International Conference on the Stewardship of Biodiversity and Sustainable Use

Conference Proceedings

Moyvalley, Ireland

November 18th & 19th, 2016

The Irish Hawking Club

In association with

The International Association of Falconry and the Conservation of Birds of Prey


IRISH HAWKING CLUB


INTERNATIONAL ASSOCIATION FOR FALCONRY & CONSERVATION OF BIRDS OF PREY
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Preface

From November 13th to 20th, 2016, the Irish Hawking Club hosted a week-long international falconry meeting in conjunction with the 47th Council of Delegates of the International Association of Falconry and Conservation of Birds of Prey (IAF).

As part of this event, it was decided, with the support of the IAF, to host a conference entitled 'The Stewardship of Biodiversity and Sustainable Use'. This was held on the 18th and 19th November at the Moyvalley Hotel, County Kildare, Ireland.

What follows are the proceedings from that conference.

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Table of Contents

Table of Contents (Contd.)

Foreword

The International Conference on the 'Stewardship of Biodiversity and Sustainable Use' was organised by the Irish Hawking Club (IHC) and the International Association for Falconry and Conservation of Birds of Prey (IAF). The Conference was an important international discussion and review on the subject of Wild Harvest and Sustainable Use of Raptors for the purpose of Falconry.

Falconry is described as '*the art and practice of hunting wild quarry in its natural state and habitat by means of a trained bird of prey'*. It is a living and developing art supported by ancient tradition and inscribed by UNESCO as an Intangible Cultural Heritage of Mankind.

The art of Falconry has been practiced in Western Europe as far back as the 5th Century AD and even further in other parts of the world. In the Far East, for example, its origins date back thousands of years. Historically, falconers have relied exclusively on wild-harvested raptors for the practice of their art until the collapse in raptor populations in the 1960s due to the widespread use of pesticides. This collapse became the catalyst for falconers to employ new techniques to develop and expand captive breeding programmes for the purpose of conservation and reintroduction and to ensure the practice of Falconry is maintained and preserved for future generations.

Today, the vast majority of falconers' birds are sourced through commercial captive breeding centres. However, the practice of wild harvest remains an important consideration for a variety of reasons. For many falconers, the knowledge and skill-set required to locate and source a bird of prey from its natural habitat remains an integral element to the art of Falconry, as well as producing unique genetic variation through natural selection which cannot be satisfied through captive breeding.

With the international guest speakers having such strong credentials in raptor biology, raptor monitoring, conservation management and science, the Conference programme focused on a number of key themes, with some overlap:

Session 1: Setting the Scene

Session 2: Falconers in Conservation

Session 3: Convention, Theory and Science

Session 4: The Future

Foreword

Among other topics, this conference explored this subject through a variety of international perspectives with regard to the principles of 'Judicious Use' and sustainability. The subject of 'Stakeholder Stewardship' was also discussed with international examples of how falconers are engaged in conservation and the management of wildlife and habitats.

In addition to the main conference, in the afternoon of each day, there were a number of informal talks on the conservation of the Grey Partridge and the Red Grouse. These talks are not covered in these conference proceedings.

Don Ryan, Director IHC
Eoghan Ryan, IHC

Acknowledgements

The Irish Hawking Club would like to sincerely thank the delegates of the IAF for their support in hosting this event and for direct sponsorship of key speakers. Sincere gratitude goes to IAF President Adrian Lombard for his guidance and suggestions in relation to the quality of the speakers from such a diverse range of backgrounds including raptor biologists, conservationists, academics, scientists, and sustainable-use advocates.

We would like to extend a special gratitude to our esteemed speakers for their time and effort in preparing presentations, taking time out of their busy schedules to attend our event in Ireland (with some travelling significant distances) and writing up their papers afterwards. Whether from a falconry background or not, all shared a passion and enthusiasm for conservation and birds of prey, with a common goal of ensuring that all species of raptors, their quarry and the habitats they depend on are adequately protected in a sustainable manner for future generations.

The hosting of the event was supported by a number of sponsors. In particular, we would like to thank Fáilte Ireland and Kildare County Council.

The IHC would also like to thank all those who attended and in particular the staff of the National Parks and Wildlife Service (Ireland) and members of the Northern Ireland Raptor Study Group – we would hope that the conference will act as an important first step in creating an open dialogue and communication on the subject of sustainable wild use and to address some of the concerns expressed from those who are opposed to wild harvest.

This document has been compiled, formatted and edited by Eoghan Ryan and Hilary White. Janusz Sielicki provided much assistance with printing and production. It would not have been possible without the generous support of the Falconry Heritage Trust – we thank you.

Within the IHC, several people were instrumental in making this event the success it was – (in alphabetical order) Anya Aseeva, Shay O'Byrne, Ed Coulson, Malcolm Edgar, Mick Quinn, Don Ryan, Eoghan Ryan, Hilary White.

This publication is dedicated to the memory of Clár Lawlor.

The Irish Hawking Club

The Irish Hawking Club is the representative body of Falconry in Ireland and is affiliated to the International Association of Falconry and Conservation of Birds of Prey (IAF), the European Federation of Associations for Hunting and Conservation (FACE), the UK Hawkboard and Countryside Alliance Ireland (CAI). First established in 1870 and reconstituted in 1967, the Irish Hawking Club is dedicated to the art and practice of falconry and to the dissemination of knowledge of Birds of Prey. The key objectives are to preserve and promote Falconry within the context of sustainable and judicious use of wildlife and to encourage conservation, the ecological and veterinary research of raptors and to support, under scientific guidance, native propagation for falconry and the rehabilitation of injured Birds of Prey.

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The International Association for Falconry and Conservation of Birds of Prey

The International Association for Falconry and Conservation of Birds of Prey (IAF) is the global organization for the promotion and advocacy of the ancient and living art of Falconry. This is a hunting art. The IAF is a non-profit NGO, registered under Belgian law and which represents 110 Falconry clubs and Raptor Conservation Organizations in 80 countries, including the whole of Europe and North America. The IAF is an accredited member of International Union for Conservation of Nature (IUCN) since 1996. It has the right to be an observer of meetings of the Standing Committee of the Bern Convention, and to representation at the Convention on International Trade in Endangered Species (CITES), the Convention on Migratory Species (CMS), the Convention on Biological Diversity (CBD) and is one of three Co-operating Partners to the United Nations Environment Programme (UNEP) and Convention of Migratory Species (CMS) Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia (the Raptors MoU). The IAF is also an accredited NGO providing advisory services to UNESCO Directorate of Intangible Cultural Heritage (NGO-90006). The IAF has a permanent office in Brussels and is a signatory to the Transparency Register of the EU Parliament.

International Association for Falconry
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Falconers lead the way to save the iconic Saker Falcon.

The International Association for Falconry and Conservation of Birds of Prey (IAF) is a proud supporter of the CMS Saker Global Action Plan and its Flagship Projects.

First Flagship Project: *The Saker Portal to Enhance Trust.*

This multilingual interactive portal has been largely funded and managed by the IAF (supported by Birdlife, IUCN and CMS/UNEP). See **www.sakernet.org**. With 5000 hits in two years, it has exceeded all expectations.

Second Flagship Project: *Satellite Tracking of Sakers.*

This project has been initiated by the IAF (assisted by ECOTONE) with ten trackers deployed in 2016 and ten more in 2017, providing invaluable data for Saker conservation.

Fourth Flagship Project: *Addressing Deadly Electricity Infrastructure.*

The IAF was the proponent of the successful IUCN Motion in 2016: Preventing electrocution and collision impacts of power infrastructure on birds (WCC-2016-Rec-098-EN).

We call on governments, funding agencies and electricity utilities to halt the slaughter!

Speaker Profiles

Dr Adrian Lombard
President of the International Association of Falconry and Conservation of Birds of Prey

Born in Harare, Zimbabwe (then Salisbury, Rhodesia) in 1953, Dr Lombard had the good fortune to go to the famous Falcon College for his Secondary Schooling. This was at a time before the Falcon College had any association with falconry, but he was fortunate to have an enlightened housemaster who permitted him to practice falconry instead of the more conventional and compulsory cricket and rugby.

He began medical studies in 1972 and his career eventually took him to the Western Cape where falconry was prohibited and there was certainly no prospect of practicing any sort of Falconry. In 1991, Adrian visited his old school in Harare where Ron Hartley was teaching and had established the famed School Falconry Club. Through Ron he linked up with Ed Oettle, who was living in the small town of Wellington, close to Cape Town and who had found a way to practice Falconry in the Western Cape. Ed had managed to prize acceptance of falconry from the Conservation Authorities in the Western Cape and Adrian joined him in negotiating a Provincial Falconry Policy that became a model for Falconry Policies across the provinces in South Africa.

Adrian then became Secretary of South African Falconers' Association and its representative to the Bird of Prey Working Group of the Endangered Wildlife Trust and then the South African Delegate to the IAF. Five years as Secretary of IAF granted him a rich insight into the status of World Falconry with its challenges and virtues. He says he has come to realize that falconry is part of our heritage and that it is one of the special things that define who we are and make us human. He was elected President of the International Association at the 2012 Council of Delegates meeting in Kearney, Nebraska, USA. Adrian flies a black sparrowhawk.

Eoghan Ryan, B.A., M.R.U.P., M.Sc.

Eoghan Ryan is a professionally qualified urban planner and urban designer with a strong interest in strategic planning and development management so as to protect (as so far is possible) the environment and maintain biodiversity. He has been a guest speaker at many national planning and housing conferences and a European Symposium. Following the national economic crisis his career shifted from the private/semi-state sector into central Government and he worked as a Senior Advisor in the Department of the Environment, Community and Local Government before moving to the Department of Social Protection (DSP) where he holds a senior management role. He sits on a Cross Departmental Steering Group for the National Planning Framework which will set out a 20-year strategy for the future sustainable economic and spatial growth of the country with an environment of the highest environmental quality.

Aside from his broader interests in environmental issues, Eoghan also has a specific interest in raptor monitoring and is a member of BirdWatch Ireland and the Irish Raptor Study Group. In 2015 he took a lead role in a pilot study to monitor the distribution and breeding success of the Sparrowhawk in specific parts of Ireland. He is a former President of the Irish Hawking Club, and his hobbies centre around the outdoors and include falconry, hiking, canoeing, gardening, foraging and art/painting (particularly wildlife art and landscape painting).

Speaker Profiles

Jevgeni Sheraglin

Jevgeni Shergalin is a raptor biologist having undertaken significant research on raptors of Northern Eurasia, and he is the author of more than one hundred articles on birds. Since 2005, he has worked as an archivist with the Falconry Heritage Trust (www.falconryheritage.com). During the 1980s Jevgeni was a regular broadcaster and journalist on wildlife conservation problems in the Estonian press. During 1991-2005 he was a consultant and translator of ornithological information from the former Soviet Union, which included about 30 books on birds, published in West Europe and North America.

Since 1999, Jevgeni was a co-moderator of Raptor Biology mailing list and in 2003 he founded and has been moderator of a mailing list "Birds in Russia and adjacent countries". He was responsible for the search of images for the book *Falconry: Celebrating a living Heritage* (Motivate Publishing, Abu Dhabi, 2009). He has been a Member of the Organizing Committee of three International Festivals of Falconry (2007, 2009 & 2011). Jevgeni is a member of the Central Council of Russian Bird Conservation Union and member of Central Council of Menzbier Ornithological Society (Northern Eurasia). Jevgeni is also a Member of the IAF Advisory Committee and Information Advisor of IAF since 2003. He is a member of the Middle East Falcon Research Group and an active member of Asian Raptor Research and Conservation Network.

Prof Tom Cade

Prof Cade is the Founding Chairman and Director of The Peregrine Fund which was founded with a Simple Mission to Save the Peregrine Falcon from Extinction.

He was a Professor of Zoology and Research Director at Cornell Laboratory of Ornithology between 1967-1988 where he constructed a 40-unit breeding facility for Falcons and founded The Peregrine Fund to support it. Tom was one of a small group of falconers who began breeding Peregrines and reintroducing them back into the wild. This initiative, which was employed by four other North American institutions and numerous falconers beginning in the 1970s, successfully concluded with the removal of the Peregrine from the List of Endangered Species in 1999 and the resumption of wild harvest a few years later. The Peregrine Fund has grown to become something more than any one of its founders could have envisaged. Today, it carries out projects on raptor conservation all over the world, as well as continuing two major domestic projects on endangered California Condor and the Aplomado Falcon. The organisation has expanded its commitment to efforts carried out overseas, particularly in places like South East Asia and South America, where many endemic raptors are likely to need help in the coming decades.

Tom is also responsible for establishing the World Center for Birds of Prey in Boise, Idaho in 1984, and was a Professor of Biology at Boise State University between 1988-1993. There, he established the first graduate program in raptor biology jointly with The Peregrine Fund.

Janusz Sielicki

Janusz Sielicki has an education in biology and spent many years in conservation as well as being a successful manager in numerous NGO's. He studied in Warsaw University and Lomonosov Moscw State University. He is Vice-president of the Society for Wild Animals "Falcon" since 2002 and a member of the Saker Task Force of the Convention for Migratory Species of IUCN, since 2011. He is also a member of the Steering Committee of EURAPMON – Research and Monitoring for and with Raptors in Europe, an ESF Research Networking Programme, since 2010 and a member of the European Sustainable Use Specialist Group and Sustainable Use and Livelihoods Specialist Group of IUCN (SULi).

Janusz is the co-editor and contributor to the definitive work on European Peregrine populations, *The Peregrine Falcon Populations – Status and Perspectives in the 21st* Century. The book is based on papers presented at the 2nd International Peregrine Conference Poland, 2007 and is the biggest collection of papers relating to Peregrine studies in Europe. Janusz is also the Director of the Tree-nesting Population Restoration Project in Poland. Janusz has been a falconer for 30 years, where he sat on the Board of the Polish Falconers Club, Gniazdo Sokolników, representing Poland at International Association for Falconry and Conservation of Birds of Prey (IAF), since 2000; member of the IAF Board since 2000; Conservation Officer of IAF since 2012 and Vice-president for Europe, Africa and Oceania of IAF since 2016. He is fluent in Polish, English and Russian.

Dr Ladislav Molnar

Dr Molnar is Head of Avian, Exotics & Wildlife at the University of Veterinary Medicine & Pharmacy, Kosice, Slovakia. He has keen interest in community involvement in conservation. He is a falconer and is part of IAF's Extended Advisory Committee (Veterinary).

Ladislav Molnar DVM., Phd., graduated in 1996 in Kosice, and is an experienced avian and wildlife clinican. He gained his experience in the Middle East where he spent 10 years as a wildlife veterinarian and director of the falcon hospitals in Abu Dhabi and Dubai. He was servicing centers for endangared Arabian and African wildlife in the United Arab Emirates, Jordan and Morocco. His interests include specialized endoscopic and orthopedic techniques in birds. As an active falconer, he is consultant in the breeding and rehabilitation programmes for captive and wild raptors in Slovakia and abroad. He is also a visiting lecturer in avian and wildlife medicine at conferences and training programmes.

Dr Andrew Dixon

Up until recently, Dr Dixon was Head of Research at International Wildlife Consultants (UK) with a BSc. Hons in Environmental Biology (Queen Mary College, University of London) and a PhD. Zoology (University of Leicester). He has had a lifelong passion for birds. Following graduation from Queen Mary College, he worked briefly as a ground engineering consultant before pursuing his ornithological interest by taking up a PhD studentship. His PhD research involved the use of DNA fingerprinting techniques to

investigate the evolution of mating and parental behaviours in birds. Following completion of his PhD, he undertook several short-term research assistant posts to carry out both field and laboratory studies before taking up a teaching post at the University of Sunderland in 1995. At Sunderland he taught undergraduate and post-graduate students on Environmental Science and Environmental Biology courses and established research projects on Reed Buntings, Peregrines, Ravens and Lapwings.

In 2001, he took up a research associate position at Lancaster University in order to study the impact of Peregrine predation on racing pigeons. Subsequently, he has worked as an environmental and ecological consultant and has provided advice on issues relating to birds of prey and racing pigeons to the UK and Scottish Parliaments. He is married with two children and lives in South Wales.

Nicola Dixon

Nicola Dixon is a Project Manager at International Wildlife Consultants (UK) with responsibility for the Mongolian Artificial Nest Project School Links Programme. She is an experienced teacher with a B.Ed. (Brighton University, Chelsea College) and manager with a passion for outreach education. During her 22 years in the teaching profession, Nicola managed staff, parent liaison, emotional and behavioural programs, international school trips, teacher exchange, dance/drama events and art displays.

Nicola was initially employed at IWC to organise the erection of 5,000 nests on the Mongolian steppe. She has since designed and managed exhibition stands in the UK, Middle East and Asia and worked as a project manager at the International Falconry Festivals. She has worked with students, teachers and falconers in the UK, USA, Mongolia, UAE and Europe to create educational resources on falconry and falcon projects. The Artificial Nest Project School Links Programme connects schools, teachers and students using the ancient art of falconry as a means of introduction.

Ralph Rogers

Ralph Rogers has served as the IAF's Vice President for the Americas and is a past President of the North American Falconers Assn. Ralph is also a founder and past Executive Director of the North American Grouse Partnership. He is a professional wildlife biologist with special interest in raptor counts and grouse surveys. He has contributed to the literature on the natural history and population status of peregrine falcons from Greenland to Patagonia.

As an educator, he is a past recipient of the National Wildlife Federation's Conservation Educator of the Year Award, and his science education program has been highlighted in the Phi Delta Kappa book on exceptional educational practices. His family has contributed to the peregrine recovery effort through the breeding and release of peregrines near the Missouri River in Montana, as well as other states. He studied Biology and Education at the University of Montana, Montana State University, and Texas State University. He is a practising falconer.

Dr Neil Sullivan

Neil Sullivan is an entrepreneur, scientist and law graduate with over 27 Years of experience of International Biotechnology and Healthcare Technologies across both private and public sector organisations. He formed Complement Genomics Ltd in April 2000 and developed it into a leading genetic testing company which is involved in human identification and clinical trials. More recently, the company has expanded into the animal and plant genetic-testing. This has four sections; a) avian services such as egg sexing, biobanking of a bird's DNA, parentage testing and species identification; b) plant and animal species identification to assist taxonomy; c) food identification/ingredient authentication, and d) environmental projects where they are involved in bat speciation, newt detection and other wildlife projects of interest.

Dr Farooq Omar Al-Ejli

Farooq Omar Al-Ejli is a genetic engineer and researcher on falcons and falconry at Al-Gannas Qatari Society. He graduated from Monash University with First Class Honours, majoring in genetic engineering (gene identification, cloning and expression). He has authored an encyclopaedic book on the history, archaeology, science, and literature of Falconry. In his book, he viewed ancient Arabic descriptive texts from a scientific standpoint, shedding light on important ancient contributions to the evolving understanding of the ethology and biology of Birds of Prey. He has also authored several articles in the field in Arabic and English. AL-Ejli moderated and spoke at Qatar's 2nd International Veterinary Falcon Conference (FalCon 2016).

Currently, his scientific research involves the application of genetics and genomics to Saker falcons to establish a foundation against the current multifactorial challenges on individual and population levels. His research scope also includes the identification of the extinct and living lineages of different species and subspecies of falcons in a phylogeographic, phylogenetic and ecological context in order to identify the risk to the species sustainability and enhance the conservation approach on a molecular level.

Dr Mike Nicholls

Mike Nicholls is an Honorary Research Fellow at Canterbury Christ Church University and Honorary Senior Lecturer at the University of Kent. Originally a plant ecological geneticist and now retired after teaching in the UK university sector for over 40 years, Dr Nicholls has had a lifelong passion for birds of prey. As well as being a practicing falconer for most of his adult life, the study of raptors has made a contribution to his life as an academic biologist, a published environmental educator and consultant. His academic interests include evolution, taxonomy and genetics of birds of prey and he has also run education workshops specialising in birds of prey, their welfare in captivity and environmental education in general the UK and overseas (Canada, Greece, Italy, Portugal, South Africa, Sweden and the USA).

Speaker Profiles

Although retired, Mike still maintains his university connections as an Honorary Research Fellow at Canterbury Christ Church University and Honorary Senior Lecturer at the University of Kent. He is an active member of the Sussex Peregrine Study and his current research interest is in the origins of the new contemporary population following their pesticide-induced extinction. Mike has been a falconer since the age of 16 and has a particular passion for hunting with small falcons. A member of the British Falconers Club since 1979, he is also an adopted member of the Irish Hawking Club.

Prof Robert Kenward

Robert Kenward is a conservationist, ecologist and a leading international raptor biologist. Robert Chairs the International Union for Conservation of Nature's (IUCN) Thematic Group for Sustainable Use and Management of Ecosystems, the European Sustainable Use Group and the Science and Technology Advisory Committee for the Langholm project on Grouse and Raptors. Robert promotes conservation through enhancing sustainable use of wild species and their ecosystems, now specialising in multilingual software to inspire and inform practitioners.

Robert has enjoyed a 40-year association with the IAF and is author of 200 scientific publications and three books which include *A Manual for Wildlife Radio Tagging* (2000) and *The Goshawk* (2006), the definitive work on the Goshawk that includes chapters on all aspects of their biology and conservation, combined with illuminating tales and insightful observations from extensive field research and time spent hunting with Goshawks for falconry.

Peter Jenny

After Serving 10 years as The Peregrine Fund's President and CEO, Peter Jenny retired in June 2016. Mr Jenny has been associated with The Peregrine Fund since the organization's beginning. In 1970, he accompanied one of the founding directors, Robert Berry, to the eastern Canadian Arctic to collect some of the first Peregrine Falcons to be used for captive breeding in the US. Once captive breeding was successful, Peter worked at one of the early release sites on the Susquehanna River in Pennsylvania. After graduating from the University of Montana with a Bachelor's Degree in Zoology, Peter pioneered The Peregrine Fund's involvement in the Neotropics with his research on the rare Orange-breasted Falcon and subsequently co-founded the Maya Project with Bill Burnham.

During his 18-year tenure as The Peregrine Fund's Vice President, Peter divided his time between managing the Northern Aplomado Falcon Restoration project and program development. A staunch advocate of collaborative approaches to conservation and private sector participation, Peter enrolled over 2 million acres of private land in support of the Northern Aplomado Falcon recovery and was instrumental in gaining federal and state approval for the resumption of a passage Peregrine harvest for falconry in the United States. A passionate falconer, Peter also enjoys bird hunting, running English Setters, fly-fishing, sailing, and flying his 1947 Stinson.

Guy Palmer

Recently retired, Guy Palmer spent 45 years working in conservation in the Western Cape Province, mostly in the Scientific Services section of the Western Cape Nature Conservation Board. He was involved in numerous studies and publications including several dealing with the prey selection of the large eagles of the area (Black, Martial, Crowned and Fish Eagle), as well as the Osprey and Barn, Cape and Giant Eagle Owls. This led to becoming involved with the development of the first falconry policy with Dr Adrian Lombard and others in the 1990s. He remained directly involved with the development and management of falconry in the province until his retirement. Alongside this he has been involved in most aspects of conservation ecology ranging from fire management to alien invasive species control, sitting on numerous advisory and management committees.

He has also been intimately involved in the successful submission to UNESCO of a nomination for the Cape Floral Region Protected Areas, World Heritage Site. This was recently extended and now covers over 1 million hectares of protected areas. He remains involved in world heritage initiatives through UNESCO, IUCN/WCPA and the Africa World Heritage Fund amongst several other things.

Dr Nick Fox, O.B.E.

Nick Fox is a conservationist, author, farmer, falconer and raptor biologist with research on New Zealand Falcons, Australasian Harriers, Northern Goshawks, Mauritius Kestrels, Red Kites, Saker Falcons and Peregrine Falcons. As Director of International Wildlife Consultants (IWC), Nick is involved in all aspects of research, breeding, conservation, heritage, event management and education. He is the author of several books and films on raptor management. His books include the best-selling *Understanding the Bird of Prey*, *A Global Strategy for the Conservation of Falcons and Houbara*, *Classical Falconry* and the book and film *Falconry – Celebrating a Living Heritage* for the UNESCO submission. He has contributed to many films and documentaries, and produced 17 films on Birds of Prey and one on animal welfare.

He is Chairman of the Falconry Heritage Trust (FHT) and the Bevis Trust, and together with his wife Barbro, breeds falcons and manages a number of farms in South Wales. He did his PhD on New Zealand Falcons and was awarded the OBE for services to Falconry and Raptor Conservation. He led the international effort to inscribe Falconry on the UNESCO Representative List of the Intangible Cultural Heritage of Mankind and has organised the first four International Festivals of Falconry. A falconer all his life, Nick has run the Northumberland Crow Falcons since 1991. This is the oldest mounted Falconry group in the UK. Nick's hobbies include planting trees, digging ponds, reintroducing lost species, designing houses and radio-controlled birds.

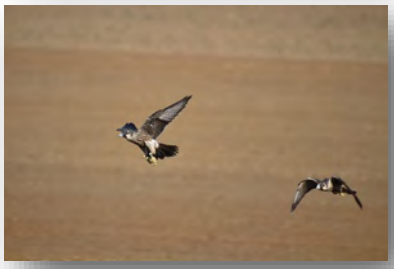
Speaker Profiles

Soňa Tomková, Czech Republic

Soňa learned falconry in Great Britain with Terry Large 23 years ago. She then completed her education in Charles University – studying biology (ornithology and ethology), geography and conservation. Since graduating, she has educated people about falconry and conservation - initially adults and adolescents, but as her professional career developed, she developed programmes for kids – she is a Director a Family Centre and Centre for Education. She now implements courses on global responsibility at the Family Centre (courses are offered at three different levels – pre-schoolers, students and adults) where a big part takes falconry as an example of sustainable use of wild animals and the role of falconers in conservation. Soňa is a board member of the Czech Falconry Club, with responsibility for professional liaison, education and the hawk register (2015-2017).

Ricardo Padilla Borja, Mexico

Ricardo has been engaged in falconry since 1986. He is one of the founders of the Federación Mexicana de Halconería A.C. and he was formerly president the regional falconry group Grupo Cetrero de Toluca A.C. Ricardo has been involved in the conservation of birds of prey since 1991 and currently works as a teacher of falconry and conservation in a Slovakian Primary School and leads projects on falconry education for future generations. He has a passion and special interest hawking with Merlins.



Opening Address and Welcome
- Dr Adrian Lombard

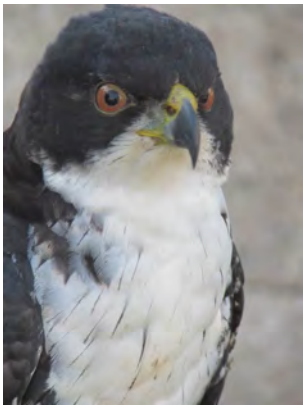
The **Convention on Biological Diversity** (**CBD**), has three main goals:

1. Conservation of biological diversity;

2. Sustainable use of its components; and

3. Fair and equitable sharing of benefits arising from genetic resources.

This Convention recognizes that, in order to halt biodiversity loss, some measure of conservation must be applied to at least 50% of the world's land surface area. Currently, some 10% of land surface area is formally conserved and this could be extended to 12 to 15%. How then can 50% be achieved? It is proposed that a measure of conservation can be achieved through encouraging sustainable use as those who use the elements of biodiversity will value and preserve these elements.



(Above): Black Sparrowhawk

It is necessary to define what is meant by "sustainable use" and best definition that I have found states that "Sustainable Use is use of wildlife associated with a process aimed at ensuring that the use can continue indefinitely and that any adverse effects can be confined within defined limits". This definition does not presume that reserves be maintained at maximal levels or that the effect of use is so minimal that it cannot be measured on the population levels.

In order for this to be achieved, however:

- Firstly there must be good conservation measures in place.
- Secondly, some concept of ownership of the resource is necessary to avoid a "tragedy of the commons" situation.

The principle that sustainable use is a conservation tool is not universally accepted. There are a large body of conservationists whose philosophies are protectionist-based and tragically this is a remnant of the pervasive conservation policies of a century ago. These protectionist principles are superficially logical and find easy acceptance amongst urban dwellers. They also find strong support from those with an animal rights leaning. It is to be regretted that conservation policies are not always based on good science and are often driven by popular sentiment. This occurs despite the very persuasive real-life examples which are available to us. Comparison of the results of protectionist versus sustainable use policies demonstrate this most dramatically if one examines the changes in numbers of large game animals in Kenya and South Africa. Sustainable use has seen the populations of large game animals increase from half a million head to over 20 million in South Africa whilst a protectionist, non-consumptive policy has seen a decline in large game in Kenya by exactly the same proportion.

(Below): Jackal Buzzard

Falconers are a unique sustainable-use group as their use extends beyond a single species and even beyond use of quarry species and the environment, as with most hunters and fishermen, but also extends to the raptors with which we work. So we find falcon-

ers, all over the world involved in conservation efforts. All falconers, as a general rule, have a fascination with raptors; so their contribution to conservation will extend beyond the raptor species of falconry interest. The conservation efforts of falconers also extend to conservation of the quarry species and of the environment within which they hunt. This has benefits for all of the biodiversity occurring within that environment. These conservation activities are wide-ranging and include: scientific studies and population monitoring, the development of legislation and enforcement of regulations, education and out-reach, as well as rehabilitation and restoration. The IAF supports and encourages falconers to participate in all of these aspects of conservation work as well as contributing, itself, in these same aspects, on a regional and global level.

Falconers obtain the raptors with which they hunt from captive breeding or from the wild. A wild harvest of raptors is permitted or accepted in a wide range of countries around the world. The access to wild raptors will depend on the policies of the nation involved, on the numbers of falconers within the nation and the accessibility of suitable raptors. We are currently living in a golden age of falconry where there are far more falconers than ever before so it is not reasonable to propose that all falconry raptors should be derived from a wild harvest. We will hear if this dependence on a wild harvest is practical and possibly desirable in some countries. Captive breeding is an essential source of raptors for today's falconers, but there are cogent reasons why it should not be considered or enforced as the only source. The reasons for enabling a sustainable wild harvest of suitable raptors would include:

- The access to a wild harvest engages falconers in the conservation effort and encourages their contribution.

- Wild-sourced raptors are necessary to maintain genetic diversity in captive-breeding stocks. This is particularly relevant if these captive stocks are seen as a resource which is valuable for restoration in the event of catastrophic declines of wild populations (as with the Peregrine).

- There is no real substitute for passage birds which have developed hunting and flying skills which are difficult or even impossible to match in most captive-bred birds. It is reasonable, given acceptance of the principles of sustainable use, for falconers to aspire to fly a passage bird if they have the requisite skills and facilities.

Where falconers are legally permitted a wild harvest, their use is held way below a level which would fit the definition of sustainable use. In some cases, population modelling is used to determine that their use is undetectable in the wild population. We have no argument with this. Within this conference, our task is to justify a broader acceptance of the principle of a permitted wild harvest. We need to examine the requirements of the European Union Wild Birds Directive which states in *Article 9* .1. *Member States may derogate from the provisions of Articles 5 to 8, where there is no other satisfactory solution, for the following reasons*:

b) for the purposes of research and teaching, of re-population, of re-introduction and for the breeding necessary for these purposes;

(c) to permit, under strictly supervised conditions and on a selective basis, the capture, keeping or other judicious use of certain birds in small numbers.

Opening Address and Welcome - Dr Adrian Lombard

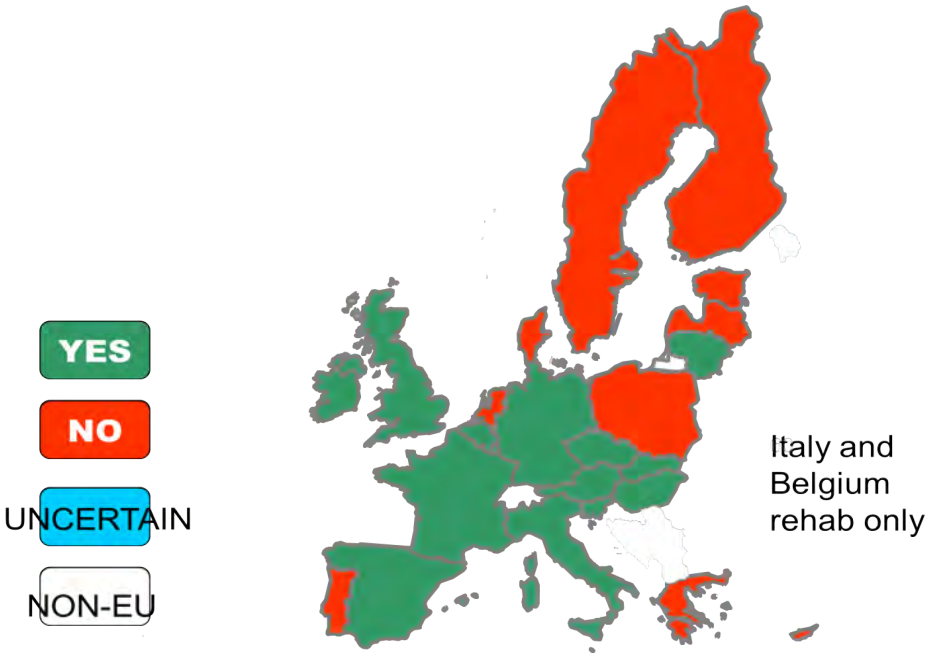
We have gathered within this conference a diverse group of individuals with considerable knowledge and skills. This is a unique opportunity to address these issues which are very close to the hearts of all falconers, not least to the hearts of our hosts from the Irish Hawking Club.

Adrian Lombard
November 2016

Setting the Scene: Introduction on Behalf of the Irish Hawking Club

In 42 countries on four continents, wild raptor populations of birds used in falconry are in such healthy numbers that a sustainable wild take is permitted (IAF, 2009). This wild use or wild harvest, as it is sometimes referred to, is in accordance with the terms of international conventions and the scientific principles governing those conventions. In these countries and in 21 others, falconers are either leaders in, or contributors to, re-habilitation and conservation projects involving both falconry and non-falconry species of birds of prey and their prey species. In France, Poland, Slovakia and Germany, the national falconry clubs are officially recognised by their governments as wildlife conser-vation organisations.

