CONNECTING WITH NATURE: A STUDY OF THE EFFECTS OF THE NATURE-MAPPING PROGRAM ON ITS GRADE SCHOOL PARTICIPANTS, THEIR SCHOOLS AND THEIR COMMUNITIES

by

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This thesis studied the effects of The NatureMapping Program, a volunteer wildlife monitoring program, on its grade school participants, their schools, and their communities. Of special interest were the effects on the students' environmental literacy, environmentally responsible behaviors, and sense of well being.

This thesis contains an overview of The NatureMapping Program, six school case studies, and comparisons across the case studies. Interviews were conducted with teachers, community members, and students who had participated in NatureMapping during the previous school year and comparable students who had not participated in NatureMapping. The coded student interview results were statistically analyzed.

The study found that The NatureMapping Program was deemed to increase the students' awareness and knowledge of their natural environments more than other outdoor education or community service activities in general. The study also found that participation in the Program strengthened the relationship between the schools and their communities.

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INTRODUCTION

Connecting with Nature

This thesis is a labor of my love for the complex and diverse natural world that evolved on Earth over billions of years, a world that by many accounts is being destroyed. I trust this love to be a part of those billions of years of life's evolution, to be an emotion that has helped us survive in the past and an emotion that will help us survive in the future. We feel emotional and spiritual connections to the natural world because we have always depended on it for air, water, food, shelter, fuel, stable climate, and intellectual stimulation. Nature is as much a part of us as we are a part of nature. Man-made substitutes for these services are impossible without the benefit of geologic time, a luxury that we do not have.

This love is being tested by a bombardment of bad news at all levels, from local to global. For the first time in Earth's history, our demands have exceeded the regenerative capabilities of the planet's major support systems. According to Brown (1999), water tables are falling on every continent, most range lands are undergoing desertification, we are in the early stages of the greatest mass extinction of plant and animals species in 65 million years, and scientists expect the buildup of greenhouse gases in the atmosphere to cause catastrophic climate changes possibly within our lifetimes. If these trends are not halted, they will result in the collapse of economies,

social order, and human health. The results of our actions can no longer be ignored, denied, or abandoned.

Because we are a part of nature, every activity in which we engage has an impact on nature. The impacts of our individual actions are magnified by our numbers (there are six billion of us), our technological prowess, and the declining resilience of the earth's natural systems. In this new era of global responsibility, every person and every organization has a local role to play in maintaining the health of the planet. The case of the Pacific Northwest salmon illustrates this phenomenon.

The dramatic decline of salmon populations in the Pacific Northwest over the past century is currently receiving much attention. The anadromous fish have deep cultural significance, economic value, and legal protection under the Endangered Species Act. The fish populations also serve as an indication of the overall health of the region's watersheds. The fight to save the salmon has taken on added significance as the world watches to see if the Pacific Northwest's environmentally enlightened public can provide a solitary haven for a species that has been extirpated elsewhere on a grand scale (Botkin 1995).

When honestly put to the task of protecting salmon from extinction, an examination of the fish's lifecycle led the people of the Pacific Northwest to conclude that everyone in salmon territory is part of the problem and hence has a role to play toward a solution. The responsible parties ranged from the ordinary citizen considering whether to use lawn pesticides, to the urban planner writing land use code for stormwater management, to the federal agency head deciding whether to breach a dam, to the international negotiator setting ocean catch limits. As shown by the salmon case, species protection requires ecosystem protection. Ecosystem protection in large,

developed areas often necessitates a ubiquitous infusion of our collective conservation goals into an uncountable number of individual decisions.

Ecological problems call for ecological solutions, i.e., solutions that recognize diversity, connectivity, multiple hierarchies, and adaptation. Thus, a single program, leader, or policy cannot be the solution; instead, it will take a seemingly infinite array of approaches with an even higher order of interaction between them. We are beginning to recognize the limitations of technology and technocrats, of the scientific method and scientists, of programs and administrators, and of political science and politicians. We are awakening to the necessity of complementing their expertise with the individual, the local, the natural, and the instinctive. It is a time for renewed involvement and stewardship, a time to form connections between people, land, and history. With a job to do, we will gain satisfaction from our knowledge, importance, and efficacy. We will rediscover the joys of relationships with others and nature. We will recognize commonalties above differences. But, most of all, we will slow and potentially reverse the damage we are inflicting on the only Earth we have.

The ecological solution represents a cultural change toward what Aldo Leopold (1949) called the “land ethic.” According to Leopold, “an ethic, ecologically, is a limitation on freedom of action in the struggle for existence (p. 202).” Leopold saw that “there is as yet no ethic dealing with man’s relation to land and to the animals and plants which grow upon it (p. 203).” and urged “the extension of the social conscience from people to land (p. 209).” The ideal of a land ethic remains with us today. For example, the President’s Council on Sustainable Development recently stated, “As a society, we must develop a central ethic that strongly encourages individuals, institutions, and corporations to take

full responsibility for the economic, environmental, and social consequences of their actions (p. 19, Sitarz 1998)."

The question remains, How can we move toward a society with a land ethic? Leopold offered a clue, "We can be ethical only in relation to something we can see, feel, understand, love, or otherwise have faith in (p. 214)." Indeed, I believe that the only way through which we can achieve balance with nature is to tap in to our innate love of nature, a love that is fostered through primary experience and knowledge. Leopold wrote, "Perhaps the most serious obstacle impeding the development of a land ethic is the fact that our educational and economic system is headed away from, rather than toward, an intense consciousness of land (p. 223)." Given the current scope of environmental problems and our increased urbanization and modernization, our need to connect with the "land and the animals and plants which grow upon it" is greater than ever.

Fortunately, especially during the past few decades, an expanding array of initiatives and programs have formed to meet Leopold's challenge. Environmental monitoring, citizen involvement, bioregionalism, ecopsychology, environmental education, experiential education, and service learning – these are new names for old, largely passed over initiatives whose time has now come. In fact, Lewis Mumford (1946) advocated the use of the "regional survey" in education three years before Leopold wrote A Sand County Almanac. Mumford saw the study of the local environment as a tremendous teaching tool that would foster holistic thinking and ultimately support a superior collaborative process for making public decisions. These initiatives have always had value but have been trumped by the more powerful economic and political forces of the times. These initiatives promote Leopold's "intense consciousness of land" and what

Orr (1992) and others now call “ecological [or environmental] literacy.” Their gaining popularity is an indication of their potential to address today’s problems.

Many people are pinning their hopes on initiatives such as these to right our course toward a sustainable existence on Earth. Surprisingly, relatively few studies attempt to document whether the initiatives lead to environmental literacy, much less “sustainability,” i.e., environmentally and socially responsible behavior. Although such studies could never be definitive, they can have value in steering and validating the initiatives’ efforts. To help fill this void, the study presented in this thesis empirically examined the effects of The NatureMapping Program, a program that contains elements from each of the initiatives mentioned above.

Purposes of this Study

The NatureMapping Program is a volunteer and student wildlife monitoring program founded in 1993 by the Washington Cooperative Fish and Wildlife Research Unit and the Washington Department of Fish and Wildlife to serve conservation planning and education needs. The participants’ wildlife observations help the two agencies assess statewide species distribution maps used for biodiversity conservation planning. With more than 50,000 Washington citizens involved in NatureMapping since it began and the adoption of the program in three other states (Virginia, Iowa and Idaho), the program has touched many people's lives (USGS 1999). However, prior to this study, there had been no systematic analysis of the effects on the participants.

This thesis research had several purposes. The main purpose was to determine the effects of The NatureMapping Program on its grade school participants. Because the Program had elements of many initiatives, the list of potential program impacts is long.

This study focused on student outcomes associated with a main objective of The NatureMapping Program – to foster participants' "environmental literacy," defined as the ability to answer the following questions: "(1) What do we have where we live? (2) What is the condition of those components? (3) How can we sustain what we have? And (4) What is my role? (NatureMapping 2000)" In other words, what do students have to say about their relationships with nature, place, and community? What influence has The NatureMapping Program had on developing their thoughts, feelings, and abilities with regard to these issues? How do NatureMapping activities and lessons translate to changes in society and the environment? And, what can the answers to these questions tell theorists, and what can theorists offer to strengthen the NatureMapping experience?

Primarily through an understanding of The NatureMapping Program and its supporting initiatives, this thesis also examined possible reasons for the observed participant effects. Because a study of the student participants would not have been complete without a consideration of the students' schools and communities, their involvement in the study provided opportunities to identify broader effects and recommendations. This information also educates the reader regarding The NatureMapping Program at the national, state, and local levels and provided a profile of the students.

It is also important to note what this study is not intended to evaluate. The NatureMapping Program is a unique blend of elements (e.g., environmental, experiential, service, etc.). This study investigates the effects of The NatureMapping Program as a unit. Without a systematic comparison to many other programs with varying attributes, it is impossible to dissect the contributions of the individual elements.

This research is not a complete assessment of The NatureMapping Program. I do not examine the effects of The NatureMapping Program on participants outside the school-based programs. Nor do I consider the contribution of the statewide NatureMapping databases to scientific understanding or community and regional planning.

Organization of this Thesis

Chapter II: Literature Review further motivates and informs this study with an account of the initiatives related to the NatureMapping K-12 program: bioregionalism, environmental monitoring, citizen involvement, environmental education, service learning, and ecopsychology. Of particular interest are the theoretical effects of the initiatives and empirical studies of these effects.

Chapter III: Methodology details the research methods used for this thesis. The research was directed toward three products: (1) an overview of The NatureMapping Program at the national and state levels, (2) a collection of six case studies of K-12 NatureMapping programs, and (3) consideration of the combined case study results. For the overview, The NatureMapping Program's Director was informally interviewed, NatureMapping Level 1 and Level 2 workshops were attended, the 2000 National NatureMapping Meeting was attended, and NatureMapping articles and websites were reviewed. The case study framework included interviews with students, teachers, and community members, observations of classes participating in NatureMapping activities, and a review of students' NatureMapping projects. The consideration of the combined case study results includes a statistical analysis of the differences between the NatureMapping and non-NatureMapping students using the two-sample t-test.

Chapter IV: Findings presents the overview of The NatureMapping Program at the national and state levels, the results of each individual case study, and the findings across the case studies. As part of the program overview, the material contained in Chapter II is applied. This yielded insights into the aspects of The NatureMapping Program that may be contributing to its effects and suggests directions for improvement. The descriptions of each case study demonstrate the diversity of projects and effects that can be sparked by The NatureMapping Program. The combining of case study results, especially the statistical analysis of the student interview responses, establishes the commonalties and suggests factors that contribute to the differences between the students who had participated in NatureMapping and those who had not. In addition, where the two student groups were similar, the results provide some insights into how Washington students think and feel about their communities, their natural environments, and their participation in community service and outdoor education activities.

Chapter V: Discussion wraps up the report with a summary of the study, a review of major conclusions, recommendations for the NatureMapping K-12 program at the school and state levels, and suggestions for further research. The appendices contain the letters of consent, the summarized teacher and community member interview responses, the student interview coding, the summarized student interview responses, and exhibits from several of the case study schools.

CHAPTER II

LITERATURE REVIEW

To place The NatureMapping Program in the context of expectations regarding its effects on students, their schools and their communities, I will briefly describe the supporting initiatives, their theoretical effects, and the empirical studies of the effects. The discussion in this chapter is organized under the headings of volunteer environmental monitoring, environmental service learning, and ecopsychology. The first two initiatives provided the inspiration for the Program.

Volunteer Environmental Monitoring

At its broadest level, NatureMapping is a form of volunteer environmental monitoring, an activity that is gaining popularity in the United States and abroad. In the realm of public policy and planning, volunteer environmental monitoring represents the nexus between environmental monitoring and citizen involvement. Environmental monitoring consists of observing and recording the existence and condition of natural resources such as water, air, wildlife, habitat, and land use. Once collected, this information can be used to make planning and public policy decisions or to advance scientific understanding. As competition for the use of natural resources and concern for their quality has increased, so has the need for environmental monitoring (Johnson et al. 1999 and NBS 1995).

The same concerns about natural resource use and conservation have led a movement toward better avenues for the public to get involved in making environmental decisions. Because natural resource issues are ubiquitous, highly complex, and controversial, their management may improve when all stakeholders, especially citizens, are at the table (Howell, Olsen, and Olsen 1987, and Daniels and Walker 1999). Because many citizens are concerned about, knowledgeable of, and available to address local issues, citizen involvement theory is often linked to political decentralization (Kemmis 1990). With the inclusion of small-scale economics and land management, the ideology becomes bioregionalism, a place-based approach to society that is offered as an antidote to the problems of industrialization (McGinnis 1999). Local cultures have evolved in response to their geographic settings, and therefore offer important sources of solutions to local environmental issues (Goble and Hirt 1999). Over the past decade, many organizations such as watershed councils have formed to take a participatory, place-based approach to environmental stewardship.

Many natural resource professionals are now realizing that their charge is too large and value-based for them to handle alone. At the same time, declining agency budgets make these needs even more difficult to handle in-house. It was this mismatch between agency need and capacity that pragmatically led to the creation of The NatureMapping Program (Dvornich, Tudor, and Grue 1995). By combining citizen involvement with intimate knowledge of the land gained through direct observation, volunteer environmental monitoring seeks to improve local stewardship of natural resources and create a stronger sense of place and community (MacGregor 1997 and Teles 1997).

Volunteer environmental monitoring has been practiced in the United States since the National Weather Service began the Cooperative Weather Observer Program in 1890. In 1900, volunteer wildlife monitoring began when the National Audubon Society initiated its annual Christmas Bird Count (EPA 1994). In the late 1960s, grassroots organizations started gathering water quality data for lakes and streams, and since that time, the size and scope of volunteer monitoring has increased tremendously (Lee 1994). A 1998 survey of volunteer monitoring organizations in the United States found 772 groups with a total of over 577,000 volunteers monitoring a wide variety of environments (EPA 1998).

During the 1990s, the trend in volunteer monitoring has been toward integrated assessments of entire watersheds or ecosystems and the linking of information to other organizations and activities such as restoration and public outreach (Lee 1994). The great majority of programs (85%) reported using their own data and more than half said that they provided data to local or regional entities (EPA 1998). In the past ten years, technological tools such as electronic databases, geographic information systems (GIS), and the Internet have greatly facilitated the growth of volunteer environmental monitoring. These tools have allowed grassroots organizations to easily consolidate, analyze, present, and share their data.

Within the well-connected network of volunteer monitors across the country, standard sampling protocols have been established, national conferences convened, and a semiannual national newsletter established. The volunteer environmental monitoring literature is replete with anecdotes of public health and environmental protection success stories. No empirical studies of the effects of environmental monitoring activities on the volunteer or student participants were found.

Environmental Service Learning

The 1998 national survey of volunteer environmental monitoring organizations found that 43% of the participants were students (EPA 1998). Indeed, many of the NatureMapping participants are K-12 students. In the realm of education, student environmental monitoring represents an activity within environmental service learning, the nexus between environmental education and service learning.

Schools and universities, nonprofit organizations, government agencies, and businesses practice environmental education. Motivated by the growing awareness of environmental problems and the role of individuals in environmental protection, environmental education seeks to provide citizens with the knowledge, skills, and motivation necessary to make environmentally responsible decisions (EPA 2000). Extending beyond the formal education system, environmental education is seen as a "life-long learning process" that applies to all members of society and takes many forms (EPA 1996).

The need for environmental education was underscored by the annual *National Report on Environmental Knowledge, Attitudes and Behaviors* released in 1997, a survey of 1,500 adults from across the United States. The report found that the American public lacked basic environmental knowledge (Motavalli 1999). Noss, O'Connell and Murphy (1997) write that although habitat destruction is the primary cause of species extinctions, the connection is not understood by much of the public. King (1995) found that children are keenly aware that environmental problems exist and they feel personally responsible to help the situation, but when asked about their role they

frequently replied that they could pick up trash. Whether a result of their age or the messages, the children related to the tangible, but not the pressing.

As an indication of the value placed on the approach, the United Nations convened the first Intergovernmental Conference on Environmental Education in 1977 (known as the Tbilisi Conference). The Tbilisi Conference Declaration stated:

> Education utilizing the findings of science and technology should play a leading role in creating an awareness and a better understanding of environmental problems. It must foster positive patterns of conduct towards the environment and the nations' use of their resources (no page number, UNESCO 1980).

In the United States, the National Environmental Education Act of 1990 directed the Environmental Protection Agency to administer various environmental education programs and activities (EPA 1996).

In 1999, 31 states (including Washington) required environmental education to be incorporated into their system-wide curricula and most schools in the United States addressed the environment in some way (Motavalli 1999 and Horton 1999). According to *The Class of 2000 Report*, 150 universities offered degrees in environmental science and another 400 offered related programs (Motavalli 1999).

The ability of environmental education to accomplish its goals as stated above is not well understood. Research seeking to identify the predictors of environmentally responsible behavior, including environmental education, are discussed in the next section on ecopsychology.

Environmental education lends itself to experiential education, especially outdoor education and service learning. Experiential education has been encouraged by theorists, most notably John Dewey (1938), and practiced to varying degrees for the past century. According to Carver (1997, quoted in Johnson and Notah 1999), the three major goals of experiential education are: "[1] allowing students to become more

effective change agents, [2] developing students' sense of belonging in the communities of which they are members, and [3] developing student competence (p. 143)."

In the early 1980s, the reports of five national commissions indicated the need to incorporate direct experience in education (Kraft and Kielsmeier 1986). Even so, at that time, very few empirical studies had been conducted to determine the effects of experiential education on students (Conrad and Hedin 1986). In response to this deficiency, Conrad and Hedin (1986) evaluated 27 experiential programs around the country. The study used a battery of pre-developed test instruments and questionnaires, and found that the programs did have a positive impact on the students' psychological, social, and intellectual development. In addition, the study discovered that no single practice or set of practices within the programs guaranteed effectiveness, but they did notice that the presence of a formal (at least weekly) seminar was the single strongest factor in explaining positive student change. It is interesting to note that in the Conrad and Hedin study, a service component within the program did not appear to make a difference. Ironically, in my search for recent empirical studies, I did not find any concerning experiential education, but I found several large studies of service learning programs.

Outdoor education is a form of experiential education and is often considered synonymous with it. According to Carlson (in Hammerman and Hammerman 1973):

> Outdoor education was first conceived [in the 1930s] as a means of acquainting children with the natural environment, enriching the school curricula, and teaching more effectively those outdoor-related subjects that were already part of the curricula. The movement was ahead of its time in its stress on those things best taught outdoors – the interrelationships of living things to each other and to the environment (p. vii).

As of 1973, very few empirical studies concerning the effects of outdoor education had been published in the periodic literature (Hammerman and Hammerman 1973). Of

particular interest to this thesis is a study of the effects of a five-day camping experience on 1,500 sixth grade students (Ashcroft 1957). Questionnaires completed by the students indicated that 93% of the students were “enthusiastic” about their camp experience and enjoyed “nature hikes” more than any other activity. The students also reported personal gains such as “learning how to take care of themselves” (94%) and social gains such as the class being “more friendly” following the camp experience (41%). In terms of environmental knowledge, 97% indicated “a new realization of the importance of good outdoor manners and practicing conservation” and 96% indicated that they “understood better the place and purpose of all creatures and plants have in the total scheme of life.” Forty-nine percent of the students reported that they might continue camp activities, such as nature study, as hobbies. Overall, these results indicate that the students had very positive attitudes about their outdoor education experiences at the camp.

In recent decades, outdoor education has strayed from its roots to become more adequately characterized as “adventure-based,” i.e., emphasizing wilderness survival and teamwork skills and organized outside traditional education channels. According to Bocarro and Richards (1998), the “literature on evaluation and research of adventure-based experiential learning programs has been fairly limited (p. 102).” Bocarro and Richards describe the existing literature on the effects of adventure-based programs as flawed for a variety of reasons such as having small sample populations, the over-reliance on self-selected samples, and the lack of comparison with control groups, appropriate measures and instruments, and longitudinal data. Thus, the current focus on adventure-based programs has not contributed much to an understanding of the effects of outdoor education as it was first defined in the 1930s.

Service learning is another form of experiential education. Service learning is defined by the National Center for Education Statistics as "curriculum-based community service that integrates classroom instruction with community service activities (NCES 1999).” Service learning differs from community service based on service learning’s educational purpose and support.

Proponents assert that service learning can foster civic responsibility and efficacy; improve intellectual, psychological, and social development; facilitate retention of academic material; provide a sense of purpose and importance; foster relationships with the community; and meet actual community needs (Waterman 1997). The 1990s saw a surge of interest in service learning and community service with the passage of the National and Community Service Act of 1990 and the National Service Trust Act of 1993, laws that provided funding to states for school-based service learning (Chapin 1998). A 1999 survey of public elementary, middle, and high schools across the United States found that 32% of all schools organized service learning as part of their curriculum, including nearly half of all high schools. One state, Maryland, had made service learning a graduation requirement beginning with the class of 1997 (Gardner 1997).

Most of the literature addressing the effects of service learning programs relies on anecdotal evidence. Scales (1999) describes the “gap between what [service learning] is done in schools and what research tells us about the impact of service learning is uncomfortably large (p. 40).” In their review of service learning articles and dissertations written in the 1980s and 1990s, Johnson and Notah (1999) only found a handful that described empirical studies. These studies focused on the affective effects on the students such as social and psychological development; attitude; sense of

isolation; personal, social, and civic responsibility; self-image; problem behaviors; commitment to school; and altruism. The most commonly used method in these studies was the administration of survey instruments (most of which were previously developed) to the students before and after the service experiences and to control groups. As summarized by Johnson and Notah (1999), the research results were "mixed regarding the noncognitive benefits of service" with significant gains in social and personal responsibility for students involved in service for an extended period of time being the most remarkable finding (from the dissertation research).

In the 1990s, several large, nation-wide studies of service learning were conducted. Niemi and Chapman (1998) reported on factors often associated with promoting citizenship among youth. Brandeis University conducted an evaluation of the national Learn and Serve America School and Community-Based Programs for the Corporation for National Service (Center for Human Resources 1999). Scales et al. (1999, referenced in Scales 1999) studied more than 1,000 sixth through eighth graders at three schools (in three states) to determine the effect of service learning.

The results of both studies were mixed and limited. The Scales et al. study found very few effects on the students from service learning. The researchers posed several explanations for this phenomenon: (1) an overriding influence of the wider school environment; (2) limited and variable support for service learning in practice; (3) the students' high levels of previous experience with service learning; (4) limited teacher preparation for service learning; (4) the focus of the teachers' educational goals (with academic achievement being the least important); (5) the small amounts of time students spent doing service learning; (6) insufficient integration of service learning

projects with the community and across the curriculum; and (7) few reflection exercises (Scales 1999).

Environmental service learning is the combination of environmental education and service learning. It is beginning to take on a life of its own as evidenced several new guides devoted to the topic (e.g., Tree Trust 1998 and Clifton, Mauney, and Falkner 1998). The proponents for environmental service learning cite the extraordinary "win-win" character of the activities that comes from meeting urgent environmental needs and educating the students in the process. Use of the environment as a learning tool has the added benefits of being readily accessible to schools and having the complexity to allow the integration of infinitely many topics and skills (Tree Trust 1998 and Lieberman and Hoody 1998). Lieberman and Hoody (1998) found in a nationwide study of 40 schools that "students learn more effectively within an environment-based context than within a traditional educational framework."

Ecopsychology

Volunteer environmental monitoring and environmental service learning provide avenues for people to develop closer relationships with nature, a feat made increasingly difficult by modern society. Consider some features of the stereotypical American lifestyle: climate-controlled house, manicured lawn, travel by automobile, work in an office (possibly a cubicle), children inside at day-care or school, imported and processed foods, and evenings watching national television. Within the past few generations, Americans have become radically out of touch – physically, mentally, and spiritually – with the natural world (Seidel 1998).

