



# A Study on the Home-Range and Habitat Use of Spot-Billed Duck (*Anas poecilorhyncha*) in Spring

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## ABSTRACT

The spring home range and habitat use of the spot-billed duck in Korea were studied using GPS-mobile phone-based telemetry (WT-300). The study areas were Anseong-si, Seosan-si, Nonsan-si, and Sejong-si. Analysis was performed using minimum convex polygon (MCP) and kernel density estimation (KDE) spot-billed ducks had an average home range of 70.28 km<sup>2</sup> (standard deviation [SD]=84.50, n=6), and a core habitat (50%) 2.66 km<sup>2</sup> (SD=2.60, n=6), according to MCP and KDE, respectively. Wetlands (41.5%) and rice fields (35.7%) were highly used as habitats. The rice field use rate was high during the day, and the wetland utilization rate was high at night. Rice fields and wetlands were the primary habitats in spring.

**Keywords:** Ecosystem, GPS-mobile phone-based telemetry, Homing behavior, Minimum convex polygon, Spatial analysis

## Introduction


Water birds prefer Korea as a stopover and wintering location because of the country's favorable geographic conditions. It is reported that over 1,340,000 domestic water birds overwintered as of 2020 (National Institute of Biological Resources [NIBR], 2020). The spot-billed duck is the third most abundant species of ducks in Korea (NIBR, 2020). However, the spot-billed ducks peaked in 2000 and currently has 100,000 (NIBR, 2020). The spot-billed ducks prefer eating on farmland, despite their primary

habitats being rivers, lakes, and reservoirs (Stafford *et al.*, 2010). The average daily distance traveled by the spot-billed duck is 1.0±0.89 km, with a maximum of 23 km (Shin *et al.*, 2016c). Factors such as food resources, the quantity of food, and human interference influence the migration routes of the spot-billed ducks (Davis & Afton, 2010; Kang *et al.*, 2014; Shin *et al.*, 2016a). Typically, the spot-billed duck spends the day resting in lakes and rivers and the night foraging in fields (Baldassarre & Bolen, 1994). The spot-billed duck has a sustainable breeding population in Korea. However, most research on the spot-billed ducks has been conducted during winter. Therefore, this study aimed to elucidate the home range and habitat use of spot-billed ducks in spring to protect and manage this species.

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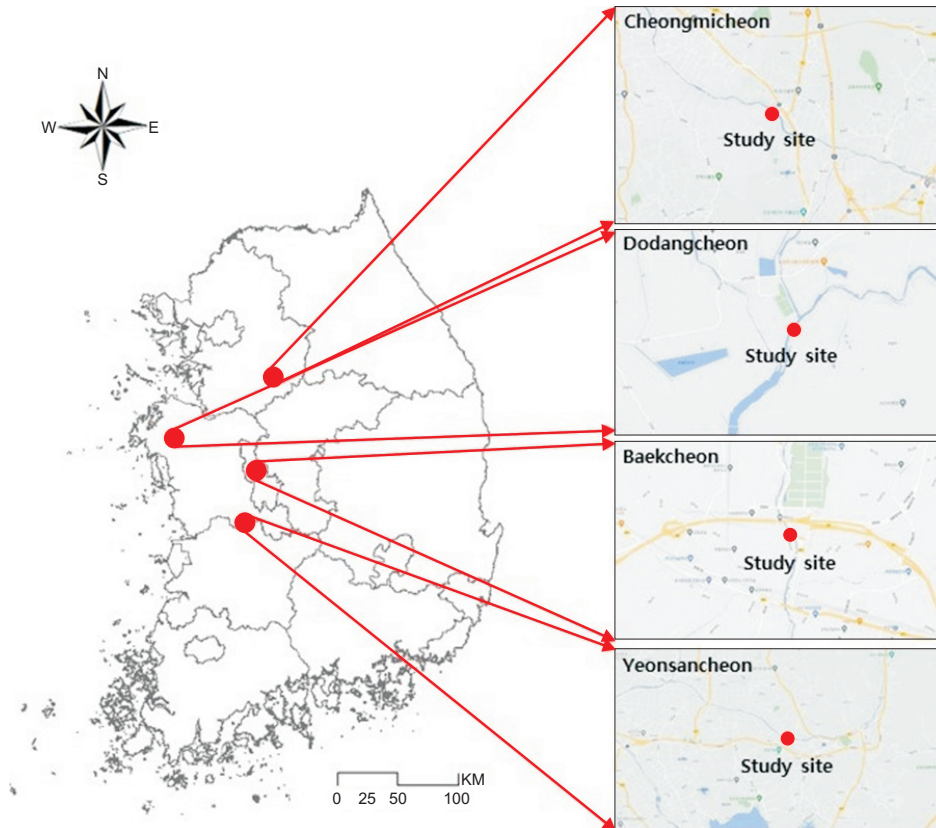


