Literature review: Wild take and the cultural traditions of falconry

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Foreword

Natural England is undertaking a comprehensive review of its approach to licensing ‘wild take’ – the taking of birds of prey from the wild for use in falconry or aviculture – to inform the development of a new policy of its licencing remit, and to set out a future approach to wild take licensing. To assist in this research and evidence gathering, Natural England has commissioned this literature review from Durrell University with the aim of expanding our information regarding the traditions and practices of falconry, within a European context.

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Executive summary

Falconry, defined by the International Association for Falconry to be "…**the traditional sport of taking quarry in its natural state and habitat by means of trained birds of prey**", remains remarkably similar to the way it was practiced in Britain hundreds of years ago. However, there have been some notable changes, including the decline in its popularity amongst the upper classes, who often relied on others to supply them with trained, wild taken birds.

Relatively recent challenges have resulted in a significant shift away from the use of wild taken birds and towards greater use of captive-bred birds for falconry in Britain, as well as in Europe and North America. Hawk[1] populations declined drastically in the last century. Concerns over conservation led to joint efforts between the falconry community, conservationists, and regulators to hasten the development of nascent captive breeding techniques and facilities. Falconers in Britain shifted away from using wild taken native hawks and began to rely almost exclusively on locally captive-bred and imported hawks. Imported hawks could be captive-bred or wild taken. Although a scarcity of available hawks is thought to have severely limited participation in British falconry in the 1970s and 1980s, today captive-bred hawk production is generally agreed to be sufficient in terms of its ability to provide a consistent supply of birds for British falconers.

This literature review examines material on the history of falconry largely within a European context and seeks to characterize the integral cultural components of falconry including the role of wild take. This review also seeks to investigate the importance of wild take and genetic identity (species integrity and/or provenance) to British falconry as it is described in the literature. The review examined texts available through Web of Science, Google Scholar, and a selection of libraries and archives.

Much of the identified literature chronicles the evolution of falconry. Historical methods of classifying and training hawks bear remarkable resemblance to those used today. This review notes some changes in modern falconry, such as the way transformations in land use have largely forced falconers off horseback, as well as a decline in its popularity amongst the nobility/upper classes. Additionally, as traditional quarry species, such as heron and crane, grew scarce, new quarry species were targeted. The literature describes the manner in which one would capture adult hawks. Anecdotal descriptions in the text refer explicitly to the capture of eyasses, or young hawks yet to leave the nest. While passage hawks, hawks caught on migration, were commonly flown in Britain historically, the literature only indicates a single location where they were caught in Britain: the frequent capture of passage hawks is described in Northamptonshire in the 1800s.

[1] In falconry, "hawk" refers to all diurnal birds of prey flown, including true hawks, falcons, eagles, and buzzards.

Otherwise, passage hawks are commonly described being imported from Europe, Africa, and the Near East.

The literature on the development of captive breeding techniques largely describes it as a product of necessity. Prior to the Wildlife and Countryside Act of 1981, captive-bred hawks were not widely available, although all of the authors reviewed demonstrated favourable views on protecting native hawk species. Following the passage of the act, some authors express dissatisfaction at being unable to take wild native hawks. However, many accept that supplies of captive-bred hawks are now sufficient to meet the needs of modern British falconers and the reviewed literature indicates that captive-bred hawks are considered to perform to a high level of satisfaction.

Most dissatisfaction with captive-bred hawks appears to stem from aesthetic grounds, focusing on how selective breeding can theoretically compromise the “sporting nature” of falconry. Select texts describe captive breeding as being in its relative infancy. This suggests, along with literature on captive breeding in other species, that selective pressures endemic to captive breeding may not have had time to manifest.

The question of genetic identity and its importance to British falconry appears to be unresolved in the literature. Very few of the identified texts discuss genetic identity or the extent to which it matters to British falconers, and few explore if there are any significant or distinct qualities relating to individual hawks of the same species that are native to discrete areas (e.g. Manx Peregrine Falcons). Mentions of hybridization appear frequently in texts describing the recent history of falconry. The same falconers outspoken against selective breeding disagree with hybridization on similar grounds. Additionally, some conservation literature expresses concern that hybrid species could escape and establish wild populations although this has yet to become a recorded issue. Authors in favour of hybridization refer to the ability to produce hardier hawks more suited to captive life.

The literature suggests captive breeding, in its current capacity, provides a sufficient supply of hawks, that perform to acceptable standards, to meet the demand of British falconers. However, the literature treats captive breeding as a process necessary for ensuring the continuation of British falconry over the past 50 years. The importance of wild take to the culture or identity of British falconers is not specifically outlined in the literature. The literature also indicates that the practice of falconry has changed over the centuries, mostly in direct response to reduced access to land, quarry, or hawks. The manner in which obtained hawks are trained has changed very little, although some techniques have been upgraded or refined to suit commercial operations and modern expectations of animal welfare. The question of genetic identity is poorly resolved in the available literature. While no explicit disadvantages are outlined, such little literature evaluates the subject that no sound conclusions can be drawn.

