

# The Birds of Shuangtaizihkou National Nature Reserve, Liaoning Province, P.R. China

MARK A. BRAZIL

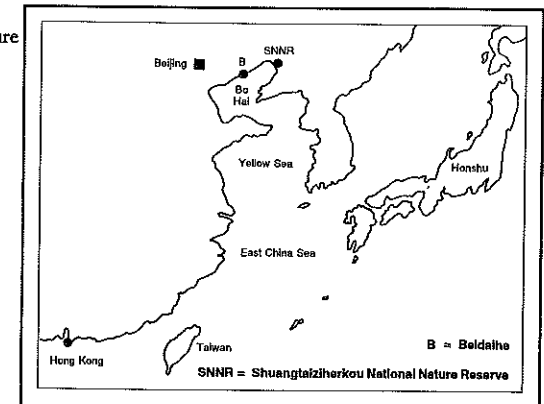
The Shuangtaizihkou NNR was established in 1985. Situated at the mouth of the River Shuangtaizi, it covers some 80,000 ha and holds important populations of Red-crowned Crane *Grus japonensis*, Saunders's Gull *Larus saundersi* and Reed Parrotbill *Paradoxornis heudei*. This paper describes the physical features of the reserve, discusses its ornithological importance and provides an annotated checklist of the 241 species recorded to date.

## INTRODUCTION

### *Location*

The Shuangtaizihkou National Nature Reserve (SNNR) is an area, on paper at least, of some 80,000 ha (approximately 38 km east to west and 39 km north to south). It straddles the mouth of the Shuangtaizi (River Shuangtaizi) (see Figure 1), and lies at the head of the Liaodong Bay, approximately 40°52' to 41°03'N and 121°35' to 121°55'E (Melville 1991). The reserve which is within the counties of Panshan and Dawa, administratively part of Panjin City, is bounded by the Daliao River in the east, the Dalin River in the west, the plain of the Liao River to the north and the Gulf of Bohai to the south. The Shuangtaizi River is connected to the Dalin, Raoyang, Fengtun, Panjin and Daliao Rivers forming a network which deposits large volumes of silt at the head of the bay from the Longgang Mountains in eastern Liaoning, the Yiwulyu Mountains in the west and the

**Figure 1.** Location of the Shuangtaizihkou National Nature Reserve (SNNR)



intensively farmed lowlands between these ranges and the sea. The region, part of the Bo Hai depression, of the central plateau of north China, continues to subside, but subsidence is made up at the same rate, historically at least, by siltation. The area is flat, low lying and only 2-4 m above sea level (Anon. 1989b).

#### Climate

The reserve lies in the semi-humid and monsoon region of the temperate zone with very cold winters (minimum  $-29.3^{\circ}\text{C}$ ) during which the ground freezes to a depth of about 100 mm, the sea freezes along the coast, and snow is not infrequent, very hot summers (maximum  $35.2^{\circ}\text{C}$ ), with 172-177 frost free days, and an annual rainfall of 610 mm (Anon. 1989a). Typhoon-related rainstorms bring extremely heavy rain falls, causing flooding from late June onwards, and as the soil of the coastal area consists largely of medium and heavy, sticky clay, dirt roads can become impassable during and after rain. Winds are predominantly from the south or south-west during spring and summer and from the north or north-east during autumn and winter. The flatness of the region and the proximity to sea and river means that, especially in spring, strong winds are a dominant feature of the reserve.

The considerable silt load carried by the rivers here leads to rapid accretion of the coastal tidal flats, an essential habitat requirement, it seems, for the endangered Saunders's Gull *Larus saundersi*. While estimates vary considerably (Melville (1991), for example, gives annual seaward advances of up to 250 m/yr and the increase of tidal flats at 2,668 ha/yr, but this rate may now have diminished), it seems that the average rate is measured at least in tens of metres seaward per year at the river mouths. These tidal flats become colonised at the upper part by *Suaeda* and inland, in progressively drier areas, different species of *Suaeda*, *Nitratia scabri* and *Phragmites australis* rapidly take over. In the past, the reserve would have consisted of extremely large areas of tidal mudflats, saltmarshes dissected by creeks and drier areas all supporting natural plant communities. The natural profile of mudflat and saltmarsh has, however, been completely disrupted by the construction of seawalls during the late 1980s; by the drainage of coastal land and by the development of virtually all of the designated SNNR as part of an oil field (the Liaohe Oil Field, China's third largest), two commercial reed farms for paper production, Zhao Quan River Reed Farm on the east reserve and Dong Duo Reed Farm on the west reserve (together said to be the second largest in the world), as rice fields, and shrimp ponds. Despite the apparently large size of the SNNR on paper only a very small proportion of it, as a consequence of this development, actually contains any natural, undisturbed or unreclaimed habitat and that is the narrow region of mudflat outside the seawall on the east side of the Shuangtaizi River and outside banks on the west side. As a consequence of the types of agriculture and agricultural regimes being practised, and of the further development of land within the seawall, the inflow of human populace, and as a result of egg-collecting and hunting, the populations of particularly the rarer birds occurring on the reserve, such as

the Red-crowned Crane *Grus japonensis*, Saunders's Gull and Reed Parrotbill *Paradoxornis heudei* are under threat. Saunders's Gull is a particular case in point, as this site holds approximately half of the known world population and is one of only three known breeding sites for the species.

#### History

The SNNR was established in 1985, as the Panjin City Shuangtai Hekou Waterfowl Nature Reserve, in the same year that the nearby Panjin City was founded. In January 1987 the reserve was upgraded by the Liaoning Municipal Government to a Provincial level nature reserve, the Liaoning Shuangtaizihou Nature Reserve and then in June 1988, after recognition of its national importance, the State Council approved the declaration of it as a national nature reserve, as a wetland reserve for wildlife conservation, especially for the protection of the Red-crowned Crane (Anon. 1989b). The reserve holds a small breeding population of this species, the southernmost in China. The reserve was and is, however, also the subject of various improvement and development plans which are rapidly altering the habitats on various parts of the reserve and threatening internationally significant bird populations.

#### Previous ornithological work on the SNNR

It appears that the ornithological importance of the once vast wetlands at the head of the Bohai Bay and their significance for both breeding and migratory birds had been quite overlooked by the early British, Russian and Japanese pioneers of 'Manchurian' ornithology during the nineteenth century and the early part of the twentieth century.

The first survey of the area was in fact not made until surprisingly late, in 1982, when the Forestry Bureau of Liaoning Province ordered a census of the fauna, but by that time the area must have already been heavily developed and reclaimed. By 1986, when the survey was reported, 135 bird species had been recorded and a breeding population of cranes found (Anon. 1989b). A subsequent survey of the Panjin wetland for the State Forestry Department was carried out by the Liaoning Ornithological Research Centre from July 1987 to May 1989 during which a total of 160 species was recorded (Jin *et al.* 1989). In 1990, David Melville, during a brief study of the reserve's Saunders's Gull population, from 27-30 May and again from 8-12 June, recorded 68 species, of which six (Eastern Marsh-Harrier *Circus (aeruginosus) spilonotus*, Mongolian Plover *Charadrius mongolus*, Terek Sandpiper *Xenus cinereus*, Rufous-necked Stint *Calidris ruficollis*, Brown Hawk-Owl *Ninox scutulata* and Bull-headed Shrike *Lanius bucephalus*) were apparently new records for the reserve, or at least had not previously been published (Melville 1991). Melville's list, which was of more than a third of the previous total in less than ten days' field work, indicated that the previous surveys had probably greatly under-recorded the number of species occurring on the reserve, and particularly those passing through on migration.

### The present study

During the spring and summer of 1991 I worked as consultant to the World Wide Fund for Nature (Project #4527) on the Shuangtaizhekou National Nature Reserve on the coast of Liaoning Province, P.R. China. While the primary aims of the project were to make the first in-depth study of the breeding biology of Saunders's Gull throughout an entire breeding season, and to draw up a management prescription for the conservation of the reserve and the gull, daily fieldwork on the reserve also enabled me to collect information on the occurrence of a wide range of other species during what is probably the most exciting period of all, the spring migration. Many of those species were new for the reserve and two of them at least, Reed Parrotbill and Zitting Cisticola *Cisticola juncidis*, appear to have been new records for the province. The work on Saunders's Gulls, and also that on Reed Parrotbills, will be described elsewhere in detail, and sound recordings made deposited at the British Library of Wildlife Sound (BLOWS), London. In this paper, therefore, I will concentrate on the bird species recorded so far from the reserve, and particularly those added to the reserve list during my stay in 1991.

During the course of the project I stayed on the east reserve from Mondays to Fridays in a field house situated at km 11 on the seawall. I visited the west reserve on Saturdays and spent Sundays in Xinglongtai District, Panjin City. Access to and from the reserve and around the west reserve was by jeep, and around the east reserve by bicycle. Visits to areas of the east reserve were made as research needs dictated, but birds observed while doing field work were noted and, whenever time permitted, detours were made past the few isolated clumps of trees, primarily those at Lao Tuo Dze, consisting of a small ring of trees around a tiny spring-fed pool, and some adjacent bushes, as well as to several very small isolated plantations aligned north to south, just to the east of the farm (see Figure 2). On journeys from the east reserve back to Panjin City detours were occasionally made through parts of the reserve not visited by bicycle, particularly the route passing the crane 'breeding centre'. Visits were not often possible on consecutive dates to the same areas or habitats and consequently numbers refer purely to those seen and may not reflect the numbers actually present on the reserve. This will apply in particular to shorebird numbers. On the west reserve circuits were made by road to search out Saunders's Gulls, cranes and parrotbills. As there were no tree clumps suitable for migrants, passerine records are much fewer there. This may help to explain why so many species, fairly common on the east reserve, had not been recorded by Jin *et al.* (1989), who concentrated their research efforts on the west reserve.

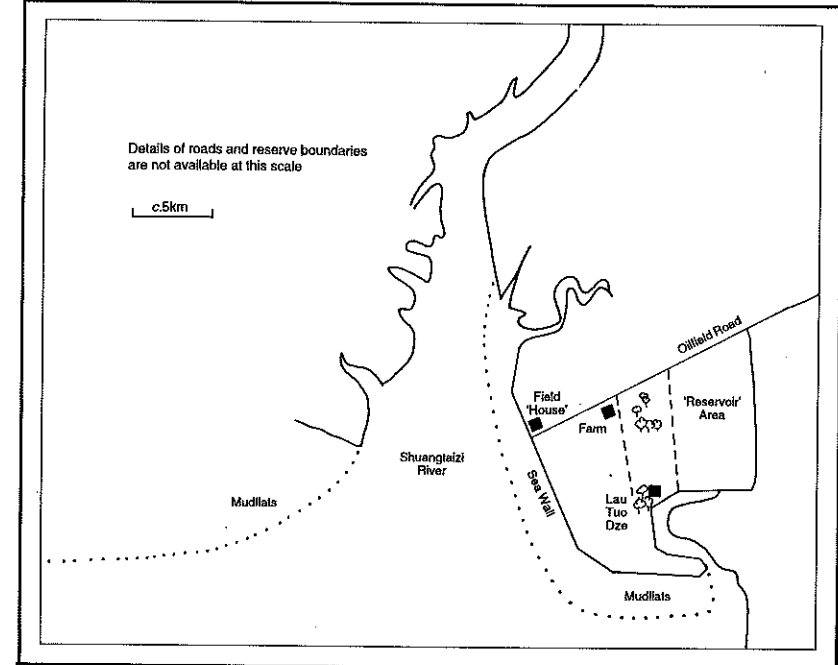
Diary of the project: I flew from Hong Kong to Shenyang on 18 April and on 19 April travelled from Shenyang to Panjin. The following dates were spent on the east reserve: 20, 22, 25-26 April, 29 April - 3 May, 6-10, 14-17, 20-24, 27-31 May, 3-6, 10-14, 17-21, 24-28 June, 1-5, 8-12, 15-19, 22-26 July, and finally on 30 July. The west reserve was visited on 21 and 27 April, 4, 11 and 18 May, 1, 8, 15 and 22 June, 6 and 28 July. The 24 and

28 April, 5, 12, 19, and 25-26 May, 2, 7, 9, 16, 23 and 29 June, 7, 13-14, 20-21, 27 and 29 July were spent in Panjin City. The 13 May, 30 June and 31 July were spent travelling between Panjin and Shenyang.

It was expected that during a long, intensive field project, from mid April until the end of July 1991, a number of new species would be recorded for the reserve. In fact, I observed 190 species during this period, more than a third of which (67) are newly published records for the reserve. The accounts of those species form an important part of this paper. During summer 1991 the reserve authorities printed a reserve leaflet (Anon. 1991) including a bird list of 172 species, adding for the first time David Melville's additional species from summer 1990 (omitting however, presumably as an oversight, D.M.'s Rufous-necked Stint and Bull-headed Shrike) and also Northern Goshawk *Accipiter gentilis*, Little Buttonquail *Turnix sylvatica*, Demoiselle Crane *Anthropoides virgo*, Greater Sand Plover *Charadrius leschenaultii*, Sanderling *Calidris alba*, Lanceolated Warbler *Locustella lanceolata*, Japanese Reed-Bunting *Emberiza yessoensis*, and Meadow Bunting *E. cioides*. This brought the reserve list to 174 species. My own additional 67 species brings the reserve total to 241 now (see Appendix 1).

