

English online edition
SPECIAL ISSUE

Vultures

Biology | Threats | Conservation

Der Falke Journal für
Vogelbeobachter

Dear Readers,

Every year, the German birdwatching magazine *Der Falke* publishes an extra issue, additional to 12 monthly magazines, with articles about a particular birdwatching or bird conservation topic, sometimes also about a group of birds. The 2016 special issue is a comprehensive compilation of articles about our four European vulture species. This issue was put together in cooperation with the Vulture Conservation Foundation (VCF, www.4vultures.org). Especially Daniel Hegglin, managing director, José Tavares, president, and Franziska Lörcher, scientific coordinator of VCF, made this possible.



Bartgeier. Foto: H. Weyrich.

Vultures are a very specific group of birds, playing an important role

in our ecosystems. Their stories of success and perspectives, as well as old and new threats that (still) need to be addressed, give an insight into the fascinating biology and ecology of these birds. They also show that these birds need our help, in Europe as well as in Africa and in Asia.

As a special thankyou to all authors, this issue „*Der Falke – Vultures*“ is now available as a pdf version in English language. Stephanie Kiel, UK, and Christian Hermann, Cyprus, have voluntarily translated the German texts, and Kylie Bull in England not only edited the translations but also any original texts to make them fit the magazine. Thanks a lot for all their work!

As the original is of 2016, we waived any more recent results and number updates. But we have added an article about Griffon vultures in Croatia, that was published in a regular *Der Falke* magazine in 2017.

If our valued readers will get caught, for example, by the story of the Bearded vulture that was extinct in the Alps and is now back due to massive conservation efforts by numerous people in different countries working together – like our volunteer editor Kylie – we achieved what we aimed for with this special issue of *Der Falke*.

Best wishes,

Dr. Norbert Schäffer



Content

Together for Vulture Protection	2		
The Vultures of Europe – an Overview	3	Help from Crete: Griffon Vultures in Cyprus	44
Food specialist Bearded Vulture:		Improving the Conservation Breeding:	
The Bird that lives on Bones	8	Eurasian Black Vulture EEP.....	46
Once gone - now returned:		Conservation Actions and Threats: Egyptian Vulture .	48
Bearded Vultures in the Alps	16	Ringling and Monitoring: Data for Science	52
The European endangered species programme for the		Opportunities and Perspectives: Vultures in Germany	56
Bearded Vulture:		A Risk for Scavenger Birds: Lead	59
The Return from Captivity into the Wild	22	The Hidden Hand of Poison	60
Bearded Vultures without Borders:		New Threats for Europe’s Vultures: Diclofenac	62
Success by Cooperation	24	LIFE GypHelp project: Minimising Collisions	64
Resident Breeder or not? History of Bearded Vultures as		The Ecology services provided by Vultures	66
Breeding Bird in the Alps	28	Taking a Look over the Mediterranean Sea:	
History and Perspectives:		Dubious Future for Africa’s Vultures	70
Bearded Vultures in the Pyrenees	30	Between Europe and Africa: Vultures in Maghreb	76
Bearded Vultures beyond the Alps:		Vulture Conservation Foundation and other	
Steps to reach the Pyrenees... ..	32	Organisations:	
Hope for the Fight against poison Bait:		Key players in Vulture Conservation in Europa	77
The Return of the Bearded Vulture to Andalusia	33	Vultures in Europe: Priorities for Conservation	78
Bearded Vulture:		Children of the Storm: Griffon Vultures in the Kvarner	
Last autochthonous Island Populations	34	Bay (<i>Der Falke</i> 5/2017, p.22-27)	81
Sout-East Europe:		Bibliography	86
Vultures in the Balkan Peninsula	36	Imprint	87
From Summer Guests to Breeding Birds:			
Griffon Vultures in the Alps	40		
Success in Massif Central and Southern Alps:			
The Return of the Griffon Vulture in France	42		

Together for Vulture Protection

Vultures do not have the best image. Outside of the ornithological world, the confession that one is excited about vultures, can easily lead to scepticism and disbelief. What on Earth motivates a reasonable person to invest so much energy into these strange birds? But for those who know the world of vultures, they can understand easily that there are people that invest a significant part of their life, with great passion and creativity in order to fight for the protection of these birds.

Vultures are in desperate need of protection worldwide, including in Europe. Indeed there have been big successes thanks to protection efforts, like for example the successful repopulation of the Bearded vultures in the Alps or the impressive return of the four European vulture species into southern France. However, the situation in Europe is still difficult and viewed from a worldwide aspect it is getting more and more critical. The catastrophic effect of Diclofenac on vultures as a result of livestock farming in India, Pakistan and Nepal will only be overcome if man is ready

to engage in the protection of these sensitive species over decades with maximum effort. In various African countries the cases of targeted poisoning by poachers has increased massively throughout the last years. Altogether, the rate of decline in vultures is very alarming.

In many locations in Europe, the conditions for the return and the long term preservation of the vultures is rather bad. Poisoned bait, used for illegal decimation of the carnivores, is a big problem. Since vultures reproduce slowly, the losses can hardly be compensated for. Also, collisions with cables, electrocution through not properly secured powerlines, and lead poisoning through hunting ammunition on carcasses still remain important issues concerning the protection of vultures. Furthermore, there is the persistent decline of extensive pasture farming as well as small numbers of wild livestock. Further risks include the increasing use of windpower, the effects of which are currently difficult to estimate. Considering these already existing challenges it is simply incomprehensible that in Spain with the so

far greatest numbers of vultures in the whole of Europe in 2013, Diclofenac has been permitted for use in farming, while being forbidden in India, Pakistan and Nepal.

Thankfully this special edition of DER FALKE is not only an interpretation and analysis of the problems that vulture conservation faces, but also an impressive testimony of all the work that has been done for the vultures. Thereby one can see the massive engagement of people and organisations, which co-operate for the return and the protection of vultures. This brings hope. And surely this issue will help to attract a wider audience to care about these impressive gliders and to promote understanding about the important functions vultures have for our ecosystems and how people can benefit from them.

Daniel Hegglin



Dr. Daniel Hegglin, president of the Vulture Conservation Foundation (VCF), is a zoologist and works as managing director for the Swiss charity Pro Bartgeier.



The Black vulture is the largest bird in Europe. Numerous people and organisations engage with great enthusiasm to make sure Black vultures as well as the three other European vulture species remain part of the biodiversity of this continent. Photo: T. Krumenacker.

The Vultures of Europa – an overview

Four species of vultures are resident in Europe: Black vulture, Bearded vulture, Griffon vulture and Egyptian vulture. A fifth species from Africa, the Rüppell's vulture is currently establishing a population in Spain. These large birds of prey are part of the family of Accipitridae with two subfamilies: "old world vultures" (Aegyptiinae; very large, often with a ruff, long neck with no or very short feathers) and Gypaetinae. Black and Griffon vultures are typical old world vultures. Until recently, the Bearded vulture was also considered to be part of this group. However, as a result of recent molecular genetic tests this species is now included into the subfamily of Gypaetinae. Other species within this subfamily include the Madagascan serpent eagle (*Eutriorchis astur*) an endemic to Madagascar, the Egyptian vulture and the African palm-nut vulture (*Gypohierax angolensis*). In addition to the vulture species of the old

world (Europe, Asia and Africa), vultures of the Americas such as the Condor are part of the new world vultures (Cathartidae). New world vultures are more closely related to storks than to vulture species of the old world. Species within this family also find prey and carrion using their sense of smell rather than by sight only as is the case for the old world vultures.

All vultures are soaring birds and are dependent on thermal up and down currents which occur in landscapes with varied topography. They usually fly at great height in a characteristic search flight pattern with their heads lowered, searching vast areas for carcasses. All vultures are scavengers and some species have further specialisations such as the Bearded vulture. Most vultures, apart from those nesting in colonies such as Griffon vultures, are also not very vocal.

With their biological similarities, European vultures are also facing similar threats which have led to drastic population declines of all species over the past two centuries. Most significant is the effect of poison. As scavengers, all vultures are exceptionally susceptible to poison which they may encounter as poison baits for predator control or targeted at vultures, an example of raptor persecution. Other threats include changes or loss of suitable habitats, reduced carrion availability as a result of changed management in pastoral farming and disease control measures, disturbance at nest sites and collisions with power lines and wind turbines. To maintain vultures as part of the European biodiversity, all of these threats need to be considered and addressed.

The following section provides a brief overview on the four European vulture species.



In connection with vulture populations and reintroduction projects important places and regions in Europa. Yellow: recommended for observation, partly with good infrastructure; light blue: "vulture restaurant" with observation infrastructure. Another "vulture restaurant" can be visited in Cyprus (not shown).

Bearded vulture *Gypaetus barbatus*

Bearded vultures which are also known as the Lammergeier or Ossifrage were once widespread across mountain ranges in Europe, Asia and Africa. As a result of persecution and the use of poison during the 19th and 20th century, the species has disappeared from most of its previous range in Europe. Small populations have only survived on Corsica and Crete as well as in the Pyrenees. Since the end of the last century, the population in the Pyrenees has been growing steadily. In the Alps, a number of reintroduction programmes have been successful in bringing back the Bearded vultures.

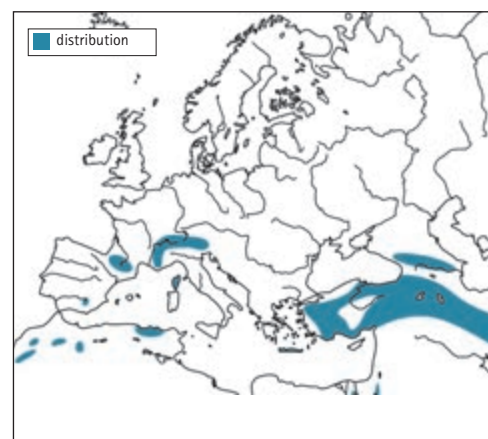
Mountain ranges and rocky outcrops with ravines are the primary habitat for Bearded vultures which prefer high altitude ranges. Home ranges of adult Bearded vultures can extend across 100 to 1000 km².

The Bearded vulture is a scavenger, specialising in bones and bone marrow as their main food source. The birds with a wing span of up to 2.90m usually forage alone by patrolling cliffs and gorges looking for carcasses of wild or domestic grazers such as Alpine ibex or chamois. They will also readily take leftovers of prey taken by

wolf, lynx or Golden eagle. A long wedge-shaped tail and long wings, which are usually held slightly low in flight are most noticeable. Bearded vultures are able to utilise the lightest thermals and tolerate lower temperatures than any of the other vulture species. This is the reason why Bearded vultures are the only species to inhabit the highest peaks of high mountain ranges.

Bearded vultures have received their name from the black feathers growing at the base of their beak which look like a black beard. The underside and head are covered with white feathers. These take on a rusty red colour from contact with mud containing iron oxides. The eyes have a yellow iris and are surrounded by a sclerotic ring which turns bright red due to blood circulation when the birds are in a state of alert.

Bearded vultures reach sexual maturity when aged between five and seven years. Research from the Pyrenees in 1979 showed that two males will sometimes pair with one female, and this seems to be occurring more and more frequently. Further research in 1996 showed that 4 % of the available territories were held by a trio of vul-



tures. The formation of breeding trios rather than pairs is thought to be the result of a number of reasons such as uneven distribution of sexes amongst the adult breeding population, food shortages, high breeding density and kinship of males. However, this phenomenon is not fully understood and there is need for further research as the formation of breeding trios and the reasons for this occurring may play an important role when developing conservation measures.

Nest building can start in the autumn when branches and sticks are used to build a nest in inaccessible crevices or ledges on high cliffs. The nests are reused and can measure up to three metres in width and two metres in height. The nest cup is lined with soft materials such as animal hair but it can also include man-made artefacts like paper or cloths. Between the middle of December and the middle of February, the female will lay one or two eggs with about a week between eggs. Both adults incubate the eggs for about 54 days. The second chick to hatch usually dies within a few days due to competition with the older chick. The chick stays in the nest for between 100 to 130 days where the adults supply food. Hatching usually occurs at the same time as the snow melt at the beginning of March which ensures that the adults can find a sufficient number of carcasses. After fledging, the young bird continues to receive food from its parents for around six to eight weeks. Thereafter, the immature bird is independent, leaves the home range of its parents and migrates widely over the following years.



Photo: H. Weyrich.

Egyptian vulture

Neophron percnopterus

The Egyptian vulture is the smallest of the European vulture species. However, in addition to its size, the shape of its beak also differs from the vulture species as it is comparatively long and slender. Apart from carcasses, Egyptian vultures also feed on rubbish, insects, eggs and small vertebrates. They often have to wait until all other vulture species have finished before they will be able to access a carcass. A speciality of the Egyptian vulture is the use of stones to break open eggs of species such as the ostrich. Depending on the size of the stone, they use them to directly hit the eggs or smash them to the ground.

Historically, this species occurred in the entire south European region with the most northerly nesting site near Lake Geneva. In addition, the species also inhabited West and Central Asia, India, North- and East Africa, the Sahel Zone and Arabia. Despite being the most flexible vulture species with regards to its food resources, the Egyptian vulture is the most endangered species in Europe and has vanished from most areas of its previous range. The largest European population is found in Spain with over 1300 breeding pairs. Further isolated populations occur mainly in the Balkan region. However, reliable data is missing from many areas which further complicates the implementation of suitable protection measures.

The plumage of Egyptian vultures turns white when they are aged around five years. Only the primaries are black. The face is not feathered, and is bright yellow just like the beak and legs. In the nominate form in Europe, the beak has a black tip. Juvenile Egyptian vultures have dark brown plumage which turns mottled in immature birds. The silhouette of the Egyptian vulture in flight is similar to that of the Bearded vulture but with a wing span of 1.80m at the most, they are considerably smaller. Also, the tail is shorter in relation to the body and more pointed and wedge shaped and the wings are stiffer. When in flight, the contrast between

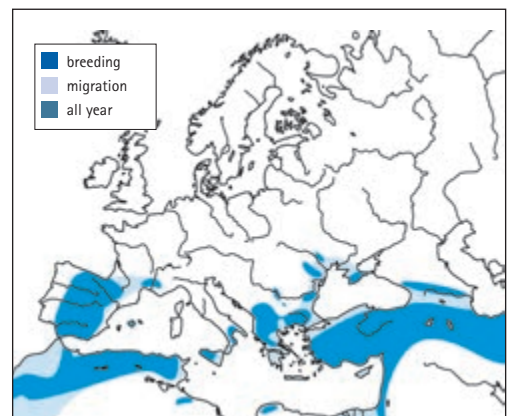


Photo: F. Lörcher.

the white plumage and black primaries is most notable.

Egyptian vultures forage alone or in small groups in open and hilly landscapes, even in deserts, and will use landfill sites or abattoirs. Like other vultures, this species also breeds in cliffs where the cavities are used as nest locations. They seem to prefer ledges under cornices to protect them from wind, rain and sun. The nests appear very untidy and contain not only branches but plenty of waste such as bones, paper, ropes and other rubbish. Two eggs are laid into a softly lined egg cup between March and July. The chicks hatch after an incubation period of around seven weeks and they remain in the nest for another 80 days before they fledge. Both parents provide carrion during this time but the chicks do not consume all of it and over time, the remains decompose at the nest edge.

In September, small groups of European Egyptian vultures migrate southwards to spend the winter in the warmer climates of Africa. For this migratory species, conservation measures need to be implemented in the breeding ranges as well as along the migratory routes and in wintering areas if the birds are to return in April or May the next year.



Griffon vulture

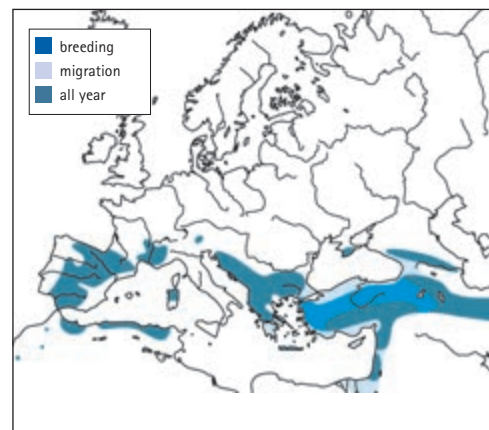
Gyps fulvus

Within the entire European range of the Griffon vulture, the population continued to decline into the second half of the 20th Century. This only changed when the use of toxic substances was prohibited in the 1970s. By then, the species was extinct in many European countries. Over the last forty years however, the population has recovered and significant increases in numbers were noted in France, Spain and Portugal. A slower recovery appears to be taking place in Italy and the Balkans, however numbers in Greece and Albania continue to go down. The increase of the European population by around 200% over the past 12 years is clearly the result of numerous successfully implemented conservation measures. The most important actions include campaigns against the use of poison and the provision of safe food resources in so called “vulture restaurants”. Due to several reintroduction projects in France, Italy and in the Balkan region, the Griffon vulture population has started expanding again.

Griffon vultures are gregarious and inhabit arid areas with varied topography in the south of Europe, North Africa, West to Central Asia, northern India and Bangladesh. They forage, nearly exclusively for carrion,

in steppe like habitats and extensive pastures. Groups of Griffon vultures usually circle at great height or move along mountain ridges in the search for carcasses of medium to large size mammals. They also closely observe other vultures and scavengers in the air and on the ground. As a result, large numbers of vultures can quickly arrive at a carcass. They prefer the organs and muscle tissue, especially when the carcasses are fresh. A strict hierarchy is maintained during foraging: Large predators such as wolf, jackal or Black vulture feed first. Within the group of Griffon vultures, the most dominant bird will forage first. This bird will often tear open the carcass with its strong beak.

In flight, the wing span of 2.80m with wings held up in a shallow V-shape is unmistakable. The wings also show bulging secondaries as well as indented and deeply fingered primaries. The tail is very short and well rounded. The plumage is bi-coloured both from above and below: the rump and front of the wings are of a buff or light red-brown colour. In contrast, primaries, secondaries and tail feathers are grey-black. In adults, the greater upper wing coverts are prominently tipped pale which creates a distinct light brown band that



the juvenile birds lack. In immature birds, the contrast between a darker rump and lighter underwings is greater than in adults. Also, their ruff is of pale brown colour whereas it is white in adults. The head and neck are covered in fine white down. Adult birds have a yellow beak ranging from dirty yellow to greenish yellow. The beak and legs of young birds are grey. Griffon vultures have full adult plumage at around six to seven years of age.

Griffon vultures breed and roost in large colonies which can have over 100 breeding pairs. They prefer steep to vertical cliffs and ravines and in contrast to the other European vulture species, which are rather quiet, Griffon vultures produce a variety of sounds such as hissing, hoarse grunting, alarm and courtship calls. They often travel in pairs.

The nests consisting of twigs and branches are placed on ledges with overhanging cliffs, rarely in trees. Between December and March, a single egg is laid into an egg cup lined with green branches or grass. The male and female take turns during incubation, which lasts around 55 days. The chick raising period lasts around 135 days and both adults brood and feed the chick. The adults bring food in their crop and regurgitate it at the nest. One of the adults always remains at the nest. A few weeks after fledging, the young Griffon vultures leave their paternal range. Prior to reaching sexual maturity, the immature birds range widely from their breeding colony.



Photo: B. Berthemy.

Black vulture *Aegypius monachus*

The Black vulture is one of the largest and most spectacular birds of prey in the world which is even larger than the Bearded vulture. Historically, Black vultures were common in southern and central Europe. However, during the 20th century, the populations decreased rapidly and led to near extinction in the Balkan region. The small Balkan population continues to be very sensitive, however in 2012, the Spanish population showed an increase of 48% over a ten-year period by reaching 2069 breeding pairs. As a result of successful reintroduction projects, numbers in France are also increasing. The most recent growth of the Black vulture populations in Spain and France give rise to hopes that this species will also recolonise other regions of its previous range.

In contrast to the other European vulture species, Black vultures usually nest in trees and only rarely on cliffs. Their habitat consists of undulating landscapes with low to moderately high mountain ranges with grassland and pastures and interspersed woodlands or single trees. On Mallorca, nests are preferably located on solitary pine trees on inaccessible coastal cliffs which illustrates the sensitivity of this species for disturbance. During the past century, changes in forestry and woodland management in many Mediterranean regions played an important role in the decrease of Black vulture populations. Especially in western Spain, many old trees and woodlands were



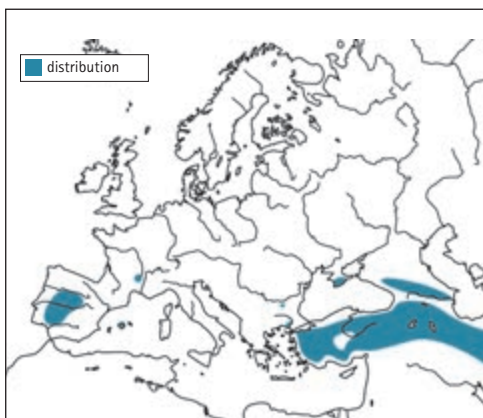
Photo: T. Kramenacker.

felled and replaced by eucalyptus plantations. This resulted in a loss of suitable nesting trees and disturbance for this sensitive bird species. The current range in Europe includes a reasonably successful population in west and south Europe (Portugal, Spain and France) and small isolated populations mainly in Dardia, Greece and Ukraine.

The flight silhouette of a Black vulture is unmistakable: the wings with a span of up to 2.95 m are evenly broad and the tail is slightly wedge-shaped. Close up their size is even more impressive as a result of the dark, chocolate brown plumage. In adult birds only, the short ruff is light brown and the short bare neck is of a blueish-pink colour. In contrast, young birds have a dark brown ruff. Adult and young birds can also be distinguished by the cere which is blue-grey in adults and pink in young birds. All ages have pale areas of skin on the head, and the feet are also pale.

Black vultures use their extremely powerful beaks to tear apart skin and sinews. When foraging at carcasses, Black vultures occupy higher ranks than Griffon or Egyptian vultures and feed first.

Courtship displays of Black vultures start in late autumn. This vulture species is monogamous and the birds appear to be very careful when selecting a partner. Although Black vultures will only start to breed when aged four or five, younger birds may form pairs before that. Several pairs gather and form loose breeding colonies. Both adults collect branches and twigs to build a vast nest high up in a tree which is later lined with grass. Preferred nesting trees include stone pines and holm oak. Between December and January, the female lays a single egg which is incubated by both adults for around 55 days until the chick hatches. The chick raising period extends over nearly four and a half months during which the adults bring food to the nest in their crops.





In order to „scan“ the ground, Bearded vultures point their heads downwards during search flights. Photo: A. Hofstetter.

Food specialist Bearded vulture:

The Bird that lives on Bones

No matter whether it's a pork chop or a chicken drumstick, we always separate the bones from the meat and lay them on the edge of the plate. Bearded Vultures do exactly the opposite. Choice experiments show they prefer bones to flesh. They are ossivorous, and bones account for 70-90% of their diet. No other bird, indeed no other vertebrate, specializes in bones to this extent. Such a specialization requires anatomical and physiological adaptations, and the bird's way of life and its habitat choice must also fit its peculiar diet.

For many people, the Bearded vulture or Lammergeier, *Gypaetus barbatus*, makes a spectacular impression because of its size and elegant flight, but just as fascinating is its singular ecological niche, which is still not fully understood, though our knowledge of its feeding biology

have increased enormously over the last 20 years.

Bearded vultures very rarely take live prey, although tortoises are eaten occasionally (see below). To obtain the bones they need they must have access to animal carcasses. Bearded vultures are the final link in the chain

comprising the guild of large carrion eaters, which in Europe consists of the obligate necrophagous birds Griffon, Black, and Egyptian vultures, as well as more opportunistic feeders like Golden eagle and raven. Red fox and wolf also belong in this guild. Only when these others have stripped a carcass of all available flesh and departed does the Bearded vulture arrive to deal with what they have left as inedible: the bones. The Bearded vulture gets access to its preferred food only after all the other scavenging species have removed the flesh from a carcass. In contrast to the Griffon vulture, which is highly social and often seen in large numbers at a carcass, the Bearded vulture is in general solitary.

The nutritional value of bones

Although bones appear at first glance to be less attractive and nutritious than muscle meat, there are advantages to metabolizing them. Although the bone consists of 50% minerals (principally calcium hydroxyapatite, a phosphate) and up to 25% water, bone also contains around 25% organic material of which over 90% is collagen, a protein. In addition, the marrow inside the bones contains a



The Haute Ariège in the french Pyrenees present a typical habitat for Bearded vultures. Photo: M. Kaczmar.

high proportion of fat. Who would have thought that the nutritional value of bones would be similar to that of meat? The marrow in animal bones means that they have an even higher energy content than muscle (6.7 vs. 5.8 KJ/g). When their differing metabolism is considered, 100 g of bone supplies 387 KJ and the same weight of flesh 440 KJ. Bones have another advantage: in contrast to flesh, which decomposes very rapidly, bones can last for months. If they lie for a long period of time, the inevitable loss of water actually helps to preserve the collagen and bone marrow.

Despite their high nutrient content, bones are not an attractive dietary option for most animals. The Bearded vulture is the single exception in this regard. Although many birds of prey ingest pieces of bone along with the flesh of their prey, and are capable of digesting them, such portions are necessarily small. Some raptors regurgitate bone fragments, together with hair or feathers, as undigested leftovers in the form of pellets. For owls this behavior is obligatory, and their behavior is exploited by Bearded vultures in a rather bizarre fashion. In the Pyrenees „specialist“ individuals search for Eagle owl perches and consume the bone-rich pellets on the ground below as a kind of dessert. In addition, Bearded vultures commonly ingest the bone fragments from their pellets immediately after regurgitation. The obvious explanation for this kind of recycling is that bone remains are of nutritive value.

It is clear that Bearded vultures must employ specific processes to metabolically break down and digest large bones. Such digestive processes are possessed by very few carnivores. Even Striped and Spotted hyenas, which are well known for their ability to crack large bones in their powerful jaws, ingest only a small proportion of bones in their diet.

How Bearded vultures deal with bones

Most (93%) of the bones consumed by Bearded vultures are from mammals, with just 6% from birds, and 1% from reptiles. The largest proportion, around 70% of bones remains come from medium-sized ungulates,



Bearded vultures are capable to swallow even long bones in one piece.

Photo: N. Becke.

mainly sheep, goats and deer (Caprinae; Cervinae). Large bones are usually deliberately broken before being consumed but Bearded vultures swallow whole limb bones up to 30 cm long and 4 cm thick, as well as vertebrae up to 8 cm across. The ability

to swallow such large pieces of bone requires some special anatomical adaptations.

The first thing we notice is the pronounced curvature of the large, highly arched upper mandible; the lower mandible is short and flattish.



View into the open bill: visible is the pushed forward mobile tongue with the larynx at the base. Behind, the pharynx opens. The bill can be opened very wide. The nostrils are completely covered by the thick, layered bristles of the upper mandible.

Photo: A. Margalida.



The angle of the bill (commissure) reaches further back behind the eye than with any other bird of prey. Also note the mighty neck. Photo: M. Stähli.

The bill functions simultaneously as a hook, flat pliers, and secateurs. Despite its apparent bulkiness, the bill is capable of plucking feathers and hair from skins, accurately stripping tissue and sinews from bones, neatly disarticulating a skeleton by sever-

ring the sinews and ligaments at the joints, and biting through the thinner bones. Unlike in other raptors, the nostrils at the base of the upper mandible are completely covered by the thick, layered bristles on top of the mandible (the bristles on the lower

mandible hang down up to six centimeters, forming the „beard“). The powerful concave tongue is short and very mobile. Although it has been reported that the tongue is used to „spoon“ marrow out of the center of bones, this is not the case. The root of the tongue, with the opening to the throat (larynx), is placed far forwards halfway along the lower mandible. This forward position of the larynx is an adaptation to the swallowing of large pieces of bone; if it were farther back, long bones could possibly obstruct the air passages.

The bill can be opened in a wide gape, since the angle of the bill (commissure) reaches further back (behind the eye) than in any other bird of prey. The buccal cavity, esophagus, and stomach are all enormously expandable and „so wide, but so little interfering with each other, that yak and other bovine vertebrae, including their awkwardly protruding dorsal and transversal extensions, and 10cm thick fragments of horse and cattle limb bones can be swallowed“. If a Bearded vulture has swallowed a long bone, one can get the (false) impression that „one end is already being digested in the stomach while the other is still sticking out of the bill“. Sometimes one even sees Bearded vultures in flight with long limb bones thus protruding. Even very long bones are swallowed in an astonishingly brief time, mostly within 10 to 20 seconds, during which time the bird seems to make the occasional „thoughtful“ pause. One has the impression, as with snakes, that an awkward food item disappears down the throat in steps, according to how much the esophagus is „pushed over“ the bone in jerks. This motion is analogous to the peristaltic contractions and bouts of forward jaw movement seen in snakes when swallowing large prey.

In preparing food for eating, the powerful foot is employed, pressing the bone onto the ground. The vulture's claws are short and strong, in complete contrast to those of an active hunter like Golden eagle. When a bone is carried in flight then the 1st (hind) toe and the 2nd (inner) toe act together like the human thumb and forefinger, while the remaining 3rd and 4th toes are rarely used.



The bill of a Griffon vulture is formed completely different. Like a hook it can break holes in the strong Bauchdecke of large mammals. The angle of the bill ends before the eyes, the nostrils are not covered.

Photo: A. Kauffmann.



Carrying a bone, the 3rd toe (front middle) and the 4th toe (front outer) are not used for grabbing but are held lightly on top of the bone.

Photo: M. Kakzmar.

All birds of prey, and the vultures in particular, possess an expandable crop as a store for larger, quickly swallowed amounts of food, but this is absent in Bearded and Egyptian vultures. A crop-type expansion of the esophagus would most likely be a hindrance when swallowing long or sharp bones, since it would form a sort of „cul-de-sac“. It seems clear that in the Bearded vulture the entire length of the esophagus is used as a temporary container for long or awkwardly shaped bones, since the capacity of the stomach is insufficient. The walls of the esophagus are thickened and serve as protection against the sharp edges of bone fragments. In addition, unlike most other vertebrates, the esophagus of the Bearded vulture possesses no mucus glands. In contrast to the short alimentary tract of raptors that actively hunt prey - to avoid unnecessary weight - that of the Bearded vulture, as well as other large carrion feeders, is especially long (esophagus 25 cm, stomach 17 cm, intestine 185 cm). The stomach is a very elastic tube with no separate gizzard to crush bone fragments. The stomach wall has a high density of hydrochloric-acid-producing cells (11 cells per 1000 μm^2) and the acid

content of the stomach reaches a pH value of 0.7. This is almost pure hydrochloric acid, as strong as that in car batteries, and stronger than in any other carnivore and in humans. The lower the pH the more rapidly the bone is dissolved and demineralized. A pH of 1.5 - which is still strongly acidic - would double the time required to break down bones. Given such an extreme digestive environment, it remains a mystery how the bird's stomach remains free of ulcers. This is clearly an active process, for following the death of a Bearded vulture autolysis (self digestion) of the digestive tract is rapid.

