# The White-headed Duck *Oxyura leucocephala* in the Tengiz-Korgalzhyn Region, Central Kazakhstan

**H. Schielzeth[1], L. Lachmann[2], G. Eichhorn[3] and T. Heinicke[4]**

[1]Institute of Landscape Biology, University of Münster, Robert-Koch-Str. 26, D-48149 Münster, Germany. Email: schielz@uni-muenster.de
[2]RSPB, European Programmes Dept., The Lodge, Sandy, Bedfordshire SG19 2DL, UK. Email: Lars.Lachmann@web.de
[3]Zoological Laboratory, University of Groningen, P.O. Box 14, NL-9750 AA Haren, The Netherlands.
[4]Reiterweg 7, D-14469 Potsdam, Germany.

This paper presents recent data for the White-headed Duck *Oxyura leucocephala* in the Tengiz-Korgalzhyn Region, Central Kazakhstan. Most data were collected during surveys in the summer and autumn (July-October) 1999-2002. The region proved to hold significant numbers of the Central Asian population of White-headed Duck in late summer/autumn. Numbers peak in September. It is estimated that 4,000-4,500 birds are present at this time of the year. The size of the local breeding population is unknown. It is assumed that both the local population and birds from northern Kazakhstan and southern Siberia contribute to the autumn gatherings. Most autumn aggregations were found on lakes outside the Korgalzhynskij Nature Reserve (*Zapovednik*), while the reserve itself holds the main breeding sites. As it is essential to maintain numbers to ensure the survival of the Central Asian population, threats and conservation actions are discussed. The legal protection status seems favourable for the protection of the population. The main threats stem from water supply and management. Further problems include disturbance by hunters and fishermen.

**Key Words: population size, age and sex composition, phenology, breeding, conservation**

The White-headed Duck *Oxyura leucocephala* is a globally threatened species classified as endangered by IUCN (2000) and BirdLife International (2000) based on the A1 criterion (population decline of >50% in 10 years). Its range and population size have decreased drastically since the early twentieth century from probably over 100,000 to about 10,000 birds (Green & Hunter 1996: 10,000 individuals; BirdLife International 2000: 2,500-10,000 individuals; Wetlands International 2002: 8-13,000 individuals).

Currently, four separate populations are distinguished (Wetlands International 2002): west Mediterranean (Spain, Morocco: 2,500 individuals), north African (Algeria, Tunisia: 400-600 individuals), east Mediterranean/southwest Asian (5,000-10,000 individuals), Pakistan winter population (10 individuals). Of these, the east Mediterranean/southwest Asian population is the largest and, as it is also the population least threatened by hybridisation with the introduced Ruddy Duck *Oxyura jamaicensis*, it is of major importance for the conservation of the species (Li & Mundkur 2003).

Kazakhstan is believed to hold the bulk of the southwest Asian population. Current data about the White-headed Duck in the country are very sparse but have recently been summarised by Li & Mundkur (2003). Within Kazakhstan the Tengiz-Korgalzhyn Region in Central Kazakhstan has long been known to be a breeding site, but numbers were usually considered to be relatively small (Dolgushin 1960; Anstey 1989). At least Krivitskij *et al.* (1985) suggest that larger numbers are present at times. They mention regular counts of about 500 birds, with maximum of 1,200 birds between 1973 and 1978. Interestingly, autumn numbers are said to total only about 200 birds. A record of 600 in spring, cited by Cresswell *et al.* (1999), arose from a misunderstanding and is erroneous (Cresswell, pers. comm).

According to recent data, the region holds a much larger proportion of the world's known population of White-headed Ducks than previously thought. This article summarises topical data collected between 1999 and 2002 and gives detailed information about the White-headed Duck's distribution within this region.

## The Tengiz-Korgalzhyn Region

The Tengiz-Korgalzhyn Region is situated about 130km southwest of the national capital, Astana, and comprises the western lower parts of the Central Kazakh Depression. It is characterised by large numbers of saline, brackish and freshwater lakes within a dry and mainly flat steppe landscape.

The deepest part of the depression is formed by the large, undrained and therefore saline Lake Tengiz, which is fed by the Rivers Nura and Kulanutpes. The River Nura runs through a series of shallow freshwater lakes before reaching Lake Tengiz. The last of these freshwater lakes is Lake Korgalzhyn, which is actually a vast system of reeds

and bodies of open water; it is separated from Lake Tengiz by both natural and artificial dams. Together with some adjacent steppe landscape, the two lakes form the Korgalzhynskij Nature Reserve (*Zapovednik*) (IUCN category 1a), which was established in 1968 and is the largest nature reserve in Kazakhstan (2,370km$^2$).