It is argued that humans have an innate affinity for nature – what E. O. Wilson (1984) terms "biophilia" – and desire relationships with nature that include the intimacy of primary experience and the reciprocity of stewardship. Recently, Kahn (1999) conducted five studies spanning three countries and found “deep commonalties in the development of the human relationship with nature (p. 192).” As with strong relationships between people, strong relationships between people and the land require direct experience and reciprocity. Thus, as a result of our detachment from nature, many of the joys, satisfactions, and curiosities that could be derived from direct experience with nature are not being realized. Instead, through the media and formal education efforts, most of what Americans know about the environment is that its decline has reached global proportions, a phenomenon in large part caused by the highly consumptive American lifestyle deficient in viable, environmentally-responsible alternatives. At the same time, we are told to buy more by commercials presenting products in pristine natural settings. We receive from nature but rarely give back to nature. The resulting feelings of grief, guilt, emptiness, impotence, and denial perpetuate psychologically and ecologically destructive behavior. People are anxious for the opportunity to connect with and serve their communities and natural environments, but they often do not have a way (Roszak 1995).

The burgeoning field of ecopsychology recognizes the importance of a close relationship between people and nature, and ecopsychologists offer theories and practices (therapies) focused on restoring this relationship. Similarly, “deep ecologists” arrive at the same directive from spiritual and philosophical perspectives. According to the theorists, a person with an appropriate relationship with the natural environment will

experience heightened well being, awareness, and drive to protect the environment (Roszak 1995).

Consideration of the psychological aspects of our relationship with nature is especially important when designing programs and settings for children. Because adults determine most of children's social and physical environments, they often make the mistake of not taking into account children's heightened sensitivities and development needs. For example, environmental education as it is typically practiced focuses on the severity of the world's problems and abstract concepts (Sobel 1996). The result may be what Sobel calls "ecophobia – a fear of ecological problems and the natural world (p. 5)." In turn, this may have an effect counter to the goals of environmental education; i.e., in an effort to keep their sanity, the students may turn away from the issues and not face them with hope and enthusiasm. Instead, Sobel advocates that environmental education should have a different tenor and style during each of the three stages of development as children form their relationships with nature:

> In early childhood, activities should center on enhancing the developmental tendency toward empathy with the natural world; in middle childhood, exploration should take precedence; and in early adolescence, social action should assume a more central role (p. 12).

During each of the stages, Sobel writes, "children desire immersion, solitude, and interaction in a close, knowable world," and we should therefore "engage children more deeply in knowing the flora, fauna, and character of their own local places." *Stories in the Land* describes eleven such place-based environmental education programs funded by The Orion Society (Orion Society 1998).

Besides understanding the mental health benefits of the human-nature relationship, the field of psychology can offer society strategies for fostering environmentally responsible behavior. Environmental attitudes and their influence on

behavior have been studied since 1970 with research targeting specific behavior areas such as litter control, energy conservation, and solid waste recycling. Other problem areas such as environmental pollution, water conservation, conservation of land and biological resources, and the human impacts on global environmental changes have not received much attention (McKenzie-Mohr and Oskamp 1995). Overall, the studies found that education efforts had the least impact on pro-environmental behavior (Sundstrom et al. 1996). This is an interesting finding, but it should be remembered that education can take on a wide range of forms and, overall, it has been changing, especially in recent years. Some researchers found that environmentally responsible behavior was significantly related to experiences in nature and active participation in environmental activities outside the classroom (Zelezny 1999). Chawla (1999) found in a recent study of 56 environmentalists that experiences in natural areas ranked first and formal school experiences ranked fourth or fifth in the number of mentions when the environmentalists were asked about significant experiences affecting their commitment to environmental action. Research into the predictors of environmentally responsible behavior is demonstrating the complexity of the topic, but it is also shedding light on the most effective forms of environmental education.

Review

The study's main purpose of determining the effects of The NatureMapping Program on the participating students was in response to the potential importance of such programs and the lack of empirical research into their effects. As discussed in this chapter, most accounts of the effects of programs fitting within the various initiatives are anecdotal. The studies that have been conducted typically focus on specific effects, use

narrow research instruments such as surveys, and have mixed results. Moreover, the studies have not typically addressed the complexity and diversity of the programs, issues that can strongly influence the effects. Thus, the products and methods of this thesis research took the approach of being broad, descriptive, and experiential, an approach that may be generally considered “naturalistic,” but at the same time retaining some options for quantitative analysis (Lincoln and Guba 1985). Determination of the effects of The NatureMapping Program on its student participants is of most interest to practitioners and scholars involved with any of the supporting initiatives and to those directly involved in The NatureMapping Program (e.g., program staff, teachers, school administrators, and funding sources). Once these audiences were identified, the thesis products and methods were further refined to be of maximum use to these audiences. The products and methods are discussed in the next chapter.

CHAPTER III

METHODOLOGY

The three products of this thesis are: (1) an overview of The NatureMapping Program and identification of the program elements potentially influencing the effects on the students, (2) six school case studies, and (3) an analysis of the case studies as a whole, particularly a statistical treatment of the student effects. These products not only present the effects of The NatureMapping Program, but also provide basic background information about the Program and its implementation at the school level.

The sources of information for the description of The NatureMapping Program and its elements were the Program's website, the academic literature, and informal communication with Karen Dvornich, the National Director of The NatureMapping Program. The NatureMapping Program's Level 1 and Level 2 workshops and the 2000 National NatureMapping Meeting were attended. The Level 1 workshop was a two-day introduction to The NatureMapping Program; the Level 2 workshop taught the development of projects incorporating the basic NatureMapping activities.

The research methods used for the case studies were structured, open-ended interviews with the students, teachers, and community members who had participated in the NatureMapping during the previous school year (1998-99), observations of students participating in NatureMapping activities (during Spring 2000), and reviews of the schools' NatureMapping projects (from 1998-2000). The multiple sources of information

allowed “triangulation” of the results, i.e., the comparison of different perspectives of a situation to strengthen the conclusions.

Arrangement of the Case Study Schools

This study focused on the effects of The NatureMapping Program under optimum conditions and a variety of settings. Thus, the case study schools were chosen based on the following criteria: Ms. Dvornich considered the school programs to be exceptional; the schools had been involved with NatureMapping for several years; the schools were located in different communities; and the schools represented a variety of grades.

Each case study involved three groups: (1) students and teachers at the school that was participating in The NatureMapping Program (the case study school), (2) students who participated in The NatureMapping Program at that school during the 1998-99 school year, and (3) students who have never participated in The NatureMapping Program and are otherwise identical to the students who did participate in NatureMapping.

Initial contacts were made to the case study schools by calling each teacher contact provided by Ms. Dvornich. Teacher involvement in the study meant that the teacher would be interviewed, allow a to visit their class during NatureMapping activities, and provide assistance in arranging student and community member interviews. Each teacher was receptive to participating in a case study. The teachers were also asked at what schools the students to be interviewed could be found. Whenever practicable, the control group students were chosen from the same school and grade as the NatureMapping students.

With the teacher's verbal interest in participating in the study, each administrator was contacted and mailed a packet containing the letter requesting school approval to participate in the study, example teacher, parent, and student consent forms, and the interview questions (for teachers, students, and community members). Appendix A contains examples of these letters and consent forms. The letters instructed the administrators to reply in writing giving their permission for the school to be involved in the study and to forward the teacher consent form to the contact teacher. If the administrators gave verbal approval, the administrators of the schools attended by the student populations from which the students would be picked for interviews were contacted. All schools and/or districts and teachers identified for the study agreed to participate.

Teacher and Community Member Interviews

The teachers directing the case study schools' NatureMapping programs were interviewed. The teacher interview questions were designed to gather information on each school's NatureMapping program and the teacher's impressions of their program's barriers and threats; effects on students, school, community, and own self; strengths of the Program; and weaknesses of the Program. The teachers were also asked to recommend ways in which The NatureMapping Program could be improved. Table 1 contains the teacher interview questions.

The teachers recommended community members for interview. Every community member recommended was "publicly available." The community member interview questions, shown in Table 2, paralleled the teacher interview questions.

TABLE 1. Teacher Interview Questions

Question Number	Question
1	Describe your school and the classes you teach.
2	Describe when, why, and how your school became involved with The NatureMapping Program. (What were your educational objectives?)
3	Describe your NatureMapping program. Please distinguish between this school year and last school year and include: 1. How do you interface with The NatureMapping Program? 2. What outside assistance or partnerships has your program had? Please suggest involved community members for me to interview. 3. How are students selected for the program? 4. What are the student characteristics (number, age)? 5. How do you prepare the students for NatureMapping? 6. Where, when and what do you monitor? 7. What have you added to the basic NatureMapping program? 8. Do your students formally reflect on their NatureMapping experiences? If so, how?
4	Has your NatureMapping program replaced other educational programs? If so, what?
5	Are there other outdoor education or community service activities that the students participate or have participated in?
6	Have there been any barriers or threats to your NatureMapping program? How have you dealt with them (or plan to deal with them)?
7	Have there been any assessments of your NatureMapping program? If so, what did they find with regard to effects on students? On the school? On the community? If not, what do you think the effects have been? (Did the your NatureMapping program meet your educational objectives?)
8	How has involvement with The NatureMapping Program affected you?
9	What do you think are the strengths of The NatureMapping Program? Weaknesses? How could The NatureMapping Program be improved?
10	What are your plans for future involvement with The NatureMapping Program?

TABLE 2. Community Member Interview Questions

Question Number	Question
1	Describe your involvement with The NatureMapping Program.
2	Have there been any barriers or threats to your involvement with The NatureMapping Program? How have you dealt with them (or plan to deal with them)?
3	What do you think the effects of The NatureMapping Program have been on the participating students? On the school? On the community? On you?
4	What do you think are the strengths of The NatureMapping Program? Weaknesses? How could NatureMapping be improved?
5	What are your plans for future involvement with The NatureMapping Program?

The teachers and community members were offered the option of confidentiality. Appendix A contains the teacher and community member consent forms. The teachers and community members were interviewed in person at their convenience. All teacher and community member interviews were audiotaped with their permission. The interview results were transcribed and coded to allow tabulation of similar remarks.

Student Interviews

Because this thesis research involved children from the ages of 9 to 18 and included the audiotaping of one-on-one interviews with the children, the University of Oregon required their Human Subjects Compliance Program to review the research protocol. Thus, the following research methods were developed with the assistance and approval of Human Subjects Compliance.

Two student groups were formed for interview purposes: the NatureMapping group and the non-NatureMapping group (i.e., the control group). The students selected for the NatureMapping group must have been involved in NatureMapping during the

1998-99 school year. The students selected for the non-NatureMapping group must never have been involved in NatureMapping. For each case study, ten students, five boys and five girls, were selected from each group (NatureMapping and non-NatureMapping). The schools' teachers and administrators were asked to choose the students at random from their respective populations (participant and control). An exception occurred at Hyla Middle School, the school providing the non-NatureMapping students for the Sakai Intermediate School case study. Hyla Middle School preferred that the students sign up for the interviews if interested.

The schools provided each selected student's parents or guardians with consent forms that were prepared. These forms are contained in Appendix A. The forms requested the parents or guardians to sign and return the forms to the schools if they agreed to allow their child to participate in the study. I guaranteed the students' confidentiality and offered the option of not allowing their child's interview to be audiotaped. All students whose parents approved their participation in the study and returned the signed consent forms to the school were interviewed. At the time of the interviews, the students were asked to sign an assent form (contained in Appendix A) if they had not already signed and returned the assent form provided in their parents' consent form packet.

The students were interviewed, individually and in person, at their schools. Before each interview began, the student was told the purpose of the study. For the students who had not participated in NatureMapping, a brief overview of the Program was given. Following this introduction, the material in the student assent forms was reviewed and each student was asked if he or she gave permission to audiotape the

interview. Only two students (out of 79) did not want their interviews taped. In those cases, notes were taken.

The NatureMapping and non-NatureMapping students were asked the same questions with slight modification when the questions addressed involvement with specific programs (Questions 8 through 12). The student interview questions were designed to (1) gather background information on the students (especially their involvement with community service and outdoor education activities); (2) ascertain the cognitive, affective, and behavioral effects of The NatureMapping Program on the students and the reasons for those effects; and (3) request student input on how The NatureMapping Program or similar programs could be improved. Table 3 contains the student interview questions.

On occasion, a student was not asked one or more of the interview questions. This occurred for three reasons. (1) Based on the student's responses, the interview may have been terminated by design. This happened twice when students said that they had not been involved in any outdoor education or community service activities. In those cases, the remaining questions (8 through 12) did not apply. (2) The question may have been fully addressed in a previous question. To ask a question that was fully answered previously would have been annoying to the student because it would appear that attention was not being paid to him or her or that the previous answer was not correct. (3) A question may have been accidentally skipped.

Each student interview audiotape was transcribed. Responses for each student were coded using the methods described in Appendix B. The results for the NatureMapping and non-NatureMapping student groups were compared with the use of a two-sample t significance test, as statistical tool to determine the confidence level that

two populations are different. The two-sample t significance test was very appropriate for use in this study because the total number of students interviewed was high (close to 80), and the sample student groups (NatureMapping and non-NatureMapping) were roughly the same size (37 and 42, respectively) (Moore and McCabe, 1999).

TABLE 3. Student Interview Questions

Question Number	Question
0	How old are you? What grade are you in? How long have you lived in this community? Where did you live before moving here?
1	What can you tell me about this community?
2	What can you tell me about its [this community's] natural environment?
3	What condition is this community's natural environment in?
4	How can the good things about this community and its natural environment be maintained or improved?
5	What is your role in doing these things [to help or maintain the good things about this community and its natural environment]?
6	Do you do any of these things [to help or maintain the good things about this community and its natural environment] now? If so, what?
7	Have you been involved in any outdoor education or community service activities? If so, what? If not, end interview. If so, what did you do?
8	What did you learn from NatureMapping [or other outdoor education/community service activities]?
9	How did participation in NatureMapping [or other outdoor education/community service activities] make you feel?
10	Has participation in NatureMapping [or other outdoor education/community service activities] had any other effects on you? If so, explain.
11	Is NatureMapping [or other outdoor education/community service activities] important? Explain.
12	How can NatureMapping [or other outdoor education/community service activities] be improved?

Limitations of this Study

The study relied on self-reported data regarding environmentally and socially responsible behavior, experience with community service and outdoor education, and the effects of those experiences. The self-reported data was not confirmed through record reviews, testing, or direct observation.

The study did not determine who would participate in The NatureMapping Program. I.e., students were not randomly assigned to The NatureMapping Program. This design feature leads to several study limitations. Students who participated in NatureMapping were linked to particular teachers and classes. These teachers and classes tend to provide other outstanding instruction and outdoor education/community service activities as well. Likewise, the research was constrained by the difficulty in constructing a control group identical in all respects except for the participation in NatureMapping. NatureMapping within a school usually included all students taking a given class. For example, if NatureMapping were taught as part of a biology class, all biology students in the school would be involved in NatureMapping. Since students who choose to take biology may have a sympathetic leaning toward environmental issues, fieldwork, and/or science, they are biased from the control group students based on this initial self-selection.

An inherent and potentially influential factor in interpreting the results of the student interviews is that the NatureMapping students better understand the focus of the study (and the reason for the interviews) and thus may consciously or unconsciously narrow the scope of their responses. This factor was addressed in the study design by my describing The NatureMapping Program to all the students that had not participated

in NatureMapping before beginning each interview, but this concern cannot be completely dismissed.

The main limitations of this study may be summarized as falling into two areas: self-reported information and inherent biases. These limitations should be kept in mind when interpreting and using the findings and results of this study as discussed in the next chapter.

CHAPTER IV

FINDINGS AND RESULTS

Overview of The NatureMapping Program

The NatureMapping Program originated from the data needs of the Washington Gap Analysis Project (WAGAP). WAGAP began in 1991 and is administered and conducted by the Washington Cooperative Fish and Wildlife Research Unit housed at the University of Washington in Seattle. WAGAP is a state-level application of the national Gap Analysis Program. In 1987, the nation began an effort to identify gaps in biodiversity protection. Gap Analysis uses Geographic Information Systems (GIS) to map vegetation and species distribution and land ownership in order to identify areas that should be set aside for nature preservation. The Gap Analysis process determines vegetation from satellite imagery and predicts species distributions based on species range maps and knowledge of species habitat affiliation (Scott et al., 1993). Since species range maps were often incomplete and outdated, and the vegetation designations needed verification on the ground, WAGAP required additional data gathering.

Although WAGAP combined the resources of local, state, and federal natural resource agencies, non-profit organizations, corporations, and Indian nations, the data needs were larger than they could provide. As a result, the Washington Gap Analysis Outreach Program was created to bring in retired natural resource professionals to ground-truth the land-cover maps. The program quickly expanded to include public

observations of reptiles and amphibians and bird counts by National Audubon Society members in areas that had not been previously sampled (Dvornich, Tudor and Grue, 1995).

In 1990, Washington State mandated environmental education for all K-12 students from kindergarten through twelfth grade. At the same time, curriculum restructuring encouraged teachers to provide interdisciplinary, real-world experience. In response to these educational needs, the Washington Department of Fish and Wildlife (WDFW) developed programs for students and teachers to explore nature within their communities. The WDFW identified areas of uncertainty in wildlife understanding and provided schools the opportunity to address the questions. In 1993, Karen Dvornich, the WAGAP Assistant with the Washington Cooperative Fish and Wildlife Research Unit, in partnership with Margaret Tudor, the WDFW Program Manager for Environmental and Wildlife Education, asked students to collect information to assess the statewide biological database. Within 18 months, the pilot project included 320 teachers, it received a RENEW America National Award on Environmental Sustainability, and interest from other states prompted the creation of a national program. The program's name, S.A.V.E (Student And Volunteer Education Program), was changed to NatureMapping in 1995 (Dvornich, Tudor and Grue, 1995).

According to Dvornich, who serves as the Director for both the national and Washington NatureMapping programs, The NatureMapping Program serves four customer groups: individuals, schools, community groups and researchers. Individuals want to make a difference in environmental protection. Schools want to involve their students in the collection of real data that teaches about the environment. Community groups enjoy the structure and training afforded them by being a part of NatureMapping.

Researchers appreciate the increased amount of data and the opportunity to submit personal field notes.

In an interview included in Chase Middle School's *Glenrose Watershed Gazette*, Karen Dvornich replied to "Why do you think Nature Mapping is important?" with:

> (1) We are involving all of the public to learn about biodiversity because we depend on it to survive. (2) Scientists do not have enough data, time or funding to collect all the data alone especially since we are modifying habitats as quickly as we are. (3) Students should be given a chance to have a say in their future and through Nature Mapping we give you a chance to be involved (p. 5, Chase Middle School, 1999).

By 2000, Washington NatureMapping participants reported 160,000 observations of at least 415 species (Ely, 2000, and USGS, 1999). "Keeping common species common" is a NatureMapping slogan that attests to the importance of all species. NatureMapping provides data on species that agencies and scientists don't usually track (Ely, 2000). The participants tracked mammal, amphibian, reptile, fish, invertebrate, and plant species in their backyards, around their schools, in other areas of town, on public land and other private land. Many participant groups combine related community activities with NatureMapping.

At present, the WAGAP has completed the terrestrial maps and is now focusing on an inventory of aquatic systems. The NatureMapping Program observations go into a perpetual database for monitoring purposes. The resulting maps are shown on the NatureMapping website and are available to those who request them. Dvornich also tries to provide participants with a compilation of their observations in database and GIS formats. She said that this feedback is very meaningful to participants and that this is an area of the program she would like to expand.

The creation and success of The NatureMapping Program in Washington provided a ready and reliable solution to the other states' needs. As other states

embarked on their surveys, they discovered the same data needs and resource restrictions as those encountered by Washington. (Washington was ahead of most states in performing their statewide Gap Analysis Project.) The states also recognized the social benefits of involving citizens and students in environmental monitoring. At this time, programs based on NatureMapping have been started in Norway, British Columbia, Idaho, Iowa, and Virginia and thirteen other states are interested (Ely, 2000).

The organizational approach of The NatureMapping Program is to provide national support yet allow each state to form their own entity. NatureMapping holds frequent leader (e.g., teacher) and participant workshops in Washington and an annual national conference (held in Virginia in 2000). The NatureMapping Program workshops are offered at three levels: Level 1 is an introduction to observing wildlife and geography, Level 2 focuses on project design, and Level 3 covers the use of technology. The NatureMapping Program has an extensive website (http://www.fish.washington.edu/naturemapping/) that operates as a guide and showcase. The NatureMapping Program has also created a CD-ROM that educates NatureMapping participants on wildlife and data recording procedures.

To comprehend the possible contributions to the impact of The NatureMapping Program on grade school students, their schools, and their communities, the elements are identified below. This thesis does not try to evaluate the contribution of each of the elements, but a consideration of the potential effects may provide a theoretical basis in concert with the research findings. Or, findings opposite those predicted by the theory may call into question the assumptions and beg further inspection. Programs that differ from the NatureMapping Program in any of the elements may have an entirely different result.

Elements of the NatureMapping K-12 Program

When schools participate in The NatureMapping Program, their activities involve many elements. At its most basic level, NatureMapping includes the outdoors, monitoring, wildlife, the environment, place, service, education, experience, and community. More advanced NatureMapping can include projects, curriculum integration, and teamwork. In varying combinations, these elements are key features of major planning/public policy and educational initiatives. The relationship between the initiatives and The NatureMapping Program begins with the following observation: The NatureMapping Program resides in the nexus between volunteer environmental monitoring and environmental service learning. Projecting one level higher encompasses the initiatives of environmental monitoring, citizen involvement, environmental education, and service learning. The NatureMapping Program also fits within experiential education, outdoor education, and place-based study initiatives. The links to the initiatives suggest the possible effects that the Program's elements may have on the participants, their schools, and their communities.

Based on the theories supporting the initiatives (and to a lesser degree, empirical research), The NatureMapping Program may affect student participants' knowledge, skills, attitudes, and behaviors. NatureMapping should increase students' knowledge of their local environment, especially with respect to wildlife. With teacher or community member support, the students should gain better awareness and understanding of ecological principles (e.g., diversity, interconnectedness, dynamics, and hierarchies), human impacts (e.g., development, introduction of non-native species, and land management), and community decision-making processes, agencies, and programs

(e.g., planning and community organizing). NatureMapping should increase students' skills such as observation, species identification, data recording, and spatial conceptualization. If NatureMapping is incorporated into a project, the skills learned may include scientific reasoning, data analysis (e.g., use of spreadsheets, charts, graphs, and maps), communication (e.g., writing, drawing, and speaking), and interpersonal relations. NatureMapping may increase students' appreciation and respect for wildlife and nature, foster a sense of place and community, heighten concern for the condition of the natural environment, instill an environmental ethic, improve their attitudes toward school, and strengthen feelings of efficacy, hope, and well-being. In response to the knowledge, skills, and attitudes gained through NatureMapping, the students may become more engaged in school, the environment, and the community. Students may work harder at school, develop new hobbies and interests, and act on their environmental and social concerns. Overall, NatureMapping should contribute to students' personal and social developments.

The relationship between the NatureMapping K-12 program and the organized initiatives described above is illustrated in Figure 1. The elements of the initiatives and their presence in The NatureMapping Program are presented in Table 4.

Many of the potential effects of The NatureMapping Program rely on the details of the Program's implementation at the schools. From school to school, the NatureMapping activities and educational and community support can vary widely. For these reasons, this thesis conducted case studies of six schools' involvement with NatureMapping. The characteristics of the six schools' NatureMapping programs are described next.

