

COMMON CHARACTERISTICS OF BEHAVIOUR, HABITAT, AND
DIET OF ENDANGERED WETLAND BIRDS

by

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ABSTRACT

Wetland birds are birds that depend on wetlands for survival. They can be separated into endangered and abundant species. The protection of wetland birds has become a critical topic, as pollution, habitat loss and changes to food sources are major factors leading to some extinctions. This review reveals that the endangered group of species has slower rates of reproduction. The best way to protect this group from extinction is to reduce the rate of loss of wetland habitats. In addition, degradation of wetlands must stop by reducing the use of pesticides and fertilizers.

Keywords: Wetlands, Endangered species, Habitat, Wetland bird

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INTRODUCTION

Birds have been in existence over 100 million years from the late Jurassic. In this long evolutionary process, new species continued to arrive as ancient species have become extinct. According to the paleontologist's record from fossils, about 90% of the birds that have been present since ancient times have become extinct (Alan, 1999). For these extinct species, we can only study them from fossils. Since the advent of modern humans, especially from the recent few hundred years, the extinction rate of species is getting faster and faster (Li, 2007). It is difficult to determine whether a bird species has been extinct because it is difficult to determine whether the bird has disappeared in the whole world, especially the area which humans barely reach. The International Union for Conservation of Nature (IUCN) has defined the extinction of a species that is not recorded in a 50-year period. However, some birds were rediscovered more than 50 years after "disappearing" (Du, 2016). The Crested ibis (*Nipponia nippon*) was considered extinct in the 1960s and 1970s, but in 1981, seven ibises were found in Yang county (Shaanxi Province, China), a news sensation (Ding, 2005).

The "Ramsar Convention," which was signed in 1971, presented that wetland birds are the birds that depend on wetlands for survival. China includes some of the largest areas of wetland habitat in the world and their use is distributed among many species of Asian waterfowl, the vast majority of which are recorded only in China (He, 2013). In China, there are many types of wetlands that are extensive in distribution

and favorable to inhabiting and migrating waterfowl. Wetlands in China can be divided into reproductive habitats in northern China, over-wintering habitats in southern China, unique Qinghai-Tibetan plateau habitats, and coastal habitats (Chen, 1997).

The goal of this thesis is to detect possible causes of extinction that could provide direction and suggestions on the protection of endangered species. The objective is to show the trends of species in several wetland habitats. I predict that these data will help readers to understand the characteristics of wetland birds, very helpful for their protection. Through this paper, I hope we can put more attention on endangered species and prevent them from extinction.

LITERATURE REVIEW

One of the main reasons of extinction risk for wetland birds that migrate from Eastern Asian to Western Australia is the decrease of wetland area in China. Among the nine major global migration routes for migratory birds, the “Eastern Asian-Western Australia” route is the most important one. There are 492 species of about 50 million waterfowl traveling to and from the route each year, of which 246 stop, breed or winter in China’s coastal wetlands (Jie, 2015). Chunguang Lei, dean of Beijing Forestry University Natural Reserve, said that nearly 50% of birds on the route are on the decline. Among them, there are at least 27 species of endangered waterfowl, accounting for almost half of the species of endangered waterfowl in the world and 22 species passing through China.

The Strategic Study on Coastal Wetland Protection and Management in China, which was released October 19th, 2015, showed that 53% of temperate wetlands, 73% of mangroves, and 80% of coral reefs have disappeared along China’s coast, which makes up important habitats for many migratory birds (Jie, 2015). Zhengwang Zhang, a professor in Beijing Normal University, said the survival of some birds is most entirely dependent on the survival of a wetland in China. For example, a migratory bird named Red Knot (*Calidais canutus*) passes by Bohai Bay when it migrates northward in spring. Eighty percent of the migratory individuals will rest for a month in the Luannan coastal wetland in Hebei Province to recharge their energy (Jie, 2015). Currently, the wetland has only 12 km of coastline and is still facing ongoing

reclamation and new reclamation threats. Hebei (2015) agreed that it is an important wetland, but it has not yet been effectively protected.

