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Ecological literacy, environmental attitudes and behaviors of residents adjacent to the Coahcella Valley Preserve

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ECOLOGICAL LITERACY, ENVIRONMENTAL ATTITUDES AND BEHAVIORS OF RESIDENTS ADJACENT TO THE COACHELLA VALLEY PRESERVE

A Thesis

Presented to the

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In Partial Fulfillment

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by

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ABSTRACT

This thesis researched the dynamics of ecological literacy levels, environmental attitudes and behaviors of the residents that live in the Coachella Valley of southern California. The primary hypothesis was that there would be varying levels of ecological literacy between urban, suburban, and rural residents. This study attempted to test this hypothesis by quantifying various levels through a survey of ecological literacy, environmental attitudes, and frequency of behaviors of residents with urban, suburban, and rural areas that surround the Coachella Valley Multiple Species Preserve. The results show that ecological literacy levels did vary slightly between residential subgroups within the Coachella Valley, and that ecological literacy levels were higher in the suburban and rural subgroups, and lower in the urban subgroups for all of the principles tested. Attitudes on the environment were generally favorable in all subgroups, and residents felt an average to high sense of responsibility towards their communities. Finally, certain environmental behaviors are more frequent in some of the residential subgroups than in others. Discussion of these results and the implications for educational outreach conclude the thesis.

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During the process of researching and writing this thesis I have learned from and become indebted to several individuals for their guidance and wisdom. I am grateful to Dr. Darleen Stoner for increasing my knowledge about the importance of environmental education and introducing me to the topic of ecological literacy. Also, I am very grateful to Dr. Herbert Brunkhorst and Dr. Joseph Jesunathadas for assisting me with their expertise during the editing process. Special thanks to Dr. Cameron Barrows for his invaluable insight and inspiration as a conservation practitioner and naturalist without which this thesis would have never been developed. Finally, I wish to thank Dr. Michael Allen, Dr. John Rotenberry, and Veronique Rorive, for never failing to encourage my enthusiasm in learning the intricacies about the social and biological implications of conservation strategies and the designation of preserves. It is my belief that the world is a better place because each of you decided to inspire the world to aspire for better.

DEDICATION

This thesis is dedicated to my grandmother, Anna, for being the first to show me the beauty of a flower garden and always encouraging me to learn more about biology; to my father, Harold, for inspiring a sense of wonder in me about all things wild; to my beloved Michael for his unfailing mental and physical support without which none of this would have been possible; and finally to my daughter Kayla for always seeing the universe within the flower. My sincerest love, gratitude, and appreciation to all of you!

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CHAPTER ONE

BACKGROUND

Introduction

Our lives tend to be centered around communities, whether they are small or large. The community is where we acquire our resources, gain knowledge, and interact with people from many different professions and backgrounds. Our communities link us to the rest of the world. Natural ecological communities also weave a web of dependence within themselves. They are complicated dynamic systems where the biological and the physical environments are tied together by intricate processes.

Although the two systems, human and natural, appear as different as night and day, upon closer inspection the two are inseparable. Human culture has developed a paradigm that we are above and apart from the natural world, because we have the ability to control and manipulate the environment. However, in the past several decades, scientists have learned a great deal more about the importance of biodiversity. The sustainable future of the world could hang upon a coming paradigm shift where we would have to teach how dependent life is on the

connections between the two systems (Orr, 2004, pp. 131-151).

Education is part of an extremely important communication process that helps to bridge the gap in perception between the human and natural communities. Providing ecological knowledge to the public, be it by a policy advisor, a landowner, or a high school student, helps to increase environmental literacy, and helps to open communication channels throughout the community.

> Education at all levels is needed to help people understand the interrelationships between humans and their environment… Educational approaches range from information and problem-oriented programs in schools to activities addressing environmental values and attitudes in communities and better technical training for resource professionals (Jacobson, 1999, p. 223).

With so many potential audiences within the community, communicating to the public through educational initiatives at many levels is essential to sustain the protection of biodiversity.

Conserving natural communities is of primary importance when attempting to design reserves which protect rare and sensitive species. The growing strategy

in the United States to address sustainable development practices and to accomplish the goal of maintaining ecological processes and biodiversity is to develop multiple species habitat conservation plans. These are comprehensive land use plans under the Federal Endangered Species Act that protect against habitat loss by creating multiple species reserve systems based on habitat type, while at the same time, balancing local economic development elsewhere in less critical lands (Scott & Sullivan, 2000). Multiple species reserves protect a community of species, their dynamic relationships with each other and the environment instead of just focusing conservation efforts on one endangered species. Multiple species reserves can not be designed and managed without the input of the public. Therefore, increasing awareness within the community of local ecological issues and dynamics could be one of the best tools that an ecologist has when attempting to reach a conservation goal.

General Statement of the Problem

A key component to conservation is communication of ecological knowledge and conservation goals to policy advisors and public stakeholders. No conservation plan can be implemented to protect species without communication.

However, more often than not important ecological knowledge seems to be lost in the communication process, and as a result knowledge about the dynamic processes that drive ecological associations may not be included in management policy or public value. The purpose of this thesis is to research the dynamics of ecological literacy levels, environmental attitudes and behaviors of the residents that live near the Coachella Valley Preserve.

Context of the Problem

The context of the problem is to address the many processes that guide communication between the public and conservation ecologists, and how one's knowledge of the area around them could affect communication between groups. How can ecologists communicate complex ecological relationships in a framework that is understandable and yet comprehensive? Can ecologists provide the public with sufficient information that will aid them in planning a sustainable future for their community? Education is the most effective form of communication between the community and the scientists. However, to gain a better environmental literacy among the public, many forms of educational programs could be used to communicate local ecological knowledge. As a basis for these educational

programs, a study of the various levels of ecological literacy within the community should be considered. Researching the ecological literacy levels that are prevalent in a community may ultimately be useful when conveying information to the community, and in turn may aid public involvement in the decision and implementation of local development plans.

Significance of the Thesis

This thesis is relevant to the current strategy for designing multiple species reserves through the development of multiple species habitat conservation plans. These plans are placed in context within larger general plans for economic development. The designation of wildlife habitat is used to preserve ecological communities and the environmental processes which help to sustain them. Bradley, Hanson, and Walbeck (2004) stated that with the development of these habitat conservation plans, a lack of environmental literacy among the public with regard to implementation and management decisions has lead to the design of reserves which may not be sustainable.

Are there varying levels of ecological literacy both in knowledge and attitudes held by the general public who

live in communities surrounding potential reserve networks? This thesis attempted to address this question by quantifying various levels of ecological literacy and environmental attitudes of residents in urban, suburban, and rural areas that surround the Coachella Valley Multiple Species Preserve. The hypothesis that was tested was that there would be varying levels of ecological literacy between urban, suburban, and rural residents. In addition, this study tested a secondary hypothesis that environmental attitudes and ecological literacy levels may be higher in the rural towns that are closer to the Preserve, followed by suburban cities, and urban cities. Through analysis of the results, and a review of the history of the Coachella Valley Multiple Species Habitat Conservation Plan, this thesis then could be a basis for recommending effective educational strategies for increasing public interest and support of future plans. Increasing the local ecological knowledge of the community before the generation of habitat conservation plans is of utmost importance if the community is to understand the dynamic processes within the ecological community necessary to best preserve local wild areas.

The research addressed in this thesis may be applicable to increasing public involvement and awareness

in the community development and ecological conservation of the local deserts and perhaps in other areas nationally. If effective communication across groups can be increased by learning how much people understand about their local ecology and the frequency of their environmental behaviors, the efficiency and effectiveness of multiple species habitat conservation plans may be increased, along with the general community plans which are developed around them.

Assumptions

The following assumptions were made regarding this study:

1. Where a person resides is related to environmental knowledge and attitudes.
2. If environmental literacy levels can be identified, the knowledge could be used to improve the effectiveness of environmental education and habitat conservation plans.
3. People have the ability to alter their behaviors and attitudes through education.
4. Comprehensive educational programs could help bridge the gap of understanding between scientists and the public.

Limitations

1. This study was limited by time, resources, and funding.
2. This study was a one time sampling with a limited population.
3. This study limited itself to desert communities in the Coachella Valley.

Delimitations

1. This study used surveys to attempt to quantify residents understanding of the local ecology in the Coachella Valley as well as the frequency of residents' environmental behaviors.
2. All residents surveyed in the study had to live in the Coachella Valley for at least one year.

Definition of Terms

For this thesis, the following definitions apply:

1. Biodiversity applies to measurements of species richness and diversity of life (Pullin, 2002).
2. A biotic community is an interacting association of organisms that live together in the same locality (Molles, 2002).

3. Corridors refer to the zones between habitat patches which are used by species for dispersal between species populations and gene flow (Pullin, 2002).
4. Environmental education is an integrated multiple subject way of teaching about the natural world that emphasizes inquiry and acquisition of skills necessary for problem solving (Volk & McBeth, 2005).
5. A habitat is the environment where an organism exists (Pullin, 2002).
6. Inquiry-based teaching requires the student to ask questions of and explore the world around them (Sobel, 2004).
7. Interdisciplinary is the use or inclusion of two or more fields of study (Jacobsen, 1999)
8. Place based education is the process of using resources of the local community and environment to teach multiple subjects emphasizing real world experience and hands on techniques (Sobel, 2004)

CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

Chapter Two first examines how communication and education have helped to strengthen and sustain the conservation movement over the last century. It then continues to investigate the background of the issues and places that are part of this study. Because this study focuses on a few southern California desert communities that are adjacent to two major wilderness areas and the Coachella Valley Preserve, the literature review discusses the history and development of habitat conservation plans as a means to protect both economic development and critical habitat for sensitive species. The environmental threats facing the Coachella Valley and local conservation efforts through habitat conservation plans are reviewed as well the biodiversity and ecological complexity of this region. Afterwards, this review will introduce ecological literacy studies by others, and finally it will consider studies of how community-based educational initiatives have been successful in communicating ecological issues, and explores various strategies.

History and Importance of Communication to Conservation Goals

Conservation of endangered species and sensitive habitat has been a heated issue for over a century within the United States. When the movement began in the late nineteenth century, it was generally regarded as a uniquely different school of thought from the competitive capitalism that prevailed due to industrialization. Conservationists believed that land had value beyond economic gain, and that the rampant extermination of species due to western expansion had to stop in order to have a sustainable society. They felt that the only way natural resources could be preserved was to establish lands that were owned by the public of the United States. This ideal started a conflict that continues to this day between conservationists and those in favor of unrestricted economic exploitation of natural resources. The most notable figures associated with this movement would eventually also debate among themselves, taking sides as preservationists who valued nature for its intrinsic value versus conservationists who advocated wise use of natural resources for economic gain (Foster, 1999).

The great advocates of conservation at the start of the movement are well known because they communicated to

the public that a problem had developed. John Muir, Theodore Roosevelt, and Gifford Pinchot all found surprising support for their movements in growing urban centers of America. The citizenry of these urban areas had been thoroughly exposed to environmental degradation from large businesses and factories, and were overwhelmingly opposed to exploitation of the environment for profit (Foster, 1999). The public determined the large support base that was essential for the movement to be successful. Without relating the problem of disappearing species and habitats to urban planning and quality of life, many of these early advocates would not have been recognized as notable individuals within American history, and many of the environmental quality and protection laws might never have been passed.

