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MONITORING OF BIRD POPULATIONS IN THE LAKE NEUSIEDL AREA

Hans Winkler, Peter Berthold & Bernd Leisler

Abstract

Birds respond to various factors in their environment with their numbers, with habitat choice and with demographic changes. In the area of the recently founded National Park at Lake Neusiedl several long term studies on herons and spoonbills, on small passerines, and on waders disclosed that habitats significantly changed in the last decades. Numbers of breeding herons and numbers reed dwelling passerines caught in the fall are influenced by local water levels. Because the data also indicate influences operating at a larger than regional scale, the importance of an international monitoring network is stressed.

Winkler, H., P. Berthold & B. Leisler: **Monitoring von Vogelpopulationen im Neusiedlersee Gebiet.**

Vögel reagieren auf die verschiedenen Faktoren in ihrer Umwelt zahlenmäßig, bezüglich ihrer Habitatwahl und mit demographischen Veränderungen. Einige Arbeiten im Gebiet des seit kurzer Zeit bestehenden Nationalparks Neusiedler See an Reihern und Löfflern, an Singvögeln und an Limikolen zeigten, daß in den letzten Dezennien deutliche Lebensraumveränderungen stattgefunden haben. Die Zahlen brütender Reiher und die Zahl an schilfbewohnender Singvögeln, die im Herbst gefangen werden, hängen von lokalen Wasserständen ab. Weil die Daten auch überregionale Zusammenhänge erkennen lassen, wird die Wichtigkeit eines internationalen Monitoring-Netzwerkes betont.

Winkler, H., P. Berthold & B. Leisler: **Monitorování ptačích populací v oblasti Neusidlerského jezera**

Ptáci reagují na změny prostředí změnou početnosti populace a výběrem stanoviště. Dlouhodobé studie volavek, kolpíků, vrabcovitých a brodivých skupin ptáků v oblasti nově vyhlášeného národního parku Neusidlerské jezero poukázaly na výrazné změny těchto lokalit v posledních desetiletích. Počty hnízdících volavek a vrabcovitých hnízdících v rákosinách jsou ovlivněny místními poměry vodní hladiny. Neboť získaná data poukazují i na vlivy zasahující větší než jen oblastní měřítko, zdůrazněn je význam mezinárodního monitorovacího programu.

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INTRODUCTION

Several factors effect population changes, including external factors and interactions between the internal dynamics of reproduction and mortality with age structure and behavioural strategies. Population monitoring attempts to document these changes, whereby target groups may be selected due to conservation concerns or to assess the conditions of the supporting ecosystem. Animal and especially avian responses can be used to monitor various aspects of the environment. The reactions may be numerical as in the presence or absence of species and in the number of individuals with which they are represented, and they may also be expressed as demographic changes or as characteristic patterns of habitat choice.

In the area of the recently founded National Park at lake Neusiedl, several long term studies provide data relevant to the conservation of the species monitored, which can also be used to demonstrate ecological changes. One data set comprises breeding colonies of herons and Spoonbills in reed beds of the lake; a second, data from mist netting small passerines; and a third, observations of waders in shallow pools east of the lake. All three data sets disclose information on significant habitat changes in the last decades. Moreover, these changes are in a larger than regional scale.

Lake Neusiedl and its surroundings form one of the most important wetland areas of continental Europe. For this reason conservation efforts have long focused on this area. The entire region is under low level protection, which mainly encompasses strict construction codes with some limitations on agriculture and development. The reedbeds are economically exploited during winter and are especially protected during the breeding season. Some of the shallow natural ponds located east of the lake in the so called Seewinkel are protected by state laws. Recently, parts of the reed beds, some wetlands and terrestrial habitats around the lake and some ponds of the Seewinkel have been designated as a national park. A national park has also been declared for the Hungarian section of the lake. The area is part of the Ramsar Convention and a UNESCO biosphere reserve has been established by Austria and Hungary in the southern reed beds.