Ten Endangered Wetland Birds

Red-naped ibis

The red-naped ibis (*Pseudibis papillosa*), also known as the black ibis or the Indian black ibis, is a species found in the plains of the Indian Subcontinent (Hancock, 1992). The red-naped ibis prefers to live in marsh woodland and forest streams but can also be found in relatively dry fields. The Red-naped ibis is omnivorous, feeding on carrion, insects, frogs, and other small vertebrates as well as grain. Pairs copulate on trees and never on the ground. The eggs are two to four in number and pale bluish-green in color.

Crested ibis

The crested ibis (*Nipponia nippon*), also known as the Japanese crested ibis, makes nests at the top of trees on hills to hide its eggs (Bird Life International, 2012). The crested ibis usually eats frog, small fish, and some other small animals. This species starts nesting in May and breeds with two to four eggs in a nest once a year.

Glossy ibis

The glossy ibis (*Plegadis falcinellus*) is a wading bird. Its nest is usually on a platform of twigs and vegetation positioned at least 1 m above water, sometimes up to 7 m in tall, dense stands of emergent vegetation, low trees or bushes (Bird Life International,

2012). The glossy ibis consumes aquatic insects, insect larvae, shrimp, crustaceans, mollusks and other small invertebrates for food. Three to four eggs (occasionally five) are laid and are incubated by both male and female birds for 20 and 23 days.

Whooper swan

The whooper swan (*Cygnus cygnus*) is the only bird that can fly over Mount Everest, and the highest flying can reach 9000 m above the ground (Zhengjie, 2001). The whooper swan prefers aquatic plants leaves, stems, seeds and rhizomes for food, such as lotus root and *Elaeagnus*. Females build their nests alone and generally produce four or seven eggs per time, the spawning time is mostly in early to mid-May. Eggs are white or slightly yellowish gray, the average size of 113×73 mm, weight 330 g.

Red-crowned crane

The red-crowned crane (*Grus japonensis*) is a large East Asian crane and among the rarest cranes in the world. It is also known as a symbol of luck, longevity, and fidelity. The migratory populations of the red-crowned crane breed in Siberia and northeastern China in summer. The breeding range centers in Lake Khanka, on the border of China and Russia. This species nests in wetlands or near rivers. Normally, the crane lays two eggs, but only one survives (Klenova, 2008). In the fall, the red-crowned cranes start to migrate to Korea and east-central China to avoid cold winter. At this time, their habitats are mainly paddy fields, grassy tidal flats, and mudflats. They collect rice gleanings from paddy fields in order to help them survive during the cold winter (Hongfei, 2012).

Brant goose

The Brant goose (*Branta bernicla*) is a typical cold-water marine bird with cold resistance. It prefers to inhabit gulfs, seaports and estuaries (Shields, 1990). During the winter, Brant geese stay in areas around lakes and reservoirs with alkali-tolerant vegetation, on low-lying saltwater lakes, in coastal areas, and occasionally on farmland. They usually stay in the lowland of the Arctic tundra, which is not far from the seawater tidal zone, especially the tundra plains divided by many tidal streams, during the breeding season from June to August. Sometimes they also extend from coastal tidal zones to grassy inland tundra lakes and grass-growing lakes, or on slopes adjacent to the coast. After the breeding birds come out, they move to various lakes and reservoirs because more plant is available in coastal areas during winter. They usually come to the marine plants' lush seaside swamps and sea mud on the ground for food in the morning and then fly back to the sea to rest at night. Usually, four eggs per litter and the color of eggs are light yellow, light green white or olive brown.

White-tailed tropicbird

The white-tailed tropicbird (*Phaethon lepturus*) is a medium-size bird that occurs in the tropical Atlantic, western Pacific, and Indian Oceans (Harrison, 1996). It also breeds on some Caribbean islands, and a few pairs have started nesting recently on Little Tobago where it shares space with the red-billed tropicbird colony. The white-tailed tropicbird is a wandering seabird, generally nesting in the island cliffs and foraging mainly by looking at the surface of the sea while flying over the surface

of the water to find food. They fly straight down from the air to the surface rapidly to forage mainly on a variety of small surface fish, squid, and crustaceans. They breed on the tropical ocean shore and on islands, nesting in a hole or in rock crevices a few metres above the ground. Each nest produces one egg, and eggs are white, with dark purple-brown spots.

