

中国鸟类迁徙研究

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Bird Migration Research of China

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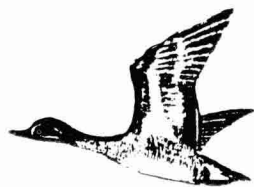
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鸟类的迁徙,是自古以来人们所熟悉的自然现象。候鸟年复一年春来秋去,往返于繁殖地和越冬地之间,往往迁飞长达数千千米,甚至上万千米,鸟类的这种习性引起人们广泛的注意:鸟类为什么要迁徙?迁徙习性是怎样形成的?迁徙有没有固定的路线?迁徙活动与气候、食物和其他生态因子有什么关系?候鸟在迁徙中是如何定向(导航)的?候鸟在迁徙中不同种间或同一种间,种群组成数量有无变化?

.....

对于这些问题,人们已进行了近百年的探索,投入了巨大的人力、物力和财力,建立起研究网络,积累了无数的资料和数据。目前全世界利用环志这种简单有效的科学手段,每年大约要环志近千万只鸟以观测它们的迁徙活动,也从中掌握了许多鸟类迁徙的规律,应用到国民经济的多个领域,获得了可观的经济、社会和生态效益。尤其是自第二次世界大战结束以来,许多高科技的手段如无线电、雷达追踪应用于鸟类迁徙研究,使鸟类迁徙规律研究获得了长足的发展,近年来人造卫星定位技术的出现,更使得能够在最短的时间内,精确、快速地获得迁徙鸟类的各项数据资料。其准确性达到可测定某一只鸟,在以分钟为计算单位的前提下迁徙或离开某一地点的数据,这种方法可以准确地掌握某一种鸟详细的迁徙路线、时间和迁徙速度。

研究鸟类迁徙掌握其活动规律,不仅在科学和国民经济发展上有重要意义,而且对于避免鸟机相撞事故,保障航空安全和预防候鸟带菌导致流行病传播等都具有重要意义和军事价值。

自1981年3月,中国政府和日本国政府签订了《中华人民共和国政府和日本国政府保护候鸟及其栖息环境协定》以后,在林业部和各级主管机构的领导下,由张孚允、杨若莉同志开拓并组织了全国的鸟类环志研究工作。自1982年迄今的10余年中,经过鸟类学家、鸟类环志工作者的辛勤劳动,在全国广大鸟类爱好者的热情支持下,全国鸟类环志研究,已获得了可喜的成绩。10多年来全国已环志放飞了鸟类372种计100966只。回收来自国内外的环志鸟132种1120只。环志鸟回收信息揭示了中国鸟类迁徙的部分规律,证实了中国鸟类迁徙的三条主要通道和候鸟穿越喜马拉雅山脉的迁徙通道的存在,以及其他鸟类生态生物学规律的数据、资料,为我国今后更广泛深入地开展鸟类迁徙规律和鸟类生态生物学研究奠定了基础。

2 序

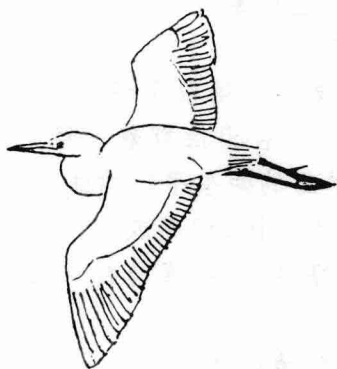
《中国鸟类迁徙研究》对我国鸟类环志的历史、发展、环志研究系列设计,世界鸟类环志的现状,我国各类群鸟类迁徙的资料、数据,全面地予以了汇集、分析、整理,以作为鸟类工作者和自然保护区工作人员以及广大鸟类爱好者和野生动物管理机构的参考。

《中国鸟类迁徙研究》的出版,标志着我国鸟类生态学研究,特别是“鸟类迁徙”这一个广阔领域处于“空白”情况的结束,也标志着中国鸟类迁徙研究填补了“全球鸟类迁徙研究”中亚洲东部区域的一大空白,并使中国鸟类研究步入了世界鸟类迁徙研究的行列,为世界鸟类资源保护和合理利用事业,为全球生物多样性保护事业提供了可靠的依据,将鸟类学研究为社会主义建设和自然保护事业作出新的贡献。

