

Distribution and Population Trends of Pygmy Cormorant *Phalacrocorax pygmaeus* in Central Asia, with Particular Reference to the Republic of Uzbekistan

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Abstract: As a result of the disastrous reduction of the Aral Sea and associated habitat degradation, the population of Pygmy Cormorants *Phalacrocorax pygmaeus* that formerly occurred in the Aral Sea and Amudarya delta declined rapidly. Since the mid-1980s, immigration and the colonisation of new sites has occurred in southwestern, southern and central Uzbekistan, linked to the recently-constructed irrigation reservoirs that were essential to support agricultural development. This establishment of new geographical sub-populations continues, enabling the species to continue to expand its breeding, migration and wintering ranges. An assessment has been conducted of the current status of the Central Asian meta-population of Pygmy Cormorants to examine the main directions and mechanisms of colonisation; some predictions are made of the likely scenario of future population evolution.

Keywords: Pygmy Cormorant, *Phalacrocorax pygmaeus*, Central Asia, Uzbekistan, range, population trend, meta-population structure.

INTRODUCTION

The Pygmy Cormorant *Phalacrocorax pygmaeus* occurs not only in coastal areas and adjacent freshwater reservoirs and river deltas of the Mediterranean Sea (the Balkan States, Turkey, Israel), the Black Sea (Bulgaria, Romania, Turkey, Ukraine), the Sea of Azov (Russia), the Caspian Sea (Russia, Azerbaijan, Kazakhstan, Iran), and the Aral Sea basin (Uzbekistan, Kazakhstan, Turkmenistan, Tajikistan) in steppe, semi-desert and desert zones, but also inland in Eastern and Central Europe where a warm continental climate predominates. Currently its European population is estimated at about 60,000–81,000 birds, with the 1% threshold for identification of sites of international importance set at 700 birds (Delany & Scott 2006). No precise estimate is available for the size of the West Asian population, but this is believed to number between 25,000 and 100,000 birds; a provisional 1% threshold of 1,000 has been

selected, based on the top end of the range (Delany & Scott 2006). The aim of this paper is to derive a valid assessment of population numbers in Central Asia through evaluation of historical (1960s–1970s) and recent (1980s–2000s) information on geographical distribution, numbers and trends.

MATERIAL AND METHODS

The basic data for this paper were collected during 32 field expeditions in the period 1995–2006. These covered almost all waterbodies in the plains of Uzbekistan, and were supported by a variety of sponsors, including the Chicago Zoological Society, the German Nature Conservation Union (NABU), the Agricultural Department of the Royal Netherlands Embassy in Moscow, Wetlands International, IUCN (Netherlands National Committee), the Royal Society for the Protection of Birds (RSPB), GEF/World Bank and the Ornithological

Society of the Middle East, Caucasus and Central Asia (OSME).

The bird counts employed standard ornithological techniques including route counts conducted by vehicle, by boat and on foot, and point counts. The observers used binoculars with 10x and 12x magnification in the route counts, and zoom telescopes with 30–45x and 20–60x magnification in the point counts.

The systematic collection of data throughout Uzbekistan since 2005, as part of the Central Asian Important Bird Area (IBA) programme, has better determined population trends for Pygmy Cormorant, trends have been reinforced by information gathered in other Central Asian countries at about the same time.

COUNTRY OVERVIEW

Prior to the above studies, the main breeding population of the Pygmy Cormorant in Central Asia was as shown in Fig. 1 (and Fig. 2, crossed circles). The species was distributed around the shores of the Aral Sea and in the large delta lakes of the Amudarya and Syrdarya river basins, mostly in Uzbekistan. In Kazakhstan, the breeding areas included the eastern Aral Sea and the delta and lower courses of the Syrdarya River, but by the end of the 1950s, the Pygmy Cormorant had ceased to nest there (Markov 1965). These populations wintered in southern Central Asia – southern Tajikistan and in the Caspian in southwest Turkmenistan (Shernazarov 2007). The proximate cause of the drastic decline in the region's breeding populations was the rapid shrinkage of the Aral Sea.

The coastline and many islands which served in the past as habitat for waterbird species were transformed into lifeless saline desert. These changes firstly affected colonial breeding species such as pelicans, cormorants and herons. These birds lost most of their traditional habitat (wetlands with reed-beds) and their populations were severely reduced. The Pygmy Cormorant population was severely affected by the Aral Sea crisis, and almost disappeared from this area.

In Kazakhstan, the Pygmy Cormorant is a scarce breeding migrant, few in number and irregularly distributed in wetlands in the semi-desert and desert zones. It nests in the Syrdarya River valley, and probably in the Ural River delta, as well as close to the town of Atyrau on the Caspian Sea (Gavrilov & Gavrilov 2005). It is notable that during wide-scale research in Kazakhstan in 2006, the Pygmy Cormorant was recorded only a few times:

- On Shalkar Sor in the Tengiz River valley in July (Erokhov & Gavrilov 2007).
- One bird seen in a flock of Great Cormorants *P. carbo* in Korgaljin Nature Reserve in September (Koshkin 2007).
- 47 birds recorded at Chardara Reservoir in February (Kovalenko & Kravchenko 2007).

