BAR-HEADED GEESE *ANSER INDICUS* WINTERING IN SOUTH-CENTRAL TIBET

MARY A BISHOP[1], SONG YANLING[2], CANJUE ZHOUMA[3] and GU BINYUAN[3]

[1]International Crane Foundation, PO Box 447, Baraboo, WI 53913-0447 USA and Pacific Northwest Research Station, US Forest Service, PO Box 1460, Cordova, Alaska 99574 USA

[2]Institute of Zoology, Academica Sinica, 19 Zhongguancun lu, Haidan, Beijing 100080, PR China

[3]Tibet Plateau Institute of Biology, 230 Beijing West Road, Lhasa Tibet, 850001 PR China

We collected information on the status and distribution of Bar-headed Geese and Ruddy Shelduck, concurrently with surveys for endangered Black-necked Cranes in south-central Tibet, People's Republic of China. Surveys were conducted during six winters: 1990-91 through 1995-96. The highest estimated count for Bar-headed Geese was in December 1993 when 10,934 geese were observed. However, this survey excluded three known wintering areas. We estimate there are 13,000 - 14,500 Bar-headed Geese wintering in south-central Tibet, representing at least 25% of the estimated world population. Approximately 70% winter in two areas: Shigatse, around the confluence of the Nyang and Yarlung Rivers; and, Penbo River valley, north-east of Lhasa. The distribution of Ruddy Shelduck overlapped with Bar-headed Geese in all areas surveyed. Shelducks occurred in lower numbers than the geese, with the highest survey producing 3,836. The largest concentrations of Ruddy Shelduck occurred along the Penbo River valley.

Keywords: Bar-headed Geese, Ruddy Shelduck, Tibet, Census, Population Size

The Bar-headed Goose *Anser indicus* is endemic to Asia, breeding on the high plateaus of central Asia and wintering in China from southern Tibet east to Guizhou, and from Pakistan east to Myanmar (Flint *et al.* 1984, Lu 1991, Perennou & Mundkur 1994). Perennou & Mundkur (1994) recently estimated the world population at 50,000 birds and increasing. The Bar-headed Goose currently does not qualify as globally threatened under the new IUCN Red List criteria (IUCN 1994, Baillie & Groombridge 1996).

Prior to this study, little was known about the status and ecology of the Bar-headed Goose wintering in Tibet. This lack of knowledge was due in part to the political inaccessibility and the physical remoteness of much of the Bar-headed Goose wintering range in Tibet. Ludlow (1928, 1950, 1951) described the Bar-headed Goose as abundant throughout the winter in the Nyang River Valley and around Lhasa, with some birds also wintering at Yamdrok Tso. He noted that it was a very tame bird, and would 'waddle across the road within a dozen yards of my pony, and barely condescend to notice me'. More recently Lu (1991) estimated 2,000 - 2,500 geese wintering in Tibet, based on 1988 surveys along the Lhasa and Yarlung rivers.

Beginning in December 1990, the International Crane Foundation (ICF) of Baraboo Wisconsin USA and the Tibet Plateau Institute of Biology in Lhasa, Tibet, PR China began a cooperative four-year study of the wintering ecology of the Black-necked Crane *Grus nigricollis* in Tibet. Aspects of this study continued through the Agriculture Bureau of the Tibet Agriculture and Animal Husbandry

Department during February 1995 and January 1996. During our studies on Black-necked Cranes we collected information on Bar-headed Geese and Ruddy Shelduck *Tadorna ferruginea*. Song *et al.* (1994) reported on the results of our Bar-headed Geese and Ruddy Shelduck surveys from the 1991-92 winter season. In this paper, we expand on these results and provide information for an additional five winter seasons. We present an overview of the numbers and distribution of wintering Bar-headed Geese and Ruddy Shelducks wintering in south-central Tibet.

Study Area

Three major river valleys and their tributaries were included in the study area: Yarlung, Lhasa (Kyi Chu) and Nyang. These are characterized by relatively high altitudes (3,400 - 4,100 m). Our primary survey area stretched east from Lhaze (29° 10' N, 87° 33'E) to Nedong (29° 15' N, 91° 47' E) and north just past Maizhokunggar (29° 45' N, 91° 45' E; **Figure 1**). Areas in south-central Tibet outside the primary study area were surveyed once including from Lhaze to Tingri (140 km south-west of Lhaze), Sakya and Dinggye (both south-east of Lhaze) and Old Lhunzhub (north-west of Maizhokunggar; **Figure 1**). In addition, we surveyed once the Niang River in east-central Tibet.