中华人民共和国林业部野生动物和森林保护司副司长
中华人民共和国濒危物种进出口管理办公室副主任

邱建华

1996年7月15日



前言



鸟类迁徙(migration of birds)是指鸟类于春秋两季在营巢地区和越冬地区之间进行移居的现象。这种迁徙具有一定的时期性、方向性、路线性和地域性。采用鸟类环志(bird banding)研究鸟类的迁徙规律是一种简便易行的科学方法,已为世界各国普遍采用。自本世纪以来,世界上许多国家相继投入了大量的人力、物力,建立了环志机构和组织,有些甚至是国际、洲际组织,广泛开展鸟类环志工作,并将鸟类环志工作视为全球性应用生态学研究的基础工作。中国虽早在春秋战国时代即有萌芽时期的“环志”研究活动,但科学地应用环志研究鸟类迁徙,是从本世纪80年代初期开始,这较之周边国家的日本(1924)、原苏联(1915)已迟了半个多世纪。自1982年起步的中国鸟类环志研究事业,在国家各级主管部门和社会各界人士的大力支持下,10余年来,有了长足的进展,已为鸟类迁徙规律研究奠定了基础,也填补了中国鸟类生态学研究及世界鸟类环志研究在亚洲东部地区这一重要领域中的空白。

1983~1993年的10余年来,通过全国各地各机构鸟类环志工作者的努力,广大鸟类爱好者的热忱支持,中国已经累计环志放飞了鸟类372种100966只,回收国内外环志鸟133种1120只。

这些回收鸟所提供的信息使我们得以了解:我国候鸟南北迁徙有三条不同路线,其中东路来自澳大利亚的候鸟在沿海有着途经中国大陆和途经中国台湾、日本、韩国或俄罗斯东部堪察加半岛的两条平行的通道。中国西部雁鸭类、鸥类和鹤类可以途经喜马拉雅山脉往返于中国、印度或中国、孟加拉国之间,而印度鸬鹚类经喜马拉雅山脉东端迁至天津塘沽,表明喜马拉雅山脉已成为小型鸟类迁徙的地理屏障。

中国东部地区的丹顶鹤自繁殖区迁往华东沿海及长江中下游越冬,与日本丹顶鹤迁徙明显形成相隔离的两个群体。其他几种鹤的环志回收及日本利用卫星追踪结果,表明俄罗斯远东与中国毗邻湿地的白枕鹤除经中国,与中国湿地的白枕鹤群体一起经朝鲜半岛迁往日本越冬外,还与白头鹤、白鹤等分别经中国沿海三条不同的路线,迁至华东沿海和长江中下游鄱阳湖等湿地越冬。

研究还表明,家燕和鹤等并非终生配偶不变,甚至在育雏期间尚有弃雏而另行配偶繁殖的现象。不同种群的候鸟虽受气候影响其迁徙时间有后移现象,但各种候鸟在种群间或种群内均有明显不同的年迁徙和日迁徙节律,中国东部沿海迁

2 前 言

宁大连蛇岛老铁山鸟类环志站、山东长岛环志站、青岛环志站对 10 余年的环志和回收积累资料分析结果均确认此现象。同时,回收信息还使我们了解到其他许多以前不了解的鸟类迁徙距离、速度、寿命、种群扩散、存活等等生态学信息。

我们也清醒地看到,中国鸟类环志研究虽然已初具规模,在研究和管理上已形成较完善的体系,也为今后进一步的扩展全国鸟类环志研究奠定了基础,但仍处于刚刚起步,不论从我国所需研究的候鸟种类、濒危种的保护与挽救亟待解决的问题等方面,与世界先进国家环志研究的深度、广度相比,尚有较大的差距,这些都有待我国环志研究者去承担,去开拓。

