
STEWARDSHIP OF THE GREAT LAKES ENVIRONMENT: A LITERATURE REVIEW

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Key words: attitude, barrier, behavior, belief, environment, Great Lakes, incentive, intention, Lake Ontario, motivation, stewardship.

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***** EXECUTIVE SUMMARY *****

BACKGROUND

- The Great Lakes Water Quality Agreement of 1978 between the U.S. and Canada stimulated binational efforts to develop and implement sustainable approaches to environmental use and management in the Great Lakes Basin. One result of this activity has been the creation of a binational Ecosystem Objectives Work Group (EOWG). One of the group's primary objectives is a societal commitment to responsible stewardship reflected by human activities in and decisions about the Lake Ontario Basin.
- A system of indicators must be developed to determine if residents of the Lake Ontario Basin are exhibiting stewardship consistent with EOWG's goal. Health Canada and the U.S. Environmental Protection Agency funded the initial stage of an effort to develop mechanisms for measurement of socially- and politically-relevant indicators of stewardship. In support of that work, Cornell's Human Dimensions Research Unit (HDRU) conducted a review of literature on the stewardship concept and efforts to develop indicators of stewardship.

PURPOSE OF THIS MANUSCRIPT

- Clarify historic and contemporary definitions of the stewardship concept.
- Describe previous research efforts to develop measures or indicators of stewardship motivators, stewardship intentions, stewardship behaviors, and stewardship barriers/incentives.
- Outline research questions to guide future inquiries on the topic of environmental stewardship.

METHODS

- We systematically searched 25 computerized databases and identified more than 180 sources related to the stewardship concept or efforts to develop indicators of environmental stewardship.
- The final list of references was divided into literature concerning concepts of environmental stewardship, books and articles related to indicators of environmental stewardship, and other citations. Citations listed in the first two categories were divided further into sources of primary importance and sources of secondary importance. Sources of primary importance were located and reviewed.

THE STEWARDSHIP CONCEPT

- Stewardship can be defined as *the moral obligation to care for the environment and the actions undertaken to provide that care*. The moral obligation to care for the

environment implies the existence of an ethic of personal responsibility, an ethic of behavior based on reverence for the Earth and a sense of obligation to future generations. To effectively care for the environment, individuals must use resources wisely and efficiently, in part by placing self-imposed limits on personal consumption and altering personal expectations, habits, and values. Appropriate use of natural resources within the stewardship ethic involves taking actions that respect the integrity of natural systems.

STEWARDSHIP INDICATORS

- Given the above definition of stewardship, measuring behaviors alone would provide only a partial picture of the concept. Stewardship motivators, stewardship intentions, and stewardship barriers/incentives also must be analyzed to fully understand stewardship and why its expression may change over time. Moreover, research has shown that behavior is influenced by a host of factors beyond the obligations a person feels. Measuring stewardship behavior alone would provide an incomplete assessment of the extent of a stewardship ethic in the Lake Ontario Basin. A sense of obligation, or motivation, is an important component of stewardship, as is intention. Because intervening factors may prevent an individual's intentions from being realized as stewardship behavior, an understanding of barriers or incentives to stewardship is also necessary if one seeks to increase the prevalence of sound stewardship in the Lake Ontario Basin (or elsewhere).

Stewardship Motivators:

- Potential indicators of an internalized source of motivation could include: environmental knowledge and awareness, perceived health risks from the environment, concern and fear about environmental quality, attitudes toward the environment, and perceived personal economic consequences of stewardship behavior.
- Characterization of stewardship motivations will necessitate a multidimensional, multivariate measurement approach. Some research also has shown that motivational indicators are best as predictors of behaviors that demand a high level of commitment (motivation may be a poor predictor of behavior that demands little personal investment).

Stewardship Intentions:

- Stewardship intentions have been inferred through questions about individuals' willingness to devote money, time, or political support to improving and managing local communities or the Great Lakes ecosystem generally. The contingent valuation method (e.g., asking people to disclose the value they place on an unpriced good like clean water) has been used to measure people's willingness to pay for improved environmental protection and environmental quality. This method has been used extensively in surveys as a measure of respondents' attitudes and intentions. If used properly, this method can be both valid and reliable.

- Some research indicates that a growing proportion of Americans are willing to pay for environmental conservation, but behaviors such as voting for conservation funding initiatives do not reflect such willingness. Similarly, some research has found that concern about the environment has increased and that a majority of U.S. adults now support environmental protection. However, actual public support for new environmental initiatives and personal behavior change has remained very limited in the U.S.

Stewardship Behavior:

- To date, work on environmentally responsible behavior has focused on three research questions: (1) what are the demographic and personality characteristics of people who perform environmentally responsible behaviors; (2) how successful are interventions at promoting such behaviors; and (3) how do cognitive and psychological variables influence environmental behavior. Positive environmental actions have been linked to factors such as age, education, and moral norms.

Stewardship Barriers/Incentives:

- Incentives and barriers are those external factors that actually (or are perceived to) encourage or discourage people to act on their commitment to and beliefs about stewardship. Research has shown that cultural, psychological, economic, political, sociodemographic, and knowledge factors may be potential incentives/barriers to behavior.
- Research suggests that environmentally responsible behavior can be increased in the short term by manipulating the conditions before or after the behavior. Manipulations include: (1) prompts (i.e., written or verbal encouragement to recycle); (2) commitments (i.e., verbal or written pledges to recycle); (3) environmental alterations (e.g., providing services or containers that make recycling more convenient); (4) goal setting (i.e., setting personal or group targets for the amount of recycling activity to be accomplished); (5) feedback; (6) rewards; and (7) penalties.
- While incentive and intervention measures to date have been linked to short-term behavior change, few researchers have been able to document any long-term influence on behavior.

RESEARCH NEEDS

Research Related to Stewardship:

- *How should stewardship be measured?* To date, researchers have not developed a tool to assess stewardship attitudes. A valid and reliable instrument to assess and measure stewardship attitudes must be developed. This instrument may require multiple scales to assess the various domains of the stewardship concept.

- *How does stewardship vary across publics?* Data are needed about how stewardship attitudes differ with regard to characteristics such as: age, education, gender, income, urban/rural background, and ethnicity. More insights are needed about how stewardship attitudes differ across activity groups (e.g., farmers, anglers, environmentalists).
- *How does stewardship vary by geographic region?* We recommend studying stewardship commitment in different locations (e.g., the Lake Ontario Basin, New York City Watershed, and the Columbia River Basin) so that data can be compared on stewardship attitudes.
- *What are the trends in stewardship attitudes over time?* Without time-series data, we don't really know if the American public is becoming more or less committed to environmental stewardship. Future researchers should set a goal of long-term measurement of commitment to stewardship in particular areas. For example, researchers might set as their goal a study measuring stewardship commitment among different samples of residents in a particular watershed every 5-10 years.
- *What will motivate behavior change?* Such data are needed so that government and nongovernment organizations can take actions to create incentives to foster environmentally-friendly behavior.

Research Related to Stewardship Indicators:

- *Develop valid and reliable scales to measure each of the various types of potential stewardship motivation.* Though many example items now exist, development of additional items appears warranted. The conceptual area of stewardship motivations is so rich and multi-faceted that existing items may not address all of the interests expressed by members of the EOWG Advisory Committee.
- *Policy makers and researchers must decide which types of motivations are of highest priority to monitor, since there are too many types of motivations to cover in one instrument.*
- *More should be learned about intentions to behave in specific contexts.*
- *Determine what behaviors are of greatest interest to decision-makers and design specific instruments to match those interests.*
- *Future researchers should develop a variety of new questionnaire items in the area of stewardship incentives/barriers.* Some work has been done to develop indicators of monetary stewardship incentives, but more work is needed to develop and assess nonmonetary stewardship incentives. Guidance in this area may come from further review of existing stewardship programs (e.g., New York State's Forest Owner Stewardship Program).

- ***A conceptual model is needed to guide research. We suggest using existing models (e.g., Theory of Planned Behavior) to design instruments that can help researchers predict stewardship behaviors.***
- ***Site-specific instruments to measure behaviors, intentions, and barriers/incentives in different geographic regions should be developed.***

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INTRODUCTION

The Great Lakes Water Quality Agreement of 1978 between the United States and Canada, as amended in 1987, includes provisions for developing ecosystem objectives and indicators for each of the Great Lakes. The U.S. and Canadian governments established the binational Ecosystem Objectives Work Group (EOWG) to carry out this mandate, focusing their initial efforts on Lake Ontario. EOWG proposed several objectives for Lake Ontario, including the perpetuation of a healthy and diverse wildlife community; the prevention of significant levels of chemical contaminants in the waters, fauna, and flora of the Lake; and a commitment to responsible stewardship reflected by human activities in and decisions about the Lake Ontario Basin (Bertram and Reynoldson 1992).

The Lake Ontario Responsible Stewardship Subcommittee of EOWG developed a goal and objective related to Lake Ontario stewardship. The goal is that "we as a society shall recognize our capacity to cause great changes in the ecosystem and we shall conduct our activities with responsible stewardship for the Lake Ontario Basin" (Bertram and Reynoldson 1992:94). The stewardship objective is that "human activities and decisions shall embrace environmental ethics and a commitment to responsible stewardship" (Bertram and Reynoldson 1992:94). The goal and objective imply that important indicators will include measures of (a) the extent to which members of society are aware of, and accept responsibility for, the ecosystem effects caused by human activities; (b) the type and extent of adoption of certain ethical environmental beliefs held by decision-makers (individuals and groups in governmental and non-governmental spheres); (c) human activities that may reflect stewardship; and (d) commitment to stewardship.

One of EOWG's guiding principles is that no activity of the present generation shall adversely affect the use and enjoyment of Lake Ontario by succeeding generations (Bertram

and Reynoldson 1992). To maintain this intergenerational equity and develop policies concerning the utilization and protection of natural resources, the U.S. and Canadian governments must work towards understanding and fostering environmental stewardship attitudes and behaviors among the residents and key leaders of the Lake Ontario Basin. Key leaders include government officials, educators, business managers, and directors of environmental organizations.

Without a citizenry that has adopted a responsible stewardship ethic, political, financial, and institutional support for programs implementing the Lake Ontario Toxics Management Plan and the Lake Ontario Lakewide Management Plan will not exist. It is critical that provincial, federal, and state governments of the Lake Ontario Basin (i.e., Canada, the United States, Ontario, and New York State; hereafter referred to as the Parties) understand (and do not just assume they understand) the current environmental ethic of Basin citizens.

To address these needs, Health Canada and the United States Environmental Protection Agency (EPA) established the Stewardship Indicators Pilot Project. The purpose of the Pilot Project was to develop a survey instrument that provides the Parties with a mechanism for monitoring progress toward widespread stewardship ethics and behaviors in the Basin, and progress toward partnerships and common understandings between Party representatives and the citizens of the Basin. A Binational Advisory Committee was created to provide guidance for that effort. The Advisory Committee included academics (L. Milbrath [U.S.], S. Lerner [Can.], N. Lister [Can.]) and agency staff (L. New [U.S.], M. Gadoua [U.S.], J. Rae [Can.]).

The Stewardship Indicators Pilot Project will develop the mechanisms for measurement of socially- and politically-relevant indicators. Once established, use of these indicators to

monitor change over time will be a powerful assessment of the success of efforts of the Parties to achieve ecosystem management in the Lake Ontario Basin and would be the next phase of the Stewardship Indicators Project (i.e., a major measuring effort to follow the Pilot Project). The Stewardship Indicators Pilot Project also will develop means to assess the accuracy of perceptions held by the Parties about the environmental attitudes and behaviors of citizens in the Basin and about the attitudes and approaches of key leaders in various sectors. The goal of the Parties should be to achieve over time a match between their perceptions of citizen attitudes and behavior and actual attitudes and behavior. Without such an understanding, the Parties may be making policy that cannot be implemented for lack of support, or that may be weaker than would have been supported, or that may be in conflict with the citizens they represent.

An extensive literature review was conducted as part of the Stewardship Indicators Pilot Project. The primary purpose of this document is to present the findings of that literature review. A secondary purpose of this report is to guide future research efforts by Cornell University's Human Dimensions Research Unit (HDRU) and others on the topic of environmental stewardship. We begin the document with a brief discussion of the methods used to identify relevant literature. Then we analyze literature that provides historic and contemporary definitions of the stewardship concept. Next, we describe the four major stewardship indicators to be developed as part of this project, and we discuss past efforts to develop related behavioral and attitudinal measurement instruments. Finally, we outline research questions and a research agenda that we believe should be addressed through the Stewardship Indicators Project and other initiatives.

METHODS

At the time this research was conducted, Cornell University's Mann Library Gateway system provided access to 180 computer-based databases. We searched the most relevant

of these databases for citations concerning stewardship concepts and indicators. The names of the databases searched are listed in Figure 1.

We identified three primary key words and 17 secondary key words to use when searching each database (see Figure 2). First, a primary key word would be entered into the search command. The computer would identify the number of literature citations in that

Figure 1: List of Databases Searched

Agricola	PAIS International
BIOSIS	Periodical Abstracts
CARL Uncover	Pollution Abstracts
Cornell Online	PsychINFO
CRIS/USDA	Public Opinion Online
Energyline	Scisearch
Enviroline	Social Science Index
Environmental Bibliography	Social Scisearch
ERIC	Sociological Abstracts
Health Periodicals Database	Waternet
Health Planning and Administration	Water Resources Abstracts
Life Sciences Collection	Wilson Combined Index
NTIS	

Figure 2: Key Words Used in Database Searches

<u>Primary Key words:</u>	
Great Lakes	
Lake Ontario	
Stewardship	
<u>Secondary Key words:</u>	
Public	Survey
Opinion	Poll
Knowledge	Questionnaire
Belief	Conservation
Value	Environmental Protection
Attitude	Water
Awareness	Air
Perception	Energy

database that contained the key word. If fewer than 200 citations were found, the researcher examined each reference and recorded the ones related to stewardship concepts, indicators of environmental stewardship, and protection and degradation of natural resources in the Great Lakes Basin. If more than 200 citations were listed, the researcher entered each secondary key word and recorded the appropriate references. After all of the databases were searched, the recorded citations were compiled and duplications were deleted.