Additionally, there are several smaller lakes and lake systems around the reserve that currently have no protection status. Many of these, not being fed by the River Nura, hold saline or at least brackish water. A fluctuating water regime within and between years is typical for the lakes in the region, therefore conditions for waterfowl vary considerably in time and space. However, because of water management, ie the building of dams, Lake Korgalzhyn retains a relatively stable volume of water.

In 1976 the Soviet government declared the Korgalzhyn Nature Reserve a Ramsar site. Since its independence, Kazakhstan has not re-confirmed its status as party to the Ramsar Convention. Nonetheless, the reserve is officially considered to be a Ramsar site.

## Methods

In 1999-2002 volunteer ornithologists surveyed the region in the summer and autumn (mainly July-October, see **Appendix 1**). These activities were made possible through co-operation between the German Society for Nature Conservation (NABU) and the Administration of the Korgalzhyn Nature Reserve. At other times of year, ornithological investigations have been less intensive and have comprised only occasional counts by a staff member of the reserve and short visits by foreign birdwatchers.

Counts of White-headed Ducks were carried out with telescopes and usually by one or two observers; accuracy was ensured by counting individuals or groups of 10 individuals. No estimates or projections have been made. Whenever possible (in relation to about 60% of the data) a distinction was made between (a) immature and adult males (second calendar year and older) and (b) females and first-year birds.

Some of the most important lakes were visited fairly regularly during the summer months, but the region is far too large and difficult to access for complete counts to be made. Some sites were counted only occasionally and it is quite possible that smaller concentrations of White-headed Ducks are still awaiting discovery. **Appendix 1** lists all the lakes where White-headed Ducks were recorded in any year in autumn.

Totals of individuals were calculated on the basis of approximately 10-day periods each month using the maximum count per site and year. For illustration, individual sites have been totalled by the five major lake regions (**Table 1** and **Figure 1**) from these maximum site counts.

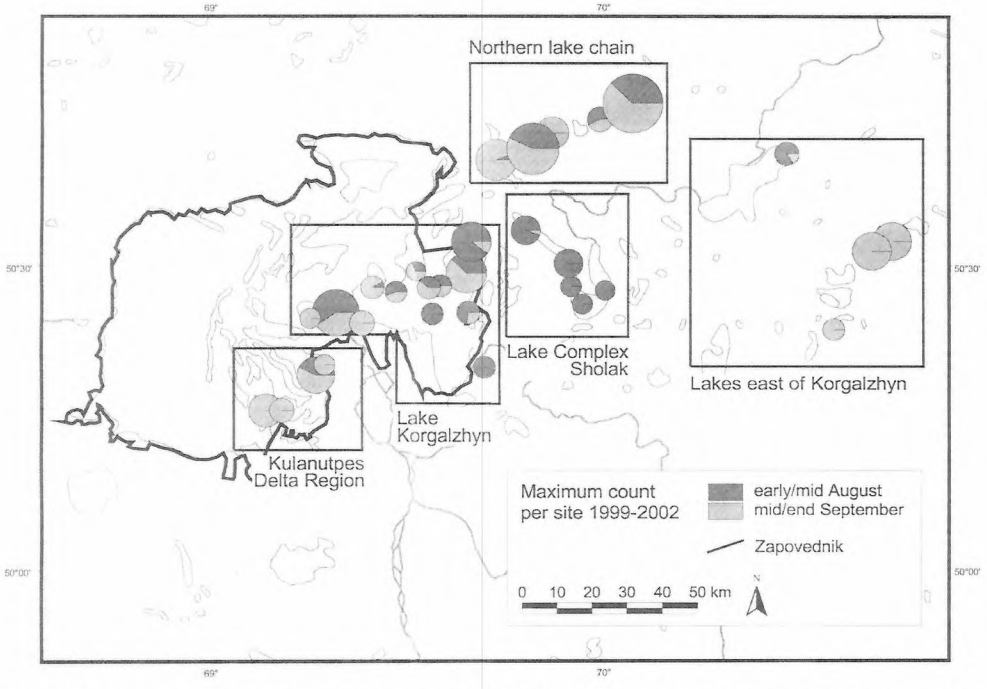


**Figure 1**. Map of the Tengiz-Korgalzhyn Region, Central Kazakhstan, showing the main lake regions and complexes and the distribution of White-headed Duck in 1999-2002. The size of the pie charts is proportional to the maximum site count at each site. Sectors of pie charts show the relationship between maximum August and maximum September counts at the respective sites.

