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DIGITAL FEATHERS

Extension of BRIS with macroscopic feather characters

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Summary

Identification of bird remains is an important factor in the analysis of bird strikes. Once the bird species involved is known, aimed preventive measures can be taken to avoid repetition of such hazardous and costly events in the future. The European Centre for the Identification of Bird Remains at the University of Amsterdam, The Laboratory for Feather Remains Identification at Tel Aviv University, and ETI have bundled their knowledge on feather identification and information technology into the BRIS expert-system. BRIS is a computer assisted multimedia Bird Remains Identification System on CD-ROM and is available for both Windows and Macintosh. Research is currently carried out to develop BiFIS: Bird Feather Identification System, an identification system based on macroscopic feather characters, which will be integrated into BRIS. BRIS is constructed in such a way that it can be easily extended and updated with e.g. DNA, skeleton skulls, Geographic information. This way it can serve as a platform for specialists working in different fields related to the identification of bird remains. We propose an international network of specialists to expand BRIS.

Keywords: identification, feathers, microscopic, macroscopic, computerized, information.

Introduction

With growing numbers of airplanes in the air, more reliable information on the risks of bird strikes is needed. This type of information is highly dependent on data collecting and proper identification of bird remains after bird strikes. Once the species is known, preventive measures can be taken to avoid repetition of such hazardous and costly events in the future. Determination of the bird species involved, depends on the identification of pieces of feather, skin, and blood. The European Centre for the Identification of Bird Remains at the University of Amsterdam, The Laboratory for Feather Remains Identification at Tel Aviv University, and ETI have bundled their knowledge on feather identification and information technology into an expert-system called BRIS (Bird Remains Identification System) (fig. 1). This article deals with the current status of BRIS, and on the research on macroscopic feather characters which is currently carried out at the European Centre for the Identification of Bird Remains at the University of Amsterdam. Also, future BRIS related projects are announced and readers are invited to provide their comments and suggestions.

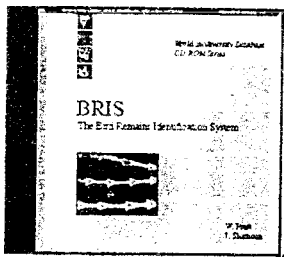

Figure 1: Cover of BRIS CD-ROM that can be used on both Windows and Macintosh computers.

BRIS: microscopic characters

BRIS is a computer based multimedia Bird Remains Identification System on CD ROM. It contains descriptive and pictorial information on the microscopic stricture of the downy part of body feathers for 200 bird species from Europe and the Middle cast. its image library contains a unique set of more than 1400 photographs of downy barbules. Photographs were taken at different magnifications and from preparations which were made using three different techniques of slide preparation: dry slides (Brom 1986), downy barbs embedded in Flo-Texx (Laybourne and Dove 1994), and SEM (Laybourne *et al.* 1992) (fig. 2). BRIS also contains a multiple entry identification key (Prast *et al* .1994) which is based on a character state matrix on the microscopic downy characters. In total 47 character states spread over 11 characters are used in the identification key (Prast *et al.* 1996). The identification key assists the user in the identification of the bird remains by giving the user a set of possible observation-based choices of characters. Selection of character states results in a measure of probability on the listed species. BRIS also contains general bird information on the 200 species (57 families, 21 orders), like habitus pictures, information on ecology, interactive distribution maps, a glossary, and bird sounds. BRIS was developed to preserve the knowledge on feathers and to make knowledge on feathers accessible to more people interested. BRIS is based on ETI's Linnaeus 11 software (Schalk and Los 1994).

BRIS is the result of fruitful cooperation between different parties: The European Centre for the identification of Bird Remains at the University of Amsterdam, the Laboratory for Feather Remains Identification at Tel Aviv University, ETI, the Society for the Protection of Nature in Israel, the Royal Netherlands Air Force, and the Israel Air Force. BRIS is available for both Windows and Macintosh.

Macroscopic feather characters

For identification to the lowest taxonomic level possible, it is best to combine all the different pieces of information one can find; circumstantial evidence, like location and time of year of the bird strike, and most important both microscopic and macroscopic characters in the bird remain. With the combination of macroscopic and microscopic identification one can often reach species level (Prast and Shamoun 1997). Identification is generally carried out in two steps. Recognition of microscopic characters in the downy feather part is the first step. In most cases this will determine the family, order, or group of species from which the bird remain originates. In the second step

macroscopic characters in the remains are compared with the skin collection to determine the species from which the bird remain originates. This second step is only possible when sufficient material has been recovered.

