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01

## Zebra Finch

### Sex-specific brain development and song learning

The Zebra Finch (*Taeniopygia guttata*) of the *Estrildid* family (order Passeriformes) originates from Australia and, next to being a popular pet bird, is the most important model species for the study of almost all current questions of organismic biology. This colony bird is an opportunistic breeder that depends widely on water and food availability, which facilitates breeding in captivity.

Zebra Finches are sexually dimorphic singers with the female producing only unlearned calls while the males utter learned, rather stereotyped songs and contact calls. In relation with this sex-specific vocal behaviour, the brain vocal control system of the Zebra Finch is sexually dimorphic. Certain vocal control regions are not well developed in the female finches if not females are exposed to high levels of estrogens shortly after hatching.

This hormone-dependent development of brain and behavior is studied on the molecular level to identify the underlying genetic constraints leading to a male or female brain. Second, since singing is learned it serves as a model for the study of sensory-motor learning, analogous to human speech development; both involve the memorization of auditory models that are templates for vocal motor learning, a process that requires auditory-motor feedback. We are particularly interested in cellular mechanisms of song learning that are anchored in the forebrain vocal control areas.

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02

## Blue Tit

### Faithful females

Most Blue Tits are socially monogamous.

However, about half of the broods contain some young that are sired by extra-pair males. Behavioural observations suggest that females actively seek extra-pair copulations, often with older, neighbouring males. This behaviour might have evolved because it allows females to optimize their mate choice and produce better offspring.

Indeed, in broods with mixed paternity, extra-pair young have a higher probability to survive than their within-pair nestmates. We investigate whether this is due to intrinsic differences in quality among males or because of genetic compatibility. Earlier work showed that individual genetic diversity (heterozygosity) is an important predictor of fitness-related traits such as survival and reproductive success. One of the intriguing questions is why some females are faithful while others are not. Are there intrinsic differences in the females' propensity to be promiscuous, or is it all a matter of opportunities ?

Blue Tits are one of the model species in studies of behavioural ecology. At the MPIO, a key effort goes into a long-term study of a population breeding in nestboxes. Our research focuses on mate choice, the evolution of promiscuity, the timing of behaviour and on the importance of genetic diversity.

The **Blue Tit** (*Cyanistes caeruleus*) is a small (about 10 g) passerine bird in the tit family *Paridae*. It is a widespread and common hole-nester that readily accepts nestboxes for breeding. Females can lay a clutch of up to 16 eggs. Blue Tits are found throughout temperate and subarctic Europe and western Asia in deciduous and mixed woodlands. Most Blue Tits are resident, i.e. they do not migrate.

They are one of the most common birds observed in our gardens.

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03

## European Starling

### Herbs for health

The European Starling (*Sturnus vulgaris*) is a passerine bird in the family *Sturnidae*. This species of starling is native to most of temperate Europe and western Asia. It is resident in southern and western Europe and southwestern Asia, while northeastern populations migrate south and west in winter to these regions, and also further south to areas in Iberia and north Africa where it does not breed.

European Starlings occur almost all over the world. They nest in natural cavities or nest boxes provided by humans, often in colonies where males defend one or more nest boxes and mate with one or several females. Males perform complex songs to court females and keep rivals away. They also show fresh plant pieces and flowers to females to attract their attention. Males, using their sense of smell, preferably pick herbs rich in volatile compounds like milfoil, hogweed or goutweed from the meadows and incorporate them into their nests. They cease this behaviour when the first egg is laid. The herbs emanate compounds with medicinal properties into the nest box air. Nestlings from nests experimentally provided with herbs were heavier, more of them returned from their African winter quarters, they carried less bacteria, had more beneficial white and red blood cells and lower plasma levels of the stress hormone corticosterone than nestlings from herbless nests. Lice fleas and mites were not reduced in nests rich in herbs. The males display of green plants and the olfactory stimuli evaporating from a nest situated in a dark hole could be reliable signals to females for good male and offspring quality.