Indeed, this continues to be the case well into the present. Environmental awareness and protection have always been at their height when prolific writers and speakers bring to light the evidence of environmental degradation by placing it in a framework that is easy to understand yet emotionally stunning. A great example of this is Rachel Carson's *Silent Spring* published in 1962.

> These sprays, dusts, and aerosols are now applied almost universally to farms, gardens, forests, and

> homes – nonselective chemicals that have the power to kill every insect, the "good" and the "bad," to still the song of birds and the leaping of fish in the streams, to coat the leaves with a deadly film, and to linger on in soil – all this though the intended target may be only a few weeds or insects. Can anyone believe it is possible to lay down such a barrage of poisons on the surface of the earth without making it unfit for all life? They should not be called "insecticides," but "biocides."(Carson, 1962, pp. 7-8)

A public outcry resulted from Carson's brilliant description of the horrid images of springtime without the sound of birds, and the application towards the loss of biodiversity to public health and quality of life. As a result, people became more concerned than they previously had about the persistence of harmful pesticides. Carson's integration of conservation goals and public concerns provides an excellent example of why communication is essential to conservation. No effort can be made to conserve lands or species without gaining public support. One of the best ways to accomplish this is to integrate the complexity of the issue with several public values,

such as health, safety, aesthetics, and quality of life (Jacobson, 1999).

In recent years, strategies to enhance communication channels and increase public awareness through education have been a main focus for scientists involved in protecting endangered species and sensitive habitats (Pullin, 2002). A gap between communication and understanding exists not only between the public and conservation scientists, but also between the scientists and practitioners (Bradley, et al., 2004). Research may exist to support and to refute public planning decisions; however, scientists rarely are able to present research in a framework that is useful to policy advisors. Increasing communication channels between these two groups of professionals is essential for successful identification of environmental problems and solutions (Pullin, 2002).

Design of Habitat Conservation Plans

Reserve design and species management are currently implemented within community general plans, called habitat conservation plans. The first habitat conservation plan was approved in 1983 for a large housing development on critical habitat of the endangered Mission blue butterfly near San Francisco. Since then, there have been a dozen

plans ratified from 1983 to 1993, 330 ratified during Clinton's term in office from 1993 to 2000, and as of 2001 200 more were being developed or had their approval pending (Watchman, Groom, & Perrine, 2001). Scientific expertise of ecological processes and biodiversity is increasingly being integrated into the design and adaptive management of sustainable reserve systems within these conservation plans. The idea of sustainable development and habitat conservation plans arose out of an economic and social need to identify local development strategies within a larger context of environmental conditions, biodiversity, and community impacts. Biodiversity has four general economic values that are considered in these plans including direct use value, indirect use value, option value, and existence value (Pullin, 2002). Because of their comprehensive framework, these plans are generally thought of as "win-win" collaborations by the economic and environmental interests when, in reality, evidence suggests that these plans are often used to continue the onslaught of environmental degradation (Peterson, Peterson, & Peterson, 2005).

In modern years, there have been several attempts at trying to define the term "sustainable development." The argument began with a need to meld ecology and economy for

the Brundtland Report, due to increasing concern over environmental degradation and economic stability. Originally for this report, the term sustainable development was defined as, "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987). In 2002, at the World Summit on Sustainable Development at Johannesburg, the term sustainable development was the subject of much contention and debate. The definition settled on there being three pillars associated with it, including balancing economic and social development with environmental protection. However, especially in the literature, the term "sustainable development" has been defined numerous times ranging from very lax to fairly rigorous (Hammond, 2006).

Although a majority of experts use the Brundtland Report's definition as the main tenet to guide policy, the debates over this term are basically grouped into three ranges. Does sustainable development mean having to integrate environmental concerns into the economic development process, or is it about creating and implementing a new innovational time of development? Does the concept of sustainable development emerge from the

political, social, economic, or ecological realm? And finally, is the concept an oxymoron, and if it is, what exactly is the conflict about (Jenson, 2007)?

Much of the literature reveals a need for sustainable development to be the newest paradigm of innovational ideas which will lead to a new type of development that challenges conventional views of economic and social development. This need also can be broken down into three main tenets that reflect the original definition of sustainable development. First, there should be a realization of the interconnectedness of physical, social, and economic systems, which inherently suggests that we should integrate policy and knowledge for more efficient management of the biosphere. Second, there should be as much of a balance as possible between producing goods and conserving resources. Finally, participation and cooperation are crucial when projecting, writing, and implementing policy and these lie not just with the international government but with local government and community as well (Jenson, 2007).

The discussion of equitable sustainable development policy is very complex and may include the perspective of world views, quality of life measures, and also how development creates disparity. All of which can differ

with geography. Because of this, there is a growing diversity of development approaches that range between "fast" development to address social needs and "slow" more sustainable development (Pike, Rodriguez-Pose, & Tomany, 2007). Holistic approaches to sustainable development emphasize the role of state and international government in cooperation with civil government to address the local and regional issues of poverty, inequality, and competition in a global marketplace (Pike, et. al, 2007).

To thoroughly discuss the origins and development of habitat conservation plans, one must look at the history of the United States Endangered Species Act and for the purposes of this thesis, the California Endangered Species Act. Passed in 1973, the Federal Endangered Species Act was written and implemented to protect flora and fauna from extinction by listing the target species as either threatened or endangered. In 1984, the California Endangered Species Act followed suit, protecting species at a state level. Originally, once a species was listed, there was little that could be done to harm the species or its habitat, regardless of the economic consequences that limited development would bring to the surrounding areas. "Take" is defined in the Federal Endangered Species Act broadly as, "to harass, harm, pursue, hunt, shoot, wound,

kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 C.F.R. §§ 1531-1543, 1988). So any form of "take" could potentially result in a criminal investigation. Furthermore, critical habitat had to be established for the protection of the species on federal and state land (Fulton & Shigley, 2005, p. 376-377).

Permits for incidental take can be applied for under both federal and state agencies. However in cases of development, these permits used to have to be filed on a species by species basis. Critical habitat designations were also made on a species by species basis which was largely problematic when trying to maintain ecological systems and communities that also supported the target species. Because of the amount of listings under both the federal and state laws, the regulations became burdensome both fiscally and legally. A controversial solution to these problems was to create stipulations in the Federal Endangered Species Act, 16 C.F.R. §§ 1531-1543 (1988) that allowed for incidental take permits to be given for large developments in exchange for plans that would conserve large amounts of habitat for a species, and would simultaneously, if not voluntarily, conserve ecological associations of the target species within the plan area. Land developers soon after developed the idea of multiple

species habitat conservation plans so they would not have to plan for each species individually. These newer laws have shaped the way land planning and policy affect our communities today (Fulton & Shigley, 2005, pp. 379-383).

This newer form of the land planning process has been widely implemented across southern California since 1993. Scott and Sullivan (2000) in their investigation of many details of Multiple Species Habitat Conservation Plans (MSHCPs), their development, and various preserve selection criteria, observed:

> Faced with a one-time process that would create inflexible preserve boundaries, conservation groups demanded a rigorous scientific approach to preserves selection and management plans. From their perspective, this would deliver the greatest probability of species and ecosystem persistence within preserve systems. Most questions about the science in MSHCPs can be traced to participant ambivalence about long term certainty, specifically the potential costs of ineffective or inefficient systems derived through negotiated compromise (p. 40).

The referenced negotiations are between federal and state agencies, the effected public, land developers,

scientists, and land managers. Decisions have to be finalized about ecological drivers such as how much land will preserve genetic diversity and evolutionary processes, because long term sustainability of the preserves is of great consequence. However, scientists still do not know everything about these patterns and processes, and thus there could be a reasonable amount of uncertainty in predicting future behaviors based on current data (Moritz, 2002, p. 238). Between these groups is a wide spectrum of understanding of ecological terms, systems, and communities. These negotiations are a delicate balance of economic and ecological goals, and so it is extremely important for all parties to understand as much of the science behind the issues as possible before assuming that "environmentalists" or "big business" is out to take it all.

History of the Conservation Efforts in the Coachella Valley

The Coachella Valley consists of a variety of habitats and is unique in its biogeography. At about 100 miles east of Los Angeles, it is bordered on the west by the San Jacinto, San Gorgonio, and Santa Rosa mountain ranges and is at the northwest boundaries of the Colorado

desert, and on the east of the Valley lies the popular Salton Sea. The Coachella Valley is an extremely arid desert region that is characterized by aeolian sand communities, fan palm oases, creosote shrub, alluvial fan, and salt scrub communities (Author's observation).

The most direct threat to biodiversity of the area is habitat loss. In the 1940s the area south of the Coachella Valley was converted to large scale agricultural operations, utilizing the new water available through the Coachella Canal. Over the next few decades, development began to expand into the blowsand areas that used to dominate the valley, completely eliminating around 90% of that habitat (Beatley, 1994, p. 69-70). Currently, the Coachella Valley is home to some of the fastest growing cities in the United States, including Palm Desert, Rancho Mirage, and Indio.

The Coachella Valley Fringe-toed Lizard is adapted to the arid dunes, and was seriously threatened by the loss of blowsand habitat. In the 1970s a group of concerned citizens and scientists got together to form the Coachella Valley Fringe-toed Lizard advisory committee. Studies were done to identify the best possible areas for a lizard preserve. In 1978, the U.S. Fish and Wildlife Service began the process to list the lizard as threatened and

designated land for critical habitat that would include large amounts of present day Palm Springs, Palm Desert, Rancho Mirage, and Indio. Many people became alarmed about this prospect, although the lizard was never listed at that time. The Coachella Valley Association of Governments decided to take steps to create a lizard reserve in less invasive areas of the valley and thus created a reserve of five square miles in an attempt to mitigate any critical habitat designations that might come as a result of listing the species. However the lizard was listed anyway in 1980 on both federal and state lists (Beatley, 1994, p 71-80).

In the next few years, scientists, land managers, public officials, and agencies came together to develop the Coachella Valley Fringe-toed Lizard Habitat Conservation Plan. This plan became the second habitat conservation plan to be approved by the U.S. Fish and Wildlife Service in October of 1986. Three reserves were designed as a result of several pressures and much debate. Each fragment had its own population of Coachella Valley Fringe-toed Lizards which would allow three separate subpopulations that could persist if environmental factors wiped the others out. Also of concern were the sources of their blowsand habitat. If sand sources were not able to

deliver the sand to the dune habitat, the reserve design would not be sustainable (Beatley, 1994, 81-94).

By the end of the twentieth century, 27 species in the Coachella Valley were identified as being affected by pressures of land development and conversion of habitats. From 1996 to 2008, the citizens, scientists, land managers, and federal and state agencies of the Valley converted the original plan into a conservation plan that offered protection to these species and preserved over 200,000 acres of open space. This comprehensive land planning essentially covers the evolutionary and ecological processes and community biodiversity in the Valley to make the plan more sustainable. In the future, ecologists and land managers will make sure that the species are persisting on the preserved lands through a process known as monitoring. The plan is currently in review by federal and state agencies but has been approved by all cities involved in the collaborative effort (Coachella Valley Association of Governments, 2006).

Ecological Literacy

Environmental education offers a unique way to inform the public and teach the connections between the built and natural environments. Although environmental education can

have many definitions, this one is simple and elegant in nature: "Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work towards their solution" (Stapp, et al., 2005, p. 34). Efforts to incorporate environmental education have been found successful at increasing environmental literacy. It is most successful when incorporating a mixture of cognitive skill development, socio-political knowledge, and ecological knowledge (Volk & McBeth, 2005).

