this species exists only in captivity, and efforts are underway to reintroduce 'Alalā to the wild within the next several years. 'Alalā reintroduction is rife with contention, particularly among individuals who wish to pursue activities such as hunting on public and private lands where access may be restricted as a result of habitat restoration and species recovery plans. Success of this reintroduction depends in part on habitat fencing and restoration, including removal of invasive plant and game species. However, the ability of conservation organizations to partner with local communities and attend to the diversity of perspectives that exist when developing outreach and communication strategies will play a critical role in achievement of these conservation goals.

Secondly, learning about nature in a culturally relevant way may have impacts on community social issues affecting youth. Though a large body of literature has investigated, for example, the mental health benefits of environmental education for youth in America (Chawla, 1999; Jordan & Robinson, 2008; Taylor & Kuo, 2006; Wells & Leckies, 2006), few studies have focused specifically on mental health benefits associated with nature-based education for

American youth with unique indigenous perspectives. Some have hypothesized that encroachment of Western values along with declines in community cohesion and the rise of the nuclear family, coupled with lack of economic opportunities, have contributed to distress among youth in the South Pacific (Hezel, 1989; Macpherson & Macpherson, 1987; McDade, 2002; Rubinstein, 1992).

### *Project background*

During the summer of 2011, I conducted research that sought to understand the outcomes of a place-based summer enrichment program for a group of Hawaiʻian youth. Results indicated that learning about nature through a cultural lens affected the type of knowledge gained (i.e., knowledge of native Hawaiʻian species and their role in nature and culture as opposed to knowledge of non-native invasive species) from participating in the program and a different perspective on the role humans should play in natural resource stewardship (Thomas, Teel & Bruyere, 2014). While conducting this research, I developed relationships with community elders, conservation leaders and NGO affiliates in addition to youth and their families. I spoke informally with these individuals regarding their perceptions of youth connections to nature and stewardship of cultural and natural resources in Hawaiʻi in addition to ways in which the education system could be more responsive by adapting and developing locally-relevant, place-based curriculum. Following this research, I returned to the area in 2012 to share the research findings with the community and discuss ideas for future work, which revealed the need for more rigorous and culturally relevant evaluation of the outcomes of youth environmental education programs. In particular, evaluation of these programs should focus on benefits beyond rote knowledge gain and should consider community perspectives on metrics or indicators of success.

### *Research questions*

Building from this prior work, the purpose of the present study was twofold. First, the study sought to compare current local environmental knowledge with that of past generations in a rural Hawaiʻian community. Secondly, the study entailed a more applied focus, which aimed to set the stage for development of a culturally relevant and comprehensive evaluation strategy that could be used to document long-term outcomes of conservation education programs that seek to facilitate acquisition of local environmental knowledge in Hawaiʻi. In order to achieve this purpose, semi-structured interviews were conducted with environmental education practitioners and community elders in a rural community in Hawaiʻi in response to the following research questions (Kupuna and practitioner interview guides are contained in the Appendix, along with Table 2, which summarizes interview questions organized by research question):

1. What are the similarities and differences between past and present local environmental knowledge about nature?
2. What are the barriers to learning about nature for youth?
3. What measures of success/failure indicate that local environmental knowledge has been shared successfully?

### **Methods**

Developing an informed conservation education program evaluation strategy requires collaboration between practitioners and local community members who understand the local context and issues and evaluators familiar with social science techniques, such as semi-structured interviews, which demand a certain level of expertise (McKenzie-Mohr, 2012). Furthermore, Berkes (2008) recommends inviting indigenous peoples to challenge and question the academic process while maintaining an active role as researchers in the study to ensure that their voices are



heard (pp. 35-36). Others have pointed out the inherent difficulty in measuring locally relevant cultural conceptualizations (Kohrt et al., 2009), and the conceptual domain of knowledge is nebulous. Therefore, local partners were involved in all stages of this project as co-creators of knowledge. Given the importance of story-telling in the Hawaiʻian culture, a semi-structured interview approach was utilized, viewing the interviewees as experts on their situations (Groleau, Young, & Kirmayer, 2006). Interviews can be an important source of information and are particularly well-suited for studying cases in which the research is aiming to discern the “how” and “why” aspects of a particular phenomenon (Yin, 2008). The purpose of the interviews was to allow kūpuna (respected Hawaiʻian elders within a community) and conservation education practitioners to elaborate on their thoughts and experiences regarding current and historical local environmental knowledge in Hawaiʻi.

Interview questions stemmed from research questions and were developed collaboratively between the local field assistant, primary author and Colorado State University researchers (see Appendix for interview guides and matrix of research questions by interview questions). All interviews were recorded after receiving signed consent from the participants. Some interviews took place at private residences and others took place in public locations (e.g., coffee shops, restaurants, farmers markets). Interviews lasted between 20 minutes and 2.5 hours. Kūpuna were compensated \$20 USD for their time. All interviews were transcribed verbatim. Key themes were noted and MaxQDA software (Version 11.2.1) was used to categorize concepts using axial codes (Strauss & Corbin, 1998) with attention given to repeated themes (Levy & Hollan, 1998). Research questions were then used to integrate, refine and organize axial codes into broader theoretical categories, or selective codes (Strauss & Corbin, 1998). A complete

codebook, including definitions of codes and coded segments, is included in the appendix.

Confirmability was ensured through peer review and maintaining a data trail (Glesne, 2006)

### *Site*

The research took place in a rural district of an island in the state of Hawai'i comprised of several communities situated in proximity to former sugarcane plantation lands. Modern-day districts in Hawai'i can be traced to the ancient division of land under the ahupua'a system, whereby the island was divided into watershed management units stretching from the mountains to the lagoon and reef (Kaneshiro et al., 2005).

### *Participants*

Kūpuna elders from two specific geographic districts (i.e., watershed units) in Hawai'i were selected by the local field assistant to participate in interviews. These districts were selected due to their proximity to a large forest reserve and past difficulties on the part of conservation organizations in conducting conservation education programs there. Eleven kūpuna were selected for inclusion by a key informant with longstanding connections in the community (Merriam, 1998) based on family history in the area and knowledge of past and current integration of cultural knowledge into teaching others about nature. Six of the kūpuna were interviewed in pairs. Kūpuna 4 and 5 were friends interviewed together at a local senior center. Kūpuna 6 and 7 and kūpuna 10 and 11 were married couples interviewed together. Deviant cases were included to facilitate a richer understanding of shared experiences. For example, one kupuna lived outside of the geographic are of the study and two individuals had moved to Hawai'i from the mainland approximately 10 years before the study but had become integrated into the community. They shared their perspectives of how youth learned in the past based on what they had heard from others in the community. This yielded a total of 8 interviews.

Practitioners who currently or previously conducted conservation education as a part of their jobs were selected for inclusion based on the primary author's previous affiliations in the area and knowledge of organizations offering conservation education programs in the region of interest. These organizations included both local, regional and national NGOs as well as governmental organizations. All nine practitioners were interviewed individually. All but one practitioner grew up in Hawai'i, and of these, all but one grew up on the island where the study took place. The oldest practitioner was in his 50's and the youngest was in her mid-20's. The practitioners represented a wide range of previous work experience. Some of them held undergraduate degrees in environmental education and communication while others had more extensive experience (i.e., 10+ years) working in the field of conservation education. One had just started a new outreach and education position and several began their careers in land management and maintenance before working in environmental education and outreach. The perspectives of the practitioners and the kūpuna were used to triangulate each other in comparing past and present knowledge acquisition.

#### *Data analysis*

A list of 26 *a priori* and emergent codes was developed collaboratively among three researchers (Thomas, Gavin, Hauptfeld) using existing theoretical perspectives on traditional ecological knowledge (Berkes et al., 2000) and emergent themes, schemas and prototypes noted in the data to analyze the transcripts (Levy & Hollan, 1998; Strauss & Corbin, 1998). Two researchers each independently coded one practitioner interview and one kupuna interview. Intercoder agreement was assessed using two methods (MaxQDA, 2015; Strauss & Corbin, 1998). First, presence of each code in the document was examined. Secondly, the number of times each code appeared in each document was assessed. Discrepancies were resolved through

discussion as coded segments were jointly reviewed line-by-line, which led to revision and clarification of code definitions and elimination of three of the *a priori* codes (see Table 3 in the Appendix for a description of the final 23 codes).

Intercoder agreement was then re-calculated for the revised documents. Method 1 yielded 100% agreement for both the kūpuna and practitioner interviews. Method 2 yielded 72.4% agreement for the practitioner interview and 65.5% for the kupuna interview. One of the coders tended to code large segments of text while the other generally broke the large segments into smaller coded segments, which resulted in the lower numbers for Method 2.

Remaining interviews were then divided and coded independently by the researchers; Researcher 1 coded five practitioner interviews and four kūpuna interviews in addition to one set of field notes from a pre-interview conversation with one of the kupuna. Researcher 2 coded three practitioner interviews and four kūpuna interviews. Following this process, quotation reports were generated from the complete set of coded transcripts for each coding category for further interpretation in order to expand upon the overall themes in the data.

## **Research Findings**

The purpose of this study was to compare past and present local environmental knowledge in a rural Hawaiʻian community. Additionally, the study aimed to inform the development of a culturally relevant and comprehensive quantitative evaluation instrument that could be used to document long-term outcomes of conservation education programs that seek to facilitate sharing of local environmental knowledge in Hawaiʻi. The primary themes are organized by research question and presented below, using specific examples from the data (see Appendix for detailed frequencies and additional examples of coded data and supplementary quotations organized by theme and a detailed codebook). While examples from several specific

individuals are included below, these examples were selected because they represented a common sentiment or outcome shared among the larger group of study participants.

### *Historical local environmental knowledge*

When describing past local environmental knowledge, kūpuna reflected on actual experiences and practitioners based on what they had heard from their parents or grandparents. Comments often centered upon both the knowledge itself and the ways in which the knowledge was historically transmitted. For example, many respondents focused on the importance of apprenticing with parents who possessed expertise in a given area (e.g., medicinal plants or making nets for fishing) as a means through which knowledge was transmitted. Additionally, respondents indicated that knowledge was shared through practice and belief in the past.

**Location of historical knowledge acquisition.** Many respondents recalled memories of learning that took place in a specific location. Most respondents described outside settings (e.g., in the mountains or near the ocean). Several respondents mentioned learning about nature in a neighborhood setting near their homes, and others mentioned learning about nature through involvement in chores or family life (e.g., working in the family garden):

K8: Back in the old days, the plantation days, there were camps up in the mountains where they put us. You had like Filipino camps, Japanese camps, Chinese camps. Our camp was right below the mountains, so you know, that was our playground...we used to go up the gulches and we had beautiful ponds where we go swimming, nice clean cold water. And then like I say, we played up there so we knew where all the fruits, you know, bananas, peaches, guavas. And that was our grounds.

K5: We...as kids, we used to go up in the mountains to play and...K4: We eat everything...K5: And we learned...I don't know, the old kids told us what was edible. Nobody died yet (laughs).

A few participants described learning that took place in a formal classroom setting, and others described learning that took place as part of a formal school program but happened outside (e.g., on the playground at recess or while engaging in a school gardening lesson):

K6: I don't really remember that many animals growing up. Plants. I was interested in plants. At recess, when it was real hot, they'd be out in the playground playing kickball and stuff. I didn't want to go out in that heat and I'd sit in the shade and examine the seeds of the plants and how they fit together. My teachers probably thought I was - seeing me sit there alone by the fence picking all the plants apart. I could have been a botanist probably.

K10: Like old days, we used to, even when we was young, we used to have gardening class like that, one period. But you know, that – the importance of raising things.

**Source or mode of historical knowledge acquisition.** All of the kūpuna and most of the practitioners also described sources or modes of historical learning. For example, most respondents mentioned that past generations would have learned about nature through observation or experience, which included apprenticing under someone more knowledgeable.

K3: ...plants was from my grandmother, to my mom, and what was the things used for medicinal purpose. Most of the things we use as my, you know, medicinal purpose. And uh, my grandmother, you would say on my mom's side was like a, was a kahuna. She - and, I've seen it done, and it happened when my grandmother would take my mom and her - if my oldest brother broke his leg, which he did, they would put the pain on the knee. And it worked. It works, so yes. There was medicinal purpose for each plants that we use. I: Yeah, so observing family members is what I'm hearing. K3: Yes, yes, yes. And describing what is this plant used for, what is this plant good for, as far as that, for uh, healing or I mean as far as that, so do we depend on the doctors?

P6: I would think that in olden times, it wouldn't have been an active learning. It was very much a quiet, learn, observe from people around you kind of thinking.

K2: ...How you get to learn the old traditions, you have to get involved in like, we were interested in fishing. My dad was a fisherman so that's how I got into fishing from very young age. You learn how to make nets and everything...when I was five years old, I start, you know? He makes the net and I just hold these, you tie these spot out and then you...but to start me from learning, he made me hold this and he made. I: And you learned about the current from your dad? K2: From my dad, yeah. I: And he learned from his dad? K2: From his dad, yeah.

Knowledge about nature acquired through direct observation or experience also included engaging in cultural practices associated with local environmental knowledge. Most comments about practice were centered upon particular current or historical cultural practices. These included practices such as chanting, naming places, gathering plants for lei-making or making other natural adornments, canoe-making, gathering salt, hula, fishing, not asking questions,

making cordage, gathering food, trading food, following the moon cycle in fishing and harvesting, use of medicinal plants, paddling, respect and care for plants, acquiring respect or permission when entering a new place and practice in general.

P1: So, I was never brought up to uh, dance hula, but when we came to this island is when we got pushed into it. Didn't have a choice. But that was a lesson in itself, and I'm thankful that we moved here and that my family does that and that we get into it because it really gave me what I was missing culturally as far as how I was connected to the forest. We gather things to make lei, we dance about, the reason why you dance is because of the forest, you know? There are a lot of things that hula has that you cannot find anywhere else...P1: Uh, we have certain, remember I was talking about the strongholds? Where the cultural knowledge is intergenerational, you know? This generation gonna teach that generation, they gonna teach that. And it's all within the confines of the practice...

Kūpuna and practitioners both reflected upon beliefs that stemmed from experiences through which knowledge was historically gained. Discussion of beliefs included beliefs about plants and included relating to plants as friends, deification of plants, mindfulness and care of plants, medicinal use of plants, and representation of family and ancestors as plants. Beliefs about animals and beliefs about fishing were also mentioned and included thoughts about animals as 'aumakua or spiritual guardians and deification of animals and animals as family or ancestors. Beliefs about fishing were focused on fishing by the moon phases or the tide, beliefs about actions or behaviors that could bring bad luck, and deities. Other beliefs included beliefs about historical events, beliefs about respect for place and beliefs about weather.

P7: ...to truly be a Hawai'ian of the land is to mālama or to take care of these sacred places. This area is the wai akua, which is the like, the realm of the gods. And the realm of the gods meaning this is where your kūpuna trees are and like I said, a life of a human was on the same level as the life of a hundred, I mean five hundred year old koa tree, you know? And so protecting these areas, in the Hawai'ian culture, we have these different deities that, um, are able to manifest themselves um, as things of the environment. Say like maybe um, I don't know how to explain, um, so when protecting these trees we are protecting our gods because these gods are our Kū. These gods are our Laka, these gods are Lono, these gods are Kanaloa, and we are protecting our akua or our gods in the form of the environment. I don't know if that makes sense.

### *Current local environmental knowledge*

Current local environmental knowledge acquisition often occurred outside, but in contrast to past learning, many respondents focused on the role of structured conservation education programs or extracurricular activities in facilitating learning. The Internet, including social media, was mentioned as a mode of transmission that would not have existed in the past. Respondents also discussed ways in which they had been or desired to be personally involved in sharing knowledge with others and described the role of practice, belief and integration of cultural knowledge in achieving these goals. Changes in social context, food systems and agriculture and values, ethics and perspectives were discussed in comparing today's learning with that of past generations.

**Location of current knowledge acquisition.** Outside locations were mentioned most frequently by both kūpuna and practitioners. These locations included a camp or program site, general outside locations, neighborhood locations, the forest, the school garden, at a club meeting (e.g., canoe club), or while engaged in a family cultural practice at a hunting or fishing site or gathering grounds. Inside locations were mentioned less frequently and included classroom locations.

P4: I think school because they spend so much time there, you know. Their full time job, so it seems like, like they will connect things that we talk about in the field to stuff they've learned in school.

K8: ...other programs going on at the schools, the colleges, and uh, we in Hawai'i are really moving now because of...everybody's back in the ukulele, everybody back into canoe paddling, everybody doing that and this, everybody learning Hawai'ian now. Which is good, everything is coming back strong again. You know what, it's nice – I go to the mall and I hear young kids talkin' in Hawai'ian. That is nice, you know?

P1: ...I'm required to um, bring in different learners from the community, from different schools, from clubs, programs, um, they'll request to come up and also I'm, you know, always looking for groups that fit with what is the purpose of (site name), to bring them up. Um, and then you know, part of it is to use the place (site name) as a classroom, so it's kind of bringing you know, learners to a classroom but in an outdoor classroom



setting, and allowing them to use their senses of, and to be a part of the learning instead of just reading out of a book or something like that.

**Source or mode of current knowledge acquisition.** Details about current or potential learning sources or modes were mentioned by a majority of kūpuna and all of the practitioners. The primary learning sources or modes described by the respondents could be categorized in several ways. Unstructured learning involved learning about the natural world through direct observation or experience such as time outside or free choice learning at a specific facility (e.g., zoo). Kūpuna and practitioners both mentioned indirect learning, such as learning through media outlets like books or television and learning on the Internet or through technology, including social media. Other responses focused on a structured learning experience, which could take the form of an experiential learning program or club, learning in a formal classroom setting at school, learning through university courses, or taking part in a school-based experiential learning program (e.g., a field trip).

K3: ...it kind of depends on what school they're in, and what their families are involved in. I just took my daughter to her first hula class last week, and so that community gets a lot of their environmental education through hula, and it's a pretty large community. They're all from different – some of them are actually from (region), and some of them are from (city). But then you can go into the DOE schools and they have nothing. They drive from, you know, 15 minutes away to their school and they don't get out of (city). Or if they do, they drive over (road) and they're probably looking down at something when they're driving, and so they don't – I guess they get their information from, from their parents, or you know, depending on what their families are involved in.

Many respondents also mentioned incorporation of cultural knowledge about nature into practice. This included learning about a practice through intergenerational communication between family members. Specific cultural practices that were mentioned in this context included hula, music, paddling, studying the Hawai'ian language, hunting, fishing and gathering. Respondents also discussed ways in which cultural knowledge is currently integrated into programs. Several practitioners and kūpuna discussed details about cultural knowledge

integration. Most often, respondents referred to a cultural tradition or practice as a way to integrate cultural knowledge. These traditions or practices included talk story (i.e., informal conversations through which information is shared), chants, hula, gathering plants for lei-making, fishing, referrals to deities, language and historical practice.

