

# Supplementary Materials for “Using Tracking Data to Identify Gaps in Knowledge and Conservation of the Critically Endangered Siberian Crane (*Leucogeranus leucogeranus*)”

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## Overview

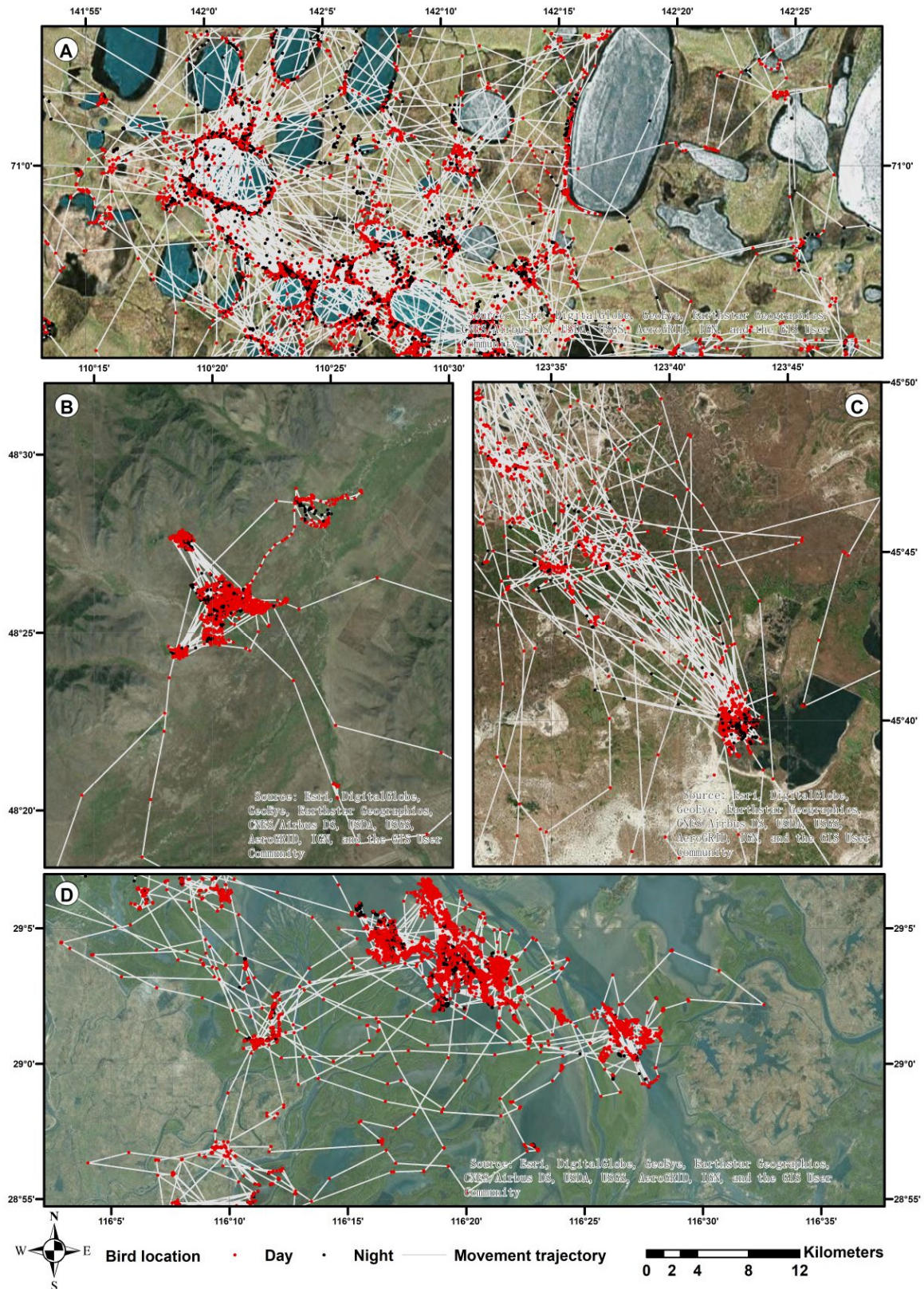
These Supplementary Materials accompany our paper, Using Tracking Data to Identify Gaps in Knowledge and Conservation of the Critically Endangered Siberian Crane (*Leucogeranus leucogeranus*). Below we list additional relevant appendices, figures, and tables that help to explain the data, methods applied, movement trajectory traits, bird individual information, migration parameters, and critical stopover sites presented in the part of the analyses:

