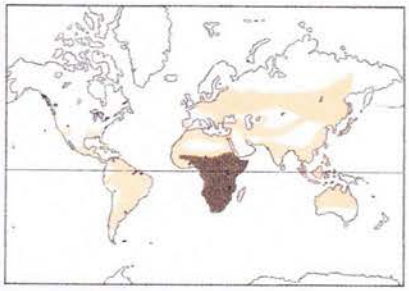
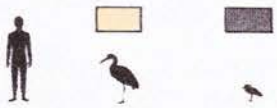
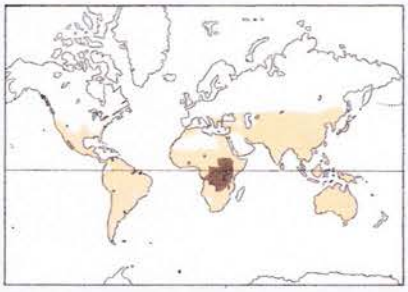
STORKS AND SPOONBILLS

Families: Ciconiidae, Threskiornithidae, Scopidae, Balaenicipitidae
Order: Ciconiiformes (suborders Ciconiae, Balaenicipites).
Fifty species in 25 genera.
Distribution: see maps and table.





Storks **Hammerhead stork**



Whale-headed stork **Spoonbills, Ibises**

► **Part of the furniture.** This church in Spain is festooned with nests of the White stork. Despite the ancient associations between storks and human habitations, many European villages have only a single pair of storks and even these are disappearing in many areas.

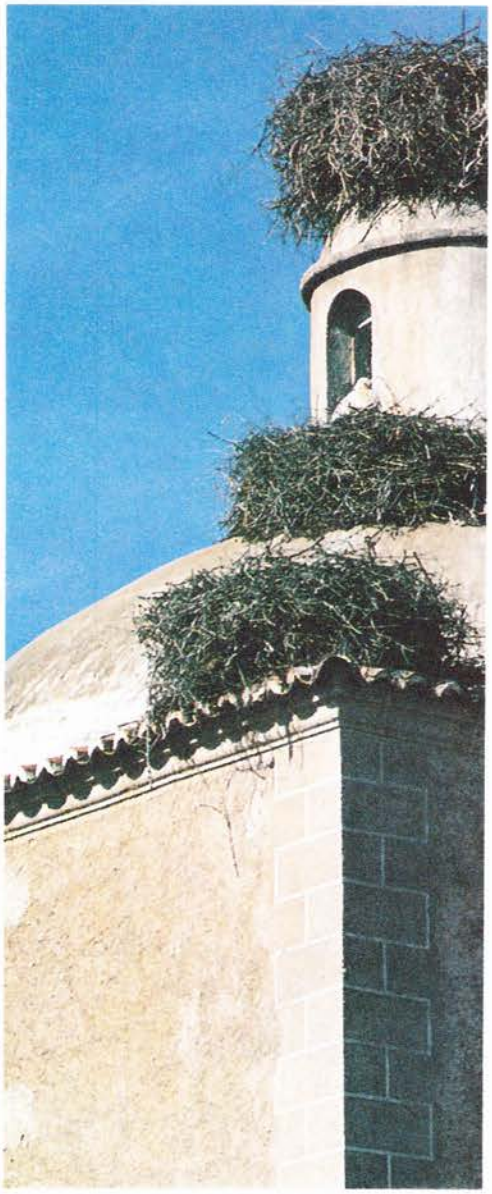
► **The gaping bill** of a Yellow-billed stork. Despite the scientific name (*Ibis ibis*), this is a stork not an ibis.

