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REDUCTION OF CROP DEPREDATIONS BY CRANES AT DAURSKY STATE BIOSPHERE RESERVE, SIBERIA

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Abstract: The Daurisky State Biosphere Reserve (SBR) in southern Siberia includes the Torey Lakes, the largest lakes in the Trans-Baikal region. The Torey Lakes support tens of thousands of breeding waterbirds and about a million waterbirds during migration. Peak numbers of birds staging during fall coincide with grain harvest. Crop fields around the Torey Lakes attract 50,000 to 70,000 waterbirds, primarily cranes with lesser numbers of waterfowl, causing significant crop damage in fields near Daurisky SBR. Investigations of the problem have been ongoing since 1992. Field consultation by Cornely and Bouffard in 2001 resulted in recommendations to reduce depredations. The consultation was initiated by The International Crane Foundation with funding from The Trust for Mutual Understanding, and with support from the Daurisky State Biosphere Reserve and the U. S. Fish and Wildlife Service. Implementation of the recommendations resulted in a significant reduction of crop damage. Changes in management practices implemented included moving main grain fields 10-15 km from roost sites, cultivation of lure crops near roost sites, and leaving fallow fields uncultivated to facilitate the growth of green bristlegress (*Setaria viridis*), a preferred food item of cranes. The program is currently supported by the cooperative farms without government subsidies, as the lure crop program costs about one tenth of the previous damage.

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Key words: *Anthropoides virgo*, common crane, crop depredation, Daurisky State Biosphere Reserve, demoiselle crane, *Grus grus*, *Grus monacha*, *Grus vipio*, hooded crane, Russia, Siberia, white-naped crane.

Farmers near Daurisky State Biosphere Reserve (hereafter SBR) in southeastern Russia have long been pressuring the Reserve staff to solve crop depredation problems attributed to cranes. Daurisky SBR is an important breeding area for white-naped cranes (*Grus vipio*) and demoiselle cranes (*Anthropoides virgo*). It is also an important summering area for these species, and for nonbreeding hooded cranes (*G. monacha*) and a few Siberian cranes (*G. leucogeranus*). The breeding and summering birds are joined in fall by large numbers of migrants. Peak populations of cranes and waterfowl coincide with grain harvest, and damage is considerable at times. Mean annual crop damage was about 20% on fields near the Torey Lakes with damage as high as 70% in some fields that had the heaviest use by cranes. Thousands of ducks and geese are also present during fall and contribute to depredation problems, but complaints focused primarily on cranes. Crop depredations in and near Daurisky SBR have been investigated since 1992. We met in September 2001 to observe peak fall migrations of cranes and other waterbirds and to develop recommendations for reducing their impacts on crops (Bouffard et al. 2005). This paper reports preliminary results of the implementation of our recommendations.

STUDY AREA

Daurisky SBR is located in Transbaikalia (about N 50°00', E 115°30') in southeastern Siberia adjacent to the Mongolian border and 50 km west of the Chinese border (Fig. 1). Daurisky SBR was established as a State Nature Reserve in 1987, became a RAMSAR Site in 1994, and was designated a Biosphere Reserve in 1997 (Wetlands International 2003, UNESCO 2005). It has also been designated as an Internationally Important Bird Area (Goroshko 2000). Daurisky SBR, along with Mongolian (Mongol-Daguur Strictly Protected Area) and Chinese (Dalai Nor Nature Reserve) protected areas comprise the Dauria International Protected Area established in 1994 (World Wildlife Fund 2001).

Daurisky SBR is located within the Daurian-Mongolian Steppe Biogeographical Region. Dominant steppe vegetation includes grasses such as *Stipa baicalensis*, *S. krylovii*, *Festuca lenensis*, and others (UNESCO 2005). Elevations range from about 600 to 800 m with flat to slightly rolling relief. Steppes include numerous shallow lakes with wetlands that attract waterbirds. The climate is dry and continental with average annual temperatures ranging from -0.5 to -4°C. Amplitude of winter and summer extreme temperatures is 84-93°C (from about -45 to 45°C). Amplitude of day and night extreme temperatures is 20-30°C. Duration of the growing season is 150-180 days per year. Total annual precipitation is 200-300 mm, with about 50-70% coming during July and August (Wetlands International 2003, UNESCO 2005).