Contents

1. Introduction

1.1 Background

Falconry is estimated to have existed for over 4,000 years (Glasier, 1986). Up until recently, this sport was fuelled by the capture and trade of wild hawks – where "hawk" refers to any diurnal raptor used in falconry (Upton, 1991). A multitude of threats, culminating with the recognition of pesticide toxicity in the mid-20th Century, pushed falconers, environmentalists, and regulators to support the development of captive breeding programs in North America, Europe, and the United Kingdom (Beebe, 1976). As these programs developed, they replaced the legal supply of wild hawks for British falconry. The last permit for the collection of wild hawks for falconry in Britain was used in the late 1980s (Fox, 2022). Recent increases in many native hawk populations at the national level have encouraged renewed interest in taking wild British hawks. Potential applicants include falconers, exhibitionists, and breeders operating at various scales. In line with its statutory responsibility for determining licence applications on behalf of the UK Environment Secretary, Natural England has requested a review of the available literature focusing on the traditional practices and cultural aspects of British falconry. This report seeks to characterize the results of this literature review, namely in regard to three primary areas: the practices that are considered integral components of British falconry, the described cultural importance of wild-origin hawks, and the described cultural importance of the genetic provenance and profile of hawks used for falconry.

1.2 A Summary of British Falconry History

Falconry is known to have originated in the Far East (Glasier, 1986). Archaeological evidence places its appearance in Great Britain in the early Middle Ages (Mellor, 2010). Evidence supporting its practice is widespread in England and Wales. One example is a depiction of a falconer on the Bewcastle Cross from the 7th or early 8th Century (Mellor 1949). Historically, falconry took one of two forms depending on the type of hawk flown. Layfolk used Northern Goshawks (Accipiter gentilis) or Eurasian Sparrowhawks (Accipiter nisus) to hunt ground game, such as rabbits and hares (Berners & Blades, 1901). These hawks were used primarily to catch game for the table, and those who flew them were known as "austringers" (Mellor, 1949). The nickname of the Northern Goshawk, the "cook's hawk", is thought to support this theory (Kenward, 1981). While these hawks belong to the family Accipitridae, or true hawks, all raptors flown for

falconry were, and still are, called hawks. An austringer's hawks were known as "short-winged hawks", in contrast with the "long-winged hawks" (raptors in the family Falconidae) (Cox, 1721).

The traditional sport of falconry involved the use of long-winged hawks, such as the Peregrine Falcon (Falco peregrinus), to hunt wild, airborne quarry. For hundreds of years this style of falconry was entirely the remit of royalty and nobility (Mellor, 2010). Captive bred hawks were non-existent until the mid-1900s, so all hawks had to be obtained from the wild. Because many different hawks were commonly used in British falconry (Table 1) some were captured in Britain, while others had to be imported, sometimes from as far afield as Africa (Upton, 1991). The Scottish Highlands were well-known for harbouring Peregrine Falcon eyries, or nesting sites (Oggins, 2004). Stewards for these areas would capture eyasses, young falcons just about to leave the nest, and train them for their wealthy patrons. Some falconers used hawks captured as adults, although these were less likely to come from Great Britain.

Table 1. Raptor species described in historical practice of falconry in Great Britain.

Common Name	Species Name	Native to Great Britain
Northern Goshawk	Accipiter gentilis	Yes
Eurasian Sparrowhawk	Accipiter nisus	Yes
Lanner Falcon	Falco biarmicus	No
Saker Falcon	Falco cherrug	No
Merlin	Falco columbarius	Yes
Peregrine Falcon	Falco peregrinus	Yes
Gyrfalcon	Falco rusticolus	No [note 1]
Hobby	Falcon subbuteo	Yes

Note 1: [While Gyrfalcons are not native to the island, errant specimens are sighted infrequently].

Hawks were not only sourced via Scotland. Another group of falcon catchers in Valkenswaard, a small village in the Netherlands, also provided a steady source of

passage hawks, a term for hawks on migration, and haggards, a term describing a hawk in full adult plumage (Ray, 1678). Many historical authors considered the older hawks to be more capable hunters than those trained as eyasses, as older hawks learned their skills from their parents and honed them in the wild (Campbell, 1773). Many modern authors disagree on the innate superiority of passage hawks (Upton, 1991; Michell & Speedy, 1992). While hawks came from numerous places, these two sources provided the majority of hawks used by British falconers up until the 1900s (Grassby, 1997).

Falconry in the royal court took the form of a grand spectacle known as the haute vol. Unlike most practices in Britain today, falconers would accompany their royal patrons, and a host of other nobility, who would be mounted on horseback (Oggins, 2004). The falconer, or team of falconers, would manage the hawks and accompany the host on foot (Mellor, 2010). Traditionally, the haute vol consisted of flying hawks at high-flying quarry, such as kites (the bird of prey) and cranes (Oswald, 1982). As various factors impacted the abundance of these species, the haute vol targeted alternative quarry, such as herons (Freeman & Salvin, 1859). The haute vol is sometimes considered to be the apex of leisurely social activity in the Middle Ages (Wall, 2004).

1.3 Evolution of Modern Falconry

For hundreds of years, falconry was so popular it formed a core component of upper-class education (Oggins, 2004). However, by the 1700s its significance and popularity had declined (Grassby, 1997). Its survival during this time is largely attributed to the reprinting of old falconry manuals (Mellor, 2010). These manuals were important because, although falconry evolved to suit its conditions, the basic skills never changed (Grassby, 1997). New practitioners were ensorcelled by these manuals and ushered falconry through a rapidly changing pre-industrial Britain. Enclosure, a slow persistent process that culminated in the Enclosure Acts, drastically decreased the amount of space available for falconry; between the passing of the Enclosure Acts and 1914, 6.8 million acres of land were fenced (Fox, 2022). The intensification of agriculture led to a reduction in wetlands, which resulted in less available wetland habitat for heron and crane nesting grounds (Blaine, 1936). As these species became too rare to hunt, falconers flew their hawks at partridge, grouse, skylarks, sea gulls, and rooks (Upton, 1991).

