

*Full Length Research Paper*

# Enabling the disabled through acoustic ecology and environmental education by listening to the ecosystem of the turtle

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**Environmental education and awareness projects foster environmental-friendly attitudes and contribute to the protection of the environment through active participation. Special Environmental Education provides to groups of people with disabilities, opportunities for both education and active participation in environmental protection projects. The science and art of Acoustic Ecology may function as an especially useful educational tool or listening path which could assist students with disabilities to metaphorically cross the listening path of environmental education. The National Marine Park of Zakynthos (NMPZ) is officially recognized as a nesting beach of the sea turtle “*Caretta caretta*”. Appropriate environmental education material was created for special groups, and particularly for people with visual disabilities, hearing disabilities, as well as for people with mobility disabilities. The above mentioned protected area of the National Marine Park of Zakynthos was chosen as the location for the case study, because it appeared to be an ideal site for environmental education activities that could ‘embrace’ people with disabilities. An interdisciplinary approach was adopted for the development of the environmental education material for special groups, combining Acoustic Ecology with Conservation Education, which is education for ecosystem’s management and conservation. The current research drew on knowledge from these two fields. The educational material was created and successfully implemented, resulting in the participants’ increase of environmental awareness and the development of environmentally friendly attitudes, as demonstrated by the research results. The produced educational material included power point and oral presentations, audiovisual material, interactive activities based on observation, touching and listening, as well as a visualization model of the protected area.**

**Keywords:** Acoustic ecology, special environmental education, protected areas, education for ecosystem’s management and conservation (conservation education), and people with disabilities.

## INTRODUCTION

### **Environmental Education – Acoustic Ecology – Conservation Education**

Environmental education enhances the participants’ awareness and understanding of environmental issues, while at the same time it increases their willingness to participate in environmentally friendly actions for the

care and management of protected areas (Dimopoulos, 2007).

Environmental education that is designed and adjusted to the needs of special groups may help the people involved develop their self esteem, promote their social integration, and provide them with opportunities to participate in environmental actions. The process of understanding the complicated systems of nature turns environmental education into a tool for nurturing the participants’ self-worth and perception of the self (Gibson (1979), supports that our perceptual systems

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are at the same time *exterosensitive* and *propriosensitive*; able to provide us with information about the external and internal worlds. Therefore, based on his ecological approach to perception, one's perceptual acts in the environment may improve his/her perception of the exterior world but also the perception of him/herself in it.) (Pentovoulou–Ziaka, 2007). When designing environmental education material for people with disabilities, it is particularly important to consider ways of activating their senses so as to transfer knowledge primarily through sensory stimuli and not so much through simple visual symbols, which they may be unable to perceive. From this perspective, image, sound and touch, either individually or in combination, may function as invaluable educational resources and tools. Stressing emotional engagement in the planning of environmental education activities is of utmost importance as well, if one takes into account that in special groups, emotion and sentiment tend to dominate experience and may facilitate knowledge acquisition (Blanchet and Trognon, 2002). Finally, since special groups tend to respond in the average at a slower rate than that of general groups, it is important for learning to focus both on knowledge and on meta-knowledge (Lundberg and Olofsson, 1980; Mayer, 1987; Sternberg, 1977), in order to facilitate understanding and the development of 'friendly' attitudes towards the environment.

Acoustic ecology can be implemented and utilized as a learning tool for the visually impaired. Sounds, sonic ecosystems, superficial sounds, variable sounds, are the parts that compose a synthesis which may compensate for the lack of visual information about the landscape and its biodiversity (Wojciechowski, 2008).

Recording the sounds of a protected area's ecosystem is a way of mapping the area's geomorphologic characteristics, its different species, the landscape, human interventions and presence, as well as cultural elements. The recordings of the sounds produced by various species, like the sea turtle "*Caretta caretta*" under study in this paper, are accompanied by additional multimedia material, such as videos, which present sounds not as isolated audio files, but as real sounds in their original context. In this way, the material can describe biological processes (e.g. laying eggs), instead of simply presenting snapshots of biological sounds.