Black-winged stilt

The black-winged stilt (*Himantopus himantopus*) is a slender black and white wetland bird with a total of four subspecies. It inhabits open lakes, shallow ponds, and marshes. Non-breeding periods occur in shallow rivers, paddy fields, fish ponds and freshwater or saltwater pools, and marshes near the coast (Boyd, 1987). It is often foraging alone or in pairs in shallow water or wetlands, mainly consuming small aquatic insects. Black-winged stilts move to the breeding ground in northern China from early April to early May in spring and leave the breeding ground to move south in September-October. Breeding from May to July, they establish nests in open lakeside swamps, grasslands or on lake surfaces and exposed shoals and wetlands. The nest is dish-shaped and made up of reed stems, leaves and weeds. Usually four eggs are laid per brood and the colour of eggs are yellow-green or olive-brown, with dark brown spots; the egg is pear-shaped or oval.

Ringed plover

The ringed plover (*Charadrius hiaticula*) is a small bird that breeds in Arctic Eurasia. Ringed plovers inhabit wetlands and cannot be living without water. They are

distributed in northern Eurasia, Canada, and Greenland (Jobling, 2010). It is common for three to five individuals to form a small group that is not easy to approach. The main food includes the dragon louse and other insects, crustaceans, earthworms and other small invertebrates, plant shoots and weed seeds. Reproduction occurs in the northern hemisphere, eastern Asia Wusuli River basin and northern China and Japan. The breeding period is from May to July. They nest is usually on sand or gravel on the ground floodplain beach sand between the concave near water (Hahn, 2017). Male and female ringed plovers breed in pairs. When they arrive at the breeding ground, some begin to seek couples, while others are already in pairs when they begin migrating. Each nest spawns three to four eggs and breeding always takes a whole day. The shape of the egg is pear, co-incubation by male and female birds.

Painted snipe

The painted snipe (*Rostratula benghalensis*) is a short-legged and long-billed bird that is similar to the true snipes, but its plumage is much more striking. The activity period for the painted snipe is in the twilight and at night. During the day, these snipes always hide in grass. They inhabit plains, hills and also hide in reeds in mountain ponds, swamps, canals, riverbank grass and paddy fields. Their food source is mainly insects, locusts, crabs, shrimp, frogs, earthworms, mollusks, snails, plant leaves, buds, seeds and cereals (Shigemoto, 1983). Their breeding season starts during May and July. They nest in shallow reeds or plants, and the nest is mainly made up of hay, usually nestled on a heap of grass or a soil beach (Wesley, 1993). Usually, three to six eggs are laid per brood and eggs are oval and pear-shaped, brown yellow.

Ten Abundant Wetland Birds

Cotton teal

The cotton teal (*Nettapus coromandelianus*) is a small perching duck that breeds in Pakistan, India Bangladesh, Southeast Asia and south to Queensland (Bird Life International, 2012). Its habitat is in rivers, lakes, reservoirs and marshes, especially among aquatic plants. Its food source is mainly aquatic plants and terrestrial plant buds, leaves, roots, aquatic insects, worms, snails, mollusks, crustaceans and fish. Foraging activities are in the daytime. The breeding season is from May to August. The establishment of nests is in trees not far from water and sometimes in abandoned chimneys. Cotton teals can spawn 8-14 eggs per brood; the egg color is white.

Stone-curlew

The stone-curlew (*Burhinus oedicephalus*) is also known as the dikkops or thick-knees. Stone-curlews mainly inhabit the stony, low mountain deserts and the banks of large rivers. They are often solitary but may form small groups in the evening and early morning. Crabs, shrimp, snails, molluscs, insects, small reptiles and amphibians are their main food sources (Kochan, 1994). Stone-curlews breed during the January-August period. Their nests are set up on sandy river banks and a nest is a bare pit on the ground, usually with two eggs per brood.