Interest in falconry lost its ubiquity among the nobility, but a wider privileged class organized a succession of hawking clubs that ensured the sport’s continuation until the 1900s (Oggins, 2004). These clubs attempted to pool resources in order to defray the high costs of maintaining falcons and procuring space for hosting flights (Wall, 2004).

As firearms became more commonly available, falconry was forced to compete with “shooting flying”, the shooting of birds with firearms, for both space and quarry (Cox & Lascelles, 1986). Additionally, gamekeepers, keen to capture as much profit as possible from the grouse and partridge on their lands, shot and poisoned raptors found on their land (Blaine, 1936). Habitat loss and persecution caused raptor populations in Britain to decline slowly throughout the 1800s (Fleming, 1934; Crick, 1999). Following the First and Second World Wars, a sharp and sudden increase in falconry becomes apparent in the literature. This renewed interest is followed shortly by the acknowledgement of steep population declines of wild hawks in Britain. The literature describes a speculative mix of egg and hawk poaching, habitat loss, persecution, and pesticide toxicity as major factors for this decline. The prolific application of organochlorines, namely dichlorodiphenyltrichloroethane (DDT) is the only factor specifically identified as having a measurable ecological effect (Beebe, 1976; Morel, 2016). This is likely a result of the relative ease with which DDT and its impacts could be measured in laboratory settings (Beebe, 1976).

In a show of cooperation, falconers, regulators, and environmentalists worked together to monitor known eyries and develop policy to help protect the remaining hawks in Britain (Upton, 1991). Possessed hawks had to be registered, import requirements for foreign hawks became more robust, and the capture of wild hawks had to be authorized through newly developed permitting procedures (Woodford & Upton, 1987). Falconers and scientists in North America, Europe, and Britain worked to develop reliable breeding techniques for captive-bred falcons (The British Falconers’ Club & the Hawk Trust, 1970; The British Falconers’ Club & The Hawk Trust, 1973). A series of breakthroughs in the 1970s eventually established the foundation for what is a robust captive breeding landscape today. While British falconers suffered through a scarcity of legal hawks in the 1970s and early 1980s, modern British falconry relies almost exclusively on captive breeding to meet its demand for hawks (Fox, 2022). These hawks range from traditionally used species, such as Peregrine Falcons, Gyrfalcons (*Falcon rusticolus*), and Northern Goshawks, to foreign species, like the now commonly used North American Harris’ Hawk (*Parabuteo unicinctus*). Captive breeding has also enabled the hybridization of many hawk species. In the 1990s, hybrid hawk production outpaced other captive bred hawks (Kenward, 2009).

1.4 Literature Review

Despite the regulatory limitations introduced in the 1980s, the ability of falconry to adapt in the face of change has allowed the sport to flourish. In 2007, the United Kingdom’s Hawk Board led an audit that estimated around 25,000 falconers kept 70,000 raptors in

the United Kingdom- these numbers exceed historic estimates by several orders of magnitude (Fox, 2022). However, increasing numbers of some wild hawk species, particularly Peregrine Falcons, have sparked discussions about the possibility of a resumption in legal wild take to supply birds for British falconry (Natural England, 2022). This has led Natural England, with support from the Department for Environment, Food, and Rural Affairs, to undertake a review of this topic and update its licensing policies. Speculative resumption in wild take licence applications has led to questions about the necessity of using wild raptors for falconry and the extent to which sourcing hawks from the wild might be considered a fundamental cultural aspect of modern British falconry. Falconry was inscribed on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity in 2010, but the United Kingdom is missing from the list of inscribing countries, despite the number of notable British falconers leading the inscription effort (Fox, 2022; UNESCO, 2022). In order to ascertain the importance using native, wild hawks to the modern practice of falconry in Britain, Natural England has established several specifications that this literature review seeks to address.

Falconry has been practiced in Britain since at least the 8th Century, with many estimates placing its beginnings a few hundred years earlier than that. As such, this literature review seeks to characterize the practice of falconry in Britain from its origins to the present day and identify those elements that constitute its integral components. As part of this focus, the ways in which falconry has evolved over this time period will also be evaluated. One of these integral components, at least until the 1970s and 1980s, was the capture or import of wild hawks. Much of the domestic supply of hawks for British falconry today comes from hawks bred in captivity in Britain (Fox, 2022). However, many hawks are also imported. These imported hawks may be captive-bred, such as North American Harris' Hawks, or, less frequently, they may be wild-caught from countries that permit wild take (Morel & Horobin, 2016). This review seeks to determine how authors of falconry literature regard the collection of hawks from the wild. Particular attention is paid to any differences in perspective that occur before and after 1981, the year the Wildlife and Countryside Act (which regulates the taking of birds from the wild for this purpose) was passed in the United Kingdom. This review also seeks to characterize the opinions authors hold regarding genetic identity and hybridization in falconry (see Appendix for the methodology followed).

