

# The Sacred Ibis in Europe: ecology and management

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**Abstract** The Sacred Ibis *Threskiornis aethiopicus* is common and widespread in its native range. The species' adaptability means that it thrives in landscapes modified by human activity. In recent decades, non-native populations have become established in several areas of Europe as a result of escapes or deliberate releases from collections. Such populations have the potential to become established and increase quickly, and thus to have a significant impact on native species. This paper summarises the current situation in Europe, with particular reference to France. The largest non-native populations in Europe became established in France between about 1990 and 2005, prompting a costly eradication programme, the progress and results of which are described.

## The Sacred Ibis in its native range

The Sacred Ibis *Threskiornis aethiopicus* is common and widespread throughout much of sub-Saharan Africa, and a small, isolated and decreasing population persists in southern Iraq (Bonn 2005). The world population, estimated at some 200,000–450,000 individuals, is thought to be stable or declining (Wetlands International [wpe.wetlands.org](http://wpe.wetlands.org); BirdLife [www.birdlife.org](http://www.birdlife.org)), and it is treated as a species of Least Concern under IUCN criteria ([iucnredlist.org](http://iucnredlist.org)).

In South Africa, where most studies have been carried out, the Sacred Ibis bred only on coastal islets near Cape Town at the beginning of the twentieth century, moving to inland marshes in winter. Subsequently, it benefited from irrigation, agriculture intensification, and conservation measures, and progressively established colonies as far inland as Zimbabwe (Harrison *et al.* 1997; Kopij 1999). Although it is nominally resident, over 50% of ring-recoveries are more than 100 km from the ringing site (Hockey *et al.* 2005), while post-breeding movements of up to 1,000 km occur, and some consider the Sacred Ibis to be more accurately described as nomadic (Clark & Clark 1979; Harrison *et al.* 1997; Underhill *et al.* 1999).

The Sacred Ibis is a social breeder, in colonies from a few tens up to c. 2,000 pairs. Nests are built on a variety of supports, mostly in trees and bushes but sometimes on the ground or among rocks (Urban 1974; Brown *et al.* 1982; Hancock *et al.* 1992). Around Cape Town, ibises breed in reedbeds, on the ground, in trees and bushes and even on artificial breeding platforms. In all cases, breeding sites are completely surrounded by water or on an offshore island, and the species will breed almost anywhere provided that the 'island' criterion is met (Doug Harebottle *in litt.*).

Ibises are similarly social when feeding, mostly foraging in groups, often with other long-legged species such as Yellow-billed Stork *Mycteria ibis*, African Spoonbill *Platalea alba* and Little Egret *Egretta garzetta* (Hancock *et al.* 1992). In Africa as a whole, the main foraging habitats are farmland, wetlands, and rubbish dumps (Brown *et al.* 1982), while in South Africa over 80% of records are from grassland habitats, the remainder mainly from freshwater wetlands and estuaries (Harrison *et al.* 1997). The species will also use a wide variety of man-modified and artificial habitats (Clark & Clark 1979).



94. Sacred Ibises *Threskiornis aethiopicus*, Lac de Grand-Lieu, France, May 2011.

The Sacred Ibis feeds mainly on locusts, grasshoppers, and aquatic beetles; it will also take a variety of other aquatic and terrestrial invertebrates, in addition to fish, amphibians, lizards, birds and small mammals. Carrion, vegetable and animal refuse, offal and seeds are also taken. In addition, breeding birds can raid neighbouring nests for eggs and chicks, and some individuals specialise in raiding the nests of other birds, sometimes pulling adult birds out of their nest to take the eggs or young. Victims include pelicans, herons, spoonbills and cormorants, gulls and terns on offshore islands, and two Endangered species (African Penguin *Spheniscus demersus* and Cape Cormorant *Phalacrocorax capensis*), and they will even take eggs of the Nile Crocodile *Crocodylus niloticus* (Clark 1979; Brown *et al.* 1982; Harrison *et al.* 1997; Hockey *et al.* 2005; Williams & Ward 2006).

### The Sacred Ibis as a non-native

The Sacred Ibis is absent from the paleontological and archeo-zoological record in Europe (Mourer-Chauviré 1993), and there is no evidence for natural vagrancy out of Africa. In the early nineteenth century the species still bred in Egypt, in the Nile Valley, but disappeared within a few decades (del Hoyo *et al.* 1992). There are no modern-day

reports from Egypt (Egyptian Ornithological Rarities Committee <http://chn-france.org/eorc>), and none has reached Morocco although it is common in Mauritania (Thévenot *et al.* 2003; Moroccan Rarities Committee [www.go-south.org](http://www.go-south.org)). Consequently, any Sacred Ibis recorded in the wild in Europe can be regarded as a former captive, released either deliberately or accidentally. Such escapes remained a rare sight until it became more common for zoological collections to house free-flying groups of ibises (Clergeau & Yésou 2006; Fàbregas *et al.* 2010). In recent decades, the number of escapes has led to the establishment of significant non-native populations in some areas.