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04

## House Sparrow

### Testosterone and ornaments

The **House Sparrow** (*Passer domesticus*) is probably one of the best-known passerines around the world. It belongs to the Old World Sparrows and successfully invaded many continents where it is often considered as a nuisance or even pest. It is a non-migratory species that can be found all year round in habitats associated with human modified environments, such as farms, urban and residential areas.

Male House Sparrows display several ornaments, each probably signalling different aspects of their quality. The most studied ornament is the breast badge that signals dominance according to its size.

Other ornaments are the white wing bar and bill coloration. In males, bill colour changes from a pale grey in the non-breeding season to a dark black in the breeding season. The bill of females remains pale all year round.

Male bill colour is related to plasma testosterone levels and it is the most flexible of all ornaments as it can be changed within a period of about three weeks.

Colours of all ornaments of male House Sparrows are based on melanins, which are by-products of the amino-acid catabolism. Female House Sparrows do not display such distinct ornaments, but bill colour as well as plumage characteristics vary between individuals.

The two genders are all year round dimorphic in plumage and can be easily distinguished. Hatchling birds however resemble females.

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05

## Island Canary

### Seasonal singing in wild canaries

The song behaviour of Island Canary males was investigated in detail on the small island „Ilhéu Chão“ that is part of the Madeiran archipelago.

The birds possess a distinct song repertoire that changes seasonally such that breeding season songs consist of a higher proportion of fast frequency modulated syllables that are attractive for females.

On that island the breeding season usually lasts from the beginning of February until July. However, large amounts of rain in autumn, and subsequent early growth and flowering of feeding plants, leads to breeding activities as early as December, which suggests a remarkable plasticity in responding to environmental cues.

A phylogeographical study of the canary populations of the three archipelagos led to the assumption that the colonization of the Atlantic islands by the canaries occurred very recently (around 1 million years ago) and that there is no persisting gene flow between different populations.

The **Island Canary** (*Serinus canaria*) is a small finch (family *Fringillidae*, order *Passeriformes*) that breeds in the Azores, Madeira and Canary islands.

This species is the ancestor of the larger domesticated canary that is known as one of our most popular pet birds.

Wild canaries occur in all habitats from sea level to high mountains and are fairly common residents on the three archipelagos. Sexes differ with adult males being more yellow on forehead and throat.

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06

## Red-billed Quelea

**Bird of extremes**

The Red-billed Quelea (*Quelea quelea*) is the world's most abundant bird species (excluding domesticated species), with an estimated adult breeding population of 1.5 billion.

It is a small passerine bird of the weaver family *Ploceidae*, native to sub-Saharan Africa.

Red-billed Queleas are the most abundant bird species, they breed in the densest and biggest colonies and they are the fastest reproducing. They are also the world's worst avian agricultural pests.

However, one thing that Queleas are only second best at in birds is being variable in plumage coloration – nevertheless the variation in the appearance of male queleas during the breeding season is striking. Much of the research at MPI on Queleas is on the function and developmental mechanisms of the variable plumage coloration in this species.

Unlike most other species, variation in male colors appears to be a fixed, genetically-determined trait that does not reflect aspects of a male's health and vigor. Instead, plumage color appears to function more like a „name-tag“ a signal of individual identity that males use to facilitate recognition among territorial nest-neighbours.

Why might Queleas need such a signal ?

It all ties back to the other extremes of this species. Since the breeding in this species is so fast-paced and dense, territorial males would be constantly harassed by the males next-door if they were not easily and correctly recognized as belonging to the neighborhood.

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07

## White Stork

### Migration and long-distance flight



The White Stork (*Ciconia ciconia*) is a large wading bird in the stork family *Ciconiidae*, breeding in the warmer parts of Europe (north to Estonia), northwest Africa, and southwest Asia (east to southern Kazakhstan). It is a strong migrant, wintering mainly in tropical Africa, down to the south of South Africa, and also in the Indian Subcontinent.