Black-necked crane

The black-necked crane (*Grus nigricollis*) is a medium-size crane in Asia that

breeds on the Tibetan Plateau and in remote parts of Indian and Bhutan. Black-necked cranes mainly inhabit altitudes of 2500-5000 m above sea level, on plateaus or in meadows, marshes and reed swamps, as well as in lakeside meadows and river valley swamps. They are the only crane in the world that grows and reproduces on the Chinese plateau. Black-necked cranes are omnivorous and consume plants, leaves, rhizomes, corn, insects, fish, frogs and crop residues in farmland (Ali, 1980). Black-necked cranes fly to the breeding grounds from the end of March to the beginning of April each year. After mating, black-necked cranes nest on the grass surrounded by water, among reeds or on the ground. It is common for them to build nests of grass or lush reeds around a ring of water (Sekhar, 1978). Unlike other cranes, they have no nesting period before eggs are laid. Instead, they lay their eggs first and then build nests. The nest is very rudimentary and consists mostly of recently collected hay. They usually lay two eggs per brood and occasionally one egg. Eggs are oval, dark green, light green or olive gray, with dense brown or brown spots, especially denser on the blunt end.

Saunders's gull

The Saunders's gull (*Chroicocephalus saundersi*) is also named Chinese black-headed gull and is a species in the family Laridae. Saunders's gulls often stay in small groups. Insects, crustaceans, worms and other aquatic invertebrates are the main food for them (Pons, 2005). Their breeding period is from May to June. They usually nest in an open coastal beach area, and the disc-shaped nest is more or less on a mound above the surrounding ground. Nests have one to three eggs, and eggs are

yellow-green with dark-brown spots.

Moorhen

The Moorhen (*Gallinula chloropus*) is medium-size wetland bird and a member of the rail family. There are 12 subspecies. Moorhens mainly eat leaves of aquatic plants, young shoots, rhizomes and aquatic insects (Baird, 1991). They often forage alone during the whole day. The breeding season starts in April to June and they nest in shallow water among reeds or water plants. Occasionally, they nest in grass on the water's edge or in small willow trees in the water. Their nests are surrounded by reeds or tall grass and are very hidden. The shape of the nest is like a bowl, mainly composed of dry reed and grass. The inner part is reed leaves and grass leaves. Usually six to ten eggs are laid per brood, with a maximum of 12 eggs (Boles, 2005). The species is distributed over a wide range and is relatively common. It is not close to the critically endangered criterion for species survival. The distribution or fluctuation range is less than 20000 km², and habitat quality and population size are high with its distribution having little fragmentation.

Mandarin duck

The Mandarin duck (*Aix galericulata*) is a very famous species in China; it was seen as a symbol of love because it always appears in pairs. Mandarin ducks mainly inhabit mountain rivers, lakes, reservoirs, reed swamps, and paddy fields (Madge, 1987). The winter habitat is on large open lakes, rivers and marshes. Commonly, they can be found in coniferous and broad-leaf forests that are nearby water. The food

varies according to the season and habitat. In the spring and winter, they may eat nuts or corns, sometimes grass and leaves or fruits. During the breeding season they mainly consume animal foods like ants, stoneflies, locusts, mosquitoes, beetles and other insects, but also eat small aquatic animals. They breed in the mountain forest and nest in the hole of an old tree near water, always 10-18 m above the ground. The nest material is very simple, in addition to the tree's own wood shavings inside the nest, the female plucks feathers to line the nest. Breeding begins in early May, with seven to twelve eggs per brood, and eggs are ovoid-white and smooth without spots.