Non-native species that become established in the wild may have a negative impact on native species, potentially with a significant loss of biodiversity as well as economic impacts, and are termed ‘invasive species’ (e.g. Mooney & Cleland 2001, Vilà *et al.* 2010, Martin-Albarracín *et al.* 2015). Accordingly, the European Parliament and the Council of the European Union adopted a regulation to ‘prevent, minimise and mitigate the adverse impact on biodiversity of the introduction and spread within the Union of invasive alien species’ (European Commission 2014). This required the Commission to adopt a list of

invasive alien species of Union concern, which came into effect in August 2016 (European Commission 2016). The list contains 37 species, including three bird species: House Crow *Corvus splendens*, Ruddy Duck *Oxyura jamaicensis* and Sacred Ibis. In addition, a pan-European research programme has identified the Sacred Ibis among the invasive species of main European concern (DAISIE 2009 [www.europe-aliens.org](http://www.europe-aliens.org)). These three species are now the subject of control and eradication programmes throughout the EU.

The House Crow has established populations in over 20 countries outside its native range and often rapidly attained pest status, for example through predation of native species and as a carrier of human and animal disease (GISD 2017). The threat posed by the Ruddy Duck to the conservation of the endangered native White-headed Duck *O. leucocephala* in southern Europe and the consequent eradication programme in the UK are well known (e.g. Henderson 2009, Holling *et al.* 2017). The remainder of this paper considers the potential problems of established non-native Sacred Ibis populations. Focusing on the situation in France, where the largest introduced population in the world has spread, we highlight the difficulties encountered in setting up an eradication programme to deal with such a large and widespread population. When not otherwise stated, the information presented here has been collected by the authors and their institutions.

### Introductions in Europe and elsewhere

Free-flying Sacred Ibises have been reported from several European countries. Breeding has occurred in the wild in France, Spain, Portugal, Italy, the Netherlands and possibly other nations. A number of free-ranging colonies have become established; the situation in France is treated in more detail below, but a brief summary of breeding status in other European countries is given first.

#### Spain and Canary Islands

Sacred Ibises that escaped from Barcelona Zoo settled in a nearby public park, where breeding first occurred in 1974. This continued throughout the 1980s and 1990s, after which the colony was controlled, and breeding was last recorded in 2001. The breeding birds also visited nearby wetland areas including the Llobregat and Ebro deltas (Jordi Clavell *in litt.*). In the Canary Islands, where the species was first recorded in 1989, free-ranging ibises have nested regularly on Fuerteventura since at least 1997, with 2–5 pairs nesting in the early 2000s (Yésou & Clergeau 2005) and unknown numbers since then.

#### Portugal

Three Sacred Ibises escaped from a zoo near Coimbra in 1998; a pair nested nearby and reared three young that year, after which they disappeared. Since 2009 the species has been observed almost year-round in the Algarve



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95. Sacred Ibises *Threskiornis aethiopicus*, Banc du Bilho, Loire estuary, France, April 2005.

with up to six birds together, but breeding has so far not been recorded (de Juana & Garcia 2015; Gonçalo Elias *in litt.*).

### Italy

Breeding in the upper Po Valley, Piedmont, began in 1989, and 26 pairs nested there in 2000, when approximately 100 individuals were present. In 2003 breeding occurred at a second site in the same area, with possibly 25–30 pairs, and a few more pairs were found at a third colony in 2004 (Yésou & Clergeau 2005). More recent information, from the 2001–10 winter waterbird counts (Zenatello *et al.* 2014), which may not have monitored the whole population, revealed increased dispersal away from Piedmont, which led to breeding attempts in Venetia and Tuscany. The highest national winter count up to 2010 was 70 in 2008, but numbers have increased since (Nicola Baccetti *in litt.*). In 2015 there were at least 140 nests in ten colonies, with a much greater non-breeding population: hundreds of ibises came in to roost at some colonies (Mauro Fasola *in litt.*). In late 2016, a census coordinated by GPSO, the Piemontese ornithological group, found 4,068 individuals in 13 roosts in northwest Italy. The Italian population, which remained low for about 20 years, is now suddenly booming (Gianfranco Alessandria *in litt.*). As yet there is no coordinated control programme for the population in Italy.

### The Netherlands

Free-flying Sacred Ibises that escaped from a zoological park in Zuid-Holland attempted to breed in 2001, and successful breeding occurred in 2002. Numbers increased to ten breeding pairs in 2003 and 15 pairs in 2007. Eradication measures began in 2008 and only 4–5 pairs remained in 2009. A few birds are still at large, possibly new escapees or birds arriving from Germany (Smits *et al.* 2010; Robert *et al.* 2013; [www.cr-birding.org](http://www.cr-birding.org)). Sporadic reports of breeding birds continue, most recently a single pair at De Wieden NP in 2016 (Ronald Messemaker pers. comm.).

### Other European countries

Other free-flying colonies are known in Belgium (Antwerpen Zoological Garden; Gunter de Smet *in litt.*) and Germany (a colony at Walsrode bird park in the 1980s had disappeared by the end of the 1990s, while another colony, at Munich Zoo, was the likely source for birds seen in Switzerland; Andreas Buchheim and Nicola Baccetti *in litt.*). Also in Germany, 12 young Sacred Ibises escaped from a bird sanctuary in the Munster area, where they were hand-raised by a researcher from the Konrad-Lorenz Institute for Ethology; part of that group seemingly reached the Netherlands (Smits *et al.* 2010, [www.michelklemann.nl/ibis/mail/ebn20001125.html](http://www.michelklemann.nl/ibis/mail/ebn20001125.html)). In the UK, several free-flying Sacred Ibises dispersed from a zoo near



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96. Part of the Sacred Ibis *Threskiornis aethiopicus* colony at Banc du Bilho, Loire estuary, April 2005.