The White Stork is a prominent research partner of the institute since its oldest days of the foundation as „Vogelwarte Rossitten“ (today „Biological Station Rybachy“, Russia). Since 1903, it was one of the pioneer species in the first large-scale „bird ringing experiment“ and in demonstrating avian intercontinental long-distance migration up to southern Africa. In retention-and-release-experiments in the 1930s, White Storks pioneered again investigations to elucidate avian orientation capacities. In the successor institute – Vogelwarte Radolfzell – White Storks were prominent subjects of studies of population dynamics since the 1940s. This then allowed for several European-wide almost complete censuses of their breeding pairs. Since 1991, White Storks were among the first few species to help to introduce satellite tracking in Europe as a novel method for the study of avian movements under permanent control.

The female „Prinzesschen“ became world-famous as she could be tracked to and from Africa for almost ten years until her death in 2006. Meanwhile, she has become unforgettable on a special stamp. Now, White Storks are again of great importance for the institute with respect to understand avian adaptations in migration, breeding and other events to global warming.

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08

## Weaver Birds

### Avian architects of the savannah

Weaver birds are the avian architects of the African savannahs. Their tightly woven dome-shaped nests, often aggregated in huge colonies, are a dominant feature next to seasonal ponds and human settlements.

Nest-building is a challenging task. The nest material, fresh grass, is only growing after good rains and the skillful weaving and knotting of grass culms has to be learned and practiced in „play colonies“ for up to one year.

Once experienced, males move to breeding colonies, compete with other males for the best nest sites and try to attract receptive females. In this context the nest may act as an „extended phenotype“ of a male, and variation in nest quality could be used by females as an indicator of a males' experience or genetic background in mate choice decisions.

Another spectacular peculiarity of some *Ploceus* weaver species is their variation in egg appearance.

Background colours of eggs can vary from white to green/brown and each female lays eggs with a unique and highly consistent pattern of brownish or reddish spots. Parasitic cuckoos, laying their eggs into weaver nests may have promoted variation in egg appearance in the host, where female weavers laying rare egg morphs benefit from easier recognition and rejection of parasitic eggs.

Weaver birds of the genus *Ploceus* are small to medium sized passerines that are mainly distributed in tropical Africa and Asia. Their life history and mating system is highly variable, ranging from monogamous species that breed solitarily in dense forests to polygynous species breeding in huge colonies in semi-arid savannahs.

A unique feature of all weaver species are their tidily woven grass nests which are built by the males in a time- and energy-consuming process.

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09

## White-browed Sparrow weaver

### Social status dependent singing and the brain

The White-browed Sparrow weaver (*Plocepasser mahali*) is a cooperatively breeding songbird belonging to weaverbird family *Ploceidae* (order Passeriformes). Its distribution ranges from the Northeastern to the Southern parts of Africa. Sexes can be distinguished by bill colour, with females having a horn-coloured and males a black bill. Birds live in groups of 2 to 10 individuals in year-round territories with a dominant breeding pair and male and female subordinates.

White-browed Sparrow weavers possess an elaborate vocal communication system, with two types of song; male solo song, and duet/chorus song of all group members. Temporal organization and repertoire composition of solo and duet songs are completely different, and comprise large repertoire sizes, respectively.

Significantly, male solo-singing is strictly status-dependent. Only the dominant male of the group performs the solo song, i.e. it possesses two distinct repertoires.

The transition from a subordinate helper to a dominant breeder male induces the production of the solo song. We showed that this change in social status of adult males affects the morphology of a behavioural control circuit, the song control system of songbirds that is composed of large neuron populations.

Furthermore, dominant males have several times larger testes than subordinates, which is, however, not reflected in circulating androgen and oestrogen levels.

These data suggest a remarkable differentiation of adult vertebrate brains in relation to changing social cues.

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## Pectoral Sandpiper

### Macho males

When Pectoral Sandpiper males arrive at the Arctic coast of Barrow, Alaska, they can hardly take a break. From the moment they arrive in late May or early June until they leave again about a month later, they compete incessantly for a territory and access to fertile females.

Males chase each other and perform flight displays, which include a series of hooting calls produced through rhythmic expansion of an inflatable throat sac.