The lake stretches from north to south for 36 km and is about 7 to 15 km wide. It covers an area of approx. 320 km2 of which more than a third is taken up by reed. Lake Neusiedl is rather shallow, ist maximum depth is below 2 m, wth an average depth of about 1.5 m. The lake's hydrology is very complex. Basically the water levels depend on precipitation within a rather small area. As in many other wetland systems, water levels fluctuate although floodgates prevent high levels. However, in the last few years precipitation was very low and direct anthropogenic influences on water levels were negligible.

The *Seewinkel* is a flat area with very shallow ponds which are more or less brackish. Over the last decades many of the ponds have been lost through drought, the extensive growth of higher vegetation, caused by discontinued of grazing, eutrophication and by the long-term effects of an extensive drainage system. Agriculture, particularly wine growing, has intensified over the years and has encroached on the ponds with either no or only small puffer zones.

HERONS AND SPOONBILLS

Great White Egrets *Egretta alba*, Purple Herons *Ardea purpurea* and Spoonbills *Platalea leucorodia* are characteristic breeding birds of the reed beds. These species occur only locally in Central Europe which has made them the focus of conservation efforts for many years. In the last decades, many attempts were made to census the nests which are mainly clumped in colonies. Census data from various sources

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were compiled by DICK et al. (1993). They are mainly based on aerial counts. Our personal data was obtained by aerial survey coounts by helicopter (FESTETICS, LEISLER & GRÜLL in prep.)
Towards the late nineteenth century, these species had developed appreciable population sizes which have fluctuated considerably since (DICK et al. 1993). Tables 1-3 summarise their development over the last six decades. DICK et al. (1993) demonstrated the dependency of Great White Heron numbers on lake water levels. Low water levels in one year result in reduced numbers of herons in the next. However, the herons respond to higher water levels immediately with higher numbers of breeding pairs. The mechanisms of these reactions have not yet been studied in detail.

Table 1: The breeding population of the Great White Heron at Lake Neusiedl (DICK et al. 1993) with some additions.

Year	Number of pairs
1932	≥100
1938	?
1947	?
1950-52	120-140
1960	329
1972	327
1973	326
1981-92	152-429

Table 2: The breeding population of the Purple Heron at Lake Neusiedl (DICK et al. 1993) with some additions.

Year	Number of pairs
1947	210-220
1950-52	240-300
1960	273
1972	325
1973	331
1981-92	60-107

Table 3: The breeding population of the Spoonbill at Lake Neusiedl (DICK et al. 1993) with some additions.

Year	Number of pairs
1932	≥300
1938	approx. 100
1947	≥120
1950-52	200-250
1960	179
1970-74	125-255
1972	235
1973	133
1981-92	0-63

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PASSERINES

The next examples concern migrants. Processes within migrant populations, interaction with different environments, and monitoring efforts form complex relationships which are considered in data analysis.

The seasonal cycle of migrant populations commences with the return from wintering grounds. Depending on local conditions, breeding populations build up. Mortality and natality are affected by the conditions at the breeding site. The number of birds present after the young have been produced depend both on the number of birds returning from the winter quarters, the (relative) suitability of the habitat for establishing nests and the factors responsible for fecundity as well as adult, egg, and juvenile mortality. The next stages are the preparation for migration and then migration itself. Passing migrants or migrants using a certain site as staging post for the next step of their journey build up local populations. Since migrants do not reproduce in their winter quarters, changes in population size are only due to mortality.

Monitoring bird numbers in the fall is advantageous since it reflects both aspects of population dynamics, natality as well as mortality. However, one has to be wary of possible global and local effects.

Local effects become manifest in two ways. First, monitoring may mainly reflect local habitat suitability during the reproductive phase, both through initial attractiveness for the adults and via recruitment. Second, habitat conditions near the trapping site or at the point of observation can determine bird numbers recorded. Both factors may interact, of course.