- **Figures:**

- ✧ **Figure S1.** Movement trajectory traits of the Siberian crane in the breeding ground (A), summering ground (B), stopover sites(C), and wintering ground(D) based on Ornitela 10-minute tracking data combined from two individuals (SC1901 and SC1902).

- **Tables:**

- ✧ **Table S1** Summary information relating to four Siberian cranes (*Leucogeranus leucogeranus*) (undetermined sex) fitted with telemetry loggers in 2015, 2016, and 2019 to record positions (accurate to 2 m based on static field trials) at regular intervals (with a time and date stamp) and download these data via the GSM telephone network when within coverage. The five cranes of the 1990s were tracked through Argos System, which are the same as those in Kanai et al. (2002).
- ✧ **Table S2.** Migration parameters of nine Siberian cranes (*Leucogeranus leucogeranus*) on twelve spring/autumn migration trips.
- ✧ **Table S3.** The list of 17 critical stopover sites classified by birds staging for more than 14 days.
- ✧ **Table S4.** List of 18 stopover sites classified by birds staging for more than two days.
- ✧ **Table S5.** Extent of tagged cranes used areas and conservation status



**Supplementary Materials Figure S1.** Movement trajectory traits of the Siberian crane in the breeding ground (A), summering ground (B), stopover sites(C), and wintering ground(D) based on Ornitela 10-minute tracking data combined from two individuals (SC1901 and SC1902).

**Supplementary Materials Table S1.** Summary information relating to four Siberian cranes (*Leucogeranus leucogeranus*) (undetermined sex) fitted with telemetry loggers in 2015, 2016, and 2019 to record positions (accurate to 2 m based on static field trials) at regular intervals (with a time and date stamp) and download these data via the GSM telephone network when within coverage. The five cranes of the 1990s were tracked through Argos System, which are the same as those in Kanai et al. (2002).

Bird ID	Capture date	Capture site		Company/ Country	Satellite system	Location accuracy	Temporal resolution	Total number of locations	Number of days generating data	Age at capture	Cut-off date	Ratio of Logger and bird body mass
		Latitude	Longitude									
SC1901	2019-06-15	48.378	110.299	Ornitela/ Lithuania	GPS	2m	144 locations per day	75,392	607	Adult	2021-02-10	0.57%
SC1902	2019-06-05	48.297	110.353	Ornitela/ Lithuania	GPS	2m	144 locations per day	124,390	951	Subadult	2021-12-11	0.57%
SC1603	2016-07-19	49.166	112.737	Koeco/ Korea	GPS	2m	12 locations per day	3479	288	Adult	2017-05-02	0.92%
SC1504	2015-07-22	48.298	110.353	North Star/ USA	GPS	2m	~1.5 locations per day	1107	713	Subadult	2016-12-20	0.39%
SC9605	1996-07-25	71.126	148.467	NTT/ Japan	ARGOS	150 m	~2.5 locations per day	295	117	adult	1996-11-18	<2%
SC9606	1996-07-24	71.017	148.181	NTT/ Japan	ARGOS	150 m	~2.3 locations per day	385	166	adult	1997-01-05	<2%
SC9607	1996-07-21	70.910	147.916	NTT/ Japan	ARGOS	150 m	~0.9 locations per day	118	136	adult	1996-12-03	<2%
SC9508	1995-08-07	71.089	146.446	NTT/ Japan	ARGOS	150 m	~1.9 locations per day	290	149	adult	1996-01-02	<2%
SC9509	1995-08-04	71.088	148.304	NTT/ Japan	ARGOS	150 m	~2.4 locations per day	368	156	adult	1996-01-06	<2%

**Supplementary Materials Table S2.** Migration parameters of nine Siberian cranes (*Leucogeranus leucogeranus*) on 17 spring/autumn migration trips.