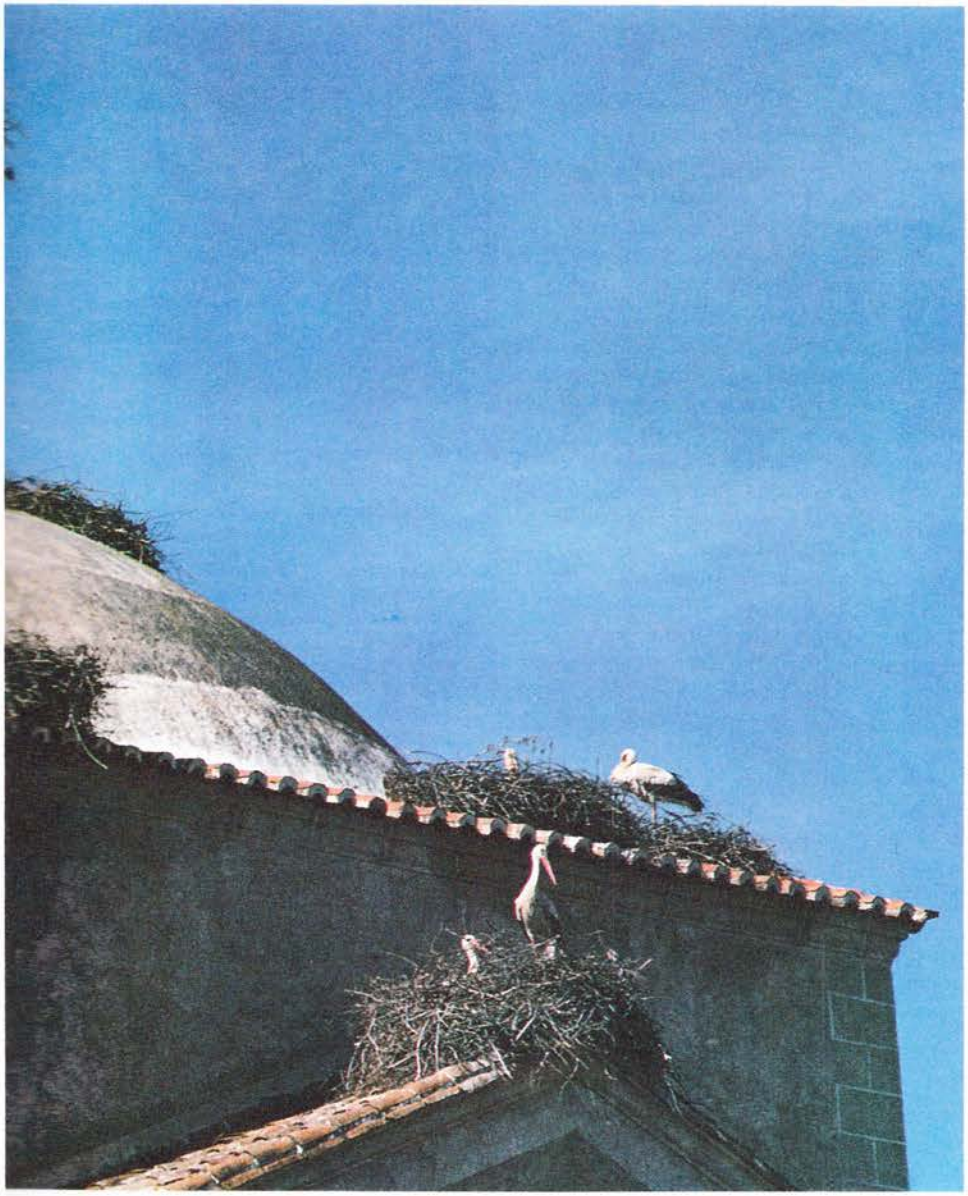
THE White stork has long been a symbol of pilgrimage and continuity in European and Islamic cultures. It nests happily close to people in villages, makes long migrations, but shows great fidelity to its nest-site. Such reliability has always appealed to human beings and perhaps led to the folk tale, which originated in Germany and Austria, that storks deliver babies. At any rate, storks are a reassuring presence.

Storks are large to very large wading birds having long legs, long bills, a stately upright stance and striding gait. They are birds of wetlands and water margins, as well as fields and savannas. They prefer warm continental climates and tend to avoid cool and damp regions. As a result, they are widespread in the tropics and subtropics, whereas few occur in temperate regions. The greatest numbers of stork species are found in tropical Africa (eight species) and tropical Asia (nine). White and Black storks are particularly widespread, nesting in Europe, East Asia, North Africa and southern Africa. Both species spend most of the year in Africa or India. The White stork inhabits cultivated countryside, whereas the Black stork tends to avoid areas of human activity.

Storks have long, broad wings and are strong fliers. They fly with their necks outstretched, except for the species of adjutants, which retract their head. Most storks alternate flapping flight with soaring in warm air-currents (thermals). Such currents are only found over land, which restricts the migration routes. Storks nonethe-less can engage in remarkable aerobatics, such as diving, plummeting from the sky, and flipping over in flight. The Black stork, having relatively narrow wings, relies more on flapping flight than on soaring.

The bills of storks are long and heavy. Most are straight but those of wood storks are downcurved, and that of the jabiru is slightly upcurved. Wood storks, adjutants, and the jabiru lack feathers on their heads. The sexes look similar, but males are noticeably larger than females. Dark irises distinguish male Black-necked and Saddle-bill storks from the yellow-eyed females. Air sacs lie under the neck skin, and the marabou and the Great adjutant have long, bare, pendent throat sacs. Juvenile plumage is dull, reaching full development over the first year. Nestlings of the otherwise white Maguari stork are black, probably as camouflage. The African open-bill stork is black, whereas the closely related Asian species is white.





The colors of the bill, together with the bare skin of the head and legs, are characteristic for each species, and they intensify during courtship. The breeding Maguari stork has a striking blue-gray bill, becoming maroon near its red face. The jabiru has a pink neck band that changes to deep scarlet when it is excited.

Most storks feed alone but also will form large flocks when food is abundant. They walk, wade, or run about, grabbing prey with thrusts of their bills. A typical stork will walk slowly across fields with its neck extended and head down looking for prey. The White stork's diet during nesting is varied, including aquatic vertebrates, insects and earthworms. On its African winter ground, this stork is known as the Grasshopper bird because it follows locust swarms. White storks also follow mowing machines. The Black stork is more closely associated with marshy margins of streams and pools where it feeds on fishes. The White-bellied stork often hunts in large flocks, especially near grass fires and locust swarms.

The adjutants are largely scavengers and carrion-eaters. They are well known for their attendance at carcasses, along with vultures and hyenas. Although not adept at tearing flesh, their size and large bills allows them to steal bits of meat from nearby vultures. Requiring over 700g (25oz) of food per day, marabou frequent predator kills, domestic stock yards, plowed fields and rubbish dumps, as well as drying pools that

Feeding by Touch

Most birds feed by sight, first observing a potential food item and then grabbing it with their bills. Storks, spoonbills and ibises also have an alternative foraging strategy, using the sense of touch rather than sight. Although all these birds can feed by sight, and some, such as the typical storks, do so customarily, spoonbills, wood and open-bill storks, the jabiru and most ibises usually feed by touch, and other species do so on occasions.