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Daursky SBR has a strictly protected core area of 45,700 ha and a buffer zone of 163,530 ha. The total area including Tsasuchinsky Bor Nature Protected Area is 267,200 ha. Public entrance and public use of any kind are prohibited in the core area. More than 2000 people live in 2 villages within the buffer zone where limited human activity is allowed; perhaps another thousand nomads roam through the area (UNESCO 2005). Hunting, pollution, and other threats to flora and fauna are not allowed in the buffer zone. The main activities in the buffer zone and other areas adjacent to Daursky SBR are livestock production (primarily sheep and cattle with lesser numbers of horses and camels) and cereal agriculture (mainly wheat and oats, more rarely barley, millet, and rape). Three cooperative agricultural farms, comprising some 1,448 ha, are located near Daursky SBR (Wetlands International 2003). About 20% of the steppe of southeastern Transbaikalia has been plowed. Until the late 1980s, about 60% of the plowed land was used as crop fields and 40% was fallowed for restoration of soil fertility. In the 1990s and early 2000s, livestock production and agriculture in the region decreased significantly because of overgrazing and an economic crisis. Currently, only about 10% of arable land is used for crops and the remainder is fallow and not being worked. Most land is communally or government owned (Goroshko 2004).

The Daursky SBR includes the Torey Lakes. Barun Torey (570 km²) and Zun Torey (30 km²) are the largest lakes in the Trans-Baikal region. The lakes are fed primarily by the Imalka and Uldza Rivers that arise in Mongolia. The lakes have no outlet and are quite alkaline. The lakes are connected by 2 channels. Depending on precipitation patterns the lake levels can vary significantly, in severe long-term droughts being nearly dry (Wetlands International 2003, UNESCO 2005).

The Lakes are an internationally important site for waterbirds, supporting tens of thousands of breeding waterbirds.

Table 1. Peak numbers of selected species during fall migration at fields near Torey Lakes in Daursky SBR, southern Siberia, during 1995-2004.

Species	No. birds	% of world population
Siberian crane	32	1
White-naped crane	135	2
Common crane	1,300	< 1
Hooded crane	1,100	12
Demoiselle crane	31,200	14
Swan goose	2,369	4

They are also an internationally important stopover site for about a million waterbirds within 2 major flyways: the East Asian-Australasian and the Central Asian-Indian (Goroshko 2000). Daursky SBR provides habitat for 6 species of cranes. It is an important breeding area for white-naped cranes and demoiselle cranes, whereas common cranes (*Grus grus*) and red-crowned cranes (*G. japonensis*) occasionally breed there. It is also an important summering area for white-naped and demoiselle cranes, plus nonbreeding hooded cranes and a few Siberian and red-crowned cranes. The breeding and summering birds are joined in fall by 50,000-70,000 other cranes and waterfowl (Table 1, 2). Daursky SBR also attracts large numbers of swan geese (*Anser cygnoides*), ruddy shelducks (*Tadorna ferruginea*), and mallards (*Anas platyrhynchos*), all of which nest regionally, and northern nesting species such as greylag geese (*Anser anser*) and bean geese (*Anser fabalis*). Peak numbers of demoiselle cranes and hooded cranes comprise >10% of the world populations and the peak number of swan geese is >4% of world population (Goroshko 2002a). Five species of cranes feed in crop fields during autumn migration: Siberian, white-naped, common, hooded, and demoiselle. Peak populations of cranes and waterfowl coincide with grain harvest, with cranes being the most numerous birds in

Table 2. Peak numbers of 10 focal species on agricultural fields near Torey Lakes in Daursky SBR, southern Siberia in fall, 2002.