## Results

### Population counts

The site maximum per 10-day period is used as a first approach to estimating the size of the White-headed Duck population. **Table 1** lists the number of White-headed Ducks counted during summer and autumn 1999-2002. Maximum 10-day totals for each of these years vary between 1,700 and 3,400 birds. None of the counts covers all relevant sites, therefore these values should be regarded as minimum values. Using the maximum per site in the respective 10-day period and ignoring the year of counts yields a maximum of 4,575 birds in mid-September. This is possibly an overestimate, as the distribution of White-headed Ducks may vary between years; however, it may function as an upper limit for population estimates.

The most complete count was carried out between 19 and 28 September 2002; it covered most of the important sites and yielded a total of 3,964 birds. However, at least three important lakes were not counted (Lakes Kumdykol, Nygis and Kambak), where 963 birds

**Table 1**. Maximum site counts of White-headed Duck in the Tengiz-Korgalzhyn Region, Central Kazakhstan, between 1999 and 2002 on the basis of 10-day periods summarised by main lake regions (cf. **Figure 1**). Note that these lake regions are not equally well covered, therefore numbers should be treated as minimum values.

| 1999 | July | | August | | | September | | | October | |
|---|---|---|---|---|---|---|---|---|---|---|
| Kulanutpes Delta Region | | | | | | | | | | |
| Sholak Lake Complex | | | | | | | | | | |
| Lake Korgalzhyn | | 527 | 308 | 222 | 1806 | 659 | 868 | | | |
| Lakes east of Korgalzhyn | | 3 | | | | | | | | 25 |
| Northern Lake Chain | | | 39 | | | 90 | 549 | 299 | 108 | |
| Others | | 2 | | | | | | | | |
| Total | | 532 | 347 | 222 | 1806 | 749 | 1417 | 299 | 108 | 25 |

| 2000 | July | | August | | | September | | | October | |
|---|---|---|---|---|---|---|---|---|---|---|
| Kulanutpes Delta Region | | | | | | | | | | |
| Sholak Lake Complex | | | 166 | | | | | 8 | | |
| Lake Korgalzhyn | 25 | 24 | 333 | 8 | | 25 | 335 | 7 | 88 | |
| Lakes east of Korgalzhyn | | | 15 | | | 972 | | 1 | 41 | |
| Northern Lake Chain | | 110 | | | | 1981 | 610 | 1742 | 584 | |
| Others | | | | | | | | 8 | | |
| Total | 25 | 134 | 514 | 8 | | 2978 | 945 | 1766 | 713 | |

| 2001 | July | | August | | | September | | | October | |
|---|---|---|---|---|---|---|---|---|---|---|
| Kulanutpes Delta Region | | | | | | | | | | |
| Sholak Lake Complex | | 308 | 58 | 137 | 163 | | | | | |
| Lake Korgalzhyn | | | | 175 | 78 | 38 | | | | |
| Lakes east of Korgalzhyn | | | | | | | | | | |
| Northern Lake Chain | | | | 1396 | 1122 | 1077 | | | | |
| Others | | | | | | | | | | |
| Total | | 308 | 58 | 1708 | 1363 | 1115 | | | | |

| 2002 | July | | August | | | September | | | October | |
|---|---|---|---|---|---|---|---|---|---|---|
| Kulanutpes Delta Region | | | | 320 | | | 761 | | 1303 | |
| Sholak Lake Complex | | | | | | | | | | |
| Lake Korgalzhyn | | | 33 | | 54 | 1 | 151 | 90 | 8 | |
| Lakes east of Korgalzhyn | | | 34 | | 47 | | | 3 | | |
| Northern Lake Chain | 72 | | | 889 | 933 | | 2502 | 3109 | 1578 | 4 |
| Others | | | | | | | | | | |
| Total | 72 | | 67 | 1209 | 1034 | 1 | 3415 | 3202 | 2889 | 4 |

were recorded on 9 September 2000. Unfortunately these lakes were also not counted in the second half of September 2000 and were not at all in 2001 and 2002.

Using these key values, the Tengiz-Korgalzhyn population of White-headed Duck is estimated as 4,000-4,500 birds in September. In the authors' view, this is a minimum estimate. Numbers in August are lower and in the range of 1,800-2,000 in the middle of the month (**Table 1**).

## Breeding

Most breeding takes place inside the nature reserve, ie on Lake Korgalzhyn. Breeding on lakes outside the reserve has yet to be confirmed. This may be due to a lack of survey, but specific searches at lakes important during the post-breeding period, suggest this assumption to be true.

Breeding starts at the end of May, and full clutches are reported from the middle of June (Krivitskij *et al.* 1985). The first pulli can be seen in the first days of July (Krivitskij *et al.* 1985) and fledged juveniles by the end of the month (eg 27 July1999), although pulli have also been recorded at that time (eg 31 July 1999).