2. Literature Review Findings

2.1 Falconry Literature by the Numbers

2.1.1 Overall

A total of 168 texts matching the criteria were identified across search strategies. 63 texts matching the criteria were identified using Google Scholar, 49 were identified using Web of Science, and 56 were identified through searches of library and museum archives. 14 texts were identified through two or more search strategies. After the removal of duplicates and triplicates, 152 unique texts remained. The most frequently occurring types of media were academic journal articles and books, accounting for 82% of selected texts. The least frequent types of media were informational brochures and conference proceedings, accounting for 4% of the total selected materials. The two most common themes were history and Reference Manuals, accounting for 35% and 20% of total materials respectively. The least common theme type was law, with only one occurrence. Within the history theme, the most frequently occurring subthemes were culture and chronicle, accounting for 29% and 27% of history themed texts respectively. Within the biology theme, two of the three texts fell within the physiology subtheme while the remaining text fell under genomics.

2.1.2 Web of Science

The initial Web of Science query using the search term “falconry” yielded 277 texts. After filtering these results to match the literature review criteria, only 49 remained. Of these results, 94% were academic journal articles, 4% were books, and 1% were periodical articles. The overwhelming majority of texts were published within the last few decades, although many included analyses of historical texts. The history theme accounted for 41% of relevant texts found using Web of Science. The remaining texts were spread across a variety of technical themes such as biology, psychology, and technology (Figure 1). While materials identified through Web of Science characterized some of the integral components of British falconry, none of the material specifically referenced the importance of wild take to the practice, nor did they address issues of genetic identity.

2.1.3 Google Scholar

The initial search in Google Scholar using the term “falconry” resulted in over 18,000 results. The search only included the first 500 of the resultant items. Beyond the first 250 items, the results were almost exclusively citations referencing previous works. Of these, 63 texts were identified as relevant to this literature review. In contrast to the Web of Science results, 40% of results identified through Google Scholar were academic articles, 27% were books, 16% were chapters within books, and 11% were academic dissertations. The most frequently occurring themes were history, which accounted for 51% of the texts, and Reference Manuals, which accounted for 17%. Within the history subtheme, 28% focused mainly on culture, 25% were chronicles of historical events, 22% were analyses of historical literature, and 19% described archaeological research. Of the texts identified through Google Scholar, only two refer to the review specifications as established by Natural England. These texts evaluate the potential role of falconers as stewards of natural resources and explore the ways in which conservation and falconry have interacted in the past. Both texts are written by Kenward (2008, 2009), a notable figure in falconry literature. A third, earlier text by Kenward (1981) documents the re-establishment of Northern Goshawks in Britain from individuals imported for falconry.

2.1.4 Library and museum archives

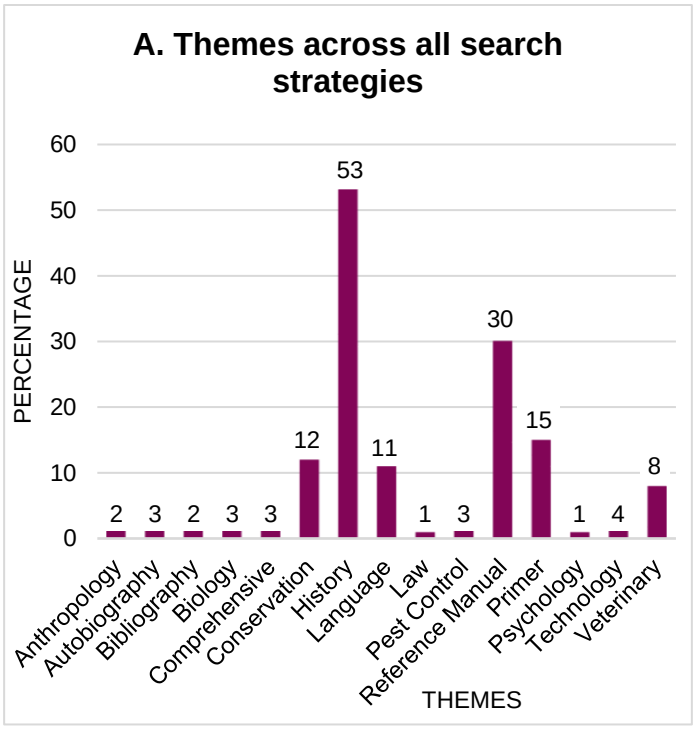
A total of 64 texts were reviewed at archives and special collections, although only 56 were determined to be directly relevant to the literature review criteria. 22 texts were reviewed at the Bodleian Library in Oxford, 20 were reviewed at the Zoological Society of London (ZSL) library (ZSL Prince Philip Zoological Library and Archives), eight were reviewed at the Natural History Museum (NHM) ornithology library at Tring, 10 items were reviewed at the NHM archive at South Kensington, and 12 items were reviewed at the British Library in London. Attempts were made to review materials at the British Archives of Falconry (BAF), but these efforts were complicated by a lack of volunteers available to staff the facility. However, one of the members of the BAF offered access to their own private collection where key texts had been identified and access had not been possible through other libraries. Of all the texts reviewed from library and museum archives, 88% were books, 7% were brochures, and three items were collections of abstracts from presentations given during academic conferences on raptor conservation. 27% of the identified relevant texts were categorized as Reference Manuals, 23% were categorized as primers, and 11% were designated under the history theme. 50% of texts within the history theme were subcategorized as chronicles, 42% were assigned the culture subtheme, and one item focused on historical literature. Ten of the texts identified at archives and special collections directly address the focus