Great white pelican

The great white pelican (*Pelecanus onocrotalus*) is also known as the eastern white pelican. It breeds in southeastern Europe and throughout Asia and Africa (Bird Life International, 2012). Great white pelicans prefer to inhabit lakes, rivers, coastal and marshland and can be found in Qinghai Lake in China (Xinjiang Province). They mainly eat fish, and 0.9 to 1.4 kg of fish are needed for them every day. During periods of starvation, they also eat seagulls and ducklings. The breeding season is in mid-April or May, and their nest locations are different, some prefer nesting on trees, but most of them nest on the ground with grass, sticks, feathers and other materials. Usually one to four eggs occur in a clutch, an average of two eggs.

Black-crowned night heron

The black-crowned night heron (*Nycticorax nycticorax*), commonly called night heron in Eurasia, is a medium-size bird that can be found in large parts of the world

(Bird Life International, 2012). Its habitat occurs in the plains and hilly area of streams, reservoirs, rivers, swamps and paddy fields. The night herons forage in a group at night and their main foods are fish, frogs, shrimp, aquatic insects and some other young birds. During the day they hide in trees or bushes. Night herons usually nest in a variety of tall trees, often grouped in camp nests and together with egrets. The Chinese pond heron and gray heron always nests in mixed groups with night herons. The nest is made of dry branches and grass, and the structure is relatively simple. Usually, three to five eggs are laid per brood and eggs are oval and blue-green with an average weight of 24 g.

Little grebe

The little grebe (*Tachybaptus ruficollis*), also known as dad-chick, is a member of the grebe family of wetland birds. Little grebes prefer eating small fish; sometimes they capture shrimps and other small aquatic arthropods (Bird Life International, 2012). Like other grebes, they nest at the water's edge, and usually four to seven eggs are laid per brood. When adult birds leave the nest, they will cover their nest with weeds that can protect eggs from predators. Young birds can be attacked by the black-crowned night heron and large predatory fish, so most of the time they feed beside adult birds and stay on adult bird's backs when they migrate. The little grebe is one of the most common waterfowl in China and can be found easily in eastern China.

Tundra swan

The tundra swan (*Cygnus columbianus*) is a small Holarctic bird that can be

separated into two subspecies: the Bewick's swan (*Cygnus bewickii*), occurring in the Palearctic, and the whistling swan (*Cygnus columbianus*) of the Nearctic (Jieman, 2005). As their common name implies, the tundra swan breeds in the subarctic tundra, where it inhabits shallow pools, lakes, and rivers. Swans arrive on their breeding grounds around mid-May and leave for the winter at the end of September. In the breeding season, the habitat is mainly open lakes, reservoirs, swamps, and tundra wetlands. Elsewhere, they mainly inhabit large lakes, reservoirs, rivers, wet grasslands, flooded plains, swamps, beaches and estuaries. They build large mound-shaped nests from plant material at an elevated site near open water and defend a large territory around it. Usually three to five eggs are laid per brood and eggs are white. The foods of the tundra swan are mainly leaves, roots, stems, and seeds of aquatic plants. It also consumes snails, molluscs, aquatic insects and other small aquatic animals.

METHODS AND MATERIALS

The description of these 20 wetland birds came from several books and papers, which are the achievements of bird-lovers and bird researchers (Tables 1 and 2). The investigation of bird population involves strenuous field work and requires a large sample of data and repeated surveys in order to obtain satisfactory results. Especially for some endangered birds, the data is hard to get.

Bird survey methods include sample point interpolation, sample line interpolation, mark release-recapture, plotting methods, sound replay methods and rallying points surveys (Sutherland, 2004). The sample line method and sample point method are the two most commonly used methods of bird investigation. The observer moves along a sample line at a certain speed and at the same time records the individual birds (including those seen and heard) on both sides of the line; the sample-point method refers to the observer staying at a pre-selected point for 5-10 minutes, counting the number of birds found with a certain range (Bibby, 2000). In contrast to other bird survey methods, the sample-line and sample-point methods take less time. Long-term survey data obtained from the analysis of the two methods can help to understand the trend of changes in the number of bird population (Verner & Ritter, 1985).