Global conditions also determine the number of birds recorded at a monitoring site. In the particular case of migrants, events in the wintering grounds have to be regarded as remote and global. Continent-wide weather conditions, long term climatic changes, changes in habitat quality through agricultural practices including application of pesticide and so forth may affect populations on a large scale. The impact of global changes on the data depends on the relative contribution of local versus extraneous (sub)populations to the birds recorded as well as to what extent local conditions, as specified above, are contingent on global changes.

Populations are not homogeneous and the resilience of a species to disturbances depends on its internal structure. In simple terms, if a population is divided into several units which grow and wane independently and which are loosely connected by dispersal, the meta-population is more robust than if all subunits react in the same direction or if no such sub-populations exist (HANSKI 1989).

Of all the examples discussed in this paper, the MRI-program represents the most elaborate monitoring effort. It comprises a standardised bird catching and banding scheme, which is carried out at three different sites in Central Europe. It is organised by the Vogelwarte Radolfzell at the Max-Planck-Institut für Verhaltensphysiologie. Birds are caught in mist nets from the end of June to the beginning of November, the entire fall migration period. All sites maintained their respective structure thanks to careful management of the vegetation and standardisation of the trapping and work methodology (BERTHOLD & SCHLENKER 1975).

The analysis of the first monitoring period, from 1974 and 1983, revealed a decline for about 70% of the bird populations monitored (BERTHOLD et al. 1986). These results were of great concern for all agencies involved in conservation. It was concluded from the data that population levels of migrating species through Central Europe are subject to nearly uniform, common factors. Followiing the subsequent interruption after first analysis, the program has since resumed operation. In accordance with the previous methods, we analysed the numbers of birds caught for the first time in a

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particular year at the three stations. These season totals are thought to reflect population fluctuations properly.
The statistical model used for the analyses is based on the ecological concepts presented above. Local conditions are represented by the water level, which is the most important single factor in this wetland system. Monthly means of the station at Mörbisch were used. These data comprise measurements in cm relative to the local zero level of the gauge. Global effects are incorporated by using data from other stations and by allowing for a general linear trend in the numbers. Correlations among stations serve as an indicator for the overall robustness of the species. The trends may be seen as reflecting changes not accounted for otherwise and may be used as indicators for the long-term fate of a species. All bird numbers were log-transformed (BERTHOLD et al. 1986, BÖHNING-GAESE 1992). Stepwise Multiple Linear Regression Analysis was used to evaluate the model. Although this method has some inherent difficulties in general (JAMES & MCCULLOCH 1990) and time-series pose some particular problems, we feel that the analyses have great heuristic value. The methods are robust enough and the results agree well with those obtained by different methods (BERTHOLD et al. 1986, BÖHNING-GAESE 1992).
Two species showed significant negative linear trends in simple regressions, namely Great Reed Warbler *Acrocephalus arundinaceus* and Marsh Warbler *Acrocephalus palustris* . All the other species considered here declined as well. These species are Reed Warbler *Acrocephalus scirpaceus*, Moustached Warbler *Acrocephalus melanopogon*, Sedge Warbler *Acrocephalus schoeobaenus*, Savi's *Warbler Locustella luscinioides*, and the Reed Bunting *Emberiza schoeniclus*.
The full analysis of the Great Reed Warbler data shows that this species is influenced by local conditions, the water level in June. However, a strong, unexplained negative trend remains and the rather high correlations among trapping stations indicate a high vulnerability of this species (Fig. 1).