In this paper, principal location names are taken from Stanfords International map of south-central Tibet (3rd edition, 1993) and are given in Pinyin Chinese, followed by transliterated Tibetan (when available). The largest towns (Shigatse, Gyantse, Lhasa) are written in transliterated Tibetan.

Winters are cool and dry in south-central Tibet. Average monthly minimum and maximum temperatures at Lhasa during January, the coldest month, are -13.1°C and 5.7°C, respectively. The study area has a continental monsoon climate and an annual precipitation of 300 - 500 mm. October to April are the dry season, characterised by low precipitation (<10% of annual). Localised snowfall occurs infrequently and melts quickly. High winds occur regularly throughout south-central Tibet from January to April.

Agriculture is the dominant land use on the Bar-headed Geese wintering areas with most lands managed for spring barley, spring wheat and winter wheat production. Other crops include broad beans and oil seed rape with broad beans typically interplanted with spring wheat. In most parts of south-central Tibet, fields are tilled and planted using livestock (cattle and dzo, a hybrid yak-cow) and harvested with hand-held scythes. Crops are harvested in early autumn, August to September. Plowing takes place either immediately after harvest or in early spring. Irrigation is used extensively during the growing season, from April to September, and to a lesser extent in the winter. Grazing is the second dominant land use with sheep and goats the most important livestock.

Methods

We surveyed the wintering populations of Bar-headed Geese and Ruddy Shelduck in south-central Tibet from 1990-91 to 1995-96. We conducted surveys between 1 January-11 February 1991, 21 December 1991-22 January 1992, 10-20 February 1993, 3-31 December 1993, 17-24 February 1995, and 16-21 January 1996. Bar-headed Geese were surveyed all six winters, and Ruddy Shelduck during four winters, excluding February 1995 and January 1996. While we surveyed all of our primary study area the first two winters, the other four field seasons were surveyed in portions only. Our most thorough coverage of the study area occurred during our second, 1991-92 winter survey. Those surveys included more complete coverage of the Penbo River valley and its side valleys, and the Shigatse area, including the Shang River/Aima Plateau area south of Namling (**Figure 1**).

We surveyed Bar-headed Geese using a Toyota Landcruiser on the available road access, driving primary roads through each valley and their major tributaries. We stopped to scan with a 22x telescope every 2-3 km in suitable habitat, from any major vantage point, or whenever a flock was observed. Where visibility to the river was limited, we used

secondary roads or climbed to vantage points. In some areas, one side of a valley was not accessible by car.

Whenever geese or ducks were observed, information collected included: location, flock size and habitat. Care was taken to not double count flocks, and when there was any doubt, the more conservative estimate was used. Based on our survey results, a population estimate was determined for each geographical area. In areas surveyed more than once in a season, the higher population estimate was used.

Results

Distribution and numbers

Bar-headed Geese arrive in south-central Tibet from mid to late October and stay in to April. The winter distribution overlapped with Ruddy Shelduck in all areas surveyed. Geese and ducks wintered at altitudes ranging from 3,570-4,480 m. We observed both species from Lhaze east to Samye (29° 19' N, 91° 25' E) on the Yarlung Tsangpo (river), north to Maizhokunggar on the Lhasa River and south to Gyantse (28° 55' N, 89° 36' E; **Figure 1, Tables 1, 2**). For both species, we found flocks in abundance in two areas: Shigatse area, both on the Yarlung Tsangpo (hereafter referred to as Yarlung River) and Nyang River; and in the Penbo River Valley, around Lhunzhub. No geese were observed during a January 1991 survey along the Choyate River from Renda to Sakya and between Sakya and Dinggye (4,260 m altitude), nor during a December 1991 survey of agricultural fields around New Tingri (Xegar) and Tingri (4,350 m altitude). In December 1993 we found no geese when we surveyed 390 km of the Niang River from Maizhokunggar to the twin cities of Bayi and Nyingchi (Linzhi) near where the Niang flows into the Yarlung River.