Competition often involves „sizing each other up” in parallel walks or flights, and this occasionally leads to extended physical fights. „You snooze, you lose”, and indeed males hardly if ever sleep during the period when females are fertilizable. During the 24-hour arctic summer day, they attempt to impress females with their displays, so that they settle and nest on their territory.

Observations suggest that females copulate only once or a few times before laying their clutch of four eggs. In most cases, the territorial male fathers all the offspring and males can have up to four females breeding in their territory. The winners are those that come with huge body reserves and can withstand the intense competition.

The **Pectoral Sandpiper** (*Calidris melanotos*) is a medium-sized sandpiper that breeds in the Arctic tundra of North America and Siberia and winters in South America. It is one of the few members of the family *Scolopacidae* with a polygynous mating system. Males are easily distinguishable from females, based on size and the presence of an inflatable throat sac. Pectoral sandpipers are occasionally observed in Europe, and a recent breeding event has been reported in north-eastern Scotland.

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## Blackcap

### Migratory and sedentary behaviour

The **Blackcap** (*Sylvia atricapilla*) is the most common species of the genus *Sylvia* and also has the widest distributional area from western Africa up to central Siberia. It lives in a wide range of habitats from forests through shrub- and wetlands or parks to house gardens. Most of the time well hidden in the vegetation the wonderful singer is much more often being heard than being seen.

Among the Eurasian songbirds, the Blackcap is unique in its migratory and sedentary behaviour. On Atlantic islands (Cape Verdes, Azores), its populations are all-year resident, in the Mediterranean area, Blackcaps are partially migratory (in part resident, in part leaving for distant wintering areas), and through central Europe to Scandinavia and Siberia, exclusively migratory populations change from middle- to long-distance migrants migrating up to southern Africa. Even a migration divide occurs separating central European birds wintering on the one hand in the Mediterranean area, on the other hand on the British Isles.

Thus, the Blackcap was the ideal main target species for a long-term experimental „warbler program“ to elucidate step by step fundamental questions of the control of avian migration. After the demonstration of basic endogenous „annual calendars“ large-scale breeding of Blackcaps allowed to start two novel research fields: experimental genetics and experimental evolutionary biology of migration. It could be demonstrated that all essential migratory features have a strong genetic basis. Furthermore, in experiments as in the field, Blackcaps have shown that migratory events can rapidly be adapted by selection. For instance, in the course of global warming migratory Blackcaps could become resident just within a few decades.

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## Blackbird

**„Stress and the city“: ecological and evolutionary consequences of urban life**

The European Blackbird (*Turdus merula*) is a European member of the thrush family *Turdidae*. It is common in woods and gardens over all of Europe and much of Asia south of the Arctic Circle. Populations are resident except for northern birds which move south in winter. The warmer microclimate and relatively abundant food within cities allow the birds to establish territories and start reproducing earlier in the year.

Nowadays, human activities are changing environmental conditions throughout the world at a dazzling rate. One of the most striking man-made ecological alterations is the ongoing spread of urban areas. There is no doubt that cities significantly differ from nearby non-urban habitats in a variety of biotic and abiotic factors. As a consequence, urbanization may have led to altered selection regimes compared to the surrounding environment. This should have pervasive evolutionary consequences and may greatly accelerate evolutionary change. Indeed, there is increasing evidence that animals responded to the environmental conditions of urban ecosystems and have become significantly different from the original non-urban populations in morphology, physiology and behaviour. Whereas ecological consequences of urban life are receiving increasing attention, evolutionary consequences have been largely neglected. We use comparative studies on Blackbirds to (1) examine whether urban life changes behaviour and underlying physiological mechanisms and (2) to address to what extent urbanization causes micro-evolutionary changes in animals thriving in cities. This integrated research program helps to extend our limited knowledge of the ecological and evolutionary consequences of our rapidly urbanizing world.

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## European Robin

### Female singing

The **European Robin** (*Erithacus rubecula*) is a small songbird of the thrush family *Turdidae* (order Passeriformes) that occurs all over the Western Palearctic. Males and females look identical while young birds have no red breast and are spotted golden brown. In many places the robin can be seen year-round. However, since it is a facultative short-distance migrant, the summer and winter populations of robins in the same area may not be composed of the same individuals.