《中国鸟类迁徙研究》出版的目的在于将我国鸟类环志工作者 10 余年来所积累的资料数据分析整理成文,以供今后有志于环志事业的各位同仁参考,通过这本书,可以了解中国鸟类环志发展的历史和迄今所获得的成果。书中对某些规律性现象的分析,可作为将来进一步深入探讨的课题。

著 者

1997. 6. 11



SUMMARY

Bird migration, the phenomenon of movements of birds between their nesting grounds and wintering grounds in spring and autumn, is a well-known natural phenomenon. Why do birds make migration? How did this behaviour evolved? Do birds have definite migration routes? What is the relationship between bird migration and the environmental factors, such as food, light, climate? How many kinds of migration patterns? What is the significant of bird migration in the evolution? Why bird populations vary with its geographical distribution?..... There are a lot of publications dealt with the above questions.

Migrants start to migrate as season changes in order to change their habitats. This kind of migration takes place in a certain of time, direction and range. The long-distance migrants can fly across many countries, even can across different continents. Most migrants fly in the direction of north and south. A few species may migrate in east and west direction. In 1986, a Redpoll *Carduelis flammea* (Ring Number V329497) from Finland was recovered in Muohe County, Heilongjiang Province of China. It had travelled across the Eurasian continent from west to east.

Many long-term studies on bird migration have been carried out in both the developed and developing countries. Bird banding is a simple and scientific way to study bird migration, and it has been used in many countries in the world. The information from recovery of the banding birds can indicate the time, route, population size, navigation, mortality, survival and longevity of the migrants, as well as the relationship between bird migration and environment of breeding and wintering grounds. Since 1950s, apart from using bird banding, some international ornithological organizations have begun to apply many new techniques, such as radar tracking, aerial photography in bird studies, in order to obtain more precise data and information of bird migration.

As a large country situated in the eastern part of Asia and faced to the Pacific Ocean, China owns a vast territory which include 5 different climate regions from the tropical zone to the cold-temperate zone. From east to west, the latitude of China increases from the plain at the sea level to the roof of the world, Qinghai-Tibet Plateau. The complex topography forms many kinds of ecological environments, which provide good breeding sites, wintering grounds and stop over for birds. According to a census in 1982, China owns 565 species of migrants belong to 223 genus in 56 families, 20 orders, which is the most numerous in Asia. As the main flyway of migrants living in both the southern hemisphere and northern hemisphere, the success of bird banding in China plays a key role in the studies of bird migration in the eastern part of the world. Bird migration studies not only have significant benefits to science and economy, but also can provide important information for making our "National Instructions of Navigation" and avoiding the bird strikes.

2 Summary

China is one of the earliest countries which bird banding originated. As early as 2000 years ago, one maid in the Palace of Wu once banded House Swallow using silk strips and tried to find that if it return to the same place or not in the next year. It was about 1000 years earlier than the similar experiment conducted in Germany in 1230, which people banded herons with slip piece and then released. In the classic *The Lu's Spring and Autumn Annals* which written by the scholars of Qin in 230 B. C. , it recorded that "*The Migratory Geese go Northward in the First Month of Spring*". In *The Book of Rites* written by Zheng Xuan in Han Dynasty, it recorded "*The Migratory Geese Comes Both in Spring and Autumn*". Afterwards, there are a lot of descriptions of bird migration appeared in the many classic historical books.

Due to many historical reasons, the scientific studies of bird migration had not started in China until 1960s, when a few ornithologists carried out some short-term bird banding studies in order to know the population dynamics of a given species of migrants (Li, 1960). In the middle of 1960s, Prof. Cheng Tso-hsin the famous Chinese ornithologist, wrote several papers to introduce the objectives, significance and scientific methods of bird banding studies. At the mean time, he commented China would carry out bird banding research programme as soon as possible.

In 1980s, along with the economic development and carrying out the open policy, bird banding study as one of the important fundamental research work in Chinese wildlife conservation was paid more attention by the Government. On March 3 of 1981, the first migratory birds protection agreement in China history *Agreement on Protecting Migratory Birds and Their Habitats Between China and Japan* was signed by the two Government. The first article in the Agreement is: According to recovery of banding birds, the species moved between the two countries have been confirmed. In the same year, the State Council published *The Notice of About Carring Out the Sino-Japan Migratory Birds Protection Agreement*, which play an important role in the migrants studies in China.