In Kazakhstan, the Pygmy Cormorant is listed for only three IBAs – 3% of the 100 IBAs in the plains. (Kazakhstan has a total of 121 IBAs; BirdLife International 2008). One of the three IBAs is in the Kazakh Volga Delta and hosts birds belonging to the Caspian Sea population, but the other two – Chardara Reservoir and Akzhan Lake in southern Kazakhstan - host birds of the Aral Sea population; here some 600 to 1,500 Pygmy Cormorants have been recorded in winter or on migration (Table 1). The species is not listed for many other sites where it might occur: the Lesser (northern) Aral Sea, Syrdarya Delta and Shoshkakol Lakes. In central Kazakhstan (Sorbulak Lake, Tengiz-Korgalzhyn region and Kolykol Lake), it is an occasional migrant (Gavrilov & Gavrilov 2005).

In Tajikistan, the Pygmy Cormorant was once numerous, wintering in the south, in the Vakhsh River valley, but as a result of dam construction regulating the flow of the river, the lakes in southern Tajikistan became so degraded that the species ceased to winter there (Shernazarov 2007). It is now found only on two of the five IBAs on the Tajik plains (Tajikistan has a total of 18 IBAs; BirdLife International 2008), namely Kayrakkum Reservoir in the Fergana Valley (Syrdarya basin) and on the lakes of Tigrovaya Balka Nature Reserve in the lower reaches of the Vakhsh River-Amudarya basin. The winter counts of 2003 and 2004 revealed 400–700 and 170–630 birds respectively (BirdLife International 2008) (Table 1).

In Turkmenistan, Pygmy Cormorants were recorded wintering in small numbers (34–75 individuals) on the lakes of the middle Amudarya River basin and in Gassan-Kuli Bay (Caspian Sea) in the 1970s and 1980s (Karavaev 1991, Rustamov & Khakyevev 1978), but nowadays, the species occurs mostly on irrigation lakes or reservoirs that have been constructed for agricultural development since then. Most reservoirs are in the lower and middle course of the Amudarya River along the border with Uzbekistan or in the centre of the Republic along the Karakum Canal. Its current status in bays on the Caspian Sea is not clear. The Pygmy Cormorant is listed for nine IBAs in Turkmenistan, some 20% of the 44 IBAs on the plains (Turkmenistan has a total of 50 IBAs; BirdLife International 2008). It breeds in four IBAs, and has been observed as a migrant or wintering bird in the other five, its numbers fluctuating from 700–800 to 2,500 individuals. An increase in numbers has been noted at recently-constructed artificial wetlands.

In northern Kyrgyzstan, Gavrilov & Gavrilov (2005) reported that in 1967 the Pygmy Cormorant was an occasional migrant in the Chu River Valley.

In Uzbekistan, although the Pygmy Cormorant has disappeared from parts of its former range in the north as a result of transformation of the habitat, it has successfully colonized many of the recently-constructed reservoirs in desert regions. Since the 1970s and 1980s, it has been found at the Khoresm oasis and on the Amudarya, Zarafshan and Kashkadarya rivers, in the middle reaches of the Syrdarya River and in southern Uzbekistan (Sagitov 1987). Nowadays, it inhabits the larger lakes and reservoirs that lie on the plains at quite some distance from the Aral Sea. Pygmy Cormorants were first recorded in winter in the late 1980s, but are now often observed in large numbers at this season. The Pygmy Cormorant occurs in 19 of the 35 IBAs on the plains of Uzbekistan (Uzbekistan has a total of 48 IBAs; BirdLife International 2008), but it is also found on many wetlands that do not have IBA status.

From the above overview, it is clear that the current distribution of the Pygmy Cormorant includes a significant expansion to the south, and that the core of the Central Asian population is in Uzbekistan. An analysis follows of the species' distribution and population trends in Uzbekistan.

