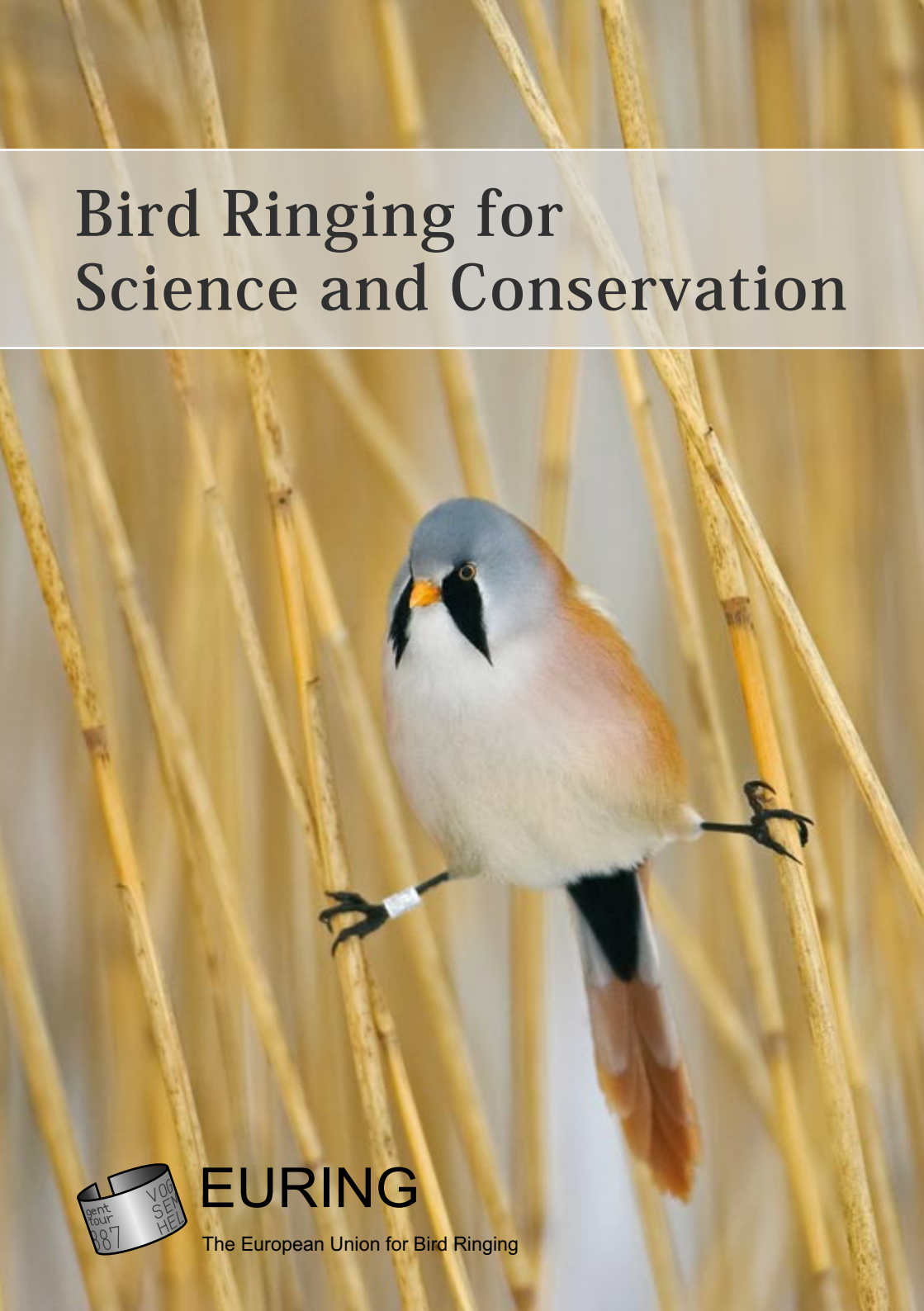
Bird Ringing for Science and Conservation



EURING

The European Union for Bird Ringing

Preface

We live in a rapidly changing world where human activities are causing rapid declines in many species of animals and plants, linked to widespread environmental change. Within a few decades it is predicted that global climate change will bring about even greater changes than we have seen so far. Action to address these issues must be based on sound science. Information concerning the status of our wildlife resources is needed for effective targetting of conservation action, while robust understanding of ecological processes is essential for predicting the effects of policy and management actions.

Birds are excellent tools for monitoring and understanding environmental change, as well as being a charismatic wildlife resource that brings enjoyment to many millions of people. Bird Ringing involves the marking of individual birds by highly trained ornithologists to provide vital data on migration patterns, demography and ecological processes. We are fortunate that many volunteers contribute to this activity, allowing us to study populations at large spatial scales. In Europe these activities are organized by national ringing centres in each country, co-ordinated by EURING. This brochure explains how these activities are contributing to conservation science, and how they can be developed further to address some of the conservation challenges of the 21st century. We hope that it will provide a useful overview for conservationists, policy makers and environmental scientists, and that it will also be of interest to all those who are concerned about how and why our bird populations are changing.

Stephen Baillie, Chairman of EURING

Matthias Kestenholz

Bird ringing data are useful in both research and management projects. Individual identification of birds makes possible studies of dispersal and migration, behaviour and social structure, life-span and survival rate, reproductive success and population growth.

Bird Ringing for Science and Conservation

What is Scientific Bird Ringing?

Scientific bird ringing is a research method based on the individual marking of birds. Any record of a ringed bird, either through recapture and subsequent release, or on the occasion of its final recovery as a dead bird, will tell us much about its life. This technique is one of the most effective methods to study the biology, ecology, behaviour, movement, breeding productivity and population demography of birds.

Tracking back the journeys of ringed birds allows us to define their migratory routes and staging areas, so providing crucial information for the planning of integrated systems of protected areas for our birds. Other information derived from recoveries and recaptures include population parameters (e.g. survival estimates, lifetime reproductive success), which are essential to determine the causes of changes in population sizes.

Much of the data for this work are gathered by well-trained "professional amateurs" whose motivation is not money but the simple privilege of working with birds for the ultimate purpose of conservation.

Because almost 4 million birds are ringed annually in Europe alone and because many birds migrate freely across political boundaries, the use of individual rings and the collection of data from birds recovered need efficient organisation. A network of fully co-ordinated ringing stations and National Ringing Schemes has been indispensable for the management of scientific bird ringing in Europe. EURING, the European Union for Bird Ringing, guarantees the efficient collaboration among national ringing schemes.

Marcel Burkhardt

The main aim of ringing is to gain results which can be used in research and management. Ringing is not a goal in itself, but a scientific method of collecting desired information on the life of birds.