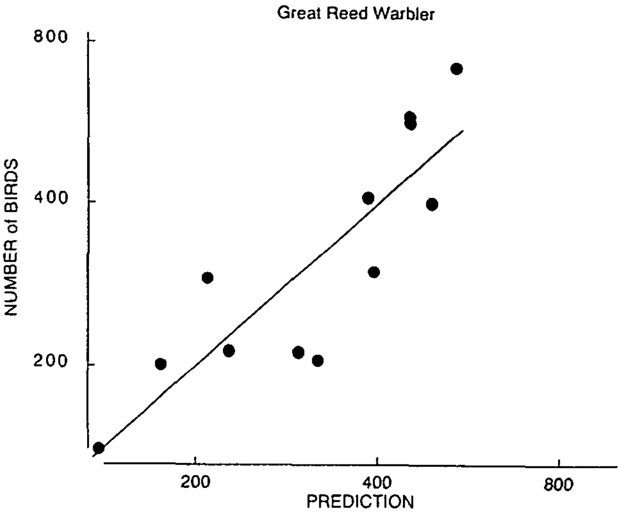

Fig. 1. Observed and predicted numbers of Great Reed Warblers *Acrocephalus arundinaceus* trapped at Illmitz, Lake Neusiedl. Predictions based on the regression ($p<0.02$) of log-number of birds caught on time (year) ($p<0.05$, correlation negative), water level in June ($p<0.05$) and numbers of Great Reed Warblers caught at the same time at Lake Constance ($p<0.1$).

The negative trend in Marsh Warbler numbers is moderate. Numbers among stations correlate well and no local effects can be shown. Because of the exceedingly short breeding period of this species, trapping data may not reflect the status of the local population, but instead only those of more northern populations passing through. This would explain the good correspondence with two other stations.
Reed Warbler numbers are clearly related to local conditions. A strong positive correlation with water levels in April was determined. Correlations with other stations were not very high and a negative trend was found as well.
No appreciable trend is exhibited by the trapping records of the Moustached Warbler. However, a strong positive influence

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of the water levels in March exists (Fig. 2). Since this species does not occur at the other stations, no statements about its vulnerability can be made.

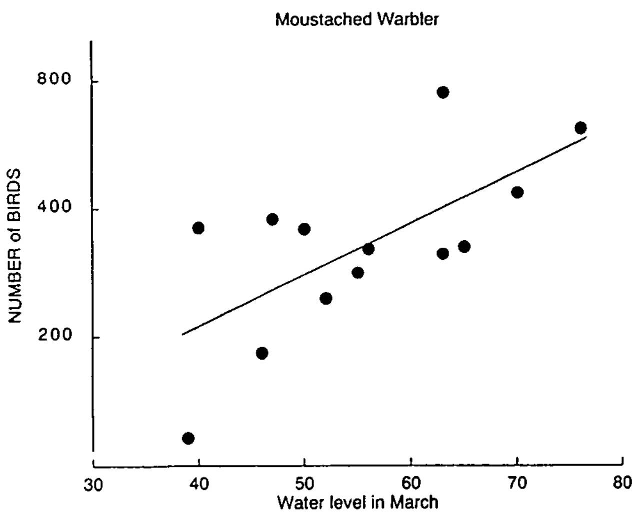

Fig. 2. The number of Moustached Warblers *Acrocephalus melanopogon* trapped at Illmitz, Lake Neusiedl in relation to water levels in March ($r = 0.668$, $p<0.02$).

The Sedge Warbler is a particularly interesting species due to its decline for many years. Detailed studies of British populations revealed that population changes are unrelated with recruitment. The main driving variable for these populations is winter mortality which in turn depends on the rainfall in the Sahel (PEACH et al. 1991). Analysis of the Illmitz data discloses a negative trend which is parallelled by the numbers caught at the two other stations. Together, these variables explain 52% of the variance ($p<0.1$). However, the most important factor is the water level in April ($p<0.05$), which together with the other variables accounts for 79% of the total variance ($p<0.02$). We conclude, that in years with high water levels in April, more Sedge Warblers settle in the area. June is the month in which most nestlings are produced (GLUTZ VON BLOTZHEIM & BAUER 1991), and water levels in June also exhibit, albeit a weak, positive influence on the number of Sedge Warblers caught in fall.