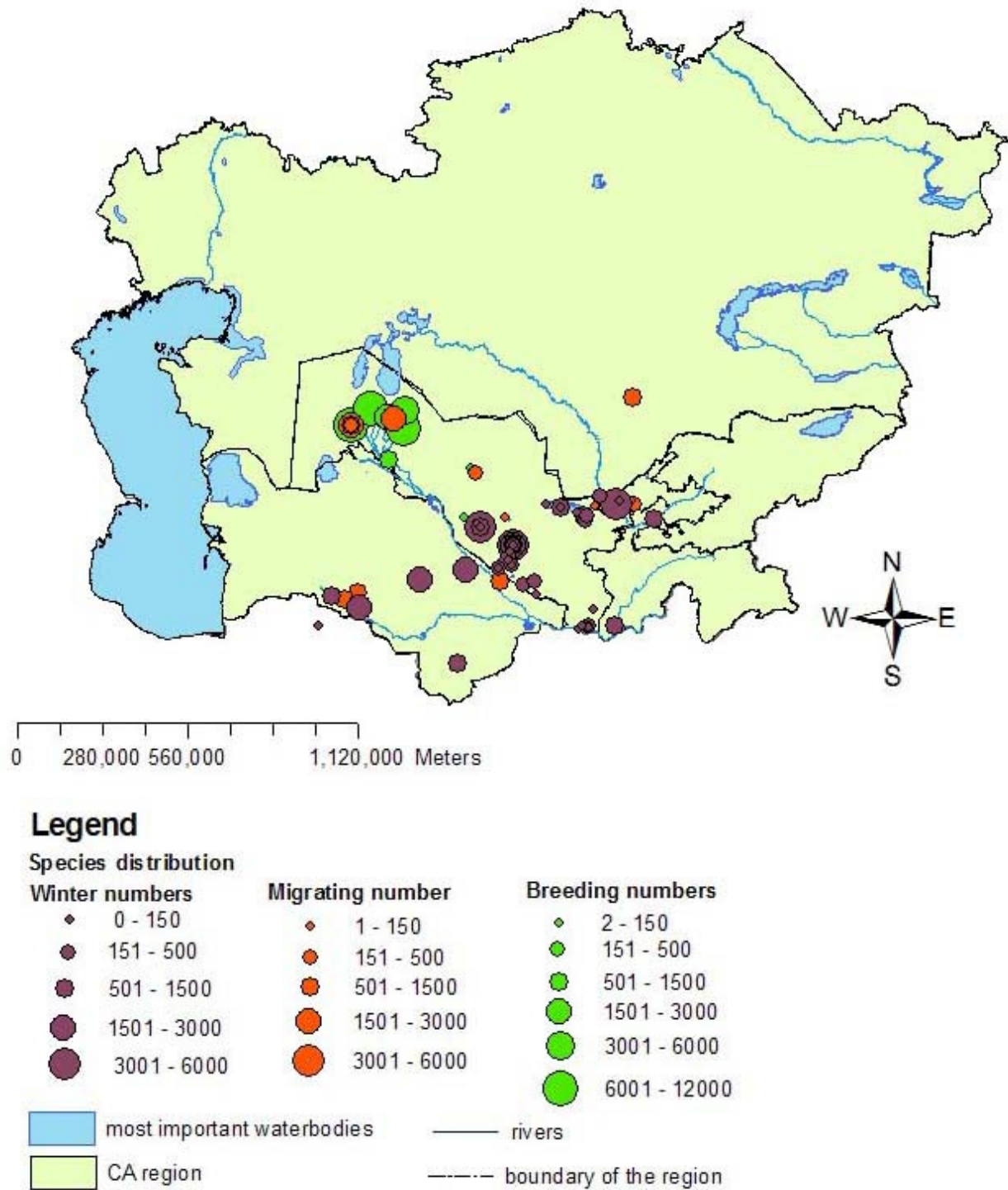


Figure 1. Current distribution of Pygmy Cormorant in Central Asia.

Table 1. Pygmy Cormorant occurrence in Central Asian IBAs (Aral Sea basin population). B= breeding birds recorded, not counted; N= non-breeding birds recorded, not counted; P= passage birds recorded, not counted; W= wintering birds recorded, not counted.

IBA	Coordinates	Area (ha)	Type of habitat	First record	Breeding (pairs) 1999–2006	Passage (individuals) 1999–2006	Winter (individuals) 1999–2006	Criteria (based on current status)
UZBEKISTAN								
Sudochie	43°29'N,58°31'E	46,467	lake	1936	600–900	2800+		A4i
Zholdyrbas	43°30'N,59°49'E	29,723	lake	1916	1,500	3000		A4i
Aksay	42°05'N,63°00'E	350	lake	2000	N	P		-
Rogatoe	41°57'N,63°19'E	3,861	lake	1990		40–500		A4i
Karakyr	40°24'N,63°29'E	64,242	lake	1987	10–80	P	5,560	A4i
Kagan fish farm	39°47'N,64°41'E	1,763	ponds	1998	50	50–1500	common	A4i
Tudakul, Kuyumazar	39°51'N,64°50'E	33,648	reservoirs	1996	22–300	40–3200	3,200	A4i
Djeiran Ecocentre	39°37'N,64°39'E	5,145	lakes	1984		4–100		
Zekry	39°15'N,64°40'E	1,555	lake	2000	B	P	26–188	
Achinskoe	38°41'N,65°04'E	6,363	lake	1997	33	P	33–385	
Talimarjan	38°22'N,65°34'E	8,040	reservoir	2004			6	
Amudarya near Termez	37°23'N,67°00'E	10,623	river	2001	B	P	30–163	
Aktepe	37°25'N,67°29'E	2,987	reservoir	2001	1–5	P	149-751	
South Surhan	37°51'N,67°39'E	1,208	reservoir	2001	N	P	15–579	
Tuzkan	40°40'N,67°32'E	107,732	lake	1998	850	500–1000	500–1000	A4i
Arnasay	40°51'N,67°50'E	31,706	lakes	2000	4–60	8	152	
Northern Aydar	40°59'N,66°52'E	158,198	lake	1998	B	2,500	500	
Balikchi fish farm	40°53'N,68°45'E	4,446	ponds	2000	N	3,249	3,287	A4i
Tuyabuguz	40°58'N,69°19'E	1,450	reservoir	2001		100–200	100–200	
KAZAKHSTAN								
Akzhar	43°59'N,69°45'E	25,714	lakes	2006		600-1,000		A4i
Chardara	41°10'N,68°11'E	96,010	reservoir	2003		P	20-500	A4i
TAJIKISTAN								
Kayrakkum	40°24'N,70°11'E	115,216	reservoir	2004		396-693	396-693	A4i
Tigrovaya Balka	37°19'N,68°27'E	45,943	river, lakes	2003		176-630	176-630	A4i
TURKMENISTAN								
Deryatakyr	38°21'N,58°52'E	6,871	reservoir	2006		10-1500		A4i
Gorelde	40°39'N,62°50'E	23,546	river	2000	B			
Gurtli	38°10'N,58°22'E	1,421	reservoir	2006		700		A4i
Kattashor, Romankul	39°06'N,62°55'E	12,123	lakes	2005	B	2,000	2,000	A4i
Kopettdag-khovudan	38°14'N,57°52'E	4,407	reservoir	2006		750	750-800	A4i
Mergen	37°55'N,58°56'E	289	lakes	1996		12-2500	12-2,500	A4i
Muskinata	42°17'N,59°50'E	901	river	2007	1,000			A4i
Saryyazy	36°22'N,62°38'E	7,601	reservoir	2006	1,100	1,100	1,100	A4i
Soltandag, Kyzylburun	38°47'N,64°11'E	11,695	lakes	2006	B	P	W	

