ENVIRONMENTAL EDUCATION AND TECHNOLOGY: USING A REMOTELY OPERATED VEHICLE TO CONNECT WITH NATURE

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Abstract.—One hundred seven young people (12-14 years old) and 183 adults (25-86 years old) used an underwater remotely operated vehicle (ROV) to explore shipwrecks and marine habitats in the Great Lakes and various inland lakes during the summer of 2005. Content analysis of responses regarding the types of impact the ROV had on their perception and experience with the natural environment revealed various positive perceptions. Positive impacts expressed included increased accessibility to marine environments, opportunities for experiential education, and ease of using the ROV. Although less frequently noted, negative impacts were also expressed, primarily focusing on the potential for environmental disturbance. However, the disturbances noted were relative to the boat in which the ROV was used rather than the ROV itself.

1.0 INTRODUCTION

Today more than ever before, technology is playing a larger role in the everyday life of most Americans. There is a perception that this increase in the use of technology has led to a change in the relationship between individuals and nature (Louv 2005). That change can include less time outside and an emphasis on activities that result in a separation of the individual from nature. Although technological equipment is often cited as creating a barrier between people and nature or drawing them away from the natural environment, it may also be possible that this same equipment can enhance individual interactions with nature.

Using the marine environment as one representation of nature, this study sought to examine impacts of underwater ROV activities on individuals' interactions with and connection to the natural environment. As part of this study, educators were asked in focus groups what their perception was of the impact of technology on young people's relationship with nature. Their overwhelming response was that technology is playing a role in the distancing of young people from the outdoors through a change in activities. According to these educators, young people are choosing to relate to the outdoors through computers and other formats that are technology-based. Instead of directly being in nature, the youth of America are visiting web sites to have their nature experience. For the natural resource manager, this change in the relationship brought about by the increased use in technology could have major implications in the long-term public support

2.0 PREVIOUS WORK

Researchers have suggested that technology is affecting our way of interacting with nature. Ewert & Shultis (1999), for example, question whether individuals are using technology to access wild places or are visiting wild places to use technology. Louv (2005) recently discussed how young people are interacting less frequently with the outdoors, in part, because of their preference for indoor technology usage. At the very least, he suggested, young people are having a different interaction with nature than the older generations of Americans had. Conversely, Ballard's (2006) current work with ROVs in youth education provides anecdotal evidence suggesting technology is useful in connecting young people to the natural environment. However, little empirical evidence is available to support that observation.

A review of the literature relative to technology and its use in facilitating human connections to the natural environment, reveals minimal empirical evidence. Therefore, this study was designed and undertaken to add to that knowledge base.

2.1 Similar Programs

The ROV programs developed by Ballard in the early 1990s currently deliver educational activities to thousands of young people through an effort referred

to as the Jason Project. The Jason Project uses ROV technology to foster an understanding of underwater resources. Utilizing distance-learning techniques, Ballard undertakes programs that involve ROVs transmitting live footage of underwater explorations from distant locations to school groups in the United States. Often those school groups have an opportunity to view these programs in a museum setting. These programs are primarily directed toward young people with the primary objective to develop not only a stronger interest in science but also a greater understanding of the natural resources located underwater through observation of these activities. The Great Lakes ROV programs that are being used in this study are modeled after the Jason Project programs.

An additional national program referred to as Marine Advanced Technology Education (MATE) involves the design and construction of an ROV by groups of individuals. College and high school students compete with their self-designed ROVs to complete a series of underwater tasks (i.e., a mission). This study included one MATE program that was sponsored by Thunder Bay Sanctuary that involved educators constructing their own ROV.

3.0 METHODS

We used a small underwater robot to test how certain technological advances could be incorporated into natural resources educational programming and influence an individual's connection to nature. Worldwide there are many types of ROVs engaged in a number of activities, including oil exploration, military applications, and research. The ROV used for this study is small, weighing less than 15 pounds. It has two TV cameras, one color and one black /white, a manipulating arm to pick up small items, forward and rear lights, and three motors that propel it forward, backward, upward, and downward through the water. Power and control is supplied through an attached tether that allows for operation from the surface. This ROV has the capability to reach depths of 500 feet underwater, but rarely went below 150 feet in the course of this study.

3.1 Data Collection

Several study sites were identified whose current environmental education programs would also be able to facilitate using the ROV as part of an educational program. The ROV was either observed or operated by participants at each location. The educational programs were located in the Great Lakes region and included small inland lakes as well as the larger lakes Huron, Michigan, and Superior.

