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Identification of bird remains for bird strike analysis: a literature synopsis.

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INTRODUCTION

At the meeting of the Analysis Working Group during BSCE 17 in Rome, discussions of the work on the analysis of feather remains showed that there was a need for the formation of a sub-group to deal with this specialised area. The main goal of this sub-group is to pursue the work on the identification of bird remains, with emphasis on the microscopic structure of feather remains.

This paper intends to provide an introduction to relevant literature (including abstracts) in order to make knowledge and techniques for the identification of bird remains more accessible for those who are interested in this field of research and who wish to refine their identification methods.

Publications featuring the research on identification of bird remains can be roughly summarized into five categories:

1) Papers dealing with basic research of feathers.
2) Papers denoting the need for proper identification of bird remains.
3) Papers using the results of microscopic identification of feather remains.
4) Papers on identification methods for complete bird bodies or big parts, such as bills, feet, wings, tail and skeletal.
5) Papers on biochemical identification methods for blood, amino-acids, etc.

LITERATURE SYNOPSIS

1. Papers dealing with basic research of feathers

Brom, T.G. & L.S. Buurma 1979. The quality of identification: a microscopic key to the determination of feather-remains. 14th Meeting BSCE (The Hague), working paper 19: 1-6

Principles of identifying feathers by studying the microstructure of downy barbules are explained (and were illustrated with slides during the meeting) and the influence of careful analysis on bird strike statistics is briefly discussed.

Brom, T.G. 1980. Microscopic identification of feather remains after collisions between birds and aircraft (Amsterdam): 1-89 (out of print)

A reference collection of more than two thousand feather preparations (a number of which are presented as photographs), from some 350 species of birds was made. Microscopic examination reveals taxonomic differences in the structure of downy barbules relating to number of prongs, number, shape, position and size of nodes. An identification key is compiled which can be used for bird strike analysis.

Brom, T.G. 1986. Microscopic identification of feathers and feather fragments of palearctic birds. Bijdr. Dierk. 56 (2) (in press)

An updated version of the report mentioned above (with 48 photographs).

Chandler, A.C. 1916. A study of the structure of feathers, with reference to their taxonomic significance. Univ. Cal. Publs. Zool. 13: 243-446

An extensive study of the structure of pennaceous feathers of North American birds that reveals large differences between different groups of birds. From a few species also the downy barbules were studied and evidence is provided that the structure of these barbules is of diagnostic value.

Day, M.G. 1966. Identification of hair and feather remains in the gut and faeces of stoats and weasels. J. Zool. 148: 201-217.

Qualitative analysis of prey remains collected from small carnivores depends on being able to identify feather (and hair) fragments. Feather identification is based on the structural variations to the downy barbules of feathers. A key to the main bird orders is devised.

Laybourne, R.C. 1984. Identification of bird remains from bird-aircraft incidents by the microstructure of the downy part of the feather. Proc. 17th Meeting BSCE (Rome): 282-286.

The principles of identifying feathers by studying the microstructure of downy barbules are explained (and were illustrated with slides during the meeting).

Laybourne, R.C. 1986. The variation of the nodal structures on downy barbules of some species of birds. This BSCE Meeting.

Slides of scanning electron microscope (SEM) photographs were presented illustrating the variation of nodal structures in Wood Pigeon, American Kestrel, Gyrfalcon, Double-crested Cormorant, Mute Swan, Whistling Swan, Greylag Goose, Brant, Mallard, Pied-billed Grebe, and Northern Oriole.

Robertson, J., C. Harkin & J. Govan 1984. The identification of bird feathers. Scheme for feather identification. J. forensic Sci. Soc. 24: 85-98.

The structure of downy barbules is reviewed. Features of the feathers are selected giving discrimination at order level. Quantitative data are presented.

2. Papers denoting the need for proper identification of bird remains.

Brom, T.G. & L.S. Buurma 1981. Microscopische herkenning van veerresten: hulpmiddel bij de analyse van aanvaringen tussen vliegtuigen en vogels. Het Vogeljaar 29 (1): 9-17.

The effect of microscopic identification of feather remains on RNLAF bird strike statistics is described. Photographs of bird remains and feather preparations are included (in Dutch).

Brom, T.G. 1984. Microscopic identification of feathers in order to improve birdstrike statistics. Proc. Conf. Wildlife Hazards to Aircraft (Charleston, S.C.), report no. DOT/FAA/AAS/84-1: 107-120.

The influence of microscopic feather identification on RNLAF bird strike statistics is demonstrated by comparing identification results obtained by the macroscopic method of comparing feathers with bird skins, with those obtained by the microscopic investigation of feathers. Identification results from 1960-1977 are compared with those from 1978-1983, and the effect of the introduction of the identification key on bird strike statistics is discussed.

Buurma, L.S. & T.G. Brom 1979. The quality of identification: its effects on birdstrike statistics. 14th Meeting BSCE (The Hague), working paper 20: 1-8.

The risk of overrepresentation in bird strike statistics of easily recognizable birds (e.g. big and white ones) and more or less intact bird corpses (that can be collected easily) is evaluated. The study of the microstructure of feathers as a method to avoid this type of bias in bird strike analysis is discussed.

Buurma, L.S. & T.G. Brom 1980. Harde feiten over zachte veren. Veilig Vliegen 27 (1); 9-13 (this article also appeared in Technisch Informatie Programma (KLM) 9 (92): 14-16).