P7: We come from a more modern time now where we have that freedom and so these stories, these mo`olelo, was passed down and because it's tying in with certain foods that we eat, certain plants that we see in the forest, certain landscapes like mountains and, or rock formations – I think that's something you can't forget. And although the language was taken away, when you see that certain mountain, you remember the history and um, in a time where you can share that now, they'll refer back to, oh, well this mountain was symbolic of this story and this is how it got its name, or, so I think that's how the culture was carried, through chants and dances, um, it was memorized because of maybe certain events, like a certain volcanic eruption, um, maybe 1860, the 1868 lava flow, and maybe they dedicated a hula in commemoration of that kind of life giving force and so um, you memorize it. It's almost like, I don't know, the ABC's you know? Something you just memorize. You know the tune. Someone can take it away from you and say you can never sing the ABC's anymore, I mean, it's - that tune. You will never forget because it's embedded in your brain because it's symbolic of knowing the alphabet.

Many respondents discussed ways in which current knowledge about nature is embedded in belief. This included examples of sharing beliefs with the next generation within the context of a formal program.

P3: So, a lot of what we do is to try to teach respect, um, especially when we arrive to a place, you know, it's important to acknowledge that we are visitors there, um, and that um, we need to ask permission and um, you know, sometimes we have another person there kind of representing that place, and uh, the people of the forest or the people of whatever of that place and they can respond or sometimes it's like, you know, you just have to wait for...you know, a sign from the environment to tell you yeah can or no can't or so, kind of, you know, we teach them protocol, but it's really a sense of you know, respect for the area and for the things of that area and acknowledging – acknowledging them and it also helps you to get into the focus of what you're doing.

**Personal involvement in facilitating knowledge acquisition for others.** Some respondents shared ways in which they had been personally involved in sharing local environmental knowledge with others. When discussing personal involvement, many respondents focused on content. This included sharing with others about nature through

information about cultural significance, how to do something or practice a skill, sharing information about a productive fishing spot or modeling behavior for apprentices who will carry on traditions in the future. Other content was described in terms of cooking, camping, combining academics with field experience, and an informational brochure. Potential involvement was mentioned five times, and included expressed desire for involvement, intention to teach or share knowledge, intention to engage in professional development to improve knowledge transmission skills and ideas for sharing knowledge.

K1: ...I keep asking other people, oh call me up if you have questions. Nobody calls.  
P2: But I'm somewhat of a storyteller. And so when I have the kids out there and I show them an 'ie 'ie, and talk bout the aerial vines, I take that and I talk about the...statuettes or puppets they would make with that and they would put the bones of the ali'i in them...

The format or intended audience of the knowledge transmission was mentioned by both kūpuna and practitioners. Kūpuna discussed personal involvement in teaching their own children about nature, giving guest presentations in school classrooms, hosting university students in the field and sharing knowledge with visitors to the community. Practitioners mainly reflected on involvement in conducting formal programs or collaborating with teachers or other practitioners. Both kūpuna and practitioners mentioned targeting programs and communication toward at-risk youth and engaging in community outreach.

P7: ...We took community members up to the proposed fencing site, took them on trips to, I want to say like educate, but kind of show them the condition of our environment and, and what we can do to not maybe restore but assist the environment in bringing back our resources such as the watershed areas, and um, and another part of you know, fencing off that particular area of the forest, uh, 20%, we wanted to be able to give them more access to the more, uh, least impacting areas, you know, of the forest for recreational stuff, like hiking and hunting and just creating areas where they can go and relax and have a relationship with the forest...

### **Integration of cultural knowledge into conservation education programs.**

Respondents often reflected on connection to place, which referred to heritage values, connection to the past, connection to place through practice, protocol for entering a place, place names and viewing oneself as part of nature in a place. Others mentioned characteristics of learning, which included experiential learning; curriculum that integrates cultural knowledge into, for example, lessons on math or language; and integrating cultural information alongside biological information. Collaboration in the form of institutional support and collaboration with other cultural groups or local partners and the general importance of integrating cultural knowledge were both mentioned four times.

K2: (niece speaking) Well it's like when we went to (location) and they were like, well, we need a chant cause we do chants here. And I'm like they (fishermen) don't chant. The kahuna chants. You get a kahuna to come in and do the chant. But fishing is a silent tradition so then I had to go make up a chant, you know? I made up a chant and a dance, but it's like that's not the real thing. That is the net making and having him tell you stories, that's all the real stuff. And that was so cool to incorporate when they were making, tell them some of the old stories and having like...having her stories that were his grandfather's or your family's, you know, then you can do story time while they're making net. You know?

P2: ... And then I would say, and – and that brings up another story. Have you heard of ...do you know how that relates to (place) here, what happened?...And so, but all that from the `ie `ie. And I've told it in a way that's like, this army came here and then this guy went here, and oh, you heard about the fight last night? Steven came down from up mauka and he called Jonathan out from the house...the kids would be there, and? And? And? Well, that's what I just did but historically...and, AND – related to a plant. And then we go look at this fern, this fern – how tall do you think this fern is? Oh that fucker gotta be 20 feet, 21 feet. We say they believe a hāpu'u grows at one inch a year, so at 20 feet tall, how old would it be?

**Comparison of historical and current knowledge.** When asked to compare current knowledge about nature of today's youth that of past generations, most of the comments were focused on drivers of change in knowledge, such as the style of learning or interaction with the instructor and changes in the curriculum. This theme also included changes in interest and curiosity and changes in motivation to learn. Changes in the source of knowledge were also

mentioned, and a majority of these comments were focused on the transition from direct (i.e., knowledge acquired through direct experience observing environmental phenomena) to indirect (i.e., knowledge acquired from a book or in school) knowledge acquisition. Others mentioned changes in cultural practices and changes in the knowledge itself. Changes in the environment, such as natural resource availability and human influence, were mentioned four times and change in general was mentioned three times.

K1: ...old people have the way they learn things from whoever they learned it from. We know things, and if you only read things in a book and say oh yeah, they used to do this, oh yeah, they used to go strip hau and soak it and make cordage, looking at – it's like, the reason I'm interested in this feather thing and one of the things I asked the people at the museum and they, you know, I asked them – why aren't people coming in and asking these questions? They said, they don't want to see the feather. They want to see the thing made of feathers. They want to see the cloak. They want to see the cape, they want to see the helmet. They don't care about the fact that the feathers are this big and there's a little bundle of 'i'iwi feathers tied at the bottom with this really skinny thread made of who knows what. They want to see the big thing. And to me, it's important to know that this – these shells came from the beach...40 something years ago and I gathered this hau and I made this cord and I filed pukas in these shells and strung them on this cord. I know how to do this and I've taught people how to do this. That's important. If you can't do that and you look at pictures in the book, the knowledge might still be there but the practice is gone. And that, to me, is going to be a really, really sad thing.

**The influence of social context on changes in past and present knowledge.** Social context was also mentioned frequently by respondents when comparing and contrasting current knowledge with that of past generations, and included changes in upbringing, social ills or illicit behaviors (e.g., access to drugs and alcohol) and a culture of consumerism, and changes in community life. Changes in content and transmission of local environmental knowledge were also discussed within the context of social fabric. These changes included shifting baselines and access right, outside influence, outside commodities, perspectives on money, lifestyle or upbringing, school systems and societal expectations were all components of a broader change in social fabric. These affect both the knowledge itself and the modes of transmission.

P5: Yeah. And (district) is some pretty interesting social dynamics. Some challenges. I: Definitely. Would you consider those also some of the barriers in teaching? P5: Yeah, I would. I would. Just the, you know, lack of jobs and income I think is a big, a big factor. People have a different way of looking at things here because they just don't have the other resources, so they look at pig hunting even though it probably costs them more than to go and buy a ham at the store, but they look at it as this resource, and fishing, and perhaps overfishing. Things like that, that yeah. It's definitely an influence. And a challenge. I: Yeah. What do most people do here job-wise? P5: You know, that's, I'm going to defer to someone else for that. I think, um, from what I can see, there's an awful lot of people living on the public dollar here. An awful lot. And it's generational. Since the sugarcane closed up, there just, all those jobs just went away, and we're so remote, there's not that many other ones. Yeah. I: Yeah I know a lot of P5: And now there's generations of people where it's starting to be a normal thing not to have a job. I: Being stuck in the cycle P5: Yeah, and I think that's why fishing and hunting become even more important. I: Being able to sustain yourself. P5: Yeah, so that's definitely a challenge.

P6: Yeah, and that's what, that conversation about measuring ourselves of success is to me about, cause to me, yes we all want cars, we all want to be able to afford our house. We have to. But is that really what's gonna make, you know, having - that is not a measure of success. You know, having a community that is, for the most part, happy. And that sounds so, like, Barney, lala, I love you, and I don't mean it that way cause I know that not everybody is gonna be happy all the time, but I think if we could see lower rates of incarceration of native Hawaiian people, higher ability to make a living wage, and I don't mean that we need to go to college, you know, 70% of jobs in Hilo do not require a four year degree. How do we elevate those so that they're able to earn an income where they can be happy and sustain themselves semi-comfortably, you know, those kinds of societal things, to me that's what all of these programs are about. It's - finding things - I always think you know with the video games and stuff like that, you know when we take away our environment, when we take away our culture, what do we fill - what replaces it? And so it creates a vacuum, we fill it with these other pieces that don't fit um, and it causes such social ills and to me that's what the environmental education is about in Hawaii at least is we - providing something to be a basis for who people are, you know, cause we - we're losing some of that. It is getting replaced with real housewives and Kardashians.

For example, many respondents also discussed concerns as they relate to the social fabric of the community. These concerns included concerns about overall human health and wellbeing, concerns of future change due to outside influence, lack of opportunity and jobs, social ills, historical concerns related to government restrictions on speaking the Hawai'ian language, and Hawai'i as a microcosm of similar issues in other parts of the world.

K1: The health and wellbeing of our people. I think that's my biggest concern. I think everything else (pause) comes from that, and yeah. You know, the education of our kids is what's critical. Cause if they're clueless, we're gonna end up with a clueless country. I: And I wonder, it's something I've been thinking about over these last few weeks, so you mentioned drugs and that's something else that other people have been saying, and so I can't help but think that these things are connected, right? So becoming removed from that connection with the land leads to all of these kind of social problems. K2: Yeah problems, to get involved in things, and bad things. Cause I know my nephews you know, they fished with me for a long time and they weren't into drugs. FA: That's why the fishing business is gone K2:- is gone. I have one nephew he was interested in taking over the whole fishing business but he went to drugs...I, you know, that's their choices they make. I: But it's still sad K2:It's still sad, you think you can turn things that you've worked so hard for and learned so hard, turn them over to your nephew, the biggest thing that you can do, but today, if I die tomorrow it's gone. Everything's gone. There's nobody else.

Many respondents also discussed changing social relationships as a component of changes in local environmental knowledge. This is worth noting because changes in *from whom* youth learn leads to changes in *what* they learn. These relationships included relationships with family members and relationships within the community in addition to the relationship of the individual to the broader social system that contribute to overall community cohesion and wellbeing. Discussion was focused on character development of individuals, including respect. Additionally, respondents discussed the importance of heritage in terms of pride in oneself and one's heritage. Several respondents mentioned bright spots in social context, which included thoughts about environmental education programs that, if well executed, can alleviate many of these concerns; opportunity for becoming involved in initiating positive change; positive outcomes of incorporating Hawai'ian language into curriculum and programs; cultural resurgence; and collaborative natural resource management. Ideas and thoughts about moving forward were mentioned seven times. These included the importance of remembering the past and sustainability of natural resources and cultural traditions.

K8: My aunty lived down there on the beach and when we come down, we'd bring like peaches, squash for the pigs, whatever we - you know, age, cause back in the old days up

in the forest, there were chickens running around. Nobody believed - the only caged chicken you got was the fighting. The hens would lay eggs all over, and we'd get the eggs and we used to come down, spend a weekend down at the beach and then before we go home, we go home with like crab, fish, little bits shells, dry meat, dry fish, and that's how it was. And if you go up in the forest and you go up to the gulches, you'll find trails that come out of the gulch and you wonder how come there's seashells like 'opihi shells, lipid shells all in a pile in certain areas. What it was the old days, people in the ocean, it's the meet, you know, you'd walk up the trail was the gulch then you would trade for whatever you got up in the hills and you'd trade for whatever you got from the ocean. That's why people find shells way up in the mountain and stuff, that's how it was. P2: Well part of it is, it's a small change, but when I grew up, all the teachers lived in (location removed for anonymity). If you were a young teacher from Iowa, and you got a job at (school name) school, there was an apartment at the school for you. It wasn't, oh, I gotta find housing, I gotta commute - no one would have even thought of commuting from Hilo to teach. And so they, everybody was here, the community, you got to know the parents the kids, la-da. You went to the Christmas party, you went to this, you went to that. Maybe during Christmas break you left to go home, but other than that you were here for everything. And then that stopped and the whole commuting thing, so you got - the majority of teachers I personally believe are driving into the district to teach, and they live up in Volcano or somewhere where it's, you know, they're part of the intellectual community. They're not down here with the heathens. And so they come down, put in their time and get the hell outta dodge.

### **The influence of food systems and agriculture on changes in past and present**

**knowledge.** Changes in knowledge about local environmental knowledge were also discussed within the context of food systems and agriculture and associated influences on community life. For example, when respondents referred to food and agriculture, they were most often discussing learning about nature through food. Many respondents focused on upbringing in rural communities, gardening at home, and knowing where food comes from. Others discussed cooking, harvesting plants to eat, plantation life, traditional foods, and harvesting farm animals. Commercial food systems were also mentioned frequently. Respondents discussed sugarcane plantations that existed in the area in the past, changing land use patterns, changing lifestyle, commercial fishing, coffee, taro and ranching. Some participants referred to historical subsistence patterns while others described current subsistence in the context of hunting, fishing, providing for one's family and teaching others about how to survive from the land.



Unsustainable use was mentioned in several interviews, and was represented by comments about farm animals becoming invasive, unsustainable harvest in the name of subsistence and ideas for sustainable farming. Social connections with others in the community through food and desire to practice farming were also mentioned.

P1: ...so the resources have changed, you know, and not only on the land, in the ocean there are fewer and fewer fish, there are fewer and fewer things like 'opihi, which is a favorite thing for a lot of people, and even all of that is relative. If you go to (island) and there's nothing. (Island) people come here and say oh you folks have lots. But those of us who live here know that no, we used to have lots and now we don't have so much. So even that's a big concern.

K5: (town) looks kind of bleak right now. I mean, I don't see – I don't know what the future industry or anything right here, that's terrible, right now whatever the people do is either with the nuts and coffee, you know, but since sugar left there has not been anything to replace it. Ranching is a small part. You can see all the vacant homes they have here. There's really – I don't know, I feel very, very sad every time I come through town. It's nowhere near the town it used to be when we were young. I feel sad.

### **The influence of values, ethics and perspectives on changes in past and present**

**knowledge.** Nearly all of the respondents mentioned values, ethics and perspectives. The theme of shifting baseline or changing values could help to explain changes in local environmental knowledge. This included access rights, cultural identity, outside influences on a community or place and hunting.

K1: I think, I may have mentioned this a little bit earlier, the notion of gathering rights and whether or not you're gathering things on the land or at the coast or in the ocean, um, I think those are cultural practices. A concern of mine is that with the right to gather comes a responsibility to ensure that resources will remain into the future. And it, it's a situation where some people don't seem to understand that part, and you know, I talked about a little bit early the boundary commission testimonies of the 1870's made it very, very, very clear. If you're not from this place and you come here and you take things - resources - and we catch you, we're going to take them away from you. You know, today it seems like it has turned into um, anybody can go anywhere to gather anything that they think they need, and I don't appreciate that sentiment. Well maybe not anybody. Hawaiians. You know, native Hawai'ians.

P2: I feel that the collection of resources has shifted from collecting some resources for your family to a fear, greed-based gathering of resources with the end result of proving manhood. Boy. Where's doctor Freud? (all laugh) FA: So pretty much overharvesting for like trophy gathering and - P2: Yeah, but tied to all that, all that pig hunting and all that

gathering is - FA: Do you have - P2: So you three wahine are sitting here and I come in with my bucket and I go, oh, do you guys like fish? And I dump out like 80 kampachi on the table here and you guys are going, oh, wow, man, where you get that? Ah, I went down 'ere. What a man, what a man! You might even be attracted to me. Look at what I can do. But if I came with four, look what I caught, oh, isn't he cute? Right? Not right, but I think there's a - men here in our culture don't have a lot of ways to show manhood. I: And why do you think that is (shifting baselines)? P7: I think that because of their love for maybe hunting or their love of gathering, you know? Um, they don't see a balance because they're so used to taking and taking and taking and as long as it's still there, they're gonna continue to take, you know? And um, you know, hunting wasn't something that our, the Hawai'ian culture had practiced. You know, if you look in the old histories of, I mean, pigs who were reared and raised - I mean raised next to your hale, next to your home, you know, like how we tie up dogs and stuff, pigs were tied up because our people were aware of the destruction that these pigs could do unto our environment, and so um, so yeah. So there weren't any free roaming pigs in the town, you know? The environment was so intact. Um, and I just - I don't understand how they may have gotten the misinformation, but it's become a, a new kind of culture in Hawai'i, and um, you know, they say oh, the state is eradicating the pigs! But you go to the average hunter's house and you'd see all of the pig tusks and jaws all hung up on their wall, I mean by the 400's and 500's, all on their garage posts, and it's like - you know? You're the eradication.

Several individuals discussed the concept of restoration and grappled with what should be restored and to what state. Several respondents commented on value placement or the value of certain things. For example, should people value making money and having a high paying job over choosing a lifestyle of lesser impact on the environment? In a similar vein, several respondents expressed the sentiment that there is greater value in something that a person makes or gathers him/herself as opposed to purchasing a product from a store. Others discussed the concept of an overall land ethic, including personal philosophies of reducing waste, sustainability, ethics of cultural practices and understanding human connections with nature. Some also discussed precursors to values or an overall land ethic. Relation to nature, self and others was discussed, and included thoughts on the importance of purpose or intention when interacting with natural resources, looking out for and caring for others in the community via natural resource use (e.g., collectivism) and sense of pride or self worth.

P1: ... I mean, it's prior to them as well, but their parents had lived through the initial, I'd say they were brought up in that generation where it wasn't normal to speak Hawaiian. It wasn't normal to practice your culture, it was more valuable for you to go to school and learn English or get a job or be in the military, those type of things...the generation we're talking about, you know, the one you're interviewing, and conservation isn't important, it wasn't important to them. Ranching was important, you know. So it's that missed gap where from 1900's to today or to like 30 years ago where all those things wasn't important, the language was illegal, it was more important to get a job or be in the military or those types of things, where today it's like well, it's more important for you to know who you are, where you come from so you can figure out where you're gonna go. It's more important for you to take care of your natural resources because if you don't, where you gonna get water from? Of all the things which are so, I mean, obvious, but it's now, it's more important now for some reason, through the renaissance, through the Hawaiian renaissance, or public charter schools, all those movements, um, hula, you know, merry monarch becoming so, popular. And like all of those things have natural resources integrated in them. That's what it is. The practice is a natural resource.