Ecological literacy is a subsection of environmental literacy and is defined as, "the understanding of interactions between natural systems and human social systems" (Mancl, Carr, & Marrone, 1999). To address environmental problems adequately, "we need a environmentally literate citizenry that is not only capable of taking individual action, but of making well informed public policy decisions collectively" (Simmons, 2005, p. 67). Ecological literacy uses basic principles of ecology to describe the interrelatedness between human and wildland communities (Odum, 1994).

According to Gigliotti in Jacobson (1999), studies have found that the opinions of most Americans on

environmental issues are based on a very shallow understanding of ecological principles. Public concern for wildlife is not much more encouraging because it is limited to the most renowned and appealing species. Because there is a lack of understanding and concern, ecologists may have a difficult time communicating the complexity of environmental problems. Also as a result, the public does not have adequate background information to ask questions during political planning processes. This vicious circle has created the challenge of, "a citizenry that is emotionally charged but woefully lacking in basic ecological knowledge" (Gigliotti in Jacobson, 1999, p. 3).

Studies have attempted to quantify levels of understanding of ecological principles and environmental behaviors. Mancl, Carr, and Morrone (1999) conducted a telephone study of 504 Ohio adults using the eight widely accepted basic principles of ecology including biogeography, the Earth as a biosphere, ecological energetics, carrying capacity, ecosystem succession, biotic interactions, materials cycling, and importance of biodiversity. This study found that Ohio residents understood biogeography, biosphere, ecological energetics, and carrying capacity, but had less of an understanding about ecosystem succession, biotic interactions, and the

importance of biodiversity, and a very low understanding of materials cycling. In addition they surveyed environmental attitudes and behaviors within the same 504 residents surveyed. From these answers they had the opportunity to correlate which portions of the population had the lowest and highest understanding of ecological principles and what their attitudes were on environmental issues and the frequencies of certain environmental behaviors among the population (Mancl, Carr, & Morrone, 2003).

Similarly, Hull et al. (2002) used a qualitative interview to investigate the differences in environmental assumptions of landowners, land managers, and policy administrators in Virginia. From this study the team was able to show that assumptions about the environment get transferred into conservation policy; yet between individuals there are great discrepancies in how they interpret certain phrases such as "environmental quality." Also from this study the team learned that many people have feelings that "nature knows best" which can influence management perspectives for reserves and create bias towards a preservationist ideal over a conservationist ideal or an adaptive management approach.

Summary

Pertinent literature to this thesis was reviewed in this section. Topics included the importance of communication to conservation goals, development of the policy and inclusion of conservation plans, the history of conservation efforts in the Coachella Valley, and the importance of environmental education and ecological literacy. The studies reviewed in this section were instrumental in offering background knowledge in what research has already been conducted in these topics, and ultimately provided information and issues with designing the methods and data analysis procedures for the research in this thesis.

CHAPTER THREE

METHODOLOGY

Introduction

Chapter Three documents the steps used in developing the thesis. This study is an investigation of how ecological literacy levels and environmental attitudes of residents in the Coachella Valley with exploration of variation between rural, suburban, and urban subgroups that surround the Coachella Multiple Species Preserve. Within the deserts of southern California, there are many proposed multiple species habitat conservation plans.

Development of Surveys

To quantify ecological literacy, the format of an aptitude test used by Mancl, Carr, and Morrone (1999) to assess the ecological literacy levels of adults in Ohio, was selected. After gaining approval and recommendation from the authors (Appendix D), the test which was based on the ecology of the Ohio River Valley, was altered to include desert community-related questions grouped as part of the eight basic ecological principles as discussed in the following paragraph.

Within the principle of ecosystem succession all four questions were altered from their original form based on the Ohio River Valley ecology and formed into similar questions about desert ecology. For example, the original question was "flooding on a river renews and replenishes the river environment, true or false (Mancl et. al., 1999), which was then rewritten to "periodic floods in the desert renew and replenish natural resources, true or false (this study)." Another question in the original study dealt with how dams in streams change the entire ecosystem downstream, which was modified to an equivalently related use of off highway vehicles and how they change the entire ecosystem. Both of the other questions for this principle were altered from the original study in a similar fashion, but remaining in the parameters of the principle being tested.

In the questions for ecological energetics, three of the original questions were used because they broadly inquired about the world's supply of fossil fuels, the primary source of energy on the Earth, and the amount of energy derived from the food chain. In the fourth question, the topic was streambed flooding due to log jams, and for the purposes of this study the question was

changed to how riparian areas effect flooding and the speed of water downstream.

Within the questions on carrying capacity, two of the original questions remained the same because they were broadly stated to ask about the world's population capacity, and the positive correlation between an area's population and the amount of pollution in that area. A question for the original study on unlimited population growth and food production was altered to become a question about water and unlimited population growth for the desert. Similarly, the fourth question for this principle was altered by changing out food (in the original study) for water, and the native deer in the original study for mesquite and fan palm oases of the desert.

The questions in the principle of biodiversity for the original study were based on different types of crops grown in the Ohio River Valley. This study used less of an agricultural approach for these questions, and based them on the biodiversity of native plants, animals, and community ecology of the desert region. In the questions related to biotic interactions, one question was maintained from the original study because it was a general question about competition for resources. Another

question related to predator-prey relationships, and so for the sake of this study the wolf and deer were replaced by native mountain lion and bighorn sheep. A third question related pesticides and pest resistance, and so mosquitoes were changed to include the flies and ants that are sprayed for several times per year in the Coachella Valley. The fourth question in this principle was based on the importance of not eradicating a beetle pest in the Ohio River Valley. This question was altered to include blowsand and its importance to the diversity of the Coachella Valley even though it is considered a bane most of the time.

In the biogeography principle, three of the four original questions were maintained because they were broadly stated about endangered species management and reserve design. The fourth question was altered from a question about the greatest threat to migratory birds, which for the purposes of this study was broadened to include the major threats to all plants and animals in the Coachella Valley. In the section on materials cycling, three of the original questions were kept dealing with the water cycle, nitrogen, and phosphorus runoff. The fourth question about lakes and PCBs was altered into a question

about nitrogen deposition from the smog that bombards the desert region of southern California.

For the questions on the biosphere, two of the original questions concerning the warming of the Pacific Ocean and the effect of volcanic eruptions on the atmosphere were kept. The third question was altered from the effect of burning fuel in Ohio homes to the same question for the burning of fuel in southern California. Finally, the fourth question concerning waste sewage in Ohio was changed to include in this study a very relevant question about drawing excess water from the Colorado River.

To quantify attitudes, behaviors, and feelings of responsibility towards the environment, a survey by Mancl, Carr, and Morrone (2003) was used unaltered, except to ask place and length of residence in the Coachella Valley. The surveys that were used to test the public environmental literacy levels, environmental attitudes and behaviors are included in Appendix B.

This research focused on rural, suburban, and urban communities directly affected by the development of the Coachella Valley Multiple Species Habitat Conservation Plan. The first focus was two of the most populace urban areas that surround the Coachella Valley Preserve which

includes the cities of Palm Desert and Indio. The second focus was the suburban areas of Palm Springs and Thousand Palms which border the Coachella Valley Preserve. The third focus is the three rural and unincorporated towns of Snow Creek, Sky Valley, and Indio Hills. Snow Creek lies directly adjacent to one of the most diverse areas of the proposed conservation lands, and in between two vast wilderness areas, known as the San Gorgonio Wilderness Area and San Jacinto and Santa Rosa Mountains National Monument. Sky Valley and Indio Hills are positioned between Joshua Tree National Park and the Coachella Valley Preserve System. These towns are in a unique position, making them critical habitat as corridors between two large protected areas. All the above mentioned cities and towns are opportune areas for researching ecological literacy levels of the public because the current Coachella Valley Habitat Conservation Plan will be decisive in the land use planning and development of these areas (see map in Appendix A).

Survey of Participants

Individuals were randomly selected in public areas of rural, suburban, and urban sites to take the ecological literacy and the environmental attitudes survey. The

residential subgroups included rural (n=41), suburban (n=40), and urban cities (n=40) that border the Coachella Valley Preserve. These sites include the rural towns of Indio Hills, Sky Valley, and Snow Creek Village, the suburban areas of Palm Springs and Thousand Palms, and the urban cities of Palm Desert and Indio. Participants were asked through direct face-to-face interaction at community centers and parks in these areas, and after reviewing the informed consent page, self selected either to take the survey, or not to take the survey. The survey of ecological literacy and environmental attitudes took between 10 and 20 minutes for the residents to fill out themselves. In the earliest part of the study, 50 surveys and informed consent forms were mailed out through homeowners associations in the more rural areas. Self addressed stamped envelopes were provided with return addresses only marked as resident of the rural area. However, because only two surveys were returned by mail, seeking out face-to-face interaction with possible participants in rural areas was essential to the completion of the study.

Population Served

A total of 121 residents were surveyed (n = 41 rural, 40 suburban, and 40 urban). All residents had lived in the Coachella Valley at least one year, and were above the age of 18 years. No other identifying personal data were recorded for the public surveys to ensure that the participants' anonymity was maintained.

Data Analysis Procedures

After the surveys were completed, each respondent had their ecological literacy survey graded on the four questions in each of the eight major topic principles. A point was given for each question answered correctly with 0 being the lowest score and 4 being the highest in each subgroup. Mean correct answers and standard deviations from the means were then calculated for each principle to determine the range of opinions and knowledge given the particular question within each residential subgroup (rural, suburban, and urban). Paired t-tests were calculated to a 95% confidence interval ($p < .05$) to identify significant differences between residential subgroups in the understanding of the ecological principles tested.

The environmental attitudes and behaviors survey was also given with 20 questions. Questions one through five were related to an individual's attitude towards living in harmony with nature, locus of control, human interference with nature, mankind's dominion over nature, and technological fixes to environmental problems. Questions in this section were graded on a Likert scale of one to four with one being strongly agree, two being agree, three being disagree, and four being strongly disagree. Means and standard deviations were taken for each residential subgroup and compared. Questions six through nine were related to an individual's feeling of personal responsibility towards the environment in the community, state, nation, and world. These questions were graded on a Likert scale of one to five, where one indicated no responsibility, and five indicated a feeling of a great deal of responsibility to these areas. Means and standard deviation of the results of each residential subgroup were calculated.

Questions 10 through 20 indicated the frequency of an individual to partake in environmentally conscious behaviors. Within these, questions 10 through 15 were graded on a frequency scale of one to six, with one being never, two being less than yearly, three being yearly,

four being monthly, five being weekly, and six being daily. Questions 16 through 20 were graded on a Likert scale of one to five with one being never and five being often. Means and standard deviations were also calculated for these results.

Summary

The data collection and analysis procedures were outlined in this section. A survey on environmental attitudes and ecological literacy was given to the public, and scored quantitatively to produce means and standard deviations. Results are presented and data tables displayed in the next chapter.

CHAPTER FOUR

RESULTS

Presentation of the Findings

This research found that overall the ecological literacy of the rural, suburban, and urban residents of the Coachella Valley had mean correct answers ranging from 1.5 to 3.0 in all principles tested (Figure 1) on a scale of 1 to 4, with one point given for each of four questions per principle. The mean correct answers and standard deviation for each principle can be viewed in Table 1.