The final list of references was divided into literature concerning concepts of environmental stewardship, books and articles related to indicators of environmental stewardship, and other citations. Citations listed in the first two categories were divided further into sources of primary importance and sources of secondary importance. Sources of primary importance that were available through the Cornell library system were located and reviewed. In addition, articles previously acquired by the Principal Investigator were reviewed and incorporated into the text of this report where appropriate. Sources of interest that we did not reference in the text are listed in a bibliographic section at the end of this document.

DEFINITIONS OF STEWARDSHIP AND RELATED CONCEPTS

According to V. Alaric Sample (cited in Kaufman 1992:55), conservation efforts will succeed only if the condition of ecosystems is improved for future generations; resource management focuses on "desired future resource conditions" rather than short-term production; resource management is in harmony with the biological and physical capabilities of the land; and land stewardship comprises both a scientific base and a "moral imperative." Although the idea of stewardship as an essential ingredient in the field of conservation is a relatively new concept (Decker et al. 1991), the doctrine of stewardship has existed for centuries. St. Augustine in the fifth century A.D. realized that people's natural concern for their descendants leads one generation to compromise its immediate interests for the sake of

future generations. Today, people recognize that the concept of stewardship is related not only to physical and biological conservation (Anonymous 1990), but also to morality and ethics, apparent in Sample's principles for the future of conservation efforts.

Environmentalists, economists, theologians, and others have proposed numerous definitions for the term stewardship. Some recurrent themes run through most of these definitions, including an ethic of personal responsibility and behavior based on reverence for the Earth, an obligation to future generations, a need for personal action and participation, and a commitment to use resources both wisely and efficiently (see for example President's Commission on Americans Outdoors 1986, Leopold 1989, Wilkinson 1991, diZerega 1992, Beavis 1994). Contemporary definitions of stewardship often include a concern for conservation of biological diversity and a goal of sustainable development (see for example Resler 1983, Decker et al. 1991).

The word stewardship shares a common root with the words economics and ecology. *Webster's Dictionary* (1985:1157) defined a steward as a manager or a person "who actively directs affairs," and stewardship as "the individual's responsibility to manage his life and property with proper regard to the rights of others." For example, managers of public lands often are considered to be stewards of those lands, within the context of having dominion over the land or manipulating the future of the land (Giltmier 1990). Similar to Webster, Resler (1983:6) defined a steward as an individual "who has charge of the household of another" or "who manages the property of another." In the New Testament, the term steward is the common translation of the word *oikonomos* and stewardship is translated from the term *oikonomia*. The word economics, derived from the Greek *oikonomos*, originally meant "the management of one's household." The word ecology, which can be expressed as *oikologos*, expands the concept of "household" to a global scale. It refers to the entirety of

interrelationships between living organisms and the environment (the scientific discipline of ecology is the study of the interactions that determine the distribution and abundance of living organisms). Thus, the term economics can be translated as "managing the household" and the term ecology as "understanding the household" (Williams 1990:91, Wilkinson 1991:216-217).

Resler (1983) defined Earth as a household and stated that it is the obligation of individuals and nations to manage the planet in a manner that will allow current generations to use its resources while not adversely affecting the ability of future generations to do the same. Thus, stewards will judge their actions in terms of how those actions affect themselves as well as their descendants. Coddington (1991) also emphasized the importance of maintaining resource benefits for future generations. Overall, good stewardship can be viewed as "economic growth coupled with responsible protection of the environment" (Resler 1983:6), and therefore can be equated with the concept of sustainable development.

As with the doctrine of stewardship, the concept of sustainable development emphasizes intergenerational equity, limits to economic growth and productivity, and a commitment to use resources in a wise and efficient manner. Sustainable development recognizes that economic growth and technological development are compatible with and sometimes essential to sustaining the resource base (Spaargaren and Mol 1992), and thus requires that economic and ecological considerations in decision-making be merged (WCED 1989). Widespread use of the term sustainable development began after the United Nations' World Commission on Environment and Development (WCED) used this phrase in their 1987 report *Our Common Future*, popularly known as The Brundtland Report (Mathews 1991). In that report, sustainable development was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

(WCED 1989:8). A basic assumption of the notion of sustainable development is that economic growth is an essential component of solutions to environmental problems, yet there are limits to that growth (Mathews 1991). Examples of limitations include the state of technology, the condition of social organizations, and the ability of the biosphere to adapt to changes resulting from human activities. The first two of those limitations can be managed and improved to encourage economic growth (WCED 1989:8). To distinguish between sustainable growth and nonsustainable growth, the following are necessary: a long time frame, a broad geographic view, and detailed knowledge about biological relationships (Mathews 1991). In sum, approaches used to achieve sustainable development must be multi-disciplinary, integrative, and holistic (Myers 1993).

The principle of intergenerational equity referred to in discussions of both stewardship and sustainable development also has been expressed in discussions of Christian ethics (Bratton 1983:227-8):

Those who are dedicated to wise stewardship over the resources of the good earth hold tenaciously to the concept that 'the earth is the Lord's' ... and that adequate supplies of food and shelter must cover a period that extends far into the future because this is the only world we have and the total heritage of our descendants (Ebenreck 1981:34).

The notion of respect for the earth and natural systems is present in Christian, Jewish, Buddhist, Hindu, and Muslim teachings (Dewitt 1991). For example, in commenting on the Buddhist perspective about environmental stewardship, the Venerable Lungrig Namgyal, abbot of Gyuto Tantric College, India, stated,

Disregard for the Natural Inheritance of human beings has brought about the danger that now threatens the peace of the world as well as the chance to live of endangered species. Such destruction of the environment and the life depending upon it is a result of ignorance, greed and disregard for the richness of all living things... We are the generation with the awareness of a great danger. We are the ones with the responsibility and the ability to take steps of concrete action, before it is too late (quoted in Scherff 1991:251-2).

Although the world's major religions address stewardship ethics to some degree (Scherff 1991), stewardship often is considered to be a Christian concept of environmental management (Bratton 1983). Christians traditionally have viewed stewardship according to a hierarchical structure, with God at the top, men in the middle holding the land in trust for both God and future generations, and the land at the bottom as an item that is owned and used (Ebenreck 1981). According to Cunningham (cited in Cooper 1980:240-1), stewardship is "man's responsibility before God to live all of life within God's world according to the will of God as revealed in Jesus Christ." Moule (1967) also emphasized that the Bible considers one of man's duties to be using nature in a manner consistent with God's will. Man's treatment of nature has far-reaching consequences for both the animate and inanimate components of the world. Moule (1967:12) also suggested that:

restoration and liberation come when man assumes his proper position in ecology, not contracting out of his responsibilities and giving up the use of nature, but using it responsibly and according to the will of God.

In practice, stewardship refers to the methods by which individuals acquire and ultimately dispose of their resources. According to Bratton (1983:230), good stewardship is simply the "wise use of resources." The primary motive guiding Christian stewardship is a feeling of responsibility, obligation, or duty towards the Church and other good causes (Cooper 1980).

Christian definitions of stewardship suggest that God provided the world as a blessing to man and man has a moral obligation to be a good caretaker of the Earth. For example, Graham Ashworth defined stewardship to be "the holding of land in trust for God and the general benefit of Mankind" (cited in Ebenreck 1981:34). Nelson (cited in Ohlman 1990:92) suggested that "the responsibility to be good stewards of the earth follows from the essence of the biblical creation message - that man alone among creatures was created in the image of God and that man therefore has unique responsibilities for the rest of the earth." Nelson

based his idea of stewardship in part on Genesis 1:26 (R.S.V., cited in Moule 1967:1), in which God said:

Let us make man in our image, after our likeness; and let them have dominion over the fish of the sea, and over the birds of the air, and over the cattle, and over all the earth, and over every creeping thing that creeps upon the earth.

Wilkinson (1991) suggested that humans were given dominion over nature by God and they are expected to use that dominion to serve both humanity and nature. Similarly, Curry-Roper (1990) interpreted Biblical passages to mean that man was uniquely created in the image of God and given dominion over nature with the authority to make it fruitful and develop it. The question therefore is not if humans are stewards but rather how people are to exercise dominion. Wilkinson (cited in Stivers 1981:389) answered this question by stating that "the tasks of Christian stewardship are the care for the earth and the promotion of justice."

According to Bratton (1983:232), conservative interpretations of scripture suggest that:

the primary purpose of Christian stewardship is both to serve God directly and to exercise authority over creation in a Christ-like fashion. This should in turn result in fairer distribution of resources and greater concern for one's neighbor.

Thus, both Wilkinson and Bratton suggested that humans have dominion over nature and stewardship of the Earth's resources involves not only the manipulation of technologies but also the ways individuals think and value.

Some Christians now believe the Church should adopt a theology of interrelationship to replace the stewardship model. According to that theology, the natural world is valuable "because of its relationship to God, rather than its utility for humanity" (Frame 1990:38). The idea of dominion over the Earth that is enmeshed in some traditional teachings about Christian stewardship also is rejected within the worldviews represented by deep ecology (Sessions and Duvall 1985) and ecofeminism (King 1989, Warren 1990, Merchant 1992, Plumwood 1992, Warren 1994). However, proponents of ecofeminism, deep ecology, and a

Christian stewardship ethic would all agree that the abuse of natural resources for short-term profits is unjust. Public land managers, who often label themselves as land stewards, would generally agree that misuse of natural resources is unjust and that wise use of natural resources is morally justified. Wise use of natural resources for the benefit of current and future generations of people has been a guiding principle of professional natural resource management in the United States (Murphy 1994:49). This "wise-use" philosophy is widely held by natural resource managers and is often expressed in professional and lay publications. For example, Gilmier (1990) suggests that science-based manipulation of the land for sustained harvest of natural resources is ethically appropriate to the degree that: (1) scientific stewardship of the land leads to a sustainable future for the community and ensures that future generations will benefit from the land's resources; (2) the steward, through caring for the land, is providing more for the community than for himself; and 3) sustainable stewardship focuses on long-term, continuing benefits rather than short-term profits. Decker et al. (1991:12) suggested some of the same ideas about land stewardship:

Although land stewardship does not suggest adoption of a non-use or 'hands-off approach,' it does place primary concern on maintaining the integrity of the ecosystem. The land steward has to weigh needs and desires today against long-term ecosystem considerations, keeping in mind that conservation of healthy, diverse biological resources contributes greatly to the welfare of humans of current and future generations. This broader philosophy of a land stewardship ethic is still in its infancy. Few professional natural resource managers or private landowners have had experience in its full application and, to date, researchers have not presented much more than piecemeal elements that are difficult to apply on the land.

Decker's ideas on stewardship repeat themes expressed by Aldo Leopold, a seminal thinker on environmental conservation. In 1949, a collection of Leopold's essays were published in *A Sand County Almanac*. That collection of essays defined his "land ethic," which has had a powerful influence on natural resource management. Leopold believed that ethical

considerations should be extended to relationships between man and his community (Coulal 1989). He defined the community to include "soils, waters, plants, and animals, or collectively: the land" (Leopold 1989:204). Leopold was convinced that:

a system of conservation based solely on economic self-interest is hopelessly lopsided. It tends to ignore, and thus eventually to eliminate, many elements in the land community that lack commercial value, but that are (as far as we know) essential to its healthy functioning (Leopold 1989:214).

Leopold suggested that ethical obligation on the part of private landowners was the only resolution to this problem (Leopold 1989:204). Furthermore, he believed that a land ethic "changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it. It implies respect for his fellow-members, and also respect for the community as such" (Leopold 1989:240). In the same way, Decker et al.'s (1991) writing implies that the integrity of the ecosystem, or community, as well as the welfare of both current and future generations should be considered when making land management decisions. Lastly, both Leopold (1989) and Decker et al. (1991) stressed the importance of ecosystem integrity. This ecocentric focus is perhaps best evidenced in Leopold's (1989:224-225) frequently quoted statement, "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."

Leopold's land ethic represents a body of ideas that contradict those developed within the dominant social paradigm of western rationality. It represents a major reorientation of man's relationship to nature, not just a reformation of the dominionistic, anthropocentric relationship now in place. Environmental sociologist Raymond Murphy describes this orientation as "de-rational," in contrast to western rationality, which views nature as malleable (Murphy 1994).

Perhaps because it represents such a contrast to the dominant social paradigm (i.e., western rationality), Leopold's land ethic has not yet been fully adopted as the guiding

principle of natural resource management in the U. S. Even so, many natural resource management professionals have tried to integrate a stewardship ethic into their decisions and management practices. For example, in 1990, The Society of American Foresters (SAF) were considering adoption of a land ethic canon into their professional code of ethics (Linnartz et al. 1991). The professional code they were considering recommended that the decisions made by foresters and forest owners should: consider all ecological elements of a landscape (not just individual elements like the forest), stress the importance of maintaining and enhancing resource productivity and integrity, include viable alternatives for landowners to meet their objectives, address sustainable production of resources, and emphasize the personal responsibility of landowners in ensuring that others are aware of the effects of their activities on the productive capacity of the landscape.

Others, such as diZerega (1992), also suggest that land managers and landowners should be guided by a code of conduct that addresses a set of responsibilities that go beyond those of "land owner." DiZerega (1992) posits that landowners act in a responsible manner only for moral reasons external to the concept of ownership. In this sense, stewardship rather than ownership best describes humans' relationship to land as a "moral relationship situated within a network of relations possessing intrinsic value" (diZerega 1992:355). DiZerega (1992:356) further separated the concept of land stewardship from land ownership with the following statements:

Stewardship requires that responsibility and obligation accompany power. The natural world unavoidably serves human needs and desires, but human beings owe consideration to it as well. Stewardship means, at a minimum, that the thing over which it is exercised should not be left worse off, in the sense that its basic role within the environment should not be seriously compromised.