### Research Objectives

The general objectives of the present research were: (a) to familiarize special groups with the ecosystems and the species that inhabit them, (b) to enhance their willingness to participate in environmental actions, and (c) to highlight their options to participate in the management of a protected area through environmental and management activities. Other objectives were: social integration, enhancement of self esteem,

physical, social, professional, psychological and cognitive development, knowledge acquisition and adoption of appropriate attitudes towards the management of protected areas.

An interesting secondary effect of the present research is the socialization of special groups through environmental education and awareness projects, as well as through their active participation in protecting the environment, with the help of sensory stimuli in the form of educational material designed to stimulate hearing, touch and vision.

Another significant aspect of the present research is the development of environmental 'ethos', since environmental morality is more or less a part of contemporary communities and societies. The environmental morality and the respect towards nature, as determined by Taylor's Theory (1981), consist of three elements: a system of beliefs, a moral attitude, and a set of norms regarding our duties. Participants can develop a system of beliefs through a holistic program of environmental education, particularly through the knowledge they gain. They can adopt a moral attitude through their participation, action, and awareness reinforcement. They can create a set of norms by engaging in ecosystem management.

## METHODOLOGY

### Environmental Education Material

In the framework of recording the soundscape of the National Marine Park of Zakynthos, the sounds were first classified into distinct categories. The sounds were recorded during the sea turtle egg-laying season (May-October), and cover four parts of the day: a) morning, b) noon, c) afternoon, and d) evening. Apart from audio recordings, audiovisual material was also produced. The sounds were classified according to the different ecosystems of the area, such as beaches, dunes, seaside pine forests, rural areas and touristic areas. The classification was realized according to the referential aspects of the sounds (such as in Schafer, 1994/1977). At the same time, we recorded the sounds made by species that inhabit the protected area. These sounds were not short isolated audio files, but an ensemble of sounds displaying continuity and coherence, which is a complete soundscape. Particular emphasis was placed on distinguishing between surface sounds (foreground) and background sounds and the balance and imbalance of soundscape--as viewed from the perspective of acoustic ecology--in relation to the management of the protected area.

In the context of the research for this doctoral thesis, environmental education material was produced, based on audio and video recordings of the egg-laying process of the "*Caretta caretta*" sea turtle. The presentation of audio files to the special groups begins by listening to the recordings of the sea turtle. The

recorded files include a) breathing as she emerges from the sea, b) crawling in the sand beaches, producing by her movement different sounds depending on whether the sand is wet or dry, c) digging with her fins to make her nest, d) laying her eggs to fill the nest, e) covering the nest with sand, f) breathing intensely and returning to the sea. The audio narration that has been added to the audiovisual material helps provide the participants with necessary environmental information. The implementation of the material showed that, by listening to the turtle's "ecosystem", participants perceive space and time data, such as geomorphologic features, season, time, human presence and activity.

The audio files we collected, were delivered to the National Marine Park of Zakynthos and added to its audio library, which includes various sounds from different sources, of natural, urban, rural or human origin. The specific combination of these kinds of sounds constitutes each area's soundscape, and is unique in space and time (Truax 1999; Schafer 1977). Background sounds, surface sounds, soundscape changes over time and space at the same locations, all these form the soundscape of the NMPZ, which provides disabled participants with data necessary for the protection and management of the area, helping them analyze the situation. These recordings formed the basis for the development of environmental education material for the hearing impaired and for people with mobility disability.