Figure 1: IAF Survey 2009 - Are you, in any region of your country, permitted to use wild-taken raptors for falconry (either eyass, passage or rehabilitated)?



However, while custom and practice in many of these countries has estab-lished wild take, one should not take it for granted. At all times it should be considered in the context of the overall health of the environment and the potential impact wild take might have, if any, on the wild population.

In the weeks leading up to this conference, the World Wildlife Fund (WWF) published its *Living Planet Report 2016: Risk and Resilience in a New Era*, in which it stated that on average, monitored species population abundance declined by 58% between 1970 and 2012. This information was sourced from the Global Living Planet Index which relies on 3,000 data sources and the tracking of over 14,000 species of vertebrate. The Report finds that by 2020, even with United Nations targets to halt the decline of biodiversity, species populations may have declined by on average 67% over the last half a century.

Around the same time as the publication of the *Living Planet Report*, Ireland's Environmental Protection Agency published its Sixth *State of the Environment Report*, in which it highlighted that:

- Just over a half of all the species in Ireland protected under the EU Habitats Directive are in a favourable condition.
- Only 9% of the protected habitats that many species need to survive are in a favourable condition.
- There has been a dramatic reduction in the number of our "pristine" rivers, with only 21 sites now classified as such compared to over 500 in the late 1980s.

The *Living Planet Report* states that monitored species are increasingly affected by pressures from unsustainable agriculture, fisheries, mining and other human activities that contribute to habitat loss and degradation, overexploitation, climate change and pollution. Humanity currently needs the regenerative capacity of 1.6 Earths to provide the goods and services we use each year and increasingly people are the victims of the deteriorating state of nature.

The report identifies the key threats from human activities that impact on the planet through unsustainable resource use, and these include: habitat loss and degradation, species over-exploitation, pollution, invasive species and disease, and climate change. The WWF believes that redirecting our path toward sustainability requires immediate fundamental changes in two important systems: energy and food – these are the most critical and have led to the most significant impacts on wildlife species and biodiversity.

Species overexploitation is highlighted – both direct overexploitation from unsustainable hunting, poaching or harvesting, or indirect overexploitation, such as when non-target species are killed unintentionally (such as the bycatch from fishing). Legal wild take, as it operates in Europe, the United States and South Africa, does not lead to overexploitation and as will be demonstrated, has a negligible impact on wild bird populations. The conference speakers advocate: a respect for the environment; conservation efforts to protect species and their habitats; the monitoring of raptor and prey species; the rehabilitation of injured birds of prey and the stewardship of biodiversity – both through direct conservation efforts, advances in genetics and/or educational programmes that create awareness and respect for the environment.

Setting the Scene: Introduction on Behalf of the Irish Hawking Club

Ultimately, a sustainable wild-harvest system can only operate in the context of a healthy wild bird population and a number of examples that demonstrate this approach are reflected in the conference proceedings.

The WWF advocates transitioning towards a resilient planet; this entails a transformation in which human development is decoupled from environmental degradation and social exclusion. This requires a transformation in terms of the way in which we think about problems and act upon them. New and revised principles and approaches are being advocated such as 'citizen science', 'green infrastructure', 'ecosystem services', 'natural capital' and 'biocapacity'. A principle advocated by the IAF and explored further in our conference (refer to the papers by Robert Kenward and Andrew Dixon) is the principle of 'Conservation through Sustainable Use'. Falconers – through sustainable wild take – can and are part of this conservation story/paradigm. As Albert Einstein said, '*we cannot solve our problems with the same thinking we used when we created them*'. Falconers have to be part of the solution.

As we move into an increasingly urbanised and consumptive society, where the divide between urban and rural becomes increasingly blurred and rural landscapes are transformed by urban demands for food, water, natural resources and energy (largely sourced in rural areas), wildlife and amenity is seen as secondary to making a livelihood, commercial interests or greater exploitation of resources in the light of global competition. This increasingly urbanised society is increasingly anti-hunting – and by association, anti-falconry. Yet hunters (and falconers) are likely to have a better understanding of nature, habitats and biodiversity; they are likely to have a better appreciation and love of the outdoors.

Yet falconry and the act of wild take is a special and sacred act that intrinsically connects us to the earth and the sky. Falconry is the art of hunting quarry in its wild state with a trained bird of prey. This is what we seek to protect, a part of our heritage that we wish to pass on to future generations. Falconry has a low impact on prey species (less than any wild bird of prey), and as such it is the greenest of the hunting sports.

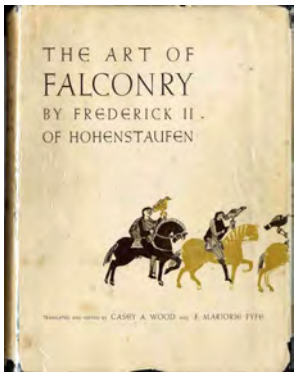
Derek Ratcliffe in his masterpiece *The Peregrine Falcon* (1980) refers to falconry, and in particular an '*irregular fringe created by those who bend or break the law... the lawless fringe has, however, continued to tarnish the image of falconry*'. There appears to be a perception, and among some, a negative perception – either conscious or unconscious – about falconers and the role they can play in conservation efforts. All our actions contribute to these perceptions – how we hunt, what we hunt, our birds' mews and accommodation,

Which group are more likely to have a good understanding of nature, habitat and biodiversity? Which group are likely to have a greater appreciation and love of the outdoors? Who are the key stakeholders and how can they help?

their health and condition – all shape the world's view and perception of falconry, and every falconer, whether affiliated to a club or not, has a duty of care to respect our falconry heritage and tradition. We must hunt in an ethical manner. As falconers, we are afforded a special insight into the world of birds of prey, a unique view and a tremendous knowledge of their capabilities and hunting strategies. This knowledge and appreciation has led to many developments of interest and benefit to conservation – from simple imping, rehabilitation techniques, breeding biology, captive breeding, artificial insemination and hacking-back into the wild. Some of these developments and initiatives and others are explored in the conference. The conference provides some great examples of the range of ways in which falconers can and have assisted in successful conservation efforts and the stewardship of the biodiversity.

Falconry as part of World Intangible Heritage

A presentation on the history of Falconry and Wild Take throughout the world based on the Falconry Heritage Trust (FHT) digital archive.
Jevgeni E Shergalin, Falconry Heritage Trust, PO Box 19, Carmarthen, SA33 5YL, UK.
fht@falcons.co.uk



On 16 November, 2010 in Nairobi, falconry was officially recognized as a part of Intangible Cultural Heritage under aegis of relevant UNESCO Convention. Five years before, in May, 2005 in England, during British Falconry Fair, the first inaugural meeting of the Falconry Heritage Trust (further FHT) was held. A group of well-known falconers concerned by rapid rates of disappearance of falconry skills and knowledge in different parts of the world established a non-commercial charity organisation registered in the UK but with a global coverage. Its main tasks include the collection, storage and accumulation of information on falconry history in all 75-80 countries of the world where falconry existed or exists now. The aim was complicated by the great diversity of languages and a great difference in income among different nations. In several countries such as Austria, France, Germany, Kazakhstan, Netherlands, Portugal, Russia and the United States there are already museums on falconry history with physical artefacts. In some countries, there are already exhibits on falconry history as part of hunting museums. Logistically, some of them are quite difficult to access. As a result, an idea was born – to set up a digital databank, open and free to everyone who is interested in falconry and its history. The main distinguishing feature of the FHT is the absence of physical artefacts in it – this Museum exists only in virtual cyberspace as a databank of pictures and descriptions of the real physical artefacts.

Funding of this organisation is carried out by means of an investment fund of £1million sterling, kindly donated in 2009 by HH Sheikh Mohammed bin Zayed bin Sultan Al-Nahyan who is the Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces. These funds have been invested in order to provide an annual return to cover our running costs, including grants and to provide for the future. This is not a bottomless fund and there are no other fundraising activities of the organisation hence this investment has to sustain the Charity for its lifetime. At the present time only one person has a salary – an archivist of FHT.

FHT provides grants of various size but it is usually up to $3,000 USD. Grants are provided to organizations and private persons who submit applications with a description of their project for the introduction of unknown sources and translation from foreign national languages into English – previously unknown manuscripts on falconry history for promotion of different falconry schools and perspectives from different regions of the world. Applications for grants are considered by the Board of FHT which consists of 12 people representing Belgium, Italy, Japan, Mongolia, the Netherlands, Taiwan, UK, and the USA. At the present time, the Chairman of FHT Board is the well-known British falconer Dr Nick Fox OBE. The Trust has a team of advisors consisting of 37 representatives from 37 countries. At this time, applications for grants have been granted to the UK (2), Germany (1), Ireland (1), Italy (1), Pakistan (2), Nepal (1), the Netherlands (2), Turkey (1), Ukraine (1), Croatia (1), and Japan (1). As of this date, the FHT has received only one application from the territory of the ex-USSR (Northern Eurasia) – a documentary on falconry in Georgia, shot by Ukrainian falconer Mykola Rud.

Artefacts are entered in the general database of *falconryheritage.com* by means of a system of key words and are classified by countries, types of artefacts, species of hunting birds of prey and age (century). At the present time, there are about 3,400 artefacts in the database. Artefacts are categorised by country and in the following way (in declining order) – **Europe:** UK – 218, France – 119, European part of the Russian Federation – 96; **Middle East:** Iran (Persia) – 32, UAE – 21, Saudi Arabia – 16, Qatar – 11; **Asia:** Kazakhstan – 80, India – 80, China – 68, Kyrgyzstan – 66, Japan – 48, Mongolia – 35; **North Africa:** Morocco – 18, Algeria – 15, Tunisia – 10; **North America:** USA – 60, Mexico – 7, and Canada – 5.

The complete pages of the website are divided by the following types of artefacts: Pictures – 293, photos – 292, art – 280, books – 116, falconry ammunition – 114, articles – 113, different other artefacts – 100, sculptures – 85, manuscripts – 22, post stamps – 16 and coins – 14.

Artefacts are distributed by groups of hunting birds of prey, so: Falcons – 780, hawks – 344, eagles – 262, and unidentified species – 206. The age distribution of artefacts is quite predictable: 20th Century – 604, 21st Century – 301, 17th Century – 154, 18th Century – 126, and the 16th Century – 85.

The 17th Century is represented better than the 18th Century as falconry began to decline with the advance of firearms. We know particularly little about the history of falconry in Russia during the 11th-15th Centuries due to a very limited number of preserved documents and chronicles. In Russia, Moscow Princedom and Pomorie (the north around Murmansk and Arkhangelsk) are represented the best of all while data in Muslim nations of Russia (Bashkkirians, Dagestanians, Ingushetians, Tatarians and Chechenians) are very incomplete and fragmented. Descriptions are discovered not only in ornithological texts but in ethnographical sources, a wide range of literature on hunting, travel diaries, and history of art. There is a unique collection of photographs on falconry history in the photo collection of the Museum of Anthropology and Ethnography in the Russian Academy of Sciences in St Petersburg. Interesting and unexpected artefacts are popping up more and more often at auctions and in private art collections.

Circulation of information on new artefacts is carried out by means of FHT Facebook (facebook.com/falconryheritagetrust) where updates appear almost every day. This page has already 4,100 friends and numbers continue to grow. In June 2013, the FHT became a corresponding member of IAF.

The main obstacle in establishing an extensive database is copyright. The complicated laws associated with a very diverse range of countries does not permit the uploading of many images for public viewing and access. This is true in relation to text or pictures from books younger than 70-80 years. However, these rules are not applied to the photographing of the separate artefacts in museums by means of smartphones without flash as a rule (which is strictly forbidden).

Results of databank filling in the first years of work allowed us to make some preliminary

conclusions. We know very little from former French colonies in Northern Africa and formerly closed countries for foreigners (in the past) such as Japan, Korea and China, which historically possessed a very rich falconry heritage. We know a little from Afghanistan and western countries of the Arabian Peninsula (Lebanon, Israel, Jordan, Iraq), south-east of this peninsula (Yemen, Oman) and the eastern part of Northern Africa (Egypt, Libya). We do not know enough about the falconry history in the countries of the Balkan Peninsula.

Since 2008, a group of French researchers (Dr Patrick Paillat and Catherine Tsagarakis-Ostrowski) have led a research project which is being prepared for publication of the ancient Arabic manuscripts on falconry. The Germans and the Austrians know their falconry history quite well. The British falconers have known their falconry history mainly owing to three books written and published in the 1980s by the well-known British falconer Roger Upton OBE. His son, the falconer and artist Mark Upton, is a head of the British and Irish Archives of Falconry, a recently established organisation for the preservation of falconry history in Britain and Ireland.

FHT participated in scientific conferences on the Gyrfalcon in Boise, USA in January 2011 (Shergalin 2011a); the history of falconry in the countries of Scandinavia and Northern Europe in Gottorf, Germany in March 2014; a conference on falconry history and biodiversity conservation in Suprasl, Poland in October 2015, and a conference on falconry history in the Mediterranean Sea region in Abu Dhabi, UAE. The latter gathered together professional academic historians in November 2015. The FHT has been an active participant at all four International Festivals of Falconry, in 2007, 2009 (in the UK), 2011 and 2014 (in the UAE – Shergalin 2011b).

The FHT has published articles on falconry history in the Crimea (Шергалин 2008), in Trans-Caucasia (Shergalin 2011c) and North Caucasia and in neighbouring regions

(Шергалин 2014), and sets of illustrations on falconry history are published in *FALCO* – Newsletter of the Middle-Eastern Falcon Research Group from Uzbekistan (Shergalin 2014) and Kyrgyzstan (Shergalin 2015) (www.mefrg.org/falco.asp).

One of the most important projects of FHT started in 2012 and this is video interviews of the oldest and most respected falconers across the globe. The main purpose of this project is to simulate local national clubs to do such a job independently before it will be too late. Everything should be recorded on video or audio tape – achievements and victories of such experienced people and also their mistakes and failures and funny recollections. The minimum requirement is the recording of the interviews in their native language but the hope is that translations are then done to broaden access to them. In addition to direct interviews, FHT also encourages people to recollect some joint moments about the sport with the late people. The duration of the interview is usually 25-40 minutes but any deviations are possible. Interviews can be in the form of a monologue or as dialogue. The FHT has prepared a special list of the most typical questions, available at the website and/or upon request. So far, 23 interviews in 70 parts have been recorded from 23 falconers across 11 countries: Argentina, Belgium, Brazil, Colombia, Georgia, Ireland, Japan, Kazakhstan, Poland, Russia, USA, and Uzbekistan; and in four languages: English, Flemish, Russian and Spanish. Interviews are available to watch at FHT YouTube channel.

The FHT has prepared for publication a collection of memoires of falconers from the former USSR from the 1970s and 1980s.

The FHT is extremely grateful to all the people who support the organisation with their time, experience, skills, energy and enthusiasm. The enrichment of the databank of FHT completely depends on the initiative of all falconers. FHT would be delighted to receive any new images of any falconry artefacts, with gratitude.

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The Wild Take Experience in Ireland

Eoghan Ryan, B.A., M.R.U.P., M.Sc.

An overview of wild take in Ireland having regard to its European legislative context; the establishment of wild take in Ireland (its legal and regulatory context); how it operates in Ireland – and a comparison of population trends of wild raptors (subject to wild take licensing).

Legislative Context

The Wildlife Act, 1976 and the Wildlife (Amendment) Act, 2000, provides the legislative basis for protecting wildlife, habitats, biodiversity and for governing hunting, including falconry in Ireland. Irish Law, and in particular, Statutory Instrument (S.I) No. 8/1984 Wildlife Act, 1976 (Bird of Prey) Regulations 1984, clearly establishes the principle of wild take for the purposes of falconry.

Wild Take Species in Ireland

In the 1980s, the primary source of birds of prey for falconry in Ireland would have been wild take. Kestrels (*Falco tinnunculus*), sparrowhawks (*Accipiter nisus*) and peregrines (*Falco peregrinus*) were and are the typical species sought, with the very rare and occasional application for merlin (*Falco columbarius*) being granted. By way of context, the populations of other native Irish raptor species most typically used for falconry – namely Common Buzzard (*Buteo buteo*), Northern Goshawk (*Accipiter gentilis*) and Golden Eagle (*Aquila chrysaetos*) – have remained historically either very low or extinct. The population of buzzards in the 1970s and 1980s was extremely low but there was a gradual recolonization of the species over the past number of decades and the species is now widespread and found nationwide, with very high densities in some eastern coun-

ties. Although the Goshawk was a widespread raptor in medieval times and very popular for falconry, a combination of deforestation of native woodlands and persecution over the centuries has seen its number decline to single digits. The Golden Eagle became extinct around 1912, or shortly thereafter, but has been the subject of a reintroduction programme initiated by the Golden Eagle Trust (GET) since 2001.

Objective of Wild Take

When the Bird of Prey Regulations were first introduced to Ireland, wild take was the exclusive means by which the average falconer could obtain a bird and engage in falconry. However, since then there has been a growing interest in falconry, with an increase in the number of falconers participating in the activity. At the same time there has been significant advances in captive breeding, with the result that most falconers obtain their birds from captive-breeding projects (both hobby breeders and commercial breeders) and the vast majority of falconry birds are sourced in this manner. Nonetheless, the need and purpose of wild take in Ireland is still relevant for the following reasons:

- To ensure genetic diversity of breeding stock from within the Irish Peregrine gene pool.
- To minimize and reduce the risk of 'contamination' from imported captive-bred 'peregrines' that may have been bred from sub-species not native to Ireland (for example, F.p. calidus, F.p. brookei, F.p. anatum, etc.) or from species that may not have a 100% peregrine gene pool.
- To ensure that egg sizes and breed sizes are maintained (consistent with the Irish wild population). Burhan et al. (1984, as reported in Sielicki & Mizera, 2009, p. 739) reported observations of the eggs laid by a captive breeding peregrine decreasing in size over a period of years.
- The more freely available peregrines are within Ireland, the less demand there will be for both hybrids and non-native birds of prey. There is a very strong tendency for fewer hybrids to be produced or used in countries that provide sufficient numbers wild raptors for 4-20% of their falconers annually (IAF Survey 2000 & 2005).
- For the protection of flora and fauna. If there was another environmental disaster and a population crash similar to the 1960s DDT epidemic, then any reintroduction programme would be dependent on the captive population for propagation and release (as in the huge falconer-led initiatives to re-establish peregrines back into the wild in both the US and Europe). The genetic purity of the wild population would be highly desirable in such cases.

The number of falconers that successfully breed peregrines in Ireland is relatively small and requires significant investment in facilities, equipment, research and time (some breeding pairs can take several years to successfully breed in captivity). The number of those breeding merlins, sparrowhawks or kestrels in Ireland is low, and success is intermittent or sporadic. There has been no consistent, concerted effort to breed kestrels or sparrowhawks in recent years.

1. In an independant study of a wild peregrine population in North Rhine-Westphalia region of Germany, P. Wegner et al. (2009) found a significant deviation from the Hardy-Weinberg –equilibrium which confirmed the predicted low genetic variability in that area (Refer to P. Wegner et al. 'Development of an urban population of Peregrine Falcons in North Rhine-Westphalia, Germany: population status, nest site selection and some biological results,' 2009).

European Policy and Law – Establishing the Principles of Wild Take.

Council Directive 79/409/EEC on the Conservation of Wild Birds is a wide-ranging instrument aimed at the general conservation of wild birds in the European Union. This is its over-arching objective. Therefore, if we consider the issue of wild take of birds of prey in Ireland, the most fundamental issue is to ensure that the population of the species remains at healthy levels and that harvesting of species would not impinge, or negatively impact, on wild populations.

The Committee in its opinion on the proposal for a Council Directive on bird conservation of 25 May 1977 (O.J. N° C 152/3 of 29.6.77) stated "*2.8.1. The absence of a possibility of derogating in order to take birds of prey for falconry was noted. It was pointed out to the Commission that this was a legitimate and ancient sport, which if properly controlled, harmed neither birds of prey populations nor the populations of birds pursued in the course of falconry. Some provisions should be made therefore to allow the continuation of this on a controlled basis*".

In order to address these and other concerns and clarify matters relating to hunting, wise use, etc. the Council Directive 79/409/EEC on the Conservation of Wild Birds, did provide for derogations – allowing for wild take – and these are summarised within the document *Guide to Sustainable Hunting under the Birds Directive* (European Commission 6/01/2009; http://ec.europa.eu/environment/nature/conservation/wildbirds/hunting/docs/hunting_guide_en.pdf). The preamble of the document states that it will provide principal stakeholders with some security in terms of what they can expect and it provides the basis for exercising derogations, especially under Article 9. 1 (c).

The European Charter on Hunting and Biodiversity (2007), prepared by the Council of Europe and the Bern Convention (the Convention on the Conservation of European Wildlife and Natural Habitats), establishes the principles of 'Sustainable Hunting' and of 'Sustainable Harvest'. The Charter encourages hunter involvement in monitoring, management and research efforts directed towards stewardship and the conservation of wildlife and their habitat. It also promotes cooperation between hunters and other

stakeholders in the conservation and management of biodiversity. Principle 3 of the Charter also seeks to '*ensure that the harvest is ecologically sustainable*'.

Thus, the principle of wild take is well established in both European policy and law – in the Bern Convention/European Charter on Hunting and Biodiversity and in the derogations from Article 9 of the Birds Directive.

General Obligations arising from the Birds Directive

Article 2 contains the general obligation on Member States to '*take the requisite measures to maintain the population of the species referred to in Article 1 at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements, or to adapt the population of these species to that level*'.

Hence this article specifically requires Member States to take into account both 'cultural' as well as 'recreational requirements' when implementing measures to maintain the population of the relevant species. Falconry, as a cultural and recreational activity, should be noted in this context.

2. Technical considerations in conjunction with the potential application of an Autumn 2014 derogation for the live-capturing of Golden Plover (Pluvialis apricaria altifrons) and Song Thrush (Turdus philomelos)

Wild Birds Regulation Unit Parliamentary Secretariat for Agriculture, Fisheries and Animal Rights Ministry for Sustainable Development, the Environment and Climate Change May 2014

http://msdec.gov.mt/en/documents/downloads/wbru/spring%20hunting%202015/annex%20i%20-%20conservation%20status%20assessment.pdf

Article 10 requires Member States to encourage research and '*any work required as a basis for the protection, management **and use** of the population of all species of bird referred to in Article 1'*. The Court of Justice confirmed that this provision creates an obligation for Member States and has to be transposed and implemented in national domestic legal orders. Article 10, Annex V requires member states to 'assess the influence of **taking wild birds** on population levels'. European law therefore acknowledges the principles of both the use and the taking of wild birds.

The legal basis for the potential application of a derogation to allow a wild take for falconry is provided by Article 9(1)(c) of the Birds Directive, which allows Member States to derogate from the provisions of Articles 5, 6, 7 and 8, where there is no other satisfactory solution, to permit, under strictly supervised conditions and on a selective basis, the capture, keeping or other judicious use of certain birds in small numbers.

The key terms here are 'no other satisfactory solution', 'judicious use', 'selective basis' and 'certain birds in small numbers'.

No other Satisfactory Solution

In a previous technical consideration by the Wild Birds Regulation Unit (EU Parliamentary Secretariat) in connection with a derogation for the live capturing of Golden Plover (*Pluvialis apricaria altifrons*) and Song Thrush (*Turdus philomelos*), it determined:

> *'It is understood that the lack of any "other satisfactory solution" does not refer to the lack of any "satisfactory alternative", but to the lack of any acceptable and sufficiently appropriate (i.e. satisfactory) solution in relation to the objective pursued.'*

If we consider this paragraph in the context of Section 2, above (The Objective of Wild Take as espoused by this author), it is clear that the wild take process, as administered in Ireland, complies with the requirement of 'no other satisfactory solution.' Furthermore, in considering the issue of 'no other satisfactory solution', the Courts, with several qualifications, accepted the possibility of derogations to deal with problems of consanguinity and the lack of genetic diversity in captive bred stocks (Judgment of 12 December 1996, Ligue Royale Belge pour la Protection des Oiseaux ASBL and Société d'études Ornithologiques AVES ASBL v. Région Wallonne, case C-10/96, ECR 1996, p.6775. 46).

Judicious Use

The Guide to Sustainable Hunting under the Birds Directive, also deals with the issue of 'judicious use' (Section 2.4.7). Judicious use or wise use, as it is referred to 'implies sustainable use with an emphasis on maintaining populations of species at a favourable conservation status'. In the broader context of sustainable use of resources; the Guide states that;
'the concept of wise use needs not necessarily be limited to consumptive use. It must recognise that birdwatchers, nature lovers, scientists and society as a whole also have a legitimate right to enjoy or explore wildlife, as long as they exercise this right responsibly' (Section 2.4.10).
It is not unreasonable to include falconry groups like the Irish Hawking Club in this group of 'society as a whole'. The wild take system in Ireland represents a non-consumptive use of resources and it is a well-regulated system carried out responsibly and under strict licensing requirements.

Certain Birds in Small Numbers

While the derogation refers to 'certain birds', these are not specified in the Directive. In Case C-182/02, the Court stated (119) that the condition as to 'certain birds in small numbers… cannot be satisfied if a hunting derogation does not ensure the maintenance of the population of the species concerned at a satisfactory level'.

The Guide (Section 3.5.36) states that the 'overall annual mortality is an appropriate parameter to quantify small numbers because it takes population size, status and population dynamics into account. Within this framework "small numbers" should be considered as being any taking of around 1% of the annual mortality for species…'. The document also notes that the parameters of population dynamics are seldom known to within less than 1%, and bird taking to less than 1% can be ignored from a mathematical point of view in model studies.

Furthermore, it states in section 3.5.42;
'For abundant species with a favourable conservation status, taking in excess of the 1% threshold (up to 5% of annual mortality) may be considered following an in-depth scientific analysis by the competent authority which authorises the derogation. This would be in order to verify that the derogation is not incompatible with the objectives of the Directive'.

In the 'Second report [of the Commission] on the application of Directive 79/409/EEC on the conservation of wild birds' of November 24, 1993 (COM(93) 572 final), 'small numbers' are any sample of less than 1% of the total annual mortality rate of the population in ques-

3. The quantities are based on the work of the ORNIS Committee for the Adaptation to Technical and Scientific Progress under the Directive, instituted under Article 16 of the latter and consisting of representatives of the Member States.

4. The Guide notes that good management of populations can increase this yield.

tion (average value) for those species which are not to be hunted and a sample in the order of 1% for those species which may be hunted.

The Guide to Sustainable Hunting under the Birds Directive refers to the term 'maximum sustainable yield' (because of the vagaries in ecological systems, harvesting rates are usually set at a somewhat lower rate, which is defined as the optimal sustainable yield). It is worth considering this in the context of wild take in the US. The United States has a strong tradition of wild take for falconry and their Fish and Wildlife Department has prepared two Environmental Impact Assessments, one on Wild Take generally and the other on the Wild Take of the Peregrine Falcon (2008). The EIA has a section on 'Harvest Biology' in which it cites Millsop and Allen (2006) who concluded that the Maximum Sustained Yield (MSY) for a harvest of passage peregrine falcons in the US from a healthy, non-migratory population was about 17% of the first-year cohort. The EIA, concluded that a wild take of 5% of the productivity of wild peregrines in the US could be permitted. So while the United States has based its wild take criteria on productivity levels, the EU has based its criteria on the mortality rate (less than 1%). The US Fish and Wildlife Service Final Environmental Assessment concluded that **'the effect of a 5% level of take is so small that it would be undetectable in any population monitoring'**. When the wild harvesting of birds of prey for falconry in Ireland is therefore compared to that of the US, it is also very clear that the requirement of 'certain birds in low numbers' is most definitely met.

Strictly Supervised and Selective Basis

Article 9(1)(c) of the Directive requires that all derogations must be undertaken 'under strictly supervised conditions and on a selective basis' (Section 3.5.48). The Guide states that the principle of strictly supervised conditions implies that any use of this type of derogation must involve clear authorisations that **must be related to particular individuals, places, times and quantities**. (Section 3.5.49 refers). Each of these requirements is fully met by the regulatory system for wild take in Ireland.

Licenses are not handed out freely to anyone. Applications for wild take are submitted to the Wildlife Licensing Unit of the National Parks and Wildlife Service. There is a clear deadline for wild take applications (usually the end of January). Applications are distributed to the relevant Conservation District. The local Wildlife Ranger visits the falconer to ensure the premises (mews/aviaries) are adequate; that any birds currently in his/her possession are licensed and, where necessary, comply with relevant ringing, microchipping and/or CITES requirements; and satisfy him/herself that the falconer has the necessary equipment and experience to train the bird of prey and engage in falconry. The ranger has to recommend that the applicant can either take a bird from the wild (as for sparrowhawks and kestrels) or be entered into the draw (as in the case of peregrine wild-take applicants). Applicants have to identify where they wish to take a bird from (nest site and townland location). District Conservation Officers have to sign-off on the process. Landowner permission has to be sought. Before a bird can be taken from the wild, it must be established that there is at least three young in the nest and the Wildlife Ranger has to be present when the young bird is being taken from the nest.

In the case of applications for peregrines, there are additional requirements:

- Applicants who are in possession of more than one peregrine falcon taken from the wild in Ireland (excluding injured) will not be included in the draw;
- Applicants must be resident in the jurisdiction;
- Applicants must not have been granted a taking license for peregrine falcons within the previous three years (three draws);
- Applicants from family members with a single address will be treated as a single application (in the interests of fairness);
- Micro-chipped requirement for identification purposes.

It is clear that the process is administered under 'strictly supervised conditions and on a selective basis.' In granting licenses, it appears that the NPWS Officials, administrators, DCOs and rangers rely on raptor monitoring data and/or persecution levels to determine that the wild bird population is healthy and to discriminate between different nest sites and areas.

It should be noted, however, that the issue of poor productivity in some counties, some years, has been used by officials to prevent the taking from certain areas in subsequent years – yet the falconry community are not provided with this knowledge prior to application stage and there is no such data available. However, Ratcliffe (1980) notes that '*breeding performance varied widely in different parts of Britain and Ireland*' and '*there is a great deal of variability in output of young from place to place'* (p.240) and in effect the higher productivity of some sites '*compensate for the heavy failure rates in the less successful districts'* (p. 241).

Year	Kestrel Wild Take		Sparrowhawk Wild Take		Peregrine Wild Take		
	Licenses Issued by NPWS	Licenses Fulfilled	Licenses Issued by NPWS	Licenses Fulfilled	No. of Applicants	Licenses Issued by NPWS	Licenses Fulfilled
2016	1	Note	11	Note	29	3	2
2015	1	0	5	2	29	1	1
2014	0	0	5	2	25	4	4
2013	3	1	14	3	22	5	3
2012	5	1	14	2	31	3	2
2011	2	0	13	3	37	5	4
2010	2	0	15	0	46	4	4
2009	0	0	6	0	41	5	4
2008	0	0	14	0	24	5	2
2007	3	1	12	0	24	4	3
2006	1	0	8	2	No Records	5	1
2005	1	0	10	0	No Records	5	1
2004	2	0	10	1	29	5	5
2003	1	0	13	2	28	5	2
2002	2	0	9	1	24	5	2
Averages	1.6	**0.2**	10.6	**1.2**	26	4.2	**2.6**

Table 1: Wild Take Licenses Issued and Fulfilled by the National Parks and Wildlife Service, 2002-2016. (Source: NPWS, 2012 and 2016)

(Above): **Dead Kestrel – Juvenile, first-year bird, suspected road kill. Found near the author's home in October, 2016. By comparison to this one kestrel, just 3 kestrels were taken from the wild for falconry in the 15 year period between 2002 and 2016. Considering the high mortality of first-year birds of prey, wild take at such levels has no discernible impact on the overall population level.**

(Below): Dead Sparrowhawk – Juvenile Female, first year bird, road casualty found near the author's home in September, 2016. Its death is equivalent to an average of one sparrowhawk taken from the wild annually for the purposes of falconry. How many other raptors nationally succumb to death from impact with vehicles?

The Influence of Wild Take on Population Levels

Article 10, Annex V requires member states to 'assess the influence of **taking wild birds** on population levels'. It has already been highlighted that falconry has become more popular over the past two decades. Table 1 below outlines the number of licenses issued by the National Parks and Wildlife Service and the number of licenses fulfilled for kestrels, sparrowhawks and peregrines, annually for the 15 years 2002-2016. Information on the number of applicants each year for each species was also sought but was only provided for the peregrine.

The table shows up some interesting findings. In relation to applications for the kestrel, the number of applicants who were issued with licenses varies between 0 and 5. In 8 of the 15 years, there was between 0 and 1 licences granted; in 6 years, there were between 2 and 3 licenses granted, and in one exceptional year, there were 5 licences issued (though only one license was fulfilled). The average number of applicants issued with a license each year is just 1.6, but over the 15 years, there were just 3 birds taken from the wild, while the population estimate for the species is 10,000+ (and has been cited as between 12,100 and 21,220 breeding pairs by the NPWS in its National Summary for Article 12, 2012). Even taking the conservative population estimate, the impact on the population is just 0.002%, which is negligible.

The annual average number of sparrowhawk licenses issued is 10.6, but the number of these that are fulfilled is just 1.2. With an estimated sparrowhawk population of between 9,100 and 14,830, this represents just 0.013% of that population (taking the lower conservative figure and ignoring any offspring bred by those birds in the season that the birds are harvested). This has a negligible impact on the wild population.