Our high estimated winter count for Bar-headed Geese was obtained in December

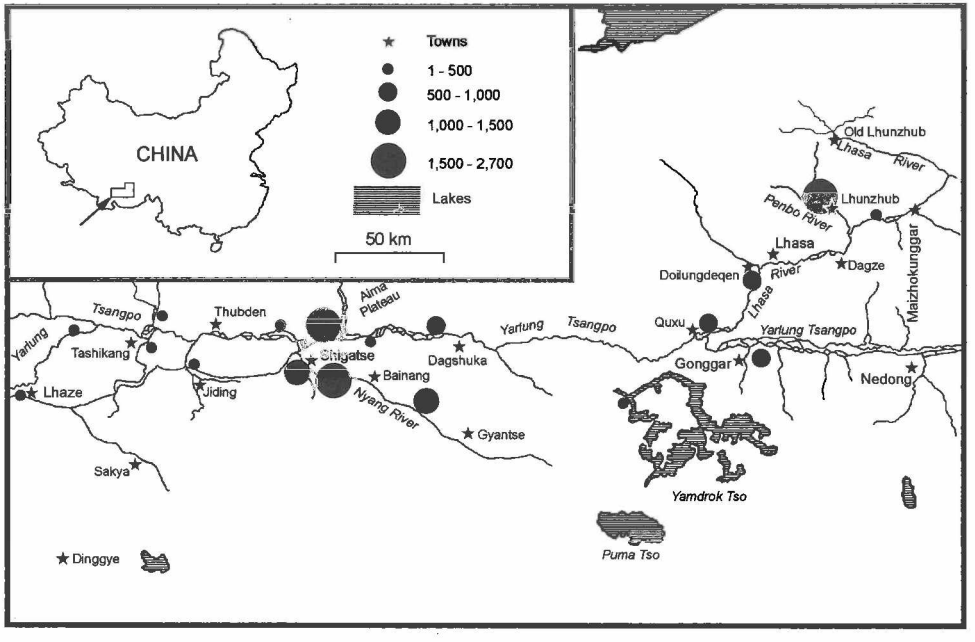

Figure 1. Distribution and abundance of Bar-headed Geese, south-central Tibet. Abundance based on maximum numbers observed on winter surveys, 1990-91 to 1995-96.

Table 1. Bar-headed Geese survey results for south-central Tibet Autonomous Region, PR China from winters 1990-91 to 1995-96. Only complete surveys reported per area. Co. = county.

	Altitude (m)	Jan-Feb 1991	Jan-Feb 1992	Feb 1993	Dec 1993	Jan-Feb 1995-96
WEST YARLUNG RIVER						
Yarlung River-Shigatse Area						
Dagshuka Ferry-Airport	3,800	200	675		25	
Airport-Aima Plateau (Namling)	3,800	300	0		0	
Aima Plateau (Namling)-Shigatse	3,840	1,000	1,215		2,215	
W. Shigatse-Thubden	3,850	125	205		0	
Nyang River						
Gyantse-Bainang	3,950	888	761		1,047	
Bainang-Shalu	3,882	1,760	1,639		2,505	
Shalu-Shigatse new bridge	3,850	350	1,000		720	
Total Shigatse Vicinity		***4,623***	***5,495***		***6,512***	
Sakya Co., Jiding, Shab River	3,910	60	200		275	
Sakya Co., Sakya, Choyate River	4,280	0				
Xaitongmoin & Lhaze Cos.						
Xaitongmoin, Rong River	3,880	200	163			
Tashikang, Re River	3,910	225	200		0	
Lhaze Co.						
Lhaze-Pindzoling, Yarlung River	4,050	470	470			800[a]
Dinggye Co., Dinggye, Yaru River	4,260	0				
Tingri Co., Xegar-Tingri	4,350		0			
TOTAL WEST YARLUNG RIVER		***5,578***	***6,528***		***6,787***	
LHASA RIVER & VALLEYS						
Maizhokunggar & Dagze Cos.	3,750	480	255	396	350	
Lhunzub Co., Penbo River	3,750		2,300	1,723	2,280	
Doilungdeqen & Quxu Cos.	3,650	335	625	750	1,250	1,075[b]
TOTAL LHASA RIVER & VALLEYS		***815***	***3,180***	***2,869***	***3,880***	
YAMDROK TSO	4,480	144[c]	90	0	267	
EAST YARLUNG RIVER						
Gonggar-Nedong Cos.	3,570	500	288	660		
EAST CENTRAL TIBET: NIANG RIVER						
Gongbo' gyamda-Nyingchi	3,050				0	
GRAND TOTALS		***7,037***	***10,086***		***10,934***	

[a] Surveyed January 1996. [b] Surveyed February 1995. [c] A. LeSeur, pers. comm.