Species	Date	No. of birds	
		Counted	Estimated
Mallard	03 Sep	7,150	9,800-14,500
Great Bustard (<i>Otis tarda</i>)	03 Sep	5	5
Ruddy Shelduck	04 Sep	11,470	11,400-12,100
Swan Goose	04 Sep	2,369	2,360-2,400
Demoiselle Crane	04 Sep	23,450	26,000-28,000
Graylag Goose	04 Sep	628	640-710
Hooded Crane	19 Sep	869	1,000-1,150
Eurasian Crane	19 Sep	1,225	1,300-1,500
White-naped Crane	19 Sep	68	80-90
Bean Goose	19 Sep	65 ^a	80-110 ^a
Total		47,299	52,665-60,565

^a Incomplete data - census occurred prior to peak of migration of the species.

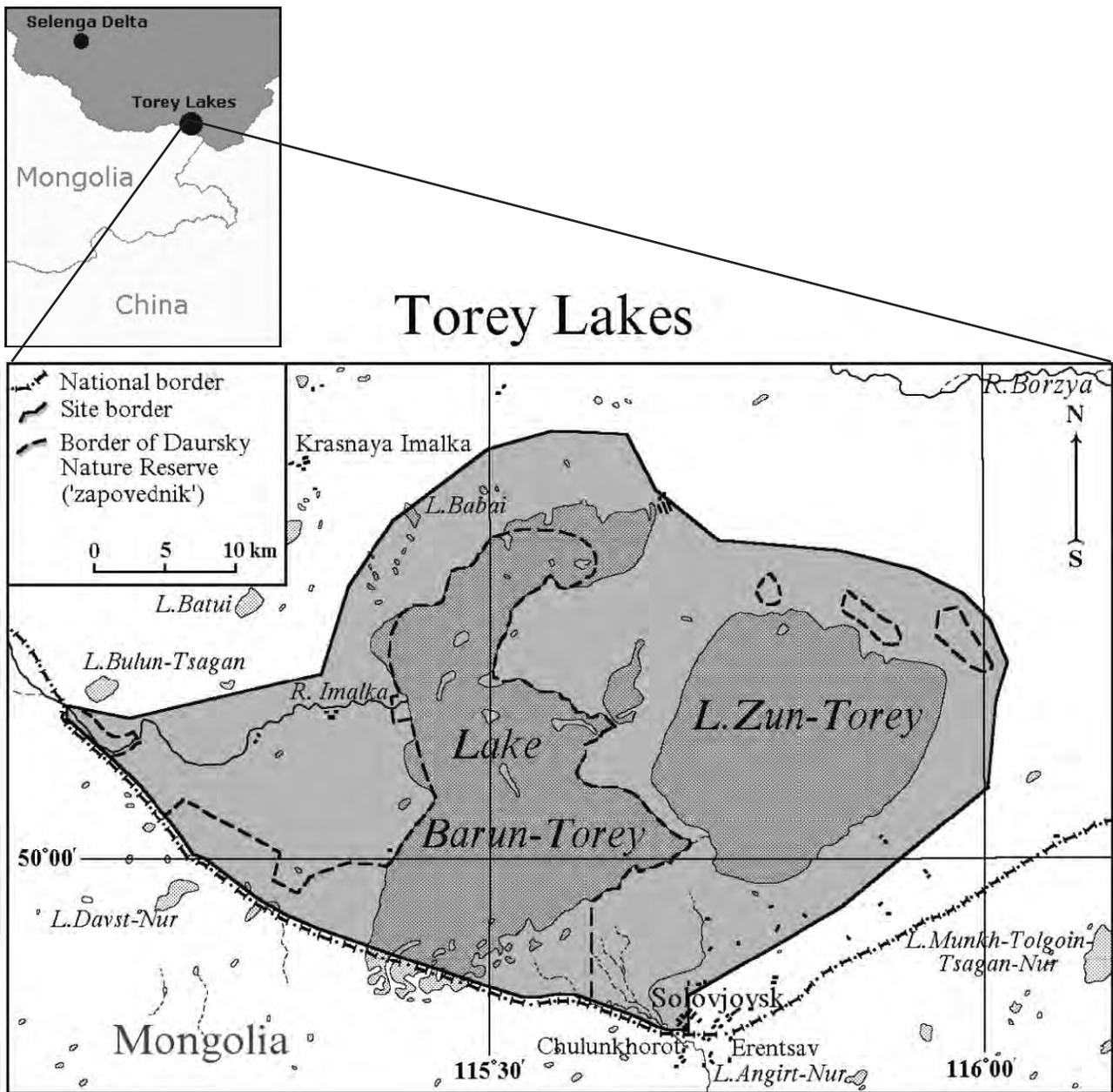


Figure 1. Map of Daursky State Biosphere Reserve and Ramsar Site, located in southern Siberia. Crane depredation problems occurred north and west of Lake Barun Torey and on the cape extending into the lake opposite the mouth of the Imalka River. Smaller map shows geographic location of Torey Lakes (UNESCO 2005, Wetlands International 2003).

crop fields. These migrating birds can cause significant crop damage (Goroshko 2003).

Major reductions in the number and area of crop fields beginning in the 1990s through the early 2000s have concentrated birds and damage to crops in the remaining fields increased significantly. According to our observations, birds destroyed up to 70% of the crop in some fields. The attitude of local farmers toward the staff of Daursky SBR and the cranes became quite negative and farmers near Daursky

SBR increased the pressure on the Reserve staff to solve crop depredation problems. Traditionally, cranes are respected and loved birds in Transbaikalia, but during the last 10 years attitudes toward cranes gradually became more negative. To protect crops, farmers often hazed the concentrated birds, but the flocks just flew to neighboring fields. All species of cranes using the area (except common crane) are protected by law (Red book of Russian Federation - Animals 2001). In spite of the legal protection, local farmers began to shoot cranes.