Muscle is fully digested within 3-6 hours in flesh-eating raptors (and in the Bearded vulture), whereas bone digestion by Bearded vultures takes 24-30 hours. The breakdown of the mineralized bone mass simply needs more time, even though the peristalsis of the stomach helps to accelerate the process. Pepsin and other proteolytic enzymes, whose effect is optimal at low pH values, break down collagen and other proteins. The digestive efficiency - the proportion of ingested food that is metabolized - is 75-80% in raptors, but is just 50% in the Bearded vulture, although the pro-



X-ray of a bearded vulture that had swallowed two long bones, in the esophagus and the stomach.

Photo: A. Senosiain.



The 1st (hind) and 2nd (front middle) toes are those to grip the bone. The right foot shows all four toes and one can imagine the function of the 1st and 2nd like tongs. Photo: H. Weyrich.

teins and fats from the mineralized bones are completely utilized. This represents an enormous physiological achievement and illustrates one of the Bearded vulture's remarkable adaptations.

The mineral component of bone is excreted unchanged and comprises principally hydroxyapatite, and accounts for the Bearded vulture's unusual cream-colored, cylindrical droppings. These are called coprolites and resemble pieces of chalk used on a school blackboard. Bearded vulture coprolites have lasted for centuries at well-sheltered nest sites. It is far from clear how Bearded vultures deal with these high concentrations of calcium. While the proportion of calcium in

the commercial feed given to domestic chickens cannot exceed 1.2% due to the risk of hypercalcemia, bone consists of 15-18% calcium. Apparently the calcium phosphates, during their passage through the gut, are simply separated from the bone but not absorbed by the intestine wall. Bearded vultures need to drink a lot, not only because their diet is literally „bone-dry“ but presumably also because large amounts of water are necessary for the excretion of minerals.

Like other raptors Bearded vultures produce pellets, mainly of hair and the horn of hooves, both of which are composed of indigestible keratin. Fragments of bone in the pellets are picked out and re-swallowed. Some-



Coprolites (hard, chalky droppings) of Bearded vultures feeding on bones. Scale (square) 5 mm. Photo: K. Schulze-Hagen.

times pieces of bone can be regurgitated from the stomach.

Knowing about this behaviour helped to solve another riddle: Bone fragments preserved in large numbers in a cave on Crete had led to the “osteoporosis hypothesis” regarding the extinction of the Pleistocene fauna c. 10 000 years ago. According to this hypothesis the dwarf Cretan deer (*Candiacervus*) became extinct because of overgrazing and resulting malnutrition, based on the fact that the bones that had been found were often osteoporotic. But, paleontological re-examination of fossil bone fragments from this and from other caves revealed that many of them are the remains of Bearded vulture food. Therefore, osteoporosis or decalcification was not the result of a food deficiency; it occurred after death due to the bones having been in the stomachs of Bearded vultures.

Handling the bones

Large bones that are too bulky to swallow are not rejected by Bearded vultures, but are broken up. As skillful fliers Bearded vultures achieved perfection in executing this operation. Bones of up to 3 kg - nearly half the bird's body weight - can be held in flight in one of the powerful feet (see above), and may even be pressed against the body to improve the aerodynamics. Hence Bearded vultures are in the literal sense Greifvögel [German for raptors: „gripping birds“], in contrast to Griffons, which are unable to carry objects in their feet while flying. The Bearded vultures spiral upwards then release the bone from a height of 50 to 80 m above a scree slope or an area of flat-tish rock. As the bone falls through the sky the Bearded vulture follows it closely and when the bone shatters the bird lands and consumes the pieces. If the bone remains unbroken it may be carried back into the air and dropped as many as 20 times until it finally breaks. However, it takes on average 4-5 drops over 5.3 minutes in total. This behavior is reflected in the bird's Spanish name Quebrantahuesos, and the Austrian Boanbrücherl. Both words mean bone-breaker, a name recorded in the Alpine region first in 1806 by Johann Rudolf

Steinmüller (1773-1835) in his journal „Alpina“. Good places for dropping bones are visited regularly and are frequently covered in discarded bone fragments (see below). They are known as „bone smithies“ or ossuaries. Preparation of food by dropping it from a height is practised by other species, such as Golden eagle, gulls, ravens and crows, but it is not executed as regularly and accurately as by Bearded vultures. Their closest relative, Egyptian vultures, can also work on their food items, but use stones as tools, throwing them with their bills onto eggs of birds like ostriches until the shell breaks.

Bearded vultures seem to increase the velocity with which bones fall by going into a dive before releasing them. Aiming accuracy, flight altitude, angle of fall, and wind conditions must all be coordinated if the bone is to shatter successfully. Long experience and continual training over the course of the bird's juvenile development are necessary. The conspicuous and frequent play-flights of young Bearded vultures, as well as the acrobatic dropping and catching of bones or large sticks in the air, are probably essential components of this training.

Bearded vultures in the wild require about 300-400 g of bone each day, and in captivity 250-275 g. This intake seems relatively low. However, the nutritional value of bone is high, as mentioned earlier, but there is bone and bone. Those bones that are most nutritious are preferred and eaten first. The bones utilized first are the ones with the highest fat (oleic acid) content, namely the limb bones, especially those towards the hoof, the so-called 3rd phalange. In contrast, the skull, jaws, shoulder blade, vertebrae, and ribs whose nutritional content is lower, lie the longest at the ossuaries or at the eyrie before they are possibly consumed.

It is not only bulky, large bones that are broken up. Fragments of smaller bones are selected by Bearded vultures to feed these to their chicks so that they can be taken more easily. The nestlings are able to swallow and digest small pieces of bone even a few hours after hatching, though the by far largest fraction of the diet in the first two months of life is meat. Food

for the offspring is transported in the bill or the legs and not, as in other vultures, regurgitated. The ossuaries are used intensively when young are in the nest (in 71% of cases studied), hence they are often found near eyrie sites (about 800 m away).

The ossuaries are primarily used for breaking up of bones and the preparation of food items. Just as at the eyrie, more and more bones and bone fragments accumulate, which are not, or not immediately, eaten. These locations can therefore act either like a garbage tip or a food store. Additionally, niches in rock walls can also serve as bone depots, which are useful on the occasions when weather conditions prevent searching for fresh food. Previously rejected bones then provide essential emergency rations.

The perfect ecological niche

A remarkable range of anatomical, physiological and ecological adap-



After having thrown a bone down to earth from a greater height, the Bearded vulture spirals down to feed on the broken pieces.

Illustration: H. Maass.



Ossuaries are often found where the ground is covered with smaller rocks and stones; the bones are thrown down to areas with no vegetation.

Photo: A. Margalida.



Limestone (here in the Katalanian Pyrenees) on a geological scale is preferred as plenty of cliffs are formed providing good thermal conditions, and to build nests on ledges.

Photo: A. Margalida.



Different bone pieces found in an ossuarie.

Photo: A. Margalida.

tations enable the Bearded vulture to support itself on a diet of bones. Given that the occurrence of carrion is unpredictable, and that meat quickly rots, the members of the scavenger guild are always under both competitive and time pressure.

However this does not apply to Bearded vulture, which can survive on leftover bones that are usable for at least ten times as long as meat. An ossivorous carrion feeder there needs only a tenth of the number of carcasses to survive. If we assume a daily consumption of 300 g of bone, then a Bearded vulture could make a single sheep skeleton last for a month. This is precisely how it is able to live even in the inhospitable high Himalaya, where the density of ungulates is often very low.

Why has no other bird adopted the bone-eating "trick"? First, carrion feeding is especially profitable when the energy expended on foraging is less. All vultures have perfected the technique of soaring and thereby expend far less energy on foraging than hunting raptors. The high energy demands of smaller birds precludes them from being able to utilize



The skeleton of an ibex killed by an avalanche are providing food for Bearded vultures for months. Photo: P. Schild.

bones because bones need more than 24 hours to be digested. In addition, the weight of a stomach full of bones would seriously impair the flying abilities of a smaller bird. Vultures, being large birds, can survive for long periods without food better than smaller ones, and so bone feeding is an option only for large soaring species in a montane habitat. Only the Bearded

vulture has succeeded in doing this. Its niche, however, is a complex one, making it - as a highly specialized large bird - vulnerable to human-caused changes in its environment such as increasing human population density with intensified farming, tourism, and energy production.

Karl Schulze-Hagen, Hans Frey, Antoni Margalida



A nest with a young about 50 days old - plenty of bones of middle sized herbivores, partly with hooves, decorate the edge. Photo: A. Margalida.



Dr. Karl Schulze-Hagen is a ornithologist with a preference for warblers and brood parasitism. As medical doctor he has been fascinated by the complete digestion of bones by bbearded vultures.



Dr. Hans Frey, formerly a scientist at the Veterinary University in Viennan, keeps the breeding book for Bearded vultures and coordinates the Bearded vulture project. He is also manager of the Owl and Raptor Conservation Station in Haringsee.



Dr. Antoni Margalida is a scientist at the universities of Lleida and Bern. His work is focussed on Conservation Biology, Behaviour Ecology and the ecological modelling of endangered vertebrates, especially of Bearded vultures.

Literature (s. Seite 86):

Blumstein 1990; Brown & Plug 1990; Frey & Llopis 2015; Girtanner 1879; Glutz von Blotzheim et al. 1971; Heredia et al. 1990; Hirzel et al. 2004; Houston & Copsey 1994; Kruuk 1972; Margalida & Bertran 2001; Margalida et al. 2003; Margalida et al. 2007; Margalida 2008a; Marin-Arroyo & Margalida 2012; Robert & Vigne 2002; Robert Attard & Reumer 2009; Robin et al. 2003; Ruxton & Houston 2004; Schäfer 1938; Stemmler 1932; Thaler et al. 1986.



Photo: H. Weyrich.

Once gone – now returned:

Bearded vultures in the Alps

Stealing lambs and killing children – such false accusations were once the Bearded vultures' fate. Consequent persecution led to the extinction of the Bearded vulture in the Alps at the beginning of the 20th century. Despite this, conservationists started to engage in saving this charismatic inhabitant of the mountains. Thanks to efforts all across the Alps during the last decades, this vision is reality today. There is still work to mount but the Bearded vulture is back in the Alps and starting to conquer the mountain regions again.



The last photographic evidence of an Alpine bearded vulture. The animal was killed in October 1913 in the Aosta Valley by Augusto Paganoni (pictured). This shoot marked the end of the original Bearded vulture population in the Alps.

Photo: J. Brocherel.

Back in the 18th century, Bearded vultures were characteristic across the crescent of the Alps. Its pure size and imposing nature have always impressed people and given rise to speculations. Science books from the 19th century completely overlooked that Bearded vultures are highly specialised in consuming the bones of perished animals. Instead, the species was regarded as a “Gyr” or even as “hyena of the air”, taking lambs and even small children. This misinterpretation was fatal for the Bearded vulture. Lucrative shooting provisions and the emergence of modern guns led to a rapid and ongoing decline during the 19th century. The last bird to be shot down in the Alps, documented by photography, took place in Aosta valley in Italy in 1913.

Historical Distribution und Disappearance

At first Bearded vultures vanished from the German Alps. Until the mid 19th century the area was inhabited only sporadically. The last shot bird dates back to the year 1855, near Berchtesgaden.

In Austria the distribution originally ranged from Vorarlberg to the most eastern foot-hills of the Alps. There is some sparse evidence regarding breeding back to the year 1880. At the beginning of the 20th century, several sightings were recorded: Stubai Alpen in 1905, Liesertal in 1906, and Gasteinertal in 1926. After that, until the 1960s nearly every year individual Bearded vultures could be observed mainly in the valleys of Hohe Tauern, and also in north Tyrol. Near Rauris, Hohe Tauern, one further observation was made and verified by photograph.

In the Italian Alps, Bearded vultures could survive and breed for longer. Although, as mentioned, the last guaranteed shot bird in the Italian Aosta valley marks the end of Bearded vultures in the Alps, in the 1920s two Bearded vultures were observed in the Gran Paradiso National Park. After that, two immature Bearded vultures were recorded in the Regionalpark Alpi Marittime in 1977, 1978 and 1980. It is assumed that the vultures flew from Corsica.

Prehistoric findings show that Bearded vultures bred in continental France as far back as the Upper Pleistocene era (about 700,000 to 10,000 BC). As in Italy, the complete wipe-out of the species in the French Alps most likely only happened between 1920 and 1930. The sad story of persecution is well documented by Mingozzi and Esteve (1997). Due to the preparation of Bearded vultures for private as well as official collections the species became a target for poachers and hunters. The Museum of Grenoble alone hosts 16 such individuals. Between 1780 and 1930, 67 Bearded vultures were shot down legally - not included in this number are many Bearded vultures to be found in private collections. This data proves that until about 1850 Bearded vultures could survive anywhere in the French Alps, from Lake Geneva

up to the low mountains of the French Riviera. As early as 1911 Lavauden noted, that in the near future Bearded vultures might become merely a memory. Unfortunately this prophecy became reality quite soon with the species being extinct as a breeding bird in the French Alps in 1930.

Historical records of Bearded vultures' eyries in Switzerland concentrate in the eastern Swiss mountains although round about 1850 only five would have been used. The last eyries were situated in western Switzerland in Graubünden. Many examples of Bearded vultures and eggs in Swiss museums show that the species lived nearly all over Switzerland and was under enormous pressure from all kinds of persecution, like shooting, trapping, poisoning, and egg collection. As in neighbouring countries the Bearded vulture was seen as a threat to game, and even humans.

The long Story of Reintroduction

As early as 1930, at the same time of the extinction of Bearded vultures in the Alps, Carl Stemmler from Switzerland mentioned the idea of reintroducing the Bearded vulture into the Swiss National Park. In a first attempt at the beginning of the 1970s,

Paul Geroudet and Gilbert Amigues released Bearded vultures from Afghanistan into the French Alps. Due to high losses and difficulties in obtaining birds, the project failed. For the first time a Bearded vulture was bred in captivity in 1973 in Alpenzoo Innsbruck by Hans Psenner, creating the basis for another reintroduction attempt.

At the meeting of the International Birds of Prey working group in Vienna in 1975, Winfried Walter (WWF/Austria) and Marteen Bijleveld (IUCN) suggested to use Bearded vultures hatched in zoos for the reintroduction project. In 1978, the official passing of the resolution took place at a meeting in Morges in Switzerland. With the help of the Frankfurt Zoological Society (ZGF), led by Bernhard Grzimek and Richard Faust, in Haringsee, Austria, the Vienna Breeding Unit (VBU, today known as Richard Faust Bartgeier Zuchtzentrum, RFZ), was built as a central breeding station. Thanks to longterm funding by ZGF, it was possible to establish a local breeding population, followed by an international breeding network.

Once a comprehensive habitat study had been done by Jürg Paul Müller and Chasper Buchli, both



Since 1986, Bearded vultures have been released year after year in the Alps. The project is not yet completed but the resettlement is already a success story that shows how well-coordinated efforts to bring back a once-vanished species can succeed.

Photo: H. Weyrich.



Bearded vultures breed today in the Alps again. The first succeeded in 1997 in Haute Savoie and continues to this day. Over 170 young birds have fledged in around 40 breeding territories.

Photo: H. Weyrich.

Swiss biologists, the preparation how best to release the birds by VBU, and intensive information and awareness efforts for the public, the project started in the “Valley of vultures”/“Tal der Geier”, in the Kruml Valley in the Hohe Tauern National Park (NP). Here, in 1987, the Bearded vultures known as “Hans“, “Ellen“, “Fritz“ and “Winnie“ were released to pioneer the return of the “Boanbrüchls“, an old Tyrol name for the Bearded vulture. In 1987, the first release in France took place, at the Bargy in Haute Savoie. The growing breeding population provided for the beginning of additional releases in Switzerland, in 1991 in the Engadin NP, followed by the Mercantour NP in the French south Alps only two years later, and the Regionalpark Argentera in Italy in 1994.

Bearded vultures are philopatric so that a local population is highly likely to establish, with consequent releases at the same place – a very important condition for the birds to build breeding pairs and territories. Due to this encouraging development sometimes release places have to be moved short distances. In the Hohe Tauern NP, since 2000, releases have taken place alternately in Osttirol, Salzburg and Kärnten. Also in 2000, a new release place was established in the Martell Valley in the Italian NP Stelvio.

The Bearded Vulture is establishing

Bearded vultures reach maturity fairly late, at about six years of age. On average it takes a mere eight years until the birds breed successfully for

the first time. So it was 1996, that at the Bargy in France the first pair, the male “Balthazar“ (born 1988) and female “Assignat“ (born 1989), laid an egg, only few hundred metres away from the release point - unfortunately no chick hatched. Only one

before 1800	Bearded vultures are characteristic all over the Alps
until 1850	Bearded vultures are still sporadically settling in the German Alps
1855	last shot down of a Bearded vulture in Germany, Berchtesgaden
until 1880	scarce breeding records for Austria
1885	last breeding record in Switzerland (Vrin)
1886	last Bearded vulture killed in Switzerland (Visp)
1905	secured observation in the Stubai Alps, Austria
1906	secured observation in the Lieser valley, Austria
1906	last shot down of a Bearded vulture in Austria
1913	last shot down of a Bearded vulture in the Aosta Valley, Italy (photo proof)
1924-1925	observation of two bearded vultures in Gran Paradiso, Aostatal
1926	secured observation in the Gastein valley, Austria
1920-1930	complete wipe out of the Bearded vulture in France
1928	secured observation, Valle dell’Orco, Italy
1930	secured observation, Valsavaranche, Italy
1950	secured observation, Gran Paradiso, Italy
1951	secured observation, Rauris valley, Austria
1956	dead bearded vulture found in Chiavenna, Italy
1957	secured observation, Leuk, Switzerland
until 1960s	regular sightings in the Hohen Tauern and northern Tyrol, Austria
1962	secured observation, Stelvio NP, Italy
1964	secured observation, Mürren, Switzerland
1973	secured observation, Bouches du Rhone, Camargue, France
1975	secured observation, Allier, France
1978	records of two immature Bearded vultures in the Regionalpark Alpi Maritime
1980	secured observation, Basse Ardèche, France
1985	secured observation near Rauris, Hohe Tauern

beginning 1930er	Carl Stemmler suggests reintroduction in the Swiss NP
beginning 1970er	first attempt to release adult bearded vultures from Afghanistan in the Alps – all birds die shortly after heving been released
1973	first breeding in captivity in Alpenzoo Innsbruck
1975	suggestion to reintroduce Bearded vultures born in zoos
1978	official resolution in Morges, Switzerland
1986	first release in the Rauris valley, Salzburg, Austria
1987	first release at the Bargy, Haute Savoie, France
1991	first release in the Engadin NP, Graubünden, Switzerland
1993	first releases in the Mercantour NP, southrn Alps, France
1994	first releases in Regionalpark Argentera, Italy
1996	first pairing at the Bargy, Haute Savoie, France
1997	first wild-born Bearded vulture „Phönix“ fledged, Bargy, France
1997	first pairing in the Stelvio NP, Italy
1998	first successful brood in the Stelvio NP, Italy
since 2000	releases alternating in eastern Tyrol, Salzburg and Kärnten, Austria
since 2000	first release in the Martell valley, Stelvio NP, Italy
2002	first pairing in Gastein, Austria
since 2006	releases at various places in Andalusia, Spain
2007	first successful brood in Engadin and Wallis, Switzerland
2008	first and until today only release on Sardinia
2010	first successful brood in the Rauris valley, Austria
2010–2014	releases in the Calfeis valley, St. Gallen, Switzerland
since 2010	releases in Vercors, French Pre-Alps
since 2012	releases in the Central Massif, France
2014	first pairing in the Cazorla NP, Andalusia, Spain
since 2015	releases in Melchsee-Frutt, Obwalden, Switzerland
2015	first successful brood in the Cazorla NP, Andalusia, Spain
2016	30 years of Bearded vulture reintroduction in the Alps

year later, in 1997, the first wild born Bearded vulture, aptly named “Phönix“, hatched, more than one century after the species' extinction in the Alps. Until this day, 13 siblings have followed. Since then, Bearded vultures paired in eight territories in the region of Haute Savoie and the neighbouring Vanoise NP. Comprising 53 successful broods, this region is the most successful within the reintroduction project.

In 1997, the first pairing in the central Italian Alps in the Stelvio NP took place, and in 1998 the first young vulture hatched there, only about 20km from the release point in the Swiss NP. Five more breeding pairs established in the national park in the surrounding area. Until 2015, 37 young have hatched in this region. And the breeding success is extremely high, with 0.68 chicks per pair. A similar positive development can be observed in the neighbouring Alpine valleys in Switzerland. Although the first successful brood in Switzerland took place only in 2007, in the region around Engadin in seven territories 27 chicks fledged until 2015. Besides the region of Haute Savoie/Vanoise, the Italian-Swiss borderline region is the most productive sub-population of Bearded vultures in the Alps.

In the western Italian Alps, the establishment of breeding territories took longer. Near Valsavarenche Aostatal, in 1992 a pair was recorded, but one partner might have fallen victim to a Golden Eagle atck in spring 1993. Also in the following years pairs formed, but only for short times (Stura Tal 2000–2004, Maira Tal 2004–2006; Varaita Tal 2006–2007, Orco Tal 2011–2012). 2004 one pair was recorded in Valdigne, and 2008 a polygyn trio in the Rhemes Valley, the latter being regarded the first evidence of pairing of two females with one male. Successful broods took place in this region in 2012 in both territories. Today five breeding territories exist in the western Italian Alps, four of them in the Aosta Valley. Until 2014, five young vultures fledged, making the breeding success 0.54 juv./pair.

In the eastern and southern Alps, the wild population developed slowly. In Austria the first pairing took place in 2002 near Gastein, but it took until 2010 that the first wild-born Bearded

vulture in Austria fledged. In 2012 a second breeding pair was recorded (Katschberg). Until today, these two pairs have raised six young. In the southern Alps, the first successful brood dates back to 2008, in the French Vallée de l'Ubaye. Here also six young vultures have fledged so far until this day. Since 2015, a second pair has established, and raised one chick for the first time that year.

Nearly there?

In 2016 the reintroduction project in the Alps celebrates its 30th anniversary, with unique successes reached within those decades. In the Austrian, French, Italian and Swiss Alps, until 2016, 219 Bearded vultures were released, and in the meantime 173 wild-born chicks fledged. The survival rate is very high, with 0.88 in the first years and 0.96 in the following years (s. Schaub et al 2009). The number of wild-born Bearded vultures today overtakes the number of released birds by far. Regarding numbers, the wild population sustains itself and grows without support. But the genetic diversity is still very low, due to many of the released vultures being related. The Vulture Conservation Foundation (VCF, former FCBV)

now tries to improve the situation through the release of birds with special value genetic heritage in optimal habitats (i.e. since 2010 Calfeisental, since 2015 Melchsee-Frutt).

Another element that should lead to the success of the reintroduction project is the connection between the Alpine population and the Pyrenees' population. To reach this goal and establish a meta-population in the long term, birds have been released in the French Pre-Alps (Vercors, starting 2011) and Cevennes (starting 2013).

The project's results so far are extremely positive, an opposite to the situation of many vulture populations worldwide, and that gives hope for the future. Remarkably the Bearded vultures in the Alps are not dependant on feeding stations, like vultures in other regions, to be safe from poisoned baits or have enough food. Basically the strong populations of wild ungulates - nearly non-existent at the beginning of the 20th century - provide a strong base for this success; a result of conservation measures in the past as well as, in the case of the Alpine ibex, of reintroduction projects.

Decades of ongoing close cooperation between zoos, national parks,

nature organisations, governmental institutions and numerous vulture friends, as well as the coordination of VCF have helped to bring back an extinct species to the unique habitat of the Alps. This strong team is confident of securing the Alpine population of the Bearded vulture in the long term and to address new goals within the species' conservation, hence Bearded vultures should be resident again also in other regions of their former distribution range.

**Hans Frey, Michel Terrasse,
Daniel Hegglin, Paolo Fasce**



Since the 1960s the chemist and nature filmmaker Michel Terrasse has been closely involved with the protection of birds. Most of his films are about birds of prey and their biology, but also the problems of protecting them. He is a member of the Advisory Board of the VCF and also on the board of LPO.



Paolo Fasce has been involved since the beginning of the resettlement of the Bearded vulture project in the Alps. He was first secretary and until 2007 President of the FCBV.

Dr. Hans Frey: see page 15.

Dr. Daniel Hegglin: see page 2.



The Bearded vulture population in the Alps is growing.
Photo: H. Weyrich.

Wandering Bearded Vultures

Bearded vultures are adapted to mountainous habitats. However, surprising excursions far outside the Alps are regularly reported from bearded vultures of the Alps. In 1994 the first of such excursions was observed. Helmut, a young bird that was released in 1993 in Austria, fell into the Atlantic Ocean close to Rochefort (France). Luckily he had been found and saved by a fisherman and – after the bird had recovered could later be released again in the Alps.

As this story shows, excursion outside the Alps can be dangerous for bearded vultures. The thermal up-winds found in the mountains are missing and flying gets more difficult and exhausting for the big gliders. Especially after landing, the birds have to use a lot of energy to get airborne again. In addition, it is difficult for bearded vultures to find enough food in the lowlands, as most accessible carcasses in the open fields are removed, mainly because of veterinary reasons.

However, since Helmut, many bearded vultures started excursions outside the Alps. Interestingly most excursions went to the north, where the birds explored Belgium, Czech Republic, Denmark, northern France, Germany, the Netherlands, and even Great Britain, as well as to Poland, Slovakia and Ukraine. Frequently they have roamed along the coast of the North Sea. Only one case is known when a juvenile bird left the Alps towards south where it spent one winter in the Apuan Alps near Genova. In total eleven released and at least six wild hatched birds were observed far outside the Alps. Most of them found their way back to the Alps by themselves. However, four birds had to be recaptured because they were weak and could not fly anymore. All of them could be recaptured back in time, nourished back to health and then be re-released in the Alps. The most recent and sad story is Larzac, which was released 2014 in the Massif Central, flew to Holland in June 2015 where he was guarded by our Dutch colleagues. He then

continued to northern Germany where the transmitter stopped working beginning of July. Some days later, the carcass of Larzac was found underneath a powerline.

Notably, the vast majority of the animals were in their second calendar year when they started these excursions to the north, always in May or June. Only one bird which was observed in May 2015 in the Netherlands was in his third calendar year already. The known birds were released at different release sites in the Alps, although more north-flying birds were released in the more northern parts of the Alpine chain, Switzerland and Austria. However, historic observations of the species in areas where they have died out long before, give evidence this vagrant behaviour is not a peculiarity of the re-introduced population. In general bearded vultures in their second

calendar year tend to fly around a lot. But why so many of these birds leave the Alps towards North, whereas so far never a released bird from the Alps has been recorded in the much closer Pyrenees, is not clear. Interestingly it has also been observed that several bearded vultures released in Andalusia made excursions to the North. These birds flew up to the Pyrenees and back to Andalusia thereby connecting the Andalusian population with the autochthonous Pyrenean population. A possible but not yet carefully analysed hypothesis is that the bearded vultures fly north together with the returning migrating raptors from the south or are carried north by strong winds from the south.

**Franziska Lörcher, Hans Pohlmann,
Richard Zink, Daniel Hegglin**

An amazing example of international co-operation

In June 2015 Schils, a young male released in the Swiss Calfeisen-Valley in 2014, flew all the way to the Netherlands in only two days, on one day he was flying around 500 km. Then a fantastic story of international cooperation started: Schils was brought to Marije de Heer from the Dutch bird sanctuary Rehab Centre De Bonte Piet. Never before has she received such a huge bird of prey. Such a large bird needs a large aviary. Therefore, Schils was taken to Hetty Sinnema and Andries Zijlstra who have a large enough aviary in their Rehab Centre De Fûgelhelling. Meanwhile, the ornithologist Hans Pohlmann of the Dutch Birding Association got in contact with Franziska Lörcher, who connected the Dutch team with the bearded vulture veterinary Hans Frey. Thanks to the excellent cooperation and sharing of information between the Dutch team, the Stiftung Pro Bartgeier, and the VCF-team, Schils quickly regained his strength. The dedicated Dutch team even brought Schils back to Switzerland, where he has had some last veterinary checks from Martin Wehrle at the Natur- und Tierpark Goldau. Only two weeks after Schils was captured in The Netherlands he could be re-released at the bearded vulture release site in Switzerland.



Just before Schils was released the second time, the Dutch team, the local ranger, and team Pro Bartgeier met. Left to right: Marije de Heer, Hetty Sinnema, Jaap Denee, Franziska Lörcher, Daniel Hegglin (with Schils), Hans Pohlmann, Hans Spichtig, Christine Jutz und Andries Zijlstra.

The European endangered species programme for Bearded vultures: The Return from Captivity into the Wild

Since 1973, the Alpenzoo in Innsbruck has been exceptionally successful in breeding Bearded vultures in captivity. This triggered the development of an international breeding programme to form the basis for a cross-border reintroduction project. In Morges, Switzerland, aims and methods were agreed in 1978. One basic principle was the restriction to only work with individuals already held in captivity or injured birds from the wild. A Centre to coordinate breeding was founded in Haringsee near Vienna (the Vienna Breeding Unit, VBU, now called Richard Faust Bartgeier Zuchtzentrum, RFZ). In 1978, the Frankfurt Zoological Society became responsible for funding the RFZ and acquired all chicks hatched in captivity to set up a breeding population. These Bearded vultures then became the property of the Foundation for the Conservation of the Bearded Vulture (FCBV), which is now known as the Vulture Conservation Foundation (VCF). VCF is leading this project.

Successful breeding of Bearded vultures appeared to be strongly dependent on natural selection and learning processes during the appropriate age. In Haringsee, an approach was developed using Black kites which largely replicates with the natural process of emancipation of the chicks. The function of the adult birds is taken over by a team of carers at the release location. Social interaction

is provided by ensuring that at least one other young bird is present. The ability to learn and adapt is strongly related to the age of the young birds and the developed approach allows the youngsters to grow up in their surroundings at the appropriate time and to adapt to the specific requirements in the best way, very similar to the process of fledging as it would occur in the wild. The young birds are placed

as nestlings into artificial eyries from which they will fledge some three to four weeks later. This has the added benefit of philopatry which describes the behaviour of an animal to return to its natal area to breed. After repeated reintroductions in the same area, a local population develops over time which is an important prerequisite for the subsequent formation of breeding pairs.

In 1978, it was evident that only the existing population in zoos could be used for a captive breeding programme. All autochthon populations were either endangered or not researched well enough. Around forty Bearded vultures were held in captivity across European zoos at the time, with only a single successfully breeding pair. Due to the efforts by Hans Psenner and Richard Faust (Director of the FZG) the majority of the birds were transferred to Haringsee to allow the formation of pairs and study the behaviour of problematic birds. Based on the experiences of the Alpenzoo in Innsbruck, this was followed by the preparation of guidelines for keeping Bearded vultures in captivity. Established pairs and young birds were returned to the zoos thereafter and between 1978 and 1985, a European breeding network was established. This formed the precursor of the later European Endangered Species Programme (EEP). The aims were clearly defined from the start and continue to be followed



Very young Bearded vultures are fed by their parents with meat.