My own observations support and extend the statement made by Jin *et al.* (1989) that one of the main characteristics of the avifauna of the Panjin

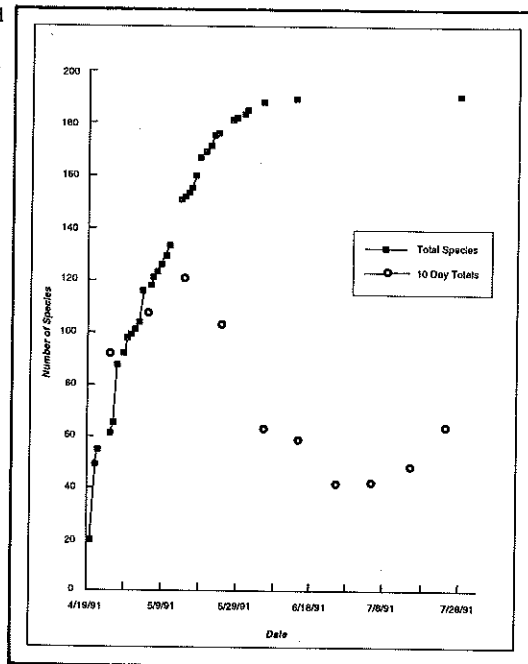
Figure 2. Sketch Map of Shuangtaizhekou National Nature Reserve (SNNR)



wetland is that the majority of the birds recorded there are migratory. In fact, only a very small proportion recorded by Jin *et al.* (1989) are resident, some of which may no longer be so as their whereabouts were not known by reserve staff. The migratory seasons are from March to May in spring (Jin *et al.* 1989) with large numbers of waterfowl, storks and cranes passing through in March and early April. All of the latter and the bulk of the waterfowl had already passed on northwards by the time I arrived on the reserve on 20 April 1991. During late April and May considerable numbers of migrant shorebirds and passerines were in evidence. Warblers, flycatchers and buntings were especially noticeable, occurring conspicuously and often in large numbers. Surprisingly though, the majority of these had previously been unrecorded from the reserve. Peak migration during this study was deemed to occur during the middle ten day period of May when 121 species were recorded (see Figure 3), although numbers were in fact high (more than 100 species) throughout May. Species diversity declined rapidly after the end of May, but appeared to be on the increase again during July as shorebirds and even the first few passerine migrants re-appeared. According to Jin *et al.* (1989), the autumn migration period is during September and October. Given the increase in species observed during July, however, I imagine that August too is a very important month particularly for shorebirds.

Jin *et al.* (1989) list just seven winter visitors: Chinese Grey Shrike *Lanius*

**Figure 3.** Cumulative total bird species observed at Shuangtaizihou NNR, Panjin, Liaoning Province, P.R. China: 20 April – 31 July 1991.



*sphenocercus*, Eurasian Skylark *Alauda arvensis*, Short-eared Owl *Asio flammeus*, Long-tailed Rosefinch *Uragus sibiricus*, Hawfinch *Coccothraustes coccothraustes*, Common Reed-Bunting *Emberiza schoenicus* and Lapland Longspur *Calcarius lapponicus*, and as residents they record: Hen Harrier *Circus cyaneus*, Little Owl *Athene noctua*, Crested Lark *Galerida cristata*, Black-billed Magpie *Pica pica*, Carrion Crow *Corvus corone* and Eurasian Tree Sparrow *Passer montanus*. I was surprised that I did not see either Little Owl or Crested Lark and that the field team were uncertain of where on the reserve they occurred or their identification; and I only once saw a Carrion Crow. Similarly, of the summer visitors mentioned by Jin *et al.* (1989) I was surprised not to encounter Slavonian Grebe *Podiceps auritus*, Watercock *Gallinula cinerea*, Long-eared Owl *Asio otus*, Blyth's Pipit *Anthus godlewskii* (though see comments in main text) or Azure-winged Magpie *Cyanopica cyana*.

The location of the SNNR, situated at the head of a major gulf, on the major east Asian coastal flyway, makes it of great importance for migratory birds on their way to and from north-east China and Siberia; and in theory at least the reserve provides an important, protected, stop-over site for many migrants, and moulting, breeding or wintering grounds for others. I cannot agree, however, with Jin *et al.* (1989) that one of the attractive features of the area is its low human population. The reserve already has a population of more than 140,000 people and includes a number of towns and villages, while seasonal labour is extensive – semi-permanent fishing dwellings were increasing in number even during the period when I was resident, and during winter extremely large numbers (thousands) of people are employed for the hand-harvesting of the reed crop. Even the only area of natural habitat remaining, outside the seawall, is regularly disturbed by fishermen setting nets across the mudflats, and by very large numbers (several hundred men at a time) harvesting small bivalves to be ground up for shrimp food. I also disagree with Jin *et al.* (1989) when they suggest that the large numbers of waterbirds on the reserve list are indicative of the pristine nature and stability of the wetland ecosystem. It is fortunate that the reed farming which dominates the reserve provides some suitable habitat for wetland birds, but it is far from ideal or pristine. A considerable amount of oil pollution occurs, and the virtually complete harvesting of the reed crop down to ground/water surface levels during the winter, leaves little or no habitat suitable for cranes to nest in the following spring, or for over-wintering Reed Parrotbills. The fresh-water wetland ecosystem is, in fact, highly degraded and artificial, while the salt-water ecosystem is so highly disturbed as to seriously and imminently threaten the survival of the breeding population of the already rare Saunders's Gull.

#### Significance of the SNNR

The reserve owes its designation as a national nature reserve to the presence of a small population of Red-crowned Cranes. The various authorities involved disagreed, however, as to the numbers present or breeding, and

numbers given to WWF and to the Wild Bird Society of Japan also differed. The 50 or so I was told about could have been almost completely comprised of migratory individuals pausing on their way northwards in late March or early April. Certainly, during my stay, I was unable to ever find more than a fifth of this total and the number of observations of pairs together during the breeding season suggests that even of those remaining to summer, few are breeding. The presence of a considerable proportion of the world's Saunders's Gull (first discovered there in 1989) mainly on the east reserve, and the presence of a newly discovered population of the Reed Parrotbill, mainly on the west reserve, add further, and greatly, to the biological significance of the reserve. In addition, it is clearly an extremely important and vital stopover for a wide range of migratory species, especially shorebirds. The SNNR then is of extreme importance. It holds important breeding populations of three rare, even endangered, bird species and attracts numerous migrants. As a consequence, it deserves far greater attention and protection, and to this end a joint project was undertaken between WWF and the Ministry of Forestry, Beijing to draw up a management prescription for the reserve which, it is hoped, will help to encourage and facilitate the future conservation of this important area.

#### *Background to the annotated list*

As no information was available to me on the species recorded from the reserve prior to my arrival in Hong Kong in early April 1991 I established a predicted list by examining the distribution maps in Wild Bird Society of Japan (WBSJ) (1982) and Japan Association for the Preservation of Birds (JAPB) (1988) (the maps cover eastern Asia), which show those species that should be resident, or regular summer and winter visitors to the region, and from which it is also possible to predict roughly which species should migrate through the region. These two references, however, do have many inaccuracies in their distribution maps and so this list could only be hypothetical. In addition I have drawn on my own knowledge of certain species expanding their ranges northwards and or eastwards in eastern Asia (Brazil 1991). This exercise provided an overall list of species quite a large proportion of which, inevitably, it transpired, had already been recorded by Jin *et al.* (1989), a copy of which I did not see until I reached Hong Kong. Many more species, however, additional to Jin *et al.* (1989) were predicted to occur, and found during my stay, and such species are given the superscript P in the annotated list, while the remaining predicted species which I did not find but which are very likely to occur, perhaps at other seasons, are included for completeness in Appendix 2).

The 160 species recorded by Jin *et al.* (1989) are given superscript J (and the number given in Jin *et al.* (1989)). Additional species included in the Shuangtaizhekou NNR bird list, (a single sheet leaflet) which included 172 species by July 1991 (Anon. 1991), are given superscript R (and the number given in Anon. (1991)). The 67 species observed during the period which are newly published records for the reserve are marked \*. As the reserve is

located on a major migration route, and as both the Bo Hai Bay and the Shuangtaizhekou itself act as a funnel, the likelihood of more species being recorded there is extremely high. A number of species previously on the reserve list were not recorded, mainly because they occur at different seasons, but the number of additional species, recorded essentially incidentally while conducting research on Saunders's Gull, suggests that the reserve has been greatly underwatched.

#### *A selected annotated species list for the SNNR including recent additions, species of international importance and birds known to or presumed to breed*

Species in upper case were observed during the present study, although those in square brackets refer to birds not in the wild. Species in lower case are those recorded during previous studies but not this one and are included so as to provide a complete checklist for the reserve. Species order follows Brazil (1991), with names following recent OBC standards.

**LITTLE GREBE** *Tachybaptus* (= *Podiceps*) *ruficollis*<sup>J001</sup> Presumably a fairly common summer visitor and breeder at pools amongst reed fields, primarily on the west reserve but also at the northern part of the east reserve. One was heard 'singing' on the west reserve on 21 April, and by 27 April, 50 had arrived there and birds were seen regularly throughout the period.

**BLACK-NECKED GREBE** *Podiceps nigricollis* (*caspicus*)<sup>J002</sup> A summer visitor to areas of reeds and marsh according to Jin *et al.* (1989), and presumably on this basis a breeder, but not seen during this study.

**GREAT CRESTED GREBE** *Podiceps cristatus*<sup>J003</sup> A summer visitor, occurring in small numbers at pools and flooded areas on the west reserve where it is presumed to breed. Four were seen on 27 April, two pairs on 4 May, 15+ on 11 and 18 May, two on 8 June and one on 28 July.

**GREAT BITTERN** *Botaurus stellaris*<sup>J010</sup> A fairly common summer visitor to the extensive fields of the reed farm. The first birds, two, were seen on the west reserve on 27 April, and up to five were subsequently recorded throughout the summer with one still calling on the east reserve on 25 July.

**YELLOW BITTERN** *Ixobrychus sinensis*<sup>J008</sup> A late arriving, common summer visitor to the reed farm areas where it is assumed to breed. None was seen during May, but then suddenly on 1 June, 40+ were seen at widespread localities on the west reserve with many males in display flights following females. Thereafter 10-30 were seen on each visit, and smaller numbers on the east reserve.

**SCHRENCK'S BITTERN** *Ixobrychus eurhythmus*<sup>J009</sup> As with the previous species this is a late arriving summer visitor which is assumed to breed, but very different in that many migrants were seen in dry areas. The first bird was flushed from the edge of the farm trees on 20 May. There was a major fall on 28 May when 65+ were found along the line of the farm trees, but otherwise

a few pairs were seen throughout the summer on both the east and west reserve.

\*LITTLE HERON *Butorides striatus*<sup>P</sup> A new species for the reserve list seen first on 6 May, when one flew in to the northwest corner of the 'reservoir' area. On 28 May one was at LTD and another at the southern farm trees, and on 5 June one was beside the seawall and one over the farm trees.

CHINESE EGRET *Egretta eulophotes*<sup>J007</sup> A rare migrant to areas of reeds and marsh according to Jin *et al.* (1989), but not seen during this study.

\*LITTLE EGRET *Egretta garzetta* An out of range addition to the reserve list, found on the west reserve on 1 June.

\*INTERMEDIATE (PLUMED) EGRET *Egretta intermedia* An out of range addition to the reserve list. One was on the west reserve on 15 June.

PURPLE HERON *Ardea purpurea*<sup>J005</sup> A common summer visitor, primarily to the reed fields of the reed farms. It was first seen on 20 April when one was on the east reserve, and subsequently found in increasing numbers sometimes in excess of 50 during April and May with slightly smaller numbers remaining throughout June and July, particularly on the west reserve.

ORIENTAL (WHITE) STORK *Ciconia (ciconia) boyciana*<sup>J011</sup> A rare migrant according to Jin *et al.* (1989), not seen during this study.

COMMON SHELDUCK *Tadorna tadorna*<sup>J020</sup> Presumed to be a late winter and early spring migrant. It was first seen on 21 April when c30 were on the west reserve. Flocks of up to 120+ were seen regularly on the east reserve during May, and on the west reserve a pair was present during May and June. The presence of some birds throughout the summer suggests that breeding might possibly occur.

MANDARIN DUCK *Aix galericulata*<sup>J033</sup> A rare migrant according to Jin *et al.* (1989), not seen during this study.

SPOT-BILLED DUCK *Anas poecilorhyncha*<sup>J025</sup> A not uncommon late winter/spring migrant especially on the west reserve during April and May, with a few pairs remaining to breed mainly on the east reserve, and with small flocks being seen from early July onwards.