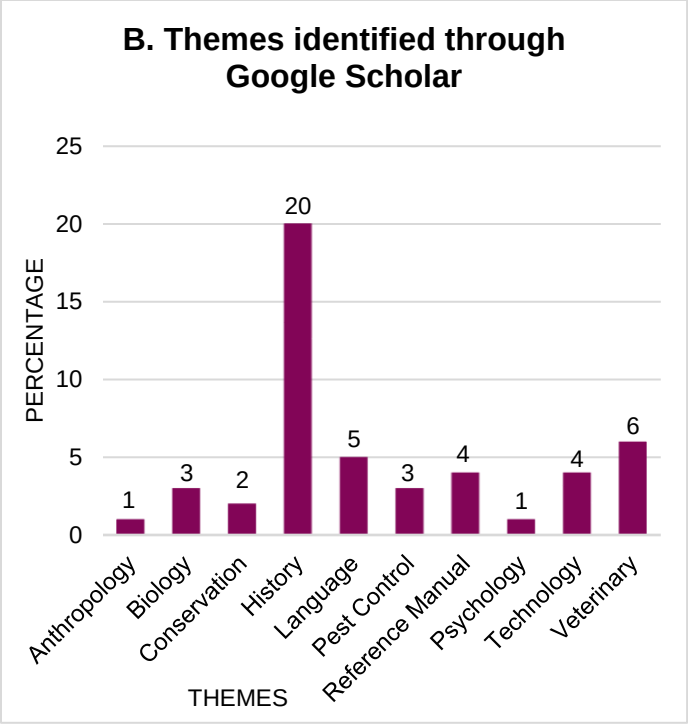
of this literature review (Table 2). All of these texts are books and all but two fall under the primer theme. These two texts are comprehensive materials on falconry, raptor life history, and raptor physiology. All ten of these texts were published after 1980.

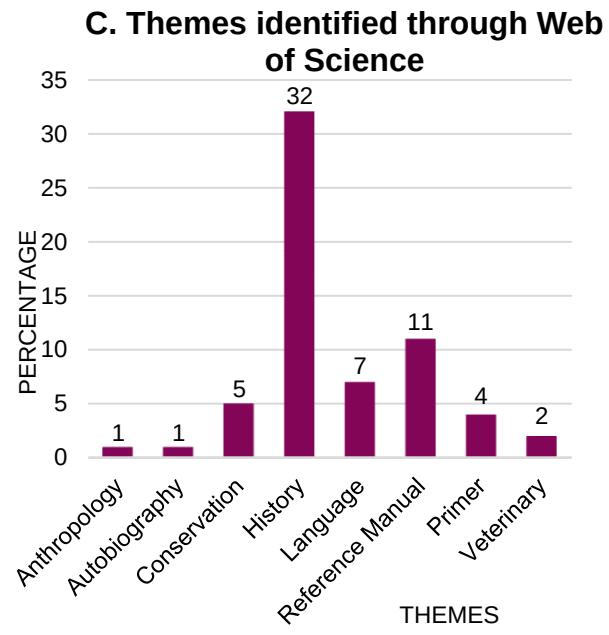
2.1.5 Falconry literature addressing review specifications.

Of the identified texts, 12 specifically refer to the importance of wild take and genetic identity in relation to the practice of British falconry (Table 2). Of these, only van de Wall's The Loo Falconry: The Royal Loo Hawking Club 1839-1855 openly claims that captive-bred falcons are innately inferior. This is the only modern text that retains the historically common definition of falconry as "…the art of using wild falcons to capture wild birds and animals…" (van de Wall, 2004, p9). Other modern definitions appear to have dropped "wild" as a necessary requirement for defining hawks flown in falconry (Upton, 1991; Macdonald, 2006; Morel, 2016). Six of the texts suggest that captive-raised hawks are at least equal to wild origin hawks in terms of their hunting abilities and flight performance. Two authors express an interest in flying wild hawks and lament what they see as unnecessary limitations on wild take in a time where native hawk populations are on the rise (Upton, 1991; Harris, 1998). van de Wall (2004) expressed a similar sentiment, although he made no reference to his own involvement with falconry outside of chronicling its history. The remainder of identified authors do not express an opinion on whether wild collection of hawks is necessary or should be permitted. However, they do describe the conditions that led falconers away from using wild native hawks in Britain.

Genetic identity is discussed within the literature in terms of hybridizing species and subspecies of hawks. While Humphrey (1973) briefly describes the reputation of Manx Peregrine Falcons as excellent falconry hawks, the qualities of hawks endemic to specific areas is otherwise not described in significant detail. Only two authors express explicit concerns regarding the capacity for hybridization to compromise the "sporting" aspect of falconry (Upton, 1991; van de Wall, 2004). They regard selective breeding as a dangerous precedent for the development of trendy "super-falcons". Proponents of hybridization clarify that what constitutes "sporting" is up to the individual falconer to determine for themselves (Fox, 2022).