Similar attempts to encourage intensified environmental stewardship can be found among the broader scientific community. In a 1993 declaration, the Union of Concerned

Scientists (UCS) warn that, "a great change in our stewardship of the earth and the life on it is required, if vast human misery is to be avoided and our global home on this planet is not to be irretrievably mutilated" (Cornell Science and Technology Magazine 1995:28). The UCS (a group of 1600 scientists, including over 100 Nobel prize laureates) makes five recommendations to avert future crises: (1) bring environmentally damaging activities (like energy production) under control to protect the integrity of the earth's systems; (2) manage resources more effectively; (3) stabilize human population; (4) reduce and eventually eliminate poverty; and (5) ensure sexual equality and guarantee women control over their own reproductive decisions (Cornell Science and Technology Magazine 1995:28).

Criticisms of the Stewardship Approach

The 1993 declaration by the UCS helps illustrate that some in western society are coming to believe that more efficient use and management of the environment will be necessary to avoid a future global environmental crisis. But the proponents of deep ecology (Sessions and Duvall 1985, Sale 1988, Foreman 1991) go even further. They reject the notion that looming environmental crisis can be avoided within an intensified form of the rationality that guided man's relationship to nature in the 19th and 20th centuries. They argue that only a profound reordering of patterns of production and consumption associated with modern capitalism and an anti-rational (Bookchin 1991:60) or "de-rational" approach (Murphy 1994:91-98) can lead to the achievement of a sustainable world (Sagoff 1993). Deep ecologists would criticize the notion of stewardship to the degree that it assumes more efficient use and management of the environment will be enough to sustain human development.

Some deep ecologists also have criticized the stewardship model because they believe it assumes natural resources exist primarily for human use and it does not distinguish

between vital human needs and human desires (diZerega 1992). The central tenet of deep ecology is the belief that "nature possesses value independently of our attitude toward it," and thus property rights should reflect the value of the nonhuman world as well as efficiency in meeting human desires (diZerega 1992:331). The key to these views is that a reverent relationship to the earth requires a transformation of individuals' loyalties, affections, and fundamental ideas of the good life. According to deep ecologists, not only do good stewards practice efficient use of resources, but they also hold fundamental beliefs about how little is actually necessary for a decent life (Orr 1993, diZerega 1992).

Contemporary Applications of the Stewardship Concept

Contemporary resource stewardship ethics often are concerned with specific groups of resources rather than all natural resources. For example, a stewardship ethic in agriculture is expressed in the statement that "farmers must consider long-range productivity for the good of future generations and so husband the resources of land and water for the future" (Ebenreck 1981:34). Farmers are encouraged to practice low-input, sustainable agriculture since this method utilizes the best procedures and products to increase profits for the producer while maintaining or improving the farmland's natural resources (Jann 1990). Decker et al. (1991) provide an example of a contemporary stewardship ethic related to wildlife conservation. Decker et al. (1991) proposed that a land stewardship ethic for wildlife comprised of five elements: tradeoffs between species affected by land-management actions; landscape connectedness (i.e., a parcel of land is part of a larger landscape); the results of actions on future generations of people and natural resources; evolutionary consistency; and a commitment to using native plant species when enhancing or restoring habitat.

Numerous programs exist in government agencies and non-governmental organizations to promote stewardship. For example, the Water Stewardship Program,

sponsored by the Division of Water within New York State's Department of Environmental Conservation (NYSDEC), focuses on "commitment, taking action, and helping others get involved in water stewardship" (Rosenbach 1992:47). Program supporters encourage stewardship activities as a way to improve the environment, increase awareness about environmental problems, and foster community activity. The Natural Heritage League, a coalition of government agencies and nongovernmental organizations established in 1982 in Ontario, Canada, encourages private land stewardship as an alternative to protection through land acquisition or local official laws and zoning plans (Van Patton 1992). The League defines the term stewardship to "encompass the care given to natural heritage by a landowner - care that in most cases involves primarily leaving the site undisturbed, since most ecological sites in Ontario do not require active management for ecosystem maintenance" (Van Patter et al. 1990:121-122). Another example is the USDA Extension Service, which promotes environmental stewardship education through its national 4-H program (Snyder et al. 1994). The National 4-H Council has developed a resource guide to help educators promote environmental stewardship by infusing programs on energy and the environment into their curricula.

Table 1 illustrates the variety of agencies and organizations promoting resource stewardship in the United States and the diversity of activities and programs that they have developed and sponsored. Although not explicitly mentioned in the table, individuals not associated with the types of agencies and organizations listed also play a major role in developing stewardship activities. For example, the Department of Interior's Take Pride in America campaign awarded prizes to individuals who displayed a strong commitment to environmental stewardship. Those persons engaged in various activities, including creating wildflower displays along highways, initiating programs to educate the public about natural

TABLE 1. Examples of stewardship activities in the United States (U.S. Dept. of the Interior 1988).

TYPE OF ORGANIZATION	NAME OF ORGANIZATION	STEWARDSHIP ACTIVITIES
Constituent Organizations	Delaware Nature Education Society, DE	• Instructed students about conserving natural areas & protecting wildlife habitat.
	Trout Unlimited, CA	• Built streambank stabilization structures along three creeks to improve fish habitat.
Businesses/Corporations	Northeast Utilities, CT	• Developed an outdoor environmental education program in Massachusetts.
	Mobil Oil Company	• Employed youths to restore local parks & neighborhoods during the summer.
Youth Groups	Wildlife Explorer Post 637, OK	• Assisted OK Dept. of Wildlife Conservation in managing deer & banding Canada geese.
	Boy Scout Troop 414, NM	• Organized & participated in restoration activities at the Pecos National Monument.
Civic/Citizen Organizations	Memorial Chapter of the Izaak Walton League	• Launched a "Save the Prairie" campaign to conserve 16 acres of natural prairie in Illinois.
	Kalihi-Palama Community Council, HI	• Sponsored a public information/education campaign to restore the Kapalama Canal.
Media	KCNC-TV, CO	• Informed & educated viewers about the importance of public lands & the need to take personal responsibility for these lands.
	<i>Wichita Eagle-Beacon</i> , KS	• Publicized campaigns, proposals, & ideas that encouraged resource conservation.
Educational Institutions	National Outdoor Leadership School, WY	• Stimulated awareness about resource stewardship through a 31-day course.
	New York City Board of Education, NY	• Encouraged students at all city high schools to volunteer in the Gateway National Recreation Area cleanup.

Table 1. Continued.

TYPE OF ORGANIZATION	NAME OF ORGANIZATION	STEWARDSHIP ACTIVITIES
Public/Private Partnerships	Friends of the Rouge, MI	•Worked with state agencies, municipalities, counties, & private citizens to cleanup logjams and debris in & along the Rouge River in an annual, one-day event.
	Stop Oregon Litter and Vandalism, OR	•Worked with groups & communities to promote awareness about litter & vandalism & encourage participation in community cleanup & repair projects.
Local Governments	City of Hazen, AK	•Organized the "Heart of the Prairie" committee to preserve the town's tallgrass prairie.
	City of Norfolk, Dept. of Parks and Recreation, VA	•Coordinated activities to clean up, restore, & preserve Norfolk's beaches for present & future generations.
State Governments	Pennsylvania Dept. of Transportation, PA	•Sponsored a cleanup program to collect litter from highways, school yards, & parks.
	New Jersey Pinelands Commission, NJ	•Educated residents about the Pinelands, the country's first National Reserve.
Federal Government	The Extension Service and Forest Service, Dept. of Agriculture (USDA)	•Operated the Range Etiquette program in AZ to inform urban range users about multiple-use range management.
	U.S. Fish and Wildlife Service, Dept. of the Interior (DOI)	•Developed & produced a series of educational packages concerning wildlife, habitat, & natural resource management.

resources, raising funds to clean up and restore parks, and organizing a community-wide cleanup of polluted river banks (Dept. of the Interior 1988).

Many government agencies and non-governmental organizations located in the Great Lakes Basin also are involved in coordinating and encouraging stewardship activities among Basin residents. Concepts related to stewardship are evident in the "ecosystem approach"

being promoted for management of the Great Lakes Basin. The 1978 Great Lakes Water Quality Agreement defined the Great Lakes Basin ecosystem as "the interacting components of air, land, water and living organisms, including humans, within the drainage basin of the St. Lawrence River at or upstream from the point at which this river becomes the international boundary between Canada and the U.S." (GLWQA, Article I(g)). The ecosystem approach recognizes that the various components of the environment are interconnected and therefore environmental contamination or degradation in one area can cause problems in another. This concept requires all individuals whose activities may adversely affect the environment to recognize and reduce impacts. In practice, the ecosystem approach requires people to avoid actions that may directly or indirectly lead to contamination of the lakes (Great Lakes Water Quality Board 1991). To fully implement the ecosystem approach for the Great Lakes Basin, governments must begin operationalizing the ecosystem approach in resource management and regulatory programs, and individuals must assume personal responsibility to protect the ecosystems in which they live and ensure that their behaviors will not adversely impact the quality of the Great Lakes Basin (Hartig and Zarull 1992).

Stewardship: A Working Definition

Based on our literature review, we define stewardship as *the moral obligation to care for the environment and the actions undertaken to provide that care*. The moral obligation to care for the environment implies the existence of an ethic of personal responsibility, an ethic of behavior based on reverence for the Earth and a sense of obligation to future generations. To effectively care for the environment, individuals must use resources wisely and efficiently, in part by placing self-imposed limits on personal consumption and altering personal expectations, habits, and values. Appropriate use of natural resources within the stewardship ethic involves taking actions that respect the integrity of natural systems.

INDICATORS OF STEWARDSHIP

Because behavior is influenced by a host of factors beyond the obligations a person feels, measuring stewardship behavior alone provides an incomplete assessment of the extent of stewardship in the Lake Ontario Basin. As noted in the definition of stewardship, a sense of obligation, or motivation, is an important component of stewardship, as is intention. Because intervening factors may prevent an individual's intentions from being realized as stewardship behavior, an understanding of barriers to stewardship is necessary if one seeks to increase the prevalence of sound stewardship in the Lake Ontario Basin. Thus, any instrument developed to examine stewardship should include indicators of: (1) stewardship motivators, (2) stewardship intentions, (3) stewardship behaviors, and (4) stewardship incentives/barriers.

In this section we discuss each of those four concept areas, summarize input from the EOWG Advisory Committee on stewardship indicator development, and briefly review past efforts to develop related indicators. Three appendices are provided as a partial cross-reference of existing indicators by study and concept area.

Measures of Stewardship Motivators

Motivation is a psychological concept that refers to the underlying reasons for human behavior. Deci and Ryan (1985:3) define the study of motivation as "the exploration of the energization and direction of behavior." Early theories of motivation, rooted in a mechanistic view of human behavior, suggested that human behavior is motivated by instinctive drives (e.g., hunger, thirst, pain avoidance). Later motivation theories have arisen from an organismic theory of human behavior. Those theories of motivation assume that only a portion of behaviors can be explained by fulfillment of basic drives; people also participate in

activities that they believe will produce valued psychological outcomes, such as self-actualization, competence, and interpersonal relatedness (Deci and Ryan 1985).

We define stewardship motivators as those factors that prompt an individual to feel a responsibility to protect the environment. We hypothesize that stewardship motivation (and thus, stewardship behavior) may be influenced by: values and beliefs, perceived responsibilities, expected benefits of stewardship behavior, awareness and knowledge of key issues and concepts, relative concern about environmental quality, information sources, and locus of control.

Deci and Ryan (1985) offer a theoretical framework (i.e., self-determination theory) that has provided some explanation of motivation in work, leisure, and classroom settings. They suggest that all behaviors are either intrinsically motivated (i.e., performed because they are intrinsically satisfying) or extrinsically motivated (i.e., performed to avoid a penalty or receive a reward). They suggest that extrinsic motivations can be characterized into subgroups based on the degree to which the motivation has been internalized (Table 2).

The Deci and Ryan (1985) theoretical framework may be useful for our purposes because the Advisory Committee has expressed interest in assessment of stewardship motivation along a continuum of internalization. The Advisory Committee is interested in the role of external regulation as a stewardship motivator (e.g., financial, legal, and normative incentives to perform stewardship behaviors). We discuss external regulation in the section entitled "stewardship barriers and incentives." The Advisory Committee also is interested in motivators that are more internalized and self-determined. Potential indicators of an internalized source of motivation could include: environmental knowledge and awareness, perceived health risks from the environment, concern and fear about environmental quality, attitudes toward the environment, and perceived personal economic consequences of

TABLE 2. Types of human motivation proposed by Deci and Ryan (1985) in their Theory of Intrinsic Motivation and Self-Determination.

DOMAIN LABEL	DOMAIN DESCRIPTION
Intrinsic motivation	Behavior performed because the actor finds the behavior intrinsically satisfying.
External regulation	Extrinsic motivation: behavior performed because of an external system of reward, punishment, or constraint.
Introjection	Extrinsic motivation: a formerly external motivation now internalized as feelings of guilt, anxiety, self-esteem, etc.
Identification	Extrinsic motivation: behavior performed because it is congruent with the actor's values and goals.
Integration	Extrinsic motivation: behavior performed not only because it is congruent with the actor's values and goals, but also because it has become part of the actor's sense of identity.
Amotivation	Actor doesn't really know why he/she did the activity because he/she sees no particular connection between her behavior and related outcomes; actor can't give a clear explanation for actions because he/she doesn't feel like personal actions can really change things.

stewardship behavior (Table 3). Committee members have articulated a need to distinguish between motivators that affect behaviors and those that affect people's attitudes or intentions. This characterization of stewardship motivations will necessitate a multidimensional, multi-variate measurement approach.

Luc Pelletier and others (Tuson et al. 1991, Pelletier et al. 1993) have developed a scale of items that may be especially useful as indicators of stewardship motivators. Pelletier et al.'s 1993 Motivation Toward the Environment Scale (MTES) contains 24 items, with four items in each of six motivational subscales. Pelletier et al. (1993) used Deci and Ryan's (1985) theory of motivation as the basis for their scale. Items in the MTES and examples of other items related to factors that may influence stewardship behaviors are shown in Appendix A.