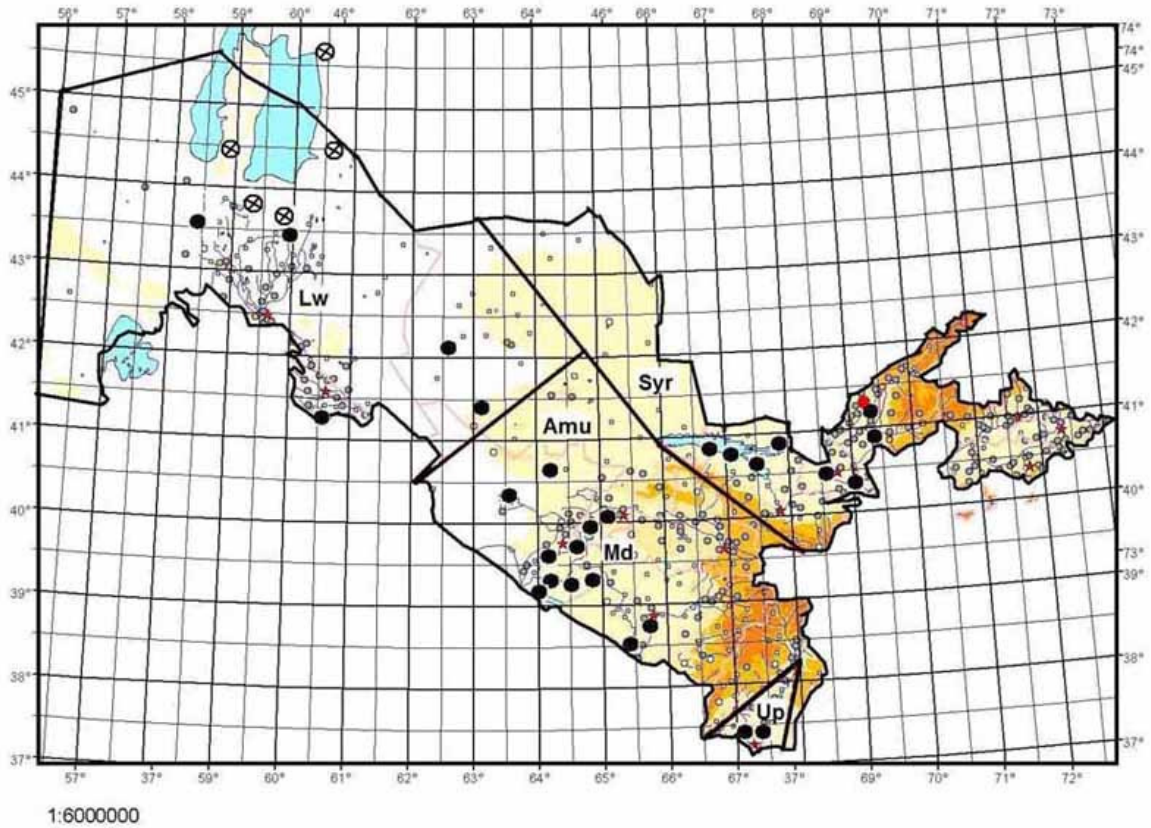


Figure 2. Distribution of the Pygmy Cormorant in Uzbekistan. Key to symbols: ⊗ crossed circle – past occurrence of Pygmy Cormorant; ● solid circle - current habitats of Pygmy Cormorant in Uzbekistan, **Amu** - Amudarya River basin; **Lw** – lower Amudarya River basin, **Md** – middle Amudarya River basin, **Up** - upper Amudarya River basin; **Syr** – Syrdarya River basin.