Migration strategy*	Bird ID-Year-season	Departure Date	Arrival Date	Migration Duration (day)	Stopover Duration (day)	Travel Duration (day)	Migration distance (Km)	Migration Speed (km/day)	Travel speed (km/day)	Step length (km)	Number of Stopovers	Straightness index
<b>Short autumn (N=4)</b>	SC1901_2019_autumn	2019-10-03	2019-11-19	47	38	9	3352	72	376	1676	1	0.65
	SC1902_2019_autumn	2019-09-09	2019-11-05	57	49	8	3502	62	448	1751	1	0.63
	SC1603_2016_autumn	2016-09-06	2016-10-29	53	44	9	3274	61	357	1091	2	0.684
	SC1504_2015_autumn	2015-09-08	2015-10-29	51	43	8	3164	62	382	1582	1	0.668
<b>Long spring (N=4)</b>	SC1901_2020_spring	2020-03-15	2020-5-20	66	49	17	5890	89	342	2945	1	0.84
	SC1902_2020_spring	2020-04-04	2020-5-19	45	35	10	5820	128	564	1455	3	0.84
	SC1902_2021_spring	2021-04-16	2021-5-16	30	19	12	5619	186	487	2810	1	0.88
	SC1504_2016_spring	2016-04-12	2016-05-20	38	23	15	5089	133	329	1696	2	0.955
<b>Long autumn (N=9)</b>	SC1901_2020_autumn	2020-10-01	2020-11-23	53	37	16	5812	109	362	1453	3	0.81
	SC1902_2020_autumn	2020-09-19	2020-11-07	49	42	7	4391	90	636	732	5	0.88
	SC1902_2021_autumn	2021-09-23	2021-11-02	40	29	12	5759	142	484	1440	4	0.85
	SC1504_2016_autumn	2016-09-20	2016-11-15	56	12	45	4986	88	111	2493	1	0.996
	SC9605_1996_autumn	1996-09-17	1996-11-10	54	32	22	5202	96	237	1734	2	0.976
	SC9606_1996_autumn	1996-09-17	1996-11-19	63	31	32	5433	86	169	1811	2	0.931
	SC9607_1996_autumn	1996-09-15	1996-11-16	62	15	47	4925	79	105	2463	1	0.965
	SC9508_1995_autumn	1995-10-03	1995-11-14	41	26	16	5270	128	335	1757	2	0.956
	SC9509_1995_autumn	1995-09-30	1995-11-11	42	20	22	5607	134	252	2803	1	0.904

\*Migration strategy: Long journey between the arctic region and the Yangtze river; Short journey between Mongolia and the Yangtze river.

**Supplementary Materials Table S3.** List of 17 critical stopover sites classified by birds staging for more than 14 days.