FIGURE 1. Relationships between the NatureMapping (NM) K-12 Program and Planning and Public Policy and Education Initiatives

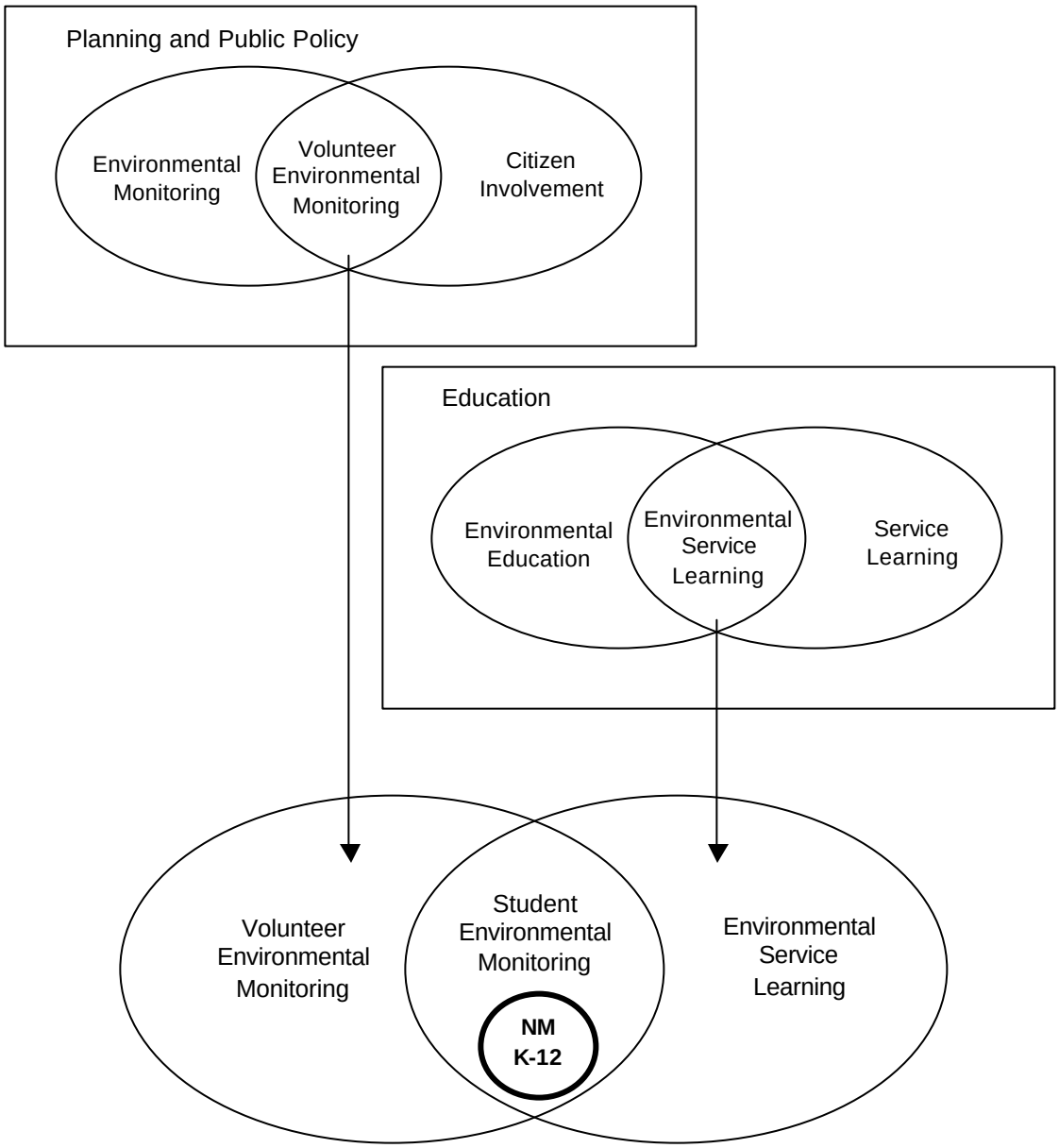


TABLE 4. Program Elements Associated with Initiatives

Initiative	Program Element								
	Community	Education	Experience	Environment	Outdoors	Service	Place	Monitoring	Wildlife
Citizen Involvement and Community Service	X		X			X			
Experiential Education		X	X						
Environmental Education		X		X					
Outdoor Education		X	X	X	X				
Service Learning	X	X				X			
Environmental Service Learning		X		X		X			
Place-based Study	X	X	X	X			X		
Environmental Monitoring			X	X	X	X	X	X	
Volunteer Environmental Monitoring	X		X	X	X	X	X	X	
Student Environmental Monitoring	X	X	X	X	X	X	X	X	
NatureMapping K-12	X	X	X	X	X	X	X	X	X

Overview of the Case Studies

Six schools that have and are participating in The NatureMapping Program were chosen for case study from across Washington using the criteria discussed in the previous chapter on methodology. These schools were: (1) Waterville Elementary School in Waterville, (2) Sakai Intermediate School in Bainbridge Island, (3) Orchard Prairie School in Spokane, (4) Chase Middle School in Spokane, (5) Evergreen High School in Vancouver, and (6) North Mason High School in Belfair. Waterville is a small

town in Central Washington near Wenatchee, Bainbridge Island is a suburb of Seattle in the Puget Sound, Spokane is a large metropolitan area in Eastern Washington, Vancouver is in Southwestern Washington along the Columbia River north of Portland, Oregon, and Belfair is a small community on the eastern side of the Olympic Peninsula. The schools ranged in size from enrollment of 70 at Orchard Prairie School to 2,300 at Evergreen High School. Participation in The NatureMapping Program ranged from 4 years for Orchard Prairie School to 7 years for Sakai Intermediate School, Evergreen High School, and North Mason High School. Table 5 summarizes this information about each case study school. The teachers and community members interviewed and activities observed are shown in Table 6.

Following the selection of the case study schools, the schools attended by the students to be interviewed were identified. For three of the case studies, these schools were one and the same. For two of the case studies (Sakai Intermediate School and Chase Middle School), the students who had participated in NatureMapping at the case study school during the 1998-99 school year had graduated into a different school (Woodward Middle School and Ferris High School, respectively).

Whenever practicable, the control group students were chosen from the same school and grade as the students who had participated in NatureMapping. For two of the case studies (Sakai Intermediate School and Orchard Prairie School), this was not possible because nearly all the students at these schools had been involved in NatureMapping during the 1998-99 school year. For the Sakai Intermediate School, non-NatureMapping students were selected from Hyla Middle School, a small, private school in the same community as Sakai Intermediate School. For Chase Middle School, non-NatureMapping students were selected from Chase Middle School because both

Orchard Prairie School and Chase Middle School are located in Spokane's urban fringe and contact with Chase Middle School as a case study had already been established. The communities and schools involved in each of the three groups are listed in Table 7.

TABLE 5. Case Study School Characteristics, 1999-2000 School Year

Case Study School	Community (in Washington)	Grades at School	Number of Students at School	Number of Years Participating in NatureMapping	Approximate Number of Students Participating in NatureMapping
Waterville Elementary School	Waterville	1-6	150	6	50
Sakai Intermediate School*	Bainbridge Island	5-6	600	7	300
Orchard Prairie School	Spokane	K-7	70	4	50
Chase Middle School	Spokane	7-8	940	5	130
Evergreen High School**	Vancouver	9-12	2,300	7	40
North Mason High School	Belfair	9-12	800	7	30

*Sakai Intermediate School, grades 5 and 6, opened for the 1999-2000 school year. During the 1998-99 school year, sixth grade students on Bainbridge Island attended Woodward Middle School.

**Many students who had attended Evergreen High School during the 1998-99 school year now attend the new Heritage High School.

TABLE 6. Teachers and Community Members Interviewed and NatureMapping Activity Observed for Each Case Study

Case Study	Teachers Interviewed	Community Members Interviewed	NatureMapping Activity Observed
Waterville Elementary School	Diane Peterson Cathi Nelson*	4 farmers involved with the students' study	Meeting with students (grades 2, 4 & 5) and farmers to update and continue short-horned lizard study; joined by Karen Dvornich
Sakai Intermediate School	Tom Leigh	Connie Waddington (Bainbridge Island Land Trust) Libby Hudson (City of Bainbridge Island)	Field trip with 1/3 of sixth grade class to sites across the island
Orchard Prairie School	Edward McCarthy	Jan Reynolds (naturalist and artist)	Field trip with grades 1-7 to wildlife refuge; joined by high school students
Chase Middle School	Heather Cassidy Diane Gibson	Anonymous	Preparation of watershed newspaper by eighth grade science class
Evergreen High School	John Akers Kristy Harger	none	Students in Field Ecology class introduced to NatureMapping
North Mason High School	Karen Lippy	Dan Hannafious (Hood Canal Salmon Enhancement Group and NatureMapping Program)	Group work on class projects at the Environmental Learning Center (NatureMapping not a part)

*Cathi Nelson was informally (non-structured) interviewed and no audiotape or notes were taken.

TABLE 7. Schools Involved in Case Studies

Case Study	School Participating in NatureMapping	Interviewed Students Current School (NatureMapped)	Interviewed Students Current School (Not NatureMapped)
1	Waterville Elementary School	Waterville Elementary School	Waterville Elementary School
2	Sakai Intermediate School*	Woodward Middle School	Hyla Middle School
3	Orchard Prairie School	Orchard Prairie School	Chase Middle School
4	Chase Middle School	Ferris High School	Ferris High School
5	Evergreen High School	Evergreen High School	Evergreen High School
6	North Mason High School	North Mason High School	North Mason High School

*Sakai Intermediate School, grades 5 and 6, opened for the 1999-2000 school year. During the 1998-99 school year, sixth grade students in this community attended Woodward Middle School.

Tables 8 through 10 list the number of students interviewed for each case study, their gender and status regarding participation in NatureMapping, their grades, and their median ages and length of residence in their current community.

TABLE 8. Grades of Students Participating in NatureMapping and of Students Interviewed for Each Case Study

Case Study	Grades Participating in NatureMapping in 1998-99 School Year	Grades Interviewed (Nature-Mapped)	Grades Interviewed (Not Nature-Mapped)
Waterville Elementary School	4	5	4-5
Sakai Intermediate School	6	7	7
Orchard Prairie School	K-7	6-7	7
Chase Middle School	8	9	9
Evergreen High School	10-12	11-12	11-12
North Mason High School	10-12	10-12	11-12

TABLE 9. Number and Gender of Students Interviewed for Each Case Study

	Participated in NatureMapping		Did Not Participate in NatureMapping		
Case Study	Boys	Girls	Boys	Girls	Total Interviewed
Waterville Elementary School	3	7	3	3	16
Sakai Intermediate School	2	5	3	3	13
Orchard Prairie School	2	3	0	6	11
Chase Middle School	2	3	4	4	13
Evergreen High School	3	4	3	3	13
North Mason High School	1	2	6	4	13
Grand Total	13	24	19	23	79

TABLE 10. Median Age and Median Length of Residence in Community of Students Interviewed for Each Case Study

Case Study	Participated in NatureMapping		Did Not Participate in NatureMapping	
	Median Age of Student	Median Length of Residence (Years)	Median Age of Student	Median Length of Residence (Years)
Waterville Elementary School	10	5.5	10.5	7
Sakai Intermediate School	13	6	13	8.5
Orchard Prairie School	13	9	13	11.5
Chase Middle School	15	15	15	13
Evergreen High School	17	7	17	12
North Mason High School	17	15	18	12
Across all case studies	13	7	15	11

Waterville Elementary School Case Study

Waterville Elementary School is located in the small town of Waterville (population approximately 900) in central Washington's wheat farming country. Diane Peterson and Cathi Nelson first brought outdoor education to Waterville Elementary School in 1993. They were teaching science to grades 4 through 6 and wanted to show them the ecology of Douglas Creek, a small creek in a canyon about 6 miles southeast of Waterville. When the teachers learned of The NatureMapping Program, they incorporated NatureMapping activities into their frequent visits (12 per year) to Douglas Creek. In subsequent years, NatureMapping observations from their classroom windows and from the students' homes were added.

Ms. Nelson was transferred to teach second grade, so Ms. Peterson continued their NatureMapping Program on her own. Ms. Peterson found that trying to look at all species while NatureMapping was too much for her students, so she and Karen Dvornich came up with the idea of conducting a short-horned lizard study instead. The short-horned lizard is known locally as a “horny toad.” Ms. Dvornich noticed that the students knew quite a bit about the lizards, whereas the scientific community had little data on them. Since short-horned lizards are sometimes difficult to find, this posed a barrier to NatureMapping for the lizards. Ms. Peterson considered who would see the most short-horned lizards and thought of the area’s wheat farmers. She knew that they sometimes saw the lizards from their tractors, so she decided to recruit farmers to be involved in the students’ study.

Ms. Peterson’s fourth grade class began their short-horned lizard study in the spring of 1999. A letter was written by the students and sent to enough farmers for each student to be paired with a farmer. The farmers were invited to join the study and attend a kick-off meeting at the school. Over 20 farmers attended that first meeting where they met the students and were given the data collection forms to be used for short-horned lizard sightings over the summer. The students were also instructed to look for short-horned lizards during their summer break, and if they were found, to measure and photograph them (with a disposable camera given to them by the school). In the fall of 1999, the students (now in fifth grade, but still with Ms. Peterson since she had a combined fourth and fifth grade class) invited the farmers back to the school to share their data. The farmers and students placed dots on a map indicating where the farmer had seen short-horned lizards and how many had been seen. No student brought back

their own short-horned lizard data, but Ms. Peterson said that when the farmers returned with their data, the study “got real” for the students at that time.

During the 1999-2000 school year, Ms. Peterson’s students added to their short-horned lizard study by holding a few lizards held in captivity in the classroom. The students investigated aspects of the lizards’ behaviors. Ms. Nelson’s second grade students joined in the study by investigating the lizards’ food preferences. The students analyzed their in-class study data and the farmers’ data with charts and posted these on their website. Portions of the website are provided in Appendix E. In early 2000, Ms. Dvornich arranged for several students to travel to Idaho with their parents (one of whom was a participating “farmer”) to present their short-horned lizard study findings at a herpetology society meeting. In June 2000, the students invited the farmers back to their classroom to hear an update of their study and to start the farmers on the second summer of data collection.

Ms. Peterson said that her main educational objective with The NatureMapping Program was to involve her students in “real science.” She said that NatureMapping “fits all the science benchmarks.” Ms. Peterson also said that the NatureMapping project gave the students a reason to use math and writing skills. Ms. Peterson pointed out that through the short-horned lizard study, the students demonstrated their understanding of the scientific process, and she has seen them begin to think like scientists and ask more questions. Ms. Peterson said the students also learned how to use computer software to summarize and present data.

Ten Waterville students who had been involved in NatureMapping during the 1998-99 school year were interviewed for this study. The interview questions were almost too advanced for several of the students. Overall, the students thought that they

learned a lot about “horny toads,” mainly through their study of them in the classroom. The students also expressed that they saw themselves as contributing to scientific understanding. For example, one student said, “there is lots of stuff that I could do about getting some of the research because we have a really big field in our backyard with a bunch of holes.” Most of the students said that they felt good being a part of something important. When asked why they thought NatureMapping was important, the responses ranged from giving the students something to do over the summer to keep them out of trouble, to wildlife conservation, to discovering the benefits of wildlife. The student suggestions for improving NatureMapping (i.e., the short-horned lizard study) were even more varied and included the following ideas: meet over the summer, feed the lizards different food, leave the lizards in the wild, map more species, make sure the farmers come to the meetings, and breed the lizards.

Sakai Intermediate School Case Study

Sakai Intermediate School is located on Bainbridge Island, a suburb of Seattle in the Puget Sound. Sakai Intermediate School is the only public school serving the fifth and sixth grade students on the Island and has an enrollment of about 600. Sakai Intermediate School opened at the beginning of the 1999-2000 school year. Before Sakai Intermediate School was built, the sixth grade students on Bainbridge Island attended neighboring Woodward Middle School.

Then Woodward Middle School sixth grade social studies and language arts teacher Tom Leigh, now at Sakai, introduced his students to The NatureMapping Program in about 1994. Mr. Leigh saw NatureMapping as a good match for his Exploratory period, a “catch all” class that included curriculum on environmental

education and in later years “contemporary issues.” Mr. Leigh said that he was attracted to The NatureMapping Program because it “made study relevant to the community” and had an element of “outreach” with other agencies.

Mr. Leigh described the first few years that they did NatureMapping as “very crude,” not taking much time to implement. The students mainly did their observations in their own backyards. He said that they used the data collection forms, but they “really didn’t know what they were doing,” that they “didn’t know what to do with the data.” But with persistence and the help of community members, especially Connie Waddington with the Bainbridge Island Land Trust, the school added to their NatureMapping program each year. During the last few years, in addition to the backyard observations, the students took field trips to locations along the island’s designated wildlife corridors. The students learned about the purpose and placement of the wildlife corridors through in-class presentations by Libby Hudson, a planner for the City of Bainbridge Island. For the 1999-2000 school year, eleven teachers and 300 sixth grade students at Sakai Intermediate School participated in NatureMapping. Mr. Leigh said that the school’s NatureMapping program was getting to the point where their “data is starting to mean something.”

Seven Woodward students who had been involved in NatureMapping during the 1998-99 school year were interviewed for this study. The students said that they learned much about the local nature of the island, especially birds. Several students remarked that they didn’t realize the nature on the island was so diverse and abundant. In the words of one student, “living here you just walk around, you don’t realize that there are all these different kinds of things…until you acknowledge it.” In general, the students found NatureMapping to be fun and interesting. The students thought that

NatureMapping was important mainly for what it taught the participants about local nature, especially so that people can know the status of wildlife populations. When asked how NatureMapping can be improved, most students suggested a modification of the field trips, e.g., going to different sites, forming smaller groups, or going out more often. One student thought that the teachers should place more emphasis on the service aspects and lessons of NatureMapping.

Orchard Prairie School Case Study

The Orchard Prairie School, grades K through 7, is located in the northern, rural outskirts of Spokane, a metropolitan area with about 400,000 people. Orchard Prairie School celebrated their centennial anniversary several years ago and has maintained its "one room schoolhouse" atmosphere. In the 1999-2000 school year, approximately 70 students attended the school.

Orchard Prairie School teacher Edward McCarthy brought NatureMapping to the school in 1997. Mr. McCarthy currently teaches reading to grades 3 and 4, and math and science to grade 7. Until the 1999-2000 school year, students were selected for NatureMapping based on their interest and dependability, and grades ranged from kindergarten to seventh. The Orchard Prairie NatureMapping activities consisted of several group outings in the fall and spring. The School used four study areas: the school's wildlife refuge, Sullivan Pond, a private nature sanctuary, and the Little Spokane River. The school's wildlife refuge was created by Orchard Prairie students a couple of years ago and is located across the street from the school. The other study sites were also in the area. During the 1999-2000 school year, the school took all the

students in grades 1 through 7 on one NatureMapping field trip in the spring to the Turnbull National Wildlife Refuge where they joined a high school biology class.

Because Mr. McCarthy teaches the same students over several years, he has chosen a different project involving NatureMapping each year. In the spring of 1998, the students traveled to the first national NatureMapping meeting and presented a biodiversity skit highlighting the students' NatureMapping experiences. During the 1998-99 school year, the students wrote a book, *Little River Boy*, about the adventures of a toy floating down the Little Spokane River and discovering the different habitats along the way (Orchard Prairie School 1999). For the 1999-2000 school year, the students submitted comments to be considered in the Environmental Impact Statement for a road realignment project planned for their area. The students included several years worth of the NatureMapping data that they had gathered for the sites potentially impacted by the road realignment and conducted a survey of area residents' attitudes toward the road realignment. The students concluded their project with the creation of several, one of which showed the potential effects of the road realignment alternatives. A portion of this poster is shown in Appendix E.

Several resource people provided expertise to the Orchard Prairie School NatureMapping program: Jan Reynolds, Easy, and Tracy Grover. Ms. Reynolds, a local naturalist and artist, spent many hours in the classroom and in the field teaching the students how to identify wildlife. Easy is very involved in community-based nature work (such as the Little Spokane Watershed) and helped Mr. McCarthy develop projects for grant proposals and learn to use geographic information systems (GIS) software. Tracy Grover is a GIS expert at Washington State University in Spokane and also assisted the school's use of technology.

Five Orchard Prairie students who had been involved in NatureMapping during the 1998-99 school year were interviewed for this study. The students said that through NatureMapping they mainly learned how to identify birds, but that they also discovered that “there is a lot of natural environment [in their area] that is not anywhere else on the prairie” and “how important it is to have the wildlife around.” Most of the students stated that NatureMapping had made them want to spend more time in nature and/or be more involved in its protection. When asked why they thought NatureMapping was important, they made the direct connection between NatureMapping and species protection. As one student said, “if we don’t recognize the birds, maybe they will die away and never come back.” As far as ideas for improvement, the Orchard Prairie students wanted to spend more time NatureMapping and suggested that more people get involved. One student said that if more people did NatureMapping, “they’d be aware of what’s going on and not be so careless about what they do.”

Chase Middle School Case Study

Chase Middle School, grades 7 and 8, is located in the southern, rural outskirts of Spokane. About 940 students are enrolled. Science teacher Heather Cassidy first brought NatureMapping to Chase Middle School in 1995, and was later joined by science teacher Diane Gibson. Ms. Cassidy saw NatureMapping not only as outdoor education, but also as opportunity for her students to work with “real researchers,” gathering data that would be useful to others and the community. Ms. Gibson was attracted to The NatureMapping Program because she saw it as a way to “spark more of the desire to learn on the kids part” and to “get [the students] more connected with their local environment.” Ms. Gibson also felt that The NatureMapping Program provided a

vehicle to cover the required curriculum and meet the state's essential learnings in life science.

To conduct their NatureMapping observations, the students made weekly class visits to several monitoring sites established on the school grounds. In 1998-99, the NatureMapping sites were expanded beyond the school grounds to include a Department of Natural Resources (DNR) property and a nearby pond. The students were also given the opportunity to meet at school before classes started to NatureMap for extra credit. The visits occurred over a six-week period in spring.

Beginning in the 1997-98 school year, Ms. Cassidy and Ms. Gibson received a technology grant through their school district. The grant was awarded to the teachers for the purchase of computers to be used for their work with NatureMapping. That year, the students produced the first *Glenrose Watershed Gazette*, a newspaper describing the students' NatureMapping activities and related research. The newspapers were delivered to all 2,000 residences in the Glenrose watershed, the small watershed in which Chase Middle School is located. Publication of the newspaper has become an annual project, although only Ms. Cassidy's class was involved in NatureMapping and the newspaper during the 1999-2000 school year. The newspaper included articles, artwork, photographs, charts, graphs, and maps.

To produce the newspaper, the students learned various computer software programs. Ms. Cassidy thought that based on what the students wrote in the newspaper, they had a better understanding of the concepts through NatureMapping. In general, Ms. Cassidy found that production of the newspaper led students to work harder. Portions of the Spring 1999 issue of the *Glenrose Watershed Gazette* are contained in Appendix E.

According to Ms. Cassidy, the newspaper strengthened ties between the residents of the Glenrose area and the school and students. Ms. Cassidy and Ms. Gibson both reported hearing from community members that they liked the *Glenrose Watershed Gazette* and that it gave them a better image of the school and students. Although the teachers were not aware of any direct use of the NatureMapping data by the community, the Inland Northwest Land Trust approached Ms. Cassidy in July 2000 to express their interest in using the students' data.

Several resource people provided expertise to the Chase Middle School NatureMapping program: Jan Reynolds, Easy, Tracy Grover and Karen Dvornich. Ms. Reynolds, a local naturalist and artist, and spent hours in the classroom and in the field teaching the students how to identify wildlife. Easy is very involved in community-based nature work (such as the Little Spokane Watershed) and helped Chase Middle School start their NatureMapping program, especially with regard to the use of technology. Tracy Grover is a geographic information systems (GIS) expert at Washington State University in Spokane and has given several GIS workshops to the Chase teachers and students. Ms. Dvornich occasionally visited the school to give presentations on the use of technology and the importance of gathering the wildlife data.