Dalton-in-Furness, Cumbria, and moved to the nearby coast (Ian Carter *in litt.*).

**Releases and escapes outside Europe**

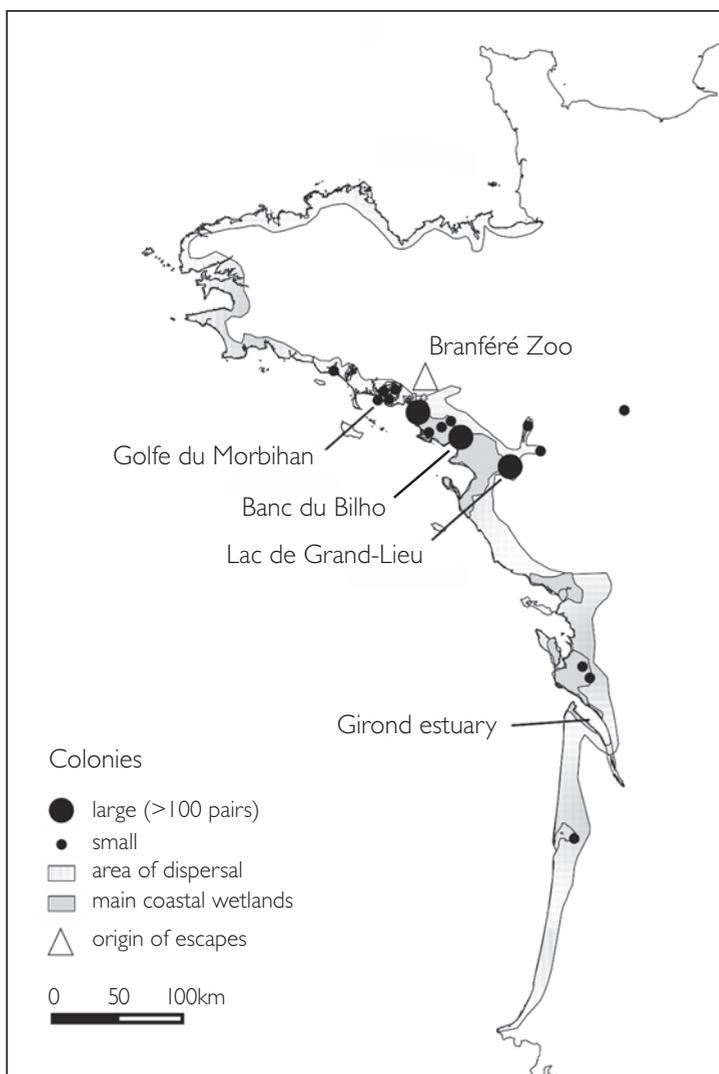
Since 1989 a small introduced population has persisted on Sir Bani Yas Island in the United Arab Emirates (Yésou & Clergeau 2005). A dozen birds that escaped from a zoological garden in Taiwan in the early 1990s rapidly established a thriving population, with hundreds of birds living in the wild by 2002 (Agoramoorthy & Hsu 2007; Adam Welz, Wayne Hsu and Lucia Liu Severinghaus *in litt.*). In the USA, five Sacred Ibises escaped from Miami Zoo, Florida, in 1992 when Hurricane Andrew destroyed their enclosure. Initially they bred in the area and numbers grew unnoticed until they began breeding in the Everglades. Local government, and state and federal administrations joined forces to eradicate the species, and now all Sacred Ibises living in the wild in southern Florida, approximately 75 birds, have been removed (Herring & Gawlik 2008; Johnson & McGarrity 2009).

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**The Sacred Ibis in France**

In the 1970s, the owners of Branféré Manor, in southern Brittany, imported various bird species, including 20 Sacred Ibises that came from Kenya in four deliveries between 1975 and 1980. These were later supplemented by ten birds from a French zoo in 1987. During

this period a breeding colony became established and while the introduced adults had their wings clipped, their offspring were left free to fly. At the owners' wish, the site became a zoological garden when they passed away. By 1990 there were 150 pairs of Sacred Ibises nesting in the zoo and visiting nearby wetlands, but some moved several hundred kilometres along the Atlantic coast. Breeding in the wild and away from Branféré Manor was first noted at Lac de Grand-Lieu in 1993, c. 70 km from Branféré, and at Golfe du Morbihan in 1994, c. 25 km from Branféré Manor (Marion & Marion 1994; Frémont 1995; Yésou 2005).



**Fig. 1.** The location of Sacred Ibis *Threskiornis aethiopicus* breeding colonies in western France.

No young raised at Branféré Manor have been left to fly free since 1997, but sufficient birds were already breeding elsewhere to establish a thriving population from southern Brittany to the Arcachon Bay, south of Bordeaux (fig. 1, and documented in detail by, for example, Yésou & Clergeau 2005, Philippon & Yésou 2012, Yésou & Reeber 2014). Winter roost counts revealed c. 2,500 birds in 2003/04, and c. 3,000 in 2004/05. Breeding numbers increased steadily, reaching c. 1,700 pairs in 2006 (fig. 2), and between 1,430 and 1,860 pairs in 2007, the uncertainty being linked to the initiation of control measures. The eradication programme brought the French Atlantic breeding population down to 150–160 pairs in both 2015 and 2016, and January counts of c. 500 in 2016 and 300–350 in 2017 (Maillard & Yésou 2016; Aurélie Barbotin *in litt.*).