The number of applications for peregrine wild take is significantly greater, and has ranged from 22 (in 2013) to 46 (in 2010). What is particularly interesting is the fact that the number of licenses actually granted annually varies. The falconry community had understood that 5 licenses were issued annually, but it has become clear that this is not the case, and the Department (NPWS) has failed to provide a rationale for this. Over the 15 years of data, the number of licenses issued has varied from 1, 3, 4 and 5. On average, 3.2 licenses are granted to take peregrines from the wild but only 2.6 licenses, on average, are fulfilled on an annual basis. With the breeding population estimated at 515 pairs, a conservative estimate would be an annual impact of 0.25% and this is without taking into account the non-breeding population (floaters) or the offspring fledged by those pairs in the breeding season.

There is an obvious discrepancy between the number of applications granted for species such as the sparrowhawk, in particular, and the number of licenses fulfilled. A lot of this can be accounted for by the fact that the license application for wild take has to be submitted by the end of January, and applicants may not be fully committed to the wild take of this species but appear to be 'hedging their bets'. As the year progresses, they change their mind, possibly due to the availability of captive-bred birds as the season advances (sparrowhawks being later breeders than the other species), work or family circumstances.

These wild harvest numbers and rates outlined above should be considered in the context of the high mortality of first-year raptors i.e. approximately 54% as cited in Craig et al., 2004. Another factor to be considered is that Conway et al. (1995) found higher survival rates for nestlings in eyries from which a sibling had been removed (this principle is well established and is one of the basic premises for reintroduction programmes in a process that takes from one nest site in one area to be hacked into the wild at a new site in another). When these two factors are taken into account in the context of actual licenses fulfilled, it becomes even clearer that there is a negligible impact from wild take, as administered in Ireland, on those species which are licensed for the purpose.

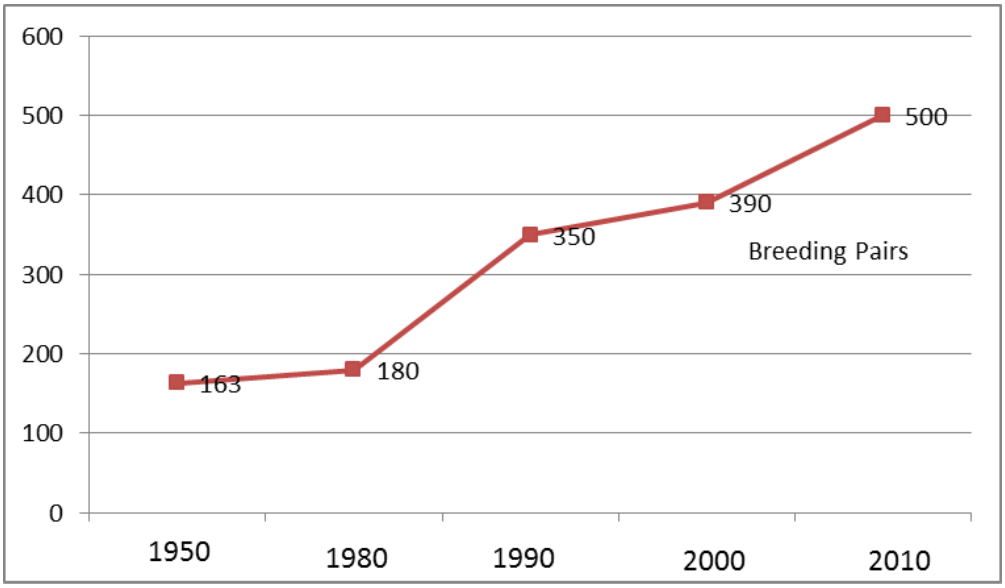
Peregrine Population Trends having regard to Wild Take

Table 2 (below) outlines the estimated number of breeding pairs of peregrines in Ireland from 1939 up to the present day. It is clear from the figures that over a 32-year period of harvesting peregrines (1980 – 2012), the population has grown considerably from an estimated 180-200 breeding pairs in 1980 (when the first licence was issued) to over 515 breeding pairs in 2012. It is therefore clearly evident that the provision of wild take has had no impact whatsoever on the wild peregrine population. The status of the peregrine under the BOCCI (Birds of Conservation Concern in Ireland) list, is 'Green' which means that their status is presently considered favourable.

Table 2: Estimated Number of Breeding Pairs of Peregrines in Ireland 1939 to 2012

Year/ Period	Estimated Number of Breeding Pairs of Peregrines	Source
1939-49	163	Ferguson-Lees as quoted by Ratcliffe, Derek, *The Peregrine Falcon*, T & AD Poyser Ltd., London, 1980 (ISBN - print - 978-1-4081-3684-3); though Ratcliffe believed that the pre-1950 estimate was 180-200 breeding pairs.
1980	180-200	Ratcliffe, Derek, *The Peregrine Falcon*, T & AD Poyser Ltd., London, 1980 (ISBN - print - 978-1-4081-3684-3).
1990	350-355	(Madden, B., Hunt, J., & Norriss, D., The 2002 Survey of the Peregrine *Falco Peregrine*s Breeding Population in the Republic of Ireland, *Irish Birds* 2009, Volume 8, 543-548);
2002	390	(Madden, B., Hunt, J., & Norriss, D., The 2002 Survey of the Peregrine *Falco Peregrine*s Breeding Population in the Republic of Ireland, *Irish Birds* 2009, Volume 8, 543-548);
2012	515+	National Parks and Wildlife Service, *Status and Trends of Ireland's Bird Species* - National Summary for Article 12 Reporting, NPWS, Ireland, 2012).

Figure 1: Peregrine Population Trends in Ireland (Breeding Pairs 1950-2010)



Country	Estimated Population	Geographical Area	Density (sq. kms that support a breeding pair)	Source/Chapter from Sielicki & Mizera, 2009.
Northern Ireland	80-100 pairs (Recent NIRSG figures exceed these numbers).	13,843	154	Wells, James H., & Ruddock, Marc, 'Population Dynamics of the Peregrine Falcon in Northern Ireland'
Ireland (Republic)	515+ breeding pairs	84,421	164	NPWS 2012
Italy	1100-1400 pairs (20% of European population)	301,230	241	Paolo Taranto, 'Status of the Peregrine Falcon in Italy'
Croatia	160-200 pairs.	56,594	314	Jelena Kralj, et al., 'Status and trends of the Peregrine in Croatia'
Austria	200-250 pairs	83,855	373	Anita Gamauf, et al., 'The Peregrine Falcon in Austria: population development and ecological requirements'

Country	Estimated Population	Geographical Area	Density (sq. kms that support a breeding pair)	Source/Chapter from Sielicki & Mizera, 2009.
Germany	Germany	1,000 pairs	357	P. Wegner et al., 'Development of an Urban population of Peregrine Falcons in North Rhine Westphalia, Germany'
Norway	Norway	800-1000 pairs (presumed)	428	Odd Frydenlund Steen, 'The Peregrine Falcon Recovery in SE Norway'
Armenia	Armenia	67 pairs approx. (56 pairs estimated in three regions but only 31 confirmed pairs)	444	Karen Aghababyan et al., 'On the breeding of Peregrine *Falco peregrinus brookei* in some regions of Armenia'
Slovakia	Slovakia	100+ pairs	490	Jozef Chavko et al., 'The population of Peregrine Falcon in Slovakia in 1994-2007'
France	France	1200-1250 pairs	551	Rene-Jean Monneret, 'Evolution and current situation of the Peregrine Falcon in France'
Bulgaria	Bulgaria	200 pairs	555	Dimitar Ragyov et al., 'Peregrine in Bulgaria – General Overview'
Finland	Finland	241 pairs	1,404	Tuomo Ollila, 'Status of the Peregrine Falcon in Finland 1993-2006'
European Russia	European Russia	1500-2000 pairs (of 3 peregrine subspecies *Falco peregrinus calidus*, *Falco p. peregrinus*, and *Falco p. Brookei*)	2,263	Ryabtsev, V. V. et al, 'Peregrine Falcon in the Baikal Region, Russia'

Table 3: Peregrine Population & Density – European Comparisons (Source: Sielicki & Mizera, 2009 and the NPWS, 2012).

Country	Estimated Population	Geographical Area	Density (sq. kms that support a breeding pair)	Source/Chapter from Sielicki & Mizera, 2009.
Romania	50-150 pairs estimated	238,931	2,389	Istvan Komaromi et al., 'The Status of the Peregrine Falcon in Romania'
Sweden	175 pairs	449,964	2,571	Peter Lindberg, 'The fall and rise of the Swedish Peregrine Falcon population'
Ukraine	120-130 pairs	603,628	4,829	Vetrov, V.V. et al., 'Distribution and Number of the Peregrine in Ukraine'
Hungary	12 pairs	93,030	7,753	Janos Bagyura et al., 'Status of Peregrine Population in Hungary 1964-2007'
Denmark	3 pairs (not all bred)	43,094	14,365	Niels Peter Andreasen, 'Distribution and present status of the Peregrine Falcon (in Denmark)'
Lithuania	4 pairs	65,200	16,300	Vilius Baranauskas & Darius Daugela, 'Peregrine Falcon in Lithuania'
Poland	10-20 pairs	312,685	20,846	Tadeusz Mizera and Janusz Sielicki, 'Breeding status of the Peregrine Falcon in Poland during the pre-and post-DDT era'
Belarus	0 - No evidence of breeding	207,600	207,600? (No evidence of Breeding).	Vladimir Ivanovsky & Alexander Vintchevski, 'Status of the Peregrine Falcon in Belarus'

Rescued Sparrowhawks: A clutch of Sparrowhawks that had their nest cut down in 2014 and were handed into a falconer. Of the five, one already had a broken leg and was put down, the other four were reared by the falconer, trained to hunt for themselves and three were released. A license to keep the forth was obtained after it had an unfortunate accident whilst being rehabilitated

When national breeding populations of peregrines in Ireland are compared to those of the rest of Europe, it is clear that Ireland and Northern Ireland have the strongest peregrine population in Europe. It is also worth mentioning that the species in Ireland is also non-migratory. Irish population estimates were derived from the NPWS, while all other European estimates were derived from Sielicki (2009). The geographical areas (square kilometres) were divided by the population estimate to give a relative density figure. A review of regional figures cited in Sielicki et al. revealed particularly high densities in more localised studies in the UK, and similar surveys and studies in Ireland would suggest very high densities in some areas of the country (with good agricultural land close to coasts and/or quarries for breeding) relative to lower densities in other areas (uplands, areas of higher rainfall rates and particularly where prey numbers have been reduced by over-grazing). Figures of somewhat higher peregrine densities in specific regions and areas are in-keeping with the findings of Ratcliffe (1980), and cited above, on the variable breeding success and the manner in which different geographical areas compensate for each other.

Low productivity levels tend to be around one (or less) successful fledglings per territory holding pair whereas in most sites (particularly lowland sites), higher successful fledgling rates are circa two young/territory holding pair/year. There have been regular recordings of four young in a nest and even five have been recorded. Ratcliffe (1984) cites a figure of 0.69 young/territory holding pair/year as the critical productivity level required to provide population stability. All known peregrine survey data results (made available to the author) from Ireland have consistently exceeded this figure despite poor productivity levels in years of poor Spring weather (NPWS, FOI, 2009).

5. The reasons for the high density of the peregrine population in Britain and Ireland can be attributed to the extensive coastline with suitable cliff faces; upland areas with cliff and escarpments; lowlying areas with quarries, historic buildings and other man made structures, however another important factor (relative to other countries) is the lack of competition for eyries from other cliff nesting falcon species, which are evident in other countries such as Long-legged Buzzards, Lanner and Saker Falcons (in southern and Eastern Europe) and the lack of predation from European Eagle Owls (as cited in Rathcliffe, 1980 and numerous other authors such as Ragyou in Bulgaria; Monneret in France; Wegner in Germany; Gamauf in Austria; Chavko in Slovakia); and Golden Eagles (as cited by Kozlowski, USA, 2009 and Rathcliffe, UK, 1980) both of which nest on cliff faces and provide direct competition for peregrines (references referred to in Sielicki and Mizera, 2009).

Conclusion:

There is a very high mortality rate for first-year birds in the wild. The hazards are many – tree-felling during the breeding season, busy roads and motorways, electrocution (from poorly insulated and designed transformers), wind farms, wire fences, poisoning and even deliberate shooting or destruction of nest sites. The casualties from these incidents, although difficult to measure, far exceeds the negligible impacts of a sustainable wild-take provision. The vast majority of falconers in Ireland become a natural point of contact with the public, vets and local wildlife rangers when an injured bird of prey is found and needs rehabilitation. Through 'wild take licensing', falconers are a user group but they also give back through their efforts and successful rehabilitations. Most of these cases go undocumented and incur a not insignificant amount of time and money (particularly veterinary fees). Falconers need to be more proactive in promoting this work. Birds taken from the wild and captive-bred specimens do get lost (despite the advances in telemetry) and are sometimes deliberately released back into the wild. In this way, there is a cyclical process. In this respect, falconers are a distinct group of people partaking in wild use whose process is not all one way.

This paper has outlined how the Irish model of wild take operates. It is a system that is not without faults or potential improvements. Despite this, the system has operated for 36 years and it operates in a tightly managed and controlled manner. It clearly demonstrates how a wild harvest system can operate within a framework of a European Directive, transposed into Irish Law and subject to particular policy criteria and at all times subject to a healthy wild raptor population. The paper has demonstrated how the model is sustainable, with no discernible impact whatsoever on wild populations of the Irish raptor species used in falconry. When compared to the US, the Irish model is a very conservative one and while the author is not proposing this, the population could withstand a considerably heavier annual harvest without any adverse effect.

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Population Modelling of Peregrines in Ireland

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Summary:
The simple arithmetic model was formulated which includes available population data. This model measures the population growth/decline, the level of acceptable mortality and sustainable use. It can be adjusted to any population data available and can predict future population dynamics. The model was previously used for modelling Saker populations in the process of the preparation of the Saker Global Action Plan (Kenward et al., 2013; Kovacs et al. 2014). The model provides the possibility to estimate population age structure and to calculate other indices necessary for stochastic models. Vortex 10 was used to confirm the results for the stochastic modelling of the Irish peregrine population.

The model fits the Irish peregrine population data for three points when such data is available – population sizes in 1970, 2002 and 2012. The harvest of peregrines at current level was also added to the model. The findings are that the safe level of future harvest could be at the level of 10% of chicks born, while the population will grow as it is now. Additionally, the stochastic model showed no risks to the population. The data confirms that the 5% level set in the US in the Millsap & Allen 2006 work seems to be a very conservative level and entirely safe if it were to be applied to the wild harvest in Ireland.

1. Introduction
Mathematical modelling of large raptors is very difficult, but gives the possibility to optimize conservation strategies and eventual sustainable-use level. The most commonly used programmes for modelling are prepared for rodents. Large birds of prey hold large territories, live in pairs, start breeding at a late age, have small numbers of offspring and live long. An additional difficulty is that population data for birds of prey is usually only the number of breeding pairs, not the whole population size, like in most mammal studies and models.

There is not much data on the peregrine population in Ireland – especially regarding productivity, mortality and population size over time. There are a few assumptions required to model the Irish peregrine population dynamics, namely population size, mortality rates and productivity. In the current model, the habitat capacity was not included as it seems that the population has not reached a limitation yet. The general assumption was made that peregrine populations are safe from DDT effect as they are growing worldwide and there is clear data that populations are recovering worldwide (Sielicki & Mizera 2009, Ambrose et al 2016).

2. Population data
The 1939-49 population size before the DDT crisis was estimated at 163 breeding pairs (Ferguson-Lees as quoted by Ratcliffe, 1980); though Rathcliffe believed that the pre-1950 estimate was 180-200 breeding pairs. Both figures are far lower than current population size.
Estimates for the population in 1970 are derived from *The Bird Atlas of UK and Ireland 2007-2011*, which displays Ireland as having a Breeding Distribution Change (since 1968-1972) of +276%. The estimated number for 1970 is thus 132 pairs.
In 1980, the population size was estimated at 180-200 breeding pairs (Ratcliffe, 1980).
In 1990, the population size was estimated at 350-355 (Madden et al., 2009).

- Data for the current Irish peregrine population is based on an official government document – The Article 12 submission to the EU in March 2014 (National Parks and Wildlife Service, 2012): "*The third and most recent survey of breeding peregrines in the Republic of Ireland was undertaken in 2002, which estimated 390 occupied breeding territories (Madden et al., 2009). Recent evidence has suggested that the population has increased since 2002 (See Balmer et al., 2013, Burke, 2012, O'Brien, 2013 and expert opinion by J Lusby). In the absence of a national survey, a contemporary national population estimate was derived by extrapolating from the recorded increase in breeding territories at study sites located in counties Mayo, Sligo and Wicklow, which were also surveyed as part of the 2002 national survey. The peregrine population is estimated to have increased by 32% since 2002 at these study sites. Applying this increase to the 2002 national population estimate, a contemporary population estimate of 515 occupied territories is calculated*."

3. Sielicki Excell modelling general assumptions for Ireland

To calculate the general population indices, an Excel model was used. This model includes population size, breeding population size, age structure of the population, productivity (clutch size) and survival rates, breeding age, life span and probability to breed for a single bird. All the data for modelling, except population size, is based on general literature on peregrines, not specifically the Irish population (as such data is not available).

Indices of mortality and productivity for the German population were used (Kleinstäuber et al., 2009).

The model should fit the modelled population to the following population sizes known from literature:

1970 – circa 132 pairs
1980 – circa 180 pairs
2002 – circa 390 pairs
2012 – circa 500 pairs

The figures for 1990 seem to be over-estimated, as they do not fit into model, while the other four points fix very well.

The first assumption on mortality of juveniles is 54%, as stated for the British population (Ratcliffe, 1993). The general assumption is that at 3+ years adults can breed, and their maximum life span is 18 years. All the other important indices are based on general peregrine biology. Indices for the model will be:

- Mortality of juveniles
- Mortality of sub-adults
- Mortality of adults
- Average clutch size
- Probability to breed for a single bird

It is assumed that mortality of adults and sub-adults is between 10% and 20%, average clutch size is just over 2 per successful pair, and probability to breed for a single adult is below 50%. The age structure is not flat and needs to be estimated. Model iterations were used to estimate a stable population structure. The full population structure of 1970 was recalculated, based on the structure of the stable population in following iterations.

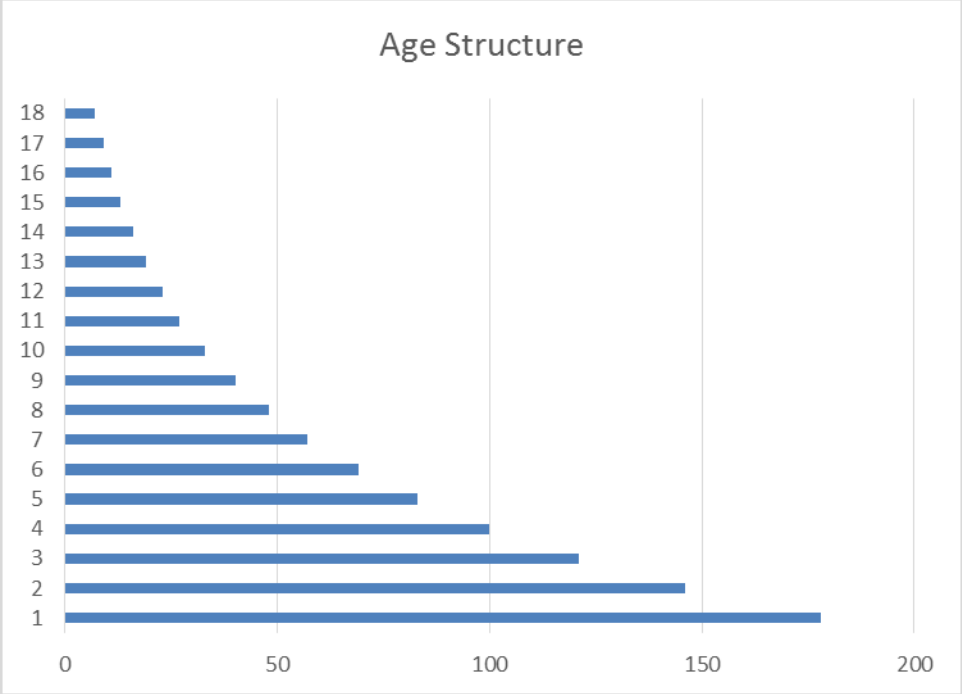


Fig. 1. General age structure of Irish peregrine population based on excel modelling

Modelling attempts with initial data show that the survival estimates and productivity in literature are underestimated. With such indices, the population will not grow to the levels observed in 2002 and 2012. As the indices should fit the population dynamics known from observations, the indices were recalculated. With the above assumptions, the model shows that mortality of young was a bit overestimated and productivity was underestimated.

Table 1: Population indices as result of recalculations taken into account for the next analyses

Survival rate 1 year	50%
Survival rate 2 year	84%
Survival rate 3+ year	86%
Probability to breed for a single adult	46%
Expected number of young per pair	2.40

Additionally, since 1985 every year 5 chicks were harvested in the model.

As a result, with the indices calculated, the total population size in 1970 is estimated at 132 pairs, 807 birds at the beginning of the season and 316 chicks born.
For 1980, the closest to population data of 180 pairs are: estimated number of 171 pairs, 1132 birds at the beginning of the season and 420 chicks born, 0 harvested.
For 2002 the closest to population data of 390 pairs are: estimated number of 374 pairs, 2412 birds at the beginning of the season and 897 chicks born, 5 harvested.
For 2002 the closest to population data of 500 pairs figures are: estimated of 512 pairs, 3295 birds at the beginning of the season and 1228 chicks born, 5 harvested.

4. The estimate of current Irish peregrine harvest rate

There are a few options available in calculating the harvest rate based on the number of chicks born, the general population size or general mortality. The Irish harvest of 5 peregrine chicks per year can be thus calculated for different approaches. For the population size and mortality, different assumptions can be used – the number of juveniles, adults or the whole population. 1985 was the first year of issuing licenses for wild use of peregrines in Ireland. The ORNIS Committee estimated the maximum harvest rate at 1%, but there is a lack of precise information about the basis for that calculation.

Table 5 shows different approaches of harvest rate.

Table 2: The 5 Peregrine Licences for Ireland in 1985 as an Index to Population Figures.

Bases for Calculation	Number in Population Model	5 chicks Harvest Rate
Estimated number of chicks born in this year	501	1.0%
Estimated mortality of juveniles	248	2.0%
Estimated mortality of breeders	135	3.7%
Estimated mortality of adults	201	2.5%
Estimated mortality total	449	1.1%

The calculation based on productivity and total mortality is the closest to the given 1% estimation for the 5 licences.

If we assume the level at 1% of productivity of the population, the current level for 2016 could be as high as 14-15 chicks – 1% of 1461 chicks born that year.

If we assume the level at 1% of total mortality of the population, the current level for 2016 could be as high as 13 chicks – 1% of 1316 birds which died that year.

On the above basis, the current level of peregrine population wild-use is far below population capacity.

5. Potential Population Safe Level of Chick Loss
With the given numbers, the population was modelled for the next generation. An additional element was added to the model – maximum capacity for the whole population. That figure was set at 1,000 pairs in the model. With this additional index, the population cannot grow without limit. With a growing population, the non-breeder level is growing. To test the maximum level of loss of the chicks in the population, different scenarios were tested. The idea is to find a level of chick loss at which population stabilises in future.

In the tested scenarios with 5%, 10%, 15% and 20% loss of chicks born, the population continues to grow. The model provided in this scenario, with a very high loss in the number of chicks born of potentially 22-23%, is the point at which the population is stabilised, not declining nor growing.

Those figures are added to the current natural mortality rate for juveniles, which already includes all losses caused by natural reasons, as well as those human-related causes which occur now and are specifically known.

Table 3: Population growth with different levels of chick loss

Initial population size (as in 2014)	Level of chick loss	Population size in 25 iterations	Trend
568 pairs, 1,358 chicks born, 3,659 adults	1% of born chicks	1,000 pairs, 2,400 chicks born, 7,538 adults	Population stabilised at maximum capacity level
568 pairs, 1,358 chicks born, 3659 adults	5% of born chicks	1,000 pairs, 2,400 chicks born, 7,097 adults	Population stabilised at maximum capacity level
568 pairs, 1,358 chicks born, 3659 adults	10% of born chicks	1,000 pairs, 2,400 chicks born, 6,255 adults	Population stabilised at maximum capacity level
568 pairs, 1,358 chicks born, 3659 adults	15% of born chicks	840 pairs, 2,016 chicks born, 5,200 adults	Population growing, will stabilises at maximum capacity level within another 14 seasons
568 pairs, 1,358 chicks born, 3,659 adults	20% of born chicks	703 pairs, 1,687 chicks born, 4,294 adults	Population slowly growing
568 pairs, 1,358 chicks born, 3,659 adults	22% of born chicks	654 pairs, 1,569 chicks born, 3,967 adults	Population stabilised, very slowly growing
568 pairs, 1,358 chicks born, 3,659 adults	23% of born chicks	630 pairs, 1,512 chicks born, 3,811 adults	Population stabilised, very slowly decreasing

These figures show how resistant the peregrine population in Ireland currently is. The 20%+ level of potential chick loss is a kind of insurance against loss of young due to human persecution, poisoning (direct and indirect), electrocution, collisions with man-made structures or transportation, etc. The potential falconry usage at the current level of 5 chicks per year represents circa 0.3% of the population productivity, which is 1.5% of the population's safe chick loss.

6. Vortex - Population Viability Analysis Software

Vortex (Lacy, Pollack, 2014) is an individual-based simulation of deterministic forces as well as demographic, environmental and genetic stochastic events on wildlife populations. It can model many of the extinction vortices that can threaten persistence of small populations. Vortex models population dynamics as discrete, sequential events that occur according to probabilities that are random variables following user-specified distributions. Vortex simulates a population by stepping through a series of events that describe an annual cycle of a typical sexually reproducing, diploid organism: mate selection, reproduction, mortality, increment of age by one year, dispersal among populations, removals, supplementation, and then truncation (if necessary) to the carrying capacity. The simulation of the population is iterated many times to generate the distribution of fates that the population might experience.

7. Vortex 10 Simulations of Irish Peregrine Population

As the Excel model does not include stochastic elements and does not include the possible "catastrophes", the model was tested in Vortex 10, the simulation programme, which is very popular for population dynamics studies. The Vortex gives estimations of probability of extinction of population with some characteristics. Vortex has many disadvantages from the point of view of modelling species like the peregrine. The main problem is that the model is based on the number of animals, not the number of pairs. It is therefore necessary to calculate the estimation of population structure.

Vortex does not give a possibility to set up a dynamic harvest rate, so the data was set based on the number of chicks in the first year. To simplify the model, the assumption of a 1,000 population size was made. 1,000 adults make circa 155 pairs and produce circa 340 young – this is roughly the 1980 situation.

Models tested differ in the level of chick loss, combining the wild-use harvest as well as other losses. Those figures are added to the current natural mortality rate for juveniles, which already includes all losses caused by natural reasons, as well as those human-related causes which occur now and are specifically known.

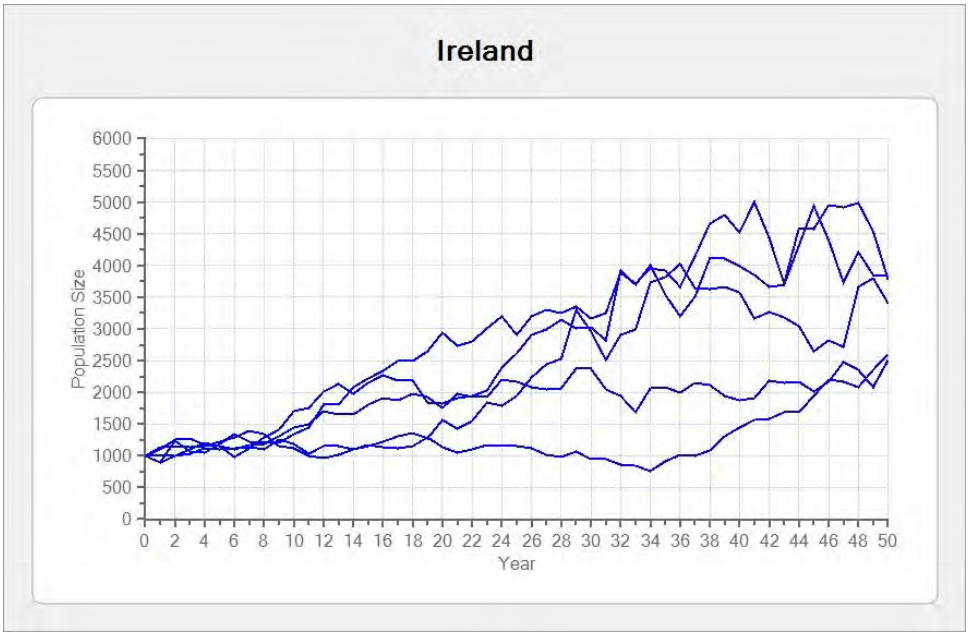
The following models were tested:

- 1st model – total loss of 4 young, circa 1% of total number of chick production.
- 2nd model - total loss of 17 young, circa 5% of total number of chick production.
- 3rd model - total loss of 34 young, circa 10% of total number of chick production.
- 4th model - total loss of 50 young, circa 15% of total number of chick production.
- 5th model - total loss of 68 young, circa 20% of total number of chick production.

The scenarios were tested for 50 years, 5 iterations for each scenario. The input data is the same as for the Excel model, plus the maximum size of brood was set at 4. The model does not include maximum capacity, so long-term population growth is never limited.

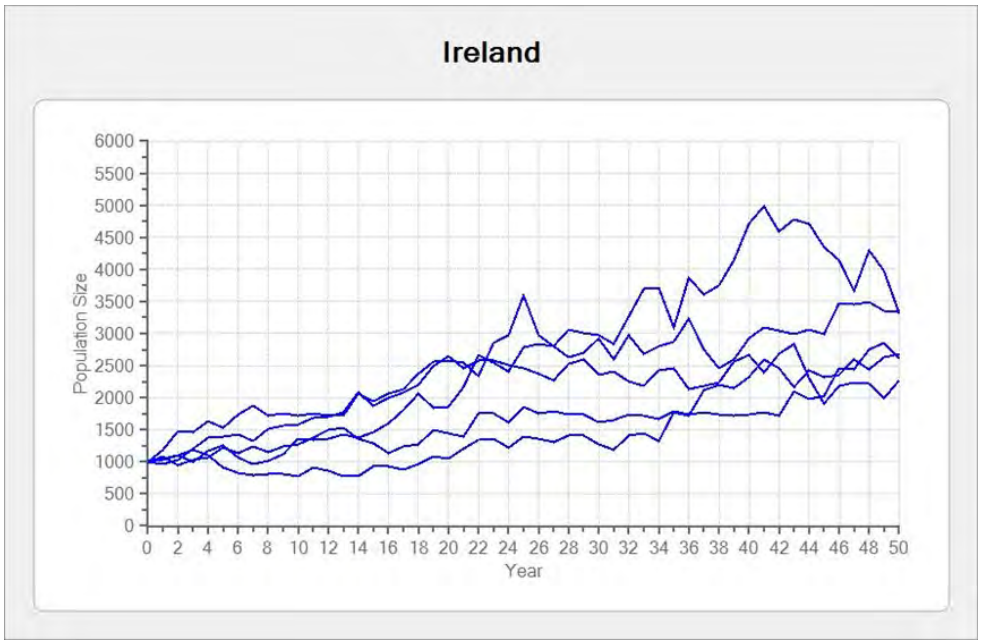
No chick-loss scenarios

The zero loss scenarios show strong long-term population growth, with average population size after 50 iterations at about 3,000-3,500 birds.



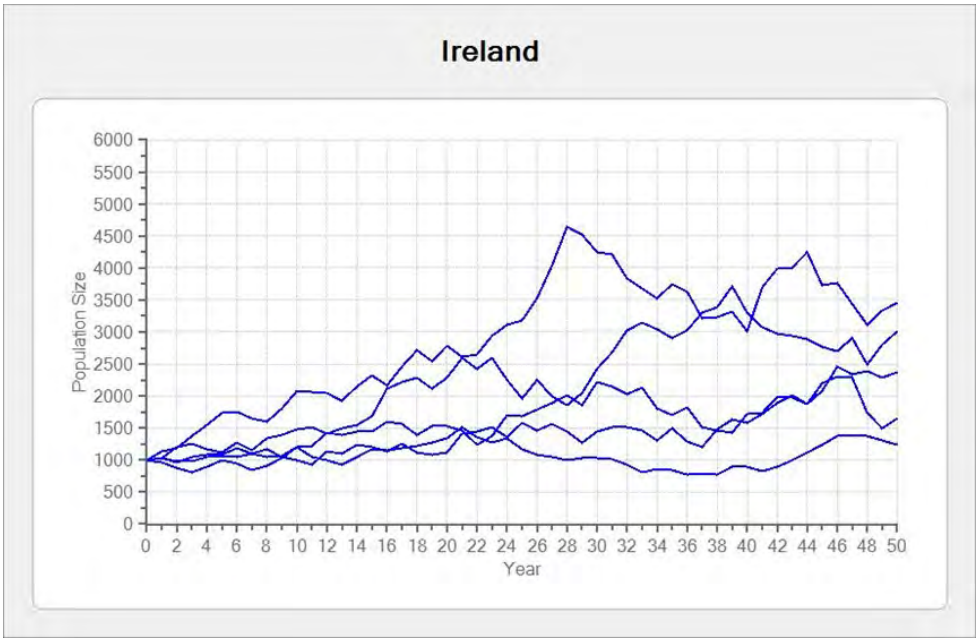
1% chick-loss scenarios

The 1% chick-loss scenarios are very close to the non-harvest lines. The 1% loss scenarios show strong long-term population growth, with average population size after 50 iterations at about 3,000 birds. This scenario is closest to the current level of wild Irish peregrine-use for falconry.