Five Ferris High School students who had been involved in NatureMapping at Chase Middle School during the 1998-99 school year were interviewed for this study. Each of the students said that the main thing they learned from NatureMapping was how to identify birds. The students expressed some feelings that their NatureMapping experience was work, but they generally enjoyed going outside and seeing the wildlife. Several students remarked that NatureMapping helped them and others become more aware of what is in nature, thus leading to new discoveries and more concern over what

may be lost if habitats are not protected. One student said that NatureMapping was important because “one person can’t keep track of all the species of birds.” When asked how NatureMapping can be improved, most of the students suggested more community outreach to recruit participants and to share results. Two of the students wanted to study more aspects of the natural environment during their NatureMapping outings.

Evergreen High School Case Study

Evergreen High School is located in the rapidly developing southeast area of Vancouver, Washington. Approximately 2,300 students, grades 9 through 12, are enrolled at the school. At the beginning of the 1999-2000 school year, about half of the students who were attending Evergreen High School were transferred to the new Heritage High School.

NatureMapping has been a part of Evergreen High School’s Field Ecology & Natural Resources class since the 1994-95 school year. John Akers, a science teacher at Evergreen High School and the school district’s environmental education coordinator, created the class, which is primarily offered to juniors and seniors, and incorporated NatureMapping into it. Mr. Akers said that NatureMapping was an activity that corresponded to his main objective of giving the students hands-on experience with nature and fit well with the curriculum.

Students in Mr. Akers’ class conducted their NatureMapping activities as part of regular class assignments, and students could also choose to do NatureMapping as part of their class project requiring at least eight hours of work each trimester. Two features of Mr. Akers’ use of NatureMapping were variety and flexibility in terms of frequency, duration, location, and curriculum topic. During the 1998-99 school year, the Field

Ecology & Natural Resources students visited a lake near the school to conduct their NatureMapping observations. The students' main tasks were to create habitat maps and describe the area's food web. Kristy Harger, a science teacher at Evergreen High School, was involved with NatureMapping during the 1998-99 school year as she assisted Mr. Akers with his Field Ecology & Natural Resources classes. During the 1999-2000 school year, since Mr. Akers' classroom moved to the Environmental Learning Center at Evergreen Fisheries Park, the NatureMapping activities were concentrating on the Park and occurring over about a week's time.

After connecting with The NatureMapping Program, Mr. Akers became involved with several other programs in which they incorporated their NatureMapping data: the Green City Data Program sponsored by Metro Green Spaces and the Student Watershed Research Project. The Green City Data Program was a program similar to NatureMapping but with a local focus. When Evergreen High School was involved with the Green City Data Program (until the 1997-98 school year), the students presented their NatureMapping data to the Metro Council. The Student Watershed Research Project (SWRP) is a regional (western Washington and Oregon) program that focuses on water quality testing but includes habitat and wildlife surveys for which the Evergreen students have used NatureMapping data. In May 2000, Evergreen High School presented at the SWRP "Watershed Summit" and included some of their animal species inventories from NatureMapping.

Mr. Akers stated that the greatest strengths of The NatureMapping Program are that it is "hands on science" and the results "actually go to a professional for some purpose." According to Mr. Akers, "that makes all the difference in the world to [the students], rather than going out and doing something that is fictional."

Seven Evergreen High School students who had been involved in NatureMapping during the 1998-99 school year were interviewed for this study. The students said that through their projects involving NatureMapping, they became much more knowledgeable and aware of different aspects of nature in their area. Several students expressed surprise at what they found and said that they enjoyed the experience. One student said when asked how NatureMapping made her feel, “This [experience] is actually changing my idea for the future, because…this has just intrigued me so much and I want to learn more.” She continued, “After [the project involving NatureMapping], I volunteered for everything after school and everything down [at the Hatchery Park]…it opened my eyes to different things.” Another student said, “I wish I would have done NatureMapping more.” A few students mentioned that their NatureMapping activities involved working and communicating with others. Four of the students said that NatureMapping was important because it helps with environmental planning and management. Two of the students thought that NatureMapping was an effective way to teach people about nature. When asked how NatureMapping can be improved, the students suggested more in-class preparation and more time allowed in the field. One student said that more people should participate in NatureMapping so that they become “more used to what is around.”

North Mason High School Case Study

North Mason High School is located in the rural, unincorporated community of Belfair, Washington, on the eastern side of the Olympic Peninsula. Approximately 800 students, grades 9 through 12, attend the school. Science teacher Karen Lippy brought NatureMapping to Evergreen High School in 1993. For the past five or six years, Ms.

Lippy has taught two elective classes, Aquatics World and Hood Canal Institute, from a satellite classroom at the Hood Canal Wetlands, a highly valued asset of the Belfair community. Aquatics World is a tenth-grade class that integrates the curriculum around the environment and includes project-based service learning. The Hood Canal Institute is an upper-level class that is entirely project-based learning. Ms. Lippy's students have worked on stream restorations, scientific studies, and forestry and stream assessments, among other projects.

When Ms. Lippy first became involved in NatureMapping, she was still teaching at the high school and wanted activities for her students to do at the Hood Canal Wetlands. Ms. Lippy stated that NatureMapping was a good tool to slow the students down and have them focus on the nearby nature, i.e., NatureMapping was a good activity for beginners. Ms. Lippy said that she usually took the Aquatics World classes out to the wetlands for one NatureMapping session once or twice per year and later instructed the students to go out on their own two or three times. Much of Ms. Lippy's use of NatureMapping was done on an ad hoc basis. She said that she found NatureMapping to be a good assignment to give students who are struggling with more complex assignments. Ms. Lippy's students also incorporated NatureMapping into their stream survey work.

Ms. Lippy believes that the best way for students to learn about nature is to experience it, therefore she has not spend much time in class preparing the students for their NatureMapping outings. Instead, she has guided them once they begin. Ms. Lippy submitted the NatureMapping data from her students and other wetlands visitors to Karen Dvornich. Other than for the stream surveys, Ms. Lippy has not had her classes analyze their NatureMapping data. Ms. Lippy does not bring in experts to discuss

NatureMapping with her students, although she may refer students to Dan Hannafious, a wildlife expert who works at the Hood Canal Wetlands center and is also associated with The NatureMapping Program.

Three North Mason High School students who had been involved in NatureMapping during the 1998-99 school year were interviewed for this study. Because NatureMapping activities were such a small part of the activities at the Environmental Learning Center and were often conducted on an ad hoc basis, several of the students who had been selected for interview because Ms. Lippy thought that they had been involved in NatureMapping had not actually conducted NatureMapping observations. Thus, the number of NatureMapping students interviewed was small.

Two of the three students said that they learned more about animal behavior through their NatureMapping experiences. The other student said that she learned that wildlife was abundant at the wetlands. In answering the other questions, one student focused on the fun of watching wildlife, while the others felt that NatureMapping provided useful data. A student added that it showed her “how we need to preserve the stuff that we have so it all doesn’t get polluted.” When asked how NatureMapping can be improved, the students said that it should be done more often and should include more “creatures” than birds. One student said that more students should be made aware of activities like NatureMapping.

Comparisons across the Case Studies

Comparison of the Case Studies

When the case studies are considered as a group, the information can be arranged in several ways. When compared side by side, the case studies represent the

variety of ways in which NatureMapping can be implemented at the school and community levels. When the findings from each case study are consolidated, the similarities indicate typical features of The NatureMapping Program. Most importantly, the collection of student interviews allows a comparison between the NatureMapping students and the non-NatureMapping students.

Perhaps the most striking feature of The NatureMapping Program that appears when the case studies are compared is its extreme flexibility. NatureMapping at the case study schools was conducted by all grades except ninth. Several of the schools brought different grades together for their NatureMapping activities. For example, Orchard Prairie School had students from first to seventh grades NatureMapping with high school students. The portion of each school participating in NatureMapping also had a wide range, from one teacher's class, to all classes in a grade (Sakai), to all grades in a school (Orchard Prairie).

The case study variety continued with respect to the characteristics of the NatureMapping activities at each school. Each case study school's NatureMapping project orientation was very different from the others. The projects were a lizard study, wildlife observations in nature corridors, comments submitted to a road realignment proposal, a watershed-based newsletter, habitat and food web maps, and an introductory exercise in nature observation. NatureMapping provided the basis for some projects and was supplemental to others. For most of the schools, the students were involved with NatureMapping for one year only. The exceptions were Orchard Prairie School where students NatureMap every successive year at the school (K-7) and Waterville Elementary School where students have the same teacher (Diane Peterson) for two years in a row. In most cases, the teachers had a history of involvement with

outdoor education and a continued interest in developing that aspect of their classes. Thus, NatureMapping was considered a part of a larger experiential and service approach to education. As teachers developed their larger approaches, NatureMapping observations tended to become more supplemental.

Table 11 contains a comparison of the characteristics associated with each school's NatureMapping program, organized by field activities and in-class activities. For all the case study schools, the total number of hours each student spent NatureMapping in the field was very small, from 2 to 6 hours each year. The students usually conducted their observations during spring. The high school programs had classes dedicated to outdoor education, so their students spent much more time outside doing other activities besides NatureMapping. The other schools would typically provide their students with additional outdoor education experiences, but the quantity of time in the field was not as great as with the high schools.

The students conducted their NatureMapping observations individually and/or in small groups. On occasion, parents, community members, or experts accompanied the students during their NatureMapping outings. NatureMapping sites included school (or satellite classroom) grounds, field trip sites, and the students' homes. The species observed ranged from only one (Waterville short-horned lizard study) to all flora and fauna (Evergreen habitat maps and food webs). Several of the schools tended to focus on birds because they were easily seen and identified with the use of field guides. Although NatureMapping was usually adopted into science curriculum, teachers often took the opportunity to integrate many other subjects (e.g., math, social studies, composition, history, and art) and skills (e.g., data and spatial analyses, sketching, communication, technology, non-scientific research, and community planning).

TABLE 11. Characteristics of Case Study Schools' NatureMapping Programs during the 1998-2000 School Years

Characteristic of School's NatureMapping Program	Case Study School					
	Waterville Elementary School	Sakai Intermediate School	Orchard Prairie School	Chase Middle School	Evergreen High School	North Mason High School
Field Activities						
Approximate total time each student spent NatureMapping in the field (hours per year)	1	3	6	3	2*	3
Approximate timeframe of field activities (months per year)	3	2	4	2	2	1
Students were alone	X	X			X	X
Students were in a group	X	X	X	X	X	X
Accompanied by community members, parents or experts		X	X	X		
Conducted on school grounds**			X	X	X	X
Conducted at field trip sites		X	X	X		
Conducted at students' homes or other locations of students' choosing	X	X				
Classroom Activities						
Approximate timeframe of classroom activities (months per year)	6	1	6	3	1	0
Preparation for NatureMapping	X	X	X	X	X	
Experiments	X					
Technology	X		X	X		
Community planning		X	X	X		
Data or spatial analyses	X		X	X	X	
Communication	X		X	X	X	
Art			X	X		
Non-scientific Research			X	X		

* This represents the number of hours that the Evergreen students spent observing wildlife, not the total time the students spent in the field for their habitat mapping and food web projects.

** The school grounds include Orchard Prairie School's wildlife refuge, the Evergreen Fisheries Park, and the Hood Canal Wetlands.

Curriculum integration was primarily accomplished through projects. Time spent on NatureMapping related classroom work ranged from approximately one to six months. Within the case study schools, the middle grade programs (i.e., Orchard Prairie seventh grade and Chase eighth grade) had most curriculum and project integration around NatureMapping. Most of the teachers and several of the community members had attended at least one NatureMapping workshop, but not recently.

Teacher and Community Member Interviews

The consolidated results of the teacher and community member interviews are presented in Appendix C. Eight teachers and nine community members were formally interviewed. Four of the nine community members were Waterville farmers who were interviewed as a group, so their responses are considered to represent one respondent for this discussion. Thus, the number of "community members" given in Appendix C is five.

The teachers and community members were asked to describe the effects of The NatureMapping Program on their students, their schools, their communities, and themselves. The teachers and community members frequently stated that the students gained knowledge of nature and learned observation and recording skills. To a lesser degree, the teachers and community members said that the students learned about their local communities and agencies, about the impacts human activities have on nature,

how to ask questions, and how to analyze and communicate results. In terms of changes in student attitudes and behaviors, the teachers and community members thought that the students believe that their NatureMapping results are useful to others, that NatureMapping heightens the students' sense of environmental stewardship, and that the students enjoy the NatureMapping outings.

The teacher and community member interviews illuminated the general school and community effects. According to the teachers, the most significant effect that The NatureMapping Program had on the schools was to improve the communities' impressions of the schools and their students. Likewise, when asked about the effects on the community, the teachers and community members cited "more interaction between school and community" most often. The next most common responses regarding effects on the community were the results of the specific projects and the indirect effects on the students' parents. In terms of the effects of the Program on the teachers and community members themselves, many said that they found NatureMapping to be enjoyable or interesting and that they appreciated the networking between teachers, experts, community members, and agency staff.

When asked to describe the strengths of The NatureMapping Program, the most common reply was that The NatureMapping Program is "real," i.e., it has goals and objectives beyond education. As a result, the teachers thought that the students put more effort into the NatureMapping tasks because other people would use the results. In addition, the experiential aspects of the Program were considered strengths, especially because of the positive effects it had on students who were not excelling in the traditional academic settings and for the involvement of students in scientific study. The teachers also frequently stated that the Program addressed the Washington Essential

Academic Learning Requirements (EALRs), i.e., the teachers expected the Program to impart important academic knowledge and skills.

The teachers and community members were also asked to describe the weaknesses of The NatureMapping Program and offer suggestions for improvement. These responses are included in Appendix C, but they are not discussed until the Recommendations section of Chapter V.

Student Interviews

The results of each student interview question are shown in Appendix D and are arranged according to whether the student had participated in NatureMapping or not and presented in terms of number and percentage of students making a comment in a given category, and the confidence level that the two populations are different with a confidence level greater than 90% (using a two-sample t-test, $p < 0.10$). The student interview coding and statistical analysis tell three stories about the students: (1) similarities between the NatureMapping and non-NatureMapping students, i.e., the areas in which NatureMapping may not have a significant effect, (2) where the results are similar between the two groups, the responses paint a portrait of students' thoughts, feelings, and activities, and (3) differences between the NatureMapping and non-NatureMapping students, i.e., the possible effects of The NatureMapping Program.

Similarities between NatureMapping and Non-NatureMapping Students

The similarities between the NatureMapping and non-NatureMapping students were more common than the differences between the two groups. Out of 291 comment categories, only 41 (14%) were significantly different (confidence level greater than

90%). As shown in Table 12, the highest numbers of differences occurred when the students were specifically asked to address their involvement with either The NatureMapping Program or other outdoor education/community service activities in Questions 8, 11, and 12 (although the responses to Questions 9 and 10, also addressing the particular involvement, were very similar between the two groups). The two groups were most similar when answering Questions 1 and 2.

TABLE 12. Number and Percentage of Significantly Different Comment Categories for Each Student Interview Question

Question	Topic	Number of Significantly Different (C>90%) Comment Categories	Total Number of Comment Categories	Percent Difference
1	Community	1	37	3%
2	Natural environment	1	38	3%
3	Condition	6	38	16%
4	What can be done	4	30	13%
5	What is your role	2	29	7%
6	What do you do	2	25	8%
7	Community service or outdoor education	2	26	8%
8	Learned	11	20	55%
9	Feel	1	11	9%
10	Other effects	1	10	10%
11	Important	4	11	36%
12	Improved	6	16	38%

The student interviews were not designed such that the frequencies of their responses represented the larger student populations of NatureMapping students, non-NatureMapping students, or Washington students. For conclusions about the larger populations to be drawn with a high degree of certainty, a study would have to be designed to interview a much larger sample of students (at least 400) chosen at random from the population of interest (NatureMapping students, non-NatureMapping students, or Washington students).

Nonetheless, the response rates for the 79 students interviewed are an indication of student views. With the exception of the 16 students from Waterville Elementary School, the students were adolescents (ages 12 to 18) living in suburban (or bedroom) communities that are experiencing high rates of urban development. Those responses being made by more than 20% of the students indicate aspects of the students' communities, environments, and activities that dominate their thoughts. These responses are grouped by questions generating similar responses and listed in Tables 13 through 16 and are discussed below. Responses meeting the 20% cut-off that were not grouped (because they occurred for only one question) are discussed in the text.

In response to Question 1 (community), 70% of the students described "social" aspects, 63% described the "built environment," 63% gave a "general" statement (such as "it is beautiful"), and 41% mentioned a feature of the "natural environment." Within the "social" comments, community "interaction" was mentioned the most (27%). Within the "general" comments, 43% of the students gave their community a favorable overall assessment.

TABLE 13. Common Responses (mentioned by 20% or more of the students) for Consolidated Selected Responses to Questions 1, 2 and 3: Describe the community, its natural environment, and the condition of its natural environment.

Comment*	Number of Students Who Made Comment	Percentage of Students Who Made Comment (n=79)
Natural environment (Q1-3)		
Plants	32	41%
Wildlife	45	57%
Landscape	59	75%
Habitat	18	23%
Weather or seasons	16	20%
Diversity	17	22%
Specific area	37	47%
Condition of natural environment (Q1-3)		
Pollution or trash	28	35%
Urbanization	43	54%
Rate of development	40	51%
Human interaction with natural environment (Q2-3)		
Enjoyment	26	33%
Concern	22	28%
Access	19	24%

*No significantly significant differences ($p<0.10$) were observed between the NatureMapping and non-NatureMapping students for the responses in these categories for any of the questions.

TABLE 14. Common Responses (mentioned by 20% or more of the students) for Consolidated, Selected Responses to Questions 4, 5 and 6: Describe how the good things about the community and its natural environment can be maintained or improved.

Comment	Number of Students Who Made Comment	Percentage of Students Who Made Comment (n=79)
Individual actions		
Pick up trash	33	42%
No littering or polluting	17	22%
Planning and policy		
Development (Q4-5)	26	33%
Inventory	16	20%
Community action		
Projects	24	30%
Communication	20	25%
Involvement*	20	25%
Maintenance or engineering	17	22%

*A significantly significant difference ($p<0.10$) was observed between the NatureMapping and non-NatureMapping students for the responses in this category for at least one of the questions.

TABLE 15. Common Responses (mentioned by 20% or more of the students) to Question 7 without NatureMapping Activities: Have you been involved in any outdoor education or community service activities? If so, what?

Comment (Not including NatureMapping activities)	Number of Students Who Made comment	Percentage of Students Who Made Comment (n=79)
Organization		
School	56	71%
Activity		
Clean up	23	29%
Nature study, survey, research or testing	43	54%
Nature construction or management	21	27%
Activity element		
Educational objectives	56	71%
Environmental education	54	68%
Environmental service	45	57%
Outdoors	68	86%
Local environment	51	65%
Wildlife	16	20%
Local community*	25	32%
Social service	28	35%

*A significantly significant difference ($p<0.10$) was observed between the NatureMapping and non-NatureMapping students for the responses in this category for at least one of the questions.

TABLE 16. Common Responses (mentioned by 20% or more of the students) for Consolidated Selected Responses to Questions 8 through 12: Describe the effects of these [NatureMapping or outdoor education/community service] activities on yourself and if the activities are important.

Comment	Number of Students Who Made Comment	Percentage of Students Who Made Comment (n=77)
Learn about nature (Q8 and 11)*	58	75%
Protection of nature (Q11)**	30	40%
It was fun, interesting or rewarding (Q8-11)	45	58%
Developed skills (Q8 and 10)*	29	38%
Went outside (Q9 and 11)	16	21%
Respect or appreciation for nature (Q8-10)	16	21%
More motivated to act or protect nature (Q8-10)*	25	32%
Helped others or the environment (Q8-11)*	31	40%
More participants (Q12)*	23	30%

*A significantly significant difference ($p<0.10$) was observed between the NatureMapping and non-NatureMapping students for the responses in this category for at least one of the questions.

**For this comment category, n=70.

In response to Question 2 (natural environment), 80% of the students described the natural environment in terms of some “ecology” concept such as the “landscape” or “diversity,” 62% described a relationship that people have with the natural environment such as personal “enjoyment” of nature, 53% discussed the “condition” of the natural environment and often related causes and effects, 52% mentioned animals, and 35% mentioned plants. In response to Question 3 (condition of natural environment), 35% of

the students gave an overall assessment of “good,” 40% said “average,” and 3% said the environment was in “bad” shape.

As shown in Table 13, in response to Questions 1 through 3, students most often described the elements of their local natural environment in terms of its “landscape” (75%), “wildlife” (57%), and a “specific area” (47%). The students most often described the condition of their local natural environment in terms of “urbanization” (54%), “rate of development” (51%), and “pollution or trash” (35%). The “rate of development” was typically described as high. In fact, if the Waterville students are removed from the calculation and the responses from Question 4 are included, 75% of the students stated that urban development in their community was occurring at either “medium” or “high” rates. I noted this as a major theme during the interviews. The student descriptions of this development and its impacts on their lives and the natural environment were often passionate. The following quotes offer a glimpse at the concern that many of the interviewed students have over community growth:

> A lot of trees are now getting built over for new homes, new parks, different things. So it is kind of getting crushed down a little bit. All our wildlife and all that is kind of going away and moving out. (Chase student, age 13)

> If we keep the development up at this rate without much consideration for the environment, it will go downhill, the quality of it. (Evergreen student, age 17)

> We have septic problems. People would rather put that on the back burner because the contractors are bringing growth to the community, instead of looking at the environmental aspects. (North Mason student, age 18)

In responding to Questions 2 and 3, the students most often described their relationship with the local natural environment in terms of “enjoyment” (33%), “concern” (28%), and “access” (24%). As an example, this statement includes elements of “enjoyment” and “access” (and “concern” may be implied): “Right by my house, there is a mini-forest…It is a cool place to go walk through. You can see birds, you can see

raccoons, stuff like that. I think it is a really nice place, but it is going to be torn down (Evergreen student, age 17)."

In response to Question 4 (how to maintain or improve the good things), 59% of the students offered "planning and policy" approaches, 52% gave "community action" as a solution, and 35% described actions by individuals. In answering Question 5 (student's role), 59% described "community action," 56% mentioned "individual action," and 41% believed that they had a role in "planning and policy" approaches. Replying to Question 6 (what student does to maintain or improve the good things), 51% said they are or have been involved in "community action," 49% mentioned "individual action," 23% described "planning and policy" involvement, and 21% said that they do not do anything.

As shown in Table 14, in response to Questions 4 through 6, the "individual actions" given most often related to "picking up trash" (42%) and "not littering or polluting" (22%). In addition to the "development" theme, I was surprised to find that trash and littering were major concerns for students ranging from fourth grade to twelfth grade. The most common "planning and policy" approaches were "development" (33%) and "inventory" (20%). The relatively high reference to "development" fits with the students' high level of awareness of community growth. For example, a 13-year-old student from Chase said that the good things can be maintained or improved by "studying the natural habitats so people can't go in and build homes on animals' grounds" (Chase student, age 13). It is interesting to note that a non-NatureMapping student made this statement. And, for "community action," the students most often gave answers in the categories of "project" (30%) (such as through school), "communication" (25%), "involvement" (25%), and "maintenance or engineering" (22%). The comments falling into the "maintenance and engineering" category most often indicated a

fundamental difference in interpretation of the natural environment from most of the other students. In these cases, the students thought of the natural environment as the highly human-modified areas having vegetation such as yards and mowed parks.

The most common (greater than 20%) responses to Question 7 (outdoor education or community service) without the NatureMapping activities are shown in Table 15. There were no statistical differences (with confidence greater than 95%) between the NatureMapping and non-NatureMapping students. This finding suggests that the NatureMapping and non-NatureMapping students have very similar community service and outdoor education histories except for The NatureMapping Program. This study presumes that an outdoor education/community service experience, i.e., The NatureMapping Program, may have a profound effect on the students. Thus, similar experiences may also have profound effects on the students, and it is therefore desired that the two student groups not significantly differ in this respect.