When a bird feeds by touch, it responds when an unseen prey animal encounters its open bill by immediately snapping it shut. In the American wood stork, this happens within 25 milliseconds, one of the fastest reflexes among vertebrates. Touch-feeding is probably facilitated in part by sensitive touch receptors under the horny covering of the bill. Or the bill snap may be stimulated by the jaw muscle being stretched by a prey item. Feeding by touch can be remarkably effective, and permits feeding in very turbid water, muddy pools, dense underwater vegetation or at night.

contain the natural prey necessary to raise young. Marabou are attracted from great distances to grass fires, where they march along the fire front. The size range of their prey varies greatly. Marabous stand at termite mounds eating swarming insects, but also take quite large prey, killing young crocodiles, young and adult flamingos, and small mammals. The Greater adjutant was formerly common in Indian cities, where it consumed refuse that included human corpses.

The four species of wood storks feed by touch, wading slowly with their partially opened bills inserted in shallow water (see box). The bill of the open-bill storks is used for dealing with mollusks, especially large water snails. The bill tip is inserted into the opening of the shell, cutting the snail's muscle, which permits extraction of the body. An open-bill may ride on a swimming hippopotamus to capture the snails it stirs up. The Black-necked stork sometimes feeds by running back and forth, jumping and wing-flashing. The largest New World stork, the jabiru, feeds by touch, wading slowly and periodically inserting its open bill into the water.

By soaring, storks can forage long distances from their colonies and roosts. The White stork, wood storks and adjutants are particularly adept at reaching high altitudes, and then gliding toward distant feeding sites. This behavior helps birds locate places of concentrated food, where many birds may forage together. In East Africa as many as seven species of storks may feed in the same location.

Most storks undertake seasonal population movement; several species (eg the White-bellied stork from North to South Africa) migrate across the equator. The migrations of the European storks have been known since biblical times. European White storks use two migratory routes, one down the Iberian Peninsula, the other across the Middle East through Egypt, both avoiding the long sea crossing of the Mediterranean. All storks, even those from Europe and Asia, therefore spend most of their year in the tropics; some yearling White storks remain in Africa throughout their first summer. The population movements of other species are less long distance migrations than population shifts in response to feeding conditions and rainfall patterns.

The nesting cycle of all storks is strongly seasonal, apparently determined by food supplies. Only the White and Black storks regularly leave the tropics to nest, during the temperate spring and summer. The American wood stork nests during the dry season when prey are concentrated in drying pools and are easily captured using touch to guide them (see box). Other species of wood storks nest during the wet season, when most food is available in their situation. The marabou nests in the dry season when carrion and drying pools become available, while the White-bellied stork is

▼ **Representative species of storks and spoonbills.** (1) Roseate spoonbill (*Platalea ajaja*), showing the broad, flattened bill characteristic of spoonbills. (2) Black stork (*Ciconia nigra*), a species similar in many ways to the White stork, but which lives in more wooded areas. (3) Whale-headed stork (*Balaeniceps rex*) in its freshwater swamp habitat. (4) Hammerhead (*Scopus umbretta*), showing the extreme wedge-shaped head that gives it its name. (5) Marabou (*Leptoptilos crumeniferus*) with its large throat pouch. (6) Glossy ibis (*Plegadis falcinellus*). (7) Sacred ibis (*Threskiornis aethiopica*), a species that was revered in Ancient Egypt. (8) White stork (*Ciconia ciconia*) performing the "Up-Down" display on the nest.

considered a "rain bringer:" in Ethiopia it nests during the first heavy rains, which produce a flush of its insect food.

Wood stork colonies may exceed tens of thousands of nests, whereas many European villages have only a single White stork family nesting there. Most storks nest in trees, but they may also use cliffs or nest on the ground. Non-colonial tropical species, such as Saddle-bill storks, may remain paired year-round, and White storks often re-pair because both birds are attracted to the nest of the previous year. Nests are situated near sites providing suitable food supplies: drying pools for American wood storks; carrion-producing rangeland for marabou; agricultural fields for White storks.

The nest site, selected by the male, is defended against all intruders. The male gives advertisement displays, and the attracted female responds with appeasement behavior (see pp82–83). Differing between the species, advertisements may consist of up-down movements, calls and bill-clattering. In its extreme form, a stork bends its neck backwards until its head touches its back. In some species, this posture forms a resonance chamber in the throat that amplifies the sound of snapping its two mandibles.

Even newly hatched young behave in this way. Both parents incubate and feed the relatively helpless young by regurgitating food onto the nest floor. Storks may also regurgitate water over their eggs and young, presumably to cool them.

Nesting success is determined by prey availability and weather conditions. Wood storks only fledge young when high densities of food remain available throughout the entire nesting season. White stork nesting success is poor in years or locations having very high rainfall.

Some populations of storks have undergone massive population decreases. As a harbinger of good fortune and many children, the White stork has been protected in Europe for centuries, and has been censused longer than any other bird. Nonetheless, between 1900 and 1958, western European populations decreased by 80 percent, and by 92 percent between 1900 and 1973. Storks no longer nest in Sweden or Switzerland, and occur only in small numbers in other countries. The reasons for the decrease are not certain, but the following factors have been suggested: cooler and wetter summers; loss of nest-sites; pesticide poisoning; hunting on the winter grounds; changing agricultural practices. The last hypothesis is of interest in that it is possible that storks had previously increased in Europe following deforestation; populations have decreased as modern agriculture has destroyed more and more foraging sites. Hunting pressure in wintering areas in Africa is also certainly an important cause of their decrease.

The Greater adjutant population has been critically reduced throughout its range. The Milky stork, confined to the mangrove forests of southeast Asia, is in jeopardy because of habitat destruction. Some species, such as the Black-necked stork, are rare over wide ranges, while others such as the Asian openbill stork, are numerous, but only locally. Although remaining abundant in South and Central America, the American wood stork has decreased in southern Florida, because of ecological changes in the vast

► **The Saddle-bill stork,** a large species found from Ethiopia and Senegal to South Africa.