### *Barriers to acquiring local environmental knowledge*

Many respondents mentioned barriers to getting the message across when discussing integration of local environmental knowledge into conservation education. These included barriers related to characteristics of the knowledge acquisition experience (e.g., stemming from the instructor or the characteristics of the audience), institutional barriers, barriers rooted in modern interpretation of cultural practices and outside influences.

**General barriers to knowledge transmission.** Barriers to knowledge acquisition were mentioned at least once in each interview. These included adults (e.g., not permitting kids to engage in unstructured experiential learning through play), consumerism (e.g., today's generation may prefer to purchase items from a store instead of making or gathering them in nature) and cultural barriers (e.g., it is not one's place to know or share knowledge about something). Additionally, audience values and perspectives can be a barrier to sharing information with others, as can barriers stemming from the instructor or teacher, such as knowledge loss or change, sharing misplaced or misguided knowledge, lack of teaching skills and inability to document program outcomes to secure funding for continuation. Communicating

with certain audiences that are often difficult to reach through conservation education programs was also viewed as a barrier to sharing local environmental knowledge by many of the practitioners. Most of these comments focused on specific audiences or groups. These included certain groups within the hunting community, kids involved in other activities, those without access to transportation, outsiders who “stir the pot”, and those who are hard to reach or contact. Characteristics of audience perspectives included groups or individuals who are set in their views, those with different attitudes, those with different political perspectives, and those with different perspectives rooted in a loss of knowledge.

P7: ...when we had that one meeting about fencing off 20% of our forest for protecting watershed, for native plants to thrive and for possible area for these ‘alalā to live because their food source would be within that area, uh, it would have um, blocked access of people going into that area, but it would be a protected area where pigs and feral ungulates wouldn’t be able to go, and you know, gnaw at the trees and stuff, um, so that was a big deal here in (region), and a lot of people, you know, were in support or still are in support of protecting that part of the forest because they realize, uh, you know, the importance of water, but um, there’s a lot of outsiders that come and try to speak for the people of (region), and um, you know, bring up points that is irrelevant to the task at hand. You know, we had some people from the (city) side talking about how the state is just land-grabbing and taking away from the Hawai’ians and I think the meaning or the culture of the Hawai’ian people.

P5: ...there are some people who are so set in their ways that they’re never – they never want to hear the other side of the coin at all. And they’re never going to, you know, they’re just – they’re very – and most of those folks aren’t really who we’re trying to reach to be honest, they’re from somewhere else coming in.

P6: Well, I think the greatest – or one of the barriers is um, we don’t know a lot of things. We’ve lost a lot of knowledge that we did have. And that’s one.

K3: Not too much people know anymore. There’s very few uh, people that knows about this stuff. This, this type of lifestyle. It’s honestly, it is fading away. It is fading away. And there’s just a few of the family that knows that takes it in and does it as far as the, so time is changing, yes it is.

K5: I think our generation is very, very happy to share whatever we know. And, but the generation below us, I think, maybe know less. You know? Just a changing of times. You know, just changing of times. And you lose a lot of the knowledge.

K2: ... my net I use is 34 years old. Cause I mend them all. They go through three nets a season, like that’s 8 months. They wreck three nets, throw ‘em away. They just buy another one, but as soon as they go along there’ll be no nets. I tell them, I says, you know, after the three of us die, I give you guys 10 years and you guys be out of business cause there’s no nets after that. But you know, they still don’t want to learn.

The current educational system was also mentioned as a barrier. In a similar vein, institutional barriers (e.g., sharing information is outside the scope or mission of a given organization, lack of funding and appropriate training to equip staff with the skills they need to communicate information to public audiences) that prevented sharing local environmental knowledge were mentioned. Lack of access to land/resources (e.g., certain native bird species no longer exist in close proximity to cities and towns and therefore people are not able to learn about them) was mentioned in a small number of interviews, whereas others mentioned lack of collaboration among scientists as a barrier. Other barriers included lack of curiosity about or interest in nature, lack of comfort in nature, loss of knowledge, upward trends in mobility or people moving out of the area, modernization, social ills (i.e., drugs and alcohol), societal expectations (e.g., getting a good job that pays the bills), and technology.

K1: And I don't know, you know, I keep saying I have no idea how I turned out the way I did, but I think our generation was more in touch with the land, the earth, you know, all of that stuff, cause it was, it wasn't – it was more primitive. If you went to the beach, you went to the beach and you took your own food, your own water, your own map, your own everything, and it took you a long time to get there because the road was junk and it took you a long time to come home. It was like a major commitment, and it's just now things are so, so, so different. It's crazy. You don't even have to go to the beach. You can go to YouTube and look at going to the beach.

K1: I fear we're becoming more and more intellectual and less and less physical I guess in our lives and that to me is not a good thing. It's not good. People who live in high rises, they can't hear the rain falling on the roof. They don't know what kind of rain is falling. They don't know how cold or hot it is outside because they either have heat or air conditioning...

P5: And (location) has some pretty interesting social dynamics. Some challenges.

P4: Like I think about, you know, when I see these kids on their phones or on their iPads or on whatever media thing it might be at the moment, and thinking that that didn't even exist when I was 10 years old, or you know, even 15. I didn't have that kind of phone and all that kind of technology in my hands, so, and I notice, like, I really do think that being on that kind of technology device all the time prevents kids from fully experiencing whatever place they might be in or around or um, they make the choice to use that technology device rather than go outside, even if it's just outside their house, you know? So yeah.

**Modern cultural practice as a barrier.** Some participants viewed modern practice as a barrier. For example, when discussing current cultural practices, some mentioned ways in which certain practices (e.g., hunting) have changed or developed over the years and become internalized. One practitioner discussed the importance of integrating practice into learning about the natural environment and one practitioner described negative social consequences (e.g., lacking a sense of self or connection to one's identity) that may manifest as a result of lacking practice.

I: And why do you think that is? P7: I think that because of their love for maybe hunting or their love of gathering, you know? Um, they don't see a balance because they're so used to taking and taking and taking and as long as it's still there, they're gonna continue to take, you know? And um, you know, hunting wasn't something that our, the Hawai'ian culture had practiced. I: Yeah, yeah. So it sounds like they're a misinterpretation- P7: Yeah, misinterpretation and misunderstanding of the real culture. I: So they're saying it's because of the culture but they don't want - P7: We need to practice our culture, we need to be able to continue our cultural practices. It's a modern cultural practice.

**Outside influence.** Outside influences were mentioned in seven kūpuna interviews and six practitioner interviews. Outside influence was defined differently in different contexts. In other words, some respondents described influences from outside a specific geographic region or community and others described outside influences in the Big Island or the entire state of Hawai'i. Many respondents focused on outsiders coming in to an area. This theme was represented by comments focused on use of natural resources or access rights, biological invasive species, changing community makeup or social invasive species or tourism. Other comments were focused on policy, including outsiders making decisions or speaking on behalf of people of a particular area and military influence. Still others described outside cultural influences (e.g., religion or language), and outsiders as a part of the conservation community. Twenty-two comments focused on modernization as an outside influence. These comments included comments about technology, including media influences; modern societal demands or

expectations; Hawai'ians moving away and losing connections to local knowledge; development and pressure on natural resources. Other comments associated with modernization were focused on outside commodities, such as products, foods and fashion trends. All of these outside influences could be conceptualized as barriers to learning local environmental knowledge.

K5: ...and I tried to teach my children what I knew, but they've all except for one of them, the three live on the mainland...just out of high school. And that's one of the problems we have today. I suffered from empty nest syndrome and I think they forgot...because they've grown up on the mainland...I think they've forgotten a lot of the things that I knew...because they've been away longer now than the years they lived in Hawai'i...so that's a shame.

K6:...they keep wanting to put in housing developments...and you do that, and they're gonna build homes like they have in San Diego and then you're gonna have people from San Diego here that don't get the island. And they'll want to turn this into San Diego...that road where you make the left and go down, if you stay on that road going toward the ocean, you come on, you get onto a road that's (road name). And nobody on it, but yet there's the hillside here, a nice sloping hill, and a nice sloping hill going down to the ocean and you can guess what's going in there. What's gonna for sure, they'll be subdivisions and they'll be expensive.

K8:...you get all these new people are coming and all our life we kill a pig in the backyard because we got farming, now you get new people that call the board of health and say oh people killing pig in the backyard, there's a lot of flies. What we tell them, close your curtains! Put up your window! We been doing this for years. And you come here and you just want to change? Come here and get adapted to the, you know, to the place you want to live, you know? You the one bought the house here...other people you know damaging the forest, like cutting trails, which is unnecessary because trails was always there. It's just that the new generation of outsiders, non-Hawai'ians, they're going in there, they don't realize there trails, they start making their own so they start cutting stuff and a lot of locals know what is in the indigenous plants. But like the Filipinos, you know Micronesia, they don't know that so they just go and start chopping stuff down. (inaudible). The old Hawai'ians left the history on certain ways of piling up rocks. Rocks are called puakō. Stone. And each - certain way of piling up rocks meant certain things. When Sea Brewer came to build the sugar, they just leveled out history. Ok. The orchard. A lot of places. The airport. Kona. You go Kona, you see all this, all push. So there went our history. We didn't have pencils and all that. Certain way with rocks. So that was a loss.

P2: Remember when that phase came out where everybody wore their pants down around their ass and their underwear was sticking out and they wore their hats like this (turns hat sideways). They were imitating people in Los Angeles and Chicago. Those - that's where they want to be.

### *Metrics of successful sharing of local environmental knowledge*

Metrics of program success were categorized based on whether or not they were cognitive, behavioral, social or conservation-oriented. In addition, when discussing the metrics described above, 16 participants mentioned the importance of using metrics to measure long-term program, particularly for programs designed to educate youth about the environment. These included the extent to which today's youth could feel empowered to create a better life for their own children, perpetuating cultural traditions, future job-seeking behaviors and interest in a conservation-oriented career path, long-term personal growth and future lifestyle choices (e.g., financial support of conservation initiatives, voting behavior and consumer behavior).

**Cognitive metrics.** Kūpuna and practitioners mentioned cognitive metrics most frequently. Cognitive metrics included general knowledge measured by, for example, a questionnaire or science grades; knowledge of how to engage in a specific cultural practice, such as how to tie a fishing net; opportunity to experience a place in a way that leads to changes in curiosity or views about how people fit into nature; attitude in terms of wanting to return to the program site or participate in the program again; environmental sensitivity measured through a combination of understanding, awareness and appreciation for nature; positive attitudes toward conservation initiatives; and an influence on what people value or where they place their value.

P3: ...I guess for the kids, it's like seeing them having that interest to participate in more programs...

**Behavioral metrics.** Behavioral metrics were mentioned by both kūpuna and practitioners. Changes in behavior that would indicate success of a program included sharing or passing knowledge on to family and friends; engaging in a cultural practice; volunteering for a conservation organization or donating money; and choosing native species to plant on one's property.



K8: Indicators that knowledge has been shared sufficiently? Kids are doing these things. They are hunting, they are gathering. They are eating the things they find. Food is important in the Hawai'ian culture. They are going to a potluck and taking, eating traditional foods instead of hot dogs and hamburgers.

P5: ...you know, the lack of evaluation of those kind of program is huge. They can't – they have a hard time in seeing the value in what they've – in what those programs are, and how those really work...and impacts on their families of course too. Actually see changes. But that goes to them explaining it to someone else. If we had evidence that some of those kids were going back and talking, you know, we heard back from one of the parents, or you know, said yeah, here we were off fishing and my kid's worried about the fish size or something. You know, something that they're taking back and telling. That's cool.

**Social metrics.** Social metrics were mentioned by only practitioners. These included interacting with others differently (e.g., exuding greater confidence when greeting someone), community cohesion, enhanced sense of self or sense of purpose informing an overall land ethic, character development and prevention of social ills (e.g., incarceration, involvement in drugs, inability to financially sustain oneself).

P1: Um, well, I would break it down by demographics, I'd break it down by island. I would seek out you know, different um, outcomes. You know, what outcomes do I wanna see? And basically, I want, all that I want to come out from their participation in a program is for them to experience it for themselves. To be there, and to understand that they're looking at something that is not found anywhere else in the world. For them to feel that because I came here, I know who I am now. Or I've learned a little bit about who I am and where I come from and what is, what should be important to me. I mean paying the bills is important, taking care of your family is important, all of those things is important. But the same thing, from a Hawaiian perspective, when you were born, you were born with a responsibility and that was to take care of the land and understanding that the land will take care of you. And as cliché as it might sound - it's so important...

P6: But I think on a personal level, I think environmental education is just one part of teaching of having a community that are good. Are good people. You know? That, and when we start to see positive changes within our community, that's when you know you're making big changes, and you know, like we were talking about earlier, not everybody can be a forester, not everybody can work in conservation, but I think the lessons you learn from being within the environment, being in a small group of 8-12 kids, all of those lessons feed into being a good person, whether it's to the environment, to be good people to other people, and to me, and this is my own personal, this is the ultimate goal of all of these programs, and I feel like connecting people back to the environment is a, we have to do that, because so many kids are so angry in many ways, partly because they lost that connection and they don't even understand why...you know, how do you, you know that whole epigenetics thing or whatever, it's like how do you take a land-

based people for generations, how do you take them away from that and not expect there to be any kind of health - mental health consequences? You know, there's gotta be things - if, if somebody can go through war and transfer post traumatic stress disorder to their baby because of genetic changes that happen, then how could that not be the same for other things like generations of - anyway, I could go on and on.

**Ecological metrics.** There was only one mention of an ecological metric by a practitioner, who indicated that her organization perceives plant survival to be a metric of a successful volunteer outplanting program.

**Current measurement.** Four practitioners discussed ways in which success of programs is currently measured. Overall, half of the comments focused on formal evaluation measures. The remaining comments focused on informal measures. Three respondents indicated no measurement is currently taking place, and one described measures from a former program in which she was involved in a different location.

P1: I've always thought about evaluating what I do, you know, how do we measure what we're doing and how is it impacting the learner. So we've had different types of like assessments, you know, to give the students when they first come in, when they leave, or we'll just do it orally, you know, raise your hand, so there's different ways that we've done it. But for me, I like to, I kind of assess, I do like a personal assessment I guess (laughs) where I'm looking at the kids and talking to them, and like, sharing different - to me, important points, I'm looking for who is comprehending through eye contact, through the questions that they ask, through the interest that they show. Are they falling asleep? So those kind of things, for me, is an indicator of, is it valuable, what we're doing. And then, I like to test them and see what they know, and I will ask questions and feel out, each group is different, feel out the group and see what is their background, where are they coming from, culturally, you know, and also I guess scientifically.

P5: I think they would, I get that from our communications person who's still here really wants some, some very good evaluation to be able to show this is how it will work, and this is what it will impact. Definitely. Um, that said, she's more of the social media and that kind of side of the communications PR and I don't know if her heart um, or mind are into more of the environmental education side of things. I: Right, or the conservation outcomes, you know P5: Yeah, so how many you know, people like us on Facebook? I don't care. (laughs) I: Right. Yeah. P5: But that's me. Yeah.

I: ...What metrics do you use to evaluate the success of your programs? P5: Um, well, for the ones we're doing...I - I would have to say we don't really...we have no evaluation for that at all.

I: How do you evaluate those (program)? How do you know that they've been successful? P8: Actually, we don't. We don't have an after survey process, um, there

haven't really been um, you know, tests that have been administered by the teachers to see what the kids retained from one of our tours six months later, there actually really has not been, so unfortunately none. But it's probably a gap in our program that we really need.

I: ...What metrics do you use to evaluate the success of an environmental Ed program? P9: Oh, that's a great question. That one's really difficult. Um. I'll say...from... that's very difficult. I don't know. I don't know how they do that. That's something - we've been given, our program, uh, (organization) statewide doesn't have the same flexibility and uh, free movement to, to work in the community that we do. Um, other islands, don't really have community offices that are located wherever it's reasonable for them to run the office out of, but we've got a very different mission for the (district) program, and the metric that we use when we are working with our funders, we report how many hours, which forest project, how many individuals, volunteers or kids, um, came out, um, and we're not able to place a value on it.

## **Conclusion and Implications**

Social science, and in particular, the fields of communication and conservation education, are likely to play a critical role in conservation moving forward due to the increasing recognition that all humans, animals and ecosystems on the planet are connected. In particular, human well-being can be affected by the health of the ecosystems around them (Decker, Evensen, Siemer, Leong, Riley, Wild, Castle and Higgins, 2010) and by conservation decisions (Harihar et al, 2014; Zahran, Snodgrass, Maranon, Upadhyay, Granger, & Bailey, 2015). In order to preserve the knowledge, we must also work to preserve the culture within which the knowledge is situated (Agrawal, 1995) in order to gain better insights into the role of social learning in processes of adaptive natural resource management (Dudgeon & Berkes, 2003). In exploring these issues, it is important to recognize that outcomes are often context-specific, and the current study used a locally grounded approach to compare past and present knowledge.

This project sought to compare ways in which local environmental knowledge is currently transmitted with how it was transmitted in the past in a rural Hawai'ian community. A secondary purpose was to set the stage for development of a culturally relevant and comprehensive quantitative evaluation instrument that could be used to document long-term

outcomes of conservation education programs designed to facilitate transmission of local environmental knowledge in Hawai'i. In order to achieve this purpose, semi-structured interviews were conducted with environmental education practitioners and community elders in a rural community in Hawai'i to determine 1) the similarities and differences between past and present local environmental knowledge about nature; 2) the barriers to learning about nature for youth; and 3) measures of success/failure which indicate that local environmental knowledge has been shared successfully.

When describing historical local environmental knowledge, participants noted the importance of experiential learning, mentorship and apprenticeship (e.g., time spent learning alongside a parent or relative), and integration of belief and cultural practice. The findings were consistent with literature exploring youth relationships with nature situated in a Western framework that suggests learning about nature for past generations occurred through direct daily experiences (Kahn & Kellert, 2002). Additionally, these findings are consistent with literature that focuses specifically on transmission of TEK in an indigenous context, and suggests that past learning about local environmental knowledge and associated beliefs occurred through intergenerational oral tradition (Cavalli-Sforza, Feldman, Chen, & Dornbusch, 1982; Cristancho & Vining, 2009; Ruddle, 1993). Furthermore, the respondents focused on the importance of learning from parents who possessed expertise in a given area (e.g., collecting and using medicinal plants or making nets for fishing) as a means through which knowledge was transmitted. This reflects research findings that document vertical transmission of TEK through a hierarchy of expertise, often from parent to child (Casagrande, 2002; Eyssartier, Ladio & Lozanda, 2008; Lozanda, Ladio, & Weigandt, 2006; Ohmagari & Berkes, 2007).