Table 2. Ruddy Shelduck survey results for south-central Tibet Autonomous Region, PR China from winters 1990-91 to 1993-94. Only complete surveys reported per area. Co. = county.

	Altitude (M)	Jan-Feb 1991	Jan-Feb 1992	Feb 1993	Dec 1993
WEST YARLUNG RIVER					
Yarlung River-Shigatse Area					
Dagshuka Ferry-Airport	3,800	115	370		240
Airport-Aima Plateau (Namling)	3,800	100			15
Aima Plateau (Namling)-Shigatse	3,840	180	150		165
W. Shigatse-Thubden	3,850	20	136		0
Nyang River					
Gyantse-Bainang	3,950	367			418
Bainang-Shalu	3,882	273	570		420
Shalu-Shigatse new bridge	3,850	425	106		100
Total Shigatse Vicinity		***1,480***	***1,332***		***1,358***
Sakya Co., Jiding, Shab River	3,910	3	222		260
Sakya Co., Sakya, Choyate River	4,280	0			
Xaitongmoin & Lhaze Cos.					
Xaitongmoin, Rong River	3,880	7	12		
Tashikang, Re River	3,910	0	20		0
Lhaze Co.					
Lhaze-Pindzoling, Yarlung River	4,050	125	56		
Dinggye Co., Dinggye, Yaru River	4,260	0			
Tingri Co., Xegar-Tingri	4,350		4		
TOTAL WEST YARLUNG RIVER		***1,615***	***1,646***		***1,618***
LHASA RIVER & VALLEYS					
Maizhokunggar & Dagze Cos.	3,750	150	150	145	490
Lhunzub Co., Penbo River	3,750		1,400	930	1,100
Doilungdeqen & Quxu Cos.	3,650		157		580
TOTAL LHASA RIVER & VALLEYS		***150***	***1,707***	***1,075***	***2,170***
YAMDROK TSO	4,480	0	13	0	8
EAST YARLUNG RIVER					
Gonggar-Nedong Cos.	3,570	75	470	270	
EAST CENTRAL TIBET: NIANG RIVER					
Gongbo' gyamda-Nyingchi	3,050				0
GRAND TOTALS		1,840	3,836		3,796

1993, when 10,934 geese were counted. The December 1993 survey, however, did not include two of the three valleys west of Shigatse, nor the eastern Yarlung River from Gonggar to Nedong (**Table 1**). Based on survey results from other years, we estimate 13,000-14,500 Bar-headed Geese winter in south-central Tibet. For Ruddy Shelduck, the maximum winter count was during the January-February 1992 survey, when at least 3,800 ducks were counted (**Table 2**).

Bar-headed Goose distribution and abundance by geographic area.

Yarlung River Valley: Lhaze to Pindzoling
At Lhaze, the Yarlung River swings north-east until Pindzoling where it flows east joining the Raka River. The valley between Lhaze and Pindzoling is approximately 70 km long and ranges from <1 - 5 km wide. We surveyed this area during three winters, including most recently in January 1996. We observed geese primarily in the fields behind the town of Lhaze, upriver 25 km near Genda (200 - 400 geese combined sites) and approximately 50 km north of Lhaze where the Yarlung River narrows at Panching (270-450 geese).

Rong and Re River Valleys
Approximately 18 km east of Pindzoling, the Yarlung River widens to 8 km. Here the Rong River flows in from the north and the Re River in from the south forming a 26 km long valley, 2-4 km wide. When we conducted our surveys, it was not possible to survey both valleys on the same day because no bridge joined them. In two winters that surveys were conducted in both areas, we located between 350-450 geese (**Table 1**) from Tashikang north and throughout the Rong River Valley.

Yarlung River: Rong River to West Shigatse
Along the 30 km stretch of the Yarlung River, from the Rong River valley east to Thubden, there is little agriculture and we observed no geese. From Thubden for 30 km east to Shigatse, grain crops are cultivated and <200 geese winter. Approximately 18 km east of the Rong and Re River valleys, the Xiabu River (Shab Chu) flows into the Yarlung River. Approximately 100-250 geese winter in this valley around the town of Jiding, 16 km south of the Yarlung River where the Xiabu River broadens.

