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The German Military Geophysical Service. Bird Migration Observation, Warning and Forecasting System: New Developments towards an Automated Bird Migration Information System

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Summary

The German Military Geophysical Office (GMGO) has a more than 30-years experience in all fields of bird strike prevention. Military training and flight operations usually take place in low altitudes, where also a lot of birds are present, especially near coasts and during migration periods. About one third of all the GAF bird strikes occurs during low level flight operations. The most effective tool for bird strike prevention in military low level flying is the well proved system of

- continuous actual bird migration observation (visual and by radar),
- immediate reporting,
- centralised risk evaluation,
- online warning (BIRDTAM),
- immediate distribution of BIRDTAM to air staff and pilots,
- strict regulations for military flights and
- a regular bird strike risk forecast for planning purposes.

The paper gives an overview over recent and near future developments towards an Automated Bird Migration Information System (AVIS(lat.:Bird): "Automatisiertes Vogelzug Informations-System") for Germany and adjacent areas. The important modules of this system are described. The actual state of the project is outlined.

Bird Migration Observation

The actual bird migration observation system is based upon the following networks and techniques:

- (i) The synoptic weather observation network, consisting of approx. 150 stations. Observers are trained and assigned to monitor bird migration visually. Only larger bird species and flock sizes are relevant for reporting.
 - (ii) 6 air defense radar stations in combination with Air Defense Control and Reporting Centers (CRC) distributed across Western Germany. The present operational observation system monitors all moving targets within a circular range of 60nm. Hourly observations are automatically recorded by a personal computer and a video camera as a 10-minute time lapse recording from the PPI-Display (Fig.: 1). Video images show two dimensional movements of bird flocks. The 2-D clutter image is automatically processed and stored. If certain parameter values are exceeded, the system gives an alarm to the radar staff, who is assigned to interpret and report if necessary. Additionally, each PC is completely remote controlled via modem by GMGO, either Biology Section or Geophysical Forecast Center. At any time a connection can be initiated and an actual, recent or archived observation files can be looked at.
 - (iii) A system of 5 radar stations, also remote sensors in Northeastern Germany is using a prototype of a Bird Radar Data Interface, which gathers continuously preselected 3-D radar plot data (only primary radar plots, which are not correlated with secondary radar plots) and stores them into data files of 20 minutes duration.
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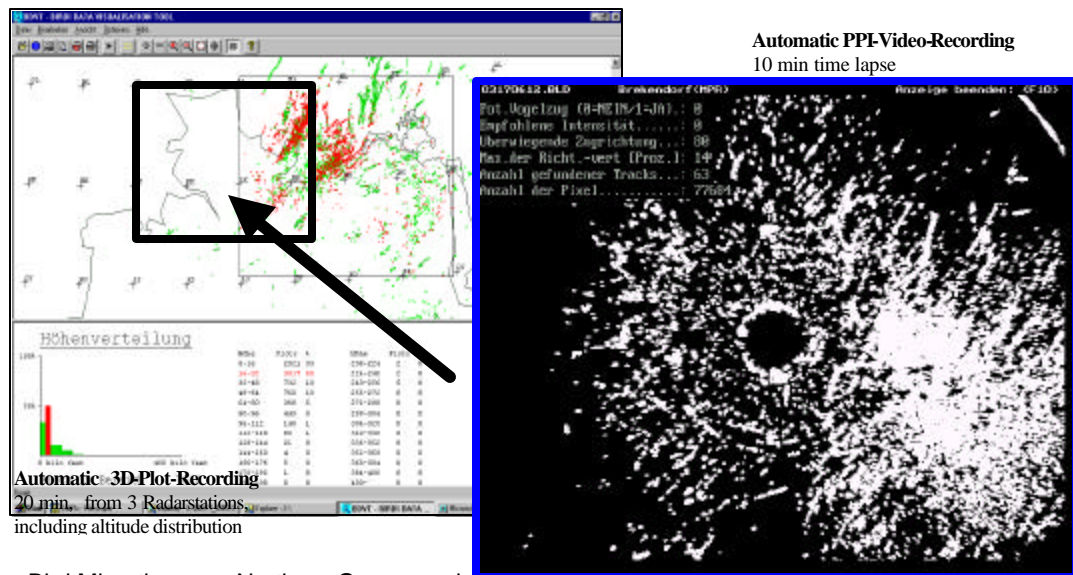