Fig. 1. Study areas.

Table 1. Summary information of 6 spot-billed ducks (*Anas poecilorhyncha*)

Study areas	No	Weight (g)	Tracking period	No. of GPS fixed	GPS fixed time/day	Battery lifespan
Cheongmicheon	SB1	1,310	2022.03.01-2022.05.31	1,104	12	92
Cheongmicheon	SB2	1,280	2022.03.01-2022.05.31	1,104	12	92
Cheongmicheon	SB3	1,205	2022.03.01-2022.05.31	1,104	12	92
Dodangcheon	SB4	1,070	2022.03.01-2022.04.27	693	12	58
Yeonsancheon	SB5	1,340	2022.03.01-2022.05.31	1,104	12	92
Baekcheon	SB6	1,045	2022.03.01-2022.05.31	1,102	12	92

## Materials and Methods

### Study areas

The GPS-mobile phone-based telemetry (WT-300: 22 g) was attached to four locations for this study: Cheongmi stream in Anseong-si Gyeonggi-do, Dodang stream in Seosan-si Chungcheongnam-do, Yeosan stream in Nonsan-si, and Baek stream in Sejong-si (Fig. 1). WT-300 was attached to six spot-billed ducks (three in Cheongmi streams and one each in Baek stream, Dodang stream, and Yeosan stream). GPS acquired location information 12 times per day at 2 hours intervals. Data were analyzed from March 1 to May 31, 2022. Five (SB1, SB2, SB3, SB5,

and SB6) of the six spot-billed ducks were tracked for 92 days, while one (SB4) was tracked for 58 days (Table 1).

### Home range analysis

The analysis methods employed were the minimum convex polygon (MCP) and kernel density estimation (KDE). The home range determination strategy used a KDE method with three steps (90%, 70%, and 50%), where the MCP was set at 100%. By following the standard research method, we divided the calculated home range by 50% to determine the core habitat (Kauhala & Autttila, 2010).

**Table 2.** Land coverage map (middle classification) reclassification system

Reclassification	Code	Middle classification
Wetland	510	Inland wetlands
	520	Coastal wetlands
	710	Inland waters
	720	Sea water
Rice field	210	Rice field
Field	220	Field
Others	110	Residential area
	120	Industrial area
	130	Commercial area
	140	Culture-Athletic Recreation area
	150	Traffic area
	160	Public facilities area
	230	Facility cultivation area
	240	Orchard
	250	Other cultivated land
	310	Hardwood forest
	320	Coniferous forest
	330	Mixed forest
	410	Natural grassland
	420	Artificial grassland
	610	Nature bare land
	620	Artificiality bare land

### Habitat use

The habitat classification was based on the land cover map (2020) issued by the Ministry of the Environment. The ecology of the spot-billed duck and the findings of previous studies were utilized to reclassify the study area into wetlands, rice fields, and other fields. The habitat utilization rate was categorized by time into all (24 hours), daytime (06:00–18:00 hours), and night time (20:00–04:00 hours). The average springtime sunrise and sunset were used to determine the day and night standards (Table 2).