This study was conducted in three phases. First, three separate focus groups were conducted with 20 to 30 K-12 educators. Pre-developed interview questions guided the focus group discussions; however, participants were encouraged to contribute their personal experiences and ideas for developing an effective educational program related to the ROV. Data gathered from this stage of the study were used to develop the educational program tested in phase two. In addition, focus group comments were used in developing the questionnaire that was part of phase three of the study.

Phase two of this study involved the pilot testing of the educational program to be used in phase three. The goal was to design the ROV program in such a way that it could be repeatedly delivered consistently. After over 70 pilot programs, two final consistent programs were adopted. Those two programs were then used for the final phase of the study.

In phase three of the study, 27 programs were conducted with the ROV, and data were collected using written questionnaires. Two basic programs were used in this phase of the study. The first program involved participants observing the ROV in operation but not operating the vehicle. For this program, a technician operated the ROV at different depths of the lake(s) (e.g. 2 feet to 70 feet, 2 feet to100+feet). While the technician operated the ROV, an environmental educator explained changes at each depth. In the observed programs, there were three to four stops per outing.

The second program was designed to allow participants to operate the ROV themselves as well as observe

Table 1.—Location distribution and mean age of all respondents

Location	Program content & design	Number of respondents	Age of respondents
Thunder Bay Marine Sanctuary	Adult educators constructed own ROV & operated study ROV in a pool	13	Mean = 45.77, s.d. = 11.08
Lake Michigan	Environmental education program for adults to observe	16	Mean = 50.73, s.d. = 15.28
Black Lake	Environmental education program for adults to observe	37	Mean = 52.97, s.d. 19.70
Douglas Lake	Environmental education program for adults to observe	99	Mean = 56.20, s.d. = 15.08
Clear Lake	Environmental education programs 8-person youth groups with adult educators	122	Mean = 14.15, s.d. = 9.00

colleagues operating the ROV. Similar to the observation-only programs, the ROV was used to explore underwater but only in shallow water usually at depths of 2 feet to 20 feet. In these programs, minimal educational interpretation was offered to participants, but self-directed education using visual aids such as fish charts were available.

3.2 Sampling

One of the goals for this study was to include responses from both younger and older age groups, as well as relatively equal representation from males and females. Every student participant and educator participant in each of the 27 programs conducted during phase three of the study was asked to complete a questionnaire. Ninety percent of adults (i.e., educators) and 75 percent of youth (i.e., students) completed questionnaires. Adult questionnaires were completed; however, 12 percent of the youth questionnaires were incomplete and unusable, resulting in final samples of 107 youth and 183 adults.

4.0 RESULTS

A total of 290 respondents completed the questionnaire during the summer months of 2005 from five study sites (see Table 1 for complete breakdowns). Ages ranged from 10 to 86 years old, but the Clear Lake site was predominantly composed of 13- and 14-year-olds.

Respondents were evenly split into women (49.0%) and men (51.0%) but lacked ethnic diversity (i.e., 95.1% indicated they were white or Caucasian). All of the respondents were from Michigan and among the adult respondents, residences varied from farm or rural area to large city (see Table 2). However, they expressed having a higher income than the average Michigan resident (i.e., 2005 median income = $44,476) (U.S.Census Bureau 2005).

When asked about their overall perceptions of the ROV in relation to their recent interaction, respondents indicated agreement predominantly with positive aspects of the vehicle (See Table 3). However, some negative perceptions were noted as well.

Among respondent, 83 percent indicated the ROV impacted their natural resources educational experience. When further asked to identify specific advantages and drawbacks to using the underwater ROV, respondents expressed a variety of opinions. Positive comments were expressed more frequently than drawbacks. Three primary categories of advantages to using the

Table 2.—Characteristics of adult respondents

Characteristic	Responses
Residence	
Farm/Rural	26.9%
Small Town	26.9%
Large Town/Small City	12.6%
Medium City	21.6%
Large City	12.0%
Income	
<$20,000	3.0 %
$20,000 - $39,000	13.5%
$40,000 - $59,000	18.0%
$60,000 - $79,000	13.5%
$80,000 - $99,000	18.0%
$100,000 or more	33.8%

Table 3.—Perceptions of the underwater remotely operated vehicle expressed by all respondents

Perception	Mean	Standard Deviation
The ROV is creative	4.50	.99
The ROV is exciting	4.38	.98
The ROV is educational	4.36	1.04
The ROV helped me to understand the natural resources	4.17	1.08
The ROV was easy to operate	3.82	1.23
The ROV was relaxing to operate	3.59	1.22
The ROV was difficult to operate	2.03	1.27
The ROV was stressful to operate	1.75	1.22
The ROV was boring to operate	1.38	.91

*Responses were on a 5-point scale with 1=strongly disagree and 5=strongly agree

ROV in their educational programs were identified: environmental education, first-hand experience, and, accessibility. Exploration, science and research, fun, natural resource conservation, technology, low impact, safety, interesting, and natural resource connection were also identified as advantages. Environmental education was expressed by older participants in statements such as:

> *"Better education and more interest in conservation using the ROV."*
> *"Better understanding of human impacts on natural resources."*

Both younger and older respondents indicated they felt the ROV was a good opportunity for interacting first-hand with marine environments they may not have previously been able to experience. For example, one Clearwater student stated:

> "Being able to see what is below makes it more real."