After they found that cranes were edible, local hunters began to shoot cranes illegally and use them for food. Each year illegal shooting of cranes increased. Hunting of migratory bean geese feeding at crop fields is traditional and very popular in Transbaikalia. Until the 1960s, bean geese were very numerous at Torey Lakes during migration, but numbers have decreased significantly since the 1960s and now bean geese are rare migrants in Transbaikalia. The reduced numbers of bean geese may have contributed to increased shootings of cranes. We recorded dead and wounded demoiselle and white-naped cranes in fields and have been told that local people also shoot hooded and common cranes. Because Torey Lakes is one of the most important migration stopover sites for cranes in eastern Asia, serious losses of cranes to shooting is an international issue. From Daursky SBR, white-naped and hooded cranes fly to southeastern China (Poyang Lake) and to Japan (Izumi), red-crowned cranes fly to southeastern China, and demoiselle cranes fly to India to winter (Higuchi et al 1994, Kanai et al. 2000, Higuchi et al. 2004).

METHODS

We used these observations to document patterns of habitat use by field type, species, and whether it was early, peak, or late fall migration. We counted cranes and waterfowl feeding during morning and evening on agricultural fields located around the Torey Lakes during the fall migration period (August – October). We counted birds in feeding fields using 8X or 10X binoculars and a 35X spotting scope from high points in the terrain. A few days before each census, we studied the timing and distribution of feeding cranes by traveling throughout the area by vehicle during morning and evening feeding periods. We located the areas where cranes were concentrating their feeding activities and determined the best locations for observers. An optimal vehicle route was planned to expedite counts while minimizing disturbance and flushing of cranes. When possible we completed counts from hilltops on the west side of fields during morning feeding and on the east side of fields during evening feeding. If no hills or other high spots were available, we counted cranes from the top of a vehicle. We completed counts in approximately 2 hrs during the most intensive feeding activity.