TABLE 3. Suggested^a topic areas for consideration as subindicators of stewardship motivators.

Subindicator Topic Area	Topic Description
Knowledge/Cognitive	<ul style="list-style-type: none"> ● Awareness and understanding of factual information available on environmental issues in the Basin ● Ability to make connections and linkages between both simple and complex facts (e.g., understanding links between personal behavior and global environmental problems). ● Understanding cause and effect well enough to make personal behavior changes that positively affect the environment.
Health	<ul style="list-style-type: none"> ● Perceived risks to personal health. ● Perceived threats to ecosystem "health."
Concern/Fear	<ul style="list-style-type: none"> ● Perceived outcome if nothing is done to address existing environmental problems (e.g., perception that dire consequences may result from inaction). ● Perceived need to consider "rights" of future generations, society generally, or the environment (ecosystem) generally. ● Perceived trend in environmental quality (e.g., is the quality of the environment expected to decline). ● Perceived threat to local, regional, or national economic stability.
Affective	<ul style="list-style-type: none"> ● Values and ethics (e.g., perceived responsibilities to other people and the environment). ● Perceived trade-offs between environmental quality and jobs for Basin residents, economic growth in the Basin. ● Willingness to make personal lifestyle changes to safeguard the environment.

^aSubindicators identified by members of the Advisory Committee of the Bi-National Ecosystems Objectives Work Group (EOWG).

Key values and beliefs: The New Environmental Paradigm (NEP) scale developed by Dunlap and Van Liere (1978) offers one instrument for measurement of environmental values and beliefs that may motivate stewardship behavior. The NEP scale contains 12 items that examine three concept areas: limits to economic growth, the balance of nature, and anti-anthropocentrism. They proposed the instrument as a means of determining where people fit on a continuum between an anthropocentric and a biocentric environmental paradigm. The former represents the dominant social paradigm in North America (the dominant view perceives people as separate from nature; views the environment as a resilient, if not limitless supply of resources for human use; and sets unlimited economic growth as a societal goal). The "new environmental paradigm" espoused in the contemporary environmental movement asserts that there are limits to economic growth and that human use of the environment should be secondary to maintenance of natural systems and processes (Catton and Dunlap 1978, Dunlap and Van Liere 1978, Van Liere and Dunlap 1981, Catton 1982, Dunlap and Van Liere 1984, Edgell and Nowell 1989). The NEP scale has been used in several studies (Dunlap and Van Liere 1978, Albrecht et al. 1982, Dunlap and Van Liere 1984, Arcury et al. 1985, Gray 1985, Gigliotti et al. 1992). It appears to provide a valid and reliable instrument that may be of value to researchers interested in stewardship motivations.

Fortner and Mayer (1983, 1988, 1991) developed a set of items that also may be of use in assessing whether people hold attitude positions that might motivate stewardship behavior. They collected information on attitudes about the Great Lakes with a randomized sample of fifth and ninth graders in three regions of Ohio. They developed a set of 10 semantic differential items with adjectival pairs describing Lake Erie. Results showed generally positive attitudes toward Lake Erie, but little change in attitudes four years after students were exposed to a Great Lakes education program.

Perceived responsibilities: A review of research on environmental behaviors (Hines et al. 1987) indicated that such behavior is positively correlated with a sense of personal duty or responsibility. However, some studies suggest that individuals often believe that people other than themselves are responsible for environmental problems. For example, Johnsen et al. (1992) measured perceptions of water quality, perceptions of pollution sources, and water quality requirements for particular types of recreation with a sample of 700 adults in Green Bay, Wisconsin. They found that the majority of respondents viewed industries as the major source of pollution in the lakes. A minority perceived recreational use of the lakes, city sewage, or salt runoff as major sources of pollution. While respondents favored lake rehabilitation activities, recreational users of the lakes were no more likely than nonusers to support increases in user fees to help fund those programs. Those findings identify the possibility that Lake Ontario Basin residents may not see the connection between their own behaviors and environmental pollution.

Similarly, Dunlap (1991) found evidence that people generally blame industry for environmental problems, while failing to see themselves as personally contributing to those problems. A national telephone survey of Canadians (Decima 1993) found perceived personal responsibility to be more widespread. In that study, a majority (66%) of Canadians felt some responsibility to create a healthy environment (Decima Research 1993). Asked who they thought should be held most responsible for activities to create a healthy environment, 35% said individuals, 31% said the federal government, 14% said environmental groups, and 19% said private companies.

Awareness and knowledge about the Great Lakes: Education programs often stress dissemination of information and knowledge acquisition as the basis for altering students' values and attitudes (Reading and Kellert 1993) and promoting environmentally responsible

behavior (Hungerford and Volk 1990). Education alone, however, does not guarantee the development and retention of environmental stewardship ethics and values. Simply providing students with facts and information about environmental stewardship will not necessarily result in supportive attitudes because knowledge is only one of many factors that influence attitudes (Rokeach 1972; Ramsey and Rickson 1976; Sinden and Worrell 1979; Brown and Manfredi 1987; Hungerford and Volk 1990; Kellert 1992). According to Borden and Schettino (1979), knowledge about the environment and affective reactions about environmental issues are independent variables. Ecological and biological concepts can be taught in the classroom, but the results of this type of education are variable, sometimes yielding little or no change in students' attitudes or values.

Some studies, however, *have* shown strong links between education, knowledge and environmental values. For example, in a national study of adults in the U. S., Kellert found education to be "a powerful force shaping perceptions of nature and living diversity" (Kellert 1996:54).

" . . . The higher a person's education, the more likely that person is to express greater concern, affection, interest, and knowledge (and less exploitive and authoritarian attitudes) toward animals and the natural world. This tendency is especially pronounced among the college educated. . . . Perhaps this tendency reflects the impact of 'deferred adolescence' and delayed entrance into the work force, enabling people to internalize a more benign and less exploitive relationship to the natural world. College education may also promote greater knowledge and sense of stewardship toward nature and animals. Whatever the explanation, these results reflect the progressive impact of higher education."

Similarly, Arcury et al. (1986) found that education is positively correlated with knowledge about the environment and strongly positively linked to a more ecological world view, Pfeffer and Stycos (1995) illustrated through their study that educational efforts aimed at improving environmental knowledge can be effective in establishing a basis for the development of an ethic of responsibility. Studies have shown that children who have been

exposed to a formal environmental education program will demonstrate, in a natural setting, more conservational and less destructive behavior than a control group (Asch and Shore 1975; Leeming et al. 1993). Research also has indicated that the manner in which ecological material is presented can influence students' attitudes about the issues being discussed (Ramsey and Rickson 1976). Thus, environmental education, though not a panacea, represents one important mechanism for increasing responsible stewardship among all segments of the population. Both indoor and outdoor education can sensitize people to nature, increase their awareness about environmental issues and their knowledge of ecological principles, help them develop problem-solving skills, and clarify their beliefs and values (Monroe and Kaplan 1988), in part by providing them with an experimental foundation on which to base their decisions.

Of all the potential influences on stewardship motivation (and behavior), knowledge about the environment has probably received the most research attention. Many studies have measured environmental knowledge levels, including: Bailey 1971, Fortner and Teates 1980, Resources for the Future 1980, Fortner and Mayer 1983, Buethel 1985, Walter and Lien 1985, Brody and Koch 1986, Arcury et al. 1987, Arcury and Johnson 1987, Blum 1987, Fortner and Mayer 1988, Brody et al. 1989, and Caron 1989. Most of these studies have found relatively low public knowledge of environmental issues. For example, Fortner and Mayer (1983) collected information on knowledge and attitudes about the Great Lakes with a randomized sample of fifth and ninth graders in three regions of Ohio. They replicated their 1979 study with the same cohort of people in 1983 (Fortner and Mayer 1988) and 1987 (Fortner and Mayer 1991). Through a process of expert review and pretesting, they developed a pool of 53 knowledge items. Three different survey forms were created, each containing six core items, and a partial set of science-, social science-, and humanities-related knowledge items.

They found student knowledge about the Great Lakes was low, but they found some improvement in general knowledge about the Lakes four years after a Great Lakes education program.

Fortner et al. (1991) developed a set of knowledge items suitable for use with adult respondents. They conducted a review of planning documents from a variety of Great Lakes agencies to create a composite list of 32 environmental issues facing the Great Lakes. A panel of Great Lakes scientists reviewed the issue list and a set of knowledge questions (one for each issue). They reported that knowledge levels were low for a sample of convenience (i.e., adult shoppers who passed their display tables at two Cleveland malls) and a "user group" sample (i.e., attendants at a Cleveland boat show).

Brothers et al. (1991) measured the effect of television news on knowledge of Great Lakes issues held by adults in Cleveland, Ohio. Through a process of expert review, they developed a set of 31 multiple choice knowledge items. They also developed a vocabulary list of 14 words and a set of Likert-type opinion items. Three questionnaire forms were developed, each containing 12 knowledge items, the 14 vocabulary words, and nine opinion statements. They found some tentative evidence that televised educational programs can improve knowledge.

Relative concern about environmental quality: Jones and Dunlap (1992) presented data from the National Opinion Research Center's General Social Surveys (1973-1990). During 18 years of research using those surveys, respondents were asked the following:

"We are faced with many problems in this country, none of which can be solved easily or inexpensively. I'm going to name some of these problems and for each one, I'd like you to tell me whether you think we're spending too much money on it, too little money, or about the right amount."

"Improving and protecting the environment" (later revised to read, "the environment") was listed as one of the problems (NORC 1986). Jones and Dunlap found that the social bases for environmental concern have remained very stable; the environmental concern emerging in the 1960's has not spread to new demographic groups nor has change in concern been strongly associated with personal or societal economic conditions.

A range of items assessing concerns about the environment were developed for a national telephone survey of Canadians (Decima 1993). That study found a high level of concern about the effects of the environment on Canadians' health. The "Health of the Planet Survey," developed by the Gallup International Institute, contained several items assessing attitudes and values about the state of the environment (Dunlap et al. 1992). Use of the instrument in a 22-nation study revealed high concern about the environment in most of the developed and developing nations studied. They also found that a substantial proportion of residents in many nations believe environmental protection should have priority over economic growth.

Items on environmental concern also occur in another national telephone survey of Canadians (Decima 1993). That research found 92% of Canadians were somewhat or very concerned about the quality of the environment and its effects on their health. Fifty-eight percent felt their health was threatened by the quality of the environment. The majority thought the quality of the environment had gotten worse during the past 5 years.

Fourteen issue items were developed for Canada's Health Promotion Survey 1990 (Stephens and Fowler Graham 1993). Among the health issues presented, environmental pollution ranked first in terms of perceived need for government action. Eighty-six percent of Canadians ranked environmental problems as extremely important.

Slovic et al. (1992) developed 33 risk perception and 40 attitudinal items on health concerns for their Health Risk Perception in Canada study. Their study revealed high perceived risk associated with industrial pollution.

Information sources: Fortner and Mayer (1983, 1988, 1991) used one multiple choice item to identify the media source that students believed was most important in teaching them about the oceans and Great Lakes. Many other studies have included items on information sources (e.g., Decima 1989, Johnsen et al. 1992, Decima 1993).

Measures of Stewardship Intentions

Stewardship intentions are defined as the extent to which people express commitment to responsible stewardship. Stewardship intentions (Table 4) might be inferred through questions about individuals' willingness to devote money, time, or political support to improving and managing local communities or the Great Lakes ecosystem generally (e.g., Decima 1989, Maloney et al. 1975, Labatt 1991, Dunlap 1991, Decima 1993).

Johnsen et al. (1992) measured support for key action items in a Great Lakes Remedial Action Plan (RAP), willingness to pay to implement the RAP, attitudes toward funding the RAP, and support for alternate implementation structures with a sample of 700 adults in Green Bay, Wisconsin. They found that a considerable portion of respondents use the Bay even though they perceive the water quality to be far below what is appropriate for those uses. Respondents "did not perceive obstacles to environmental improvement as insurmountable and supported all the key action items in the RAP . . ." (Johnsen et al. 1992:19).

Public opinion research conducted since 1970 provides some evidence that most Americans do not express behavioral intentions (or behaviors) that match their degree of concern over environmental quality and stewardship. In a manuscript titled, "Public opinion in

TABLE 4. Suggested* topic areas for consideration as subindicators of stewardship intentions.

Subindicator Topic Area	Topic Description
Willingness to pay money	<ul style="list-style-type: none"> ● Determine individuals' preferences for natural resources and environmental quality by determining how much they would be willing to pay for specific improvements in the environment.
Willingness to devote time	<ul style="list-style-type: none"> ● Determine individuals' preferences for natural resources and environmental quality by determining how much time they would be willing to devote to improving environmental quality.
Willingness to make personal sacrifices	<ul style="list-style-type: none"> ● Determine individuals' preferences for natural resources and environmental quality by determining how willing they are to make personal sacrifices to help improve the quality of the environment.

*Subindicators identified through literature search: see Sinden and Worrell (1979); Mitchell and Carson (1989).

the 1980's: clear consensus, ambiguous commitment," environmental sociologist Riley Dunlap synthesized public opinion research from the late 1970's, 1980's, and early 1990's that repeatedly used three particular items to measure public concern about the environment (Dunlap 1991). National polls in the U.S. suggested that concern about the environment in the U.S. increased during the 1980's and that a majority of U.S. adults supported environmental protection by 1990. However, as Raymond Murphy notes (Murphy 1994:228), actual public support for new environmental initiatives and personal lifestyle changes have remained very limited in the U.S.

"There is no shortage of theories claiming that society is moving to a new ecological paradigm (Dunlap and Van Liere 1978, 1984; Cotgrove 1982; Milbrath 1984, 1989), or post-modern ecological awareness (Ophuls 1977; Beck 1992a, 1992b). There is even some survey evidence that attitudes have changed in an ecological direction (Council on Environmental Quality et al. 1980; Dunlap 1989; Olsen et al. 1992). What is lacking is evidence that these attitudinal changes have affected behavior, life styles, and institutions in a way that leads to a symbiotic relationship between humans and their environment. . . Ecologically aware social action is not fading, but it is not advancing very quickly either."

