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Adaptive Management on Danube Delta's Biodiversity

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Biodiversity is a heritage of life that could hold the information needed for the wellbeing of human kind. The challenge of biodiversity preservation was addressed by various management solutions, the newest being the adaptive management. The paper aims to give insights for the application of adaptive management and to reveal its potential for increasing the effectiveness of ecosystem management in the Danube Delta. Carefully designed adaptive management action plans could allow important improvements in the information base that support decisions related to reed valuation.

Keywords: *biodiversity; adaptive management; ecosystem services; Danube Delta.*

Introduction

Nature protection was one of the first recognition of the importance of ecological balance for human existence and the destructive potential that human activity can have on nature. The first nature reserve in the USA is Yellowstone National Park, established in 1872, long before the environment became a matter of public interest. Moreover, in the same period overexploitation raged bringing many species to extinction. Between 1800 and 1875, bison there were killed about 2.5 million bisons annually and in 1883 the last flock was destroyed [1].

The rate of species extinction is at unprecedented level and it is determined primarily by human activity. The intensity of the process is about 100 to 1000 times higher than the basic extinction (so-called normal extinction rate).

Effective management of ecosystems must face problems raised by complexity and uncertainty. Complexity is based on the existence of a network of interconnected components that cannot be classified into a pattern manifested in the structure, sequence and function, resulting from the interaction of various components [2].

Adaptive management is an approach to natural resource management and ecosystem that recognizes the inherent uncertainty and complexity of the natural systems that limit knowledge and understanding of ecosystem functioning [3].

Adaptive management allows addressing situations of uncertainty by incorporating research into conservation actions [4]. Specifically, this means integrating design, management and monitoring to test assumptions and learning to adapt. In the adaptive management process measures are treated as experiments, learning by trial and error being combined with rigor and specific explanation of the scientific method in order to make learning both relevant and valid.

Biodiversity conservation paradigm shift led to the development of a new field of action and knowledge, namely the economic approach to biodiversity and its protection. Economic substantiation decision conservation became a key requirement for the resolution of which adaptive management is considered crucial [5].

Implementation steps for adaptive management

The necessary stages in their logical order are: problem formulation, management plan design (experiment management), management plan implementation, monitoring, evaluation and adjustment [6].

Problem formulation is best achieved by organizing meetings with several stakeholders. First of all there is systematized the existing knowledge and formulated a model of the system that will be used to explore different options. For simple problems, the model can be a chart or a graph, and in the case of complex problems we resort to simulation models. The process is

iterative, so that we can return to some steps as the analysis progresses. The steps are:

- ✓ Defining measurable management objectives and the establishment of the list of possible actions;
- ✓ Identifying key indicators for each objective;
- ✓ Exploring the effects of actions on the indicators;
- ✓ Formulating the explicit predictions regarding the response of the indicators for managerial options;
- ✓ Identification and assessment of knowledge for a better understanding of ecosystem functioning (key uncertainties).

Designing the management plan is a decisive stage. Before designing it, there are recommended pilot projects that reduce the number of plausible options and enable improved methodologies. In situations where the risk of high or irreversible environmental loss is high, it is possible that the intervention should be delayed until the relevant information becomes available. Also in this stage it is important to plan how the data will be managed and analysed, how the options, goals and models will be adjusted, and how information will be communicated. The steps in the design are:

- ✓ Designing of the management plan and monitoring program;
- ✓ Assessment of options and choosing one for implementation;
- ✓ Monitoring protocol design;
- ✓ Management planning and analysis;
- ✓ Specifying the adjustment of the options or targets;
- ✓ Designing the system for revealing the results.

However, changes might be necessary so that decisions could be taken regarding scheduled actions and type of deviations that are accepted. You must provide a clear description of the circumstances in which changes can be produced, or "tyranny of small decisions" can affect the success of the management experiment.