## Phenology

The White-headed Duck is a summer visitor to the Tengiz-Korgalzhyn Region. The first records are usually from the second half of April (earliest observation: 12 April 1977 (Krivitskij *et al.* 1985); in recent years the dates have been 1 May 2001, 14 April 2002, 2 May 2003). Spring migration probably peaks in the first half of May. Records of larger spring counts are given in **Table 2**.

In summer and early autumn White-headed Ducks gather in flocks of several hundred individuals (**Figure 2**). As they are dispersed and rather cryptic during the breeding period, numbers in July are probably an under-estimate of birds present at this time.

It is difficult to evaluate the extent to which the local breeding population contributes to the overall numbers and how many birds visit the region exclusively to moult and stage. Peak counts usually date from the second half of September. In October numbers decline steeply. While in the first 10-days of the month flocks of a few hundred birds are not unusual, White-headed Ducks have usually completely departed by the middle of the month. The autumn departure depends strongly on weather conditions, and the freezing of lakes can cause large numbers of White-headed Ducks to leave the area overnight. Last observations are from the first half of October (11 October 1999, 15 October 2002).

## Distribution

**Figure 1** shows the distribution of White-headed Duck records in the Tengiz-Korgalzhyn Region in early/mid August and mid/end September respectively. The sites can be divided into five main areas:

**Table 2**. Spring counts of more than 50 White-headed Ducks in the Tengiz-Korgalzhyn Region, Central Kazakhstan, in 1999-2002. The lake region of the respective site is given in brackets.

| Site | Co-ordinates | Date | WHD | Observer |
|---|---|---|---|---|
| Lake Karachi-Kyzylkol (Kulanutpes Delta Region) | 50°20.2'N/69°17.1'E | 11.05.99 | 63 | Eichhorn, G. |
| Lake Sultankeldy (Lake Korgalzhyn) | 50°29.4'N/69°31.0'E | 16.05.98 | 60 | Helbig, A.J. |
| Lake Aktobe (Lake Korgalzhyn) | 50°25.4'N/69°39.1'E | 23.05.00 | 53 | Heinicke, T. |
| Central part of Lake Korgalzhyn | 50°25.2'N/69°33.5'E | 24.05.00 | 110 | Heinicke, T. |
| Lake Kumkol (Northern Lake Chain) | 50°45.8'N/70°04.3'E | 13.06.01 | 52 | Eichhorn, G. |

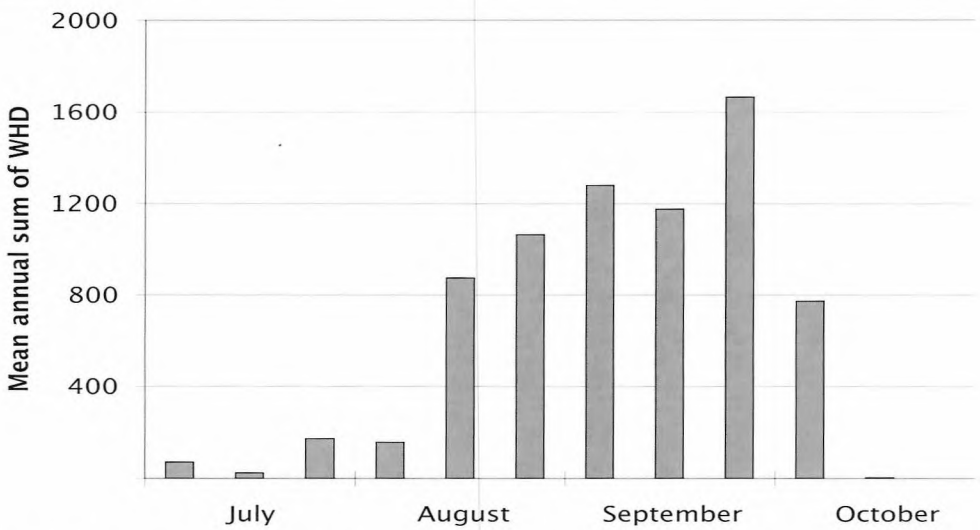


**Figure 2**. Phenology of White-headed Duck in the Tengiz-Korgalzhyn Region, Central Kazakhstan, in the summer/autumn months 1999-2002. Only records from the most regularly surveyed sites (Northern Lake Chain, Sholak Lake Complex, part of Lake Korgalzhyn) have been included.