Fig. 1: Bird Migration over Northern Germany observed by video-Digitising and by BIRD-System on 17.03.1999 at ~06.15 UTC.
(Corr.: Altitude values are in hecto feet, instead of kilo feet)

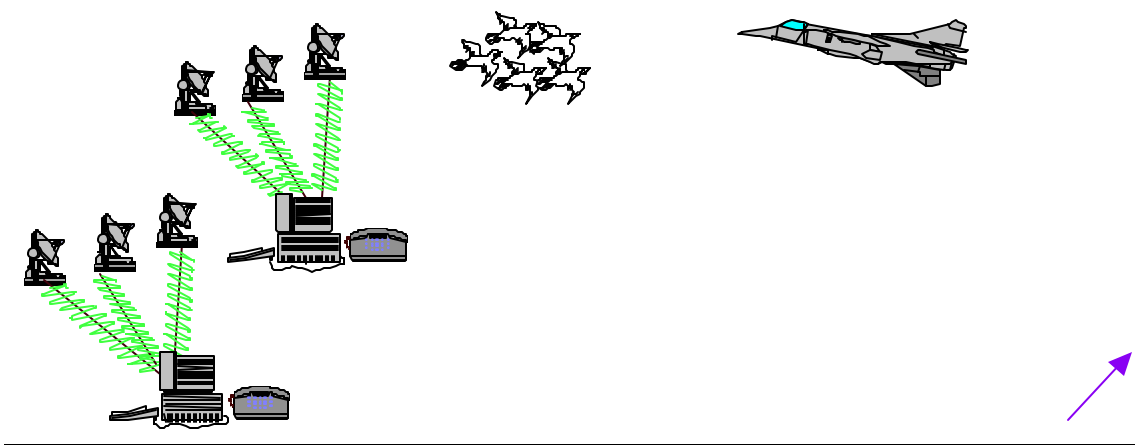
An example of the visualised bird migration data obtained by the video technique and the BIRD-System is shown in Figure 1. It displays the same situation, but slightly different observation areas. The advantage of the BIRD-System is obvious, especially concerning the altitude information. However the general information about bird migration and its intensity can well be extracted from the video image by an experienced radar controller.

Reporting and Message Transfer

Due to the close connection to the meteorological services, reports of visual bird migration observations and reports from CRCs are transmitted on the World Meteorological Global Telecommunication System (WMO-GTS). Additionally BIRD MIGRATION WARNINGS from neighbouring countries are received via Aeronautical Fixed Telecommunication Network (AFTN).

In the new AVIS-System the BIRD-System data are displayed in the CRC during recording. Complete data files are requested for and transferred, whenever necessary, via modem link and the MS-Remote Access System (RAS) within the Closed Military Telecommunication Network. Interpretation and message submission is no longer the task of the CRCs.

BIRDTAM-Messages are directly submitted in easily readable and handling ASCII-Format to the WMO-GTS and AFTN Systems. Everyone who has access to these systems is able to receive them world wide. GAF-Pilots during flight training get relevant BIRDTAM directly from their guiding CRC.