BAER'S POCHARD *Aythya baeri*<sup>J031</sup> An uncommon summer visitor (?) seen only on the western part of the reserve at or over pools amongst areas of reed. The first observation, on 4 May, was of a flock of 29 birds. A flock, this time of 15 birds, was seen at the very same place on the 11 May. Thereafter only much smaller numbers were observed (presumably because birds had either moved off completely or dispersed to breeding sites): a pair on the 18 May and 1 June, and two males and one female on the 8 June. None at all was recorded after that date and chicks were not seen. It is possible that birds left the reserve entirely in early June or that they become much more secretive during the breeding season.

\*ORIENTAL HONEY-BUZZARD *Pernis (apivorus) ptilorhyncus*<sup>P</sup> A new species for the reserve, first seen on 8 May when one flew north over the Saunders's Gull colony west of the 'reservoir' road. On 11 May three were over the west reserve, then on 16 May at least 25 were moving north over the seawall at km 11 on the east reserve, with several only just above sea level. The last record was on 8 June, when one was over the west reserve being mobbed by Lapwings.

PIED HARRIER *Circus melanoleucos*<sup>J039</sup> A fairly common migrant and summer visitor to both the east and west reserves, first seen on 26 April on the east reserve and subsequently seen throughout the season with displays seen on several dates during May. They were frequently mobbed by Saunders's Gull and presumably they may predate gull nests.

EASTERN MARSH-HARRIER *Circus (aeruginosus) spilonotus*<sup>R41</sup> Surprisingly overlooked by Jin *et al.* (1989) and added to the reserve list by Anon. (1991), seemingly on the basis of Melville's records from summer 1990 (Melville 1991). It is probably both a migrant and a breeding summer visitor in small numbers as birds were seen throughout the period. My first record was on the west reserve on 21 April when 4 males and a female were seen. Thereafter up to ten were seen in late April and during May with smaller numbers seen during June and July on the west reserve. Also observed being mobbed by Saunders's Gull and presumably they may predate gull nests.

\*JAPANESE SPARROWHAWK *Accipiter gularis*<sup>P</sup> An addition to the reserve list, first seen on 14 May, when two males were seen chasing passerine migrants amongst the trees at LTD. Singles were then seen on 15 and 23 May and three on 24 May. This is presumably a regular migrant in small numbers through the region which had previously been overlooked.

\*NORTHERN SPARROWHAWK *Accipiter nisus*<sup>P</sup> Another new small raptor for the reserve list first seen on 25 April when a female was observed being mobbed by Saunders's Gulls on the east reserve. Subsequently, another was observed on 2 May, and on 4 May two were seen on the west reserve.

\*AMUR FALCON *Falco amurensis*<sup>P</sup> A new species for the reserve list, first seen on 27 April, when a female was on the west reserve. On 10 May a male was on wires near the north end of the 'reservoir' road, and a female was seen flying north along the reservoir road shortly afterwards. The last record was of a male on the west reserve on 18 May.

\*MERLIN *Falco columbarius*<sup>P</sup> An addition to the reserve list which probably passes through on migration. Singles were seen on the west reserve on 21 April, and on the east reserve on 22 April.

JAPANESE QUAIL *Coturnix japonica*<sup>J042</sup> Quite common, particularly in the drier areas of the east reserve and presumed to breed, though obviously far more often heard than seen. The first record was of two on 27 April seen on

the west reserve, and two were subsequently heard there on 4 May; thereafter up to six were heard during May and birds were flushed quite frequently. During June only one was encountered, flushed from damp *Suaeda* out beyond the seawall, on 5 June, and none was heard. The very last record was of one on 23 July, which was calling north of the oil field road in the early morning and again in the afternoon, the first heard for nearly two months.

**COMMON PHEASANT** *Phasianus colchicus* <sup>J043</sup> Presumably resident on the reserve, though not recorded as such by Jin et al. (1989). Males were heard on 28 May, and 19 June, and one seen on 31 May, all on the east reserve.

**COMMON MOORHEN** *Gallinula chloropus* <sup>J049</sup> Given the amount of wet reedbed habitat available, especially on the west reserve, a surprisingly uncommon summer visitor, though presumably it breeds. First seen on the west reserve on 11 May, no more than 25, and usually many fewer, were seen on any one day thereafter.

**WATERCOCK** *Gallinula cinerea* <sup>J048</sup> A summer visitor, and presumably therefore a breeder, to areas of reeds and marshes according to Jin et al. (1989); however, I was unable to locate any during this study.

**COMMON COOT** *Fulica atra* <sup>J050</sup> Apart from two seen on the east reserve on 10 May, this species was only encountered on the west reserve where it frequented wet reed fields. It was first recorded on 21 April when 25+ were seen. The largest total was of 250+ on 27 April, and subsequently recorded regularly in smaller numbers throughout May and June. On 6 July a pair was seen with well-grown chicks, and on 28 July a single immature was seen.

**RED-CROWNED CRANE** *Grus japonensis* <sup>J045</sup> Varying information was given on the population of this species on the reserve, though apparently none of it based on research. The estimates of 50 or more probably relate to migrants passing through. Though the southernmost breeding site known, few pairs seem to be breeding, probably as a result of the lack of suitable nesting habitat for them in early spring. My first record was of three near the crane centre on the east reserve on 20 April; however, as they flew in to a whistle they were probably free-living ex-captives. Subsequent records on the east reserve were: two pairs and a single north-east of the sluice at km 6 on 2 May, a pair on 9 May, one on 10 May, two flew across the oil field road heading north on 19 May. None was then seen until 12 July when two flew in from the southwest landing near the farm before continuing northwards. On 16 July a pair was foraging out on the, now flooded, main Saunders's Gull colony area, and on 25 July four were in the same area.

On the west reserve, three singles were observed on 21 April, and on 27 April seven were seen (five singles and a pair; the largest total I was able to observe), on 4 May there were five (two pairs and a singleton), on 11 May two singles, and on 18 May one pair was on the west reserve.

Based on experience from crane breeding grounds in Hokkaido, Japan, the regular observation of pairs of individuals together during the breeding

season suggests that breeding was not successful. No chicks were observed at all during the period.

[**SIBERIAN CRANE** *Grus leucogeranus* <sup>J046</sup> A weak immature was captured by farmers and delivered to the crane centre on the east reserve on 25 April, where I first saw it on 26 April. I was told that it would be looked after until fit, but it was still in captivity at the end of July and seems destined to remain so now.]

**COMMON OYSTERCATCHER** *Haematopus ostralegus* <sup>J051</sup> A summer visitor and breeder to the reserve, first seen on the east reserve on 20 April, and on the west reserve on 21 April. Small numbers, ranging from 2-10+, were found throughout the period on both sections of the reserve and several nests with eggs were found. On 10 and 11 July 50+ were seen on the east reserve, with the largest total of all, 100+, seen there on 24 July.

**BLACK-WINGED STILT** *Himantopus himantopus* <sup>J077</sup> A common migrant and a small number remaining to summer, and breed (one nest seen on the west reserve). It was first seen on the east reserve on 20 April, when 10-15 were at roadside pools. More than 200+ were present on the west reserve on 21 April with flocks in excess of 100 seen into early May, thereafter numbers dwindled to no more than 20 during June and July.

**PIED AVOCET** *Recurvirostra avosetta* <sup>J078</sup> An uncommon migrant and perhaps a breeder in small numbers (on the west reserve where it seemed to be present throughout the summer).

**ORIENTAL PRATINCOLE** *Glareola maldivarum* <sup>J079</sup> Up to six birds were seen a number of times on both the east and west reserve between 29 April and 22 July, but only at drier areas or foraging over flooded areas. Although possibly breeding neither nests nor chicks were seen.

**KENTISH PLOVER** *Charadrius alexandrinus* <sup>J057</sup> A very common and widespread migrant and summer visitor first seen on 20 April. Birds were seen on just about every day in the field with numbers seen usually estimated to be around 10-50, although the total population was no doubt considerably larger. The largest total, of 300-400, was on the east reserve on 25 April. On the west reserve it was generally less common resulting from less available suitable habitat. The first nest was found, complete with three eggs, on 10 May. Thereafter several nests and chicks were seen.

**GREY-HEADED LAPWING** *Vanellus cinereus* <sup>J053</sup> An infrequently seen summer visitor, but which may have been a very locally distributed breeder. It was first encountered on 20 April when one was over crane centre on the east reserve. On 4 May two individuals were seen on the west reserve, one of which was mobbing a Northern Lapwing; on 10 May one was near the crane centre again where it was seen mobbing a farm worker and may have been nesting nearby. On 11 May one was on the west reserve.

**NORTHERN LAPWING** *Vanellus vanellus* <sup>J052</sup> An uncommon migrant and



summer visitor presumably breeding in small numbers. The first bird was seen on the east reserve on 20 April, subsequently no more than 25+, usually fewer, were seen throughout the season mainly on the west reserve.

\*GREAT KNOT *Calidris tenuirostris* <sup>P</sup> A new record for the reserve, with a distant flock of 60 over the mudflats on the east reserve followed by six very close on 3 May. Birds were found on a number of occasions during May, June and July, the largest totals being: on 6 July a flock of 98 were at roost at the edge of the flooded Saunders's Gull colony on the west reserve; on 16 July 200 were roosting out near a flooded area of the 'reservoir'; and on 24 July 1,140 were counted flying to roost.

\*RED KNOT *Calidris canutus* <sup>P</sup> A new species for the reserve. Most records were from the east reserve where it was first seen on 17 May, when four separate individuals all in summer plumage were found along the tide edge at km 9.5. On 22 May 225 were out on the mudflats, on 29 May 6-10 were amongst a Grey Plover *Pluvialis squatarola* flock roosting at the 'reservoir'; on 15 June 25+ were on the west reserve, and on 24 July three were seen amongst Great Knot on the east reserve.

\*LONG-TOED STINT *Calidris subminuta* <sup>P</sup> A new species for the reserve, only recorded on 23 July, when 5 were seen amongst a flock of Sharp-tailed Sandpipers *C. acuminata* on the east reserve.

\*BROAD-BILLED SANDPIPER *Limicola falcinellus* <sup>P</sup> A new species for the reserve list first seen when small groups totalling 50 were seen throughout the day on 22 May. Small numbers were then seen on several dates in late May and on 11 July, all on the east reserve.

\*PINTAIL SNIPE *Gallinago stenura* <sup>P</sup> Added to the reserve list on 10 May when two were near the crane centre with Common Snipe *G. gallinago*, and three birds, probably of this species, were seen on 14 May.

\*ASIAN DOWITCHER *Limnodromus semipalmatus* <sup>P</sup> An addition to the reserve list, first seen when one was amongst a flock of Grey Plovers roosting at the southwest corner of the 'reservoir' on the east reserve on 29 May. On 24 July three flew over the seawall at km 14, also on the east reserve.

\*EURASIAN WOODCOCK *Scolopax rusticola* <sup>P</sup> A new species, flushed on the east reserve on 22 April.

COMMON REDSHANK *Tringa totanus* <sup>J065</sup> A common migrant and breeding summer visitor widespread on both eastern and western reserves. First seen on 20 April. Subsequently numbers ranging up to 75+ were seen almost daily until late June when numbers began to increase. For example 500+ were at a high tide roost on 11 July, and 200+ on 24 July on the east reserve. Aerial display flights were seen for the first time on 26 April, and the first nest was found on 8 May complete with four eggs, west of the reservoir road.

\*GREY-TAILED TATTLER *Heteroscelus brevipes* <sup>P</sup> An addition to the

reserve list seen only on 31 May, when 8 birds flew north calling over the mudflat off km 9.

SAUNDERS'S GULL *Larus saundersi* <sup>J083</sup> Already one of the rarest of the world's gulls, only three breeding sites have been reported two of which (Yancheng in Jiangsu and Panjin in Liaoning) hold approximately 1,000 birds each, whilst at the third (in Nei Mongol) only six nests have been reported (Shi *et al.* 1988). It is a specialist, occurring only along coastal saltmarshes and estuaries and perhaps at similar sites at major inland waters, where it feeds primarily on crabs, but also on small fish and worms obtained from mudflats. It nests above the high tide line along the saltmarsh edge, but below the level of permanent dry land vegetation (Brazil and Melville 1991). At least 100 birds were already present on the east reserve when I arrived on 20 April, and about 30 were on the west reserve on 21 April. Numbers recorded daily varied enormously depending on the state of the tide and the sector of the reserve I was working in. Generally, however, numbers seen at any one area ranged from 50-260 on the east reserve with up to 100 on the west reserve. Two small colonies and one large extensive colony were located in early May and on 6 May the first nest was found and several birds observed incubating for the first time.

On 1 June, 90+ were discovered over a new small colony on the west reserve where 14 birds were seen incubating; this colony was however later destroyed when the area was flooded for fish ponds.

On 19 June, 510-520 were counted over the main colony representing the largest single count inland. On 3 July the first flying immatures of the year were seen and subsequently more and more were found as they moved towards the mudflats.