Suburban subgroups scored the highest mean correct answers on the four principles of Ecosystem Succession, Biodiversity, Materials Cycling, and Biotic Interactions, and tied with rural subgroups on two principles, Carrying Capacity and Biogeography (Table 1). The rural subgroup had the highest mean correct answers for the two principles of Ecological Energetics and the Biosphere, tied with suburban on Carrying Capacity and Biogeography as was mentioned above, and had the second highest means on the four principles for which suburban scored the highest means. On all principles, the urban subgroups scored the lowest mean correct answers.

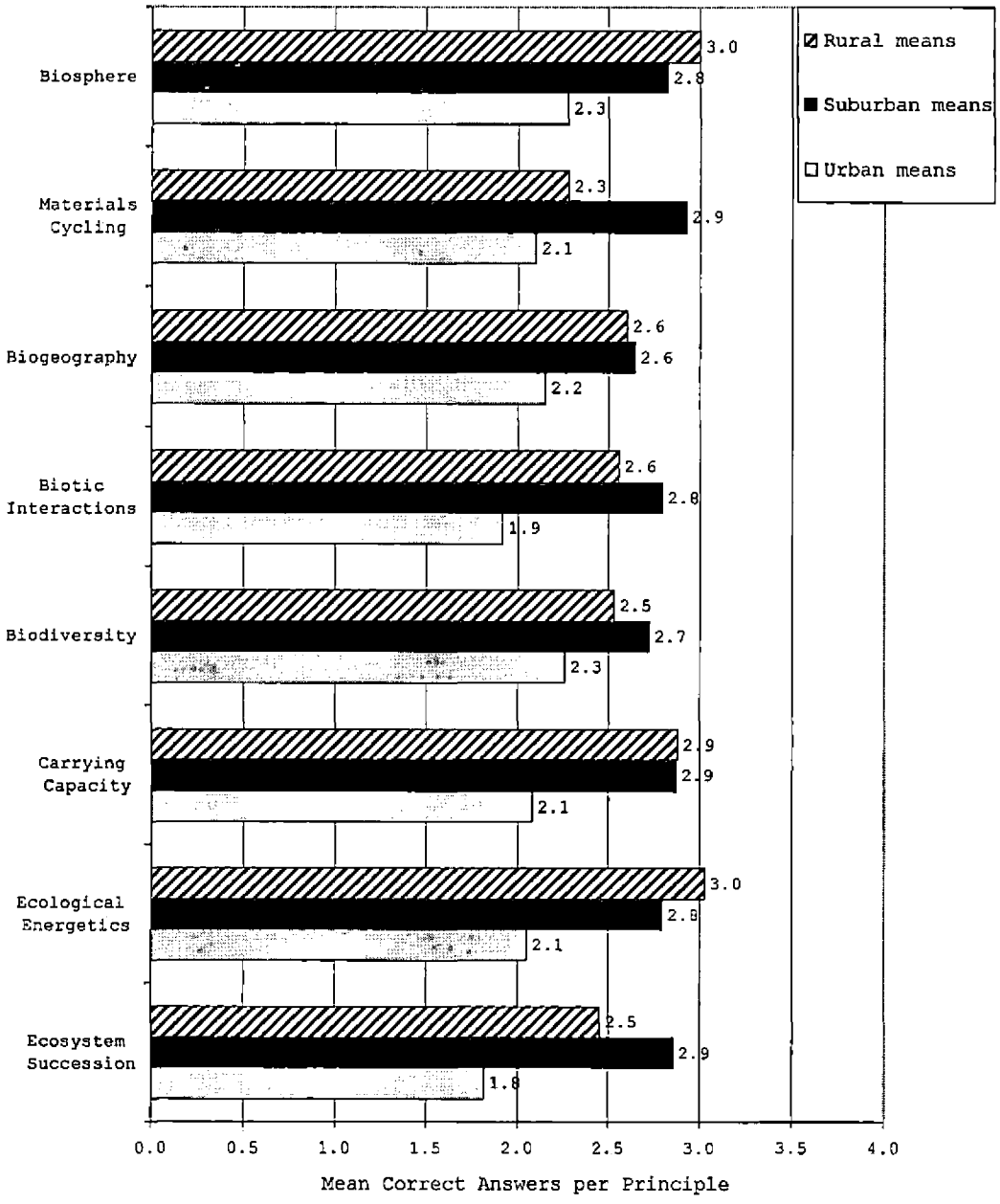


Figure 1. Ecological Literacy of Residents Grouped by Rural, Suburban, and Urban Residents

Table 1.

Mean Correct Answers and Standard Deviations Per Ecological Principle As Grouped by Rural, Suburban, and Urban Residents.

Principle	Rural (n = 41)	Suburban (n = 40)	Urban (n = 40)
Ecosystem Succession	2.5 ± 1.0	2.9 ± 1.0	1.8 ± 1.3
Ecological Energetics	3.0 ± 0.8	2.8 ± 1.1	2.1 ± 1.0
Carrying Capacity	2.9 ± 1.1	2.9 ± 0.9	2.1 ± 1.4
Biodiversity	2.5 ± 1.0	2.7 ± 1.1	2.3 ± 1.0
Biotic Interactions	2.6 ± 0.9	2.8 ± 0.9	1.9 ± 1.2
Biogeography	2.6 ± 0.9	2.6 ± 1.2	2.2 ± 1.0
Materials Cycling	2.3 ± 1.0	2.9 ± 1.0	2.1 ± 1.2
Biosphere	3.0 ± 0.8	2.8 ± 0.9	2.3 ± 1.2

Significant differences calculated through paired t-tests to a 95% confidence interval ($p < .05$) were not detected in between the results when compared between rural vs. suburban residents including those in Carrying Capacity, Biotic Interactions, Biodiversity, Biogeography, and Biosphere. Also rural vs. urban residents had no significant difference between their results for Carrying Capacity, Biodiversity, and Materials Cycling; however all other principles tested were significantly different. Suburban vs. urban results showed that significant differences did occur between results in all ecological principles tested except Biodiversity and Biogeography (Table 2).

Table 2.

Results of Paired T-Tests to Compare Differences in Mean Correct Answers Between Rural, Suburban, and Urban Residents

Principle Tested	P - values Rural vs. Urban	P - values Rural vs. Suburban	P - values Suburban vs. Urban
Ecosystem Succession	0.001*	0.0048*	0.001*
Ecological Energetics	0.001*	0.009*	0.0032*
Carrying Capacity	0.0059*	0.9825	0.0032*
Biodiversity	0.2318	0.4085	0.0615
Biotic Interactions	0.001*	0.2478	0.0005*
Biogeography	0.0377*	0.9633	0.0626
Materials Cycling	0.8053	0.0042*	0.0005*
Biosphere	0.0019*	0.3350	0.0208*

** Results where significant differences were detected.*

Results of questions one through five of the environmental attitudes survey were assessed by a Likert scale of one to four, with one correlating to strongly agree, and four correlating to strongly disagree (Figure 2 and Table 3). Results showed that all groups (rural = 2.1, suburban = 1.9, urban = 2.2) tended to agree that humans should live in harmony with nature (Question 1), and that human interference (Question 3) with nature usually produces disastrous consequences (rural =2.3, suburban = 2.3, urban = 2.4). Furthermore, those surveyed tended to disagree (rural = 3.5, suburban = 3.3, urban = 3.2) that humans could fix the environment with technology (Question 5), and that humankind was meant to rule over (rural = 3.1, suburban = 3.1, urban = 3.3) the rest of nature (Question 4). Varying opinions from those surveyed were recorded for the question regarding the issue that one person can not do anything to help the environment (Question 2), as rural residents neither agreed nor disagreed with a mean of 2.6. Urban and suburban residents however tended to disagree slightly more strongly with this statement (urban = 2.9, suburban = 3.0).

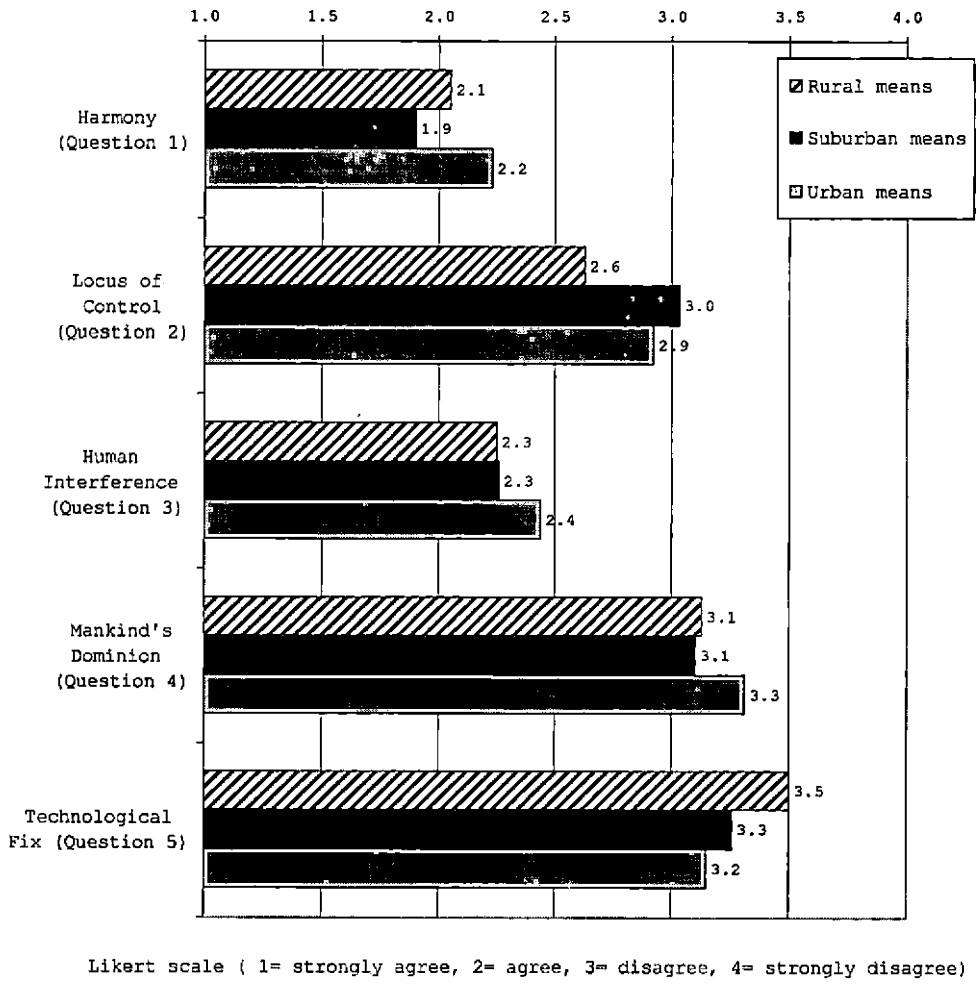


Figure 2. Environmental Attitudes of Rural, Suburban, and Urban Residents

Table 3.