We collected fecal samples at feeding, roosting, and resting sites to investigate crane diet ($n = 1,250$). Samples were compared from fields at different distances from wetlands. We also compared samples from fields with different quantities of weeds and compared samples from fields with standing grain to those with swathed grain. Additional comparisons were made among fields planted with wheat, oats, barley, and millet. We also checked for variation at different periods during the fall. Crane foraging and resting behaviors were observed from blinds located in croplands and wetlands. In September,

2001, Cornely and Bouffard visited Daursky SBR to review the situation and assist with field investigations. We discussed depredation problems and recommended potential methods to reduce crop damage with reserve staff and with officials from the grain farming cooperatives. Those discussions have continued since then by Goroshko.

Our recommendations (listed below) were published and explained in a brochure (Goroshko 2002b) that was distributed widely among farmers in Transbaikalia.

1. Planting grain fields further from the wetlands (especially roost sites) is the best option to reduce depredations. Since cranes can fly some tens of kilometers from roost sites to feed, this strategy may work only as long as some food, such as lure crops, remains near the lakes.

2. We recommended cultivation of special lure fields located near wetlands used as roost sites. Millet and wheat can be planted and fields can be small (about 5-10 ha). The recommended configuration of lure fields was long, narrow bands. Lure crops should not be harvested; at least until the grain harvest is completed.

3. We recommended using millet for lure crops because: a) it is preferred by cranes, geese and shelducks; b) if the millet is not harvested or is partially harvested and the millet field is not plowed during subsequent years, self-seeding millet will grow for many years after the initial planting; and c) birds are attracted to such fallow fields to feed.

4. Green bristlegrass (*Setaria viridis*) is a common weedy annual grass in fields near Torey Lakes and is a preferred crane food item. We recommended that some fallow fields with abundant green bristlegrass located near wheat fields be left unworked. These fields will attract some of the cranes that would otherwise feed in unharvested crop fields.

5. We recommended that the wheat fields located closest to wetlands be harvested first. If remote fields are harvested first, most birds will continue to feed at unharvested fields located near roosting sites. Once harvested these fields will be more attractive to cranes, keeping them from unharvested fields.

6. We recommended that standing grain be combined, rather than being swathed. It had been common practice to swath some fields to allow for more complete drying of the seeds before harvest. Cranes feed in swathed grain much more than in standing grain. Cranes gather in large numbers in fields with swathed grain. They not only feed on the grain, they shatter seeds from the heads by walking on the swaths and scatter the swaths. As a result of their activities, the harvest yield is reduced.

Goroshko met with farmers near Torey Lakes for consultation and assisted them in the selection of best sites for lure fields. In 2003, Daursky SBR bought millet seed, provided some financial support, and provided consultation for farmers near Torey Lakes to facilitate cultivation of millet lure fields. Goroshko has continued observations following

implementation of these recommendations to assess their effectiveness

RESULTS

Foraging Behavior and Crop Losses Before Recommendations Were Implemented

Cranes, geese, and shelducks began to gather in flocks in the Torey Depression at the end of July or early August with the peak numbers occurring in early September, coinciding with grain harvest. Southward departure started in early to mid-September and the last migrants left the region by late October. Birds used crop fields during the entire time they were in the area, feeding in fields during morning and evening and resting in fields or wetlands during the middle of the day. During 1992-2002, large numbers of cranes concentrated at crop fields near Torey Lakes. In 2003-2006, because of severe drought, crops were very poor and the birds did not concentrate in the SBR area.