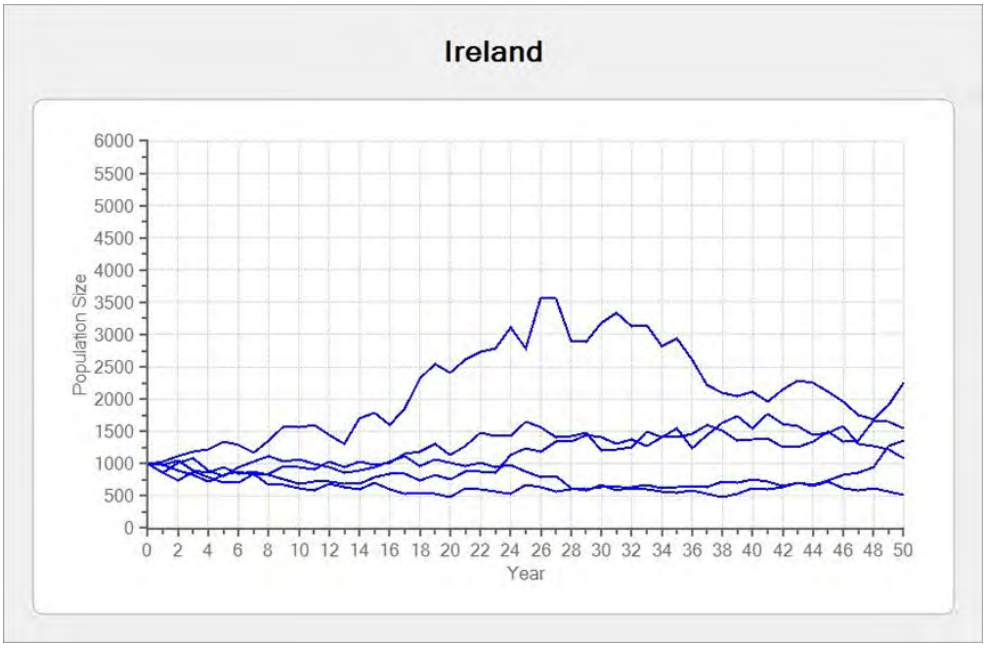
5% chick-loss scenarios

5% chick-loss scenarios also are very close to the non-harvest. The 5% loss scenarios show strong continuous population growth, with average population size after 50 iterations at about 2,500 birds.



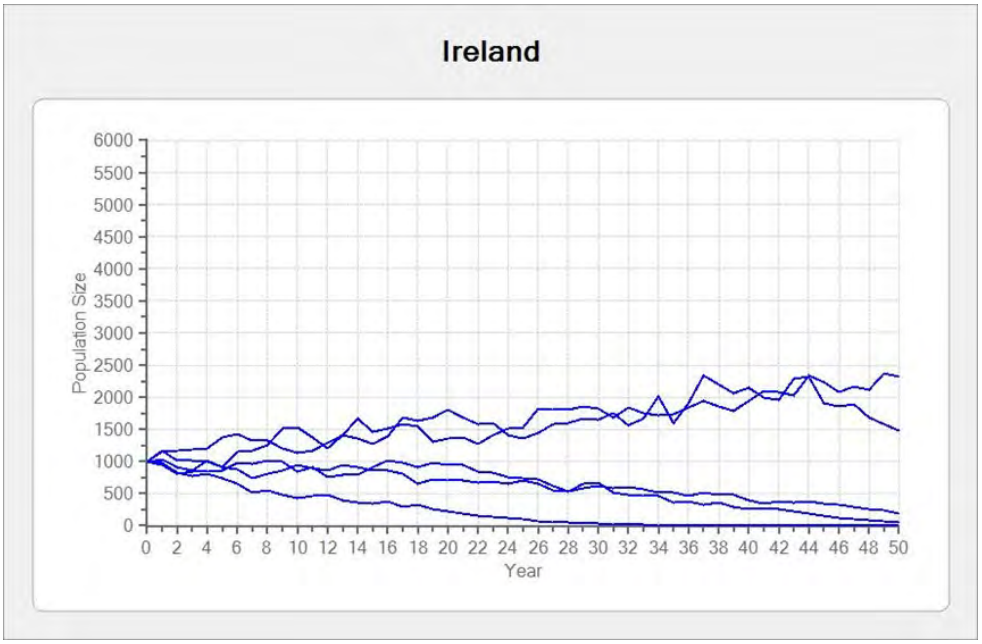
10% chick-loss scenarios

With 10% chick loss, some scenarios show the stabilisation of population. In some scenarios, the populations grows. The worst scenario gives the figure at around 500 birds after 50 iterations, with the average at around 1,250 birds.



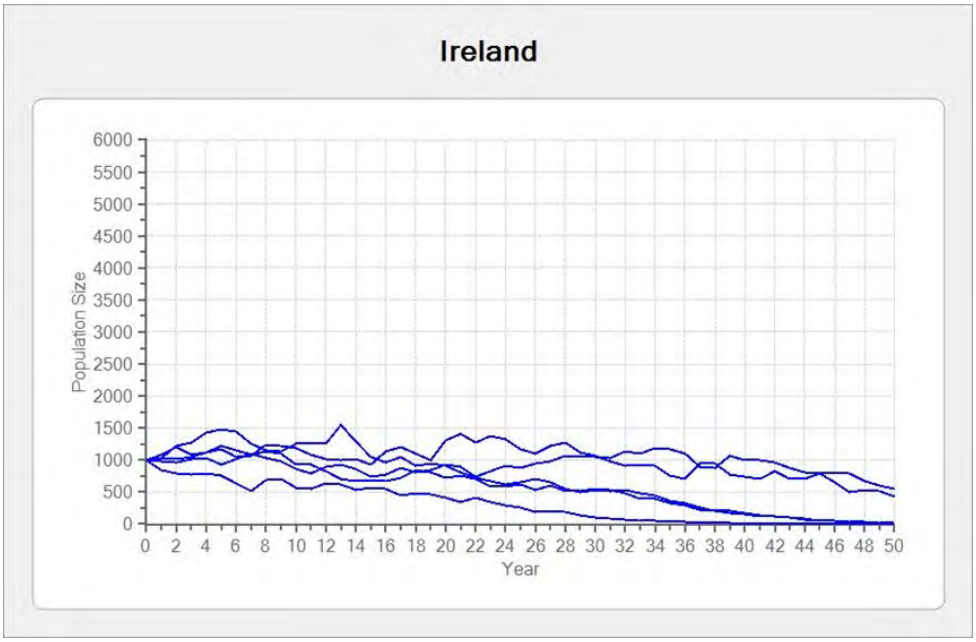
15% chick-loss scenario

The 15% chick-loss scenarios are more pessimistic, some of them showing population decline and some stabilisation.



20% chick-loss scenarios

The 20% chick-loss scenario is always showing a decline of population in the long term.



Summary of modelling the Irish Peregrine population

The Excel model and Vortex 10 models were compared, with the results suggesting that up to 22-23% of chicks reared can be additionally removed from the population and the population will continue its growth. With chick-loss rates of 15%, the population reaches the maximum capacity level in a short term.

Vortex scenarios of 0%, 1% and 5% chick loss always show growth in the population.

Vortex scenarios of 10% chick loss show moderate growth or stabilisation.

Vortex scenarios of 15% and 20% chick loss always show a decline in the population.

To summarise, the Vortex with added stochastic effects shows that a safe level of potential chick loss is half of the level estimated from the Excel model. It is important to repeat that the estimated safe chick-loss level is added to the current natural mortality rate for juveniles, which already includes all losses caused by natural reasons, as well as those human-related causes which occur now and are specifically known.

Current levels of wild use of peregrines for falconry (set at 5 chicks per year) is an extremely safe level for the population and does not negatively affect it in any options of the modelling.

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Falconry and the Restoration of the tree-nesting Peregrine Falcon in Poland 1990-2016

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Abstract

The tree-nesting population of the peregrine falcon *Falco peregrinus peregrinus* formerly inhabited a large part of Central and Eastern Europe. Its range covered northern-eastern Germany, eastern Denmark, Poland, southern Sweden and Finland, the Baltic States, Belarus, northern Ukraine and the lowlands of Russia up to the Ural Mountains. In the 1950s, peregrine populations drastically decreased through its whole worldwide range because of environmental contamination (mainly Persistent Organic Pollutants, including DDT). Some populations became extinct, including the whole tree-nesting European population. The last tree nest in Poland was found in 1964.

Falconers started to breed peregrines and developed methods for intensive breeding and reintroduction, at first in the US, then in Germany and other countries. With the ban on DDT in most countries, the situation of the peregrine began to improve and populations that survived the crisis began to rebuild.

Reintroduction significantly accelerated the restoration process in many places, with some populations being restored from absolute zero. Unfortunately, the tree-nesting population did not begin to regenerate naturally and so the only way to restore it was reintroduction.

The tree-nesting project was successfully conducted in the eastern part of Germany. It was started after the German reunification and was conducted between the East German protectionist organisation Arbeitskreis Wanderfalkenschutz (AWS), the hunter's organisation Landesjagdverband Mecklenburg-Vorpommern (LJV) and falconers from German Falconers Orden (Deutscher Falkenorden – DFO). In Germany, around 50 pairs breed on trees now.

In Poland, falconers started their first attempts to breed peregrines at the end of the 1970s, with the first results in the mid-1980s. Reintroductions in Poland started in 1990 and were conducted mainly in forest areas, with some in mountains (Pieniny) and cities (Warszawa, Kraków). The first breeding attempt in Poland was in Warsaw in 1998, with first success in 1999. The population established in cities and mountains in south.

Since 2010, the whole restitution programme is being conducted by the Society for Wild Animals Falcon. Between 2010 and 2016, a total of 576 young peregrines were released in forests. In Poland, the first chicks from a tree nest were ringed in 2012, with eight known pairs on trees in 2016.

Tree-nesting population recovery is based on the idea of imprinting on the place of birth. That proved to be successful with both the established and growing population in Germany and the seed population in Poland.

Poland is a key country for the success of the tree-nesting peregrine recovery in Europe. Currently, the work on this ecotype is also being conducted in Germany and projects are planned for Lithuania, Belarus and Russia. The necessity to conduct the tree-nesting recovery project was included by IUCN/Birdlife International into the Species fact sheet, and while the peregrine on a global level has a 'least concern' status, the tree-nesting population requires further active conservation actions.

Key words: Peregrine, reintroduction, tree-nesting, conservation, falconry

First synthesized in the end of the 19th century, DDT (dichlorodiphenyl-trichloroethane) appeared to be an extremely efficient insecticide, awarding its discoverer a Nobel Prize in 1948. DDT made it possible to overcome lice among troops during World War II, and after the war, in the 1960s, it was widely used in agriculture to protect crops. Although seemingly harmless to higher animals in initial testing, DDT revealed its destructive properties after prolonged use.

DDT takes a very long time to decompose and is not removed from the body but is instead deposited in the adipose tissue, transferring to and accumulating in subsequent levels of the food chain. It results in hormonal changes impacting, for example, calcium metabolism. This caused the shells of the eggs laid by birds to become thin and crack under the weight of the brooding female. Top of the food chain species, especially raptors, reacted to these changes differently. Most of their populations decreased. The peregrine falcon proved to

be the most susceptible species and became extinct in most of its ranges in the 1950s and 1960s (Hickey ed. 1969). This way, the tree-nesting peregrines of Central Europe became completely extinct. After the use of DDT was banned, many species gradually restored their populations. Unfortunately, in many areas the peregrine falcon did not have the necessary means to re-populate. In Poland, the last sighting of nesting peregrines was in 1964 (Sielicki, Mizera, 1994).

Fortunately for this species, for thousands of years peregrines have been held in high esteem by falconers and were used for hunting. As its natural population approached the brink of extinction, many birds still remained in the hands of falconers. In the mid-1960s, these falconers began an intensive breeding programme. Because the birds used in falconry were trained for hunting and were quite used to changing environments and falconers knew their needs rather well, it was possible to start breeding the peregrines in artificial conditions (Weaver, Cade, 1991). At one point, there were more peregrine falcons bred in captivity than there were in nature. This was an ideal time to try reintroducing the birds in their natural habitat. First attempts took place in the USA under the auspices of The Peregrine Fund, and this success was later replicated in Germany. Through the vast amounts of work conducted by falconers and the great number of reintroduced birds, the peregrine falcon started to return to its natural environment. In many places around the world today the population is greater than before the collapse, for example, in Holland or Belgium (White et al., 2014). Since the 1970s, the peregrine has nested in cities. This process is progressing (Drewitt, 2014), and the species frequently appears in places it has never been seen before. The experience and methods developed by falconers in the process of reintroducing the peregrine were later applied to many other species in need, such as the Mauritius Kestrel (*Falco punctatus*) or the California Condor (*Gymnogyps californianus*), etc.

In Poland, the last nests of wild peregrines were found in 1968. Later, only individual birds or nesting attempts were sighted. By the time of the revival of falconry in Poland in the 1970s, the Polish populations of the peregrine were already gone. This period saw a new beginning of Polish falconry based mainly on the goshawk. By the 1980s, falconers in Poland started thinking about reintroducing peregrines into the Polish skyscape. That was the time when the first two peregrine falcon breeding centres were established. The first one, managed by Zygmunt Pielowski, was founded at the Research Station of the Polish Hunting Association in Czempin; the other one was run by Czesław Sielicki (Sielicki, 2009) under the auspices of the District Office in Włocławek. Since the peregrine was absent in the Polish environment, our first breeding peregrines were donations from falconers from Western Europe. It was not until Günther Trommer came to Poland with his best breeding pairs when a breakthrough happened, enabling the first pilot projects on introducing the peregrine into the natural environment in 1990 (Sielicki, Sielicki, 1994). The first Polish reintroduction was of four individuals.

(Above): Hacking box in tree (fot. Archive)

Subsequent years saw the release of more and more birds. New institutions and people started to join the peregrine restitution programme in Poland: The Agricultural Academy in Kraków – Zbigniew Bonczar, Polish Falconry Order in Tuchola – Mariusz Nowogrodzki, the Society for Wild Animals "Falcon" – Sławomir Sielicki, and many more. In 1992, in Ciechocinek, all of the stakeholders signed a treaty. Between 1990 and 2009, the project managed to release 345 young falcons into the natural environment. Falcons were mainly released in forest areas, but also in hills (Pieniny) and cities (Warsaw). In 1998, these actions resulted in a first attempt at natural breeding in Poland. The birds tried to nest at the top of the Palace of Culture and Science in Warsaw. The female was released in Warsaw two years prior while the male was released in 1994 near Włocławek. Probably due to the female's young age, the breeding attempt failed. In 1999, two more pairs of falcons started breeding in Włocławek and Torun and successfully produced nestlings. By the end of 2009, we had as many as 15 breeding sites in Poland, nine in urban areas and six in the mountains. However, not all of them were successful every year. Up to that point, 124 young peregrines hatched in natural nests (Sielicki, Sielicki, 2010).

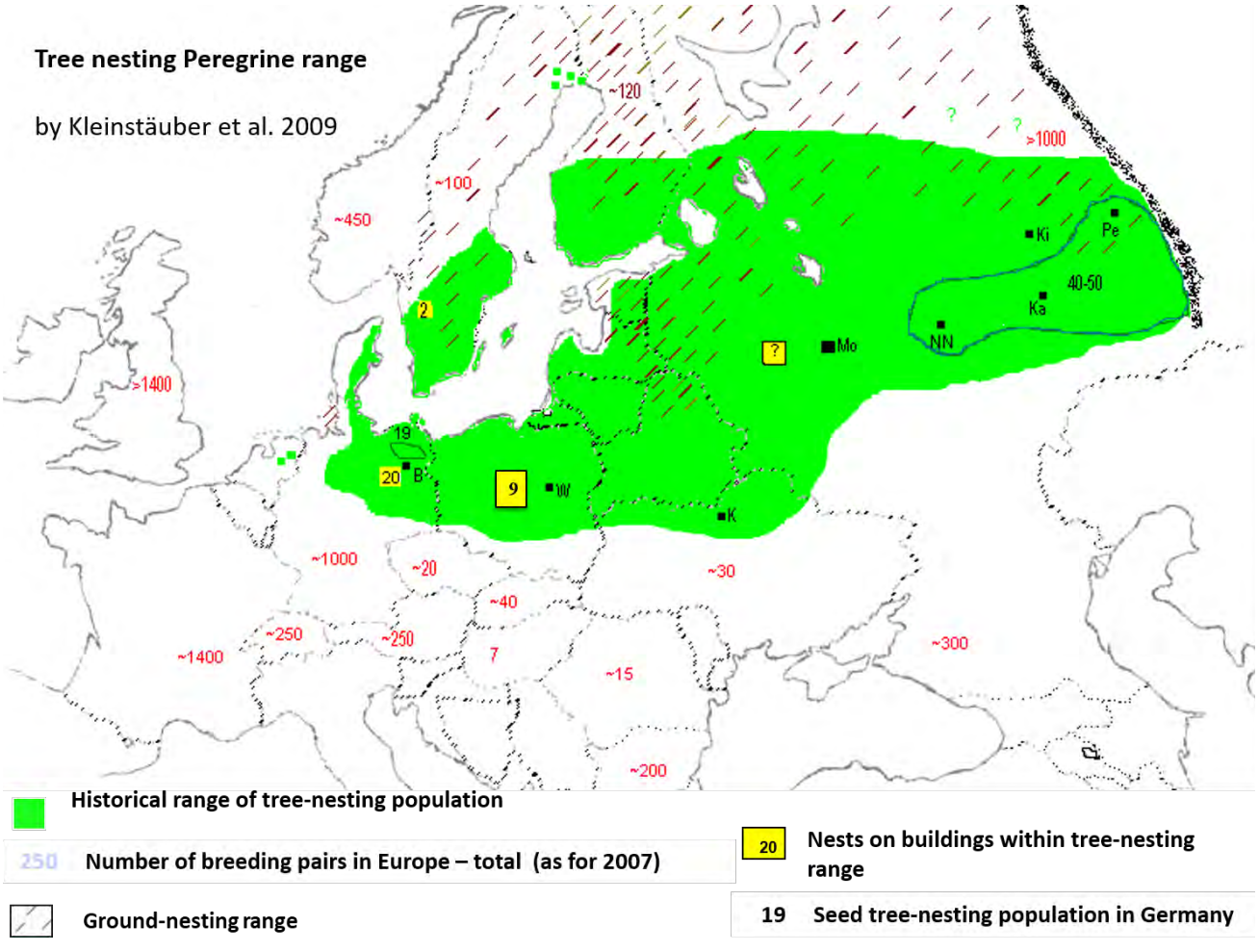

Figure 1. Tree-nesting Peregrines in Europe (after Kleinstauber et al. 2009)

Unfortunately, for various reasons, some of the institutions which initially participated in the programme ceased to exist while others reduced their breeding efforts. Consequently, in 2009 only three birds were reintroduced into the wild. Also, there was no prospect for further functioning of the programme in its current state.

In order to intensify the work on rebuilding the population and find funding, the Society

for Wild Animals “Falcon” was established in Włocławek. From the very beginning, it took over the monitoring of peregrines in the natural environment, overseeing all known and accessible nests and ringing juvenile falcons.

In 2007, the Society partnered with Birdlife Hungary and other organisations to hold a conference on “Peregrine Falcon Populations – status and perspectives in the 21st Century”, with participants from more than 20 countries from across Europe, America and Australia.

The conference discussed what had been accomplished in terms of rescuing the species, and indicated the directions for further work (Sielicki, Mizera, 2009). One of the more important aspects of the conference was the support for the restitution of the arboreal population of the peregrine in Central and Eastern Europe.

The conference allowed us to spread our wings and double our efforts.

(Above): First nest on tree in Barlinek 2012 (fot. S. Sielicki)

In 2009, the Society for Wild Animals “Falcon” received a large grant from the Norwegian Financial Mechanism, allowing us to release as many as 56 juvenile peregrines into the wild in 2010. This was almost twice as many as we used to release in previous years. Also, we made a complete turn in our fundamentals. We used to release several birds at a time in many different locations – now we designated just three locations where we released up to several dozen birds. In 2011, we added a fourth location, allowing us to release even more birds and achieve a rate of 120 birds per year. In the years 2010 to 2016, we reintroduced a total of 576 birds in forests of Poland in four designated locations, a lot more than we had released in the previous 20 years.

Intensive work proved effective. More and more falcons were observed in the wild. Already in 2012, we were able to find a tree-nesting site. In 2014, two more tree nests were found. In 2015, we managed to observe three forest-breeding pairs, making it possible to assume that there are more pairs nesting in this type of habitat. In 2016, three more tree-nesting pairs were found.

The number of nests in urban and mountain areas is also on the increase. Generally speaking, each year we are gaining one, two, perhaps even three pairs. In 2015 we were able to identify seven new breeding pairs of peregrines, with unconfirmed reports of additional birds. In 2016, the total number of breeding sites in Poland almost came to 40, with 27 active and producing 68 hatchlings (Sielicki S. in litt). From 2010 to 2016, we saw more than 250 birds born in the wild, bringing the total number of birds bred naturally up to 393 since 1999. The significant increase of the number of new breeding pairs

Falconry and the Restoration of the tree-nesting Peregrine Falcon in Poland 1990-2016

(Left): First two chicks from a tree nest ringed in Barlinek 2012.

Year	Biotope				
	Forest areas	Mountain areas	Urban areas	Natural breeding	Total
'90	4				4
'91	3			0	3
'92	10			0	10
'93	14	3		0	17
'94	14	2		0	16
'95	7	3		0	10
'96	14	3	3	0	20
'97	5		3	0	8
'98	9			0	9
'99	11	3	3	6	23
'00	11	3	2	8	24
'01	12		3	4	19
'02	19		2	9	30
'03	24		2	11	37
'04	24			17	41
'05	35		7	10	52
'06	31		5	14	50
'07	25			14	39
'08	16		7	15	38
'09	3			16	19
10	56		2	23	81
11	66			27	93
'12	75			30	105
'13	142			36	178
'14	128		1	31	160
'15	76			54	130
'16	33		3	68	104

in recent years and the growing number born in the wild are the results of years of efforts by Polish falconers, environmentalists and many different institutions and individuals who contributed to rescuing this priceless species. However, these recent years have been crucial for the restitution process. Thanks to support from European and national programmes, 1% tax contributions, and the backing of private business, we can be sure that we will successfully restore this species into the Polish natural environment.

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Moffat's Equilibrium and the Harvestable Surplus of Falcons

Professor Tom Cade

I. Introduction:

Falconers appear always to have had strong concerns about protecting falcons and hawks and restricting their use for falconry to certain individuals. At first these concerns were mainly proprietary in nature: Only people of high rank in society were allowed to keep and hunt with the best raptors. Severe punishments were meted out for stealing another person's hawk or taking a wild one without authorization. I have always liked the old 8th Century Burgundian law that states, "*If any man presumes to steal another's hawk, we command that the bird itself eat six ounces of flesh from the breast of the thief*."

Only much later with increasing demands on natural resources did the concern switch primarily to one of conserving the dwindling supply of hawks and quarry for falconry. This is the stage of history we find ourselves in now, and the need for conservation becomes increasingly great as we move rapidly toward a human population of 10 billion persons.

II. My early interest in falconry:

My interest in falconry began by reading articles about it in the National Geographic Magazine and the Encyclopedia Britannica when I was nine years old. I was completely self-taught and did not meet a real falconer until my family moved to California in 1943 when I was 15 years old, and, therefore, I made many early mistakes struggling with Cooper's Hawks and kestrels. I wrote to the Smithsonian Institution asking for help, and none other than Alexander Wetmore, the Secretary, replied telling me of the recent publication of Casey A. Wood's translation to English of the famous Latin treatise by Frederick II of Hohenstaufen. My practice began to improve. I have had this book in my possession for more than 70 years.

In 1949 I used my educational benefits under the GI Bill of Rights to attend the University of Alaska, because an old egg-collector and museum curator at the Los Angeles County Museum told me I could find lots of Peregrines and Gyrfalcons in the Territory of Alaska. By 1952 I had made ornithological surveys on St. Lawrence Island in the Bering Sea, in the Alaska Range around Mount Denali, on the Yukon River in central Alaska, and on the Colville River in northern Alaska. I did find quite a few Peregrines and some Gyrfalcons.

At the University of Alaska I became associated with the newly formed Alaska Cooperative Wildlife Research Unit and learned about wildlife management and the basic concepts such as renewable resources, harvestable surplus, and maximum

sustainable yield. We actually used the old textbook titled "Game Management," written by Aldo Leopold in the 1930s. I remember he had some nice things to say about falconry. I retained my interest in wildlife science and management throughout my career, although I became a professional ornithologist.

I took the information I gathered on falcons in Alaska to the University of California, Los Angeles, where I completed a Ph.D. dissertation on the "Ecology of the Peregrine and Gyrfalcon Populations in Alaska" in 1957 (Cade 1960). During this time I joined a local group of falconers, mostly high school students, called "The Southern California Falconers' Association." Observing some of their behavior I got to thinking about how to apply wildlife management theory and practice to falconry, which at that time had no legal recognition.

Col. R. Luff Meredith, the father of American falconry, who was then president of our national organization, The Falconry Club of America, invited me to write an article for "Falconry News and Notes", which I did in 1954 entitled "The Biology of Falcons and the Ethics of Falconers." My main conclusion was that falconers exert the least impact on falcon population dynamics by taking eyasses, branchers, and passage birds in that order, and the most impact when they take haggards, a conclusion that has been abundantly supported by subsequent research (Millsap and Allen 2006). However, the mantra of "no haggards" may have less biological justification than once thought, as I explain shortly.

III. The pesticides impact on raptors:

In that article I also called attention to the fact that falconers and bird-banders were beginning to notice greatly reduced reproduction and abandonment at long active falcon eyries. In 1954 not one of 12 formerly active Peregrine nests on the lower Hudson River produced young. By 1965 the world knew there had been major population declines in several raptor species--Peregrines Bald Eagles, Ospreys in particular (Hickey 1969)—and the era of pesticide effects arrived, shutting off falconers' access to many wild-taken hawks, particularly in Europe. This circumstance brought about great efforts to breed falcons and hawks in captivity, saving falconry in Europe and producing more than 10,000 captive bred and released Peregrines for restoration on two continents. Falconers played dominant roles in both the breeding and release of these birds, as some of you know from first hand experience. It is still, I believe, the largest effort undertaken to restore an endangered species. Today we enjoy an abundance of Peregrines unknown even before the modern period (Cade and Burnham, 2003).

IV. Contemporary management of falconry as a hunting sport:

By the time falconry became a legally recognized sport in the United States in 1972, the practice of wildlife management had morphed into wildlife science, becoming much more quantitative and precise in both theory and practice than in Aldo Leopold's time but perhaps less philosophical and less devoted to the pursuit of happiness. Estimates of comfortable old concepts such as "harvestable surplus" and "maximum sustainable yield" did not always pass the test of statistical analysis and scientific scrutiny.

The hardest question to answer has always been to know how many and what categories of individuals comprise a surplus that can be harvested without reducing the needed number of breeders to maintain the overall population. This is an especially difficult question to answer for species that have very large total populations, such as fish, waterfowl, and some big game.

Fortunately for birds of prey there is a relatively good way to estimate the harvestable surplus if the population size is known and data on its vital rates can be obtained or accurately estimated within some narrow limit of error. A long known indication that many raptor species have more adults in their populations than can find suitable nesting locations in their habitats comes from observations on the rapid replacement of lost mates at a nest site, often within a day or two of disappearance. Forced replacements by fighting between two males or two females occur far more frequently than we knew before the existence of webcams on the internet. One of the earliest reported cases (Peterson, 1948) involved a well-known falconer in the Washington, D. C. area who succumbed to his lust to possess a haggard Peregrine and so trapped a breeding tiercel at a nest. In a day or so his guilt got the better of him, so he returned the bird to its nest. On releasing it a new tiercel came roaring out from the cliff followed by a prolonged aerial fight ending with the two birds bound together and falling to the ground below the cliff. The initial tiercel finally took back his nest and mate. Several removal experiments have been performed on birds of prey that demonstrate rapid replacement, such as the one carried out by Johnstone (1998) in the Canadian Arctic, where he removed 14 adult Peregrines from nests with young for 24 hours. All six vacancies for females were filled by new birds, and males were replaced on five other territories. These surplus adults are now usually called "floaters" because they tend to move about over the landscape (Brown, 1969; Hunt, 1998) and therefore impossible to count. Their numbers can be estimated with fair accuracy if breeding population size, adult and juvenile mortality and productivity are known.

V. Charles Moffat and Bird Populations:

In 1903, an Irish naturalist named Charles Moffat, who had been influenced by Darwin's

theories of evolution and natural selection, published an important but little read paper entitled "*The Spring Rivalry of Birds*." By carefully observing the breeding behavior of the common species of birds nesting in the countryside surrounding his home, Moffat became convinced that each species of bird was limited in number by the fixed number of suitable nesting locations in the environment. The rivalry occurred because there was a greater number of adult birds than suitable areas in which to nest, thus leading to a relatively fixed breeding population size from year to year, so long as habitat features and vital rates remained unchanged. He clearly understood the idea of avian territoriality and its implications for population dynamics, although he did not use the term "territory," which was introduced into the language of ornithology about two decades later (Howard, 1920). His theory was clearly at odds with the prevailing Malthusian explanation of population dynamics.

Unfortunately, Moffat, like Gregor Mendel, published his paper in an obscure journal not widely read. He was occasionally cited in historical accounts about the development of the avian territoriality concept, but among the 20th Century authorities on bird population dynamics only a couple paid attention to his ideas. David Lack (1954, 1966), the great proponent of density dependent regulation, ignored Moffat's ideas even after having his attention directed to them. My close colleague, Grainger Hunt (1988, 1998, 2015, Hunt and Law 2000) has championed Moffat as a unique and important contributor to population dynamics theory, because he clearly demonstrated that for territorial birds a population equilibrium between fecundity and mortality can be achieved with or without the intervention of density dependent interactions. Because natural selection and genes drive organisms to reproduce at maximum rates, a consequence of territorial limitation on the number of breeders is the development of a cohort of nonbreeding adults called floaters (Brown 1969). At equilibrium when natality equals mortality the number of floaters is also regulated, and this number can be estimated from the vital rates and breeding population size using Hunt's "Moffat models" [which can be found on The Peregrine Fund website: www.peregrinefund.org].

V. The Peregrine example:

As an example we can consider a hypothetical population of 100 nesting pairs [200 total breeders] held constant from year to year by the number of suitable nest sites in their range. Each year they produce on average 150 juveniles [1.5 per pair]; 50% of those young survive their first year of life, at which time they are molting into adult plumage and are able to breed at the end of their second, sub-adult year, although few do so because of competition with the adult floaters. Adults survive at the rate of 85% per year [mid-range for several known populations]; in other words, only 30 replacements are required for the breeders, 11 for sub-adults, and approximately 30 more for the 193

floaters calculated at equilibrium by Hunt's Moffat model, leaving a surplus of 122 birds not needed to replace losses in the adult/sub-adult population. Thus, the total population at the end of each breeding season consists of 200 adult breeders, 75 sub-adults, 150 juveniles, and 193 ranging floaters for a total of 618 birds.

It might be argued that floaters are not members of the population from which they originate because they are highly dispersive, and some of them end up nesting a thousand or more kilometers from their natal areas. On the other hand, most Peregrines are highly phylopatric, and a large majority of them settle to nest within 100 kilometers of where they were hatched (White et al. 2002).

So what is the harvestable surplus that could be taken from this population without reducing the number of breeders [and floaters] over the long haul? Two U.S. government scientists, Brian Millsap and George Allen (2006), used Hunt's Moffat model to estimate safe harvest levels for eight species of raptors used in falconry, including the Peregrine Falcon. Applying known vital rates to the Moffat model they estimated the impact of various harvest rates on the first year cohort of young birds, including nestlings, branchers, and passage birds. For the Peregrine Falcon population of Colorado (Craig, White, Enderson, 2004) they found that the breeding population remained stable until the harvest level reached 15% of annual production, at which time the floaters are gone and drastic decline in the number of breeders, sub-adults, and juveniles begins. Their management conclusion and recommendation to government was that a 5% take of first year birds could easily be sustained over the long haul, but even 10% was feasible if there were a high enough demand for birds.

In my example involving 100 nesting pairs and slightly different vital rates than for the Colorado falcons, a 5% take equals 4 birds and 10% would be 8 birds; even at 20 %, 60 birds remain from the original juvenile cohort, indicating how differences in vital rates can change the results, particularly for adult survival. In this comparison a difference of only 5% in adult survival nearly doubled the floater to breeder ratio. For Peregrines one might consider a juvenile take of 10 to 20% to be the range for maximum sustainable yield depending on the vital rates.

Since for many Peregrine populations only about 60% of the floaters are needed each year for replacement of lost adults, a modest harvest of haggards taken in the non-breeding season could be justified. If that were allowed, some adjustment in the first year take might be politically appropriate.

VI. Conclusion:

Because determining harvestable surpluses and maximum sustainable yield are difficult to do with high accuracy, after setting harvest regulations based on the best available data, governmental agencies need to conduct breeding population surveys for high use species every 5 to 10 years to check for any signs of population instability, such as the presence of sub-adult breeders, nest occupancy by single birds, reduced productivity, and abandoned eyries. These indicators of trouble are not necessarily caused by overharvest for falconry, but they indicate population difficulties requiring a scientific investigation and the likely need for reduced harvest. If wildlife agencies are unable, for any reason, to carry out these periodic surveys, then falconers and other interested parties should be authorized to do so.

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Wildlife Casualties and the Importance of Falconers in Nature Conservation

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Falconry as an ancient way of hunting using birds of prey and has been listed by UNESCO as intangible human heritage. Students and clinical practitioners of the University of Veterinary Medicine and Pharmacy in Kosice use wild life casualties and protected raptors and owls in the course of their studies and their work. In particular, the University has implemented aspects of falconry in:

- Education
- Research
- Clinical practice and training
- Public relation and institutional cooperation

(Above): the selection and use of suitably sized hoods assist in calming an injured bird of prey

(Above): A hooded bird of prey ahead of treatment

(Above): Dr Molnar attending to an injured bird of prey at the clinic

Education: Students can select an optional subject like Falconry and Wildlife Rehabilitation, and during the course they gain knowledge about biology, legislation, welfare and diseases affecting wild or captive birds of prey. The use of falconry birds can develop hands-on experience and skills which can later be used to provide special veterinary care to wildlife causalities.