In 1981, after the permission of the State Council of China, the National Bird Banding Office in charge of the administrative affairs of bird banding programme was established by the Ministry of Forestry, China. In 1982, the National Bird Banding Centre was set up in China Academy of Forestry. The Centre is in charge of scientific studies of bird banding in China.

The National Bird Banding Centre determined metal leg rings as the bird markers in Chinese bird banding studies. The metal ring is made of binary alloy of nicket and copper (binary alloy of nicket and aluminium). There are the number, unit name, post box and country name in both English and Chinese on the surface of the ring. The Latin letter in front of the number represents the ring size.

Since bird banding studies started in 1983, the National Bird Banding Centre has strong links with the bird banding organizations in Japan, USA, UK, Australia, Malaysia, India, Germany, Finland, Denmark, the former Soviet Union, etc. and often exchanges

information and data with these organizations.

From the first bird banding activity conducted in the Bird Island of Qinghai in 1983 to the end of 1993, totally 100966 individuals of 372 species in 163 genus, 51 families, 18 orders of birds had been banded in China. Among them, 32704 were birds of prey, 15222 were shorebirds, 5869 were waterfowls and 47171 were songbirds. Comparing the number of migrants banded in different groups, it is not difficult to find that, 8 orders of songbirds and other birds, such as Passeriformes and Columbiformes, are the most in number, which is 46.7% of the total number of banded birds.

However, the recovery of the banded songbirds was only 1.11%, based on a calculation of the 530 songbirds and other birds of 64 species recovered in China.

Birds of prey is an important group of banded birds in China. The banded individuals of Falconiformes and Strigiformes in 1984-1990 about 30% of the total birds banded in China in the same period. Birds of prey are not only the protected species under the National Wildlife Law, but also the top species in the ecosystem. At present, as the developing of economics, they have become the more vulnerable threatened species. Therefore, as the first-class indicator of quality of environment and dynamic of epidemic disease, birds of prey has become the key species which need study and protection. Since 1984, China National Bird Banding Centre has cooperated with the bird banding stations of Changdao, Qingdao of Shandong province and Laotieshan in Dalian of Liaoning Province to conduct a research project entitled "Studies on migratory patterns of birds of prey in the eastern coasts of China".

The shorebird is another group of migrants followed with interests in China. In the period of 1984~1993, totally 15222 individuals of shorebirds had been banded and released in the country, which include 34 Red-crowned Cranes (*Grus japonensis*), 2 White-naped Cranes (*G. vipio*), 9 Demoiselle Cranes (*Anthropoides virgo*), 128 White Spoonbills (*Platalea leucorodia*) and 8 White Storks (*Ciconia ciconia*) banded in 1984 in Zhalong Natural Reserve of Heilongjiang Province.

From 1983 to 1993, China National Bird Banding Centre had recovered 1120 individuals of 133 species of birds banded in China and other countries, which included 4 kinds of recovered birds, e. g. recovered at the same site (the banding site) in China, recovered at other sites in China, recovered the birds banded by other countries in China, and recovered Chinese banded birds in other countries.

The banded birds have been recovered in different sites of 28 provinces, autonomous regions and municipalities directly under the central government of China. Analysing the number of the recovered birds, we can find that most of them occurred in the eastern coastal areas, very few in the west. The small-size songbirds had the lowest rate of recovery.

A census of China banded birds recovered in foreign countries and the foreign banded birds recovered in China found that, our banding project involved 13 countries, include Japan, Russia, Kazakhstan, Mongolia, D. P. R. Korea, Korea, Malaysia, India,

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Bangladesh, Australia, New Zealand, USA, Finland.