Results of Environmental Attitudes Survey with Standard Deviations As Grouped by Rural, Suburban, and Urban Residents

Question	Rural (n = 41)	Suburban (n = 40)	Urban (n = 40)
Harmony (Question 1)	2.1 ± 0.9	1.9 ± 0.6	2.2 ± 1.2
Locus of Control (Question 2)	2.6 ± 0.6	3.0 ± 0.5	2.9 ± 0.9
Human Interference (Question 3)	2.3 ± 0.9	2.3 ± 0.7	2.4 ± 1.0
Mankind's Dominion (Question 4)	3.2 ± 0.8	3.1 ± 0.5	3.3 ± 0.8
Technological Fix (Question 5)	3.5 ± 0.6	3.3 ± 0.7	3.2 ± 0.8

Residents were asked to quantify in questions six through nine on the environmental attitudes survey, what they felt their level of environmental responsibility was to their community, state, nation, and the world (Figure 3 and Table 4). Answers were given on a Likert scale from one to five, with one being no responsibility towards these areas and five being a feeling of a great deal of

responsibility for these areas. Most residents in all subgroups tended to feel a great deal of environmental responsibility for their community (Question 6) with means from 3.9 in rural areas, 4.0 in urban areas, and 4.4 in suburban areas.

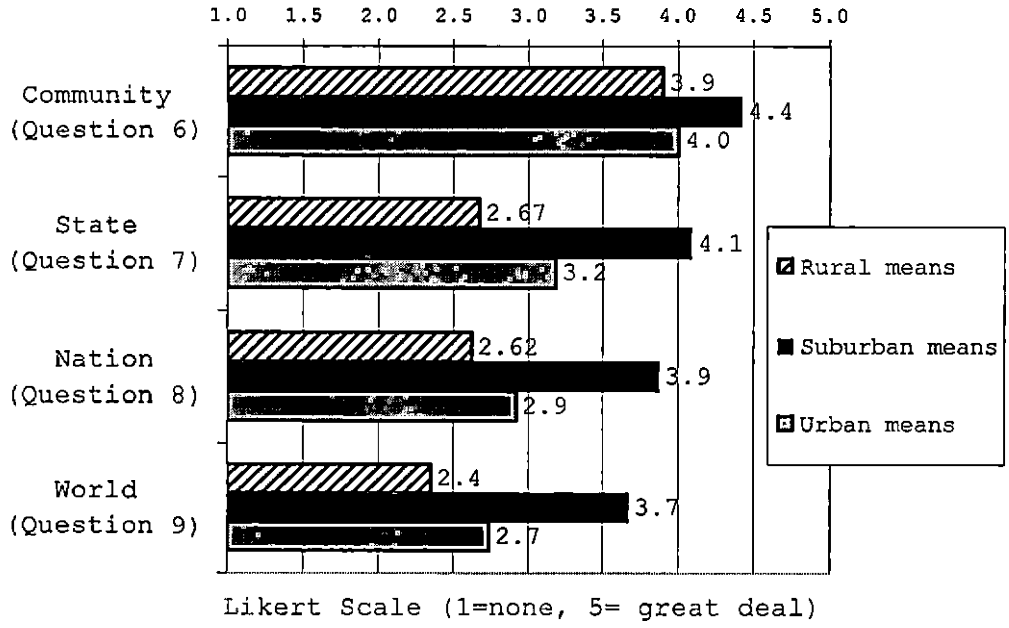


Figure 3. Feelings of Environmental Responsibility Among Rural, Suburban, and Urban Residents.

Table 4.

Means and Standard Deviation for Feelings of Personal Responsibility for the Environment in Different Regions As Grouped By Rural, Suburban, and Urban Residents.

Personal Responsibility	Rural (n = 41)	Suburban (n = 40)	Urban (n = 40)
Community (Question 6)	3.9 ± 1.2	4.4 ± 0.8	4.0 ± 1.2
State (Question 7)	2.7 ± 1.2	4.1 ± 1.0	3.2 ± 1.0
Nation (Question 8)	2.6 ± 1.1	3.9 ± 1.2	2.9 ± 1.1
World (Question 9)	2.4 ± 1.1	3.7 ± 1.1	2.7 ± 1.3

As the location became farther removed from the local community, the feelings of responsibility tended to decrease. In questions seven through nine, the scores for the state (rural = 2.7, suburban = 4.1, urban = 3.2), nation (rural = 2.6, suburban = 3.9, urban = 2.9), and world (rural = 2.4, suburban = 3.7, urban = 2.7) declined modestly within groups. For all locations, these feelings of responsibility were highest in suburban areas and lowest in rural areas.

As part of the environmental attitudes survey, residents were asked in questions 10 through 20 to indicate the frequency of their environmental behaviors. For questions 10 through 15 answers were judged on a scale of one to six with six being daily, five being weekly, four being monthly, three being yearly, two being less than yearly, and one being never (see Figure 4 and Table 5). For questions 16 through 20, responses were graded on a scale of one to five with one being never and 5 being often (see Figure 5 and Table 6).

In considering all subgroups, results indicated that rural residents were more likely to be frequent supporters of environmentally conscious candidates (3.4), and to consider excess packaging amounts during purchases (4.6). Rural residents also indicated the highest participation in fishing characterized by more than monthly but less than yearly (3.5). Suburban residents tended to be more frequent at composting kitchen wastes (3.8) and recycling (5.1). The suburban subgroup scored the highest on camping (4.1), and spending time in a flower or vegetable garden on a monthly basis (3.8). Scores for urban residents indicated that they tended to be more frequent at purchasing products in recycled, reusable, and refillable containers (4.1). Similar behaviors were scored for all

subgroups relative to visiting a zoo, hunting, and using alternative methods of transportation.

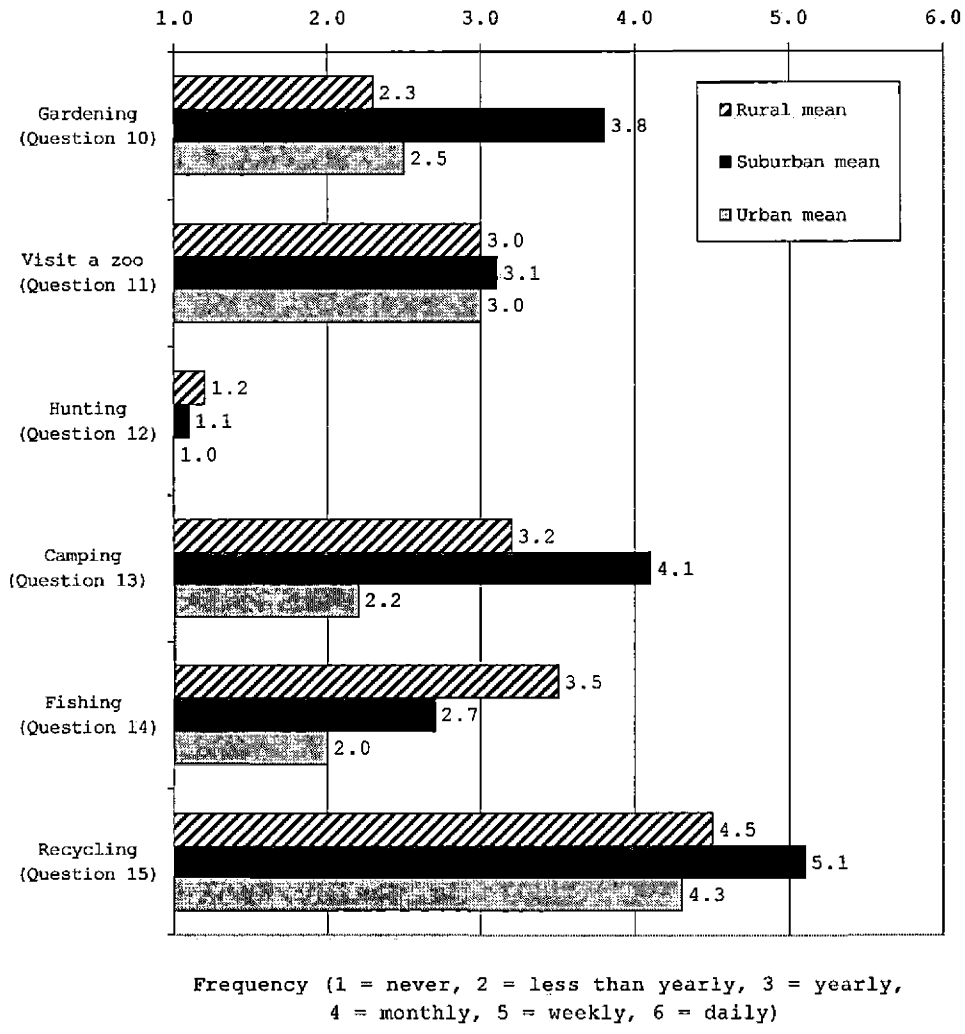


Figure 4. Frequency of Environmental Behaviors Among Rural, Suburban, and Urban Residents (Questions 10-15).

Table 5.

Means and Standard Deviation for Frequency of Environmental Behaviors As Grouped By Rural, Suburban, and Urban Residents.

Behavior	Rural (n = 41)	Suburban (n = 40)	Urban (n = 40)
Gardening (Question 10)	2.3 ± 1.2	3.8 ± 1.4	2.5 ± 1.2
Visit a Zoo (Question 11)	3.0 ± 1.0	3.1 ± 1.3	3.0 ± 1.0
Hunting (Question 12)	1.2 ± 0.5	1.1 ± 0.2	1.0 ± 0
Camping (Question 13)	3.2 ± .8	4.1 ± 1.3	2.2 ± 0.5
Fishing (Question 14)	3.5 ± 1.0	2.7 ± 1.2	2.0 ± 1.2
Recycle (Question 15)	4.5 ± 0.5	5.1 ± 0.9	4.3 ± 1.0

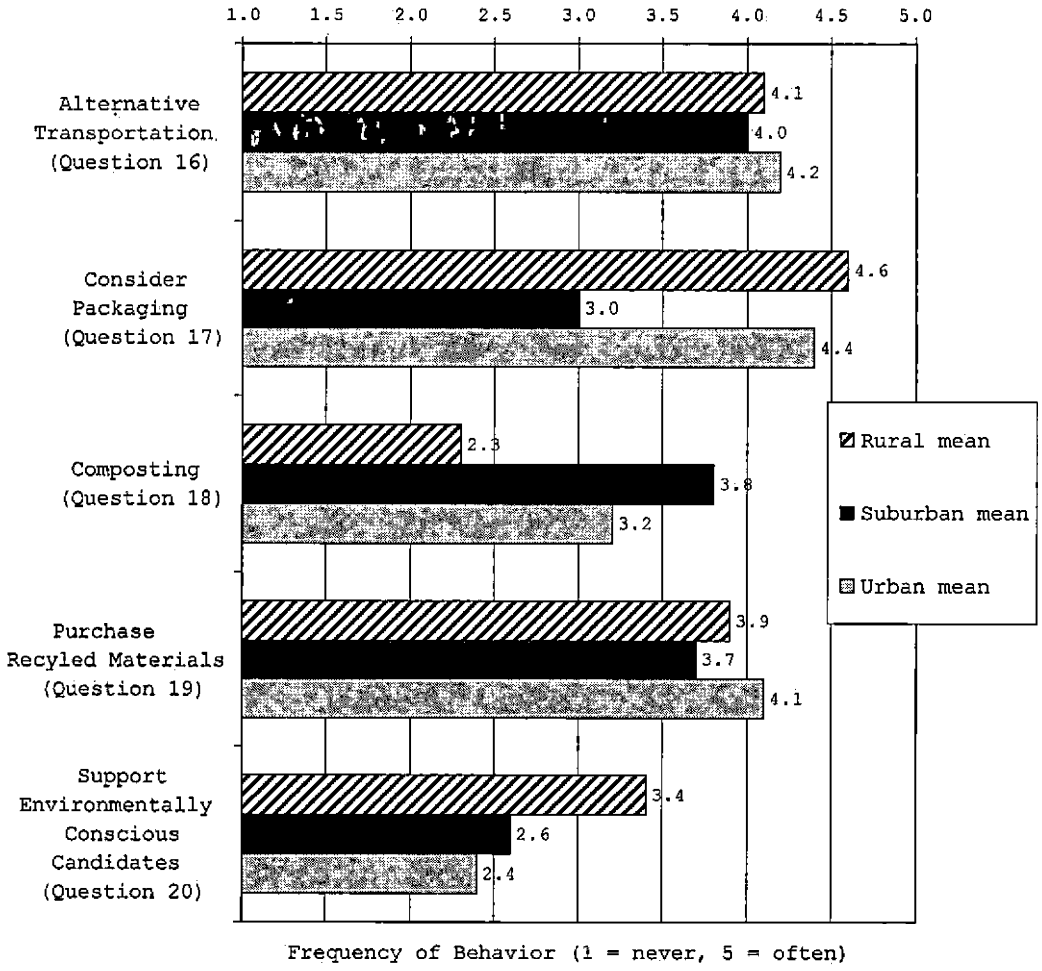


Figure 5. Frequency of Other Environmental Behaviors Among Rural, Suburban, and Urban Residents (Question 15-20).