Findings from this study indicate that although transmission pathways may not have changed substantially (e.g., vertical transmission from elders to youth still occurs), the knowledge itself has changed. This points to a broader change in culture, which may be driving both changes in knowledge transmission and changes in the knowledge that is transmitted (Agrawal, 1995), presenting a challenge for conservation education practitioners who may wish to share a message with an audience that conflicts with messages youth receive from parents and other community members. Many respondents mentioned barriers to getting the message across when discussing integration of local environmental knowledge into conservation education. These included structural barriers (e.g., stemming from the instructor or the characteristics of the audience), institutional barriers, barriers rooted in modern interpretation of cultural practices and outside influences. Barriers identified by this study, such as outside influence and changes in values, ethics and perspectives, are consistent with those identified by others. For example, McCarter (2012) found that changes in environmental and socio-cultural contexts, including influence from outsiders, may be driving changes in transmission of TEK on Malekula, Vanuatu. Responding to this change demands a more complete understanding of the forces of modernization that have influenced, for example, local environmental knowledge of youth. Further, it points to a need to better understand how institutional practices such as standardized Western education influence interactions with nature as well as social and ecological outcomes Hawai'i.

Metrics of successful sharing of knowledge were categorized based on whether or not they were cognitive, behavioral, social or conservation-oriented. In addition, when discussing the metrics described above, 16 participants mentioned the importance of using metrics to measure long-term program outcomes, particularly for programs designed to educate youth about the

environment. These included social metrics such as the extent to which today's youth could feel empowered to create a better life for their own children, and long term cognitive and behavioral metrics such as interest in a conservation-oriented career path, long-term personal growth and future lifestyle choices (e.g., financial support of conservation initiatives, voting behavior and consumer behavior), and perpetuating and engaging in cultural traditions and practices. Ecological metrics were only mentioned once, indicating a disconnect between issues and metrics that should be considered when developing program outcomes.

Common themes from this study will later be used to develop a comprehensive evaluation strategy, which will be used to assess long-term outcomes of conservation education programs. This will ensure that the objectives of the evaluation strategy and methods used will be relevant to participants and attentive to analytic processes (Kohrt et al., 2009). This approach has been applied successfully in the field of public health by linking ethnographic methods with quantitative methods to test hypotheses (Dressler, 2005).

### *Limitations*

Because evaluations are often designed with the needs of the stakeholders in mind and used to improve upon existing programs, samples often lack internal validity (Mertens and Wilson, 2012). This project stemmed from a need for more tailored evaluation of conservation education programming in a rural community in Hawai'i. The extent to which the results may apply to other areas, therefore, is limited. Additionally, kūpuna elders and practitioners shared thoughts about learning for today's generation of youth. Including a voice and perspective from youth participants could have strengthened the study.

### *Suggestions for future research*

To what extent might interacting with the natural world in a culturally meaningful way lead to improved outcomes of conservation education initiatives? This question could be of particular interest as researchers continue to seek better understanding of social-ecological systems. There are methodological considerations related to the development of culturally sensitive instruments that can be used to describe and predict, for example, health outcomes (Brown, Kuzara, Copeland, Costello, Angold & Worthman, 2009; Kohrt et al., 2009). It is important to note that adapting scales for use in other cultures can be problematic, so developing culturally-specific scales is advised (Ice & Yogo, 2005). Moreover, these scales should take into consideration the cultural variation that might exist in a given geographic location to account for the extent to which individuals interpret and make sense of their identities (Kirmayer & Swartz, 2013) and connection to natural resources. The next steps of this study, therefore, will involve developing more relevant measures for outcomes of conservation education. Additionally, it is worth noting that few native Hawaiʻian species were mentioned by name in the interviews. However, because interview questions were broadly focused on knowledge from the perspectives of the participants and respondents were not asked about Hawaiʻian species specifically, the extent to which knowledge of native species exists or does not exist is unknown. Future research on this particular domain of knowledge may be useful to conservation education practitioners wishing to share information about native species with program participants.

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## CONCLUSION

The purpose of this dissertation was to use an evidence-based approach to investigate evaluation of conservation education on a global scale in order to garner lessons learned for the future of the field and to address an applied conservation education need for more rigorous and culturally relevant evaluation of program outcomes in a rural community in Hawai'i. This was accomplished by conducting a systematic review of conservation education evaluations conducted over the last quarter century and utilizing a person-centered interview approach to advance evaluation of conservation education programs in Hawai'i beyond rote knowledge gain by considering community perspectives on metrics or indicators of program success. Information collected through this dissertation will be used to inform the development of a culturally relevant and comprehensive evaluation strategy that could be used to document long-term outcomes of conservation education programs that seek to facilitate sharing of local environmental knowledge in Hawai'i and will contribute to the need identified in Article 1 for evaluation strategies that consider cognitive, behavioral, social and ecological metrics and outcomes.

Increasingly, conservation scientists and practitioners have recognized the need for conservation education as a central facet of a broad-based response to anthropogenic threats to biodiversity (Bickford et al., 2013; Clayton et al., 2013). After all, given the realization that conservation problems and solutions are heavily rooted in human behavior (Schultz, 2011), conservation education aimed at behavior change has achieved greater significance in recent years. However, the role of education is still frequently overlooked in conservation planning due to a perceived lack of positive impacts and methodological rigor (Cartwright et al., 2012; Zelesny, 1999).

The purpose of the first article was to highlight the trends and broad conclusions from the last quarter century of published research on conservation education in order to contribute to an evidence-based framework for the field and to recommend a path forward for the future. Findings indicated that evaluation of conservation education programs, particularly those which have been developed in response to ecological and social issues, is on the rise in countries around the world. However, metrics to indicate effectiveness and outcomes to measure effectiveness remain rooted largely in changes in cognition. As such, there is a need to think more holistically about outcomes of conservation education programs. By adopting a narrow view of outcomes that fails to take into account a broad array of potential outcomes (e.g., including social and ecological outcomes that may require measurement over longer time periods), understanding of program impacts is limited and this could in turn limit funding and future support for programming. Additionally, development of evaluation strategies, including methods, evaluation design, and reporting of both successes and failures, should consider the needs of key stakeholders in order to ensure community engagement and support throughout the process. Finally, longitudinal evaluation is needed to ensure outcomes and impacts persist into the future.

The second article, framed with literature on traditional ecological knowledge change, sought to compare current local environmental knowledge with that of past generations in a rural Hawaiʻian community. Additionally, the applied focus of this article aims to set the stage for development of a culturally relevant and comprehensive evaluation strategy that could be used to document long-term outcomes of conservation education programs in Hawaiʻi. Results indicated that although transmission pathways may not have changed substantially, the knowledge itself has changed, thus presenting a challenge for conservation education practitioners who may wish

to share a message with an audience that conflicts with messages the audience may receive from elsewhere. Barriers to sharing knowledge were also identified, and these included outside influence and changes in values, ethics and perspectives. Most participants discussed the importance of social, cognitive and behavioral metrics that could be used to indicate successful sharing of knowledge; however, few mentioned ecological metrics. Additional research is needed to better link current ecological issues with metrics of successful conservation education strategies and measurable outcomes, and should integrate community perspectives and long term evaluation of conservation programs that more holistically consider both social and ecological outcomes.

In conclusion, as indicated by the research reported in this dissertation, the use of evidence-based approaches to evaluating conservation education programs can lead to the development of strategies for more comprehensively documenting program outcomes. This can lead to improvement of existing programs and can justify the need for increased funding for conservation education initiatives. However, although a systematic review facilitates a broader global perspective, it doesn't account for local conservation and cultural context, which is critical for the field of conservation education moving forward into the future.

## APPENDIX

## **Transmission of cultural knowledge about nature – Practitioner Interview Guide**

Across the U.S., learning about nature is occurring in indirect ways as opposed to through direct experiences. Research has pointed to the need for locally relevant environmental education programs to better connect youth with the natural world. This project builds from prior research that identified social connections with local kūpuna elders and transfer of traditional knowledge as key features leading to increased knowledge about ecology during a summer enrichment environmental education program for kids in (location removed for anonymity).

You have been selected to participate in this interview because you currently work as an environmental educator on (name of island removed for anonymity). We would appreciate the opportunity to discuss your experiences in this area. Depending on the breadth of your experiences, the interview could take up to one hour. After this initial interview, if you are willing, we may wish to follow-up with additional questions. Your participation is completely voluntary and confidential. Personal identity will remain confidential during any reporting of results.

These questions are intended to help us gain an understanding about how cultural knowledge is integrated into environmental education programs to teach youth about nature and culture. While the questions presented below provide a general format for the interview, based on our conversation, the order and questions may be modified, and questions not listed may arise. If a question is unclear please feel free to ask for clarification.

1. Tell us briefly about the kinds of programs offered by your organization.
2. Where do kids get information about nature?
3. How does this compare to how learning about natural resource stewardship might have occurred for past generations?
4. In what ways has cultural knowledge of natural resources been integrated into environmental education programs offered by your agency/organization?
5. Are there certain audiences/segments you feel your organization is having trouble reaching?
6. What are the barriers that exist in your organization to teaching this information? What are the biggest obstacles moving forward (prompt if needed – are there barriers related to institutional support, involving elders, etc.)?
7. Where do you go for guidance, coaching or support when you are planning an EE program?
8. What metrics do you use to evaluate the success of an environmental education program?
9. What other organizations can you think of that are currently offering environmental education programs on the Big Island?
10. Is there anything else you would like to share that was not covered?

Thank you



## **Transmission of cultural knowledge about nature – Kupuna Interview Guide**

Across the U.S., learning about nature is occurring in indirect ways as opposed to through direct experiences. Research has pointed to the need for locally relevant environmental education programs to better connect youth with nature. This project builds from prior research that identified social connections with local kūpuna elders as a key feature leading to increased understanding of Hawaiian ecology during a summer enrichment environmental education program for kids in (location removed for anonymity). Many important lessons can come out of the experiences and perspectives of kūpuna elders when developing future outreach and education programs for youth. You have been selected to participate in this interview because members of your community feel that you are knowledgeable about the linkages between culture and the natural world. We would appreciate the opportunity to discuss your experiences in this area. Depending on the breadth of your experiences, the interview could take approximately one hour. After this initial interview, if you are willing, we may wish to follow-up with additional questions. Your participation is completely voluntary and confidential. Personal identity will remain confidential during any reporting of results.

These questions are intended to help us gain an understanding about how you learned about nature as a child. We also hope to elicit barriers to communicating and learning about nature for today's generation and identify ways educators can better collaborate with kūpuna elders to teach youth about nature and culture. While the questions presented below provide a general format for the interview, based on our conversation, the order and questions may be modified, and questions not listed may arise. If a question is unclear please feel free to ask for clarification.

1. Can you share any stories of how you learned about particular plants, animals or processes in the natural world as a child (allow considerable time to elicit a few example stories about specific species)?
  - a. What made these experiences memorable (repeat this question for each experience shared)?
    - i. From whom did you learn this information?
    - ii. Where were you when you learned this information?
    - iii. Why is this important?
2. Where do kids get information about nature today?
3. How are people generally involved in sharing this kind of information with kids? How have you been personally involved in sharing this kind of information? Are there other ways you would like to be involved?
4. Given the experiences you have had as a child and your observations of today's children, what do you think gets in the way of kids learning this information? What would be the most successful approach to overcoming these challenges?
5. What is it that you most want your kids or grandkids to know? How do we know that knowledge has been shared successfully? What are kids doing to indicate that knowledge has been shared sufficiently?
6. Is there anything else you would like to share that was not covered?

Thank you!

Table 2. Interview questions organized by research question

<b>Research question</b>	<b>Kupuna interview question</b>	<b>Practitioner interview question</b>
How is cultural knowledge about nature currently transmitted?	Where do kids get information about nature today?  How are people generally involved in sharing this kind of information with kids?	Where do kids get information about nature today?  In what ways has cultural knowledge of natural resources been integrated into environmental education programs offered by your agency/organization?  What other organizations can you think of that are currently offering environmental education programs on the Big Island?
How was cultural knowledge about nature historically transmitted?	How have you personally been involved in sharing this kind of information?  Are there other ways you would like to be involved? Can you share any stories of how you learned about particular plants, animals or processes in the natural world as a child? What made these experiences memorable? From whom did you learn this information? Where were you when you learned this information? Why is this important?	How does this compare to how learning about natural resource stewardship might have occurred for past generations?
What are the barriers to integrating cultural knowledge into environmental education programs?	Given the experiences you had as a child and your observations of today's children, what do you think gets in the way of kids learning this kind of information? What would be the most successful approach to overcoming these challenges?	Are there certain audiences/segments you feel your organization is having trouble reaching?  What are the barriers that exist in your organization to teaching this information? What are the biggest obstacles moving forward? Where do you go for guidance, coaching or
What support networks exist for offering environmental		

education programs that integrate cultural information about nature?		support when you are planning an environmental education program?
What measures of success or failure can contribute to environmental education program improvement?	What is it that you most want your kids and grandkids to know?	What metrics do you use to evaluate the success of an environmental education program?
	How do we know that knowledge has been shared successfully?	
	What are kids doing to indicate that knowledge has been shared successfully?	
Overall comments	Is there anything else you would like to share that was not covered?	Is there anything else you would like to share that was not covered?

Table 3. Description and examples of *a priori* and emergent codes used in final data analysis<sup>1</sup>

Open code (Axial code)	Code description	Example
Ideas for teaching others about nature (Knowledge transmission/sharing)	Ideas for ways to teach others about nature that haven't been implemented or may be implemented in the future	So my take on it was, was to get the kids, get 'em up there, get 'em in the forest and then at least start the process that there's other things up here besides pigs. And rubbish. (laughs) You know?
Personal involvement (Knowledge transmission/sharing)	This code indicates ways in which the respondent has been PERSONALLY involved in sharing information about nature with others, OR how they would like to be more involved personally.	And when I went through a substitute teaching, that's what set me off was I said, you know, you guys, you don't realize where you're living. You're living in an incredible place. There's no place like this on earth. And as I'm saying it, they're going, oh, mister boring over here, I sick of this, I can't wait to go, and oh, boring. Boring, boring, boring. So I thought, when I got this job, we had to put an end to boring. And the way to do that was to take 'em up in the forest.
Cultural knowledge integration (Knowledge transmission/sharing)	EXAMPLES of INTEGRATION of CULTURAL knowledge	I would also was a student of Edith Kanaka'ole, so a lot of the oli and hula that we learned have to do with

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<p>Knowledge/observations (Knowledge transmission/sharing)</p>	<p>into teaching or learning - can be through a formal EE program or examples from personal experience, including IDEAS for integration. PAST or PRESENT.</p>	<p>Pele, and that sort of thing, and I've studied legends, myths - I don't like calling them myths and legends. Stories I guess about Pele. And in particular there's a series of chants that...signify very dramatic, convulsive volcanic events and as it turns out, many of us believe that they relate to the eruptions here at the summit, some of which were very explosive in the 1400's. So, you know, connecting - trying to connect modern-day science and cultural traditions I think is a really important thing that interests me. I don't really remember that many animals growing up. Plants. I was interested in plants. At recess, when it was real hot, they'd be out in the playground playing kickball and stuff, I didn't want to go out in that heat and I'd sit in the shade and examine the seeds of the plants and how they fit together. My teachers probably thought I was (inaudible), seeing me sit there alone by the fence picking all the plants apart. I</p>
<p>Practice (Knowledge transmission/sharing)</p>	<p>This code describes examples of knowledge about the natural world in terms of local, observational knowledge of species and other environmental phenomena. This could include personal <i>observation</i> of phenomena OR accounts of prior knowledge that have been handed down in addition to facilitating knowledge sharing with others. This code illustrates how knowledge is or has been enacted through cultural practice in terms of the way people carry out THEIR USE OF NATURAL RESOURCES</p>	<p>Yeah there's all kind of stuff that could go on that way. So everybody, you know, there are many, many different schools of knowledge. I don't necessarily know many specific chants for, or protocols for doing specific things. But I try to be generally respectful and mindful of you know, this is not my place, and even if I grew up someplace, or live, I've lived here - I'm not going to just go out and chop down whatever I need chopping down for my yard. I feel bad when I have to - I felt bad when the 'Ōhi'a trees have to be cleared for my house and I saved them all, you know, if a tree gets too</p>

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Belief (Knowledge transmission/sharing)	This code indicates belief about the natural world or the way things work in nature - belief about the way people FIT INTO OR RELATE to the ecosystem	big now and I have to go prune it, it's like - it's not difficult but it's, you know, I recognize that I have to cut this thing now. So you know, the things that I'm aware of are more to do with gathering plants um, that sort of thing. And again it's more of a mindfulness and care in cultivating and making sure that you're gonna have some more the next time you come. You know, don't take it all at one time. I'm respectful of the plants, I look at them as my ancestors, and it's my responsibility to take care of them because they are so much older and wiser than I.
Compare past and present learning (The present)	This code indicates ways in which past learning about nature is different or similar to current learning about nature	Growing up in our classrooms we didn't ask many questions, and that, I believe is a cultural thing. You were taught. You weren't encouraged to ask questions and I don't know if was a - the teacher didn't have time for questions or what. And that is a real um, Hawai'ian, native Hawai'ian cultural practice. Don't - don't be asking too many questions. Just use your eyes and be a really good observer and you'll figure it out, you know? And then, when you have time, you go take your own thing or do your own netting or do whatever. That kind of goes into my next question: where do kids today get information about nature? K1 I would hope in nature. But my fear is from books. From the Internet. From wherever young people go these days. You know, some of them are fortunate, they can go to camp. They can go to a program somewhere. But even the educational system now, everything is different
Current or potential learning source and modes (The present)	Ways in which people today currently learn about nature	

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Current or potential learning location (The present)	Where are you or others currently when you are learning about nature/where might you potentially be in the future	And when I went through a substitute teaching, that's what set me off was I said, you know, you guys, you don't realize where you're living. You're living in an incredible place. There's no place like this on earth. And as I'm saying it, they're going, oh, mister boring over here, I sick of this, I can't wait to go, and oh, boring. Boring, boring, boring. So I thought, when I got this job, we had to put an end to boring. And the way to do that was to take 'em up in the forest.
General involvement of others (The present)	How are people generally involved in teaching others about nature?	I think our generation is very, very happy to share whatever we know. And, but the generation below us, I think, maybe know less. You know? Just a changing of times. You know, just changing of times. And you lose a lot of the knowledge.
Organizations (The present)	Organizations currently offering EE programs on the Big Island	Nā Pua No'eau is one. I think if you go to every public charter school you'll find a program connected to it...the Edith Kanaka'ole foundation... I: So it sounds like a lot of bright spots in schools, you know? P1: Mm-hmm. Especially public charter schools.
Support networks (The present)	Where do you go for guidance or support when planning an EE activity? This code can also indicate support from within an organization to, for example, integrate cultural information into communication programs. This code includes planning support and also collaboration within and between organizations currently or planning to offer EE/communication/outreach programs on the Big Island.	P1: And even if I don't, like let's say they don't have enough money to take care of me for another three or five years or whatever, I'm still gonna be there cause I have the Discovery Forest connection, you know, I've formed this network of conservation people and just, it's never gonna end. I'll be doing this forever I think. In one way or another.