Research: Birds of prey, as top members of the food chain, provide important biological material to monitor diseases affecting wildlife species as well as environmental contamination and pollution. These research studies are pursued as part of diplomas, degrees, and post graduate studies and there are research grants available towards scientific publications.

Clinical practice and training: Students during their clinical training in the Clinic of Birds, Exotics and Wildlife are involved in the handling, examination and treatment of wildlife causalities, especially raptors and owls, which are presented by the public after being injured or disabled.

Public relations and institutional cooperation: The University is part of the network of Wildlife Rehabilitation Centres in Slovakia and has a well-established infrastructure to provide a first point of contact for the public when injured wildlife is found. In the process of rehabilitation, students actively participate with members of the Falconers' Club.

The importance of falconers in the rehabilitation of injured wild birds of prey is emphasised with their research demonstrating the higher success rate and survival of rehabilitated birds that have been the subject of falconry techniques (manning, training and flying) over simple 'rest and release' programmes, so as to ensure that the raptors have the necessary level of fitness to enable them to hunt independently again in the wild.

Wildlife Casualties and the Importance of Falconers in Nature Conservation

The University of Veterinary Medicine and Pharmacy in Košice (UVMP in Košice) is the sole university for veterinary education in Slovakia, which is provided both to domestic and foreign students. Veterinary medicine and pharmacy rank among the so-called regulated professions, the study of which must meet the demands of European Union guidelines. UVMP in Košice meets the standards required by the EU and a diploma conferred by the university is valid in all countries of the European Union. The university was established by an act of the Slovak National Council on December 16th, 1949 as the Veterinary College in Košice, though it began its teaching activities with its first lecture on October 5th, 1949.

(Above): Raptor Anaesthesia.

(Below): Damaged Eagle Wing; falconers provide the feathers for imping and repair before the bird is released back into the wild.

The university has about 2,000 students in each of the three levels of study in both full-time and external forms, about 250 of whom are foreign students who each year arrive at the university to study veterinary medicine through the English language, particularly from Norway, Sweden, Ireland, Great Britain, Greece, Cyprus, Malta, Iceland, Israel, Belgium, Austria, Japan and USA. The students are attracted, in particular, by the high level of practical preparation and permanent contact with animals, not only at the university's five clinics but also on the university farm, at the special facility for studying breeding and diseases of wild animals or the equestrian grounds.

The Special Facility for Breeding and Diseases of Wild Animals, Fish and Bees in Rozhanovce

This facility offers space for pedagogical and scientific research activities with a focus on aspects of breeding and the diseases of wild animals, fish and bees as well as for the practical part of instruction concerning diseases of game. The facility also includes a rehabilitation station which is used for temporary placement of protected wildlife species from natural surroundings, their medical treatment, rehabilitation and their release back to their natural environment. The hunting grounds are used for the educational process, additional re-stocking of game and enhancement of fauna. Within the LIFE ENERGY project, the special facility in Rozhanovce has closely been collaborating with the Clinic of Birds, Exotic and Wild Animals.

Clinic of Birds, Exotic and Wild Animals

The clinic is a specialised unit whose activities include therapeutic care (non-hospital treatment) and educational activities, during which the university students get acquainted with basic breeding and health problems in exotic animals, both theoretically – in the form of lectures, and practically – in the form of practical instruction and internships during the clinic's office hours. The major areas of instruction at the clinic are diseases of exotic birds, raptors, reptiles, and small mammals.

The clinical activities include a veterinary practice for treatment of exotic animals, which is made available to the general public during work days and which provides hospitalisation of patient animals in case intensive care is needed. Surgery and some specific medical procedures such as X-ray, ultrasound or endoscopy are also performed at the clinic. Clinical cooperation with pre-clinical departments such as parasitology, microbiology, virology and pathological anatomy provide diagnostic help and research background.

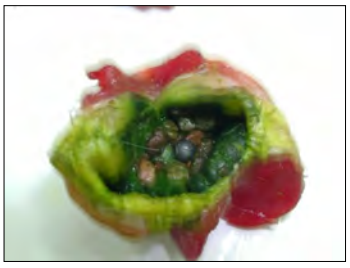
An important activity carried out at the clinic is the treatment of protected wild species. Mostly, these include raptors of European importance such as the saker falcon and the imperial eagle, which has a strong population in Eastern Slovakia.

Research projects implemented at the clinic

The clinic provides veterinary assistance to various wildlife projects of large carnivores in Slovakia such as the satellite monitoring of brown bears, lynx, wolves and different bird species such as storks and raptors, or terrestrial monitoring of Eurasian bison. Pre-release examination of rehabilitated birds is carried out also. Harvested samples are used in monitoring emerging wildlife diseases like West Nile virus, parasites and their vectors in Slovakia, as well as viral diseases in wild boar and cervid species.

Falconry and falconer's birds have provided the foundation for study and experimentation of avian veterinarian techniques and medical advancements that would not otherwise have been possible and can be readily employed to rehabilitate wild raptors.

(Above): Repairing a fractured leg



(Above): Lead pellets in the gizzard; and retrieval in pellets

(Above): Lead pellets in the gizzard; and retrieval in pellets

Potential role of a sustainable falconry harvest in Saker Falcon conservation

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Abstract: The Saker Falcon (*Falco cherrug*) is a species of cultural importance for Arabian falconry that is highly valued and desired by many falconers in the Gulf States. Modern Arabian falconry has created a significant demand for falcons that is met primarily by international trade, both legal and illegal, of captive-bred and wild-sourced birds. This commodification of the Saker Falcon has resulted in widespread trapping and trade over much of its global distribution range, which is considered an important causal factor behind the population declines witnessed across extensive areas of Central Asia. Failure to address population declines over the last 25 years has been accompanied by debate, often antagonistic and highly politicized, as to the most effective way to conserve the species. The Saker has become a problematic issue for conservationists as restrictions on legal harvests and trade do not pertain to a trade that is largely illegal, while stronger legal enforcement does not bear upon the underlying market demand. The problem of commodification may alternatively provide an opportunity for conservation, enabling financial resources to be directed at conservation management for the Saker Falcon. In this talk, I present two case studies from Mongolia to demonstrate ways in which the commercial trade could generate resources to benefit the conservation of the species.

Saker Falcons and the Falconry Trade

Falconry is a deep-rooted and culturally significant practice in the Arabian Gulf, and globally is recognized by UNESCO as part of humanity's Intangible Cultural Heritage (Ceballos, 2009; Wakefield, 2012). Sakers are traditionally the main species used in Arabic falconry (Allen 1980; Upton, 2002), and demand from wealthy falconers in the Gulf States of Arabia has created a lucrative market for the species (Seddon and Launay, 2008). This demand is met primarily by harvesting from the wild, mainly through unregulated and illegal international trade (Barton, 2000; Riddle and Remple, 1994).

Traditional autumn trapping of 'passage' falcons for Arabian falconry has taken place for millennia, but in recent decades the geographic scope, scale and nature of trapping has increased. In the 1990s, the socio-economic upheaval associated with the dissolution of the Soviet Union is believed to have stimulated a surge in the supply of wild-caught Sakers from Central Asian states that were formerly outside the geographic scope of the Arabian falconry market. Furthermore, the trapping period has extended from the time of autumn passage when migrating birds were targeted, into the breeding season in the former Soviet states of Central Asia, and now includes the trapping of breeding birds and the removal of eggs and chicks from nests (Kenward et al., 2007). In most range states, the trapping and trade of wild Sakers is illegal under national laws (Kovács et al., 2014). Notable exceptions exist, including Saudi Arabia, which allows trapping and trade of wild Saker falcons within the country, and Mongolia, which issues permits for their harvest and international trade within CITES regulations. The development of the Mongolian Saker falcon trade for the Arabian falconry market presents an interesting case study, providing insights into the conservation, ecological, economic and social aspects of this wildlife issue.

(Above): Saker Falcons trapped for Arabian falconry in Mongolia

The Mongolian Saker Falcon trade: a missed opportunity

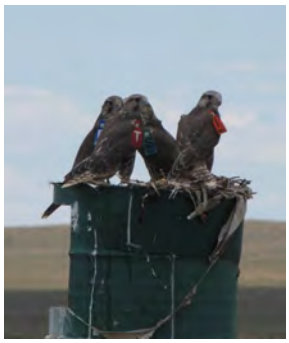
The Mongolian Saker falcon trade developed following the Democratic Revolution of 1990, when the harsh economic conditions of the early 1990s and the potential of international trade to the Gulf States provided the incentive for 'entrepreneurial' ornithologists to initiate a relatively small-scale private trade in wild-caught Saker falcons. However, by the time the Mongolian government had become a signatory to CITES in 1996, this trade had been appropriated by the state and was controlled and regulated by government officials. However, by 2005 CITES considered this trade to be of 'urgent concern' and Mongolia was urged to suspend the issuance of export permits for Saker falcons. Nevertheless, the Mongolian government continued to issue CITES permits for the harvest and export of Sakers, reflecting both a lack of capacity within the Mongolian government to adequately administer their obligations to the CITES convention and the absence of a formal structure of governance of the Saker Falcon trade.

To address issues relating to the conservation and harvest of Saker falcons in Mongolia, a MoU was agreed between the Environment Agency - Abu Dhabi (EAD) and the Mongolian Ministry of Nature, Environment and Tourism (MNET), which outlined a programme for establishing a sustainable Saker falcon harvest based on the use of artificial nest sites. Subsequently, CITES endorsed this positive management regime, enabling Mongolia to set its own future harvest quotas. However, there was a twist to come – after turbulent debate about the exploitation of national resources, the Mongolian government used the designation of the Saker falcon as the national bird in 2012 to announce that it was implementing a five-year moratorium on the 'commercial trade' in the species. What exactly constituted 'commercial trade' is unclear: from 2013 through to 2016, Mongolia continued to host international falcon trappers to harvest and export of Saker falcons.

The situation that currently pertains in Mongolia is that the management of Saker falcons using artificial nests has not been adopted by the national authorities as a way of ensuring a sustainable falcon harvest. At the same time, the falcon trade has become opaque, with

little clarity on the level, management or regulation of the harvest. There is anecdotal information suggesting that illegal trade has increased since the 'commercial trade' ban, with cross-border exchange of falcons including laundering of Russian-caught Gyrfalcons through Mongolia. The opportunity to establish a demonstrable, viable and transparent management sysem for the Mongolian Saker falcon trade has been squandered, although the potential to re-establish the programme within a relatively short timescale remains. Given that the CMS Saker Falcon Global Action Plan (SakerGAP) incorporates a management and monitoring system for harvesting Saker falcons, there is hope that a future Mongolian administration may revisit the issue and implement the type of programme described here.

(Above): Saker Falcon at artificial nest in Mongolia



(Above): Four young fledglings at a nest box

Conservation management and the potential for a sustainable harvest of Saker Falcons in Mongolia

The underlying basis of the Saker Falcon management programme was to create a new, managed breeding population occupying artificial nests that are amenable to monitoring, which can provide the data required to determine a sustainable harvest quota. A monitored population occupying artificial nests can provide data on breeding productivity (incorporating annual and regional variation), adult survival and breeding dispersal (based on breeding turnover), natal recruitment and dispersal, and the age composition of the breeding population. These vital statistics can be used to accurately model a sustainable harvest quota based entirely on the managed and monitored population.

In 2009-10, 5,000 artificial nests for Saker falcons were erected on the central Mongolian steppe. Nests were spaced at 1.5km intervals in areas of open steppe where few natural nest sites existed, but which held prey resources in the form of small mammals and birds. Annual monitoring of these nests began in 2011 to record occupancy and breeding success of Sakers. The number of Sakers breeding in the artificial nests increased annually over the first four years until 2014, reflecting recruitment from a local non-breeding population, rather than by immigration via breeding dispersal from pre-existing populations elsewhere. Saker falcons breeding at artificial nests in the Mongolian steppe

produce an average of 3.2 (±0.3) fledglings per nesting attempt (Rahman et al., 2014). The artificial nest programme demonstrated that Sakers can be practicably managed at a scale amenable to developing a sustainable harvest.

Saker Falcons and electrocution at power lines

Medium-voltage electricity distribution lines can, where pole hardware is inappropriately configured, present a serious electrocution risk for birds of prey. The issue is serious enough for CMS to review the problem and produce guidance for mitigation (Prinsen et al., 2011a, b). Mitigation techniques are available to reduce the risk of electrocution for birds of prey at existing dangerous electricity distribution lines, which include deterrents that are designed to prevent birds perching in high-risk locations, insulation covers for live phases and reconfiguration of cable-carrying hardware. However, a lack of knowledge about the issue among executives and engineers responsible for power lines, together with the exigencies of cost efficiency has meant that in many circumstances mitigation, or even the initial deployment of raptor-safe power lines, receives little attention.

The Saker falcon is a large bird of prey that occupies open landscapes and it often hunts small ground-dwelling mammals, using power poles as elevated perch sites in habitats where alternative perch sites for hunting are scarce. Consequently, the species is particularly at risk from electrocution at power distribution lines, and electrocution events are known to occur throughout the global breeding distribution of the species. Saker falcon mortality due to electrocution in Mongolia results in losses in the order of magnitude greater than that arising from the Saker trade discussed earlier. The trade in falcons provides a potential mechanism whereby the species can generate the finances to pay for its own conservation.

Electrocution of Saker Falcons in Mongolia

How many Sakers are electrocuted in Mongolia each year? This simple question does not have a simple answer. In the open steppe, the most important factor is the concomitance of abundant small mammal populations and dangerous power poles (Dixon et al., 2017).

(Right): Electrocuted Saker Falcon in Mongolia

Potential role of a sustainable falconry harvest in Saker Falcon conservation

(Above): Mitigation work undertaken on a dangerous power line in Mongolia

Long-term, daily surveys found 251 Saker falcon carcasses at poles on a 26-km stretch of medium-voltage power line running through an area of the Mongolian steppe with a high density of small mammals. There was marked variation in the number of Sakers electrocuted during each calendar month of the year. Numbers increased from June to September, as fledglings dispersed from their nesting sites and aggregated in areas of high small-mammal density, with a rapid decline from September to November as many birds, particularly juveniles, migrated to wintering areas in China. Electrocution rates remained low over winter but rose again in April when migrants, especially second-year birds, returned to the Mongolian steppe, with a subsequent gradual decline as the breeding season progressed.

In an area with a high density of small mammals, an average medium voltage power line will kill an estimated 168 Saker falcons, with only six killed at comparable lines in areas with a low density of small mammals. Many areas of open steppe in Mongolia have high densities of small mammals, consequently, the estimated number of electrocuted Saker Falcons across Mongolia over 1 year is 4116 individuals (90% CI = 713–7951 birds).

Can the Saker Falcon pay for its own conservation?

Saker falcons have a monetary value; the Mongolian government has in recent years charged fees of ca. €10,000 per bird for trappers to catch and export birds for Arabian falconry. Arabian falconers have no incentive to see the species decline or become extinct in the wild. Quite the opposite – a thriving wild population has advantages in securing a long-term supply of falcons that have the phenotypically diverse characteristics they desire. Commodification offers an opportunity, whereby Arabian falconers can contribute directly to conservation of the species by funding the procedures required in Mongolia to generate long-term, sustainable production via artificial nests and to limit mortality rates by remediation of dangerous power lines. Depending on the type of mitigation employed, electrocution can be significantly reduced at a cost of €20-€200 per pole. Thus the income generated by a single Saker falcon could potentially pay for the mitigation of all poles on an average 52km-long dangerous power line. Furthermore, this funding mechanism could

have associated benefits of raising awareness of conservation issues in the countries of production and consumption.

Acknowledgments
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School Links Programme: Using Falcon Conservation and Falconry to Establish International Links between Schools

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International school links can have a positive effect on students and schools generating enthusiasm for learning and inspiring a desire for a positive change locally and globally. Students learn to appreciate diversity and respect for others and the way they live. Embedding international learning into a classroom is key to deepening a student's understanding and respect for the world around them.

Falcon conservation is a global issue that provides a good foundation for curriculum development in science and humanities. Falconry is a widespread and culturally important practice incorporating aspects of heritage, history, literature and science. This makes falconry an ideal subject for an education programme and school link, as it represents a common theme that cuts across a diverse range of cultures.

The School Links Programme (SLP) was established in 2011 as part of a conservation and wildlife management project targeted at Saker Falcons in Mongolia. In 2010, 5,000 artificial nests were erected on the Mongolian steppe to increase the numbers of this endangered falcon species and create a breeding population that could be easily monitored.

The primary aim of the SLP was to increase local understanding of the Saker Falcon conservation project in the 20 districts where it was being implemented. We linked local Mongolian schools with international schools and a unit of work was written to introduce students to falconry and the sustainable use of falcons for falconry. Presently there are 42 schools actively involved from the Middle East, Europe, North America, Africa and Asia.

The SLP provides educational resources, in multiple languages, using falcon conservation and falconry topics in units of work related to biology, ecology, conservation, history, literature and cultural heritage that can be easily slotted into the curriculum. Each unit of work is designed to encourage students to seek further information on a specific topic and contains a PowerPoint, student worksheet and activity to aid understanding.

Students can access the resources independently from the project website or units of work can be delivered to a class or small group by a teacher, falconer or raptor biologist. Many schools run the SLP as a lunchtime club, with students deciding which unit of work they access. The ancient art of falconry and local falconry heritage is covered along with resources on electrocution of birds of prey, migration of Peregrines, raptors and eco-systems and falcon reintroduction.

Student communication is important for a successful school link. Partnered schools are encouraged to deliver the same unit of work at the same time where possible as this can provide a common theme for interaction between link schools. All schools select students to exchange pen-pal letters, photographs, artwork and written presentations. The programme also provides a closed, multi-lingual chat room, available through the website and accessible only during school time. This is password protected and provides students with a safe way to communicate with their link school daily if they choose.

Participation in the SLP is free to all schools and coordinated in the UK and Mongolia. The SLP is supported by a dedicated website www.schoollinksprogramme.org and open and closed Facebook pages where children and teachers can communicate, share good practice and culture using falconry and raptor conservation as a shared theme.

Peregrine Falcon Recovery in Montana: Eighteen Years of Searching… and Counting

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Jay Sumner: Montana Peregrine Institute; P.O. Box 317, Arlee, MT 59821

The catastrophic decline of the American Peregrine Falcon (*Falco peregrinus anatum*) began with the introduction of DDT and other chlorinated hydrocarbons in the 1940s. The contaminants affected calcium metabolism, caused egg-shell thinning, and resulted in inviable eggs. Peregrine falcon populations crashed over most of their known range. By the time biologists figured out that peregrines were in trouble, the population had fallen to just 12% of previously known levels. When the species was listed as federally endangered in 1970, the population was being sustained by the longevity of adults. Reproduction and recruitment from the very few pairs remaining was approaching zero.

The 1972 ban on DDT in the United States proved the essential step in reversing the peregrine population decline. However, because so few birds remained, peregrines needed additional help. The Peregrine Fund was established by a group of falconers at Cornell University. The purpose was to breed peregrine falcons in captivity for release back into the wild. The Peregrine Fund expanded to the western US with a second facility in Fort Collins, Colorado (later Boise, ID), and there were comparable coordinated efforts led by falconers at the University of Minnesota, and U. California, Santa Cruse. There were successful smaller breeding facilities established by falconers throughout the US and the Midwestern reintroduction effort through the University of Minnesota used only birds bred from small falconer-owned facilities. These groups developed techniques for hatching birds in captivity and then placing chicks on a cliff in a “hack” box with a front screen for the birds to see out.

The entire recovery in the US was falconer-led, including in western locations like Montana. Falconers were instrumental in detecting the decline, performing the field work leading to the discovery of its cause, creating the means to augment failing populations, re-establishing populations in landscapes where the bird had disappeared, and now, recording and quantifying the recovery data. The combined efforts of The Peregrine Fund and the Rogers family resulted in the release of over 600 peregrines in Montana by 1998. During 1994-1998, the population was also augmented by the fledging of a known 120 peregrines from newly established wild birds.

Following the peregrine’s removal from the list of Endangered Species, the US Fish and Wildlife Service developed a monitoring protocol to survey a statistically valid cohort of total known population throughout the US. Given the fact that peregrines are a relatively long-lived bird, the FWS survey was completed every third year for 15 years. One problem with the survey design used by the US FWS is that it can only detect a stable or declining population. It will not record or quantify a population which is expanding either in distribution or numbers. For Montana peregrines, we wanted to know more than the FWS protocol would provide. Montana is unique in that the Montana Peregrine Institute (established by falconers and directed by a falconer) has surveyed, since 1999, all historically known sites, all sites that have been active in modern times, most accessible areas consistent with “good” peregrine habitat, and we have followed up on all reporting of peregrine sightings. Montana, in essence, has the only full faith data set reflecting what the recovery actually looks like and is by far the best data set available.

Introduction of hacked falcons and the increase in both number and productivity of wild eyries have helped re-establish a viable peregrine falcon population in Montana. By the

early 1980s, biologists and falconers could not locate a single nesting peregrine in the state of Montana. By 1994, a mix of state, federal, and private biologists (Montana Peregrine Falcon Working Group) documented 13 known active peregrine eyries. The number of known eyries remained stable at about 17 until the beginning of more intensive survey efforts in 1999 when 27 eyries were found. By the end of 2016, territorial pairs of peregrines had attempted to breed at 207 different locations in Montana.

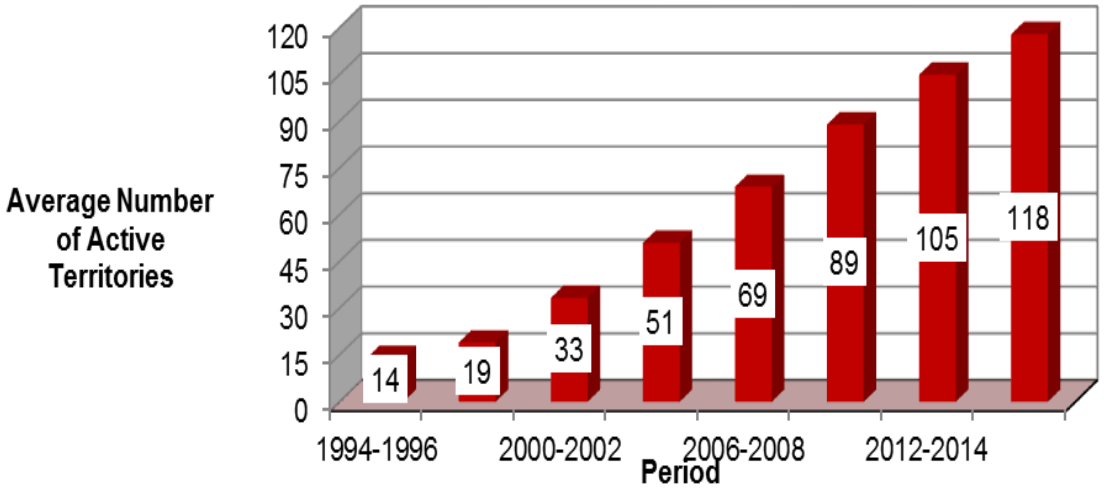


Figure 1: 2016 number of active Peregrine Falcon territories recorded in Montana (118) compared to the average number of active territories according before that in successive three-year periods (1994-2016).

The original recovery goal, set by the Montana Peregrine Falcon Working Group, was for 20 known wild eyries, state-wide. Montana has more than five times that number and is now home to more known peregrine eyries than any time in the past half century. The peregrine's restoration might have faltered without the cooperation and commitment of federal biologists, state and national falconer associations, private organizations, the Bureau of Indian Affairs, Bureau of Reclamation, Bureau of Land Management, Forest Service, United States Fish and Wildlife Service, the Montana Fish Wildlife and Parks, and Salish-Kootenai Tribe. According to Arnie Dood, a coordinator with the Fish, Wildlife and Parks (FWP), "the beauty of the peregrine recovery is you had all these players working together to do the right thing… that's different from so many other wildlife conservation efforts that bog down in conflict and controversy". FWP continues to support peregrine recovery by helping fund the Montana Peregrine Institute's monitoring program.

Nationwide, more than 6,000 peregrines have been hacked from sites ranging from mountain cliffs to urban skyscrapers. So quickly did the peregrine falcon recover that the US Fish and Wildlife Service removed it from the endangered species list in 1999. In 2005, Montana took the bird off the state endangered species list after the population had more than doubled its recovery goal.

Fish, Wildlife & Parks (FWP) Chief of Staff Chris Smith, who espouses the Endangered Species Act (ESA), is quoted as saying: "We took a species in jeopardy, restored the population, removed it from the list, and now are allowing removal of some birds from the wild for falconry." In 2007, FWP hosted open houses across Montana on the proposed "take" of five to seven peregrine chicks (a conservative number representing roughly less than 5% of the known production of young) from the wild for falconry. Permits would go only to licensed general or master falconers, who must undergo a two-year apprenticeship and pass a test before they are allowed to possess a falcon. In January 2008, the FWP Commission agreed to let licensed falconers remove up to three chicks each year. That number was expanded to five peregrines every year available for resident falconers and one to a non-resident falconer. Five peregrine chicks per year currently meets the needs of the Montana falconry community and is being taken from a population that, in 2015, produced in excess of 233 known wild falcon chicks. Harvest at that level is harmless and undetectable to any population of that size.

(Date circa 1969) Some of the falconers who worked for decades to re-establish peregrine falcons in the USA: (L-r, standing) Tom Cade, Jim Ince, Grainger Hunt, Tom Smylie, Frank Bond. (Kneeling) Ralph Rogers, Jim Weaver

Table 1. Reproductive History of Active Montana Peregrine Falcon territories (1999-2015). Note: This is a truncated table derived from a Master File with all 194 nest entries.

Territory Name	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Albert Creek											2	Inactive	inactive	inactive	inactive	inactive	inactive
Alberton						3	2	4	1	2	3	0	2	3	2	2	0
Allen Creek Clinton)													2	2	inactive	inactive	inactive
Avalanche	2	inactive	inactive	inactive	inactive	inactive	inactive	inactive	inactive	inactive	inactive	Inactive	inactive	active	inactive	inactive	inactive
Bad Rock Canyon								0	3	3	inactive	Inactive	2	2	inactive	1	active
Baker Mountain	active	inactive	inactive	inactive	inactive	inactive	inactive	inactive	inactive	inactive	inactive	Inactive	inactive	inactive	inactive	inactive	inactive
Baldy Mountain	2	active	0	active	active	1	no√	no√	no√	2	inactive	Inactive	inactive	1	no√	active	active
Bass Creek												2	2	2	3	3	2
Bear Canyon												3	inactive	inactive	4	1	inactive
Bear Creek	3	1	2	3	2	1	2	2	1	1	inactive	3	3	3	3	3	2
Bear Creek(YNP)														3	3	3	3
Bearmouth														3	3	2	2
Beartooth Mountain								3	inactive	inactive	inactive	Inactive	no√	no√	no√	no√	no√
Beaver Cr.(Missouri)														3	inactive	active	active
Beaver Cr.(Prentice)	3	1	2	3	0	3	no√	4	2	2	4	3	2	3	active	2	3
Beehive (Teapot)				4	3	4	4	4	3	3	4	4	4	3	inactive	2	4
Big Creek East													0	0	0	active	inactive
Big Creek(Bitterroots)		1					0	no√	inactive	no√	inactive	0	inactive	0	inactive	inactive	inactive
Big Creek(Kootenai)											3	0	0	2	inactive	1	active
Big Sky																	3
Big Timber Creek								4	2	3	2	1	active	inactive	active	no√	no√
Black Butte																active	no√
Black Canyon (BHRA)										0	2	no√	no√	inactive	no√	no√	4
Black Canyon (BHRA)-B																	3
Black Canyon (YNP)								1	2	no√	2	1	0	inactive	inactive	inactive	inactive
Black Lake																	3
Blackleaf Creek								3	2	2	3	1	inactive	2	3	1	1
Blacktail Creek										3	2	no√	no√	3	no√	no√	4
Blodgett Canyon	active	3	2	3	2	2	2	3	2	4	1	0	2	3	3	1	3
Bobcat Creek											3	no√	no√	1	no√	no√	inactive
Bonner									3	1	4	2	2	3	1	2	2
Boulder Creek			2	2	1	0	1	2	2	2	1	4	0	inactive	3	inactive	inactive
Browne Lake															3	inactive	3
Brownes Creek																2	inactive
Bull Lake					2	2	active	0	0	active	nrd	1	no√	inactive	no√	active	active
Bull River														active	inactive	inactive	no√
Bullis Creek											2	Unknown	no√	active	3	0	3
	TRUNCATED TABLE (alphabetical records for sites beginning with A, B and from T to Z shown)																
Tally Lake														3	1	4	4
Tamarack Creek														2	inactive	inactive	inactive
Taylor's Fork		0	1	0	3	2	0	0	0	0	inactive	Inactive	inactive	0	3	active	active
Tenderfoot River							0	inactive	no√	no√	inactive	Inactive	inactive	inactive	inactive	inactive	inactive
Tepee Mountain													active	active	1	2	active
Three Sisters	0	3	2	2	3	3	no√	1	2	active	active	Unknown	active	active	active	active	no√
Tin Cup Creek	active	4	3	1	3	0	3	3	2	2	5	2	3	2	2	inactive	0
Trapper Peak								2	0	0	0	4	1	4	3	3	3
Trout Creek		2	3	2	4	3	1	3	inactive	active	inactive	Inactive	inactive	inactive	inactive	inactive	inactive
Trout Creek (Smith R.)														active	active	inactive	inactive
Valentine Creek				3	3	4	2	0	0	inactive	inactive	Inactive	inactive	inactive	inactive	active	1
Valley Creek												3	4	4	1	2	inactive
Wall Creek		2					no√	no√	no√	no√	no√	no√	no√	no√	no√	no√	no√
West Fork Madison						4	no√	2	inactive	inactive	3	0	inactive	2	inactive	inactive	inactive
Wilson Creek	2	1	0	3	3	3	4	3	3	3	0	0	0	0	2	3	3
Woods Bay	1	4	2	3	3	3	3	4	2	0	2	3	2	0	0	active	0
Yankee Jim Canyon												0	1	2	1	1	2
York Bridge												2	active	1	inactive	inactive	inactive
Youngs Point								0	2	2	4	2	0	4	3	1	3

Total active	28	29	37	36	40	51	52	67	68	74	84	74	80	108	85	93	128
Total active with productivity Counts	24	28	37	35	40	51	49	66	68	67	79	69	66	97	62	69	97
Young fledged	43	59	66	77	80	101	94	147	108	125	176	114	100	203	133	141	233
Young /active territory	1.8	2.1	1.8	2.2	2.0	2.0	1.9	2.2	1.6	1.9	2.2	1.7	1.5	2.1	2.0	2.0	2.0
Cumulative number territories	32	38	48	52	59	69	75	86	92	100	113	119	129	145	154	166	193
17 year average number of young/territory			2.0														
Active=Territory was active, but no productivity was gathered																	
Inactive=Territory was checked and no activity was observed																	
Unknown=No information available for this year.																	
no√=Territory not checked for activity																	
Note: Active territories must have two adults present and attempting to nest.																	

Table 2. Occupancy rates of Peregrine Falcons at territories in Montana (1999-2016)

	Territories active previous year			Other historic territories			Total		
Year	No. Checked	No. with pairs	Percent Occupancy	No. Checked	No. with pairs	Percent Occupancy	No. Checked	No. with pairs	Percent Occupancy
1999	14	13	93%	42	0	0%	56	13	23%
2000	27	25	93%	47	0	0%	74	27	36%
2001	27	26	96%	49	2	4%	76	27	36%
2002	35	31	89%	52	1	2%	87	32	37%
2003	35	32	91%	47	0	0%	82	32	39%
2004	38	38	100%	49	1	2%	87	39	45%
2005	43	42	98%	no tally	no tally	no tally	no tally	no tally	no tally
2006	51	49	96%	36	0	0%	87	49	56%
2007	65	60	92%	36	0	0%	101	60	59%
2008	67	59	88%	22	0	0%	89	59	66%
2009	73	65	89%	49	0	0%	122	65	53%
2010	72	64	89%	34	5	15%	106	69	65%
2011	82	73	89%	34	5	15%	116	78	67%
2012	77	74	96%	33	9	27%	110	83	75%
2013	93	62	67%	27	2	7%	120	64	53%
2014	80	68	85%	24	4	17%	104	72	69%
2015	87	73	84%	44	26	59%	131	99	76%
2016	123	88	72%	0	0	0%	123	88	72%

Sources:

http://fwp.mt.gov/mtoutdoors/HTML/articles/2008/PeregrineFalcons.htm
Montana Peregrine Institute www.montanaperegrine.org

New Frontiers in Raptor Biology — Can DNA Technology Play a Role?

Dr Neil Sullivan, Complement Genomics Ltd

Introduction

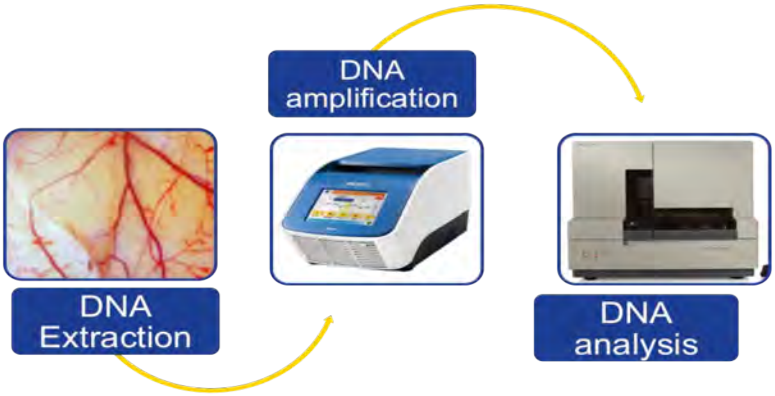
DNA is the fundamental code common to all forms of life and it determines all the instructions for growth, development, functioning and reproduction of living organisms. New technology means we can determine the complete sequence of the DNA in an organism, which gives us an unprecedented data set for understanding how the animal or plant works, for the identification of genes which are associated with distinguishing characteristics, for the identification of individuals and for the improvement of the germ line.