Table 6.

Means and Standard Deviation for Frequency of Other Environmental Behaviors As Grouped By Rural, Suburban, and Urban Residents.

Behavior	Rural (n = 41)	Suburban (n = 40)	Urban (n = 40)
Using Alternative Transportation (Question 16)	4.1 ± 0.7	4.0 ± 1.0	4.2 ± 1.0
Considering Packaging (Question 17)	4.6 ± 0.8	3.0 ± 1.3	4.4 ± 1.0
Composting (Question 18)	2.3 ± 0.7	3.8 ± 1.5	3.2 ± 1.4
Purchasing Recycled Containers (Question 19)	3.9 ± 1.3	3.7 ± 1.2	4.1 ± 1.2
Supporting Environmental Candidates (Question 20)	3.4 ± 0.7	2.6 ± 1.0	2.4 ± 0.8

CHAPTER FIVE

CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

Conclusions

The conclusions extracted from the project follows.

1. Ecological literacy levels did vary slightly between residential subgroups within the Coachella Valley, although very few differences appear to exist between the rural and suburban subgroups in most of the ecological principles tested. Significant differences were identified for between residential subgroups especially when comparing rural vs. urban, and suburban vs. urban results. Therefore, the primary hypothesis that there are varying levels of ecological literacy between residential subgroups that was tested for this thesis appears to be true.
2. Ecological literacy levels are highest in the suburban and rural subgroups, and lower in the urban subgroups for all of the principles tested in areas surrounding the Coachella Valley Preserve. The secondary hypothesis for this thesis appears to be false because the suburban subgroup tested higher on four of the six principles.

3. Attitudes on the environment were generally favorable in all subgroups, and residents felt an average to high sense of responsibility towards their communities.
4. Certain environmental behaviors are more frequent in some of the residential subgroups. Rural residents had a higher frequency of supporting environmentally conscious candidates, considering packaging, and fishing. Suburban residents had a higher frequency at composting kitchen wastes, recycling, and gardening. Urban residents had a higher frequency of purchasing recycled goods. The frequency of behavior across subgroups was very similar for hunting, visiting zoos, and using alternative methods of transportation.

Discussion of the Results

The findings of this study indicate that there is some variation in the understanding of ecological differences between rural, suburban, and urban residents in the Coachella Valley. Ecological literacy tends to be lowest in the principles of biotic interaction and ecosystem succession in urban areas, materials cycling and ecosystem succession in rural areas, and biogeography and

the importance of biodiversity in suburban areas. Suburban residents tended to have a thorough ecological literacy in all of the principles tested.

These results may indicate that although there are differences between residential subgroups, a more in depth study may more aptly define what variables exist among individuals and not necessarily between subgroups. For example, suburban residents surrounding the Coachella Valley Preserve may have a higher educational level than their rural and urban neighbors, but further study and a profile of these results would have to be conducted before any conclusions could be made to this effect. Noticeably though suburban residents have a more thorough understanding of certain issues, but as indicated in the results of this study, they take somewhat less of an interest of being involved with local policy issues concerning the environment.

It is reasonable to assume from the results of this study that development of educational programs in the elementary and secondary schools, as well the implementation of conservation education programs for residents, especially in the urban centers, should help increase public awareness and generate concern for environmental problems on a local scale. Also, educational

programs could serve to enhance communication between scientists and the public which could lead to a better understanding of what would encourage the development of sustainable and ecologically friendly community action strategies that are essential to improve quality of life, as well as to preserve native habitat and wildlife (Robertson & Hull, 2001).

The need for an environmentally literate citizenry has led to a movement to incorporate environmental education into school curriculum, interpretational programs, and conservation education. Studies to support these educational programs have ranged from quantifying environmental behaviors and ethics of preserve and state park visitors (Negra & Manning, 1997), to reviews attempting to understand how an increased public understanding of ecology could assist with developing more sound environmental policy by including input from ecologists, citizens, land managers, and policy writers (Robertson & Hull, 2001).

Surveys and observations should be utilized to determine the current environmental literacy of the population which will assist in developing the most efficient strategies for communication through educational programs. An increase in the ecological knowledge of the

public should provide a citizenry with understanding of why a given design is necessary to conserve habitat and wildlife while opening up new economic areas for development.

Within the field of conservation biology it is imperative to understand that the ultimate purpose to the science is to assist communities with conservation policy, so it will always be an interdisciplinary science that will include sociological, biological, educational, and legal aspects (Robertson & Hull, 2001). Decision makers rarely have an adequate amount of knowledge about the ecological literacy and environmental attitudes of residents that they need because locally relevant data are usually not available. In turn, they are less prepared to determine how much the public stakeholders understand about issues affecting the conservation strategy of the region (Bradley, et al., 2004). It is one of the duties of conservation professionals to reach out and form partnerships within the community, so that residents will have a more vested interest in the conservation of natural resources in their community (Brewer, 2006).

Outreach programs and community partnerships could be more effective if they had more information about the public's understanding of local ecological issues. Foci

for these programs should be to first learn about how much ecological literacy does exist among residents, and how the prevailing attitudes towards the local environment may influence the residents' decisions about planning efforts. Outreach programs and partnerships with the community should then build on what is learned from the residents by allowing them the opportunity to understand how science is used to build conservation plans and management efforts, by including the public in data collection and monitoring procedures, and offering more opportunities beyond planning meetings for the public to have a constructive dialectic with local scientists and policy makers as well (Brewer, 2002)

Recommendations

The recommendations resulting from the project follows:

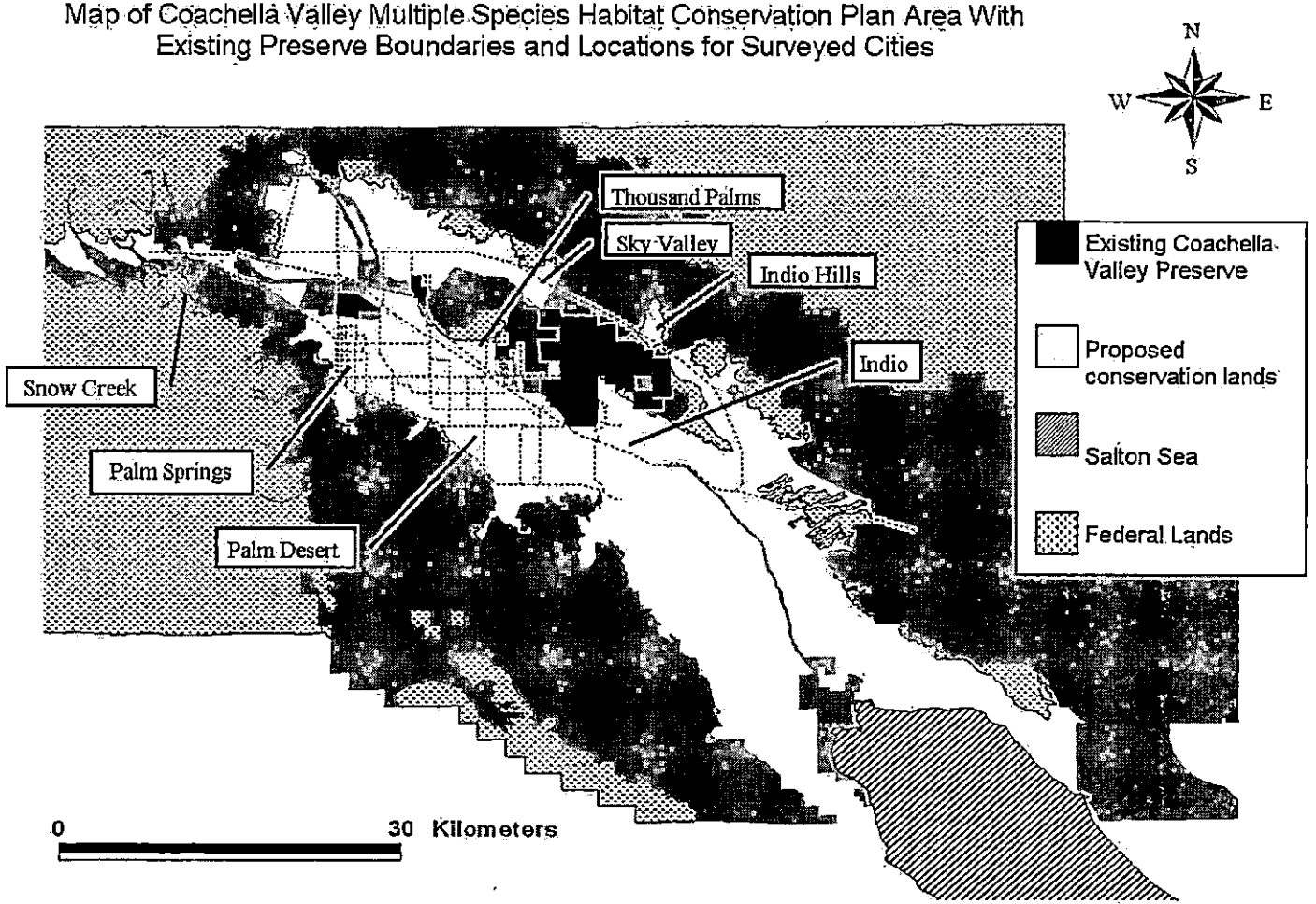
1. Develop outreach programs through educational initiatives at the elementary and secondary school levels, and community partnerships that give the public the opportunity to learn more about their local ecology and how conservation plans are made through interactive opportunities.

2. Focus more directly in ecological and conservation education programs on ecological principles that are lacking within residential subgroups.
3. This study should be replicated in the future to include a larger sample size of the population, and include a profile of the educational levels of residents. It should then be used as a part of the conservation protocol for developing plans to learn where deficiencies may exist in the ecological literacy of residential subgroups.

APPENDIX A

MAP OF COACHELLA VALLEY MULTIPLE SPECIES HABITAT CONSERVATION PLAN AREA WITH EXISTING PRESERVE BOUNDARIES AND LOCATIONS FOR SURVEYED CITIES.