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	Also, this code was used when respondents discussed feeling generally unsupported in what they do (lack of institutional support or otherwise).	
	It was also used when the respondent described how he or she supports the work of others.	
Values/ethics/perspectives (Social codes)	This emergent code was used to indicate ethics or values/perspectives. For example, (Rokeach 1973) - instrumental values - preferred modes of behavior that facilitate achievement of terminal values (enduring belief about desired end state).	A concern of mine is that with the right to gather comes a responsibility to ensure that resources will remain into the future. And it, it's a situation where some people don't seem to understand that part, and you know, I talked about a little bit early the boundary commission testimonies of the 1870's made it very, very, very clear. If you're not from this place and you come here and you take things - resources - and we catch you, we're going to take them away from you. You know, today it seems like it has turned into um, anybody can go anywhere to gather anything that they think they need, and I don't appreciate that sentiment. Well maybe not anybody. Hawaiians. You know, native Hawai'ians. (Town removed for anonymity) looks kind of bleak right now. I mean, I don't see - I don't know what the future industry or anything right here, that's terrible, right now whatever the people do is either with the nuts and coffee, you know, but since sugar left there has not been anything to replace it. Ranching in a small part. You can see all the vacant homes they have here. There's really - I don't know, I feel very, very sad every time I come through town. It's nowhere the
Social fabric (Social codes)	This emergent code includes respect, social learning, ability/inability to fulfill cultural/social expectations. This code was also used to describe social ills such as getting into trouble, drinking, incarceration, etc. in addition to broader social problems or issues, like lack of access to affordable housing and land for farming.	

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<p>Food and agriculture (Social codes)</p>	<p>Emergent code to describe connections to nature and culture through food systems or agriculture. FOOD specifically. EATING.</p>	<p>town that used to be when we were young. I feel sad.  LP: And your kids left  K5: And my kids left because they didn't feel they had a great future here, after they (inaudible) school, got jobs, well one is on 'Oahu, she's doing well on 'Oahu. But that's 'Oahu now, we're not talking about Big Island, and the other three on different parts of the mainland. And I wish they were here.  So we had organic range fed chickens, we had range fed beef, we had organic vegetables out of the garden, you know, we had all of that stuff because we were poor. We didn't know we were poor, but in the meantime, society got to be McDonaldized and you know, everything comes in a can or wrapped up in plastic, and people don't know where their food comes from. So that simplicity of just knowing where everything comes from, it kind of went full circle, you know, from me having to do it when I was younger to now it's a luxury to be able to eat that way because all of that stuff costs more. You want hooked fish out of the ocean rather than a farmed fish out of somebody's pond someplace, it costs more. You want range fed beef, you pay more for it.</p>
<p>Outside influence (Social codes)</p>	<p>This emergent code was used to indicate influence from outsiders or coming from outside the community, including invasive species.</p>	<p>I: What were some of the native species you remembered seeing?  K8: You got the...the black raven, the black crow. The Hawai'ian Crow.  I: You remember seeing them?  K8: Yeah, they used to be all up here but throughout the years they migrate because you get all these plantation start going up opening up fields so they start moving. Same</p>

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Historical learning location (The past)	Where were you when you were LEARNING about nature in the past; can be personal OR indication of where learning historically occurred.	<p>with the goats and the Mouflons. Used to be all up in the mountain all wild goats. But slowly they move away because of, you know, people building this, building that. That's why a lot of the, you know, a lot of the species gone.</p> <p>K5: And stuff, we as kids we used to go up in the mountains to play and</p> <p>K4: We eat everything</p> <p>L: Eat everything that's there</p> <p>K5: And we learned (inaudible), I don't know, the old kids told us what was edible. Nobody died yet (all laugh)</p>
Historical learning source and modes (The past)	This code indicates from whom/from what/how a person learned about nature - modes of transmission - from a family member, from a friend or school teacher, self-taught through unstructured experience, from a book; can be personal OR indication of how learning HISTORICALLY occurred.	<p>some people have asked recently how do you know what you know, and I think that the big categories are I've had some really, really good teachers, um, many of the people who wrote many of the books that people study from were teachers of mine. And we didn't just sit in a classroom. We went outside, and were shown things in the field. I have an extensive library, I'm really, really curious. I have the ability to look up information, and to sort through what might be incorrect because you know, somebody wants to write something and they write a story or a book. I also have personal outdoor, on the ground, in the field experience. How, when, why, where do you go pick kupe'e, you know, somebody tells you but stuff like that, they don't really share very much</p> <p>So there's a lot of things that you kind of have to figure out on your own.</p>
Personal history (The past)	This emergent code was used to identify details about the respondents' personal histories - where they you born, where they work,	<p>One of the jobs at the park I had was I was a cave resources manager for about five years. So I did a lot of research about that stuff - lava tubes and caves. I know where many of</p>

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Current barriers to knowledge transmission (Barriers)	<p>upbringing, experience in the military.</p> <p>What currently gets in the way of learning about nature? Can be institutional barriers (standardized school curriculum) or personal barriers (such as lack of interest, or greater interest in technology).</p> <p>Can also include shifts in natural resource availability (e.g., lands now barren that weren't before)</p> <p>Includes lack of collaboration or communication within institutions, lack of access, technology, lack of curiosity, outside influence, lack of comfort being outdoors</p>	<p>them in the park are.</p> <p>So it's it's really complex, and I just get sad watching all of this and you know, the big thing that I came to mind when you started asking the questions was people need to get outside. You know, you can look at your iPad all you want and it will show you really good pretty pictures of lehua and probably kupe'e crawling around on the rocks at night. But unless you're there picking it and getting wet and cold or hot and sweaty and thirsty.</p> <p>FA: Experiencing the sounds, the air K1 Yeah. It means less it's, you're, the whole experience then is diminished.</p>
Difficult audiences (Barriers)	<p>Specific audiences that are difficult to reach through EE programs</p>	<p>So you lose that part of your culture. But, and there are also community members um, I got, I read a letter to the editor, there was a, so there was an article a couple months ago in the Hawai'i island newspapers that was printed about the (facility name removed for anonymity) and it wasn't just about 'alalā, it was about all the birds that they have there, but there was a big picture of the 'alalā in the paper, and it was a great article. Very, you know, just straightforward reporting. Nothing like, biased either way. But of course people wrote letters to the editor in response to it, and there are people out there, I guess maybe there always are, um, whenever tax dollars are being spent and whatnot, but who are going to complain (laughs) and be radical about their complaints,</p>
Metrics or indicators of success (Metrics)	<p>How do we know efforts to educate the next generation about nature have been</p>	<p>when you see them out in the field. When you see kids out there in the taro fields you see kids out there</p>

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Current measurement of outcomes (Metrics)	<p>successful? How do we know knowledge has been shared successfully? This could take the form of ecological metrics (e.g., decline in deforestation, kids participating in a beach cleanup, etc.), behavioral metrics (they communication what they've learned with their family or bring others to experience nature), cognitive metrics (change in awareness, attitude, perception - e.g., greater comfort outdoors, curiosity), social metrics (decrease in social ills, increase in community cohesion, increase in respect for others, respect for self, nature, etc.)</p> <p>What metrics are currently being measured or assessed?</p>	<p>chopping certain stuff.</p> <p>I: So that's a good lead-in to my next question, which is what metrics do you use to evaluate the success of your programs?</p> <p>P5: Um, well, for the ones we're doing at (organization)?</p> <p>I: Mm-hmm</p> <p>P5: I - I would have to say we don't really. We leave it up to folks like (organization). Um, and what the things, the informal stuff we do do is take people up into the forest, no. We have no evaluation for that at all.</p>
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<sup>1</sup>Some segments were coded with more than one code

Additional examples of research themes organized by axial and open code

### **The past – historical learning location**

When describing how learning about nature occurred in the past, many respondents recalled memories based on specific locations. Historical learning location was coded a total of 39 times in eight kūpuna interviews and five practitioner interviews. Most respondents described learning that took place in an outside setting, and a few described learning that took place in a formal classroom setting. Several respondents described learning that took place as part of a formal school program but happened outside. When describing historical learning about nature, many participants referenced a specific location. For example, learning in the mountains was mentioned a total of four times and learning at the ocean was mentioned nine times. Two practitioners and two kūpuna mentioned learning outside in a general, unspecified location (mentioned a total of six times. Learning in the classroom was mentioned twice. Additionally, some participants described learning in an outside setting associated with school (e.g., on the playground at recess or while engaging in a school gardening lesson). Several respondents mentioned learning about nature in a neighborhood setting near their homes (mentioned 10 times), and two kūpuna mentioned learning about nature by working in the family garden.

The following quotes capture many of the themes described above:

K5: We...as kids, we used to go up in the mountains to play and

K4: We eat everything

K5: And we learned...I don't know, the old kids told us what was edible. Nobody died yet (laughs)

K6: I don't really remember that many animals growing up. Plants. I was interested in plants. At recess, when it was real hot, they'd be out in the playground playing kickball and stuff. I didn't want to go out in that heat and I'd sit in the shade and examine the seeds of the plants and how they fit together. My teachers probably thought I was...seeing me sit there alone by the fence picking all the plants apart. I could have been a botanist probably.

K8: Back in the old days, the plantation days, there were camps up in the mountains where they put us. You had like Filipino camps, Japanese camps, Chinese camps. Our

camp was right below the mountains, so you know, that was our playground...we used to go up the gulches and we had beautiful ponds where we go swimming, nice clean cold water. And then like I say, we played up there so we knew where all the fruits, you know, bananas, peaches, guavas. And that was our grounds.

### **The past – historical learning source/modes**

All of the kūpuna and six of the practitioners described sources or modes of historical learning. Apprenticing under someone more knowledgeable was mentioned a total of 25 times by kūpuna. Formal education was mentioned only by practitioners a total of 13 times. Learning through observation or experience was mentioned a total of 52 times by both kūpuna and practitioners. One practitioner mentioned practicing the culture as a mode of learning, and one practitioner couldn't comment or speculate on historical modes of learning.

The following quotes illustrate the themes described above:

K3: ...plants was from my grandmother, to my mom, and what was the things used for medicinal purpose. Most of the things we use as my, you know, medicinal purpose. And uh, my grandmother, you would say on my mom's side was like a, was a kahuna. She and, I've seen it done, and it happened when my grandmother would take my mom and her if my oldest brother broke his leg, which he did, they would put the pain on the knee. And it worked. It works, so yes. There was medicinal purpose for each plants that we use.

I: Yeah, so observing family members is what I'm hearing. K3: Yes, yes, yes. And describing what is this plant used for, what is this plant good for, as far as that, for uh, healing or I mean as far as that, so do we depend on the doctors?

K2: ...How you get to learn the old traditions, you have to get involved in like, we were interested in fishing. My dad was a fisherman so that's how I got into fishing from very young age. You learn how to make nets and everything...when I was five years old, I start, you know? He makes the net ad I just hold these, you tie these spot out and then you...but to start me from learning, he made me hold this and he made.

I: And you learned about the current from your dad?

K2: From my dad, yeah.

I: And he learned from his dad?

K2: From his dad, yeah.

K2: And then the other part of it is like it was just a daily protocol. He did this, you didn't need to ask questions, you didn't talk, you just learned, you know?

K4: Cause I remember my grandfather taking the berries and putting them in the tea leaf and roasting them over the stone fire. And then would make this, this uh, liquid and I would drink that, for like opening up, uh, the chest when it's all congested.

K8: ...and they would teach us certain stuff in the forest, what to eat, what not to eat. What was good for rash, mosquito bites, stuff like that. So we learned early age...

K10: Like old days, we used to, even when we was young, we used to have gardening class like that, one period. But you know, that – the importance of raising things.

P2: When I started working for (removed for anonymity) and I used to go into the forest and pick maile. I would go and do that, and I did the bird transects with the national park, camping, coming down, the very first one, and I dug that but I still didn't go to the plants yet. And I realized because nobody said anything. Nobody took the time to say, you know what that plant is? No, I never thought about that. Maybe it's ignorance, I don't know, but I just didn't, and when I started working for (removed for anonymity), (name removed) started saying this is this, and this is this, and I just began to learn it. And I learned it.

P6: I would think that in olden times, it wouldn't have been an active learning. It was very much a quiet, learn, observe from people around you kind of thinking.

P9: I would say, you know, and I never really even thought about it that much, but as a kid, that was what most of my focus was, was the fact that when you go out, when you get in the forest, you're able to get away from, one all of the rules. You don't have anyone to watch you and say that's ok or this is ok. You can make your own mistakes, um, you can probably do things that are bad too, like I'm sure I probably peed on some plants that I shouldn't have done but I learned about it in time to stop doing that, but I would say that it's a huge part to a balance you need and if they get the opportunity to, to um, experiment like that.

### **The past – personal history**

All of the kūpuna and all but one practitioner commented on details of personal history.

For the practitioners, these details were focused mostly on work history and upbringing. For the kūpuna, text segments dealing with personal history were focused primarily on upbringing, military experience and recent details (e.g., where their adult children currently reside or when they moved to their current residence). Excluding military, only one kūpuna discussed past work experiences. Military experience was mentioned three times in two kūpuna interviews. Recent details were discussed a total of ten times in two kūpuna interviews and three practitioner interviews. Upbringing was discussed most frequently and was mentioned in all of the kūpuna interviews and two of the practitioner interviews a total of 31 times. Work was mentioned a total of 19 times in three kūpuna interviews and six practitioner interviews.

The following quotes illustrate the themes described above:

K10: ...I wanted to become a teacher, but two months after...the war started, so that was it and then they called because ROTC was required in those days. Like it or not, all males had to be in the ROTC. So I was in, and that's when they called for volunteers on December, I went to the armory cause they gonna form the Hawai'ian...to help regular army soldiers watch the shoreline...so I tell – I said can do...so I step forward.

K11: I asked him was it patriotism that made you want –

K10: It was monkey see monkey do, cause I was only 18.

K4: ...My oldest daughter lives in Michigan

K8: So, and then all the camps were all like sugar plantation workers. Some of the houses were maybe like three single Filipino men working. In our camp there were twelve houses, six here and six across, and we was the only one with family. The rest was all like single.

K7: So I came back and went to work for the division of highways and worked for them, I worked for Technicolor for awhile, right, by the Disney studios in Burbank. And I was a mailman for, learned about dogs. Um for about six months, eight, ten months?

### **Barriers – Current barriers to knowledge acquisition**

One hundred and eight segments of text were coded as current barriers to knowledge transmission at least once in each interview. When discussing barriers to sharing knowledge about natural resources with the next generation, two respondents mentioned adults. Two mentioned consumerism (mentioned three times). Two mentioned cultural barriers (e.g., it is not one's place to know or share knowledge about something). Six practitioners mentioned that different audience values and perspectives can be a barrier to sharing information with others. The educational system was mentioned 18 times by two kūpuna and six practitioners. Four practitioners and one kupuna mentioned institutional barriers a total of ten times (e.g., sharing information is outside the scope or mission of a given organization, lack of funding and appropriate training to equip staff with the skills they need to communicate information to public audiences). Two kūpuna and one practitioner mentioned lack of access to land/resources (e.g., certain native bird species no longer exist in close proximity to cities and towns and therefore people are not able to learn about them). One kupuna and two practitioners mentioned lack of

collaboration among scientists as a barrier (mentioned four times). One kupuna and one practitioner mentioned lack of comfort in nature (mentioned three times). Three kūpuna and three practitioners mentioned lack of curiosity or interest as a barrier (mentioned 10 times). Several respondents mentioned that the knowledge has been lost or there is no one to share it with the next generation (mentioned a total of nine times in four kūpuna interviews and two practitioner interviews). One kupuna mentioned mobility or moving out of the area as a barrier, and linked to this, two kūpuna mentioned modernization as a barrier (mentioned three times). One kupuna and one practitioner drew upon the idea that social ills (i.e., drugs and alcohol) present a barrier to communicating with the next generation (mentioned five times). Linked with this was the idea of societal expectations (e.g., getting a good job that pays the bills) standing in the way of learning about natural resources (mentioned a total of eight times by three kūpuna and one practitioner). Finally, technology was mentioned sixteen times in four kūpuna interviews and three practitioner interviews.

The following quotes illustrate the themes described above:

K1: And I don't know, you know, I keep saying I have no idea how I turned out the way I did, but I think our generation was more in touch with the land, the earth, you know, all of that stuff, cause it was, it wasn't – it was more primitive. If you went to the beach, you went to the beach and you took your own food, your own water, your own map, your own everything, and it took you a long time to get there because the road was junk and it took you a long time to come home. It was like a major commitment, and it's just now things are so, so, so different. It's crazy. You don't even have to go to the beach. You can go to YouTube and look at going to the beach.

K1: I fear we're becoming more and more intellectual and less and less physical I guess in our lives and that to me is not a good thing. It's not good. People who live in high rises, they can't hear the rain falling on the roof. They don't know what kind of rain is falling. They don't know how cold or hot it is outside because they either have heat or air conditioning...

K3: Not too much people know anymore. There's very few uh, people that knows about this stuff. This, this type of lifestyle. It's honestly, it is fading away. It is fading away. And there's just a few of the family that knows that takes it in and does it as far as the – so time is changing, yes it is.



K2: I tell the young guys cause there's some young fishermens that's starting to learn to do the 'Ōpēlu fishing, and they only want to catch the fish and sell them and make money, so I told them, you know, I think right now for making 'Ōpēlu nets there's only about two or three of us alive. So I told them you know, well now it's ok, they need a new net they can buy them from us, we can make it. I said well, what's going to happen when the three of us die, you know? This is going to be a lost tradition because nobody's supporting starting to learn. You can tell them and that's about all you can do. You cannot make them do, but I, you know, I feel kind of sorry for them because that's one of how our lifestyle you know, fishing and...another Hawai'ian boy fishes is not interested in going through the whole process, you learn to make net, they don't know how to mend their nets, so they – I can – my net I use is 34 years old. Cause I mend them all. They go through three nets a season, like that's 8 months. They wreck three nets, throw 'em away. They just buy another one, but as soon as they go along there'll be no nets. I tell them, I says, you know, after the three of us die, I give you guys 10 years and you guys be out of business cause there's no nets after that. But you know, they still don't want to learn.

K5: A lot of it now is just passed down, just verbally. And I tried to teach my children what I knew, but they're all except for one of them, the three live on the mainland. They...very young, just out of high school. And that's one of the problems we have today.

P4: Like I think about, you know, when I see these kids on their phones or on their iPads or on whatever media thing it might be at the moment, and thinking that that didn't even exist when I was 10 years old, or you know, even 15. I didn't have that kind of phone and all that kind of technology in my hands, so, and I notice, like, I really do think that being on that kind of technology device all the time prevents kids from fully experiencing whatever place they might be in or around or um, they make the choice to use that technology device rather than go outside, even if it's just outside their house, you know? So yeah.

P6: Well, I think the greatest – or one of the barriers is um, we don't know a lot of things. We've lost a lot of knowledge that we did have. And that's one.