Photo: K. Robin.

to this day. They include the preservation of genetic diversity as a genetic reserve (ex situ), natural and optimal rearing conditions (by means of parents or nursing birds), reintroduction of the species into former ranges and establishment of a wild population (in situ) that will be independent and not require human support. These aims can only be achieved when the young birds bred in the network possess an intact range of behaviours as a result of which hand raising has to be avoided. The motto of the Bearded vulture EEP is "Quality over quantity"

To ensure that chick rearing conditions are appropriate to the species, all chicks are raised by their parents or nursing birds. The reintroduction project for Bearded vultures in the Alps was one of the first examples of a successful cooperation between ex situ and in situ projects. As such, it was an important signal by the zoos regarding their function in the support of endangered species.

The EEP structure – a colourful mosaic

The Bearded vulture EEP is a network consisting of a plethora of partners: public and private zoos, private breeders and breeding centres, public rehabilitation centres. Many of these partners are not associated with the European Association of Zoos and Aquaria (EAZA). The international charity VCF therefore safeguards the compliance with EEP aims. The network is currently formed by forty mainly European zoos, three large and two small specialised breeding centres and two private partners. Of the currently 164 Bearded vultures of the EEP, around 80% are owned by the VCF.

Forming new breeding pairs is difficult and risky. For that reason, specialised breeding centres were created where experienced long-term staff work on many levels. This includes forming new pairs, introducing new birds (injured wild birds) into the network, analysing problematic birds from zoos, taking on young birds for adoption and monitoring the genetic diversity. The main role of the other project partners is the care for established pairs to achieve the best reproductive results possible.



The aviary for breeding Bearded vultures in the Parc Animalier des Pyrénées, France, is a good example for an enclosure, that meets the needs of the species as well as the expectations of visitors.

Photo: A. L. Dell, Herbst 2013.

Achievements to date

Between 1978 and 2016, 488 young birds were successfully raised. Of these, 199 were reintroduced to the Alps, 44 to Andalucía, 22 to the Cevennes (Grand Causses) and French foothills of the Alps (Vercors), two to Corsica and three to Sardinia as part of the in-situ projects. 218 young vultures were kept to create and maintain a captive breeding population. The average breeding success in the specialised breeding centres is 0.89 juveniles per pair. The first successful breeding attempt occurs at an average age of 9.2 years and the average life expectancy is 27.1 years. Comparative values of the other EEP partners are 0.39 juveniles per pair, 12.4 first breeding age and 16.6 life expectancy. These significant differences confirm the importance of the specialised breeding centres and are the result of the continuous presence of staff with many years of experience.

Zoos however are significant in a number of ways. Even though overall reproductive success is lower, numerous young birds are contributed to the project every year. Also, the distribution of Bearded vultures into a large network of partners significantly reduces the risk of losses as a result of possible epidemics. Of particular significance however is the special role that zoos play with regards to working with the public: they have the potential to reach and inform millions of people all across Europe.

The future of the Bearded vulture EEP

The aim of the EEP is to increase the captive population to at least 200 individuals. The high number of young birds needed for current reintroduction projects delays this requirement. Current endeavours also focus on improving breeding success in the non-specialised centres as well as increasing average life expectancy. To achieve this, the VCF offers assessments at the centres to analyse the captive conditions of the birds and provide suggestions for improvements.

The in situ programmes are heavily reliant on good breeding success at the specialised breeding centres, however the centres are under threat as these NGOs have no income at their disposal. The upkeep of these centres is only possible with the financial support of partner organisations such as zoos or reintroduction sites. The EEP for Bearded vultures is an impressive example of how the aim of recreating a wild and viable European population has been achieved only by mutual support of the project's partners. It is an example for successful cooperation between zoos (ex situ) and natural habitats (in situ) to achieve the conservation of a species.

Alex Llopis Dell, Hans Frey



Dr. Alex Llopis is a vet and has been working with Bearded vultures since his dissertation. He is the coordinator of the EEP and leads the Bearded vulture breeding programme for the VCF.

Dr. Hans Frey s. page 15

Success by Cooperation

During the 1978 conference of the World Working Group on Birds of Prey and Owls (W.W.G.B.P.), the idea of reintroducing Bearded vultures into the Alps emerged. It has become one of the most successful conservation projects in Europe. The key to this success was the creation of an interdisciplinary and international network, in which the large Alpine conservation areas play a particular role. An international, long-term reintroduction project extending over decades is a huge task. Strong partnerships with many institutions and on many different levels are essential for the successful return of the Bearded vultures into the Alps.

The special significance of the National Park Hohe Tauern

An international think tank identified four release locations in the Alps, all of which were located in large conservation areas at similar distances to each other. As a consequence of this field study, the first reintroductions took place in 1986 in the Kruml valley near Salzburg where four young Bearded vultures were released. A further 59 birds were released after that, initially all from the Kruml valley and after the year 2000, alternating between Carinthia, Tyrol and Salzburg. Since 2010, Bearded vultures have been breeding again in the Hohe Tauern National Park and the area has become the cornerstone of the Austrian Bearded vulture population. At the same time, this population has an important function as a spearhead to access the south of Europe. Over the years, the Hohe Tauern National Park has been fully committed to this conservation project. In addition to developing

the project to enable the releases, their efforts also included publicity work to raise awareness of this fascinating vulture species. Furthermore, they have taken on not only the monitoring of Bearded vultures within the National Park but across all of Austria. The project benefited specifically from the excellent network and relationship which the National Park maintains with landowners, hunters, scientists, conservation bodies, statutory bodies, zoos and others. As a result of the excellent cooperation with the Alpine conservation areas, the Hohe Tauern also became the leading partner for the international monitoring programme for Bearded vultures (IBM). Over time, the project has developed from an Alpine to European project which is led by the Vulture Conservation Foundation (VCF).

Manmade borders do not exist for Bearded vultures. The project takes account of that and the cooperation across country and state borders is excellent. As a result, the project is not only exemplary for a successful, international conservation project, it also showcases what a National Park can deliver to raise awareness. The reintroduction of the Bearded vultures is the one of the most spectacular and popular long-term projects of the national Park. The birds are no longer feared by the people but the sight of a majestically circling vulture high above the mountain peaks is greeted and welcomed by all.

The success of the largest and most successful reintroduction project of the entire Alpine region from its early beginnings until today has only been possible thanks to the support of the National Park Hohe Tauern. It serves as a large-scale conservation area and represents both a stepping stone as well as an area of refuge for endangered species. At the same time, the National Park is an institution with its own, independent management and contributes its knowledge and experience relating to habitat management, science and environmental education to the project.

Ferdinand Lainer

Release of two young vultures "Pinzgarus" and "Rurese" in the Kruml valley on 12 June 2008.

Photo: Nationalpark Hohe Tauern/Salzburg.



Swiss Charity for Bearded Vultures

Before Bearded vultures could be released into the wild, a lot of preparatory work was done. The basis was establishing an international breeding programme (which has become the EEP of the EAZA today) however, the extraordinary achievements of this programme are often overlooked. In Switzerland, the La Gartenne Zoo and the Nature and Animal Park Goldau, which funded a Bearded vulture breeding station, contribute to the project in two ways. Both institutions support the project by raising large numbers of young vultures but they also raise public awareness for the return of Bearded vultures into the wild. Prior to the start of any reintroductions, two Swiss ecologists Hans-Ueli Müller and Chasper Buchli searched the entire Alps for suitable release locations. After the initial releases in the Hohe Tauern in 1986, it was apparent that young vultures travel significant distances and that they would easily reach the Swiss Alps. This triggered the need for action in Switzerland where Bearded vultures until then had a rather bad reputation. The Bündner Nature Museum (BNM) led an initiative to introduce the Bearded vulture as a fascinating bird of prey to the public. As the intention to also release Bearded vultures in Switzerland already existed back then, Jürg Paul Müller (BNM), Hansjörg Blankenhorn and Rolf Anderegg (Federal Office of the Environment, Forestry and landscape, BUWAL), Hanspeter Pfister (Swiss Bird Conservatory, Sempach), Heinz Stalder (WWF-CH) and Chasper Buchli (Format AG) funded a private initiative. This was initially called the "Society for the reintroduction of Bearded vultures in the Swiss Alps" (GWB) and then became the Charity Pro Bartgeier (SPB). The charity started creating a strong network to enable the return of the Bearded vulture into the Swiss Alps. This included the early involvement of WWF, the Swiss National Park, federal and district authorities and of zoos. Furthermore, the GWB initially and later on the SPB maintained close contacts with their partner organisations in the neighbouring Alpine countries. The release events which first took place in the Swiss National Park in 1991 have been and still are organised as large

In Switzerland, the charity Pro Bartgeier coordinates the reintroduction of Bearded vultures. The success of the project is a result of a strong cooperation and partnerships. This includes other organisations working on the project.

Photo: M. Stähli.

events which results in wide and strong support of the project by the local population. The reintroduction programme in Switzerland covers only a small proportion of the costs by public funds. The majority of the costs are funded by intensive fund raising. This hindrance however also has a positive effect as it allows many institutions, nature lovers, regional business organisations and interested media to be involved. In addition to their financial support, there is the opportunity for them to publicly demonstrate their support for the project. Other strong partnerships are also required to ensure population monitoring and for scientific evaluations, for example with the Swiss Bird Conservatory in Sempach, the Conservation Biology unit at Bern University, and the Institute for Evolutionary Biology and Environmental Science of Zürich University. The importance of good networks was apparent during the releases outside of the Swiss National Park. In two regions (Calfeisental in St. Gallen and Melchsee-Frutt in Obwalden), regional patronage committees were funded. These include regional authorities, rangers, landowners, Alpine farmers, regional economic representatives, local nature conservation and hunting bodies as well as tourism organisations. Members of all these bodies worked closely with the SPB from the very start as part of the committee. This strong participation is a key element of the reintroduction in Switzerland. It achieves a strong identification with the project which is considered to be an important factor for the successful protection of Bearded vultures. To achieve a situation where an entire region is appreciating Bearded vultures, and locals rightfully take pride in their return to the area is vital to safeguard the future of this iconic species in the long term.

Klaus Robin, Daniel Hegglin



Bearded Vulture reintroduction in Upper Savoy

The reintroduction of the bearded vulture has started in Upper Savoy well before 1987. In fact it was in the 1970s when the director of the departmental direction of agriculture, visionary Gilbert Amiguiès, launched the reintroduction programmes of the Bearded vulture, beaver and ibex in Upper Savoy. Environmental protection was in its very early stages so that this striking man had to be very persistent and courageous.

Thanks to initial efforts regarding reintroduction of Bearded vultures in Austria, the Upper Savoy department and Asters joined the reintroduction project that was carried out by the Zoological Society of Frankfurt and the WWF. The first chicks from captive breeding were reintroduced in the mountain massif of Bargy, a calcite massif in the northern foothills of the Alps. These were the first steps of the reintroduction programme, from which we know today that it is successful, but moreover it was an extraordinary human adventure. The residents of the village Reposoir discovered this unusual raptor as part of their surrounding nature, and were proud to welcome it there. Today Bearded vultures have become a commonly used emblem for ski stations or a track race in the mountains. Scientists from overall the Alps got collaborations going around the breeding station, the reintroduction sites and the bearded vultures' monitoring. Since birds were only few in the beginning in such a vast territory, obser-



A very successful network of observers and organisations ensures best monitoring of the vultures.

vers were scanning the horizon for days without seeing anything. To prevent failure of the project there was a collaboration formed between the field technicians from Asters, the guards of the Vanoise National Park and volunteers, a network of observers which is still very performant today. Eleven years after the first reintroduction into the wild the Bearded vulture compensated all of them by giving birth to the first young wild born in the Alps since this species had disappeared.

Marie Heuret



Near Passy, two pairs of Griffon vultures have taken territories.



Resident breeder or not?

History of Bearded vultures as a breeding bird in the Alps

Following decades of hard work and a successful reintroduction programme, Bearded vultures are again a resident breeder in the Alps. Many would like to also see the Bearded vulture return to the Bavarian Alps. But it is not clear whether this species actually ever was a resident breeder in Bavaria. Old literature does not provide any credible evidence. It is possible that this question can never be answered as even very old sources cannot shed light on the issue.

The book “The birds of Bavaria” which was published in 1891 by the Franconian priest Andreas Johannes Jäckel is without any doubt one of the best sources for avifaunists. Similar to Walter Wüst nearly a hundred years later, both collated, reviewed and analysed a vast amount of data and observations regarding the avian assemblage in Bavaria. However, neither of these books point to a historic breeding range of Bearded vultures in Bavaria.

In a former hunting castle at St. Bartholomä near the Königssee however is a 17th Century oil painting which is the most well-known indicator for a possible breeding range. The painting shows two adult Bearded vultures in life size. The birds were killed at the castle on the 9th and 10th of April 1650 by Hans Duxner. A plaque states that Duxner, a hunter and fisherman, shot a total of 127 “Gämbseiger” which literally translates to Chamois vulture. There are also historic reports that Urban Fürst-

müller, a master fisherman of St. Bartholomä shot 43 Bearded vultures between 1670 and 1700, in addition to 25 bears. His two sons reportedly killed a further 31. However, it is doubtful that these numbers relate to Bearded vultures only. This has already been doubted by Jäckel as Golden eagles were also referred to as Chamois vulture. Furthermore, Bearded vultures had a number of other common, German names which include Lämmergeier which is likely the source for the English name of Lammergeyer. Golden eagles however were a resident breeder in the area around Berchtesgaden and probably also in the entire Bavarian Alps. And it is likely that Golden eagles would have been much more common than Bearded vultures at the time.

There is currently only a single piece of evidence for a breeding range. It originates from a report in “Bergheimat” (mountain home), a supplement to the local Berchtesgaden newspaper. This report describes how in 1830, two

forestry workers observed a Bearded vulture flying towards his eyrie in the Wimbach valley near Berchtesgaden. In his talons, the vulture was carrying a goat kid which had a bell around its neck and it was the ringing bell that alerted the men to the vulture. This may sound like a believable story, however whether it really happened cannot be confirmed nearly 200 years later. In 1850 however, the last Bearded vulture was reportedly killed at the Königssee.

There – but rare

Around 1850, a zoologist called Wagner working with the University of Munich drew up a distribution map of the most unusual wild animals in Bavaria. His attempt was apparently based on reports of the royal forestry offices and personal experiences. This map illustrates various animal species and it includes Bearded vultures in a single location – in the Alps at Berchtesgaden. Another reference can



This impressive painting in St. Bartholomä at lake Königssee documents the shooting down of two probably adult Bearded vultures.



Old illustrations repeatedly show Golden eagle (left) and Bearded vulture (right) as terrifying huge birds of prey. Both species were frequently considered together, not only when adding numbers of birds shot but also as species to be eradicated.

be found in the “Gelehrten Anzeigen” dating back to 1846 which briefly mentions Bearded vultures amongst other bird species. According to this publication, Bearded vultures were even back then one of the rarest species in the Bavarian High Alps. The author stated that he had never been able to obtain a specimen. However, the species was present just as stated by Wagner, as an adult male was shot near Berchtesgaden in 1827. The royal forestry office in Ruhpolding reported that single pairs of Bearded vultures were occasionally noted and mentioned breeding in the high mountains of Marquartstein. The forestry office in Tegernsee also reported the observation of some vultures but no evidence of eyries was ever reported. In the Alps near Benediktbeuren, the local forestry office reported single individuals in the highest rocky outcrops. However, no historical reports were made by forestry offices in Partenkirchen and Immenstadt. The conclusion back then was therefore that this was a very rare species.

It can be safely assumed that Bearded vultures in Bavaria were not as common as the large numbers of shot birds and reports suggested. As a result of intense persecution with traps and bullets it was only a question of time until the Bearded vulture became extinct in Bavaria. In 1855, the last Bavarian Bearded vulture fell victim to a hunting assistant.

Today, following the successful reintroduction of Bearded vultures to the Alps, the distribution in Bava-

ria appears to differ from historical reports. The majority of Bearded vulture observations are made in the Allgäu region, followed by observations near the Berchtesgaden Alps. A few records relate to the Karwendel region, the Wetterstein mountain range and the Ammergau mountains in the Werdenfeller region. At least one of the young vultures originating from the Allgäu was recorded in the Ammergau mountains which illustrates the vast distances this species travels when foraging. Around 10 per cent of young Bearded vultures even travel as far as the north of Germany or the Netherlands (Der Falke 2016, Issue 7).

A key role for the Alpine ibex?

As scavengers, Bearded vultures are not demanding with regards to their food supply, especially as this species can utilise the protein rich bone marrow. It is notable that many observations of Bearded vultures are made in areas where Alpine ibex occur. According to historical records, Alpine ibex never inhabited the German Alps apart from the Wetterstein mountain range. In the neighbouring Tyrol however, a stable population was present until the beginning of the 18th Century. This will have likely led to the occasional animal moving into Bavaria. Ibex inhabit the high and craggy mountain ranges year-round. In contrast, Chamois move into lower valleys especially during snowfall, and Red deer are kept in winter enclosures. Meanwhile, the Ibex move into the highest

areas and perished individuals are likely to represent an excellent food source for Bearded vultures during the winter months. Domestic animals such as cows and sheep only spend the summer months on the Bavarian Alpine meadows and pastures. When any of these die during the summer months, they are transported into the valleys, occasionally even by using helicopters and hence are not available to foraging Bearded vultures.

In the past, Bearded vultures probably frequently visited the Bavarian Alps from other Alpine regions. As political boundaries do not exist for animals, Bearded vultures from neighbouring Austria can now once again be observed in Bavaria.

Hans-Joachim Fünfstück



Hans-Joachim Fünfstück has been studying Golden eagles in Bavaria for 33 years and also works as a nature photographer. He has been a member of DER FALKE's editorial team since 1999.

Observing and reporting Bearded vultures

For many years, the Allgäu has been offering the best chances of observing Bearded vultures. Every year, individual birds are reported from here. The likelihood of observing Bearded vultures in the rest of the Bavarian Alps is much lower. The number of observations between 1988 and 2015 range from 75 in the Allgäu, to 16 in the Berchtesgadener area, and 12 in the Werdenfeller region. All Bearded vulture observations should be reported via www.ornitho.de. Alternatively, an online form is available at <http://bartgeier.ch/meldung>. <http://bartgeier.ch/>.

History and Perspectives:

Bearded vultures in the Pyrenees

Only one population of Bearded vultures dwells in the Pyrenees, distributed along the 450 km-long French and Spanish border. This population is currently isolated because of the progressive extinction of the species throughout the Iberian Peninsula. Thanks to protection measurements the population has increased and in the central Spanish Pyrenees capacity is nearly reached. Now it's time for the vultures to colonise a wider region of this mountain range.

Bearded vultures have been found as a breeding species in the Pyrénées-Atlantiques since the 1960s by the Terrasse brothers and a group of passionate ornithologists, who extended their surveys to the Spanish Pyrenees, to High Navarre and to High Aragon, along with the expert Rafael Heredia and other Spanish ornithologists. The 1960s and 1970s were a time of surveying, the Pyrenees being then hardly accessible, but also a very dark time for the large vultures, considered as pests until their legal protection in the early 1970s. The Bearded vulture monitoring (numbers surveying, nesting monitoring) may be considered as exhaustive since 1978-1980.

The nesting habitat of this species consists mainly of large calcareous cliffs. The lowest known eyries are 650 metres high, whereas the highest ones in the central Pyrenees are 2550 metres high.

The Pyrenean population has been estimated at around 30 pairs in 1980, of which 20 pairs in the central and western Spanish Pyrenees and 10 pairs in the western half of the French Pyrenees. Despite the creation of national parks, the Bearded vulture population is on the verge of extinction; nest robberies for collectors, shootings and poisonings are mainly responsible.

The legal protection of the species and the Pyrenean chamois' population restoration especially in Catalonia were key factors to the restoration of the numbers and the area of the species from the 1980s onwards on the Spanish side. Feeding sites have been set up in the 1980s on both sides of the border, in order to improve not only the situation of the Bearded vulture but also the situation of the Egyptian

vulture and the Griffon vulture, two species also in a critical situation, as well as surveillance campaigns of the eyries the most exposed to human disturbance. Enhanced by the first Spanish Action Plan, implemented as soon as 1988, these measures allowed the Spanish population to grow up to 50 pairs in the 1990s. On the French side, the numbers increase much slower (15 pairs in the 1990s).

A European LIFE programme has tried to reinforce the conservation means of the most threatened large Pyrenean fauna in the middle of the 1990s: Bearded vulture, Brown bear and Pyrenean ibex (*Capra p. pyrenaica*). This plan was implemented too late for these last two species, and more or less well accepted reintroduction programmes have been carried out years later with exogenous sub-species. Nevertheless, this programme has catalysed a successful rescue for the Bearded vulture through out the Pyrenees: it allowed developing numerous studies, and the Bearded vulture conservation has become a major concern of the environmental politics applied throughout the massif between France, Spain and Andorra.

New threats

The French and Spanish population has grown from 65 pairs to 180 pairs between 1995 and 2015. Half of them currently nest in Aragon and in the central Spanish Pyrenees; Catalonia and France share the other half with Navarre (7 pairs) and Andorra (1 pair). The numerical evolution of the population is comparable in the three main regions (Aragon, Catalonia, France) during this period. However, the area restoration

has been slower in France. The population remained in the western part of the massif until the 20th century thanks to a vivid traditional pastoralism whereas the species disappeared from the eastern part of the French side of the massif and from a large part of Catalonia. The recovery of the former area started in the 1980s on the Spanish side, mostly thanks to the creation of reserves in Catalonia, while it happened gradually from 1995 onwards on the French side, thanks to a network of specific feeding places supplied in winter from the central Pyrenees to the Mediterranean region.

The population is still growing to this day, but new threats have appeared in this changing mountain habitat, because of the economical and tourist development as well as the changings in pastoralism. Road and electric network, ski resorts, electric power plant, forest activities and outdoor tourism development as well as the exponential increasing of helicopter overflights and the regular arrival of new activities remain a challenge for the conservation of the species and its habitats, particularly on the French side where these activities regularly affect the breeding success. Meanwhile, collisions with cables, illegal shootings because of the bad press of the Griffon vulture and the increase of the illegal use of poison since the reintroduction of the Brown bear and the presence of the Grey wolf in the eastern part of the massif have made the death rate worryingly increase, which affects the viability of the species. In addition, lead poisoning due to lead shots found in ungulates carcasses, which are an important part of the



In the Pyrenees, original populations of Bearded vultures could survive the longest in all of Europe. This population should now act as a source population to revive other regions naturally.

Bearded vulture's diet, reduction of food availability in Spain after modifications of the health directive, and more recently the launch onto the market (in Spain) of the drug Diclofenac, responsible for the near extinction (between 95 and 99%) of three species of vulture in Asia in the 1990's, are direct threats to the survival of Bearded vultures.

Range expansion

Nevertheless, major efforts of conservation have been carried out on both sides of the Pyrenees: on-the-spot official surveillance networks, food supplying, forest and game monitoring, military over-flight limitation, modification of hazardous electric lines (especially in Spain), raising awareness of users, managers and inhabitants, and research projects for conservation launching. The situation of the Bearded vulture has substantially improved thanks to the motivation of many naturalists, professional technicians and scientists, thanks to the responsible management of

the administrations of the massif, thanks to the financial support from the local, regional, national and European authorities, and thanks to the natural interest of most of the Pyrenean inhabitants.

What perspectives do we have for the Pyrenees, apart from carrying on our efforts? Even though the French population is still in a recolonization phase and the one in Navarre remains fragile, the population of the Spanish central Pyrenees (Catalonia, Aragon) seems saturated: an important percentage of trios (>30% of the breeding territories) has been counted and the productivity of the dense central core of the population is decreasing. Now, this nice population has to recolonize other massifs in order to guarantee the long-term conservation of the species in western Europe, where in the end only 220 pairs bred in 2015.

To reach that goal, we try to stimulate the dispersal of the non-territorial Pyrenean individuals to the north-east of the massif in order to increase exchanges between the Pyrenees and the Alps via the Mas-

sif Central, where the species is currently being reintroduced, thanks to a feeding program carried out between these two massifs: these exchanges would allow a better genetic variability. The first successful reproduction in 2015 in Andalusia is the first step toward the success of this reintroduction program, and can be seen as a strong signal on the path we have to follow.

Martine Razin, Antoni Margalida, José María Martínez



Martine Razin has been working for LPO (BirdLife France) on monitoring Bearded vultures in the French Pyrenees as well as the successful national Action Plan since 1994.

José María Martínez is a biologist and works for the government of Aragon, specially monitoring the population of Bearded vultures in this region.

Antoni Margalida see page 15

Bearded vultures beyond the Alps: Steps to reach the Pyrenees...

Almost 30 years after the first releases of Bearded vultures in Haute-Savoie and Austria, the Vulture Conservation Foundation pursues its goal of recreating a metapopulation of Bearded vultures between the East of Europe, and North Africa.

After the excellent results obtained in the Alps, the VCF has decided to adapt its strategy. It would have been tempting to stop the releases as the number of young birds born in the wild in the Alps had significantly exceeded the number of birds released annually. However, other options have emerged to colonize the territories abandoned by the species starting with Andalusia or Sardinia and considering in the long term, a return of the species in the Balkans.

The importance of poison, which in the Alps remained anecdotal, has unfortunately become a major issue in Sardinia where the first project initiated in 2008 failed with the poisoning of three released birds, and in Andalusia where fortunately a very dynamic poison control campaign helped overcome the first missteps. In 2015, the first for more than 30 years wild bred Bearded vulture in Andalusia fledged.

France, after more than forty years of protection and reintroduction of

vultures, became a kind of “good student” for scavenger birds’ conservation.

This has certainly been important to reassure the members of the VCF and engage this foundation alongside the Regional Natural Park of Vercors and LPO in the “Corridor” project between the Alps and Pyrenees.

Other arguments encouraged them, such as the presence of Black and Griffon vultures, the reintroduction programs in the south of France, are both remarkable success and tangible proof that the conditions are right to allow a successful return of the “bone-breaker”.

On a strict Alpine extension plan point of view, apart from the fact that this project perfectly fulfills the different required criteria, it represents for this species a great interest. Centrally situated, Drôme and Grands Causses attract birds to a sub-Mediterranean type of habitat, which extends in the south of France from Vercors to the first reliefs of Aude. The Bearded vultures have certainly begun colonizing the cliffs of these sectors some centu-

ries ago. Their return to these habitats, used in addition by other species of vultures, opens new perspectives to complete the colonization from Asia to North Africa.

Finally, and this will not be the least of the advantages of this location, completion of an air corridor by the decision of future releases in Corsica, within reach of wings of the continent, must also promote movement of birds between the Pyrenees and the Alps, but more importantly, we hope, will save the genetic treasure that represents the remainder of this original population.

Thus, European populations will be opened up physically and genetically this way. This could enhance, with the future projects in the Balkans, a strong trans-European metapopulation, with real chances to link towards the declining population of the Maghreb.

In that perspective, several initiatives for the Bearded vulture conservation are emerging in the North African countries in particular in Morocco and Algeria.

To encourage these efforts and reflections, the VCF and members of the IBM wish to extend further, their relations and partnerships around the conservation of the Bearded vulture. No doubt all these energies will allow positive conservation of Bearded vulture from Maghreb to Asia.

Raphaël Néouze



Raphaël Néouze coordinates the vulture keeping and reintroduction programmes in Grands Causses in the south of France.

Centuries ago Bearded vultures had already settled the cliffs in south France. “Layrou” that was released in 2013, has taken the chalky rocks of the Jonte Valley for home now as well.

Photo: R. Néouze. Causse Méjean, 25.7.2015.



Hope for the Fight against poison Bait:

The Return of the Bearded vulture to Andalusia

The last time that Bearded vultures attempted to breed in Andalusia was in 1983. In 1986, only a single bird remained. At the time, shooting, poisoning and nest predation were the main reasons for non-natural mortality of this species. Two years later, the local government assessed the feasibility of a reintroduction project and the conclusion was that the mountain area around Cazorla in the East of Andalusia was suitable to support 15 breeding pairs.

In 1996, a collaboration with the “Foundation for the Conservation of Bearded Vultures”, the predecessors of the present international Vulture Conservation Foundation (VCF) facilitated the creation of a breeding centre with aviaries in the mountains around Cazorla. The Guadalentin breeding centre is exceptionally successful with regards to breeding and survival rates: With a total of 22 birds which include 7 breeding pairs, this is one of Europe’s leading facilities for breeding Bearded vultures.

To increase the likelihood of survival after release, the project leaders worked to establish a charity, the Fundación Gypaetus which also took on responsibility for the vultures in captivity. In 2004, this resulted in a LIFE project and action plan against illegal poisoning.

The reintroduction project in Andalusia is a multi-disciplinary project with many partners: the VCF is coordinating the European breeding network, the Doñana Biological Station provides scientific support and the Gypaetus Foundation very much functions as the executing body. The plan is coordinated by the Regional Plan for Recovery and Conservation of Necrophagous Birds.

Many of the released vultures move vast distances and seem to return to mountainous areas near their release locations. Other birds exhibit a roaming behaviour along the entire mountain range of the Iberian Peninsula, even as far as the Pyrenees. However, these birds too return to the mountains around Cazorla. A total of 37 young vultures have been released

between 2006 and 2015. At least ten of these have so far been found dead. Four birds died after feeding on poisonous baits which had been left to control predator numbers and two birds were poisoned inadvertently by the lead content of ammunition. The cause of death of the other four vultures is unknown. After the fourth poisoned vulture was found in 2011, further releases were temporarily halted. An effort was made to fight the poisoning of animals which included the use of specially trained dogs to find poisoned baits. Furthermore, the efforts were supported jointly by forestry wardens, nature conservation police, local shepherds and hunters. Since 2012, further birds have been released and no further losses have been reported to date.

In 2015, a pair of vultures consisting of a male named Tono and a female called Blimunda successfully fledged their first chick in the wild. The chick was called Esperanza – Hope. A second pair (male Hortlano and female Marchena) were observed mating in their territory and two further territories were occupied by females without a mate. The reintroduction project is making great progress, however care needs to be taken and the fight against the poisoning of animals will continue

Rafael Arenas González



The biologist Rafael Arenas González is coordinating projects on the release of vultures in Andalusia and their protection. He is also the president of Gypaetus.



The first Bearded vulture hatched after over 30 years. The female chick was named Esperanza – Hope and was ringed and tagged before fledging.

Photo: R. A. González.