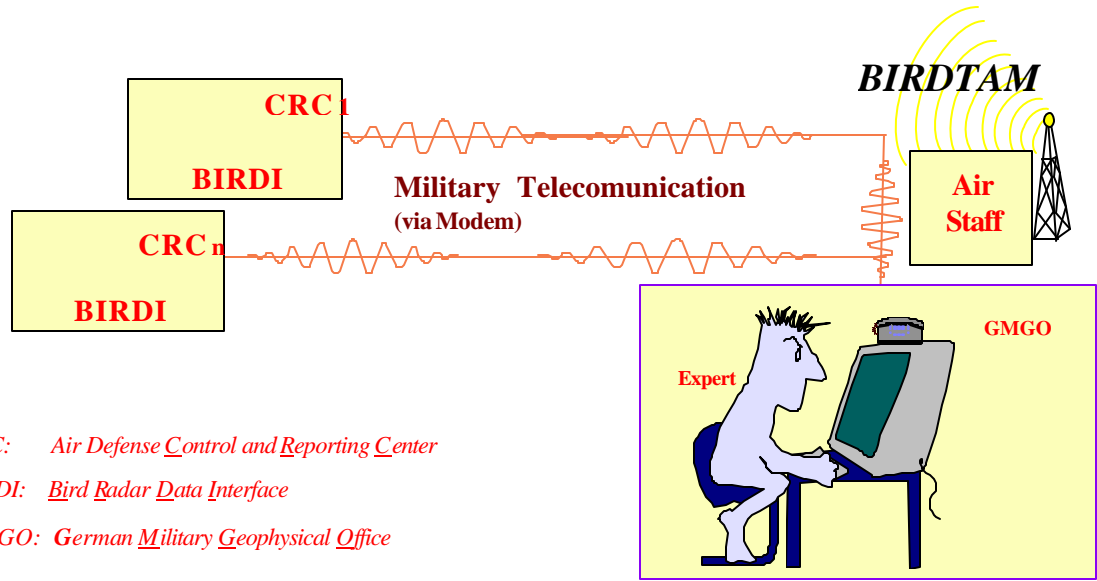


Fig. 2: Message Transfer within AVIS

Risk Evaluation and Warning

It is necessary that Bird Strike Warnings (BIRD TAM) have a standardized content and format to avoid confusion in national or international flight operations. For this reason the NATO Standardization Agreement STANAG 3879 has been ratified by 8 Air Forces.

In Germany data processing of all bird migration messages is centralised in the German Military Geophysical Office (GMGO) in Traben-Trarbach. All incoming bird migration messages and radar data are automatically processed by the GMGO-developed computer system for the evaluation and transmission of bird strike warnings (BIRD TAM), which is called „CoBiBe: Computerunterstuetzte Biologische Beratung (Automized Biological Support)“. The Server, on which the Software runs has a permanent data link to the WMO-GTS-Server. Foreign bird information is also routed into the System.

Each Message is automatically decoded. Those messages who are not following the message standards, are transferred to a computer screen in the Geophysical Forecast Center of the GMGO, where an assistant transfers it into readable format. As soon as the message has been recognised a BIRD TAM basic data set is formed and written into a data pool, which is emptied after fixed time intervals, usually 5 – 10 minutes. All incoming data are ranked according to importance and reliability. The gathering of data in selectable time intervals helps to reduce the number of BIRD TAM Messages without really losing actuality. All the data sets in the data pool are then internally plotted into a first warning situation matrix. An adjustment and smoothing algorithm is then used to form the complete BIRD TAM-Situation, so that already existing BIRD TAM-altitudes, void times and boundaries are adjusted.