UZBEKISTAN

Northern Uzbekistan (the lower Amudarya River basin and the Central Kyzylkum desert) (Fig. 2)

The Pygmy Cormorant formerly bred in the Aral Sea region (Zarudny 1916, Spangenberg & Feigin 1936, Dolgushin 1960, Kenjegulov 1965), but the size of the population was never calculated (Sagitov 1987). Information on the numbers of Pygmy Cormorants in the Aral Sea region is ambiguous. On the one hand, many sources suggest that it was an uncommon species, breeding in low numbers in the wetlands of the Amudarya Delta and on islands in the Aral Sea (Markov 1965, Sagitov 1987, Shernazarov 2007). On the other hand, Lukashevich (1990), who carried out research in the Amudarya Delta reservoirs in 1987–90, estimated that there were 26,000–32,000 pairs of Pygmy Cormorants at several breeding colonies in the Sudochie,

Karajar and Toguzture lakes; at Sudochie Lake alone, the breeding population was estimated at some 10,000–12,000 pairs. In 1999–2002, Pygmy Cormorants were observed at Sudochie Lake in almost every season of the year, but numbers fluctuated widely according to water levels, from almost 3,000 individuals down to zero (in autumn 2001) when drought severely desiccated the reservoir (Kreuzberg-Mukhina & Lanovenko 2007) (Tables 2& 3). Even rough approximations indicated that there were many fewer birds than had been found by Lukashevich (1990) in the late 1980s. However, a survey in August 2005 showed that Pygmy Cormorants were present at six wetlands in northern Uzbekistan (four lakes in the Amudarya Delta and two in Central Kyzylkum) where again their numbers varied depending on the condition of the wetlands (Table 2).

Table 2. Pygmy Cormorant counts in Uzbekistan.

Month ► Wetland ▼	Sep 1996	Jun 1997	May 1998	Jan 2000	Apr 2000	Mar 2001	Aug 2001	Dec 2001	Jan 2002	Jan 2003	Jan 2004	Sep 2004	Jan 2005	May 2005	Aug 2005	Jan 2006	June 2006
NORTHERN UZBEKISTAN (lower Amudarya River basin and Central Kyzylkum desert)																	
Dautkul															15		
Zholtyrba s															60		
Achikul															1900		
Sudochie					270		333								1341		
Aksay															16		
Rogatoe															5		
Subtotal					270		333								3337		
CENTRAL UZBEKISTAN (middle Syrdarya River basin)																	
Aydar						67	5	507		90		40					
Tuzkan			4	189	180	15	261	411		650		785				894	
Arnasay											260						176
Syrdarya					35			41		25		448					
Balikchi fish farm														721	3249	3287	
Rokhat								100	34								
Subtotal			4	189	215	82	266	1059	34	765	260	1273		721	3249	4181	176
SOUTHWEST UZBEKISTAN (middle Amudarya River basin)																	
Tudakul	102	44		3258	404			3092	89	2287	3141	119	1019	64	162	3982	
Kagan fish farm																	1500
Hadicha	421	26		757					825	23	20	1126	105	226	918	1450	
Achinsko e		10									473		485				
Karakyr		8	4	35	20			786				12	26	91		5560	169
Shorkul									118							33	
Dengizkul										15	220		12				
Zekry, Deukhona										26	53	6	83	24	118	188	
Ayak- agitma					1										67		
Talimarja n											6						
Karshi ponds											221						
Subtotal	523	88	4	4050	425			3878	1032	2351	4134	1263	1730	405	1298	11180	1669
SOUTHERN UZBEKISTAN (upper Amudarya River basin)																	
Uch-Kyzyl						2			19	39							
Aktepe						197			65	144	366	1	751				11
South Surkhan						1				15			579				
Amudarya									111	188							
Other						36			64	42							
Subtotal						236			259	428	366	1	1330				11
TOTAL	523	88	8	4239	857	318	599	4937	1291	3544	4760	2537	3060	1126	7884	15361	1856

Table 3. Pygmy Cormorant counts in Sudochie (Northern Uzbekistan, Amudarya delta)

Month ► Wetland ▼	Oct 1999	Apr 2000	Jul 2000	Oct 2000	Apr 2001	Aug 2001	Oct 2001	Apr 2002	Jul 2002	Oct 2002	Aug 2005
Sudochie	2043	270	1718	274	1025	333	0	2727	4	676	1341

At Rogatoe and Aksay lakes in Central Kyzylkum, Pygmy Cormorants were recorded only during migration from the Aral Sea region to more southerly waterbodies, with numbers fluctuating from 40 to 500 individuals in the period 1979–2006 (O.V. Mitropolsky, pers.com.). As of 2008, the Pygmy Cormorant still breeds at some wetlands in the Amudarya Delta, where its numbers fluctuate sharply, reflecting the unstable environmental conditions. It also still appears on lakes in Central Kyzylkum, but only during the migration seasons.

Southwest Uzbekistan (the middle Amudarya River basin) (Fig. 2)

In Bukhara Region, the Pygmy Cormorant was very rare in the past, and was recorded only during the migration seasons and not in winter (Sagitov 1987). However, it moved into this region after the deterioration of the main breeding habitat in the Aral Sea region. The first nesting attempt in northern Bukhara Region was recorded at Karakyr Lake in 1987; two colonies were located, holding 18 and 23 nests respectively. The incubation stage lasted until early May, but chicks appeared in only a few nests (Sagitov *et al.* 1989). In 1990, there were only 18 nests (Shernazarov 2007), but nowadays, the Pygmy Cormorant is a common breeding and wintering species in increasing numbers (E.N. Lanovenko, pers. com.). The first records of Pygmy Cormorants in southern Bukhara Region were reported from the Alan Lakes in October 1987 and January 1988; 106 and 309 birds respectively (Shernazarov & Nazarov 1990).