Birdsong is generally associated with males.

Male robins are well known for its fluting, warbling song in the breeding season that is somewhere between March and July.

However, one of the European songbird species in which female song has been observed is the European Robin.

In England, females are reported singing in winter during the non-breeding season while defending own territories aggressively against conspecifics.

So far, there is little to no documentation of the song of female Robins and its similarities/differences to male songs. Further, in light of the dependence of male breeding songs of testosterone, we investigate the endocrine control of female singing. Similar to the males, testosterone treatment induces song in female robins.

As a first step towards understanding female song, we record and compare singing males and females in winter and spring in a sedentary Robin population in the Rhine-valley.

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## Stonechat

### Seasonal timing and life-history diversity

Stonechats have been a model taxon for studying seasonal behaviour and life-histories at our institute since the early 1980s. They adjust their seasonal activities to environmental conditions by combining endogenous circannual rhythms (from circa = around and annus = a year) and external timing cues. In Stonechats from equatorial Kenya, the underlying circannual rhythms are particularly robust. When exposed to constant equatorial daylength, captive birds show freerunning reproductive and moult cycles for years, whereas freelifving birds are seasonal breeders, indicating synchronization by local factors. The nature of these factors is still under study, but first evidence suggests involvement of seasonal differences in light intensity or possibly timing of dawn and dusk.

Stonechats from higher latitudes use the annual change in daylength as primary timing cue. Comparative studies of European, Siberian and British Stonechats showed clear geographic differences in responses to daylength, indicating adjusted timing programs for appropriate seasonal behaviour. Comparative studies have also shown geographic differentiation in physiology and life-history, such as the timing and regulation of territorial defense.

The pictures show the aggressive response of a male Stonechat to a stuffed dummy bird mounted in its territory.

The Stonechat (*Saxicola torquata*) inhabits open landscapes across the old world. Breeding from Siberia to South Africa, it has evolved strategies for coping with diverse environments.

Its local populations, formerly considered subspecies, are now grouped into several species. Stonechats show diverse migration habits depending on the environment in which they breed.

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## Rosy Starling

### Performing in the wind-tunnel

The Rosy Starling (*Sturnus roseus*) is a passerine bird in the starling family *Sturnidae*. The breeding range of this bird is from easternmost Europe across temperate southern Asia. It is a strong migrant, and winters in India and tropical Asia. In India in winter, it often appears to outnumber the local starlings and mynas.

Sleeping animals are by definition less aware of their surrounding environment, a condition that renders them vulnerable to predation.

This inherent conflict between the simultaneous need to sleep and detect predators is exaggerated by factors that cause an animal to sleep more deeply. In birds and mammals, the depth of sleep is a function of prior time spent awake. In addition, recent work in mammals suggests that the depth of sleep is also a function of the intensity of brain use during wakefulness.

As a result, behaviors that require more intense brain use, may incur a cost paid in increased sleep intensity.

The „Sleep and Flight Group“ is currently studying this potential trade-off by measuring the effects of engaging in long flights in the wind-tunnel on subsequent sleep intensity in Rosy Starlings. Starlings are the focus of this research because they readily adapt to flying in the wind-tunnel and their flight performance has been previously studied extensively in the wind-tunnel. Determining whether engaging in flight, or other behaviors, increases a bird’s need for sleep may have implications for understanding the behavioral decisions made by birds in the wild.

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## Black Redstart

From the mountains to the lowlands

Black Redstarts originated in the Himalaya and found their way across middle Asia and northern Africa to Europe during the 19th century. Coming from and extending their range along mountains, they additionally followed human settlements and spread into the lowlands. Mountain and lowland Black Redstarts differ in a number of life-history variables.

For example, in the alps above 2.000 metres they typically raise only one brood per breeding season, whereas in the lowlands of Bavaria two to three broods are common.

Because of this plasticity Black Redstarts represent an ideal model to study differences in behaviour and physiology without having to consider phylogenetic constraints of between-species comparisons.