Birds are personalities

Individuals of the same species and sex have behavioural and physiological differences, even in standard conditions. In humans, many of these differences are treated as expressions of individual variation in personality. Yet in other animals, such explanations have often been neglected, the differences interpreted instead as either the consequence of inaccurate measurements or as non-adaptive variation.

Putting a ring to a bird's leg makes the bird a recognizable individual whose individual life history and fate can be followed. Personalities are general properties of birds, other animals, and humans. Recent studies in birds suggest that animal personality can be studied objectively. Such work has used four approaches in parallel: (1) descriptive studies, including the investigation of links among several behaviours and their specificity across situations, (2) genetic and physiological research on causal mechanisms underlying relations among several behaviours of the same profile, (3) ontogenetic studies on plasticity and environmental malleability, and (4) field studies on survival and reproduction towards understanding how different types of personality are maintained.

Different personality types may react differently to environmental changes and may show differential vulnerability to stress, leading to differences in welfare. Ultimately, such differences can have major impacts on individual fitness, response to environmental change, geographic distribution, and even rates of speciation.

Helmut Kruckenberg

Special rings and various other marks can be used to identify birds at a distance without needing to catch them again. These White-fronted Geese were marked with colour neck bands, each individually identified by numbers or letters.

Outstanding individuals

Ringing birds individually allows us to follow even the most exceptional personal fates.

The oldest wild bird ever recorded could be a Manx Shearwater captured on a little island off north Wales. The venerable bird was first captured and ringed by ornithologists in May 1957, when it was full-grown, hence between four and six years old. It had been caught in 1961, 1978 and 2002, when a warden of the Bardsey island Bird Observatory caught the seabird again. The shearwater's possible age of 52 years could make it the record holder. Until now, the world's oldest ringed bird was a US albatross estimated to be over 50.

One of the longest journeys ever recorded is from a Common Tern ringed on 27 June 2003 as a nestling in Hälsingland in central Sweden and found dead on 1 December 2003 on Stewart Island in New Zealand. If we assume a normal route from Sweden to South Africa and then to New Zealand, the tern might have covered 25,000 kilometres. Measured as straight line distances, the tern's journey is "only" 17,508 km.

The rate of migration is quite different from that attained in flights for short distances. The fastest journey is from a ringed European Barn Swallow *Hirundo rustica* that flew in 27 days from Umhlange, Kwa Zulu Natal, South Africa, to Whitley Bay, United Kingdom.

A Black-headed Gull was ringed as a fledgling on 29 June 1996 in Hämeenkyrö county, Pirkanmaa, Finland. The metal ring was sighted with a telescope on the 3 and 7 January 2000 in Fort Worth, Texas, USA. The bird was back again to its wintering quarters in Texas on 30 November 2000.

Steve Stansfield

The old Manx Shearwater must have flown at least eight million kilometres during its long life.

Beat Walser

Common Terns migrate between the two hemispheres and, by this, experience both northern summer and austral summer.

Methods of bird ringing

Many birds are ringed as chicks in nests but fully-grown birds have to be caught using a variety of nets and traps. Whatever the catching method, ringers are carefully trained to ensure the safety of the birds they ring. Small birds are often caught in fine mist-nets. Bigger birds, such as ducks, are often caught in "walk-in" or baited cage traps. After removal from a net or a trap, birds are usually placed in soft cotton bags or in special holding boxes where they remain quiet and dry until they can be identified, ringed, examined and released.

Special rings and various other marks can be used to identify birds at a distance without needing to catch them again. Many birds wear colour rings with numbers that can be easily read through a telescope. Waterbirds can be marked with colour neck bands, and larger birds marked with wing tags, each individually identified by numbers or letters.

Viborg Stiftsmuseum

Bird ringing for scientific purposes started in Denmark in 1889, when H. Chr. C. Mortensen released Starlings that were fitted with metal rings engraved with successive numbers and a return address. Since those pioneer times, bird ringing quickly evolved into a standard research technique used in all parts of the World.

Geert Brodvad

A wide variety of ring sizes is used to mark different species, depending on the dimension and structure of the leg and the habitats the birds live in. The weight increase to the bird from the ring can be roughly compared to that of a wristwatch for a human.

Joël Krebs

Matthias Kestenholz

Many birds like this Tawny Owl are ringed as chicks in nests.

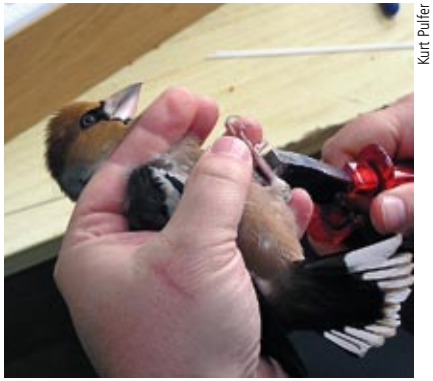
A row of mist-nets at the bird ringing site Col de Bretolet in the Swiss Alps. By co-ordinating the activities of ringing stations throughout Europe and Africa, EURING is helping to unravel the mysteries of bird migration.

Waterbirds like ducks are often caught in baited cage traps.

Matthias Kestenholz

Kurt Pulfer

Mist-nets are made of very thin nylon threads and are cheap and safe for catching small birds, such as this male Lesser Redpoll.



Kurt Pulfer

An individually numbered ring is closed around the leg of a Hawfinch using specially produced ringing pliers.

Kurt Pulfer

Close scrutinity of the details of plumage may allow the ringer to identify the age and sex of the bird in the hand.

Kurt Pulfer

Measuring a particular primary feather gives a good indication of overall size of an individual bird.

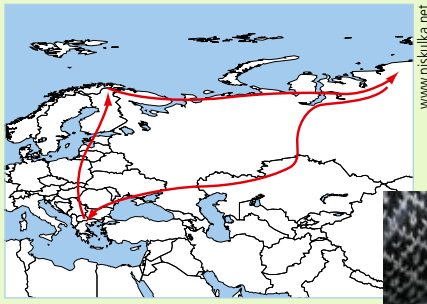
Satellite tracking

One method that has added a new dimension to avian research in recent years is satellite tracking. Tiny transmitters, usually carried in harnesses strapped to the birds' bodies, are linked to satellites. Each harness is custom-designed for each species and manually adjusted for each bird for maximum comfort of fit. The system enables researchers and conservationists to track individual birds continuously.

The results achieved by satellite tracking are ground-breaking. For the first time, the whole spatio-temporal pattern of successful migrations can be captured at a level of detail far exceeding that provided by ringing. Satellite tracking can also help discover unknown breeding, moulting or wintering areas of endangered species or causes of massive losses. When combined with other devices, such as thermometers or miniature cameras, additional information of the bird's behaviour may be transmitted to the satellite.