Yarlung River: Shigatse east to Dagshuka
The Yarlung widens to 4 - 6 km and has many channels from its confluence with the Nyang River at Shigatse, to Dagshuka some 80 km east. Approximately 1,300-2,000 geese winter in the 18 km from Shigatse east to the Namling Ferry, at the base of the Aima Plateau. Geese are found around the State Farm, located at the north end of Shigatse by the Yarlung River, and around Tama and Tashigang Xians to the east. At Tama, we also had our only sighting of a single White-fronted Goose *Anser albifrons* in February 1991. At the Aima Plateau, on the north side of the Yarlung River, we observed no geese.

Further east along the 28 km stretch between the Shigatse airport and the Dagshuka Ferry, access and visibility from the main road is often limited. Our high estimated count for this area was 675 geese, although we probably overlooked flocks. East of Dagshuka, the Yarlung River narrows and is surrounded with steep mountains on both sides. There is very little agriculture in this area, and no geese winter here. For >110 km, geese do not appear again until the Yarlung widens, approximately 12 km south-west of where the Lhasa River flows into the Yarlung at Quxu.

Nyang River: Shigatse south to Gyantse
The Nyang River, one of south-central Tibet's major rivers, runs north-west through Gyantse, and empties into the Yarlung River at Shigatse. In some areas the Nyang has been channelised. Nevertheless, there are several remaining oxbows in the river where we observed geese and other waterfowl. Depending on the winter, an estimated 3,000-4,300 geese winter along the Nyang River from Gyantse, north-west 90 km to Shigatse. We saw flocks numbering in the hundreds flying up and down the Nyang River to and from the Yarlung River. Most likely the geese observed between Shigatse and Shalu (approximately 18 km distance) roost in the

Yarlung River and also use the agricultural fields at the north end of Shigatse in the State Farm area.

Lhasa River

We observed up to 1,600 geese wintering in this valley from Quxu, where the Lhasa River empties into the Yarlung River, north 160 km to Maizhokunggar. The area around Lhasa has experienced a dramatic increase in human development in recent years. We never observed geese flying over Lhasa, nor did we observe any in the Tobing Chu Valley, immediately north-west of Lhasa. We did, however, observe geese within 10 km of Lhasa, on the Lhasa River near Doilungdeqen.

North-east of Lhasa, we regularly observed flocks along the river near Dagze (<100 geese), at a marsh below the Penbu Monastery (50-350 geese), and at the village of Dongbugang (100-300 geese) just south of Maizhokunggar. We never observed geese on the Lhasa River between Maizhokunggar and Zekong during our many surveys of this area. Nor do geese appear to winter along the upper Lhasa River between Zekong and Old Lhunzhub, although we were able to survey this area only once.

South of the city of Lhasa, the river is 2-4 km wide until it joins the Yarlung at Quxu, 65 km south. Geese are common along the southern Lhasa River. Access and visibility, however, are limited in some areas and we may have underestimated winter abundance. We observed as many as 900 geese roosting on the Lhasa River near Drolma Lhakhang, 22 km south of Lhasa. Just past the Quxu bridge near the turnoff to Kamba La Pass flocks are easily observed resting and roosting on sandbars of the Yarlung River.

Penbo River

This river flows into the Lhasa River approximately 40 km north-east of Lhasa. The Penbo is a narrow river, and is channelised throughout much of the valley. Geese wintering here are usually found in the main valley east of Lhunzhub, the county seat. This is the only area we surveyed in south-central Tibet where wetlands were still plentiful. There are many semi-dyked wetlands, and wet meadows characterized by *Kobresia* spp. and *Blysmus sinocompressus*. There are also two large reservoirs in this valley: Kazi in the center of the valley, and Houtou at the far west end of the valley. We observed as many as 1,200 geese roosting for the night at Kazi, and 350 at Houtou. Both reservoirs are also used by geese for daytime roosting.

East Yarlung River: Gonggar to Nedong

East of the confluence of the Lhasa and Yarlung Rivers, approximately 500-700 Bar-headed Geese winter on the 25 km stretch of Yarlung River between Gonggar and Chiteso. A few (<50) winter farther east in Zharang County near Samye. During three surveys, we observed no Bar-headed Geese in the Zetang (Tsedang) and Nedong area.

