6

The Wildlife Management System of Schleswig-Holstein. A GIS - Based Tool to Monitor Game and Endangered Species

Peter Fischer

University of the Saarland, Environmental Research Centre

Keplerstrasse 14, D-66117 Saarbrücken, Germany, +49-171-4350271, fischer@rz.uni-sb.de

Abstract

For the realization of a wise game management in the Land of Schleswig-Holstein (Northern Germany), the hunting association of Schleswig-Holstein in collaboration with the Institute of Biogeography of the University of the Saarland is implementing a computer - based wildlife management system to monitor game and endangered species. Main aim of this system is to monitor, analyze and visualize the distribution, the quantity and the possible chorological changes of game and endangered species to establish a valid data basis for political discussions related to hunting, agriculture and nature preservation.
One essential requirement in the realisation of such a cadastral is the definition of an adequate sampling design to obtain representative and comparable information from field working. Another demand is the availability of an appropriate system to handle the data, collected in the field. Especially in longterm monitoring, we have to collect voluminous data sets, to handle with Environmental Information Systems as todays adequate tools in view of the permanent demand for a fast and qualified action at the environmental sector. Geographical Information Systems are normally the functional kernel of such Environmental Information Systems,

Environmental Software Systems Vol.2 R. Denzer, D.A. Swayne & G. Schimak (Eds.)

because of their capability to realize spatial analyses, important especially for detecting chorological changes of organisms.

Keywords

Wildlife Management, Sustainable Use, Ecological Cadastral, Sampling Design, Geographic Information System

1 INTRODUCTION

Main objective of nature conservation activities today is the preservation of the organisms, the protection of the ecosystems and the avoidance of the impairement of the natural resources like water, soil and air. The solution of this task is possible only with a consolidated knowledge about the interactions within our ecosystems (ODUM, 1980).
Environmental problems are basically complex depending on which problem one chooses to challenge. If questions relating to species protection, biotope and ecosystem protection, or relating to essential ressources such as water, land and air are to be answered, one will show the interaction between different and complex systems in addition to their dynamic behavior (see BOSSEL, 1994).

To avoid an excessive use of ecosystems in our landscapes, in the middle of Europe mainly formed by man, every kind of human activity should be suitable and sustaining. The wise-use principle is especially important for game management in co-ordination with nature preservation, agricultural landuse and forestry (MÜLLER, 1995).
To recognize possible changes in ecosystems, especially within their biocoenosis, we have to monitor the organisms for a long time to be able to distinguish between normal fluctuations in populations and real expansions or regressions. Therefore, we have to install ecologigal cadastrals like the Wildlife Management System described in this paper.

For the realization of a wise game management in the Land of Schleswig-Holstein (Northern Germany), the hunting association of Schleswig-Holstein in collaboration with the Institute of Biogeography of the University of the Saarland is implementing a computer - based wildlife management system (WMS).
Reason for the implementation of such a system is the current discussion in Germany, forced by nature conservationists, to protect some game species (e.g. *Lepus europaeus, Perdix perdix, Coturnix coturnix, Scolopax rusticola, Meles meles*) by law (Bundesartenschutzverordnung) because of a significant decrease in there population densities. Furthermore we discuss to abolish (or not) the protection of other species (e.g. *Corvus corone, Pica pica*), now permitted again by the EU legislation and claimed by hunters and farmers. The question whether

the conservation of *Corvus corone* is worth-while or not shows the difficult situation: the ones feel it is an endangered species, for the others it is a pest organism, necessarily to be controlled by hunting.
Because of the lack of valid data covering the whole surface of the region, the discussion is strongly influenced by subjective opinions and meanings. The establishment of the cadastral described below shall bring back the discussion on an objective level which will allow the realization of regionally adapted protection- and management - concepts.

The main aims of this WMS are:

- to register the distribution, the quantity and chorological changes of game species and endangered species in the whole Land with approved methods,
- to realize an exact description of the living-conditions of these species in representative areas
- to input high-quality-data in the discussion for species-protection in future,
- to establish a data basis for political discussion related to hunting, agricultural landuse, forestry and nature preservation

The establishment of the WMS started in 1995 with the collection of data of the species *Pica pica, Corvus corone, Perdix perdix, Lepus europaeus* (Game) and *Vanellus vanellus* and *Circus pygárus* (endangered species). The game species are choosen for the reasons described above, the others are "accepted" endangered species whereby *V. vanellus* has a special image effect as bird of the year 1996.
In the first two years, information about the conditions (landuse, biotopes, soil, climate, etc.) in the sampling-areas selected will be completed.