Bearded vulture: Last autochthonous Island Populations

During the 19th century, the Bearded vulture suffered a significant decline in Europe, disappearing almost everywhere, and consequently the European populations became isolated from each other, decreasing their viability. The different island populations became more isolated and the Bearded vulture also disappeared from Sicily and Sardinia. On Sicily (the biggest Mediterranean island, the Bearded vulture vanished in the beginning of the 20th century with the last bird shot on the 30th of March 1916 on Mt. Siccia (Messina Straits). Sardinia (the second biggest island) hosted a population of about 35-40 breeding pairs towards the end of the 19th century. Nevertheless the species disappeared from the island in 1967 or 1968. Today, Bearded vultures live on only two Mediterranean islands: Corsica and Crete.

The French island Corsica and the Greek island Crete have a similar surface (around 8.500 m²) and mountains as high as 2.500 m. Despite this, there are also some dissimilarities: The average height on Crete is only 200m and its vegetation is very degraded by human action. In contrast half of Corsica is covered with forest and two-thirds are covered with mountains, forming a single mountain chain. Since the end of the 20th century both populations have been exhaustively monitored: they both show a similar number of occupied territories, but with a completely opposite population's tendency. While the breeding population on Crete is slowly recovering and growing, unfortunately the Corsican population is decreasing.

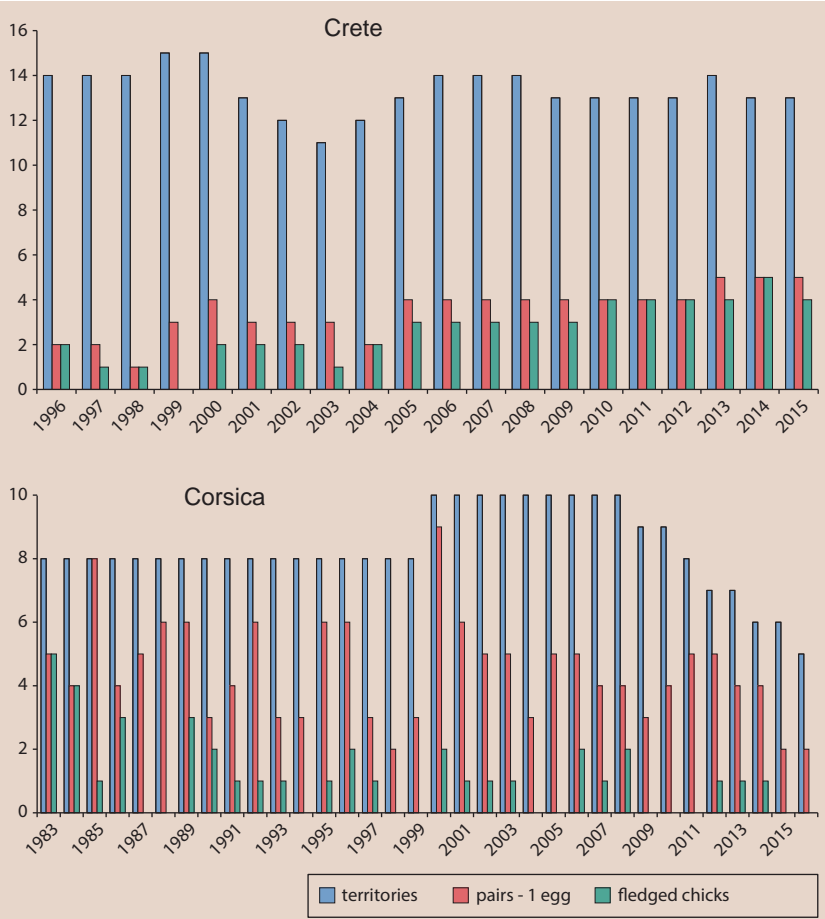
The Bearded vulture is a legally protected species on Crete since 1979. Although in the late 90s and early 2000s the situation was fragile, with only four breeding pairs and poor breeding success (between zero and two fledglings per year). The implementation of four LIFE projects helped to decrease the threats in Crete –principally shooting and poisoning could be controlled. Since then the population slowly recovered, showing in the last ten years a higher breeding success (0.9 fledglings/ nesting pairs) and productivity (0.6 fledglings/reproducing unit). Even if the threats which caused the declines are nowadays controlled, new ones appeared. Because of the big energy demand of the island, it has been necessary to install large solar energy plants which degrade the

environment. More worrying is the planned installation of wind farms in several points of the island which will affect 71% of the breeding sites. Although the species in Corsica is protected, the population is suffering a severe decline. During the last 25 years the number of fledglings was very low (between zero to two fledglings per year). More worrying is that the last ten years the number of occupied territories decreased from ten to six, and in only four years the number of nesting pairs decreased from five to two. This dramatic evolution is partly due to a decline in the main natural food resources. In former times large numbers of small domestic ungulates lived on the island and are now reduced to comparatively small flocks of *Ovis orientalis musimon*, insufficient to provide enough food for a healthy Bearded vulture population. The disappearance of the extensive livestock farming of domestic ungulates has caused the loss of grasslands and consequently the natural encroachment of open spaces, reducing additionally the accessibility of the few existing food resources. In addition, the genetic diversity of the Bearded vultures is very low and inbreeding might be a problem.



Only few Bearded vultures live in the Corsican mountains. Intensive protection efforts are trying to save the birds for the future.


Photo: F. Lörcher.



Demographic data of the island populations show a significant decline in breeding pairs and chicks within the last 25 - 30 years in Corsica, in contrast to relatively stable numbers of breeding birds in Crete, where the number of chicks increased.

med a similar meta-population with birds from the Balkans. Given the limited area, Bearded vultures were probably never abundant on both islands, and their survival depended on a healthy habitat with abundant food resources. Furthermore the co-existence of neighbouring island and mainland populations assured the genetic variability on the islands. The genetic diversity present on Crete is almost double the genetic diversity on Corsica. This might be due to the shorter time the population is isolated from the surrounding bigger mainland population and a population growth on Crete instead of a population decline on Corsica. To ensure the longterm existence of the Bearded vultures around the Mediterranean one goal of the Vulture Conservation Foundation (VCF) is to re-establish the former meta-population across from Andalusia, the Pyrenees, Alps, Corsica and Sardinia, and the Balkans.

Franziska Lörcher, Alex Llopis Dell



Franziska Lörcher is a biologist and did her master thesis on the genetic diversity in Bearded vultures in the Alps. She works for Pro Barteiger in Switzerland and the Vulture Conservation Foundation, mainly on Bearded vultures.

Dr. Alex Llopis Dell s. Seite 23

Metapopulation around the Mediterranean Sea

The Corsican and the Cretan Bearded vultures are both remaining populations from a former meta-population around the Mediterranean Sea.

Genetic studies show that before the extinction of the Alpine population at least the Bearded vultures from the Pyrenees, Alps, Corsica, and Sardinia were forming a meta-population with genetic exchange. It can be assumed that the Cretan Bearded vultures for-

A young Bearded vulture near Dikti, Lassithi Plateau - hunting and poisoning are no threats any more for vultures on Crete, but with renewable energies increasing they are facing other threats like wind farms.

Photo: V. Pitropakis. 2016.



South-East Europe:

Vultures in the Balkan Peninsula

During the 19th century the Balkan Peninsula was a stronghold for the four vulture species in Europe, and probably looked very much alike the Iberian Peninsula nowadays. Over the 20th century (especially the second half) the trend of vulture populations in Europe was mostly negative and resulted in narrowing their distribution ranges. The Balkan vulture populations also faced intensive decline and disappearance in some regions especially after World War II. The species were not extinct, but survived as small populations on below the critical minimum. At the end of the last century vulture conservation efforts seemed to be effective in the other parts of Europe (Spain and France), numerous conservation projects managed to stop the negative vulture trend and showed incredible success in reintroducing some of the species in areas where they were extinct for decades. This was not the case in the Balkan region; here the vultures were still suffering serious threats and the non-existence of an active system for their protection lead to extinction of the species in some of the Balkan countries.

The critical vulture situation in the Balkan Peninsula provoked a discussion among the leading vulture conservation organizations at that time: the Foundation for Conservation of the Bearded Vulture (FCBV) and the Black Vulture Conservation Foundation (BVCF); the vulture experts recording successful work on the Griffon Vulture reintroduction in France, Black vulture reintroduction in Majorca (Spain) and France and on the massive reintroduction project

for the Bearded vultures in the Alps. As a result, the decision was taken to start up a vulture conservation programme for the entire Balkan region. This initiative was mainly driven and financially supported by the Frankfurt Zoological Society (FZS).

Therefore, in 2002, an 'Action Plan for the Recovery and Conservation of Vultures on the Balkan Peninsula and Adjacent Regions' (in short called: Balkan Vulture Action Plan - BVAP) was drafted as a joint effort of many

national and international entities, coordinated by the Black Vulture Conservation Foundation - BVCF until 2009 and since 2010 the responsibility was taken by the Vulture Conservation Foundation - VCF. The FZS was a major player in the BVAP providing the baseline funding for the coordination of the projects and direct funding for specific projects in the Balkans. International entities such as BirdLife International, the International Union for Conservation



In aviaries, Griffon vultures, including those from Spain, have time to get used to the surroundings before they are released to strengthen the local population and to disperse.

Photo: F. Lörcher.

of Nature - IUCN and the “Ligue pour la Protection des Oiseaux” - LPO were also involved in the BVAP.

The aim of the Balkan Vulture Action Plan (BVAP) is to design and develop a long-term strategy for the recovery of the four vulture species on the Balkan Peninsula - an important part of their European distribution area, creating the best possible conditions for natural recovery, and, where necessary, implement reintroduction or restocking projects. The strategy of the Action Plan is based on local and international cooperation, in which international organisations provide expertise to increase professional skills and capacity of local project partners, who implement the projects actually.

Within the first decade of the BVAP, all the countries from the region were participating in the Balkan Vulture Action Plan (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Macedonia, Serbia, Turkey and Ukraine), and no less than 34 NGOs and Institutions were involved. A political framework has been achieved with the signing of Memorandums of Understanding between the governments and the NGO consortium of these countries, giving the BVAP stability and recognition in the long term. During this period about 50 different projects have been initiated, some of them continuously were operating for more than ten years. Furthermore, workshops, seminars and meetings have been organized on a regular basis. About two million euros were invested in vulture conservation within the BVAP during the period 2002 - 2012, mainly provided by the FZS.

Threats to Vultures in the Balkan Peninsula

The main cause for the decline of vultures in the Balkan region and the current limiting factor for their recovery is the use of poison against wild predators that come into conflict with human activities (mainly livestock farming and hunting). This is not the only threat affecting the vultures in the region, as they also face a lack of food, loss of habitat, collisions with power lines and wind-turbines.



The population of Griffon vultures in the Balkan Peninsula is estimated at about 600 – in contrast to other vulture species, Griffon vultures are currently thriving in some countries of the Balkan peninsula.

Photo: T. Krumenacker.

Habitat loss was a serious problem in the past, during the industrial and traffic infrastructure development. The shooting of large birds of prey was a common practice mainly during the first half of the last century, when vultures were considered as popular trophies among hunters and soldiers, but at present, since this practice is now illegal in all of the countries from the region it is not considered to be a limiting factor for the species. Although, the land abandonment and the intensive farming and agriculture had and is still having a negative impact on the food source (quantity, availability and quality) for the species. The extensive-traditional farming was much more favourable for vultures – more food was available in the field. The intensive and modern agricultural practices include a greater use of pesticides (insecticides, herbicides and rodenticides) that have toxic effects to vultures. The use of poison to combat or control predators (wolves, foxes, feral dogs, etc.) is definitely the main threat to these species in the Balkans, and has contributed to the regional extinction or severe depletion of all the vulture species in the region.

During the 50s and the 60s, and in some of the countries until the 90s, poisoning was a legal practice imple-

mented by the authorities in order to control wild predators. These were dark decades for wildlife and especially for vultures, and not only in the Balkan countries but also across the Mediterranean.

At present this practice is illegal in Europe, including the Balkans, but it is still in use by local people as a quick “solution” for resolving the conflicts with the predators. The main driver for such an intensive use of poison is the fight of livestock breeders against wolves. Its widespread use has also been facilitated by the poor enforcement of the legislation and the free availability of poisoning substances on the markets.

Vulture Conservation Actions

The intensive vulture conservation work in the Balkan region starts with the implementation of the BVAP (in 2002), before that, little information was available and only in some countries regarding the status of the vultures and their threats. Therefore, the BVAP projects were including the data gathering on the status, distribution, identification of threats and conservation needs in the region, also anti-poisoning campaigns, feeding and monitoring programmes, habitat restoration and conservation

measures, increasing public awareness and environmental education was implemented where possible.

The outstanding efforts and endless motivation of all the BVAP partners have led to some remarkable results in the past decade within the BVAP:

- Capacity and equipment for project management and vulture conservation work were created or strengthened mainly in the NGO sector in most of the countries.
- A lot of effort in monitoring activities: the territories, status and trend of the four vulture species in the Balkan region are known.
- All vulture threats have been identified in the region and where possible corresponding actions were implemented.
- A feeding sites network was established across the region, about ten feeding sites were established and maintained between 2002 - 2012, to provide safe food to vultures.
- Promotion of traditional agricultural practices.
- Public awareness and education of the public, NGOs and governmental institutions.
- Development of eco-tourism – promoting vultures.

In 2012 the FZS dramatically reduced the funding for the BVAP due to the change of their internal strategy of funding and as a result some of the projects stopped. Some of the BVAP partners-entities with greater resources and from the EU members countries managed to secure funding from other sources such as the Life+ programme of the EC. Several important Life+ vulture conservation projects were initiated: one led by Green Balkans: “Vultures Return in Bulgaria” - The reintroduction of the Griffon Vulture in Bulgaria and the specific Life+ project on the Egyptian Vulture in Bulgaria and Greece “The return of the Neophron” led by the Bulgarian Society for Protection of Birds – BSPB, Hellenic Ornithological Society, HOS and Dadia – WWF Greece. These two projects are recording remarkable results but of course are not assuming all the vulture conservation work in the region, therefore funding is still needed in the region as vulture conservation must be always considered on a wider regional level as vultures are constantly moving from one to another country.

Although the BVAP has no funding secured in the last few years, it

has to continue to focus on connecting all of the partners, collecting data and relaying them between partners and to the international public, such as the development of regional projects in the direction already targeted at the last BVAP meeting, including the Balkan Anti-poison Campaign and the establishment of a network of feeding sites, a common monitoring scheme, a reintroduction strategy and special action for conserving the Egyptian vulture.

Current situation

Of the four vulture species, the Bearded vulture and Black vulture are now on the edge of regional extinction, with the first one virtually gone from the Balkan Peninsula. The last population of Bearded vultures in the region is on Crete, numbers around six pairs, and of the Black vultures in Dadia, Greece, around 28 pairs (90-100 individuals). The number of Egyptian vultures has declined by more than 80% in the last 50 years, and continues to fall. This species is still present in Bulgaria, Macedonia, Greece and Albania, totalling around 60 pairs. Only the situation with the Griffon vultures looks positive, showing positive trends in parts of its breeding range (Croatia, Bulgaria, Serbia and Crete-Greece), but has also been depleted and has disappeared from many countries (Albania, Bosnia & Herzegovina and Montenegro), whilst in the rest, isolated and small populations are highly threatened (continental Greece, Macedonia). A total estimate for this species in the region is up to 600 pairs.

Jovan Andevsk



Jovan Andevski is a biologist and has been involved in vulture conservation in Macedonia since 2003. Since 2008 he has been coordinator of the Balkan

Action Plan for vultures. He also was involved in reintroduction projects of Black vultures in France and Griffon vultures in Bulgaria.



In Madjarovo, Bulgaria, currently three different vulture species can be observed. Griffon vultures and Egyptian vultures are breeding here. Black vultures are regularly seen, coming from neighbouring Greece. In Madjarovo, there is a visitors centre to inform about vultures and other animals of the region.

Photo: F. Lörcher.



From Summer Guests to Breeding Birds: Griffon vultures in the Alps

The Alps stretch across 1200km from Provence in southern France to the northern foothills of the Balkan peninsula in Slovenia. Griffon, Black and Egyptian vultures have historically bred only in the southern foothills, but the Bearded vulture can cope with a harsher climate and is also breeding in the central Alps. Griffon vultures from neighbouring regions move to the southern Alps in the summer. The biggest mountain range in Europe represents the northern frontiers of the Griffon vulture breeding area in Europe. The number of birds overwintering in the Alps is constantly rising.

Beyond the forest frontier the Alps are distinguished by open grasslands, where the vultures search for food. Wide, formerly open areas in the southern limestone Alps, are intensively forested today due to a decline in natural grazing. The alpine pastures are grazed by numerous livestock that serve as a food source for vultures. Year-round availability of food is the most important factor for the future of the vulture population in this area.

Until the end of the 19th century, Griffon vultures were breeding at numerous places in the Prealps, and for some time longer in the Central Massif region. Griffon vultures disappeared from large areas of the Italian

Alps around 1900. Breeding presence in the Maritime Alps, in Venice and Friaul are suspected but reliable data is not currently available. There were a small number of suspected breeding pairs in the northern Alps but these disappeared in the early middle ages.

Only in the eastern Alps has the Griffon vulture never completely disappeared. The Griffon vultures of the eastern Alps originate from Croatia and they spend the summer here. The amount of vultures who spend the summer in the Alps is directly related to the number of breeding birds in the areas of origin. With the collapse of the vulture population in the Balkans, the number of summer guests decreased steadily. Thanks to intensive pro-

tection efforts the population in Croatia has been continuously increasing over the last 20 years and currently amounts to approximately 130 breeding pairs. Additionally, in the Regional Natural Reserve of Lake Cornino in Friuli, Italy a new colony has been created, currently with 35 breeding pairs, through the release of 75 Griffon vultures. A feeding site built at the reserve provides food for both the local Griffon vulture colony as well for the migrating Croatian vultures. Next to the feeding area is a visitor centre from where the vultures can be viewed feeding.

The greatest number of Griffon vultures that spend the summer in Austria choose the Hohe Tauern



Hurled down cattle provide the food base for Griffon vultures in the Alps – carcasses are discovered mostly within short time and used up completely.

Photo: M. Knolleisen. Hohe Tauern NP, Austria, 6.8.2013.



A Griffon vulture above the snowy eastern Italian Alps – the significant higher east Austrian Alps further north are only visited in summer.

Photo: F. Genero. Karnic Pre-Alps, Friaul-Julisch-Venezia, Italy, 11.12.2014.

National Park as their home. A small group of Griffon vultures lives in the Salzburg area throughout the year. These birds, less than ten in number, are free flying zoo birds. The first summer guests reach the eastern Alps in May and stay there until October. The presence of Griffon vultures in the Austrian East Alps has been documented for decades. The number of vultures spending the summer has been relatively steady in the last 100 years, despite strong yearly fluctuations. Current numbers indicate 30 – 50 vultures. In the whole of the eastern Alps (Austria, Italy, Slovenia) the number has been rising significantly for years, which mirrors a positive trend in the places of origin (Friuli and Croatia). Nowadays, 250 to 300 summer guests can be expected.

French Alps provide for Vultures

Griffon vultures have been a rare sighting in the western Alps since the extinction of the breeding grounds in southern France around 1900. After the successful reintroduction in the Central Massif, a total number of 227 Griffon vultures have been released since 1996 in the French Prealps. Today approximately 200 pairs are breeding in this area. The area visited by the French Griffon vultures is expanding eastwards from year to year: a few years ago one could only see those who chose to spend their summer in western Switzerland.

Today there are migratory flights as far as the west of Austria.

Areas that are suitable for Griffon vultures throughout the year are much larger in France than in the eastern Alps. Decisive for the repopulation of an area by the Griffon vulture is the handling of dead grazing animals. In Italy most of the carcasses are being disposed or buried. In France though, through the reintroduction projects, some feeding sites have been created, where local farmers can deliver their dead cattle. This results in a year-round food source for the vultures. The placement of the feeding sites depends on the amount of suitable carcasses and is therefore relatively similar to the natural environment. Conversely, in Friuli there is only one feeding site. In both areas the feeding sites play a central role throughout the winter.

For decades almost all carcasses in Austria were flown by helicopter to be disposed of in the valleys. Today the decision over disposal is the responsibility of the local veterinarians. Since the beginning of the Bearded vulture reintroduction there has been intensive discussion towards that subject and an appropriate change of thinking has taken place. Ever more often farmers are allowed to leave their dead cows at the mountain pasture and are saving themselves as well as the community a lot of money.

Every year in the middle of August, all known vulture roosting places in the Alps are inspected: In 2011 there

were 550 Griffon vultures, and in 2015 the number had risen to 1732. Most of them (90%) are being counted in the western Alps. The biggest roost accounted for over 400 vultures in 2015.

Thanks to the protection projects in Friuli and in southern France there is once again a link between the western European Griffon vultures (Balkans and Spain) and there is a growing population in the Alps. The number and the duration of stay of the Griffon vultures in the summer is associated with the availability of food and therefore with carcass management. A transnational vulture friendly solution for the problem is yet to come.

Michael Knollseisen, Fulvio Genero



Michael Knollseisen is a freelance biologist and alpine farmer. For 16 years he works about Bearded and Griffon vulture in the Hohe Tauern National Park. He breeds sheep and hen on his farm in the mountains of Kärnten.



Fulvio Genero is a worldwide expert on vulture conservation and a member of the advisory board to the Vulture Conservation Foundation. His work focus is on reintroduction of Griffon vultures in the eastern Italian Alps.

Success in Massif Central and Southern Alps: The return of Griffon vulture in France

Let's try to dive back into the French and European atmosphere in the late 1950s, when the first ornithologists (including us) tried to assess the situation of raptor and vulture populations. In the case of France, the war raged on against birds of prey, by then regarded as pests: shootings, strychnine or pesticide poisonings, destruction of nests or thefts of eggs for museums or collectors had led these birds to the edge of extinction. Maybe there was a chance to get them back to dive the sky above Southern France? A story of success.

The Pyrenees seemed to be the last refuge for the vultures, and our first discoveries in 1960 (first Griffon vulture colony and first Bearded vulture eyrie) were acclaimed by the ornithological press as a significant event. Only about 30 pairs of Griffon vulture, a few dozen pairs of Egyptian vulture and less than 10 pairs of Bearded vulture remain on the French side of the Pyrenees. No Black vultures have been spotted in over 50 years, and we have to face that overwhelming obvious fact: vultures would disappear from the skies of France... if nothing was done. The first step was to ensure the Pyrenean colonies protection, and the first feeding stations were a success, along

with education campaigns. Around this time, we sought survivors in the Grands Causses gorges (Massif Central) where the Griffon vulture remained common until the 1920s, but in vain.

Vast empty skies ...

Whereas we were enthusiastically improving our knowledge of Pyrenean and Spanish vultures and setting the first protection measures, the 1960s were deeply marked by the nostalgia of our trips in the Grands Causses, where we could not get used to those empty skies over the gorges and the canyons.

That is how this mad idea to reintroduce the Griffon vulture germinated, like a bet started by some friends that are crazy about these birds and unable to resign to their absence.

But how to get there? That is a long story, and fortunately new driving forces (gathering the few European and French ornithologists interested in this species, under the guidance of the Intervention Fund for Raptors - Fonds d'Intervention pour les Rapaces -, now known as LPO Bird-Life France, and the National Park of the Cévennes) joined us to imagine and build up this project.

When this adventure officially started in 1968, little was known about Griffon vultures' biology. In particular, immature vagrancy, which drags many young vultures to Spain and even Africa was under-estimated.

The first four chicks, captured in the nest with the approval of the authorities from Spanish Navarre, were released after a year of captivity in an aviary, located across the last known colony.

These few juvenile birds released in 1969 and 1970 either disappeared (electrocution, shooting, poisoning...) or slowly drifted away, driven by their migratory instinct. After this relative failure, we decided to postpone the next releases in order to keep the vultures at least four to five years in the aviaries so the adult birds became sedentary. Getting releasable

Clearly this Griffon vulture above Jonte valley can be identified as young with its brown collar.

Photo: O. Duriez, October 2009.



birds became very difficult without any international CITES regulation. It took over ten years of trial and error to consider the first releases, during which about forty vultures were obtained. Most of the help came from the zoos but some birds were seized from traffickers or born in our own aviaries. This long period however was not useless. An anti-poisoning campaign allowed us to raise awareness in the local hunters and slowly but steadily obtain the ban of Strychnine. The experience was near the end when the first aviary opened in 1981. A brand-new technique was set up for the releases to have the best chance of success: we decided to wait until autumn for this world premiere. This time of the year was picked because of the first displays of reproductive behaviour that we considered as the best chance to settle the first pairs.

First reproduction the following year

This project, that had started more than ten years ago, was considered as a failure by most of the distant observers. People in charge of monitoring the first pioneer vultures, released during a rainy autumn, had a hard time searching the birds, who spread out in the vastness of the Causses. The first accidents (electrocutions and the inability to adapt were the main causes of loss of birds) and the dispersion of the pairs already formed in the aviary could make us fear the worst...

Who could have imagined that four couples were going to gather during that winter of 1982 and build nests straight away in the very cliff where the 1920s' survivors had built their last eyrie? And the cherry on the cake was the presence of an egg and an unhoped-for hatching, a red-letter day for the beginning of this adventure.

With the release of about sixty vultures until 1986, the colony grew bigger around the initial core of the first released pioneer pairs, slowly at first then faster and faster.

This successful return in the south of the Massif Central soon gave ideas to our neighbours, helped by the new vagrant Spanish vultures flying to



Pairs of Griffon vultures are mostly wandering together. In twos, the birds fly above the colony like the one of the Tarn canyon in Southfrance, and mark the great success of the projects.

Photo: O. Duriez. May 2010.

the north-east. The Alpine naturalists (southern Alps) took part in enabling the return of these scavengers in all the southern regions of France. A convention was signed to start the next projects under the guidance of the French Ministry of Environment, with the help of the Spanish regions which provided birds for the releases.

The original technique, successfully tested in the Grands Causses, was complemented and sometimes enhanced (cf. Griffon vulture technical guidebook), and other Griffon vulture programs were successfully launched as soon as 1994 in the Baronnies then in the Diois region and the Verdon Alps. The last step was the launch of the Black vulture reintroduction project in France with the same network, along with Black Vulture Conservation Foundation. The release techniques had to be adapted, using either the hacking technique for the chicks born in zoos or acclimatisation in aviaries for the older wild birds brought back from Spain.

Towards a Europe of vultures...

Today, one may be amazed when we look back at what a long way we've

come! 50 years later and despite the fact that the vultures had totally disappeared from these regions, the south of France is once again overflowed by these two species. About 800 pairs of Griffon vultures now breed in the south of the Massif Central and in the Alps. A population of about 30 pairs of Black vultures now breeds in the same area. The most impressive thing is the reconstitution of major migratory flyways from Spain to the south of France. Thanks to similar projects aiming to reintroduce the Black vulture in the Pyrenees (Catalonia), this species now dares to take part in this grand journey, which may lead vultures to the north of Europe and prepare them to settle in new areas.

One may surely say that the Europe of vultures is on its way.

Michel Terrasse, Olivier Duriez



Olivier Duriez is a scientist at the University of Montpellier. His focus is on biology and behaviour of vultures, mainly in connection with protection measurements.

Michel Terrasse s. page 20

Help from Crete:

Griffon Vultures in Cyprus

Historically, the Griffon vulture used to be common and widespread on Cyprus. Until the late 1950s - early 60s, hundreds could be counted at carcasses. Since then, a decline of the population of at least 100 individuals has started. Of several vulture colonies on the island, only the largest at Episkopi cliffs still exists today.

After the Turkish invasion of 1974 and the de-facto partition of the island, the Griffon vulture had been exterminated from its northern colonies at Pendathaktylos range by the mid-1980s, even though Episkopi cliffs, the largest colony on the island, produced ten (six successful) nests in 1979 and 16 in 1982. The species was still considered as “fairly common resident but slowly declining in numbers.” The population was estimated at 20-30 pairs in the mid-1990s but declined to eight to ten pairs by 2000.

The reasons that led to Griffon vulture decline are summarized as follows:

- mortality due to poisoned baits placed for the control of foxes and feral dogs in livestock areas

- reduction of food availability due to the change from traditional, extensive livestock husbandry to intensive farming, and changes in the disposal of carcasses due to relevant legislation
- disturbance during the nesting period due to construction of roads near colonies, low-flying aircrafts, quarries, visitors
- exclusion of livestock from Pafos forest and changes in the landscape due to reforestation

According to Cypriot Game and Wild Birds Law 152 (I) 2003, the species is listed as endangered. The population of the Griffon vulture in Cyprus has been declining rapidly over the past 20 years. A December 2012 population census covering all the species

range in the southwest part of the island estimated the wild population at ten to eleven individuals.

Despite past efforts made to help the population of the Griffon vulture in Cyprus, these have not been successful to reverse its decline. During the past decade, only one to three pairs have been reproducing annually, with the fate of the young vultures still uncertain.

The option for reinforcing the small Cypriot population with individuals from abroad was considered as the only realistic conservation action. Due to the island's small size, the existing population is vulnerable to environmental changes, disasters, but also inbreeding.

Codename “GYPAS” (Vulture in Greek)

The competent authorities in Cyprus in cooperation with Bird-Life Cyprus drew up a management plan for the Griffon Vulture, whose main conservation action was the reinforcement of the population with individuals from abroad.

The Vulture population in Crete was considered the most suitable one for the reinforcement of the Cypriot population because of its island nature, geographical proximity to Cyprus and similar ecological characteristics. Also, transportation logistics were much simpler from Greece than from any other country.

The project was carried out under the ‘Cross Border Cooperation Program Greece-Cyprus 2007- 2013’ and was co-funded by the European Regional Development Fund and national funds of Greece and Cyprus. The “Gypas” Project star-



At a vulture feeding station in Limnatis, Cyprus, marked birds from Crete have mixed with un-marked Cypriot birds.

ted in September 2011 and lasted for 29 months (January 2014). It was led by the Game & Fauna Service in Cyprus, and partners in the programme are BirdLife Cyprus and the Department of Forests in Cyprus, and the Natural History Museum of Crete and Gortyna Municipality in Crete.

During this project, 25 Griffon vultures came to Cyprus in four groups from June 2012 until November 2013. After at least a year stay in acclimation cages built within two feeding stations, they were released in the countryside. Releases commenced on December 2013 and were completed by early February 2015. Three of the vultures released were adults that were held at Attikon Zoo, Athens, for several years, were recaptured since they could not adapt to the wild. After agreement with Israel Nature and Parks Authority, these three birds were sent to Israel to reinforce their existing captive breeding programme. They have already reproduced and raised one chick.

Two chicks produced from a captive pair in Limassol Zoo in 2013 and 2014 were also tagged and released with the Cretan birds, after staying with them in cages.

Fifteen GPS/GSM loggers and one VHF transmitter were placed



At a feeding station in Limnatis, near Limassol, all vultures are regularly photographed by automatic cameras.