The level of baseline involvement in community service and outdoor education activities is also very important because that indicates the novelty of The NatureMapping Program, and hence the novelty of the possible effects. If the students have a high level of involvement with community service and outdoor education activities, then similar programs may have already achieved the potential effects of The NatureMapping Program and there would be some redundancy. In that case, the effects of The NatureMapping Program would not be as pronounced. As seen from Table 15, the students have a substantial amount of experience with community service and outdoor education activities. In fact, the students' involvement in these types of activities was probably under-represented by the students because of memory lapses or narrow interpretation of the question.

Only two students (3%) stated that they have not participated in any outdoor education or community service activities. Seventy-one percent of the students stated that they had been involved in school-sponsored outdoor education or community service. This figure does not include activities indirectly associated with school such as through school-supported clubs (e.g., FFA). No other organization category received more than 20% of the student comments. The next largest category was “church” at 9%, followed by “scouts” and “4-H” at 8% each. The most common type of activity was “nature study, survey, research or testing” (54%), and the schools usually (but not always) organized these activities. The next most popular activity was “clean up” (29%). Many groups organized these activities: schools, church, scouts, 4-H, etc. “Nature construction or management” was another common activity (27%) that was sponsored by a variety of organizations.

As discussed in the previous section “Program Overview,” the effects of The NatureMapping Program may be attributed to program elements. These elements are listed in Table 15 and provide a point of comparison between The NatureMapping Program and the averaged assortment of community service and outdoor education in which the students have been involved (excluding the NatureMapping activities). The elements having the smallest percentages may indicate those areas in which The NatureMapping Program has something different to offer. The elements having the largest percentages may indicate those areas in which the students have had a relatively high level of exposure and additional exposure through The NatureMapping Program may not have much impact. There are two important caveats to the preceding discussion, though. The data in Table 15 only indicate where the student has been involved in an activity or not. They do not indicate the quantity or quality of involvement,

two extremely important parameters in determining the type and degree of effect on the students.

The activity elements having the lowest representation are “wildlife” (20%), “local community” (32%) (not to be confused with “local environment”), and “social service” (35%). “Wildlife” is the only activity element (out of these three) on which NatureMapping focuses. The activity elements having the highest representation are “outdoors” (86%), “educational objectives” (71%), “environmental education” (68%), and “local environment” (65%). “Environmental service” falls closer to the middle at 57%. Although “outdoors” is so heavily represented, it must be remembered that the outdoor experience can vary widely in quality, quantity, and objectives. For example, a one-day roadside trash pick-up and a yearlong habitat study on the school grounds are both “outdoor” activities, but they are very different in their purposes and results. From this rough analysis, it appears that NatureMapping has the most to offer Washington students in the areas of its “environmental service” and “wildlife” aspects.

In response to Question 8 (learn), 68% of the students described “knowledge,” 38% discussed how the felt (“attitude”), and 35% said that they learned “skills.” As shown in Table 16, in response to Questions 8 through 11, ignoring the comment categories indicated on the table as having significantly different results between the NatureMapping and non-NatureMapping students, the students described the following aspects of their outdoor education or community service activities (including NatureMapping): “fun, interesting, or rewarding” (58%), “protection of nature” (40%), “went outside” (21%), and “respect or appreciation for nature” (21%). The other categories, for which there were significant differences between the two student groups, are discussed in the next section. For Question 12 (also shown in Table 16), the only

response with greater than 20% mention (“more participants” at 30%) is also significantly different between the two student groups, so it too will be discussed in the next section.

Differences Between NatureMapping and Non-NatureMapping Students

Most of the differences occurred for Questions 8, 11, and 12. Although Appendix D lists confidence level greater than 90%, for the purposes of focusing the discussion, only those comment categories with a greater than 95% confidence level ($p < 0.05$) for a two-sample t-test between the NatureMapping and non-NatureMapping students are considered below. These comment categories are compiled in Tables 17 and 18, where Table 17 lists the comment categories where more NatureMapping students responded and Table 18 lists the categories where more non-NatureMapping students responded.

Before considering each of these significant differences in more detail, a general caveat should be applied. As discussed in the previous chapter on methodology, the NatureMapping student responses may be biased by the fact that they have a better understanding of the focus of this study, i.e., The NatureMapping Program, and may either consciously or unconsciously weight their responses toward topics of NatureMapping such as wildlife and habitat. This effect is probably small because very few students made reference to The NatureMapping Program unless specifically asked about it (as they were in Questions 7 through 12). The students did not appear to be concerned about the purpose of the study or how their responses would be used, nor did the NatureMapping students give the impression that they were trying to relate what they said to what may or may not have been associated with NatureMapping activities. The bias of the high school students based on their self-selection into ecology programs cannot be discounted.

TABLE 17. Statistically Significant (confidence level greater than 95%) Differences between NatureMapping and Non-NatureMapping Students Where More NatureMapping Students Made the Comment

Comment	Participated in NatureMapping		Did not participate in NatureMapping		Significance Test Confidence Level
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=42)	
Q2 – Natural environment					
Interconnected	5	14%	0	0%	>96%
Q3 – Condition of natural environment					
Plants – general	9	25%	2	5%	>98%
Q4 – What can be done					
Involvement	12	32%	5	12%	>96%
Create habitat	5	14%	0	0%	>96%
Q5 – Student's role					
Wildlife*	4	13%	0	0%	>95%
Q6 – Student does					
Planning and policy	12	33%	5	13%	>96%
Q8 – Learn					
General nature	23	62%	15	38%	>96%
There is more to nature than originally thought	8	22%	2	5%	>96%
Observation, research or testing	12	32%	4	10%	>98%
Q11 - Important					
Learn about nature	28	76%	16	42%	>99.5%
Q12 - Improvements					
Involve non-students	4	11%	0	0%	>95%

*As discussed in the text, qualitative analysis of the individual quotes fitting into the "wildlife" category suggests that NatureMapping may not have caused the difference between the two student groups.

TABLE 18. Statistically Significant (confidence level greater than 95%) Differences between NatureMapping and Non-NatureMapping Students Where More Non-NatureMapping Students Made the Comment

Comment	Participated in NatureMapping		Did not participate in NatureMapping		Significance Test Confidence Level
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=42)	
Q3 – Condition of natural environment					
Industry	0	0%	4	10%	>95%
Q5 – Student's role					
Vote	0	0%	5	14%	>96%
Q8 – Learn					
There is a lot of trash around	0	0%	4	10%	>95%
Recreation	0	0%	4	10%	>95%
Attitude	9	24%	20	50%	>98%
More motivated to protect nature	0	0%	6	15%	>98%
Work ethic	0	0%	4	10%	>95%
Q12 – Improvements					
More participants	6	16%	17	43%	>98%
Coordinate activities between organizations	0	0%	4	10%	>95%
Expand program to involve more people	0	0%	8	20%	>99.5%

The five students whose response to Question 2 (natural environment) included the concept of “interconnected” represented four schools (Evergreen, North Mason, Orchard Prairie, and Sakai). The student from North Mason used the phrases “complete system” and “taking the pieces out.” The North Mason student made reference to a “watershed.” One Orchard Prairie student noted the connection between an area’s elevation and the types of trees. The other Orchard Prairie student noted that springtime leads to water filling a vernal pond and thus attracts migrating swans. The Sakai student (at Woodward) described nature as “in strips, [there] is not really a chunk of it” as a result of development. In each case, NatureMapping and associated activities may have played a role in leading these students to make these comments. It should be noted that the concept of interconnectedness is broad, abstract, and loosely defined. These qualities make this category more difficult to code accurately and consistently. Thus, this result should be taken as tentative.

The nine students whose response to Question 3 (condition) included the concept of “plants-general” represented all the case study schools. The Evergreen student mentioned non-native plants. Two Chase students (at Ferris) and one Sakai student (at Woodward) mentioned that trees were being cut down to make way for development. One Chase student (at Ferris) described where trees were located (more on the mountain). Both North Mason students stated that there was an abundance of trees, but one student remarked that that was changing as a result of development. One Orchard Prairie student related the presence of “weeds” in the farm fields. The Waterville student thought that the “trees were really healthy.” Thus, five out of nine responses dealt with the impact of development on the amount of trees in the area. Given the similar levels of sensitivity to development that both NatureMapping and non-

NatureMapping students expressed over the course of Questions 1 through 3 (especially in terms of “cutting down trees”), it is surprising to find that the NatureMapping students made significantly more comments about this phenomenon when discussing the condition of the natural environment. Perhaps the NatureMapping students view the loss of trees as having more impact than the reduction in human enjoyment; e.g., the NatureMapping students could see the trees (or forest) as habitat for wildlife.

Three schools (Evergreen, Chase, and Sakai) represented ten out of the twelve students responding to Question 4 (what can be done) with the concept of “involvement”. The Evergreen students called for “community help and government help” because of the expense involved, “it is a chain reaction…the school is where everything starts in the community,” “more care on the residents’ behalf…[because] invasive [plant] species…bombarding this area.” The Chase students (at Ferris) said, “people who are involved in the community need to spread the word and be more willing to preserve it,” “all of Spokane…drop everything and clean up the entire place,” “the community could join together.” The Sakai students (at Woodward) said, “cleaning up…using less cars, “friendly…cleaned up,” “clean up…plant another tree…not littering…build houses together,” “adopt a highway…well maintained.” The Evergreen students related to the enormity of the task of solving environmental problems. The Chase students stressed the need for communication and community organizing. The Sakai students stressed the unit of the island. These results match well with their NatureMapping activities: NatureMapping at Evergreen explored ecosystem details, NatureMapping at Chase involved community awareness through the publication of a newspaper, and NatureMapping at Sakai emphasized the island as a whole (although island may dominate the Sakai students’ thinking without NatureMapping). The non-NatureMapping

student responses falling into this category generally mentioned people "doing their part" by cleaning up trash.

The five students whose response to Question 4 (what can be done) included the concept of "create habitat" represented four schools (Evergreen, Chase, Waterville, and Sakai). The Evergreen student suggested that housing developments incorporate "nature reserves." The Chase (at Ferris) student said to "put some more trees in everywhere" to "have it be more like the East Coast." One Waterville student recommended "putting in more plants and everything to make our community healthier." The other Waterville student said that an improved natural environment is "probably going to be like new trees growing and stuff. There will be more animals pretty soon, and more trees and wildflowers." The Sakai (at Woodward) student suggested having more trees around buildings. Although the students' increased concern for habitat, especially in developed areas, may be considered a result of The NatureMapping Program, the quotes indicate an immature understanding of ecosystem health. Trees may be pleasing to humans and beneficial to some wildlife, but the planting of trees does not automatically benefit the environment, and in some cases it may cause harm.

The four students whose response to Question 5 (student's role – wildlife) included the concept of "wildlife" represented four schools (Evergreen, North Mason, and Waterville). The student from Evergreen created wildlife habitat in her backyard. The North Mason student mentioned his work with the Salmon Enhancement Group through school. Both Waterville students said that they could try and stop people from hunting or fishing at Douglas Creek, clear references to a particular project (not NatureMapping). Three out of four responses in this comment category appear to be associated with NatureMapping only in that the teachers who bring NatureMapping to the classroom

provide other outstanding outdoor education opportunities to the students as well. Thus, NatureMapping does not appear causal.

The 12 responses to Question 6 (student does – planning and policy) from the NatureMapping students represented every case study school except Chase. Four of the students were from Orchard Prairie School and each of their comments directly related to their NatureMapping activities. Three out of five of the high school student comments related to non-NatureMapping school projects. Thus, the results for Question 6 appear to be dominated by two phenomena: the Orchard Prairie students' strong connection with their NatureMapping activities and the self-selection bias of the NatureMapping high school students into ecological study and the resulting access to a variety of environmental service learning projects.

The NatureMapping and non-NatureMapping students differed on the most counts in their responses to Question 8, "What did you learn…" These comment categories were: "general nature," "there is more to nature than originally thought," and "observation, research or testing." Students from each of the case study schools made comments that fell into the "general nature" category. Students from Evergreen, North Mason, Orchard Prairie, and Sakai stated that they learned that "there is more to nature than originally thought." Students from Evergreen, Chase, Orchard Prairie, and Waterville stated that they learned about "observation, research or testing."

The differences between the NatureMapping and non-NatureMapping students in the responses to Question 8 can be easily explained by the fact that the NatureMapping students are describing The NatureMapping Program and the non-NatureMapping students are describing a broad variety of activities that they consider to be "outdoor education or community service." According to their responses to Question 7 (given in

Appendix D), the non-NatureMapping students' community service and outdoor education activities are not all directed towards the same goals as The NatureMapping Program. It is understandable that The NatureMapping Program would stand apart from outdoor education and community service activities in general. The comments stated by the NatureMapping students more often may indicate NatureMapping's strongest suits.

For Question 11 (important), the differences between the NatureMapping and non-NatureMapping students in the comment category of "learn about nature" had a very high level of confidence (99.5%). NatureMapping students from each of the case study schools made comments falling into this category. There were no other categories for Question 11 that were significantly different (confidence level greater than 95%) between the two student groups. This result is consistent with the significantly different comment categories in response to Question 8. Thus, according to the students, NatureMapping is much more effective at teaching about nature than the average outdoor education and community service activity or program.

The four students whose response to Question 12 (improved) included the concept of "involve non-students" represented four schools (Evergreen, Chase, North Mason, and Orchard Prairie). Two of the four students recommended that non-students be involved as resource people. The Evergreen student suggested that if professionals spoke to the class, the students would learn more. The North Mason student recommended "having not just students work on it because some [students] don't take it seriously." Since NatureMapping is a program with scientific and environmental planning purposes, unlike most of the other outdoor education/community service activities conducted by the students, it makes sense that some students would want to strengthen this aspect of NatureMapping by having more professional interaction and direction. The

other two students making this comment did not specify the way in which the non-student people could be involved, but from their quotes, it appears that these people would be involved as participants. Because NatureMapping provides a service of value to the local community, it is reasonable that some students would consider NatureMapping to be a worthwhile effort for non-students, i.e., The NatureMapping Program is not just an academic assignment.

In the preceding analysis, the Evergreen High School students contributed more to the differences than did the students from the other schools. Three possible causes for the dominance of Evergreen High School are (1) the students' NatureMapping experiences, (2) the students' broader Field Ecology and Natural Resources class experiences, and (3) the students' ages compared to the other case study schools with the exception of North Mason High School. It should be noted that North Mason High School students contributed to the differences as much as the other schools (except Evergreen) with a handicap of only three students. If more NatureMapping students from North Mason High School had been interviewed, their results may have been similar to that of Evergreen High School. It seems as though the causes of Evergreen High School's contributions to the differences include all of the above. We now turn to the statistically significant differences where more non-NatureMapping students made the comments.

The four students whose response to Question 3 (condition) included a comment on industry represented three schools (Chase as control group for Orchard Prairie, Hyla as control group for Sakai, and North Mason). The Chase student said, "every city has pollution from industry." The Hyla student related the low levels of pollution on the island to few factories. One of the North Mason students said that industry has had an impact

on the natural environment. The other North Mason student said that there was “not a whole lot of heavy industry here.” No NatureMapping student commented on industry in response to any of the interview questions. NatureMapping students were possibly more focused on issues that directly linked to their NatureMapping experiences (such as habitat loss) and led to this result.

The five students whose response to Question 5 (own role) included a comment within “vote” represented three schools (Chase as control group for Orchard Prairie, Evergreen, and Ferris). For the two Evergreen students that made this comment, they remarked that they are now eligible to vote (by being 18 years of age). The Chase student remarked that as a teenager, there is not much she can do, but she can vote once she becomes an adult. One Ferris student suggested “voting against building stuff.” The other Ferris student stated “as a future voter, tell them…” No NatureMapping student mentioned voting in response to Question 5 (or any other question). Perhaps the same reason as offered to explain the difference in mention of “industry” to Question 3 applies here.

The statistically significant comments that the non-NatureMapping students stated in response to Question 8 may indicate what NatureMapping does not (intentionally or unintentionally) emphasize: “there is a lot of trash around,” “recreation,” “attitude,” “more motivated to protect nature,” and “work ethic.” The category “attitude” is the combined result for the subcategories of “fun, interesting or rewarding,” “respect or appreciation for nature,” “more motivated to protect nature,” “good to help others or the environment,” “can make a difference,” and “work ethic.” The most surprising result here is that the non-NatureMapping Programs created more motivation to protect nature. When all responses in this category are combined across Questions 8, 9, and 10, the

comment “more motivated to act or protect nature” was made by 8 (or 22%) of the NatureMapping students and 17 (or 43%) of the non-NatureMapping students.

Only for Question 8 (learn) was the difference in stating “more motivated” between the NatureMapping and non-NatureMapping students significantly different (i.e., greater than 90% confidence level). The most obvious explanation for this is that Question 8 asks what the student “learned.” Answering “more motivated to protect nature” does not really answer the question. Instead, it better addresses how the experience made the student “feel” or “other effects.” When NatureMapping students were asked what they learned, they more appropriately answered in substantive terms such as “I learned how to identify birds.” When comparing NatureMapping to the other outdoor education and community service activities that the non-NatureMapping students had been involved, NatureMapping was more integrated into the curriculum and taught more factual material. Thus, the NatureMapping students could readily associate NatureMapping with learning something scholastic whereas participants in other activities could not as easily come up with an answer to this question, so they instead searched for something else to say.

To investigate this issue further, the student responses falling into the comment category for “more motivated to act or protect nature” for Questions 8, 9, or 10 were reviewed. Nine (or 53%) of the comments by the non-NatureMapping students used the words “clean,” “litter,” or “pollute.” Only one (or 13%) of the NatureMapping students used any of these words (in this case, “clean”). Thus, the non-NatureMapping students were more likely to associate their outdoor education/community service activities with increasing their motivation to keep their community and its environment “clean.” This seems reasonable given (1) the level of trash clean-up activities performed by the non-

NatureMapping students (33%) and (2) the generalities encouraged when asked to answer a question about such a broad range of activities as “community service and outdoor education.” Given these considerations, there is strong indication that the difference between the NatureMapping and non-NatureMapping students for this comment category is most likely an artifact of the interview design. Additional research should be conducted before any conclusions can be drawn regarding the effect of The NatureMapping Program on students’ motivation to act in the interest of the community or its natural environment.

An interesting side observation to the above analysis is that every Chase Middle School student (representing the control group for Orchard Prairie and thus in the non-NatureMapping group) commented either “more motivated to protect nature” (5 students) or “appreciate nature” (1 student) in response to Question 10. All students had participated in some combination of “Camp Spalding,” “habitat study,” or “clean-up.” Camp Spalding was a short environmental education camp attended during sixth grade. The habitat study occurred at their elementary school.

The differences between the NatureMapping and non-NatureMapping responses to Question 12 (improve) have a high degree of confidence, but are baffling. If the two categories “more participants” and “expand program to involve more people” are combined, 6 (16%) of the NatureMapping students made these comments and 23 (58%) of the non-NatureMapping student made one or both of these comments, a difference with confidence level 99.9%. Without more information and more detailed analysis, this difference is difficult to explain. One observation worth noting is that of the 23 non-NatureMapping students making one or both of these comments, 19 of these students were represented by four schools: Chase (control group for Orchard Prairie), North

Mason, Ferris, and Hyla. Many of the Chase and Hyla students had participated in a school-sponsored outdoor camp in the past two years. The North Mason and Ferris students had been involved in a variety of outdoor education/community service activities. The six NatureMapping students making remarks in one or both of these categories represent three schools: Evergreen (1 student), Ferris (3 students), and Orchard Prairie (2 students). This result for Question 12 may be connected to the results from Question 8 in the "attitude" categories. The possible relationship between students responding to Questions 8 through 10 that their activities were "fun, interesting or rewarding" and/or "helped others or the environment" was examined, but no statistical difference was found. Rather than speculate, this matter should be reconsidered elsewhere.

The many findings and results presented in this chapter, and the study's framework, are distilled into the most important points in the next chapter, Discussion.

CHAPTER V

DISCUSSION

Summary

In the past thirty years, the growing scope and severity of the Earth's environmental problems and our recognition of them and their causes has led to solution strategies that incorporate all aspects of human behavior. The overarching principle sought to guide the innumerable individual decisions is an ethic that extends beyond people to include ecosystems. Many theorists believe that a necessary ingredient in establishing this ethic is for people to gain greater understanding and appreciation of nature, primarily through direct experience and education. "Environmental literacy" is a term used to describe this heightened awareness of nature and includes the knowledge and skills needed to act in environmentally responsible ways. Answering the calls for environmental literacy and participation in environmental problem solving are initiatives such as citizen involvement, bioregionalism, environmental monitoring, ecopsychology, environmental education, experiential education, and service learning. Moreover, these initiatives make claims that they contribute to social capital and psychological health. These initiatives are receiving broad support at the theoretical, administrative, and practitioner levels, but the research into their effects on participants, their communities, and ultimately the environment has been narrow and inconclusive.

In response to this lack of research, this thesis examined the predicted and observed effects of The NatureMapping Program, a program that incorporates many

elements from the initiatives mentioned above and therefore has the potential to affect its participants accordingly. The primary purpose of this thesis was to determine the effects of The NatureMapping Program on its grade school participants, their schools, and their communities. Of special interest were the effects of the Program on the students' environmental literacy, environmentally responsible behaviors, and sense of well being. The secondary purposes of this thesis were to educate others about The NatureMapping Program as it is implemented at the national, state, and local levels and to offer recommendations for Program improvement. No study of this kind had been previously conducted on The NatureMapping Program.

This thesis organized the research findings and results into three products: (1) an overview of The NatureMapping Program and its elements, (2) six case studies of Washington schools involved with NatureMapping, and (3) consideration of the case studies as a whole, particularly a statistical analysis to determine the differences between students who had participated in NatureMapping and students who had not. In addition to meeting the stated objectives of the study, the third product provided a general profile of students' thoughts and activities.

Information for the overview of The NatureMapping Program and its elements was assembled through an extensive literature review, attendance at NatureMapping Levels 1 and 2 workshops and the National NatureMapping Meeting, and informal communication with the Program's Director, Karen Dvornich. The six case study schools were selected from across Washington based on their high levels of involvement with The NatureMapping Program. The case study schools were Waterville Elementary School in Waterville, Sakai Intermediate School in Bainbridge Island, Orchard Prairie School in Spokane, Chase Middle School in Spokane, Evergreen High School in

Vancouver, and North Mason High School in Belfair. For each school case study, Structured, open-ended interviews were conducted with teachers (n = 8), community members (n = 6), and students who had participated in NatureMapping during the previous school year (i.e., 1998-99) (n = 37). The Interviews were complemented with observations of the schools' NatureMapping activities (during the 1999-2000 school year) and reviews of their NatureMapping products. Comparable students who had not participated in NatureMapping (n = 42) were also interviewed. Because the students were generally randomly chosen for interview from both the participant and non-participant groups, the results lent themselves to statistical analysis with a high degree of confidence. The two-sample t significance test was applied to the coded student responses to determine the areas that The NatureMapping Program did and did not appear to affect. The teacher and community member interviews, the class observations, and the reviews of the school NatureMapping products allowed triangulation of the effects on the students, their schools, and their communities. The interviewees also contributed their insights into the strengths of The NatureMapping Program (i.e., reasons for the Program's successes) and suggestions for Program improvement. Lastly, the student interviews generated the rough sketch of the students. The major findings and results of this thesis are presented in the next section.

Conclusions

Elements of The NatureMapping Program

The NatureMapping Program is a national, state-administered volunteer wildlife monitoring program. Participants submit their wildlife observations to the Program for inclusion in a statewide database used to assess the state's species distribution maps

for biodiversity conservation planning. The Program was created in response to the data needs of Washington's Gap Analysis Project and the Washington schools' experiential, service, and environmental curriculum needs resulting from state education reforms.

When schools participate in The NatureMapping Program, their activities involve many elements. At its most basic level, NatureMapping includes the outdoors, monitoring, wildlife, the environment, place, service, education, experience, and community. More advanced NatureMapping can include projects, curriculum integration, and teamwork. In varying combinations, these elements are key features of major planning/public policy and educational initiatives: environmental monitoring, citizen involvement, environmental education, and service learning. The NatureMapping Program also fits within experiential education, outdoor education, and place-based study initiatives.