2 SAMPLING DESIGN AND DATA-COLLECTION

Quality assurance systems for environmental field investigations are still at the beginning of their development and acceptance (WAGNER, 1995). Sampling design and data-collection in the field are therefore often the weakest links in the chain of ecosystem analyses (FISCHER & WAGNER, 1992). This is all the more astonishing, as field-investigation is the first practical step in the whole monitoring process not offering the opportunity for corrections afterwards.

To avoid errors in environmental sampling for wildlife analyses we have two basic requirements. One of them is the representativity of the data, the other is the comparability. Representative in this respect means, that the sample has to show a maximum of similarity to the total entity to be studied. Especially the ecological and the geographical representativity of the data has to be guaranteed.
To win representative data for the whole Land of Schleswig-Holstein, the selection of the sampling sites has to meet the following criteria:

There must be:

- a size of 1000 ha of every research unit (exclusion of side-effects)
- some sampling sites in every geological formation
- no significant changes in geology and landuse within a research area
- sampling-sites in every district
- the presence of a skilled editor

The aim is to to realize 100 sampling-areas spread over the whole Land of Schleswig-Holstein covering six percent of the total Land size.
In every research area, the responsible honorary editor (e.g. rangers, nature-conservationists) collects the data of the landuse and biotopes on each parcel. In addition, he has to measure the meteorological data (precipitation, temperature) over the year. The geological data and the information about the soils, stored in the german "Liegenschaftskataster" will complete the information about the research unit by integration of this data into the WMS. To interpret chorological changes pointed out by the analyses of the collected species-data, there is a high necessitiy especially for the information about the changes in landuse and weather.

The comparability of the information will be guaranteed by the collection of the data by specially trained staff which uses accepted standard operating procedures. Every second year, there will be a new registration of the dynamic data like species information and landuse.
All the relevant data including possibly relevant occurrences during field-working are written on data-sheets, specially designed for every species to monitor. The completed data sheets will be send to the project center, where the information will be digitized and verified.

3 TECHNICAL REALIZATION

Because of the differentiation of the problems in space and time, the environmental information has not only the thematic content but also a relation to space and time. Over the years, this implies the collection of voluminous data sets, impossible to handle with conventional methods.
Today, Environmental Information Systems with its different dimensions are a very important tool in view of the permanent demand for a fast and qualified work at the environmental sector. They serve as a representation of environmental conditions and could be employed as planning and control instruments used to quickly recognize dramatic environmental changes due to damaging processes.

Because of their capabilities to realize spatial analyses, Geographical Information Systems are normally the functional kernel of Environmental Information Systems. Especially in detecting chorological changes of organisms, Geo-

Information-Systems are helpful tools to monitor the distribution dynamics and to search for the causes of the changes (FISCHER, 1995).

The Wildlife Management System of Schleswig-Holstein as a tool to monitor the chorological changes is composed by mainly four modules with a Geographical Information System in its centre (see Figure 1). These modules are:

- a relational database management system (RDBMS) to enter, verify and store the collected field-data,
- a Geographical Information System (GIS) to analyze and visualize the spatial data,
- a method-toolbox (MTB) for the special analyses, and
- a specially designed user interface (GUI)

The main problem occurring in the technical realization of the system was the handling of critical information while digitizing the data-sheets. Specially the validation of the integrated data and the handling of missing information for analyses are difficult to manage because of the high number of the field-editors (nearly one hundred) and the high quantity of the data-records to be digitized.