However, satellite tracking will never replace bird ringing. The reasons for this are simple: transmitters are relatively expensive, a large amount of technical equipment is necessary, and the technique is limited to larger species (though transmitters now weigh as little as 10 g).

EURING will incorporate data from satellite tracking into its database in order to ensure that these extremely valuable data are stored in perpetuity.



www.piskulka.net

Ingar Jostein Øien

The Lesser White-fronted Goose is at present one of Europe's most endangered bird species. The most important single threat throughout it's range is the high mortality due to hunting and poaching. The core problem was, and partly still is, that the staging and wintering grounds for the species are virtually unknown. To locate them, a few individuals from the Fennoscandian population were equipped with satellite transmitters. They revealed a loop migration from the Norwegian breeding sites to the moulting area in arctic Siberia, and the winter quarters in Greece.

Bird ringers and ringing centres

By definition, "bird ringers" or "ringers" possess a ringing licence. Though the exact way of becoming a ringer and gaining a licence differs from country to country, the basic principles are the same everywhere. Every examinee has to demonstrate his knowledge of bird identification, of sexing and ageing, the practical and administrative details of ringing, and, last but not least, the ethical and conservational aspects of this research method.

In most countries, trainee ringers have to spend a number of years of practice before ringing on their own. These years of probation and the ringing courses are of great importance in acquiring the methods of safe handling of the birds and the equipment, becoming experienced in the identification of the different, common and uncommon species. Also it takes a few years to meet all the specific, rarely-used capturing methods and to become skilled in measuring the birds.

The form and the content of the ringing licence differ according to varying legislation in the various countries. Ringing on strictly protected areas or capturing endangered species usually requires special licensing and can only be maintained by experienced ringers engaged in a particular species-conservation or study program. Moreover, some ringing centres allow ringing only for well-designed, accepted conservation programs.

Only a fairly small proportion of ringers are professional scientists. They are employed mainly by universities, using bird ringing in special research programs. A very small number of ringers are employees of ringing stations or field assistants of certain conservation projects.

Non-professional ringers form the majority (around 70 %) of the ringers' community, and perform this activity in their spare time, as voluntary work. Most of the ringers are involved in co-ordinated projects, following the welcome general trend of designed projects in bird ringing. Without the help of these volunteers, it would be impossible to work ringing stations and maintain centrally co-ordinated projects, such as Constant Effort Sites, national and international species-orientated projects. From the dawn of bird ringing, many millions of records have been gathered from all over the world mainly by those tens of thousands of dedicated volunteers. This enormous field work, together with the invaluable help of all the informants, forms the basis of the numerous books, and publications, describing most of our recent knowledge of bird migration.

Bird ringing is organized by national ringing schemes. The responsibility of the national ringing schemes is to co-ordinate and canalize the ringing activities. The role of EURING is to co-ordinate analytical and field projects at a continental or flyway scale, and also to facilitate standardization and the exchange of technical information. Processing data gathered in this way, on a wide geographic scale by standardised methods, gives a much more detailed picture of bird migration, dispersion and population trends. Regular feedback and publication of the results is essential for the thousands of volunteers.

The numbers of birds ringed annually and the numbers of ringers licensed by each ringing centre. If several ringing centres operate in one state, summary figures are given. It is estimated that 115 million birds have been ringed in Europe during the 20th century and the number of recoveries now exceed 2 million.

EURING – The European Union for Bird Ringing

Birds do not respect national boundaries, so international co-operation is required in order to study them effectively. EURING is the organisation which enables co-operation in all scientific aspects of bird ringing within Europe. All European bird ringing schemes are members. The EURING Board (Chairman, Vice-chairman, General Secretary, Treasurer, and from three to five other members, all elected by the ringing schemes) meets at least once a year. A general meeting, for representatives from all the schemes, is held every two years.

EURING was founded in 1963. By 1966 it had defined and published the EURING Exchange Code allowing easy data transfer between schemes and simplified data analysis. Developments in technology allowed an enhanced version of this code to be published in 1979 with further development of the code 2000.

High-quality, quantitative methods are essential for research based on bird ringing. For this reason, EURING encourages the development of statistical techniques and computer software specifically to handle the particular problems involved in the analysis of data gathered through bird ringing. EURING organises technical conferences every few years attracting specialists from all over the world. They have, so far, concentrated on the use of ring recovery data for research on avian population dynamics.

Through pan-European ringing projects, we can increase understanding of bird populations. EURING organises projects which can involve many ringers across the continent. For example, the Swallow Project aims to discover more about the species' breeding, migrating and wintering strategies. A European-wide constant effort ringing programme is being developed to give annual changes in abundance, productivity and survival for many species.

Mark Grantham

The EURING Data Bank is hosted by the British Trust for Ornithology at Thetford, UK.

The EURING Data Bank (EDB) was established in 1977 as a central repository for European ringing recovery records. Until 2005, it was hosted by the Netherlands Institute of Ecology. It is now held by the British Trust for Ornithology. Recovery data are made available to many researchers. Data have been used to study a wide variety of aspects of ornithology – migration routes and strategies, survival and dispersal rates, the impact of human activity on bird populations and the impact of bird activity on humans. Data have been supplied to amateur researchers, research students, professional ornithologists and research organisations. Many papers have been produced using the data.

The EDB is also compiling archives of annual totals, by species, for all ringing schemes; of data supplied to researchers, and of publications using EDB data.

EDB Holdings

Total number of records	4,743,373
Total number of species	485
Number of species with over 10,000 records	87
Number of species with 1,000 to 10, 000 records	119
Number of ringing schemes submitting computerised recovery data	28

How to obtain data from the EDB?

Full details of the EDB dataset and the system for applying to analyse data from the EDB are available on-line. http://www.euring.org/edb

Achievements of EURING

- Undertakes applied analyses of ringing data at a European scale
- Co-ordination of a network of over 500 Constant Effort Sites throughout Europe
- Promotes European-wide research projects involving networks of volunteer ringers
- Promotes the development of statistical and computing methods for the analysis of ring ringing data.
- Provides guidelines and standards for bird ringing
- Devised a standard code for the computerisation and exchange of ring recovery data
- Established the EURING Data Bank
- Facilitates communication between schemes, ringers and members of the public through its website

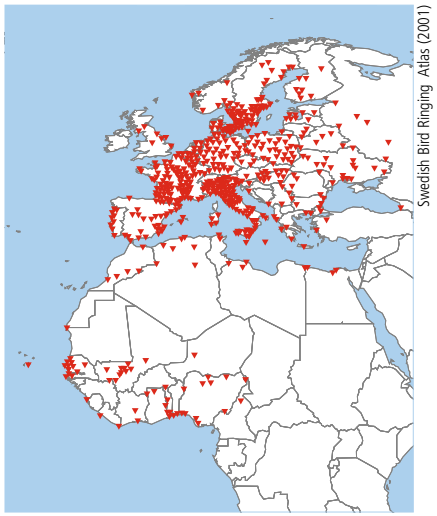
Understanding Bird Migration – The Need for Bird Ringing

A flying bird can quickly move long distances and this makes it possible to migrate regularly between areas that are suitable during different periods of the year. In areas with strong seasonality, migratory birds can successfully take advantage of a short but very productive summer to breed and raise young. At northern latitudes, such as northern Europe, most of the breeding bird species are migratory and leave for some period of the year. In most areas of the world, climate and/or food availability varies over a year. This means that annual movements, in order to increase survival, can be advantageous everywhere. Migration is a most important key to the large and fascinating diversity of birds in the world.