The contingent valuation method (if used to measure people's willingness to pay for improved environmental protection and environmental quality) offers another means of measuring stewardship intentions. That method originated in the early 1960's, and has been used extensively in surveys as a measure of respondents' attitudes and intentions (Mitchell and Carson 1989) (for examples, see Appendix B). The contingent valuation method involves asking survey respondents to disclose the value they place on unpriced goods (e.g., clean water, biodiversity) given a specific situation (Cummings et al. 1986). If used properly, this method can be both valid and reliable (Mitchell and Carson 1989). For example, Kay et al. (1987) asked survey respondents to indicate how much they would be willing to pay for a license to fish on restored salmon river systems, and how much they would pay to ensure the continuation of the program to restore Atlantic salmon to New England waters.

Measures of Stewardship Behaviors

One of the goals established by the Lake Ontario Responsible Stewardship Subcommittee of EOWG is that "we as a society shall recognize our capacity to cause great changes in the ecosystem and we shall conduct our activities with responsible stewardship for the Lake Ontario Basin" (Bertram and Reynoldson 1992:94). Future residents of the Lake Ontario Basin will not enjoy the same level of benefits now available from Lake Ontario unless current Basin residents exhibit year-round behaviors that reflect an internalized sense of responsible stewardship.

Over the past two decades, researchers have begun to analyze several aspects of environmentally responsible behavior (a large portion of this research has focused on energy conservation behaviors and waste management behaviors like recycling and composting). Work to date has focused on several primary research questions: (1) what are the demographic and personality characteristics of people who perform environmentally responsible behaviors; (2) how successful are interventions at promoting such behaviors; and (3) how do cognitive and psychological variables influence environmental behavior (for a detailed discussion of this work, see Taylor and Todd 1995).

The EOWG Advisory Committee has expressed interest in assessment of behaviors that occur at the personal and community level. Committee members have discussed a wide variety of personal behaviors that may provide a useful focus for stewardship indicator development. Example behaviors include: product purchasing and disposal; household waste disposal; food consumption; water, land, and energy use; and personal decisions about family size (Table 5). Some of those behaviors have been examined previously by various researchers. For example, Statistics Canada (1992) assessed such behaviors as recycling, composting, and home energy use (Appendix C).

Tuson and Pelletier (1992) developed an environmental behavior scale with four subscales: recycling, conserving, purchasing environmentally friendly products, and seeking and sharing environmental information. The Tuson Pelletier behavior (1992) scale has been used by Green-Demers et al. (1993) to examine hypotheses about the relationship between motivation and environmental behavior. They found some support for the hypothesis that differences in motivation are a better predictor of behavioral frequency when the behaviors are difficult (motivational differences may be less salient with regard to environmental behaviors that are easy to perform).

TABLE 5. Suggested^a topic areas for consideration as subindicators of stewardship behaviors at a personal level.

Subindicator Topic Area	Topic Description
Organization Membership	<ul style="list-style-type: none"> ● Active membership in a grassroots community organization related to water quality, energy conservation, sustainable agriculture, etc. ● Membership in a national environmental organization.
Product Purchase, Disposal	<ul style="list-style-type: none"> ● Influence of environmental considerations on purchase of durable goods (e.g., major appliances, automobiles). ● Degree to which appliances are repaired rather than replaced. ● Degree to which products are purchased singly or in bulk. ● Degree to which consumers try to "reduce, reuse, and recycle." ● Direct use of renewable resources (e.g., trees, fish, wildlife). ● Purchase of locally-produced goods. ● Disposal of solid wastes, household chemicals, hazardous materials.
Patterns of Food Consumption	<ul style="list-style-type: none"> ● Personal production of fruits, vegetables. ● Purchase of organically-grown foods. ● Practicing vegetarianism. ● Making dietary changes based on perceived health risks associated with particular foods.
Water Use and Conservation	<ul style="list-style-type: none"> ● Utilization of conservation tools and technologies (e.g., water-saving shower heads or faucets). ● Practicing water use reduction measures (e.g., repairing faucet leaks, reducing shower length). ● Recycling water (e.g., collection of gray water for a second use).

TABLE 5. Continued.

Subindicator Topic Area	Topic Description
Lawn and Garden Care	<ul style="list-style-type: none"> ● Use of fertilizers, herbicides, insecticides. ● Controlling erosion, reducing runoff, increasing percolation. ● Outdoor burning of garbage and leaves.
Energy Use and Conservation	<ul style="list-style-type: none"> ● Personal transportation behavior (e.g., car ownership and use, use of mass transit, carpooling, trip planning). ● Use of energy for heating, cooling, and lighting (e.g., types of fuels used, use of conservation devices and technologies).

*Subindicators identified by members of the Advisory Committee of the Bi-National Ecosystems Objectives Work Group (EOWG).

Committee members also have identified a range of community-level behavior categories that may provide a useful focus for stewardship indicator development. Indicators of community-level behavior may include trends in: environmental organization membership, political activity involvement, annual volunteer service hours per capita, daily water or energy use per capita, or municipal waste disposal per capita (Table 6). Community level actions have been measured by Maloney et al. (1975), Labatt (1991), and Decima Research (1989, 1993).

The popular press may also prove useful as a source of inspiration for development of stewardship behaviors indicators. Environmental action guides, such as "Fifty Things You Can Do to Save the Earth" (The Earth Works 1989) and "Fifty Things Kids Can Do to Save the Earth" (The Earth Works 1990) offer numerous examples of stewardship behaviors related to energy and water use, product purchase and disposal, information seeking and sharing, and recycling.

TABLE 6. Suggested* topic areas for consideration as subindicators of stewardship behaviors at a community level.

Subindicator Topic Area	Topic Description
Political Activism	<ul style="list-style-type: none"> ● Voting behavior. ● Involvement in non-government organizations that sponsor lobbying activities. ● Service as an elected, appointed, or volunteer representative of government and/or non-government organizations influencing environmental decision making. ● Participation in public meetings, hearings or other public involvement programs focused on issues related to the environment. ● Becoming informed about public decision-making processes and opportunities related to the environment.
Land Use and Land Clean Up	<ul style="list-style-type: none"> ● Participating in community clean-up programs. ● Participating in habitat restoration programs (e.g., restoring vacant lots, repairing streambank erosion, planting native plants, restoring greenways). ● Participation in land conservation or preservation programs (e.g., conservation easements, land trusts).

*Subindicators identified by members of the Advisory Committee of the Bi-National Ecosystems Objectives Work Group (EOWG).

Measures of Stewardship Incentives/Barriers

We define incentives (Table 7) as external factors that encourage people to act on their commitment to and beliefs about stewardship. Barriers are external factors that discourage expression of stewardship behavior (Table 8). Cultural, psychological, economic, political, sociodemographic, and knowledge factors have been suggested as potential incentives/barriers to behavior.

The EOWG Advisory Committee has discussed the importance of local, regional and national policies as potential incentives/barriers to wise stewardship behavior. For example, some community leaders may encourage community population growth as a means to

TABLE 7. Suggested^a topic areas for consideration as subindicators of stewardship incentives.

Subindicator Topic Area	Topic Description
Financial	<ul style="list-style-type: none"> ● Economic incentives. ● Government subsidies.
Legal	<ul style="list-style-type: none"> ● Laws and regulations.
Normative	<ul style="list-style-type: none"> ● Peer pressure and social pressure. ● Role of ethical and moral structures (e.g., religion, group culture). ● Ways in which operations of one community affect neighboring communities.

^aSubindicators identified by members of the Advisory Committee of the Bi-National Ecosystems Objectives Work Group (EOWG).

TABLE 8. Suggested^a topic areas for consideration as subindicators of stewardship barriers.

Subindicator Topic Area	Topic Description
Logistical barriers	<ul style="list-style-type: none"> ● Perceived lack of resources, such as time, money, etc.
Educational barriers	<ul style="list-style-type: none"> ● Perceived lack of knowledge about and/or training in environmental issues and concepts.
Attitudinal barriers	<ul style="list-style-type: none"> ● Individuals' neutral or negative attitudes about the environment. ● Perceived lack of support or encouragement from peers. ● Perceived lack of influence on the state of the environment, on decisions made by environmental agencies and organizations, etc. ● Perceived inconvenience associated with environmental stewardship behaviors
Fear and anxiety	<ul style="list-style-type: none"> ● Physiological and sociological/psychological concerns about outdoor activities.

^aSubindicators identified through literature review: see Ewert (1986); Ham and Sewing (1987/1988); Simmons and Widmar (1990).

promote business and economic expansion. Committee members have suggested that those same leaders could establish development guidelines that facilitate environmentally sound land use patterns (e.g., preservation of open space, natural areas, and soil and water quality). Furthermore, community leaders could establish budgets, policies, and regulatory mechanisms that encourage good stewardship behaviors (e.g., more use of gray water, more community recycling, appropriate disposal of toxic wastes).

Stewardship incentives: Our literature search uncovered a variety of studies that have examined stewardship incentives. For example, in a review of psychology literature, Porter et al. (1995) found evidence of 27 published studies during the past 25 years that used interventions to encourage people to recycle. Some of those studies manipulated the conditions antecedent to recycling behavior. Those studies focused on: (1) prompts (i.e., written or verbal encouragement to recycle), (2) commitments (i.e., verbal or written pledges to recycle), (3) environmental alterations (e.g., providing services or containers that make recycling more convenient), and (4) goal setting (i.e., setting personal or group targets for the amount of recycling activity to be accomplished). Some of those studies manipulated the consequences that occur after recycling behavior. Those studies focused on: (1) feedback, (2) rewards, and (3) penalties. Most of those studies found that interventions are associated with short-term behavior change. However, nearly all of those studies found little or no long-term influence on behavior.

A publication by the Natural Heritage League in Ontario, Canada offers a model of seven stewardship enhancement techniques which may function to encourage landowners to formally commit to protection of their land and natural resources (Van Patter et al. 1990). Those techniques include landowner education, written and verbal stewardship agreements, land management agreements, conservation leases and easements, and land purchase with

saleback to landowner. Those techniques can be organized into a hierarchical model, with education at the bottom and purchase with saleback at the top. Van Patter et al. (1990) suggested that the lowest level, education, is the most widely applied and the least expensive in terms of labor, but it also results in a relatively low degree of commitment to stewardship.

Prestby et al. (1990) and Knoke and Prenskey (1984) each developed a similar three-part typology of incentives to join voluntary organizations (e.g., environmental groups). Those typologies describe membership incentives as material/utilitarian (i.e., tangible rewards), solidarity/affective (i.e., benefits of social interaction, group membership, interpersonal relationships), and purposive/normative (i.e., personal values that create a sense of concern and personal responsibility). Some of the items developed for those studies may be adaptable as indicators of stewardship incentives.

Pettus and Teates (1983) and Lane et al. (1994) developed items that can be used to explore incentives that encourage educators to teach environmental education (Appendix D). Those items may be useful to assess the degree to which increased teacher training, instructional materials, and financial assistance may encourage formal stewardship education.

Stewardship barriers: We found several studies that had examined barriers to environmental stewardship behaviors. For example, Johnsen et al. (1992) measured perceived social and economic obstacles to environmental rehabilitation with a sample of 700 adults in Green Bay, Wisconsin. Campbell (1989) assessed barriers to production of biomass for energy production on small farms in the Great Lakes Basin (a behavior that could have environmentally beneficial consequences for the Basin). In his 1992 article, Brown discussed differences in professional and lay ways of thinking about environmental health risks as barriers to effective use of environmental health data (and societal actions based on that data). Simmons and Widmar (1990) explored participation in a local recycling program. In

their mail survey, they included two sets of items as indicators of barriers to engaging in recycling behaviors: one concerning respondents' perceived lack of knowledge about recycling, and the other focusing on a lack of personal salience and efficacy. They found that individuals confident in their knowledge about recycling engaged in this activity significantly more than those who perceived they had less knowledge about recycling. Furthermore, their results indicated that individuals who lacked a sense of personal salience and efficacy were less likely to recycle than persons with a strong sense of personal salience and efficacy.

Several studies concerned with barriers to environmental stewardship behaviors have focused on what inhibits teachers from implementing environmental education programs or incorporating environmental issues and concepts into their class curricula (Appendix E). Ewert (1986) discussed how fear can be a barrier to teachers conducting outdoor environmental education programs. Ham and Sewing (1987/1988) measured teachers' perceptions about four categories of barriers: conceptual, logistical, educational, and attitudinal. Conceptual barriers relate to perceptions about the content and scope of environmental education, while logistical barriers include those stemming from a perceived lack of resources (e.g., time, money). Educational barriers result from teachers' perceptions about their own inability to teach environmental issues and concepts. Finally, attitudinal barriers stem from teachers' attitudes about teaching environmental issues and concepts. Their results indicated that lack of time was the most important barrier preventing teachers from engaging in environmental education. Okebukola and Jegede (1992) conducted a survey to determine factors that stress science teachers, including lack of time to prepare lessons and poor attitudes of students toward learning about science.

Ryder (1990, p. 623) suggested that the largest barriers to a program of ecosystem management in the Great Lakes are institutional and political.

"... the fundamental roadblocks to a successful rehabilitation program in the Great Lakes would seem to be (1) a lack of coordination in achieving a consensus on ecosystem objectives, (2) inappropriate institutional arrangements for the implementation of various detection or sampling processes such as the Dichotomous Key, and (3) lack of political will directed toward proactive rehabilitation programs. None of these bottlenecks are intractable, but the accumulated inertia generated by them makes a timely and effective solution to the various ills of the Great Lakes basin ecosystem unlikely indeed."

