Science and Justice 55 (2015) 90–96

Contents lists available at ScienceDirect

Science and Justice

journal homepage: www.elsevier.com/locate/scijus

An investigation into the detection of latent marks on the feathers and eggs of birds of prey

Helen McMorris, Kevin Farrugia, Dennis Gentles *

School of Science, Engineering & Technology, Division of Computing and Forensic Sciences, Abertay University, Dundee DD1 1HG, UK

ARTICLE INFO

Article history:
Received 19 August 2014
Received in revised form 25 November 2014
Accepted 10 December 2014

Keywords:
Fingermark
Enhancement
Magnetic powders
Fluorescence
Feathers
Eggs

ABSTRACT

There are numerous enhancement techniques (physical and chemical) which have been developed for the successful visualisation of latent fingermarks. Nonetheless, problems arise when latent fingermarks require enhancement on difficult surfaces such as human skin, food stuffs, fabric and animals. The ability to develop latent fingermarks on the surface of bird of prey feathers and that of their eggs was investigated. Red and green magnetic fluorescent powders proved to be most suitable on the surface of bird of prey feathers whereas black magnetic powder was the most suitable technique on the eggs. These powders produced the highest quality of visible ridge-detailed developments over a controlled period of time.

1. Introduction

The Royal Society for the Protection of Birds (RSPB) reports that since 1989, in Scotland alone, there have been over 500 birds of prey killed by illegal poisoning with a further 340 confirmed as shot, trapped or with their nests destroyed [1]. Wildlife crime may be defined as, "the buying, selling, harming or disturbing of wild animals or plants that are protected by law," and at the beginning of 2012 the poisoning, trapping and illegal shooting of protected wildlife were thought to be more widespread than it has ever been in the past 50 years [2]. In the same year and region, there were 25 reported incidents of egg collecting and egg thefts, and seven reports of eggs being sold [1]. Illegal egg collection is now a well-equipped activity with the nest disturbers being in possession of all the necessary outdoor clothing and climbing gear needed to reach the more highly sought after eggs.

Fingermarks may be recovered from numerous crime scenes and can still provide a categorical conclusion rather than one based on probability for evidence such as DNA or fibre analysis and are now being researched as the main method by which this vital wildlife crime to suspect link can be forged [3]. Additionally, the Home Office Centre for Applied Science and Technology (CAST) reports that despite some public perceptions that fingermarks have mostly been superseded by DNA, fingermarks still account for appreciably more identifications overall and show no sign of being phased from use [4]. The surface onto which a fingermark has been deposited will ultimately determine the enhancement technique selected to develop that mark, in particular its porosity; however the condition and/or composition of the latent fingermark itself and the level of contamination present within the deposition, if any, are also contributing factors. Recent research endeavours in latent mark detection on difficult surfaces include human skins [5–7], food stuffs [8–10], fabric [11] and animals [12–14]. Cyanoacrylate fuming and powdering techniques have been reported as potential enhancement techniques for deer antlers, elephant tusks and live reptiles [12–14].

With the killing of wild animals equating to big business for poachers, wildlife DNA analysis is currently popular for the characterisation of different species [15–17]; however the use of fingermark enhancement in the investigation of wildlife crime appears to be limited. The microscopic weave structure of a feather has been likened to that of fine weave fabrics such as nylon, upon which it is may be possible to develop grab marks using vacuum metal deposition and touch DNA profiling. The main aim of this study was to investigate a range of latent fingermark development techniques for the development of latent fingermarks on specific bird of prey feathers and eggs.

2. Materials and methods

2.1. Sample preparation

A total of six species of bird of prey feathers (kestrel, sparrowhawk, buzzard, red kite, golden eagle and white-tailed eagle) and seven species of bird of prey eggs (kestrel, sparrowhawk, golden eagle, goshawk, tawny owl, barn owl and long-eared owl) were examined (Fig. 1). The

* Corresponding author. Tel.: +44 1382 308110.
E-mail address: d.gentles@abertay.ac.uk (D. Gentles).

http://dx.doi.org/10.1016/j.scijus.2014.12.004
1355-0306/

Fig. 1. Examples of buzzard feathers.