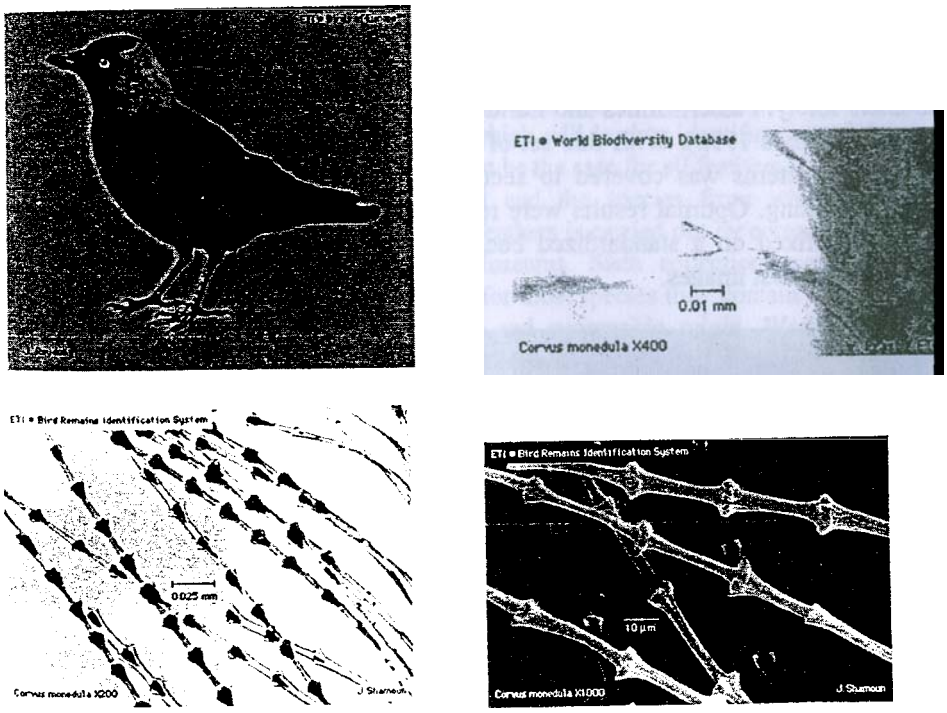

Figure 2: Habitus picture and microscopic photographs of the Eurasian Jackdaw (Corvus monedula) in BRIS. Microscopic photographs were made using different techniques of slide preparation and magnifications.

BiFIS

A bird's skin hosts very high numbers of feathers, depending on its size. Among European species this varies from, 1500 feathers for the Swallow *(Hirundo rustica)* (fig. 3) till 25000 for the Tundra Swan *(Cygnus columbianus bewickii)* (Brown et al 1987). Besides this, in many cases a bird has a winter- and summer plumage, a juvenile- and adult plumage, and a male- and female plumage. Combined with the knowledge that a bird's plumage also varies individually and regionally, it will be clear that it is ruled out to develop an expert-system for all feathers of the 200 BRIS species. Decisions had to be made on which types of feathers should be included in BiFIS, and which species should be concentrated on at this stage. Also, several techniques in the image processing had to be tested.

Types of feathers chosen in BiFIS, are listed in table 1. Flight feathers and coverts are included since they are the most species specific. Breast and head feathers are included because they are often recovered after bird strikes. The species included in the first version of BiFIS are listed in table 2. Included are species which are often found in bird remains sent to The European Centre for the Identification of Bird Remains after bird strikes, Also, a number of Passeriformes and Laridae is included, since these groups are difficult to identify till species level based on microscopic characters solely. Passeriformes and Laridea are also often identified after bird strikes worldwide (Pinos 1992). With this set of species a wide range of feather structures, colors, and patterns was covered to= secure proper testing of different methods in image processing. Optimal results were reached with the direct scanning of feathers, which were fixed on a standardized background. Using a high resolution scanner resulted in the best images.

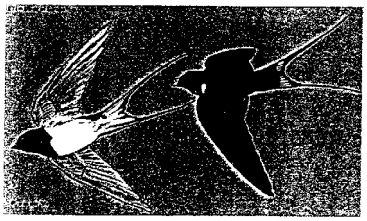

Figure 3: The skin for a relatively small bird like this Swallow (Hirundo rustica) hosts approximately 1500 feathers (Brown 1987).