The variation in migratory behaviour is extremely large; some birds move only short distances, while others can migrate vast distances to wintering areas in the southern hemisphere. Some species move on broad fronts while others follow very narrow routes. Irruptive movements occur in several northern species in response to food shortage.

The original purpose of bird ringing was to unravel the mysteries of bird migration. Within Europe the broad patterns of migration are now known for most bird species. In recent decades the member countries of EURING have greatly intensified their efforts in the area of migration research. The computerisation of the archives of recovery data has been a prerequisite for many of the recent recovery analyses and also for producing national recovery atlases. Comprehensive atlases have been published in several member countries and work has begun on them in a number of others. This is an important step because it will make results from ringing easily accessible. It will also show where knowledge is missing and where efforts in the future ringing should be focused. As migration pattern change over time, particularly in relation to factors such as climate change, continued bird ringing is important even for common species.

Rolf & Sales Nussbaumer



Swedish Bird Ringing Atlas (2001)

Recoveries of Ospreys ringed in Sweden and reported during the period August-November show that this species migrates on a broad front.

Sergio Tirro

after Zink and Bairlein 1995

Parallel and narrow migration routes shown by different populations of Chaffinches ringed during passage at two bird observatories in Europe. Black dots refer to recovery places of birds ringed at Courish Spit, Russia (filled square) and open dots refer to birds ringed at Col de Bretolet, Switzerland (open square).

Migration is a challenge within nature conservation work since many populations of birds regularly move over huge areas, and problems en route or in the wintering quarters can result in declining breeding populations in areas far away. Many migratory birds are declining in numbers and detailed information about the annual movements, including important stop-over sites and winter quarters, is a top conservation priority.

Large numbers of ringing recoveries are now held in the EURING Data Bank and they can be used to analyse more complex questions about bird migration. Results of such analyses could form the basis of detailed laboratory and field research into the navigational cues and fuelling strategies that birds use when migrating.

The EURING Swallow Project

A worldwide symbol of bird migration all across its vast geographical range and for different human cultures, the Barn Swallow is also an important bio-indicator for habitat types which are under threat in different continents.

It breeds colonially in farmlands, sharing this habitat with a concentration of bird species showing worrying population declines.

Before leaving the northern hemisphere for its long migrations, the Swallow stores energy reserves during a crucial roosting phase, when the birds congregate at dusk in reedbeds, again a habitat which is facing severe reduction at a global scale.

Roosting behaviour is also typical of the winter period spent in the southern hemisphere, in vast areas of sub-Saharan Africa for the Western Palearctic populations. These areas of reeds and elephant grass are also under threat from human activities and agricultural development.

The fascination of its journeys makes the Barn Swallow a very popular research subject among ringers. For all these reasons the EURING Swallow Project (ESP) was launched in 1997. During five years of activities on the breeding grounds, as well as along the migratory routes and on the wintering grounds, nearly one million Swallows have been ringed by many hundred ringers in 25 different countries in Europe, Africa, and Asia. This amazing effort has allowed the unravelling of different aspects of the life-cycle and migrations of what used to be regarded as a very well known species.

The large-scale geographical coverage has also offered a unique opportunity to test optimal migration theories. Data gathered in Italy could confirm a trade-off between the completion of body moult and the accumulation of fat reserves during the pre-migratory roosting phase. At an intensively studied roost in northern Italy it has been shown that birds can only start accumulating fat when their body moult approaches its final stages. Optimal migration theory also predicts that birds will reach their final departure conditions just before embarking on the crossing of possible ecological barriers, like the Mediterranean and Sahara for European Swallows flying to Africa. By analysing data gathered from Finland southwards across Europe it has been possible to confirm this theory. Swallows leave Finland still with reduced fat stores, which are quite larger already in birds analysed in Switzerland. Still across Italy and Spain, the amount of fat reserves in birds in the north of these countries is significantly lower than that of swallows leaving the southernmost latitudes.

Hans Reinhard

One million Swallows ringed in 25 different countries have shown the potential of large-scale EURING projects as a basis for scientifically sound international conservation policies.

Adriano de Faveri

The Swallow – a symbol of international co-operation.

Even though it had long been thought that an aerial feeder like the Swallow would not need to store fat before migration, but rather adopt a "fly and forage" strategy, the project has shown that the amount of fat accumulation in European Swallows matches that of other long-distance songbird migrants.

The network of EURING Swallow Project roost ringing sites has also offered the first confirmation based on field data, that the amount of fat reserves at departure towards Africa is correlated to the distance that first-year and totally un-experienced swallows will have to fly across ecological barriers they have never seen before. Young swallows leaving southern Iberia, which will cross the narrow stretch of the westernmost Mediterranean and the Western Sahara, will depart with lower fat reserves than those of swallows leaving southern Italy. Those departing from Italy will fly a long distance over the sea and across the widest part of the Sahara desert, and are in fact much fatter.

The huge number of Swallows ringed during the project has also produced a large number of recoveries and described yet unknown wintering quarters for different geographical European populations. This has also led to increased action for Swallow conservation in Africa, where huge numbers of birds were and still are killed for food in Nigeria, Central African Republic, and Congo.

Thanks also to the EURING Swallow Project, the Swallow is now, more than ever before, a global symbol not only of bird migration but also of the need for internationally based conservation efforts and strategies.

Bird Ringing as a monitoring technique

In 2001, EU countries committed themselves to halt biodiversity decline by 2010, and to evaluate this target. Beyond legal obligation, monitoring – the study of variation in space and time of bird populations – is a tool for acquiring knowledge on which good conservation practice may be based. Monitoring is also the main source of information to alert the general public on the status of biodiversity and thus contributes to conservation by affecting policy and behaviour.