1) Lake Korgalzhyn, with its different subsystems

2) Sholak Lake Complex

3) Northern Lake Chain: a series of lakes from Lake Saumalkol to Lake Kumkol (not a single hydrological unit)

4) Lakes east of Korgalzhyn: some hydrologically unrelated lakes, the most important of which are Lakes Bestobe, Nygis, Kumdykol and Bolshoj Korzhynko

5) Kulanutpes Delta Region

There are many other waterbodies in the region that are important for other waterbirds but do not hold significant numbers of White-headed Ducks.

While the interior of the nature reserve holds the bulk of the birds during the breeding season, there is a shift to lakes outside the reserve in the course of the summer. In September, lakes outside the protected area are likely to hold 60-80% of the region's staging population (**Figure 3**).

## Population structure

In July and August, flocks outside the reserve are dominated by males (**Figure 4**), which presumably gather to moult, whereas females and young birds are relatively more numerous at Lake Korgalzhyn and Lake Sholak. Over the course of the autumn, the proportion of males outside the reserve declines. In mid-September to early October only 20-50% of the birds are

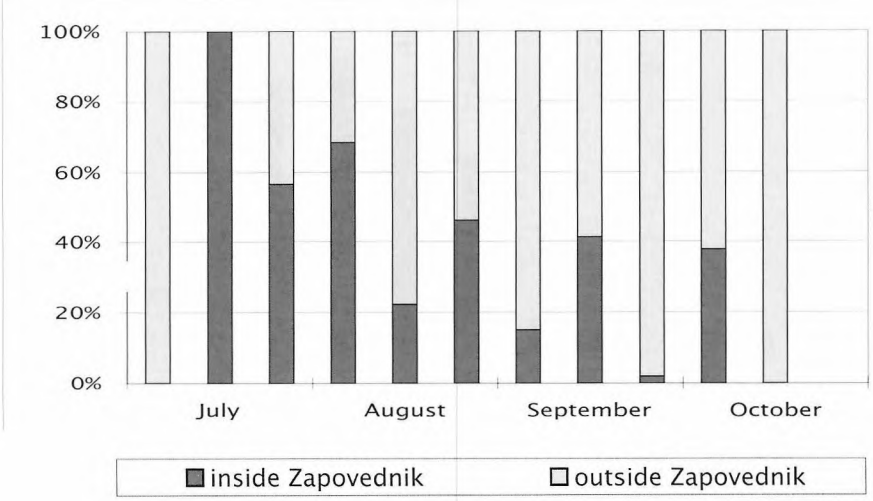


**Figure 3**. Percentages of White-headed Ducks inside and outside the Korgalzhyn Protected Nature Reserve (*Zapovednik*) area, Tengiz-Korgalzhyn Region, Central Kazakhstan, in summer/autumn 1999-2002.

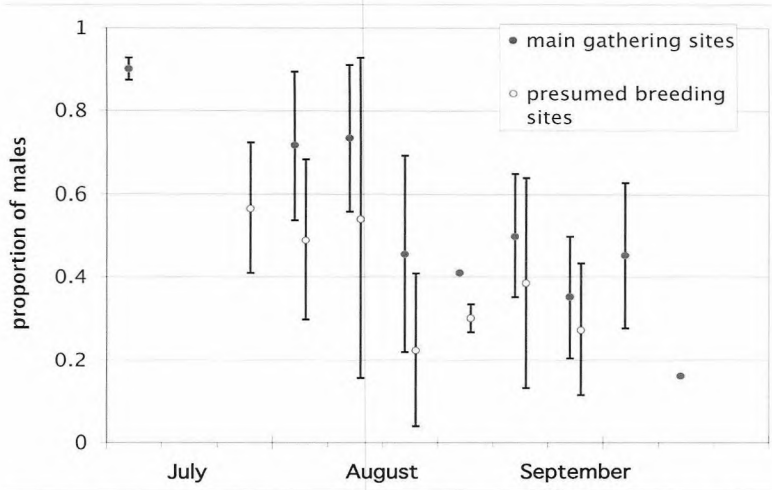


**Figure 4**. Proportion of male White-headed Ducks (second calendar year and older) in the Tengiz-Korgalzhyn Region, Central Kazakhstan. Means and standard deviation are shown. Counts from the main Lake Korgalzhyn and Sholak Lake Complex are included in the category 'presumed breeding sites'; all other lakes are included in 'main gathering sites'.

adult/immature males, which can be attributed to females and juveniles joining the flocks.

There are few data with more detailed age classification. Four counts in spring revealed proportions of immature males of 20±8%. Four counts in summer/autumn showed 81±11% of first years among 'female-type' birds.