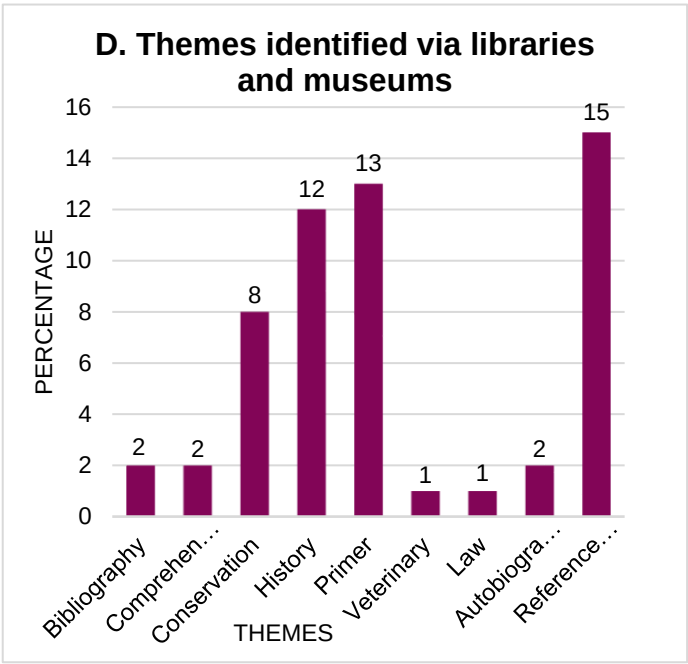


Figure 1. Relative occurrence of themes across search strategies. Chart A. depicts the occurrence of themes across all search strategies. Chart B. represents themes identified through Google Scholar. Chart C. depicts themes identified through Web of Science. Chart D. depicts the relative occurrence of themes identified via libraries and museums.

Table 2. Texts identified through the literature search that directly address the issues of wild take and genetic identity in British falconry.

Title	Author(s)	Issues	Publication Date
Falconry	Humphrey, A. E	Wild take	1973
Falconry	Ford, E.	Wild take	1984
A Manual of Falconry	Woodford, E. & Upton, R.	Wild take	1987
Falconry: Principles & Practice	Upton, R.	Wild take/ Hybridization	1991
Falconry for Beginners	Harris, L.W.	Hybridization	1998
Falconry: Care, Captive Breeding and Conservation	Parry-Jones, J.	Wild take	2003
The Loo Falconry: The Royal Loo Hawking Club 1839-1855	van de Wall, J.W.M.	Wild take	2004
Opportunities in Falconry for Conservation Through Sustainable Use	Kenward, R. E. & Gage, M.	Wild take/ Hybridization	2008
Conservation Values from Falconry	Kenward, R.E.	Hybridization	2009
Observations in Modern Falconry	Stevens, R.	Wild take	2010
The Art of Falconry	Morel, P. & Horobin, D.	Hybridization	2016

Title	Author(s)	Issues	Publication Date
Understanding the Bird of Prey	Fox, N.	Wild take/ Hybridization	2022

2.2 Summary of Findings

2.2.1 Overview

The identified literature provides a robust characterization of falconry in Britain throughout much of its history. The majority of the available literature chronicles the evolution of falconry and provides aspiring falconers with guidance in the form of reference manuals. This provides ample information to characterize the integral components of British falconry and any major changes they have undergone throughout its history. While the literature identified in this review indicates that falconry is becoming an increasingly popular subject in academic journal publications, this popularity is shown to be a relatively recent phenomenon. Most of the reviewed academic journal publications focus on the historical aspects of falconry or the influence of falconry on art and literature; there is limited reference to the potential cultural significance of wild take to falconers in Britain or to the importance of the genetic identity of the hawks that are used. However, these topics do receive some coverage in books, largely those written by falconers and/or falcon breeders (see below for further details).

2.2.2 Integral components of British falconry

The elements of falconry as it is practiced today remain similar to those described in some of the oldest identified texts (Frederick II et al. 1949; Loft, 2003). A hawk must be obtained, trained, and then used to hunt frequently so it retains what the falconer considers good habits. Historically hawks used in Britain were obtained from the wild. While this has changed in the United Kingdom, and elsewhere in Europe since the mid-to-late 20th century, falconers in many countries still source their birds from the wild, either as eyasses, passage hawks, or haggards (Fox, 2022). Both wild taken and captive-bred eyasses must develop healthy flight feathers before they are trained. Eyasses are typically “hacked”, allowed to fly free under surveillance, or maintained in an aviary until they are “hard-penned”. A “hard-penned” hawk has fully developed its critical flight feathers (Illingworth, 1969). Once the hawks can fly safely, they are carried, or “manned”, to acclimate them to a human presence (Mavrogordato, 1973; Latham et al. 2017). This is typically the stage where passage hawks and haggards begin their training (Salvin & Brodrick, 1855). After a hawk is manned, it is taught to fly to the falconer’s glove and to fly to the lure. The latter develops the pattern of rewarding the hawk with a small piece of meat for flying at quarry (Mavrogordato, 1966).

While the process of training a hawk has changed very little, some elements of falconry have undergone various degrees of transformation. Veterinary care is the foremost among these. Until the 1900s, instructions for attending to the afflictions of hawks are largely based on anecdotal evidence or repetition of the advice found in older texts. Special care is paid to the crop of the hawk, with reference manuals instructing the reader to scrutinize their hawks’ castings and not to feed the hawk unless that morning’s casting is identified

(Turberville, 1575). Less practical care advice includes feeding a hawk stones and applying various tinctures and powders to the hawk's skin (Campbell, 1773; Freeman & Salvin, 1859). From the early 1900s onwards, the convergence of veterinary science and falconry led to robust clinical appraisals of common hawk maladies (Cooper, 1978). Hawk husbandry and captive-breeding efforts played a significant role in modernizing hawk medicine (Parry-Jones, 2003). Now, veterinary care available to hawks is more advanced and is used to maintain a high standard of health in captive-breeding operations (Fox, 2022).