Research at the institute focuses on potential differences in the behavioural and hormonal responses to territorial challenges and environmental stressors between mountain and lowland birds.

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Department for Behavioural Neurobiology

The Black Redstart (*Phoenicurus ochruros*) is a small short-distance migratory bird belonging to the thrushes (*Turdidae*), order Passeriformes. Normally breeding in mountainous rock crevices, black redstarts have adapted to live within human settlements and now commonly nest in crevices and holes of buildings. Despite a large impact of house cats on the survival of juvenile redstarts, they belong to the most common songbirds associated with human settlements in Central Europe.

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## Black Coucal

### Sex-role reversal

Black coucals are special because they are sex-role reversed. Females are larger than males, they sing and defend large territories.

The territory of a single female may embrace the territories of up to three males. A female lays separate clutches of eggs into the nests of each of her mates.

While the female tries to attract further males or lays eggs for one of her other mates, the male takes care of the offspring. Each male incubates the eggs in his nest and feeds the young until they become independent. This mating system, termed „classical polyandry“, is rare among birds. Black coucals represent the only known bird species combining classical polyandry with an altricial development of young. Research at the institute focusses on the hormonal control of reversed sex-roles and the properties and function of song in females.

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The Black Coucal (*Centropus grillii*) lives and breeds in wetlands of sub-Saharan Africa. It belongs to the coucals, a genus within the cuckoo family (order Cuculiformes), whose members occur in Africa, Asia and northern Australia. Unlike their famous European relative, coucals are no brood-parasites. Typically, both females and males care for their offspring, but the Black Coucal is different ...



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## Purple-crowned Fairy-wren

Endemic Australian songbird

Purple-crowned Fairy-wrens are small Australian songbirds. They are riparian specialists of the tropical savannah of northern Australia, inhabiting the dense vegetation along creek lines, particularly those dominated by healthy growth of Pandanus palms.

Like other Australian Malurids, they live and breed in social groups, existing of a dominant breeding pair, with up to 8 subordinate auxiliaries (mostly males), often young from previous breeding attempts. Groups are fiercely territorial year-round. Breeding is nominally seasonal but practically erratic, being largely dictated by rain fall during the preceding wet season. The dominant pair forms a very cohesive social unit, spending most of their time in close proximity. Unusually, they coordinate half of their songs to form duets, that are so closely overlapping that it is hard to distinguish that there are two birds singing.

Like other Fairy-wrens, purple-crowneds are seasonally sexually dichromatic, which means that for part of the year males develop a bright purple-and-black breeding plumage, whereas outside the breeding season they are dull brown, resembling the female and juveniles.

The Purple-crowned Fairy-wren (*Malurus coronatus*) is a member of the passerine family *Maluridae*. It is endemic to northern Australia; two sub-species are recognized. The species is listed as threatened with extinction (status = vulnerable) due to destruction of their specialised riverside habitat by livestock.

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## Upland Goose

**Bright aggressive males and  
cryptic females**

Upland Geese exhibit striking sexual plumage dimorphism, males being white and females brown. Male Upland Geese defend territories by posturing aggressively, and the white coloration of males serves to enhance conspicuousness in territorial signaling.

On the other hand, a white bird is easily visible to predators, and this colour therefore is not suitable for an open-nesting bird during incubation, which explains the brown, cryptic coloration of females. Parental investment during the early part of the reproductive cycle of this species is associated with distinct sex roles. Females produce the eggs and incubate them, interspersed with short feeding bouts. Males defend territories and sources of freshwater, and are frequently killed in territorial interactions when the density of breeding birds is high. Sexually distinct mortality rates may be compensated by investment into more offspring of the shorter-lived sex. At the dense colony of New Island, Falkland Islands, we found that more families had male-biased than female-biased broods, and that the total number of male juveniles exceeded that of females by 50%. Because territorial fights between males contribute substantially to male mortality, this might be a driving factor selecting for a male-biased sex ratio in offspring.

The Magellan Goose or  
**Upland Goose** (*Chloephaga picta*)  
is a South American member of the  
duck, goose and swan family *Anatidae*.  
Males have a white head and breast,  
whereas the females could be  
mistaken for Ruddy-headed Geese.  
They are found in open grasslands.