## Habitat preferences

White-headed Ducks in the Tengiz-Korgalzhyn Region show a strong preference for fresh to brackish lakes; they never occur on saltwater bodies like Lake Tengiz. Most lakes are medium-sized, permanent and shallow. The brackish delta region of Kulanutpes River is also of significant importance.

Breeding apparently occurs predominantly on freshwater (or slightly brackish) lakes with abundant emergent vegetation (especially reeds *Phragmites australis*) within or close to the nature reserve.

Post-breeding aggregations are often found on lakes lacking significant emergent vegetation along their shores, some of which are more saline than the breeding lakes. Flocks of White-headed Ducks were often associated with species such as Black-necked Grebe *Podiceps nigricollis*, Tufted Duck *Aythya fuligula* and Goldeneye *Bucephala clangula*, and also with large numbers of *Anas* species, Red-crested Pochard *Netta rufina* and Coot *Fulica atra*.

## Discussion

### Population size and trend

An estimated maximum of 4,000-4,500 birds seems probable, based on the counts given in **Table 1**. Estimates of the eastern Mediterranean/Central Asian White-headed Duck population (5,000-10,000 birds) are based on mid-winter counts (Wetlands International 2002); they are therefore not directly comparable because mortality up to midwinter is not known. Nevertheless, the Tengiz-Korgalzhyn Region holds a reasonable proportion - probably at least one third - of the known Central Asian population in September at this time of the year.

For an estimate of how many potential breeding pairs this number corresponds to, calculations were based on September numbers. Assuming 60% of the September birds to be female and 20% of these to be adult females (based on the data in **Figure 4**), total count of 4,000 birds would mean 480 adult females. A similar estimate based on proportion of adult males in August (70% males, 80% of which were adults, a total of 1,800 birds) yields 1,000 adult males. As many duck species show a male-biased sex ratio, it is assumed that the number of adult females is closer to the potential number of breeding pairs. Hence, autumn numbers in the Tengiz-Korgalzhyn Region probably correspond to about 450-800 pairs. As birds from other regions may have joined the local breeding population, the provenance of these 'pairs' is uncertain. Counts between May and July are incomplete and make estimation difficult. However, a range of several dozens to a few hundred pairs is possible.

The number of birds counted has increased between 1999 and 2002. This is due partly to the fact that better knowledge of the resting sites has facilitated better coverage. Nevertheless, combined counts from Lake Korgalzhyn, Sholak Lake Complex and the Northern Lake Chain, which have been covered reasonably well in all years but 2001 (when counts ended before expected peak numbers in September), gave 1,806 (1999), 2,006 (2000), 1,708 (2001) and 3,199 (2002) birds. This may indicate a true increase in autumn numbers, but may also be attributed to a possible shift of resting sites.

The number of White-headed Ducks using this area as a breeding and/or post-breeding staging site appears to have increased over the last few decades. Earlier counts gave a maximum of a few hundred birds during staging, and in the past few birds were believed to breed here (Dolgushin 1960; Krivitskij *et al.* 1985; Anstey 1989). A possible reason for this increase might be the rise in the water levels of Lakes Tengiz and Korgalzhyn after a period of very low water levels in the late 1980s and early 1990s. Higher water levels in Lake Korgalzhyn provides more suitable breeding habitat.

## The Tengiz population in a Central Asian context

As mentioned above, the Tengiz-Korgalzhyn Region holds a high proportion of the eastern Mediterranean/ Central Asian population of White-headed Duck. In addition to the local breeding population, possible origins of the birds that are present in autumn may be northern Kazakhstan, southern Siberia and Mongolia.

The Mongolian breeding population is estimated at c.250 pairs (Li & Mundkur 2003). Although the Tengiz-Korgalzhyn Region is located along a possible migration route to the wintering grounds in southwest Asia, it seems more likely that these birds choose a route further east, through eastern and southern Kazakhstan to Uzbekistan. This assumption is supported by recent observations from Lake Kyzylkol near Taraz (southern Kazakhstan), where 2,000-3,000 birds were counted in September 2001 and 2002 (Grieve, pers. comm.; Li & Mundkur 2003); numbers decline to about 800 birds in mid-October. As September is also the peak month in the Tengiz-Korgalzhyn Region, it seems likely that most of these records refer to different birds, presumably from the Mongolian populations; therefore birds from Mongolia may not contribute much to the aggregations in the Tengiz-Korgalzhyn Region.

The breeding population in northern Kazakhstan and southern Siberia was estimated to be c.230 pairs in the late 1980s (Gordienko 1998). It seems likely that birds of this population head for the Tengiz-Korgalzhyn Region to moult and/or pass through during migration. If this is the case, birds from that region might contribute about one third to one half of the estimated number of breeding pairs, which corresponds to the September counts.