► **Unusually elegant** and serene for fledglings, BELOW three young White storks bask on their nest. They will almost certainly return close to this same nest-site after their first migration.

The 4 Families of Storks and Spoonbills

[E] Endangered. [V] Vulnerable. [R] Rare.

Storks

Family: Ciconiidae
Seventeen species in 9 genera.

Southern N America, S America, Africa, Eurasia, Australia, East Indies. Habitat: marshes, savannas and fields. Size: 75–150cm (30–60in) long; to 2–9kg (4–20lb); 145–320cm (57–126in) wingspan. Plumage: chiefly white, gray and black, some with pink tinge. Voice: bill-clatter; various species also hiss, moo, whistle, peep and grunt. Nests: platforms made of sticks in trees or on cliffs; one species nests on buildings. Eggs: usually 3–5 (the Saddle-bill stork lays one), white becoming stained with age; incubation period 30–50 days; nestling period 7–18 weeks. Diet: fish, insects, carrion, depending on species.

Species include: **African open-bill stork** (*Anastomus lamelligerus*), **American wood stork** (*Mycteria americana*), **Asian open-bill stork** (*Anastomus oscitans*), **Black-necked stork** (*Xenorhynchus asiaticus*), **Black stork** (*Ciconia nigra*), **Greater adjutant stork** (*Leptoptilos dubius*), **Jabiru stork** (*Jabiru mycteria*), **Lesser adjutant stork** (*Leptoptilos javanicus*), **Maguari stork** (*Euxenura maguari*), **marabou** (*Leptoptilos crumeniferus*), **Milky stork** [V] (*Ibis cinereus*), **Painted stork** (*Ibis leucocephalus*), **Saddle-bill stork** (*Ephippiorhynchus senegalensis*), **White-bellied stork** (*Ciconia abdimii*), **White-necked stork** or **Woolly-necked stork** (*C. episcopus*), **White stork** (*C. ciconia*), **Yellow-billed stork** (*Ibis ibis*).

Spoonbills and ibises

Family: Threskiornithidae
Thirty-one species in 14 genera.

Southern N America, S America, southern Europe and Asia, Africa, Australia. Habitat: marshes, lake shores, plains, savannas. Size: 48–110cm (19–43in) long. Plumage: chiefly white, brown, or glossy black; the Scarlet ibis is red; the Roseate spoonbill is pink. Some, eg the Sacred ibis, the Straw-necked ibis, have modified display plumes on their neck, back or crest. Voice: honks, croaks; can bill clatter; one ibis yelps. Nests: platforms of sticks or reeds in trees, marsh plants, or on cliffs, often with an inner lining of leaves. Eggs: usually 2–5; white or blue, some with darker spots; incubation period about 21 days; nestling period 20–30 days. Diet: insects, crustaceans, carrion and other animal material.

Species include: **African spoonbill** (*Platalea alba*), **American white ibis** (*Eudocimus albus*), **Australian white ibis** (*Threskiornis molucca*), **Bald ibis** [R] (*Geronticus calvus*), **Black-faced spoonbill** (*Platalea minor*), **Black ibis** (*P. papillosa*), **Buff-necked ibis** (*Theristicus caudatus*), **Giant ibis** [R] (*Pseudibis gigantea*), **Glossy ibis** (*Plegadis falcinellus*), **Green ibis** (*Mesembrinibis cayennensis*), **hadada** (*Bostrychia hagedash*), **Hermit ibis** or **waldrapp** [E] (*Geronticus eremita*), **Japanese ibis** [E] (*Nipponia nippon*), **Oriental ibis** (*Threskiornis melanocephala*), **Puna ibis** (*Plegadis ridgway*), **Roseate spoonbill** (*Platalea ajaja*), **Royal spoonbill** (*Platalea regia*), **Sacred ibis** (*Threskiornis aethiopica*), **Scarlet ibis** (*Eudocimus ruber*), **Straw-necked ibis** (*Threskiornis spinicollis*), **Wattled ibis** (*Bostrychia carunculata*), **White-faced ibis** (*Plegadis chihi*), **White spoonbill** (*Platalea leucorodia*), **Yellow-billed spoonbill** (*P. flavipes*).
Total threatened species: 6.