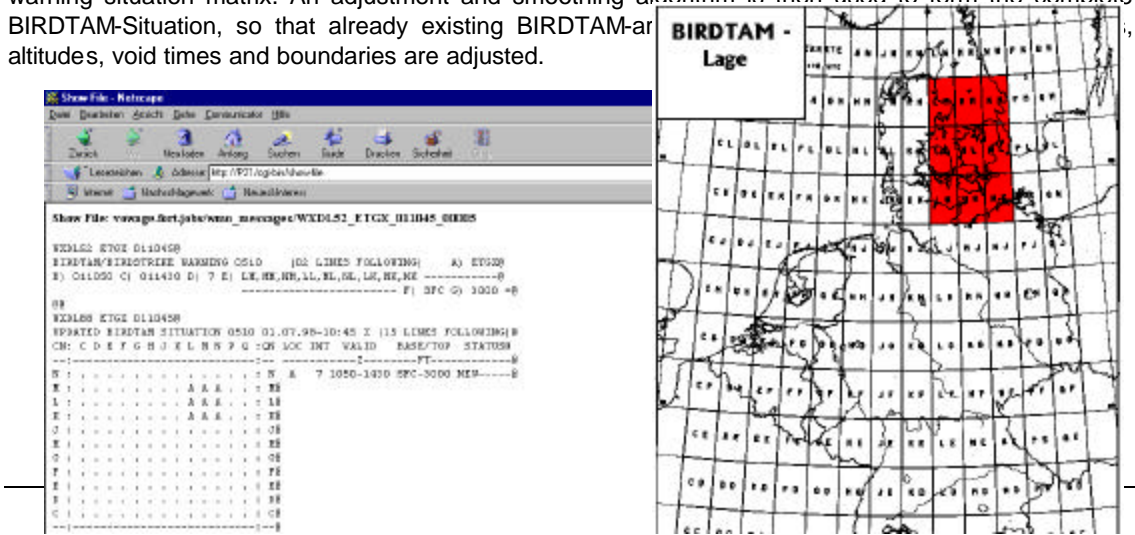


Fig. 3: Automatic BIRDTAM generating by COBIBE-System: Looking at a message file and graphical display of the corresponding actual BIRDTAM-situation.

The updated BIRDTAM-situation is displayed and transformed into different types of messages, which are automatically distributed in the above mentioned ways. This procedure makes sure that there are immediate and systematic reactions on actually observed bird concentrations aloft. BIRDTAM-messages are always transmitted in fixed format, so that display software converts the alphanumeric messages into graphical displays, according to the special needs of the users. The system is running permanently with low maintenance efforts.

A permanent controlling of the COBIBE-System is assured by using internet browser technology (HTML and JAVA-Script). From any computer in the GMGO-LAN there is a possibility for the staff of the biological branch and the forecast center to look into data files and watch the background processes.

Regulations

German Air Force Pilots have order not to enter or pass BIRDTAM areas and altitudes. As soon as a BIRDTAM is received, the pilot has to obey strict regulations, e.g.:

- (i) Fighter pilots are not allowed to pass through BIRDTAM areas of intensities 6 - 8.
- (ii) Only under certain safety conditions fighter pilots are allowed to fly through BIRDTAM-areas of intensities 4 and 5.
- (iii) Helicopter pilots have to use visors, when flying through BIRDTAM areas.

For the exact definition of warning areas it is essential that exact boundaries are defined, which is done by using the Geographic Reference System (GEOREF).

At every pilot's briefing the actual BIRD STRIKE RISK Forecast is presented and has to be taken into account in flight planning.

Bird Strike Risk Forecast

For planning and scheduling flight training and missions, every morning a Bird Strike Risk Forecast for a period of 24 hours and twice a week an outlook for the following 3 days on the basis of ornithological conditions and meteorological forecasts is evaluated and transmitted similar to BIRDTAM messages.

The evaluation algorithm is based on former statistical analysis of weather charts and polaroid radar PPI-Photos. A decision tree diagram is still used by the meteorological staff of the GMGO-Forecast Center. There are different algorithms for each season. Main input is the weather forecast for departing areas and crossing areas of migrating birds. Very important weather parameter are wind direction and wind speed (surface and aloft), temperatures, temperature changes and weather phenomena. During migrating seasons an update is given around noon with the additional information of observed bird migration taken into account.

Since there will be a much better data base on radar data, a new evaluation will be possible in future. Relevant meteorological data from numerical forecast models are archived already continuously in 3 hours intervals on a grid over central Europe. Maps of roosting places will be evaluated on a national scale by co-operation of professional and non-professional ornithologists.

Outlook towards an Automated Bird Information System

Recent developments towards an widely automated bird migration information system, which are going to be implemented area wide in 1999/2000, will use continuous three dimensional digital data from all air defense radar stations in Germany, collected by the BIRDI (Bird Radar Data Interface). In a first step the gathering of selected standard radar data and the central interpretation unit at the GMGO will be implemented. In a further step the quality of the data will be improved by using non filtered radar data.