The effect of microscopic identification of feather remains on RNLAF bird strike statistics is described (in Dutch).

Buurma, L.S. 1982. Birdweight and aircraftspeed in birdstrike statistics. 16th Meeting BSCE (Moscow), working paper 17: 1-6.

Microscopic analysis of even the smallest and most distorted feather remains highly improved RNLAF bird strike statistics. Some types of bias as over-representation of 'airfield bird species' and under-representation of small birds struck 'en route' are discussed.

Buurma, L.S. 1983. Increasing birdstrike rates and improved birdstrike analysis of the Royal Netherlands Air Force. Paper presented at the Conference on Aerospace Transparent Materials and Enclosures (Scottsdale, Ar.): 1-25.

The primary aim of this paper is to show why bird strike statistics to a varying extent fail to produce a realistic picture of the bird strike risk. Several types of bias are described. Problems can be reduced by improving reporting standard and by taking microscopic examination of miniscule bird remains as a routine procedure.

Thompson, M.M., R.P. DeFusco & T.J. Will 1986. U.S. Air Force bird strikes. This BSCE Meeting, working paper 8, 11 pp.

The importance of positively identifying birds which are involved in collisions with aircraft cannot be overemphasized, because only then can realistic reduction measures be taken. In the past few years, increased emphasis on post-strike feather identification has provided a much more accurate picture of which birds to concentrate control efforts on.

3 Papers using the results of microscopic identification of feather remains.

Buurma, L.S., A. Dekker & T.G. Brom 1984. On the spatial and temporal distribution of bird species involved in RNLAF bird strikes. Proc. 17th Meeting BSCE (Rome): 212-226.

Results of the analysis of RNLAF bird strikes are summarised, with special reference to the temporal and spatial variation in the contribution of different bird categories and species. Proper identification procedures, to start with microscopic examination of feather remains, appears to be a prime prerequisite. Especially the seasonal fluctuations of ratios examplified for collisions "above airbases" and "en route" respectively show how many details can be extracted from a relatively small data base.

Davies, A. 1970. Micromorphology of feathers using the scanning electron microscope. J. forensic Sci. Soc. 10 (3): 165-174.

An account of the work done as a result of a case of bird larceny being brought to the Metropolitan Police Forensic Science Laboratory.

Deedrick, D.W. & J.P. Mullery 1981. Feathers are not lightweight evidence. FBI Law Enforcement Bulletin (September 1981): 22-23.

Microscopic feather identification as forensic tool. Feather-related examinations are made in cases of rape, homicide, burglary, bird strikes, and even a hoax bombing.

Gilbert, F.F. & E.G. Nancekivell 1982. Food habits of mink (Mustela vison) and otter (Lutra canadensis) in northeastern Alberta. Can. J. Zool. 60: 1282-1288.

Scats of mink and otter were studied. Feather remains were identified using Chandler (1916) and a reference collection.

Hargrave, L.L. 1965. Identification of feather fragments by microstudies. American Antiquity 31 (2): 202-205.

One investigator, trained in the technique of feather identification, was tested intensively to determine the accuracy of his identifications.

Messinger, N.G. 1965. Methods used for identification of feather remains from Wetherill Mesa. American Antiquity 31 (2): 206-215.

Feathers provided by archaeologists were examined under a microscope. Trial-and-error comparisons were made until the characters of the unknown species matched those of a known species.

Olsen, A.R. 1981. Distinguishing common food-contaminating bat hairs from certain feather barbules. J. Assoc. Off. Anal. Chem. 64 (4): 786-791.

In order to analyse food samples, differences are described between bat hairs and similar-appearing downy barbules of passeriform birds. Feather identification mainly based on the work of Day (1966).

4. Papers on identification methods for complete bird bodies or big parts, such as bills, feet, wings, tail and skeletal.

Besides the many ornithological handbooks and field guides available, the following study is of particular interest:

Hansen, W & H. Oelke 1973-1983. Bestimmungsbuch fur Rupfungen und Mauserfedern. Beitr. Naturk. Niedersachsens 26 (1973): 25-51, 27 (1974): 2-54, 29 (1976): 85-160, 31 (1978) 53-128, 36 (1983) 1-52

Extensive study on measurements and patterns of tail-feathers of European birds (with many illustrations) (in German).

5. Papers on biochemical identification methods for blood, amino-acids, etc.

Bont, A. de, J.F. Boomans, P. de Raeve, E. Hoet & B. Verachtert 1986. Strategies for the identification of bird remains from birdstrikes. Survey and advanced approach by biochemical analysis of tissues. This BSCE Meeting, working paper 12, 10 pp.

Several biochemical techniques for analyzing bird strike remains are discussed (with their main advantages and drawbacks): thin layer/paperchromatography, gas chromatography, electrophoresis, SDS electrophoresis, isoelectric focusing, and immunological methods. Although none of these methods can be applied in bird strike analysis as a routine, the most promising seem electrophoresis techniques.

LaHam, Q.N. 1967. Report on aircraft turbine engine birdstrike investigations. National Research Council of Canada, Associate Committee on bird hazards to aircraft, Field Note 43: 1-27

Microscopic investigation of scrapings collected from engines combined with the use of amino-acid analysis of protein residues leads to the diagnosis of bird strikes. In this way, defective engines rapidly can be separated into those due to bird strikes and those due to mechanical failure.