Hammerhead

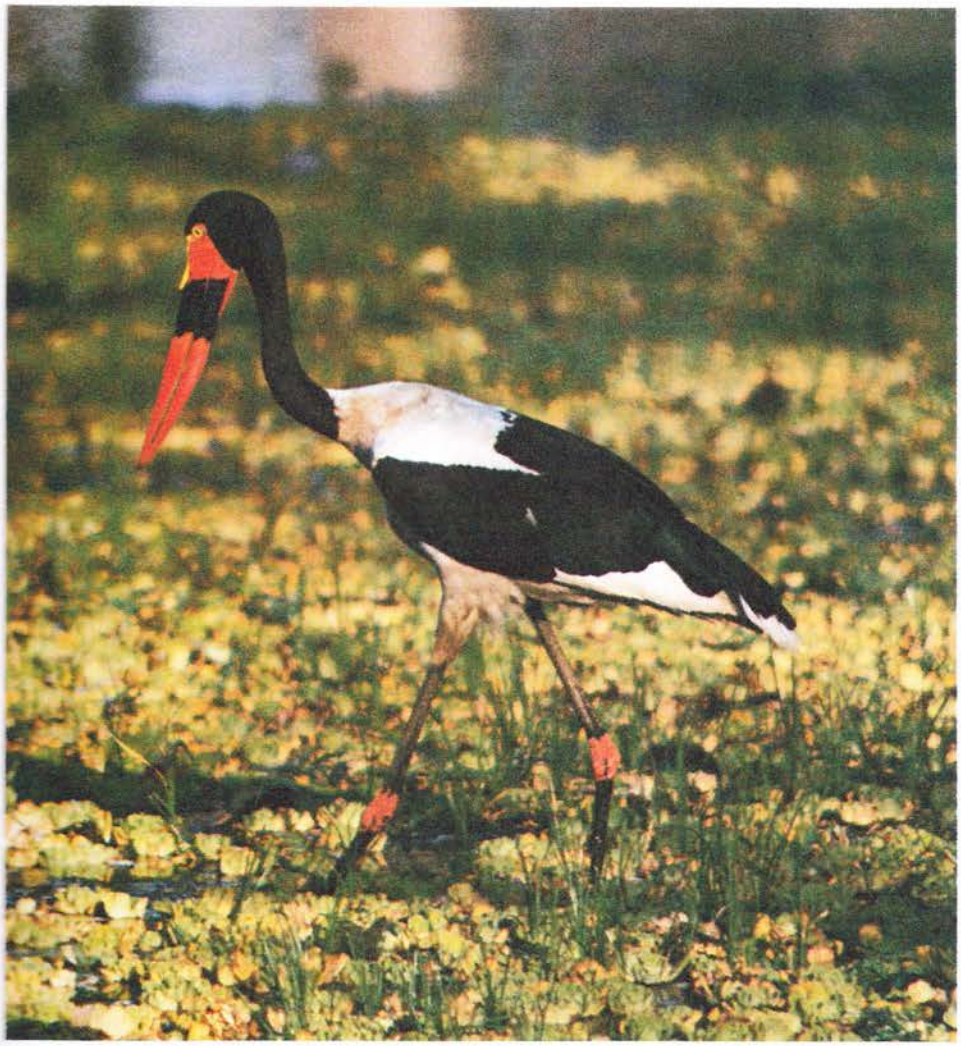
Family: Scopidae
Sole species *Scopus umbretta*.
Hammerhead, hamerkop, or Hammerhead stork.

Africa south of the Sahara. Habitat: found near water; even small ponds are sufficient. Prefers open woodland to forest. During and after rains it may move seasonally to areas which are normally dry. Size: length about 50cm (20in). Plumage: dark brown; bill and legs black. Voice: usually silent, but utters wide range of high notes when flying or during courtship. Nests: an enormous domed structure built of sticks, weeds, grass, usually in a tree overhanging water at varying heights; the domed entrance is plastered with mud. Eggs: 3–7, white becoming mud-stained; average weight 27.6g (0.95oz); incubation period 30 days. Diet: amphibians, especially frogs, but also fish and invertebrates. Often scavenges near human habitation.

Whale-headed stork

Family: Balaenicipitidae
Sole species *Balaeniceps rex*.
Whale-headed stork or shoebill.

Swamplands of southern Sudan and western Ethiopia south through Uganda to southern Zaire and Zambia. Possibly to be seen in western Kenya (rarely) and more recently in Botswana. Habitat: fresh water swamps with tall vegetation of reeds, tall grass and papyrus. Feeds in pools and channels within the swamp. Size: length about 120cm (47in). Plumage: head gray with lighter crown. Slate gray wings with black tips. Belly nearly white. Adult bill color varies between pink and yellow, immature birds being darker. Legs black. Voice: usually silent. Frequent bill-clattering; at the nest, gives a high "gull-like" mew. Nests: on floating vegetation in deep water; sometimes on termite mounds which have become flooded. A large flat nest of reeds and other vegetation collected from nearby. Eggs: 1–3, usually 2, white. Diet: mainly fish, amphibians and reptiles, but also small birds and mammals.



Everglades marsh. The inability to obtain sufficient food to raise their young has caused continuous reproductive failure in this stork population. Thus protection of wetland habitat, and other feeding sites, is essential for conservation of storks. JAK

Ibises and spoonbills are medium-sized birds having distinctive down-curved or flattened bills. Most species are highly social, nesting, feeding, and flying in large groups. A formation of ibises gliding to their chosen night roost before a setting sun is a memorable sight. In most areas several species occur together: as many as seven in the Venezuelan *llanos*.

The most distinctive features of these birds are their bills. Ibises have long, thin, down-curved bills; spoonbills have long, broad bills, flattened at the tip. Both characteristically lack feathers on their faces; the Sacred ibis lacks feathers over its entire head and neck. Most are uniformly colored and have distinctive ornamentations, such as the elongated secondary feathers of the Sacred ibis, bright red skin color of the American white ibis, or the colored head tubercles of the Black ibis. Males are generally larger than females. The juveniles of White and Scarlet ibises have gray-brown backs for a year.

Ibises are an ancient group, the fossil record of which goes back 60 million years. The divergence of spoonbills from ibises represents the fundamental radiation within the group. Although fossils are few,

subfossils from Hawaii and Jamaica demonstrate the repeated evolution of flightlessness on islands. These island representatives may have become extinct in relatively recent times, because of man.