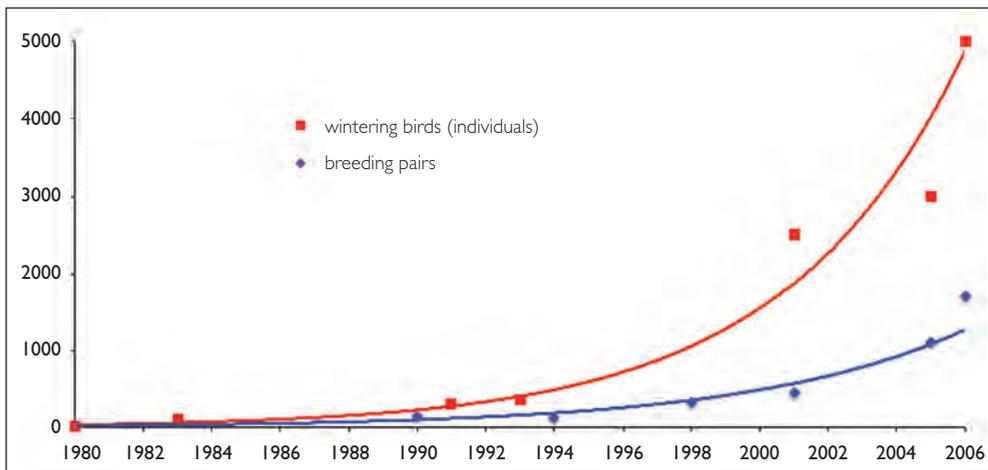
Outside the breeding season the ibises range widely along the Atlantic coast, some south to the foot of Pyrenees, others reaching the English Channel coast in northern Brittany and Normandy, and a few birds moving inland. A ringed bird reached the Belgian border in 1999 (Clergeau *et al.* 2005), another was in the Netherlands in 2012 (Ralf Smits *in litt.*), and one was seen with a group of ten birds in Doñana National Park, Spain, in the 2008 breeding season (Carlos Gutiérrez Expósito *in litt.*).

On the Mediterranean coast, eight Sacred Ibises were imported from a zoo in the UK to

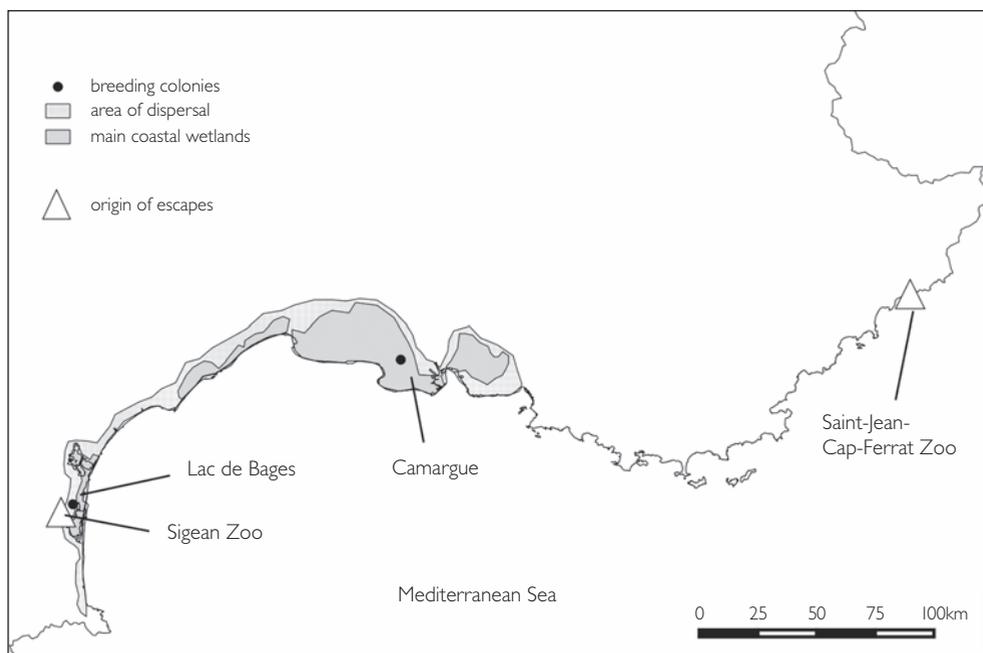
a safari park at Sigean, in 1982 (fig. 3). From 1989 onwards they were able to roam freely within the park and breeding took place in 1991. Sightings outside the zoo became regular from 1995 and a colony of eight nests was found at the nearby Lac de Bages in 2000, which increased to 75 pairs in 2004 and 105 pairs in 2005. The total population, including immatures and non-breeders, was estimated at 370 individuals in 2007. These birds dispersed along the Mediterranean coast, eventually reaching the Camargue, where the first breeding attempt was recorded in 2000 (Kayser *et al.* 2005; Yésou & Clergeau 2005; Mouronval 2013). Ibises seen in Cataluña, Spain, in the early 2000s were thought to come from this population (de Juana & Garcia 2015). Control measures in the late 2000s saw the Mediterranean population almost completely extirpated, with only two birds remaining in the wild by 2015, in the Camargue (Maillard & Yésou 2016). Contrary to reports, 38 birds that escaped from a zoo at Saint-Jean-Cap-Ferrat in 2007 were rapidly recaptured and did not supplement the Mediterranean population (Jean-Marc Cugnasse *in litt.*).