A series of counts made from the seawall on 11 and 24 July by the field team, combined with the numbers known to be on the west reserve and an average of the numbers usually over the main colony suggested that this year the reserve held 1,000-1,200 adults and a minimum of 370 young were reared to the flying stage by 24 July. This total represents approximately half of the known world population.

The results of the detailed field research into the behaviour, ecology and breeding biology of Saunders's Gull done during spring and summer 1991 will be described in full detail elsewhere.

\*MEW GULL *Larus canus* <sup>P</sup> New for the reserve list but only seen on 27 April, when two adults and an immature were seen on the west reserve.

\*GLAUCOUS GULL *Larus hyperboreus* An unexpected new record for the reserve when an adult was seen out on the mudflat off Km 7, on 2 May.

GULL-BILLED TERN *Gelochelidon nilotica* <sup>J086</sup> A quite common migrant and summer visitor with some breeding amongst Saunders's Gulls on the east reserve and a colony found on the west reserve, although this was destroyed by flooding for fish ponds.

It was first observed on the west reserve on 21 April. During May mostly small numbers were observed except over the west reserve colony which had



attracted 100+ birds by 22 June and these had built 40 nests. By 6 July, when 100 were seen again, their colony had been partially flooded, and many of the nests washed away; the colony had been abandoned by 28 July. Several nests were found on the east reserve during June and one flightless chick was found at the edge of the Saunders's Gull colony on 8 July.

**COMMON TERN** *Sterna hirundo*<sup>J088</sup> A fairly common migrant and summer visitor with small numbers breeding, particularly amongst a Gull-billed Tern colony on the west reserve. It was first recorded on 27 April, and subsequently seen throughout the season. Birds regularly joined mobbing Saunders's Gulls over colonies. On 22 June 30 birds with 12 nests were found amongst the Gull-billed Tern colony on the west reserve; one individual clearly had an orange rather than a black bill, suggesting that it was of a different subspecies from the others. By 28 July, when the nesting colony had been flooded out, only three were seen on the west reserve. Although no nests were found on the east reserve, breeding was assumed to have occurred there also, because on 15 July an immature bird was seen there flying out over the seawall.

**LITTLE TERN** *Sterna albifrons*<sup>J089</sup> A fairly common migrant and summer visitor with at least one nesting colony (50+ birds) on the west reserve, although this was completely destroyed by floods. First seen on 25 April, then from 10-50 seen throughout the season,

**WHISKERED TERN** *Chlidonias hybridus*<sup>J084</sup> A very common migrant and summer visitor, presumed to breed on the reserve. Nest material was seen being collected, but no nests were found. It was seen first on 21 April and subsequently seen throughout the season with the largest total of 650, of which 600 were in a single loose flock, foraging over an area of flooded reed fields, on the west reserve on 11 May. Several hundred were also present throughout June, though numbers were rather smaller during July.

**\*ROCK PIGEON/FERAL PIGEON** *Columba livia* Surprisingly uncommon and only recorded on 10 July when two appeared at the house at dusk. Apparently not recorded previously on the reserve.

**\*HODGSON'S HAWK-CUCKOO** *Cuculus fugax*<sup>P</sup> A new species for the reserve, seen only on 24 May, when one was flushed twice from the north farm trees.

**\*INDIAN CUCKOO** *Cuculus micropterus*<sup>P</sup> An addition to the reserve list, first seen on 23 May, when one was found amongst the north farm trees. Presumably the same individual was still present on 24 May, and one was at the southern farm trees on 28 May.

**COMMON CUCKOO** *Cuculus canorus*<sup>J091</sup> A common migrant and summer visitor, clearly taking advantage of the sizeable population of Oriental Reed Warblers *Acrocephalus orientalis* breeding on the reserve. The first record was on 14 May, then by 1 June hundreds were seen everywhere on roadside wires, posts and bushes. Obviously a sudden major arrival had occurred, but

numbers dwindled quickly and the largest totals during the remainder of the summer were 50+ on 8 June and on 6 July. It seems likely that the extremely high densities estimated by Melville (1991), 22/ha, were a consequence of surveying during the peak of the spring passage and not entirely indicative of the size of the breeding population.

**\*ORIENTAL CUCKOO** *Cuculus saturatus*<sup>P</sup> New for the reserve. A bird possibly of this species was seen on 14 May, at the southern farm trees, then on 5 June one was seen and heard singing at LTD.

**\*LESSER CUCKOO** *Cuculus poliocephalus*<sup>P</sup> New for the reserve, first seen on 21 May, when a probable female was at the farm trees, and a male was at the trees north of the oil field road. On 5 June a brown phase female was at the north farm trees.

**\*ORIENTAL SCOPS OWL** *Otus (scops) sumia*<sup>P</sup> New for the reserve, with records on 20 May, when one was found amongst the northern farm trees, and on 23 May when one was found dead at LTD.

**\*WHITE-THROATED NEEDLETAIL** *Hirundapus caudacutus*<sup>P</sup> New for the reserve on 16 May, when one flew in low over a small Saunders's Gull colony on the east reserve. On 18 May, two were seen moving east along the Shuangtaizi river from the west reserve, and on 22 May one flew in east over the seawall on the east reserve.

**\*FORK-TAILED SWIFT** *Apus pacificus*<sup>P</sup> New for the reserve on 1 May. It seems, however, to have been overlooked in the past as it proved to be a fairly common migrant with the main movement occurring in early and mid June. The largest single total was of 50+ on 17 June, but birds continued moving northwards all that afternoon and probably totalled several hundreds. The last records were on 11 and 22 July.

**\*DOLLARBIRD** *Eurystomus orientalis*<sup>P</sup> New for the reserve on 28 May, when two, possibly three, were seen being mobbed by Saunders's Gulls; later the same day one was at LTD and two were at the north farm trees.

**\*RUFIOUS-BELLIED WOODPECKER** *Dendrocopos (Picoides) hyperythrus* New for the reserve when a female was seen at LTD on 14 May. Subsequently a female was at the farm trees and a male at LTD on 20 May. On 24 May a male was at LTD, and on 28 May there were two males there and a female at the southern farm trees. The last record was of a female at the south farm trees on 5 June.

**ASIAN SHORT-TOED LARK** *Calandrella cheleensis*<sup>J102</sup> A fairly common summer visitor. A single bird was first seen on the west reserve on 21 April, and on the east reserve on 25 April. Thereafter from 5-20+ were seen on virtually all dates spent on the reserve, and it was presumed to breed.

**BARN SWALLOW** *Hirundo rustica*<sup>J106</sup> A common migrant and summer visitor mainly to villages and towns where they occurred in much larger numbers, but first seen on 21 April when one was on the west reserve, and

on 22 April when two were on the east reserve. Thereafter they appeared in increasing numbers and 5-50+ were seen on the reserve on most days. The largest total over the reserve was of 250+ moving north over the west reserve on 18 May. Two pairs built nests in and around the field house.

**RED-RUMPED SWALLOW** *Hirundo daurica*<sup>J107</sup> A fairly common summer visitor, which probably breeds around villages on the reserve. The first ones were seen on 3 May, thereafter small numbers were seen regularly with a maximum of 50+ on 18 May.

**\*ASIAN HOUSE-MARTIN** *Delichon dasypus*<sup>P</sup> A new species for the reserve, seen only on 22 May, when one flew north over the mudflats.

**RICHARD'S PIPIT** *Anthus novaeseelandiae*<sup>J111</sup> A widespread summer visitor in small numbers to drier habitats. Commoner on the east than on the west reserve because of the availability of habitat. First seen on 30 April. It was subsequently seen on many dates when numbers ranged mostly from 2-5, although on 9 May 10-15 flew north over the mudflats during the morning. From late June onwards I noted slightly larger numbers up to 10-15 per day perhaps reflecting the fledging of young on the reserve.

**\*RED-THROATED PIPIT** *Anthus cervinus*<sup>P</sup> A new record for the reserve, first seen on 4 May, when two were flushed on the west reserve, and subsequently one was seen nearby on 11 May.

**\*BUFF-BELLIED PIPIT** *Anthus (spinoletta) rubescens*<sup>P</sup> Although new for the reserve, it is presumably a fairly common early spring migrant. I observed it only once, on 22 April, when seven were on the east reserve.

**\*FOREST WAGTAIL** *Dendronanthus indicus*<sup>P</sup> New for the reserve on 14 May, when one was found along the western margin of the 'reservoir'.

**YELLOW WAGTAIL** *Motacilla flava*<sup>J108</sup> A fairly common migrant with small numbers remaining on the reserve to breed. The first record was on the west reserve on 21 April, and it was subsequently seen most often on the west reserve throughout the season, with food carrying seen on 8 June.

**\*ASHY MINIVET** *Pericrocotus divaricatus*<sup>P</sup> New for the reserve on 14 May when 15 flew over very high calling.

**\*RUFIOUS-TAILED ROBIN** *Luscinia (Erithacus) sibilans*<sup>P</sup> New for the reserve list, but probably a regular migrant in small numbers, first seen on 14 May when one was at LTD, and then regularly during May and early June. On 28 May there was an appreciable fall with one at LTD, 18+ at the south farm trees (one of which was singing), and 16-17 at the mid and north farm trees. The last records, four birds, were on 5 June.

**\*SIBERIAN RUBYTHROAT** *Luscinia (Erithacus) calliope*<sup>P</sup> A new record for the reserve, added on 4 May, when two males and a female were found on the west reserve. It was subsequently found, however, to be a common migrant throughout May, with up to 20 or more on some dates. The last record was on 30 May.

**\*BLUETHROAT** *Luscinia (Erithacus) svecica*<sup>P</sup> A new record for the reserve added on 4 May, when a red-spotted male was found on the west reserve. On 8 May, two or three were on the east reserve, and on 28 May one was there.

**\*DAURIAN REDSTART** *Phoenicurus auroreus*<sup>P</sup> A new species for the reserve; a female was observed at LTD on 10 May.

**\*PIED WHEATEAR** *Oenanthe pleschanka*<sup>P</sup> New for the reserve, first seen on 26 April when a female was found on the east reserve. A second female was found on 8 May.

**\*WHITE-THROATED ROCK-THRUSH** *Monticola gularis*<sup>P</sup> Although a new species for the reserve list, it proved surprisingly common. It was first seen on 14 May when three males were at the middle and northern farm trees. Up to five birds were seen on several dates during May, and the last record was of a female at the southern farm trees on 5 June.

**\*SIBERIAN THRUSH** *Zoothera sibirica*<sup>P</sup> A new bird for the reserve, first recorded on 23 May when a male was at LTD and three males were amongst the farm trees. It was subsequently seen on 28 May when a female was at LTD, a male was at the southern farm trees, and two were at the northern farm trees. The last record was of a male at LTD on 5 June.

**\*EYEBROWED THRUSH** *Turdus obscurus*<sup>P</sup> A new reserve record first found on 4 May. It proved to be a fairly frequently encountered, though uncommon, migrant during May and early June, with up to 20 birds on any one date. The last record was of one at the north farm trees on 10 June.

**\*MANCHURIAN BUSH-WARBLER** *Cettia anturians*<sup>P</sup> A new species for the reserve, first seen on 23 May, when two were at LTD and one was at the farm trees.

**\*ZITTING CISTICOLA** *Cisticola juncidis* An unexpected addition to the reserve list, and seemingly a new record for Liaoning Province (It was not recorded by Cheng (1987) for the province, or Zhao (1988) for northeast China). One was found in song flight display on 11 May, along the western edge of the west reserve.

**\*PALLAS'S WARBLER** *Locustella certhiola*<sup>P</sup> New for the reserve, though probably a regular though very uncommon late migrant, with the first record on 5 June, when four were seen. The only other record was of one near the farm on 14 June.

**\*GRAY'S WARBLER** *Locustella fasciolata*<sup>P</sup> Although new for the reserve, it has no doubt been overlooked previously because of its skulking behaviour. It was first seen on 28 May and again on 30 May. On 5 June three were seen, and finally one was present on 10 June.

**BLACK-BROWED REED-WARBLER** *Acrocephalus bistrigiceps*<sup>J136</sup> A far less common migrant and summer visitor than the Oriental Reed-Warbler. It was first seen on 14 May then up to ten were recorded regularly throughout the season.

\*PADDYFIELD WARBLER *Acrocephalus agricola* A very unexpected addition to the reserve list; one was caught in mist nets on 28 July, on the west reserve, and attributed to subspecies *A. a. tangorum* by D. S. Melville (*in litt.*).

ORIENTAL REED-WARBLER *Acrocephalus orientalis*<sup>1135</sup> A common late arriving summer visitor, and an even commoner (super-abundant) migrant. Probably not as abundant, however, as suggested by Melville (1991) since his estimates of 22/ha (and perhaps up to half a million on the reserve) were based on surveys done during what appears to be the peak of the spring migration period. None was seen until 18 May, but then more than 100 were on the west reserve, after seemingly a sudden arrival of large numbers which had begun to sing and set up territories. On 1 June hundreds, possibly thousands, were singing on the west reserve, yet by 8 June only 50+ were there, reflecting the passing of the peak of migration.