The general aim of monitoring is to document changes in numbers. For most bird species, direct counting is far more cost effective than ringing to achieve this aim. But counts alone are inefficient for determining mechanisms and for inferring causes. From one year to another, change in population size is the result of a long list of demographic events: reproduction, juvenile survival, dispersal, recruitment (new individuals entering the population), adult survival, etc. Most of them can be monitored efficiently through ringing. Hence, an appropriate monitoring system using ringing may be able to determine which of productivity or survival drives population changes, whether population are regulated and thus more prone to be resilient to global changes, etc. Moreover, long-term time series allow correlation of demographic rate variation with climatic fluctuation. Combined with other methods of bird monitoring, monitoring by ringing allows prediction of the fate of a bird population facing climate changes.

Emile Barbelette

Ringing data can be used to determine survival rates of long-lived seabirds such as the Common Tern.

Matthias Kestenholz

Great Tits easily accept to breed in nest-boxes which renders them accessible for ringing. Hundreds of thousands have been ringed for long-term population studies that provided fundamental insights into evolutionary processes, population dynamics, breeding biology and behavioural ecology.

Monitoring through ringing may either rely on intensive co-ordinated schemes or be the outcome of the accumulation of long-term database. The former is best illustrated by the "Constant Effort Site" scheme (CES; also known as "Monitoring Avian Productivity and Survival" in North America, an acronym that speaks for itself). Initiated in 1983 in the UK and Ireland, CES is currently organised in 16 EU countries, on 600 sites where over 100,000 birds are caught annually. CES is unique in producing annual indices of reproductive success of more than 30 species throughout Europe. CES data have, for example , shown that hot weather in spring was negatively affecting productivity of already declining species. This suggests a link between climate warming and long term population trend through reproductive success for a large number of species. The production of annual indices of productivity at a European scale is under study and is likely to be achievable in the near future. The long term ringing database is also most useful to monitor changes, through time, of key demographic parameters of bird population. Among them, changes in migration route, migration timing and migration probabilities are the most evident. Last but nor least, one of the few globally threatened bird species for which Europe has the main responsibility, the Aquatic Warbler, is almost entirely monitored through ringing, allowing us to determine the stability of the stopping-over network from Western Russia and Poland to Spain.

The most useful monitoring schemes are those that cover a large scale and that may be run in the long term. Although CES is showing the way, there is considerable room for improving the efficiency of monitoring by ringing. Another direction of improvement is the continuous integration of different monitoring schemes. This means more organisation and support for the volunteers who make up the only network able to monitor biodiversity throughout Europe. This is achievable by encouraging scientists to work in close association with ringing schemes.

Ringing birds to understand population dynamics

Understanding the mechanisms underpinning population growth and decline is central for conservation and many ecological and evolutionary questions. The variation of the size of a population from one year to another is determined by the number of individuals that have survived, were recruited, have immigrated or emigrated. Estimates of survival, recruitment, immigration and emigration rates can be obtained, if the fate of individuals can be followed through time and space. Birds that are ringed can be recognized individually allowing to estimate demographic rates.

However, the estimation of demographic rates is complicated by the fact that marked individuals cannot always be observed. Some individuals may be hidden at the time when the researcher wants to check them. Consequently, only fragments of the life of a ringed bird are known, and statistical methods have to be developed to deal with this problem. Technical meetings regularly organised by EURING deal mainly with this challenge, and they have helped considerably to advance statistical methods. Nowadays, sophisticated computer programs exist with which demographic rates can be estimated from capture-recapture data or from data from dead recoveries. Here we highlight three different studies showing the potential of data, gathered from ringed birds, to understand population dynamics.

There are many studies about survival rates in birds obtained from either capture-recapture data or from recoveries of dead individuals. Several of them have shown that survival rates of migratory birds depend on the availability of food

Jean-Lou Zimmermann

Greater Flamingos, the 3rd individual to the right wearing a colour ring.

resources during the non-breeding period. For example, annual survival rates of White Storks are significantly lower in years with droughts in the Sahel. Because White Storks from most European populations spend the non-breeding period at least partially in the Sahel, the sensitivity to droughts can explain why population changes across large areas in the European breeding area are synchronous. Moreover, this example highlights that successful conservation needs to integrate the complete life cycle of the species under question, not only the breeding period.

Recruitment, the establishment of locally hatched individuals in the population, is important for the maintenance of a population. To understand the impact of recruitment on population dynamics it must be known at which age young birds breed for the first time and how many there are. These questions can be studied if nestlings are marked and if it is noted in which year they reproduce. Researchers from France have studied recruitment in Flamingos in the Camargue. The first individuals started to breed at the age of 3 years, but there were also individuals that delayed their first breeding up to an age of 9 years. Recruitment was higher in years following a severe winter with higher mortality, showing that the effects of strong winters are offset by earlier recruitment, which reduces the impact of hard winter on population dynamics.

In order to understand population dynamics, it is vital to be able to assess how much variation in survival, reproduction or dispersal contribute to population change. Surviving adults of Willow Tits contributed 64 % to the growth rate of a Finish population, whereas the contribution due to immigration (22 %) and due to local recruitment (14 %) were significantly lower. The contribution of surviving adults was constant across time, but highly variable for local recruits and immigrants. Thus, the dynamics of this willow tit population were mainly due to variation in recruitment and immigration. However, because surviving adults contribute so much to population growth, any slight decline in adult survival rate has a very strong effect on the population.

All these insights were only possible, because birds have been ringed. Without individual recognition of birds in a population, it is hardly possible to understand demographic reasons for population changes. Bird ringing is therefore the basic field method to study population declines and increases.

Tero Niemi

Willow Tit

Bird ringing in evolutionary and behavioural studies

When competition between species of Darwin's finches in the Galápagos archipelago is magnified during periods of drought, Medium Ground Finches with smaller beaks have less overlap in their food spectrum with the much bigger Large Ground Finch than their bigger conspecifics. Thus, those Medium Ground Finches carrying genes that cause them to have smaller bills survive better and will have more descendants in the next generation. Consequently, the frequency of the genes causing smaller beaks will increase in this population. Evolution has occurred.

Since it is individuals, and not populations, that carry the genes, an in-depth understanding of evolution is rarely possible without studying individuals. This, however, requires that individuals can be recognized and followed over a period of time, ideally over their entire lifespan. Individual identification is particularly straightforward in birds through the use of a combination of metal and coloured rings. To no small extent, the widespread ringing of birds is the main reason why birds are the best studied vertebrates in evolutionary biology.

Mating patterns are one important trait that affects evolution. If certain birds have an opportunity to mate, while others do not, a change of gene frequencies will also occur. Thus, the study of animal behaviour underlying mate choice decisions and other crucial behavioural traits is central to a better understanding of evolution in natural populations. Again, only data from individually recognizable animals can help us answer some of these questions. Inbreeding, the mating of relatives, for example, has long been an issue of great interest among animal and plant breeders. How often does

Matthias Kestenholz

The Alpine Chough is a social bird living in high mountain areas. Though highly gregarious, ringing and colour-ringing of this confiding species not only provided insights into home range and population structure, but also allowed to study individual foraging strategies.