### Breeding biology

Breeding colonies were established at both brackish and freshwater wetlands on the Mediterranean coast, while in western France they were found in freshwater wetlands, various coastal sites and in private parks.



**Fig. 2.** Population growth of the Sacred Ibis *Threskiornis aethiopicus* in western France from 1980 to 2006, showing breeding pairs in blue and numbers in winter (individuals) in red. Numbers reached c. 5,000 in winter 2005/06 and c. 1,700 breeding pairs in 2006. Fitted lines are exponential curves.



**Fig. 3.** The location of Sacred Ibis *Threskiornis aethiopicus* breeding colonies on the Mediterranean coast of France.

Most colonies were surrounded by water, but in two regularly occupied parks the lawn surrounding isolated stands of trees seemingly provided a sufficient ‘island’. Another colony was established in a mixed heronry in a small wood. Nests are most often built in trees: willow *Salix* and alder *Alnus* in marshes, mostly cypress *Cupressus*, tamarisk *Tamarix* and Maritime Pine *Pinus pinaster*, but also oak *Quercus* and chestnut *Castanea*, when colonies are located on dry ground. Breeding has been noted occasionally in wet reedbeds, and also on the ground, as in the case of one of the most impressive aggregations of nests, 735 pairs on a small (c. 0.2 ha) artificial island with little vegetation.

The nesting season extends from early March to August; most clutches are laid in April–May with later ones being replacement clutches. No marked synchrony is observed across large colonies, but there is often a high degree of synchrony among groups of (typically) 8–15 pairs that build nests very close together (just a few tens of centimetres apart), as a colony subgroup. The nests, typically around 30 cm in diameter, are usually made of dry plant material, such as pieces of reed, twigs or driftwood, collected close to the site. On one island where little dry

material was available, nests were simple scrapes on the ground, mostly lined with grass. Additional material, sometimes including greenery, is often added during incubation, increasing the nest diameter. At this stage neighbouring nests may come into contact, forming what could be described as a ‘community platform’. On the ground, one such platform held 246 nests on c. 120 m<sup>2</sup> (Yésou *et al.* 2006).

Apart from Wild Boars *Sus scrofa* destroying clutches in reedbeds, which may explain the scarcity of breeding attempts in this habitat, the Sacred Ibis has no obvious natural predators in France. This surely contributed to the species’ breeding success before the control programme began with, on average, one young or more fledged per breeding attempt (at least 1.3 young per pair for 818 pairs in 2005, 1.0–1.2 young per pair for 1,100–1,200 pairs in 2006). Sightings of ringed birds suggest that, following a failed attempt, Sacred Ibises often move to another site to lay a replacement clutch, either within the same large wetland or up to tens of kilometres away.

Sacred Ibises nesting in trees often, though not always, share colonies with herons and similarly large, colonial species

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97. A cluster of Sacred Ibis *Threskiornis aethiopicus* nests forming a ‘community platform’, Banc du Bilho, Loire estuary, France, April 2005.

and also breed in close proximity to large gulls on small islands. It has been claimed that Eurasian Spoonbills *Platalea leucorodia* were attracted by breeding Sacred Ibises and that the (then) locally rare Spoonbill population in France would benefit from the presence of ibises (Marion 2006). To test this, the locations of all nests of both species were plotted and their period of laying recorded over five breeding seasons at Grand-Lieu (Clergeau *et al.* 2010a). This showed that Spoonbills began to breed significantly earlier than ibises (by 15–25 days), and

that both species preferentially settled at places previously occupied by their own species. The results thus offered little evidence that ibises play a role in the conservation of Spoonbills.

**Diet and feeding ecology**

In France, as in its native range, the Sacred Ibis is an opportunistic feeder. Invertebrates generally form the majority of its varied diet, but individuals may specialise on other food types, at least temporarily (Clergeau *et al.* 2010b). Table 1 shows the main foraging habitats in western France. The increasing importance of freshwater marshes may reflect the spread of the invasive Red Swamp Crayfish *Procambarus clarkii*, which is an important item in the bird’s diet. A large rubbish dump close to one of the main colonies was regularly attracting huge numbers of ibises, up to 700 simultaneously, until it closed in 2007. Smaller dumps continued to attract birds until 2010 at least, in groups of up to 150 individuals.

Away from these core habitats, ibises have also been observed feeding in a variety of ‘human’ habitats such as slurry pits, poultry farms and water treatment ponds, not to mention the collections and wildlife parks

**Table 1.** Main foraging habitats used by the Sacred Ibis *Threskiornis aethiopicus* in western France, 2000–04 (n=98; Clergeau *et al.* 2010b), and 2007–09 (n=60; ONCFS unpubl. data).

foraging habitats	2000–04	2007–09
agricultural landscape	28.6 %	2.4%
wet meadows	18.4%	4.0%
tidal habitats	22.4%	11.3%
salt pans	12.2%	19.6%
rubbish dumps	9.2%	31.7%
freshwater marshes	9.2%	31.0%

they originated from (in western France Branféré Zoo deliberately fed ibises up to 2002).