We are now in a position to suggest which species could be used for monitoring the reed bed conditions. Since our concern here is not to monitor global changes, those species which are vulnerable to local effects should be preferred. Three species of reed dwelling passerines seem to be very suitable for such local monitoring: Moustached Warbler, Reed Warbler, and Great Reed Warbler.
Reed Warblers and Great Reed Warblers are trans-Saharan migrants and thus subject to extrinsic effects, in principle. However, exactly this fact allows for a critical consideration of the relative contributions of local versus global effects. Particularly, the Great Reed Warbler with its apparently low meta-stability deserves great concern in the years to come. Moustached Warblers seem not to be affected by events in their wintering grounds, at present. Its relatively large numbers and its special status in Central Europe should render it as the ideal species to be monitored.

WADER (CHARADRIIFORMES) COMMUNITIES

Waders of the avian order Charadriiformes breed and rest in the Neusiedl area in great diversity and numbers. The most common species are Ruff *Philomachus pugnax*, Lapwing *Vanellus vanellus*, Black-tailed Godwit *Limosa limosa*, Wood Sandpiper *Tringa glareola*, Redshank *Tringa totanus* and several species of the genus *Calidris*.
The phenology of both breeding and migrating species has been well documented (WINKLER & HERZIG-STRASCHIL 1981). Since the phenology of waders is well documented in those places where they appear in considerable numbers during migration in Central Europe, comparisons could easily be made to discern the local from global effects. Although recent changes are well docomented, they still await analysis. The ecological relationships of waders in this area have been well studied

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over the last decades (WINKLER 1977, 1983). The results suggest that biomass of and consumption by these birds are important factors in the wetland ecosystems of the *Seewinkel*. Raw data of wader counts are confounded by the effects of the size of suitable habitat patches (WINKLER 1983). After removing these effects, it has been shown that species diversity at a particular site increases with increasing bird numbers to a certain point and then decreases for higher densities. The shallow soda ponds in which visiting birds are abundant at comparatively low diversity levels are highly eutrophic. The monitoring and analysis of wader communities will prove to be a very important research activity and will certainly be exceedingly useful in future conservation and managing efforts.

CONCLUSIONS

We have presented several examples of how birds can be good indicators for certain aspects of an ecosystem. If carefully monitored under standardised procedures, they provide many invaluable data. These data are most useful if actions are interpreted both at the local and supra-regional level.
With the possible exception of the herons and spoonbills, all the species groups dealt with in this paper quickly respond to changes in their environment. The reactions of the birds to the water levels are pronounced and seem to be rather predictable.
Water levels in the lake and in the *Seewinkel* are influenced by weather conditions including long term trends in climatic change and interaction with human activities. The latter mainly concern the operation of floodgates, drainage systems and possibly the use of groundwater for drinking and irrigation. In the past, groundwater has been added to desiccating ponds - both for fish farming and for attracting birds. This makes evident the ample opportunity to manage water levels within the limits set by short term precipitation. Based on the rapid reaction of bird populations, consequences of certain actions can be assessed almost immediately.
Given the present state of knowledge, nearly precise predictions about the effects of water level changes can be made. Therefore, the next step would be to discuss goals and express them as the desired number of birds. The monitored species could itself be the target of the management effort or be used as an indicator for general conditions in the area. Subsequently, management of the hydrological key factors could be employed. Together with continued monitoring efforts, a genuine feed-back control managing system (GRAY & JENSEN 1993) could be established.
The analyses presented here also show that local monitoring only makes sense if local and global changes in the environment and in the populations monitored are recorded as well. Continuous monitoring and possibly control of local influences has been alluded to already. The primary concern for future efforts should be to extend and to maintain the network of stations which provide trapping records of high standard. Only then will our local and global efforts to save our heritage of natural assets be based on and aided by scientific principles.

ACKNOWLEDGEMENT

We wish to thank Dr. Alfred Grüll for useful information and comments to the project. He also helped in getting the data on the water levels collected by the State Goverment of Burgenland. Some of the research reported on here (MRI-program) was supported by the FRG Federal Ministry for Environment, Conservation and Reactor-Safety. However, the authors are fully responsible for the content and possible errors. Miss S. Kleindorfer helped in editing the English text.

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