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LARCH-AIRPORT: A GIS-BASED RISK ASSESSMENT MODEL

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Abstract

There is a great need for a tool that makes risk assessment of bird strikes in the vicinity of airports possible. Such a tool must be based upon the landscape structure and knowledge of bird habitat preference and behaviour. The LARCH model (Landscape ecological Analysis and Rules for the Configuration of Habitat) has been developed to assess the biodiversity potential of fragmented landscapes by analysing the landscape from the perspective of a selection of indicator species. The model can be adapted to map movements of birds through the landscape, following this same principle: looking at the landscape from the perspective of a selection of species that are relevant for bird strike problems. Detailed vegetation-cover maps become available from remote sensing. From these GIS maps, breeding, foraging and resting habitat can be mapped with LARCH for a selection of species. From the area and configuration, population size estimates can be derived. The algorithm can be calibrated using census data. In The Netherlands, such data are available. The model predictions can be tested using bird strike information in combination of flight frequency etc. Overlaying maps of bird core habitat with maps of airports and take-off and landing routes, it is possible to point out potential problem areas. LARCH-subroutines can determine where the take-off and landing routes lie in the vicinity of airports.

To underline the necessity of risk assessment the case study of Eindhoven Airport will be presented. The dangers were researched the construction of an artificial lake could pose in the vicinity of Eindhoven Airport in The Netherlands. The research was especially focused on the danger of waterfowl near an airport. As a result of the research the planned artificial lake near Eindhoven Airport will not be constructed. This research was carried out without the use of models or GIS, but the procedure can be automatised as a module of the LARCH model. Then it can be applied to other airports with little extra effort and a minimum of field work.

During the meeting of the IBSC the first results will be presented of adapting the LARCH model to situations near airports. It will take some time to transform the LARCH model in order to predict the movement patterns of birds in the landscape realisticly. Using the model, it will be possible to collect data of wildlife near airports in a more fundamental way. Furthermore it will be easier to compare the risks of different airports.

Key Words: Airport Eindhoven The Netherlands, Landscape ecology, Water, Wetlands, Preflight planning, Forecasting, Guidance, Organisation, Risk assessment, Local bird movements, Land use, Reporting, GIS, Models, Decision support.

Introduction

In July 1996 there was a crash involving a Hercules aircraft of the Royal Dutch Air Force at Welschap military airfield near Eindhoven in the Netherlands. The accident could be ascribed to a number of causes, but the presence of starlings on the runway at the time was certainly a factor. This plane crash cost the lives of many of the young passengers on the aeroplane, and had an enormous regional and national impact. The Welschap base is located relatively nearby the built-up area of the city of Eindhoven. For some years, the Eindhoven local authority has been considering the construction of a housing estate in the immediate vicinity of the airfield. This development is being planned with distinctive qualities that would enable Eindhoven to compete effectively with surrounding districts. Until recently, one important feature envisaged for the area - called Meerhoven - was a 40-hectare lake. This would have been located 1.5 kilometres from the airfield's runway. Fairly soon after the Hercules crash, a debate began in Eindhoven about the desirability of creating the lake, given the risk of bird strikes by aircraft. The size of the lake, in particular, was at issue. Concerns were expressed that a body of water on the scale envisaged would attract water birds, which could present a danger to aircraft. Approximately 50,000 flight movements took place at the base in 1997, 5000 of them military in nature. Although it is a military airfield, civil aviation accounts for the majority of its usage.

Just before the Hercules crash, and with a view to the situation around the airfield, research began into the presence of water birds in the Eindhoven region. The accident took on a new aspect. As well as the bird populations, their movements were examined with regard to how these could affect Welschap. This resulted in thorough studies which contained a comprehensive picture of the bird situation around Eindhoven. But at this

stage of the process, it was not explicitly asked whether the construction of a lake of the shape and size planned would be wise. Meanwhile, the debate on this issue continued both locally and nationally. In June 1999, four interested parties - the Dutch Civil Aviation Authority, the Royal Dutch Air Force, the City of Eindhoven and the Province of Noord-Brabant – approached the Alterra Rural Research Institute in Wageningen with the request to:

- assess the existing studies of bird life in the Eindhoven region;
- assess the advice issued by the Netherlands Bird Strikes Committee about the lake's attraction of birds;
- express an opinion about that attraction; and,
- assess a number of variants on the proposed form of the lake.