As already implied, the environmental education of special groups draws heavily on experiential learning and on the activation of the senses (Chrysafidis, 1994). The teacher of a special group approaches the learners through touch, sound and movement. For the learners, this process forms an autonomous and complicated system of recognizing and experiencing, which ultimately leads to the creation of cognitive structures, such as tactual-sonic-mobility perception, tactual-sonic-mobility memory, perception map (Argyropoulos, 2004). The environmental education material was created with the objective to include experiential elements that are comprised of audio, tactual and visual tools (Even though acoustic ecology focuses primarily on sounds, Schafer stresses the importance of a multimodal approach in children's education. According to him, "[...] a total and sustained separation of the senses results in a fragmentation of experience. [He proposes that we consider] once again the possibilities of synthesis of the arts." (Schafer, 1986: 249) Such an approach could be proven especially effective in the context of developing environmental education material for disabled students) Depending on the special group involved, their particular combination facilitates the transfer of environmental information. During the implementation of the material, the audio recordings were accompanied by a three-dimensional model representation of the protected area and by tactile natural materials. The model is a precise geomorphologic representation of the protected area describing management details and

the human presence and its influence. Additionally, the tactile natural materials represent eco-paths of the protected area and important details for species and their development.

Schafer suggests that one way to improve the soundscape is "to increase sonological competence through an education programme that attempts to imbue new generations with an appreciation of environmental sound" (Wrightson, 2000: 13). Listening is in the heart of acoustic ecology According to Schafer (1986: 246), "the habit of listening [should not be confined] to the music studio and the concert hall. The ears of a truly sensitive person are always open") and a sound education which opens the students' ears to the sounds of the environment leads to an awareness of the unique characteristics of the soundscape (Dietze, 2000). This sound approach was incorporated in the present doctoral thesis. More specifically, the research implementation suggests that environmental education and awareness reinforcement may begin with a general narration, including description and historic data on the protected area chosen. It could then provide a detailed description of the protected species and present the priorities of managing the protected area. This may be followed by the audio or video recordings, to provide a holistic approach to the protected area, species and environmental problems. In this way, participants are virtually transported to the protected area to "observe" experientially the area and its species. Lastly, the structured activities, such as "biodiver. (The "Biodiversity boxes" were four different boxes which included natural material from the protected area like sand, seaweed, shells, pieces of wood and moreover material possibly found at the beach like plastic items, fishing hooks, nets etc. The observation and touch of 'parts' of the environment was intended to provide direct information about the protected area and the existing eco-reality) and hearing files imprinting the situation in the protected area, may help participants perceive the unique character and importance of the protected area through visual, audio and tactile stimuli. By implementing project methods and experiential activities and by activating the senses in an effort to achieve environmental friendly knowledge and attitudes, Table 1 provides the results of the implementation of the environmental material to different educating groups.

### **Implementing the Environmental Education Material**

Five special schools were chosen for the presentation, implementation and evaluation of the environmental education material. The Greek Educational Authorities granted a specific permit for this applied research project. The participants' age ranged from 13 to 25 years. Overall, 110 students participated, of which 65 were with special needs and 45 without disabilities (The environmental education material was carried out in special schools and in general schools with integration

**Table 1:** Comparison of participant's classes following three main sessions: A: Knowledge B: Awareness-Understanding of environmental problems, C: Managing perception and Willingness to participate

Class		Session A: Knowledge	Session B: Awareness-Understanding of environmental problems	Session C: Willingness to participate and managing perception
1 <sup>st</sup> Gymnasium	Av	6,1	3,7	3,0
	MV	6,0	4,0	3,0
	TD	0,8	1,6	1,3
	N	10	10	10
3 <sup>rd</sup> Gymnasium	Av	6,5	3,3	2,5
	MV	7,0	3,5	2,5
	TD	1,0	1,7	1,3
	N	4	4	4
1 <sup>st</sup> Lyceum	Av	5,6	3,9	2,7
	MV	6,0	4,0	3,0
	TD	1,0	0,4	1,4
	N	6	6	6
2 <sup>nd</sup> lyceum	Av	5,2	3,8	2,2
	MV	5,0	4,0	2,0
	TD	1,1	0,8	1,3
	N	9	9	9
3 <sup>rd</sup> lyceum	Av	4,4	3,1	2,8
	MV	5,0	3,0	3,0
	TD	2,0	1,1	0,7
	N	8	8	8
Vocational training Institutes	Av	5,8	3,4	3,6
	MV	6,0	4,0	4,0
	TD	0,4	1,5	0,5
	N	5	5	5
MOSSD <sub>0,05</sub>		±1,4	No statistically significant difference	No statistically significant difference

classes. In the latter case, the teaching was realized in mixed groups including students with and without disabilities).