The equipment and housing used in falconry, known as the "furniture", is also strikingly similar to examples described in the earliest reference manuals. Most changes in furniture result from upgrades to more durable and lightweight modern materials (Ford, 1982). A wider diversity of hoods is available today, as is a wider range of bells and bell suppliers (Ford, 1984). At various points in the history of British falconry, equipment could only be obtained from small number of producers, otherwise falconers had to produce the necessary material themselves (Bert, 1619; Cox & Lascelles, 1986). Now, a diversity of sellers may be identified, however authors advise aspiring falconers to use care and avoid purchasing cheap, faulty products (Glasier, 1990). Aviaries appear to have improved the most, based on their descriptions in early texts. Modern aviaries are spacious, provide many comfortable perches, and nesting boxes (Parry-Jones, 2003). They are also constructed out of materials that can resist falling debris, such as trees, and challenge the most industrious foxes and weasels (Parry-Jones, 2003).

The style of hunting has changed as well, as mentioned previously. Falconry grew more widely accessible as the middle class became more prominent (Cummins, 1988; Oggins, 2004). This, combined with enclosure and other changes to the landscape helped turn British falconry from a mounted sport into one that occurs primarily on foot (Steward & Steward, 2005; Mellor, 2010). Land changes also influenced quarry options, as species abundance was known to change as certain habitat types became less widespread (Freeman & Salvin, 1859). Whereas heron, cranes, and kites are known to be favoured quarries of historical falconry, they have been replaced with rooks, gulls, and other fast-flying birds in the modern age of falconry (Woodford & Upton, 1987; Mellor, 2010). Hawks are still commonly trained to work in teams with dogs, especially if their chosen quarry necessitates the "waiting-on" method of hunting (Blaine, 1936; Upton, 1991).

2.2.3 Wild-origin hawks as described in the literature

The literature does not explicitly describe the cultural value or importance of wild-origin hawks in British falconry. It does however suggest that the current state of British falconry, in which captive-raised hawks comprise the majority of the hawk supply, was, at least initially, borne out of necessity. Prior to the mid-20th Century, all hawks used in falconry were wild caught (Lascelles, 1971; Glasier, 2017). After this point, measures were introduced to address declining wild populations, limiting access to wild origin hawks.

All of the literature written within the last century describes noticeable sharp declines in native hawk populations. Protective legislation aimed at native hawks was widely supported by falconers at the time, as were captive-breeding operations (Upton, 1987; Parry-Jones, 2003). However, there was concern within the literature about whether captive-bred hawks could perform as well as wild hawks. Humphrey (1976) writes, “If enough hawks could be bred in captivity, it would not be necessary to take any birds from wild stocks at all. It is not yet clear whether a captive bred hawk would be as good from a falconry point of view as a wild bred one. But even if it were not as good in some respects, it would still be preferable to having no hawk at all” (p. 149). This sentiment highlights the consideration that hawk populations and falconry were in a dire position in the 1970s. Later texts provide the sense that captive-bred hawks have been able to perform to a similar standard as compared to birds taken from the wild (Upton, 1991; Fox, 2022).

Despite this, there are still a small number of authors who express an interest in wild hawks. While Upton (1991) concedes that captive hawks can satisfy the needs of British falconry and that captive-bred eyasses perform just as well, if not better, than wild-caught eyasses, Upton laments the lack of opportunity afforded to modern falconers to capture and train passage hawks. Wall (2004) makes a bolder claim that stands apart from the rest of the literature, in which he states that: “The use of captive-bred birds has undeniably lowered the high standards of falconry” (p. 122). Wall’s opinion appears to be in the minority, as captive-bred hawks dominate today’s practice of falconry in Britain and Europe. According to Kenward and Gage (2008), in 2005, only 88 wild hawks were licensed to be collected in the European Union. This is compared to the thousands of captive-bred hawks produced annually.

The remaining literature addresses the issue of wild take by describing the process by which captive-bred hawk production became the dominant source of supply. Parry-Jones (2003) describes a number of challenges to be managed by breeders, such as welfare considerations and concerns regarding over-production of unwanted species. Fox (2022) notes that captive-breeding is still in its relative infancy and the technology for reducing congenital defects and other issues has only recently become more widely available.

2.2.4 Genetic identity of hawks as described in the literature

Very few of the identified texts describe the importance of genetic identity to British falconry. Of those that do, three primary trends appear. Descriptions of captive-breeding document the production of hybrid hawks (Parry-Jones, 2003; Kenward, 2009; Fox, 2022). Some texts outline concerns held about the potential for hybrid hawks to cause alien introgression in native hawk populations, should they escape (Cooper, 1978; Kenward & Gage, 2008; Morel & Horobin, 2016). Finally, some texts describe hybridization as being “unsporting” and upsetting the natural balance between the trained hawk and its prey (Upton, 1991; Williams, 1998; Wall 2004). To the latter, Fox (2022) responds that this balance must be maintained by each individual falconer and that hybrid hawks are a product of the market.

Several authors describe the potential negative impact that escaped hybrid hawks could have on wild populations if they were to breed successfully. However, according to the literature, this is as yet to occur in Britain or Europe (Kenward, 2009; Morel & Horobin, 2016). The literature suggests the issue of genetic identity is much affected by the relative infancy of captive-breeding. Selective pressures resulting from captive-breeding may not have had time to manifest, albeit that they may not manifest at all if such populations are effectively managed. Fox (2022) describes an innovative genetic database used to minimize congenital defects in the pedigrees his facility produces, however it is unclear if all captive-breeding operations have access to similar technology.