Table 1. Website and documents of endangered wetland birds

Ten Endangered Wetland Birds	
Red-naped ibis	Storks, ibises and spoonbills of the world
Crested ibis	https://en.wikipedia.org/wiki/Crested_ibis
Glossy ibis	BirdLife International (2012). "Plegadis falcinellus"
Whooper swan	Bird of China
Red-crowned crane	https://en.wikipedia.org/wiki/Red-crowned_crane
Brant goose	Analysis of mitochondrial DNA of Pacific Black Brant
White-tailed tropicbird	Seabirds of the World
Black-winged stilt	The Black-winged Stilts at Holme Norfolk Naturalists' Trust reserve
Ringed plover	https://en.wikipedia.org/wiki/Common_ringed_plover
Painted snipe	Nest Attendance of Parent Birds in the Painted Snipe

Table 2. Website and documents of abundant wetland birds

Ten Abundant Wetland Birds	
Cotton teal	https://en.wikipedia.org/wiki/Cotton_pygmy_goose
Stone-curlews	https://en.wikipedia.org/wiki/Stone-curlew
Black-necked crane	Blacknecked Crane in Bhutan and Arunachal Pradesh
Saunders's gull	BirdLife International
Moorhen	A New Flightless Gallinule from the Oligo-Miocene of Riversleigh, Northwestern Queensland, Australia
Mandarin duck	Wildfowl: An identification guide to the ducks, geese and swans of the world
Great-white pelican	https://en.wikipedia.org/wiki/Great_white_pelican
Black-crowned night heron	https://baike.baidu.com/item/%E5%A4%9C%E9%B9%AD/2869832?fr=laddin
Little grebe	https://en.wikipedia.org/wiki/Little_grebe
Tundra swan	https://en.wikipedia.org/wiki/Tundra_swan

RESULTS

From the description of 20 wetland birds, I found that most of the wetland birds are omnivorous, meaning they can eat both animals and plants, and the breed season is from May to August. The majority of these species are migratory, but they would come back to specific breed ground during the breed season. They inhabit areas near water for easier access to food. For the abundant species, they have a strong reproductive ability and usually breed more than twice each year, while endangered species usually breed once a year and no more than five eggs per litter.

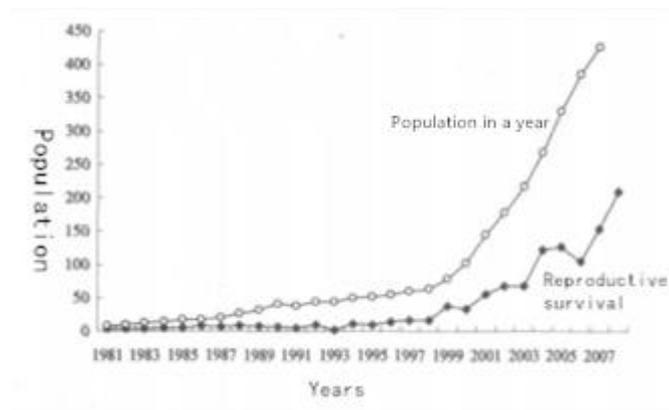


Figure 1. Trend of Crested ibis population in China

Crested ibis

Since the crested ibis was rediscovered in Yang city, the population has increased considerably (Figure 1). The increase was influenced by the "bottleneck effect" in the early years of crested ibis protection. However, the population grew slowly when first introduced. From 1998 onwards, the population of this species steadily increased, and in 2003, the number of young birds in the country exceeded 100 for the first time. As of July 2007, the total number of wild crested ibis has grown to 1084.

Glossy ibis

The glossy ibis is hard to see in the wild. The first glossy ibis was recorded in YuXi city, Yunnan province in 2012, and in 2013, 10 of the group birds were located in Honghe city for 30 days (CNS, 2013).

Whooper swan

The Sanmenxia Reservoir region is typical habitat for the whooper swan. Thousands will come to the reservoir for overwintering. From 2010 to 2014, the wintering population increased from 3492 to 7857. The population decreased to 1478 at the begin of 2015 because of avian influenza (Table 3).