Foto: Game and Fauna Service.

on vultures to monitor movements and survival. No birds died or left the island during the time their transmitters were active.

An important monitoring tool was the use of motion-sensored wildlife (trail) cameras at the fee-

ding stations so to resight the marked (and unmarked=Cypriot birds) and to monitor survival of the released birds. Wildlife (trail) cameras were placed regularly since January 2014 to this day and monitor vulture visits at feeders. All but two of the released birds have been photographed at the feeding stations.

There is a need to bring more birds from abroad so as to build up a large enough number of pairs so to re-establish a viable breeding population, given that the limiting factors responsible for population decline cease to be that important.

Nicolaos Kassinis



Nicolaos Kassinis is a biochemist and wildlife manager. Since 1994 he has worked for the Cyprus Game & Fauna Service (GFS), mainly on the ecology of Mufflons on Cyprus and monitoring programmes for birds. He represents GFS in the re-introduction project for Griffon vultures and in the Oroklini Special Protection Area LIFE Project.



The habitats for Griffon vultures on Cyprus (picture) are similar to those on Crete, so re-introducing vultures from Crete seems to be a good solution to re-inforce the local Cypriot population.

Photos: N. Kassinis.

Improving the conservation breeding:

Eurasian

Black vultures EEP

The Eurasian Black vulture or Cinereous vulture is the largest and one of Europe's most impressive raptor species. Its current wild distribution extends from southern Europe to central Asia. Former breeding sites in northern Africa and most of central and eastern Europe have been lost in past centuries leaving currently less than 2000 pairs in two major wild populations in Europe. Alarmed by the dramatic loss of the wild populations in Europe, the European zoos, in collaboration with the Black Vulture Conservation Foundation (BVCF) established a conservation breeding and reintroduction programme for the Eurasian black vulture in 1987. This European Endangered Species Programme (EEP) aims firstly to sustain a genetically healthy and diverse captive population and secondly to be a source population for reintroduction programmes overseen with captive-born young.

Successful reintroductions to former natural habitats of the species have so far been carried out by the BVCF in cooperation with the EEP in Mallorca since 1988, France since 1992 and mainland Spain since 2007. Young birds originating from the EEP zoo population are released at an early age,

some weeks before their first flying attempts at well monitored release sites. Ideally, this so-called release by hacking attracts further wild vultures into the region and accelerates repopulation.

The Eurasian black vulture has been bred in European zoos since the early 1980s, with first successes

at Berlin Tierpark, Zoo La Garenne in Switzerland and Antwerp Zoo in Belgium. Contrary to the successes of the reintroductions, the EEP breeding programme itself suffers from limited success – a mere 20% of the eggs laid in zoos successfully yields surviving fledglings, and until a few years ago on average only four to five vultures are born in the European zoo population annually. In contrast, studies of natural populations in Spain and Greece, and reintroduced populations in France demonstrate that breeding success in the wild can be up to 70% to 90%. In the captive population, the majority of breeding failures seem to be caused by eggs being unfertilised and/or damaged. This can be attributed partly to the sensitive and nervous nature of the species. However, more importantly, the typical characteristics of the species' biology seem to interfere with achieving a good breeding success in captivity: Eurasian black vultures have long life spans and reach sexual maturity relatively late, they have long reproductive cycles and typically produce one single egg per breeding season, and they show strong monogamy with extensive bi-parental care for the nest, egg and offspring. Generally speaking in species with such characteristics the partners are very picky in whom they choose to breed with, and once chosen they form



Extensive greeting is part of the bonding process in a Black vulture pair. Successful breeding pairs show this behaviour.

Photo: T. Krumenacker.

strong pair bonds with associated behaviours. Indeed, detailed analyses of the behaviours shown in the zoo-housed birds indicate that a lack of pair-bonding behaviours appears to correlate with breeding failure. In the EEP matching up of breeding pairs used to be done based on genetic suitability, but unfortunately not based on partner preference. And this may actually be the key to improving the success of the breeding programme. After all, whether or not the chemistry between two black vultures is good cannot (yet) be inferred from the studbook.

Modern day matchmaking

To assist in choosing the “right” partner, dating aviaries were introduced at Planckendael Zoo (Antwerpen, Belgium) during the mid-1990s. The idea behind these aviaries is to house several young unattached vultures of both sexes together, and allow naturalistic mate choice to occur spontaneously. Instead of a human matchmaker deciding for them, literally the chemistry between two individuals will tell whether they pair off and should be moved to a more private breeding enclosure. So far, the concept has proven successful repeatedly, for example, pairs matched up in Planckendael’s dating aviary and subsequently moved to another zoo as a pair, seemed to be more successful breeding partners. Standardised observations of the birds’ behaviours, initially established for evaluating the individuals in Planckendael’s dating aviary, are now carried out during breeding season in various EEP zoos by scientific staff, keepers and university students to better understand the development and quality of pair bonding behaviour in Eurasian black vultures. In 2016 the EEP aims to establish a second dating aviary in the Netherlands to expand the possibilities for the formation of suitable pairs.

As part of trying to better understand the relatively low breeding success in the zoo population we started to perform in-depth analyses of the information available in the studbook using genetic tools.



In dating aviaries, like the one shown here in Planckendael, young Black vultures have the possibility to choose a mate for themselves. Standardised observation will help to better understand the mating behaviour of Black vultures.

Photo: J. Verhulst. 25.1.2016.

Accurate knowledge of the origin of the birds in the breeding programme is not only crucial for the management of the captive population, but it is also highly relevant for the success of the European reintroduction campaigns. After all, preferably one would like to know where the parents of the reintroduced bird came from and how that might affect the local populations. So far, genetic analyses of the birds in EEP suggest that a large fraction may actually not have European roots but rather originated from an Asian background, thereby contradicting the data in the studbook. Interestingly, preliminary analysis indicated that birds of mixed origin may have a lower hatching success compared to birds from the same geographic area. These population genetic analyses additionally allowed us to evaluate the sex of the birds involved. Surprisingly, our analyses revealed several cases of supposedly long-term “breeding” pairs in the EEP studbook that actually appeared to be same-sex individuals, mostly two females. Without male contribution, however, eggs from same-sex pairs are bound to remain unfertilized. Within the Black vulture EEP we will be working towards a situation where genetic determination of sex and origin will be a standard operating procedure.

The key focus of scientific research on genetics underlying mate choice in the Eurasian black vulture is the

major histocompatibility complex (MHC). MHC genes play a central role in the immune system, and they are involved in numerous biological processes. Its relevance in mate choice has been addressed across a diverse range of species, including rodents, primates and birds. Criteria driving mate choice in captive and wild Eurasian black vulture pairs are currently being investigated at Antwerp Zoo in collaboration with the Leibniz Institute for Zoo and Wildlife Research in Berlin. In addition, EEP studbook data on the sex and origin of all birds in the population are being genetically verified and general relationships of EEP individuals assessed. Along with behavioural observations, these concentrated efforts will eventually tell what shapes pair bonding and hopefully provide guidance for future matchmaking in the Eurasian black vulture. Ultimately these studies will benefit the survival of the wild populations with an improved understanding of their structure and necessary conservation actions.

Zjef Pereboom, Marleen Huyghe



Dr. Zjef Pereboom is manager of the Centre for Research and Conservation in Antwerp Zoo. He investigates the mechanisms of partner choice and reproduction in Black vultures.



Marleen Huyghe is curator for birds in Tierpark Planckendael and Antwerp Zoo. She has coordinated the Black vultures stud book since 1998, has been member of the Vulture Conservation Foundation since 2009 and the experts committee since 2012.

Conservation Actions and Threats: Egyptian vulture

The Egyptian vulture is Europe's most threatened vulture, the only of the four European vulture species to be listed by the IUCN as endangered. Although the other three vulture species populations are increasing, the Egyptian vulture still faces major threats across its range, and even though there are some regional increases the population trend overall is decreasing. Within Europe, there has been a continuous decline in Portugal, Italy, and Greece. Even in Spain which has the largest population of Egyptians (around 1300 breeding pairs) there was an approximate 25% decline in these pairs from 1987 to 2000, despite small local increases in the islands and north-eastern areas. But why?

The single populations of Egyptian vultures in Europe are very widespread, the major threats to regional populations vary. The causes of population decline are poorly understood but scientists agree that it is likely to be a combination of several known threats and that many of these are from human factors. However, studies agree that it is non-natural adult mortality that is driving

the overall decline. The main known threats are poisoning, loss of habitat, declining food availability, poaching, and power lines. Often these threats become interrelated and exacerbated, such as in Spain when a loss of prey and thus a shortage in food availability resulted in adults moving closer to human establishments, where the possibility of finding poisoned bait was higher.

Unlike its fellow European vultures, the Egyptian vulture is a migratory species. This creates unique challenges which necessitate a different conservation approach; an international, collaborated conservation effort is needed along the flyway path it migrates through. During migration, these birds can fly a gauntlet of windfarms, airports, human establishments, and war-



A main reason for the high mortality in adult Egyptian vultures seems to be the immense back drop of the European population.

Photo: N. Peters.

torn areas where it is not unheard of for marked birds to be suspected as enemy spy technology. In both Italy and the Balkans, juvenile birds that had been tagged with GPS transmitters showed that up to 70% of tagged individuals drowned on their first migration, in an unsuccessful attempt to cross the Mediterranean Sea. It is still unknown what the cause for this extremely high mortality is, but one hypothesis suggests that a declining adult population has resulted in too few experienced birds to pair up with the young and show them the proper, safe path to Africa. For the Spanish population, the highest juvenile mortality during migration occurs crossing the Sahara, rather than the sea.

In Africa where the population winters threats like poisoning, poaching, electrocution and wind farms are present. Poaching for uses in 'muti' or traditional medicine is also practiced in some areas, as vultures are associated with death and purification. Thus the cost of being a migrant for the Egyptian vulture is very high, compared to small non-migratory populations where survival rates are much better.

Protection is possible

Currently there are two ongoing LIFE projects that focus on the conservation of the Egyptian vulture: LIFE Rupis in Douro International valley, Portugal, and LIFE Return of the Neophron in Bulgaria and Greece. Both projects focus on research and actions to improve breeding success and reduce mortality. They aim to do this through monitoring, GPS tagging of birds to discover threats and causes of mortality, as well as proactive measures like feeding stations to provide safe abundant food, inclusion and education of the community, and nest guarding to prevent disturbance. Both projects have partnered with the VCF in their work, and updates as well as GPS maps of the tagged birds can be seen on the website <http://www.4vultures.org/our-work/monitoring/egyptian-vulture-online-maps>.

One of the main objectives of the LIFE Return of the Neophron project is to address key threats along the migratory flyway, and to create a Flyway Action Plan to advise governments and organizations for the most effective conservation actions.

With this intention an international workshop was held by the Bulgarian Society for Protection of Birds (BSPB) in Sofia in 2015, with experts from Europe, Caucasus, Middle East, and Africa coming together to discuss the threats to vultures in their region and what should be done. This information compiled at the meeting has been put together into an official Action Plan, to be published in the near future.

Conservation actions are ongoing, trying to find the best measures. Supplementary feeding sites seem to play a large role in the conservation of these vultures; studies suggest they regularly use predictable food sites and that food availability is a key component in the preservation of the species. Spatial use and communal roosting have been shown to be associated with predictable food sources, and thus scientists can use these to anchor birds to safe locations, further away from threats like wind farms.

Captive breeding may also start to play a large part in the future of this species. In 2012, the captive breeding of the Egyptian vulture became a coordinated European Endange-

For the causes of the decline in the smallest of Europe's vulture species researchers need to investigate populations of the Egyptian vulture on a local scale.

Photo: N. Peters.



red Species Programme (EEP), and through the exchange of information the breeding success has seen a positive increase. With this increment in birds produced, 12 juveniles were able to be released in southern Italy between 2004 and 2012, six in 2015, and 2016 year for the first time three birds were sent to Bulgaria where they were hacked into the wild. These have mostly been small and experimental releases but with the growth and success of the EEP, population restocking efforts and reintroductions could be a useful tool to help save these birds.

Overall a huge part in the conservation of this species is understanding the cause of decline at a better level. There are still huge gaps in knowledge, and information or data is lacking for most of the population trends. Capacity and funding for conservation and research in many of the flyway countries is limited, and adds to the lack of knowledge for threats in these areas. Even in small areas in Catalonia, Spain, where the population seems to be increasing, the reasons are not fully understood. In the Balkans where the LIFE project Return of the Neophron has been working for the past five years, Egyptians still face imminent extinction despite large scale conservation

actions. According to a study published in 2013, the declining population is becoming more and more fragmented creating genetic challenges, and extinction is still a very possible future. In 2016 the BSPB published that for more than half of the cases of breeding failure studied, the causes remained unknown. Missing data is one of the biggest issues in the conservation of these birds. There is a need to mark more birds to get better population estimates, movement information, and regional causes of decline.

Local scale solutions

However, there is still hope yet for this species. Migration counts of Egyptian vultures showed a linear increase of +4% per year over the Strait of Gibraltar and southern France throughout a 15-year period from 1999-2013, which may indicate a widespread population increase. Areas in Spain from 2000-2009 have shown possible population increases. And there is still room for optimism, as scientists know it is possible to reverse negative trends as seen in past successes like in the Canary Islands. Here, during the LIFE project Guirre Fuerteventura, research found electrocution to be the main cause of

mortality and after modifying power lines the negative trend was reversed, and all 35 chicks marked in the project survived. Local factors are key in understanding the conservation actions needed. Many of these sub-populations are unique, and thus need research into specific causes of declines. Efforts focussing on reducing non-natural mortality at a local scale are imperative.

Long-term regional studies have helped shed light on populations and their specific needs, and other actions like anti-poison measures have also proven to be vital as poison is a major risk throughout Europe. Poisoning, which happens indirectly when a poison bait is used to kill predators or directly when it is aimed at the vultures, has been addressed in areas and has proven to have good results for the population when removed. Outside of Europe, focussing on helping to build capacity along the flyway to bridge gaps in knowledge and promote collaboration are needed for a well-rounded and successful approach to conservation.

The future of the Egyptian vulture is precarious. There are still large gaps in information and no simple or singular solution to the situation. Challenges of multi-national cooperation and communication toughen the process. Even in areas that show promising data, new risks still arise. Currently the veterinary drug Diclofenac, which is responsible for the crash of vultures in India, has begun to be introduced into Europe with potentially devastating effects. Yet there is still hope, and all is not lost. Conservation measures have shown to be effective, and each piece of data collected is a step closer to understanding and achieving success. The Egyptian vulture is on the precipice of extinction, but we still have the ability to save it, and keep these majestic birds flying in our skies.

Natasha Peters



Natasha Peters is a biologist with special interest in vultures. She works for the Bulgarian Society for Protection of Birds to develop and implement conservation measures for the protection of Egyptian vultures.



After the danger of electrocution was minimised, all the young Egyptian vultures marked in a project on Fuerteventura survived. This young bird is two to three years old and still in his juvenile plumage.

Photo: T. Krumenacker.



Ringling and Monitoring: Data for Science

Appropriate monitoring measures are essential for the success of every conservation and reintroduction programme. Therefore the marking of vultures to be reintroduced into the wild is an essential task. Throughout Europe a lot of vultures are being marked by using bleached feathers, footrings and also GPS trackers. Thanks to this effort we can find out more about the individual species year after year, which leads to an improvement in the efforts of protection.

In early summer, one of the most spectacular actions in vulture protection and conservation takes place. Before flying out, when the vulture chicks are still safe in their nests, an ornithologist visits to attach rings and perhaps also a GPS tracker to the birds. In some projects the vultures are being marked additionally individually, by bleaching several feathers. This form of marking allows the determination of the individual birds also from a greater distance. Nonetheless the attachment of the rings and GPS is still important because after approximately the first two years, some of the feather markings become victims

of the first moult. Further genetic analysis of the young vultures can be collected by this opportunity. Feathers that have been found or gathered at the nesting site of breeding animals, offer the possibility of comparison, while they can be identified through their genetic fingerprint in the database.

While it is easy, to mark vultures before they are being released from a breeding programme or a relocation, the marking of vultures that have been hatched in the wild is a very difficult task. To be able to get to the young birds, one needs to climb to their nests, that – depending on the

species of the vulture – are located on high trees or on steep or overhanging cliffs. Nevertheless it is enormously important for the birds that hatched in the wild to be marked, in order to gain information on their movement and distribution patterns to be able to evaluate the demographic parameters of different colonies and populations.

In order not to disturb the adult birds as well as to avoid injuring the youngsters, the best timing for marking is crucial. Valuable information is being delivered by the monitoring of reproduction at the beginning of the breeding season. All known nests for the type of vulture such as eligible breeding locations on cliffs and wooden slopes are being explored. Through this action the egg-laying season is relatively well known and this is later confirmed through the hatching of the young bird. The chicks must not be marked too young or too old in case this affects plumage and flight feathers.

Several abseiling and climbing techniques help to reach the nests. The optimal climbing route is vital for success. Actually the location of the nest is adventurous enough. It all begins with a securely anchored rope, in most cases from above. Once the ornithologist reaches the nest, the attachment of the ring has to take place as quickly as possi-



The Bearded vulture named „Ortler“ with colour rings, bleached feathers and GPS-tracker; the antenna can be seen. Thanks to these markings and also through feathers found, which the genetic profiles of the reintegrated animals can be checked against, it is possible to follow the Bearded vultures and their individual live histories. Photo: M. Genswein / I. Greve.



A young Bearded vulture is marked with a GPS-tracker which is fitted with an elastic halter in two slings around the bird's legs and pelvis.

Photo: H. Weyrich.

ble. Sometimes the young birds are stressed and pick at the hand attaching the rings. The ornithologist takes biometrical data and collects feather samples for genetic analysis. As soon as the ringing as well as the placement of the GPS tracker is completed, the ornithologist retreats. The effort of the ringing of the birds is enormous. On the french Grands Causses for example all young Black vultures as well as fifty young Griffon vultures are being marked with rings directly in the nest. It is impossible to ring all of the young Griffon vultures, since this would be a long and very difficult task and some of their nesting places are hardly reachable. Even the ringing of the Black vulture nestlings is a difficult task, since it takes place on 15 m high pines with no branches to hold on to.

Scientific implementation

Following the relocation regulations of the IUCN every resettlement programme has to be accompanied by solid and scientifically significant monitoring. Appropriate monitoring

Many vultures equipped with trackers roam above Europe, and some individuals' movements can be followed online. A collection of links is to be found under: www.4vultures.org → Our work → Monitoring → GPS tagged vultures

Bearded vultures build their nests very often in gaps in steep cliffs, so they are extremely inaccessible. Photo: A. Bouissou.





Parts of shedding skin at the base of growing feathers are excellent material to retrieve DNA. They can be found and collected near the nest after the young vulture has fledged, and be used to identify the genetic fingerprint of this bird. In case the parents' DNA is also registered in the data base, the parents can also be identified. Photo: H. Weyrich.

methods guarantee that the success of resettlement programmes is measured and possible risks and failures are recognised in time. The same is true for protection programmes, that do not depend on relocation.

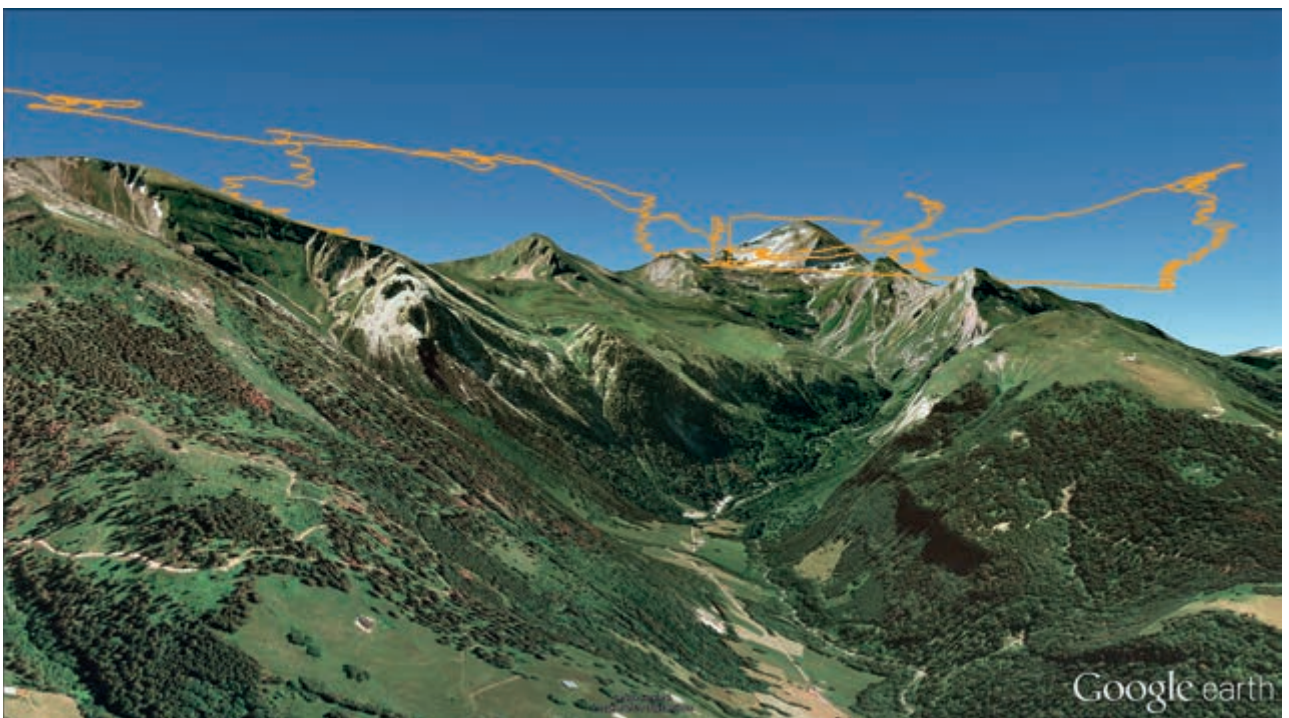
The monitoring of vultures with GPS trackers allows a valuation of various demographic parameters such as survival rate and reproduction and therefore also an assessment of the breeding success in the vulture colonies or vulture populations. With the

help of mathematical models, collected data are being processed to possible scenarios in the future as well as the sustainability of populations.

GPS tracker recordings and ring sightings deliver valuable information on the movement of separate individuals. For example through ringsighting of two Griffon vultures in Senegal it was possible to prove their distance covered from the French Causses. Another specimen from the Causses has been found in

Latvia. The latest information shows that one Black vulture that hatched in the French Gorges de la Jonte, spent two years in Spain before returning to his initial colony.

GPS delivers a very detailed picture of the space utilisation behaviour. Depending on the season and the material used, some or more hundred datapoints can be determined per day, which allows a detailed overview on the day to day movement on the individuals carrying a GPS



Under good conditions (sun rays), modern GPS-trackers are able to record flying sequences in times of seconds. So the flight behaviour and the use of thermals can be analysed in detail - for example of the Black vulture *Bernardus*.

Illustration: LPO PACA-SWILD.

tracker. The movements can vary a great deal between separate birds and whole populations. For example data of Bearded vultures that were carrying GPS trackers revealed a totally different movement pattern in the Pyrenees, Andalusia and the Alps, between all three populations. The juvenile individuals in the Alps and Andalusia covered considerable longer distances than those of the Pyrenees, which has significant influence on the migration between the populations and the creation of a viable metapopulation.

Monitoring based on genetic samples appears to be less impressive. Nevertheless there is, thanks to enormous efforts during the reintroduction programmes for Bearded vultures in the Alps, a database, where almost all of the released birds and a large part of the Alpine wild population is recorded. Based on this database it is possible, through feather samples of the young birds from their nesting places, to obtain conclusions on the identity of their parents and therefore to create a lineage/family tree of more generations, which delivers information about the genetic situation within the population.

All in all an adequate monitoring guarantees ideal programme control for the maintenance of species, and it gives various valuable information on the biology of these birds of prey. Reasons for mortality, demographic information such as generation periods or the age of the first reproduction, range needs and selection of habitat, behavioural patterns such as nesting location and loyalty to the partner are some such aspects that can be learned with these methods. This basic knowledge over the general biology of the vultures is necessary, in order to be able to sustain these wonderful creatures long-term.

**Raphaël Néouze, Franziska Lörcher,
Daniel Hegglin**

Raphaël Néouze s. page 32
Franziska Lörcher s. page 35
Daniel Hegglin s. page 20

Help with Vulture Monitoring

The monitoring of vultures relies on the help of ornithologists, who share their observations with vulture-protectors:

- Observe very carefully if markings like bleached feathers or rings are to be seen.
- If rings are visible, try to recognise the colours and note the letters and numbers for every foot separately (left or right leg always from the perspective of the bird).
- Whenever markings can be registered, try to take a picture. Especially the patterns of bleached feathers can be photographed successfully over long distances.
- Write your observations as soon as possible down and transfer it to an online-database such as *ornitho*.

Monitoring Methods for Bearded Vultures and the IBM Database

The reintroduction of Bearded vultures is being watched very closely. The responsibility lies with the IBM (International Bearded Vulture Monitoring) for the Alps and the corridor between the Alps and the Pyrenees. The IBM is a network of all institutions/bodies that are taking action for the reintroduction and the protection of Bearded vultures in this region¹. With the help of various methods, survival rates of reintroduced young vultures are being measured and evaluated as well as their pattern of movement, their space utilisation behaviour, the presence or development of disruptive or threatening influences and the necessity of interventions. The basis for these tasks is a qualified network of local experts, who are able to document observations of individuals with a tracker attached. In the Alps all this information is being collected by regional coordinators and transferred to the central database of IBM. The monitoring of the Bearded vulture in the Alps as well as the corridor region relies primarily on:

- Individual patterns of bleached feathers on reintroduced birds, which allows recognition while flying at least before the first moult (approximately two years).
- Preferably long and stable footrings, since Bearded vultures can get very old. Plastic rings can be read much better than those made out of aluminium.
- GPS trackers (solar-powered GPS/GSM and GPS/Argos devices), that can provide significant information on the movement of the birds (Lifespan 2-5 years).
- Genetic fingerprints of birds that have been released into the wild and collected material from the nests of the Bearded vultures as well as their environment.
- Specialised observers, that register the development of pairs as well as the breeding success and protocol the data for IBM.
- An observation day every year, on which the observation is being done simultaneously between the Alps as well as the corridor.

¹ Partners of IBM (Status 2016): A.S.T.E.R.S., LPO Grands Causses, Nationalpark Hohe Tauern, Parc National de la Vanoise, Parc National des Écrins, Parc National du Mercantour, Parc Naturel Régional du Vercors, Parco Naturale Alpi Marittime, Parco Nazionale dello Stelvio/NP Stilsferjoch, Regione Autonoma Valle d'Aosta & Parco Nazionale Gran Paradiso, Stiftung Pro Bartgeier, Vulture Conservation Foundation, Association Vautours des Baronnies.

Opportunities and perspectives:

Vultures in Germany

Vultures belong to the natural range of species of the south- and central European ecological system. In earlier days they were also to be found in the northern part of the Alps, as regular visitors as well as breeding birds. Persecution and the change of habitats have altered this picture. As late as the beginning of this millennium, vultures began visiting Germany more frequently.



A Griffon vulture flying in; to be distinguished from a Black vulture by its darker feet and lighter underwings, in contrast to darker pinions.
Photo: D. Haas, Extremadura, 18.4.2012.

Breeding grounds of the Griffon vulture were very strong in the area of Trier and the upper Danube valley in historical times, as far back as the prehistoric era. Evidence for this includes the spectacular find of a flute made out of Griffon vulture bone. This happened in a cave (Hohler Fels) at Blaubeuren on the Swabian Alb and it is thought to be 35,000 years old – which makes it the oldest known musical instrument.

After the extinction of the Bearded vultures in the Alps and until their successful reintroduction, sightings

were very seldom within the Alps region in Germany. In the 19th century there were documented accounts from Germany, whereas there were none in the 20th century until the 1970s. Only after the successful reintroduction of the species in the Alps post-1986 was evidence recorded in Germany, with an increasing tendency.

Individual juvenile Bearded vultures (not mature enough for breeding) roam the whole of Germany as well as the neighbouring countries and are searching for near-natural

landscapes up to the coast regions of north-east Germany. One of the most recent sightings in this area was in 2016, when a Bearded vulture with a GPS tracker attached was found dead under an overhead power line. For the last 11 years Bearded vultures have been observed in the Bavarian Alps. They are being seen regularly in the Bavarian National Park Berchtesgaden as well as the Allgäu High Alps, where there had been carcasses of wild game as well as defrosted chamois avalanche victims as a food source.

The Egyptian vulture is the smallest European vulture and the only obligatory migrating vulture in continental Europe. The species' main wintering grounds lay in African Sahel. Evidence acquired partly by hunting indicates that these vultures were found in various regions in Germany in the 20th century. Due to the continuously decreasing population of the Egyptian vulture in south east of Europe, the sightings in Germany are more likely to correlate to the successful protection measurements in France. Following the relocation of the Griffon vulture in south east France the Egyptian vulture also increased in numbers, with further dispersion to the north

Meanwhile, there is secure evidence that the Black vulture as well as the Griffon vulture have been flying to Germany through the whole of the 20th Century. Until the beginning of the second half of the 20th century evidence was collected as a result of hunting. In the 1990s there were secure sightings and observations of Griffon vultures in Germany, and for the Black vulture some breeding successes closer to central Europe in the French Alps, the Causses and the Spanish Pyrenees have been recorded.

Vulture flights to Germany since 2000

Since 2004 the evidence of vulture flights to Germany of all four European species increased dramatically. There is well documented evidence every year of the presence of the Griffon vulture as well as the Bearded vulture, distributed across Germany. Especially impressive was the vulture invasion in 2006, where at least 164, but most probably more than 200 Griffon vultures, accompanied by some Black vultures were observed in Germany. The reason noted was the enormous shortage of food that followed the intensification of EU Hygiene Standards, that led to the closing of the traditional slaughterhouses in Spain. There, deceased cattle was left for the vultures to feed on. The new requirements led to a devastating food shortage for the south European vultures. Further modification to the EU Hygiene regulations in 2009 and 2011, which took into consideration the protection of threatened scaven-



Under good conditions, a Black vulture is best to be recognized by its light feet, that contrast the dark underside. The dark underwings are in clear contrast to lighter pinions (Griffon vulture other way round).

Photo: D. Haas. Extremadura, 24.4.2012.

gers, improved the food situation, especially in France and Spain (EU Hygienedirective 1069/2009).

The vulture influx continued unabatedly after 2009 and show a constant pattern through the years. The incoming flights of small groups of Griffon vultures and Black vultures, as well as some Bearded vultures into the lowlands, begin mostly in May. Frequent observations continue until July.