## Results

### Home range analysis

The MCP analysis of six spot-billed ducks revealed an average home range of 70.28 km<sup>2</sup> (standard deviation [SD]=84.50, n=6). KDE showed that 90% of 9.96 km<sup>2</sup> (SD=9.25, n=6) and 70% of 4.91 km<sup>2</sup> (SD=5.10, n=6) were used, whereas core habitats (50%) was 2.66 km<sup>2</sup> (SD=2.60, n=6) (Fig. 2, Table 3).

### Habitat utilization rate

Analysis of the habitat utilization rate of the spot-billed ducks demonstrated that wetlands (41.5%) had the highest utilization rate, followed by rice fields (35.7%) and others (20.8%). During the day, rice fields (40.0%) were used the most followed by wetlands (35.4%) and others (23.2%). However, wetlands (50.1%) were used the most at night, followed by rice fields (29.7%) and others (17.4%). Therefore, rice fields were used more during the day, whereas the wetlands were most utilized at night (Fig. 4).

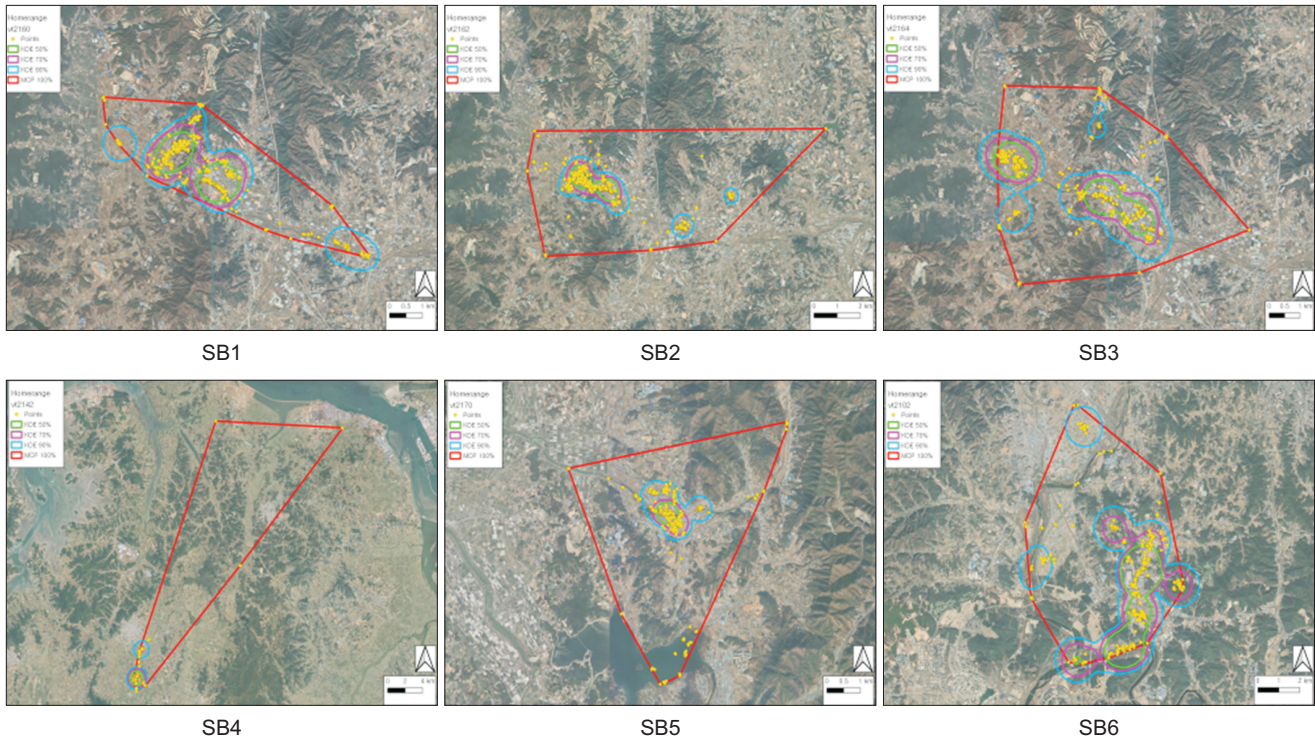
## Discussion

The winter home range (KDE 50%) of spot-billed ducks includes more urban than rural areas (Hwang *et al.*, 2016). From these findings, we conclude that the spring home range (KDE 50%) of the spot-billed duck was similar to that of the rural areas and smaller than in urban areas (Hwang *et al.*, 2016). Spot-billed ducks, like other duck species, show differences in mobility and home range depending on environmental and anthropogenic factors (Davis & Afton, 2010; Kang *et al.*, 2014; Yoo *et al.*, 2008). A limited home range in the spring allows for the provision of food and a hiding spot according to the grass. Therefore, they used a small home range and avoided extensive travel during the spring.