Johann Hegelbach

The Dipper. Colour ringing has shown that this attractive species can sometimes be infanticidal and incestuous.

inbreeding occur in the wild and what are its consequences? When birds of one population are individually colour-ringed for many years, we can construct pedigrees that allow us to infer the degree of inbreeding and thus its causes and consequences. On a small island in Canada, for example, Song Sparrows have been shown to mate with a relative as often as expected by chance. Thus, Song Sparrows do not seem to avoid mating with relatives, despite the fact that inbreeding considerably reduces reproductive success and survival.

In a population of European Dippers in Switzerland, one female paired up with her son which himself had originated from a pairing between her and her brother. On the other hand, one male of these *Cinclus c. aquaticus* was resighted in Poland, mated to a dipper that had been ringed in Sweden as *a C. c.cinclus*. It is difficult to conceive of more opposite mating patterns among individual birds from the same population.

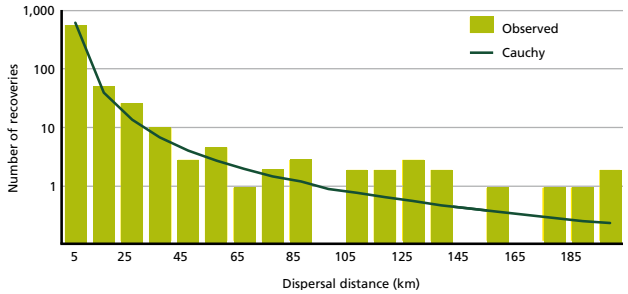
Some of the most interesting behaviours are those that appear at first to contradict simple evolutionary explanations. One such behaviour is infanticide which has been described in a small number of bird species including the European Dipper. Why would male Dippers kill young in nests of other pairs in the population when they do not seem to have anything to do with that nest? At first sight, one is tempted to explain such occurrences as aberrant behaviours. However, an alternative, evolutionary explanation is that the infanticidal males are killing the young so that the females will lay a new clutch which could be fathered by the infanticidal male. Observations of individually colour-ringed birds combined with genetic analyses have the potential to resolve this and many other fascinating questions in modern biology.

Dispersal and population persistence

Most European bird populations live in habitats that are highly fragmented as a result of human activities. The dynamics and genetic diversity of populations inhabiting such landscapes are often critically dependent on dispersal patterns, as well as on reproduction and survival within habitat patches. To gain a better understanding of how to manage these landscapes for birds we need information on dispersal derived from bird-ringing.

Two main types of dispersal are recognized in population ecology. Natal dispersal refers to movements between the place of birth and that of first breeding, while breeding dispersal refers to movements between subsequent breeding attempts. There are two complementary ways of studying dispersal using bird ringing. Mark-recapture and mark-resighting data can be used to measure dispersal within local populations, or between populations occupying a limited number of colonies or habitat patches. These studies provide a high resolution picture of local movements but may miss long-distance ones. In contrast, analyses of ring recoveries provide a broad overview of dispersal patterns including long-distance movements, but may lack fine detail. In both of these methods it is important to control for variation in recording effort.

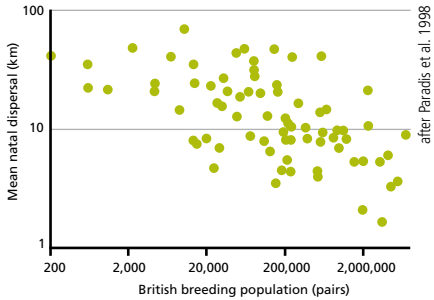
Current knowledge of natal and breeding dispersal is based on analyses of ringing data. For most species natal dispersal is greater than breeding dispersal, and species with higher natal dispersal also tend to move further between subsequent breeding years. Average (geometric mean) dispersal distances vary greatly between species. For example, in Britain and Ireland Blackcaps have an average natal dispersal distance of 17,5 km while House Sparrows move an average of only 0,2 km between their natal and breeding sites. Dispersal patterns are influenced mainly by the ecological characteristics of individual species, with those occupying more restricted and patchy habitats showing greater dispersal. Scarcer species generally occupy more restricted and patchy habitats and this results in a negative relationship between dispersal and abundance. For similar reasons, dispersal is greater amongst birds occupying wetland habitats. Dispersal is also greater in migrants than in residents, presumably because of the opportunities for the former to explore new areas. There is much scope to explore such patterns further using data from the EURING databank.



Natal dispersal distances of Song Thrushes measured using ring recoveries from Britain and Ireland.

There is now increasing evidence from fieldwork and mathematical modelling that frequencies of occurrence and densities of many bird species are lower within habitat fragments than in large areas of continuous habitat. For example, a study in Northern Belgium found that Nuthatch densities in forest fragments were about half those in continuous areas of forest. In this species, dispersal distances are larger and territory vacancies are filled more slowly in fragments than in continuous habitat. Furthermore, areas where most of the habitat is fragmented act as sinks, with populations only being maintained by immigration from more continuous habitat. In order to manage populations within fragmented landscapes it is vital to understand these relationships between population density, habitat quality and dispersal. Understanding dispersal is equally important for the conservation of colonial species such as seabirds, where immigration and emigration are key determinants of colony size.

Dispersal also has important implications for the maintenance of genetic diversity within populations, and for rates of evolution in changing environments. In most bird species the greater natal dispersal of females compared to males helps to reduce inbreeding depression. A study of colour-marked Great Reed Warblers in Sweden found that low genetic variation and the occurrence of inbreeding depression were associated with restricted dispersal and with a lack of any dispersal difference between males and females. These genetic studies further emphasise the importance of improving our understanding of dispersal, which remains poor relative to that of other demographic processes. Large-scale studies of marked birds should form an important part of this research effort.



The relationship between average natal dispersal distance and population size for 75 species. More abundant species generally occupy a wider range of habitats and need to move less far in order to find potential nesting sites.

Alain Saunier

The Nuthatch is a good example of a species where patch occupancy in fragmented woodland habitats is influenced by dispersal.

Bird Ringing and Global Climate Change

Birds as highly mobile and easily observable organisms are extremely responsive to climatic changes. They were among the first organisms that made it obvious to scientists and the public that climate is now changing at a remarkable rate. Earlier spring arrival of migrants, earlier onset of the breeding season, a northward shift of breeding areas and an increase in winter reports of migratory species gave clear evidence for a general rise in temperature over most of Europe.