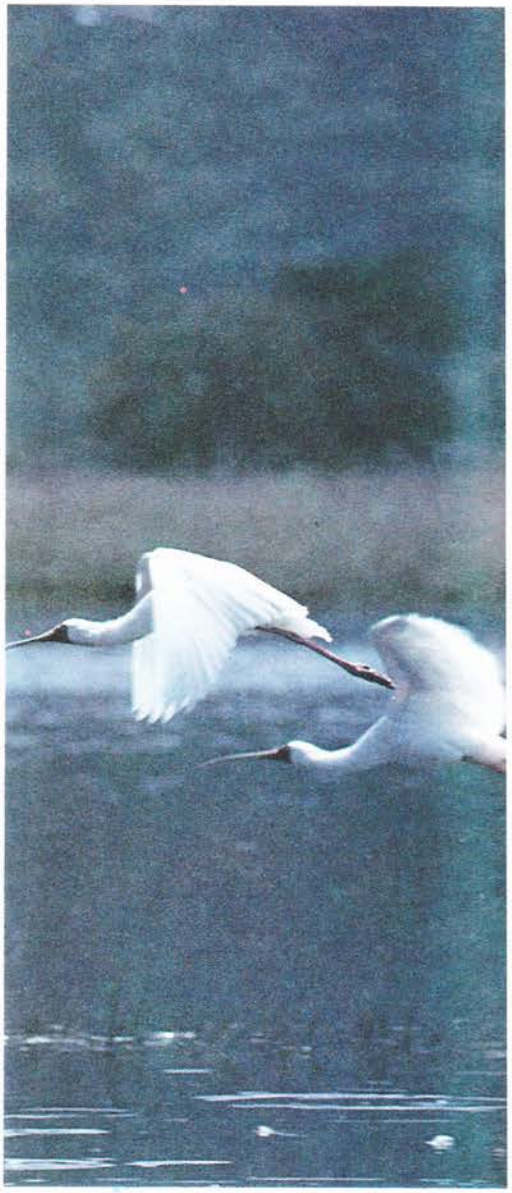
As birds of marshes, swamps, and savannas, both ibises and spoonbills feed on a variety of insects, frogs, crustaceans and fishes. Both feed primarily by touch rather than by sight (see p73). Ibises use their long bill for probing in soft mud, holes or under plants. Ibis species that are typically aquatic tend to have longer bills than terrestrial species. They catch slow moving or bottom-dwelling prey. The American White ibis specializes in eating crayfish and fiddler crabs; the Hermit ibis feeds on terrestrial insects and worms; the Sacred ibis often feeds on carrion scraps and associated insects. It also eats pelican and crocodile eggs broken by predators. Spoonbills usually swing their open bill from side to side in the water. The width of its bill is an aid for capturing prey, especially fish and aquatic insects.

Most species nest colonially, some at sites that can include tens of thousands of birds. Other species, such as the hadada, nest in isolation, but even this species is social when not breeding.

The nesting cycle is usually two to three months, with re-nesting sometimes occurring after a failure. Most species place their nests in bushes, but considerable variability occurs in placement. The American White ibis nests on trees, bushes, reeds, or on the ground in marshes and swamps. Hermit and Bald ibises nest on cliffs; the hadada sometimes nests on telegraph poles. Black ibises take over raptor nests. The Buff-necked ibis nests in single pairs in palm trees in Venezuela, on cliffs in the puna and on the ground in colonies in Argentina. Isolated places, such as trees or islands surrounded by open water or marsh, are often chosen for nesting, as ground predators are less likely to occur there.

During pair formation, coloration and display accessories, such as the throat pouch of the American White ibis and black plumes of the Sacred ibis, are at their seasonal peak. In the few species studied, the male chooses a potential nest-site from which it advertises, using bill pointing and bowing displays. Females attempt to land near the male, who at first repulses them. When he accepts a female, the pair engages in mutual bowing and display preening. Solitary species use loud vocalizations to maintain contact, and may remain paired all year round. The common name of the hadada reflects its distinctive call.

The male usually gathers nest materials, which he ritually presents to the female, and both sexes defend the nest-site. Copulation takes place at the nest, and in some species "extra-marital" copulations are frequent. Both sexes incubate and feed the young regurgitated food, which the nestling



▲ **A flock of African spoonbills.** In flight, when the bill is seen side-on, spoonbills and ibises look similar. Both will travel long distances to find food when their swamps and marshes dry up.

◄ **As if dyed** from head to rump, a group of Scarlet ibises in their resplendent plumage, roosting in a tree. They are joined here by a few American white ibises, whose distribution extends north into the southern USA.

Nomadic Waders

Several species of ibises show remarkable nomadic tendencies. The Straw-necked ibis and White ibis of Australia depend on aquatic food made available by suitable water conditions. During droughts, both species disperse widely, but they concentrate to nest in intermittently flooded swamps after heavy rains bring forth an abundant supply of invertebrate food. Because such rains are unpredictable in their location, season and amount, nomadic migrations permit ibises to locate those water conditions suitable for breeding. As a result, except in areas of dependable food supplies, the size and location of ibis colonies vary.

The American white ibis undertakes similar population movements. Foraging flocks of White ibis wander over the vast inland marshes of southern Florida during the course of a year, remaining in areas where water is sufficiently shallow for foraging. As the flooded area contracts in the dry season, ibis follow the receding water, establishing a succession of night roosts near current feeding grounds. This population shift enables ibises to use most of the available habitat during the course of the year. If food supplies persist, such a roost may become a breeding colony.

Other characteristics also adapt ibises for nomadic life. They can rapidly begin nesting when conditions are suitable and can complete nesting within 2–3 months. Flock-feeding assists the birds in finding and using sites of short-lived food supplies. A variable nesting schedule and an ability to skip nesting completely are also adaptations of some ibises to make the best use of variable food supplies. As a result, some species are able to occupy highly changeable habitats and to maintain large populations.

obtains by inserting its bill down the parent's gullet. Young later leave the nest and, in colonial species, roost in groups. Fledging success depends on food supplies. Nesting failure at any stage is not uncommon when food supplies give out.