Based on the theories supporting the initiatives (and to a lesser degree, empirical research), The NatureMapping Program may affect student participants' knowledge, skills, attitudes, and behaviors. NatureMapping should increase students' knowledge of their local environment, especially with respect to wildlife. With teacher or community member support, the students should gain better awareness and understanding of ecological principles, human impacts, and community decision-making processes, agencies, and programs. NatureMapping should increase students' skills such as observation, species identification, data recording, and spatial conceptualization. If NatureMapping is incorporated into a project, the skills learned may include scientific reasoning, data analysis, communication, and interpersonal relations. NatureMapping may increase students' appreciation and respect for wildlife and nature, foster a sense of place and community, heighten concern for the condition of the natural environment,

instill an environmental ethic, improve their attitudes toward school, and strengthen feelings of efficacy, hope, and well-being. In response to the knowledge, skills, and attitudes gained through NatureMapping, the students may become more engaged in school, the environment, and the community. Students may work harder at school, develop new hobbies and interests, and act on their environmental and social concerns. Overall, NatureMapping should contribute to students' personal and social developments.

Many of the potential effects of The NatureMapping Program rely on the details of the Program's implementation at the schools. From school to school, the NatureMapping activities and educational and community support can vary widely. For these reasons, this thesis conducted case studies of six schools' involvement with NatureMapping. The characteristics of the six schools' NatureMapping programs are described next.

School Implementation of The NatureMapping Program

The case study research demonstrated The NatureMapping Program's flexibility in suiting individual school and community needs. Student participants ranged from kindergarten to twelfth grade, and many schools' NatureMapping activities involved multiple grades making observations together. The number of students involved in NatureMapping at each school ranged from 30 to 300. Students spent from 2 to 6 hours each year NatureMapping in the field, sometimes individually and sometimes as groups. On occasion, parents, community members, or experts accompanied the students during The NatureMapping outings. NatureMapping sites included school grounds, field trip sites, and the students' homes. The use of NatureMapping at the schools varied

from serving as an ad hoc, beginner-level activity within a well-developed, project-based environmental learning program to serving as the defining theme and information source for a community newspaper. Although NatureMapping was usually adopted into science curriculum, teachers often took the opportunity to integrate many other subjects and skills. Within the case study schools, the middle grade programs had most curriculum and project integration around NatureMapping. The teachers motivated the activities by discussing the use of the students' data in statewide efforts for biodiversity protection, but because NatureMapping activities were usually performed for one year only and concentrated in the spring, the students did not typically receive feedback from The NatureMapping Program regarding their observations. In some cases, Ms. Dvornich provided either in person or through reports the importance of the students' data and feedback on previous classes' work.

Profile of Students

An adjunct result of the 79 student interviews was a qualitative description of Washington student thoughts, feelings, and activities. The student responses that were not significantly different as a result of The NatureMapping Program indicated student views on their communities/natural environments and environmentally/socially responsible actions. The interviews with the students who had not participated in NatureMapping also provided their general impressions of community service and outdoor education activities. The results summarized in this section provide the context in which to interpret the apparent effects of The NatureMapping Program discussed in the next section.

When asked to describe their communities and natural environments, the students gave holistic accounts. The community descriptions contained similar response frequencies in the categories of social aspects, the built environment, and general aspects. Many students (41%) included mention of the natural environment when asked to describe their community. When the students were specifically asked to describe their natural environment, 80% provided an ecological or landscape view, 62% discussed the human relationship with nature, and 53% relayed the condition of the natural environment. When asked to describe the condition of their natural environments, the students most often discussed the levels of urbanization (54%) and development (51%). Pollution or trash was mentioned by 35% of the students. Although the students were not specifically asked how they feel about their natural environments, 33% said that they enjoy the natural environment, 28% expressed concern over its condition, and 24% described their visits to natural areas.

The holistic views carried over into the student responses regarding maintaining or improving the good things about their communities and their natural environments. When students were asked how this could generally be done, planning/policy and community action approaches dominated at 59% and 52%, respectively. Thirty-five percent of the students described individual actions. When asked about their role in doing these things, community action and individual actions led with 59% and 56%, respectively. Forty-one percent said that they had a role in planning/policy approaches. When asked what the student does to help maintain or improve the good things, 51% said that they were involved in community action, 49% said individual actions, and 23% described planning/policy involvement. The most popular individual action, picking up

trash, was reported by 42% of the students. Twenty-one percent of the students said that they do not do anything environmentally or socially responsible.

The students were asked to state what outdoor education or community service activities in which that have been involved. Only 3% of the students said that they had not participated in any of these types of activities. Not including the NatureMapping activities, the most common type of activity was categorized as “nature study, survey, research or testing,” with 54% having participated. This type of activity was usually coordinated through the students’ schools. Again excluding the NatureMapping activities, the students had participated in activities involving the outdoors (86%) and educational objectives (71%). Fifty-seven percent of the students had been involved in environmental service activities (not including NatureMapping). When asked to describe what effects the activities had on them, in addition to focusing on what they learned, 58% of the students said that their experiences were fun, interesting, or rewarding. The other common responses to these questions were statistically different between the NatureMapping and non-NatureMapping students and are discussed in the next section.

Effects of The NatureMapping Program on Students

The primary source of information regarding the effects of The NatureMapping Program on the participating students was the student interviews. As the previous section alluded, the similarities between the NatureMapping and non-NatureMapping student interview results were much more common than the differences. In this regard, The NatureMapping Program appears to have limited impact on the students beyond the students’ baseline involvement with other community service and outdoor education activities.

This should not be surprising given two factors: (1) the relatively high baseline level of exposure to other community service and outdoor education activities and (2) the very short periods of time (a few hours per year, usually for only one year) that the students spend in the field conducting NatureMapping observations. By the same token, the differences are remarkable given these factors. Some of these observed effects resulted from the classroom time devoted to activities related to NatureMapping and some resulted from the uniqueness of the NatureMapping outings.

Most of the differences between the NatureMapping and non-NatureMapping student responses occurred when the students were directly asked about the effects of either The NatureMapping Program or other outdoor education/community service activities. The most significant exception was when the students were asked to describe what actions could be taken to maintain or improve the good things about their communities and natural environments. Significantly more NatureMapping students mentioned community involvement as an approach, and the specific methods tended to match the features of the students' NatureMapping projects. Thus, this effect may not be present if the NatureMapping activities are not framed within a project.

When directly asked about The NatureMapping Program, the significant responses represented what the students had learned in the areas of general nature, the diversity of the local environment, and observation, research, or testing skills. In fact, 76% of the students stated that NatureMapping was important because it taught participants about nature. As an indication of what The NatureMapping Program does not accomplish compared to the generic outdoor education/community service activity, significantly more non-NatureMapping students reported that their experiences

increased their awareness of trash, taught them recreation skills, and exposed them to hard work.

Although the student interviews were designed to be receptive to most if not all of the predicted effects of The NatureMapping Program based on the supporting initiatives, many of these effects were not observed. It should be emphasized again, though, that these results indicate the effects of the NatureMapping above the effects from the students' exposure to other community service and outdoor education activities. If The NatureMapping Program had been the only outdoor education/community service activity that in which the students had participated, the observed effects may have been more substantial.

The secondary sources of information regarding the effects of The NatureMapping Program on the student participants were the teacher and community member interviews, the class observations of NatureMapping activities, and reviews of the schools' NatureMapping project products. The teacher and community member interviews supported the findings from the student interviews, mainly that the students gained knowledge of nature and learned observation and recording skills. To a lesser degree, the teachers and community members said that the students learned about their local communities and agencies, about the impacts human activities have on nature, how to ask questions, and how to analyze and communicate results. In terms of changes in student attitudes and behaviors, the teachers and community members thought that the students believed that their NatureMapping results were useful to others, that NatureMapping heightened the students' sense of environmental stewardship, and that the students enjoyed the NatureMapping outings. Although the class observation notes

or the schools' NatureMapping project were not analyzed in great detail, these sources of information appear to support the findings above.

When asked to describe the strengths of The NatureMapping Program, the teacher and community member responses provided additional insights into the potential reasons for the observed student effects. The most common strength given was that The NatureMapping Program is "real," i.e., it has goals and objectives beyond education. As a result, the teachers thought that the students put more effort into the NatureMapping tasks because other people would use the results. In addition, the experiential aspects of the Program were considered strengths, especially because of the positive effects it had on students who were not excelling in the traditional academic settings and for the involvement of students in scientific study. The teachers also frequently mentioned that the Program addressed the state's essential academic learnings.

To summarize, The NatureMapping Program was deemed more effective at teaching the students to notice and have knowledge of their natural environments than were the students' typical experiences with other outdoor education or community service activities. In other words, the students, teachers, and community members thought that the Program increased the students' ability to answer the first question associated with environmental literacy, "What do we have where we live?" We now turn to the findings for the schools and communities.

Effects of The NatureMapping Program on Schools and Communities

The most obvious effects of The NatureMapping Program on the schools and communities studies were the activities and products of the schools' NatureMapping projects. The Waterville Elementary School program involved farmers and contributed to

the scientific knowledge on short-horned lizards. The Sakai Intermediate School program provided the Bainbridge Island Land Trust and the City of Bainbridge Island with yearly data on wildlife use of the Island's nature corridors. The Orchard Prairie School program submitted several years of NatureMapping data for inclusion in the Environmental Impact Statement for a road realignment. The Chase Middle School program published three annual issues of a watershed-based newspaper. The Evergreen High School program determined the flora and fauna at a local lake. The North Mason High School program documented wildlife presence in the Hood Canal Wetlands.

The teacher and community member interviews illuminated the general school and community effects. According to the teachers, the most significant effect that The NatureMapping Program had on the schools was to improve the communities' impressions of the schools and their students. Likewise, when asked about the effects on the community, the teachers and community members cited "more interaction between school and community" most often. The next most common responses regarding effects on the community were the results of the specific projects and the indirect effects on the students' parents. In terms of the effects of the Program on the teachers and community members themselves, many said that they found NatureMapping to be enjoyable or interesting and that they appreciated the networking between teachers, experts, community members, and agency staff.

Recommendations

The recommendations for improvement of The NatureMapping Program at the national, state, and local levels were developed through several means. First, the

teachers, community members, and students were directly asked how The NatureMapping Program could be improved. Second, the teachers and community members were asked to describe the barriers and threats to, and weaknesses of, The NatureMapping Program. Some of the recommendations below are potential responses to those stated barriers, threats, and weaknesses. Third, based on the findings and results of this research, this thesis offers some ideas.

Implementation at the National and State Levels

1. When describing the Program to teachers and administrators, emphasize the Program's strengths as identified in this thesis: (1) NatureMapping is a "real" program that improves student effort and learning; (2) NatureMapping theoretically and substantively addresses essential academic learning requirements (EALRs); and (3) NatureMapping has the flexibility to meet any teacher's needs. With regard to (3), show how NatureMapping can be used by itself, be the basis for a project, or be incorporated into an existing project.
2. Provide teachers with advice on how to address their funding and resource needs, the main barrier facing the schools.
3. Redesign the NatureMapping data management system so that it is very easy for teachers and community members to enter, retrieve, and analyze their own data. For example, Excel is an easy and common spreadsheet program that could be used. Many teachers and community members did not like the current FoxPro method of managing the data, because the program is not common, user friendly, or well understood by the teachers.

4. Provide teachers, students, and community members with more feedback regarding The NatureMapping Program's use of their data and the data of others.
5. Provide teachers, students, and community members with advice on how to put their NatureMapping data to use in their communities. This should include ways to improve or address data validity concerns.
6. Continue to offer workshops. Teachers receive very little training on experiential education or service learning, so the workshops are a strong asset. Workshops are also an effective way of first "hooking" teachers.
7. Establish systems for allowing students to submit non-wildlife data such as for invertebrates and plants. This data may not have immediate use by The NatureMapping Program, but allowing the participants to submit these types of data would be rewarding for them.
8. A regular newsletter from The NatureMapping Program could contain articles addressing many of these recommendations and have additional benefits. The newsletter could profile school programs, answer frequently asked questions, and describe the status and use of the statewide databases. A newsletter would provide ongoing support to teachers long after they have attended the NatureMapping workshops.

Implementation at the School Level

1. Place NatureMapping activities within a larger study of the local ecology and the community. When preparing the students for their NatureMapping activities, teachers should focus on ecological concepts, observation skills, and environmental planning methods.

2. Emphasize the experiential and service aspects of NatureMapping, especially through involving more professionals and other non-students.
3. Tailor the NatureMapping activities to fit the students' grade level. The younger students do not have the attention spans and discipline to make difficult observations (e.g., identifying birds in flight or far away in a pond). Younger students become excited being outside, and although this excitement should be controlled, it should not be squelched; nor should the young students run free and unfocused. Give the older students more freedom, but have higher expectations regarding the effort and attention to detail.
4. Modify NatureMapping outings by increasing their frequency, duration, and number of locations. Ask the students for their input regarding these changes. Pick sites where the students will most likely see some wildlife, e.g., ponds or the edges of forests. This offers immediate gratification and confirmation of their observation skills.
5. NatureMapping outings should occur in small groups led by people with the ability to direct the students' attention to the task and to assist in the identification of species. The guides do not have to be experts, but they should have some minimal skills. The small group setting allows quiet and focused nature observation, but provides the support and encouragement of others. Moreover, the school strengthens their relationship with the guides (parents, volunteers, agency staff, etc.) in the process.
6. Find ways to increase the students' enjoyment of NatureMapping without jeopardizing the wildlife observation and data collection aspects. Perhaps this can be accomplished by taking the students outside for nature tours and

exploration before they begin NatureMapping. Enjoyment may also be fostered by making NatureMapping a more social experience by incorporating aspects of planning at the beginning and recognition/reflection at the end.

7. Allow time and support for students to analyze, interpret, and apply their NatureMapping data. Stress the usefulness of the data, especially at the community level.
8. Link the NatureMapping activities and data to community planning efforts.

Suggestions for Further Research

This thesis provides a glimpse of the impacts of the NatureMapping K-12 program. Because empirical studies into the effects of similar programs were limited, research methodology that could detect and present a broad spectrum of impacts was used – a first pass of sorts. With the results of this study in hand, it is time to consider the next steps.

This thesis restricted its scope to The NatureMapping Program as represented by six exceptional school programs in Washington. A larger study of The NatureMapping Program, perhaps at the national level, could refine and increase the confidence levels of these findings and provide additional tools for analysis. For example, the effects of the program elements (e.g., length of time in the field) or the obscuring effects of other programs could be examined. A larger study could use similar methods as this thesis, but take measures to address the limitations.

The most important finding in this thesis was that The NatureMapping Program reportedly increased the students' knowledge of local nature, the first step in developing environmental literacy. This result was based on the opinions of students, teachers, and

community members who had participated in NatureMapping. An important next step could be to test the students' knowledge or examine the results of statewide standardized testing in the areas that The NatureMapping Program is expected to affect.

This thesis investigated the effects of The NatureMapping Program as reported by the students one year after their participation and by the teachers and community members at the time of participation. Further research could investigate the effects of the Program years later when the former participants have become adults and are more able to act and reflect on their environmental knowledge, skills, and attitudes.

Finally, this study was limited to the effects of The NatureMapping Program on its grade school-based participants and associated local communities. Other research could be undertaken to determine the effects of the Program on its adult, volunteer participants or to examine the use of the NatureMapping data at the state or regional levels.

APPENDIX A

LETTERS OF CONSENT

May 5, 2000

Sakai Intermediate School
9530 NE Sportsman Club Rd.
Bainbridge Island, WA 98110

Dear Principal Vander Stoep:

Your school is invited to participate in a research study conducted by Kathryn Frank, a graduate student from the University of Oregon Department of Planning, Public Policy and Management. I hope to learn about the effects of the Washington NatureMapping Program on its grade school participants, their schools, and their communities and report these findings in my masters thesis. Your school was selected as a possible case study because one of your school's teachers, Mr. Tom Leigh, and his sixth grade students have participated in the NatureMapping Program.

If your school decides to participate in this study, your school will be involved in five research components taking place during May and June, 2000:

?? I will obtain Mr. Leigh's informed consent to participate in this study (see attached). If he chooses to participate, I will interview him in person at his convenience at your school for about 45 minutes. I will provide him with the interview questions (attached) in advance. These questions will focus on your school's involvement with the NatureMapping Program. If he approves, I will audiotape the interview so that it may be accurately recorded. His letter of informed consent will offer him the option of maintaining confidentiality.

?? If Mr. Leigh is leading his students in NatureMapping activities at the time of my visit(s), I will observe the activities and take field notes. None of the students observed will be interviewed or identified by name in my notes.

?? Since I wish to interview students who were involved in NatureMapping activities at your school during the 1998-99 school year (as well as comparable students who were not involved), I have contacted Woodward Middle School to obtain permission and assistance to involve these students in this study. I will ask for your school's assistance in verifying whether the students selected by Woodward Middle School participated in NatureMapping activities last year.

?? If direct or indirect assessments of your NatureMapping activities have been performed, I will ask permission from your school to obtain the summarized results.

?? Since I wish to interview community members and others who have assisted with your school's NatureMapping activities, I will ask your school to send such persons (as identified by Mr. Leigh) letters of consent (example attached) to participate in this

study. If they reply with an interest in being interviewed, I will contact them and schedule an interview at their convenience. The community member interview questions are attached.

I expect this study to benefit future participants of the NatureMapping Program and similar programs. The study will also provide information to better understand community and regional planning, educational initiatives, and human psychology. However, I cannot guarantee that your school will receive any benefits from this research. After my thesis is completed (in August), I will send you a summary of the results.

If I may conduct this study at your school, **please reply to me (as soon as possible) at the address below with a letter on your school's letterhead stating that you:**

1. **have reviewed the study protocol as described in this letter,**
2. **agree to allow me to conduct the study at your school, and**
3. **will ensure that all applicable standards for maintaining the rights of persons involved in research are met (for example, confidentiality and informed consent).**

If your school or district requires changes or additions to the study protocol, indicate what they are in your letter to me. If approval must be given by another entity (for example, the school district), please let me know and I will contact them.

If you have any questions, please feel free to contact me at (541) 481-9494, 1209 University of Oregon, Eugene OR 97403-1209. You may also contact my thesis advisor, Dr. Michael Hibbard at (541) 346-3897, at the same address. Thank you for your assistance.

Sincerely,

Kathryn Frank
Masters Candidate
Community and Regional Planning

May 5, 2000

Sakai Intermediate School
9530 NE Sportsman Club Rd.
Bainbridge Island, WA 98110

Dear Mr. Leigh:

You are invited to participate in a research study conducted by Kathryn Frank, a graduate student from the University of Oregon Department of Planning, Public Policy and Management. I hope to learn about the effects of the Washington NatureMapping Program on its grade school participants, their schools, and their communities and report these findings in my masters thesis. You were selected as a possible participant in this study because you and your students have been involved in the NatureMapping Program. I contacted Principal Vander Stoep and have requested approval from her to conduct this research study at your school if you choose to participate.

If you decide to participate, you will be involved in three components:

1. At your convenience, I will interview you in person at your school for about 45 minutes. I will provide you with the interview questions in advance. These questions will focus on your school's involvement with the NatureMapping Program. I will ask for your opinion of the Program and what you think its effects have been. If direct or indirect assessments of your NatureMapping experience have been performed, I will ask permission from your school to obtain the summarized results. If you approve, I will audiotape the interview so that it may be accurately recorded. I will also ask for referrals to community members and others who have assisted with your NatureMapping activities so that I may interview them. Your school will send them the informed consent forms that I prepare, and I will contact them with their permission.

2. If you are leading NatureMapping activities at the time of my visit(s), I will observe the activities and take field notes. None of the students observed will be interviewed or identified by name in my notes.

3. I will interview several students who were involved in your NatureMapping activities last school year (1998-99) and several students who were not involved with NatureMapping (with their current school's permission and the permission of their parents/guardians). I will ask for your assistance in verifying whether the students selected for interviews participated with you in the NatureMapping Program last school year.

I expect this study to benefit future participants of the Washington NatureMapping Program and similar programs. The study also provides information to better understand

community and regional planning, educational initiatives, and human psychology. However, I cannot guarantee that you personally will receive any benefits from this research. After my thesis is completed, I will send you a summary of the results.

If you choose, any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. I would accomplish this by using a code list to match you with your interview audiotape and transcript and by applying a pseudonym to any of your responses described in the thesis report.

Regardless of your interest in maintaining confidentiality, the audiotape of your interview (if taken) will be destroyed upon completion of the thesis report (in August 2000), and I will not permit others to access your interview transcript unless you give additional written approval for me to do so at the time of the request. I may use the study results in published papers or presentations related to my thesis topic and will seek additional approval from you as is appropriate for such dissemination.

Your participation is voluntary. Your decision whether or not to participate will not affect your relationship with your school, the Washington NatureMapping Program, or any other institution. If you decide to participate, you are free to withdraw your consent and discontinue participation at any time without penalty.

If you have any questions, please feel free to contact me at (541) 481-9494, 1209 University of Oregon, Eugene OR 97403-1209. You may also contact my thesis advisor, Dr. Michael Hibbard at (541) 346-3897, at the same address. If you have any questions regarding your rights as a research study participant, contact Human Subjects Compliance, (541) 346-2510, University of Oregon, Eugene OR 97403.

A copy of this form is provided for you to keep.

Sincerely,

Kathryn Frank

Your signature indicates that you have read and understand the information provided above, that you willingly agree to participate, that you may withdraw your consent at any time and discontinue participation without penalty, that you will receive a copy of this form, and that you are not waiving any legal claims, rights or remedies.

Signature_____ Date_____

SIGN ONLY IF YOU DESIRE CONFIDENTIALITY:

Your signature below indicates that you wish for any information that is obtained in connection with this study and that can be identified with you to remain confidential and be disclosed only with your permission or as required by law.

Signature_____ Date_____

May 5, 2000

Bainbridge Island Land Trust
P.O. Box 10144
Bainbridge Island, WA 98110

Dear Ms. Waddington:

You are invited to participate in a research study conducted by Kathryn Frank, a graduate student from the University of Oregon Department of Planning, Public Policy and Management. I hope to learn about the effects of the Washington NatureMapping Program on its grade school participants, their schools, and their communities and report these findings in my masters thesis. You were selected as a possible participant in this study because you were involved with the Sakai Intermediate School NatureMapping activities last school year.

If you decide to participate, I will contact you and, at your convenience, interview you in person at a location of your choosing for about 30 minutes. I will provide you with the interview questions in advance. These questions will focus on your involvement with the school's NatureMapping project. I will ask your opinion of the project and what you think its effects have been. If you approve, I will audiotape the interview so that it may be accurately recorded.

I expect this study to benefit future participants of the Washington NatureMapping Program and similar programs. The study also provides information to better understand community and regional planning, educational initiatives, and human psychology. However, I cannot guarantee that you personally will receive any benefits from this research. After my thesis is completed, I will send you a summary of the results.

If you choose, any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. I would accomplish this by using a code list to match you with your interview audiotape and transcript and by applying a pseudonym to any of your responses described in the thesis report.

Regardless of your interest in maintaining confidentiality, the audiotape of your interview (if taken) will be destroyed upon completion of the thesis report (in August 2000), and I will not permit others to access your interview transcript unless you give additional written approval for me to do so at the time of the request. I may use the study results in published papers or presentations related to my thesis topic and will seek additional approval from you as is appropriate for such dissemination.

Your participation is voluntary. Your decision whether or not to participate will not affect your relationship with Sakai Intermediate School, the Washington NatureMapping

Program, or any other institution. If you decide to participate, you are free to withdraw your consent and discontinue participation at any time without penalty.

If you have any questions, please feel free to contact me at (541) 481-9494, 1209 University of Oregon, Eugene OR 97403-1209. You may also contact my thesis advisor, Dr. Michael Hibbard at (541) 346-3897, at the same address. If you have any questions regarding your rights as a research study participant, contact Human Subjects Compliance, (541) 346-2510, University of Oregon, Eugene OR 97403.