Predominantly juvenile vultures are flying into Germany. Black and

Bearded vultures are often still in their juvenile plumage at the beginning of their second year whereas the Griffon and Egyptian vultures are mostly older, but still not mature enough to breed. The flight feather conditions of these incoming birds are generally very good. Birds with significant damage to the flight feathers, which indicates restricted stamina, chronic illness or injury (for example a shot through the feathers, excessive stress stripes or excessive wearing out of the feathers through a

delay in moulting), were not detected. In the breeding areas of European vulture populations, damages in the feathers can be observed regularly.

The facts point to the vulture influx into central Europe as being normal migration and not for breeding purposes. The flight from south Europe is being made at a time when there is no great shortage of food in the breeding areas. Nevertheless the departure of the young vultures in the nestling phase might increase the nutritional basis of the youngest generations. Immature Old World Vultures of every species take long flights before reaching breeding maturity and settle as breeding birds often far away from their birth place. A small number of the young vultures are becoming remarkably well-travelled. Bearded as well as Griffon vultures have been documented in Finland as well as Norway. Particularly interesting is the overwintering of an adult Griffon vulture nearby a former big breeding colony from the middle ages in Trier, in the winter of 2013/2014.

Nutrition and Sources of Danger

Observation of individual Griffon vultures is possible every month. A Griffon vulture that was observed since the 6.9.2011 in Ruegen, was found dead (through electrocution) below a mast on the 15.11.2011. Observations of Griffon vultures, of obviously healthy birds, in the middle of a hard winter in east Germany led to the conclusion that in favourable nutritional habitats an overwintering in Germany is possible (amongst others on 31.12.2011, 6 and 29.1.2012, Winter 2013/2014, 15.12.2015). The biggest dangers for the birds are anthropogenic, actually easily avoidable interferences, through irresponsible hunting practices like using toxic ammunition that contains lead. Also appropriate feeding places are necessary, to be able to protect the immature vultures on their long journey. Studies show that the young vultures fly into Germany in a quite good state of health. If the plentiful available food sources (perished grazers and wild animals that are victims to traffic accidents) that they would find on their natural food flights are systematically remo-

ved, they switch to secondary sources of nutrition: sometimes to poisoned baits or dumps. They risk their lives through starvation and through the ingestion of often toxic food.

This is only a partial aspect of the ecological deficit created by systematically removing dead animals from the landscape. Because just like dead wood, dead animals, especially carcasses of large animals, play an important role in the functioning ecological system. A disposal of this abuse can be mostly achieved in our national parks. This is shown by a current example in Austria. In the National Park Hohe Tauern, in only one vulture flying hour south of the German border, there were approximately 60 Griffon vultures, two Black vultures and one Golden eagle discovered eating on four cattle that died through a lightning bolt on the 3.08.2013.

Areas with high protection status, particularly our national parks, are extremely important regarding the security of the routes of the Old World vultures. Even better would be the provision of areas, where large herbivores such as bison and elk, can play their role again in the ecological system. Such areas are planned in various European countries. The first steps for the reintroduction of eradicated large herbivores are being made also in Germany. These areas are being requested by the society as nature discovery parks and have an enormous potential for the promotion of biological diversity. Vultures can then return as a natural part of the ecosystem, at least as feeding visitors to this habitat with a rich fauna. The flooding in the last few years, particularly in the catchment area of the Elbe as well as the Danube, have alarmed politicians as well as the population. A future orientated solution, for flooding to be less catastrophic, is therefore the partial opening of the dykes in order to create new retention areas. From an economic and ecological point of view, undoubtedly the management of the newly-acquired near-natural flood plains with grassland and grazing animals makes sense.

It is interesting to note that on the flight of vultures to Germany in 2013, Griffon vultures were initially

discovered in the northeast of Germany and then, when the water level decreased after the flood catastrophe, they slowly moved towards the west. They probably found food during the height of the flooding of the Elbe and therefore have recycled drowned wild animals and pets. The authors of this article would be very grateful for observations that point to the food intake of vultures in disaster areas. Photo credits would, from a nature conversation perspective, be of the highest importance.

All evidence of the vultures' flights to Germany are interesting and of scientific importance, so we appeal to please send all vulture observations to dghaas@web.de, geiermeldung@online.de and www.ornitho.de.

Dieter Haas, Edgar Reisinger



Dr. Dieter Haas is mainly active in nature conservation on NABU-confederation level, he also is leader of the vulture protection initiative GESI. For more than ten years his team has been working about ornithological-scavenger ecological studies using wildlife cameras permanently in southern Germany.



Edgar Reisinger is deputy head of the species and habitat conservation unit und Biotopschutz, Forest ecology of the Ministry for environment, Energy and nature conservation in Thüringen.

Thanks for reviewing the manuscript and important hints go to Jean-Pierre Choisy, Herbert Fuchs, Karl Fidelis Gauggel und Karl Roth.

All vulture observations known to GESI (incl. existing photos) in Germany are listed under <http://www.naturschutzbuero-zollernalb.de/geier/datensammlung.htm>, often complemented with interesting extra information.

A risk for Scavenger Birds: Lead

In Europe acute lead poisonings of scavenger birds are documented regularly, including Griffon vultures, Golden eagles and Bearded vultures. Scavenger birds are especially exposed to the toxic lead, since they absorb the metal very quickly due to the extremely acidic environment in their digestive tract. In the Alps, the widespread Golden eagle and the recently reintroduced Bearded vulture are affected. The latter is classified as very vulnerable. Between 2005 and 2012 at least six cases of lead poisoning have been documented, on both migrating young birds as well as adult birds.

In order to clarify the origin of the lead in scavenger birds, in the Stilfserjoch National Park and the Swiss Bird Observatory Sempach conducted studies on Bearded vultures and Golden eagles. The results found that of the 36 Golden eagles and six Bearded vultures examined from the central Alps there was a very high concentration of lead in their bones (average: Golden eagle 12,45 µg/g; Bearded vulture 38,9 µg/g). The findings of a lead-isotope-analysis on Golden eagles, Bearded vultures, their prey and soil samples point to hunting ammunition as a source for lead. A further examination on the non-scavenging Eagle owl revealed only a small concentration of lead. This suggests that the presence of lead in Bearded vultures as well as Golden eagles is being caused through the consumption of carcasses or their parts. The ways in which lead can reach the scavenger birds is shown in an analysis of 153 hoofed animals, that were shot



A subadult Golden eagle at the innards, few hours after the ibex was shot in Graubünden.
Photo: D. Jenny, Val Sinestra, Engadin, 11.10.2014.

in the 2009/2010 hunting season in the province of Sondrio: in 62.1% of those examined, lead was established through radiography. The lead fragments were higher in Roe deer and chamois than Red deer. Golden eagles systematically feed on the carcasses of chamois, Red deer, Roe deer and ibex that have been killed in game hunting, as the results of a study with photo traps in Unterengadin show. Bearded vultures, that eat the fatty layer of the innards can also absorb lead in this way.

In order to further investigate the nature of lead intake in Golden eagles, flight feathers were divided into three segments and analysed. During the growth of the feather introduced lead is stored in the feather structure enabling conclusions towards a temporal pattern. Increased levels of lead in the feathers were shown mostly in one of three segments, which points to an episodic intake of lead, like

for example on lead fragments of carcasses. Animals that have been shot with lead ammunition and left during the hunting season, can act as a source of lead for raptor birds.

The studies confirm the high risk of lead poisoning for big raptor birds such as Bearded vultures and Golden eagles in the areas where hoofed animals are hunted traditionally. They underline therefore the concern regarding the use of lead ammunition.

**David Jenny, Enrico Bassi,
Maria Ferloni**

In the Alps reintroduced Bearded vultures found dead or recaptured with lead poisoning.

Bearded vulture	Place of reintroduction	Year of reintroduction	Year of death/recapturing
Doraja	Rauris, NP Hohe Tauern, Austria	2005	2012
Ikarus	Martell, Stelvio NP, Italy	2008	2009
Glocknerlady	Fleisstal, NP Hohe Tauern, Austria	2012	2012 recaptured; released again after treatment
Lousa	Vercors, France	2010	in captivity, due to permanent damage of the nerve system
Nicola	Rauris, NP Hohe Tauern, Austria	1991	2012
Sina	Swiss National Park	1997	2008, single shots in the body



Dr. David Jenny is a biologist and works at the Sempach Bird Observatory as well as for Pro Bartgeier. He coordinates monitoring programmes about Golden eagle, Eagle Owl and Bearded vulture.



Enrico Bassi is a scientist and has been working as consultant and ornithologist for the Stelvio National Park since 2004. Since 2007 he has been member of the IBM (International Bearded Vulture Monitoring) steering group.



Maria Ferloni works as a biologist at the nature administration of the Sondrio Province. From 2012 until 2014 she also was member of the IBM steering group.

The studies were also supported by A. Gugiatti, L. Pedrotti, M. Di Giandomenico, G. Grilli und L. Jenny.

The Hidden Hand of Poison

A golden rule in psychology is that we are aware only of what we see, not of what we don't. In an abstract sense we all know that poison kills vultures and is driving species to extinction globally. In this article, poison is referred to as pesticides set out to deliberately kill wildlife, not veterinary agents or heavy metals that may be present in carcasses and also be harmful. So, what prevents us from knowing about poison when it is right in our midst and decimating our vulture populations? The answers lie in a fateful combination of reasons.

The day begins as an ordinary day for an adult female Black vulture named 4FJ on her yellow PVC ring. Leaving her mate on duty at the nest, she goes in search of food and finds a few scattered delicious rabbit carcasses. Meanwhile, the male grows hungry as he awaits with increasing impatience. But 4FJ will never come back. Only minutes after sating her appetite, she convulses, vomits and dies in acute pain. Some days later, the male departs the nest to avoid starvation. Left behind, the chick succumbs in prolonged agony to dehydration. Researchers monitoring the colony

record the cause of this breeding failure as "unknown reason, female missing". Several months later, a jumble of feathers and bones is discovered some three kilometres from the vulture colony. The PVC ring reveals her identity: 4FJ. Laboratory tests undertaken on what is left of the highly degraded carcass are inconclusive, and this report reads: "cause of death unknown". Years later, additional off-the-record analyses are conducted and minute traces of a pesticide commonly used to deliberately poison wildlife are detected in the bird's talons. Nonetheless, the end of year report

on the colony makes no mention of "poison" in relation to the death of this female or her chick.

Often the only Evidence: the Bait

Few of us ever witness an incident of poisoning first-hand, and only a fraction of poisoned vultures are actually reported as such in the statistics produced by organizations and authorities worldwide. The effect of poison is felt in many different subtle ways, and only rarely are we able to establish it as the true cause of death. This is somewhat easier when large numbers of vultures are found dead around a carcass (as is frequently the case in too many parts of the world) than when birds are discovered under more routine circumstances. However, even when we are actively on the lookout for poison and isolated carcasses are detected in the field, our chances of detecting lethal compounds in the birds' tissues remain low, leaving us with the highly undesirable prospect of obtaining a false negative.

The combination of different factors makes it difficult to identify poison as cause of death. For once, the foraging range of these birds is extensive, it can cover thousands of kilometres in mere minutes. The chemical nature of the toxic compounds used to poison baits, also makes it difficult. Incidences of poisoning in vulture populations are frequently underestimated for several reasons, including that birds die far from well-monitored breeding colonies. Yet even if poisoned birds are found near colonies soon after they perish and are then immediately submitted to the lab, the true cause of death



This female vulture fell avictim to poison. Together with her chick besides, they were found dead on the nest. In general, in the case of the adults death the chicks cannot survive either- so the poison's effects are doubled.. Photo: I. Fajardo. Sierra Pelada, Huelva May 2007.

Very rarely, only once in a hundred cases, vulture conservationists manage to apply first aid to a bird found with symptoms of poisoning in time. This young Black vulture was treated with activated carbon. After successful treatment the bird was released.

Photo: I. Fajardo. July 2007.



may still not be revealed. Carbamate and organophosphorus compounds, currently favoured as poisons in many parts of Europe, are a case in point. These degrade rapidly in the environment and are so fast-acting as to kill the bird shortly after the poison-laced food enters its mouth, sometimes before it can even swallow. Given these factors, a typical analysis of the stomach contents and/or digestive tract may not reveal poisoning. Furthermore, many laboratories still seem to be restricting their analyses to samples like liver or fat only because of a 'bias' towards formerly popular organochlorines or strychnine, instead of considering a broader selection of samples in which residues of the real culprit might be present.

Very often, no residues are detected in the carcasses of the victims, even though there were strong indicators of poisoning. There could be several reasons, but the worst of these, and an all too common scenario, is that the samples in which residues were present were simply not collected. Indeed, the bait is quite often the only sample in which a positive toxicological result can be obtained. Poisoned birds may vomit prior to death, and since vomiting is unusual in birds, that in itself should flag suspicion of poisoning. But not everybody called upon to recover carcasses knows this, and so the

regurgitated bait - the 'smoking gun' - may be left behind at the scene, or taken away by secondary scavengers.

Standardised Protocols

The universal theme in the fight against poison is that we cannot solve this problem until we fully grasp its many facets. Having reliable, well-trained field teams who can recognize the visual repercussions at individual and population levels as they unfold is the only way to achieve this goal. Unfortunately, such capacity is still a relative rarity, and so we continue failing to identify the presence of poison and its tangible but nuanced direct and indirect impacts on our vultures.

In addition, it is the duty and responsibility of all laboratories receiving these samples to use the most appropriate sampling and analytical protocols. This entails keeping apprised of the poisons most likely to be in use at any given time and targeting optimal samples, where the chances of detecting the 'poison du jour' are highest. This requires considerable experience and good practices, not to mention strong communication with those on the front lines in the field.

Finally, all the valuable information gathered in the field must be collated with the lab results

and observations then channelled through strong and reliable law enforcement networks. All poisoning incidents should be investigated so as to bring the culprit(s) before a judge. Although legal procedures are long and intricate, it is worth the effort. Our vultures, and all those who have worked so meticulously gathering the evidence, deserve nothing less.

The moral of 4FJ's sad story is that if we want to defeat the enemy, we first have to know it is in our midst, then we must be able to prove conclusively that it has struck.

Iñigo Fajardo, Ngaio Richards



Dr. Iñigo Fajardo is a zoologist specialised on forensic investigations in wild animals as well as environmental crimes. Besides lecturing at university, he works for the anti-poison-campaign and the programme against crimes on wild animals of the Andalusian government.



Dr. Ngaio Richards did her PhD in forensic studies on wild animals. She published several investigations e.i. on the effects of carburetor as typical poison against animals, pesticides and harmful veterinary substances. She trains dogs to find important evidence in cases of wildlife crimes.

New Threats for Europe's vultures: Diclofenac

Could you imagine a world without vultures? Can you picture the empty skies without their ominous silhouettes over the mountains? The nightmarish sight of carcasses left to rot untouched under the sun? If we cannot turn the trend observed in recent years this might become a reality earlier than we think. Vultures are decreasing worldwide, and in the last 30 years almost two thirds of all currently recognized vulture species (14 out of 23) have become threatened with extinction. One main cause is veterinary practice.

In the early 90s, a new veterinary drug prescribed for the treatment of inflammations, fever and pain in livestock arrived to the Indian market and expanded rapidly throughout the Indian subcontinent. Its name is Diclofenac. At the same time the once-thriving populations of vultures in the country started to decrease at an alarming rate. Although this decline was reported from an early stage, it wasn't until 2003 that the deaths and Diclofenac were linked. By the time the cause behind the mortality in vultures was discovered, it was too late: between 1992 and 2007, over 99.9% of the population of White-rumped vulture (*Gyps bengalensis*) – by then considered one of the most abundant raptors in the World – had disappeared, making it the fastest collapse in any avian population ever recorded in history. Likewise, the populations of the Indian vulture (*Gyps indicus*) and

Slender-billed vulture (*G. tenuirostris*) had also decreased by > 96.8%. Red-headed vulture (*Sarcogyps calvus*) and Egyptian vulture populations had also declined by 91% and 80% respectively in that period, although their declines and use of Diclofenac could not be linked empirically. Overall, it's estimated that over 95 to 99% of all Indian vultures have disappeared in the last two decades.

Mode of action, Causes and Consequences

The non-steroidal anti-inflammatory drug (NSAID) Diclofenac is highly toxic for vultures that feed upon carcasses of domesticated ungulates that have been treated with the drug shortly before death. Within 24h, vultures start showing lethargy and neck drooping, increasing in intensity until death, 39 to 40h after consump-

tion. Vultures were reported dropping from their roosts, frequently remaining suspended in their perches, or dying in the nest. The LD50 (median lethal dose, the dose required to kill 1/2 of the individuals of a tested population) of Diclofenac is of 0.1 to 0.8 mg/kg in species of this genus, which is an extremely high value compared to other animals. Although it has not been empirically proven, it is expected it might have a similar effect on other scavenging birds, too. It has been estimated that a mere 0.8% of ungulate carcasses available to foraging vultures would need to contain a lethal dose of Diclofenac for this to have caused the observed population declines.

The actual reason of mortality in vultures caused by Diclofenac is the acute kidney failure and the subsequent visceral gout (accumulation of uric acid salts in internal organs). This is the result of an inhibition of the transport of uric acid at the level of the kidneys.

Another important factor – and perhaps the key to the whole situation – is the effect of Diclofenac's half-life (T1/2, the time it takes for a substance to lose one-half of its pharmacologic activity), which in this case refers to the time the drug is active and present in the subject. Meloxicam is another veterinary drug used as an alternative to Diclofenac for livestock treatment, which have been proven innocuous for vultures. Under in vitro conditions, both drugs have similar toxicity levels and act in the same way, but they actually differ in their half-life: whereas Meloxicam have a T1/2 of ±0.5 hours, Diclofenac has a T1/2 of ±12 hours. This means that it is not only the effect of the drug that



Lethargy and drooping necks are two of the main symptoms that show within the first 24 hours after taking in Diclofenac.

Photo: J. Parry-Jones, International Centre for Birds of Prey.

affects the animal, but specially the long period of time that it stays active in the system, leading to the consequences aforementioned.

In India, the outcome of the “vulture crisis” has had a cascading effect: The decrease in vulture populations caused an explosion in the numbers of small scavengers such as rats and feral dogs, which are not as efficient at disposing of carcasses as vultures, and unlike these birds can carry diseases from corpses such as rabies or anthrax, making them an important vector for the outbreak of infections in humans. As of 2015, the cost of the decrease in Indian vulture populations has been estimated at around 25 billion USD.

Ban in India, Concession in Europe

Another consequence of this vulture decline impacted one of the world’s oldest cultures: One of the ancient Zoroastrian culture’s best known customs is their traditional “sky burial”, in which the bodies of deceased Parsis are brought to the tower of death, where vultures consume the dead and leave the bones untouched, which are then retrieved and buried. After the disappearance of vultures

from the Indian skies, bodies were not able to be disposed of this way. This has forced the Parsi community to start considering alternatives to the sky burial; a century-old and sustainable tradition that might now be lost.

The joint effort of the scientific community, NGOs and government has managed to stop this decline, and the actions undertaken to revert the crisis have started to show some encouraging results. In 2006, India, Nepal, Pakistan and Bangladesh decided to ban the veterinary use of Diclofenac, and other actions such as the Gyps Vulture Reintroduction Programme started in 2016 are already underway. The negative trend is slowly reverting, but even so, some experts believe vulture populations might never fully recover from this catastrophe

The disappearance of a species from an ecosystem creates an “ecological vacuum”, an unstable state in which other species will step in to take over the extinct species’ role in the environment and proliferate until the system is balanced again. This situation alters the whole ecosystem at every level, and the changes are even more extreme following the loss of a key species such as vultures. Unfortu-

nately, it is possible that by the time vulture populations are on the road to recovery, the ecosystem would have undergone an ecological re-arrangement and no longer be suitable to sustain the same numbers as it did before.

In spite of all we have learned about Diclofenac and its enormous impact on vultures, the drug was allowed to be marketed in five European countries, including Spain, which has 95% of the European vulture populations.

The VCF together with other organisations have been campaigning to ban veterinary Diclofenac, but after a long evaluation period – and although it has been acknowledged that Diclofenac represents a threat to European vultures – The European Commission has decided to implement mitigation measures rather than a total ban of the drug. We can only hope this time we will learn from the past and avoid a new “vulture crisis” in Europe.

David Izquierdo



David Izquierdo is a biologist with focus on protection and re-introduction of raptors. He works in Lleida for VCF as assistant to the Bearded vulture-EEP-coordinators.

95% of all European vultures live in Spain. The legal use of Diclofenac in some European countries bears a high risk for their future.

Photo: D. Izquierdo.



LIFE GypHelp project: Minimising Collisions

The objective of the LIFE GypHelp project, supported by the European Union, is to protect one of the most threatened species in Europe: the Bearded Vulture. Disappeared from the Alps, it has been reintroduced there since 1986. In 2014, despite all efforts for the conservation of the species, there are only 175 breeding pairs in Europe and only 50 in France.

The balance remains fragile: any mortality case of an adult can quickly revert the current development of the population, which is naturally very slow.

Since June 2014, the LIFE programme is implemented for 4.5 years by Asters as leader, beside its partners: National Parks of Vanoise and Mercantour, Vulture Conservation Foundation, Observatoire des Galliformes Montagne and Fédération Départementale des Chasseurs de la Haute-Savoie. The LIFE GypHelp takes place in a space which includes the nine breeding pairs of the French Alps of the 24 breeding pairs present in the Alps at times.

The LIFE GypHelp project aims to reduce the anthropological threats on the populations of Bearded vulture in the French Alps:

- percussion against aerial cables
- poisoning
- disturbance during the breeding season.

For the sake of consistency, it integrates the protection of other species concerned by the same risks like other birds of prey, and galliformes (Black grouse, ptarmigan), with the Bearded vulture considered as an “umbrella species”.

Infrastructures implanted in mountains especially for the practice of Alpine skiing, contain numerous aerial cables (ski lifts, electric lines, cables for explosives transport) which

can be at the origin of an important mortality on bird species.

Skilifts

Ski lifts inventories are made on the 60 ski resorts concerned by the programme. Then for each ski resort a visualisation plan is developed: the objective is to plan the cable visualisations works over several years. The most dangerous infrastructure is the draglift: ropes, because of their small diameters, are invisible especially in foggy weather. “Red eggs” are put every two metres in order to make cables more visible to birds.

Power Lines

Two kinds of risks exist regarding power lines: the risk of percussion and the risk of electrocution. Thanks to partnerships with the various network managers (ERDF, RTE, private electric companies), neutralisations are implemented on identified sensitive zones.

Electrocution can be avoided by insulation by putting plastic protections or dissuasion by installing vertical stalks at the top of posts, to spare birds getting an electric shock, and incentive by installing artificial perches.

Collisions are a threat easy to minimise or dispose of. Measures should be implemented as far as possible in all areas affected.

Marie Heuret



Marie Heuret coordinates and controls the French National Action Plan for Bearded vultures in the French Alps.



Alpine infrastructure including cables and ropes is an underestimated threat for Bearded vultures. Special markings can help to make such obstacles visible for birds. Photo: A. Rezer.



Photo: Thomas Krumenacker



From high above vultures search vast areas to find dead animals. Photo: O. Duriez.

The Ecological Services provided by Vultures

People generally have an image of vultures being ugly birds eating stinky carrions in battlefields or garbage dumps. This image is often far from the reality and actually vultures are very useful for both men and ecosystems. But what exactly is it that makes vultures so important for conservation biologists?

Vultures are considered as the most efficient scavengers among terrestrial vertebrates. Finding a dead animal is not as easy as it looks. Mortality is generally hard to predict, both in time and space. So a scavenger cannot simply wait for an animal dropping dead in front of it, unlike a predator that can wait, hidden, for a prey passing by. Vultures must actively search for carcasses and their flight ability allows them to find carcasses from the sky much more efficiently than any terrestrial scavenger. In addition, vultures are social birds when it comes to feed: a dead cow is large enough to be shared by many individuals. So birds can cooperate to find carcasses

even more efficiently, as all birds can simultaneously search for carcasses by looking to the ground, and observe other vultures in case some of them have found a carcass elsewhere. Finally, large numbers of vultures can eat a carcass very rapidly: less than 30 minutes for 100 vultures to eat an adult sheep weighing 60 kg! And contrary to common belief, vultures prefer to eat freshly dead animals than rotten carcasses of animals dead for several days or weeks. These features made the success of vultures vital in natural ecosystems with abundant wildlife like African savannas, American deserts or European mountains.

Where there are Shepherds, there are Vultures

In areas with higher human density, wildlife was generally replaced to some extent by livestock. But vultures adapted very well to these modified landscapes, and since Antiquity, vultures are described as allies of farmers and shepherds. Ancient Romans used to say “Ubi pecora, ibi vultures” (“where there are shepherds, there are vultures”) and vultures were celebrated like gods in Ancient Egypt (whose country name comes from Gyps, vulture in greek). Vultures have always played a role as natural cleaners of the environment, at the service of shepherds. In rural areas of southern

Europe, there used to be communal feeding sites where all farmers from a village would leave their carcasses for vultures. Such communal feeding sites, called 'muladares', were still used in Spain until the 1990s. Vultures were also common in villages and cities, cleaning garbage. This is, or was, still the case in India, Africa, and the Middle East, until recently.

Unfortunately the modern world has forgotten their utility. Sanitary rules forbid to leave carcasses in the field: they must be burnt or destroyed by quartering services. The return of vultures thanks to conservation programmes necessarily poses the question of food availability in the long term.

The immediate solution used in conservation programmes is to open a few feeding stations, (locally called "vulture restaurants") provisioned with butchery wastes. This must be viewed as an emergency solution, not viable in long term, but which has the advantage of providing safe food, without contaminants like pesticides, heavy metals or veterinary medicine.

Vulture Restaurants

Such feeding sites are still necessary for highly endangered species like Bearded vulture in Corsica, or Californian condors. In Israel, these feeding sites are used to control the quality of food available to vultures, and in case a poisoning event is noticed, all feeding sites are rapidly provisioned throughout the country, in order to attract vultures to these safe sites as a diversion, until the poisoning problem has been solved.

The second step is to provision the feeding sites with carcasses of livestock that died naturally on the farms nearby. The farmer with a dead animal has the choice to call the quartering services or dedicated staff that will collect the carcass. Those 'heavy' feeding sites (where several tons of carcasses can be deposited every month) played a decisive role in boosting vulture populations throughout Europe. As such, they are important management tools, both for vulture populations, but also to manage dead animals. They are also educational tools, where the public and stakeholders can see vultures in action to



Vultures never hunt actively, they entirely live on dead and often just dead animals.

Photo: O. Duriez.

better understand their behaviour. However, concentrating many carcasses every week at a few feeding sites makes food highly predictable in space and time. This situation is far from the natural situation encountered in the wild and biologists are

debating whether this can alter vultures' natural behaviour. The communal feeding sites as described above had the advantage to be more widely spread geographically.



In some regions in southern Europe, muladares on farms are allowed (again). In the background of vultures landing at a carcass, there is a grazing sheep flock.

Photo: O. Duriez.

Economical benefits of Vultures

Vultures do not only bring advantages to farmers and shepherds through quartering services. Their large size, fantastic flight performances, spectacular display behaviours both at colonies, when flying in groups, or when feeding, rank them high among ecotourism / wildlife watching destinations and as popular tourist attractions. Raptors, and particularly vultures easily catch the attention of people by being symbols of wild nature. Birdwatchers commonly travel to southern Europe to see vultures. Vultures are among favourites of wildlife photographers and special hides have been installed at feeding sites for photographers.

But casual observers and the general public can also easily appreciate vulture shows, because vultures are conspicuous and easy to see, even without telescopes (although binoculars are recommended!). They only need to go in front of a vulture colony (in general Griffon vultures are the target of these destinations because they are large and abundant, or less rare).

Several exhibition centres have been created to educate the public and help them understanding vulture biology and conservation actions. They generally offer to the visitor a museum about vulture population and conservation actions, a viewing terrace, and sometimes a live projection of vulture nests from remotely controlled cameras.

All these attractions generate economic income for the local people and the region, since a visit is accompanied by money spent at restaurants or hotels. In Grands Causses, it was estimated in 1995 that vultures participate to 1% of the total tourist income of the Aveyron Department. It is likely that this amount has grown now that

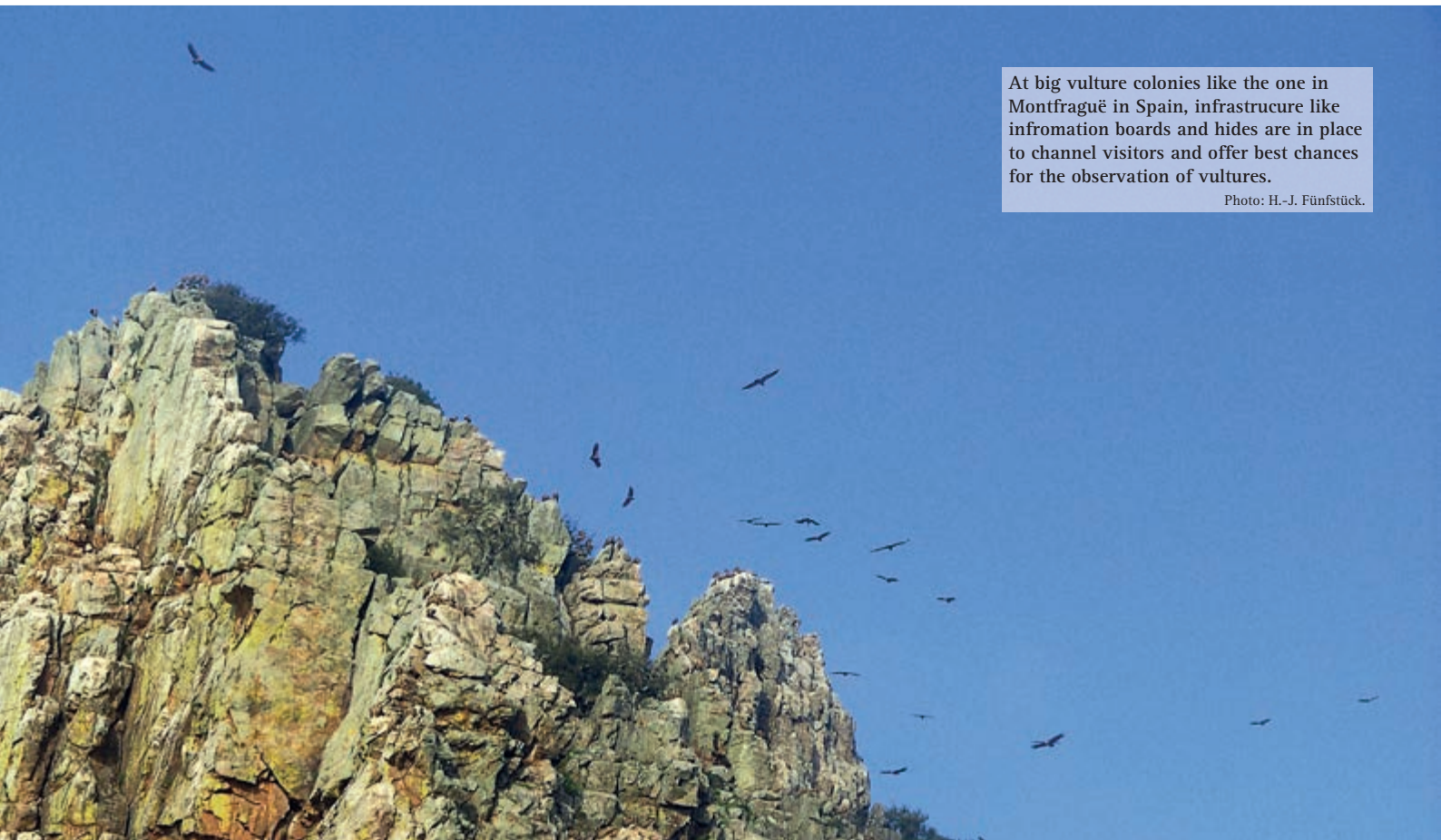
the vulture population has been multiplied by almost 10. In Israel, tourists visiting a vulture colony and nearby feeding site proved to be of positive value for the locals and that money should be spent on vulture conservation. Beside the business around vultures, it is noticeable that vultures can become a symbol of a region. In the Grands Causses, vulture pictures are displayed on almost all flyers and advertising of tourist attractions, even if not related at all with vultures, like kayaking activities! A wonderful example is the inclusion of a vulture, above a shepherd and its herd, on a large signpost on highway A75, promoting the new Unesco World Heritage label.

