ROVs in the Great Lakes: National Park Case Studies

Laurie Harmon, School of Recreation, Health, and Tourism, George Mason University, 10900 University Boulevard, MSN 4E5, Manassas, VA 20110; lharmon3@gmu.edu.
Mark Gleason, Michigan Technological University, 813 Ottawa Street, Harbor Springs, MI 49740; gleason@mtu.edu

Introduction

The ways we connect with the natural environment and our actions, or lack of actions, relative to the environment are under increasing scrutiny. Recent publications, e.g., Louv (2005), have sparked discussions regarding the perceptions that people, particularly youth, are spending less time in the outdoors than previously. In addition, the National Park Service reports a 4.8% decrease in visitation since 1987 (NPS 2006). Evidence suggests we are more likely to engage in protective behaviors towards places with which we interact and understand (Vaske and Kobrin 2001). A reduction of interactions with the outdoor environment, then, could predict a future lack of support for our public recreation lands.

One proposed reason for less outdoor activity participation among youth is the increased used of indoor electronics such as video games (Pergams and Zaradic 2006). Rather than working against the attraction of modern technology, it may be possible to, instead, use technological advances to generate interest about natural environments with youth. In this study, we used such a technology, a remotely operated vehicle (ROV), as a tool for introducing youth and adults to underwater environments.

Remotely operated vehicles (ROVs) were introduced to the public in the early 1950s via the marine work of Jacques Cousteau. The original vehicles were quite large and cumbersome, generally weighing several hundred pounds. Following work conducted by marine researchers such as Edward Link in the 1960s and Robert Ballard in the 1980s, coupled with technological advances in electronics, underwater robots were built that were smaller and more maneuverable. Some of the small ROVs can be seen in James Cameron's work on the film *Titanic*. The design of these smaller robots greatly facilitated the development of ROV-based marine exploration programs, such as JASON (Ba et al. 2002).

New marine exploration programs are being increasingly introduced as strategies for increasing students' understand of the marine environment. The National Oceanographic and Atmospheric Administration (NOAA), for example, developed a curriculum meeting national science standards of the K–12 public schools. The JASON project is another program, which, in addition to the standard curriculum, offers a component where participants can use an underwater robot fitted with a camera to observe marine life in real time. While these programs are popular, minimal systematic data measure the specific impact of the ROV or how the ROV impacts people and their interactions with aquatic environments (Ba et al. 2002). Therefore, this study was designed to examine the impacts using an underwater ROV had on individuals' interactions with and connection to the natural environment.

ROV program development

In 2004, 2005, and 2006, we used an underwater remotely operated vehicle to research and involve the public in aquatic educational programs. Prior to initial program implementation, demonstration programs and focus group studies were conducted in early 2004 to identify general expectations, concerns, and interests relevant to using an ROV for exploration and education. Demonstration programs were conducted at Isle Royale National Park, Keweenaw National Historical Park, Pictured Rocks National Lakeshore, and Sleeping Bear Dunes National Lakeshore. Focus group studies were also conducted with volunteer participants that included K–12 educators participating in an ROV enhanced program at Indiana Dunes National Lakeshore. The ROV program was modified based on their feedback.

In late 2004 and early 2005, ROV-based programs were designed and implemented. In one program, K–12 teachers participating in a science exploration program on the *R/V Lake Guardian* were given the opportunity to use the ROV for shipwreck exploration in lakes Superior and Michigan. In another program, youth, grades 7–12, operated the ROV and explored an inland lake at the U.S. Forest Service's Clear Lake camp in Michigan. There were also numerous public demonstrations of the ROV for educational programs such as Elderhostel, Michigan 4-H, and high school groups during this initial time period. Participants were encouraged to operate as well as observe during these programs. In each case, observational data were collected and analyzed to identify emergent positive and negative interaction themes. These data were used to develop the more structured educational programs used in the final data collection process.