The wintering grounds of the Tengiz-Korgalzhyn population are not known. In Uzbekistan there are counts of about 3,000 and more birds in late October, early April and July (Kreuzberg-Mukhina *et al.* 2001), but also over 1,000 in January (Li & Mundkur 2003). It is not known whether these are birds that move through the Tengiz-Korgalzhyn Region. Large numbers recently recorded in Azerbaijan (3,000 birds in winter 2002, Heinicke & Ryslavy 2002), Turkmenistan and Iran (Li & Mundkur 2003) indicate that birds from the Tengiz-Korgalzhyn Region might also take this route to the Caspian Sea wintering sites. Another possible wintering country for the Tengiz population is Turkey.

## Threats

The current conservation status of White-headed Duck in the Tengiz-Korgalzhyn Region is favourable; nevertheless some potential threats can be identified.

The size of the White-headed Duck population in the Tengiz-Korgalzhyn Region is influenced by the fluctuating hydrological conditions typical of arid regions; however, the large number of lakes in the region allows some degree

of movement to alternative sites within the region.

Artificial dams regulate the water level of Lake Korgalzhyn, which is the most important breeding site within the region. Inefficient water management may lead to lower water levels and unfavourable breeding conditions. The main supply to the region's lakes, the River Nura, is potentially threatened by water abstraction to meet the needs of the nearby and growing new capital city of Astana.

For many years the water quality of the Nura River has suffered from high pollutant loads, especially of mercury, originating from industrial pollution around the cities of Temirtau and Karaganda in its upper reaches. As a result of the economic situation that followed independence, pollution has been reduced. Unfortunately, as yet no reliable data on either the intensity or effect of pollution are available.

Disturbance to the White-headed Duck in its breeding habitats is minimal, because the areas are largely part of the nature reserve. But on lakes outside the reserve, mainly important as post-breeding staging sites, disturbance by fishermen and hunters can be considerable. For instance, in 2001 White-headed Ducks left Lakes Sholak and Kumkol in large numbers immediately after the start of the hunting season on 1 September and moved to other lakes. However, the White-headed Duck is listed in the Red Data Book of Kazakhstan and is therefore not a game bird itself, and disturbance seems to affect the species less than other waterfowl (eg geese and dabbling ducks). To date, hunting pressure has not been regarded a serious threat to the population.

Mortality due to drowning in fishing nets has been proved in a few cases (especially at Lake Kumdykol), and one young bird was found dead under an electric power line near Lake Sultankeldy in 1999.

## Conservation action

To ensure that the White-headed Duck population in the region continues to thrive, there needs to be a careful water management regime for Lake Korgalzhyn, both inside the reserve, for the whole watershed of the River Nura and within all the other small watersheds outside the reserve.

Additionally, disturbance on lakes with major concentrations of this species needs to be reduced to a minimum. The ban of fishing and hunting inside the reserve has to be enforced properly, and the establishment of tourism in the reserve needs to be carefully managed. Outside the reserve it would be suitable to reduce hunting to only a few lakes, simultaneously declaring other lakes as hunting-free zones, taking the preferences of the White-headed Ducks into account (eg Lakes Kumkol, Zhumaj and Sholak).

All these measures could be realised in connection with the current efforts to establish a UNESCO Biosphere Reserve comprising not only the existing reserve but also the whole

Tengiz-Korgalzhyn Region. This would mean the promotion of sustainable development, including issues of water management and land use, in the whole of the region. The key players in local conservation actions are the Administration of Korgalzhyn Nature Reserve, Rodnik - a local NGO, and NABU.

## Acknowledgements

The authors would like to thank NABU and the Administration of the Korgalzhyn Nature Reserve for their initiative and support for ornithological research. Further thanks go to the German volunteer organisation, ASA, for its financial assistance. We thank Axel Bräunlich, Andreas J. Helbig, Aleksej Koshkin, Jörg Ratayczak and Jürgen Steudtner for providing additional data and experience. Finally, we thank Timur Iskakov and Johannes Wahl for their valuable technical support.

## References

Anstey, S. 1989. The Status and Conservation of the White-headed Duck *Oxyura leucocephala*. IWRB Special Publication No. 10. International Waterfowl and Wetlands Research Bureau, Slimbridge, UK.

BirdLife International 2000. *Threatened Birds of the World*. Lynx Ediciones & BirdLife International, Barcelona, Spain, and Cambridge, UK.

Cresswell, W., Yerokhov, S., Berezovikov, N., Mellanby, R., Bright, S., Catry, P., Chaves, J., Freille, J., Gretton, A., Zykin, A., McGregor, R. & McLaughlin, D. 1999. Important wetlands in northern and eastern Kazakstan. *Wildfowl* 50: 181-194.