\*EASTERN CROWNED WARBLER *Phylloscopus coronatus*<sup>P</sup> New for the reserve, first seen on 14 May. A second bird was seen on 23 May.

\*PALE-LEGGED LEAF-WARBLER *Phylloscopus tenellipes* An unexpected new species for the reserve, first found on 4 May when one was on the west reserve. However, on 23 May there was something of a fall with 10-15 at LTD, although only one remained there on 24 May. On 28 May one was found at LTD and another at the southern farm trees, and on 5 June one was at LTD.

\*GREENISH WARBLER *Phylloscopus trochiloides* An unexpected new bird for the reserve list seen in roadside scrub on the east reserve on 28 May.

\*LEMON-RUMPED WARBLER *Phylloscopus proregulus*<sup>P</sup> A new record for the reserve, and one that proved surprisingly common given that it had not been seen by Jin *et al.* (1989). It was first seen on 29 April. It was found frequently during May usually in small numbers, however, on 14 May a major fall occurred and 30-40 were at LTD. The final records were on 5 June.

\*RADDE'S WARBLER *Phylloscopus schwarzi*<sup>P</sup> A new species for the reserve, first found during a major fall of *Phylloscopus* warblers on 14 May, when one was seen along the track to LTD, three or four were amongst the trees at LTD and two or three were among the farm trees. One was seen on 15 May, and three on 5 June.

\*DUSKY WARBLER *Phylloscopus fuscatus*<sup>P</sup> A new species for the reserve, found on the west side on 18 May.

\*DARK-SIDED FLYCATCHER *Muscicapa sibirica*<sup>P</sup> A new bird for the reserve, found on 20 May, when 2-3 were amongst the southern farm trees. Then one was at LTD, and 4-5 were amongst the farm trees on 23 May. On 28 May singles were near the tower and at the south farm trees. On 30 May one was near the northern farm trees, and finally on 5 June one was at LTD and three were at the south farm trees.

\*ASIAN BROWN FLYCATCHER *Muscicapa latirostris*<sup>P</sup> A new species for the reserve, and one that was not uncommon during May, but only on the east reserve. It was first seen on 7th, and then regularly, with up to seven birds, throughout May. The last record was of one on 5 June.

\*RED-THROATED FLYCATCHER *Ficedula parva*<sup>P</sup> A new reserve record, but one that it was surprising that Jin *et al.* (1989) had missed, given the frequency with which I encountered it. The first bird, a male, was found amongst low vegetation around the trees at LTD on 30 April. Then subsequently up to seven birds were found during May, the last on 22 May.

\*MUGIMAKI FLYCATCHER *Ficedula mugimaki*<sup>P</sup> A new record for the reserve first seen on 14 May, when two males were found. On 15 May they still remained, and on 20 May a female was amongst the southern farm trees. All records were from the east reserve.

\*ASIAN PARADISE-FLYCATCHER *Terpsiphone paradisi* An unexpected new bird for the reserve seen on 28 May.

\*REED PARROTBILL *Paradoxornis heudei* An unexpected discovery. Not only the first for the reserve but also for Liaoning Province, although it seems quite likely that this species had been misidentified as Long-tailed Tit by Jin *et al.* (1989), who only had access to WBSJ (1982) and hence had no illustrations of this species. It was first seen on 21 April, when three were found on the west reserve. Four were found on 27 April, and on 4 May, by which time I had obtained recordings, 25 responded to play-back. The species was recorded on the east reserve for the first, and only, time on 10 May, when three responded to tapes 0.5 to 2 km west of the crane centre. Twenty plus on 11 May, 23 on 18 May, 25 on 1 June, ten on 15 June, four were seen on the west reserve on 22 June, and on 28 July, one male and one female were caught in mist nets set for the purpose on the west reserve. Further details of population surveys and behavioural observations will be published elsewhere.

\*EURASIAN PENDULINE-TIT *Remiz pendulinus*<sup>P</sup> Although predicted to occur on the reserve, and in fact an old nest, presumably taken from the reserve, was kept in the reserve office in Panjin, there seem to have been no sight records from the reserve until 27 April, when two were on the west reserve. Subsequently, on 4 May 20 were on the west reserve, six were at LTD on 8 May and on 11 May four were on the west reserve.

\*TIGER SHRIKE *Lanius tigrinus*<sup>P</sup> New for the reserve, first seen on 20 May, when a female was found at the southern farm trees. Up to six were seen thereafter on several dates during May with a fall of 19 on 28 May. The last records were on 5 June when five were at LTD and six were at the farm trees.

BLACK-BILLED MAGPIE *Pica pica*<sup>1122</sup> It seems that it is most likely to be a resident (although it was not recorded as such by Jin *et al.* (1989)) with small numbers along the western border of the west reserve and some at the north-eastern corner of the east reserve. Up to 20 birds were seen throughout

the summer, and several nests observed on concrete power poles and metal pylons. It is known locally, apparently, as a 'bird of danger' because wet nests bridging wires sometimes cause short-outs!

**EURASIAN TREE SPARROW** *Passer montanus* <sup>J146</sup> Not particularly common on the reserve except around villages and buildings. It was first seen on 20 April, when c10 were seen on the east reserve, and subsequently numbers ranging from 2-50+ were seen regularly on both the east and west reserves. Numbers appeared to suddenly increase in late June and early July, for example on 8 July a flock of about 100 birds, many of them young, was near the northwest corner of the reservoir.

\* **COMMON ROSEFINCH** *Carpodacus erythrinus* <sup>P</sup> New for the reserve on 14 May, when two males and four females were found on the east reserve. Up to six birds were found on a number of dates during May and on 20 May several were found in cages at Dawa county street market. The last record was of a female on 30 May.

\* **JAPANESE GROSBEAK** *Eophona (Coccothraustes) personata* <sup>P</sup> New for the reserve on 14 May. One was seen again on 20 May, and several were found for sale at the Dawa county street market.

\* **BLACK-FACED BUNTING** *Emberiza spodocephala* <sup>P</sup> A very predictable new reserve record, but one that proved to be so common that it was surprising that it had been overlooked by Jin *et al.* (1989). The first record was on 29 April when 3-4 were around the LTD trees, including one which sang briefly, and thereafter up to six were seen on a number of dates during May. Three were on the west reserve on 1 June, then none was seen until 3 and 4 July when a male was at the roadside near the field house.

\* **CHESTNUT-EARED BUNTING** *Emberiza fucata* <sup>P</sup> A new reserve record, first seen on 29 April when a male was in roadside scrub north of the LTD trees on the east reserve. On 4 May, a female, and on 18 May a male were on the west reserve, while on the east reserve a male was 1 km east of the house on 10 May, one was near the tower and one was along the 'reservoir' road on 29 May, and on 5 June one was along the seawall.

\* **YELLOW-BROWED BUNTING** *Emberiza chrysophrys* <sup>P</sup> New for the reserve; a poorly marked male was on the west side on 18 May.

\* **TRISTRAM'S BUNTING** *Emberiza tristrami* <sup>P</sup> A new reserve record. The first, a male, was seen on 29 April. On 3 May, a male and female, with a male Little Bunting *E. pusilla*, flew in to *Suaeda* just outside the seawall at km 10.5. On 10 and 23 May a male was at LTD, and on 23 May one was also at the north farm trees, where there was a female on 28 May.

\* **CHESTNUT BUNTING** *Emberiza rutila* <sup>P</sup> New for the reserve, first seen on 15 May, when a male was found on the east reserve. On 18 May, two males were seen flying over the west reserve with Yellow-breasted Buntings, then a pair were seen on the ground. On 20 May 30+ were found to be on sale at the Dawa county street market indicating that large numbers were

migrating. On 23 May a male was at the north farm trees, and finally two females were at LTD on 5 June also on the east reserve.

\* **PALLAS'S REED-BUNTING** *Emberiza pallasi* <sup>P</sup> Although new for the reserve list, it proved surprisingly common. It seems likely that this species had been overlooked in confusion with Common Reed-Bunting (a winter visitor) by Jin *et al.* (1989). It was first seen on 21 April when three, possibly more, were on the west reserve, several times more during April, then on several dates during May when much larger numbers were present. The highest total was on 4 May when 200-300, possibly more, were on the west reserve. The last records were on 11 May, when one male was seen, and one was picked up dead on the west reserve.

The field work during which these observations were made was supported by the World Wide Fund for Nature (Project #4527). I would like to thank David Melville of WWF Hong Kong, for promoting this project, for making my involvement in it possible, and for his support and advice during it. The project was part of a co-operative conservation initiative between WWF and the Ministry of Forestry, Beijing, at the national level and carried out in co-operation with the forestry bureau of Liaoning Province, Shenyang, and Panjin, and the staff of the Shuangtaizhekou NNR. I would like to thank in particular Director Liu and Vice-Director Wei of the SNNR for facilitating the logistical aspects of the project and for assembling a team of co-workers to assist me in the field. I especially thank the field team, Sui Fengren, Li Yu Xiang (both of the SNNR), and Liang Yu (seconded from the Liaoning Ornithological Research Centre for the duration of the field work) for their assistance and companionship throughout the project, and Susanne Holschuh and 'Fox' Wong for joining me in June.

#### REFERENCES

- Anon. (1989a) [Survey report of vegetation of Shuangtaizhekou National Nature Reserve of Liaoning.] Shenyang: Liaoning Forestry Survey and Planning Institute. (In Chinese)
- Anon. (1989b) [Report of the investigation of vertebrates in Liaoning Shuangtai Hekou National Nature Reserve.] Shenyang: Liaoning Forestry Survey and Planning Institute. (In Chinese)
- Anon. (1991) [Liaoning Shuangtai River National Nature Reserve.] Panjin City: Shuangtaizhekou NNR. (In Chinese)
- Brazil, M. A. (1991) *The Birds of Japan*. Christopher Helm: London.
- Brazil, M. A. and Melville, D. S. (1991) *An immediate short-term management strategy for Saunders' Gull Larus saundersi*. Hong Kong: WWF.
- Cheng Tso-hsin. (1987) *Synopsis of the avifauna of China*. Beijing: Science Press.
- Japan Association for the Preservation of Birds. (1988) *A guide for bird lovers*. Tokyo: JAPB.
- Jin, L., Liang, Y., Zhang, Y., Hu, Y., Wang, J., Wei, H., and Sui, F. (1989) [A survey of birds in Panjin Wetland, Liaoning Province.] *Transactions of Liaoning Zoological Society* 7 (1): 21-38. (In Chinese)
- Melville, D. S. (1991) Notes on birds of Shuangtaizhekou National Nature Reserve, Liaoning Province, China. *Hong Kong Bird Report* 1990.
- Shi, Z. R., Thouless, C. R. & Melville, D. S. (1988) Discovery of the breeding grounds of Saunders's Gull *Larus saundersi*. *Ibis* 130: 445-446.
- Wild Bird Society of Japan. (1982) *A field guide to the birds of Japan*. Tokyo: Wild Bird Society of Japan.
- Zhao, Z. (ed) (1988) [The birds of northeast China.] Shenyang: Liaoning Science and Technology Press. (In Chinese)
- Mark A. Brazil B.A., Ph.D., *The Japan Times*, 5-4 Shibaura 4-chome, Minato-ku, Tokyo, 108 Japan, and *Worldwide Features*, 27 Colville Road, Melton Constable, Norfolk NR24 2DD, U.K.

## APPENDIX 1

## A COMPLETE LIST OF BIRDS RECORDED SO FAR FROM THE SHUANGTAIZIHEKOU NNR

Species added to the reserve list during this study are marked \* with those predicted as likely to occur also marked <sup>P</sup>. Those recorded by Jin *et al.* (1989) are marked <sup>J</sup>, those added in the recent reserve list (Anon. 1991) are marked <sup>R</sup>, and those by Melville (1991) <sup>M</sup>.