As early as 1950s, according to observations on migrants or the process of appearance of the birds in different areas, many ornithologists proposed: "The migrants of China mostly go south from the coastal areas of northeastern provinces to southern Asia and the islands of southeast Asia; or from Inner Mongolia via Qinghai and then along Hengduan mountains in west Sichuan (the old name is Xikang) and west Yunnan, go southward to Burma, Vietnam, India and Malay Peninsula... these are the two migratory routes in China." "The other route is from the islands in southeast Asia, go northward to Taiwan... across the ocean to the mainland; but mostly via Ryukyu-gunto to Japan, then go in two routes, one route is from southern Japan across Japan Sea to Korea and then northward to northeast China, Mongolia and Siberia; another route is from northern Japan via Kuyie Island to the further north areas (Zheng, 1955).

In 1982, according to analysing more than 700 papers and reports published in 1928-1982, we suggested that, Chinese migrants (winter visitors, summer visitors and passage migrants) mostly migrate in the directions diagonal to the south and north line, besides, some migrants also make journeys on an east and west line. For the south-north migrants, their migratory routes include the following regions:

(1) Western migratory region

This region includes the dry grassland of western Inner Mongolia, desert, semi-desert grassland, alpine meadow grassland of Gansu, Qinghai, Ningxia. During migration, many summer visitors of this region may go along the A'nyenagen mountains, Bayan Har mountains and Qionglai mountains, southward to western Sichuan Basin, Yunnan and Guizhou Plateau, and even to the Indo-China Peninsular for overwinter via Hengduan mountains.

(2) Middle migratory region

This region includes the grasslands in eastern and central Inner Mongolia, western North China and Shaanxi. In winter, the migrants in this region may go along Taihang Shan and Lüliang Shan, pass through Qinling and Daba Shan to Sichuan Basin or further south areas.

(3) Eastern migratory region

This region includes the Northeast and eastern North China. The migrants in this region may mostly migrate along the coasts to the middle or southern China, and even to southeast Asia.

Apart from the migrants living in above migratory regions, there are also some other migrants, which include the winter visitors come from the Asian parts of Russia and some short-distance migrants in Qinghai-Tibet Plateau and Yunnan-Guizhou Plateau (Yang, 1982).

The results of bird-banding and recoveries in the past ten years have confirmed our suggestions that there are three major migratory regions of birds in China.

1. Banding studies of birds of prey in China

Bird of prey is the important group of migrants in the bird banding studies in China. It has 88 species in 40 genus of 2 families. Not only 90% of them are migrants and they are at the top position in ecosystem, but also 7 species of them have been listed as first class and 81 species listed as second class of the national wildlife of China for protection. Liaodong Peninsular and Shandong Peninsular in Bohai region of eastern China are good flyways of migratory birds of prey, where are the main sites to study the migration patterns of birds of prey.

In the period of 1984-1993, totally 32704 individuals of 19 species of birds of prey had been banded in Laotieshan Station of Liaoning, Changdao Station and Qingdao Station of Shandong. And 100 individuals of 10 species of the banded birds of prey had been recovered either in China or in other countries. The recoveries of birds of prey show that, most part of the flocks of birds of prey which come from the North arrive at Laotieshan of southern Liaodong Peninsula during their southward migration in autumn, then fly across Bohai Strait, pass through Changdao Island, go across Shandong Peninsula to the inland via Fushan of Qingdao and Jiaozhou Estuary. So far, no banded birds of prey had been recovered in Chongming Island and Hangzhou Estuary of the lower reach of Yangtze River. We know that, after crossing Bohai Strait, birds of prey migrate to Jiangxi, Anhui, Hunan, Hubei, Guangdong and Guangxi, then occur in the coastal areas again. During the short period from October to December in Weizhou Island of Guangxi, large flocks of birds of prey always can be found flying southward to Vietnam. While except a few of Red Kite (*Milvus korschus*) can be found, very difficult to see other migratory birds of prey in the other areas of Guangxi.

According to observations in Beidaihe and Tangshan of Hebei Province, during the autumn migration, some of birds of prey migrate along the western coasts of Bohai rather than go across Bohai Strait (Zhang, 1985). In the next spring, most birds of prey fly northward following their former migratory routes. However, the banded Besra Sparrowhawk (*Accipiter virgatus*) (Ring No. G00-4422) and the banded Sparrow Hawk (*Accipiter nisus*) (Ring No. G00-9756) were recovered in Hengshui City of Hebei Province and Tanggu of Tianjin City, respectively. The two recovered sites shift westward from the normal migratory routes $4^{\circ}54'$ and $3^{\circ}0'$, respectively, which indicate that birds of prey may use different routes during their two migrations in the same year.