A copy of this form is provided for you to keep.

Sincerely,

Kathryn Frank
Masters Candidate
Community and Regional Planning

Your signature indicates that you have read and understand the information provided above, that you willingly agree to participate, that you may withdraw your consent at any time and discontinue participation without penalty, that you will receive a copy of this form, and that you are not waiving any legal claims, rights or remedies.

Signature_____ Date_____

Please give a phone number where Kathryn Frank may reach you:

_____ and indicate the best time for her to call _____

Please return the signed form to Kathryn Frank, 1209 University of Oregon, Eugene OR 97403-1209 as soon as possible. Thank you.

SIGN ONLY IF YOU DESIRE CONFIDENTIALITY:

Your signature below indicates that you wish for any information that is obtained in connection with this study and that can be identified with you to remain confidential and be disclosed only with your permission or as required by law.

Signature_____ Date_____

May 23, 2000

Dear Parent or Guardian:

Your child is invited to participate in a research study conducted by Kathryn Frank, a graduate student from the University of Oregon Department of Planning, Public Policy and Management. I hope to learn about the effects of the Washington NatureMapping Program on its grade school participants, their schools, and their communities and report these findings in my masters thesis. Your child was selected as a possible participant in this study because he/she participated in NatureMapping activities at Woodward Middle School last year.

If you decide to allow your child to participate in this study, at your child's convenience, I will interview him/her at Woodward Middle School for about 15 minutes. The interview questions will focus on your child's general understanding of your community and environment and his/her involvement with the NatureMapping project. If you and your child approve, I will audiotape the interview so that it may be accurately recorded. Before beginning the interview, I will ask your child if I have his/her permission to interview and/or audiotape him/her. A copy of the letter that will be read and presented to your child is attached.

I expect this study to benefit future participants of the Washington NatureMapping Program and similar programs. The study also provides information to better understand community and regional planning, educational initiatives, and human psychology. However, I cannot guarantee that you personally or your child will receive any benefits from this research. After my thesis is completed, I will send you a summary of the results.

Any information that is obtained from your child in connection with this study and that can be identified with your child will remain confidential and will be disclosed only with your permission or as required by law. I would accomplish this by using a code list to match your child with his/her interview audiotape (if taken) and transcript and by applying a pseudonym to any of your child's responses described in the thesis report. The audiotape of your child's interview and the code list will be destroyed upon completion of the thesis report (in August 2000). I will not permit others to access your child's interview transcript unless you and your child give additional written approval for me to do so at the time of the request. I may use the study results in published papers or presentations related to my thesis topic and will seek additional approval from you and your child as is appropriate for such dissemination.

Your decision to allow your child to participate is voluntary and will not affect your own or your child's relationship with Woodward Middle School, the Washington NatureMapping Program, or any other institution. If you decide to allow your child to

participate, you are free to withdraw your consent and discontinue his/her participation at any time without penalty.

If you have any questions, please feel free to contact me at (541) 481-9494, 1209 University of Oregon, Eugene OR 97403-1209. You may also contact my thesis advisor, Dr. Michael Hibbard at (541) 346-3897, at the same address. If you have any questions regarding your rights and your child's rights as a research study participant, contact Human Subjects Compliance, (541) 346-2510, University of Oregon, Eugene OR 97403.

A copy of this form is provided for you to keep.

Sincerely,

Kathryn Frank
Masters Candidate
Community and Regional Planning

Your signature indicates that you have read and understand the information provided above, that you willingly agree to allow your child to participate, that you may withdraw your consent at any time and discontinue your child's participation without penalty, that you will receive a copy of this form, and that you are not waiving any legal claims, rights or remedies.

Signature_____ Date_____

Please print your name: _____

Please print your child's name: _____

And initial next to your choice:

My child's interview MAY_____ or MAY NOT _____ be audiotaped.

Please return the signed form to your child's school as soon as possible. Thank you.

May 8, 2000

Dear Parent or Guardian:

Your child is invited to participate in a research study conducted by Kathryn Frank, a graduate student from the University of Oregon Department of Planning, Public Policy and Management. I hope to learn about the effects of the Washington NatureMapping Program on its grade school participants, their schools, and their communities and report these findings in my masters thesis. The Washington NatureMapping Program is an experiential, environmental education program. Your child was selected as a possible participant in this study because he/she has not participated in the NatureMapping Program.

If you decide to allow your child to participate in this study, at your child's convenience, I will interview him/her at Hyla Middle School for about 30 minutes. The interview questions will focus on your child's general understanding of your community and environment. If you and your child approve, I will audiotape the interview so that it may be accurately recorded. Before beginning the interview, I will ask your child if I have his/her permission to interview and/or audiotape him/her. A copy of the letter that will be read and presented to your child is attached.

I expect this study to benefit future participants of the Washington NatureMapping Program and similar programs. The study also provides information to better understand community and regional planning, educational initiatives, and human psychology. However, I cannot guarantee that you personally or your child will receive any benefits from this research. After my thesis is completed, I will send you a summary of the results.

Any information that is obtained from your child in connection with this study and that can be identified with your child will remain confidential and will be disclosed only with your permission or as required by law. I would accomplish this by using a code list to match your child with his/her interview audiotape (if taken) and transcript and by applying a pseudonym to any of your child's responses described in the thesis report. The audiotape of your child's interview and the code list will be destroyed upon completion of the thesis report (in August 2000). I will not permit others to access your child's interview transcript unless you and your child give additional written approval for me to do so at the time of the request. I may use the study results in published papers or presentations related to my thesis topic and will seek additional approval from you and your child as is appropriate for such dissemination.

Your decision to allow your child to participate is voluntary and will not affect your own or your child's relationship with Hyla Middle School, the Washington NatureMapping Program, or any other institution. If you decide to allow your child to participate, you are

free to withdraw your consent and discontinue his/her participation at any time without penalty.

If you have any questions, please feel free to contact me at (541) 481-9494, 1209 University of Oregon, Eugene OR 97403-1209. You may also contact my thesis advisor, Dr. Michael Hibbard at (541) 346-3897, at the same address. If you have any questions regarding your rights and your child's rights as a research study participant, contact Human Subjects Compliance, (541) 346-2510, University of Oregon, Eugene OR 97403.

A copy of this form is provided for you to keep.

Sincerely,

Kathryn Frank
Masters Candidate
Community and Regional Planning

Your signature indicates that you have read and understand the information provided above, that you willingly agree to allow your child to participate, that you may withdraw your consent at any time and discontinue your child's participation without penalty, that you will receive a copy of this form, and that you are not waiving any legal claims, rights or remedies.

Signature_____ Date_____

Please print your name: _____

Please print your child's name: _____

And initial next to your choice:

My child's interview MAY_____ or MAY NOT _____ be audiotaped.

Please return the signed form to your child's school as soon as possible. Thank you.

CHILD'S ASSENT

May 24, 2000

“Student Wildlife Monitoring: A Study of the Effects of the Washington NatureMapping Program on its Grade School Participants and Their Communities” - Thesis research conducted by Kathryn Frank, University of Oregon.

Child's name:_____

I am interested in helping kids learn about their communities and the natural environment, and I'd like for you to help me. I'd like to ask you several questions. All you have to do is say as much or as little as you like to answer them. There are no right or wrong answers, so there won't be any grade. Since I won't use your name when I share the results of my study, no one except me will know that the answers you give are yours. [If parent allows audiotaping, include the following:] If it is o.k. with you, I will audiotape our conversation so that I can most accurately recall what we said.

At any time, you can ask me to explain what a question means. Answering all of my questions will take about 15 minutes, but you can rest as much as you like, and you can stop answering whenever you want. In fact, if you don't want to answer any questions at all, you don't have to. Just say so. Also, if you have any questions about this, or if you can't decide whether to do it or not, just ask me if there is anything you'd like me to explain.

If you want to answer the questions, please sign your name on the line below. Your parent(s) have already told me that it is alright with them if you answer my questions. Remember, you don't have to, and once you start you can rest or stop whenever you like.

Signed:_____ Date:_____

[If parent allows audiotaping, include the following:]

And, write your initials next to your choice:

It is O.K. _____or NOT O.K. _____ for this conversation to be audiotaped.

APPENDIX B

STUDENT INTERVIEW CODING

The responses to each student interview question were coded to facilitate comparison between subgroups and to allow quantitative and statistical analysis. The comment categories were chosen through an informal three-step process. During the first step, the experiences of interviewing and transcribing produced substantial familiarity with the types of responses and directed the creation of general groups of categories for each question. For example, the general groups of categories for question 1 are: built environment, natural environment, social, and general. Since sets of questions elicited similar responses, the general groups of categories were standardized when possible.

During the second step, responses were reviewed one question at a time across all the students. This focused on the context of the question and not individual student interviews in their entirety. This allowed more consistent coding within the context of each question. The responses for each question were read beginning with the 13 ninth grade students from Ferris High School (Chase Middle School case study) and running through all the students grouped by school. The Ferris student group was a good starting point because their age group was roughly the median for the entire sample and contained both NatureMapping and non-NatureMapping students.

The comment categories were chosen to allow the responses to maintain their main concepts. Mutually exclusive categories were chosen whenever possible. Based on the responses, a few categories overlap. In such cases, the category that best fits with the response is used. For example, questions 4, 5, and 6 have overlapping categories “leave alone” and “protection” as ways in which the good things can be maintained or improved. Two separate categories were needed so that no assumptions were made and that the core concepts were expressed.

The comment categories were created and placed within the general groups of categories as the student interviews were read. Most of the comment categories were in place after reviewing the responses from the first third of the students. As later students identified categories representing important concepts or differences from the existing categories, they were added. A spreadsheet was used to record student responses with each row representing a student, e.g., Ferris01, and each column representing a comment category. Symbols were then added to match the student to the corresponding comment category. Although not discussed in this thesis, responses within each comment category were coded to represent quantitative or qualitative aspects of the response: “low,” “medium,” or “high” or “bad,” “average,” or “good,” respectively. If the response did not indicate a quantitative or qualitative aspect, it was coded with an “X.”

During coding, every attempt was made to not make assumptions about what the student was saying. For example, a mention of the scotch broom plant does not necessarily mean that the student recognized it as a non-native (and thus potentially disruptive) plant. Thus, unless the student specifically addressed the concept of its place in the ecosystem, the response was categorized as “Plants – specific” rather than “Exotic species.” It is also important to note that a single sentence may, and usually does, contain several concepts. Thus, a single sentence may be coded into several categories. But, strict attention was paid to not allow the concepts to be represented more than once in the coding. For example, mention of a forest falls under “Landscape” and not “Plants – general.” On a few occasions, a student’s intent was ambiguous and the student’s responses to other questions were reviewed to gain additional context for assistance in interpretation. Rarely were assumptions made about what a student meant, and in those cases it was done with much supporting evidence. In no case was a

response extrapolated to other concepts. In cases where the student went beyond answering the question at hand, the responses were still coded for the question that had just been asked. This situation was common because several sets of similar questions exist. For example, in response to question asking for a description of the natural environment, the student may offer an explanation of its condition, the focus of the third question. Later, during the data analysis phase, the results were consolidated across similar questions.

Two types of responses were ignored in the coding. The first was “I don’t know” when it preceded a substantive answer to the question. In these cases, “I don’t know” served as filler until the student had a chance to think about what he or she wanted to say. If a student only said “I don’t know” it was coded in the “Don’t know” category. The second type of response ignored in the coding was small that had nothing to do with the interview questions. Small talk during the interviews was infrequent and did not distract the interview process. Occasionally, a student would not be asked one or more questions. In this case, the “Not asked” category was used.

For the third step, the results were reviewed as a whole. The comment category names were reviewed for consistency and clarity, and a few revisions occurred. Comment categories receiving only one entry for a given question were consolidated into an “other” category.

The reader’s general understanding of the short description of each comment category should suffice. For each comment category, it represents a response with that element, but it does not presume any qualitative or quantitative aspects. For example, “rate of development,” a comment category that appears in the coding for questions 1, 2, and 3, can contain responses that indicate a high or low, or good or bad, rate of

development. In some cases, the comment category has qualitative connotations, such as “clean” for question 1. Responses falling within these categories generally had the corresponding qualitative connotations, but the categories did not exclude the opposite, e.g., “polluted.”

APPENDIX C

TEACHER AND COMMUNITY MEMBER INTERVIEW RESPONSES

Teacher and Community Member Responses to: What Barriers or Threats Has Your NatureMapping Program Faced?

Comment	Number of Teachers Making Comment (n=8)	Number of Community Members Making Comment (n=6)
Lack of funding and resources	4	4
Others think it does not meet curriculum or testing goals	3	1
Amount of energy needed	2	
Amount of time needed	1	
Lack of administration support	1	
If only a portion of students participate, must figure out what to do with the rest	1	
Others think it pushes students too hard	1	
Others cannot recognize the program's flexibility		1
Some concern for endangered species and private property		1

Teacher and Community Member Responses to: What Effects Do You Think Your NatureMapping Program Has Had on the Participating Students?

Comment	Number of Teachers Making Comment (n=8)	Number of Community Members Making Comment (n=6)
Knowledge		
Wildlife and other aspects of nature	3	3
Local community and agencies	3	1
Human impacts on nature	2	2
Ecological principles	1	3
Changes over time (years, seasons)	2	1
Local environment	2	
Importance of the data	1	1
Careers	1	1
Ecological terminology		1
Importance of accurately recording data		1
Skills		
Observation and recording	3	3
Asking questions	2	2
Analytic and communication	1	3
Technology	2	
Able to apply concepts	1	
Attitude		
Feel like they are doing something useful	4	3
Environmental ethic or sense of stewardship	4	2
Enjoy going outside, looking at wildlife	3	2
More interested in learning	2	1
Pride in product (e.g., newspaper)	2	1
Enjoy learning skills	1	1
Greater appreciation for local nature		1
Behavior		
More observant in everyday life	2	1
Work harder	2	
Talk the their parents about activities	1	
Overall		
Better learning through experiential, service, or project aspects	4	
See connections between studies and real world	1	

Teacher and Community Member Responses to: What Effects Do You Think Your NatureMapping Program Has Had on the School?

Comment	Number of Teachers Making Comment (n=8)	Number of Community Members Making Comment (n=6)
Community has better image of school and students	5	
Provided ready-made activities	2	
Led to participation in other outdoor education activities	1	1
Brings school together	1	
Connects school with parents	1	
Educates teachers about nature		1

Teacher and Community Member Responses to: What Effects Do You Think Your NatureMapping Program Has Had on the Community?

Comment	Number of Teachers Making Comment (n=8)	Number of Community Members Making Comment (n=6)
More interaction between school and community	5	4
Results of specific project	4	3
Indirectly affects parents (students talk to parents)	2	3
Educates community	3	
Directly involves parents (parents help students)	1	1
Shows scientific community that citizens know their land and local nature		1

Teacher and Community Member Responses to: What Effects Do You Think The NatureMapping Program Has Had on You?

Comment	Number of Teachers Making Comment (n=8)	Number of Community Members Making Comment (n=6)
Enjoyable or interesting	3	1
Connect with experts, agencies, community members, teachers	2	2
More aware of nature	2	
Rewarding	1	1
Opened eyes to outdoor education	1	
Opened eyes to technology in education	1	
Challenged to learn and present findings	1	
Enjoyed positive feelings in class	1	
Enjoyed feedback from public	1	
Enjoyed working with students		1

Teacher and Community Member Responses to: What Are the Strengths of The NatureMapping Program?

Comment	Number of Teachers Making Comment (n=8)	Number of Community Members Making Comment (n=6)
Program has goals and objectives beyond education (it is a "real program")	5	1
Addresses state essential learnings (EALRs) or curriculum	5	
Experiential	4	1
Alternative form of learning for kids with different learning styles or discipline problems	4	1
Students participate in "real science"	4	
Outdoors	2	1
Easy and flexible	2	1
Results have scientific or planning value	2	1
Well-organized	1	
Strong leadership	1	
Study immediate surroundings	1	
Students drawn to nature	1	
Ties concepts together	1	
Allows peer tutoring and mentoring	1	
Good starting point for more localized, detailed studies of nature	1	
Gives people an opportunity to express their concern for nature		1
Network of people interested in nature		1
Repetition and extended time frames better than "one-shot" field trips or camps		1

Teacher and Community Member Responses to: What Are the Weaknesses of The NatureMapping Program?

Comment	Number of Teachers Making Comment (n=8)	Number of Community Members Making Comment (n=6)
Data feedback from Program is insufficient	3	2
Gap data not used by school or community	3	1
FoxPro data entry and retrieval is cumbersome	2	1
Suspect data validity		3
Too focused on birds and wildlife, ignores other aspects of ecosystem	1	1
Too focused on data and mapping	1	1
No time to assess meaning of data	1	1
Aspects of data collection are cumbersome		2
Only have students for one year	1	
Lacks rigor of traditional teaching methods	1	
Proper data collection may be too advanced for younger students		1
Cannot map plants; habitat codes not sufficient		1
ArcView too difficult for most teachers		1
Focused on state database rather than on community or ecoregions		1
Biased toward the west side of Washington		1
Large groups of students scare animals away		1

Teacher and Community Member Responses to: How Can The NatureMapping Program Be Improved?

Comment	Number of Teachers Making Comment (n=8)	Number of Community Members Making Comment (n=6)
Provide basic (easy) tools for schools to analyze their data	2	1
Recruit more participants	2	
Provide more teacher training and support	1	1
Be a smaller piece of outdoor education	1	
Make results more public	1	
Incorporate into broad curriculum restructuring	1	
Make new informational video	1	
Provide localized maps of species		1
Provide more lines of communication between schools and community		1
Students should participated over a longer period of time		1
Get parents more involved in helping the students		1

APPENDIX D

STUDENT INTERVIEW RESPONSES

Student Responses to Question 1: What Can You Tell Me about This Community?

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping		Significance Test Confidence Level (only shown if >90%)
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=42)	
Built environment	23	62%	27	64%	
Size of community	8	22%	14	33%	
Variety	1	3%	1	2%	
Degree of urbanization	14	38%	10	24%	
Rate of development	5	14%	12	29%	
Redevelopment	0	0%	1	2%	
Traffic	2	5%	1	2%	
Transportation	2	5%	2	5%	
Distance from other communities	3	8%	3	7%	
Specific neighborhood	4	11%	2	5%	
Natural environment	16	43%	16	38%	
Weather	4	11%	4	10%	
Diversity	1	3%	1	2%	
Wildlife	7	19%	7	17%	
Landscape	13	35%	11	26%	
Conservation	1	3%	1	2%	
Social	25	68%	30	71%	
Population	2	5%	2	5%	
Demographics	6	16%	3	7%	
Interaction	10	27%	11	26%	
Crime	2	5%	7	17%	
Attitudes	4	11%	7	17%	
School	4	11%	4	10%	
Friends	2	5%	1	2%	
Family	0	0%	1	2%	
Activities	6	16%	9	21%	
People in need	1	3%	2	5%	
Family-oriented	1	3%	1	2%	
Economy	5	14%	4	10%	

Governance	1	3%	3	7%	
General	22	59%	28	67%	
Overall assessment of “good”	12	32%	22	52%	>90%
Aesthetics	2	5%	4	10%	
Historic	6	16%	3	7%	
Quiet	4	11%	5	12%	
Clean	3	8%	2	5%	
Don’t know	1	3%	0	0%	

Student Responses to Question 2: What Can You Tell Me about Its [This Community's] Natural Environment?

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping		Significance Test Confidence Level (only shown if >90%)
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=42)	
Plants	12	32%	16	38%	
General	8	22%	13	31%	
Specific	5	14%	4	10%	
Wildlife	22	59%	19	45%	
General	8	22%	10	24%	
Specific	16	43%	15	36%	
Ecology	32	86%	31	74%	
Landscape	17	46%	22	52%	
Habitat	6	16%	9	21%	
Weather	3	8%	4	10%	
Dynamics	3	8%	2	5%	
Diversity	8	22%	8	19%	
Animal behavior	2	5%	0	0%	
Interconnected	5	14%	0	0%	>96%
Specific area	15	41%	13	31%	
Condition	19	51%	23	55%	
Maintained	1	3%	4	10%	
Pollution or trash	2	5%	4	10%	
Urbanization	8	22%	9	21%	
Rate of development	11	30%	10	24%	
Logging	1	3%	1	2%	
Industry	0	0%	1	2%	
Restoration	1	3%	1	2%	
Conservation	3	8%	3	7%	
Domesticated	8	22%	6	14%	
Agriculture	7	19%	3	7%	
Yards and parks	3	8%	2	5%	
Domestic animals	1	3%	2	5%	
Human interaction	22	59%	27	67%	

Assessment of “good”	3	8%	6	14%
Enjoyment	10	27%	10	24%
Aesthetics	2	5%	5	12%
Concern	9	24%	7	17%
Access	8	22%	7	17%
Ecosystem services	0	0%	2	5%
Historic	3	8%	2	5%
Program	4	11%	5	12%
Don’t know	2	5%	2	5%

Student Responses to Question 3: What Condition Is This Community's Natural Environment in?

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping		
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=36)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=41)	Significance Test Confidence Level (only shown if >90%)
Plants	9	25%	2	5%	>98%
General	9	25%	2	5%	>98%
Specific	2	6%	0	0%	
Animals	6	17%	3	7%	
General	3	8%	2	5%	
Specific	5	14%	1	2%	>90%
Ecology	17	47%	19	46%	
Landscape	15	42%	10	24%	
Habitat	1	3%	2	5%	
Weather or seasons	3	8%	2	5%	
Species populations	1	3%	0	0%	
Specific area	11	31%	14	34%	
Condition	26	72%	28	68%	
Maintained	4	11%	2	5%	
Pollution or trash	12	33%	8	20%	
Exotic species	1	3%	0	0%	
Urbanization	8	22%	10	24%	
Rate of development	11	31%	15	37%	
Logging	0	0%	3	7%	>90%
Industry	0	0%	4	10%	>95%
Restoration	3	8%	0	0%	>90%
Conservation	4	11%	8	20%	
Domesticated	6	17%	3	7%	
Agriculture	1	3%	0	0%	
Yards and parks	4	11%	2	5%	
Domestic animals	2	6%	1	2%	
Human interaction	29	81%	38	93%	
Assessment of "good"	11	31%	16	39%	
Assessment of "average"	12	33%	19	46%	

“average”				
Assessment of “bad”	1	3%	1	2%
Enjoyment	3	8%	3	7%
Aesthetics	2	6%	3	7%
Concern	4	11%	5	12%
Access	3	8%	2	5%
Historic	4	11%	1	2%
Program	4	11%	1	2%
Don’t know	1	3%	1	2%

Student Responses to Question 4: How Can the Good Things about This Community and Its Natural Environment Be Maintained or Improved?

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping		
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=42)	Significance Test Confidence Level (only show n if >90%)
Individual actions	15	41%	13	31%	
Pick up trash	8	22%	7	17%	
No littering	5	14%	4	10%	
Recycle	2	5%	0	0%	
Transportation	5	14%	2	5%	
Reduce or reuse	0	0%	1	2%	
Planning and policy	21	57%	26	62%	
Leave alone	2	5%	5	12%	
Laws	1	3%	1	2%	
Development	10	27%	16	38%	
Protection	3	8%	6	14%	
Industry	0	0%	2	5%	
Logging	3	8%	1	2%	
Wildlife	3	8%	2	5%	
Compensate	5	14%	1	2%	>90%
Restoration	1	3%	0	0%	
Inventory	2	5%	4	10%	
Community action	23	62%	18	43%	>90%
Educate	3	8%	5	12%	
Recreation or access	1	3%	2	5%	
Projects	2	5%	1	2%	
Communication	2	5%	0	0%	
Involvement	12	32%	5	12%	>96%
Change attitude	4	11%	1	2%	
More money	2	5%	1	2%	
Maintenance or engineering	7	19%	6	14%	
Practices	2	5%	5	12%	
Create habitat	5	14%	0	0%	>96%
Futile	0	0%	2	5%	
Don't know	2	5%	0	0%	

Student Responses to Question 5: What is Your Role in Doing These Things [to Help Maintain or Improve the Good Things about This Community and Its Natural Environment]?