Preferred foods were millet, green bristlegrass, wheat, barley, and oats. If available, birds fed in fields with preferred crop plants. Millet is the preferred crop plant but was rarely planted. Because wheat was commonly planted and is a preferred food, wheat fields attracted the most birds and suffered the most damage. Analysis of fecal droppings showed that cranes ate wheat and green bristlegrass seeds in unharvested fields. Cranes selected the grass over the wheat. About 50% (range 10-90%) of the food intake from unharvested grain fields was bristlegrass seeds (Goroshko 2002a). The amount of grass in diet of birds appeared to be partly related to abundance of the grass species in crop fields. Where this grass was common, cranes preferred its seeds even when abundant wheat was present. Green bristlegrass usually ripens earlier than wheat, and birds may select it because it has soft seed heads; the unripe wheat seeds available at that time are more difficult to eat. Even when selecting other food items, cranes still cause extensive crop losses in unharvested fields by shattering heads and knocking over stems. In harvested fields, fecal analysis showed that cranes consumed mostly waste wheat.

Cranes and waterfowl preferred to feed in shorter vegetation. Before harvest began, birds selected wheat fields with comparatively short vegetation. Once harvest began, birds concentrated mainly in harvested fields. Birds also concentrated in fields with swathed crops, which provided both short cover and ample food. Both before and after harvest, some birds fed in unworked fallow fields, selecting green bristlegrass and a self-seeding subspecies of millet (*Panicum miliaceum ruderale*). Worked fallow lands were seldom used by birds because they were plowed and harrowed several times over the summer in preparation for planting and weed control.

Much of the depredation problem was related to placement

of the crop fields. Wheat fields on a cape projecting into wetlands at Barun Torey Lake experienced the worst damage (up to 70%). Most of the feeding cranes were in fields <1 km from roost sites. Cranes very rarely visited fields located >5 km from wetland roost sites. Demoiselle cranes roosted on pebble beaches, whereas other species of cranes roosted in shallow marshes and geese roosted on islands.

Effectiveness of Depredation Reduction Practices

Cooperative farmers used some of the authors' recommendations, resulting in reduced crop depredations by cranes. Moving croplands further from roosting areas, using lure crops, and changing some agricultural practices all combined to reduce depredations. The savings in crop damage was sufficient for the cooperative farms to increase their profits while paying for all the damage control actions themselves.

Since 2000, 1 farming cooperative has been moving fields farther from the roosting and resting sites at Torey Lakes (up to 15 km from the lake). This process is continuing. According to our censuses, cranes use of these fields was 36% of that for fields 1-2 km from Torey Lakes. Geese and shelducks usually did not visit the fields located >2 km from Torey Lakes.

In 2001, 1 cooperative farm began to develop lure crops of millet with very good results. Cranes fed in the millet and stayed out of adjacent wheat fields until after harvest. We studied the diet of cranes at that area during the entire fall migration. Before wheat harvest, cranes ate mainly millet and green bristlegrass (about 90% of diet); wheat comprised only 10% of the diet. Just after initiation of wheat harvest, crane diet shifted to about 65% millet and green bristlegrass and 35% wheat. Cost of production of lure crops (especially self-seeding millet) was 10%-20% of previous depredation losses. Therefore, development of fields for lure crops is profitable for farmers even if they do not receive financial support from Daursky SBR or other sources.

Changing common agricultural practices have reduced depredations. Farmers have begun harvesting fields that historically had problems first, before significant damage occurs. This creates highly attractive feeding areas in harvested fields close to roosting areas and in locations that cranes traditionally use. Swathing crops is being phased out in favor of combining standing crops. Fallow fields close to Torey Lakes with good stands of green bristlegrass and/or millet are being encouraged.

DISCUSSION

Implementation of our recommendations seems to have had good results. Crop depredation at migration staging areas of cranes appears to have reduced significantly. It is helping solve

crop damage problems while conserving crane populations and improving relationships between farmers and Daursky SBR. Perhaps this effort may serve as an example for similar problems in other locations. We know that depredation problems are unlikely to ever be totally resolved. Drought conditions have apparently resulted in redistribution of cranes during fall migration in 2003-2006, so more years of observation are needed to fully assess the effectiveness of the new program. It appears that significant progress is possible and there is potential for more. The Daursky SBR will work for the continued implementation of these methods to improve the compatibility of agriculture with migratory bird conservation in the Torey Depression and the Daurian steppe ecological region.

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