Table 3. Changes in the wintering population of whooper swans in the Sanmenxia Reservoir region

Year	Population	Year	Population
2010	3492	2011	4357
2012	4109	2013	5748
2014	7857	2015	1478

Red-crowned crane

Since the beginning of the investigation in 1976, the population of red-crowned cranes in Heilongjiang dropped from 1310 to approximately 520 in 1986 (Table 4). Due to the protection carried out, the number since 1986 gradually increased. By the end of 1993, the number that overwintered in the protected areas of Yancheng reached 876, maintaining more than 700 in recent years.

Table 4. Comparison of the population of Red-crown crane between China and the world during 1976 to 1994.

Year	China's red-crowned crane population	World's red-crowned crane population
1976	1310	N/A
1981	1300	1631
1984	700	1290
1985	606	N/A
1986	520	1000
1994	707	1050-1200

DISCUSSION

Endangered wetland bird species have a low reproductive ability. With decreases in their habitat area, and for some as a result of high commercial values, their populations have decreased considerably in recent years. Endangered species protection has been a big topic. There are several physical and chemical factors that affect wetland bird survival, and the impact of environmental changes caused by human activities on wetland birds is the most critical among them. Other activities include wetland cultivation and other changes to wetlands, global climatic changes, excessively exploited biological resources, and polluted waters in wetlands.

Impacts of wetland changes on birds

The crested ibis, the original species endemic to East Asia, can only be found in China now. According to Zhijun Ma's report, the adult bird forages in paddy fields during the winter. The size of paddy fields is one of the main factors for this species to choose areas for foraging. The area of winter paddy fields decreased from 200 m² in the early 1980s to 26.7 m² in recent years. According to Dong-chou Shi et al. (1991), the reduction of the crested ibis population and its extinction in the local areas are directly affected by the large area reduction of area of paddy fields (Zhijun, 2001).

Impacts of climate change on wetland to birds

Deforestation of large areas of primeval forests, skyscrapers, cars and airplanes, and the destruction of the ozone layer lead to global warming and to several issues that have affected wetlands. Since the 1990s, except for a slight decrease in the

average temperature in 1992, China has maintained a warming trend. According to the authority of the Intergovernmental Panel on Climate Change (IPCC) in 1990, it is predicted that by the middle of the 21st century, the global average temperature will increase by 1.5-4.5 °C and the CO₂ concentration will be doubled than the current level (Jian, 1998). In China, the winter is becoming warmer and warmer especially in the northern China. The warmer winter would delay plant growth and the freezing period of soil.

Over-exploitation of biological resources in wetland ecosystems on birds

Due to poverty and other reasons, wetland biological resources have become the main income for local residents. Overexploitation of fish and shrimp, harvest of wetland plants, overgrazing, detoxification of poisonous aquatic organisms by poison bait, deforestation and so on have all plundered the food resources of wetland birds. The reduction in the number of birds is an inevitable result.

Impacts of water pollution on birds in wetland ecosystems

Industrial wastewater and domestic sewage are directly discharged into wetland water without standardized treatment. Pesticides and fertilizers are used in agricultural irrigation, which seriously pollutes wetland water bodies. Birds eat polluted food that is detrimental to their health, further leading to a large number of deaths due to some toxic substances such as heavy metals. There are many reports published in recent years that show how non-environmentally friendly products used by humans affect wetland birds.

Effects of heavy metal pollution on birds

Birds are at or near the top of food chain and consequently suffer from accumulating environmental pollutants. Because containment of heavy metals in the feathers and eggshells of birds reflect the background abundance of these pollutants, birds can be a useful indicator of heavy metal pollution in the environment (Table 5). The presence of heavy metals in air, soil, and water has a serious impact on living organisms and is extremely dangerous because of their bioaccumulation and amplification in the food chain. For example, in the transfer of phytoplankton → copepods → fish, a typical marine food chain, mercury concentrations increase with trophic levels (Bryan, 1984).