Monitoring is often neglected in the management process, but achieving it can be crucial both for the experiment and for the management in general. By monitoring there is ensured the fulfilment of an explicit requirement of adaptive management namely the regularly comparison of actions and objectives with the obtained results. Information resulting from this comparison can be used to assess the effectiveness, serving as inputs for adjustment. Basically, the monitoring objectives are evaluation of the

implementation, evaluation and validation of the efficacy parameters and relationships considered in model building, namely establishing the accuracy of the assumptions. Is to compare the results with the predictions made taking into account issues such as:

- ✓ Causes which may lead to differences in results and predictions;
- ✓ The extent to which the assumptions are supported by the results.

Evaluation should explain why the results occurred and include recommendations for future action. On the other hand, the results may be a consequence of the action taken, as well as the influence of factors which were not controlled. Soundness of deductions depends on how the experiment was designed and upon the quality of management and of the monitoring program.

The results which do not confirm the predictions should not be neglected, as they may also be a valuable source of information.

Regardless of the configuration results in agreement or not predictions, they should be documented and communicated to stakeholders who may encounter similar situations.

The information obtained by the managerial experiment should be utilized to verify and improve the models used to formulate predictions and adjust actions. The way that actions can be adjusted is already prefigured in designing of the management plan, but the results may be less clear than requirements set out in that phase. In addition, procedures may produce information that was not anticipated to be obtained, which may have an important role in improving ecosystem management. New information can lead to new management options and the identification of new problems to be solved, triggering another cycle of adaptive management. The sequence may include:

- ✓ Identifying uncertainties that were diminished and those that remain;
- ✓ Adjusting the model so that its predictions to be consistent with the results;
- ✓ Adjustment of the decisions and objectives: to decide what adjustments to be made will take into account the causes of differences between predictions and results;
- ✓ Formulating new predictions, designing new experiments and testing new managerial options: new experiments will address

emerging new uncertainties or persistent uncertainties impacting the predictions or decisions.

Adaptive management is a complex process, and the knowledge of actions sequences does not inherently lead to a favourable outcome. Therefore, the expertise of those involved and managerial skills of project leaders can become crucial to their success. In addition the practice of adaptive management regards facing the validation of the planning and implementation sequence [7].

Biodiversity in the Danube Delta

The biological community of the Danube Delta ecosystems consists of 5,380 species. Compared to the surface, we can say that Delta is a hot spot for biodiversity, especially as the territory under this indicator is comparable to the Great Barrier Reef or Galapagos Islands respectively the areas of the world as the most species-rich. Of the total of 5380 species, about two thirds are animal species (3541) and one third plants species (1839). Regarding the major classes of species, the vascular plants (higher plants) and insects are predominant. Surprisingly for the temperate climate zone is the large number of plant species whose development is supported by the variety of soil and hydrological conditions. Compared to other deltas in the continent and beyond, Delta focuses an impressive number of species. These species belong to many systematic units covering almost all categories differentiated phylogenetic ally, represented both unicellular species, inferior and most evolved species, both plant kingdom and the animal kingdom.

Another feature of the biodiversity of the delta is large number of rare species that have become extinct in other habitats. It should be added that the inventory of species is indicative only for a certain period of time because inventory has yet to encompass all areas.

The large number of species and the relationships between them makes any assessment of the importance of the species difficult. However, a number of species have become emblematic for the Danube Delta, even if their ecological importance does not always justify the popularity enjoyed. Some of these species are very popular because they are widespread (reeds, rushes, willows, poplars, carp, pike, herons, ducks etc.), while others have become popular precisely because they can be found only in the Danube

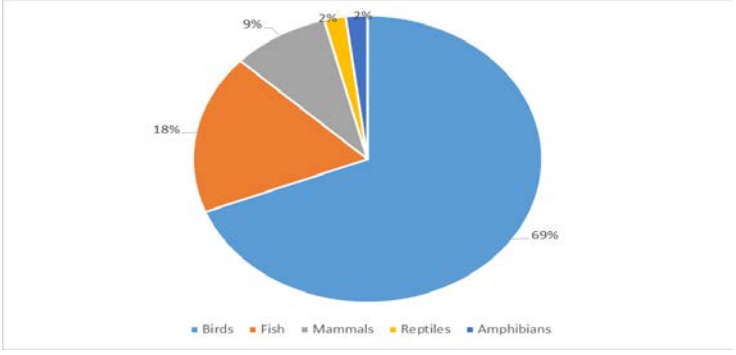
Delta, even if their presence is not so obvious (vine, Dalmatian pelican, bustard, sturgeon, muskrat, raccoon, etc).