In this paper we will look at how this new technology could assist falconers in their activities and how the future use of genetics could provide new opportunities for conservation and trait selection.

Sexing of chicks from egg membranes

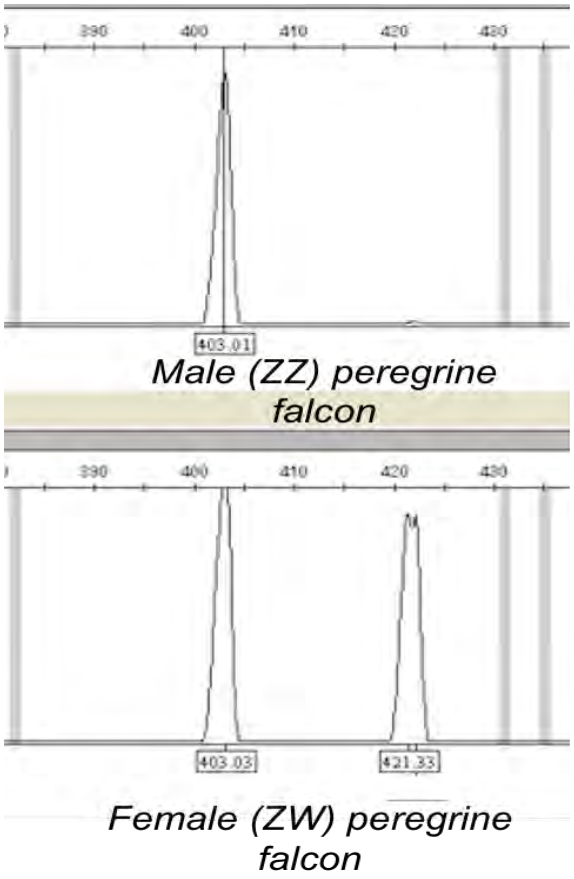
DNA technology allows us to identify whether a chick is male or female from a small segment of its egg membrane. The reader will perhaps be familiar with the concept of the X and Y chromosome system in humans. That is, there are two separate chromosomes (a packaged and organised section of DNA) and males are XY (having one of each) and females XX (having two copies of the X chromosome) and the sperm determines the sex of the organism. In birds, the situation is different and there is a ZW chromosome system, where the sex is determined by the ovum. Hence in birds males are ZZ and females ZW. As with the X chromosome, the Z chromosome is larger and has more genes. But it is not known if it is the W chromosome that induces female features or whether male features arise from having two copies of the Z chromosome. In order to determine the sex, we dissect the membrane from the shell and then extract, amplify and analyse a specific section of DNA (Figure 1).

Figure 1: The egg membrane sexing process.



We determine the size of this fragment of DNA, which tells us the size of the Z chromosome (and this helps us determine the species) and whether or not a W chromosome is present. In the top panel of Figure 2, one can see the single peak from a male peregrine (ZZ) and the clear absence of the W peak and in the bottom panel, the presence of both Z and W chromosomes.

Figure 2: The male (ZZ) and female (ZW) peregrine profiles.



DNA storage (bio-banking) and DNA based ID cards

A number of our clients have told us of the problem they face when confronted by accusations of wild take. It is often a case of guilty until proven innocent and since record keeping is sometimes poor and microchips are not infallible, a more reliable solution is needed. Since the unequivocal signature of any individual living organism, is its DNA, we have devised a system by which owners of birds can store the DNA of their bird in our bespoke bio-bank. At any point thereafter, we can retrieve the sample and conduct say, parentage tests to prove whether or not the bird has been captive bred. If we have one of the alleged captive parents DNA and we can show a DNA match in the chick, then the chick must have been captive bred.

To do this we extract DNA from feather roots, but also blood or egg membrane can be used. We do not recommend cheek swabs. We then store this on a special type of paper in two different locations, with an ID card that also captures essential biographical information from the bird (Figure 3).

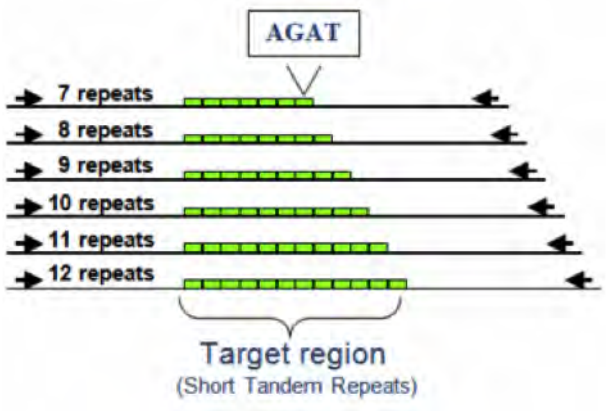
Figure 3: The new Avian ID system

This service is now being made available as "Avian ID", for storage of a bird's unique genetic code. Hopefully this system will go some way to protecting genuine breeders and owners from false accusation.

Parentage testing

We can use DNA testing technology to determine the existence of a biological relationship between individuals, or not, as the case may be. We present this as an "inclusion" – that the alleged father or alleged mother is related to the "child" or an "exclusion", where they are not. To do this we use short sections of DNA which are spaced throughout the genome and which serve as markers. These vary in size between individuals, so if we look at enough of these and there is sufficient variability in the population, we can, with a mathematical process, use this to determine relatedness between individuals. These markers are called short tandem repeats (STRs) – short because they are only say 4 base units long, tandem because they are next to each other and repeat because the base units are repeated several times.

Figure 4: An example of an STR used in genetic identification



In humans there is a huge database of STRs and their frequencies, so that when we do the calculations for paternity, the probability of parentage (if we include the mother) is often billions to one. Without the mother, we can expect probabilities of parentage around 99.9%, which means that if we randomly selected one male out of 1,000, he might have the same profile as the biological father.

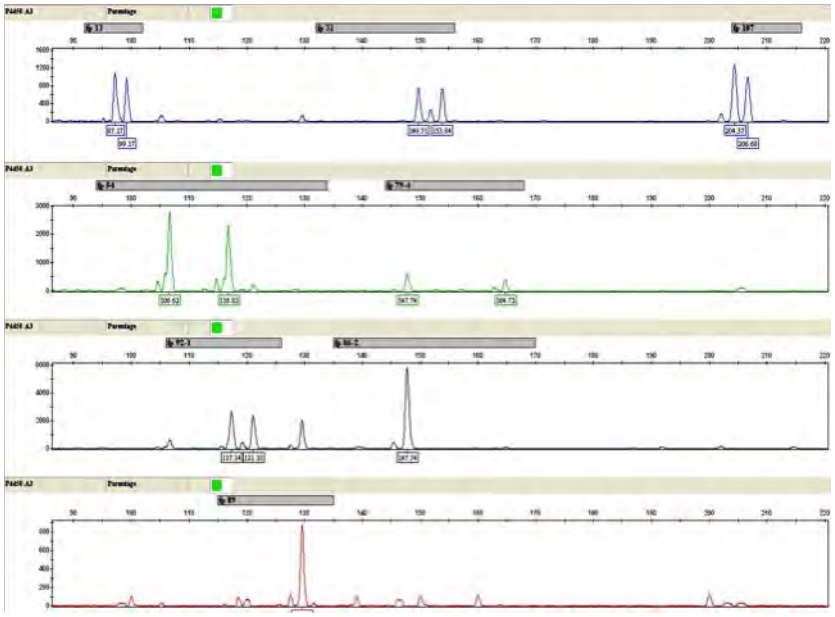
In peregrines, the science is still at an early stage since both the number of useable STR markers and the knowledge of their frequencies in the population is more rudimentary. However, we can still produce very useful results in terms of parentage determination and could expect a probability of paternity between 95% and 99%.

We must of course keep focus on the purpose of conducting these assays, such as:

a) Proof of captive breeding – in which case we need to determine a relationship of the bird in question to any captive bird, whether this is the female or male parent.
b) Determination of which male has fertilised the egg when mixed sperm has been used for insemination.

We are developing peregrine paternity assays to the point where they can be used by breeders and owners, by improving the STR assays and building up the database frequencies. This will be published in a scientific journal in due course. Over time, we will also be able to apply this technology to other bird of prey species.

Figure 5: An example of a multiplex STR assay on peregrine DNA



On the identification of hybrids

One of the most intractable questions in biology concerns the definition of a species. The "species problem" has been with us since 1686 when John Ray first noted that species always produced the same species, but there could be variation within the species. Structure was given to the problem by Linnaeus (who lived from 1707 to 1778)

and followed by the thoughts of Darwin, Mayr and Dobzhansky, among many others. Yet, there is no clear definition of what constitutes a species although DNA technology, via the medium of mitochondrial sequencing, at least for higher order animals and plants, now leads the way.

In accord with international convention, for birds of prey we use a DNA sequencing assay for the cytochrome oxidase gene, which sits within the mitochondrial DNA. The mitochondria are small organelles within each cell which generate the energy – as in humans, they are inherited down the maternal line. Our assays, will therefore deliver a species identification in accord with the maternal line. Whilst hybridisation may have happened between two bird "species", there is no way to determine the degree or extent of hybridisation (other than the obvious statement of 50:50 for the F1 generation – we can sometimes achieve this in the sexing experiment if Z and W have come from different species and Z has a different size, such as in the peregrine – merlin hybrid, the "perlin"), due to possible previous inter breeding and a host of other factors. We strongly recommend that this methodology is used to define the "species" in the Falco genus. There may be further value in the determination of the 19 subspecies of *Falco peregrinus* (as defined in the 1994 edition of *Handbook of the Birds of the World*), which could also be concluded by COI mitochondrial sequencing, but this has yet to be resolved.

Whole "exon" sequencing

There are a number of other areas where DNA technology can be of use in raptor biology and we are pursuing a number of areas which look at the genetic backgrounds associated with particular traits and characteristics. We can achieve this by the determination of the whole exon sequence of the bird and comparison to others. The exons are the parts of the genome which code for proteins and hence generally carry the functional characteristics with them. Small variations in these sequences (known as single nucleotide polymorphisms or SNPs) can be identified and correlated with characteristics of interest. The excellent work of others has derived a reference sequence for the peregrine and saker falcons; this has provided the alphabet, the essential first step. There are now many words to be created and books to be written as we seek to understand the biology of this magnificent bird.

Summary

Hopefully this paper provides a flavour of the possibilities for the use of DNA technology in raptor biology. It is a field which is in its infancy but nevertheless, we hope that the reader will have been inspired by the potential benefits that can be delivered in bird sexing, parentage testing, proof of identity (captive birds and wild take), species identification and trait selection.

Qatar Falcon Genome Project: Genetic and genomic approach, novel to the conservation of sakers (*Falco Cherrug*)

Dr Farooq Al-Ejli, Genetic Engineer and Researcher, Al-Gannas Qatari Society

Introduction: Falcons and Falconry

Since the dawn of human civilization, falcons have a played an important role in many aspects of human life. Their superiority as a birds of prey as well as their trainability have been the main reason behind the sophisticated, symbiotic relationship that has developed between humans and falcons. Perhaps the most accurate description of this relationship is an "alliance between man and bird" (Bodio, 2015). Universally, falcons have been associated with nobility, loyalty, patience, and persistence. They are considered as national birds in many nations, including the State of Qatar. Believed to have originated in ancient Mesopotamia, Arabian falconry is deeply rooted in the Arab world, especially the Gulf Region, with an exceptional appreciation of the Saker falcon. Highly esteemed and admired for their resilience and loyalty, sakers are considered to be the first species of birds of prey used for falconry by Arabs in the earlier centuries of the first millennium CE.

Falcons: Taxonomical Overview

Falcons (Genus *Falco*) consist of 37 species. Based on DNA analysis, Genus *Falco* is comprised of five major groups: kestrels, merlins, hobbies, peregrines and heirofalcons (Wink & Sauer-Gürth, 2004). Heirofalcons are a complex of superspecies which includes Saker falcon (*Falco Cherrug*), Gyrfalcon (*F. rusticolus*), Lanner falcon (*F. biarmicus*), Laggar falcon (*F. jugger*), and Australian Black falcon (*F. subniger)* (Nittinger et al. 2005).

Gyrfalcon
Falco rusticolus
(2n=52)

Peregrine
F. peregrinus
(2n=50)

Prairie
F. Mexicanus
(2n=48)

Merlin
F. columbarius
(2n=40)

Falcons' placement in the tree of life has been a debatable question; it has intrigued many and attracted the attention of geneticists, ecologists and taxonomists. Historically, and based on morphology and predatory behaviour, falcons were grouped with other diurnal birds of prey such as eagles and hawks (Sale 2016). However, a drastically different conclusion was reached by a landmark study by Hackett and colleagues (2008) based on the analysis of ?32 kb of aligned nuclear DNA sequences from 19 independent loci for 169 species. The study found that falcons are a distinct order (Falconiformes), separate from the rest of diurnal birds of prey, which were then recognized as a new order called Accipitriformes. It has also been suggested that, genetically, falcons are closer to parrots than they are to other diurnal birds of prey. The same conclusion was further supported by a genome-scale phylogenetic analysis of 48 species representing all orders of Neoaves, a clade that consists of all modern birds (Jarvis et al. 2014). These studies have demonstrated how genetics and genomics can impact what was once

considered common wisdom by avian biologists.

Saker Falcon: A Closer Look

Different species of falcons can be differentiated to a certain extent by morphology (plumage colour, size, etc). However, even to the well-trained eye, some confusion may occur between closely related species (e.g. heirofalcons). Nevertheless, a closer look at the genomes of different species grants a more detailed insight. For example, similar to the peregrine, the saker's genome size was approximated to be 1.2 Gb in length, encoding about 16,200 genes (Zhan et al., 2013). However, a gene-based analysis of both genomes underlined species-specific evolutionary adaptations; homeostasis-related genes in sakers were found to be adapted to the arid environment, which presumably explains their advantage in the desert.

The saker falcon is a Palearctic species that covers around 10,300km^2 of habitat and nesting areas. In contrast to the worldwide-spread peregrine, saker falcons have a relatively confined geographical range in the northern hemisphere, stretching from north China and Mongolia to Austria (Nittinger et al., 2007). The species was first described by British zoologist John E. Gray in 1834. Since then, many researchers attempted to address whether *F. cherrug* is a monotypic or polytypic species. The question remains open. Based on geographic distribution, behaviour and morphological variations, researchers have recognized up to eight subspecies (Pfeffer, 2009). The main reason behind this inconsistency is the clinal nature of the morphological differentiation among several populations of saker falcon (Ragyov et al., 2014). However, the most accepted theory is the division of *F. cherrug* to two subspecies; Eastern saker Falcon (*F. c. Milvipes*) and Western saker Falcon (*F. c. cherrug*) (Pomichal, Vági & Csörgő, 2014). This view has been criticized, however, for being "oversimplified" (Karyakin & Pfeffer, 2009). A more recent take on this issue was detailed in a comprehensive study by Pfeffer (2009) where he combined the scientific literature with his own experience and observations of sakers in the wild and in captivity. His study identified eight subspecies. In a 12-year period of surveys, Karyakin (2011) reached a similar conclusion, based on spatial analysis of phenotypic characters of 820 adult and 936 young sakers on 607 nesting sites. Nevertheless, neither the mitochondrial haplotype distribution nor the microsatellite analyses provide a conclusive evidence for these sub-specific divisions (Nittinger et al., 2007), keeping the door open for the debate.

Saker falcon: Conservation Status

The saker falcon (*F. cherrug)* is currently on the International Union for Conservation of Nature (IUCN) Red List as an endangered species (ROWA, 2015). Electrocution, unsustainable overhunting, destruction of habitat, secondary poisoning, collision with man-made structures and climatic change has led to a significant decline of the saker falcon populations. The near-local extinction of some lineages and local populations have been reported (Reading, Bedunah & Amgalanbaatar, 2010); Ellis, Kitowski, & Roundy, 2011). The critical conservation status of saker falcons has attracted the attention of several scientific disciplines. Ongoing conservation effort has included breed-and-release programmes (Galushin, Moseikin, Sanin, 2000), power line insulation (Bagyura et al., 2012), environmental regulations and artificial nests (e.g. Galushin, 2004).

Qatar Falcon Genome Project

The implemented conservation programmes have proved to be effective, especially in

Eastern Europe. The regrowth of local populations of sakers promises a significant recovery in the future, optimistically for the whole species. However, the full assessment of the efficacy of said conservation programs requires a comprehensive genetic and genomic analysis of the recovered populations. The quality of the recovered populations (e.g. genetic diversity) is more imperative and crucial to evaluate the success of a conservation programme than the sheer quantity.

In late 2015, Al-Gannas Qatari Society adopted and sponsored a comprehensive approach, proposed by the author, to the conservation of sakers that employs the principles and applications of conservation genetics and genomics. Launched under the name of the Qatar Falcon Genome Project (QFGP), such a comprehensive approach, involving relatively newly emerging techniques and principles of conservation genomics and genetics, has never been applied to address the conservation question of falcons, especially sakers. Aided by whole-genome sequencing, annotation and analysis, QFGP has developed a novel angle to lead the saker's conservation efforts. Combining contributions of several fields, QFGP involves population genetics, molecular ecology, molecular biology, evolutionary biology, systematics, forensics, etc.

Employed as an early warning system, QFGP aims to aid the ongoing conservation effort in several ways, including, yet not limited to, monitoring genetic changes, resolving population structure, identifying endangered populations, understanding the biology of the species, detecting hybridization and defining geographic location for release programmes. QFGP looks into the conservation status of the saker falcon from two different angles; *In situ* conservation and *Ex situ* conservation.

In situ conservation applies to the conservation of wild populations of sakers in their natural habitat, with the least impact on their genetic integrity. QFGP investigates this area by seeking to conclusively resolve population/meta-population subdivision, estimation of effective population size, the capability of populations to adapt to anthropogenic and climatic changes, and identification of Evolutionary Significant Units (ESU).

On the other hand, the scope of *Ex situ* conservation mainly involves the analysis of intraspecific and interspecific breeding, including inbreeding and outbreeding depression, adaption to captivity and admixture.

Conclusion

The ultimate objective of QFGP is to build a multidisciplinary effort that involves scientists and falconers to develop a comprehensive, long-term conservation strategy for sakers with clear priorities and well-informed management decisions. Such a strategy is to approach the species conservation starting at the molecular, genetic level.

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Return of the Sussex Peregrine: Where have they come from?

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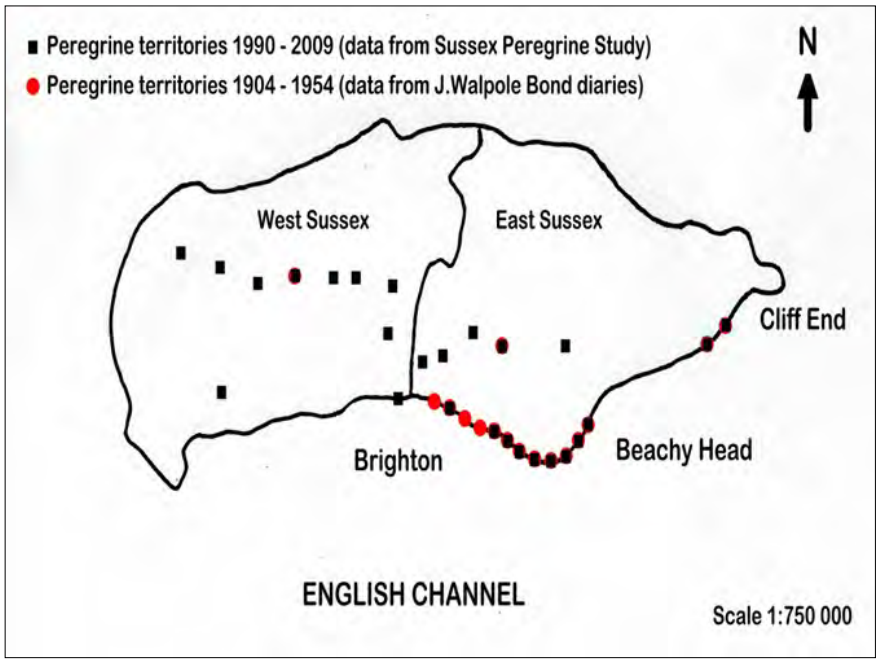
Introduction:

Primarily due to the deleterious effects of organochlorine pesticides, populations of peregrine falcons (*Falco peregrinus peregrinus*) in the UK underwent severe declines and local extinctions during the mid-20th century (Ratcliffe, 1980). In much of England, Wales and Northern Ireland by 1960 the species was virtually extinct, with much reduced population sizes in Scotland. In Sussex, which now includes two adjacent counties on the south coast of the UK (Figures 1 & 2), the pattern of peregrine population crash parallels those changes seen throughout the UK. However, after more than 30 years of post-pesticide absence from Sussex, the population there has made a spectacular recovery to more than four times pre-pesticide numbers.

Figure 1: Sussex, South East England in the context of UK and Ireland.



Figures 2: Peregrine Territories in Sussex.

Our question is where has this viable recovered population come from? One suggestion is that it originated from individuals coming from residual populations in refugia to the north and west of mainland UK (e.g. Cornwall, Wales, Scotland) where a few breeding pairs lingered on. This theory however would suggest that the current re-established Sussex population is the product of a population "bottleneck" and derived from inbred, genetically impoverished founders.

Monitoring data for the Sussex peregrines from 1990 to date shows that although the population approaches saturation it shows none of the symptoms of inbreeding: it is highly productive and exhibits high phenotypic variation. These observations raise the

Return of the Sussex Peregrine: Where have they come from?

The Sussex Coastline, providing suitable breeding territories for the Peregrine Falcon

questions as to how genetic variation has been maintained throughout the presumed bottleneck, and, in particular, whether the modern Sussex peregrine is genetically the same as the peregrine of the first half of the 20th Century. We speculate that other sources of founder variation, such as immigration from the near Continent or even falconry escapes may have contributed and we present preliminary results of molecular DNA techniques which compare Sussex peregrines with parapatric populations in Europe and in domesticity.

(Below): John Walpole-Bon and his collection of Peregrine Eggs.

Population Studies

Information for productivity of Sussex peregrines from 1904 to the middle of the 1900s come largely from the unpublished diaries of professional egg collector John Walpole-Bond (J W-B) and are described elsewhere (Franklin and Everitt, 2009). Despite virtually 100% predation of eggs by J W-B during this 50-year period, the population remained remarkably resilient at between 5 and 12 productive pairs (Figures 3 & 4). The population crash during the 1950's is presumed to be due to cumulative effects of egg removal and direct persecution, but mostly due to the direct effects of organochloride pesticides causing adult mortality. Such a cause is comparable to Ian Newton's (1986) conclusions as to the cause of the population crash of sparrowhawks in England during the same time period.

There then followed a period of absence from 1955 until 1990 when Bart Atfield, co-founder of the Sussex Peregrine Study, discovered the first breeding pair for over 30 years. Since then intensive monitoring by volunteers has recorded an exponential increase in productivity from one successful pair in 1990 to 35 in 2016 which produced a total of 46 viable young (Figure 5). Expansion of the population has relied not only on the occupation of traditional coastal cliff nest sites, but also on the exploitation of inland quarries and artificial sites such as housing blocks and industrial sites.

Figure 3:

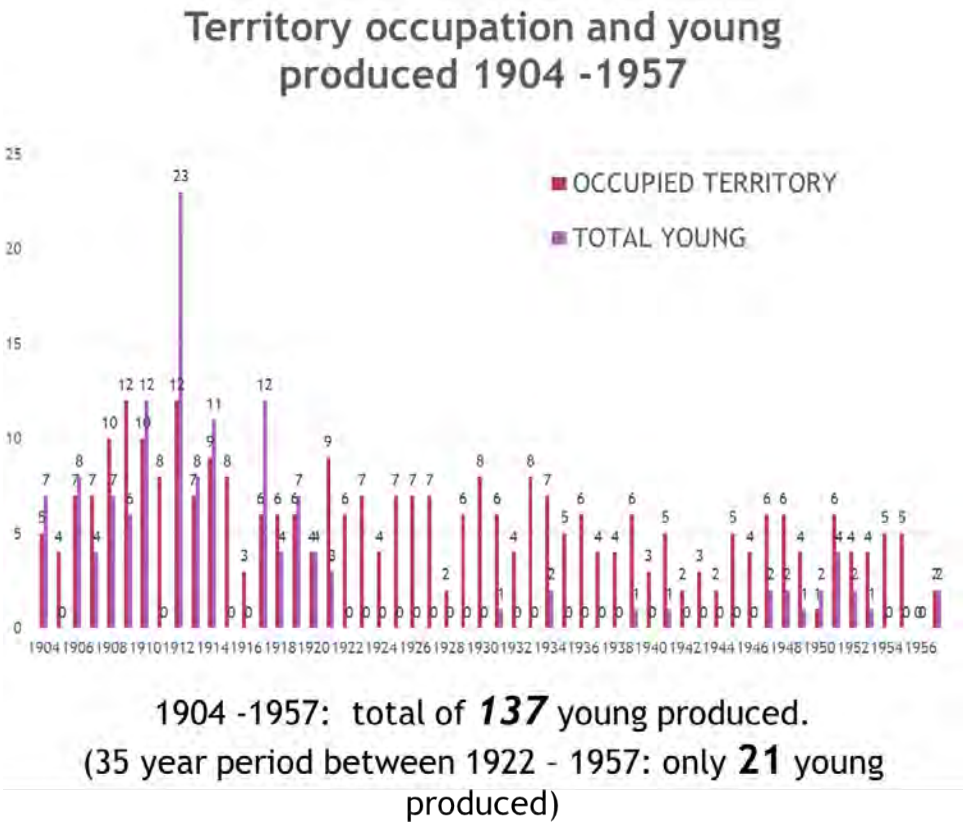
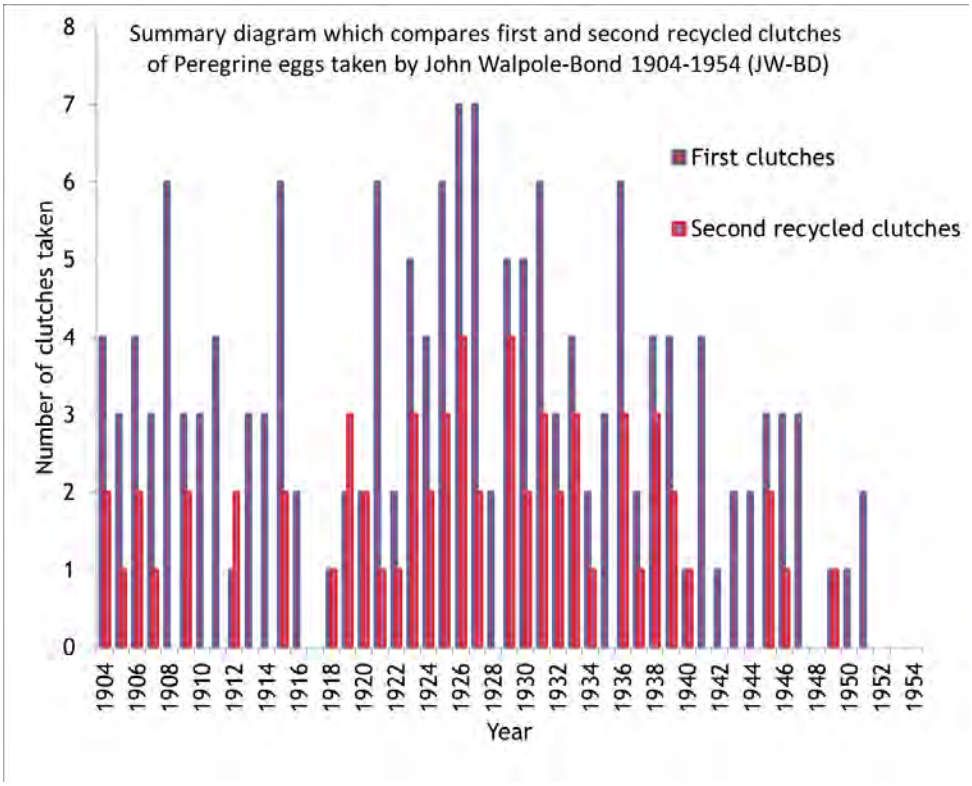


Figure 4:



Return of the Sussex Peregrine:
Where have they come from?

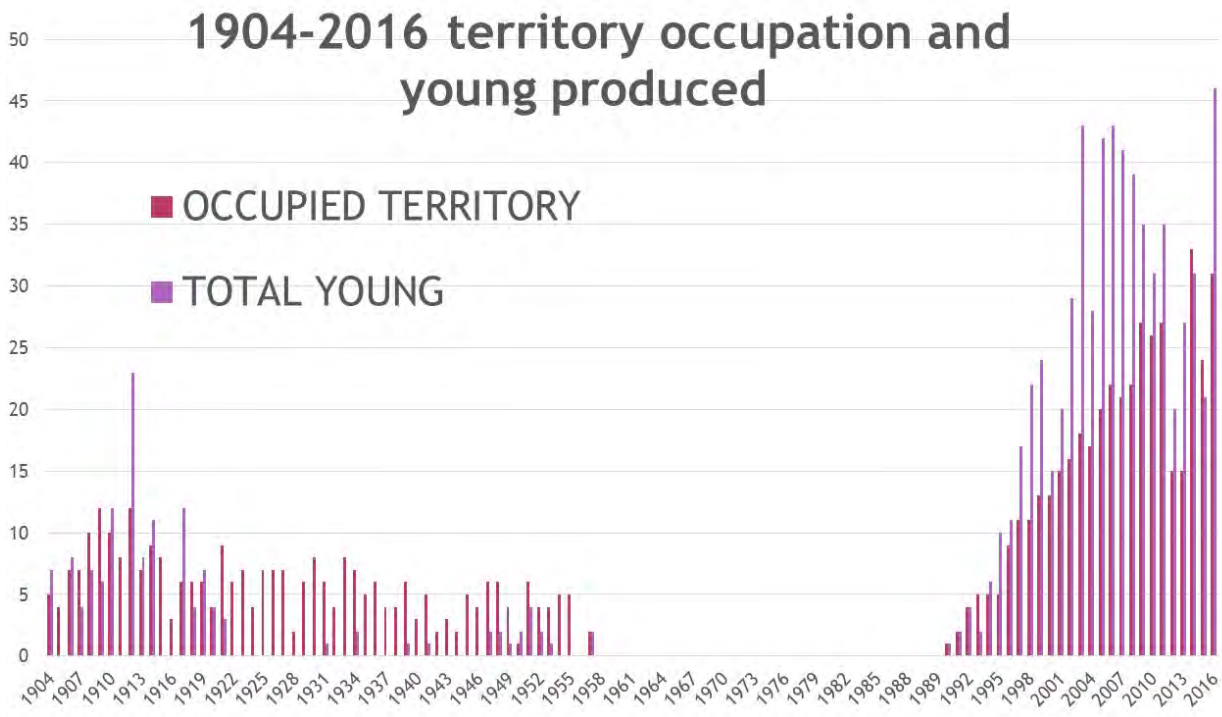


Figure 5:

Origins of the modern population

A commonly held belief of the origins of the modern Sussex peregrines is from a few founder individuals derived from small residual populations in the west and north of England, from Wales and possibly migration from the north of Scotland where stocks remained relatively healthy. We have speculated that if this is so then the modern population would be genetically impoverished, the product of a genetic 'bottleneck'. However, the Sussex population is now phenotypically extremely variable and reproductively vigorous, seemingly showing no evidence of inbreeding depression. This in turn suggests that other sources, such as migrants from nearby continental Europe, further west from Ireland or from artificially propagated ('captive-bred') falconry escapees, may have significantly contributed to the founder population. Commercially available, artificially propagated ('captive-bred') peregrines in the UK are derived from many subspecies and geographical races, and genetic introgression into the wild UK population certainly seems plausible (Flemming et al., 2011). We have therefore used molecular DNA techniques to compare Sussex peregrines with parapatric populations in other European countries and those held by bird of prey keepers.

Mitochondrial DNA studies

To help understand their origins, we present preliminary results using molecular DNA techniques (mitochondrial DNA phylogeography) which compared modern Sussex peregrines with those elsewhere in Europe and in captivity. Samples of moulted feathers of adult peregrines and down from eyasses were obtained from wild Sussex, Irish, German and artificially propagated peregrines bred by UK breeders (we here refer to as 'domestic'). Total genomic DNA was extracted using a commercial kit (Thermo

(Right): Sample photos of the variation of markings and colouring on Peregrines found in Sussex, speculating their origins

Scientific). We used PCR to amplify the mt (mitochondrial) DNA control region using primers and conditions already determined by Brown et al. (2007). PCR products were purified using a commercial kit (*Thermo Scientific*) and sequenced (*Source Bioscience*).

To infer the population history of peregrine falcons, mtDNA sequences were aligned in BioEdit (Hall, 2011) using the function ClustalW, haplotypes were inferred using DnaSP (Librado and Rozas, 2009), and a Neighbour-Joining phylogenetic tree and Median-Joining haplotype network were generated using MEGA6 (Tamura *et al.*, 2013) and Network (Bandelt *et al.*, 1999; fluxus-engineering.com), respectively. Genetic diversity indices, including number of different haplotypes, haplotype diversity (h) and nucleotide diversity (p), and mean number of pairwise nucleotide differences between haplotypes (k) were estimated using DnaSP to assess the genetic status of comparative populations.