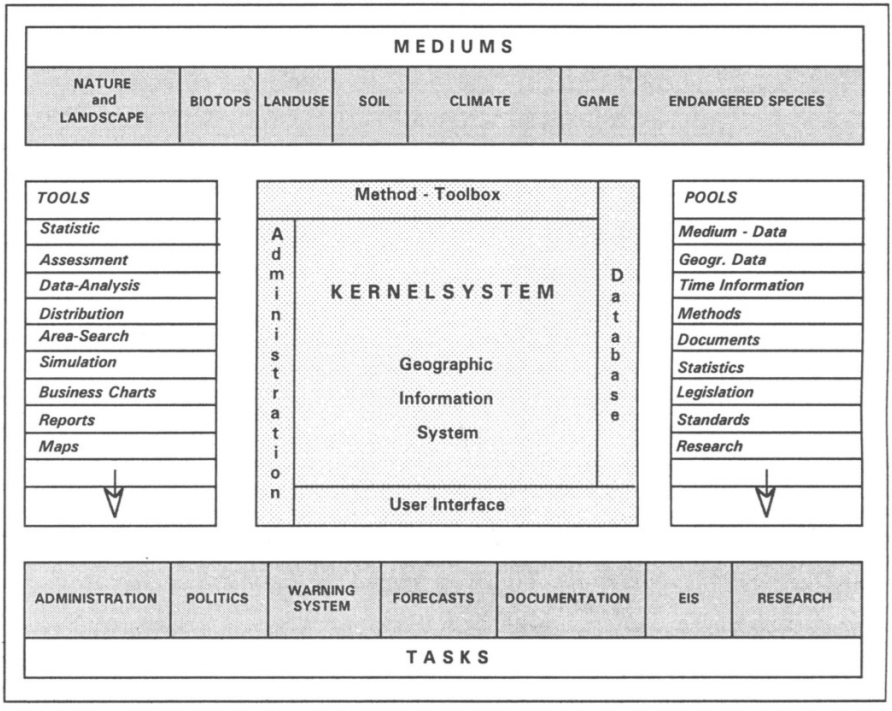

Figure 1 Structure of the wildlife management system of Schleswig-Holstein

To organize the integrity and the quality of the data, the input was realized by compulsory layouts which include scrollable sample-lists and integrated functions to verify the plausibility of the data. Furthermore, to allow other users (e.g. official agencies) the use and interpretation of the data without any problems, a supplement with the exact description of the sampling methods, the sampling designs, the accuracy of the data and the possible errors is given.
Missing data are handled first by directly requesting the editor to fill up the lack of information. Next step is the interpolation of these data, the last is excluding the whole record for this analysis.
A special user demand is the realization of a practicable and simply to handle user interface. Because of the high effort, necessary in the "how to use" reeducation of sporadically used syntax-based dialogs, we implemented a simply to use graphical user interface. To exclude navigation problems, we realized this interface by a menu organized by thematic topics. The function selection is followed by an interactive, system steered, analyzing process and output.

4 PRELIMINARY RESULTS

Main goal of the Wildlife Management System is to detect chorological changes in species distribution and to analyze the causes. Because of the small period of time available to collect field-data, it is difficult to speak about preliminary results at the present stage of the project. The most interesting part of the investigation will start in the future with the presence of longterm data-records. If we monitor real chorological changes in the future, possible as result of longterm monitoring only, we will have the possibility to find out causal correlations in population dynamics (e.g. changes in landuse or climate and regression or expansion of monitored species) and to separate them from normal natural phenomena (see LAWTON, 1995).

Today, we are able to present the information about the distribution and the population densities of monitored species, one of the primary goals of the system implemented. The following Firgure 2 shows the distribution and the density of *Lepus europaeus*, analyzed and mapped for the different natural units in Schleswig-Holstein. For the mean of the whole Land, the springtime-density in 1995 was 17,5 individuals, the density in autumn was 23,5 individuals per 100 hectars. In some research units in the marshes in northern Friesland, the editors could count often high numbers of hares (maximum 94 ind. / 100 ha), unexpected for this region and for springtime (see PEGEL 1986). Low densities (< 5 Ind. / 100 ha) were found in the sampling-units in the eastern Regions of the Geest and the hilly landscape of Holstein. The reasons for these significant differences in the population density, we are not yet able to explain definitely. Because of the lack of valid reference information from other german regions, there remains still the difficulty to order the results calculated for Schleswig-Holstein within a ranking system valid for Germany. Nevertheless, we can say that there is no reason to

characterise the hare as an endangered species for the whole Land of Schleswig-Holstein, in contrary to the official opinion of the ministery of environment.