As a result of dependence on temporarily variable food supplies, local conditions determine breeding seasons. For example, the Sacred ibis has quite different breeding schedules in various parts of Africa, coinciding with local seasonal rainfall patterns. The nesting schedule in one area may vary from year to year. The Australian White ibis is particularly nomadic, nesting when and where water conditions become suitable (see box). In each case, water conditions determine food availability. Not all species in an area nest at the same time. In

Venezuela, the Green ibis nests in the wet season, but the Buff-necked ibis nests in the dry, presumably because of different choices of prey, although such dietary differences have not been established.

The migrations of ibises have figured prominently in the annual activities of various peoples. It is possible that the occurrence of Sacred ibis along the Nile was associated with the seasonal floods crucial to farming. Similarly, along the Euphrates, the Hermit ibis's return in spring was celebrated by a festival.

The high degree of sociability of most ibises and spoonbills is exposed in flocking and coloniality. Many species fly in compact flocks or in long undulating lines, alternating flapping and gliding flight. When feeding, most species form aggregations at suitable foraging sites, often with other wading bird species. In such situations, they tolerate other birds in close proximity and often move in unison. Communal roosts are located near feeding grounds, which may be shared with herons, storks and cormorants. Specific roost sites may be temporary, lasting only as long as nearby food supplies, or may persist for years.

The conservation of ibises and spoonbills depends on their protection and habitat preservation. The Sacred ibis, a seasonal resident along the Nile for millennia, has been absent from Egypt since the first half of the 19th century. The Hermit ibis had nested in the alpine area of central Europe from at least the Stone Age into the 17th century but is now confined to small areas of North Africa and the Middle East. Hunting, despite protective laws, led to its decline, hastened by habitat change. This ibis was lost from Europe very early, and it was not until the end of the 19th century that it was found to be extant in Asia Minor. These populations total less than a thousand birds. The most endangered ibis species is the Japanese crested ibis. Fewer than two dozen individuals are known to survive in China and Japan. The species was widely distributed in these two countries until the early 20th century, and in Korea until World War II. It is possible that loss of suitable habitat—pine forests surrounded by swamp land—may have contributed to its demise. The Giant ibis, only found in lowland Southeast Asia, is also nearing extinction, and Black-faced spoonbills are becoming very scarce. JAK

▼ **The hammerhead's huge nest** attracts many other species. Verreaux's eagle owls have been known to take over the nest, and when completed Gray kestrels or Barn owls often evict the rightful owners. Smaller mammals such as genets sometimes take up residence. Monitor lizards will eat the eggs and snakes occupy the nests, making it dangerous to investigate too closely. Even during occupation by the hammerheads, small birds such as weaver birds, mynas and pigeons will attach their nests to the main nest. Old nests are quickly occupied by other hole-nesting birds such as the Egyptian goose, the Pygmy goose or the Knob-billed duck. Thus the presence of this species provides nesting sites for numerous species which otherwise would find no suitable place for breeding in the area.

The **hammerhead**, though often called "stork," is not a close relation of that family and is a distinctive species. Usually, it has been included in the heron family, but it is sometimes linked to the flamingos because it has a free hind toe; its true taxonomic position is as yet unclear.

Usually seen in pairs, this all-brown bird is common throughout the African savanna, even feeding at pools by the roadside. Its name derives from the crest extending behind the head. The toes are partly webbed. Its short tail and huge wings enable it to glide and soar easily, which it does with its head stretched forward. Usually when disturbed it will fly only a short distance. It is a sedentary species which remains in a well-defined territory, although some pairs will move to normally dry areas when the seasonal rains fill dry holes and ditches. Wherever man-made dams or canals are built, the hammerhead will quickly arrive and if trees are not available it will build its huge nest (often several in a season) on a wall, bank, cliff or sometimes even on the ground.

Hammerheads are also to be seen in group ceremonies, usually near a nest. They can involve a number of birds together and as many as ten birds may call loudly while running round each other in circles, a male

▲ **The flaking bill** of a Whale-headed stork. The huge bill is adapted for feeding on fish such as lungfish and gars and also frogs and perhaps young turtles, crocodiles and small mammals.

sometimes mounting a crouching female and sometimes pretending to copulate without actually doing so. Crests are raised, wings fluttered and a chorus of cries continues for several minutes.

True mating is usually done at a completed nest site, often on top of the nest, using displays similar to those used during the larger gathering of birds. When the eggs have been laid, both birds share incubation, although very frequently partly incubated clutches will be abandoned. When the young hatch they are covered with gray down, but quickly develop feathers, with the head and crest completed within 17 days and the body plumage within a month. While both birds feed the young, they leave them for long periods, presumably being enabled to do so because of the thickness of the nest walls which protect them. When the young are fully fledged, they remain near the nest for another month, using it to roost in at night.

A disproportionately large bill and head give the **Whale-headed stork** both its name and an oddly unbalanced look. This large stork-like bird has some of the characteristics of herons, storks and pelicans, but has no direct affinity to any of these families, so is placed in a family of its own.

The Whale-headed stork is bulky and slow moving; when it feeds it stands with its bill, which is hooked at the end, pointed downwards. It then stretches its neck and hurls itself forward with wings outstretched and gulps its prey. The prey is ground apart by a scissoring action of the mandibles and accompanying vegetation is discarded. A large drink of water is taken after the meal is consumed.