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping		
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=31)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=35)	Significance Test Confidence Level (only shown if >90%)
Individual actions	15	48%	22	63%	
Pick up trash	10	32%	11	31%	
No littering or polluting	2	6%	7	20%	
Vote	0	0%	5	14%	>96%
Write letter	1	3%	2	6%	
Recycle	2	6%	1	3%	
Transportation	0	0%	1	3%	
Reduce or reuse	0	0%	1	3%	
Garden	2	6%	0	0%	
Planning and policy	15	48%	12	34%	
Leave alone	2	6%	1	3%	
Laws	0	0%	1	3%	
Development	3	10%	5	14%	
Protection	1	3%	2	6%	
Logging	1	3%	0	0%	
Wildlife	4	13%	0	0%	>95%
Inventory	7	23%	4	11%	
Community action	18	58%	21	60%	
Educate	3	10%	5	14%	
Recreation or access	4	13%	1	3%	
Projects	8	26%	5	14%	
Communication	7	23%	9	26%	
Involvement	1	3%	2	6%	
Change attitude	0	0%	1	3%	
Maintenance or engineering	3	10%	2	6%	
Practices	0	0%	1	3%	
Create habitat	3	10%	1	3%	
Don't have a role	1	3%	1	3%	
Don't know	3	10%	2	6%	

Student Responses to Question 6: Do You Do Any of These Things [to Help Maintain or Improve the Good Things about This Community and Its Natural Environment] Now? If So, What?*

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping		
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=36)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=39)	Significance Test Confidence Level (only shown if >90%)
Individual actions	19	53%	18	46%	
Pick up trash	11	31%	13	33%	
No littering or polluting	3	8%	5	13%	
Write letter	1	3%	1	3%	
Recycle	5	14%	3	8%	
Transportation	1	3%	1	3%	
Reduce or reuse	1	3%	0	0%	
Garden	3	8%	0	0%	>90%
Planning and policy	12	33%	5	13%	>96%
Leave alone	2	6%	1	3%	
Development	2	6%	0	0%	
Protection	1	3%	0	0%	
Logging	1	3%	0	0%	
Wildlife	3	8%	1	3%	
Inventory	6	17%	3	8%	
Community action	19	53%	19	49%	
Educate	4	11%	4	10%	
Recreation or access	3	8%	4	10%	
Projects	11	31%	10	26%	
Communication	4	11%	3	8%	
Involvement	1	3%	0	0%	
Maintenance or engineering	3	8%	4	10%	
Practices	1	3%	1	3%	
Create habitat	4	11%	4	10%	
Don't do anything	6	17%	10	26%	

*This table includes any actions the students do as stated in the previous question regarding their role.

Student Responses to Question 7 without NatureMapping Activities: Have You Been Involved in Any Outdoor Education or Community Service Activities? If So, What?

Comment (NOT including NatureMapping activities)	Participated in NatureMapping		Did Not Participate in NatureMapping		Significance Test Confidence Level (only shown if >90%)
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=42)	
Organization					
School*	26	70%	30	71%	
Church	3	8%	4	10%	
Scouts	2	5%	4	10%	
4-H	3	8%	3	7%	
FFA	2	5%	1	2%	
Family	2	5%	1	2%	
Individual	1	3%	1	2%	
Ad hoc	2	5%	1	2%	
Other	6	16%	8	19%	
Unknown	2	5%	3	7%	
Activity					
Social	4	11%	11	26%	>90%
Clean up	9	24%	14	33%	
Nature study, survey, research or testing*	20	54%	23	55%	
Nature construction or management	8	22%	13	31%	
Recreation or skills	7	19%	8	19%	
Education or communication	5	14%	4	10%	
Unknown	0	0%	1	2%	
Activity element					
Educational objectives*	25	68%	31	74%	
Environmental education*	24	65%	30	71%	
Environmental service*	18	49%	27	64%	
Outdoors*	31	84%	37	88%	
Local environment*	25	68%	26	62%	
Wildlife*	8	22%	8	19%	
Local community	8	22%	17	40%	>90%
Social service	10	27%	18	43%	
Haven't been involved	0	0%	2	5%	

*If NatureMapping activities were included, these comments would be at 100% for the NatureMapping students.

Student Responses to Question 8: What Did You Learn from Being Involved With Those [NatureMapping or Outdoor Education/Community Service] Activities?

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping		
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=40)	Significance Test Confidence Level (only shown if >90%)
Knowledge	29	78%	23	58%	>90%
General nature	23	62%	15	38%	>96%
There is more to nature than originally thought	8	22%	2	5%	>96%
Some people are inconsiderate of the environment	1	3%	4	10%	
There is a lot of trash around	0	0%	4	10%	>95%
Impacts of development	1	3%	0	0%	
Skills	13	35%	14	35%	
Nature construction or management	2	5%	4	10%	
Observation, research or testing	12	32%	4	10%	>98%
Recreation	0	0%	4	10%	>95%
Social	0	0%	3	8%	>90%
Attitude	9	24%	20	50%	>98%
Fun, interesting or rewarding	6	16%	8	20%	
Respect or appreciation for nature	3	8%	7	18%	
More motivated to protect nature	0	0%	6	15%	>98%
Good to help others or the environment	0	0%	3	8%	>90%
Can make a difference	1	3%	2	5%	
Work ethic	0	0%	4	10%	>95%
Other	2	5%	5	13%	
Don’t know	0	0%	1	3%	

Student Responses to Question 9: How Did Participation in Those [NatureMapping or Outdoor Education/Community Service] Activities Make You Feel?

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping		
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=40)	Significance Test Confidence Level (only shown if >90%)
Good	16	43%	22	55%	
It was fun or interesting	15	41%	13	33%	
Learned something	12	32%	7	18%	
Went outside	6	16%	5	13%	
Appreciate nature	3	8%	3	8%	
More motivated to act	2	5%	2	5%	
Want to spend more time in nature	2	5%	1	3%	
A part of something or “doing my part”	5	14%	5	13%	
Helped others or the environment	6	16%	14	35%	>90%
Hard work	2	5%	2	5%	
Other	5	14%	7	18%	

Student Responses to Question 10: Did Participation in Those [NatureMapping or Outdoor Education/Community Service] Activities Have Any Other Effects on You?

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping		Significance Test Confidence Level (only shown if >90%)
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=36)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=39)	
Led to additional action	3	8%	1	3%	
It was fun or interesting	3	8%	2	5%	
Learned something	7	19%	3	8%	
Developed skills	1	3%	2	5%	
Appreciate nature	2	6%	2	5%	
More motivated to act	6	17%	12	31%	
Want to spend more time in nature	3	8%	1	3%	
Helped others or the environment	1	3%	2	5%	
Other	1	3%	6	15%	>90%
No other effects	18	50%	13	33%	

Student Responses to Question 11: Are These [NatureMapping or Outdoor Education/Community Service] Activities Important? If So, How?

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping		Significance Test Confidence Level (only shown if >90%)
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=38)	
Learn about nature	28	76%	16	42%	>99.5%
Protection of nature	15	41%	15	39%	
Go outside	2	5%	5	13%	
Helped others or the environment	6	16%	10	26%	
Fun or interesting	1	3%	5	13%	>90%
Sense of belonging	0	0%	3	8%	>90%
Rewarding	1	3%	3	8%	
Keeps kids out of trouble	1	3%	1	3%	
Other	1	3%	6	16%	>90%
Just yes	2	5%	1	3%	
Don’t know	1	3%	0	0%	

Student Responses to Question 12: How Can These [NatureMapping or Outdoor Education/Community Service] Activities Be Improved?

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping		
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=40)	Significance Test Confidence Level (only shown if >90%)
More participants	6	16%	17	43%	>98%
Advertise to attract participants	2	5%	7	18%	>90%
Do more frequently	5	14%	5	13%	
Do for a longer period of time	6	16%	2	5%	
Involve non-students	4	11%	0	0%	>95%
Expand scope of study	5	14%	2	5%	
Change or add study sites	4	11%	1	3%	
Keep doing	0	0%	1	3%	
Coordinate activities between organizations	0	0%	4	10%	>95%
Expand program to involve more people	0	0%	8	20%	>99.5%
More student preparation	3	8%	2	5%	
Modify methods	8	22%	3	8%	>90%
Publicize or share results and accomplishments	1	3%	2	5%	
No improvement needed	1	3%	1	3%	
Other	4	11%	9	23%	
Don’t know	2	5%	1	3%	

Consolidated, Selected Student Responses to Questions 1, 2 and 3: Describe the Community, Its Natural Environment, and the Condition of Its Natural Environment.

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping	
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=42)
Natural environment (Q1-3)				
Plants	16	43%	16	38%
Wildlife	25	68%	20	48%
Landscape	27	73%	32	76%
Habitat	7	19%	11	26%
Weather or seasons	6	16%	10	24%
Diversity	8	22%	9	21%
Specific area	17	46%	20	48%
Condition of natural environment (Q1-3)				
Maintained	5	14%	5	12%
Pollution or trash	15	41%	13	31%
Urbanization	22	59%	21	50%
Rate of development	17	46%	23	55%
Logging	2	5%	4	10%
Industry	0	0%	5	12%
Restoration	3	8%	1	2%
Conservation	6	16%	9	21%
Domesticated aspects (Q2-3)				
Agriculture	7	19%	3	7%
Yards and parks	7	19%	3	7%
Domestic animals	3	8%	3	7%
Human interaction with natural environment (Q2-3)				
Enjoyment	13	35%	13	31%
Aesthetics	4	11%	7	17%
Concern	13	35%	9	21%
Access	11	30%	8	19%
Historic	6	16%	3	7%
Program	6	16%	6	14%

Consolidated, Selected Student Responses to Questions 4, 5 and 6: Describe How the Good Things about This Community and Its Natural Environment Can Be Maintained or Improved – in General, Student's Role, and Student's Actions.

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping	
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=42)
Individual actions				
Pick up trash	15	41%	18	43%
No littering or polluting	8	22%	9	21%
Recycle	6	16%	3	7%
Transportation	6	16%	2	5%
Reduce or reuse	1	3%	2	5%
Garden (Q5-6)	3	8%	0	0%
Planning and policy				
Leave alone	4	11%	6	14%
Laws (Q4-5)	1	3%	2	5%
Development (Q4-5)	10	27%	16	38%
Protection	6	16%	6	14%
Logging	3	8%	1	2%
Wildlife	8	22%	3	7%
Inventory	9	24%	7	17%
Community action				
Educate	5	14%	10	24%
Recreation or access	4	11%	4	10%
Projects	13	35%	11	26%
Communication	9	24%	11	26%
Involvement	13	35%	7	17%
Change attitude (Q4-5)	4	11%	2	5%
Maintenance or engineering	8	22%	9	21%
Practices	3	8%	5	12%
Create habitat	7	19%	4	10%

Consolidated, Selected Student Responses to Questions 8, 9, 10 and 11: Describe the Effects of These [NatureMapping or Outdoor Education/Community Service] Activities on Yourself and if the Activities are Important.

Comment	Participated in NatureMapping		Did Not Participate in NatureMapping	
	Number of Students Who Made Comment	Percentage of Students Who Nature-Mapped (n=37)	Number of Students Who Made Comment	Percentage of Students Who Did Not NatureMap (n=40)
Learn about nature (Q8 and 11)	34	92%	24	60%
It was fun, interesting or rewarding	21	57%	24	60%
Developed skills (Q8 and 10)	13	35%	16	40%
Went outside (Q9 and 11)	8	22%	8	20%
Respect or appreciation for nature (Q8-10)	7	19%	9	23%
More motivated to act or protect nature (Q8-10)	8	22%	17	43%
Want to spend more time in nature (Q9-10)	5	14%	1	3%
A part of something or sense of belonging (Q9 and 11)	5	14%	8	20%
Helped others or the environment	12	32%	19	48%

APPENDIX E

CASE STUDY EXHIBITS

Waterville Elementary School Case Study Exhibit 1

Introduction

Waterville Elementary School Short-horned Lizard Taskforce
Our Adopt-a-Farmer Project

The Project

Karen Dvornich and Mrs. Petersen's 4/5 grade class wanted to know more about Short-horned lizards (also known as horny toads). Karen is a wildlife specialist at the University of Washington and needed our help

Where is Waterville?
If you were looking at Washington State from space, this is what you would see. The county borders are outlined and Douglas County is in the middle of the State.

Click on the map to find Waterville.

The farmers got lots of data through the summer, and when school started they brought it in to the students. Then Karen came in that same day, and helpd them (the students and farmers) make out graphs using the data that the farmers collected through the summer. There was a location graph, a size graph, a time of day graph, a habitat graph and a Did it bury itself? graph.

The graphs had lines to put colored stickers on it. The farmers and students counted how many horny toads they found.

BUT, what if your farmer did not come, what would you do, how would you get your info?! You would team up with someone else's farmer. Then, later on you would call your farmer.

Then the farmers and students put animals stickers on maps of Douglas County to show where each horny toad was seen.

Mrs. Nelson's 2nd grade class helped in a food preference study. The students collected different insects to see what the Short-horned lizards would eat.

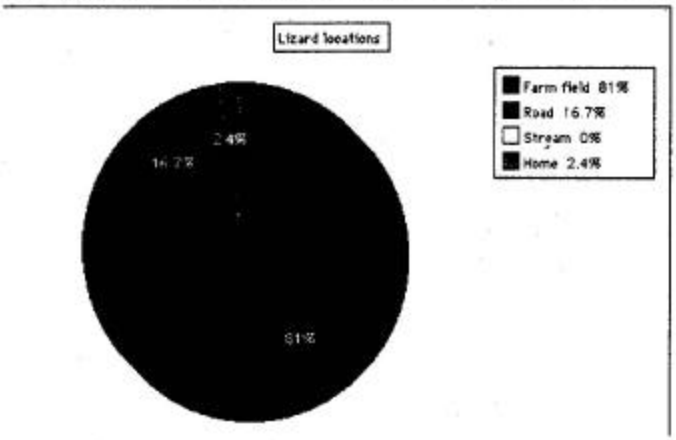
If you would like to learn more about our project click on the Short-horned Lizard

Waterville Elementary School Case Study Exhibit 2

Explanation

Here is how we got our answers

Question 2. Where can you find horny toads?

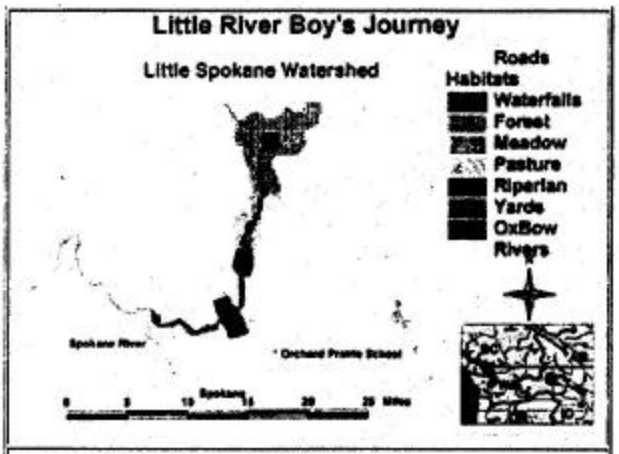


Places where Horny Toads were found
Our graph is a Pie Chart. This research is about Horny Toads. It tells you that 66.7% of the Horny Toads were found sunning themselves. 20% were running from tractors. 6.7% were in a bush, and 6.7% were found DEAD! None were under a rock, found by an ant mound, or were found eating. (M.W. and A.W.)

Back to the Questions

Back to the Menu

Orchard Prairie School Case Study Exhibit 1



The Little Spokane Watershed

The Little Spokane Watershed's size is about 625 square miles. The watershed is located in Eastern Washington. It is a small part of the Columbia River Watershed. The Little Spokane River is part of the larger Spokane River. The Little Spokane River enters the Spokane River after it has flowed about 25 miles.

Waterfall

Ahhhhhh! Falling down the waterfall was the worst experience I've ever had. Although I haven't been here that long, I thought being here would be a better experience than this. Oh no! Why is this waterfall so long? I don't understand these forces of nature.

Poor Little River Boy really did nothing wrong. If only Susie would have kept her mouth shut. "Oh no! My binoculars are getting all wet," he cried.

Help! You would think someone would listen to a class project. I knew I had to go on a journey sooner or later, but I didn't think that it would start on the rocky waterfalls.

Bump. Bump. That's all that happens. This is so scary I don't believe that this happened to me. Out of all the projects it had to be me. Man, this is so uncomfortable.

Finally, the end of the waterfall! I hope that I will never have to go through that again. Good bye waterfall. Hello

Orchard Prairie School Case Study Exhibit 2

#7 Between Palmer and Weile (D,B)

The sun just doesn't get over the rise and into this shady draw to clear the icy road in the winter. Streamside habitat on the south side of the road would be lost with Alternates D and B.

#8 Weile at Bigelow Gulch looking west (D,B)

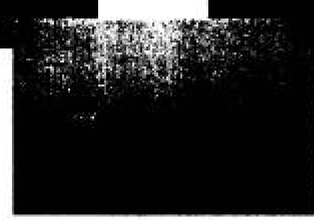
There is a lot of brush and cover for wild birds and small animals. Many animals travel along here to reach the surface for drinking water. This area is very windy and sometimes it is hard to see animals and you have to be careful driving this way in the evenings and mornings.

#10 Sullivan's Pond (D,B)

There is a small tree fort that my father and his brothers played in. The boys would jump out of the tree fort and go swimming. Runoff from Alternate D would probably fill this lovely pond with silt.

#9 Approaching Sullivan's Pond (B)

Alternates D and B would create serious problems for prairie residents. They would have to cross a busy four lane road to get on or off the road.



Orchard Prairie looking south

#11 Orchard Prairie School (B)

Alternates D and B could be trouble for Orchard Prairie School. They could more than double the time kids would be on the bus. Bigelow Gulch will be more crowded. Alternates A and C would be much safer. They can be seen in the distance in the picture at the left.

Chase Middle School Case Study Exhibit 1

Spring, 1999 Glenrose Gazette by CHASE MIDDLE SCHOOL – Nature Mapping Students

Chase Birds vs. Pond Birds

by Rj Brigman and Alex Prugh

Recently we visited the Chase area and the Pond area and collected data and water samples from the pond. The pond area is about 1/2 mile northwest of Chase Middle School. The Chase area is from Chase Middle School to about half a mile south from Chase, and to the east. We recorded how many of which birds were seen in both areas. We made a small survey at the pond and many surveys in the Chase area.

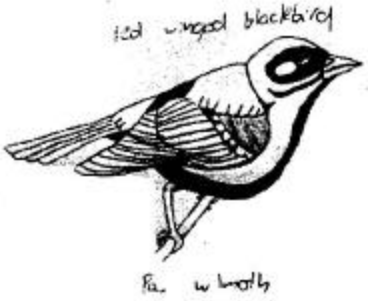
Our data sheets demonstrated that there were a total of thirty-two different types of birds in each area. Some birds were seen in both areas, some were seen in one area only. We also saw several deer tracks, many Colombian ground squirrels, and two Sara's orange tipped butterflies. We observed that 23 birds were found in both areas. For example the birds that we saw in both areas were the Red-tailed hawk, American robin, Mourning dove, Black-billed magpie, and the California quail. From our data in the two areas there were six different birds that we only saw at the pond area. There were eight different birds that we only saw in the Chase area.

The chart below shows the birds that were found only at the pond area or at the Chase area. The chart also shows the amount of birds that were seen at one site but not the other.

We concluded the reasons that we saw the type of birds at the location that we did is because that is where their habitat is. For example the reason that we saw the Coopers hawk and the Sharp-shinned hawk at the pond area may be because they were hunting for small mammals that live better in that undisturbed area. We saw ducks in both areas but the majority of the ducks were at the pond area because that is where they live. Most of the ducks that we saw in the Chase area were just flyover sightings. We also saw more of the red-tailed hawk in the Chase area because that is its habitat and there are more columbian ground squirrels and other small rodents in the fields, that they could hunt and eat.

Two different habitats that are just a couple of miles apart have many of the same species of birds and also many different species of birds. The reason is because different birds have different habitats and different needs. The Chase area and the pond area have a lot of similarities in habitat and birds, but it also has a lot of differences in the habitat and birds.

Birds Only at Chase	Number of Times Sighted
Osprey	2
Western bluebird	19
Common raven	9
Nortern flicker	2
Savannah sparrrow	2
Dark-eyed junco	41
Western meadowlark	4



Birds Only at the Pond	Number of Times Sighted
Sharp-shinned hawk	1
American goldfinch	1
Spotted towhee	2
Song sparrow	1
American tree sparrow	4
Cooper's hawk	1
Virginia rail	1

Food Chain: Energy Flow Within an Ecosystem

by Kiley Cox & Angie Clift

A pond is a quiet body of water filled with life and it is so shallow that rooted plants grow across it. Each and every living organism in the small pond is part of a living community. All these interact with the nonliving elements in their habitat such as air, water, and minerals. The minerals come from the rocks and soil that are scattered throughout the pond's bottom. The variety of habitats surrounding the pond makes a very unique ecosystem. The community of living organisms in this ecosystem depends on each other to survive.

In most cases green plants use the sunlight as their source of energy, but in some cases, the sunlight cannot reach the plants. When this happens, the pond either already contains or produces everything necessary for the plants and animals to survive. In our particular pond habitat the first link in the food chain consists of algae and aquatic plants. These producers feed other species called consumers. These species are other plant eating animals like mayflies and snails. Carnivores like leeches, water beetles, and water striders feed on other animals. Animals called scavengers and decomposers, like bacteria, feed on animals and plants that have died. By doing this it helps dead organic matter change into nutrients, which helps to replenish the soil at the bottom of the pond.

Since ponds are good places to learn about the relationships of plants and other animals to their environment, and to one another, our classes studied pond water to learn more abut the living species in the water.

In this particular area , we discovered that all the animals lived off of one another. For example at the bottom of the food chain is algae which is then eaten by a small critter called a copepod. The copepod is eaten by the water beetle. The water beetle is then eaten by a frog who is eaten by a garter snake. At the top of the food chain is the Cooper's hawk which eats the snakes.

If one of these important species was to disappear, the entire way of life would change for the animals that lived near the pond. Preservation of the entire ecosystem is essential for the survival of each of the pond organisms.

Interdependence at the Pond

by Andrea Smith and Drew Lommen

Although Glenrose may seem suburban to many people it's really not. Our Nature mapping groups visited a pond on 29th and Havana on private property. This pond is very critical to survival for birds and animals around it. If it was not there, some species would not exist in the area. There aren't very many ponds in the Glenrose area, so the birds, animals and plants at this pond depend on each other for survival.

The birds that we saw at this wetland area include Red-winged blackbirds, Brewer's blackbirds, Mallard ducks, Pygmy nuthatches, Magpies, Song sparrows, and European starlings. Other birds pass through the pond, but do not live there.

There are also raccoons and deer who wander through the area, as we saw from tracks on the muddy ground around the pond. The animals, birds and plants depend on each other to survive in many ways. The birds spread seeds for the plants (which the animals eat) to grow. Animals like raccoons also eat small frogs and other water critters in the pond.

The animals help the birds in many ways as well. Rodents and larger animals burrow in thick grass and old, dead trees. These provide perfect homes for birds to nest in. These larger animals also protect birds by killing other animals and larger predatory birds who might be a threat to their survival.

Everyday, habitats like the pond are being destroyed due to development. The pond is an example of a community in nature and it is really important that all of the plants, animals and birds stay there. If one species goes, that could upset the entire food chain of the pond.

When the migratory birds come back each year they expect the pond to be there for their needs. As long as people don't destroy the pond, the creatures living there will continue each year in the circle of life.

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