An analysis of data from the Djeiran Ecocentre Breeding Reserve (in the southern Kyzylkum Desert, 42 km southeast of Bukhara) shows that the Pygmy Cormorant was very rare in this area in the early 1980s (Mukhina & Lukashevich 1989), but afterwards became more common. It occurred only on small lakes, that have appeared recently as a result of water seepage from the Amu-Bukhara Canal into

nearby low-lying depressions. Spring migration lasted from late February to early May, the earliest record being 27 February 1994 and the latest being 11 May 1990. The peak of the spring migration was observed during March, when flocks comprising from five to 40 individuals stopped at the small lakes to feed. Individuals at the Ecocentre lakes in July and August 1992 and 1993 came from nearby breeding sites at Hadicha Lake, some 30 km away. Autumn migration was recorded at the Ecocentre from 8 October to 5 December, and involved mostly small flocks of from 10 to 40 individuals (Kreuzberg-Mukhina 2000).

In May and June 1997, five nests were found at Achinskoe Lake, in the south of Bukhara Region on the border of Kashkadarya Region. Adult birds were observed at three other reservoirs - Karakyr, Hadicha, Tudakul - where they might have bred. For example, at Tudakul Lake, 44 adult Pygmy Cormorants were recorded in 1997, but no attempt was made to discover if they had bred. About 30–35 pairs bred here in 2001 and about 60 pairs in 2003 (M. Turaev, pers. com.).

During surveys in the wetlands of southwestern Uzbekistan in the period 2000–2006, mostly carried out in winter, the Pygmy Cormorant was found on 12 large reservoirs, which represent the majority of waterbodies in this region (Table 2), and also on many small unnamed ponds and pools. On occasion, the species formed significant wintering assemblages of from several hundred to over 5,000 birds at a single location to feed or to roost overnight.

In April and May 2005, breeding colonies with a combined total of 304 adults were observed at Tudakul, Karakyr, Zekry and Hadicha lakes (Table 2). In August 2005, the numbers of Pygmy Cormorants at Tudakul and Hadicha lakes were 162 and 918 respectively (O.V. Mitropolsky, pers. com.). The most recent observations indicate that the migration in this region starts in September, when birds are present

on many reservoirs. Elsewhere, in 2006 about 50 pairs bred at Kagan Fish Farm (not far from Tudakul Lake), where between 50 and 1,500 Pygmy Cormorants were noted on migration in 2004-2006 (M. Turaev, pers. com.).

In Kashkadarya Region, the species was recorded in small numbers in the southern plains - on Talimarjan Reservoir and on ponds near the town of Karshi - during winter wetland surveys (Table 2). It also appeared on migration and in the breeding season on Kattakurgan Reservoir in the Zarafshan River valley (N.V. Marmazinskaya, pers. com.), but in January 2006 we recorded only one bird, on Sabersay Reservoir not far from the above site.

Since it started breeding on Karakyr Lake in 1987, the Pygmy Cormorant now nests on six reservoirs: Karakyr, Tudakul, Zekry, Achinskoe and Hadicha lakes and Kagan Fish Farm; it has gradually shifted from the northern to the southern border of southwestern Uzbekistan where it can now be expected at many waterbodies during the migration seasons, although it prefers to keep to the larger reservoirs in winter. All surveys conducted since 1997 have shown changes in the distribution of the species and a gradual increase in its numbers in southwestern Uzbekistan following the decline of the Aral Sea population in the 1970s and 1980s (Table. 2).

Southern Uzbekistan (upper Amudarya River basin) (Fig. 2)

In Surkhandarya Region in the summers of the 1960s, the Pygmy Cormorant was found in small numbers by Kh.S. Salikhbaev and M.M. Ostapenko on lakes in Sherabad District and in the flood-lands of the Surkhandarya River, but breeding was not proved (Sagitov 1987). During our survey in February 2001, wintering birds were found in small numbers on the lakes in the Amudarya flood-lands near the town of Termez and on small pools adjacent to agricultural land (Table 2). Our surveys during the period 2001–2006 showed that the numbers of wintering birds were gradually increasing (Table 2). However, no surveys were made in summer, the only one recorded being in September 2004 during a survey at Ak-tepe Lake. Breeding first took place

at Ak-tepe Lake and at small pools across the Amudarya River, near the Afghanistan border, in 2005 and 2006 (E.N. Lanovenko, pers. comm).

Central Uzbekistan (middle Syrdarya River basin) (Fig. 2)

Our surveys in the Syrdarya River basin during the period 1996-2004 recorded the first breeding attempt by Pygmy Cormorants in May 1998, when two nests were located in the northwestern part of Tuzkan Lake (Mukhina & Lanovenko 1998). The species had not been recorded here during surveys in 1996 and 1997. However, 189 and 180 Pygmy Cormorants were recorded during birdwatching trips in January 2000 and April 2000 respectively. Furthermore, 35 birds were observed on the Syrdarya River near the town of Chinaz in April 2000, and combined totals of 82 and 266 Pygmy Cormorants were observed at the Aydar and Tuzkan lakes in March and August 2001 respectively (Table 2). Moreover, a colony of about 100 nests was found on Tuzkan Lake. In December 2001, 411 Pygmy Cormorants were recorded at Tuzkan Lake and 507 at Aydar Lake. In January 2003, a concentration of 650 Pygmy Cormorants was located in flooded tamarisk trees beneath the Pitalitau highlands on the southern shore of Tuzkan Lake, 90 birds were counted in the bays of Aydar Lake and 25 were recorded along the Syrdarya River near Chinaz. In May 2003, 725 Pygmy Cormorants were recorded in one small bay near the breeding colony at Aydar Lake during one day excursion, but special survey was not conducted. On 1–5 October 2004, 1,273 Pygmy Cormorants were counted during a survey between Tuzkan Lake and Aydar Lake, the species occurring on small temporary pools along roads in the Mirsachul (Golodnaya) steppe, close to towns and villages.