The ROV program was formalized and implemented in summer 2005 for the purpose of measuring perceptions of technology as an environmental education tool. Programs were implemented and data were collected at the U.S. Forest Service's Clear Lake Education Center (participants were youth in grades 7–12), a series of small inland lakes in northern Michigan where programs were organized by SEE (Science and Environmental Education) North (participants were local adults), the Thunder Bay National Marine Sanctuary (participants were youth grades 6–12 observing from a remote location and K–12 teachers interacting onsite), and lakes Michigan, Huron, and Superior (participants were youth in grades 6–12 and K–12 teachers participating in science exploration programs on the *R/V Lake Guardian, S/V Denis Sullivan,* or *M/V W.G. Jackson*).

Methods

The ROV used for this study was small, weighing less than fifteen pounds, and approximately 28x18x14 inches in dimension (Figure 1). It had forward and rear video cameras, a manipulating arm to pick up small items, forward and rear lights, and three motors to propel it forward, backward, upward, and downward through the water. Power and control was supplied through an attached tether that allowed for operation from the surface. This ROV could reach depths of 500 feet. Controlled from the surface via cable, it was operated from boats and from the shore during the various programs.

Participants interacted with the ROV directly, by controlling its movements with a joystick and accompanying controls, or indirectly, by observing others operating the ROV in person, or by observing via satellite the live images as they were being recorded by the ROV. In each case, a facilitator/educator accompanied the participants as interpreters of the images. The educators also facilitated discussion of the image contexts. In addition, partici-

Figure 1. Participant prepares to deploy the ROV from the *S/V Denis Sullivan* during an exploration program.

pants interacting in person were given charts with photos and written descriptions of aquatic life they were expected to encounter during the program as part of their educational component. Upon completing the ROV program, participants were asked to respond to a five-page written questionnaire regarding their experience.

The questionnaire used for data collection was divided into three sections consisting of qualitative and quantitative questions. The first section was designed to establish the participants' personal reactions to the ROV experience. The second was designed to elicit the participants' feelings of connection to the place and their perception of how the ROV impacted their experience. The final section measured familiarity with other types of technology and demographics.

Results

Two hundred ninety individuals completed the questionnaires in summer 2005. The respondents in the study ranged from 12 to 84 years of age with over a third (39.3%) between 12 and 15 years old and another third (38.5%) over 55 years old. The remaining respondents were spread equally between 16 and 54 years old. Participants were predominantly white (96.4%), equally from rural, suburban, and urban residential areas, and reported a range of annual incomes from $20,000 to $100,000 or more.

Regarding initial perceptions of the ROV, respondents indicated strong agreement with the ROV's usefulness and positive perceptions of the ROV, including its ability to be used creatively and educationally (Table 1). They also indicated it was easy and exciting to use. Respondents predominantly indicated it was not difficult, stressful, or boring to use.

Examination of open-ended responses for emerging themes regarding the impact of the ROV resulted in predominantly positive perceptions, however, negative perceptions were also noted. Positive perceptions of the ROV included its ability to be used as a tool for environmental education. One respondent indicated, "I learned more and was more interested in conservation using the ROV," while another respondent suggested she had a "…better understanding of human impacts on natural resources."

First-hand experience or the ability to directly observe the natural world was also indicated as a positive impact of the ROV. One adult suggested, "Visuals speak a thousand words. We are visual creatures and need to see and feel what is going on versus what is read." And, a youth participating in the program told us, "Being able to see what is below makes it more real."

Respondents also noted accessibility as an important feature of the ROV. For example, one adult suggested, "The exploration of natural resources is available to everyone."

Positive perceptions expressed also included the ability of the ROV to be fun, safe, and interesting to use as well as safe, low impact, and conservation oriented. In addition, respondents suggested it was a good science and research tool, could be very useful for exploration, and had the ability to be used for connecting people to natural resources. Respondents further suggested the experiential facet of using the ROV fostered a deep understanding of Great Lakes resources and strengthened the place connection they felt.

Table 1. ROV perceptions.