Map of Coachella Valley Multiple Species Habitat Conservation Plan Area With Existing Preserve Boundaries and Locations for Surveyed Cities



Author-created using ArcView GIS 9.1 and Microsoft Publisher

APPENDIX B

SURVEY USED OF ECOLOGICAL LITERACY

AND ENVIRONMENTAL ATTITUDES

Ecological Literacy Survey

1. Ecosystem succession

•Periodic floods in the desert renew and replenish natural resources.
True or False.

•People sometimes ride off highway vehicles in the desert. What is the impact of the OHVs on the soil, plants, and animals?
a) no major impact
b) changes the plants and animals that will live there in the future
c) changes the entire ecosystem

•Exotic plants help to increase the fire danger in the Coachella Valley by providing the fuel that helps the fire travel from shrub to shrub.
True or False.

•To protect an area from blowing sand, walls and sand fences are constructed along the edge of natural habitats. As a result, species that live downwind:
a) will have an increased quality of habitat
b) will have a decreased quality of habitat
c) will have no impact on the quality of habitat

2. Ecological energetics

•At the present rate of use the world's supply of coal, oil and natural gas will:
a) last forever
b) be used up eventually
c) renew itself.

• The primary source of energy on earth is the sun. True or False.

•For a person to get the most food energy out of 100 pounds of vegetables and grain the person should:
a) eat the vegetables and grain
b) feed the vegetables and grain to an animal and eat the meat
c) feed the vegetables and grain to a cow to produce milk, feed the milk to an animal and eat the meat.

• Riparian areas are areas of vegetation next to a stream or riverbed. During periodic flood events in the desert, riparian areas:
a) help the water move faster down the streambed
b) help the water slow down
c) have no impact on the speed of the water

3. Carrying capacity

•There is enough water in the large aquifer beneath the Coachella Valley to support unlimited population growth:
True or False.

•There is a limit to how many people the world can support. True or False.

•As the population in an area increases, the potential for pollution:
Increases, Decreases, or Stays the Same.

•The amount of water that people consume in the Coachella Valley can have a significant effect on natural fan palm oases, mesquite dunes, and riparian areas.
True or False

4. Importance of diversity

•The desert is a very diverse environment where many plants and animals have special adaptations that help them to survive. True or False

•If an ecosystem is threatened, what are the most important features to protect?
a) the soil, plants, and insects
b) the watershed
c) the species most likely to go extinct.
d) all of the above

•Fan palm oases are more important to the desert environment than sand dunes or Creosote shrub habitats. True or False.

•Large animals need more space to survive. As a result large animals, such as the bighorn sheep are in more danger of extinction than small animals, such as lizards, from loss of habitat. True or False

5. Biotic interactions

•Each year your neighborhood is sprayed with the same bug killer to control flies and ants. After a few years of spraying the same product what do you think will happen? The flies and ants will likely:
a) disappear
b) become resistant to the spray
c) remain the same year after year.

•When colonizing a new area, plants, animals and even people compete for resources to live, grow and reproduce. What usually happens when an area gets crowded?
a) they compete against each other
b) they cooperate with each other
c) they usually die out.

•Blowing sand is important to maintaining healthy ecosystems in the Coachella Valley.
True or False

•As California and other western states were settled, people encountered cougars that hunted bighorn sheep and other wild animals, but the cougars threatened their families and livestock. As the cougars were eliminated to protect people, did the number of bighorn sheep: Increase, Decrease, or Stay the Same.

6. Biogeography

•Saving an endangered plant species is just as important as saving an endangered animal species. True or False.

•The most effective way to save an endangered animal is to:
a) stop hunting or eating the animal
b) provide it with an adequate food supply
c) establish a large enough reserve area for it to live and reproduce.

•The land area needed to protect an endangered animal should be:
a) large enough to support one family of animals
b) large enough to support several animal families
c) the same size reserve for all endangered animals.

• The greatest threat to the plants and animals found in the Coachella Valley is:
a) pollution
b) loss of habitat
c) exotic species

7. Materials cycling

•Nitrogen oxides from car exhaust can increase the nitrogen levels in the local soils. What kind of impact does this have on desert ecosystems:
a) helps to increase the number of exotic plants in the area
b) helps give the exotic plants a competitive edge over the native plants
c) helps to increase the fire frequency in natural lands
d) all of the above

•Phosphorus fertilizer is applied to lawns, gardens and crop fields to encourage plant growth. What happens when phosphorus washes into the Salton Sea?
a) the phosphorus kills the fish
b) phosphorus will increase the growth of algae
c) not much will happen.

•Nitrogen fertilizer is applied to gardens and crop fields to increase food production. The nitrogen is taken up into the food. When a person eats food for energy and growth they produce sewage wastes. The human sewage contains some of the nitrogen that was first applied as fertilizer.
True or False.

•The amount of water on earth is: Increasing, Decreasing, or Staying the Same.

8. The earth as a biosphere

•The warming of the Pacific Ocean influences the weather
a) just in California
b) just in the US
c) throughout North & South America

•Burning fuel in Southern California to heat homes, operate cars, and produce electricity contributes to air pollution:
a) only in the city where it's burned
b) throughout Southern California
c) burning fuel does not contribute to air pollution

•A major volcanic eruption in the Philippines creates dust and reduces sunlight only near the volcano during the eruption. True or False.

•Water is brought from the Colorado River to irrigate the agricultural fields near the Salton Sea and the golf courses across the Coachella Valley. Taking this much water:
a) has no effect on the flow of the river
b) only effects Arizona
c) has a major impact on neighboring states, Mexico, and the flow of the Colorado River

Survey of Environmental Attitudes and Behaviors

What city are you from in the Coachella Valley? _____

How long have you lived in the Coachella Valley? _____

(1.) Humans must live in harmony with nature in order to survive. (strongly agree, agree, disagree, strongly disagree)

(2.) One person can't do anything to help the environment. (strongly agree, agree, disagree, strongly disagree)

(3.) When humans interfere with nature it often produces disastrous consequences. (strongly agree, agree, disagree, strongly disagree)

(4.) Mankind was created to rule over the rest of nature. (strongly agree, agree, disagree, strongly disagree)

(5.) Humans can fix just about anything with our technology, including the environment. (strongly agree, agree, disagree, strongly disagree)

6.) To what extent do you feel it is your personal responsibility to help improve the environmental quality in your community? (Scale from 1 to 5 where 1 is none and 5 is a great deal)

(7.) To what extent do you feel it is your personal responsibility to help improve the environmental quality in your state? (Scale from 1 to 5 where 1 is none and 5 is a great deal)

(8.) To what extent do you feel it your personal responsibility to help improve the environmental quality in the US? (Scale from 1 to 5 where 1 is none and 5 is a great deal)

(9.) To what extent do you feel it your personal responsibility to help improve the environmental quality in the world? (Scale from 1 to 5 where 1 is none and 5 is a great deal)

(10.) How often do you work in a flower or vegetable garden as weather permits? (daily, weekly, monthly, yearly, less than yearly, never)

(11.) How often do you visit a zoo? (daily, weekly, monthly, yearly, less than yearly, never)

(12.) How often do you hunt? (daily, weekly, monthly, yearly, less than yearly, never)

(13.) How often do you camp? (daily, weekly, monthly, yearly, less than yearly, never)

(14.) How often do you fish? (daily, weekly, monthly, yearly, less than yearly, never)

(15.) How often do you recycle things like paper, glass, and plastic? (daily, weekly, monthly, yearly, less than yearly, never)

(16.) How often do you use alternative forms of transportation such as walking, bicycling, car pooling, or mass transit? (Scale from 1 to 5 with 1 being never and 5 being often)

(17.) How often do you avoid buying products with excess packaging? (Scale from 1 to 5 with 1 being never and 5 being often)

(18.) How often do you compost your yard waste? (Scale from 1 to 5 with 1 being never and 5 being often)

(19.) How often do you purchase one product over another because it is packaged in refillable, returnable, or recyclable containers? (Scale from 1 to 5 with 1 being never and 5 being often)

(20.) How often do you support candidates who are concerned about environmental problems and issues? (Scale from 1 to 5 with 1 being never and 5 being often)

APPENDIX C

INTERNAL REVIEW BOARD APPROVAL, INFORMED CONSENT FORM, AND LETTER OF PERMISSION FROM AUTHORS OF ORIGINAL SURVEYS

CALIFORNIA STATE UNIVERSITY
SAN BERNARDINO

5500 University Parkway, San Bernardino, CA 92407-2397

SPONSORED PROGRAMS
Institutional Review Board
(909) 537-5027
fax: (909) 537-7028
http://irb.csusb.edu

August 6, 2007

CSUSB INSTITUTIONAL REVIEW BOARD
Exempt Review
IRB# 06133
Status
APPROVED

Ms. Kathleen D. Fleming
c/o: Prof. Darleen Stoner
Department of Science, Math, and Technology
California State University
5500 University Parkway
San Bernardino, California 92407

Dear Ms. Fleming:

Your application to use human subjects, titled, "Investigation of How Levels of Ecological Literacy Can Effect the Communication and Implementation of Policy in Habitat Conservation Plans and Design of Multiple Species Reserves" has been reviewed and approved by the Chair of the Institutional Review Board (IRB) of California State University, San Bernardino and concurs that your application meets the requirements for exemption from IRB review Federal requirements under 45 CFR 46. As the researcher under the exempt category you do not have to follow the requirements under 45 CFR 46 which requires annual renewal and documentation of written informed consent which are not required for the exempt review category. However, exempt status still requires you to attain consent from participants before conducting your research.

Although exempt from federal regulatory requirements under 45 CFR 46, the CSUSB Federal Wide Assurance does commit all research conducted by members of CSUSB to adhere to the Belmont Commission's ethical principles of respect, beneficence and justice. You must, therefore, still assure that a process of informed consent takes place, that the benefits of doing the research outweigh the risks, that risks are minimized, and that the burden, risks, and benefits of your research have been justly distributed.

You are required to 1) notify the IRB if any substantive changes are made in your research prospectus/protocol, 2) if any adverse events/serious adverse events (AE's/SAE's) are experienced by subjects during your research, and 3) when your project has ended. Failure to notify the IRB of the above, emphasizing items 1 and 2, may result in administrative disciplinary action. You are required to keep copies of the informed consent forms and data for at least three years.

If you have any questions regarding the IRB decision, please contact Michael Gillespie, IRB Secretary. Mr. Michael Gillespie can be reached by phone at (909) 537-5027, by fax at (909) 537-7028, or by email at mgillesp@csusb.edu. Please include your application identification number (above) in all correspondence.

Best of luck with your research.

Sincerely,

Samuel S. Kushner, Chair
Institutional Review Board

SK/mg

cc: Prof. Darleen Stoner, Department of Science, Math, and Technology

CALIFORNIA STATE UNIVERSITY
SAN BERNARDINO
5500 University Parkway, San Bernardino, CA 92407-2397

COLLEGE OF EDUCATION
Department of Science, Mathematics,
and Technology Education
(909) 537-5290
fax: (909) 537-7522

Greetings to you.