Discussion

Our surveys suggest that south-central Tibet is a strikingly important wintering area for Bar-headed Geese, with at least 25% (13,000-14,500) of the estimated world population. While ≥16,600 Bar-headed Geese winter in India, the geese are scattered across a much larger area - from Assam south to Karnataka (Mundkur & Taylor 1993). Within China, Tibet by far hosts the highest number of wintering geese. Lu (1991) estimated that <6,000 geese winter in Guizhou, Yunnan and Xinjiang provinces. Since his update, numbers of geese have fallen at Caohai Nature Reserve in Guizhou from >1,600 birds in 1987-88 (Li 1997) to approximately 800 during the 1995-96 winter (J. Harris, ICF, *pers. comm.*). In northern Yunnan, Lu (1991) estimated 2,000-2,500 birds at Zhaotong and Napahai. However, during surveys for Black-necked Cranes throughout north-east Yunnan during the 1991-92 winter, Wei *et al.* (1993), recorded <1,000 wintering Bar-headed Geese, with most recorded at Daqiao Reservoir (800 geese) in Huize County, and <100 at Zhaotong. At Napahai, in north-west Yunnan, the maximum count for Bar-headed Geese in recent years was 145 geese in January 1989 (J. Barzen, ICF, *pers. comm.*). All these surveys indicate a possible decline in Chinese wintering areas outside of Tibet. Combined with our survey results for Tibet, we

estimate that 15,500-17,500 Bar-headed Geese winter in China. These numbers are similar to Perennou & Mundkur's (1994) estimate of 15,000+ birds.

Within Tibet, the results of our surveys over six seasons indicate a stable wintering Bar-headed Geese population. Since February 1992, both Bar-headed Geese and Ruddy Shelduck have been protected by the Tibet Autonomous Regional Government under a Class Two ('second order') protected wildlife designation (Liu 1994). Under this designation, both species can be taken in Tibet only under special circumstances (eg to meet some special scientific need or to stop crop depredation) and only with permission of the Tibet Autonomous Regional Government. Bar-headed Geese are also locally protected under a Class Two protected wildlife designation in Qinghai, Guizhou, Yunnan, and Gansu provinces. Throughout the rest of China, however, Bar-headed Geese are not protected and can be hunted during the appropriate season.

Despite their protection within Tibet, we often observed both species being hunted with guns and slingshots. During our surveys, we observed people hunting geese and Ruddy Shelduck around Shigatse, Tama, Bainang, Lhunzhub and Tashikang. Until now, cultural traditions have played an important role in the protection of the Bar-headed Goose and Ruddy Shelduck. On the wintering area, Buddhism prevails and religious beliefs prevent the hunting of wildlife. In the case of the Ruddy Shelduck, because of its yellowish color, Tibetans associate them with the 'Yellow Hat', or Geluk Buddhist Sect that the Dalai Lama heads. Tibetans venerate these ducks and they appear often in religious images and on temple walls.

With Tibet's increasing economic growth and the recent influx of migrant workers from other provinces, cultural attitudes are changing and more firearms are becoming available. Although the sale of hunting guns has been prohibited since 1991, there has been little enforcement. Geese could easily become a target for both food and sport. With a high number of the world's Bar-headed Geese wintering in Tibet, it is important that illegal hunting be rigidly controlled. At the same time, there is a need for public education in Tibet that emphasizes both the Bar-Headed Goose and the Ruddy Shelduck's protected status.

Presently none of the wintering habitat of the Bar-headed Goose is protected in Tibet except for the Penbo Black-necked Crane Nature Reserve, north-east of Lhasa and near Lhunzhub. Established in 1993 to protect wintering Black-necked Cranes, the 9,680 ha reserve is located in the second most important wintering area for Bar-headed Geese, and the most important wintering area for Ruddy Shelduck. Kazi and Houtou, two reservoirs used for daytime and night time roosting, are included in the Penbo Nature Reserve. However, the principal goose and shelduck feeding areas are east of Lhunzhub and are not within the reserve boundaries.

Throughout their Tibetan wintering grounds, the Bar-headed Goose is found most often during the day in harvested barley and spring wheat fields, followed by riverine and lacustrine wetlands (Bishop *et al., unpubl. data*). Losses of habitat, especially wetland habitats, continue to occur throughout the south-central Tibet wintering area. Since the 1950s extensive channelisation along the Penbo and Nyang Rivers have hastened the loss of river floodplain and riverine wetlands. In addition, both the Shigatse and Lhasa areas have experienced a high human population and economic growth accompanied with the loss of both agricultural and wetland habitat. There is now a paved road between Lhasa and Shigatse increasing the number of trucks and cars in both areas and further stimulating growth.