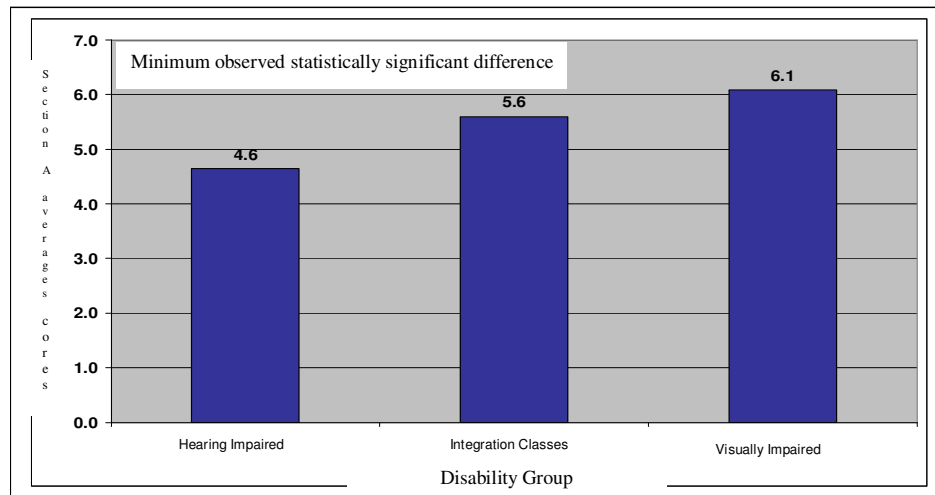
Participants' reaction to the presented material was friendly and positive. They displayed a strong willingness to participate, keenly observed the presentations, the video and audio recordings, and experimented with the tactile diagrams concerning ecopaths in the protected area and with the tactile material as part of the constructed model of the protected area. The result of the implementation was that participants were 'virtually transported' to the protected area of the National Marine Park of Zakynthos.

Through the audio recordings, they were informed about the geomorphologic features, the biodiversity and human activity of the area. The audio recordings of sea turtles laying eggs displayed the coherence of the actual sound of a biological activity, helping participants follow the process of egg-laying step by step, feeling the suspense, participating with questions, and perceiving environmental information. The sounds provided them with information about the shape of the turtle, her struggle to dig a nest with her fins, her eggs

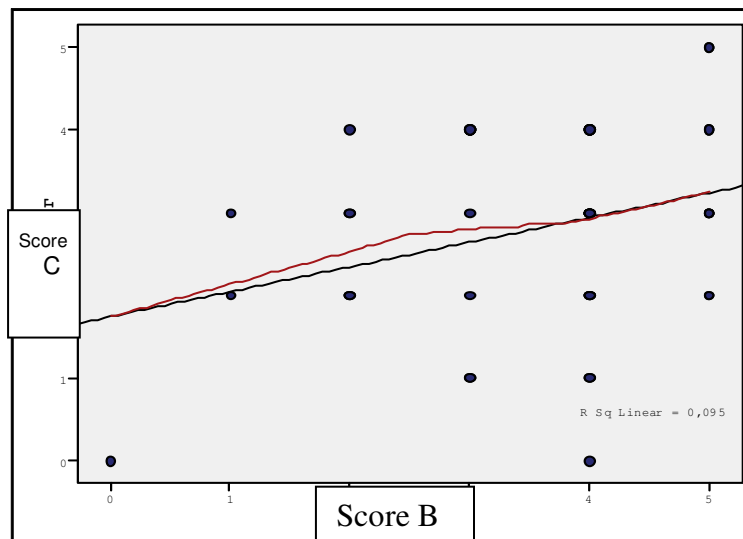
filling up the nest one by one, the volunteers who observed the process for scientific reasons, as well as the foreground and background sounds that influence and determine the data necessary for the management of the area. It should be noted that participants drew on the sounds to perceive the season, the time of day, the type of landscape and the activities in the area; for example the background sounds of the egg-laying beaches indicated that a neighboring area featured tourist and urban activities.