- LITTLE GREBE *Tachybaptus (Podiceps) ruficollis* <sup>J. R. M.</sup> A fairly common summer visitor and presumed breeder (MAB).
- SLAVONIAN GREBE *Podiceps auritus* <sup>J. R.</sup> A summer visitor, but not seen during this study.
- GREAT CRESTED GREBE *Podiceps cristatus* <sup>J. R. M.</sup> An uncommon summer visitor and possible breeder (MAB).
- GREAT BITTERN *Botaurus stellaris* <sup>J. R. M.</sup> A fairly common summer visitor and presumed to breed (MAB).
- YELLOW BITTERN *Ixobrychus sinensis* <sup>J. R. M.</sup> A common summer visitor and presumed to breed (MAB).
- SCHRENCK'S BITTERN *Ixobrychus eurhythmus* <sup>J. R. M.</sup> A common migrant and uncommon summer visitor (MAB).
- \* LITTLE HERON *Butorides striatus* <sup>P</sup>
- CHINESE EGRET *Egretta eulophotes* <sup>J. R.</sup> A rare migrant not seen during this study.
- \* LITTLE EGRET *Egretta garzetta*
- \* INTERMEDIATE EGRET *Egretta intermedia*
- GREAT EGRET *Egretta alba* <sup>J. R. M.</sup> An uncommon spring migrant (MAB).
- GREY HERON *Ardea cinerea* <sup>J. R. M.</sup> A summer visitor in small numbers, probably non-breeders (MAB).
- PURPLE HERON *Ardea purpurea* <sup>J. R. M.</sup> A common summer visitor and presumed breeder (MAB).
- BLACK STORK *Ciconia nigra* <sup>J. R.</sup> A rare migrant, not seen during this study.
- ORIENTAL (WHITE) STORK *Ciconia (ciconia) boyciana* <sup>J. R.</sup> A rare migrant, not seen during this study.
- BLACK-HEADED IBIS *Threskiornis melanocephalus* <sup>J. R.</sup> A rare migrant, not seen during this study.
- WHITE SPOONBILL *Platalea leucorodia* <sup>J. R.</sup> A rare migrant, not seen during this study.
- WHOOPEER SWAN *Cygnus cygnus* <sup>J. R.</sup> Possibly a common early spring migrant, but seen only once in May (MAB).
- SWAN GOOSE *Anser cygnoides* <sup>J. R.</sup> A rare migrant, not seen during this study.
- BEAN GOOSE *Anser fabalis* <sup>J. R.</sup> A rare migrant, not seen during this study.
- GREATER WHITE-FRONTED Goose *Anser albifrons* <sup>J. R.</sup> A flock of 11 was on the west reserve on 27 April (MAB).
- RUDDY SHELDUCK *Tadorna ferruginea* <sup>J. R.</sup> A flock of 11 was seen on the west reserve on 27 April.

- COMMON SHELDUCK *Tadorna tadorna* <sup>J. R. M.</sup> A fairly common late winter/early spring migrant (MAB).
- MANDARIN DUCK *Aix galericulata* <sup>J. R.</sup> A rare migrant, not seen during this study.
- EURASIAN WIGEON *Anas penelope* <sup>J. R.</sup> Probably a common early spring migrant, few in late spring (MAB).
- FALCATED TEAL *Anas falcata* <sup>J. R.</sup> A very uncommon migrant (MAB).
- GADWALL *Anas strepera* <sup>J. R.</sup> A very uncommon migrant (MAB).
- COMMON TEAL *Anas crecca* <sup>J. R.</sup> Probably a common migrant in early spring, rare in late spring (MAB).
- MALLARD *Anas platyrhynchos* <sup>J. R.</sup> Rare in late spring; only seen twice (MAB).
- SPOT-BILLED DUCK *Anas poecilorhyncha* <sup>J. R. M.</sup> A not uncommon late winter/spring migrant, with a few pairs remaining to breed (MAB).
- NORTHERN PINTAIL *Anas acuta* <sup>J. R.</sup> Probably a common migrant in early spring, but very uncommon in late spring (MAB).
- GARGANEY *Anas querquedula* <sup>J. R. M.</sup> A very common early spring migrant (MAB).
- NORTHERN SHOVELER *Anas clypeata* <sup>J. R.</sup> Presumably an early spring migrant, with only small numbers present into May and early June (MAB).
- COMMON POCHARD *Aythya ferina* <sup>J. R.</sup> A rare migrant, not seen during this study.
- BAER'S POCHARD *Aythya baeri* <sup>J. R. M.</sup> An uncommon summer visitor and possibly rare breeder (MAB).
- TUFTED DUCK *Aythya fuligula* <sup>J. R.</sup> A rare migrant according to Jin *et al.* (1989), not seen during this study.
- COMMON GOLDENEYE *Bucephala clangula* <sup>J. R.</sup> A rare migrant, not seen during this study.
- SMEW *Mergus albellus* <sup>J. R.</sup> Seen once in late April (MAB).
- COMMON MERGANSER *Mergus merganser* <sup>J. R.</sup> A rare migrant, not seen during this study.
- \*ORIENTAL HONEY BUZZARD *Pernis (apivorus) ptilorhyncus* <sup>P</sup>
- HEN HARRIER *Circus cyaneus* <sup>J. R.</sup> Although reportedly a resident (Jin *et al.* 1989) I found it surprisingly uncommon with only three sightings, all in April (MAB).
- PIED HARRIER *Circus melanoleucos* -A fairly common migrant and summer visitor and breeder (MAB).
- EASTERN MARSH-HARRIER *Circus (aeruginosus) spilonotus* <sup>R. M.</sup> Overlooked by Jin *et al.* (1989), added to the reserve list by Anon. (1991) on the basis of Melville (1991). Probably both a migrant and a breeding summer visitor in small numbers (MAB).
- \*JAPANESE SPARROWHAWK *Accipiter gularis* <sup>P</sup>
- \*NORTHERN SPARROWHAWK *Accipiter nisus* <sup>P</sup>
- NORTHERN GOSHAWK *Accipiter gentilis* <sup>R</sup> A rare migrant, not seen during this study.
- UPLAND BUZZARD *Buteo hemilasius* <sup>J. R.</sup> A rare migrant, not seen during this study.
- EURASIAN KESTREL *Falco tinnunculus* <sup>J. R.</sup> A rare migrant, not seen during this study.
- \*AMUR FALCON *Falco amurensis* <sup>P</sup>
- \*MERLIN *Falco columbarius* <sup>P</sup>

- NORTHERN HOBBY *Falco subbuteo* <sup>J.R.M.</sup> An uncommon spring migrant (MAB).
- JAPANESE QUAIL *Coturnix japonica* <sup>J.R.</sup> A quite common summer visitor and presumed breeder (MAB).
- COMMON PHEASANT *Phasianus colchicus* <sup>J.R.</sup> Presumably resident, though not recorded as so by Jin et al. (1989). Males heard in May and June (MAB).
- LITTLE BUTTONQUAIL *Turnix sylvatica* <sup>R.</sup> A rare migrant (Anon. 1991), not seen during this study. I was unable to establish the validity of this record, and criteria for its identification seemed not to be known by the reserve staff.
- BAILLON'S CRAKE *Porzana pusilla* <sup>J.R.</sup> A rare migrant, not seen during this study.
- COMMON MOORHEN *Gallinula chloropus* <sup>J.R.M.</sup> A surprisingly uncommon summer visitor given the amount of habitat available, presumably breeding (MAB).
- WATERCOCK *Gallixrex cinerea* <sup>J.R.</sup> A summer visitor (Jin et al. 1989); however, I was unable to locate any during this study (MAB).
- COMMON COOT *Fulica atra* <sup>J.R.</sup> A very common summer visitor and fairly common breeder (MAB).
- COMMON CRANE *Grus grus* <sup>J.R.</sup> A rare migrant, not seen during this study.
- RED-CROWNED CRANE *Grus japonensis* <sup>J.R.M.</sup> An uncommon migrant and a breeding summer visitor in small numbers (MAB).
- [SIBERIAN CRANE *Grus leucogeranus* <sup>J.R.</sup> A rare migrant, one injured bird was captive on the reserve (MAB)]
- [DEMOISELLE CRANE *Anthropoides virgo* <sup>R.</sup> A free-walking adult at the crane centre on the east reserve throughout the study, presumably once an injured bird it has been tamed to be on show for visitors.]
- COMMON OYSTERCATCHER *Haematopus ostralegus* <sup>J.R.M.</sup> A summer visitor and breeder in small numbers (MAB).
- BLACK-WINGED STILT *Himantopus himantopus* <sup>J.R.M.</sup> A common migrant and small numbers remaining to summer, and breed (MAB).
- PIED AVOCET *Recurvirostra avosetta* <sup>J.R.M.</sup> An uncommon migrant and perhaps a breeder in small numbers (MAB).
- ORIENTAL PRATINCOLE *Glareola maldivarum* <sup>J.R.</sup> An uncommon summer visitor possibly breeding (MAB).
- LITTLE RINGED PLOVER *Charadrius dubius* <sup>J.R.</sup> A very uncommon migrant (MAB).
- KENTISH PLOVER *Charadrius alexandrinus* <sup>J.R.M.</sup> A very common and widespread migrant and summer visitor (MAB).
- MONGOLIAN PLOVER *Charadrius mongolus* <sup>R.M.</sup> A fairly common spring migrant and returning quite early in the autumn, overlooked by Jin et al. (1989), and added to the reserve list (Anon. 1991) on the basis of Melville (1991) (MAB).
- GREATER SAND PLOVER *Charadrius leschenaultii* <sup>R63</sup> Although this species was added in the recent reserve list (Anon. 1991), reserve staff were unclear of its separation in the field from Mongolian Plover and could provide no information on this record.
- PACIFIC GOLDEN PLOVER *Pluvialis (dominica) fulva* <sup>J.R.M.</sup> A fairly common migrant, though less common than expected given the large numbers which migrate through the Japanese archipelago (Brazil 1991) (MAB).

- GREY PLOVER *Pluvialis squatarola* <sup>J.R.M.</sup> A common migrant particularly during May, though some remained throughout the summer and migrants began to increase again during July (MAB).
- GREY-HEADED LAPWING *Vanellus cinereus* <sup>J.R.M.</sup> An infrequently seen summer visitor, but which may have been a very locally distributed breeder (MAB).
- NORTHERN LAPWING *Vanellus vanellus* <sup>J.R.M.</sup> An uncommon migrant and summer visitor presumably breeding in small numbers (MAB).
- \*GREAT KNOT *Calidris tenuirostris* <sup>P</sup>
- \*RED KNOT *Calidris canutus* <sup>P</sup>
- SANDERLING *Calidris alba* <sup>R.</sup> A single bird on 17 May was probably the second reserve record (MAB).
- RUFIOUS-NECKED STINT *Calidris ruficollis* <sup>P.M.</sup> First added to the reserve list in June 1990 (Melville 1991). I subsequently found it to be an uncommon migrant during April and May and again in July (MAB).
- TEMMINCK'S STINT *Calidris temminckii* <sup>J.R.</sup> A single bird was seen on the west reserve on 4 May.
- \*LONG-TOED STINT *Calidris subminuta* <sup>P</sup>
- SHARP-TAILED SANDPIPER *Calidris acuminata* <sup>J.R.M.</sup> An uncommon migrant (MAB).
- CURLEW SANDPIPER *Calidris ferruginea* <sup>J.R.M.</sup> A very uncommon migrant in small numbers (MAB).
- DUNLIN *Calidris alpina* <sup>J.R.M.</sup> A fairly common migrant during April and May, and again in July (MAB).
- \*BROAD-BILLED SANDPIPER *Limicola falcinellus* <sup>P</sup>
- COMMON SNIPE *Gallinago gallinago* <sup>J.R.</sup> An uncommon migrant during April and May (MAB).
- \*PINTAIL SNIPE *Gallinago stenura* <sup>P</sup>
- \*ASIAN DOWITCHER *Limnodromus semipalmatus* <sup>P</sup>
- \*EURASIAN WOODCOCK *Scolopax rusticola* <sup>P</sup>
- BLACK-TAILED GODWIT *Limosa limosa* <sup>J.R.M.</sup> An uncommon migrant in April to June, but an early returning migrant in July (MAB).
- BAR-TAILED GODWIT *Limosa lapponica* <sup>J.R.</sup> Somewhat commoner than the previous species, but also returning early in July (MAB).
- LITTLE CURLEW *Numenius minutus* <sup>J.R.</sup> An uncommon, perhaps rare migrant during May (MAB).
- WHIMBREL *Numenius phaeopus* <sup>J.R.M.</sup> A common migrant occurring widely (MAB).
- EURASIAN CURLEW *Numenius arquata* <sup>J.R.M.</sup> A fairly common migrant, though fewer in number than the following species (MAB).
- EASTERN CURLEW *Numenius madagascariensis* <sup>J.R.</sup> A common migrant with very large numbers (up to 700) returning early in July, presumably to moult (MAB).
- SPOTTED REDSHANK *Tringa erythropus* <sup>J.R.</sup> A common early migrant, and returning by early July (MAB).
- COMMON REDSHANK *Tringa totanus* <sup>J.R.</sup> A common migrant and breeding summer visitor (MAB).