Potential Frameworks for Further Research on Stewardship Indicators

Because stewardship involves beliefs, values, and behavior, research on stewardship should be informed by a theoretical model that links these concepts. The Theory of Planned Behavior (TPB) and its precursor, the Theory of Reasoned Action (Fishbein and Ajzen 1975; Ajzen and Fishbein 1980; Ajzen 1985, 1989; Ajzen and Madden 1986) provide a means to study voluntary behavior like stewardship (see Appendix E). TPB proposes that beliefs, attitudes, and behaviors are linked in a causal chain. Beliefs form the basis for attitude formation, attitudes predispose behavioral intentions, and intentions are the immediate antecedents of behavior (Fishbein and Ajzen 1975, Ajzen and Fishbein 1980).

The model holds that behavior is a result of salient beliefs held by the actor. TPB places these beliefs in 3 categories: (1) behavioral beliefs and outcome evaluations; (2) normative beliefs and motivations to comply; and (3) control beliefs and perceived facilitation (Ajzen 1989). One's behavioral beliefs and outcome evaluations lead to positive or negative evaluation of the attitudinal object (e.g., a positive or negative "attitude" toward environmentally-friendly practices like recycling). Normative beliefs and motivations to comply lead to one's "subjective norms" for behavior (e.g., a feeling of social pressure to behave in a way consistent with the beliefs significant others hold toward stewardship actions like recycling). Finally, control beliefs and perceived facilitation lead to one's "perceived control"

over impediments to taking a particular action (e.g., one may believe actions like recycling are important and socially desirable, but may not recycle because of perceived barriers such as lack of community recycling facilities). Overall attitude toward the behavior in question, subjective norms (i.e., social pressure), and perceived control serve as the primary antecedents of behavioral intention and expressed behavior. Behavior can then serve as a basis or development of new beliefs, attitudes, and intentions.

Some researchers have gone on to propose conceptual variations on TPB. For example, Taylor and Todd (1995) developed an integrated waste management model that blends innovation-adoption theory and TPB to examine the determinants of intention to engage in recycling and composting (Appendix F, Figure 1). Siemer et al. (1994) used TPB as the basis for a model of social-psychological determinants of intentions to support a proposed oral rabies vaccine trial and expression of rabies prevention behaviors by local residents in northern New York State (Appendix F, Figure 2). Based on a meta-analysis of 128 studies, Hines et al. (1986/87) developed a model of responsible environmental behavior that also reflects key elements of TPB (Appendix F, Figure 3). Any of these models may prove useful in exploring relationships between stewardship motivations, intentions, and behaviors.

SUMMARY AND DISCUSSION

The Stewardship Concept

Stewardship is *the moral obligation to care for the environment and the actions undertaken to provide that care*. Stewardship implies the existence of an ethic of personal responsibility, an ethic of behavior based on reverence for the Earth and a sense of obligation to future generations. To effectively care for the environment, individuals must use resources wisely and efficiently, in part by placing self-imposed limits on personal consumption and

altering personal expectations, habits, and values. Appropriate use of natural resources within the stewardship ethic involves taking actions that respect the integrity of natural systems.

A stewardship approach to environmental management and conservation is becoming common in government and nongovernment environmental organizations. However, the stewardship approach is not universally embraced -- not everyone agrees that better stewardship will be enough to avoid looming environmental problems. The stewardship concept and contemporary proponents of stewardship advocate important changes in behavior by individuals and organizations. However, it is important to note that the proponents of stewardship do not advocate the sweeping societal changes proposed within some other environmental movements (e. g., ecofeminism and deep ecology). Stewardship advocates should recognize this opposition and should remain aware that the stewardship approach contains values and assumptions that are not universally accepted.

Research needs related to stewardship:

- *How should stewardship be measured?* A valid and reliable instrument is needed to assess and measure stewardship attitudes. This instrument may require multiple scales to assess the various domains of the stewardship concept. The stewardship pilot study conducted by the authors (Siemer et al. 1995) represents the first effort to address this information need.
- *How does stewardship vary across publics?* Data are needed about how stewardship attitudes differ with regard to characteristics such as: age, education, gender, income, urban/rural background, and ethnicity. More insights are needed about how stewardship attitudes differ across interest groups (e.g., farmers, anglers, environmentalists).
- *How does stewardship vary by geographic region?* We recommend studying stewardship commitment in different locations (e.g., the Lake Ontario Basin, New York City Watershed, and the Columbia River Basin) so that data can be compared on stewardship attitudes.
- *What are the trends in stewardship attitudes over time?* Without time-series data, we do not really know if the American public is becoming more or less committed to

environmental stewardship. Future researchers should set a goal of long-term measurement of commitment to stewardship in particular areas. For example, researchers might set as their goal a study measuring stewardship commitment among different samples of residents in a particular watershed every five to 10 years.

- *What will motivate positive behavior change?* Such data are needed so that government and nongovernment organizations can take actions to implement effective stewardship incentives.

Stewardship Indicators

We found that a wealth of social research has been conducted on environmental concerns present in the Great Lakes Basin, much of it touching on issues of stewardship. We also found that a variety of survey instruments have been developed to explore particular stewardship motivations, intentions, behaviors, and incentives/barriers. Much of the work to date has focused on various motivations, especially concerns, attitudes, and beliefs (including knowledge) about the state of the natural environment. Tested questionnaire items related to stewardship behaviors and intentions are available in a variety of local, regional, and national survey instruments. Less available are example items related to stewardship incentives/barriers, especially outside the context of formal environmental education.

Research needs related to stewardship indicators:

- *Develop valid and reliable scales to measure each of the various types of potential stewardship motivation.* Though many example items now exist, development of additional items appears warranted. The conceptual area of stewardship motivations is so rich and multi-faceted that existing items may not address all of the interests expressed by members of the EOWG Advisory Committee.
- *Policy makers and researchers must decide which types of motivations are of highest priority to monitor, since too many types of motivations exist to cover in one instrument.*
- *More should be learned about intentions to behave in specific contexts.*
- *Determine what behaviors are of greatest interest to decision-makers and design specific instruments to match those interests.*

- *Future researchers should develop a variety of new questionnaire items in the area of stewardship incentives/barriers.* Some work has been done to develop indicators of monetary stewardship incentives, but more work is needed to develop and assess nonmonetary stewardship incentives. Guidance in this area may come from further review of existing stewardship programs (e.g., New York State's Forest Owner Stewardship Program).
- *A conceptual model is needed to guide research.* We suggest using existing models (e.g., theory of planned behavior) to design instruments that can help researchers predict stewardship behaviors.
- *Site-specific instruments to measure behaviors, intentions, and barriers/incentives in different geographic regions should be developed.*

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Appendix A. Examples of questionnaire items¹ developed to measure stewardship motivators.

<u>Indicator</u>	<u>Literature Source</u>
Motivations:	
● Intrinsic motivation: I do environmentally-friendly behaviors for the pleasure I experience while I am mastering new ways of helping the environment.	Tuson et al. (1991)
● Intrinsic motivation: I do environmentally-friendly behaviors for the pleasure I experience when I find new ways to improve the quality of the environment.	Tuson et al. (1991)
● Intrinsic motivation: I do environmentally-friendly behaviors because I like the feeling I get when I do things for the environment.	Tuson et al. (1991)
● Intrinsic motivation: I do environmentally-friendly behaviors for the pleasure I get from contributing to the environment.	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because other people will be upset if I don't (external regulation).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors for the recognition I get from others (external regulation).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because my friends insist that I do (external regulation).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because I think I'd regret not doing something for the environment (introjection).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because I'd feel I wouldn't be doing the right thing if I was neglecting to do things for the environment (introjection).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because I would feel bad if I didn't do anything for the environment (introjection).	Tuson et al. (1991)

¹Items are paraphrased. For actual wording and response categories, refer to original document cited in Column 2.

Appendix A. Continued.

<u>Indicator</u>	<u>Literature Source</u>
Motivations: (cont.)	
● Extrinsic motivation: I do environmentally-friendly behaviors because I would feel guilty if I didn't (introjection).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because I would feel ashamed of myself if I was doing nothing to help the environment (introjection).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because it is a reasonable thing to do (identification).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because it's a sensible thing to do in order to improve the environment (identification).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because it's the way I've chosen to contribute to a better environment (identification).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because I think it's a good idea to do something about the environment (identification).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because taking care of the environment is an integral part of my life (integration).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because it seems to me that taking care of myself and taking care of the environment are inseparable (integration).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because being environmentally-conscious has become a fundamental part of who I am (integration).	Tuson et al. (1991)
● Extrinsic motivation: I do environmentally-friendly behaviors because it's part of the way I've chosen to live my life (integration).	Tuson et al. (1991)
● Amotivation: I wonder why I'm doing things for the environment; the situation is simply not improving.	Tuson et al. (1991)

Appendix A. Continued.

<u>Indicator</u>	<u>Literature Source</u>
Motivations: (cont.)	
● Amotivation: I don't really know; I can't see what I'm getting out of it.	Tuson et al. (1991)
● Amotivation: Honestly, I don't know; I truly have the impression that I'm wasting my time doing things for the environment.	Tuson et al. (1991)
Values and beliefs: (on human health, ecosystem health, natural and artificial systems).	
● NEP: Are we approaching the limit to the number of people the earth can support.	Dunlap and Van Liere (1978) [item 1]
● NEP: Is the balance of nature delicate and easily upset.	Dunlap and Van Liere (1978)[item 2]
● NEP: Do humans have a right to modify the natural environment to suit their needs.	Dunlap and Van Liere (1978) [item 3]
● NEP: Was mankind created to rule over the rest of nature.	Dunlap and Van Liere (1978) [item 4]
● NEP: When humans interfere with nature will it result in disastrous consequences.	Dunlap and Van Liere (1978) [item 5]
● NEP: Do plants and animals exist primarily to be used by humans.	Dunlap and Van Liere (1978) [item 6]
● NEP: Is it necessary to control industrial growth to maintain a healthy economy.	Dunlap and Van Liere (1978) [item 7]
● NEP: Must humans live in harmony with nature to survive.	Dunlap and Van Liere (1978) [item 8] Millbrath (1985)
● NEP: Is the earth like a spaceship with limited room and resources.	Dunlap and Van Liere (1978) [item 9]

Appendix A. Continued.

<u>Indicator</u>	<u>Literature Source</u>
● NEP: Do humans need to adapt to the environment or can they remake it to suit their needs.	Dunlap and Van Liere (1978) [item 10] Millbrath (1985)
● NEP: Are there limits to growth beyond which our industrialized society cannot expand.	Dunlap and Van Liere (1978) [item 11]
● NEP: Is mankind severely abusing the environment.	Dunlap and Van Liere (1978) [item 12] Millbrath (1985)
● NEP: Will unchanged use of natural resources lead to serious shortages of raw materials.	Millbrath (1985)
● NEP: Is storage of nuclear waste too dangerous.	Millbrath (1985)
● NEP: Should society emphasize environmental protection over economic growth.	Millbrath (1985)
● NEP: Should society consider future generations when using natural resources.	Millbrath (1985)
● NEP: Do you cherish nature over other things or other things over nature.	Millbrath (1985)
● NEP: Do you favor or oppose the environmental movement.	Millbrath (1985)
● NEP: Do you consider the state of the environment to be a major problem.	Millbrath (1985)
● NEP: Should we address energy shortage by increasing conservation or production.	Millbrath (1985)
● NEP: Do you find environmental problems to be urgent or not.	Millbrath (1985)
● Perceived impact of environment on health.	Decima Research (1993) [item 2]

Appendix A. Continued.

<u>Indicator</u>	<u>Literature Source</u>
● Greatest perceived health risk from environment.	Decima Research (1993) [items 3]
● Health problems perceived to be affected most by the environment.	Decima Research (1993) [items 4]
● Personal definition of a "healthy environment."	Decima Research (1993) [items 5]
● Perception of the environment as a "threat" to health.	Decima Research (1993) [items 41]
● Environmental Hazard Assessment Inventory	Schmidt and Gifford (1989)
Perceived responsibilities: (to other people and the environment)	
● Perceived responsibility for the environment	Decima Research (1993) [items 19,28,30,35,38,46]
● How would you rate your lifestyle: very to not at all environmentally friendly.	Decima Research (1993) [items 19]
● Perceived importance of changing personal behavior	Decima Research (1993) [items 28]
● Perceived need for personal sacrifice for environment	Decima Research (1993) [items 30]
● Who should be most responsible for the environment.	Decima Research (1993) (individuals, companies, govt., etc.) [items 35]
● Relative importance of individual and community rights.	Decima Research (1993) [items 38]
● Perceived need for U.S. -Canadian joint action to solve environmental problems of Lake Ontario.	Program for Zero Discharge [1989]

Appendix A. Continued.

<u>Indicator</u>	<u>Literature Source</u>
Personal concern about lake restoration:	
● Perception that industries have the resources to stop releasing toxics into the Great Lakes basin.	Program for Zero Discharge [1989]
● Concern about effects of environment on health.	Decima Research (1993) [items 1]
● Greatest health concern related to the environment.	Decima Research (1993) [items 17]
● Relative concern about environmental quality.	Decima Research (1993) [items 47]
● Perception that government actions are too slow, or about right to address environmental problems in lakes.	Program for Zero Discharge [1989]
● Perceived need to reach zero discharge of contaminants into lakes within 5 years.	Program for Zero Discharge [1989]
● Perceived need for stronger environmental laws in the basin, even when risks are not known precisely.	Program for Zero Discharge [1989]
● Level of concern about eating sport-caught fish from Lake Ontario.	Connelly et al. (1992) [item 14,15,16]
● Perceived risks of eating sport-caught fish from Lake Ontario.	Connelly et al. (1992) [item 18]
Relative importance of restoring environmental quality:	
● Is society spending too much, too little, or about the right amount on environmental problems.	General Social Surveys (1973-1990), National Opinion Research [see Jones and Dunlap (1992)]

Appendix A. Continued.