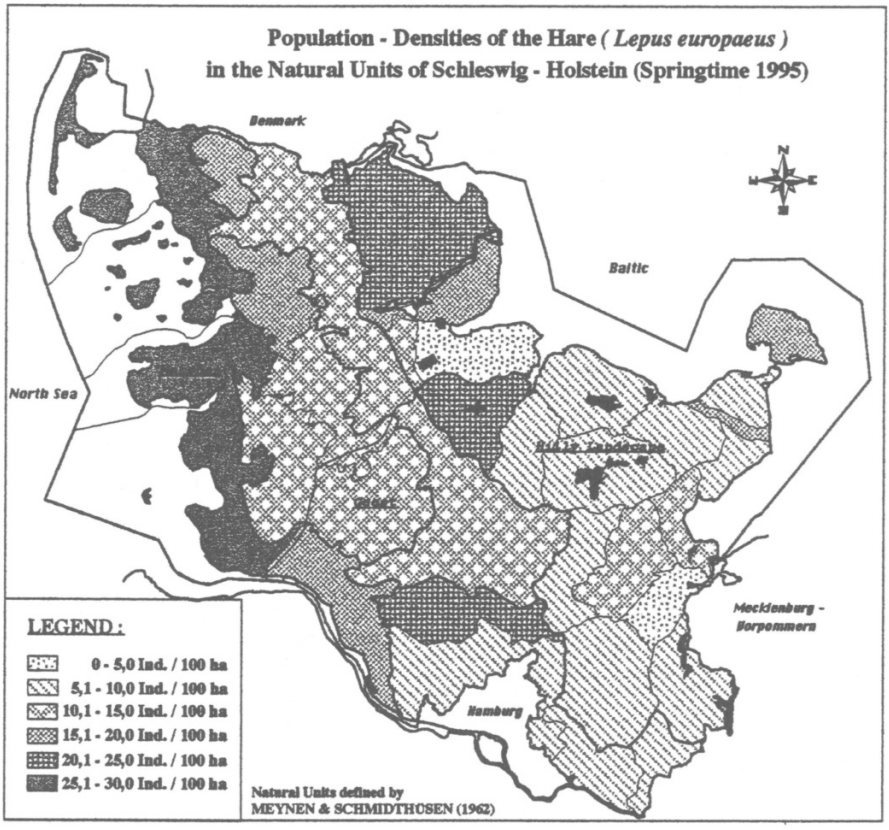

Figure 2 Population - densities of the hare in the different natural regions

Because of the large amount of hares estimated before the beginning of the reproduction cycle in springtime 1995 (ca. 240.000 Ind.), and again in autumn (ca. 320.000 Ind.), we can follow with regard to the whole Land that hunting of hares (ca. 40.000 every year) has only a small impact on the population density if there are no other damaging effects. Concerning the density-pattern and specially the low densities in different regions (e.g. some regions in the Geest), the analyses show that there exists the need for better population management in some places.
The establishment of a wildlife management system with its capabilities to detect spatial patterns is a step into the right way. With its valid data bases and its analyzing possibilities it will assist people concerned with conservation and management purposes of wildlife for a better action and reaction, to secure the diversity of our wildlife in the future.

5 REFERENCES

Bossel, H. (1994) Umweltproblematik und Informationsverabeitung, in *Umweltinformatik: Informatikmethoden für den Umweltschutz* (ed.B. Page, L.M. Hilty), Oldenbourg Verlag, München.

Chapman, J.A. and Flux, J.E.C. (1990) Conservation action needed for rabbits, hares and pikas. IUCN-draft, Gland, Switzerland, 168 pp.

Fischer, P. and Wagner, G. (1992) Sampling design to get qualified area-representative data in longterm passive environmental monitoring programs, in *Statistics for the environment. Proceedings of the SPRUCE Conference*, (ed. V. Barnett, K.F. Turkmann), Lisbon, Portugal, 7-10 April 1992, John Wiley & Sons, New York.

Fischer, P. (1995) Konzeption und Realisierung eines Gebietsinformations-systems. - Möglichkeiten zur Lösung des Daten- und Informationsproblems ökosystemarer Raumanalysen.- Diss. Phil. Fak., Univ. d. S., Saarbrücken.

Lawton, J. (1995) Population dynamic principles, in *Extinction Rates*, 147 - 163, Oxford University Press, Oxford.

Müller, P. (1995) Environmental Monitoring and Conservation by Wise Use, in *Towards Global Planning of Sustainable Use of the Earth. Development of Global Eco-Engineerimg*, 221 - 259, Elsevier, New York.

Odum, E.P. (1980) Grundlagen der Ökologie.- Bd.1: Grundlagen; Bd.2: Standorte und Anwendungen. Thieme Verlag, Stuttgart.

Pegel, M. (1986) Der Feldhase (Lepus europaeus PALLAS) im Beziehungsgefüge seiner Um- und Mitweltfaktoren.- Ferd. Enke Verlag.

Wagner, G. (1995) Basic approaches and methods for quality assurance and quality control in sample collection and storage for environmental monitoring, The Science of the Total Environment, 176 (1995), pp 63 - 71; Elsevier Science BV.

6 BIOGRAPHY

Peter Fischer was born in Blieskastel/Germany in 1964. In 1991 he finished the studies of Geography, Computer science and Hydrology and received in 1995 his Ph.D. for his thesis related to the realization of a GIS-based information system for ecological longterm studies. After working as environmental engineer at the Ministery of Environment in 1992, he was responsible for statistical evaluations and GIS applications in the framework of the German Environmental Specimen Banking Program for several years. At the Centre for Environmental Research his main scientific work is related to GIS-Applications in different kind of environmental monitoring systems. Within his position as assistent of the managing board of Game Conservancy Deutschland he is designing drafts for suistainable landuses.