## RESULT

The environmental education material was evaluated with the use of questionnaires. After each presentation, two questionnaires were administered, one to the special groups' participants and one to the educators that were present. After the research was completed, the questionnaire data was statistically processed and the results were analyzed to evaluate the environmental education material. The findings emerged from implementing the ANOVA method ( Analysis of Va-



**Figure 1:** Comparison of Sensory Disability Groups of Learners, in Section A average scores



**Figure 2:** Dissemination chart of B and C scores.

riance). The comparison of average values was carried out with the LSD criterion (Least Significant Difference). Average values differing more than 1,4 units in absolute values display a statistically important difference, of importance  $\alpha = 0,05$ .

Based on the statistical analysis, the vast majority of participants (80%) expressed a desire to visit the National Marine Park of Zakynthos, and a significant number (65%) stated a willingness to participate in protection and management actions. Regarding the educators, 96% found that the environmental education material could be easily implemented in special groups and could effectively “transfer” environmental information through the audio recordings. The statistical analysis of the relevant questionnaire answers also revealed that participants adopted an environmentally friendly attitude, stating that the protection of the environment is a priority. In the statistical analysis, the

educational material displayed different results, depending on the specific student category. The best results correspond to the visually impaired participants, followed by the integration classes, and the hearing impaired at the third place (See Figure 1).

The participants’ age and sex did not affect the formation of scores in sections A, B and C. In other words, these factors do not influence the participants’ answers, regarding their awareness and understanding of environmental problems, their management skills and their willingness to participate in environmental actions. The age of the students ranged from 14 to 20 years old. Students with visual impairments obtained significantly higher scores in terms of environmental knowledge than the students with hearing impairments. The scores on sections B and C were unaffected by the group of sensory disability (See Figure 2).

## CONCLUSIONS

Two particularly important fields of environmental studies can be utilized to produce environmental education material and be used as tools to educate special groups; these are: (a) acoustic ecology, and (b) education for ecosystem's management and conservation (conservation education). The sonic identity of an ecosystem can be easily analyzed and utilized in educating and promoting the awareness of the general public and special groups on issues that pertain to the protection of the environment. The combination of visual, audio, and tactual material, depending on the abilities of the participant groups, contributes to a more effective environmental education and awareness reinforcement.

A particular finding of the present research on special groups is that through ecosystem management and conservation education with an emphasis on sound and acoustic ecology (determining foreground-background sounds, identifying, keynotes, sound signals and soundmarks, considering issues of sound pollution). The participants appear to experience a strengthening in their willingness and eagerness to participate in environmental management activities, while at the same time they become familiar with the priorities of caring for, preserving and managing a protected area. In addition, they learn how to think about taking measures to solve environmental problems. Secondary effects of such an intervention also include the socialization of disabled people through participation in collective learning and activism for the protection of the environment.

Acoustic ecology in this project acted as a tool and a catalyst for crossing listening paths at different levels. Such crossings--literal and metaphorical--involved the listening paths of the abled and the disabled and those of acoustic ecology, biology, acoustics, environmental education and special education, to mention the most obvious ones. While being important for the students (with and without disabilities) involved, these crossings of listening paths proved to be equally important for the researchers-educators who were given the opportunity not only to create them for others but also to experience them for themselves. Crossing these 'listening paths' appears to have led everyone involved to a deeper appreciation of the environment. Disabled persons could conduct monitoring programs, participate in awareness programs and engage in conservation actions (Bright and Tarrant, 2002).

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