BIRD_ID	Year	Season	Time1	Time2	Lon1	Lat1	Lon2	Lat2	Duration(Day)
SC1902	2019	autumn	2019-9-12	2019-10-31	123.71154	45.66360	123.73969	45.63793	49
SC1901	2020	spring	2020-3-22	2020-5-10	123.23280	42.69462	123.21587	42.69556	49
SC1504	2015	autumn	2015-9-10	2015-10-23	123.31290	45.99570	123.53960	45.88280	43
SC1603	2016	autumn	2016-9-13	2016-10-22	123.53097	45.88017	123.53912	45.88208	40
SC1901	2019	autumn	2019-10-8	2019-11-15	123.23134	42.69068	123.22935	42.69004	38
SC1902	2020	spring	2020-4-11	2020-5-6	123.71214	45.66710	123.62941	45.84757	25
SC9605	1996	autumn	1996-10-5	1996-10-29	122.96500	45.23200	123.02200	45.22000	24
SC1902	2020	autumn	2020-10-11	2020-11-3	123.23425	42.68865	123.23117	42.68568	23
SC9606	1996	autumn	1996-10-6	1996-10-28	124.51400	47.18900	124.48100	47.20200	23
SC1504	2016	spring	2016-4-18	2016-5-8	123.31380	45.98430	122.87820	46.05870	20
SC1902	2021	autumn	2021-10-6	2021-10-26	123.27705	45.94149	123.13635	46.04200	20
SC1902	2021	autumn	2021-10-6	2021-10-26	123.27705	45.94149	123.13635	46.04200	20
SC9509	1995	autumn	1995-10-18	1995-11-6	123.50500	45.04700	123.14600	45.21700	20
SC1902	2021	spring	2021-4-20	2021-5-9	123.29879	45.99737	123.04089	46.17743	19
SC9508	1995	autumn	1995-10-14	1995-10-31	122.84300	45.09600	122.14700	44.94300	17
SC1901	2020	autumn	2020-10-23	2020-11-8	123.57124	45.73106	123.53436	45.76725	16
SC9607	1996	autumn	1996-10-9	1996-10-24	123.42700	45.86300	123.43300	45.86300	15

**Supplementary Materials Table S4.** List of 18 stopover sites classified by birds staging for more than two days.

BIRD_ID	Year	Season	Time1	Time2	Lon1	Lat1	Lon2	Lat2	Duration(Day)
SC1901	2020	Autumn	2020-11-8	2020-11-20	123.28710	42.72072	123.22527	42.68499	12
SC1504	2016	Autumn	2016-10-5	2016-10-17	123.44060	45.92210	123.53110	45.86060	12
SC1901	2020	Autumn	2020-10-12	2020-10-21	126.94856	51.10013	126.94681	51.06805	10
SC9508	1995	Autumn	1995-11-2	1995-11-11	121.81000	40.92400	121.89400	40.78200	9
SC9606	1996	Autumn	1996-11-6	1996-11-15	115.17600	32.35900	115.06800	32.29700	8
SC9605	1996	Autumn	1996-9-20	1996-9-28	138.15400	65.36100	138.07700	65.24100	8
SC1902	2020	Autumn	2020-9-24	2020-9-30	142.73094	68.08173	142.56676	68.02262	7
SC1902	2020	Spring	2020-5-6	2020-5-12	124.46542	47.19865	124.46605	47.20219	6
SC1504	2016	Spring	2016-5-20	2016-5-26	145.86120	69.34580	143.13100	68.64450	6
SC1902	2020	Autumn	2020-10-5	2020-10-10	123.79869	45.19169	123.71075	44.96753	5
SC1902	2021	Autumn	2021-9-27	2021-10-2	132.44748	59.25377	132.49587	59.24324	5
SC1902	2021	Autumn	2021-9-27	2021-10-2	132.44670	59.25486	132.49587	59.24324	5
SC1603	2016	Autumn	2016-9-7	2016-9-12	119.35155	47.70627	119.34534	47.70389	5
SC1902	2020	Spring	2020-4-5	2020-4-10	123.20525	42.69786	123.23399	42.68814	4
SC1902	2020	Autumn	2020-9-19	2020-9-23	143.20654	68.88331	143.06140	68.52586	4
SC1902	2021	Autumn	2021-10-28	2021-11-1	119.06462	37.80771	119.28029	37.81202	4
SC1902	2020	Autumn	2020-11-3	2020-11-7	119.00088	37.98628	118.99630	37.71066	3
SC1504	2016	Spring	2016-5-11	2016-5-13	129.34590	54.60840	129.34610	54.60910	2

**Supplementary Materials Table S5.** Extent of tagged cranes used areas and conservation status

Period	Extent (km <sup>2</sup> )	Protected		Conservation gaps	
		Area (km <sup>2</sup> )	Percentage	Area (km <sup>2</sup> )	Percentage
Breeding in Russia	801	181	22.57%	620	77%
Stopover	868	391	44.98%	478	55%
Summering in Mongolia	246	0	0.00%	246	100%
Wintering	794	395	49.81%	398	50%