Surveys of the Arnasay Lakes recorded 260 individuals in the winter of 2004, 176 in the spring of 2006, and 117 in the summer of 2006, the latter evidently being breeding birds (A.K. Filatov, pers. com.). The species also appeared at Tuyabuguz Reservoir on the Akhangaran River, south of Tashkent, and at Rokhat Reservoir on the Chirchik River on the southern edge of Tashkent (Table 2).

At Balikchi Fish Farm on the right bank of the Syrdarya River south of Tashkent, the numbers of Pygmy Cormorants have grown steadily from small numbers in 1997 to 721 birds in June 2006. These birds are all non-breeders that have come from other sites along the Syrdarya River where they probably breed. This section of the right bank of the Syrdarya River attracts many passage and wintering Pygmy Cormorants, with over 3,000 being recorded in 2006 (E.Sh. Shernazarov, pers. comm.).

Thus, in the middle Syrdarya basin, the Pygmy Cormorant appeared 10 years later than in the middle Amudarya, the first confirmed nests being found in May 1998 at Tuzkan Lake. Since then, the species has spread to the vicinity of Aydar Lake, to other reservoirs of the Arnasay Lakes and across the Syrdarya River, breeding at the large reservoirs of Aydar Lake, the Arnasay Lakes and Tuzkan Lake. Outside the breeding season, Pygmy Cormorants occur very widely on many waterbodies in the region, either during their seasonal migrations or in winter (Table 2).

Population assessment

Surveys of breeding colonies of Pygmy Cormorants are difficult because the species nests in remote and dense reed-beds, often difficult of access. Counts of wintering birds are therefore of great value in assessing the total size of the population. Such counts in Uzbekistan indicate that the numbers of wintering birds have increased from 4,000–4,500 individuals in 2000 to 15,500 in 2006 (Table 2). By extrapolation, we can estimate that in neighbouring countries and only in recognised IBAs, there are about another 8,300–10,000 birds that can be added to the winter totals (Table 1). This allows us to conclude that the total population of Pygmy Cormorants in Central Asia may amount to at least 15,000–25,000 pairs.

DISCUSSION

The over-extraction of groundwater in a non-sustainable manner led to the greatest disaster in Central Asia, causing the Aral Sea and the Amudarya and Syrdarya deltas to diminish

drastically, largely destroying those parts of the natural ecosystem that were water-dependent year-round. Agricultural development and the over-exploitation of water resources for irrigation in the middle and upper Amudarya and Syrdarya rivers since the mid-1960s reduced the average river flow into Aral Sea to 10% of its former level, decreasing the Sea's area by about 75%, reducing the volume from 1,064 km³ to 115 km³, lowering the surface from 53.46 m to 22 m a.s.l., and increasing the salinity by 6 to 12 times. As a result, the Aral Sea became two separate waterbodies. The total area of the delta lakes was reduced by half, and some 60 lakes of high biological productivity totalling over 600 km² in area disappeared through desiccation. The overall effect was to change the climate of the Aral region to continental semi-desert, with a consequent impoverishment of species communities and huge loss of biodiversity (Anonymous 2006).

The breeding population of Pygmy Cormorant in the Aral Sea area declined due to widespread habitat degradation and almost disappeared from the region. The first consequence of this decline was the appearance of unexpectedly high numbers of breeding colonies on the Amudarya Delta lakes, as reflected by R.V. Lukashevich (1990). However, these colonies later also declined, because of the inexorable degradation of Aral Sea and the associated delta lakes. However, more or less at the same time, new water-storage reservoirs were being constructed in the desert regions in southwestern, southern and central Uzbekistan. These forming habitats were settled gradually by desert invertebrate and fish species of the region, thus steadily becoming attractive to waterbird species, in particular at certain sites to the Pygmy Cormorant. This fortuitous accident quite effectively compensated in part for the lost natural habitats. The species gradually colonized the river basins from north to south, appearing in the Amudarya River basin in the 1980s and in the Syrdarya River basin in the 1990s, and taking only about 10 years to occupy all suitable artificial reservoirs. This range expansion became more widespread and perceptible in the early 2000s (Table 1), and clearly demonstrates how a

new population may be formed. Immigration and colonisation of new sites has created new breeding sub-populations. At the time of writing, the meta-population of Pygmy Cormorants in the Aral Sea basin can be divided into four breeding sub-populations:

- The lower Amudarya River sub-population (shared between Uzbekistan, Kazakhstan and Turkmenistan).
- The middle Amudarya River basin sub-population (shared between Uzbekistan and Turkmenistan).
- The upper Amudarya River basin sub-population (recently-formed on the borders of Uzbekistan, Afghanistan, Turkmenistan and Tajikistan).
- The middle Syrdarya River basin sub-population (shared between Kazakhstan, Uzbekistan and Tajikistan).