There are still many questions on the migration patterns of birds of prey, which need large number of data of bird banding and recoveries to answer. For example, except the 4 recovered birds, e. g. Besra Sparrowhawk (Ring No. M-456004) banded at Siberia of Russia, the Long-eared Owl (*Asio otus*, J00-1961) and Red-legged Falcon (*Falco vespertinus*, G01-4516) banded in China and migrated to Russia, and the Long-eared Owl (J00-1944) recovered in Korean, which indicated that the breeding birds of prey can aggregate to migrate via eastern China, no any information has been obtained to know if the birds of prey in other areas have different migratory routes.

6 Summary

The banding results in the three stations show that:

(1) There are remarkable differences on the dates of different species of birds of prey pass through the banding station during their migration each year. In autumn, birds of prey pass through the stations during their southward migration from late August to middle December. And the peak of their appearance is from middle September to the end of October.

The peak of migration varies with the species. According to our capturing and banding results, the peak migration periods of Sparrow Hawk, Besra Sparrow-hawk, Red-legged Falcon and Long-eared Owl are nearly the same, e. g. 10th September to 15th October, 15th September to 15th October, 10th October to 5th November, respectively. The earliest record of capturing Sparrow-hawk in spring is on 21st March, the latest record is on 1st June. In autumn, the earliest record is on 5th September, the latest is on 23rd November. For Besra Sparrow-hawk, the earliest record in spring is on 21st March, the latest is on 4th June; the earliest record in autumn is on 28th August, the latest is on 28th November.

(2) The duration of migration varies with species of birds of prey in spring and autumn. For example, the duration of migration in Sparrow Hawk is 62 days in spring and 79 days in autumn; in Besra Sparrow-hawk, is 74 days in spring and 91 days in autumn; in Scops-owl, is 39 days in spring and 62 days in autumn; in Long-eared Owl, is 17 days in spring and 55 days in autumn. According to our capturing records and field observations, in general, the duration of migration of birds of prey is shorter in spring than that in autumn.

(3) The sequence and characteristic of the migration of birds of prey. In the spring migration, the sequence of birds of prey pass through the banding stations is Besra Sparrow-hawk, Sparrow Hawk, Common Kestrel, Hobby, Marsh Harrier, Honey Buzzard, Common Buzzard, Upland Buzzard, Scops-owl, Long-eared Owl, Short-eared Owl and Rough-legged Hawk. The sequence of autumn migration is nearly the same as the spring migration, but the interval is longer than that in spring. In spring northward migration, males always arrived earlier than females, with an interval of 5-7 days. In autumn southward migration, females arrived earlier than males, with an interval of 5-7 days. Bird banding indicates that the regular sequence of males and females is existed in both the spring migration and autumn migration (Zhang, 1987; Liu, 1991).

(4) The daily rhythm of the migration of birds of prey. During migration, the daily activities of birds of prey are regular. Bird capturing and banding results show that, two peaks of activities occur everyday in birds of prey, e. g. 4:00-9:00 and 15:00-18:00. The active period of diurnal birds of prey is 5:00-18:00, the peak period is 6:00-9:00 and 15:00-18:00. The active period of nocturnal birds of prey is 18:00-5:00, and the peak period is 4:00-5:00 and 18:00-19:00. During the period of 4:00-9:00 and 15:00-18:00, birds of prey rest or search for food. In order to continue their migration, birds of prey have to fly frequently in the forest to replenish the lost energy or to find roost sites. Therefore, most of them are caught in the period of 9:00-15:00 and 18:00-5:00 when they pass through and

roosted (Hou and Yang, 1990).

2. Banding studies of Chinese waterfowls

Waterfowls are the first important group of birds in the bird banding studies in China, because they are the traditional hunting birds of China. Second, China owns a lot of wetlands which provide breeding grounds and wintering grounds for waterfowls. In the breeding season, a huge number of waterfowls occur in the wetlands in northern and western China, which provide favourite conditions for the waterfowls banding studies.