The Whale-headed stork seldom travels far, preferring a favorite piece of marsh in which to fish, and not moving unless forced to do so by changing water conditions. It does, however, fly up on the thermals like a stork, though it tucks in its neck like a heron. It usually fishes alone, but will join with others of its own species, as well as herons and storks, in feeding in pools which are drying out, and where the large fish stocks can be easily harvested.

Both sexes incubate the eggs, often standing to turn them with bill or feet, and in hot weather pouring beakfuls of water over them to cool them. Greeting at the nest by a pair is done by bill clattering and bowing in a manner similar to that of storks. The young have silvery-gray down. Their heads are large, but the bill takes some time to develop its extraordinary shape. Early feeding of the chick is by regurgitating food onto the floor of the nest, but later whole prey are left and the chick swallows them whole. It is most unusual for more than one Whale-headed stork chick to be successfully reared each year.

Like many highly specialized large birds which require very special habitats, the Whale-headed stork is becoming dangerously low in numbers. While it is not persecuted by native populations, the drainage of wetlands, disturbance by cattle and the robbing of nests by zoos has reduced its numbers alarmingly and probably only 1,000–2,000 still remain over the vast area of its African habitat. JH

Up-down, Flying Around

Courtship and relationships among storks

"Advertising Sway," "Flap-Dash," "Flying Around," "Gaping," "Up-Down"—these are all names given to forms of courtship display found in storks. These gestures are as repeatable and consistent as bill-shape and plumage patterns, and can be used to assess evolutionary relationships, some gestures being considered more derived and others more primitive. The advertisement display of the White stork has been well known for centuries, and was illustrated in 13th century manuscripts.

The most typical, and in some storks the most remarkable, courtship behavior is the *Up-Down*. It is a greeting issued when one member of a pair returns to its nest. In giving the display a stork raises then lowers its head in a characteristic stylized manner. Although present in all storks, it differs importantly among species. The head movement is usually accompanied by a vocalization, such as the bill-clattering of the typical storks. The amount of bill-clattering differs among the species of this group. The White stork has a loud, resonant bill-clatter that may last ten seconds or more; yet the Black stork clatters only infrequently. Such a difference in the display suggests that within the group of typical storks these two species are not closely related. The White stork also differs from the other typical storks in that its *Up-Down* is not accompanied by whistling. The typical storks are distinguished from other groups of species by uniquely sharing a *Head-Shaking Crouch*, in which the male crouches on its nest and shakes its head from side to side as if saying "no," which is probably also the message of the display, since it is given as another bird approaches its nest.

The *Up-Down* behavior is simplest in the wood storks. It consists mainly of raising the head and gaping the bill, then emitting hissing screams as the head and bill are lowered. The display differs among the four species, forming an evolutionary sequence. The American wood stork does not snap its bill during the display; the Yellow-billed stork gives a single or double snap; the Painted stork gives double or triple snaps; the Milky stork gives multiple snaps. The wood storks share three displays that are unique among storks: *Flying Around*, in which a male that has just accepted a female leaves its nest and flies in a circle before returning; *Gaping*, in which a bird holds its parted mandibles open; and *Display Preening*, in which the male pretends to comb the feathers on its wing with its bill. The displays of the open-bill storks strongly resemble those of wood storks, especially their simple *Up-Down* and also their copulation clattering, in which a male during copulation clatters his mandibles while knocking them against the bill of the female. Because of such resemblances, the wood storks and open-bill storks are thought to be more closely related to each other than they are to other storks. Open-bills also have a unique display, the *Advertising Sway*, in which a displaying male bends its head down between its legs and repeatedly shifts its weight from one foot to the next.

Differences in the details of the *Up-Down* display among closely related storks demonstrate important distinctions not otherwise obvious. The *Up-Down* of the adjutants includes moving the bill to vertical, accompanied by mooing and squealing. The marabou and Greater adjutant are similar-looking birds, which do not overlap in range. Their displays differ, however, in that marabous first throw their head upward and squeal with the bill near vertical, before pointing it downward and clattering loudly. The Greater adjutant clatters while the bill is pointed upward. The difference in this important pair-bonding display suggests that the birds would not interbreed should their ranges overlap, and so are best considered as separate species.

The Black-necked and Saddle-bill storks display infrequently because of their long-lasting pair bond. The *Up-Down* of the Black-necked stork is a spectacular greeting that includes rapid fluttering of fully extended wings and clattering of bills, but the head is not raised. These two species and the jabiru share a distinctive display given on the foraging grounds, the *Flap-Dash*, in which a bird dashes wildly through the water while vigorously flapping its wings.

Comparative behavioral observations have discovered distinctive traits from which relationships among the storks can be deduced. The distribution of these traits corresponds to other differences and similarities in morphology, plumage, and foraging habits, which support and confirm the relationships suggested by courtship displays. JAK

▲ **Stork displays.** Storks have a wide range of aggressive and courtship displays. (1) The last stage of the 'Clattering Threat" in the Yellow-billed stork. (2) "Display Preening" in the Painted stork; in this courting pair the male in front is preening behind the wing. (3) A marabou showing the "Anxiety Stretch" in response to disturbance by people on the ground under the nest. (4) A male Yellow-billed stork giving an "Up-Down" display as his newly acquired mate approaches the nest-site. (5) A courting male Asian open-bill stork performing the "Advertising Sway" at a potential nest-site. (6) "Head-shaking Crouch" of a male White-bellied stork as a potential mate approaches. (7) "Full Back," a position in the "Up-Down" display of White storks.

◂ **"Up-Down" display** by a pair of Painted storks on the nest.