### **The present – Current or potential learning source/modes**

Details about current or potential learning sources or modes were mentioned in six kūpuna interviews and all of the practitioner interviews. The primary learning sources or modes described by the respondents could be categorized in several ways. Unstructured learning involved learning about the natural world through direct observation or experience such as time outside or free choice learning at a zoo (mentioned a total of 12 times by kūpuna and practitioners). Indirect learning was mentioned a total of eight times by kūpuna and practitioners. Indirect learning involved learning through media outlets such as books or television and

learning on the Internet or through technology, including via social media. Many responses focused on a structured program (mentioned 46 times), which could take the form of an experiential learning program or club (e.g., a canoe club), learning in a formal classroom setting at school, learning through university courses, or taking part in a school-based experiential learning program (e.g., a field trip). Many respondents also mentioned cultural transmission as a source or mode through which information about nature is learned (mentioned 44 times). This included intergenerational communication between family members or through a cultural practice. Specific cultural practices that were mentioned in this context included hula, music, paddling, studying the Hawai'ian language, hunting, fishing and gathering.

The following quotes illustrate the themes above:

P7: We come from a more modern time now where we have that freedom and so these stories, these mo`olelo, was passed down and because it's tying in with certain foods that we eat, certain plants that we see in the forest, certain landscapes like mountains and, or rock formations – I think that's something you can't forget. And although the language was taken away, when you see that certain mountain, you remember the history and um, in a time where you can share that now, they'll refer back to, oh, well this mountain was symbolic of this story and this is how it got its name, or, so I think that's how the culture was carried, through chants and dances, um, it was memorized because of maybe certain events, like a certain volcanic eruption, um, maybe 1860, the 1868 lava flow, and maybe they dedicated a hula in commemoration of that kind of life giving force and so um, you memorize it. It's almost like, I don't know, the ABC's you know? Something you just memorize. You know the tune. Someone can take it away from you and say you can never sing the ABC's anymore, I mean, it's - that tune. You will never forget because it's embedded in your brain because it's symbolic of knowing the alphabet.

K8: ...other programs going on at the schools, the colleges, and uh, we in Hawai'i are really moving now because of...everybody's back in the ukulele, everybody back into canoe paddling, everybody doing that and this, everybody learning Hawai'ian now. Which is good, everything is coming back strong again. You know what, it's nice – I go to the mall and I hear young kids talkin' in Hawai'ian. That is nice, you know?

### **The present – current or potential learning location**

A current or potential location for learning about nature was mentioned in two kūpuna interviews and all of the practitioner interviews. Outside locations were mentioned most

frequently (27 times) by both kūpuna and practitioners. These locations included a camp or program site, general outside locations, neighborhood locations, the forest, the school garden, at a club meeting (e.g., canoe club), or while engaged in a family cultural practice at a hunting or fishing site or gathering grounds. Inside locations were mentioned less frequently and included classroom locations and Internet.

The following quotes capture the themes described above:

P1: ...I'm required to um, bring in different learners from the community, from different schools, from clubs, programs, um, they'll request to come up and also I'm, you know, always looking for groups that fit with what is the purpose of (site name), to bring them up. Um, and then you know, part of it is to use the place (site name) as a classroom, so it's kind of bringing you know, learners to a classroom but in an outdoor classroom setting, and allowing them to use their senses of, and to be a part of the learning instead of just reading out of a book or something like that.

P4: I think school because they spend so much time there, you know. Their full time job, so it seems like, like they will connect things that we talk about in the field to stuff they've learned in school.

P5: ...And I think that's something that, that seems to be – they spend all their time out by the ocean. I think a lot of it is firsthand.

### **The present – compare past and present learning**

When asked to compare how today's youth learned about nature with learning of past generations, themes emerged from seven kūpuna interviews and five practitioner interviews. Most of the comments (20) were focused on changes in learning. This included changes in the style of learning or interaction with the instructor and changes in the curriculum. It also included changes in interest and curiosity and changes in motivation to learn. Social context was also mentioned frequently (mentioned 18 times). This included changes in upbringing, social ills or illicit behaviors (e.g., access to drugs and alcohol) and a culture of consumerism, and changes in community life. Changes in the source of knowledge were also mentioned, and of the 16 comments, most were focused on the transition from direct to indirect knowledge acquisition. Others mentioned changes in transmission of knowledge, changes in cultural practices and

changes in the knowledge itself. Changes in the environment, such as natural resource availability and human influence, were mentioned four times and change in general was mentioned three times.

The following quotes capture the themes described above:

K1: ...old people have the way they learn things from whoever they learned it from. We know things, and if you only read things in a book and say oh yeah, they used to do this, oh yeah, they used to go strip hau and soak it and make cordage, looking at – it's like, the reason I'm interested in this feather thing and one of the things I asked the people at the museum and they, you know, I asked them – why aren't people coming in and asking these questions? They said, they don't want to see the feather. They want to see the thing made of feathers. They want to see the cloak. They want to see the cape, they want to see the helmet. They don't care about the fact that the feathers are this big and there's a little bundle of 'i'iwi feathers tied at the bottom with this really skinny thread made of who knows what. They want to see the big thing. And to me, it's important to know that this – these shells came from the beach...40 something years ago and I gathered this hau and I made this cord and I filed pukas in these shells and strung them on this cord. I know how to do this and I've taught people how to do this. That's important. If you can't do that and you look at pictures in the book, the knowledge might still be there but the practice is gone. And that, to me, is going to be a really, really sad thing.

K2: I don't know how a lot of this new generation nowadays, you know? They will never learn all that we learned, you know? There's no interest in that and I don't know, maybe they think they cannot make money with that, you know...I'm not going to be a millionaire but I have a happy life, I love what I do, and there's nothing like going to work and coming home happy because you love what you do, you know...I look at the kids nowadays and they got nothing to do just hanging around with drugs and alcohol...I think it was something with the old generation when we were young generation growing up, we was interested in one thing and worked toward their thing, you know? But I think today, there's so many things that kids can do, they cannot set their mind on what they really want to do.

### **Social codes – Food and agriculture**

Food and agriculture was mentioned in all of the kūpuna interviews and seven practitioner interviews. When respondents referred to food and agriculture, they were most often discussing learning about nature through food (mentioned 27 times). Many respondents focused on upbringing in rural communities, gardening at home, and knowing where food comes from. Others discussed cooking, harvesting plants to eat, plantation life, traditional foods, and

harvesting farm animals. Commercial food systems were also mentioned frequently (23 times). Respondents discussed sugarcane plantations that existed in the area in the past, changing land use patterns, changing lifestyle, commercial fishing, coffee, taro and ranching. The theme of subsistence was mentioned 14 times. Some participants referred to historical subsistence patterns while others described current subsistence in the context of hunting, fishing, providing for one's family and teaching others about how to survive from the land. Unsustainable use was mentioned five times and described farm animals becoming invasive, unsustainable harvest in the name of subsistence and ideas for sustainable farming. Social connections with others in the community through food was mentioned in one kupuna interview and desire to practice farming as a measure of program success was mentioned by one practitioner.

The following quotes describe the themes indicated above:

P1: ...so the resources have changed, you know, and not only on the land, in the ocean there are fewer and fewer fish, there are fewer and fewer things like 'opihi, which is a favorite thing for a lot of people, and even all of that is relative. If you go to (island) and there's nothing. (Island) people come here and say oh you folks have lots. But those of us who live here know that no, we used to have lots and now we don't have so much. So even that's a big concern.

K5: (town) looks kind of bleak right now. I mean, I don't see – I don't know what the future industry or anything right here, that's terrible, right now whatever the people do is either with the nuts and coffee, you know, but since sugar left there has not been anything to replace it. Ranching is a small part. You can see all the vacant homes they have here. There's really – I don't know, I feel very, very sad every time I come through town. It's nowhere near the town it used to be when we were young. I feel sad.

K8: Indicators that knowledge has been shared successfully? Kids are doing those things. They are hunting, they are gathering. They are eating the things they find. Food is important in the Hawai'ian culture. They are going to a potluck and taking/eating traditional foods instead of hot dogs and hamburgers.

### **Social codes – values, ethics and perspectives**

All but one practitioner and all of the kūpuna mentioned values, ethics and perspectives.

The theme of shifting baseline or changing values was mentioned a total of 34 times. This included access rights, cultural identity, outside influences on a community or place and hunting.

Several individuals discussed the concept of restoration and grappled with what should be restored and to what state. Several respondents commented on value placement or the value of certain things (mentioned 20 times). For example, should people value making money and having a high paying job over choosing a lifestyle of lesser impact on the environment? In a similar vein, several respondents expressed the sentiment that there is greater value in something that a person makes or gathers him/herself as opposed to purchasing a product from a store. Others discussed the concept of an overall land ethic, including personal philosophies of reducing waste, sustainability, ethics of cultural practices and understanding human connections with nature (mentioned 24 times). Some also discussed precursors to values or an overall land ethic (mentioned 10 times). Relation to nature, self and others was mentioned a total of 20 times, and included thoughts on the importance of purpose or intention when interacting with natural resources, looking out for and caring for others in the community via natural resource use (e.g., collectivism) and sense of pride or self worth.

The following quotes capture many of the themes described above:

K1: I think, I may have mentioned this a little bit earlier, the notion of gathering rights and whether or not you're gathering things on the land or at the coast or in the ocean, um, I think those are cultural practices. A concern of mine is that with the right to gather comes a responsibility to ensure that resources will remain into the future. And it, it's a situation where some people don't seem to understand that part, and you know, I talked about a little bit early the boundary commission testimonies of the 1870's made it very, very, very clear. If you're not from this place and you come here and you take things - resources - and we catch you, we're going to take them away from you. You know, today it seems like it has turned into um, anybody can go anywhere to gather anything that they think they need, and I don't appreciate that sentiment. Well maybe not anybody. Hawaiians. You know, native Hawai'ians.

P2: I feel that the collection of resources has shifted from collecting some resources for your family to a fear, greed-based gathering of resources with the end result of proving manhood. Boy. Where's doctor Freud? (all laugh) FA: So pretty much overharvesting for like trophy gathering and - P2: Yeah, but tied to all that, all that pig hunting and all that gathering is - FA: Do you have - P2: So you three wahines are sitting here and I come in with my bucket and I go, oh, do you guys like fish? And I dump out like 80 kampachi on the table here and you guys are going, oh, wow, man, where you get that? Ah, I went

down 'ere. What a man, what a man! You might even be attracted to me. Look at what I can do. But if I came with four, look what I caught, oh, isn't he cute? Right? Not right, but I think there's a - men here in our culture don't have a lot of ways to show manhood. P1: ... I mean, it's prior to them as well, but their parents had lived through the initial, I'd say they were brought up in that generation where it wasn't normal to speak Hawaiian. It wasn't normal to practice your culture, it was more valuable for you to go to school and learn English or get a job or be in the military, those type of things... the generation we're talking about, you know, the one you're interviewing, and conservation isn't important, it wasn't important to them. Ranching was important, you know. So it's that missed gap where from 1900's to today or to like 30 years ago where all those things wasn't important, the language was illegal, it was more important to get a job or be in the military or those types of things, where today it's like well, it's more important for you to know who you are, where you come from so you can figure out where you're gonna go. It's more important for you to take care of your natural resources because if you don't, where you gonna get water from? Of all the things which are so, I mean, obvious, but it's now, it's more important now for some reason, through the renaissance, through the Hawaiian renaissance, or public charter schools, all those movements, um, hula, you know, merry monarch becoming so, popular. And like all of those things have natural resources integrated in them. That's what it is. The practice is a natural resource. I: And why do you think that is (shifting baselines)? P7: I think that because of their love for maybe hunting or their love of gathering, you know? Um, they don't see a balance because they're so used to taking and taking and taking and as long as it's still there, they're gonna continue to take, you know? And um, you know, hunting wasn't something that our, the Hawai'ian culture had practiced. You know, if you look in the old histories of, I mean, pigs who were reared and raised - I mean raised next to your hale, next to your home, you know, like how we tie up dogs and stuff, pigs were tied up because our people were aware of the destruction that these pigs could do unto our environment, and so um, so yeah. So there weren't any free roaming pigs in the town, you know? The environment was so intact. Um, and I just - I don't understand how they may have gotten the misinformation, but it's become a, a new kind of culture in Hawai'i, and um, you know, they say oh, the state is eradicating the pigs! But you go to the average hunter's house and you'd see all of the pig tusks and jaws all hung up on their wall, I mean by the 400's and 500's, all on their garage posts, and it's like - you know? You're the eradication.

### **Social codes – Social fabric**

Themes related to social context or social fabric emerged in all of the kūpuna interviews and seven of the practitioner interviews. Many respondents reflected on social context in terms of change (mentioned 66 times). Shifting baselines and access right, outside influence, outside commodities, perspectives on money, lifestyle or upbringing, school systems and societal expections were all components of a broader change in social fabric. Many respondents also

discussed concerns as they relate to the social fabric of the community (mentioned 31 times). These concerns included concerns about overall human health and wellbeing, concerns of future change due to outside influence, lack of opportunity and jobs, social ills, historical concerns related to government restrictions on speaking the Hawai'ian language, and Hawai'i as a microcosm of similar issues in other parts of the world. Many respondents also discussed the social fabric of relationships (mentioned 29 times). These relationships included relationships with family members and relationships within the community that contribute to overall community cohesion and wellbeing. The relationship of the individual to the broader social context was mentioned 23 times. Discussion was focused on character development of individuals, including respect. Additionally, respondents discussed the importance of heritage in terms of pride in oneself and one's heritage. Several respondents discussed bright spots the social context (mentioned 14 times). These included programs that, if well executed, can alleviate many of the concerns; opportunity for becoming involved in initiating positive change; positive outcomes of incorporating Hawai'ian language into curriculum and programs; cultural resurgence; and collaborative natural resource management. Ideas and thoughts about moving forward were mentioned seven times. These included the importance of remembering the past and sustainability of natural resources and cultural traditions.

The following quotes capture many of the themes described above:

K1: The health and wellbeing of our people. I think that's my biggest concern. I think everything else (pause) comes from that, and yeah. You know, the education of our kids is what's critical. Cause if they're clueless, we're gonna end up with a clueless country.

K3: So my grandfather K was a fisherman. So we'd go and we'd fish (inaudible) and he'd make his side money (inaudible). My dad works as, he's in ranching, work on the weekend as far as for making money as far as that. So it, it was pretty hard. It was pretty hard, but it was better. It was a better living than it is now.

I: And I wonder, it's something I've been thinking about over these last few weeks, so you mentioned drugs and that's something else that other people have been saying, and so I can't help but think that these things are connected, right? So becoming removed



from that connection with the land leads to all of these kind of social problems. K2: Yeah problems, to get involved in things, and bad things. Cause I know my nephews you know, they fished with me for a long time and they weren't into drugs. FA: That's why the fishing business is gone K2: - is gone. I have one nephew he was interested in taking over the whole fishing business but he went to drugs... I, you know, that's their choices they make. I: But it's still sad K2: It's still sad, you think you can turn things that you've worked so hard for and learned so hard, turn them over to your nephew, the biggest thing that you can do, but today, if I die tomorrow it's gone. Everything's gone. There's nobody else.

K8: My aunty lived down there on the beach and when we come down, we'd bring like peaches, squash for the pigs, whatever we - you know, age, cause back in the old days up in the forest, there were chickens running around. Nobody believed - the only caged chicken you got was the fighting. The hens would lay eggs all over, and we'd get the eggs and we used to come down, spend a weekend down at the beach and then before we go home, we go home with like crab, fish, little bits shells, dry meat, dry fish, and that's how it was. And if you go up in the forest and you go up to the gulches, you'll find trails that come out of the gulch and you wonder how come there's seashells like 'opihi shells, lipid shells all in a pile in certain areas. What it was the old days, people in the ocean, it's the meet, you know, you'd walk up the trail was the gulch then you would trade for whatever you got up in the hills and you'd trade for whatever you got from the ocean That's why people find shells way up in the mountain and stuff, that's how it was.

K10: Well, for me, I look at this as people come to... you talk about schooling, medical, and I always tell them unless you have good employee, an employer that employs others. You have an employee base, but you don't have that, you're not gonna have... I mean, you - if we are like this, have to be satisfied with what we have, but let's say we had, because when sugar was around, a lot of people don't realize that the sugar companies had maintained two physicians in the district. You know. One in (town), one and then, the reason why the doctors like to come here is because they were paid a salary by the sugar company, get free housing, free vehicle, you know all the extra - LP: Perks. (laughs) K10: Yeah perks. Plus, any private patient that went to the facility, the company took care of the building and everything... So you can see there was an incentive for the doctors to practice. But now, that isn't so. So we have a difficult time maintaining, so in my opinion, you gotta have the employee base in the district. Otherwise, with people working in (city), (city), (city), and then, you know, like ranching is, doesn't employ too many people. Like sugar employed, at its peak, I say in the district, about over a thousand employees. So that makes a big difference. To me, I think that's the biggest problem the district faces. Gotta have a - to me, some kind of... for me, I feel that there gotta be a balance. You can't have one... There has to be a mix. That's the way I feel.

P2: Well part of it is, it's a small change, but when I grew up, all the teachers lived in (district). If you were a young teacher from Iowa, and you got a job at (town) school, there was an apartment at the school for you. It wasn't, oh, I gotta find housing, I gotta commute - no one would have even thought of commuting from Hilo to teach. And so they, everybody was here, the community, you got to know the parents the kids, la-da. You went to the Christmas party, you went to this, you went to that. Maybe during Christmas break you left to go home, but other than that you were here for everything. And then that stopped and the whole commuting thing, so you got - the majority of

teachers I personally believe are driving into the district to teach, and they live up in Volcano or somewhere where it's, you know, they're part of the intellectual community. They're not down here with the heathens. And so they come down, put in their time and get the hell outta dodge.

P5: Yeah. And (district) is some pretty interesting social dynamics. Some challenges. I: Definitely. Would you consider those also some of the barriers in teaching? P5: Yeah, I would. I would. Just the, you know, lack of jobs and income I think is a big, a big factor. People have a different way of looking at things here because they just don't have the other resources, so they look at pig hunting even though it probably costs them more than to go and buy a ham at the store, but they look at it as this resource, and fishing, and perhaps overfishing. Things like that, that yeah. It's definitely an influence. And a challenge. I: Yeah. What do most people do here job-wise? P5: You know, that's, I'm going to defer to someone else for that. I think, um, from what I can see, there's an awful lot of people living on the public dollar here. An awful lot. And it's generational. Since the sugarcanes closed up, there just, all those jobs just went away, and we're so remote, there's not that many other ones. Yeah. I: Yeah I know a lot of P5: And now there's generations of people where it's starting to be a normal thing not to have a job. I: Being stuck in the cycle P5: Yeah, and I think that's why fishing and hunting become even more important. I: Being able to sustain yourself. P5: Yeah, so that's definitely a challenge.