Dolgushin, I.A. 1960. *The birds of Kazakhstan*, Vol. I. Alma-Ata.

Gordienko, N.S. 1998. The modern status and tactics of conservation of rare bird species of Southern Trans-Uralia. In: *Rare Bird Species of Non-black Earth Center of Russia*. [In Russian.] Moscow; pp. 294-298.

Green, A.J. & Hunter, J. 1996. The Declining White-headed Duck: A call for information. *Threatened Waterfowl Specialist Group News* 9: 16-18.

Heinicke, T. & Ryslavy, T. 2002. Bird Observations in Azerbaidshan - Report on an ornithological survey from 24th February to 11th March 2001. Unpublished report.

IUCN 2000. *IUCN Red List of Threatened Species*. The World Conservation Union, Gland.

Kreuzberg-Mukhina, E., Lanovenko, E., Filatov, A. & Zagrebin, S. 2001. Status and Distribution of the White-headed Duck in Uzbekistan. *Threatened Waterfowl Specialist Group News* 13: 46-48.

Krivitskij, I.A., Khrokov, V.V., Volkov, E.N. & Zhulij, V.A. 1985. *Birds of the Kurgalzhinskj Zapovednik*. Alma-Ata.

Li, Z.W.D. & Mundkur, T. 2003. *Status Overview and Recommendations for Conservation of the White-headed Duck (Oxyura leucocephala) in Central Asia*, Wetlands International Global Series No. 15. Wetlands International, Kuala Lumpur.

Wetlands International 2002. *Waterbird Population Estimates*, 3rd edn., Wetlands International Global Series No. 12. Wetlands International, Wageningen, The Netherlands.

**Appendix 1.** Sites within regions described in Table 1. Lakes used for the depiction of phenology are marked with an asterisk (*).

| Region | Site | Co-ordinates |
|---|---|---|
| Kulanutpes Delta | Karachi Bay | 50°19.2'N/69°15.7'E |
| | Kerej Peninsula Centre | 50°15.7'N/69°08.1'E |
| | Kerej Peninsula East | 50°15.7'N/69°10.6'E |
| | Lake Karachi-Kyzylkol | 50°20.2'N/69°17.1'E |
| Sholak Lake Complex | Lake Birtaban | 50°27.5'N/70°00.1'E |
| | Lake Koktal | 50°27.9'N/69°54.8'E |
| | Lake Shalkar* | 50°26.2'N/69°56.6'E |
| | Lake Sholak* | 50°33.5'N/69°47.9'E |
| Lake Korgalzhyn | Abilajskaya Plotina Lakes | 50°25.4'N/69°18.8'E |
| | Lake Aktobe* | 50°25.4'N/69°39.1'E |
| | Lake Asaubalyk | 50°24.8'N/69°14.9'E |
| | Lake Isej* | 50°29.3'N/69°38.8'E |
| | Lake Isej (NE bay)* | 50°32.4'N/69°39.5'E |
| | Lake Kokaj | 50°27.8'N/69°24.4'E |
| | Lake Sultankeldy* | 50°29.4'N/69°31.0'E |
| | Lake Korgalzhyn (cntr east) | 50°25.2'N/69°33.5'E |
| | Lake Zhamankol* | 50°27.8'N/69°33.0'E |
| | Lake Korgalzhyn (cntr west) | 50°27.4'N/69°28.0'E |
| | Lake Taban* | 50°28.0'N/69°34.7'E |
| | Kolshunskaja Plotina | 50°24.3'N/69°22.8'E |
| | Lake Kyzylkol | 50°20.0'N/69°41.5'E |
| Lakes east of Lake Korgalzhyn | Lake Kumdykol | 50°32.4'N/70°43.7'E |
| | Lake Kurajly | 50°24.2'N/70°12.4'E |
| | Lake Ntgis | 50°31.4'N/70°40.7'E |
| | Lake Kambak | 50°23.7'N/70°34.9'E |
| | Lake Bestobe | 50°40.9'N/70°27.8'E |
| Northern Lake Chain | Lake Ashchykol* | 50°44.2'N/69°59.3'E |
| | Lake Bajbota | 50°42.9'N/69°52.0'E |
| | Lake Kumkol* | 50°45.8'N/70°04.3'E |
| | Lake Saumalkol* | 50°40.3'N/69°43.4'E |
| | Lake Zhumaj* | 50°41.4'N/69°49.0'E |
| Others | Lake Korzhynkol | 51°41.4'N/68°55.2'E |
| | Lake Sulukol | 49°47.0'N/69°44.3'E |