Table 1 summarises the number of haplotypes for each population sample. Results from the GenBank population provide a benchmark for number of haplotypes (15) in a random sample (n=83) from the world distribution of peregrines: approximating to 18 haplotypes per 100 birds. The English South coast (n=20), Irish (n=22) and Domestic (n=14) all share 4 haplotypes in common, while the sample (n=22) from Germany has two of these haplotypes.

Preliminary mt DNA results – Number of Genetic Haplotypes	
	Number of Haplotypes
World sample* from GENBANK (83 birds)	15
English sample (20 birds)	4
Domestic sample (14 birds)	4
Irish sample ** (22 birds)	4
German sample (22 birds)	2
(* from North America, South America, Australia, Fiji, Russia, Europe, etc.....)	

Table 1
Similarity indices were computed using the commonality and frequencies of each haplotype in pairwise population sample comparisons. For ease of comparison, these are expressed as percentage similarities in Table 2. The English south coast sample shares 100% similarity to the Domestic sample; 97% to the GenBank sample; 95% to Irish birds and 77% to German peregrines in the study. Other population sample comparisons are also presented (Table 2).

	English	German	Domestic	Irish	GenBank
English	*				
German	77%	*			
Domestic	100%	78%	*		
Irish	95%	75%	91%	*	
GenBank	97%	88%	097%	95%	*

Table 2 – Preliminary MT-DNA Results – Indices of Similarity (%)

So where have the Sussex peregrines come from?
The small samples from the English south coast and other populations presented for DNA sequencing make our study little more than a pilot investigation. Nevertheless, judging by the mtDNA results there is strong genetic correlation between the population structures of wild English peregrines and Domestic birds. Although this result may suggest gene flow between the two populations we still cannot say whether the direction of gene flow was initially from the Domestic as founders of the wild free living population (by e.g. falconry escapes), from the wild into the domestic (*e.g.* as wild disabled birds taking into breeding projects), or a combination of the two.

From communication with keepers and breeders of Domestic peregrines in the UK we understand that several subspecies (*e.g. F. p. brookei, anatum, pealei, calidus* and including sibling species, *F. pelegrinoides pelegrinoides* and *F. pelgrinoides babylonicus*) have contributed to this population. The high similarity (97%) between English and GenBank and Domestic and GenBank reference sample may give some credence to gene flow to and from the English and genetically enriched Domestic population. By the same token, however, the high similarity (95%) between the English and Irish populations also gives support to immigration to Sussex from western populations, *e.g.* from Ireland, possibly *via* Wales. The German sample has lower (77%) similarity with the English sample and is relatively genetically impoverished (only 2 haplotypes).

To fully answer the question of origins of Sussex peregrines requires not only comparisons with parapatric populations (we have here present comparison with Irish, German and Domestic birds) but also the English sympatric populations separated by time. We are therefore currently attempting genetic analysis of museum skin samples from English south coast peregrines from before 1945, *i.e.* before deleterious pesticides

were used. To date we have located more than 50 specimens in UK museums which fit these criteria and DNA analysis is ongoing. We also believe that using the mitochondrial control region may be too blunt a tool for fine grained population comparisons. At this stage, the origin of the Sussex population could not be determined based on mtDNA, but another, more variable, molecular marker will be employed to shed some light to help answer our question, and we intend to look at microsatellites.

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Conservation through Use of Wild Resources: Examples from Falconry

Prof Robert Kenward

Abstract: Membership of the International Union for Conservation of Nature (IUCN) includes 89 States and more than 1,000 NGOs. IAF has for 20 years been one of a handful of international NGO members. IUCN also has ca 1,000 staff in 45 regional offices and 20,000 volunteers, of which two groups (containing several IAF officers) are for Sustainable Use and Livelihoods (SULi) and Sustainable Use and Management of Ecosystems (SUME). During 2002-11, projects for European Commission by the group that preceded SULi and SUME raised awareness that the private spending on hunting, angling, gathering and watching wild resources exceeds Common Agriculture Policy spending, without even considering the volunteered time.

It was also shown that the vast majority of on-the-ground decisions affecting nature conservation are made by these enthusiasts and the managers of ecosystems, including for farming and forestry. The desirability of providing decision-support to guide management for rural incomes that benefit from biodiversity and ecosystem services was noted, and that the practitioners could also supply vital information on the effects of their decisions to create a virtuous cycle of improving guidance.

Sadly, concerns about how and whether to devolve capabilities have hindered setting up the knowledge-exchange systems needed for effective conservation through sustainable use. However, in 2015 IAF joined with the Convention on Conservation of Migratory Species (CMS) to pioneer a system to manage the Saker falcon. In 2016, IAF followed this by initiating a system for restoring biodiversity of farmland aimed at increasing stocks of the Grey Partridge. Just as falconers pioneered restoration of raptors in the 1970s, so they are now pioneering the socio-technology systems for conservation through use of other wild resources.

Introduction: IAF's membership of IUCN

The world authority on conservation is the International Union for the Conservation of Nature, which was founded in 1948 and holds the observer seat for the environment at the United Nations. IUCN is an inter-government and non-government organisation, whose membership consists of 89 States and more than 1,000 NGOs. As well as about 1,000 paid staff, in 45 regional offices, IUCN also has some 15,000 volunteers. The volunteers are organised in six commissions, for Species Survival (SSC), Protected Areas (WCPA), Environmental Economic and Social Policy (CEESP), Education and Communication (CEC), Environmental Law (CEL) and Ecosystem Management (CEM).

IUCN holds a World Conservation Congress at 4-year intervals, most recently in Hawaii in September 2016. Congress, which separates the votes from the Government and Non -Government Members, votes whether Motions submitted by Members should become Resolutions of the Union, and establishes other aspects of IUCN's Programme for the following quadrennium.

The International Association for Falconry and Conservation of Birds of Prey was founded in 1968 and now has member organisations in 83 countries, each of which can vote in its annual general meeting. This makes it the largest democratically-structured organisation in the world for conservation through use of wild resources. IAF has for 20 years been one of a handful of international NGO members of IUCN, and took successful motions to Congress in 2000 (on the Conservation of the Saker Falcon) and in 2016 (on

Electrocution of Raptors). Two groups within IUCN Commissions have responsibilities for conservation based on Sustainable Use of "the components of biodiversity which ensures their survival for future generations". A Sustainable Use and Livelihoods (SULi) specialist group operates across SSC and CEESP, while Sustainable Use and Management of Ecosystems (SUME) is a thematic group in CEM. Both groups contain several IAF officers and, at the 2016 Congress, IAF cooperated with both to take responsibility for coordination of IUCN Members interested in conservation through sustainable use.

IUCN Sustainable Use Activities in Europe

Following the recognition of sustainable use as a pillar of conservation in the 1992 Convention on Biological Diversity (CBD), IUCN started a Sustainable Use Initiative. Regional groups within this initiative were inherited in 2001 by a Sustainable Use Specialist Group within SSC. The European Sustainable Use Specialist Group (ESUSG) was especially ambitious, winning bids for a series of three large projects funded by European Commission, plus half a dozen smaller contracts for reports. To administer these projects, it constituted a non-profit legal body under Belgian law, which is now the European Sustainable Use Group. ESUG is now a support group for both SULi and SUME, with a network of country coordinators for projects and translation.

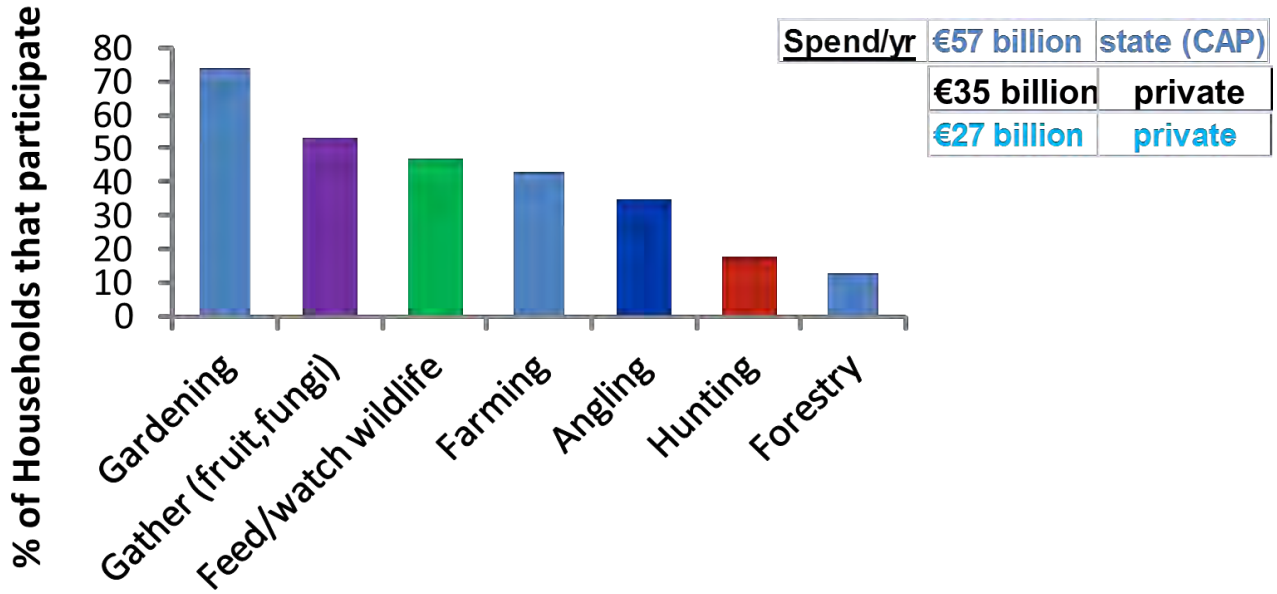
As well as the projects, ESUSG helped IUCN members in Europe draft a first charter, on hunting and biodiversity, for the European Convention on Conservation of Species and Natural Habitats (the Bern Convention), based on principles drafted in its Wild Species Resources working group. Unlike a Code of Conduct, which places responsibilities purely on practitioners of an activity, a Charter places responsibilities also on government and thus in effect gives practitioners rights as well as responsibilities. This is crucially important because the thinking being developed within CBD, and reflected in its Addis Ababa Principles and Guidelines for Sustainable Use (AAPG) and Malawi Principles (the Ecosystem Approach), both stressed the crucial nature of enabling management of wild resources at the lowest practical level. In other words, governments needed to help enlighten and empower local people for adaptive management ("learning by doing"), and not merely dictate instructions for protecting land and species as was the case in conventions (eg. on Migratory Species and International Trade in Endangered Species) which were created a decade or more before CBD. Thus the European Charter on Hunting and Biodiversity, and the subsequent ones on Recreational Fishing and Biodiversity and on Gathering Fungi and Biodiversity, make recommendations for government help to practitioners as well as to the practitioners themselves.

Whereas the policy work of ESUSG (now ESUG) involved a small number of members, most of the group have participated in the more applied projects. After an initial EU contract on multifunctional agriculture in 2002, bids were won in 2006 and 2008 to start building tools for enlightening and empowering local managers of land and species. The first, on Governance and Ecosystem Management for Conservation of Biodiversity (GEMCONBIO), assessed factors at local level that contributed to the sustainability of using species and what are now known as Ecosystem Services (for underpinning and regulating production of natural provisions and cultural benefits for humans). It found, using robust statistical analysis of 32 case studies from around the world, that the most important factors for sustainability were having a regularly consulted source of knowledge ("knowledge leadership") and monitoring with consequent changes in management (ie. adaptive management). This strongly supported the emphasis in AAPG

and the Ecosystem Approach on enlightening and empowering local practitioners.

In the GEMCONBIO project, ESUSG also took the opportunity to raise awareness of the high value of private spending on hunting, angling, gathering and watching wild resources. Hunting and angling organisations, in the Federation of Associations for Hunting and Conservation of the EU and the European Anglers Alliance, had already been collecting information on spending to illustrate their economic value for wildlife. Requests were made also to Birdlife International for estimates of spending by birdwatchers, and to any national organisations for collecting fungi or plant materials that ESUSG country coordinators could contact. Data from hunters and anglers, whose numbers could also be estimated fairly accurately from licences, came in promptly and fairly comprehensively, whereas less than half as many countries could produce data on watching birds; data on gathering were inadequate. Nevertheless, the combined total of private spending exceeded €40 billion annually, not much less than about €57billion currently being spent by the EU under the Common Agricultural Policy.

These data were improved during the following project, during 2008-11. This was work to design a Transactional Environmental Support System, in order to transfer the best guidance to local practitioners in their languages in exchange for monitoring that could improve their adaptive management and help governments improve the system. As expert guidance for each different area was bottlenecked by a shortage of experts, the concept was for an internet system to deliver decision support based on rapid improvement in development of ecological models. A first stage was to survey, for local councils and individual managers of land and species, how much environmental decision support was needed and using what sort of data, while a second stage was practical project work in communities to see what information could be generated in return.



Two things rapidly became clear. One was that although central governments were passing laws on the environment, and conducting statutory Environmental Assessments at local level, it was the individual managers of land and species (farmers, foresters and managers of land for hunting, angling and species conservation) who made decisions (on what, when and how to grow and harvest), which in terms of frequency and area covered were at least four orders of magnitude (10,000 times) more abundant. These decisions, based on local knowledge and climate as well as remote drivers (eg. trade prices) accumulated to change the countryside. The second thing to become clear was not only that a major requirement for decision-making was fine-scale maps of habitats (including soils and crops) and species but also that communities could generate these maps themselves given guidance and equipment. Local communities in five of eight countries turned to local hunters for help with their mapping projects.

There was also a particular shortage of information on socio-economic aspects of nature, which constitute the economics of ecosystem benefits and problems. In surveying the local spending on various countryside activities, opportunity was taken to sample spending on hunting and angling compared with watching and gathering wildlife. These data could be used together with the robust GEMCONBIO national data for hunting and angling to estimate total private spending of at least €60 billion annually across Europe, more than the CAP's public spending.

These projects confirmed both the practicality and desirability of providing decision-support to guide management for rural incomes that benefit from biodiversity and ecosystem services. Sadly, high level concerns about responsibility for developing such systems (and perhaps also about the autonomy that devolved capabilities could confer locally) have hindered setting up these knowledge-exchange systems needed for effective conservation through sustainable use. So although a multilingual portal (www.naturalliance.eu) was established in the last months of the survey to inform many countryside activities about the conservation they could achieve for their resources, and to gather some further information on web-support they required, the business plan for bottom-up funding of decision-support development was not implemented.

Conservation through Sustainable Use in Falconry

The conservation activities of falconers have been well documented by IAF and elsewhere. Indeed, the earliest published monitoring of raptor nest distributions appears to be in the Domesday Book of 1086, for Goshawks in the UK county of Cheshire. Domestic breeding of raptors occurred at various times in history, with the trigger for efforts to restock Peregrines during the "Pesticide Era" being successful captive breeding in Germany during 1942-43. In 1975, just seven years after being founded, IAF used rapid growth of domestic breeding by falconers in Europe and North America to dissuade the International Council for Bird Preservation (now BirdLife International) from adopting a resolution calling for a global ban on falconry. It is fascinating to see the incorrect hypothesis that falconry was driving the Peregrine to extinction being repeated for the Saker falcon, where there is some over-harvesting but clear evidence of a much bigger problem from electrocution on poorly designed power lines. During the same long period, falconers have not only identified the most serious of other insidious problems for raptors, namely lead for the Californian Condor and Diclofenac for *Gyps* vultures, but have also pioneered and applied the research to reverse the problems for these and other raptors.

Early enthusiasm by other conservationists for domestic breeding to provide what is now called "Demand Reduction" in wildlife trade discussions, coupled with livelihood creation from the breeding of raptors, led to replacement in Europe of wild eyasses and passagers by domestic-bred raptors. Fortunately, this did not lead to reduced motivation among falconers to conserve wild raptors, but instead permitted an increase in falconer numbers in Europe sufficient to achieve not only the huge effort needed to re-establish tree-nesting peregrines, but also growth in work to improve habitats for wild prey.

In 2006, IAF provided the European Commission with data showing that the countries with the largest numbers of falconers in Europe were also those with most wild Peregrine falcon pairs. It was hoped that this could lay to rest the idea that use in falconry was a threat to Peregrines. However, the role of the EU in preventing CITES down-listing from the highest category of "endangered by trade", when Peregrines now have higher populations than ever recorded in many countries, suggests that education of policymakers by falconers remains important. Ironically, of the benefits from falconry perceived among participants on the EC's Ornis committee in 2006, it was appreciation of public education on raptors by falconers that scored highest. There was also a high level of appreciation for research by falconers (eg. breeding, predation, disease), and for their management work in restocking raptors and pest-control.

Perhaps falconers, as a small minority group in Europe, are sometimes too reluctant to argue their case for better access to wild raptors. It has previously been pointed out that costs of monitoring the health of raptor populations of value for falconry could be met by a conservation fund from quotas of wild birds. For example, although birdwatchers do excellent census work on Peregrines, nesting numbers of the more elusive Goshawk are known to be considerably underestimated by nest records (let alone the large non-breeding numbers in all healthy raptor populations that falconers have shown through radio-based demographic studies). There are 55,000 pairs of wild Goshawks in Europe, which are producing about 100,000 young annually. Not only could demand of about 1,000 Goshawks per year for falconry, with a levy of €750 per bird (to minimise loss of breeder livelihoods), produce €1-2 million per year for monitoring, but a scheme that also involved eyasses and trapping of passagers could be used to achieve that monitoring through mark-recapture of ringed hawks left in nests.

The concept of a charter of rights and responsibilities may have originated in the falconry world. A draft "Charter for Conservation through Falconry" was prepared for IAF in 2003, whereas the process for the Bern Convention on Hunting and Biodiversity started in 2004. IAF also had the opportunity to reach an accommodation on use of wild raptors with European Commission in 2006 but demurred. Perhaps it is time for falconers to cease being so modest about their contributions to conservation and revisit this issue.

Convergence of IUCN and IAF Portals for Conservation

Despite lack of further funding from European Commission, ESUG continued to work with its members in Game and Wildlife Conservation Trust (GWCT) and the software firm Anatrack Ltd to develop software for outreach to local communities. In the UK, councils at the lowest level of government and local clubs were asked what they would like as web-services. A system was designed to deliver these as a website that would be

easy for them to edit (avoiding need to pay and instruct separate web-builders), without intrusive and system-slowing advertising such as pop-ups but at a reasonable annual subscription of €99. The system for community liaison (www.sycl.net), delivering scope for all basic information on the local communities, with as much uploading of news, photo galleries, documents (eg. Minutes), links and languages as required, with ability also to map interesting local sites and rambles, was built and put out to test. However, funds had reached rock-bottom, despite some income in 2013 from a contract for the UN's Convention on Conservation of Migratory Species (CMS) raptor secretariat to review sustainability modelling and design a trade-monitoring system for the Saker falcon.

However, IAF was also involved in the meetings that followed the first CMS contract and generously chose to fund an initial website to survey and link falconers, trappers and falcon hospitals across Asia. The aim was to develop conservation of the species through its traditional use in Arab Falconry, aiming to build support to implement the mark-bank techniques proposed in the IUCN Resolution and mark-recapture techniques proposed in the ESUG report for CMS. This gave scope to develop in 2015 a new multilingual template, like that used for Naturalliance but able to handle languages like Arabic, Farsi and Pushto that are read right-to-left across a site (see www.sakernet.org, as constructed in English on www.saker-staging.net).

With completion and operation of this new project site, which also had scope for language-specific diagrams and links to SYCL sites operated by falconry communities in local languages, ESUG proposed at its General Meeting in 2015 to develop a series of such portals for Multilingual Online Research/Restoration Project Hosting (MORPHS), including one for restoration of micro-habitats for small-game and pollinators. GWCT very kindly agreed to help provide content for this Portal. IAF is providing management and arranging the translation (as for the Saker Portal) and is again very generously meeting the costs.

Thus, www.perdixnet.org and the first of its networked SYCL satellite national sites (http://perdix-uk.sycl.net) was built on an improved multilingual template in June-July 2016, since when it has been translated into French, Polish and Russian, with Croatian, German, Hungarian and Italian now also arranged. The system intends to enthuse and enable the restoration of biodiversity on farmland, with increase in stocks of the Grey Partridge as a flagship indicator. Just as falconers pioneered restoration of raptors in the 1970s, so they are now pioneering socio-technology systems for conservation through use of other wild resources.

Conclusions

- Private effort and Payments for Ecosystem Services have large potential for conservation.
- Local managers of farms, forest, hunting, fishing and reserve areas can all contribute.
- Among users of wild resources, hunters are well-organised and also work well with farmers, foresters and local authorities to organise projects.
- European Charters for sustainable use are being complemented by internet tools to get all interests working together to conserve nature at local levels.
- Among bottom-up projects managing ungulates, predators, aliens and habitats, game research and falconry pioneering a first project system to restore farm ecosystems.
- game research and falconry pioneering a first project system to restore farm ecosystems.

The Importance of Wild Take in American Falconry

Peter Jenny, President and CEO of The Peregrine Fund, 2006-2016

Introduction

We gather here today with a shared passion for the ancient art of falconry, an endeavor which has a renewed value in a modern world where our steak comes wrapped in plastic rather than warm fur with big brown eyes, a world that has become increasingly divorced from nature. I can think of few activities which form a greater connection with wildlife and our natural world than falconry. In stalking, bird hunting, or fishing, our interaction with nature ends with the kill and perhaps a meal. But in falconry, like no other, a successful hunt represents only one chapter in a close and continuing one-to-one relationship with one of the most charismatic of wild animals.

(Left): Falcon flying ducks

Domestication is one of the hallmarks of human evolution. Anthropologists tell us that our domestication of plants and animals 10,000 years ago is what made civilization possible. It is surprising, in fact, given our long history with birds of prey that it wasn't until the mid-20th Century that we began to breed them in captivity. Thus, the most profound change in falconry has been the advent of captive breeding. The impact that captive breeding has had on both the availability and diversity of birds of prey now available to falconers cannot be overstated, nor can its effect on reducing harvest pressure on wild stocks.

(Above): Falconer-led captive breeding programmes have brought many benefits to wild raptors such as these rare Aplomado Fal-

With all the birds now available to falconers from captive-breeding programs, the question often posed by conservationists is why do we still need wild take?

Before going any further I want to clearly state that I am a strong proponent of captive breeding and I am proud of the birds that I have produced in my breeding facility for both falconry and conservation purposes. But as important as captive breeding has been to modern falconry, there are some concerns.

Genetics

Natural selection is one of the true miracles of life. It is this continuing process of refinement that generates "adaptive peaks" resulting in such wonders as the human brain, the hummingbird, and the Peregrine falcon.

Peter Jenny with his son and a wild Passage Prairie Falcon

Consider this: *Every* single ancestor of this passage Prairie falcon (pictured above), without exception, was successful in survival and reproduction! Every single individual a success, this going back to the very first example of the species, and farther back to the first cell division, and to the origin of life itself! The driving force in nature is "Success". In nature, failure simply does not persist.

(Beloe): White Gyrfalcons are more common in captivity than the gun-metal grey more commonly found in nature as a result of the natural selection processes.

Once a species is brought into captivity, the rules change. Raptor breeders, like all breeders, tend to select for traits such as size, conformation, temperament, or readiness to breed under captive conditions. Some of this selection is intentional, yet some is inadvertent. Perhaps the most unsettling is our penchant to breed for markings and color. How much harder is it to find a captive-bred Peregrine with a distinct malar stripe? How much more common are white Gyrfalcons in captivity than the gun-metal grey more commonly found in nature? Look at what Americans have done to the Irish setter. Traits that while important to falconers, may not be important to a species' success in nature. I think that many of the birds that end up in breeding programs are those that are not lost during the falconry season, perhaps poor performers, or even worse, those that are deemed too "valuable" to fly.

As soon as a species is maintained in captivity or "domesticated", the powerful forces of natural survival and reproductive success are broken.

Conservation

In the US, the special consideration that falconry has received from society and government during the past 40 years or so, came, in no small measure, from the role that falconers played in the restoration of the Peregrine. A great many falconers worked hard to bring them back, not only donating their birds for captive breeding, but also inventing and perfecting the very procedures we take for granted today. It was easy to see that falconry knowledge and skill was essential to the restoration process, and also that wild-taken falcons firmly connected falconry with the well-being of natural populations. Logically, the most suitable individuals for restoration were those most directly descended from wild stock. Wild take was thus shown to provide a ready source of genetically appropriate breeding stock to support recovery efforts.

And do not believe this could not happen again! Bird-eating raptors are acutely sensitive to the bio-magnification of pesticides and other pollutants, and new chemicals are constantly being invented and deployed. The catastrophe that many Peregrine populations endured last century is an example we should never forget.

I am a huge proponent of the power of having a vested interest. When incentivized by wild take, falconers represent an important bridge to understanding wild populations. In my state of Wyoming, the Game and Fish Department threatened to close the wild-take of the merlin for falconry because of declining nesting records. In response, falconers took it upon themselves to search likely habitat, and that soon resulted in the documentation of many previously unknown pairs. These data were shared with a government agency struggling with limited funding and few qualified field personnel. This resulted in a win-win scenario with continued wild take of a species and far better, real-time knowledge of a wild resource.

When for many years Peregrines were no-longer available to falconers, the State of Wyoming was one of the few sources for the take of first-year Prairie falcons. The proceeds of permit fees from the wild harvest from robust prairie falcon stocks largely funded the successful peregrine recovery in the state.

Harvest levels

I think it may be useful here to provide a brief description of the resumption of the Peregrine harvest in the United States. By 1999, all subspecies of the Peregrine had been removed from the Federal List of Threatened and Endangered Wildlife and Plants (USFWS, 1999), and the Association of Fish and Wildlife Agencies (AFWA) established a working group to determine if the resumption of wild take was biologically justified, and if so, to recommend implementation criteria.

In its Environmental Assessment and Management Plan, the United States Fish and Wildlife Service (USFWS) determined that "*because falconry has gone on for decades with negligible impacts on populations of raptors, the proposal is not a precedent-setting action with wide-reaching implications*". In 2008, the Service ultimately recommended a conservative harvest limit not to exceed 5% of the annual production of first-year birds. Their productivity assessment was based on mark-and-recapture banding data. Annual harvest limits were set at 116 nestlings for the western half of the

A wild yet tame beach hawk—passage Peregrine falcon.

United States, and up to 36 first-year migrant Peregrines captured throughout the Eastern half of the United States.

A recent population assessment of the Arctic juvenile Peregrine population, again using mark-and-capture data, estimated that, by the year 2000, the production of hatch-year falcons was approximately 21,000, and that "*using the US Fish and Wildlife Service harvest guideline, and the annualized estimate of hatch-year falcons reported here (after mortality), it appears that the combined annual harvest limit in Canada, the United States and Mexico could be conservatively set at 840 hatch-year falcons without negative impact to breeding populations*" (Franke A., 2016).

Falconer interest in the take of wild Peregrines currently exceeds the current harvest quotas, and the North American Falconry Association (NAFA) has requested that the USFWS increase the existing quota. However, agencies and conservation groups are not alone in restricting access to wild take. Falconers themselves can represent an impediment to wild take by disapproving of non-resident take by fellow falconers.

In Tom Cade's 1968 paper entitled "The Gyrfalcon and Falconry", he suggested that harvest of Gyrfalcons from Iceland may have represented something on the order of 25-50% of the total annual production of fledged young yet, although this harvest level continued for several centuries, there was no evidence that this sustained harvest had any depressing effect on the breeding population.

The Aesthetic

In my mind, the purest definition of falconry is "catching wild game with a wild raptor". Here, I risk sounding like a curmudgeon, but when I was a lad, falconers would get together and talk about eyries and trapping. Procuring a falcon or hawk required that you find a nest and climb a tree or have the fortitude to dangle over a cliff. The other option was to trap a passage bird. Either way, a modicum of knowledge of species

biology, time in the field, and gumption were required, and any deficiency often weeded out the less committed individuals. Trapping and nest hunting are really wonderful experiences that contribute greatly to the overall falconry experience and to the full appreciation of the bird, once in hand. Today, the conversation more often consists of who is breeding what, and how much money is being charged.

In my home State of Wyoming, novice falconers are required to start with either a passage Red-tailed hawk or a passage Kestrel. That way, if the aspiring falconer realizes that the demands of flying a hawk are too great, the bird can be released back to the wild.

The tradition of trapping passage Peregrines in the early days of American falconry formed a strong falconry ethic that continues today in which only first-year birds were kept, and you only caught birds for yourself. A well-hacked falcon can have excellent manners and conditioning, but I don't think they can ever match the abilities of a passage falcon, especially with regard to footing, hunting savvy, or how to use the wind to advantage.

Conclusion

- Access to wild raptors, either as eyasses or as passage birds, represents an integral part of falconry.
- Harvest of raptors from the wild for falconry has been shown to have little effect on wild populations when conducted within the limits of well managed quotas.
- Enthusiastic and skilled falconers have long provided valuable information to management agencies. Many falconers find pleasure in keeping track of local nesting and migrant populations and are thus alert to changes that might occur.
- Access to wild raptors may also provide invaluable stock for restoration efforts.
- Finally, without access to wild birds, falconry is reduced to simply another hunting sport and removed one step further from nature and all its magic.

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Falconry as practised in the Western Cape, South Africa, with special reference to 'Wild Take' and Captive Breeding

Guy Palmer, Western Cape, South Africa
Former Western Cape Nature Conservation Board 1970-2015.

Introduction

In the Western Cape Province, falconry was not a legally recognised activity until the early 1990s. It was however practised by a few individuals who 'flew under the radar', so to speak. It must be mentioned that to the best of my knowledge no one was ever admonished by the authorities, let alone prosecuted for practicing this activity. So it was that in the early 1990s the conservation authorities were approached by Drs Adrian Lombard and Edmund Oettle to test the water and to see if they could get the process of regularising this activity underway. They were met with a positive response and the relationship began.

'Policy' development

It was an interesting learning procedure for both parties, and during this extended process much understanding, insight and trust developed which was essential for a successful outcome. Eventually several documents were produced containing the policy, regulations and various conditions relating to specific aspects of falconry and raptor husbandry, from rehabilitation, exhibition, trapping and 'wild take', to captive breeding and exotics. Initially, the Cape Falconry Club, and later also the Boland Falconry Club, developed their own constitutions with rules and regulations to govern specific club activities. Before these were adopted by the clubs, the conservation authorities were given the opportunity to give input (as has happened recently with the revision of these documents). It was also decided that for anyone to practice falconry, whether with an indigenous or exotic raptor, they would have to be a member of a formally recognised and constituted club.

What had initially appeared to be a fairly straightforward exercise proved to be quite challenging, with many assumptions and perceptions having to be modified during the process. This modification has continued over the years, albeit at a much reduced pace, as circumstances, knowledge and characters have changed and developed.

'Wild Take' as opposed to Captive Breeding

During the initial stages of the process of developing the various policy documents, the conservation authorities were supportive of a small 'wild take' but felt that the falconry fraternity should ultimately be 'self-sufficient' in this regard and that captive breeding should supply their requirements. However, it was not long before a mounting body of evidence made it clear that this would not be in the best interests of conservation in the Western Cape.

There were many factors contributing to this change of attitude. It became clear from an administrative and regulatory perspective that ensuring the correct functioning of breeding facilities was not a trivial exercise, particularly as this would involve some aspects of commercialisation which inevitably elicits behaviour that requires more intense regulation. Simply being able to verify that any progeny that were produced through this process actually originated from the captive birds and had not been 'smuggled' in from the wild, although possible, was not simple. The conservation authorities were not in a position to expend the required resources on an exercise that had very little direct conservation benefit and certainly did not address any of the conservation priorities of the Western Cape at the time. On the other hand, any bird taken from the wild would always be the 'property' of the State – this simplified administration as well as any potential disciplinary measures that may be required.