- MARSH SANDPIPER *Tringa stagnatilis* <sup>J. R. M.</sup> A common migrant (MAB).
- COMMON GREENSHANK *Tringa nebularia* <sup>J. R. M.</sup> An uncommon migrant with only very small numbers until July when large numbers began to gather, presumably to moult (MAB).
- GREEN SANDPIPER *Tringa ochropus* <sup>J. R.</sup> An uncommon migrant (MAB).
- WOOD SANDPIPER *Tringa glareola* <sup>J. R. M.</sup> A fairly common migrant and one which returns very early in July (MAB).
- TEREK SANDPIPER *Xenus cinereus* <sup>R. M.</sup> A surprisingly common migrant given that it was not recorded at all by Jin *et al.* (1989) and had been added to the reserve list on the basis of just one record by Melville (1991) (MAB).
- COMMON SANDPIPER *Actitis hypoleucos* <sup>J. R. M.</sup> An uncommon migrant (MAB).
- \*GREY-TAILED TATTLER *Heteroscelus brevipes* <sup>P</sup>
- RUDDY TURNSTONE *Arenaria interpres* <sup>J. R. M.</sup> An uncommon migrant during May (MAB).
- SAUNDERS'S GULL *Larus saundersi* <sup>J. R. M.</sup> A colonial breeder, the reserve currently supports approximately half of the world population (MAB).
- COMMON BLACK-HEADED GULL *Larus ridibundus* <sup>J. R. M.</sup> A common migrant and with quite large numbers of non-breeders, mostly sub-adults, remaining to summer on the reserve (MAB).
- BLACK-TAILED GULL *Larus crassirostris* <sup>J. R. M.</sup> Small numbers, mainly of immatures, seem to summer on the Shuangtaizi River, with larger ( 150+ ) numbers at the mouth of the river during July (MAB).
- \*MEW GULL *Larus camus* <sup>P</sup>
- HERRING GULL *Larus argentatus* <sup>J. R. M.</sup> Small numbers of immatures and occasional adults during April, May, and then from late July (MAB).
- \*GLAUCOUS GULL *Larus hyperboreus*
- GULL-BILLED TERN *Gelochelidon nilotica* <sup>J. R. M.</sup> A quite common migrant and summer visitor with some breeding (MAB).
- COMMON TERN *Sterna hirundo* <sup>J. R. M.</sup> A fairly common migrant and summer visitor with small numbers breeding (MAB).
- LITTLE TERN *Sterna albifrons* <sup>J. R. M.</sup> A fairly common migrant and summer visitor with at least one nesting colony on the west reserve, although this was completely destroyed by floods (MAB).
- WHISKERED TERN *Chlidonias hybridus* <sup>J. R. M.</sup> A very common migrant and summer visitor presumed to breed. Nest material was seen being collected, but no nests were found. The largest numbers encountered were of about 600 in a single loose flock in May (MAB).
- WHITE-WINGED TERN *Chlidonias leucopterus* <sup>J. R. M.</sup> A very common, even abundant migrant and summer visitor. Breeding may well occur but was not proven (MAB).
- \*ROCK PIGEON/FERAL PIGEON *Columba livia*
- ORIENTAL TURTLE-DOVE *Streptopelia orientalis* <sup>J. R. M.</sup> A fairly common migrant (MAB).
- \*HODGSON'S HAWK-CUCKOO *Cuculus fugax* <sup>P</sup>
- \*INDIAN CUCKOO *Cuculus micropterus* <sup>P</sup>
- COMMON CUCKOO *Cuculus canorus* <sup>J. R. 1091</sup> A common migrant and summer visitor (MAB).
- \*ORIENTAL CUCKOO *Cuculus saturatus* <sup>P. M.</sup>

- \*LESSER CUCKOO *Cuculus poliocephalus* <sup>P</sup>
- \* ORIENTAL SCOPS-OWL *Otus (scops) sunia* <sup>P</sup>
- NORTHERN EAGLE-OWL *Bubo bubo* <sup>J. R.</sup> A rare migrant, not seen during this study.
- BROWN HAWK-OWL *Ninox scutulata* <sup>R. M.</sup> A rare migrant first seen in 1990 (Melville 1991). The second and third records for the reserve were in late May (MAB).
- LITTLE OWL *Athene noctua* <sup>J. R.</sup> A resident around villages, farms and grasslands (Jin *et al.* 1989), however reserve staff were not aware of its occurrence and I was unable to locate it during this study (MAB).
- LONG-EARED OWL *Asio otus* <sup>J. R.</sup> A summer visitor, not seen during this study.
- SHORT-EARED OWL *Asio flammeus* <sup>J. R.</sup> A very uncommon migrant in late April and early May (MAB).
- GREY NIGHTJAR *Caprimulgus indicus* <sup>J. R.</sup> A fairly common migrant during May and early June (MAB).
- \*WHITE-THROATED NEEDLETAIL *Hirundapus caudacutus* <sup>P</sup>
- \*FORK-TAILED SWIFT *Apus pacificus* <sup>P</sup>
- COMMON KINGFISHER *Alcedo atthis* <sup>J. R. M.</sup> An uncommon summer visitor.
- \*DOLLARBIRD *Eurystomus orientalis* <sup>P</sup>
- HOOPOE *Upupa epops* <sup>J. R. M.</sup> A not uncommon migrant from April to late July (MAB).
- EURASIAN WRYNECK *Fynx torquilla* <sup>J. R.</sup> An uncommon migrant during April and early/mid May (MAB).
- GREY-HEADED WOODPECKER *Picus canus* <sup>J. R.</sup> A rare migrant, not seen during this study.
- GREAT SPOTTED WOODPECKER *Dendrocopos (Picoides) major* <sup>J. R.</sup> A rare migrant, not seen during this study.
- \*RUFIOUS-BELLIED WOODPECKER *Dendrocopos (Picoides) hyperythrus*
- ASIAN SHORT-TOED LARK *Calandrella cheleensis* <sup>J. R.</sup> A fairly common summer visitor (MAB).
- CRESTED LARK *Galerida cristata* <sup>J. R.</sup> Although listed as a resident by Jin *et al.* (1989), I was unable to find any individuals nor were my co-workers (MAB).
- COMMON SKYLARK *Alauda arvensis* <sup>J. R.</sup> Reported by Jin *et al.* (1989) only as a winter visitor and all were presumed to have departed by the time of my arrival as I recorded none at all (MAB).
- SAND MARTIN *Riparia riparia* <sup>J. R.</sup> A very common migrant during May and July (MAB).
- BARN SWALLOW *Hirundo rustica* <sup>J. R. M.</sup> A common migrant and breeding summer visitor (MAB).
- RED-RUMPED SWALLOW *Hirundo daurica* <sup>J. R. M.</sup> A fairly common summer visitor (MAB).
- \*ASIAN HOUSE MARTIN *Delichon dasyopus* <sup>P</sup>
- RICHARD'S PIPIT *Anthus novaeseelandiae* <sup>J. R. M.</sup> A widespread summer visitor in small numbers (MAB).
- BLYTH'S PIPIT *Anthus godlewskii* <sup>J. R.</sup> A summer visitor according to Jin *et al.* (1989); however, on range it seems unlikely, except perhaps as an uncommon migrant (Cheng, 1987, who regards it as a race of *A. campestris* includes it as a migrant through Liaoning Province). It may have originally been added to the reserve list on the basis of a specimen record. Reserve staff were unclear as to its separation from Richard's Pipit, and as all the calls I noted given by large



pipits were strong "schreep" calls typical of Richard's Pipit, all were assumed to be of that species, and thus Blyth's Pipit was not recorded during this study.

OLIVE TREE-PIPIT *Anthus hodgsoni*<sup>J.R.</sup> An uncommon migrant (MAB).

\*RED-THROATED PIPIT *Anthus cervinus*<sup>P</sup>

\*BUFF-BELLIED PIPIT *Anthus rubescens*<sup>P</sup>

\*FOREST WAGTAIL *Dendronanthus indicus*<sup>P</sup>

YELLOW WAGTAIL *Motacilla flava*<sup>J.R.M.</sup> A fairly common migrant with small numbers remaining on the reserve, and presumably breeding, throughout the summer (MAB).

GREY WAGTAIL *Motacilla cinerea*<sup>J.R.</sup> An uncommon migrant, seen twice in early May (MAB).

WHITE WAGTAIL *Motacilla alba*<sup>J.R.</sup> A surprisingly uncommon migrant (MAB).

\*ASHY MINIVET *Pericrocotus divaricatus*<sup>P</sup>

SIBERIAN ACCENTOR *Prunella montanella*<sup>J.R.</sup> A rare migrant, not seen during this study.

\*RUFIOUS-TAILED ROBIN *Luscinia (Erithacus) sibilans*<sup>P</sup>

\*SIBERIAN RUBYTHROAT *Luscinia (Erithacus) calliope*<sup>P</sup>

\*BLUETHROAT *Luscinia (Erithacus) svecica*<sup>P</sup>

SIBERIAN BLUE ROBIN *Luscinia (Erithacus) cyane*<sup>J.R.</sup> A very common migrant during May (MAB).

ORANGE-FLANKED BUSH-ROBIN *Tarsiger cyanurus*<sup>J.R.</sup> A fairly common migrant during late April and throughout May (MAB).

\*DAURIAN REDSTART *Phoenicurus auroreus*<sup>P</sup>

STONECHAT *Saxicola torquata*<sup>J.R.</sup> A very common migrant during late April and May (MAB).

\*PIED WHEATEAR *Oenanthe pleschanka*<sup>P</sup>

BLUE ROCK-THRUSH *Monticola solitarius*<sup>J.R.</sup> A very uncommon migrant (MAB).

\*WHITE-THROATED ROCK-THRUSH *Monticola gularis*<sup>P</sup>

SCALY THRUSH *Zoothera dauma*<sup>J.R.</sup> An uncommon migrant (MAB).

\*SIBERIAN THRUSH *Zoothera sibirica*<sup>P</sup>

GREY-BACKED THRUSH *Turdus hortulorum*<sup>J.R.</sup> An uncommon migrant occurring in very small numbers (MAB).

PALE THRUSH *Turdus pallidus*<sup>J.R.</sup> A single bird was seen on the west reserve on the 4 May.

\*EYEBROWED THRUSH *Turdus obscurus*<sup>P</sup>

DUSKY THRUSH *Turdus naumanni*<sup>J.R.</sup> Presumably only an uncommon spring migrant, as Cheng (1987) includes it as wintering north only to the region of the Yangtze. I observed rather fewer than I had expected during late April and early May (MAB).

\*MANCHURIAN BUSH WARBLER *Cettia canturians*<sup>P</sup>

\*ZITTING CISTICOLA *Cisticola juncidis*

\*PALLAS'S WARBLER *Locustella certhiola*<sup>P</sup>

LANCEOLATED WARBLER *Locustella lanceolata*<sup>R</sup> An uncommon migrant during May (MAB).

\*GRAY'S WARBLER *Locustella fasciolata*<sup>P</sup>

JAPANESE MARSH WARBLER *Megalurus pryri*<sup>J.R.</sup> A rare migrant (Jin *et al.* 1989), but according to reserve staff Japanese ornithologists had found it in small numbers on the west reserve during the summer; however, it was not found during this study.

BLACK-BROWED REED-WARBLER *Acrocephalus bistrigiceps*<sup>J.R.M.</sup> A common migrant and breeding summer visitor (MAB).

\*PADDYFIELD WARBLER *Acrocephalus agricola*

ORIENTAL REED-WARBLER *Acrocephalus orientalis*<sup>J.R.M.</sup> A common summer visitor, and an even commoner migrant (MAB).

THICK-BILLED WARBLER *Acrocephalus aedon*<sup>J.R.</sup> A very common migrant from mid May to early June on the east reserve (MAB).

\*EASTERN CROWNED WARBLER *Phylloscopus coronatus*<sup>P</sup>

\*PALE-LEGGED LEAF-WARBLER *Phylloscopus tenellipes*

\*GREENISH WARBLER *Phylloscopus trochiloides*

ARCTIC WARBLER *Phylloscopus borealis*<sup>J.R.</sup> An uncommon migrant (MAB).

\*LEMON-RUMPED WARBLER *Phylloscopus proregulus*<sup>P</sup>

INORNATE WARBLER *Phylloscopus inornatus*<sup>J.R.</sup> A quite common spring migrant (MAB).

\*RADDE'S WARBLER *Phylloscopus schwarzi*<sup>P</sup>

\*DUSKY WARBLER *Phylloscopus fuscatus*<sup>P</sup>

GOLDCREST *Regulus regulus*<sup>J.R.</sup> A rare migrant, not seen during this study.

\*DARK-SIDED FLYCATCHER *Muscicapa sibirica*<sup>P</sup>

\*ASIAN BROWN FLYCATCHER *Muscicapa latirostris*<sup>P</sup>

\*RED-THROATED FLYCATCHER *Ficedula parva*<sup>P</sup>

\*MUGIMAKI FLYCATCHER *Ficedula mugimaki*<sup>P</sup>

YELLOW-RUMPED FLYCATCHER *Ficedula zanthopygia*<sup>J.R.</sup> A fairly common late spring migrant (MAB).

\*ASIAN PARADISE-FLYCATCHER *Terpsiphone paradisi*

\*REED PARROTBILL *Paradoxornis heudei* A fairly common resident (MAB).

LONG-TAILED TIT *Aegithalos caudatus*<sup>J.R.</sup> A rare migrant, not seen during this study.

GREAT TIT *Parus major*<sup>J.R.</sup> A rare migrant, not seen during this study.

EURASIAN NUTHATCH *Sitta europaea*<sup>J.R.</sup> A rare migrant, not seen during this study.

\*EURASIAN PENDULINE-TIT *Remiz pendulinus*<sup>P</sup>

CHESTNUT-FLANKED WHITE-EYE *Zosterops erythropleurus*<sup>J.R.</sup> A fairly common late spring migrant (MAB).

BLACK DRONGO *Dicrurus macrocercus*<sup>J.R.</sup> A rare migrant, seen twice in June (MAB).