3. Conclusion

Falconry has changed and adapted in response to a variety of social, political, economic and environmental challenges over the years. While not every challenge may be described in the literature, clear examples are shown with the decline of kites, then cranes, and then herons as important quarry species (Turberville & Derry, 2006; Mellor, 2010). Recent history has required ever greater adaptions by falconers with the drastic decline of wild hawks and consequent protective measures in the 20th Century. Despite this, falconry remains fundamentally similar to its documented practice in the 13th Century (Mellor, 1949). A hawk is obtained, trained, and accustomed to a variety of gear that has changed only slightly over hundreds of years, and then flown at various quarry, potentially working in tandem with dogs. These aspects appear to have remained consistent regardless of whether the hawk was captured from the wild or purchased from captive-bred stock. A direct answer to the question of how important wild take is to falconry as a cultural practice is absent from the literature. The literature clearly documents a shift in supply resulting from necessity. According to the literature, the current state of captive-breeding is apparently satisfactory in terms of its ability to supply birds in line with the current needs of British falconers. Genetic identity is discussed only nominally, but the available literature suggests it may be a concern worth monitoring as hybridization and captive-breeding progress. Captive-breeding has only been operating at scale for just a few decades, and the popularity of hybrid falcons did not see significant growth until the late 1980s/early 1990s (Kenward, 2009).

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Appendix

A1. Methods

A1.1 Literature Search

A search for relevant literature was performed using several strategies to identify texts relevant to the review specifications as agreed with Natural England. Only material written in English and focused on falconry in Britain and north-western Europe was considered. This filter yielded texts from Britain, Germany, France, and the Netherlands. A review of material available in library and museum archives took place in London, Tring, and Oxford, in the United Kingdom. Visited facilities included the Zoological Society of London (ZSL) archives, the Bodleian Library archives, the National History Museum (NHM) archives in London, the NHM archives in Tring, and the British Library archives, in that order. For each of these locations, a search using the term “falconry” was carried out using the archive’s special collections database query platform. Items were requested sequentially as they appeared in the search results. Previously identified texts were omitted, as were texts that fell outside of the literature review scope. Selected materials were ordered and read on location. Time spent at each location was commensurate with the amount of relevant reading material available. Some collections held too many materials to adequately review in the allotted time frame. In these instances, search results were limited to the first fifty items. Ontological themes were assigned to identified texts based on their subject focus. For texts with substantial variation within a shared theme, sub-themes were assigned to provide a narrower description of the subject focus. All texts were then categorized and labelled according to the following attributes: theme, sub-theme, media type, geographic focus, and whether they directly refer to the research questions laid out by Natural England for this project. This stage of the review began on 8th November 2022 and ended on 9th December 2022.

A second search strategy was conducted using the popular online search platforms Web of Science and Google Scholar. A search on Web of Science using the search term “falconry” was used to identify relevant texts. This search occurred on 9th December 2022. The search results were exported into Zoterro v. 6.0.18 and filtered to only include texts that were relevant to falconry, written in English, and included Britain and/or western Europe in their geographic focus. Themes, sub-themes, media type, and geographic focus

were then classified and labelled. Materials where the text could not be accessed were omitted. A search via Google Scholar used a similar methodology. Results of a search using the term “falconry” were filtered based on language and geographic focus, and then text attributes were characterized and labelled. Similar to above, materials whose text could not be located were omitted. Only unique materials from the first 500 results of the search were recorded. This search occurred on 12th December 2022. The results of all three search strategies were compared for overlapping entries.

A1.2 Themes

The following themes and sub-themes are used to categorize texts according to their primary subject focus. Sub-themes were only applied if there was substantial variation in focus between texts within a shared theme.

Anthropology: describes texts that examine various elements of human-hawk relationships and how they affect people as a group

Autobiography: refers to the author’s account of their experience with elements of falconry

Bibliography: texts that exclusively describe other written material on falconry

Biology: refers to scientific research focusing on raptors as organisms, but excluding veterinary science

Genomics: describes biological research that focuses on genetics and genomes

Physiology: describes biological research that focuses on anatomy and morphology

Comprehensive: this label refers to material that covers a wide range of falconry topics in detail

Conservation: a broad category for literature that examines the management of hawks, their populations, and their natural environment

History: describes texts that focus on events or sequences of events in the past

Archaeology: refers to texts that focus on past events through the discovery of artifacts, bones, or settlements

Culture: refers to texts that explore social dynamics, social structure, and social values in a historical context

Literature: describes research that solely analyses written material to answer questions about the past

Summary: describes texts that provide a narrative of events through history

Language: describes research that refers to way falconry affects written and spoken language

Law: texts that describe and/or summarize the laws and regulations governing actions that affect falconers and hawks

Pest Control: describes literature that focuses on the use of falconry to reduce unwanted animal presence

Primer: this label refers to texts that summarize falconry history and describe some elements of practical falconry, but do so with less detail than Reference Manuals

Psychology*:* describes the relationship between falconry and studies of human behaviour and feelings

Reference Manual*:* refers to texts designed to impart a large amount of falconry knowledge in a clear manner

Technology: innovative applied scientific knowledge inspired by or meant for studying birds of prey

Veterinary: describes texts that focus on raptor medicine

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