The Alterra Study

The Alterra study initially examined all the other studies already available. These provide a broad picture of the bird situation in the Eindhoven region. Alterra expressed its appreciation of that material. At the same time, it was clear that the issues which in 1996 and 1997 had formed the basis for the research carried out then had not, or only too late, been defined to focus on the situation at the airfield itself. From the outset, Alterra opted to take that situation as its starting point. The public debate, after all, had also increasingly turned to the safety of aircraft using the Welschap base and of residents living in its immediate vicinity. Which was not illogical following the Hercules crash. Much of the research material previously compiled had to be regarded as redundant in the light of the 1999 situation. The studies clearly indicated that the problems expected centred on the appearance of gulls and wild ducks which could use the new lake as a resting place and a base for foraging elsewhere in the area.

As a result, some of the debates conducted were no longer relevant. It was striking that the discussion had focused very much on keeping the lake deficient in nutrient substances. This would prevent birds which were looking for food from using it. The lake's design had also been an important topic of debate: steep banks and sufficient depth were recommended. The local authority in Eindhoven had already incorporated these design requirements into its plans for the lake. However, Alterra's second opinion based on the existing research was that the problems involved not so much birds seeking food but resting birds such as gulls and wild ducks. Seen from the point of view of the airfield, the construction of a lake in the form envisaged would present a risk. Its design would make it particularly inviting to gulls, since it offered them a safe haven. The research material available appeared to show that there is a size threshold, below which lakes are not frequented by gulls. We established this to be three hectares. Much also depends on the lake's smallest diameter. Gulls will assess this for safety and distance of view. In our

opinion, the surface area of the water is less important. In the form envisaged, the Meerhoven lake would add another inviting place to an urban area which is already attractive to gulls thanks to factors such as flat roofs nearby which can be used as roosts. A further consideration is that gulls are opportunistic birds which are difficult to drive away. Controlling this type of bird is a problem.

Finally, the four bodies that had commissioned the report decided - based on our findings - that the lake could not be constructed in its original form. They took this decision unanimously. This is particularly to the credit of the local authority, which of course had been in somewhat of a predicament. Homes in the new district had already been sold to future residents who had been particularly attracted by the prospect of living near a 40-hectare lake. In those circumstances, it is not easy to have to say that there will, after all, be no lake. From the perspective of their positions and responsibilities, the other parties were obviously relieved. The provincial government was able to stop the procedure for issuing a land-clearance permit. Finally, the Civil Aviation Authority and the Air Force were able to conclude that there would be no additional dangers for air traffic.

Plans for the new housing estate have since unfolded. Of course, any development near the airfield will attract birds of some kind. The plans now being developed envisage a large, landscaped park - probably containing several bodies of water which will be smaller in size than the lake originally foreseen. Such a park will attract birds. But they will probably be species which already use the environment around the airfield. The design of the base and its vicinity are already inviting to them. There is sufficient experience with bird control there, fortunately, to ease the problem. In this sense, the new centrepiece of the housing development - a landscaped park - adds no new risks.