BLACK-NAPED ORIOLE *Oriolus chinensis*<sup>J.R.M.</sup> A rare migrant seen twice in May and once in June (MAB).

\*TIGER SHRIKE *Lanius tigrinus*<sup>P</sup>

BROWN SHRIKE *Lanius cristatus*<sup>J.R.M.</sup> A common migrant from late April until early June (MAB).

- BULL-HEADED SHRIKE *Lanius bucephalus*<sup>M</sup>. Added to the reserve list by Melville (1991).
- GREAT GREY SHRIKE *Lanius excubitor*<sup>J, R</sup>. A rare migrant, not seen during this study.
- CHINESE GREY SHRIKE *Lanius sphenocercus*<sup>J, R</sup>. A winter visitor, not seen during this study.
- AZURE-WINGED MAGPIE *Cyanopica cyana*<sup>J, R</sup>. A summer visitor, not found during this study.
- BLACK-BILLED MAGPIE *Pica pica*<sup>J, R, M</sup>. Presumed to be resident, in small numbers (MAB).
- CARRION CROW *Corvus corone*<sup>J, R</sup>. Although supposedly a resident, only seen once, in May (MAB).
- LARGE-BILLED CROW *Corvus macrorhynchos*<sup>J, R</sup>. A rare migrant, not seen during this study.
- PURPLE-BACKED STARLING *Sturnus sturninus*<sup>J, R</sup>. A very uncommon migrant in late May (MAB).
- WHITE-CHEEKED STARLING *Sturnus cineraceus*<sup>J, R</sup>. A very uncommon migrant, but larger numbers, mainly of immatures, during July (MAB).
- EURASIAN TREE SPARROW *Passer montanus*<sup>J, R, M</sup>. Not particularly common on the reserve until a sudden increase in late June and early July (MAB).
- BRAMBLING *Fringilla montifringilla*<sup>J, R</sup>. An uncommon migrant (MAB).
- GREY-CAPPED GREENFINCH *Carduelis sinica*<sup>J, R</sup>. A surprisingly uncommon migrant, seen only twice during May (MAB).
- EURASIAN SISKIN *Carduelis spinus*<sup>J, R</sup>. A very uncommon migrant. Local trapping for the cage-bird markets could perhaps explain the small numbers of certain hardbilled species seen in the wild (MAB).
- COMMON REDPOLL *Carduelis flammea*<sup>J, R</sup>. A rare migrant, not seen during this study.
- \* COMMON ROSEFINCH *Carpodacus erythrinus*<sup>P</sup>
- PALLAS'S ROSEFINCH *Carpodacus roseus*<sup>J, R</sup>. A rare migrant, not seen during this study.
- LONG-TAILED ROSEFINCH *Uragus sibiricus*<sup>J, R</sup>. A winter visitor, not seen during this study.
- YELLOW-BILLED GROSBEAK *Eophona (Coccothrauste) migratoria*<sup>J, R</sup>. A very uncommon migrant (MAB).
- \*JAPANESE GROSBEAK *Eophona (Coccothraustes) personata*<sup>P</sup>
- HAWFINCH *Coccothraustes coccothraustes*<sup>J, R</sup>. A not uncommon migrant during May (MAB).
- LAPLAND LONGSPUR *Calcarius lapponicus*<sup>J, R</sup>. A winter visitor, not seen during this study.
- \*BLACK-FACED BUNTING *Emberiza spodocephala*<sup>P</sup>
- MEADOW BUNTING *Emberiza cioides*. A rare visitor (Anon. 1991), not seen during this study.
- \*CHESTNUT-EARED BUNTING *Emberiza fucata*<sup>P</sup>
- YELLOW-THROATED BUNTING *Emberiza elegans*<sup>J, R</sup>. A rare migrant (MAB).
- \*YELLOW-BROWED BUNTING *Emberiza chrysophrys*<sup>P</sup>
- \*TRISTRAM'S BUNTING *Emberiza tristrami*<sup>P</sup>
- RUSTIC BUNTING *Emberiza rustica*<sup>J, R</sup>. A winter visitor, not seen during this study.
- LITTLE BUNTING *Emberiza pusilla*<sup>J, R</sup>. A common migrant (MAB).
- \*CHESTNUT BUNTING *Emberiza rutila*<sup>P</sup>
- YELLOW-BREASTED BUNTING *Emberiza aureola*<sup>J, R</sup>. A common migrant (MAB).

COMMON REED-BUNTING *Emberiza schoeniclus*<sup>J, R</sup>. A winter visitor, seen once during this study (MAB).

\*PALLAS'S REED-BUNTING *Emberiza pallasi*<sup>P</sup>

JAPANESE REED-BUNTING *Emberiza yessoensis*. A rare visitor (Anon. 1991), not seen during this study.

## APPENDIX 2

### ADDITIONAL SPECIES PREDICTED AS LIKELY TO OCCUR ON THE SHUANGTAIZIHEKOU NNR, BUT NOT YET RECORDED, AND NOT SEEN DURING SPRING AND SUMMER 1991

- |  |  |
|--|--|
| RED-THROATED DIVER <i>Gavia stellata</i>               | ORIENTAL PLOVER <i>Charadrius veredus</i>                      |
| BLACK-THROATED DIVER <i>Gavia arctica</i>              | SPOON-BILLED SANDPIPER <i>Euryorhynchus pygmeus</i>            |
| PACIFIC DIVER <i>Gavia pacifica</i>                    | RUFF <i>Philomachus pugnax</i>                                 |
| RED-NECKED GREBE <i>Podiceps grisegena</i>             | SWINHOE'S SNIPE <i>Gallinago megalis</i>                       |
| BLACK-NECKED GREBE <i>Podiceps nigricollis</i>         | SOLITARY SNIPE <i>Gallinago solitaria</i>                      |
| STREAKED SHEARWATER <i>Calonectris leucomelas</i>      | NORDMANN'S GREENSHANK <i>Tringa guttifer</i>                   |
| GREAT CORMORANT <i>Phalacrocorax carbo</i>             | RED-NECKED PHALAROPE <i>Phalaropus lobatus</i>                 |
| CINNAMON BITTERN <i>Ixobrychus cinnamomeus</i>         | SLATY-BACKED GULL <i>Larus schinzgus</i>                       |
| BLACK-CROWNED NIGHT-HERON <i>Nycticorax nycticorax</i> | PALLAS'S SANDGROUSE <i>Syrhaptes paradoxus</i>                 |
| CHINESE POND-HERON <i>Ardeola bacchus</i>              | COLLARED DOVE <i>Streptopelia decaocto</i>                     |
| BLACK-FACED SPOONBILL <i>Platalea minor</i>            | RED TURTLE-DOVE <i>Streptopelia tranquebarica</i>              |
| TUNDRA SWAN <i>Cygnus columbianus</i>                  | COLLARED SCOPS-OWL <i>Otus bakkamoena</i>                      |
| LESSER WHITE-FRONTED GOOSE <i>Anser erythropus</i>     | URAL OWL <i>Strix uralensis</i>                                |
| GREYLAG GOOSE <i>Anser anser</i>                       | BLACK-CAPPED KINGFISHER <i>Halcyon pileata</i>                 |
| BRENT GOOSE <i>Branta bernicla</i>                     | CRESTED KINGFISHER <i>Ceryle lugubris</i>                      |
| GREATER SCAUP <i>Aythya marila</i>                     | WHITE-BACKED WOODPECKER <i>Dendrocopos (Picoides) leucos</i>   |
| HARLEQUIN DUCK <i>Histrionicus histrionicus</i>        | LESSER SPOTTED WOODPECKER <i>Dendrocopos (Picoides) minor</i>  |
| LONG-TAILED DUCK <i>Clangula hyemalis</i>              | JAPANESE PYGMY WOODPECKER <i>Dendrocopos (Picoides) kizuki</i> |
| VELVET SCOTER <i>Melanitta fusca</i>                   | HORNED LARK <i>Eremophila alpestris</i>                        |
| OSPREY <i>Pandion haliaetus</i>                        | YELLOW-HOODED (CITRINE) WAGTAIL <i>Motacilla citreola</i>      |
| BLACK KITE <i>Mitrus migrans</i>                       | JAPANESE WAXWING <i>Bombusilla japonica</i>                    |
| WHITE-TAILED EAGLE <i>Haliaeetus albicilla</i>         | BOHEMIAN WAXWING <i>Bombusilla garrulus</i>                    |
| STELLER'S SEA EAGLE <i>Haliaeetus pelagicus</i>        | BROWN DIPPER <i>Cinclus pallasi</i>                            |
| GREY-FACED BUZZARD <i>Buteo buteo</i>                  | NORTHERN WREN <i>Troglodytes troglodytes</i>                   |
| COMMON BUZZARD <i>Buteo buteo</i>                      | BLUE-AND-WHITE FLYCATCHER <i>Cyanoptila cyanomelana</i>        |
| ROUGH-LEGGED BUZZARD <i>Buteo lagopus</i>              | GREY-STREAKED FLYCATCHER <i>Muscicapa griseicauda</i>          |
| GREATER SPOTTED EAGLE <i>Aquila clanga</i>             | BEARDED TIT <i>Parus biarmicus</i>                             |
| GOLDEN EAGLE <i>Aquila chrysaetos</i>                  | VINOUS-THROATED PARROTBILL <i>Paradornis webbiana</i>          |
| LESSER KESTREL <i>Falco naumanni</i>                   | MARSH TIT <i>Parus palustris</i>                               |
| PEREGRINE FALCON <i>Falco peregrinus</i>               | WILLOW TIT <i>Parus montanus</i>                               |
| WATER RAIL <i>Rallus aquaticus</i>                     | COAL TIT <i>Parus ater</i>                                     |
| RUDY-BREASTED CRAKE <i>Porzana fusca</i>               | COMMON TREECREPER <i>Certhia familiaris</i>                    |
| SWINHOE'S YELLOW RAIL <i>Coturnicops exquisitus</i>    | DAURIAN JACKDAW <i>Corvus dauricus</i>                         |
| HOODED CRANE <i>Grus monacha</i>                       | ROOK <i>Corvus frugilegus</i>                                  |
| GREATER PAINTED-SNIPE <i>Rostratula benghalensis</i>   | TWO-BARRED CROSSBILL <i>Loxia leucoptera</i>                   |
| LONG-BILLED PLOVER <i>Charadrius placidus</i>          | RED CROSSBILL <i>Loxia curvirostra</i>                         |

ASIAN ROSY FINCH *Leucosticte arctoa*  
COMMON BULLFINCH *Pyrrhula pyrrhula*

SNOW BUNTING *Plectrophenax nivalis*  
PINE BUNTING *Emberiza leucocapitalis*

## Food-niche relationships of five sympatric north Indian herons

N. S. SODHI

In a study in Northern India, the pivotal prey groups for Cattle Egret were flies (by number) and toads (by biomass), for Little Egret fishes (both by number and by biomass), for Indian Pond-Heron frogs (by number) and fishes (by biomass), for Intermediate Egret bugs (by number) and fishes (by biomass), and for Black-crowned Night-Heron fishes (both by number and biomass). Low overlaps in number of prey categories consumed by the herons were found. However, there were high overlaps in shared prey categories, suggesting such prey may not be limited in nature. Indian Pond-Heron had the highest niche width and Cattle Egret the lowest. The size of a heron was not considered with mean length of the prey consumed.

There has been extensive documentation of the feeding habits of various herons, but such studies on herons from the Oriental region remain meagre. Here I report food resources utilized, food-niche width and overlap in food used by five sympatric north Indian herons, the Black-crowned Night-Heron *Nycticorax nycticorax*, Intermediate Egret *Egretta intermedia*, Indian Pond-Heron *Ardeola grayii*, Little Egret *Egretta garzetta*, and Cattle Egret *Bubulcus ibis*.

### METHODS

Food samples were obtained from and around Chandigarh (30°42'N 76°54'E), India, between March 1984 and March 1985. Two methods were used to obtain food samples, collecting adults in the field and gathering regurgitated food samples from heronries. Both samples were lumped in analyses because adult herons deliver the same size and composition of prey to nestlings that they have themselves consumed (Kushlan 1978: 271).

For comparison, I used high levels of prey identification as suggested by Greene and Jaksic (1983). Such food analyses of these species have been reported elsewhere (Sodhi 1985, 1986, 1989, Sodhi and Khara 1986, Singh *et al.* 1988). Food samples of Black-crowned Night-Heron were obtained only during the breeding season and of Intermediate Egret during March (2) and September (1). Data on these species were compared with samples collected from other species during that period.

Overlaps in prey categories were calculated as:— Number of common prey categories consumed by both species/total number of prey categories consumed by both species X 100. Overlap among common prey categories (see Appendix) of any two species was calculated by Horn's measure ( $2\sum p_i q_i / p_i^2 + q_i^2$ ), where  $p_i$  is the frequency of a given prey and  $q_i$  is the frequency of the same prey in the second species. (This formula renders values between 0 to 1, signifying null to complete overlap.)