Photo: O. Duriez. Causse du Larzac, France, November 2015.



At big vulture colonies like the one in Montfraguè in Spain, infrastructure like information boards and hides are in place to channel visitors and offer best chances for the observation of vultures.

Photo: H.-J. Fünfstück.



Are Vultures “Raptors”?

The main concern about vultures is a commonly reported change in vulture behaviour, from scavengers to predators, deliberately attacking live animals. Such rumours have been greatly amplified by mass media and tabloids, always attracted by fresh blood and fear... These stories have been greatly exaggerated.

Such cases of vultures eating an animal still alive are extremely rare, and, contrary to what is said in the media, have always existed and been reported for long time in ornithological literature. They never involved healthy and large animals, but always animals injured, sick, immobile, generally already condemned. As such, vultures behaved as scavengers anticipating a death to come.

Then, from a few reported cases, the rumour has spread that troops of vultures were raiding and killing livestock, first among farmers, and later in the public, amplified by the media.

After a decade of investigation, the picture gets clear. The main problem seems to be wrong interpretation of natural vulture behaviour, eating a dead animal, by people not informed or educated. For people who never saw vultures, it is terribly impressive to suddenly see tens or hundreds of vultures falling from the sky into a pasture. Then the feeding event is also very impressive, with calls, whistles, birds fighting, puling meat... sometimes, the carcass seems to move, because vultures are pulling to open the skin. In many reports of ‘attacks’, the animal was already dead, and most of the time, people have not seen the ‘attack’; one minute ago there was a live animal, and some time later, vultures were eating that particular animal, assuming then that vultures were the cause of death, that was really due to another cause (birth, injury, dog/wolf attack, disease...).

It is interesting to see that these reports started in the Spanish Pyrenees, then on the French slope as well, in the year 1995, but cases dramatically increased from 2006, concomitantly with the ESB crisis. To solve the ESB problem, several Spanish authorities (particularly Aragon and Navarra, hosting most vulture colonies in northern Spain) decided to close all the feeding sites and collect all carcasses of dead animals (domestic and wild) to burn them, leaving vultures suddenly with food shortage. In these years, it was observed a redistribution of vultures throughout Spain and France, in areas where vultures were unknown. Vultures became bolder and were sometimes sitting on farms and letting humans approach closer than before. Most importantly, given the strong competition between starving vultures to find food, vultures were not waiting several tens of minutes, or even hours or days before descending and feeding on a dead animal, but instead arrived within minutes after death. Thus the carcass of livestock (dead naturally) was often unnoticed and it was the vultures who were revealing a dead animal.

From the Pyrenees, the rumour spread in other parts of France (Causses, Alps) and the story is currently under analysis. However it is clear that the number of reports of damages is not correlated with vulture population growth, but rather linked to the colonization of new areas by vultures to search for carcasses, areas where no public education had been done beforehand. After seven years of official procedures with an independent veterinarian, most actors from the Grands Causses agree to say that the vulture problem is very minor compared to the huge benefit of the action of scavenging, eliminating for free several thousands of carcasses each year.

Individual natural Quartering Sites

The best way to reestablish the ancestral link between vultures and shepherds is certainly to leave the latter managing their carcasses directly. Such an experiment has been implemented with success in France since 2000. In the Grands Causses, where vultures have been reintroduced in the 1980s, more than 100 farmers are officially allowed to leave the carcasses of their own animals at an “individual natural quartering site”, without any intervention of an external staff. Farmers then feel much more concerned and responsible of the vulture population. Vultures are viewed as natural quartering services, much faster than any human service

(except when prolonged bad weather prevents them from flying), and for free. Calculations in Spain have estimated the benefit for the society of quartering services by vultures, as energy saving equivalent to the annual electric consumption of a city of 10,000 inhabitants... For vultures, this means food resources much more widespread in the landscape, and less predictable in time. This situation would also benefit young age classes of vultures, that have difficulties to access food at heavy feeding sites due to strong hierarchy, dominated by old adults.

In conclusion, feeding stations should not be viewed as artificial food resources. If they are provisioned with carcasses from nearby

farms, or better directly located at the farms, they can become sustainable food resources, as it has been the case for centuries before vulture extermination in the 19th and 20th century.

Olivier Duriez, Alvaro Camiña-Cardenal, Fulvio Genero



Alvaro Camiña-Cardenal is a biologist and has worked on carrion eating birds and mammals for over 30 years. He is member of numerous organisations for the protection of birds of prey.

Olivier Duriez see page 43

Fulvio Genero see page 41

Taking a Look over the Mediterranean Sea:

Dubious Future for African Vultures

Just like lions, rhinos or elephants vultures have always been part of our traditional view of Africa. Unfortunately, that perspective is no longer supported by reality. Formerly common, flocks of Hooded vultures in and around towns in western Africa or impressive assemblies of Rüppell's vultures feeding on carcasses left by lions in the Serengeti have disappeared. Presently, all African vulture species with the exception of the unique Palm-nut vulture are regarded as endangered species.



The large Lappet-faced vulture breeds in arid and semiarid areas in Africa and the Arabian World.

Photo: A. Botha.

Various causes for the decline of vulture populations have been identified in different regions of the continent: Loss of food sources (e.g. Cape vultures in southern Africa), hunting for food ('bushmeat') or for the production of traditional medicines or for items of black magic ('muti'), and more recently, purposeful intoxication. Their social behaviour, especially the more gregarious *Gyps*-species, makes vultures highly vulnerable to disastrous mass-poisoning. Outside of the protected areas up to 99.9% of the original populations have been lost. That disturbing statement holds especially true for parts of western Africa. The tremendous increase in human population in combination with insufficient economic development, overexploitation of natural resources, widespread deficits of education and political instability do not provide hope for a rapid and sustainable change of situation.

Diversity of African Vulture species

The African continent, encompassing about 30 million square kilometres, is around three times the size of Europe in terms of land mass. Some 1.2 billion people are distributed over more than 50 sovereign nations. Many of those nations are not enjoying a stable admini-

stration. The majority of the population is poor, compared to European standards. Much of the population has been excluded from the chance of modern education. Major sources for income are traditional agriculture, fishing, mining and – in some parts – tourism. Significant industry can only be found in the South African Union and Zimbabwe. The spectrum of climates ranges from summer wet subtropical areas near the Mediterranean sea to tropical rainforests in central Africa and the savannas, dry steppe or desert areas that cover the majority of the continent. The Sahara area alone (5000 km east-western, 1200 to 1500 km north-southern extension) is some 26 times larger than Germany! Tropical alpine climate can also be found in central Africa (e.g. Kilimanjaro, Ruwenzori) or Ethiopia (Abyssinian Highlands). According to the highly heterogeneous environments and the size of the African continent, the avifauna is highly divergent and is subject to specific threats and challenges. This statement also holds true for African vultures.

Of our 16 species of Old World vultures nine are inhabitants of the African continent (IUCN classification in brackets):

- Bearded vulture *Gypaetus barbatus* (NT= near threatened)
- Lappet-faced vulture *Torgos tracheliotos* (VU= vulnerable)
- Egyptian vulture *Neophron percnopterus* (EN= endangered)
- Hooded vulture *Neosyrtes monachus* (EN=endangered)
- White-headed vulture *Trigonoceps occipitalis* (EN=endangered)



Pairs of White-headed vulture can be found in savannas south of the Sahara Desert.

Photo: A. Botha.

- Rüppell's vulture *Gyps rueppelli* (EN=endangered)
- African White-backed vulture *Gyps africanus* (EN=endangered)
- Cape vulture *Gyps coprotheres* (VU=vulnerable)
- Palm-nut vulture *Gypohierax angolensis* (LC=least concern)

Moreover, thousands of European Griffon vultures *Gyps fulvus* migrate to northern and western Africa every year. Egyptian vultures observed in Africa may either be residents or migrators from Europe. While Black vultures *Aegypius monachus* of Asian origin used to migrate to north-eastern Africa that species is no longer regularly observed there.

Documentation on African Vultures is limited

Originally, vultures had been present in all open African landscapes and had only avoided major forest areas in central Africa. However, overall populations even of the most common species have always been much smaller than those on the Indian subcontinent. While in the 1980s the population of Indian White-rumped vultures (*Gyps bengalensis*) amounted to some 40 to 50 million individuals, numbers of the formerly



The areas south of the Sahara Desert stretching to Kenia and Tansania are home to Rüppell's vultures. In Southafrica this species is missing.

Photo: A. Botha.



Hooded vulture: living mainly in western Africa in former times, today the population of this smaller vulture species is rapidly declining, heavily impacted by hunting for traditional medicines as well as for food.

Photo: A. Botha.

abundant White-backed vultures or Hooded vultures did not exceed some 250,000 birds. The reason for those differences is the fact that for cultural and religious reasons great numbers of cattle have been kept in India and the consumption of beef has been strictly forbidden. Moreover, vultures have been of mythological importance and have therefore been protected from hunting or other prosecution. In contrast, African vultures are being consumed and exploited for many reasons. African vultures have mainly fed on game and livestock, which had died from natural causes or hunting. Now these animals are increasingly being culled for human consumption, rather than succumbing to natural deaths. In addition there are no religious barriers protecting livestock or the vultures themselves. Unlike the Indian subcontinent, which has been enjoying rather stable governments, most African nations have been somewhat unstable. This unfavorable situation has



The population of the formerly in countries of southern Africa wide spread Cape vulture keeps shrinking - despite intensive conservation measurements, mainly in the South African Union.

Photo: A. Botha.

been facilitated by ethnic, religious and economic conflicts as well as disintegrating cultures and education deficits. Therefore, it is not surprising that African wildlife in general has been much less protected and less well-documented than in areas such as India or Europe. While in southern and in eastern Africa numbers of vultures have been captured in a systematic manner, and conservation measures have been implemented or at least planned, estimates of northern, western and central African populations have been limited or are even missing completely.

A short introduction to African vultures

Three populations of **Bearded vultures** can be found in Africa. While the northwestern mountain ranges are inhabited (or used to be inhabited) by the nominal race *G. barbatus barbatus*, in regions south of the Tropic of Capricorn the race *G. barbatus meridionalis* can be observed. There are two populations of that race, a larger centered in the Abyssinian highlands and a smaller in southern Africa. Whereas the northwest African population has shrunk to a critical size or has perhaps even become extinct (a 90% decrease of Moroccan birds during the last three decades!) the situation of the southern subspecies would appear to be more favorable. According to Peter Mundy in 1992, the complete African population was estimated at 4600 to 7000 individuals, with some 1400 pairs in Abyssinia and some 200 in the south (Drakensberg, Natal, Lesotho). As of 1997 there had been a further decrease of the southern population to some 112 to 120 pairs. The most likely reason is – similar to other birds of prey – intended or unintended poisoning (poison baits, lead ammunition), hunting, destruction of nesting sites as well as a high mortality of juveniles (87% in the first four years).

Current conservation measures aim to maintain a level of 100 to 150 breeding pairs in southern Africa.

Currently, there is no reliable recent data about this species in the east African highlands.

Originally, **Lappet-faced vultures** used to live in all arid and semi-

arid areas in Africa and Arabia. As of today the species has disappeared north of the Sahara. Residues in Israel or on the Sinai-peninsula probably no longer exist, whereas numbers are increasing on the Arabian Peninsula. The greatest numbers are found in Namibia with some 3000 individuals and 1000 breeding pairs. Those birds represent some 50% of the global population. Recently, an annual decrease of some 2.5% has been reported. During the last 30 years there have been significant geographical differences in that respect, ranging from almost no change in the south to a worrying 97% decrease in western Africa. The main reasons for the decline are changes in agriculture, electrocution and poisoning. Interestingly, an effective method to assess the population is aerial reconnaissance since their huge nests can be easily located in the sparse vegetation.

In the past **Egyptian vultures** used to be widely distributed across the whole of Africa. Just like in India or Europe, however, current developments are causing major concern. While the north African population has almost vanished and the breeding population in South Africa was extinct already in the 1920s, it only scarcely appears in the countries south of the Sahara. In 1991 Mundy estimated the total number at some 20,000 individuals. Since then, numbers have been decreasing considerably with populations down in western Africa by 86% and a staggering 99.9% in Kenya.

Hooded vultures used to be very common in sub-Saharan countries. Great numbers of birds inhabited human settlements, where the species took profit from human waste, especially in the vicinity of abattoirs. Since the 1960s the species has been vanishing, especially near human settlements. Decreases have amounted to some 50% in western Africa up to some 98% in Kenya. According to Ogada and Buij et al. the total African overall population was estimated at 200,000 individuals in 2011.

The **White-headed vulture** obviously is the rarest and least understood species of African vultures. Its habitat is

located in the savannahs south of the Sahara desert. According to the estimates of Mundy (1992) the world population numbers some 7,000 to 12,000 individuals. This species lives in pairs or is solitary. As of today breeding populations are limited to protected areas. Yet, numbers are also decreasing in those areas (e.g. Kenya -94%, western Africa -99.9%).

Rüpell's vultures also live in the region south of the Sahara, approximately between Senegal in the west and Sudan in the east. In southern Africa the species is not regularly seen. Interestingly, the species does at times show up in Spain. According to an estimate of Verdoorn in 2004 the world population amounted to some 30,000 birds. Data from a recent paper (Ogada et al. 2015) would indicate a reduction of 44% in eastern and 99.9% in western Africa.

Historical imagery frequently showed major mixed assemblies of both Rüpell's vultures and **African White-back vultures** feeding jointly on carcasses of steppe animals (e.g. Bernhard and Michael Grzimek's famous movie 'Serengeti darf nicht sterben'). The latter remains to be the most abundant species of African vultures. Its habitats are savannah areas south of the Sahara, which are rich in game. This species is less abundant in southern Africa. Human settlements are usually avoided. Mundy et al. estimated its population at some 270,000 individuals in 1992. African White-backs suffer from a variety of threats. For example, this gregarious species depends on the availability of tall trees for nesting and these trees are often damaged or destroyed if increasing numbers of elephants in game reserves overexploit their food resources leading to the consumption of trees, which are usually spared. Of interest but also of concern is the increasing use of high voltage electric poles as roosts or nesting sites. The last three decades have seen a major regression of the species, ranging from 50% in eastern to 97% in western Africa (Ogada et al. 2015).

The third African *Gyps*-species is the **Cape vulture**. Cape vulture populations are limited to southern Africa.

Diminution of this formerly highly abundant species began in the early 1920s, when the cattle plague virus was brought in from Asia. The resulting epidemic destroyed more than 90% of the local populations of bovine and antelope species. Also political conflicts such as the Boer wars had a negative impact.

More recently, replacing former pastures with agricultural areas has further limited food supply. As of today Cape vultures are threatened mainly by poisoning, electric power lines, illegal hunting and scarce food. The number of pairs in the South African Union amounts to some 3000. The annual rate of decrease is estimated at 6.5% (Ogada et al. 2015). The South African NGO VulPro (www.vulpro.com) has focused on and committed itself to the conservation of Cape vultures.

Because of its partly vegetarian diet, **Palm-nut vultures** would appear to be very special among all vulture species in the world. Preferred habitats are located between Senegal in the northwest, Kenya in the east and the South African Republic in the south i.e. areas where Oil palms

(*Raphia australis*) are grown. Besides palm nuts these vultures consume insects, mollusks, crabs and other small animals. Carcasses of larger animals do not play a major role in their diet. Due to the increasing production of palm oil the number of animals is thought to be increasing in some regions. According to Mundy et al. the total population amounted to some 80,000 pairs in 1992.

Severely threatened by Poisoning

Like most scavengers, vultures are subject to a considerable risk of poisoning. Both accidental as well as intended poisoning are of importance. Accidental intoxication may occur, when vultures consume poisoned bait, prepared for fighting raptors, e.g. lions, hyenas or jackals. A more recent disastrous development is due to intentional poisoning. The reason for this disastrous trend is the elimination of vultures as indicators of carcasses of poached game. The accumulation of vultures would attract rangers to carcasses poached for ivory or rhino-horn and thus facilitate the location and arrest of the criminals. In order to

eliminate the risk poachers prepare the carcasses with highly toxic pesticides such as nitrofurans. Birds feeding on the carcasses may die within minutes. Due to the habit to feed in flocks, which is especially true of the gregarious *Gyps*-species, hundreds of birds as well as their offspring can be killed at one time. One should, however, not forget that besides those massive and spectacular intoxication events that have been reported in the international press many 'small' tragedies, concerning only a single or a few birds are happening almost daily. Together these may accumulate to form even more relevant losses than the shocking mass killings.

Altogether poisoning is estimated at some 61% of those fatalities where the root causes are obvious. Songbirds, waders, geese, ducks, storks etc. are also deliberately poisoned, partially because they are regarded as pests e.g. Quelea (*Quelea quelea*) and partially as a source of food for humans: 'bushmeat'. Almost every poisoned bird is said to end up in a cooking pot! Though the bodies of those birds would be expected to be dangerous there has been no clear evidence for a negative influence on



The smallest of the African vultures, the Palm-nut vulture, feeds on palm nuts and others. Due to the extension of palm tree plantations, the population apparently increases.

Photo: A.Botha.

vulture populations due to their consumption.

Quackery and Black Magic

The hunting of vultures is of major importance mainly in western and southern Africa. Vulture carcasses in total or in parts are used as traditional medicines ('muti') or as instruments for prophecy or witchcraft. For those purposes significant numbers of birds are hunted, poisoned, processed, e.g. parched and sold at markets. In parts of western Africa, vultures – mainly Hooded vultures – used to be smoked and consumed by humans. Also the birds are usually hunted by poisoning. There have been estimates that some 29% of overall vulture losses have been due to hunting for muti and some 1% for bushmeat.

The tremendous number of military conflicts as well as the demand of a growing human population for food has caused major diminution of wild stock. As a consequence the amount of food available for vultures has shrunk.

Moreover, just like in Europe, construction of windfarms and powerlines are threatening large birds. It is

believed that those structures contribute some 9% to the decline of vultures.

Future Prospects

Because of the social behaviour in searching for food, especially the gregarious species, hundreds of individuals can arrive at major carcasses. These birds can strip the carcasses of even large animals such as elephants or hippos in rather short periods. Moreover, almost every pathogen will be inactivated within the vulture's digestive tract. Those properties have made vultures the most effective scavengers in Africa. Loss of those functions increases the risk of spreading animal epidemics, e.g. anthrax both among wildlife as well as livestock. Thus the loss of vultures not also causes ecological but also economic risks.

Due to the major amount of threats caused by direct and indirect persecution as well as changes in land use and industrial development, the prospects of vultures in Africa would not appear to be very encouraging. Our pessimistic view is enforced by a lack of political stability and limi-

ted awareness of decision makers on ecological matters. A recent paper of Ogada et al. (2015) indicates that six African vulture species may be on the verge of extinction in the very near future: Egyptian vulture, Hooded vulture, African white-backed vulture, Rüpell's vulture, Cape vulture and White-headed vulture. Perspectives for Bearded- and Lappet-faced vultures are also not very sunny. Their populations are predicted to decline by 70 to 80% over the next three generations. Additional conservation measures are desperately needed. Unfortunately, existing protected areas would appear to be not sufficiently effective. Promising new initiatives have been taken up in some southern African states as well as in Kenya and Tanzania. In the long run, however, progress can only be expected if the majority of people can achieve a higher level of education and prosperity.

André Botha, Jürgen Dämmgen, Darcy Ogada, Munir Virani



37 poisoned African white back vultures - their bodyparts would be used for black magic ("Muti").

Photo: A. Botha.



Since 2004 André Botha is manager of the Endangered Wildlife Trust Birds of Prey Programme and one of the chairmen of the IUCN Vulture Specialist Group.



Jürgen Dämmgen is a veterinary pharmacologist with ornithology as a hobby. He is mainly interested in aspects of poisoning in vultures and supports the Southasian „SAVE“-Project.



Darcy Ogada is assistant director of the African programme of the Peregrine Fund. She researches especially about development of vulture populations and their impact on spreading diseases.



Munir Virani leads the African programme of the Peregrine Fund and is Research Associate at the National Museum of Kenya. His main interest is about population dynamics and ecology of birds of prey.

Between Europe and Africa: Vultures in Maghreb

Maghreb, situated in the north of Africa, is part of the Palearctic ecozone. This aspect is important regarding vultures distribution near Europe. In this area, the different vultures' populations are narrowly connected to the European populations and are part of the global metapopulations of several European species of these scavengers. Thus, in the "old World" Maghreb represents a hyphen between Africa and Europe. There is comparatively to Europe, little information about vultures' situation in these countries. Nevertheless, for some time, several initiatives concerning the knowledge and the preservation of vultures started in the countries of Maghreb. It may be time to assess the current situation and to look for a way to structure these efforts.

Maghreb is the western part of the Arab World corresponding to the Arab-Berber cultural area, which is the region of north Africa between the Mediterranean Sea, Sahel, the Atlantic Ocean and Egypt. Eight vulture species exist or have existed recently in the three north-west African countries. Two are 'former breeders' and now extinct of the region: Black vulture, disappeared from Morocco and Algeria, this species has probably not bred in Tunisia, and Lappet-faced vulture (*Torgos tracheliotos*), disappeared from these three countries for several decades.

Three are rare accidental visitors of sub-Saharan Africa: Hooded vulture (*Necrosyrtes monachus*), was an occasional visitor in the south of Morocco in the 1960s, with no recent observation reported, White-backed vulture (*Gyps africanus*), the latest observation of this species occurred in northern Morocco in May 2014. One individual was seen near Tétouan. This was only the 4th or 5th record for

the Western Palearctic and Rüppell's Vulture (*Gyps rueppellii*), frequent visitor of Morocco and Algeria since the 1990s.

Only three species still breed in Maghreb: Griffon Vulture, disappeared as breeder of Tunisia and probably also Morocco, it still nests in Algeria, Egyptian vulture, it still breeds in the three countries. However, it is more widespread in Algeria than in the two other countries and Bearded vulture, disappeared from Tunisia and still visiting Algeria (NP of Theniet El Had), very few pairs (5 to 10 ?) may still breed in Morocco. It may be at the edge of disappearance in North Africa despite some valuable efforts in the last years to monitor closely the last pairs.

Teamwork across Continents

Concerning conservation, these species are subject to several threats that are difficult to organize into hierarchy. Among the most serious threats, poisoning is an important

one, although it is usually an indirect threat, as poison is used there to get rid of small predators like foxes or jackals. Food resources availability is also a major one. There are very few wild and domestic carcasses available and it seems to be the main cause for vultures decline in the Maghreb Mountains. Then, illegal traffic and poaching is globally unknown. These species are captured to be sold alive or mostly dead in local markets for their imaginary therapeutic virtues. The low numbers of individuals represents a probable threat for species such as the Bearded vulture in Morocco.

To conclude, several local and external initiatives give some hope for the conservation of these birds in Maghreb. It is important to encourage the local people and organisations that raise awareness and work on monitoring and threat management. The objectives are to maintain Maghreb as the great area for vultures that it used to be. One way for overseas conservationists to aim in this direction is to initiate and promote some close links with local ornithologists and organisations. A good example of this kind of relation is the recent exchange of emails between some Moroccan ornithologists and French conservation programmes about the observation of a ringed Griffon vulture, born in Grands Causses and observed in Djebel Moussa in Morocco with the help of a camera trap.

Raphaël Néouze

The Egyptian vulture is the only vulture species still breeding in all three Maghreb countries.

Photo: T. Krumenacker.



Raphaël Néouze see page 32

The Vulture Conservation Foundation and other Organisations: Key players in Vulture Conservation in Europe



The VCF (www.4vultures.org) is without any doubt the leading European organisation focussed on the conservation of vultures. Its international remit, big portfolio of projects across Europe, and focus on the four species, allows it to maintain a permanent overview, and be on top of strategies for the conservation of vultures in Europe. Among other projects, the VCF is leading on the update of the European Species Action Plans for the Bearded vulture and the Black vulture, is leading the Bearded vulture reintroduction projects in the Alps, Grands Causses, and Andalusia, and is involved with Egyptian vulture conservation in Portugal, Spain, Italy and the Balkans, and with Black vulture conservation in Spain, France and the Balkans

There are many other organisations that work with vultures though. At national level, bird conservation organisations are prominent – la League pour la Protection des Oiseaux (LPO, BirdLife France) for example has a long standing vulture programme in France (see <http://vautours.lpo.fr/>), and led the reintroduction of Griffon and Black vultures in several places in the country. Bearded vulture reintroduction in Switzerland is lead by Stiftung Pro Bartgeier (www.bartgeier.ch), while in Bulgaria Green Balkans (BSPB, www.greenbalkans.org/en/) and the Bulgarian Society for the Protection of Birds (<http://bspb.org/en>) have a good track record on vulture

species. The Birds of Prey Conservation Center in Croatia (www.supovi.hr/?lang=en) and the Birds of Prey Protection foundation in Serbia (www.vulture.org.rs) also are active on Griffon vulture conservation, while in Greece WWF Greece has been managing the only Black vulture population in the Balkans (www.wwf.gr/index.php/en/endangered-species/vultures).

Some organisations are active only at local level – Vautours en Baronnies for example in the Baronnies in the French Pre-Alps (www.vautoursenbaronnies.com/), or ASTERS in Haute-Savoie (www.gypaete-barbu.com/), others are focussed on a single species – Fundación Gypaetus (<http://gypaetus.org/>) and Fundación para la Conservación del Quebrantahuesos (www.quebrantahuesos.org) for example, work on this species in Andalusia and Aragon, respectively.

At statutory level, some governments have dedicated vulture conservation programmes – the DREAL in France lead on the national species actions plans, while Andalusia for example has targeted programmes for endangered species, including vultures, and manages a very successful anti-poisoning programme. National Parks have been close allies in the very successful Bearded vulture conservation project – from the pioneering ones like Hohe Tauern (<http://hohetauern.at/de/>), that have started to reintroduced Bearded vultures in the

Alps in 1986, to Mercantour (www.mercantour.eu/), Vercors (www.parc-du-vercors.fr) and Vanoise (www.vanoise-parcnational.fr/) Parks in France, and Alpi Marittime (<http://en.parcualpimarittime.it/>) and Stelvio (<http://www.stelviopark.it/>) in Italy.

Funding is always key to advance conservation, and three funders stand out in the last decades in support for vulture conservation work: the EU LIFE fund (<http://ec.europa.eu/environment/life/>), dedicated to implement the excellent EU nature conservation directives – since 1996 there has been at least 67 LIFE projects related with vultures – only between 2008 and 2012 9 vulture conservation projects alone received 10.7 million Euros; the MAVA foundation (www.mava.org), which has supported the VCF, but also other organisations and projects in vulture conservation around the Mediterranean, and the Frankfurt Zoological Society (<https://fzs.org/en>) was instrumental in the creation of the Bearded vulture captive breeding network, at the base of the successful Bearded vulture reintroduction projects now.

José Tavares



Dr. José Tavares is a biologist, and has been director of the Vulture Conservation Foundation since 2013. Thanks to him, VCF has developed to be the leading organisation in protecting vultures in Europe.

Vultures in Europe:

Priorities for Conservation

If anyone asked the question where to go to see great quantities of Old World vultures three decades ago, one would surely point towards India, where masses of vultures scavenged in every town – the Oriental white-backed vulture (*Gyps bengalensis*) was once the commonest large bird of prey on earth, with an estimated global population of 40 million individuals; or to the national parks of Africa, where kettles of vultures above some wild ungulate carcass epitomised the typical savannah landscape.

But the situation changed radically. Vultures in the Indian subcontinent crashed dramatically (by 90-95%) and were almost completely wiped out by the emergence of the veterinary drug Diclofenac there – while the African continent is currently suffering a dramatic vulture crisis, with massive mortality caused by the widespread use of poisoning, so that four of the African vulture species are now considered Critically Endangered – the highest extinction risk.

Today if you want to see a thousand vultures flying together up in the sky, you better come to...Europe.

Indeed, Europe is the only good news in an otherwise depressing vulture world – with the exception of the Egyptian vulture, all the other three species of vulture are increasing in the continent, and recolonizing former distribution range, naturally or with the help of reintroduction projects. Reasons for this lie mainly with the excellent EU nature conservation legislation, namely the Nature Directives (Birds and Habitats), that not only minimise and/or eliminate threats but also provide for good habitat, and promote also the populations of wild prey that are key to some species (e.g. Bearded vulture). Complementary EU legislation on livestock carcass disposal (Regulation 142/2011), that has taken in consideration vulture needs and ecology, has also contributed to the existence of a reasonable food source for other species (e.g. Griffon and Black vulture).

Three main challenges remain for vulture conservation in Europe:

- Linking populations across the continent to promote the re-establishment of a proper meta-population occupying most of the former range. Being mostly philopatric and with a slow breeding rate, vultures need time to recolonize former areas, and thus this process can be facilitated through strategic reintroduction projects. This is what the VCF is doing with the Bearded vulture and the Black vulture, often using the Griffon vulture as a proxy species.
- Reverting the long term decline of the Egyptian vulture – causes for this are multiple, and occur not only in Europe but also in the migration and wintering grounds in Africa and the Middle East, which make the conservation of this species a transcontinental challenge. We are addressing this through strategic conservation projects across Europe (Iberian peninsula, Balkans, Italy).

Some of VCF's objectives are a u-turn of the negative population trend in Egyptian vultures in Europe and the protection on migration routes and wintering grounds.

Photo: B. Berthemy. France, 5.10.2008.



The population of Bearded vultures in the Pyrenees slowly has increased in recent years. In the Alps, in 2016 25 young Bearded vultures fledged - a great success for the reintroduction project.