Sacred Ibises can feed alone but most often forage in small groups, up to a few tens of individuals. Less commonly, up to 200 can be seen foraging together in the same wet meadow or marsh. Typically, they feed in single-species groups but will also mix with other species, most often Little Egret, Herring *Larus argentatus* and Black-headed Gulls *Chroicocephalus ridibundus* and, in farmland, Cattle Egret *Bubulcus ibis* and Eurasian Curlew *Numenius arquata*.

Analysis of stomach contents and regurgitates of birds in France by Clergeau *et al.* (2010b) has shown that the most frequently occurring food items are insects, particularly dipterans and their larvae (e.g. mosquitoes, midges, gnats), beetles, crayfish, refuse waste (e.g. meat, bread, vegetables), and plant matter including crops such as maize. Other food items include spiders, molluscs (gastropods and bivalves, particularly mussels), annelids (earthworms), isopods, crabs, shrimps, fish, amphibians (in particular Common Toad *Bufo bufo* and probably newts), small mammals and birds. Dry animal food was found in the stomach contents of ibises that continued to feed within the wildlife park they originated from.

Marion (2013) suggested that the spread

of the Red Swamp Crayfish was responsible for a sharp increase in the Sacred Ibis population in western France. Yet this is not supported by the available evidence, with a steady rate of ibis population growth maintained beyond the initial crayfish boom in the late 1990s (fig. 2). Marion also claimed that predation by Sacred Ibises on crayfish helps to limit the latter's spread, but again this appears unfounded. Many other species feed on the crayfish, and it seems that crayfish dynamics are mostly controlled by the survival of young individuals, at a stage where they are too small to attract avian predators.

Predation by Sacred Ibises of the nests and/or chicks of a variety of bird species has been observed in France, including Mallard *Anas platyrhynchos*, Garganey *A. querquedula*, Shag *Phalacrocorax aristotelis*, Cattle and Little Egrets, Night *Nycticorax nycticorax* and Squacco Herons *Ardeola ralloides*, Black-winged Stilt *Himantopus himantopus*, Northern Lapwing *Vanellus vanellus*, Common Redshank *Tringa totanus*, Black *Chlidonias niger*, Sandwich *Sterna sandvicensis* and Common Terns *S. hirundo*, and Black-headed and Herring Gulls. Predation is sometimes opportunistic, but there are documented instances of Sacred Ibises deliberately and systematically searching for eggs or chicks.



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**98 & 99.** Sacred Ibis *Threskiornis aethiopicus* nests, containing newly hatched and small chicks, Banc du Bilho, Loire estuary, France, April 2005.



**100.** Sacred Ibises *Threskiornis aethiopicus* picking through the bins of a burger restaurant in Sigean, southern France, in May 2005, demonstrating their catholic diet and ability to live alongside humans.

### Threats to biodiversity

Sacred Ibises have caused widespread destruction at some Sandwich and Black Tern colonies; predation within heronries, and of wader nests has also been reported, and local declines in breeding populations of these species became apparent in some areas where Sacred Ibises occurred (Kayser *et al.* 2005; Vaslin 2005; Clergeau *et al.* 2010b; unpubl. data). This was an early warning sign of the potential wider impact of the ibises on native species. In addition to direct predation, groups of foraging ibises wading through marsh tern colonies have unintentionally but repeatedly destroyed Black Tern nests. Besides birds, there are potential impacts on other wildlife groups, especially amphibians.

Farmers, particularly those rearing cattle and ducks, expressed concern that growing numbers of Sacred Ibises might be significant carriers of disease. It is known that livestock pathogens are carried by the related Australian White Ibis *T. molucca* (Epstein *et al.* 2007) and that avian tuberculosis has been detected in captive Sacred Ibises (Dvorska *et al.* 2007). Sacred Ibises regularly feed at rubbish dumps and can also commute to farmland, which may exacerbate the problem. Studies have shown that the risk of the Sacred Ibis to farm animals is only moderate, except in cases where specific outbreaks of an avian disease are causing concern (Bastian *et al.* 2010a,b), although Vorimore *et al.* (2013) described a pathogen new to science from non-native Sacred Ibises.

### An eradication programme for the Sacred Ibis in France

In 1993, the manager of Branféré Zoo alerted the Ministry of the Environment to the proliferation of free-flying Sacred Ibises released by the previous owners, but received no response. (Conservation biologists also recognised the potential threats posed and also informed the Ministry, in both 1994 and 1996, again without response.) Meanwhile, Branféré Zoo instigated their own recapture and pinioning programme in 1994, and by the end of 1996 all the free-flying ibises in the zoo had been caught. At that stage, however, many remained at large elsewhere.