From 1983 to 1993, totally 5869 individuals of 32 species in 15 genus, 7 families, 5 orders of waterfowls had been banded and 125 waterfowls in 20 species had been recovered.

The species of waterfowls that had the largest number recovered was Herring Gull (*Larus argentatus*), which were banded at Lake Baikal of Russia, totally 56 individuals had been recovered. The recovered sites were widely distributed in the coasts of northern China. A few individuals migrated to Nanjing, Chongming Island of Shanghai, the middle and lower reaches of Yangtze River, and further south to Changle areas of Fujian Province (24°18'N, 116°54'E).

The species of waterfowls that had the second largest number recovered was Black-headed Gull come from Lake Baikal of Russia. In recent years, many of this species migrated to Kunming City of Yunnan Province for overwinter. At the same time, some individuals were also found in Hebei, Shandong, Anhui, and Poyang Lake of Jiangxi, which was concoined with the records of its wintering ground in northern China (Cheng, 1987). However, the records of banded Black-headed Gulls recovered in Japan in 1961-1983 showed that, the gulls lived in eastern Siberia migrated along the route paralleled to the continent to the south of Hokkaido of Japan for overwinter. This paralleled migratory route is similar to the result from shorebirds banding studies.

However, after recovered in Shandong or banded at Poyang lake, the Bean Goose (*Anser fabalis*, B-76056) and the White-fronted geese (*A. albifrons*, L-2949, 2975, 2917) which wintered in eastern China can migrate northward to the vast areas of Siberia at latitude between 34°-70° and longitude between 44°-160° for breeding. They migrate to the coasts of Shandong and the wetlands of the middle and lower reaches of Yangtze River for overwinter. The Caspian Tern (*Hydroprogne caspia*, E-89876) which lived in Arkal lake (46°7'N, 81°52'E) of Kazakstain migrated to the coastal islands of Zhanjiang of Guangdong Province (20°54'N, 110°30'E). The Common Teal (*Anas crecca*, H 00-1113) banded at Caohai marsh of Guizhou migrated to the tundra areas of Russia (north of 60°N) in spring. These cases indicate that most waterfowls lived in the central and eastern China, as shorebirds, migrate to the Siberia tundra of Russia for breeding, with an exception that a small part of them can breed in northern China.

Among waterfowls, ducks and geese are the traditional hunting birds in China. According to a census (Lu, 1990), the annual harvest was at least 1,200 thousands

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individuals before 1990. But the number has decreased in recent years as a result of overhunting and wetland destruction. Among the 46 species of ducks and geese in China, 12 species have been listed as the national wildlife for protection. 9 species, such as Brant (*Branta bernicla*), had not been found in the three years surveys, probably had extincted.

Although China is a big country rich in waterfowls, as lacking fund and other reasons, bird banding studies have been carried out only on a few species in a few areas (for example, Poyang Lake), except the large scale banding the 4 species of waterfowls in Qinghai Lake of western China in 1983.

In 1983-1987, totally 2245 individuals of waterfowls had been banded in Qinghai Bird Banding Station, and 9 individuals had been recovered and 16 banded birds were seen to return their nests. The study indicated that:

(1) The banded Bar-headed Goose return to its former breeding sites next year. In 1984 and 1985, 4 and 12 banded Bar-headed Geese return to the Bird Island, which showed that this bird has the tendency to return its former breeding ground. We also found that a few banded young birds return to its birthplace next year although they did not breed. The recoveries of 2 banded Bar-headed Geese at Eling Lake of Qinghai in April-May in 1985 indicated that, as there were nearly 4000 geese bred at the Bird Island of Qinghai each year, if the annual increasing rate was 300% and the carrying capacity was limited, then there would be some young geese migrate from the wintering ground to new breeding sites the next year. The dispersal of Bar-headed Geese in different breeding sites is a common phenomenon in population ecology.