Photo: H. Weyrich. Pyrenees, 3.10.2015.



- Minimising or eliminating threats to vultures. Even though the impact of threats in Europe has much diminished, vultures still suffer from an array of threats, ranging from factors that induce mortality - like direct persecution, electrocution, collision with cables or wind farms, and poisoning, to others impacting on breeding productivity, namely disturbance of their nests, or decrease in food availability. Relative importance of these threats differs on a geographical and temporal scale - some threats that led to local extinction in the past (e.g. direct persecution, shooting) are for the most part not very relevant in today's Europe, while the incidence of others vary from region to region (e.g. disturbance).

Biggest Threats: Poison and Collisions

In general, threats have been well minimised or mitigated in the western part of Europe (Portugal-Spain-France), where vulture populations are doing very well, and start now to be addressed in the Balkans - where only some of the countries belong to the EU, with a recent accession date, and where nature conservation legislation and practice has still not caught up with the more established one in the western, more affluent part of Europe.

From our experience in different regions of Europe, through the imple-

mentation of different projects, with the four species, but also referring to the international (European) species action plans, three main threats remain to vultures in Europe.

Mortality due to illegal use of poisoning substances targeting predators still occurs insidiously in some parts of western Europe in spite of the campaigns and awareness (e.g. Portugal-Spain), and is locally widespread in the Balkans (e.g. Greece). Although the pattern of poisoning is changing - focussing on the use of smaller and more discrete poison baits - it is still a key factor in the decline of the Egyptian vulture (that precisely finds those baits). Also, with the resurgence of the wolf and other large predators in Europe, it is possible that the illegal use of poisoning substances may again increase. Continuing with the anti-poisoning programmes, including the well-known mix of enforcement-criminalisation-awareness-information, is a must and will continue to be part of vulture conservation programmes in Europe.

Another threat not to under estimate is mortality due to poisoning through toxic veterinary drugs used in domestic cattle - the obvious danger here is diclofenac (see page 62), but there is now increasing evidence that other veterinary drugs used in livestock also have a toxic effect on vultures. Banning diclofenac is a priority, but monitoring the situation regarding other veterinary drugs - including rigorous testing and an adequate risk evaluation process on scavenging

species before any new permits are given, is necessary.

A third big factor is mortality due to collision with wind farms, or electrocution in poorly insulated electricity lines. With the pressure for renewable energy a matter of fact, due to climate change realities, the number of wind farms will increase - and with it the number of lines in often natural areas frequented by vultures. Here we need to take in consideration the location and the patterns of movements of vultures when planning new energy infrastructure, using adequately the planning tools included in the European legislation (Strategic Environmental Assessment SEA and Environmental Impact Assessment EIA), and use established technology and known-how to insulate pylons and prevent electrocution.

Finally, a fourth priority to add to the suite of restoring vulture populations-reverting the decline of the Egyptian vulture - fighting threats: Awareness and information about the role of vultures, which often get a bad press. These avian scavengers are an essential part of the detrital food web of ecosystems and they provide a crucial important ecological service of recycling carrion biomass, and prevent the accumulation of dead biomass, thereby contributing to waste removal, disease regulation, and nutrient cycling. People need to learn to love vultures. We certainly do!

José Tavares

CHILDREN OF THE STORM:

Griffon vultures in the Kvarner Bay



Photo: H. J. Meyer, Kvarner Bay, 28.5.2016.

Griffon vulture.

The famous Bora wind attacks humans and nature in coastal Croatia. In the summer, this north-east fall wind provides a welcome cooling. But in the winter it is relentless. With top speeds of up to 200 kilometres per hour, it sweeps along the Adriatic coast from Trieste in Italy down to Dubrovnik. From autumn, when the storms are most violent, a very special storm is kindled in the Kvarner Bay: Griffon vultures begin their mating season. Today, their colonies are to be found on five islands only. The first eggs are laid during December and January, and the first chicks hatch in February.

The Griffon vultures of Croatia are unique. Compared to the colonies in other countries the breeding period starts in this northernmost established Griffon vulture population of Europe very early at the beginning of the year. The choice of nesting sites is also unique. The nests are located on steep cliffs above the sea, some only 8 to 10 m above sea level. The Bora and other weather phenomena have created natural niches in the rugged rocks, which provide protection for the birds. However, it's not just the choice of nesting sites that is unusual. The Croatian Griffon vultures, which are among the most heavy and largest representatives of their species, can travel long distances. With ring and wing tag readings, it was proved for the first time that these Griffon vultures travel tens of thousands of kilometres. Some of the most spectacular cases are those of the birds known as Oštro, Imela and Ledjni Zlajo. In June 2012 the Croatian Griffon vulture Oštro landed near a farm near the Swedish town of Tuve. After several weeks in a Swedish rescue centre in Gothenburg he was brought back to Croatia by plane at the end of August 2012. Equipped with a GPS transmitter, he was released successfully. Beside this breakaway to Sweden, the female Griffon vulture Imela was found in Russia in 2006 - near Melnichnye Pamyaly (circa 800 km northeast of Moscow!). Unfortunately, she had not survived her journey, only her skeleton with the ring on her leg remained. The southernmost documented sighting of a ringed Croatian Griffon vulture was the case of Ledjni Zlajo. As a young bird he had left his nest in August 1992. In October of the same year, he was found in the Zakouma National Park in Chad (Central Africa). Unfortunately he shared the same destiny as Imela in Russia. He was found dead. More than 75% of all juvenile Griffon vultures die in the first year of their lives.

Migration behaviour

The Croatian Griffon vultures migrate mainly in three directions: northwest to the Austrian and Italian Alps and further along to Sou-

thern France to Spain, southeast to the south of Italy to Sicily and from the Balkan region to the Crimea, and through Turkey and Israel to the African continent. In West Africa they are most likely to encounter Spanish Griffon vultures and follow them to the north of Spain. Crossing France they then go back to Croatia and thus close the circle. Some of them migrate to the north - to Denmark, Sweden, Northern Germany and Poland and to the north-east of Russia. Only the juvenile Griffon vultures travel these long distances. After reaching sexual maturity within about five to six years, they return to Croatia to find their partner for life in one of the colonies of the Kvarner Bay. But there are also exceptions: one found his partner in Greece and built a nest on the island of Naxos. Another one mated in Serbia and another in Northern Italy. The Croatian Griffon vultures mostly use winds like the Bora for their flights in the Kvarner Bay - far more than the warm thermal winds on the mainland. The islands of the Kvarner Bay are mountain peaks of a former mountain range. When the climate changed after the ice age and the sea levels increased

by 100 m, they became islands and the Bora became a feature of the region. The Griffon vultures of the Croatian population are bigger and heavier than their fellow species on the mainland. Because, by using the wind, they do not have to wait until the sun warms the land and they can soar up to the sky. As soon as the wind increases, they start their explorations, often before dawn. Even after sunset, they can still be active and consequently have more hours available for the daily search for food than their conspecifics.

More than 7000 sightings

Since 1989, every year in May the juveniles are ringed in the nests of the Kvarner Bay. The first 500 of nearly 1000 Griffon vultures were also tagged with wing marks. Later only green PVC and metal rings on their feet were applied. The age, the homeland colony, the food and migratory behaviour during the first five years of life until reaching maturity and breeding behaviour can be documented through these measures. These valuable data will be used to identify the key factors of their vul-



During the ringing of this Griffon vulture chick a second egg was found in the nest. A very rare occurrence. Normally, Griffon vulture pairs lay only one egg per year.

Photo: V. Jalži . Insel Cres, 7.5.2011.



During the breeding season in the summer months, the animals are massively disturbed by tourists. Often, the interferences last the whole day, so that the parents are not able to feed their young.

Photo: G. Sušić. Island of Plavnik, 25.8.2013.

A drowned young Griffon vulture. He jumped in total panic from the breeding cliffs and sadly did not have the strength to reach the rocks

Photo: G. Sušić. Island of Plavnik, 5.7.2007.

nerability. Ever since record-keeping began, approximately 7000 sightings have been reported to date. The research has led to many new and interesting findings. It is commonly known, that Griffon vultures annually produce only one egg. In captivity, it is possible that females may lay two eggs. This very rare phenomenon was recorded once in nature in the Kvarner Bay. The most likely explanation is, that two females shared the same nest (and the

same male), which is documented in about 1% of the population of Cape vultures. For Rueppell's vultures, this was observed only once. It is also known in White-backed vultures that two females share a nest and male. And also the constellation of a female with two males was observed. The third bird is then is called "helper" or "uncle". This behaviour is also commonly known in other bird species.

Tourism as a major threat

The first measures to protect the Croatian Griffon vultures begun years ago. In 1969, the world's first ornithological protected area for Griffon vultures was established on the island of Krk. The insight that their habitats were considered to be worthy of protection was the first important step. However, it was only with the start of scientific research - initiated by the Italian ornithologists Fabio Perco and Silvano Toso, together with the Croatian ornithologist Goran Sušić - that this population was discovered to be on the verge of extinction. After all nests had been documented in 1983, only around 60 breeding pairs existed. It was high time to take action. Besides a lack of food, tourists were (and still are today) one of the most serious threats to the Croatian population of Griffon vultures. During the summer months the young Griffon vultures are exposed to major disturbances in the nests. Boat trips are offered to the tourists, which pass the breeding rocks every half hour in daytime and all summer long. It often happens that tourists startle the young bird by screaming and clapping their hands because they want to see it flying. And then it can happen that the bird jumps out of the nest in panic and falls into the sea. Even if the vulture is able to reach the rocks by the seaside, it cannot get



Thanks to various measures the number of breeding pairs of Griffon vultures could have more than doubled since 1983. Unfortunately, the number has declined again since 2014. The reasons for this are thought to be lack of food, increased impairments due to the growing tourism industry, and illegal poisoning.

Photo: H.J. Meyer. Kvarner Bay, May 2015.

into the air from this low position. In case of an injured bird, rapid assistance is vital. It is very dangerous for the rescuer as well, because he has to balance on slippery and sharp-edged rocks to reach the bird. Although they are exhausted, the animals use their strong throat muscles to resist the person who is trying to save them. To enter the boat with the bird is even more difficult, especially when the sea is rough. These injured and grounded birds were saved from 1983 onwards. At the beginning, the rescuers brought the Griffon vultures to the zoo in the capital Zagreb, from where they were released on the island of Cres after their rehabilitation. Nearly twenty Griffon vultures were rescued this way.

Eco-centre Caput Insulae-Beli

Over the years, more and more vultures fell victim to these disturbances. The transport of birds from the islands in the Kvarner Bay to Zagreb caused organisational difficulties and severe financial limitations. So the idea of a rescue centre on Cres was born. At the beginning, a former school building served as a research and education centre for nature conservation in 1993. Two years later an aviary was built for the young Griffon vultures, most of which had fallen into the sea due to disturbances, injuries, exhaustions and poisonings. The aim of the Caput Insulae-Beli Eco-centre was to protect and preserve the biological diversity, original values and the cultural heritage of the island of Cres. A comprehensive and holistic approach had been developed. The vision "Sustainability - People and Nature in Harmony" described the project and included programmes such as the integrated protection of the Eurasian Griffon vultures and biodiversity, an interpretation centre, a nature school programme for young people, an eco traineeship and ecotourism programme. A permanent exhibition of art and history in nature was established. Stone sculptures with poetic inscriptions of local artists were exhibited, seven labyrinths (replicas of well-known labyrinths) in an ancient forest invited the hikers to rest and meditate, and numerous

Birdwatching in the Kvarner Bay

Griffon vultures: There are hiking trails from the town of Baška on the island of Krk close to the ornithological reserves. The colonies of the Griffon vultures are located on the side of the island facing the mainland. Opposite Baška you can see the uninhabited island of Prvic. With a taxibus you can go along the island and observe the Griffon vultures. Here their nests are very high above sea level, thus the danger of disturbance for the animals is largely excluded. Please do not accept any offers to observe the Griffon vultures at the island Plavnik. The nests are very low above sea level and the danger of disturbance for a young Griffon vulture is very high.

Other bird species: Golden eagle, Short-toed eagle, Peregrine falcon, Bee-eater, Cormorant, Black-eared Wheatear, Blue Rock-thrush, Rock thrush, Rock partridge, Stone Curlew, Eagle owl, Scops owl, Little owl, Nightjar, Alpine swift, Pallid swift, Eurasian hoopoe

Rare sightings: Goshawk, Eleonora's falcon, Lanner falcon, Levantine shearwater

Other animals: dolphins, coyotes

hiking trails - extended up to around 60 km - led through the magical Traumontana Forest.

After arriving at the rescue station, a period of intensive treatment begun for the rescued and often very weakened animals. First they were housed for some time in quarantine cages, to see if they showed poisoning symptoms. Often they were so weak that they had to be hand-fed with special food that provided the necessary energy. Dehydrated birds could also be treated. If the vulture

was on the way to recovery, it was released into the larger aviary to join the group of other Griffon vultures. The period of arrival in the rescue station until the release lay between ten and twelve months. The young birds doubled their weight during this time and trained their flight muscles. The long stay ensured that they were strong enough for release. In addition to physical training, the Griffon vultures learned how to deal with their conspecifics. Usually, the animals sit peacefully together but



Young Griffon vultures in the rehabilitation station in Crnika during feeding.

Photo: H. J. Meyer. 26.1.2015.



At the rescue center on Cres up to 15 rescued Griffon vultures were rehabilitated in some years.

Photo: G. Sušić. Aviary Ecocentre Caput Insulae Beli, 20.7.2010.

their behaviour changes abruptly when there is food. Within the group it comes to ranking battles. A special delicacy is the liver of a dead animal because it provides a lot of energy. Only the strongest at the “buffet” takes this top prize. Unfortunately, however, it is the most dangerous organ when the prey has been poisoned because most of the poison accumulates in the liver. Griffon vultures do not have a sense of smell and are not aware of the deadly danger. That is why the highest ranking and strongest Griffon vultures are often the first victims of poisoning. An illegal poison bait had devastating consequences on the island of Rab in 2004: the highly endangered population was decimated in a single stroke and twenty Griffon vultures lost their lives. The information and education work in the eco-centre was an important measure to prevent accidents caused by disturbances and poisoning of the animals. The project on Cres grew and attracted more and more visitors in the twenty years of its existence. It was showered with awards. In 2011, the project received a prize as the world’s best destination in the “General Countryside”

category, awarded by Skala International, an international professional association of the tourism industry. But it was the greed of the tourism industry on the island, that delivered the death blow. Conflicts between the nature conservationists and people who wanted to earn money from the

Griffon vultures (for example, excursion boats) soon became the order of the day. At the height of its success, the eco-centre was forced close.

New rescue centre on the mainland

A few months later a new site for a rescue centre was found on the mainland, in the Velebit nature park and right next to the coastal road with a direct view of the uninhabited island of Prvic, where colonies of Griffon vultures are located. On the property was a dilapidated house. The restoration of the building and the construction of an aviary took nearly two years. The newly founded organisation was named “Grifon – Birds of Prey Conservation Society”.

In September 2013, the centre was inaugurated. With the help of numerous, very enthusiastic volunteers, the formerly abandoned place flourished. The animals in the rescue centre could be observed behind mirrored windows and undisturbed by visitors. The building was outside the village and unfortunately without electricity. The operating company promised a power connection. The months passed, but nothing happened. The organisation had to use an electric generator. With each year, more visitors came, but unfortunately not enough. The running costs (especially for the food for the birds) could



In May 2016, six rehabilitated Griffon vultures were released back to nature.

Photo: H. J. Meyer. Kvarner Bay, 28.5.2016.



After having been released, a young Griffon vulture gains height up in the air above the island of Prvic.

Photo: H.J. Meyer. Kvarner Bay, 28.5.2016.

hardly be covered by ticket sales or donations. At the end of December 2016, the project was once again confronted with bad news: Croatia's Ministry of Environment and Nature changed its name to the Ministry For Environment and Energy. Due to this reorganisation, the ministry stopped co-financing for rescue centres of endangered animals in Croatia with immediate effect. This also impacted Griffon. Without the support it was impossible to cover the annual costs and this meant the final end for a project with a unique success story. Despite this bitter setback, Griffon will continue the fight for the preservation of the Croatian Griffon vulture - within the limits of financial possibilities. In 2017, the association could reach the milestone of 1000 ringed Griffon vultures. But to achieve this, the need for financial sponsors is crucial. There are also plans to establish a network of feeding places (vulture restaurants) from the Alps to Greece. This inclu-

des nature reserves in Italy, Slovenia, Croatia, Bosnia / Herzegovina, Serbia, Macedonia and Greece. In doing so, a sort of safe transit corridor for vultures would be created. A cooperation with Krka National Park on the mainland is currently underway. It will be the first of a number of feeding places. At the end of the last century, there was a Griffon vulture colony located within the park. The long term goal is to re-introduce the Griffon vultures in the national park or in other suitable areas. In the end, hope remains that future generations will realise how indispensable Griffon vultures are for a healthy environment. They are as important to the planet as natural food and clean drinking water.

Goran Sušić, Cornelia Kruchten

Literature

Sušić G 2000: Regular Long-distance Migration of Eurasian Griffon *Gyps fulvus*. In: Chancellor RD, Meyburg B-U (eds.): „Raptors at Risk“. WWGBP/Hancock House. Pp. 225-230.

A children's book is planned, which tells the true story of a Griffon vulture named Spaky. For the realisation of this book, the help of sponsors is needed. The proceeds received from the sale will be used for the project. For more information please visit www.supovi.de



Dr. Goran Sušić is an ornithologist, he was the founding president of the Eco-centre Caput Insulae-Beli, a society for the protection of the natural and cultural history Heritage of the island of Cres, and founded the Griffon - Birds of Prey Conservation Society. He is a member of the international IUCN Vulture Specialist Group.



Cornelia Kruchten has been supporting the project voluntarily since the beginning of 2014. Among other things, she is responsible for marketing and fundraising.

Bibliography

- Angelov I 2011: Rettungsaktion auf dem Balkan: Schmutzgeier in Bulgarien. Falke (9): 372–378.
- Bassi E, Ferloni M 2012: L'esposizione dei rapaci al piombo: il caso della provincia di Sondrio. In: Andreotti A, Borghesi F (eds): Il piombo nelle munizioni da caccia: problematiche e possibili soluzioni. Rapporti ISPRA 158: 53–54.
- Bassi E et al. 2014: Il rischio di saturnismo negli uccelli necrofagi in relazione alle attuali modalità di caccia degli ungulati. In: Tinarelli R et al. Atti XVI Convegno Italiano di Ornitologia. Cervia (RA), 22–25 settembre 2011. Scritti, Studi e Ricerche di Storia Nat. della Rep. di San Marino: 450–457.
- Bethge P 2013: Tiere. Nirgends Kadaver. Der Spiegel 44/28.10.13: 120, 121.
- BirdLife International 2004: Birds in Europe: population estimates, trends and conservation status. BirdLife Int., Cambridge, UK.
- Blumstein DT 1990: An observation of play in Bearded Vultures. Condor 92: 779–781.
- Brown CJ, Plug I 1990: Food choice and diet of the Bearded Vulture (*Gypaetus barbatus*) in Southern Africa. S Afr J Zool 25: 169–177.
- Cardenal AC 2011: Ein vermeidbarer Konflikt: Geier und Windenergieanlagen. Falke 58 (12): 504–507.
- Choisy JP, Terrasse M 2007: Réintroduction du vautour fauve. LPO, Parc National des Cévennes, Parc Naturel Régional des Grands Causses.
- del Hoyo J, Collar NJ 2014: Illustrated checklist of the birds of the world. Vol 1. Lynx Editions, Barcelona.
- del Hoyo J, Elliott A, Sargatal J (eds) 1994: Handbook of the Birds of the World, Vol. 2. Lynx Editions, Barcelona.
- Fajardo I et al. 2015: Técnica forense y policía científica. In: Fajardo I et al. (eds): Manual de Protección Legal de la Biodiversidad para los Agentes de la Autoridad Ambiental en Andalucía (3rd ed.); Consejería de Medio Ambiente, Junta de Andalucía: Sevilla: 318–363.
- Fajardo I et al. 2014: La investigación en los casos de uso ilegal de veneno: procedimiento y técnicas de investigación. In: Bodega Zugasti D., de la (ed): Uso ilegal de cebos envenenados. Investigación y análisis jurídico. SEO/BirdLife-Proyecto Life + VENENO: Madrid: 55–85.
- Flint P, Stewart P 1992: The birds of Cyprus. Second edition. Brit. Ornithol. Union, UK.
- Frey H, Llopis A 2015: Bearded Vulture EEP: Guidelines for feeding bearded vultures in captivity. Vulture Conservation Foundation.
- Girtanner, A 1879: Zur Pflege und Ernährung des Bartgeiers in der Gefangenschaft. Mitt. Ornithol. Ver. Wien 3: 112–115.
- Glutz von Blotzheim UN et al. 1971: Handbuch der Vögel Mitteleuropas. Bd. 4. Akad. Verlagsges., Frankfurt.
- Gu X, Krawczynski R 2012: Tote Weidetiere – staatlich verhinderte Förderung der Biodiversität. Artenschutzreport 28/2012: 60–64.
- Haas DG et al. 2009: Erfahrungsbericht zum anhaltenden Geiereinflug nach Deutschland – Schlussfolgerungen und Chancen für den Naturschutz. Pop Ökol Greifv- und Eulen 6, 133–141.
- Haas DG 2011a: Altweltgeier in der Mythologie und im religiösen Brauchtum. Der Geier als Gott. Vögel 2/2011, 52–53.
- Haas DG 2011b: Blei vergiftet unsere Großgreifvögel: Der Seeadler als Forschungsmodell. Falke, Sonderheft Greifvögel, 27–29.
- Haas DG et al. 2011: Spektakulärer Geiereinflug auf die Schwäbische Alb – Was ist künftig zu erwarten? Natursch. Alb-Neckar, (2): 21–28.
- Hauber G 1941: Raubwild im Gebirge um den Königssee. Bergheimat 21 (2): 5–6.
- Heredia R et al. 1990: Ingestion of eagle own *Bubo bubo* pellets by lammergeiers *Gypaetus barbatus*. Ibis 132: 127.
- Hirzel A et al. 2004: Ecological requirements of reintroduced species and the implications for release policy: the case of the bearded vulture. J Appl Ecol 41: 1103–1116.
- Hölzinger J 2012: Das Alter des historischen Brutvorkommens des Gänsegeiers *Gyps fulvus* im Oberen Donautal auf der Schwäbischen Alb. Ornithol. Jh. Bad.-Württ. 28: 1–18.
- Houston DC, Cope JA 1994: Bone digestion and intestinal morphology of the bearded vulture. J Raptor Res 28: 73–78.
- Izquierdo D, Zink R 2014: International Bearded Vulture Monitoring (IBM) Annual Report 2013.
- Jäckel AJ 1891: Systematische Übersicht der Vögel Bayerns. Oldenbourg, München.
- Kobell v F 1859: Wildanger – Skizzen aus dem Gebiete der Jagd und ihrer Geschichte mit besonderer Rücksicht auf Bayern. Cotta, Stuttgart.
- König C et al. 2013: Sommer 2013 – Graugänse, Gänsegeier und Kreuzschnäbel. Falke 60 (10): 410–415.
- Krüger S C et al. 2014: Trends in territory occupancy, distribution and density of the Bearded Vulture *Gypaetus barbatus meridionalis* in Southern Africa. Bird Conservation International 24.
- Krüger T, Krüger J-A 2007: Einflug von Gänsegeiern *Gyps fulvus* in Deutschland 2006: Vorkommen, mögliche Ursachen und naturschutzfachliche Grundlagen. Limicola 21: 185–217.
- Margalida A, Bertran J 1996: Quebrantahuesos (*Gypaetus barbatus*) ingiriendo sus propias egagrópilas. Butll. GCA 13: 49–51.
- Margalida A, Bertran J 2001: Function and temporal variation in use of ossuaries by bearded vultures (*Gypaetus barbatus*) during the nestling period. Auk 118: 785–789.
- Margalida et al. 2003: Territory change and nest-site switching in the bearded vulture (*Gypaetus barbatus*). J Raptor Res 37: 333–337.
- Margalida A et al. 2007: Factors influencing breeding density of Bearded Vultures, Egyptian Vultures and Eurasian Griffon Vultures in Catalonia (NE Spain): management implications. Anim Biodiv Conserv 30: 189–200.
- Margalida A 2008a: Presence of bone remains in the ossuaries of bearded vultures (*Gypaetus barbatus*): storage or nutritive rejection? Auk 125: 560–564.
- Margalida A 2008 b: Bearded vultures (*Gypaetus barbatus*) prefer fatty bones. Behav Ecol Sociobiol 63: 187–193.
- Margalida A, Bertran J, Heredia R 2009: Diet and food preferences of the endangered Bearded Vulture *Gypaetus barbatus*: a basis for their conservation. Ibis 151: 235–243.
- Margalida A et al. 2013: Uneven large-scale movement patterns in wild and reintroduced pre-adult bearded vultures: conservation implications. PLOS One 8: e65857.
- Margalida A, Moleon M 2014: Sanitary costs. Dupont 2012.
- Marín-Arroyo AB, Margalida A 2012: Distinguishing Bearded Vulture activities within archeological contexts: identification guidelines. Int J Osteoarcheol 22: 563–576.
- Mateo R et al. 2003: Lead and arsenic in bones of birds of prey from Spain. Environ Poll 126:107–114.
- Metzner J et al. 2010: Extensive Weidewirtschaft und Forderungen an die neue Agrarpolitik. Natenschutz Landschplan 42 (12): 357–366.
- Müller HU, Buchli C 1982: Projekt Bartgeier. Arbeitsbericht FORNAT, Zürich/Zernez, pp. 65.
- Psenner H 1977: The successful breeding of the Bearded Vulture in the Alpezo. Proc World Conf Birds of Prey, Vienna 1975: 370–371.
- Richards NL, Ogada D 2015: Veterinary agents and poisons threaten avian scavengers in Africa and Europe. Royal Soc Chemistry-Environmental Chemistry Group-Bulletin. January 2015: 17–19.
- Richards NL et al. 2014: Merging wildlife and environmental monitoring approaches with forensic principles: Application of unconventional and non-invasive sampling in eco-pharmacovigilance. J For Res 5: 228, doi: 10.4172/2157-7145.1000228
- Robert I, Vigne J-D 2002: Bearded Vulture (*Gypaetus barbatus*) contributions to the constitution of two different bone assemblages: Modern reference data and an archeological example in Corsica. Acta zool cracov 45: 319–329.
- Robert Attard I, Reumer JWF 2009: Taphonomic reinterpretation of a bone sample of endemic Pleistocene deer from Crete (Greece): osteoporosis versus regurgitation. Paleodiversity 2: 379–385.
- Robin K et al. 2003: Der Bartgeier. Uznach.
- Ruxton GD, Houston DC 2004: Obligate vertebrate scavengers must be large soaring fliers. J Theor Biol 228: 431–436.
- Stübing S 2011: Rückblick 2010: Gänsegeier in Deutschland. Falke 58 (1): 30–31.
- Schumann A 1916: Erfolgreiche Zucht von *Gypaetus barbatus* im königlichen zoologischen Garten von Sofia. Zool. Beob. 57: 209–216.
- Stemmler C 1932: Die Adler der Schweiz. Zürich.
- Terrasse M et al. 2004: A success story: the reintroduction of griffon *Gyps fulvus* and black *Aegypius monachus* vultures in France. In: Chancellor RD, Meyburg BU (ed.), Raptors Worldwilde, WWGBP- MME (Birdlife Hungary): 127–145.
- Terrasse M, 2006: Evolution des déplacements de vautours fauves *Gyps fulvus* en France et en Europe. Ornis 13 (5): 273–299.
- Thaler E, Pechlaner H 1978: Volierenbrut und Handaufzucht beim Bartgeier (*Gypaetus barbatus aureus*). Meeting on the reintroduction of the bearded vulture, *Gypaetus barbatus aureus* (Hablizl 1788) into the Alps. Report of proceedings, Morges 17.-18.11.1978: 81–96.
- Wagner AJ ca. 1850: Übersichtskarte der Verbreitungsverhältnisse der merkwürdigsten wildlebenden Thiere in Bayern. Ein Versuch nach den Angaben königlicher Forstämter und nach eigenen Erfahrungen. Aufbewahrt in der Staatsbibliothek München.
- Wagner AJ 1846: Beiträge zur Kenntnis der bayerischen Fauna. Münchener Gelehrte Anzeigen, Nr 81 u. f. München.
- Wolfram K, Huyghe M 2013: Sanfte Riesen mit kompliziertem Liebesleben: Mönchsgeier in Europa. Falke 60 (7): 268–273.
- Wüst W 1981: Avifauna Bavariae Bd. 1, Ornithol. Ges. Bayern, München.

Internetlinks

www.4vultures.org • www.balkanvultures.net • www.rewildingeurope.com/
www.iucn-vulturenews.org/ (Vulture News Journal)

„Vulture Conservation in the Balkan Peninsula and Adjacent Regions“ – 10 Year of Research and Conservation. Download www.balkanvultures.net/Downloads/bvap_booklet

This PDF is a translation of DER FALKE special issue “Geier”

We thank Stephanie Kiel and Christian Hermann for the translation of some of the texts into English, and Kylie Bull for editing all English texts.

Imprint

DER FALKE – Journal für Vogelbeobachter
ISSN 0323-357X,
www.falke-journal.de

Business address:

AULA-Verlag GmbH • Industriepark 3
56291 Wiebelsheim • Germany
Tel. 0049 6766/903-141,
Fax 0049 6766/903-320
E-Mail: falke@aula-verlag.de

Editorial board:

Dr. Norbert Schäffer (chief editor; sch),
E-Mail: norbert.schaffer@falke-journal.de
Georg Grothe,
E-Mail: grothe@aula-verlag.de

Science editors:

Prof. Dr. F. Bairlein (fb), T. Brandt (tb), H.-
J. Fünfstück (fü), T. Krumenacker (tk) A.
Schäffer (as), Dr. H. Stickroth (hs), Dr. C.
Sudfeldt (cs),

Editorial assistant:

Dominique Conrad
Tel.: 0049 6766/903-236;
Fax: 0049 06766/903-341;
E-Mail: falke@aula-verlag.de

Typesetting/composition AULA-Verlag:

Rolf Heisler

Sales department:

Britta Fellenzer
Phone: 0049 6766/903-206
Fax: 0049 6766/903-320
E-Mail: vertrieb@aula-verlag.de

Bank account: Wiesbadener Volksbank

BIC: WIBADE5W
IBAN: DE38 5109 0000 0015 1999 11

Copyright information:

All articles published in this journal are protected by copyright, which covers the exclusive rights to reproduce the articles, as well as all translation rights. Permissions for reproduction have to be confirmed in writing. No material published in this journal may be reproduced photographically, stored on microfilm or reproduced in other ways without first obtaining written permission from the publisher.