Table 5. Main types and sources of heavy metal pollution

Type	Natural	Artificial
Atmosphere	Cosmic rays and various geological movements of the earth.	A great deal of harmful gas and dust containing heavy metals are produced by industrial waste, automobile emissions, and automobile tires.
Water	Chemical interactions between water, soil, and rocks.	Industrial waste water and untreated sewage, refuse dumps and atmosphere sinks containing heavy metals
Soil	Contaminated rocks and biomaterials	Mining, building, accumulated solid wastes, agrochemicals, and dirty water irrigation

Heavy metals are mainly absorbed into a bird's body by the digestive and

respiratory tracts. Furthermore, a small amount of heavy metal can be absorbed through the skin and mucous membranes. The negative characteristics of heavy metal pollution are: (1) some heavy metals in water can be converted to more toxic metal compounds by microorganisms, such as in the methylation of mercury; (2) the valences of heavy metals are different, as long with their activity and toxicity; (3) their morphology can be transformed with changes to pH and redox conditions; (4) as long as there is a trace of heavy metals (usually 1 ~ 10mg / L), they can produce toxic effects, especially for mercury and cadmium, whose toxic concentration is 0. 01 ~ 0. 001 mg/L.

Effects of Persistent Organic Pollutants (POPs) on birds

There are two main sources of POPs: (1) Organochlorine pesticides are produced and applied to soils and crops due to agricultural needs; (2) Metal smelting, waste incineration and production and use of PCP and PCBs bring POPs into the environment. The effects of POPs on wild birds are mainly indirect and caused by the food chain, which can lead to birth defects, cancer, immune dysfunction, endocrine disorders, reduced susceptibility to disease, developmental and reproductive system diseases, production of soft-shelled eggs, and reduced reproductive success. The destruction of the environment by POPs also reduces the habitat of birds and may force migratory birds or highly migratory birds to migrate or change their habitats and wintering areas. Pollution of the environment by POPs causes more physical effort to be required by birds to find food. The common POPs are (1) Organochlorine pesticides (OCPs), which damage to bird reproductive function;(2) Polychlorinated

biphenyls (PCBs), which can induce the death of chicken embryos, significantly increase the mortality rate of eggs, affecting the mortality and hatching rate of embryos and chicks, causing morphological variation; and (3) Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans (PCDD/Fs), components of automobile exhaust caused by incomplete combustion or inadvertent production in certain industrial processes (Gilbertson, 1991). The absorption pathway of PCDD/Fs is mainly through the digestive tract, skin, and lungs, which can affect reproductive, immune, endocrine and nervous systems in developing animals. 4) Poly Brominated Diphenyl Ethers (PBDEs), target organs mainly adipose tissue, nervous system, thyroid and reproductive development system. PBDEs can interfere with the immune system of chicks, resulting in morphological changes of the spleen, mucus sac, thymus and antibodies, and PBDEs concentration of media reactions is significantly negatively correlated. Also, PBDEs can reduce the content of thyroxine in the blood, destroy the balance of thyroxine, reduce the amount of thyroxine available to the brain, and lead to neuro-developmental abnormalities.

CONCLUSION

Darwin's theory of evolution mentioned that creatures compete with each other, and those who can adapt to life are chosen to stay. Every kind of creature is adapting to the changes in this world, and we human beings are the best of them. We have developed science and technology to survive and have brought convenience to our lives. However, other organisms such as birds still observe the traditional ways of living habit, migration, foraging, nesting, and reproduction. They cannot tell the difference between stone and lead. They just understand that they are similar hard substances that can help them digest food. If they eat lead pellets, they will die and there is no way to convey to the birds the information that such things are inedible. Of course, they are also evolving. They know that humans will harvest crops in the fall and that they can be eaten. However, the use of chemicals will make them desperate.

Zhuang'zi mentioned "Zi fei yu, yan zhi yu zhi le" in the "XiaoYaoYou." The meaning of this sentence is: "How do you know what the fish thinks?" We study them from all aspects, and some species have played a leap-forward role in the development of science. I hope we can give them some space for survival in nowadays' rapid development. Who can determine that sparrows will not be an endangered species after a few years?

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