This study will investigate the various environmental attitudes and ecological literacy levels of the citizens in the communities surrounding the Coachella Valley Preserve. Participation is completely voluntary however please note that your opinions and knowledge are of considerable value to the results of this study. If you choose to participate you will be asked to take a semi-structured interview that will include questions about your involvement in designing and implementing the Coachella Valley Multiple Species Habitat Conservation Plan, and your knowledge of local ecology. You are free to skip any questions you feel uncomfortable with, and/or withdraw from the interview at any time. The interview should take between 30-45 minutes of your time to complete. This study is being done by Kathleen Fleming (myself), and supervised by Dr. Darleen Stoner of the Science, Math, and Technology Education department of California State University, San Bernardino. The methods of this study have been reviewed and approved by our Institutional Review Board.

Assumed benefits of this study would be to understand how the communities around the Coachella Valley Preserve perceive certain environmental issues and interpret environmental knowledge of their local areas. This information may prove useful to guiding future local community planning and educational initiatives. There is no risk involved to take part in this survey however you should know that interview questions may refer to the controversial nature of local environmental issues, and your valuable opinion of these issues.

All responses will be anonymous and held in the strictest confidentiality by myself. No identifying data will be taken during the interview and results will be only in grouped statistics. Interviews will be coded for confidentiality, and all recordings of any interview will be destroyed after the statistical results have been acquired. If you should choose to learn more about the outcomes of this study, completed results should be available by December 15th, 2007 for your review. You may obtain results or send your request to:

Kathleen Fleming c/o Dr. Darleen Stoner
Science, Math, and Technology Education
107 Chaparral Hall, California State University, San Bernardino
5500 University Parkway
San Bernardino, Ca 92407

For any further questions or comments on this study, feel free to contact my advisor, Dr. Darleen Stoner at (909) 537-5640

Thank you for your time,

Kathleen D. Fleming

Kathleen D. Fleming
MA Candidate
Science, Math, and Technology Education
California State University, San Bernardino

By placing a check mark in the box below, I acknowledge that I have been informed of, and that I understand, the nature and purpose of this study, and I freely consent to participate. I also acknowledge that I am at least 18 years of age.
Place a check mark here _L_ Today's date:_____

Date: Thu 19 Jul 19:55:04 PDT 2007
From: KAREN MANCL <mancl.1@osu.edu> Add To Address Book | This is Spam
Subject: Fwd: Question about Ohio Ecological Literacy survey from student in CA
To: Kathleen Carr <kcarr@strategicresearchgroup.com>
Cc: "Kathleen D. Fleming" <kathleen.fleming@ucr.edu>

I am forwarding your message to Dr. Kathleen Carr. Her company, the Strategic Research Group, conducted the phone poll and preformed all of the analysis. You can work with her to conduct a similar survey in California. She works all over the country conduct public opinion research.

Attachment: message.rfc822 (4k bytes) Open

Date: Wed, 18 Jul 2007 13:22:04 -0700 (PDT)
From: "Kathleen D. Fleming" <kathleen.fleming@ucr.edu>
Subject: Question about Ohio Ecological Literacy survey from student in CA
To: mancl.1@osu.edu

Greetings Dr. Mancl,

My name is Kathleen Fleming and I am a associate ecologist and environmental educator out here in the deserts of California. Over the last couple of years I have been working with our communities to build a greater understanding of our unique and wonderful deserts. I am also working on finishing my Masters thesis in conservation ecology and education which is why I am contacting you today. To gain a better understanding of the gaps in ecological knowledge here in the Coachella Valley, I am proposing to do a study of the communities that surround our large preserve here. These communities tend to have the most effect on conservation strategies and natural resource planning that are implemented in the area.

I was extremely impressed by the thoroughness of the environmental literacy instruments that you and Dr. Carr, and Michele Malone created for the 1999 and 2003 studies in Ohio. With your permission, I would like to base my ecological literacy survey off yours, with necessary changes to the questions that directly involve desert ecology. I would also like to use your environmental attitudes survey unchanged to accompany the ecological literacy survey as the two seem to complement each other very well. Of course, I intend to completely site you and your colleagues as authors, but because I wish to use your surveys for a basis, I wanted to see if you would permit me to do so first, as they are first and foremost your intellectual property.

Thank you for your time and consideration,

KD
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Kathleen D. Fleming
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Date: Wed 1 Aug 16:14:36 PDT 2007
From: KAREN MANCL <mancl.1@osu.edu> Add To Address Book | This is Spam
Subject: Re: Fwd: Question about Ohio Ecological Literacy survey from student in CA
To: "Kathleen D. Fleming" <kathleen.fleming@ucr.edu>
Cc: Kathleen Carr <kcarr@strategicresearchgroup.com>

I checked with Dr. Carr and we have no problem with you using our survey and cite the source in your reports and papers. We would like to have a copy of you findings for our files.

Thanks for checking with us first.

Karen Mancl

----- Original Message -----
From: "Kathleen D. Fleming" <kathleen.fleming@ucr.edu>
Date: Tuesday, July 24, 2007 1:09 pm
Subject: Re: Fwd: Question about Ohio Ecological Literacy survey from student in CA

> Hi again Dr. Mancl,
>
> Thank you for forwarding my information to Dr. Carr, I haven't
> yet heard from her, but I am looking forward to her input..
> This is a much smaller study than the one that you undertook
> in Ohio, and mostly I will be collecting information through
> face to face contact at community centers and through
> homeowner association mailings instead of through random
> calling (at least that is my current idea). However, before I
> proceed to submit my methods to our review panel for my
> thesis, I was hoping to get your permission to use the format
> and some of your broader questions developed for your
> ecological literacy and the environmental attitudes survey. On
> the paper I have, you are the lead author, please forgive me
> if I have misunderstood and you wish for me to seek permission
> from Dr. Carr and/or Michele Malone before I proceed.
>
> Thanks again for your time,
>
> KD
> ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
> Kathleen D. Fleming
> Center for Conservation Biology-
> Desert Studies Initiative
> University of California, Riverside
> Palm Desert Campus # B229
> 75-080 Frank Sinatra Dr.
> Palm Desert, Ca 92211
> Tel: 760-834-0594
> Fax: 760-834-0934
> ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
>

REFERENCES

Beatley, T. (1994). *Habitat conservation planning: Endangered species and urban growth.* Austin: University of Texas Press.

Bradley, M. P., R. Hanson, & E. S. Walbeck. (2004). Innovative environmental education contributes to improved management practices in the mid-Atlantic region of the United States. *Environmental Monitoring and Assessment, 94,* 205-215.

Brewer, C. (2001). Cultivating conservation literacy: "Trickle down" education is not enough. *Conservation Biology, 15*(5), 1203-1205.

Brewer, C. (2002). Outreach and partnership programs for conservation education where endangered species conservation and research occur. *Conservation Biology, 16*(1), 4-6.

Brewer, C. (2006). Translating data into meaning: Education in conservation biology. *Conservation Biology, 20*(3), 689-691.

Carson, R. (1962). *Silent spring.* Boston: Houghton-Mifflin.

Coachella Valley Association of Governments (CVAG). (2006). *Final Coachella Valley multiple species habitat conservation plan and natural community's conservation plan: Final environmental impact statement / environmental impact report.* Palm Desert, CA.

Endangered Species Act. 16, C.F.R. § 1531-1543 (1988).

Foster, J. B. (1999). *The vulnerable planet. A short economic history of the environment.* New York: Monthly Review Press.

Fulton, W., & P. Shigley (2005). *Guide to California planning.* (3rd ed.) Point Arena, CA: Solano Press Books.

Hammond, G.P. (2006). 'People, planet, and prosperity': The determinants of humanities environmental footprint. *Natural Resources Forum, 30,* 27-36.

Hull, R. B., D. P. Robertson, D. Richert, E. Seekamp, & G. J. Buhyoff.(2002). Assumptions about ecological scale and nature knowing best hiding in environmental decisions. *Conservation Ecology, 6*(2), 12.

Jacobson, S. K. (1999). *Communication skills for conservation professionals.* Covelo, CA: Island Press.

Jensen, H.B. (2007). From economic to sustainable development: Unfolding the concept of law. *Systematic Research and Behavioral Science, 24,* 505-513.

Odum, E. (1994). Ecology as a science. In R. A. Eblen, & W. M. Eblen (Eds.), *The encyclopedia of the environment* (pp. 171-173). Boston: Houghton Mifflin

Orr, D. W.(2004). *Earth in mind. On education, environment, and the human prospect.* Covelo, CA: Island Press.

Orr, D. (2005). Place and pedagogy. In M. K. Stone, & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world* (pp. 85-95). San Francisco: Sierra Club Books.

Mancl, K., K. Carr, & M. Malone. (1999). Environmental literacy of Ohio adults. *Ohio Journal of Science, 99*(3), 57-61.

Mancl, K., K. Carr, & M. Malone. (2003). Profile of Ohio adults with low environmental literacy. *Ohio Journal of Science, 103*(3), 38-41.

Michael, P. (2005). Helping children fall in love with the Earth: Environmental education and the arts. In M. K. Stone, & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world* (pp. 111-125). San Francisco: Sierra Club Books.

Molles, M. C. (2002). *Ecology: Concepts and applications.* 2nd Ed. San Francisco: McGraw Hill.

Moritz, C. (2002). Strategies to protect biological diversity and the evolutionary processes that sustain it. *Systematic Biology, 51*(2), 238-254.

Negra, C., & R. E. Manning. (1997). Incorporating environmental behavior, ethics, and values into nonformal environmental education programs. The *Journal of Environmental Education, (28)*2, 10-21.

Peterson, M. N., Peterson, M. K., & Peterson, T. R. (2005). Conservation and the myth of consensus. *Conservation Biology, 19*(3), 762-767.

Pike, A., A. Rodriguez-Pose, & J. Tomaney. (2007). What kind of local and regional development and for whom? *Regional Studies*, 41:9; 1253-1269.

Pullin, A. S. (2002). *Conservation biology*. New York: Cambridge University Press.

Robertson, D. P., & R. B. Hull. (2001). Beyond biology: toward a more public ecology for conservation. *Conservation Biology, 15*(4), 970-979.

Scott, T. A. & Sullivan, J. E.(2000). The selection and design of multiple-species habitat preserves. *Environmental Management, 26*(1),37-53.

Simmons, D. (2005). Education reform, setting standards, and environmental education. In H. R. Hungerford, W. J. Bluhm, T. L. Volk, & J. M. Ramsey (Eds.), *Essential readings in environmental education* (pp 65-72). Champagne, IL: Stipes Publishing L.L.C.

Sobel, D. (2004). *Place-based education: Connecting classrooms & communities*. Great Barrington, MA: The Orion Society.

Stapp, W. B., et al. (2005). The concept of environmental education. In H. R. Hungerford, W. J. Bluhm, T. L. Volk, & J. M. Ramsey (Eds.), *Essential readings in environmental education* (pp. 33-36). Champagne, IL: Stipes Publishing L.L.C.

Vaske, J. J., & K. C. Kobrin. (2001). Place attachment and environmentally responsible behavior. *The Journal of Environmental Education, (32)*4, 16-21.

Volk, T. L., & McBeth, W. (2005). Environmental literacy in the United States. In H. R. Hungerford, W. J. Bluhm, T. L. Volk, & J. M. Ramsey (Eds.), *Essential readings in environmental education* (pp 73-86). Champagne, Il: Stipes Publishing L.L.C.

Watchman, L.H., M. Groom, & J. D. Perrine. (2001). Science and uncertainty in habitat conservation planning. *American Scientist,* 7, 349-359.

World Commission on Environment and Development (WCED). (1987). *Our common future*. Oxford: Oxford University Press.