P6: Yeah, and that's what, that conversation about measuring ourselves of success is to me about, cause to me, yes we all want cars, we all want to be able to afford our house. We have to. But is that really what's gonna make, you know, having - that is not a measure of success. You know, having a community that is, for the most part, happy. And that sounds so, like, barney, lala, I love you, and I don't mean it that way cause I know that not everybody is gonna be happy all the time, but I think if we could see lower rates of incarceration of native Hawaiian people, higher ability to make a living wage, and I don't mean that we need to go to college, you know, 70% of jobs in Hilo do not require a four year degree. How do we elevate those so that they're able to earn an income where they can be happy and sustain themselves semi-comfortably, you know, those kinds of societal things, to me that's what all of these programs are about. It's - finding things - I always think you know with the video games and stuff like that, you know when we take away our environment, when we take away our culture, what do we fill - what replaces it? And so it creates a vacuum, we fill it with these other pieces that don't fit um, and it causes such social ills and to me that's what the environmental education is about in Hawaii at least is we - providing something to be a basis for who people are, you know, cause we - we're losing some of that. It is getting replaced with real housewives and Kardashians.

P7: I know when I was young, I wanted to get out of here, but then the more you learn about place um, I guess the more issues the town faces, you kind of get this sense of, this sense of feeling that you need to help and so I guess my train of thought changed after growing up because I realized that yeah, maybe I can leave, get educated, but my sole purpose would be to come back and give back to the community because this is home, you know? But a lot of people do leave, a lot of people do leave. A lot of my family are still here though, yeah. And if they do go, they won't go far, you know?

## **Social codes – outside influence**

Outside influences were mentioned in seven kūpuna interviews and six practitioner interviews. Most of these comments focused on outside influence. Outside influence was defined differently in different contexts. In other words, some respondents described influences from outside a specific geographic region or community and others described outside influences in the Big Island or the entire state of Hawai'i. Many respondents focused on outsiders coming in to an area (mentioned 45 times). This theme was represented by comments focused on use of natural resources or access rights, biological invasive species, changing community makeup or social invasive species or tourism. Other comments were focused on policy, including outsiders making decisions or speaking on behalf of people of a particular area and military influence. Still others described outside cultural influences (e.g., religion or language), influence from outside grants or funding, and outsiders as a part of the conservation community. Twenty-two comments focused on modernization as an outside influence. These comments included comments about technology, including media influences; modern societal demands or expectations; Hawai'ians moving away and losing connections to local knowledge; development and pressure on natural resources. Other comments associated with modernization were focused on outside commodities, such as products, foods and fashion trends.

The following quotes represent the themes described above:

K5: ...and I tried to teach my children what I knew, but they've all except for one of them, the three live on the mainland...just out of high school. And that's one of the problems we have today. I suffered from empty nest syndrome and I think they forgot...because they've grown up on the mainland...I think they've forgotten a lot of the things that I knew...because they've been away longer now than the years they lived in Hawai'i...so that's a shame.

K8:...the office of Hawai'ian affairs and people in Honolulu making decisions for (island).

K6:...they keep wanting to put in housing developments...and you do that, and they're gonna build homes like they have in San Diego and ten you're gonna have people from

San Diego here that don't get the island. And they'll want to turn this into San Diego...that road where you make the left and go down, if you stay on that road going toward the ocean, you come on, you get onto a road that's (road name). And nobody on it, but yet there's the hillside here, a nice sloping hill, and a nice sloping hill going down to the ocean and you can guess what's going in there. What's gonna for sure, they'll be subdivisions and they'll be expensive.

K8:...you get all these new people are coming and all our life we kill a pig in the back yard because we got farming, now you get new people that call the board of health and say oh people killing pig in the backyard, there's a lot of flies. What we tell them, close your curtains! Put up your window! We been doing this for years. And you come here and you just want to change? Come here and get adapted to the, you know, to the place you want to live, you know? You the one bought the house here...other people you know damaging the forest, like cutting trails which is unnecessary because trails was always there. It's just that the new generation of outsiders, non-Hawai'ians, they're going in there, they don't realize there trails, they start making their own so they start cutting stuff and a lot of locals know what is in the indigenous plants. But like the Filipinos, you know Micronesia, they don't know that so they just go and start chopping stuff down.

(inaudible). The old Hawai'ians left the history on certain ways of piling up rocks. Rocks are called puakō. Stone. And each - certain way of piling up rocks meant certain things. When Sea Brewer came to build the sugar, they just leveled out history. Ok. The orchard. A lot of places. The airport. Kona. You go Kona, you see all this, all push. So there went our history. We didn't have pencils and all that. Certain way with rocks. So that was a loss.

P2: Remember when that phase came out where everybody wore their pants down around their ass and their underwear was sticking out and they wore their hats like this (turns hat sideways). They were imitating people in Los Angeles and Chicago. Those - that's where they wanna be.

### **Knowledge transmission/sharing – Knowledge/observations**

Comments on knowledge or observations of phenomena in nature were mentioned by all of the kūpuna and six practitioners. These included both direct observation or knowledge from observation that had been transmitted orally, in writing, or through cultural practices (e.g., chants). Species were mentioned a total of 51 times, and included plants, invasive species, invertebrates, birds, fish, and hunted game species (e.g., pigs, goats). Abiotic elements in the environment were mentioned a total of 17 times, and included geological features of the landscape (e.g., caves or lava tubes), volcanoes or lava rock, weather (e.g., wind, rain), ocean currents and streams. Natural events were mentioned a total of nine times only by kūpuna, and

included lava flow, earthquake, tsunami and flood. The concept of place was mentioned a total of six times and included place names and connecting to place through species. Several respondents commented on ways in which knowledge is or can be learned (mentioned six times), including through direct experience, secondhand from others, and the importance of facilitating observation or direct experience for others. Five participants mentioned culture when discussing knowledge. This theme included mindfulness, practice, moon cycles and history.

The following quotes capture the themes described above:

P1: But understanding, you know, now is the time when the lehua is going to bloom or now is when we're gonna have a lot of rain and it's gonna be really cold, or now is when we need to go pick kupe'e or go catch whatever or the limu is going to be good over there, or go get some because now it's really hot and sunny and yay us. That and some people will say well what does it matter? You know, I think it matters. I think it matters a lot. And I think it's going to be really sad when 20 years from now it'll be like well it really mattered and poor us we don't know how anymore. That's gonna be sad.

K1: So you know part of the thing that's interesting too especially in (location) is Mauna (volcano name). You know, the lavas from Mauna (volcano name) come down and completely transform the landscape. At (place), you can see archaeological features, you know, walls and platforms and sites that are partially buried by lava, and that, you know, kind of ties into what's happening right now down in (district) you know, with the lava flows coming through (village). It's been going on forever, and people - some people seem to be really surprised that the lava is coming. But just kind of go look around, and the stones that you see didn't just fall from the sky.

I: I see. Have you noticed in any differences in the kinds of fish that are out there? K2: No, usually we just have the same kind of fish. 'Ōpelu and 'ahi and mahimahi. Yeah. But usually 'Ōpelu is, when we fish for 'Ōpelu, well this currently it's like you have the rainbow runners, we call them Hawaii salmon...you got olo, mahimahi, that...the 'Ōpelus. But other than that we mostly just see 'Ōpelu...I: I'm curious to hear more about the, uh, so you said that you tried to work with (program) and there has been some resistance of wanting you to teach - FA: Yeah, it wasn't the resistance, it was the kahea, the ask, came to me, (program) is interested but they want you to teach the old stuff, so then we just don't come. K2: Cause they, they're telling me that you know, you have to go out there on the off season and no even (inaudible) just feed the 'Ōpelu. And then the 'Ōpelu, when the time comes, you take your net and catch them. And that - I - I put my dad's years, my years and my grandfather's years, we fished I think 240 years with the new way without do the old Hawai'ian way, and there's more 'Ōpelu now than they ever did see. But they tell us no, we depleting the 'Ōpelu. I said there's no way. You know a lot of folks talk about, you guys never even seen one school of 'Ōpelu in the water. I said how big you think one school of 'Ōpelu is? I said I seen school 'Ōpelu as big as a hundred thousand pounds.

P1: And so, I think that, that, you know, is a way that it has changed today is a lot of the generation you're interviewing, you know, it's a second-hand account where it came from their parents or their grandparents, and so they can't really say. But today, we're trying to build back where we can say, you know, we have all these different types of programs and stuff, thinking, you know, pounding taro or making poi. Hula for me is one big one, for our family.

P7: I think learning from the environment can be your biggest lesson, I mean when you can sit somewhere and, and take in all of the elements and feel the land and the, just those feelings that you can gather from the environment around you, I think is one of the best teachers, like if you're out there looking at the ocean and you feel the wind coming in one direction and you notice the current ripping in the same direction and you know there's a connection between wind patterns and the current patterns, and so you know if you want to go dive, you know, um, if you're a surfer you're gonna watch where the waves break and you know, you know where to go with your board, and it's just really just observing the environment because yeah, I think that's a great uh, teacher.

### **Knowledge transmission/sharing – Practice**

Practice was mentioned in all but one of the kūpuna interviews and five practitioner interviews. Most comments about practice were centered upon particular current or historical cultural practices. These included chanting, naming places, gathering plants to make lei or other natural adornments, canoe-making, gathering salt, hula, fishing, not asking questions, making cordage, gathering food, trading food, following the moon cycle in hunting and harvesting, use of medicinal plants, paddling, respect and care for plants, hunting, respect or permission required for entering a new place and practice in general. When discussing cultural practices, some mentioned ways in which certain practices (e.g., hunting) have changed or developed over the years and become internalized. One practitioner discussed the importance of integrating practice into learning about the natural environment and one practitioner described negative social consequences (e.g., lacking a sense of self or connection to one's identity) that may manifest as a result of lacking practice.

The following quotes illustrate the themes described above:

K8: Hula was a way to connect to the land and to nature historically.

P3: And then, certain places, you know, the same or different families can come to the

same place and have a different perspective of it. I mean, like one of the beaches that I grew up at, we'd go there all the time to swim or to surf, um, and sometimes to fish, but that wasn't really a practice that my family did a lot there, but I have friends who live right there who every day they are out there and they fish that area, cause that's, that's a practice for them, or there's people who just come to sunbathe, but we still have an appreciation for that place, it just comes from a different activity that you do there.

P1: So, I was never brought up to uh, dance hula but when we came to this island is when we got pushed into it. Didn't have a choice. But that was a lesson in itself, and I'm thankful that we moved here and that my family does that and that we get into it because it really gave me what I was missing culturally as far as how I was connected to the forest, we gather things to make lei, we dance about, the reason why you dance is because of the forest, you know? There are a lot of things that hula has that you cannot find anywhere else...P1: Uh, we have certain, remember I was talking about the strongholds? Where the cultural knowledge is intergenerational, you know? This generation gonna teach that generation, they gonna teach that. And it's all within the confines of the practice. So for hula, well, what is it, we have 8, 9 generations now practicing hula and then we have you know two more generations that we re just born they're at the hālau every day when they go to practice, absorbing it, you know, but not technically dancing, but still getting it, so it's kind of being in the lifestyle of the practice. I: And why do you think that is? P7: I think that because of their love for maybe hunting or their love of gathering, you know? Um, they don't see a balance because they're so used to taking and taking and taking and as long as it's still there, they're gonna continue to take, you know? And um, you know, hunting wasn't something that our, the Hawai'ian culture had practiced. I: Yeah, yeah. So it sounds like they're a misinterpretation- P7: Yeah, misinterpretation and misunderstanding of the real culture. I: So they're saying it's because of the culture but they don't want - P7: We need to practice our culture, we need to be able to continue our cultural practices. It's a modern cultural practice.

### **Knowledge transmission/sharing – Belief**

Belief was mentioned in all but one kupuna interview and in all but one practitioner interview. Most often, respondents mentioned beliefs about plants, including plants as friends, deification of plants, mindfulness and care of plants, medicinal use of plants, and representation of family and ancestors as plants (mentioned nine times). Beliefs about animals and beliefs about fishing were each mentioned eight times. Beliefs about animals included thoughts about animals as 'aumakua or spiritual guardians, segments of the public that are unaware or lacking beliefs about animals, how to share or teach beliefs to others, how to learn about the beliefs of others, deification of animals and animals as family or ancestors. Beliefs about fishing were focused on

fishing by the moon phases or the tide, beliefs about actions or behaviors that could bring bad luck, and deities. Other beliefs included beliefs about historical events (mentioned three times), beliefs about respect for place (mentioned five times) and beliefs about weather (mentioned once).

The following quotes capture many of the themes described above:

P1: I think, you know, when we studied hula, and were told or asked to go pick things in the forest...we had to learn about protocols for picking. And it's not just you know, going out into the bushes and grabbing whatever you can get. You have to be very mindful of the fact that you're gathering things that are living and in many instances were representations of various deities. You have to do that with good intentions. There should not be negativity involved. I don't know how to explain all this - your head have to be clear. Because if you go out and pick stuff and you're in a bad mood and you're cranky, the picking is going to be affected and the plant materials that you gather will know that you're in a bad place and they're not gonna be nice, they're gonna wilt, you know, the lei that you fashion or whatever is not gonna come out good.

P3: So, a lot of what we do is to try to teach respect, um, especially when we arrive to a place, you know, it's important to acknowledge that we are visitors there, um, and that um, we need to ask permission and um, you know, sometimes we have another person there kind of representing that place, and uh, the people of the forest or the people of whatever of that place and they can respond or sometimes it's like, you know, you just have to wait for...you know, a sign from the environment to tell you yeah can or no can't or so, kind of, you know, we teach them protocol, but it's really a sense of you know, respect for the area and for the things of that area and acknowledging – acknowledging them and it also helps you to get into the focus of what you're doing.

P7: ...to truly be a Hawai'ian of the land is to mālama or to take care of these sacred places. This area is the wai akua which is the like, the realm of the gods. And the realm of the gods meaning this is where your kūpuna trees are and like I said, a life of a human was on the same level as the life of a hundred, I mean five hundred year old koa tree, you know? And so protecting these areas, in the Hawai'ian culture, we have these different deities that , um, are able to manifest themselves um, as things of the environment. Say like maybe um, I don't know how to explain, um, so when protecting these trees we are protecting our gods because these gods are our Kū. These gods are our Laka, these gods are lolo, these gods are Kanaloa, and we are protecting our akua or our gods in the form of the environment. I don't know of that makes sense.

K2: And somebody going fishing, you could not ask them if they're going fishing. They turn around and walk home. You gave them bad luck. If you ask them what, you going `olu`olu? That's ok. You ask them grandpa, you're going fishing? They go right back home. And you better not make that mistake the next time asking.



## **Knowledge transmission/sharing – cultural knowledge integration**

Seven practitioner interviews and three kūpuna interviews contained details about cultural knowledge integration. Most often, respondents referred to a cultural tradition or practice as a way to integrate cultural knowledge (mentioned 19 times). These traditions or practices included talk story, chants, hula, gathering plants for lei making, fishing, referrals to deities, language and historical practice. Connection to place was mentioned 13 times, and referred to heritage values, connection to the past, connection to place through practice, protocol for entering a place, place names and viewing oneself as part of nature in a place. Characteristics of learning was mentioned 14 times and included experiential learning; curriculum that integrates cultural knowledge into, for example, lessons on math or language; and integrating cultural information alongside biological information. Collaboration in the form of institutional support and collaboration with other cultural groups or local partners and the general importance of integrating cultural knowledge were both mentioned four times.

The following quotes represent the themes described above:

K2: (niece speaking) Well it's like when we went to (location) and they were like, well, we need a chant cause we do chants here. And I'm like they (fishermen) don't chant. The kahuna chants. You get a kahuna to come in and do the chant. But fishing is a silent tradition so then I had to go make up a chant, you know? I made up a chant and a dance, but it's like that's not the real thing. That is the net making and having him tell you stories, that's all the real stuff. And that was so cool to incorporate when they were making, tell them some of the old stories and having like...having her stories that were his grandfather's or your family's, you know, then you can do story time while they're making net. You know?

P2: I'm somewhat of a storyteller. And so when I have the kids out there and I show them an `ie `ie and talk about aerial vines, I take that and I talk about the...statuettes or puppets they would make with that and they would put the bones of the ali`i in them, or they can put their fam– or they can do whatever they wanted. And then I would say, and – and that brings up another story. Have you heard of...do you know how that relates to (place) here, what happened?...And so, but all that from the `ie `ie. And I've told it in a way that's like, this army came here and then this guy went here, and oh, you heard about the fight last night? Steven came down from up mauka and he called Jonathan out from the house...the kids would be there, and? And? And? Well, that's what I just did but

historically...and, AND – related to a plant. And then we go look at this fern, this fern – how tall do you think this fern is? Oh that fucker gotta be 20 feet, 21 feet. We say they believe a hāpu‘u grows at one inch a year, so at 20 feet tall, how old would it be?

### **Knowledge transmission/sharing – Ideas for teaching others about nature**

Ideas for teaching others about nature were described in six kūpuna interviews and six practitioner interviews. The majority of comments described characteristics of learning or teaching and focused on what or how to teach (mentioned 28 times). Suggestions emphasized the importance of experiential learning, including unstructured time outdoors; ways in which to better connect science and culture; ways in which to better connect academics and experience; fostering curiosity about and comfort in nature; and adding an element of adventure. Others mentioned the importance of fostering a strong connection to place and connecting learning to historical events. Some mentioned specific lessons that should be included, such as teaching people not to waste and how to survive on the land. Others mentioned teaching through a cultural practice or activity (e.g., through music, food, paddling or chanting). Ideas for teaching specific audiences were mentioned 14 times. These included ideas for instructing adults who could share the message with a broader audience (e.g., “train the trainer”), experiential learning for at-risk youth, the importance of beginning instruction at a young age, programs for difficult audiences or those with opposing viewpoints, and the importance of appealing to those with influence in the community. Community in general was mentioned a total of 14 times and included the importance of availability of community resources and programs, collaborating with other organizations or individuals, connecting youth with elders, facilitating access to natural resources, and focusing efforts on a landscape or watershed scale which would include humans. Six respondents mentioned barriers to teaching and learning within the context of describing ideas for teaching others about nature. These included the difficulty in passing on certain

traditions. For example, some activities, like traditional commercial fishing require long periods of apprenticeship to learn. Additional barriers mentioned were the current structure of securing grants or funding to provide programs and different perspectives on what knowledge to teach. These barriers were mentioned by one kupuna only. Four practitioners discussed ideas for social components of instructing others, including showing care or concern for youth; emphasizing social metrics when measuring outcomes; and connecting nature with overall health and wellbeing.

The following quotes describe the themes mentioned above:

Niece (K2): Well we've thought about, basically we formed an LLC and we wrote a school program and we've got pictures and last year he had a professional guy, a friend of ours came out and took big pictures, and then we have another friend Mike, you know, Mike across the street, they did some film, because the 'Ōpelu fishing has never been filmed, so we're trying to get it all documented and then, because we've thought the next step, he keeps wanting to get a grant but there's not a lot of grant money out there, cause you need enough that it pays him what he earns to stop fishing to teach the fishing as well as pay whoever wants to learn, cause you forget that this is his job. So for him to stop, there's no income. And the money's just not as available. It seems like where it's been frustrating is a lot of the people who are getting the money are people who are loud enough, and these guys don't talk, and then the kids get the money and they put it in the programs but it's half-assed what they're learning. And that's a shame. Some of the photos we're seeing and pictures, it's like oh those are old protocols you're breaking there, but nobody knows, yeah.