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Detailed studies of bird migration, covering local and regional scales within a Geographic Information System, will then be possible. A first impression gives Figure 4., in which BIRDI-Data have been incorporated into ArcView GIS™ by decoding the originally binary data into ASCII and an altitude-time distribution of a selected bird track is displayed. Besides referenced geographical features like rivers, cities, roads, isohyets etc., maps of bird concentration areas and environmentally protected areas restricted against low level flights are incorporated in the system as well.

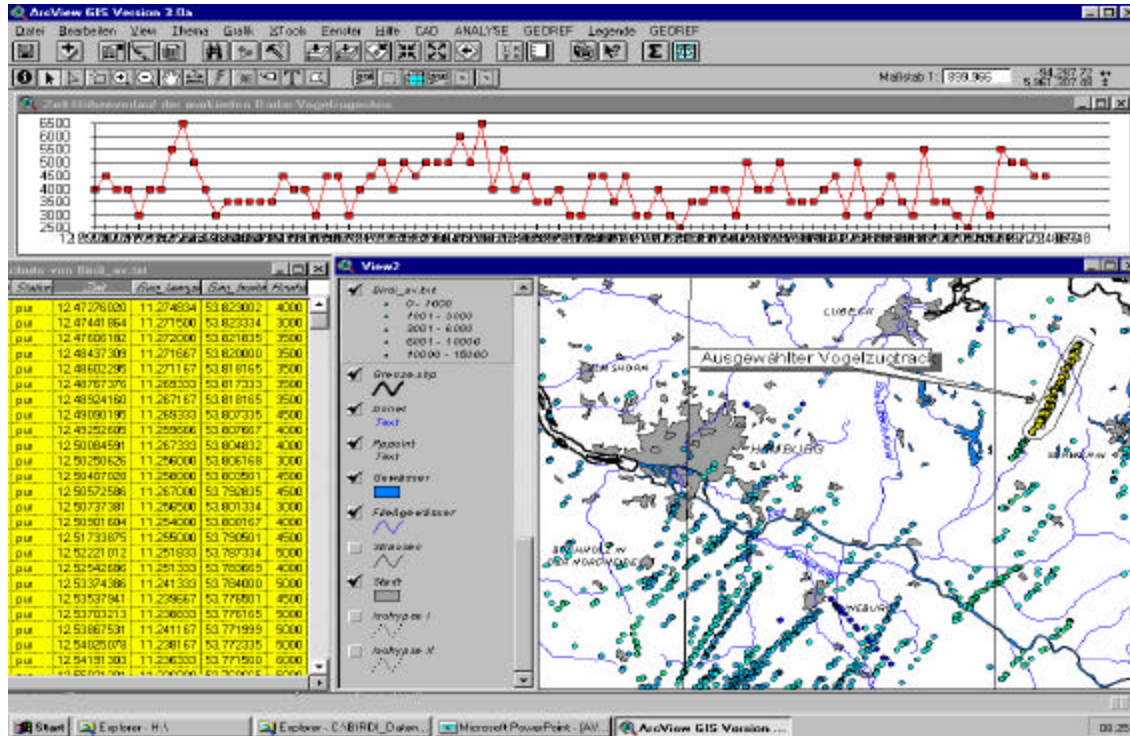


Fig. 4: Crane Migration over Northern Germany at the 18.11.98, analysed and presented in a GIS based Expert-System.

Above: Altitude distribution of bird echoes over 20 minutes.

Left: Corresponding data file.

Right: GIS presentation of bird tracks.

Selected results are easily transferred into HTML-pages, can be displayed by Internet Browser and directly published in intranets or on the world wide web.

So far separate modules will more and more become linked together to The Automated Bird Migration Information System "AVIS". However, it is not the intention to form a complete automatism, because such a complex system still needs the experts for interpretations and decisions.

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