In several countries bird ringing has been in constant use for over 100 years and data at national ringing schemes cover large geographic areas. The recovery database of birds from Britain and Ireland was used to calculate indices of migratory tendency which can be used for a variety of analyses, including detection of changes in migratory behaviour. Based on the same dataset of ring recoveries in Britain and Ireland, relationships were shown between mean wintering latitude and climate variables. In a comparable analysis on the German ring recoveries of 30 species evidence was found for significantly increased proportions of winter recoveries within a distance less than 100 km in nine species. Evidence for reduced mean recovery distances between breeding and wintering areas was found in five species and a tendency towards wintering at higher latitudes was found in 10 species.

Although heterogeneity of ring recovery data in terms of ringing activity, recapture, re-sighting effort, recovery and reporting probabilities of recoveries on a temporal and spatial scale are problems for these types of long-term analyses the data from bird ringing offer promising possibilities. First, ringing and recovery databases cover larger areas and longer time-spans than most single studies. Second, in contrast to pure observations and bird counts, individuals with deviant behaviour (like wintering in northern latitudes by migrants) can be assigned to distinct populations. Third, the datasets are readily available in standardised, electronic format. Thanks to the co-ordinating efforts of EURING, analyses of changes in migration behaviour of some species might cover many decades and large geographical areas. Furthermore the success of wintering attempts in northern latitudes, as well as fitness consequences of changed behaviour in response to any environmental change can only be measured properly when the bird is individually marked and can be recognized.

Besides the current strong tendency to assign almost all observed changes in bird behaviour to climate change it must be kept in mind that also changes in land use, winter feeding, availability of rubbish dumps and many other environmental changes may affect the position of wintering areas and the timing of breeding behaviour. Standardized data from ringing projects and the insights into life histories of individuals, as shown by ring recoveries, will help to entangle this complex framework.

Philippe Emery

During the last decades Bee-eaters, a species of the warmer regions of Europe and Africa, appeared for breeding in good numbers in Central Europe. Ringing projects will help to understand if new northern breeding colonies are self-sustainable or if these colonies need a steady influx from productive southern parts of the population.

Tomi Muukkonen

Swifts are among the species with increased reports of two subsequent broods instead of a single one per breeding season. But are the parents of both broods identical or did another pair start a late brood in the early abandoned nest site of their predecessors? Studies with individually marked birds can help to find the answer.

Bird-transmitted diseases

When avian influenza virus of the H5N1 type started its way from southeast Asia westwards into Europe in 2005, the public interest of movements of wild birds reached a peak as has never been seen before. Newspapers and broadcasting stations asked for bird migration maps showing possible links between avian influenza outbreak regions and European countries. Although the complexity of bird movements made it difficult for ornithologists to give simple answers many insights into bird migration phenology could be conveyed to the public. The results presented were largely based on recovery data from bird ringing.

Not only mass media showed an increased interest in bird ringing results but also the European Commission and many national administrations also became aware of the value of bird ringing and even funded bird ringing projects and data analyses. This general interest in bird movements was driven by the assumption that wild birds – and especially waterfowl - are the main carriers of avian influenza and thus form the main risk for the introduction of the disease into countries and into poultry holdings. Again, largely based on bird ringing results, ornithologists were able to show that there are discrepancies between the movements of birds and the movement of H5N1avian influenza virus. This demonstrates the important fact that movements of wild birds are not the only – and probably not the most important – source of avian influenza outbreak risk. Later, virologists reconstructed pedigrees of the outbreaks by analysis of parts of the viruses' genomes and supported this point of view. One famous example was a Whooper Swan which was among the first victims of the avian influenza outbreak on the German island of Rugen. This bird was marked with an individually numbered neck collar attached in its breeding grounds in Latvia and it was seen alive more than two weeks before the outbreak in the Rugen area. This bird, and some others with individual marks, told scientists a lot about transmission and epidemiology of avian influenza virus and helped to develop effective, but not excessive measures of defence against this disease.

Beat Walser

More than half of the birds tested positive for H5N1 avian influenza virus in the 2006 European outbreak were Mute Swans. Thanks to ringing programs, the movements of this partly migratory species in Europe is fairly well known.

Besides the spectacular H5N1 avian influenza outbreaks, scientists study many aspects of bird-transmitted diseases for two main reasons. Firstly, birds can be highly mobile and effective hosts and dispersers of diseases which may also effect plants, livestock, or humans. Besides Avian Influenza there is a wide range from West Nile Virus over Cercarial Dermatitis ("Swimmer's Itch") and Psittacosis ("Parrot Disease") to humming bird-transmitted floral mites causing plant venereal diseases. Tracking of individuals, marked by bird rings, through space and time help us to understand the ways of spread and transmission of the disease. This helps to develop effective defences for the benefit of man, livestock and plants.

Beat Walser

Eurasian Teal is one of the 17 species for which EURING has analysed recoveries in relation to High Pathogenicity Avian Influenza.

Secondly, the easy accessibility of birds, the large background knowledge that is already available about bird biology and the potential of a large community of amateur ornithologists gathering information make birds and their diseases ideal models for understanding the biology of hosts and parasites. With the help of thousands of amateur ornithologists watching House Finches in their gardens in the United States, scientists of the Cornell University (Ithaca, NY) were able to follow, over a whole continent, the dynamics of mycoplasmal conjunctivitis, a new eye disease infecting the finches. These observational data were completed by quantifying the effects of the disease on host demographic parameters via capture – mark – recapture modelling. By a similar approach – also requiring the individual ringing of birds – it is possible to investigate detection probabilities of disease carriers and assess disease prevalence. Both are important factors in understanding the co-evolution between a parasite (disease) and its host.

From Bird Ringing to Conservation Action

Information about connectivity of breeding, resting and wintering areas as well as survival data within and among populations is crucial information for any conservation action. These data can only be collected through marked individuals, and bird ringing still is the easiest and cheapest way to gather suitable sample sizes for sound analyses.

Migrating birds are global players and what – in a human sense – could be called their "home" is, of course, not restricted to the breeding ground. Not surprisingly, reasons for population declines or increases do not always lie in the area where a bird raises its young. Ringed and recovered birds show conservationists where their breeding grounds, stopover sites and wintering areas are situated. This enables investigation of what is happening there and if any conservation action is required.

Complex analytical methods, so-called mark-recapture analyses of marked birds, make it possible to compare survival rates between years, between regions or before and after special conservation activities. Furthermore, the impact of a special reason for mortality can be estimated. For example it was possible to show that one out of four juvenile and one out of 17 adult White Storks die each year at electrical power lines. Since the reporting probability of different causes of mortality are different, these models based on ringed and recovered individuals provide much more reliable information than any simple count of cases. It is also possible to test if a distinct reason of mortality might be offset by other reasons, thus reducing the overall effect on a population. Such analyses provide conservationists with information about the crucial issues to address and enable them to evaluate conservation effort.