Wetlands (41.5%) and rice fields (35.7%) were found to be highly utilized by spot-billed ducks. The utilization rate of rice fields was high during the day, whereas that of wetlands was high at night. This was comparable to the wintertime habitat usage rate in rural areas (Hwang *et al.*, 2016). The spot-billed ducks typically inhabit wetlands and rice fields during spring and winter. Thus, wetlands and rice fields are important habitats for spot-billed ducks. Recently, spot-billed ducks were the third largest population of wintering ducks in Korea, but their numbers have been declining continuously over the past decade (NIBR, 2020). This decrease in population is attributable to habitat changes (Shin *et al.*, 2016b). Wetland conservation efforts are critical to ensure the survival of native species and maintain a steady domestic breeding population. Although this study analyzed the habitat and home range of spot-billed ducks in spring, further research is necessary. The findings of this study can serve as fundamental data to protect spot-billed ducks by managing two of their crucial springtime habitats, rice fields and wetlands.

## Conflict of Interest

The authors declare that they have no competing interests.



**Fig. 2.** Spot-billed duck (*Anas poecilorhyncha*) Home range (dotted line is minimum convex polygon and contours represent 90, 70, 50% from outside line, respectively).

**Table 3.** Home range estimations of spot-billed ducks (*Anas poecilorhyncha*) by MCP and KDE

Study areas	No	MCP (km <sup>2</sup> )	KDE (km <sup>2</sup> )		
			90%	70%	50%
Cheongmicheon	SB1	15.04	7.90	3.75	2.07
Cheongmicheon	SB2	48.60	4.98	2.17	1.29
Cheongmicheon	SB3	34.03	10.21	4.67	2.74
Dodangcheon	SB4	239.58	6.66	3.26	1.82
Yeonsancheon	SB5	24.51	2.03	0.70	0.35
Baekcheon	SB6	59.94	27.99	14.94	7.72
Average		70.28	9.96	4.91	2.66
Standard deviation		84.50	9.25	5.10	2.60

MCP, minimum convex polygon; KDE, kernel density estimation.

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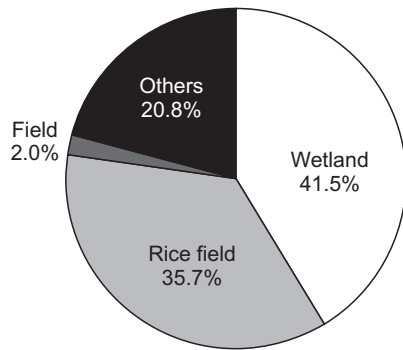
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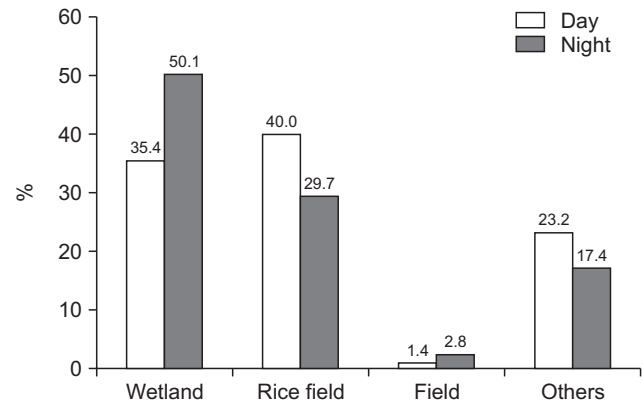
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**Fig. 3.** Percentage of total habitat use during the tracking period.



**Fig. 4.** Day and night comparison of habitat used.

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