Eventually, in April 2004, a regional meeting gathered NGOs and public bodies involved in the management of protected areas, at which participants agreed that the developing Sacred Ibis population might be of conservation concern. In December 2004 the Ministry of the Environment requested INRA and ONCFS, two French public bodies in charge of rural and wildlife management, to produce a risk assessment with proposals for management. This report discussed the pros and cons of four management scenarios, ranging from taking no action to organising the species' eradication at a national scale (Clergeau *et al.* 2005). In November 2005, the avifauna commission of CNPN, the national advisory body, unanimously recommended the eradication of the

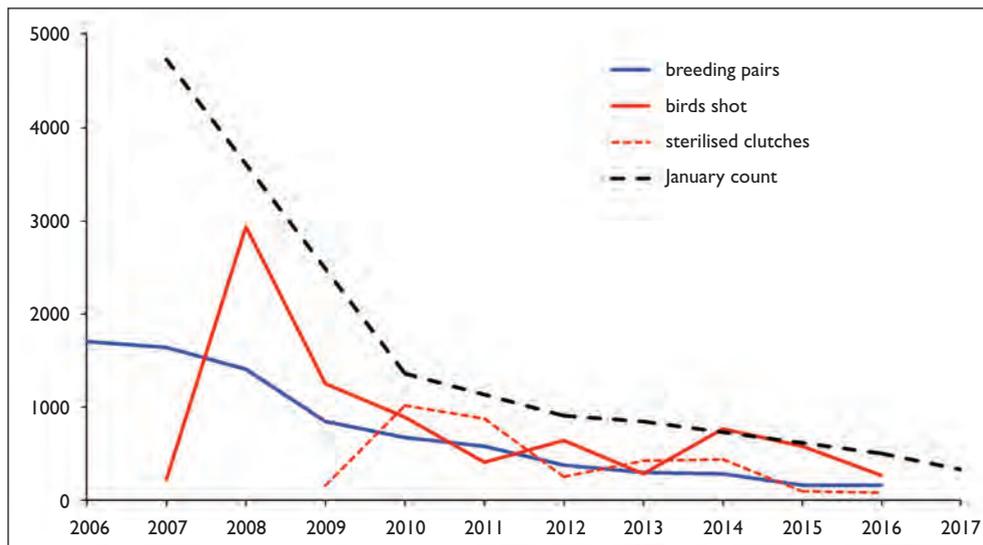
Sacred Ibis throughout France.

It was initially proposed that the eradication programme should be undertaken by hunters, but this was unacceptable to LPO (the BirdLife partner in France) and other conservation organisations, who feared that any large white bird, including egrets and Spoonbills, would also be shot. The eradication programme was temporarily postponed before CNPN recommended that it be carried out by the national wildlife service, ONCFS, beginning in 2007. ONCFS employs c. 1,400 environment officers who are responsible for the implementation of environmental regulations, including the monitoring and policing of hunting. Once the revised eradication programme had been approved by all the mandatory advisory bodies at national and regional levels, and no opposition was forthcoming from conservationists, the programme recommenced.

The eradication project enabled France to meet its international commitments, namely the Bern Convention on the Conservation of European Wildlife and Natural Habitats and AEW (the Agreement on the Conservation of African-Eurasian Migratory Waterbirds), which both demand that signatory parties eliminate introduced species when they pose a threat to native species.

### Results of the eradication programme

In 2006, when the eradication programme was (temporarily) postponed, LPO arranged for Sacred Ibis eggs to be collected from what was then the main colony, at Banc du Bilho, an island in the Loire estuary (fig. 1). A total of 1,223 eggs were collected from 663 nests. However, replacement clutches were laid and, since these were not removed, overall productivity at the colony remained high. Egg removal was thus deemed inefficient as a measure to reduce the population significantly. In 2007, ONCFS explored a number of methods for eradication, and a programme of shooting was launched in 2008. However, since officers are not permitted to shoot ibises in nature reserves, there was little impact on overall numbers in 2008; the numbers killed was almost matched by the hundreds of young fledged from Lac de Grand-Lieu (which, after culling at other sites, has been the main breeding site for Sacred Ibises since 2009). Since 2009, a programme of egg sterilisation at Grand-Lieu has ensured that most eggs do not hatch. Done twice during the breeding season, this has ensured that the vast majority of initial and replacement clutches do not hatch, and has resulted in a marked reduction in the number of fledged young. Elsewhere, most



**Fig. 4.** Sacred Ibis *Threskiornis aethiopicus* populations in France, 2006–17, showing the decline in the number of breeding pairs and non-breeding individuals (January count) present during the eradication programme, as well as number of birds shot and clutches sterilised.

Denis Lacourpaille



Denis Lacourpaille



**101 & 102.** Decoys used to attract Sacred Ibises *Threskiornis aethiopicus* during culling operations in western France, May 2013.

birds were shot, either on the ground at feeding sites or near colonies, when flying to and from foraging areas. Great care was taken to avoid disturbance to other species and collateral damage. Hence, very little work was carried out at roost sites, which usually contain other species.

In western France, a total of 8,237 Sacred Ibises were culled between 2007 and 2016, and 3,334 clutches of eggs were sterilised at the Lac de Grand-Lieu colony in 2009–16. This led to a marked population decline (fig. 4) and, in January 2017, only c. 300–350 birds were attending winter roost sites. The Grand-Lieu reserve is the only breeding site still regularly occupied in western France, after operations at alternative breeding sites led to their abandonment. Non-breeding birds continue to disperse over much of the area occupied before the eradication programme began, but in much smaller groups. This, and the fact that the ibises have become less approachable over time, makes comple-

tion of the programme more difficult. The average number of ibises culled per day decreased from 33 per officer in 2008 to 9–10 in 2012–13. The increased effort required per bird makes it difficult to predict when complete eradication will be achieved.