Meanwhile, other respondents indicated:

> "Visuals speak a thousand words."
> "We are visual creatures and need to see and feel what is going on versus what is read." Adult, 48 yrs. Old.

Repeatedly, participants in the ROV programs were also found to express the importance of increasing accessibility to marine environments. This young student, for example, said:

> *"The exploration of natural resources is available to everyone."*

Again, although positive comments were expressed more frequently, drawbacks were also identified. The most predominant concern was related to the environment. Respondents were concerned about the potential for environmental degradation based on the actual ROV, as in this statement:

> *"Potentially intrusive"*

However, they were also concerned about the potential problems of the vehicle used to bring the ROV to open water as seen in this statement:

> *"Big boats could leak gas and oil to disturb shorelines."*

Finally, some respondents indicated a general concern with technology, rather than the ROV specifically as exemplified by this expression:

> *"Technology provides means of damaging the natural resources, e.g. jet skis."*

Additional concerns identified were the cost of operating and maintaining the ROV, and the potential for replacing humans, e.g., divers, in particular job situations. Overall, though, respondents were generally in agreement that the advantages of using an underwater remotely operated vehicle were important enough to negate potential drawbacks.

5.0 DISCUSSION AND IMPLICATIONS

The purpose of the study was to examine impacts of an underwater ROV on individuals' interactions with and connection to the natural environment. Over 90 percent of respondents were in agreement that the ROV positively impacted human interaction with the environment and perceived the use of ROVs as creative, exciting, and educational. To most respondents, the use of ROVs enhanced their environmental education experience by offering hands-on, real-time observation and access when exploring nature.

ROVs were found to create access to previously minimally explored water areas. The ROV can provide opportunities for exploration to individuals who previously did not have access to marine environments. It can also provide a safe alternative to divers, who may be likely to encounter dangers resulting in underwater accidents. However, using an ROV rather than a diver can negatively impact divers, who have long been relied upon to descend to the depths of harbor waters to investigate ships, docks, and other structures.

ROVs were also found to facilitate the experiential learning process. Visitors seek benefits when visiting recreational sites such as becoming more knowledgeable about nature, and learning more about how visual information is gathered. ROVs take advantage of our visually engaging nature.

Generally, the overall position of respondents was positive, although there were also potential limitations and difficulties. Some respondents felt using the ROV was a stressful and boring experience. Though the potential exists for high levels of engagement in an educational setting, the methods for best utilizing ROVs in classrooms are yet to be fully explored.

In summary, participants in marine-based environmental education program perceived the use of ROVs as an overwhelmingly positive enhancement to the program. Although the majority of respondents indicated that ROVs impacted their experiences, for those whose experiences were not impacted, it would be valuable to know the reasons for that outcome. The effectiveness of ROVs may vary based on different learning styles, and further research is suggested to identify that relationship.

Other suggestions for future studies include measuring the differences between direct use and observed use of the ROV, and assessing learning outcomes. An interactive long-distance education where students and educators at additional schools and universities participate in real-time live chats via internet with streaming videos from expedition sites is currently planned as a future study. Students worldwide will be able to witness, study, and share experiences as a long-distance training program using ROVs as a tool in marine education and international networking.

6.0 CITATIONS

Douglass, R.W. 2000. **Forest Recreation.** Prospect Heights, IL: Waveland Press.

Ewert, A.; Shultis, J.D. 1999. **Technology and Backcountry Recreation: Boon to recreation or bust for management?** Journal of Physical Education, Dance and Recreation. 70(8): 3-8.

Louv, R. 2005. **Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder.** North Carolina: Algonquin Books.

McKibbon, B. 1989. **The End of Nature.** New York: Anchor Books.

The Jason Project. 2005. **Real Science. Real Time. Real Learning.** Retrieved April 21, 2006, from http://www.jasonproject.org/jason_about/discover.htm.

United States Census Bureau. 2005. Retrieved April 21, 2006 from http://www.census.gov/hhes/www/income/income04/statemhi.html.

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