(2) One Bar-headed Goose banded by China National Bird Banding Centre was recovered in January 1986 at Caohai of Guizhou Province by Guizhou Natural History Museum. The recovery shows that the migratory route of Bar-headed Goose from its breeding area to wintering ground is from northwest to southeast, e. g. along Mt. Animaqing southward to the lakes such as Caohai and then winter there.

(3) The Bar-headed Goose banded on 8th August 1983 (M00-1337) was recovered in India in December 1984. The goose (M00-3733) banded on 28th July 1984 was recovered in Bangladish on 3rd March 1985. The goose (M00-3981) banded on 28th July 1984 was recovered in India in December 1986. The Great Black-headed Gull (M00-1178) banded on 4th August 1983 was recovered in Assam of India in March 1984. The recovery information of the four birds banded at Qinghai-Tibet Plateau is noticeable. It was an antiquated idea that "nobody has banded birds in Qinghai-Tibet Plateau and none banded bird has been recovered in this region" which said by an American ornithologist Charles Walon. The birds we banded in Qinghai-Tibet Plateau not only been recovered in China, but also in other countries. From the migratory routes of the 3 Bar-headed Geese recovered outside China, we know that different species bred at the same site may have different migratory routes, even the different populations of the same species may use different routes during their migration. The Bar-headed Geese recovered in India and Bangladish indicated that, they probably used

the gorge of Yaluzangbu River as a channel to go through Himalaya and reached to the lower lands of India and Bangladeshi for overwinter. However, the Great Black-headed Gull migrated from its breeding area to Assam of India by fly over the Himalayan mountains. This result had provided an evidence for the former suggestions (Watton, 1906, Ludlow, 1927). The recovery of the 4 birds outside China confirmed the birds could make journeys between China and India, China and Bangladeshi. This is also the first confirmation of this migratory routes by bird banding. The recovery of India banded Red-crested Pochard (*Netta rufina*, F-40244, G-9492) in Bachu county and Talimu River of Xinjiang provided the evidence of other large and middle-size migrants can fly over Himalayas from the northeast of Qinghai-Tibet Plateau.

3. Banding studies of Chinese shorebirds

Shorebird is the group of birds had the highest recover rate in China, totally 365 individuals of 40 species have been recovered. Most of them are waders from Australia, e. g. 147 individuals of 12 species. The waders of Australia and New Zealand mostly migrate from the banding sites (South, Southeast, Tasmania and the northwest coast of Australia) to the marshes of Zhujiang Delta, Chongming Island of Shanghai, Hangzhou Estuary, Bohai Estuary, northward to Changchun and many other wetlands in Northeast of China.

The Curlew Sandpiper (*Calidris ferruginea*, AB-113616, AB-93872, AB-91167) banded in southern India banding station (10°18'N, 79 °51'E) flew northeastward over eastern Himalayas, arrived at Tanggu of Tianjing (39°00'N, 117°36'E) and had been recovered. To sum up the situations that China banded Bar-headed Goose, Great Black-headed Gull and India banded Red-breasted Pochard rather than waders can fly over Himalayan mountains, we propose that Himalayan mountains have become the geographical barriers for the small-size birds to make their south-north migrations (Zhang, 1989).

According to recovery of banded birds and field observations in the past ten years, we can get the following information and suggestions:

Among the migratory waders, apart from a few individuals of a few species (8 individuals of 7 species) migrated east-west from Japan to China, most species made their migration in flocks from the wintering ground in southern China to northern China and the Far East region of Russia for breeding. Some species, such as Red Knot (*Calidris canutus*, C-31488), can fly 12601 km during migration. It was banded at New Zealand (Jordans, 36° 34'S, 174°26'E) on February 23, 1989 and was recovered in Shanghai (30°48'N, 121°27'E) on April 16, 1990. It is the longest distance record of bird migration in China.

During the period from 1983 to 1993, totally 12087 individuals of waders had been banded and released. Comparing the migratory routes suggested by the 291 recovered waders with that suggested by the recovery information of the 128000 banded individuals of 51 species of waders in Japan in 1961-1983, we know that the waders come from the same wintering ground in Australia can pass through China and Japan to their northern breeding