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## Burrowing Parrot

Long-lived birds and  
global scale climate phenomena

The Burrowing Parrot (*Cyanoliseus patagonus*) is a species belonging to the *Psittacidae* family. It is monotypic within the genus *Cyanoliseus* and mainly found in Argentina.

A very much reduced population still survives in Chile, and migration of some Argentinean populations to Uruguay has been reported for the winter months. Sometimes strong westerly winds bring some individuals as far as the Falkland Islands.

Burrowing Parrots are highly gregarious birds. After a strong decline in the 20th Century, the species is virtually confined to arid areas of Argentina. Burrowing Parrots are associated with the bush steppe community known as Monte, the most endangered ecosystem in South America. Burrowing Parrots breed in colonies, digging holes in high cliffs of sandstone.

The largest of such colonies is situated in El Cónдор, on the Atlantic coast of Patagonia. This colony covers 12km and contains 35,000 breeding pairs. Remarkably, this is the largest known colony of parrots in the world.

Since 1998, we study the breeding biology of the Burrowing Parrots of El Cónдор. One focus of our research has been the influence of climate, especially ENSO, on reproductive success, survival and growth of nestlings.

La Niña phase of ENSO has a strong influence on the breeding success of Burrowing Parrots as it generates extremely dry conditions that affect resource availability and consequently survival and growth of nestlings. Data from our study can be used to predict the effects of environmental change on population levels and vulnerability of the *Psittaciformes*, a group already highly threatened from changes in land use, habitat destruction and pet trade.

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## Lance-tailed Manakin

### Female mate choice

Lance-tailed Manakin work has focused on female mate choice. Mate choice can be exercised by either males or females, but females' disproportionate investment in gametes and offspring care means that they are usually the choosier sex.

In socially monogamous systems, the direct benefits of mate choice are fairly apparent (e.g. paternal care of young). However, in lek-mating species it is less clear what females may gain by being choosy.

This project explores the adaptive basis of female mate choice in the lekking Lance-tailed Manakin.

How many males do females sample before deciding with whom to copulate ? Why are females so selective when choosing a mate ? Do females assess the quality of the male by observing their dance display ?

How do indirect genetic benefits influence female mate choice in this species ? What is the relative role of female choice and male-male competition in determining the opportunity for selection in this system ?

These are the type of questions we want to answer.

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The Lance-tailed Manakin (*Chiroxiphia lanceolata*) is a small, lekking Passerine in the family Pipridae. Males of this species form long-term partnerships and work together to court females with duet songs and coordinated two-male dance displays.

Female Lance-tailed Manakins fly among dispersed male display areas to observe the displays of several pairs before choosing a mate. After mating, females leave males' display areas and raise clutches of up to two chicks with no further assistance from males.

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## Tippler Pigeon

### Sleep and Flight

A **Tippler** is a breed of domestic pigeon bred to participate in endurance competitions. Flying results of up to 22 hours (non-stop) have been reported which makes it the most outstanding endurance-flying breed in recorded existence. All races of breeds of domestic pigeon have been evolved from the **Rock Pigeon** (*Columba livia*) that cohabits with man everywhere in the world.

Birds are a particularly interesting taxonomic group in which to study sleep because they seem to have independently evolved sleep patterns remarkably similar to those in mammals. Birds and mammals are the only groups that display two types of sleep, slow-wave sleep and rapid eye-movement (REM) sleep. During slow-wave sleep the electroencephalogram (EEG) exhibits high-amplitude, low-frequency „brain waves“, whereas during REM sleep (i.e. dreaming sleep in humans) the EEG resembles the low-amplitude, high-frequency pattern characteristic of wakefulness. In mammals, the intensity of slow-wave sleep increases as a function of prior time spent awake. The increase in sleep intensity manifests in the EEG as an increase in low-frequency brain waves. This relationship between wakefulness and sleep intensity in mammals formed the basis for models of sleep regulation wherein slow-wave sleep is thought to be homeostatically regulated. The „Sleep and Flight Group“ is studying pigeons to determine whether avian sleep is also homeostatically regulated. Ongoing research indicates that pigeons show an increase in slow-wave sleep intensity similar to that observed in mammals following short periods of sleep loss. Comparative studies of sleep regulation in birds and other animals may provide insight into the still disputed functions of sleep.