Broader Perspectives

The Meerhoven lake issue raised a number of questions for us. Previously, we had only had experience with the situation at Schiphol, the Netherlands' national airport. The prevailing impression was that it had the issue of bird strikes reasonably under control. The airport has set itself the objective of limiting the number of collisions between birds and aircraft to a maximum of four per 10,000 flight movements. Annual reports are also compiled about bird strikes at and around the airport. The position is rather different at the regional airports. At Eindhoven, the situation is additionally complicated because it is a military airfield. It is not clear who is responsible for recording bird strikes, certainly where civil aviation is concerned. In short, we found it difficult to obtain detailed data about bird strikes for our study. And our approach was

precisely to compare past information about strikes with future forecasts given the potential risks. One mistake often made when studying wildlife and infrastructure is that only future scenarios are considered, whereas there are risks at the present time, as indeed there have been risks in the past. The fact that there seems to be inadequate data collection on bird strikes at and around regional airports is a matter of concern. This must be improved. There should be a consistent system of data collection. And the regional airports should also be required to issue annual bird-strike reports. In our study, we have recommended that the national bird strikes committee take the lead in this. We have the strong impression that regional airfields need to be supported in recording, monitoring and evaluating bird strikes.

Another interesting topic of discussion for instance with the compilers of the earlier reports was the extent to which one needs to resort to advanced research techniques. In the broad approach of the previous studies, for example, the type of water was postulated as being an important factor in explaining differences between incidences of bird species. A distinction was therefore drawn between a fen and a quarry lake. This premise did not stem from the data. In our opinion, a more refined analytical technique could have been possible, whereby several factors are incorporated into a multiple regression model. For example, we wonder whether the age of a lake may not be a significant variable. It is notable that, in the Eindhoven region, the Aqua Best lake almost immediately became the most important roosting place for gulls in a wide area following an extension of the excavations. This kind of correlation was not drawn in the previous studies.

Likewise, we asked ourselves whether - in addition to improved recording, monitoring and evaluation - better risk forecasting might not be possible. The problem with bird strikes is that such incidents occur under exceptional rather than normal circumstances. But we nevertheless believe that with the available ecological data about bird species, breeding grounds and vegetation distribution, a fairly good picture of potential risks can be obtained. Much of this type of data can be incorporated into an ecological model entitled LARCH, which is used to predict animal movements. The LARCH model (Landscape ecological Analysis and Rules for the Configuration of Habitat) has been developed to assess the biodiversity potential of fragmented landscapes by analysing the landscape from the perspective of a selection of indicator species. The model can be adapted to map movements of birds through the landscape, following this same principle; looking at the landscape from the perspective of a selection of species that are relevant for bird strike problems. Detailed vegetation-cover maps become available from remote sensing. From these GIS maps, breeding, foraging and resting habitat can be mapped with LARCH for a selection of species. From the area and configuration , population size estimates can be derived. The algorithm can be calibrated using census data. In The Netherlands such data are available. The model

predictions can be tested using bird strike information in combination of flight frequency etc. Overlaying maps of bird core habitat with maps of airports and take-off and landing routes, it is possible to point out potential problem areas. LARCH subroutines can determine where the take-off and landing routes lie in the vicinity of airports. We have begun making this LARCH model suitable for the situation around airfields in the Netherlands. As basic input data, we have used the main ecostructure, vegetation map, the incidence of bird species, the presence of water, and airfields. The initial results are encouraging. But it is of key importance to refine the forecasts continuously through the input of data such as that produced by recording and monitoring. And, as we have already observed, improvement in these areas is certainly possible.

Conclusion

The Hercules crash at Welschap military airfield near Eindhoven shed new light on the issue of birds around the planned lake in the new Meerhoven housing development. From the moment the crash occurred in July 1996, the realisation gradually dawned on a number of interested parties that the bird issue was a cause for concern. The studies already initiated had widely covered the problem in the Eindhoven region. From the outset, Alterra concentrated on the situation at the airfield itself. It was possible to conclude from the studies that water birds, particularly gulls and wild ducks, could cause problems. They would use the lake as a resting place rather than a feeding place. It was the design of the planned lake, with its wide diameter, which would be so inviting to them. Alterra's conclusion was that the construction of the lake would present an additional risk to air traffic. It also made recommendations for the future: clear recording of bird strikes, and the monitoring and evaluation of incidents. Finally, in our opinion it should be possible to use existing ecological models for predicting animal movements to forecast bird movements close to airfields. Existing species and vegetation maps can provide the input for the so-called LARCH model.