On the Mediterranean coast, 485 ibises have been removed from the wild, 395 killed and 90 captured alive and placed in an aviary. The latter were birds that continued to feed at the wildlife parks from which they originated. Alpha-chloralose was mixed with animal food in order to capture them (the drug is used to stupefy the birds, which can then be captured and allowed to recover). Most culling took place in 2007 and 2008, and by 2010 no Sacred Ibises remained outside the Camargue, where fewer than 20 birds were still present. These birds ranged over a wide area, often vis-

iting sites where access was difficult or where they were associated with sensitive species, which meant that control was much more problematic. Despite those difficulties, only two ibises were still alive by the end of 2015.

### The cost of eradication

The full cost of the eradication programme has yet to be fully established. In the Mediterranean, the cost of culling 173 of the 395 individuals removed (44%) has been estimated at c. €50,000 (Mouronval 2013), which would extrapolate to c. €114,000 for the entire population. In western France, the cost of the cull and the egg sterilisation programme, together with associated administration costs, was estimated at c. €400,000 over the five-year period, 2008–12. Although the number of ibises has been significantly reduced, the annual cost of the eradication programme may now rise as more effort is required to remove the remaining birds in an increasingly small, widely dispersed, and now

wary population. Additional costs, not incorporated in the above estimate, include, for example, those linked to studies carried out alongside the programme, such as population surveys, and the costs of the associated legal and scientific framework.

### Conclusions

In France and elsewhere, the adaptability of the Sacred Ibis, in particular its ability to thrive in close proximity to humans, has meant that introduced populations can become established quickly. Such populations may bring significant conservation problems. Events in the Netherlands and Florida show that effective colonisation can arise from a very small founder population, only five birds in the latter case, and that the population growth rate can be even greater than that observed in France (Smits *et al.* 2010); the events in both France and Italy show that numbers in the wild can remain low for a long time before a sudden marked increase. Only a rapid response will enable such populations to be controlled, which was the case in both the Netherlands and the USA, and also in Spain. The situation in western France shows just how costly a

programme to eradicate thousands of birds can be and is surely the greatest incentive for widespread adoption of EU regulations – that no escapes from captive populations are permitted, and that programmes are developed to remove the introduced populations throughout Europe. Clearly, retrieving the current situation in Italy will not be cheap.

In the UK, the Non-native Species Secretariat ([www.nonnativespecies.org](http://www.nonnativespecies.org)) is responsible for controlling and managing the potential colonisation by non-native species and has an action plan which aims to prevent the Sacred Ibis becoming an established non-native species ([www.nonnativespecies.org/downloadDocument.cfm?id=942](http://www.nonnativespecies.org/downloadDocument.cfm?id=942)). In the first instance, any free-flying Sacred Ibis should be reported to the Centre for Ecology & Hydrology ([www.brc.ac.uk/risc/alert.php?species=sacred\\_ibis](http://www.brc.ac.uk/risc/alert.php?species=sacred_ibis)). In 2014, following a police investigation, the local zoo in Cumbria referred to earlier in this article was fined over £5,000 for allowing free-flying birds to escape. The owner shot a number of the free-flying birds when informed he was being investigated, but was still prosecuted for allowing birds to escape during the previous few years. This is a rare



Roberto Zaffi

**103.** Hybrid Sacred Ibis *Threskiornis aethiopicus* x African Spoonbill *Platalea alba*, Punta Alberete, Po Delta, Italy, August 2008. Ringed as a pullus in 2008 in the Valle Mandriole reserve near Ravenna, this bird was seen up to 2010 at least. No hybrids have been observed in western France, where Sacred Ibises and Eurasian Spoonbills *P. leucorodia* can share the same colony but differ in the timing of breeding.



Richard Chandler

**104.** Sacred Ibis *Threskiornis aethiopicus*, Cley, Norfolk, June 2012. Such birds are reported not infrequently in the UK, and may originate either from non-native populations on the Continent, most likely France, or from collections closer to home.

example of the enforcement of legislation to prevent non-native species becoming established, and shows just how seriously the potential threat from this species was considered to be.

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## Request

### William MacGillivray's *History of British Birds* – have you seen this?

In 1924 the London booksellers Henry Sotheran issued for sale a catalogue of the books that had belonged to Major W. H. Mullens, the leading ornithological bibliographer of the time. Among the items being offered was a unique set of the first three volumes of William MacGillivray's *History of British Birds* (issued in 1837, 1839 & 1840). What made this set special is that it was MacGillivray's personal set, 'containing a great amount of fresh information in the author's own handwriting throughout the three volumes, but more so in Vols. 1 and 3. The text has not only been corrected by a matter of single words, writer's and printer's errors, etc., but whole passages have been cancelled and fresh material substituted in the margins. In addition many leaves and slips have been loosely pasted in, filled with extra material, the whole being in MacGillivray's handwriting and obviously intended for an enlarged and revised edition.'

Alan Knox ([a.g.knox@abdn.ac.uk](mailto:a.g.knox@abdn.ac.uk)) has been working on MacGillivray for some time now and would like to locate these volumes if possible. It is not known who Sotheran sold them to and they may now be in private hands or in a library.