BiFIS was initiated to organize the information on macroscopic feather characters into a multimedia expert-system in order to support identifications and make this knowledge available to more people interested. BiFIS stands for Bird Feather Identification System, an identification system based on the macroscopic feather characters. Eventually, BiFIS will be implemented into BRIS. Integration of microscopic and macroscopic information will lead to a higher resolution and a broader use of the identification system.

Feather Types
-flight-feathers wing
-flight-feathers tail
-upper win, coverts
-under win, coverts
-upper tail-coverts
-under tail-coverts
-head feathers
-breast feathers

Table l: Tines of feathers selected for research for the first version of BiFIS.

Identification System based on macroscopic characters

Data on macroscopic feather characters are currently being collected for the development of an identification system. The success of the identification based on macroscopic characters is highly dependent of the amount, the quality and the type of the material in the bird remains. Two extremes: a whole and fresh bird skin on the one hand and only one loose feather on the other. In the first case, this identification should give information on the species, and even on male/female, age, and moult. In the second case, even in this one loose feather many characters may be found which give an indication of the type of bird which will lead to identification of the species (Busching 1997). This, however, will not be the case for all feathers, depending on the type of feather which was recovered and the species from which this feather originates. Until now, identification of feathers is carried out by comparison with bird skins of collections of Zoological Museums. Such collections provide the best guarantee for proper comparison since for most species they contain enough skins to cover variation in season, genus, age, and geographic origin. Working with such collections also guarantees that identifications are based on the whole looks of a bird before concentrating on one feather only, which may lead to confusion. However, these collections are not readily available to everybody. An information system on the macroscopic feather characters is a step in opening up these collections to more people interested, The information system will also contain general information on birds and their plumage, so that users will be well informed. The identification system \x ill be based on the following basic characters: size, shape, structure, pattern, colors. Since most of these characters are recognized visually, the identification process will fully benefit from the multimedia possibilities of ETI's Linnaeus II software.

Common Buzzard - Buteo *buteo* Common	Pied Wagtail - Motacilla *alba*
Kestrel - *Falco tinnunculus* Northern	Blackbird - *Turdus merula*
Lapwing - *Vanellus vanellus*	Song Thrush - *Turdus philomelos*
Black- headed Gull - *Larus ridibundus*	Redwing - *Turdus iliacus*
Common Gull - *Larus canus*	Fieldfare - *Turdus pilaris*
Lesser Black-backed Gull - *Larus fuscus*	Eurasian Jay - *Garrulus glandarius*
Herring Gull - *Larus argentatus*	Eurasian Jackdaw - *Corvus monedula*
Great Black-backed Gull - *Larus marinus*	Carrion Crow - *Corvus corone*
Rock Dove - *Columba livia*	Common Starting - *Sturnus vulgaris*
Wood Pigeon - *Columba palumbus*	House Sparrow - *Passer domestocis*
Common Swift – *Apus apus*	Tree Sparrow – *Passer mountanus*

Sky Lark - *Alauda arvensis*	Chaffinch - *Fringilla coelebs*
Sand Martin - *Riparia riparia*	Greenfinch - *Carduelis chloris*
Barn Swallow - *Hirundo rustica*	Goldfinch - *Carduelis carduelis*
House Martin - *Delichon urbica*	Linnet - *Carduelis cannabina*
Meadow Pipit - *Anthus pratensis*	Siskin - *Curduelis spinus*

Table 2: List of species which will be included in the first version of BiFIS.

International network of experts

ETI is the developer of Linnaeus II software on which BRIS is based. ETI is a NGO in operational relation with UNESCO and works with networks of scientists all over the world. BRIS is constructed in an `open' way, it can be expanded with more species and characters, and to other types of information, like macroscopical feather characters, DNA, skeleton skulls, geographical or ecological information, migration routes, etc. Work on macroscopical feather characters has already started and projects on bird mobility (BiMIS: Bird Mobility Information System) and DNA (BiDID: Bird DNA Identification Database) are expected to start in the near future. The combination of different data sets will further enhance the system and its usefulness. Also, once ¯*information is included into the system, it can be easily updated. Building and updating such a highly specialized system at its high quality level, is a job of specialists and should be based upon international cooperation and data exchange. We invite other experts to join an international network for collaboration to integrate different types of information relevant, and to cover more taxa and areas.

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