Bird Remains Identification System (BRIS) - from a Bi-national to a Global Database

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Abstract
Since the beginning of the century downy barbules of feathers were found to have diagnostic characteristics that can be used to identify birds. Following collisions between birds and aircraft, small feather fragments are usually the only evidence that a bird was involved in the incident. One of the essential steps in reducing the hazard of bird strikes is properly identifying which species are involved and pose a higher risk to aviation.

The Bird Remains Identification System (BRIS) is an interactive multimedia program on CD-ROM for identifying feather remains. It is an innovative tool designed as part of joint project between Tel Aviv University, Amsterdam University, The Royal Netherlands Air Force, The Israel Air Force and the Society for the Protection of Nature in Israel. BRIS serves two main purposes: (1) it provides a reference database of feather microstructure images and descriptions for 200 palearctic species (2) it serves as an interactive identification system. The system also includes Geographic Information System (GIS) based distribution maps, as well as other tools. This system can also be used for ecological studies of predator feeding habits, forensic work and as an educational tool.

International cooperation played an integral role in the development of this system. BRIS's design makes it easy to expand to include more information such as the macroscopic characters of feather, or DNA fingerprints, as well as expanding the species list. Joining efforts to expand such a system can benefit air forces by saving them both time and money.

Introduction
Chandler (1916) was one of the first researchers to show that the microscopic structure of feathers has diagnostic characteristics that can be used to identify birds. Bird strike statistics are an important tool for understanding and reducing bird strike hazards around the world. Therefore, one of the first steps in reducing the hazard of bird strikes should be to obtain reliable statistics by properly identifying which species are involved and pose a higher risk to aviation.

Following collisions between birds and aircraft, whether military or civilian, several techniques are available to identify birds involved in aircraft collisions. The simplest technique is unaided visual identification of bird remains found on runways during routine runway sweeps (Linnell et al. 1996). Other techniques requiring expertise and laboratory assistance
include microscopic examination of downy barbules of feathers (Shamoun & Yom-Tov 1996, Laybourne & Dove 1994, Laybourne et. al. 1992, Brom 1991), electrophoretic identification (Ouellet 1994), and DNA examination (Hermans et. al. 1996). Each technique has its drawbacks and benefits (Brom 1992). One of the main advantages of expertise identification of bird remains is that they should sample a larger proportion of the birds involved in collisions and give a more reliable representation of the bird hazard. The Bird Remains Identification System (BRIS) is an interactive multimedia program on CD-ROM that was developed as a tool to assist in identifying feather remains from 200 species of birds from Europe and the Middle East. The design and use of this system is described in this paper.

**Materials and Methods**

**Bird Remains Identification System**

The Bird Remains Identification System (BRIS) is an innovative tool designed as part of joint project between Tel Aviv University, University of Amsterdam, The Royal Netherlands Air Force, The Israeli Air Force and the Society for the Protection of Nature in Israel. The software was developed by the Expert Center for Taxonomic Identification (ETI) in Amsterdam. BRIS serves two main purposes: (1) It provides a reference database of feather microstructure images and descriptions for 200 palearctic species (2) It serves as an interactive identification system. The system is based on ETI's Linnaeus II software and designed for both Windows and Macintosh platforms (Prast et al. 1996). The program is user-friendly with all components accessible through the Navigator and hyperlinked (figure 1). The reference database in BRIS includes the microscopic structure of downy barbules of feathers examined under both light and scanning electron microscope (Laybourne & Dove 1994). The database contains photographs of the feather microstructures as well as textual descriptions of the feather structure and the species biology and ecology, an illustration of the bird as well as the bird's call. In addition to the expert identification system, “IdentifyIt”, BRIS also includes “MapIt”, a Geographic Information System providing distribution maps for each of the 200 species, as well as a glossary, an introduction with a short explanation on materials and methods, bird strike statistics, a reference section, and other tools.

**Israel Air Force Bird Remains Identification**

Since 1991, the Israel Air Force has conducted systematic identification of feather remains. Feather remains are collected at Israeli Air Force bases and sent to the Laboratory for Feather Remains Identification at Tel Aviv University, where they are identified by a combination of microscopic examination of downy barbules (figure 2) and macroscopic comparison with bird skins at the Tel Aviv University Zoological Museum. Feather remains are received along with relevant bird strike data such as time, altitude, area of birdstrike, and level of damage.
Above: Judy Shamoun-Baranes, who is in charge of the Feather Remains Identification Laboratory, examining the remains of a feather with the help of a computer program developed jointly with Holland (Photo: Lior Rubin).

Below: The CD-ROM, with 200 common birds mapped from Europe and the Middle East, allows relatively rapid identification of feather remains in case of accidents.
Above: This scanning electron microscope photo of a Long-eared Owl feather enlarged 1000 times was prepared at the Feather Identification Laboratory run jointly by the Israel Air Force, the Society for the Protection of Nature in Israel and Tel Aviv University, in cooperation with the Royal Netherlands Air Force and Amsterdam University, ETI (Photo: Professor Tsvi Malik)

Below: September 7, 1997: an F-16 crashed over the Ramon Crater, Negev, Israel, because of a Honey Buzzard which penetrated the canopy, hit the face of the pilot in the back seat. The pilot bailed out and the one in the front seat was badly wounded and lost his leg. These are the remains of the canopy with small feather remains, which was identified by Judy Shamoun-Barenes. (Photo: courtesy IAF)
The techniques used to develop the BRIS database have been used successfully for feather identification in the Israel Air Force since the early 1990's. However, bird remains are occasionally identified on the airfields by the bird control units or by the pilots during flight, without being sent to the laboratory for verification. Following, is a short description of the birdstrike statistics for 1991-1997, comparing the results of feather remains identification by Bird Control Units and air crew, not verified by laboratory examination, to a summary of all feather remains identified, combining laboratory as well as field analysis. A combination of field and laboratory identification should provide the most accurate assessment of the species involved in all bird strikes, as well as sample a larger proportion of the bird strikes. Remains were identified for a total of 527 bird strikes, 144 of which were identified in the field without laboratory analysis.