<u>Indicator</u>	<u>Literature Source</u>
<ul style="list-style-type: none"> ● Relative importance of environment as a problem to be addressed by society 	Program for Zero Discharge [1989]
<ul style="list-style-type: none"> ● Environmental protection as a public policy priority. 	Program for Zero Discharge [1989]
<ul style="list-style-type: none"> ● Relative importance of chemical/industrial toxic wastes as an environmental problem 	Program for Zero Discharge [1989]
Perceived relationship between ecosystem quality and personal behavior:	
Information sources:	
<ul style="list-style-type: none"> ● Information sources. 	Decima Research (1993) [items 31,32,34,44,66]
<ul style="list-style-type: none"> ● Most trusted source of information. 	Decima Research (1993) [item 32, 67]
<ul style="list-style-type: none"> ● Trust in sources of information on health risks from fish consumption. 	Connelly et al. (1992) [item 19a,19b]
<ul style="list-style-type: none"> ● Sources of information on fish consumption health advisories. 	Connelly et al. (1992) [item 6,13a,13b]
Awareness and knowledge:	
<ul style="list-style-type: none"> ● Self-reported awareness of potential effects of the environment on personal health. 	Decima Research (1993) [item 33]
<ul style="list-style-type: none"> ● Knowledge that dredging stirs up hazardous wastes. 	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer 1983) Fortner and Mayer(1988)
<ul style="list-style-type: none"> ● Knowledge that marshes are being filled in for construction. 	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)

Appendix A. Continued.

<u>Indicator</u>	<u>Literature Source</u>
● Knowledge of why sea lampreys were a problem in the Great Lakes.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Knowledge that toxicants are transported to the upper lakes as acid rain.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Understanding the effect of proposed diversions of water from the Great Lakes Basin.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Knowledge of DDT problems from air transport.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Knowledge of major source of phosphorus in Great lakes.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Knowledge of fish consumption advisory for Lake Erie carp.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Knowledge that municipal water use is the greatest consumptive use of water in the Great Lakes Basin.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Knowledge of fish cooking techniques that reduce contaminants in fish.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)

Appendix A. Continued.

Indicator

- Knowledge about what nutrients must be controlled to prevent algal blooms.
- Knowledge of salt and natural gas deposits under Lake Erie.
- Relationship between lake climate and fruit crop production.
- Knowledge that waves cause most shore erosion.
- Knowledge of the economic value of the Great Lakes fishery.
- Knowledge that Great Lakes shipping is the most economical method of moving some goods.
- Understanding the cause of seasonal changes in Great Lakes water levels.
- Knowledge that fish are endangered by loss of spawning areas.

Literature Source

- Fortner et al. (1991)
Brothers et al. (1991)
Fortner and Mayer (1983)
Fortner and Mayer (1988)
- Fortner et al. (1991)
Brothers et al. (1991)
Fortner and Mayer (1983)
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Brothers et al. (1991)
Fortner and Mayer (1983)
Fortner and Mayer (1988)
- Fortner et al. (1991)
Brothers et al. (1991)
Fortner and Mayer (1983)
Fortner and Mayer (1988)

Appendix A. Continued.

<u>Indicator</u>	<u>Literature Source</u>
● Knowledge of what percent of North America's fresh water is held in the Great Lakes.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Knowledge that residential development is the most common shoreline use.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Ecological reasons to protect estuaries.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Economic value of water-based recreation/tourism.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Knowledge that nuclear power plants use lake water for cooling.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Understanding legal complexities and management difficulties because problems cross local and national borders.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Knowledge of phosphorus level changes in past 15 years.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)
● Knowledge of the main products shipped on the Great Lakes.	Fortner et al. (1991) Brothers et al. (1991) Fortner and Mayer (1983) Fortner and Mayer (1988)

Appendix A. Continued.

Indicator

- Awareness of human exposure to hazardous chemicals through fish consumption.
- Knowledge of health risks associated with eating Lake Ontario fish.
- Knowledge of methods for reducing toxics in sport-caught fish.
- Knowledge of methods used to measure contaminant levels in Lake Ontario game fish.
- Knowledge of fish consumption health advisories for Lake Ontario.
- Definition: estuary
- Definition: fish advisory
- Definition: phosphorous
- Definition: nutrient
- Definition: eutrophication
- Definition: toxic
- Definition: pesticide
- Definition: dioxin
- Definition: ecosystem
- Definition: ecosystem approach
- Definition: remedial action plan

Literature Source

- Fortner et al. (1991)
Brothers et al. (1991)
Fortner and Mayer (1983)
Fortner and Mayer (1988)
Connelly et al. (1992)
[item 9]
- Connelly et al. (1992)
[item 9,17]
- Connelly et al. (1992)
[item 9]
- Connelly et al. (1992)
[item 10]
- Connelly et al. (1992)
[item 11,12]
- Fortner et al. (1991)

Appendix A. Continued.

<u>Indicator</u>	<u>Literature Source</u>
• Definition: erosion	Fortner et al. (1991)
• Definition: Lake level regulation	Fortner et al. (1991)
• Definition: diversion	Fortner et al. (1991)

Appendix B. Examples of questionnaire items² developed to measure stewardship behaviors.

<u>Indicator</u>	<u>Literature Source</u>
● Self-reports of behavior change to protect the environment as "minor" or "major."	Decima Research (1993) [item 18]
● Purchase of bottled drinking water.	Decima Research (1993) [item 20]
● Use of information on food production (i.e., use of food additives, pesticides, or fertilizers) in decisions about food purchases.	Decima Research (1993) [item 21]
● Use of products to limit exposure to sunlight (e.g., sunscreen).	Decima Research (1993) [item 22]
● Avoidance of "strong" chemicals for use in home cleaning.	Decima Research (1993) [item 23]
● Membership in an environmental group concerned about human health.	Decima Research (1993) [item 24]
● Attendance at a meeting/rally about the environment.	Decima Research (1993) [item 25]
● Writing position-statement letters on an environmental problem that affected health.	Decima Research (1993) [item 26]
● Engaging in serious argument or discussion about impact of environment on health.	Decima Research (1993) [item 27]
● Participation in curbside recycling programs.	Statistics Canada (1992) [items 11,13,15,17]
● Household participation in programs for disposal of hazardous household products.	Statistics Canada (1992) [item 19]

²Items are paraphrased. For actual wording and response categories, refer to original document cited in Column 2.

Appendix B. Cont.

<u>Indicator</u>	<u>Literature Source</u>
● Household use of disposable diapers.	Statistics Canada (1992) [item 21]
● Household use of recycled paper products.	Statistics Canada (1992) [item 22]
● Household use of reusable shopping bags.	Statistics Canada (1992) [item 23]
● Household use of lawn fertilizer, pesticides.	Statistics Canada (1992) [item 25,26]
● Household participation in composting.	Statistics Canada (1992) [items 11,13,15,17]
● Household practice of reducing the thermostat setting at night.	Statistics Canada (1992) [item 30]
● Household use public transportation.	Statistics Canada (1992) [item 33]
● Household use of water saving devices.	Statistics Canada (1992) [item 39,40]
● Household use of water purifying devices.	Statistics Canada (1992) [item 33]
● Behavior related to consumption of sport-caught fish in Lake Ontario.	Connelly et al. (1992) [item 3,7,8]
● Degree to which environmental impacts are considered in purchase of particular goods.	Maloney et al. (1975)
● Behavior related to disposal of toxic products.	Maloney et al. (1975)
● Degree to which one monitors environmental voting record of elected representatives.	Maloney et al. (1975)

Appendix B. Cont.

Indicator

Literature Source

- Extent to which Basin corporations have developed environmental affairs functions.

Labatt (1991)

- Extent to which Basin corporations provide community support for environmental programs.

Labatt (1991)

Appendix C. Examples of questionnaire items³ developed to measure stewardship intentions.

Indicator

Literature Source

Intentions to fulfill stewardship responsibilities:

Willingness to devote money, time, political support to improving and managing the Lake Ontario ecosystem:

- | | |
|---|---|
| ● Willingness to pay higher consumer prices to help pay for pollution control by companies. | Program for Zero Discharge [1989]
Dunlap and Scarce (1991) |
| ● Willingness to pay higher taxes to help pay for pollution control by companies. | Program for Zero Discharge [1989] |
| ● Extent to which people are willing to stop buying products that harm the environment. | Maloney et al. (1975) |
| ● Willingness to pay a "pollution tax" to aid environmental remediation activities or limit future pollution. | Maloney et al. (1975) |

³Items are paraphrased. For actual wording and response categories, refer to original document cited in Column 2.

Appendix D. A review of questionnaire items developed to measure stewardship barriers.

<u>Indicator</u>	<u>Literature Source</u>
Items included in surveys measuring constraints to environmental education delivery:	
• Lack of time to develop/teach environmental education.	Tewksbury and Harris (1982); Lane et al. (1994)
• Lack of funding to develop/teach environmental education.	Tewksbury and Harris (1982); Ham and Sewing (1987/1988)
• Insufficient time to add environmental education to curriculum.	Tewksbury and Harris (1982)
• Lack of appropriate expertise/background.	Tewksbury and Harris (1982); Lane et al. (1994)
• Lack of acceptance by teachers.	Tewksbury and Harris (1982)
• Concepts unrelated to subject.	Lane et al. (1994)
• Other things more important.	Lane et al. (1994); Lawrenz (1986)
• Not enough preparation time.	Lane et al. (1994); Ham and Sewing (1987/1988)
• School setting not conducive.	Lane et al. (1994)
• Not appropriate for grade level.	Lane et al. (1994)
• Other curricular responsibilities.	Lawrenz (1986)
• Materials not available.	Lawrenz (1986)
• Knowledge of energy education.	Lawrenz (1986)
• Attitude toward energy education.	Lawrenz (1986)
• Controversial nature of energy education.	Lawrenz (1986)
• Lack of instructional materials.	Ham and Sewing (1987/1988)
• My own lack of environmental education knowledge.	Ham and Sewing (1987/1988)

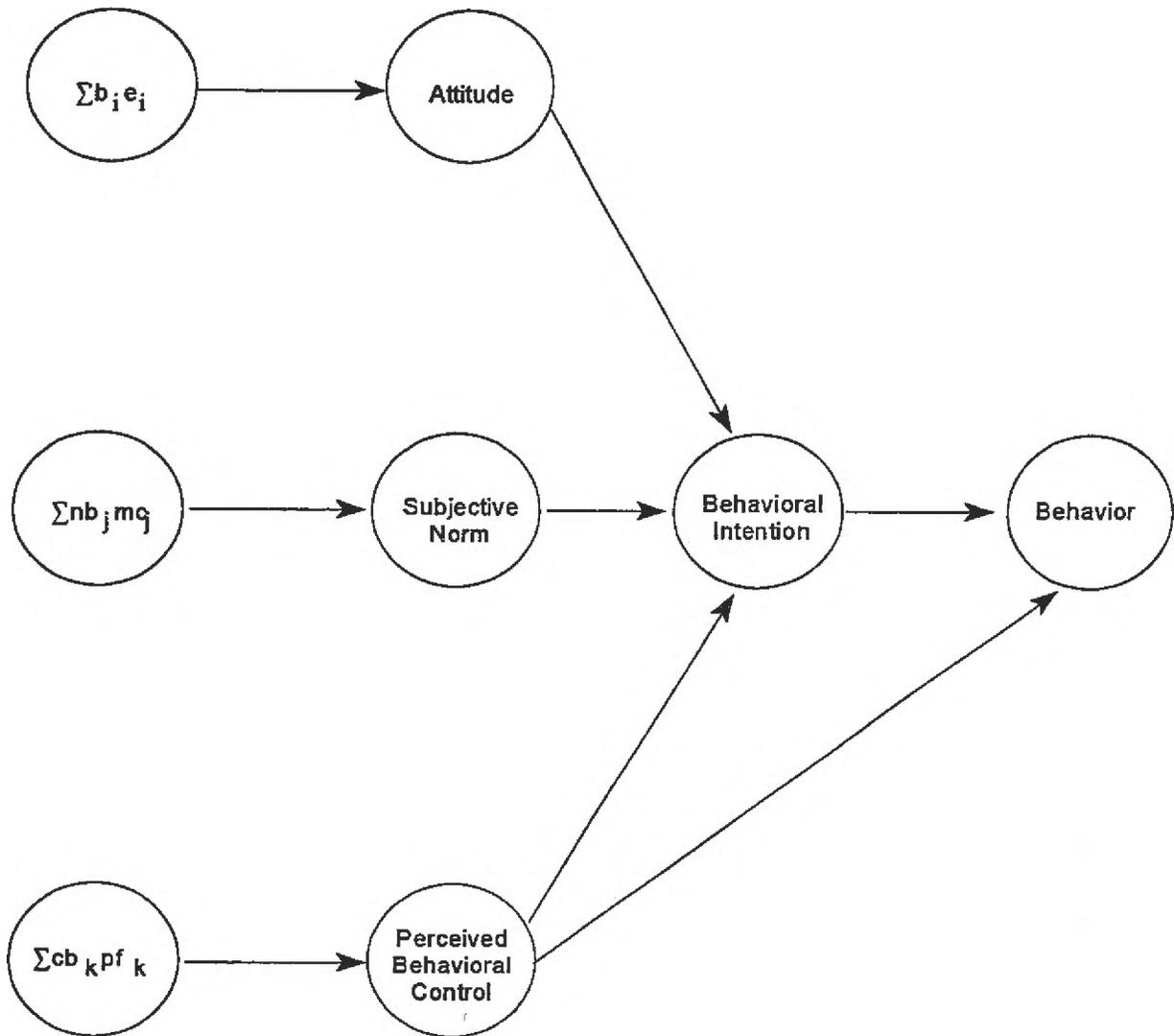
Appendix D. Cont.

