

Supplementary Materials

Table S1. Waterbird dataset and information sources from 1992-2012.

Overwintering period	Species	Individual abundance	Total abundance	Species numbers	Source
1992/1993	Black-necked crane	330	75573	32	Chen, 2002; Li, 2005 [51,52]
	Common crane	296			
1993/1994	Black-necked crane	463			Chen 2002; Li 2005 [51,52]
	Common crane	964			
1994/1995	Black-necked crane	502			Chen, 2002; Li, 2005 [51,52]
	Common crane	631			
1995/1996	Black-necked crane	535			Chen, 2002; Li, 2005; Li et al., 2014 [51,52,17]
	Common crane	483			
	Other waterbirds	74898			
1996/1997	Black-necked crane	512			Chen, 2002 [51]
	Common crane	371			
1997/1998	Black-necked crane	490			Chen, 2002 [51]
	Common crane	402			
1998/1999	Black-necked crane	504			Chen, 2002 [51]
	Common crane	632			
1999-2000	Black-necked crane	496			Chen, 2002 [51]
	Common crane	604			
2000-2001	Black-necked crane	484			Chen, 2002 [51]
	Common crane	646			
2001-2002	Black-necked crane	768			Chen, 2002 [51]
	Common crane	553			
	Other waterbirds	1220			
2002-2003	Black-necked crane	754			Li, 2003 [16]
	Common crane	528			
	Other waterbirds	1531			
2003-2004	Black-necked crane	779			Li, 2003 [16]
	Common crane	514			
	Other waterbirds	11179			
2004-2005	Black-necked crane	864			Li,2004; Li, 2005 [53,54]
	Common crane	733			
	Other waterbirds	2265			
2005-2006	Black-necked crane	1249	55431	23	Li et al., 2014[17]
	Common crane	767			
	Other waterbirds	53415			
2006-2007	Black-necked crane	1111			Crane synchronous investigation
	Common crane	1202			
2007-2008	Black-necked crane	1194			Crane synchronous investigation
	Common crane	774			
2009-2010	Black-necked crane	1131			Crane synchronous investigation
	Common crane	973			
2010-2011	Black-necked crane			41	Luo et al., 2012[55]
	Common crane	933			
2011-2012	Black-necked crane	1194	77269	33	Li et al., 2014[17]
	Common crane	790			
	Other waterbirds	74682			

Table S2. Waterbirds recorded in 1996 and winter of 2022 at Caohai wetland, China , guilds, protection levels in China and IUCN threatened levels and population size(Mean±SD).

Species	Guilds	National protection level(China)	IUCN	Population size	
Taiga Bean Goose(<i>Anser fabalis</i>)	Dabbling ducks	II	LC	127	
Greylag Goose(<i>Anser anser</i>)	Dabbling ducks		LC	3	
Bar-headed Goose(<i>Anser indicus</i>)	Dabbling ducks		LC	3547±3204	
Tundra Swan(<i>Cygnus columbianus</i>)	Dabbling ducks		LC	4±6	
Common Shelduck (<i>Tadorna tadorna</i>)	Dabbling ducks		LC	10±5	
Ruddy shelduck (<i>Tadorna ferruginea</i>)	Dabbling ducks		LC	5765±4921	
Gadwall(<i>Anas strepera</i>)	Dabbling ducks		LC	2602±2213	
Falcated Duck(<i>Anas falcata</i>)	Dabbling ducks		NT	825±2134	
Eurasian Wigeon (<i>Anas penelope</i>)	Dabbling ducks		LC	3825±3970	
Mallard(<i>Anas platyrhynchos</i>)	Dabbling ducks		LC	1197±2142	
Spot-billed Duck(<i>Anas poecilorhyn- cha</i>)	Dabbling ducks	II	LC	770±707	
Pintail(<i>Anas acuta</i>)	Dabbling ducks		LC	1063±944	
Common Teal(<i>Anas crecca</i>)	Dabbling ducks		LC	413±503	
Northern Shoveler(<i>Anas clypeata</i>)	Dabbling ducks		LC	164±173	
Garganey(<i>Anas querquedula</i>)	Dabbling ducks		LC	20	
<i>Baikal</i> Teal(<i>Sibirionetta formosa</i>)	Dabbling ducks		LC	2	
Red-crested Pochard (<i>Netta rufina</i>)	Diving ducks		LC	136	
Common Pochard(<i>Aythya ferina</i>)	Diving ducks		I	LC	1460±1661
Baer's Pochard(<i>Aythya baeri</i>)	Diving ducks			CR	38
Ferruginous Duck(<i>Aythya nyroca</i>)	Diving ducks			NT	107±94
Tufted Duck(<i>Aythya fuligula</i>)	Diving ducks	LC		555±905	
<i>Common Goldeneye</i> (<i>Bucephala clangula</i>)	Diving ducks	II	LC	16	
<i>Smew</i> (<i>Mergus albellus</i>)	Diving ducks		LC	4	
Common Merganser (<i>Mergus merganser</i>)	Diving ducks		LC	107±115	
<i>Little Grebe</i> (<i>Podiceps ruficollis</i>)	Shorebirds		LC	547±913	
<i>Great Crested Grebe</i> (<i>Podiceps cristatus</i>)			LC	131±216	
<i>Coot</i> (<i>Fulica atra</i>)			LC	15568±10230	
<i>Brown-headed Gull</i> (<i>Larus brunnicephalus</i>)			LC	27	
<i>Black-headed Gull</i> (<i>Larus ridibundus</i>)			LC	604±993	
<i>Great Cormorant</i> (<i>Phalacrocorax carbo</i>)			LC	243±359	
<i>Pied Avocet</i> (<i>Recurvirostra acosetta</i>)			Shorebirds	LC	4
<i>Northern Lapwing</i> (<i>Vanellus vanellus</i>)		Shorebirds	LC	57±61	
<i>Grey-headed Lapwing</i> (<i>Vanellus cinereus</i>)		Shorebirds	LC	49	
<i>Little Ringed Plover</i> (<i>Pluvialis fulva</i>)		Shorebirds	LC	1	
<i>Pacific Golden Plover</i> (<i>Pluvialis fulva</i>)	Shorebirds	LC	16		
<i>Kentish Plover</i> (<i>Charadrius alexandrinus</i>)	Shorebirds	II	LC	2	