BirdLife Switzerland

Analysis of ringing data revealed the first quantitative assessment in the hunting of migratory birds. Despite legal protection in many countries, shooting and trapping of migrant birds is still widespread in the Mediterranean area where they suffer from substantial losses.

Markus Jenny

By mark-recapture studies the impact of hunting and the possibility and prerequisites of sustainable harvesting of wild birds can be estimated.

Recoveries of birds reported as shot during hunting activity are of the utmost importance for the proper management of the populations of game birds. Reports of shot ringed birds are used in mark-recapture analyses to answer the question of whether hunting mortality is additive or compensatory to natural mortality and what level of harvesting of wild birds of a distinct population is sustainable. Geographical variation in the average survival rates of Robin and Song Thrush was correlated with the hunting pressure experienced by those populations. This suggests that, for these two species, hunting causes mortality that is additional to natural mortality.

Monitoring of bird populations as required by several international conventions is a prerequisite for effective protective measurements for the many declining bird species. However, counting heads does not provide information about the reasons for population changes since it does not account for survival rates, age structure, longevity or productivity in the populations. EURING holds the only long-term data set covering most bird species which can be used to study a whole range of crucial population characteristics. The potential for further co-ordinated European-wide bird ringing research is immense. EURING and the National Ringing Schemes have the potential to co-ordinate large numbers of amateur ringers for such projects (see page 17).

International Conventions requiring bird populations to be monitored

- EC Directive on the Conservation of Wild Birds (1979/409/EEC) (Articles 4, 6, 7 and 10)
- Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat (1976) (Articles 2 and 4)
- Bern Convention on the Conservation of European Wildlife and Natural Habitats (1979) (Articles 1-4,10 and 11)
- Bonn Convention on the Conservation of Migratory Species of Wild Animals (1980) (Articles 2 and 5)
- AEWA Action Plan to the Bonn Convention (1999)
- European Water Framework Directive 2000/60/EG (2000) (Article 6 and Appendix IV and V).

Martin Flade / BirdLife International

Recently, the African winter quarter of the highly endangerd Aquatic Warbler has been discovered in the Senegal delta area.

Bird Ringing in the 21st Century and the Future Role of EURING

EURING promotes research based on bird-marking in order to inform the conservation and scientific understanding of wild birds. Co-ordinated field projects and novel analyses of large-scale data will address key topics including the effects of climate change and factors responsible for the loss of biodiversity.

Throughout the Palearctic-African flyway, changing agricultural practices and land use continue to have major impacts on our bird populations. Global climate change is already affecting the phenology, distributions and migrations of many bird species, and is set to have much greater effects over the coming decades. The conservation of many migratory bird populations also requires the protection of site networks and other suitable habitat along flyways under international treaties such as the Ramsar Convention, Bonn Convention and African Eurasian Waterbird Agreement (AEWA).

To address these large-scale conservation issues we need knowledge of population dynamics and migration patterns provided by internationally co-ordinated bird marking. The examples throughout this brochure illustrate what has already been achieved as well as the urgent need for further research. EURING and its member schemes undertake research into factors affecting European birds throughout the Palearctic-African flyway, where appropriate in collaboration with colleagues from outside Europe. EURING will focus its future activities on three key areas in order to maximize the contribution of bird-marking to science and conservation. These are technical development and co-operation, the analysis and interpretation of large-scale data sets and the development of co-ordinated research programmes.

Common standards for field work, data storage and analysis are essential for high quality international research. EURING promotes best-practice in field protocols for the catching and examination of wild birds and in the training of ringers. We have a multi-language website for recovery reporting, and have developed the use of a common European web address on bird rings. Data from conventional bird-ringing can be enhanced by additional techniques including colour-marking, transponders, radio-tracking and satellite tracking. EURING will work to ensure that the most appropriate technologies are applied to address specific research questions. EURING will also maintain a series of conferences that promote collaboration between statisticians and biologists, leading to methods and software that provide better insights into migration patterns and the causes of population changes.

Maintaining and developing the EURING Data Bank as a unified source of European ringing and recovery data is central to EURING's activities. EURING provides research and interpretive services based on these data and also welcomes requests for data and collaboration from other prospective analysts. EURING will also aim to ensure that this primary research is turned into advice that is of real value to policy makers and conservation practitioners.This could be achieved by, for example, providing on-line access to summary information on movement patterns and demography. The organization of co-operative bird-marking projects is expected to form a growing part of EURING's activities. The EURING Swallow project is a recent and highly successful example of this approach (page 14). The European Constant Effort Sites (CES) scheme that is currently under development aims to monitor the abundance, productivity and survival of a range of species by standardized mist-netting (page 17). CES schemes offer the opportunity to address a range of important conservation issues such as the effects of climate change on population dynamics. The large network of volunteer ringers maintained by EURING's member schemes offers the potential for other co-ordinated projects to address key conservation issues.

Mark Grantham

Colour-ringed Stone-curlew

Andreas Schmidt

Reporting a Ring

What would you do if you found a bird with a ring? Please report any ringed bird that you find to the national ringing centre of your country (see http://www.euring.org) or directly to www.ring.ac

What Ring?	Write down the ring number and words and, if the bird is dead, please enclose the ring taped to your letter. The ring will be returned to you if you wish to keep it.
Where?	Give the location where the bird was found including the name of the nearest town or village and a grid reference if possible.
When?	Give the date the ringed bird was found.
The Circumstances	Say if the bird was alive or dead. If dead, please give the cause of death if known, e.g. was it hit by a car, brought by a cat, or found oiled on a beach? Also note if the bird was freshly dead or decomposed etc. If the bird is alive please say what happened to it.
What Bird?	Write down the type of bird or species, if you know. You might also send a photograph of the bird.
Your Details	Remember to give your name and address so that you can be sent the information about when and where the bird had been ringed. Details will normally be sent within a month, but there may be delays at busy times of the year. If you send a report of a ringed bird by e-mail, please include your postal address.

Helge Sørensen

Dead birds, such as this Long-eared Owl found at the roadside, often provide ring recoveries.

EURING

EURING – The European Union for Bird Ringing
c/o British Trust for Ornithology
The Nunnery, Thetford, Norfolk, IP24 2PU, United Kingdom
www.euring.org

The need for international funding

So far, only a small fraction of the information gathered from ringing birds is analysed and published. The vast data set of birds ringed and recovered all over the world allows analyses which had not even been imagined by front-line researchers at the time when the birds had been ringed. Today, burning questions in modern biology and in the conservation and management of birds can be tackled with this unique resource of data.

EURING will seek funding for more in-depth analyses, for a continent-wide overview of bird migration, and for transferring this vital information to the environmental community, policy makers and the general public.

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