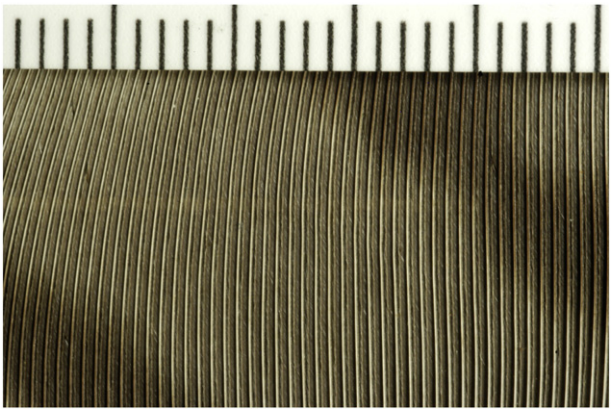

Fig. 2. Weave count of Sparrowhawk secondary flight feather (scale is in millimetres).

eagle feathers and eggs were provided by a local falconer whereas the rest of the feathers and eggs were provided by the Science and Advice for Scottish Agriculture (SASA) and a local museum. The feathers provided from SASA had been sampled from a vast range of frozen bird carcasses connected to cases of illegal poisoning which had been defrosted prior to sampling. The individual feathers were stored in breathable trays at room temperature, in normal lighting conditions and handled with gloves at all times to reduce the risk of infection from any tissue remaining on the quills of the feathers. The trays were lined with paper towels and covered with breathable brown paper. SASA also provided 2 complete buzzard wings which were placed in clear plastic bags and stored in a freezer until required. The eagle feathers provided by the falconer required cleaning and after advice from a taxidermist, an air compressor was used to gently blast the dirt and other contaminants off the surface whilst also ensuring the water-proofing ability of the feathers remained intact. The eggs were all gently bathed with a mild detergent and distilled water to remove any dirt and other contaminants that might be present before gently dried with cotton wool. The eggs were stored at room temperature in shallow cardboard boxes that were lined and covered with cotton wool.

2.2. Fingermark deposition and ageing

The suitability of 11 fingermark donors for use in the investigation, in terms of whether they are good, medium or poor fingermark donor, was assessed by the enhancement of their fingermarks on a sheet of white, blank A4 paper using black magnetic powder. 5 donors ranging from good to poor donors and between the ages of 19–45 years old were selected and asked to refrain from washing their hands for at least 1 h prior to depositing their fingermarks. Each donor was asked to rub their hands together and deposit a fingermark onto a designated area on the feather and egg surface. A diminishing series was not used in this study. Some of the eggs, such as the barn owl and sparrowhawk eggs were very small and did not allow for all 5 donors to deposit their fingermarks, therefore in some cases only 4 donors were used, and in others just 1 donor. Additionally, due to the supply of feathers, not all techniques and ageing periods could be assessed. Contact was made with the surface of the feathers and the eggs for approximately 2 s and an attempt was made to keep the contact pressure as constant as possible. Feathers and eggs from all species supplied for use in this investigation were prepared each week and developed over a 3 week period at intervals of 1 day, 3 days, 7 days, 14 days and 21 days after deposition. These time scales were repeated for all enhancement techniques under investigation.

Table 1
Grading scheme for assessment of developed fingermark.

Grade	Level of detail
0	No evidence of print
1	Some evidence of contact but no ridge detail present
2	Less than 1/3 of print showing clear ridge detail
3	Between 1/3 and 2/3 of print showing clear ridge detail
4	Over 2/3 of print showing clear ridge detail

2.3. Fingermark grading

Following enhancement, all of the developed fingermarks were graded on a scale of 0–4, depending on the quality of ridge detail, if any, that was visible on the feathers and eggs. The grading system used was that recommended by CAST [18] as shown in Table 1.

2.4. Enhancement techniques

Each deposition was photographed before and after enhancement using a Nikon D5100 digital SLR camera with an 18-55 mm lens or a 60 mm micro Nikon lens. A Mason Vectron Quasar 2000/30 connected to an Integrated Rapid Imaging System (IRIS) was used for fluorescence examination. A control set of fingermarks was taken prior to each enhancement to ensure that each development technique was working effectively. Negative controls were also performed to ensure that the enhancement techniques were not reacting to any

Fig. 3. Photography of a Sparrowhawk egg showing a developed fingermark with black magnetic powder.