Hydroelectric projects may also impact wintering Bar-headed Geese. Approximately 70 km south of Lhasa as many as 600 geese winter near and at the confluence of the Yarlung and Lhasa Rivers. As of 1996, a large hydroelectric project had almost been completed at Kamba La Pass whereby water will be pumped from Yamdrok Tso down to the Yarlung River. It is not known if this project will alter the water flow at roost sites on the Yarlung River.

A recent proposal by the International Crane Foundation to China's Ministry of Agriculture and the Tibet Autonomous Regional Government, could benefit Bar-headed Goose

and Ruddy Shelduck wintering populations. Because of the Black-necked Cranes' close association with farming areas in south-central Tibet, the International Crane Foundation has proposed that Agricultural Management Zones (AMZs) be developed in Black-necked Crane wintering areas (Harris and Bishop, ICF, unpubl. rept.). Under the proposal, guidelines would define agriculture and other activities within the zone. Crops and farming methods that provide suitable winter food for the cranes would be promoted, especially cultivation of spring barley and wheat. Each AMZ would include crane roost sites and no hunting of cranes or any other birds would be allowed within the AMZs. All measures used in the AMZs would protect the cranes and be compatible with farmers' needs. Because wintering areas of the Bar-headed Goose and Ruddy Shelduck overlap with the Black-necked Crane (Bishop *et al., unpubl. data*), all three species would benefit from creation and implementation of the AMZs.

In conclusion, south-central Tibet is a wintering area of international importance for the Bar-headed Goose. The Nyang and Yarlung river valleys around Shigatse and the Penbo River Valley are the two most important wintering areas. Because of Tibet's rapid population and economic growth, we recommend further monitoring of the wintering population of Bar-headed Geese in south-central Tibet. We also recommend that the Tibet Autonomous Regional Government create and implement Agricultural Management Zones for Bar-headed Geese and Black-necked Cranes wintering in south-central Tibet.

We thank Jim Harkness, Li Fengshan and Zhang Yao Zhong for assistance during surveys and S. Patrick Green for graphics. This research was supported by grants from the Brehm Fund for International Bird Conservation, Chicago Zoological Society, General Service Foundation, World Wildlife Fund-U.S., the Wildlife Conservation Society and U.S. Department of State.

References

Baillie, J. & Groombridge, B. 1996. *1996 IUCN Red List of threatened animals.* IUCN, Gland, Switzerland.

Flint, V.E., Boehme, R.L., Kostin, Y.V., *et al.* 1984. *A field guide to birds of the USSR.* Princeton Univ. Press, Princeton, NJ 353pp.

IUCN. 1994. *IUCN Red List categories.* IUCN, Gland, Switzerland. 21pp.

Li, Fengshan. 1997. *Developing a land management system for Cao Hai and its watershed to safeguard resources needed by Black-necked Cranes and people.* Ph.D. diss., Univ. Wisconsin, Madison, Wisconsin, USA.

Liu, Wulin. 1994. *An instant guide to rare wildlife in Tibet.* Tibet Wildlife Conservation Assoc. China Forestry Publishing House. 140pp.

Lu, Jianjian. 1991. Notes on Bar-headed Geese in China. *IWRB Threatened Waterfowl Res. Grp. News* 1:8-9.

Ludlow, F. 1928. Birds of the Gyantse neighbourhood, southern Tibet - Part III. *Ibis* 4:211-232.

Ludlow, F. 1950. The birds of Lhasa. *Ibis* 92:34-45.

Ludlow, F. 1951. The birds of Kongbo and Pome, south-east Tibet. *Ibis* 93: 547-578.

Mundkur, T. & Taylor, V. 1993. *Asian waterfowl census 1993.* IWRB, Slimbridge, UK.

Perennou, C. & Mundkur, T. 1994. *Asian waterfowl census 1987-1991 - status and trends of waterfowl populations in Asia.* IWRB Publ. 24, IWRB, Slimbridge, UK.

Song, Yanling, Bishop, M.A., & Canjue, Zhouma. 1994. The distribution and population sizes of Bar-headed Geese during winter in the area of the middle reaches of Yarlung Tsangpo River. *J. Chinese Zool.* 29:27-30.

Wei Tianhao, Wu Jingliang, Huang Guozu, *et al.* 1993. *Investigation on Black-necked Crane Grus nigricollis in winter 1991/2 in Yunnan, China.* Report to Asian Wetland Bureau, Kuala Lampur, Malaysia. 11pp.