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## Bats

### Flying mammals

Bats (order *Chiroptera*) are the only mammals that evolved true powered flight. Natterer's bats (*Myotis nattereri*, left), greater horseshoe bats (*Rhinolophus ferrumequinum*, centre) and greater mouse-eared bats (*Myotis myotis*, right) all occur in Europe. With 7 -10 g body mass, Natterer's bats are among the smaller, albeit not the smallest, of our native bats. The mouse-eared bats are among the largest European bats; they can weigh more than 30 g prior to hibernation.

Bats use echolocation to find their way at night. Some species can easily commute more than 20 km between their roosts (often in hollow trees, caves or buildings) and their foraging areas, as scientists reveal by radio-telemetry.

The more than 45 species of European bats feed on insects and other arthropods. They differ greatly, however, in how they find their prey. Diet analysis, field observations and behavioural experiments in the lab help us to understand the sensory specializations of bats. Some have refined echolocation systems that allow them to tell spiders in their webs from the leaves and branches behind. Horseshoe bats exploit the wing-beating of insects, which produce conspicuous „acoustic glints“ in the echoes. Still others, such as the mouse-eared bats, find crawling insects on the ground by listening for their faint walking sounds. These different prey detection strategies help to reduce competition between bat species and might promote their coexistence.

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(Fotografien: Dietmar Nill)



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## Barn Swallow

Acrobat of the sky

The Barn Swallow (*Hirundo rustica*) is a small migratory passerine bird found in Europe, Asia, Africa and the Americas. It has a long, deeply forked tail and curved, pointed wings. It is often just called Swallow in Europe, although this term refers more widely to various members of the family *Hirundinidae*.

Barn Swallows build cup-shaped nests constructed of mud collected in their beaks. The inside of the nest is lined with grasses, feathers and other soft materials. They normally nest in accessible buildings such as stables or under bridges and wharves. Before these types of sites became common, they nested on cliff faces or in caves.

The female typically lays 4 to 5 eggs. Both parents build the nest and feed the young. Barn Swallows will swoop and attack intruders that venture too close to their nest, often coming within inches of the throat.

The population increased during the 20th Century with the increased availability of man-made nesting sites. In recent years, there has been a gradual decline in numbers in parts of Europe and North America due to agricultural intensification reducing the availability of insect food.

However, the Barn Swallow remains widespread and fairly common in most parts of its range. It is known as a bearer of good tidings in many countries !

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## Common Raven

**Trial and effect:  
just instinctively intelligent**

Common Ravens have among the largest brains of any bird species. For an avian, they display ability in problem-solving, as well as other cognitive processes, such as imitation and insight.

One experiment designed to evaluate insight and problem-solving ability involved a piece of meat attached to a string hanging from a perch. In order to reach the food, the bird needed to stand on the perch, pull the string up a little at a time, and step on the loops to gradually shorten the string. Four out of five Common Ravens eventually succeeded, and the transition from no success to constant reliable access occurred with no „trial-and-error“ learning. Common Ravens are known to collect shiny objects such as pebbles and pieces of metal. One theory is that they hoard these treasures in order to impress other ravens.

In recent years, biologists have begun to recognize that birds engage in play. Juvenile Common Ravens are among the most playful of bird species. They have been observed to slide down snowbanks, apparently purely for fun. They even engage in interaction games with other species by playing „catch-me-if-you-can“ with wolves and dogs. Last but not least, Common Ravens are well-known for spectacular acrobatic displays, such as flying in loops.

The **Common Raven** (*Corvus corax*), is a large and shining-black passerine bird in the crow family. Found across the northern hemisphere, it is the most widely distributed of all corvids. There are eight known subspecies with little variation in appearance. However, recent research has shown significant genetic differences between populations from different regions.

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