<u>Indicator</u>	<u>Literature Source</u>
• Class size too large.	Ham and Sewing (1987/1988)
• Environmental education is not relevant to what I teach.	Ham and Sewing (1987/1988)
• Lack of principal support.	Ham and Sewing (1987/1988)
• Class size too small.	Ham and Sewing (1987/1988)
• Concern about being unable to control the environment.	Ewert (1986)
• Problems with transportation.	McCaw (1979/1980); Ham and Sewing (1987/1988)
• The district cannot afford field trips.	McCaw (1979/1980)
• Liability worries.	McCaw (1979/1980); Ham and Sewing (1987/1988)
• Study trips are not important.	McCaw (1979/1980)
• Safety of the children.	McCaw (1979/1980); Ham and Sewing (1987/1988)
• Not enough support from the system.	McCaw (1979/1980)
• Not enough information on where to go.	McCaw (1979/1980)
• Not enough places to go.	McCaw (1979/1980)
• Availability of resource people.	McCaw (1979/1980)
• Study trips not pertinent to subject area.	McCaw (1979/1980)
• Other teachers' attitudes.	McCaw (1979/1980)
• Principal's attitude.	McCaw (1979/1980)
• No natural environments readily available.	Ham and Sewing (1987/1988)

Appendix E. A review of questionnaire items developed to measure stewardship incentives.

<u>Indicator</u>	<u>Literature Source</u>
Items included in surveys measuring incentives to practice environmental education:	
• Need for curriculum guides and instructional materials.	Pettus and Teates (1983)
• Need for community involvement and support.	Pettus and Teates (1983)
• Need for research and evaluation.	Pettus and Teates (1983)
• Need for financial support.	Pettus and Teates (1983)
• Need for instructional materials.	Pettus and Teates (1983)
• Need for personnel trained in environmental education.	Pettus and Teates (1983)
• Need for field equipment.	Pettus and Teates (1983)
• Need for audiovisual materials.	Pettus and Teates (1983)
• Need for exposure to model programs.	Pettus and Teates (1983)
• Need for materials center in school district.	Pettus and Teates (1983)
• Need for district coordinator.	Pettus and Teates (1983)
• Need for inservice training.	Pettus and Teates (1983); Lane et al. (1994)
• Need for adequate physical facilities.	Pettus and Teates (1983)
• Better access to resources.	Lane et al. (1994)
• More prep time.	Lane et al. (1994)
• More support from administration.	Lane et al. (1994)

Appendix F: The Theory of Planned Behavior

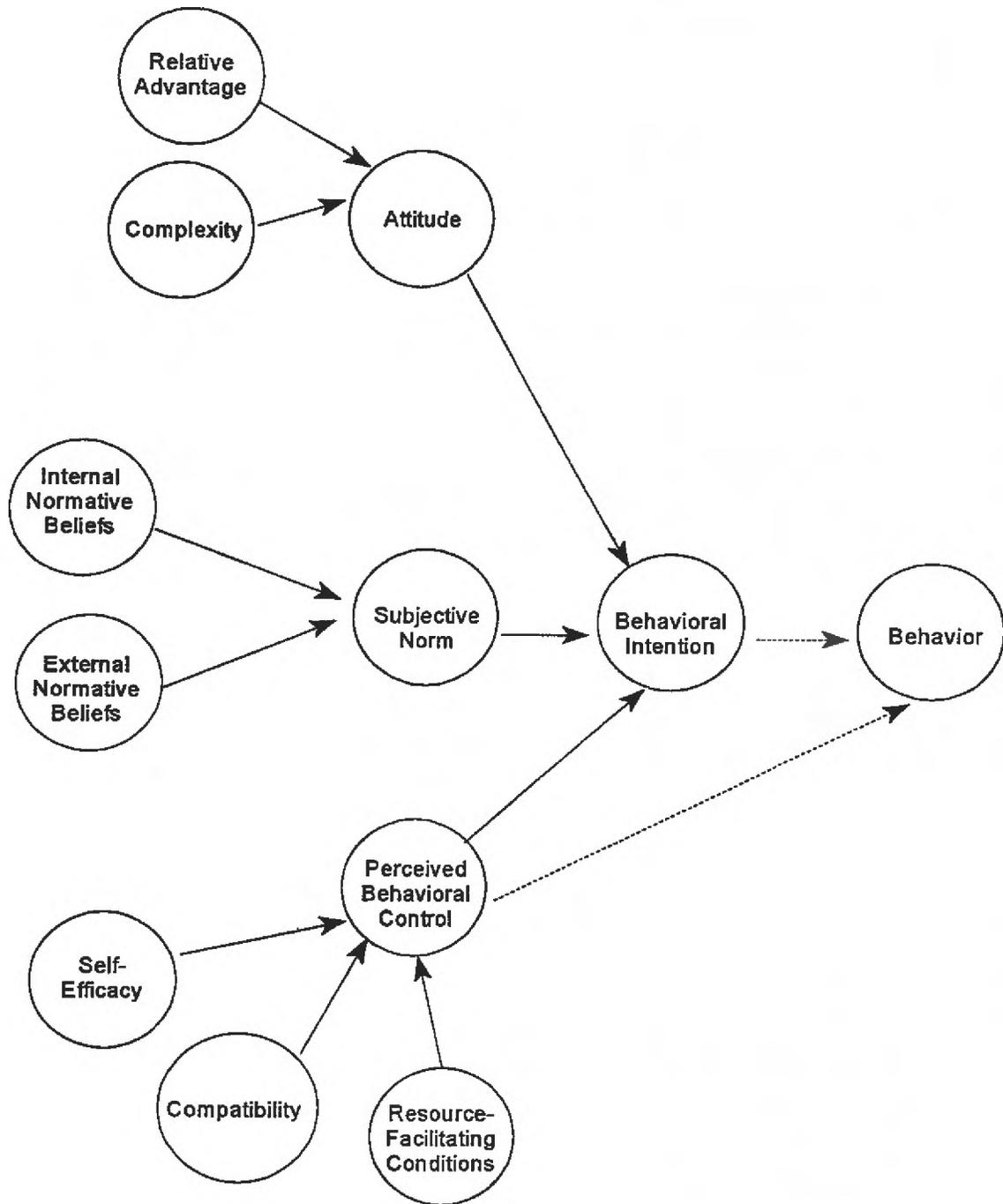


Where:

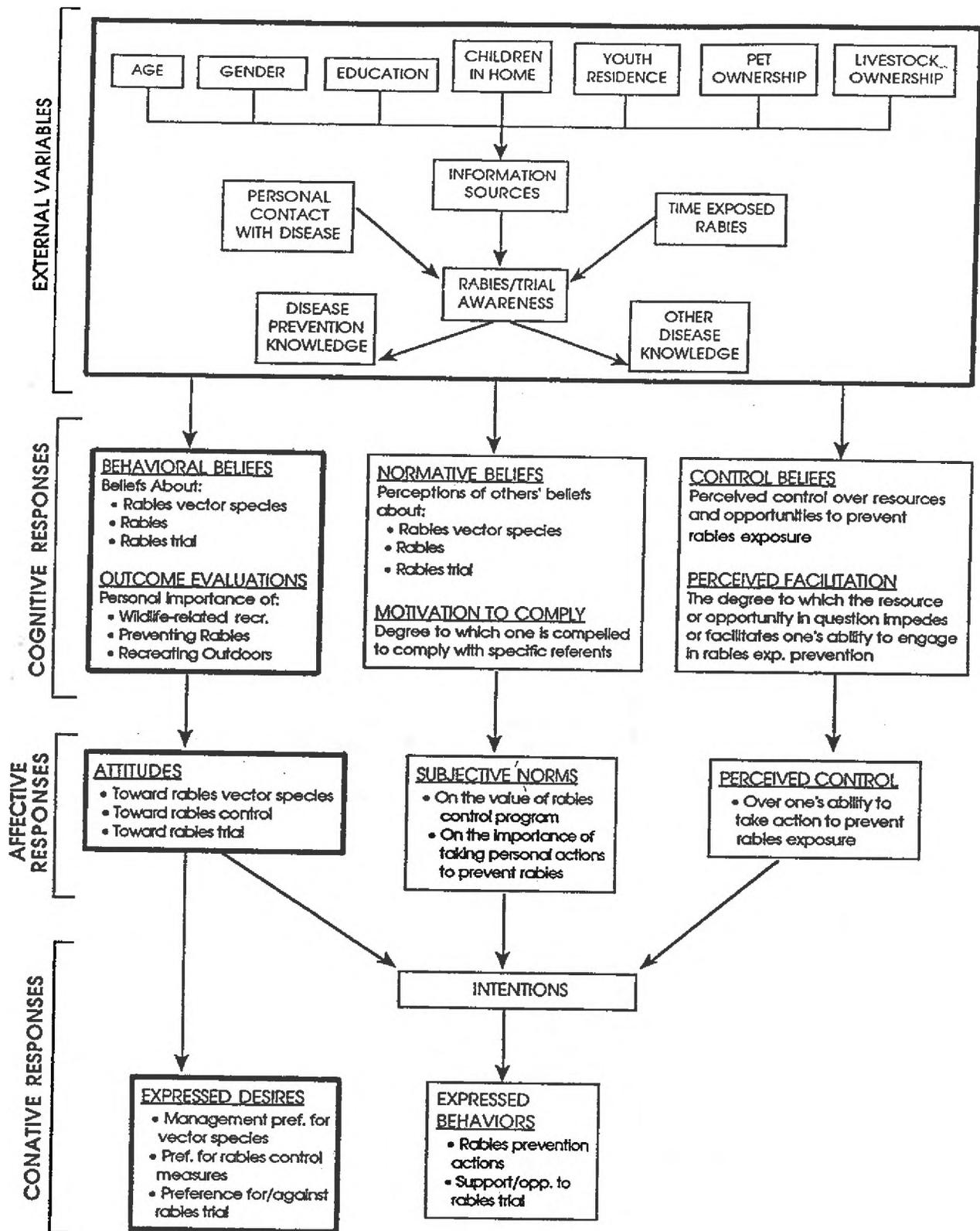
b = behavioral beliefs
e = outcome evaluations
nb = normative beliefs
mc = motivations to comply
cb = control beliefs
pf = perceived control

APPENDIX G:

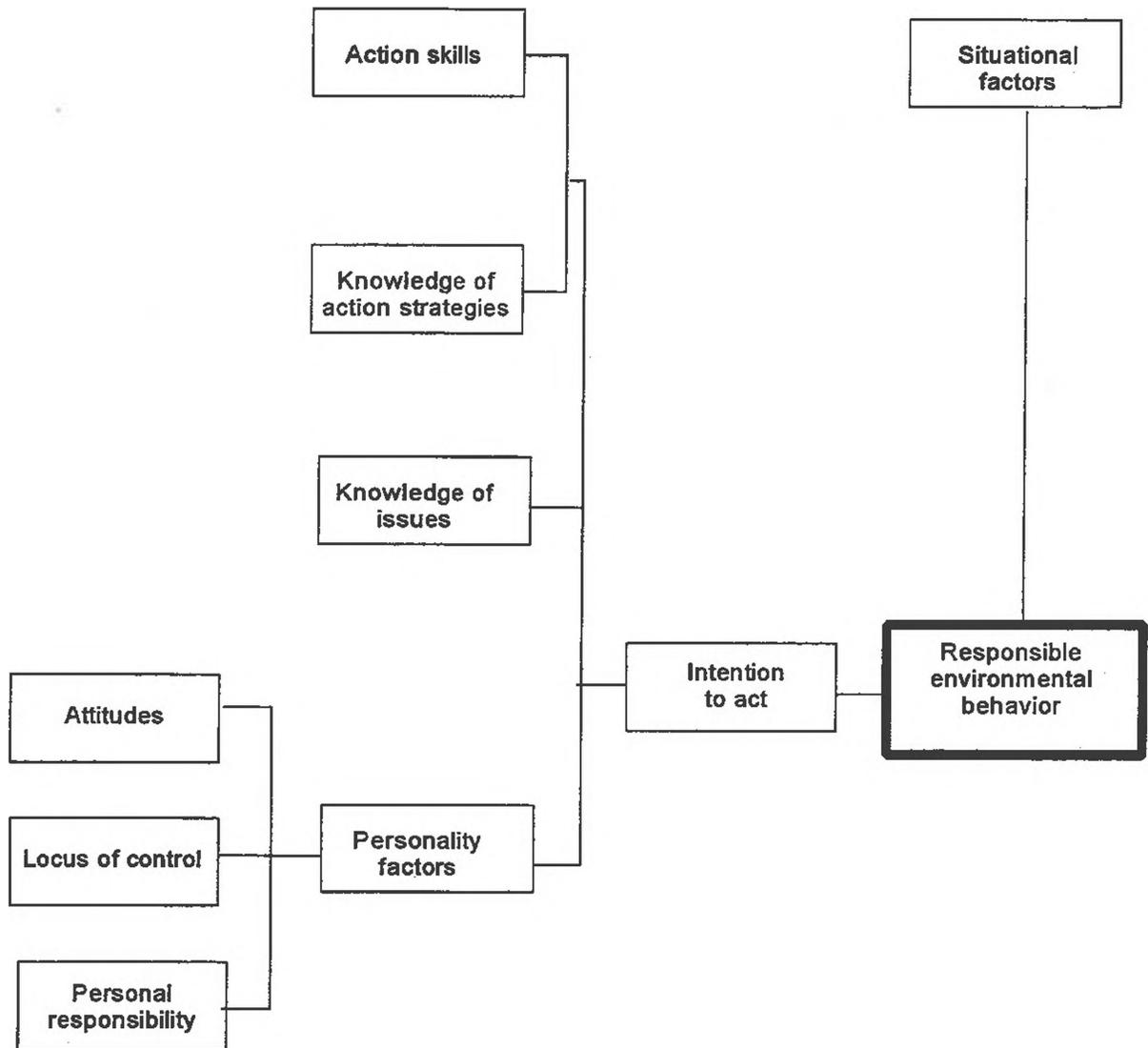
Examples of theoretical models that represent modifications of the Theory of Planned Behavior



Appendix G, Table 1. Taylor and Todd's (1995) integrated waste management model.



Appendix G, Table 2. Siemer et al.'s (1994) model of social-psychological processes determining activities and management preferences related to rabies.



Appendix G, Table 3. Hines et al.'s (1986/87) model of responsible environmental behavior.