Table 1 exemplifies some taxonomic units of the most popular species:

Table 1: Representative species for the Danube Delta

No.	Taxonomic unit	Species
1	Vascular plants	Rush, willow, poplar, thermophilic oak, vine, ivy, Greek liana, elm, ash, buckthorn pink, sea buckthorn, lilies, sand bindweed
2	Fish	sturgeon (beluga, sturgeon, sterlet, stor), herring, pike, carp, rudd, perch
3	Birds	Pelican, Dalmatian Pelican, Great Egret, heron fallow, Ruddy, cormorant, white-tailed eagle, the glossy gray heron, stork, swan, ducks, geese, stilt, bustard
4	Mammals	raccoon, jackal, otter, wild boar, horses, fox, muskrat, mink, wildcat

One element that stands out Danube Delta is the large number of bird species, respectively 331 species, unequivocally dominating the vertebrate category in which there are represented almost 70% of all species (fig. 1).



Source: own representation.

Figure 1: Species structure on the main systematic units of the Danube Delta

The Danube Delta's avifauna is remarkable not only by the large number of species, but because many of these are considered important at national and / or European level. 12 species of birds are declared monuments of nature, which can be grouped according to the year they acquired this status.

Adaptive management in harnessing the resources of the Danube Delta

Large expanses of reed from the Danube Delta are not only an element of customization to the global space, but also an important resource whose under-exploitation means losing significant revenue that could support biodiversity conservation activities.

Currently reed exploitation is regulated at national level and by the rules of DDBRA. Local people have the right to harvest two tons of cane per year / family on land belonging to the public (household).

Commercial operation of the reed is achieved through concessions. Concession contracts are concluded for a period of 10 years. The companies that receive concession contract assume responsibility for completion of the regeneration. Other provisions of the concession contracts are fees paid for the share reed harvesting and reed result in sanitation, development of resource investment protection and regeneration studies (mapping, signage, cleaning areas the proportion reed over four years is more than 25%) and in facilities and equipment, security, compliance harvesting technology.

Present exploitations are located in the following areas: coastal belt of the Black Sea Holbina-Dranov, Sinoe, Rosu-Puiu-Imputita Zmeica-Goloviţa, Somova-Parcheş and Buhaz and cover a much smaller area than the area that can be exploited estimated 35,000 hectares. The most important reed is shown in Table 2.

Table 2: The main reed areas of the Danube Delta

Reed zone	Productive potential (t)	Productivity (t/ha)	Surface (ha)
Matiţa-Merhei	4719	1,1	4290
Magearu	7496	1,1	6877
Şontea-Fortuna	1498	1,1	1369

Reed zone	Productive potential (t)	Productivity (t/ha)	Surface (ha)
Gorgova-Uzlina	9878	1,1	8980
Roșu-Puiu-Împuțita	10637	1,5	7191
Erenciuc	1628	1,1	1480
Buhaz	1958	5,0	389
Somova-Parcheș	1834	1,1	1683
Sinoe	4568	5,0	909
Zmeica-Golovița	11187	5,1	2200
Coastal belt	4071	5,1	790
Holbina-Dranov	11523	1,1	10572

Source: INCDDDT, 2005

The harvesting is performed mechanized and manually, according to the conditions laid down in the DDBRA regulation in order to protect the resource, but also birds and fish species for which this habitat is important. Reed harvesting period begins in October and ends in March, but if frost is not strong enough, ARBDD has the right to restrict the access.

Traditionally, the reed is used as building material for houses, roofs, enclosures, fences, fuel and feed, for it is harvested green. Some of these uses are found in the current conditions, the reed being marketed as a raw material for making roofs, basketry and paper manufacture and as a medicinal plant.