Species	Guilds	National protection level(China)	IUCN	Population size
Pintail Snipe (<i>Gallinago stenura</i>)	Shorebirds		LC	1
Solitary(<i>Gallinago solitaria</i>)	Shorebirds		LC	1
Common Snipe (<i>Gallinago Gallinago</i>)	Shorebirds		LC	16
Spotted Redshank (<i>Tringa erythropus</i>)	Shorebirds		LC	20±6
Common Redshank (<i>Tringa totanus</i>)	Shorebirds		LC	50
Marsh Sandpiper (<i>Tringa stagnatilis</i>)	Shorebirds		LC	1
Common Greenshank (<i>Tringa nebularia</i>)	Shorebirds		LC	116
Green Sandpiper (<i>Tringa ochropus</i>)	Shorebirds		LC	7±7
Dunlin(<i>Gallinago solitaria</i>)	Shorebirds		LC	1
Eurasian Curlew (<i>Numenius arquata</i>)	Shorebirds	II	NT	2
Purple Swampphen (<i>Porphyrio porphyrio</i>)	Wading birds	II	LC	15±5
Common Moorhen (<i>Gallinula chloropus</i>)	Wading birds		LC	362±365
Common Crane (<i>Grus grus</i>)	Wading birds	II	LC	821±351
Black-necked Crane (<i>Grus nigricollis</i>)	Wading birds	I	NT	1367±573
Black Stork (<i>Ciconia nigra</i>)	Wading birds	I	LC	2
Asian Openbill (<i>Nastomus oscitans</i>)	Wading birds		LC	135
Eurasian Spoonbill (<i>Platalea leucorodia</i>)	Wading birds	II	LC	86
Black-faced Spoonbill (<i>Platalea minor</i>)	Wading birds	I	EN	3
Black-crowned Night Heron(<i>Nycticorax nycticorax</i>)	Wading birds		LC	6
Grey Heron(<i>Ardea cinerea</i>)	Wading birds		LC	256±244
Chinese Pond Heron (<i>Ardeola bacchus</i>)	Wading birds		LC	2
Great egret(<i>Egretta alba</i>)	Wading birds		LC	28±24
Little Egret(<i>Egretta garzetta</i>)	Wading birds		LC	1262±1244
Intermediate Egret (<i>Egretta intermedia</i>)	Wading birds		LC	3±3
Cattle egret(<i>Bubulcus ibis</i>)	Wading birds		LC	17

Individual values indicate that only recorded 1~2 times, and the data differ greatly, we take the highest value as the population size .

Table S3. Parameter estimates for the three ways of the interpolation method presented in Supplementary.

Interpolation method	Parameters	Estimate	F	R ²	P	GCV
Geometric mean	Total population	10.96	11.13	0.721	0.000564 ***	0.050
	Dabbling ducks	9.92	13.6	0.939	0.000589 ***	0.022
	Diving duck	7.63	24.71	0.955	2.73e-05 ***	0.042
	Wading birds	4.33	11.03	0.897	<2e-16 ***	0.048
	Shorebirds	7.61	43.03	0.958	0.0173 *	0.131
	Coots	10.96	12.01	0.571	2e-16 ***	0.121
	Black-necked Crane	9.92	100.6	0.978	2e-16 ***	0.015
	Common crane	7.63	6.052	0.497	0.00156 **	0.108
Linear Regression	Total population	10.94	17.32	0.816	7.31e-05 ***	0.038
	Dabbling ducks	9.91	23.99	0.963	7.12e-05 ***	0.014
	Diving duck	7.72	130.4	0.991	<2e-16 ***	0.011
	Wading birds	4.39	4.861	0.918	0.0395 *	0.039
	Shorebirds	7.63	53.81	0.815	<2e-16 ***	0.272
	Coots	9.68	17.32	0.940	0.0016 **	0.089
	Black-necked crane	6.88	23.99	0.980	2e-16 ***	0.014
	Common crane	6.59	130.4	0.489	0.00176 **	0.107
Exponential regression	Total population	10.93	17.17	0.816	7.59e-05 ***	0.037
	Dabbling ducks	9.89	33.27	0.975	1.52e-05 ***	0.011
	Diving ducks	7.69	451.10	0.998	2e-16 ***	0.003
	Wading birds	7.64	53.88	0.917	2e-16 ***	0.040
	Shorebirds	4.32	10.26	0.949	0.0201 *	0.136
	Coots	9.53	10.11	0.937	0.00193 **	0.091
	Black-necked crane	6.88	109.60	0.980	<2e-16 ***	0.013
	Common crane	6.59	5.98	0.488	0.0018 **	0.106

Note: The model with the smallest GCV value is optimal [56].