K10: Well, the way I look at it, to me, technical knowledge is important, see. So you gotta have your basic, you know, like knowing the parts of the plant and then you progress in the field. So you tie your academic stuff with the field credit, I think you gotta meld the two. To me, because I worked with a lot of people in sugar. I've had people (inaudible), some (inaudible) That's all only theory but they didn't do any practical stuff. They really don't understand. That's the situation I had. I learned a lot of the things from the old timers. Like one man was - you see like we used to do a lot of - every work (inaudible) herbicide application. So rainfall was very important. And...I think a lot of people nowadays tend to be over here, they know every, they know what every compound is made of. But they don't how it works in the field.

P2: I think we need to get into the elementary school and cultivate that respect and appreciation for our natural resources. The earlier the better. The more often, the better. That's what I think.

P1: This is their backyard, you know? Um, I feel like they should know more than what they do and they should appreciate it more, but they're never given the chance, so how will they? And if I know that, then why haven't, why aren't I doing something to change

that, you know? So, I mean, I will work with anybody, but for me, it's like, if I'm in your place, this is your, where you live, then to me, that's the priority, especially if you don't know or you don't care, that makes me even more want to help or try to figure it out, you know?

P4: There is a lot of I guess you could say cultural value placed on the 'alalā, like there's mo'olelo and...um, just a lot of symbolism associated with it in terms of it being an 'aumakua and people's families still have really strong connections to that, to the bird as you know their spiritual guardian and what not, and um, I think in educating the general public and the community about the 'alalā, including that sort of information um, and sharing that with them will make the 'alalā seem more valuable in their eyes, so I think it is really important to emphasize the Hawaiian culture side of the 'alalā, not just it's, you know, a very endangered bird and it's a very important ecological species in our native forest and it provides all of these seed dispersers and all, you know, it is. That is an important part of 'alalā and why we want it to survive and why we want it to be in the wild again, but that's not the only reason.

### **Knowledge transmission/sharing – Personal involvement**

Details about personal involvement in knowledge transmission or sharing of information about nature and culture were contained within six kūpuna interviews and eight practitioner interviews. When discussing personal involvement, many respondents focused on content (mentioned 12 times). This included sharing with others about nature through information about cultural significance, how to do something or practice a skill, sharing information about a productive fishing spot or modeling behavior for apprentices who will carry on traditions in the future. Other content was described in terms of cooking, camping, combining academics with field experience, and an informational brochure. Potential involvement was mentioned five times, and included expressed desire for involvement, intention to teach or share knowledge, intention to engage in professional development to improve knowledge transmission skills and ideas for sharing knowledge. The format or intended audience of the knowledge transmission was mentioned most frequently (68 times) by both kūpuna and practitioners. Kūpuna discussed personal involvement in teaching their own children about nature, giving guest presentations in school classrooms, hosting university students in the field and sharing knowledge with visitors to

the community. Practitioners mainly reflected on involvement in conducting formal programs or collaborating with teachers or other practitioners. Both kūpuna and practitioners mentioned targeting programs and communication toward at-risk youth and engaging in community outreach.

The following quotes summarize the themes above:

P7: ... We took community members up to the proposed fencing site, took them on trips to, I want to say like educate, but kind of show them the condition of our environment and, and what we can do to not maybe restore but assist the environment in bringing back our resources such as the watershed areas, and um, and another part of you know, fencing off that particular area of the forest, uh, 20%, we wanted to be able to give them more access to the more, uh, least impacting areas, you know, of the forest for recreational stuff, like hiking and hunting and just creating areas where they can go and relax and have a relationship with the forest...

K10: Well you know I'm supposed to take (name) around to show him where the good lands are. Because you know you can look at this map and you'll have rocky fields, deep soil fields right next to each other, see. So it depends on where the flows went. Like, uh, this side over here is all deep soil, but when you come in between here it's all rocky, see. So this is a ownership map. Now if you have a soils map, you'll be completely different. Because we have soils that you can (inaudible) 15 feet, 20 feet, you won't find even small rock or pebble. And some places you hit rock already. So I'm supposed to take (name) around, but I told him you gotta do it fast because I'm not going to be around forever.

K1: And to me, it's important to know that this, these shells came from the beach...40 something years ago and I gathered this hau and I made this cord and I filed pukas in these shells and strung them on this cord (referring to necklace). I know how to do this and I've taught people how to do this. That's important.

### **The present - General involvement – actual**

When asked to comment on the ways in which others are generally involved in sharing information about nature with others, formats or venues for sharing information was mentioned most often (15 times). This included sharing information about nature through culture, sharing through family life or parenting, experiential learning, focusing on sustainability, communicating with an audience “at their level”, via social media, through formal programs, with an emphasis on improving livelihoods, and teaching others in order for information to be passed along.

General involvement through collaboration with others was mentioned a total of ten times, and

included working with elders who are willing to share, working with other practitioners, collaborating with teachers to organize field trips to a conservation site, and working with other staff within an organization. Barriers to getting the message across were mentioned six times within the context of general involvement of others. These included knowledge loss or change, sharing misplaced or misguided knowledge, teachers lacking skills in teaching and inability to document program outcomes. Overall, general involvement of others was mentioned in six kūpuna interviews and six practitioner interviews.

The following quotes capture the themes described above:

K3: Not too much people know anymore. There's very few uh, people that knows about this stuff. This, this type of lifestyle. It's honestly, it is fading away. It is fading away. And there's just a few of the family that knows that takes it in and does it as far as the, so time is changing, yes it is.

K5: I think our generation is very, very happy to share whatever we know. And, but the generation below us, I think, maybe know less. You know? Just a changing of times. You know, just changing of times. And you lose a lot of the knowledge.

### **The present – Support networks**

Eight of the nine practitioners discussed the support networks to which they turn when they're planning a communication, outreach or education program. All eight practitioners described other persons or organizations that are a part of their networks (mentioned 33 times). The majority of these comments indicated that other conservation education practitioners offered support, and further details suggested that local organizations offering culturally-relevant environmental education programs are well connected with each other. Other sources of support included supervisors, family, schools and teachers, cultural practitioners and community cultural groups, biologists, the National Park Service and kūpuna in the community. Two practitioners indicated that leaders in their organizations were generally not supportive of environmental education because it is outside the scope of the organization's mission. Three practitioners

discussed ways in which the support network can develop. These comments indicated that previous work or volunteer experiences and professional development opportunities facilitated network development. One practitioner discussed ways in which she had played a part in the development of networks of support for others.

The following quotes summarize the themes described above:

P6: Well depending on what I'm trying to accomplish and for me, I always usually go to (name) guys first cause they are my network and um, but working for (organization) now, I have, I really have a large network because my job is statewide, so I would go to, again, depending on what we're trying to do, some of our...collaboratives or partnerships, we work a lot with watershed partnerships, they help us manage a majority of their lands, so we work with them and a lot of different natural resource vendors, because we only have two staff for all of the conservation work. We have 364,000 acres and then, and then we - not just two staff to manage, but for conservation related initiatives, and so we heavily depend on all of our, then there's watershed partnerships, so I would go to them, um, to see where would be a good place to start, cause they usually have a lot of connections with communities. But definitely to someone within that community, so whatever community you're going to do that program, if at all possible, try to find someone from there to help you figure out what to do, is kind of my thinking.

P7: Where do I go? So I go to the kūpuna who have supported me in the past, and after seeking these kūpuna and uh, you know, learning their perspective of a certain subject, it helps me to broaden my, my approach to who to go to next and, and sometimes it's just by word of mouth, like this - this certain - this particular kupuna supports this, you know, and they be like, oh, ok, same like if the same idea, so I go to the kūpuna first because you know, if anybody knows better it's them. And um, if they don't know better, you know, I can give them my piece of mind and then you know, somehow we'll come and come to some kind of conclusion and be like oh, ok. You know, we try to see each other's point of view and then you know, go on from there.

I: Do you feel like you're supported within (organization)? P5: Well, not really. Because we don't have the time or inclination at the moment to do that...I: Yeah, I guess I'm just wondering if (organization) would be more supportive of community outreach as an organization if they could see some results that say, you know? P5: I think they would, I get that from our communications person who's still here really wants some, some very good evaluation to be able to show this is how it will work, and this is what it will impact.

### **The present – other organizations**

Seven practitioners and one kupuna commented on other organizations currently offering environmental education programming on the island. These comments included criticism of

some programs that are not teaching the “real stuff” and issues inherent in teaching others about traditions that are difficult to pass on in a program format (mentioned three times). Partnerships with other organizations were mentioned 12 times by almost all of the practitioners. The practitioners also mentioned other programs that they believe are effective in transmitting culturally relevant information about the environment, such as charter school or language immersion academy programs, university programs and cultural organizations. Two practitioners mentioned professional development opportunities when discussing other programs.

The following quotes illustrate the themes described above:

P3: So he’s the coordinator for (organization), and he has, um, his wife actually runs (name) summer program, and it’s actually kind of cool because a lot of kids who come to our summer program go to theirs, or if they can’t get into ours, it’s another opportunity for the students, but they too, I think they have a good perspective, especially culturally, about environmental education and how it should be incorporated...

P1: ...I think if you go to every public charter school you’ll find a program connected to it...

P4:...I know there are other programs um, through (university) that they don’t necessarily, maybe don’t brand themselves as environmental education, but science education, but they are offering programs that are hands-on, in the field, you know, offering students an experience in nature, and um, I think there are some overlaps with that, and so yeah they have high school programs in the summer and then um they also run internship programs for their, for (university) students.

### **Barriers – difficult audiences**

None of the kūpuna and eight practitioners mentioned audiences that are difficult to reach through environmental education, communication and outreach. Most of the comments (18) focused on specific audiences or groups that are difficult to reach. These included certain groups within the hunting community, kids involved in other activities, those without access to transportation, outsiders who “stir the pot”, and those who are hard to reach or contact.

Characteristics of audience perspectives was mentioned ten times, and included groups or



individuals who are set in their views, those with different attitudes, those with different political perspectives, and those with different perspectives rooted in a loss of knowledge.

The following quotes capture the themes described above:

P7: ...when we had that one meeting about fencing off 20% of our forest for protecting watershed, for native plants to thrive and for possible area for these 'alalā to live because their food source would be within that area, uh, it would have um, blocked access of people going into that area, but it would be a protected area where pigs and feral ungulates wouldn't be able to go, and you know, gnaw at the trees and stuff, um, so that was a big deal here in (region), and a lot of people, you know, were in support or still are in support of protecting that part of the forest because they realize, uh, you know, the importance of water, but um, there's a lot of outsiders that come and try to speak for the people of (region), and um, you know, bring up points that is irrelevant to the task at hand. You know, we had some people from the (city) side talking about how the state is just land-grabbing and taking away from the Hawai'ians and I think the meaning or the culture of the Hawai'ian people.

P5: ...there are some people who are so set in their ways that they're never – they never want to hear the other side of the coin at all. And they're never going to, you know, they're just – they're very – and most of those folks aren't really who we're trying to reach to be honest, they're from somewhere else coming in.

### **Metrics – metrics of program success**

Metrics of program success were categorized based on whether or not they were cognitive, behavioral, social or conservation-oriented. In addition, long-term metrics and current measurement strategies were noted. Overall, cognitive metrics were mentioned most frequently (mentioned 19 times in three kūpuna interviews and six practitioner interviews). Cognitive outcomes included general knowledge measured by, for example, a questionnaire or science grades; knowledge of how to engage in a specific cultural practice, such as how to tie a fishing net; opportunity to experience a place in a way that leads to changes in curiosity or perspective on how people fit into nature; attitude in terms of wanting to return to the program site or participate in the program again; environmental sensitivity measured through a combination of understanding, awareness and appreciation for nature; positive attitudes toward conservation initiatives; and an influence on what people value or where they place their value. Behavioral

metrics were mentioned 17 times by both kūpuna and practitioners. Changes in behavior that would indicate success of a program included sharing or passing knowledge on to family and friends; engaging in a practice; volunteering for a conservation organization or donating money; and choosing native species to plant on one's property. Social metrics were mentioned a total of 11 times by only practitioners. These included interacting with others differently (e.g., exuding greater confidence when greeting someone), community cohesion, enhanced sense of self or sense of purpose leading to an overall land ethic, character development and prevention of social ills (e.g., incarceration, involvement in drugs, inability to financially sustain oneself). There was only one mention of a conservation metric by a practitioner, who indicated that her organization perceives plant survival to be a metric of a successful volunteer outplanting program. When discussing the metrics described above, 16 participants mentioned the importance of long-term metrics, particularly for educating youth about the environment. These included the extent to which today's youth could create a better life for their own children, perpetuating cultural traditions, future job-seeking behaviors and interest in a conservation-oriented career path, long-term personal growth and future lifestyle choices (e.g., financial support of conservation initiatives, voting behavior and consumer behavior).

The following quotes illustrate the themes described above:

K8: Indicators that knowledge has been shared sufficiently? Kids are doing these things. They are hunting, they are gathering. They are eating the things they find. Food is important in the Hawai'ian culture. They are going to a potluck and taking, eating traditional foods instead of hot dogs and hamburgers.

K8: What I said earlier, because of the Hawai'ian movement everybody doing a lot of stuff. They're learning about these - they're even telling other kids oh look at that don't cut this down this is certain stuff. And you can see this in the younger generation. Especially the Hawai'ian.

P1: Um, well, I would break it down by demographics, I'd break it down by island. I would seek out you know, different um, outcomes. You know, what outcomes do I wanna see? And basically, I want, all that I want to come out from their participation in a program is for them to experience it for themselves. To be there, and to understand that

they're looking at something that is not found anywhere else in the world. For them to feel that because I came here, I know who I am now. Or I've learned a little bit about who I am and where I come from and what is, what should be important to me. I mean paying the bills is important, taking care of your family is important, all of those things is important. But the same thing, from a Hawaiian perspective, when you were born, you were born with a responsibility and that was to take care of the land and understanding that the land will take care of you. And as cliché as it might sound - it's so important...

P1: But for me, it's mainly like for each individual to experience a place without distraction. To be in tuned to a point where they can feel the wind in what direction it's coming from. They know that this is a mist, it's not a rain. They know that that's a bird that I don't hear anywhere else. Only here. Or how come there's no mosquitoes? You know. Simple things that once you're out of your everyday and come into an environment where it's not like, where they experience where those things are heightened. I don't know how you get - I mean there's other ways you can measure it but as I go through the day, you know, I see too the students and their, you know, wherever they are, who's really getting it, who isn't getting it, and not everybody is going to get it. Some are more prepared than others. Yeah, so once they get away from the distractions - this and this and this (motions like looking at cell phone), you know, out in the forest and putting their hands in the ground and feeling the soil, oh, this soil is wet, it's not like back at home or, yeah those types of things. For me, those are very important ways to say oh, what I'm doing is good.

P5: ...you know, the lack of evaluation of those kind of program is huge. They can't - they have a hard time in seeing the value in what they've - in what those programs are, and how those really work...And impacts on their families of course too. Actually see changes. But that goes to them explaining it to someone else. If we had evidence that some of those kids were going back and talking, you know, we heard back from one of the parents, or you know, said yeah, here we were off fishing and my kid's worried about the fish size or something. You know, something that they're taking back and telling. That's cool.

P6: But I think on a personal level, I think environmental education is just one part of teaching of having a community that are good. Are good people. You know? That, and when we start to see positive changes within our community, that's when you know you're making big changes, and you know, like we were talking about earlier, not everybody can be a forester, not everybody can work in conservation, but I think the lessons you learn from being within the environment, being in a small group of 8-12 kids, all of those lessons feed into being a good person, whether it's to the environment, to be good people to other people, and to me, and this is my own personal, this is the ultimate goal of all of these programs, and I feel like connecting people back to the environment is a, we have to do that, because so many kids are so angry in many ways, partly because they lost that connection and they don't even understand why...you know, how do you, you know that whole epigenetics thing or whatever, it's like how do you take a land-based people for generations, how do you take them away from that and not expect there to be any kind of health - mental health consequences? You know, there's gotta be things - if, if somebody can go through war and transfer post traumatic stress disorder to their baby because of genetic changes that happen, then how could that not be the same for other things like generations of - anyway, I could go on and on.

## Metrics – measurement

Four practitioners discussed ways in which success of programs is currently measured. Overall, five comments focused on formal evaluation measures, five focused on informal measures, three indicated no measurement is currently taking place, and one mentioned measures from a former program in which she was involved in a different location.

The following quotes illustrate the themes described above:

P1: I've always thought about evaluating what I do, you know, how do we measure what we're doing and how is it impacting the learner. So we've had different types of like assessments, you know, to give the students when they first come in, when they leave, or we'll just do it orally, you know, raise your hand, so there's different ways that we've done it. But for me, I like to, I kind of assess, I do like a personal assessment I guess (laughs) where I'm looking at the kids and talking to them, and like, sharing different - to me, important points, I'm looking for who is comprehending through eye contact, through the questions that they ask, through the interest that they show. Are they falling asleep? So those kind of things, for me, is an indicator of, is it valuable, what we're doing. And then, I like to test them and see what they know, and I will ask questions and feel out, each group is different, feel out the group and see what is their background, where are they coming from, culturally, you know, and also I guess scientifically.

I: Yeah, I guess I'm just wondering if (organization) would be more supportive of community outreach as an organization if they could see some results that say, you know? P5: I think they would, I get that from our communications person who's still here really wants some, some very good evaluation to be able to show this is how it will work, and this is what it will impact. Definitely. Um, that said, she's more of the social media and that kind of side of the communications PR and I don't know if her heart um, or mind are into more of the environmental education side of things. I: Right, or the conservation outcomes, you know P5: Yeah, so how many you know, people like us on Facebook? I don't care. (laughs) I: Right. Yeah. P5: But that's me. Yeah.

I: ...What metrics do you use to evaluate the success of your programs? P5: Um, well, for the ones we're doing at (organization)? I: Mm-hmm P5: I - I would have to say we don't really. We leave it up to folks like (organization). Um, and what the things, the informal stuff we do do is take people up into the forest, no. We have no evaluation for that at all.

I: How do you evaluate those (program)? How do you know that they've been successful?

P8: Actually, we don't. We don't have a after survey process, um, there haven't really been um, you know, tests that have been administered by the teachers to see what the kids retained from one of our tours six months later, there actually really has not been, so unfortunately none. But it's probably a gap in our program that we really need.

I: ...What metrics do you use to evaluate the success of an environmental ed program? P9: Oh, that's a great question. That one's really difficult. Um. I'll say...from... that's very difficult. I don't know. I don't know how they do that. That's something -

we've been given, our program, uh, (organization) statewide doesn't have the same flexibility and uh, free movement to, to work in the community that we do. Um, other islands, don't really have community offices that are located wherever it's reasonable for them to run the office out of, but we've got a very different mission for the (district) program, and the metric that we use when we are working with our funders, we report how many hours, which forest project, how many individuals, volunteers or kids, um, came out, um, and we're not able to place a value on it.