In the early stages of the formation of such sub-populations, instability was apparent, a cycle whose diminishing is dependent on immigrant inflow, well described by the term “rescue effect” (Brown & Kodric-Brown 1977). Subsequently, in safe and undisturbed conditions, the sub-populations become relatively more stable (e.g. in the middle Amudarya and middle Syrdarya river basins), as shown by the regular annual surveys. As expected, the most recent survey data have shown that the connections between sub-populations weaken.

That the Pygmy Cormorant occurs not only on large reservoirs possessing developed reed-beds, but also near towns and villages on small drainage pools that lack much vegetation, suggests that the species is attracted not only by the presence of suitable breeding places, but also by the existence of a good food base, especially small fish. In the 1970s, two small fish species were introduced into Uzbekistan to control malarial mosquitoes. These were the Eastern Mosquitofish *Gambusia holbrooki* and Chinese False Gudgeon *Abbottina rivularis*, both of which rapidly reproduced in artificial shallow waterbodies and quickly occupied all the reservoirs on the southern plains. We assume that there is a direct link between the sharp increase in the populations of small fish in the shallow

wetlands of the agricultural development zone and the expansion of the Pygmy Cormorant’s range. This serves as an explanation of why the Pygmy Cormorant population shifted southwards, but not to the east or north. We suggest that fish stocking of Aydar Lake with Roach *Rutilus rutilus* in the 1990s enabled the Pygmy Cormorant to colonise the middle Syrdarya basin reservoirs in the late 1990s.

In Central Asia, there has also been a tendency in the Pygmy Cormorant for wintering populations to shift northwards. The appearance of new reservoirs in the southern frostless regions of Uzbekistan and Turkmenistan has created suitable conditions for the species to overwinter, when previously it had only passed through on migration to spend the winter in more southerly regions (Sagitov 1987, Shernazarov 2007). Such wetlands are utilised by Pygmy Cormorants primarily as wintering sites and stopover places, but gradually the species has begun to nest there and become a year-round resident.

Modern strategies for water-use in Uzbekistan plan to improve the efficiency of water and land utilisation, a policy that could see some drainage reservoirs being reclaimed. Prime candidates include the huge Aydar Lake and many of the smaller lakes that serve as new habitat for the Pygmy Cormorant. In any case, some lakes in the industrial development zones in southwestern Uzbekistan (Dengizkul Lake and Deukhona Lake) have already been drained to allow for gas and petroleum production. Other lakes, such as Hadicha and Karakyr to name but two, have very unstable hydrological regimes and are affected by eutrophication in a way typical of the arid zone. The present system of irrigation reservoirs cannot, therefore, compensate in the long term for the lost habitats of the Aral Sea region, and thus the Pygmy Cormorant’s future status in the region is uncertain. Furthermore, the species is persecuted by fishermen and fish farmers who are hostile to all fish-eating birds. Obviously the Pygmy Cormorant will continue to occupy reservoirs where the hydrological regime is relatively stable, but the species’ population size will fluctuate in response to environmental factors such as the availability of food, nesting and roosting sites and how secure these remain.

CONCLUSION

The Pygmy Cormorant is currently evaluated by BirdLife International as Least Concern (IUCN 2007), only a few years after it was regarded as Near Threatened (IUCN 2004). In Central Asian countries, the species is only included in the Red Book of Uzbekistan (Shernazarov 2003, 2006) where it is evaluated as Near Threatened because of the decline in the population in previous decades. Some authors (e.g. Shernazarov 2007) have even suggested that it should be included in the list of rare and vanishing Central Asian birds, but this review allows us to conclude that the Central Asian population of Pygmy Cormorants is currently increasing and that the species demonstrates an ability to expand its range by colonising new sites. New breeding sub-populations, formed primarily by immigration from the southern shores of the Aral Sea to inland artificial reservoirs, have appeared in regions of agricultural development, while the species' wintering zone has shifted from the southern boundaries of Central Asia northwards. In some southern regions of Uzbekistan and Turkmenistan, the Pygmy Cormorant has now become resident all year round.

It is now evident that a new meta-population of Pygmy Cormorant, mosaic in structure, has formed from the old colonies in the Aral Sea basin. Since 1988, the species has become more widespread and continues to expand its range; the former key importance of the isolated northern Aral Sea sub-population is no longer apparent, for this sub-population is now unstable, fluctuating in line with prevailing environmental conditions (Table 3). The newly-created sub-populations have begun to play a key role in the survival of the species; the rate of interchange of individual birds between sites in each colonised area has increased and has become more evident (E. Kreuzberg-Mukhina, unpubl. data). The causes of such changes in the species' Central Asian population structure are anthropogenic in character.

Due to ongoing processes in water management, especially in the Sudochie wetlands, the population of Pygmy Cormorants in

the Aral Sea basin can still play an important role in the conservation of the species at global level. The IBAs in the Central Asian Republics represent ecological 'islands' in a surrounding 'sea' of human-altered habitats. The Pygmy Cormorant occurs in 33 IBAs in the Aral Sea basin in Central Asia (Table 1) which, in view of planned conservation work, can provide a valid ecological framework, essential for the species' long-term survival.

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