Results and Conclusions

Only 18 species were identified in the field compared to 90 species identified when combining field and laboratory analysis. When analyzing the various orders involved in birdstrikes (figure 3), several interesting trends are apparent. Only 18% of the birdstrikes identified in the field were caused by passerines (Passeriformes), compared to 33% identified by both methods. A similar trend was seen with the swifts (Apus sp.), 2.8% of the bird strikes were identified as swifts in the field, compared to 10% by both methods combined. This same increase in proportion of passerines and swifts using a combination of microscopic and macroscopic identification was also shown by Brom (1992) for north-western Europe.

Figure 3: Percent of avian orders involved in bird strikes identified by various methods 1991-1997: (A) in the field (n=144) and (B) in the laboratory and/or field (n=527)
Charadriiformes, Galliformes and Columbiformes were all overestimated by field identification. These groups are overestimated because they include the species commonly found on air force bases which are easily identifiable by untrained personnel, such as, Spur-winged Plovers (Vanellus spinosus) and Stone Curlews (Burhinus oedicnemus), Chukars (Alectoris chukar), pigeons and doves (Table 1) as well as Cattle Egrets (Bubulcus ibis) and Hooded Crows (Corvus corone). White Storks (Ciconia ciconia) are also overestimated, one of the reasons being that pilots often report strikes with White Storks during migration, often without having feather remains collected.

Table 1: Percentages of the most common birds involved in birdstrikes from 1991-1997 according to field identification compared to a combination of field and laboratory identification.

<table>
<thead>
<tr>
<th>Species</th>
<th>Percent of birdstrikes identified in the field (n=144)</th>
<th>Percent of birdstrikes identified in the field and/or laboratory (n=527)</th>
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</thead>
<tbody>
<tr>
<td>Stone Curlew (Burhinus oedicnemus)</td>
<td>11.1</td>
<td>9.1</td>
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<tr>
<td>Rock Dove (Columba livia)</td>
<td>16.0</td>
<td>7.4</td>
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<tr>
<td>Swift (Apus apus) and Alpine Swift (A. melba)</td>
<td>0.7</td>
<td>6.7</td>
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<tr>
<td>Chukar (Alectoris chukar)</td>
<td>11.8</td>
<td>5.1</td>
</tr>
<tr>
<td>Skylark (Alauda arvensis)</td>
<td>5.6</td>
<td>5.1</td>
</tr>
<tr>
<td>White Stork (Ciconia ciconia)</td>
<td>7.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Spur-winged Plover (Vanellus spinosus)</td>
<td>6.91</td>
<td>3.2</td>
</tr>
<tr>
<td>Kestrel (Falco tinnunculus)</td>
<td>6.3</td>
<td>3.2</td>
</tr>
<tr>
<td>Hooded Crow (Corvus corone cornix)</td>
<td>6.3</td>
<td>2.5</td>
</tr>
<tr>
<td>Cattle Egret (Bubulcus ibis)</td>
<td>4.2</td>
<td>1.5</td>
</tr>
<tr>
<td>Black Headed Gull (Larus ridibundus)</td>
<td>2.8</td>
<td>1.3</td>
</tr>
<tr>
<td>House Sparrow (Passer domesticus)</td>
<td>2.8</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Only 14% of the strikes involved birds weighing up to 100 g, according to field identifications, compared to 45% when both methods are combined (Figure 4). The proportion of smaller birds (weighing up to 100g) involved in birdstrikes are underestimated when only identified in the field, because minute feather remains cannot be identified in the field. The birds themselves are often harder to identify and probably harder to find on runway sweeps. Birds weighing 100-1000g are overestimated in the field. These mass classes include most of the common species found on bases.

Assuring the quality of feather identification is essential when using birdstrike statistics.
to develop bird hazard avoidance techniques. For this reason, identifications made by pilots and untrained staff should be used with caution if at all, and feather remains should be sent to someone trained in the field. Efforts are constantly being made to improve the level of bird-remains collection, identification, and reporting in order to receive sound statistics for further analysis and decision making.

BRIS is a unique, user-friendly system now commercially available, which provides both theoretical background information and a detailed database for identifying feather remains of birds from Europe and the Middle East. The system is particularly useful for people interested in entering the field but do not have access to reference collections of bird skins and/or funds for setting up a large database for microscopic feather structure comparison. BRIS does not eliminate the need for expertise in the field of feather identification, but is intended to be used as a tool to facilitate the learning process. This system can also be used for ecological studies of predator feeding habits, forensic work, and as an educational tool. This reference system is being expanded to include other techniques of identification as well as providing other sources of data important for bird hazard reduction (Prast et al. 1998). Expansion of the BRIS to include new techniques and additional species depends on international cooperation and any parties interested in expanding the system are invited to contact the author.

Figure 4: Mass classes (in grams) of birds identified by various methods 1991-1997: (A) in the field (n=144) and (B) in the laboratory and/or field (n=527)
References