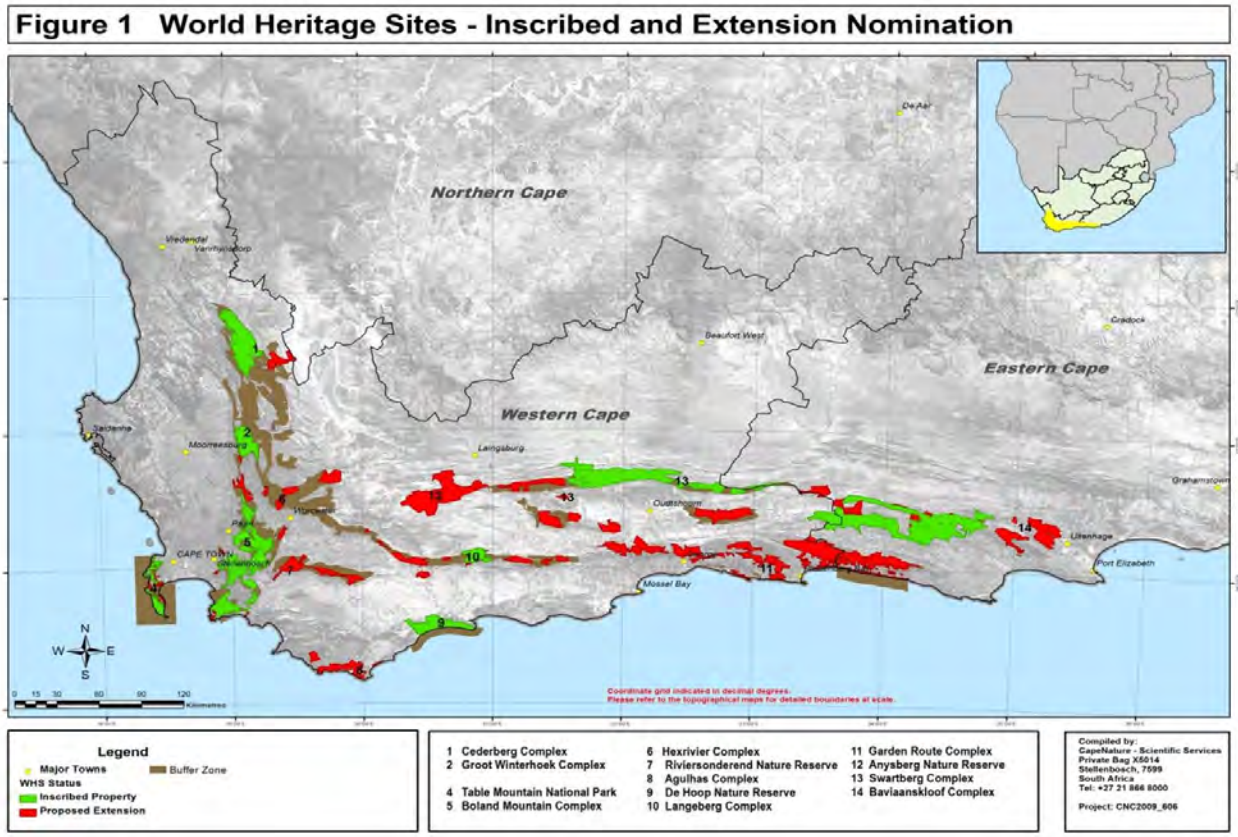
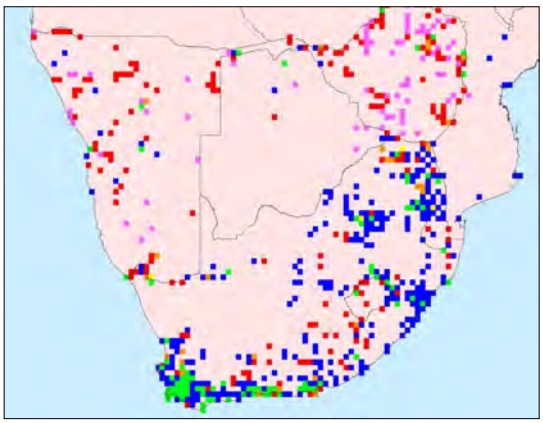
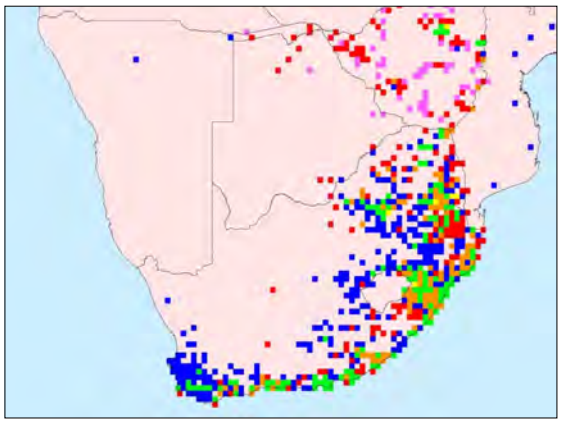
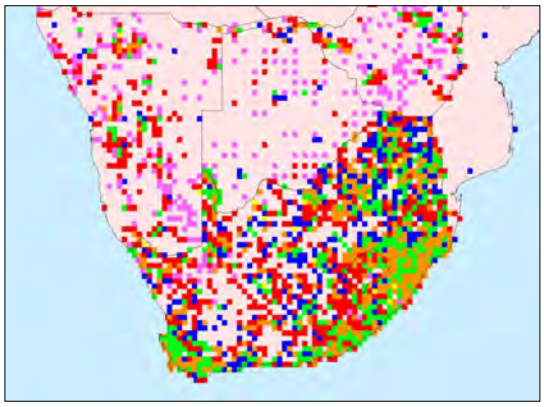


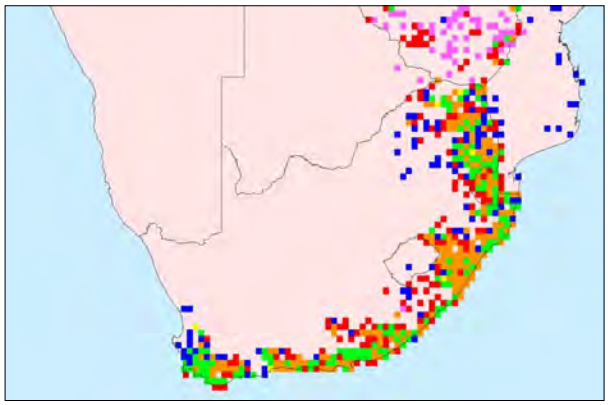
Figure 1: The South African Floral Kingdom (Capensix) is one of the recognised global biodiversity hotspots and includes a number of World Heritage Sites — Inscribed and Extensions Nominated





Distribution maps from the Southern African Bird Atlas Project (SABAP) of South African falconry species: (Above, left) Peregrine Falcon and (above, right) Black Sparrowhawk, More detailed data can be found at sabap2.adu.org.za





Distribution maps from the Southern African Bird Atlas Project (SABAP) of South African falconry species: (Above, left) Lanner Falcon and (above, right) African Goshawk. More detailed data can be found at sabap2.adu.org.za

To clarify, this scenario enabled the conservation authorities to allow the clubs to police themselves as the birds belonged to the State who, through a permit, transferred responsibility of any indigenous birds to the club, who in turn 'lent' the birds to members. This hold that the club then had over members provided an enabling environment for the club to police/manage themselves, thus reducing the resources that conservation authorities would otherwise have had to expend. It must be stated that this arrangement has worked well but does require regular interaction and feedback between the respective parties to maintain the level of compliance that had originally been decided on.

Another aspect that influenced the support of a wild harvest was the growing realisation of the potential negative genetic implications of captive breeding, especially if such efforts could not be sufficiently well regulated. The better the understanding of genetics and the concept of genetic conservation became, the more obvious it was that this would in fact be an irresponsible route to take given the local circumstances. Well documented captive breeding, to understand the specific species requirements, would be quite acceptable, but producing birds, many to be released into an environment already saturated with healthy wild birds, was not.

Another factor that influenced the decision to allow a permanent wild take of certain raptors was the small number of birds actually required for falconry on an annual basis due to the low numbers of practising falconers in the province. The policy states that there may not be more than 35 active falconers in the Western Cape, with the possibility annually of negotiating this number; this has never been necessary.

Another factor was the conservation status in the Western Cape of the raptors taken most regularly for falconry. Several of these species have increased their distribution range and/or density since the arrival of 'industrial sapiens' in 1652 and the associated agricultural transformation of much of the landscape. This transformation led to an increase in several forage species, most relevantly doves and pigeons but many small passerines as well. This was particularly beneficial to local Peregrine falcons (*Falco peregrinus minor*) that have numerous nesting opportunities in the Cape Fold Mountains that overlook the agricultural landscape (Pepler et al., 1991). This to the extent that, despite the abundance of natural nesting sites, artificial nesting structures in the urban environment are readily occupied. The assumption from this is that all suitable nesting sites are in fact occupied and that there are birds looking for nesting opportunities. This is also probably driven by the proximity and abundance of prey as many of these artificial nesting structures are placed in areas that have problems with birds invading and fouling infrastructure. There are estimates of between 200 and 400 breeding pairs in the Western Cape (Pepler et al., 2007).

The Black Sparrowhawk (*Accipiter melanoleucus*) and the African Goshawk (*Accipiter tachiro*) are two other popular falconry species that have not only increased in number but also their distribution (Hockey et al., 2005. http://sabap2.adu.org.za/index.php). This is due to the establishment of timber plantations and the spread of alien-invasive trees, mainly acacia and eucalyptus from Australia, which have supplied extensive new nesting opportunities in the relatively tree-depauperate habitat. They have both been able to adapt well to the transformed agricultural and urban environment where garden bird feeders are an added bonus. Interestingly, there is evidence that the Rufous-chested Sparrowhawk (*Accipiter rufiventris*) has also increased its range and population for the same reason (Hockey et al., 2005) but there is evidence more recently (http://sabap2.adu.org.za/index.php) that it is decreasing in density. Anecdotal evidence indicates that it is being displaced by the Black Sparrowhawk in particular.

Also taken into consideration was the number of birds that would potentially end up in permanent/long-term captivity along with the cost of constructing and maintaining these facilities and their specimens. It was felt by the conservation authorities that it would be a far more beneficial use of resources to request breeding data from the falconers, particularly anyone wishing to make use of the privilege of a wild-caught bird. This approach has yielded much useful breeding data as well as assistance with raptor rehabilitation and dealing with 'problem birds'. The rehabilitation of the many raptors that require assistance, as is inevitable with large numbers of raptors making use of the urban and sub-urban environment, have in fact supplied the majority of the falconry requirements, thus reducing the number of 'healthy' birds that would need to be taken. The birds that are taken up for falconry, instead of released once fit, are seen as part of the 'wild take' quota.

It must be mentioned that only raptors indigenous or naturally occurring in the Western Cape are considered and importation of species or individuals from outside the province is not supported. Having said that, there have been well motivated exceptions to this rule with the proviso that any such birds must be returned to the place of origin for release should this be required and may not be released in the Western Cape.

Top: Lanner Falcon
Middle: Jackal Buzzard
Bottom: Black Sparrowhawk

The following species, indigenous to the Western Cape, are considered appropriate for falconry:

Buteo rufofuscus rufofuscus	Jackal Buzzard
Accipiter rufiventris rufiventris	Rufous-chested Sparrowhawk
Accipiter minullus	Little Sparrowhawk
Accipiter melanoleucus melanoleucus	Black Sparrowhawk
Accipiter tachiro	African Goshawk
Melierax gabar	Gabar Goshawk
Falco peregrinus minor	Peregrine Falcon
Falco biamarcus biamarcus	Lanner Falcon
Falco rupicolus	Rock Kestrel
Falco rupicoloides rupicoloides	Greater Kestrel
Melierax canorus	Pale Chanting Goshawk

Wild Take

The table below lists the species and the maximum number that could be taken as requested in 2008, the year when the last adjustment to the quota was made (this despite the annual opportunity to motivate for a revision). The actual number taken in that year is also listed. This is a typical year and no quota for any species has ever been fully utilised. The original list included the Greater Kestrel (*Falco rupicoloides*), the Common Kestrel (*Falco rupicolus*) and the Little Sparrowhawk (*Accipiter minullus*), but due to a lack of demand for these species they have not been included in recent quotas. There are however numerous occasions where rehabilitation is required due to much nesting by the Common Kestrel in the urban environment and when, on occasion, there is a request to take up one of these birds, it is supported.

Table 1: 2008 Wild Take Quota and Actual Number taken in the Western Cape, South Africa.

SPECIES	Quantity	Taken
Peregrine Falcon	6	0
Lanner Falcon	6	2
Black Sparrowhawk	6	3
Rufous-chested Sparrowhawk	2	0
Pale Chanting Goshawk	2	0
Gabar Goshawk	2	0
African Goshawk	10	5
Jackal Buzzard	2	0
TOTAL	34	10

Exotics and Exotic Hybrids

There has been much debate between the conservation authorities and the falconers regarding the import and use of exotic raptors for falconry. An extract from the policy document below, sets out the conclusions finally reached quite clearly.

> "*The importation of certain exotic raptors (including hybrids) will be allowed. Cape Nature Conservation, CNC, reserves the right to veto any such importation should it be felt that there is a reasonable possibility of the conservation effort being negatively affected.*
>
> *The exotic hybrids, whether imported or locally bred, may be required to be human imprinted at the discretion of CNC. Exotics that are imported must be captive-bred, closed-rung and preferably human-imprinted. All CITES regulations must be adhered to. Locally captive-bred exotics should be human-imprinted and may, along with exotic hybrids, only be disposed of to suitably qualified falconers*."

The bottom line being that should any exotic or exotic hybrid escape and establish itself in the wild that there would be no possibility of genetic contamination of the local raptor populations through inter-breeding. For this reason, species closely related to the local raptors are not allowed. Given the low numbers that have been imported and even fewer of these birds that have been successfully flown in the Western Cape, along with the increasingly high cost of importation and huge incentive to retrieve any errant birds, the risks are deemed to be minimal. That said, these birds belong to the individual and not to the club, making it more difficult for the club to regulate any misbehaviour of club members and could create a problem should a member be expelled from the club. Licences to import and possess any non-indigenous raptor are only granted to members of recognised falconry clubs with the relevant grading. Any application submitted to the authorities for evaluation must be accompanied by written support of the club.

Black Sparrowhawk

Other Raptors.
The wild harvest of raptors not listed in the quota, particularly the large eagles, is only permitted under exceptional circumstances. This has been mutually agreed upon after some interesting learning experiences that have made it clear to both parties that the flying of eagles for falconry is not a practice that needs to be encouraged in the Western Cape. The only situation where large eagles or other raptors not normally available could be taken up would be as part of a rehabilitation effort. Not many eagles become available through this source and the requests for falconry are even lower. Birds that are found not to be suitable for release may under certain circumstances be taken up by registered display institutions and used in environmental education programmes.

Conclusion
It must be accepted that the situation in the Western Cape is different from other areas and what may be applicable here is not necessarily so elsewhere. The basic principles however remain the same. Conservation authorities have to be continually aware that their core mandate is the maintenance of biodiversity. They need to identify the threats to this biodiversity and ensure that they are prioritised and managed in the most efficient manner possible, given that resources are finite and actually decreasing as pressures and threats increase.

Captive breeding of indigenous raptors that will eventually find their way into the wild population is fraught with risks to the naturally occurring raptor species. To mitigate these risks, significant resources would be required that could be more beneficially used to deal with threats of a higher priority.

From our perspective in the Western Cape, the limited wild take of raptors has in fact proved to be beneficial to the conservation effort in that useful data on breeding and distribution is garnered and much assistance with the rehabilitation and dealing with 'problem' birds/situations is obtained. This partnership relieves much pressure from the limited number of conservation staff, with even more limited resources, that are responsible for dealing with these issues.

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Working With People rather than Against Them

Dr Nick Fox, OBE, Director of International Wildlife Consultants, UK

Abstract
This paper discusses real-life case studies that I have personally experienced over the last 50 years in falconry, raptor conservation and fieldsports. In particular, how a lot of wildlife legislation originates from political machinations which result in little practical benefits either for species conservation or for animal welfare on the ground.

The case studies include the reintroduction of the Goshawk (*Accipiter gentilis*) in the UK; the restoration of the Red Kite (*Milvus milvus*) in UK; the re-legalisation of falconry in New Zealand; the wild-take of Peregrines (*Falco peregrinus*) in UK and the development of domestic-breeding of raptors; fox-hunting controls in UK and animal-welfare issues in catching or killing wildlife; efforts to conserve Saker falcons (*F. cherrug*) and Peregrines in Asia and the Middle East; alternative approaches to conserving Houbara Bustards (*Chlamydotis undulata*) using radio-controlled replicas; restoring Water Vole (*Arvicola amphibius*) populations and reintroducing Eurasian Beavers (*Castor fiber*) to Wales.

In these examples, I highlight hands-on approaches to our conservation objectives, rather than restrictive wildlife legislation which in many cases is unenforceable as well as often being inconsistent or even downright hypocritical. I would like to see a much more pro-active approach to wildlife management, with more opportunities for young people to get their hands dirty and to get involved with real animals and habitats.

Having been involved in falconry, raptor conservation and field sports politics since 1966, I have gone from being a naïve schoolboy seeking permission to keep my hawks at school, to an idealistic biologist who thought the world should be governed by science, to a cynical, but still optimistic, jack of all trades who has seen how wildlife management is the victim of economic and political forces, often originating from factors completely off our radar.

The Author's early engagement with falconry

We would all like to think that laws, regulations and international conventions mean something worthwhile and are adhered to by all sides. Pass a law and solve a problem. The reality is different, and is often swept under the carpet as an inconvenient truth. Unless the hearts and minds of the people can be won, the battle will not be won.

When I was at boarding school, I asked permission from my housemaster to be allowed to muck out horses at a local stables in return for some riding. He refused. So when I wanted to keep my Kestrel (*Falco tinnunculus*) and later, my Goshawk (*Accipiter gentilis*) at school, I didn't ask. As Captain of Shooting, I was in sole charge of an armoury of 300 Lee-Enfield rifles, two Bren guns and a rifle range, but was not allowed to leave the school grounds without wearing a school cap. Rules are funny things aren't they? So I kept my hawks at the rifle range!

At university at St Andrews in Scotland, I got involved with the British Falconers' Club scheme to re-introduce the Goshawk to the UK. Robert Kenward was one of the organisers. We had a three-pronged approach: hacking-out eyasses, training and releasing eyasses, and hard-releasing passage Goshawks. It was before the Wildlife and Countryside Act 1981 and the IUCN Guidelines on Reintroductions, and apart from the odd BTO ring, we did no post-release monitoring. Telemetry wasn't invented and there was no media campaign or publicity. We just did it. Now Goshawks are back and accepted as part of our UK fauna once again. You could not do it nowadays.

The Goshawk was reintroduced by falconers into the UK

Doing my PhD in New Zealand in the 1970s, I was told that there were only six pairs of New Zealand Falcons (*F. novaeseelandiae*) known in the wild and that therefore I must also work on Australasian Harriers (*Circus approximans*). As part of studying the falcons, I trapped some and bred them in captivity. This was an exciting period when the Raptor Research Foundation and The Peregrine Fund were starting, and many of us around the world were developing ways to breed raptors in captivity. Of course, many cynics said it was not possible, and then, when we proved it was, they said the offspring would be no use. But we struggled, we learnt, and we proved them wrong. Meanwhile, such was the alarm over pesticides, restrictive legislation on raptors was being enacted in many countries. Whereas the pesticide companies were not prosecuted, and in many cases the

Captive-bred New Zealand Falcon

pesticides themselves were not even banned, visible interactions, such as taking or keeping of raptors for falconry, were targeted. On my return from New Zealand, I represented the BFC at a meeting with the RSPB at their headquarters in Sandy. At that meeting, they told us that although their policy on falconry as such was 'neutral', they would close down British falconry for good by stopping licences for wild take. I was a part-time government Wildlife Inspector at the time and I saw the RSPB in action. I was instructed to witness the taking under licence of a Welsh Peregrine chick (*F. peregrinus*), one of only a handful of licences ever issued. First the RSPB tipped off all the landowners in the licensed county with Peregrine nests on their land. Then they mounted a media campaign portraying the Peregrine as being 'stolen'. Then they tried to prosecute the licensee, but because I was a witness, I was able to show that the land-owner, who had disassociated herself from us under pressure from the RSPB, had in fact given signed permission. They did everything they could to prevent legal access to Peregrines. Meanwhile, regulations had come in making it hard to import raptors, and quarantine controls were introduced.

It was clear that the writing was on the wall. As falconers, we resolved to develop our breeding skills and pool our breeding stock. For several years, prices soared, but there was a spirit of co-operation, and after about two decades there were enough captive-bred raptors for the needs of British falconers, and we even started to export birds. We became producers rather than consumers. Still, the RSPB tried hard to denigrate the breeding efforts, and for sure there were people, tempted by high prices, who took raptors illegally. The Wildlife and Countryside Act 1981 is draconian in that it makes you guilty unless you can prove your innocence. DNA testing had not been developed then, and there was no way to prove that falcons were genuinely bred in captivity. Ronald Stevens and Johnny Morris here in Ireland produced young from a Saker (*F. cherrug*) paired with a Peregrine, and soon the USA were producing hybrids. We did the same in the UK. It was definitive proof of captive breeding. Finally we had saved British falconry from closure by securing the sustainable supply of raptors. We also managed to keep the legislation open so that licences could still be issued for a wild take. But every application was stymied by claims that a licence would only be issued where a need for fresh genetic diversity could be demonstrated.

One of the issues that needs clarifying is what a wild take is for. If it is for a translocation programme, such as the sort we did with Goshawks or Red Kites, usually the shorter the time in captivity, the better. If it is to provide breeding stock, then usually the best way is to take young chicks and rear them in a captive environment similar to that in which they will be expected to breed. If it is for hunting in falconry, then chicks with no hunting experience have no advantage over domestic bred chicks; what is needed are birds in their first autumn which have become independent hunters. These birds cannot just be collected from a nest, they have to be trapped, and some governments are hostile to trapping and to some trapping techniques. Finally, some falconers want a wild-take simply for the experience of trapping or collecting their own bird from the wild, and for the option of returning it to the wild later in its life. Yet in Asia, raptor trapping is a whole different industry, the first step in a long supply chain, and the trappers are not falconers. So in considering wild take, one must take into account not only the donor population but also the reasons for it and the methods to be used. In UK, the only option for falconers has been to take chicks from the nest, and this defeats the object for people wanting skilled hunting birds.

(Right) The UK Badger cull cost the taxpayer more than £6,500 per culled badger

(Far right) The author was involved with the Kite Committee in the reintroduction of the Red Kite

We thus entered a period in which certain species of wildlife, including raptors and Badgers (*Meles meles*) in UK, achieved such iconic status that any efforts to harvest, manage or cull them would be stone-walled. Public opinion is constantly massaged, and political policy ebbs and flows with the tide of Ministers. The last UK badger cull cost the tax-payer over £6,500 per culled badger. So gamekeepers kill raptors illegally, and farmers kill badgers illegally. Cheap, quick and easy, and what the public doesn't see, the public doesn't grieve over. Very often, politicians do not want to be seen to make a decision on an issue, and thus the default position is that activities are done illegally and without controls or documentation.

Falconers were engaged in the first reintroductions of Red Kites into England.

As species near extinction, it is a sad aspect of human nature that people put more pressure on them. The Red Kite (*Milvus milvus*) was reduced to about 25 pairs in UK in the 1980s. Legal protection was ineffective and egg collectors were targeting the few remaining nests. The army was used to provide surveillance at each site. So I suggested to the Kite Committee that as kites in Wales seldom reared more than one chick, why not leave just one kite egg in each nest, replace the other eggs with dummies and bring the spare eggs to us for incubation? So we did this for several years and we hatched out 53 kite chicks. But when we came to return the well-grown fledglings to their parental nests, we found our chicks were about twice the size of the parent-reared chicks. Clearly the Welsh Red Kites were under food stress. This exercise led to the decision to release kites in new areas, and I took the first two kites into England where they were joined by young Spanish kites, and in Scotland, by Swedish kites, to make a good genetic mix. Once the project was seen to be successful, the RSPB stepped in to handle the publicity and took the credit, rather than us falconers.

Working With People rather than Against Them

I served for over 30 years on the UK Hawk Board, representing hawk keepers to the British government. We fought many battles for falconers, some of them challenging the government to show the conservation benefits of restrictive legislation. As a result, over the years, the restrictions have become less onerous and fewer species now have to be registered when held in captivity. The RSPB trumpeted that without registration controls, wild raptors would be plundered. But no, nothing happened, and it was clear that registration was a complete waste of time and money, basically just a tax on hawk-keepers. We have also, both nationally, and internationally through the IAF, fought many battles on international conventions such as CITES. Always the prevailing attitude has been against wild take, sustainable trade and captive breeding, even though the Secretariat claims otherwise.

I also served for many years as Scientific Advisor to the UK All-Party Parliamentary Middle Way Group on Hunting with Dogs. Fox-hunting has for decades been a political bone that has expended many hours of parliamentary debate and political point-scoring. I published a study on wounding rates in shooting Red Foxes (*Vulpes vulpes*) in the *Journal of Animal Welfare* and was able to demonstrate that alternative methods were less humane than hunting with dogs. But the Labour Party was having none of it. They had their own political scores to settle and pushed through a ban on hunting with dogs, even though the politicians could not tell a Brown Hare (*Lepus europaeus*) from a Rabbit (*Oryctolagus cuniculus*). While the ban satiated their political appetite, it made no provisions for enforcement. The result has been that fox-hunting is still practised openly all over Britain and the law is flouted the length and breadth of the land. Social pressure is what holds rural communities together, and once it becomes acceptable to break one law, where does one stop? How many adhere strictly to the game seasons any more, or to the regulations on the use of lead shot? People are not stupid. They know when they are being treated as political pawns.

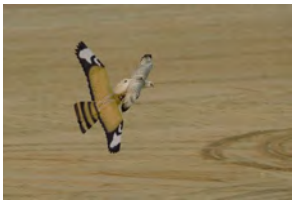
In the early 1990s, Mongolia opened its borders and the UAE started funding research on Sakers and Peregrines in central Asia. At the same time, trappers from nearby countries, such as Pakistan and Syria, started trapping falcons in central Asia and sending them either directly to the Gulf States or fed them through a quasi-legal licensing system in Pakistan. This system relied on officials at all stages receiving payments to produce the appropriate documents. So while at one level the trade was 'legal', underneath, the system was corrupt. Totally illegal smuggling also continued and there were repeated international calls to 'ban' things. But how do you ban things that are already illegal?

95% of the falcons in the UAE are captive bred.

Given that the countries are corrupt, that the boundaries are porous, that officials are in office for only a short time and wish to make the most of the opportunity, and that customs officials cannot recognise species, it was clear that enforcement was no more than lip service. Other means had to be found to swing things around. We tried supplying customs officials with raptor identification guides in Russian. But captive-breeding has been the most successful tool. It has been recognised by the CMS as a form of off-set conservation. Now about 95% of the falcons in the UAE are captive bred and the falconers have learned a way of handling and training them. The same cannot be said of less progressive countries such as Saudi Arabia that still use wild-caught falcons. And the restrictive controls on legal trade have exacerbated illegal trade.

(Above) The Saker Project Mongolia – tackling electrocutions, providing over 5,000 artificial nest sites and educating a new generation

(Below top): Measuring dimensions of Houbara (Below middle): Robaras – radio-controlled planes that look like Houbara (Below bottom): Saker 'hunting' Robaras



Meanwhile, our teams of biologists tried to estimate the numbers and identities of falcons in the wild, and the factors controlling them and their movements. These estimates have constantly been challenged and still are; Asia is a big place. We concluded that in large areas of open steppe, Saker falcons were nest-site limited, and sure enough, when we put out 5,000 artificial nests we found they produced up to 2,500 fledglings per year, fluctuating then with local prey availability. Clearly it was possible to 'farm' wild Sakers and produce a new sustainable supply. But could it work financially and politically? While the UAE funded the nest sites and the very useful monitoring research that followed, the Mongolians would not organise a sustainable monitored harvest that could bring in income both for local people and for central government. As a result, the opportunity was lost and the harvest continues both illegally and in a quasi-legal 'diplomatic' way. Western organisations continued to claim Sakers were in decline due to illegal trade, but is there really a decline, and is it really due to an unsustainable harvest? We undertook studies on electrocutions and discovered that on some Mongolian power lines, one Saker was killed every week per 10 km. This is a huge amount of Sakers, but even so, is it responsible for a putative decline or is it simply harvesting falcons that would otherwise die while over-wintering in Tibet? And so the story continues, but the lesson to take away from it is that there are many officials and organisations that have their own agendas and that solutions, if they are to have a positive benefit for the falcons, must be pragmatic and actually work and this means searching for win-win solutions rather than unenforceable controls.

As well as looking at falcon conservation issues surrounding Arabian falconry, we could see that a lot of resources were being spent on the conservation of the principle prey species, the Houbara Bustard (*Chlamydotis undulata*). While money was being spent on field research and ecology, the main thrust of the effort was to produce farmed Houbara at a fairly hefty unit cost, using imprinted parents. Lacking wild prey and places to hunt, Arab falconers have turned to competitions. Therefore, we decided to pioneer radio-controlled planes that looked like Houbara and could be caught by falcons (known as 'Robaras'). We are also producing other prey species, such as Carrion Crows (*Corvus corone*) and Pheasants (*Phasianus colchicus*) that can be caught in western falconry. Most Houbara are killed in the course of training falcons rather than in actual hunting, and we are seeking to reduce this toll using the new training 'Robaras'. If we can divert falconers from killing live Houbara during training we can not only increase the numbers of Houbara available for real hunting, but also tackle a big animal welfare problem surrounding their use – all this without pushing for any new, unenforceable laws and while keeping falconry alive as a cultural heritage.

Back in New Zealand, falconry had been declared illegal, although we could not discover the legal basis for the decision. Paradoxically, because I had maintained a colony of New Zealand Falcons for 35 years on our farm in UK, I was the only person in the world able to hunt with the species legally! But the Department of Conservation in New Zealand decided to change the law so that Australasian Harriers could be killed. We argued, successfully, that if you can kill a harrier you should be able to keep it alive and train it. So falconry became legal again, largely due to the efforts of Noel Hyde and Debbie Stewart at Wingspan. Wildlife legislation is full of such inconsistencies. In the UK, the Starling (*Sturnus vulgaris*) has been protected but you can still shoot a Black Grouse (*Tetrao tetrix*) even in southern England where they are hanging on by a thread. You can shoot a Golden Plover (*Pluvialis apricaria*) but not a House Sparrow (*Passer domesticus*). My idealism as a young biologist has been shattered and ground into the dust! Recently

licences have been issued to trap Common Buzzards (*Buteo buteo*) that are predating Pheasant (*Phasianus colchicus*) release pens, or to remove Hen Harrier (*Circus cyaneus*) broods that are depleting Red Grouse (*Lagopus lagopus scotica*). This has produced howls of protests from protectionists, and has come about through political pressure from the shooting industry. Falconry does not have this political clout and so although a falconry wild take would be only small and sustainable, we cannot exert sufficient political pressure for it to be allowed.

(Top): Eurasian Beaver
(Below): Water Vole

But laws continue to be illogical and inconsistent, and politicians continue to be self-serving and prevaricating. The Wildlife Trusts in Wales have been trying for 11 years to obtain a licence to reintroduce Eurasian Beavers (*Castor fiber*) to Wales. In July 2015, our charity, the Bevis Trust, submitted the first application based on a river at our farm. The application is still currently being kicked around the departments of Natural Resources Wales. Although Wales is signed up to the EU Habitats Directive indicating a willingness to consider reintroducing lost indigenous species, neither the ministers, nor the officials, nor the vets, want to actually sign their names to anything. As a consequence, 95% of the 350-plus beavers currently living in the wild in Britain are from illegal releases or escapees. The main legal release which has resulted in 14 individuals in Scotland, cost £2.2m. Is there a lesson here?

We also reintroduced Water Voles (*Arvicola amphibius*) on our farm, and put up boxes for Dormice (*Muscardinus avellanarius*) and other species. But Britain is top heavy with silly over-protective legislation that is not only unenforceable but that discourages any management activities. Even the word 'management' is equated with killing rather than producing. So it is legal to put up a box for Dormice but you need a licence to look inside the box! Are there seriously Dormice Police lurking in the bushes waiting to catch you breaking the law? Or is the whole thing a charade, a total waste of resources and a negative approach? We should be encouraging our children to get involved and be proactive for wildlife, not making them feel guilty for showing natural curiosity.

Can some sanity be brought back to wildlife legislation? Our reintroduced Water Voles are captive-bred animals. The Water Voles had been exterminated by introduced American Mink (*Neovison vison*) released by animal liberationists. We have three pairs of beavers breeding on the farm and hundreds of falcons. We have the technology nowadays not just to 'protect' or 'preserve' wildlife but to regenerate it and restore ecosystems so that they are capable of supporting sustainable harvests for various uses. Potentially there are win-wins for everybody if only people have the courage and initiative to support them.

The Importance of Early Education in Falconry for the Conservation of Birds of Prey Around the World (Project FALCEDU Slovakia)

Ricardo Padilla Borja (Mexico) and Sona Tomkova (Slovakia)

In Banska Stiavnicka in central Slovakia, the education system has been specifically developed and tailored to include falconry from a very early age. In kindergarden, at three to five years of age, the children start to learn about birds of prey like falcons, eagles, hawks and owls, and children have the opportunity to interact with these birds. Of course, these raptors are trained, very tame and sociable and do not represent a danger for the children. After they finish kindergarden, they begin their primary school (typically from the ages of six to fifteen) and while they continue to interact with birds of prey, they then learn through the primary subject of Falconry. This subject is provided in 45-minute classes each week and the young students are taught about a diverse range of topics like the anatomy of a bird of prey, including the parts of a raptor's body, identification of feathers, knowledge about the internal organs, general biology of the most common species in the region, conservation of nature and comprehension of the relationship between predators and prey and how to maintain a healthy raptor for falconry purposes.

Below left and right): Students at the school

(Bottom): Ricardo Padilla Borja with a student

In this primary school, of the 210 students currently attending, there are 20 very interested in falconry and they help with the maintenance of the 38 birds of prey at the school which includes species such as common buzzards, Harris hawks, barn owls, eagle owl, steppe eagles, saker falcons and common kestrels among others. These committed students help to exercise the birds, feed them and take care of their equipment and accommodation, as well as preparing food like day-old chicks, quail and pigeons. These students take this falconry subject throughout their primary education (which consists of 9 years) and when they end their primary education, they can continue studying falconry in Secondary School at the School of Forestry, where they study for four years learning more advanced techniques of falconry and the biology of birds of prey. Once they finish at the School of Forestry, students can continue studying but now in a more advanced and higher level, leading to a professional qualification at the Technical University. Here, students take a further year in the study of falconry and once qualified they are in effect a falconry professional and can start to work as a well-prepared

falconer doing bird control on airports, warehouses, factories, city dumps and/or zoos.

Through falconry, you can touch the heartstrings of children. If it is properly taught, the art and practice of falconry can create a unique awareness among children of the natural world and the need for its protection. Through their understanding, development and appreciation, they can learn about the balance between predators and prey and the ecological life cycle. This basic and fundamental appreciation of the natural world and its interdependency can achieve unimaginable and tangible benefits, both for the individuals on a personal level and for society as a whole. If this could be developed on a worldwide basis, not only would it help preserve our magnificent sport, an intangible heritage of humanity, but it could also assist in fostering a wider environmental appreciation and the stewardship of biodiversity. This can be developed either through a formal approach in schools, such as Banska Stiavnicka (Slovakia) or informally, through individual mentoring and dissemination of knowledge by falconers.

Top photo: Student tethering an owl.

(Far let): Students learning and practicing the falconer's knot.

(Near right and below): Student being taught the craft of making falconry equipment with image of a lure below.

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