Perceptions of ROV	Mean	Stand. Dev.
The ROV could be useful.	4.76	.67
The ROV was creative.	4.50	.98
The ROV was exciting.	4.39	.97
The ROV helped me understand the natural resource.	4.19	1.12
The ROV was easy to use.	3.80	.25
The ROV was difficult to use.	2.02	1.27
The ROV was stressful to use.	1.77	1.24
The ROV was boring to use.	1.38	.90

Note: Responses were measured on a 5-point scale with 1=strongly disagree and 5=strongly agree.

Negative perceptions were noted only among adults and included the possibility of becoming disconnected from nature, the cost associated with purchasing and maintaining and ROV, unfamiliarity with using technology, and the possibility for replacing humans, e.g., no longer needing divers. In addition, the possibility of environmental damage was noted. For example, one adult suggested the ROV could be "… potentially intrusive [to various species]". Another respondent was concerned with the vessel from which the ROV was operated and indicated, "Big boats could leak gas and oil to disturb shorelines."

Observationally, participants in the program were highly engaged during the program and interested in sharing their perceptions of the ROVs upon its completion. In addition, approximately one-third of participants engaged in extensive follow-up conversations with the educator/facilitator at the close of the programs. However, no formal data were collected in this context.

Discussion

Using technology as a tool for natural resources engagement can be quite effective. In this study, youth as well as adults found the ROV to be exciting and fun to use. They also believed it helped them connect to the natural environment in ways they had not previously considered. For individuals who may fear the water, have physical limitations, or want to explore depths not physically possible, the ROV offers an alternative. Not only is the ROV easy to use—the joystick is not very different from that used in a video game—it provides clear, high-resolution images of real-time activities and allows users to observe aquatic life in its natural habitat. The strong positive reaction to the ROV by users and observers alike, attests to its potential usefulness for increasing the likelihood of bringing people outdoors.

There are several limitations in this study. The polar age distribution, i.e., over two-thirds of the respondents were young teenagers or adults over 55 years old, limits our ability to generalize results across age groups. In addition, racial and ethnically diverse perceptions are not represented in this study and caution is suggested when translating these results to various user groups. However, future studies are being designed to address these limitations.

Future research will include detailed measures of specific learning outcomes, learning preference styles, and aptitude for natural science learning. Further research is suggested in the area of distance education. Specifically, the impact of using an ROV remotely can be explored in the context of a classroom or via the worldwide web. Finally, in order to further examine the effect using an ROV has on environmental learning, it will be important to compare the ROV-infused programs with equitable environmental education programs not using the ROV.

Technologically advanced products are being increasingly embedded in our daily lives. People take notes with laptops and electronic notebooks, communicate regularly via text messages, listen to music on MP3 players, and download podcasts to share with friends. We also incorporate GIS tracking systems as part of our backcountry camping gear and day hikes, participate in electronic-based outdoor activities such as geocaching, and share digital images on a variety of websites. We have an opportunity to use this societal fascination with technology as an advantage in our quest to connect visitors, especially young people, to nature. Using the ROV as a tool for engaging with and observing aquatic environments can be one such opportunity.

References

Ba, H., W. Martin, and O. Diaz. 2002. *The JASON Project's Multimedia Science Curriculum Impact on Student Learning: A Summary of the Year One Evaluation Report.* Needham Heights, Mass., and Washington, D.C.: JASON Foundation for Education and U.S. Department of Education.

Louv, R. 2005. *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder.* Chapel Hill, N.C.: Algonquin Books.

NPS [National Park Service]. 2006. *Public Use Statistics—2006 Regional Report.* Washington, D.C.: Public Use Statistics Office, National Park Service.

Pergams, O.R.W., and P.A. Zaradic. 2006. Is love of nature in the US becoming love of electronic media? 16-year downtrend in national park visits explained by watching movies, playing video games, Internet use, and oil prices. *Journal of Environmental Management* 80, 387–393.

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