At the same time reed is the raw material for the development of modern materials used in green building. The plates can be made granular and woven reed used as a basis for applying the mortar, walls and reed thatched-pressed binding with wires or binders (partitions), outer insulation reed plates, interior and roof. Very popular are the reed mats, which in the Mediterranean area are used to protect crops from weeds and harvest the fruit.

Exploiting reed is an activity that attracts few operators with an option to complete the income of local people who have no other alternative. Harnessing the full potential of this biological resource, the objective ARBDD assumed by the management plan is to be performed.

Managerial issues proposed to be addressed through adaptive management procedure is missing the target of full recovery of biological resources that can be economically exploited. Possibilities for action include:

- ✓ Including regeneration reed in the activities carried out by ARBDD possibly by establishing a minimum area of sanitation works each year;
- ✓ Acquisition by ARBDD of equipment necessary for mechanical harvesting and involvement of local people in their use by the agreed contractual relationships;
- ✓ Facilitate access to high productive potential thicket by rehabilitating canals and possibly by digging new channels.

For each of these actions are necessary financial resources beyond those currently available. Actions may be the solution itself, or part of the solution. To take decision in this regard is necessary modeling the impact of these measures on the production of reeds.

The managerial objective is to increase the production of reeds. Reed harvesting with modern equipment can greatly improve the productivity of this activity, enhancing its attractiveness in terms of economic. Operating machinery can be entrusted to fishermen organizations as an alternative activity to compensate for loss of income from fishing. Chance of success of this action is judged good to very good [8].

Facilitating access to reed fields involves interventions in the river system, namely the production of works whose environmental impact must be assessed carefully. Action can be implemented as a pilot project for an area to be determined reed after consulting experts, companies and residents seeking permits for commercial reed harvesting. The chance of success for this action is considered very high. Facilitating access can enable and extend the monitoring of species and habitats, thereby supporting conservation actions and the expansion of tourist routes visitation and observation.

Conclusions

Active adaptive management implementation is to design an experiment in which managerial will cover the stages: problem formulation, managerial experiment design, implementation, monitoring, evaluation and

adjustment. Most laborious step is the formulation of the problem, because at this stage setting targets, indicators, monitoring protocols and managerial options to help looming modeling results. Very important is the assessment phase, as it allows comparison between predictions and results, thus providing important information that will reduce key uncertainties.

Applicability of adaptive management is justified when: decisions cannot be avoided, regardless of the availability of information, management objectives can be defined and measurable create learning opportunities that reduce key uncertainties, the costs of monitoring are feasible, the involvement of the stakeholders is active.

daptive management can be applied to stimulate the exploitation of reed areas. Key uncertainties are factors that can be modified by interventions to increase the exploitation of the reed resource. For ensuring easy access to reed fields, parameters are to be monitored in order to reduce key uncertainties resulting in operating costs, workers revenue, hydrological indicators and biodiversity indicators.

References

[1] F. Bran, I. Ioan, C.L. Trică, *Eco-Economia ecosistemelor si biodiversitatea*, Editura ASE, Bucharest, 2004.

[2] S. Levin, *Fragile dominion. Complexity and the commons*, Perseus Publishing, 2007

[3] C.J. Walters, *Adaptive management of renewable resources*. MacGraw-Hill, New York, 1986.

[4] M. Dociu, A. Dunarințu, *Implementation of EMS in the economy* Quality – access to success, 12 (121), 2011.

[5] TEEB, The economics of ecosystems and biodiversity for national an international policy makers. Executive Summary: Responding to the value of nature. United Nations Environmental Program, European Commission, 2009.

[6] B. Nyberg, *An introductory guide to adaptive management. Forest Service*, Victoria, Canada, 1999.

[7] M. Drăgan, *Rezilienţa sistemului regional Munţii Apusen*i. Rezumat teză de doctorat. Universitatea Babeş-Bolyai, Cluj Napoca, 2011.

[8] C.S. Curea, C.V. Rădulescu, *Green economy – strategic visions*, Quality – access to success, vol. 12, nr.121, 2011.