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464236
100101
Nipponia nippon
2014 2022 84 1
95% 50%
12.82 ± 14.11 km² n = 84
Z = 10.60 P < 0.01
103 ± 43 m
t = 5.48 df = 83 P < 0.01
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Nest Distribution of the Reintroduced Crested Ibis
in Dongzhai, Henan Province

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Abstract: [Objectives] To understand the distribution and expansion of the reintroduced population of Crested Ibis *Nipponia nippon*, we investigated the distribution of nest sites in this species with a reintroduced

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population in Dongzhai, Henan Province, China. **[Methods]** From 2014 to 2022, we investigated the nests of rewilding Crested Ibis and its descendants in Henan Dongzhai National Nature Reserve and its surrounding area. We estimated the degree of concentration of these nests relative to the release site by a circular distribution method using Oriana 4.01 (Kovach Computing Services, Wales, UK). We calculated the distribution of the nesting area (the area where 95% of the nest sites are located) and core nesting area (the area where 50% of the nest sites are located) using a fixed kernel estimation method in ArcView GIS 3.3. In addition, we overlaid the map of nest sites, landscape coverage map, and the digital elevation model map using ArcMap 10.7 software (ESRI) to investigate the nest-site selection of this species. Using the one sample *t*-test, we compared the average elevation difference between the nest sites and the nesting range. **[Results]** The distances between most nesting sites and the release site are within 80 km (81 vs. 84) (Fig. 1 and 2). The average distance was 12.82 ± 14.11 (SD) km ($n = 84$), and the average azimuth was $138.99^\circ \pm 82.44^\circ$ (SD) (Rayleigh's *z* test: $Z = 10.60$, $P < 0.01$) (Fig. 3). The area of the core nesting ranges and nesting ranges are 74.43 km² and 549.66 km², respectively (Fig. 4). The average elevation of the nest sites is 103 ± 43 (SD) m, which is significantly lower than the average altitude of the nesting ranges ($t = -5.48$, $df = 83$, $P < 0.01$). Most nest sites are distributed in the adjacent paddy fields and forests (Fig. 1). The distribution map of the breeding area by years shows that the breeding area expands in the direction of northwest to southeast (Fig. 5), which is consistent with the analysis result of circular distribution. **[Conclusion]** Our research described the nest site's distribution characteristics and expansion trends of the reintroduced Crested Ibis population in Dongzhai. It can provide a reference for the protection of potential breeding areas and habitats of wild Crested Ibis, and optimize the allocation of human and material resources in the protection work.

Key words: Crested Ibis, *Nipponia nippon*; Reintroduction; Breeding site; Distribution area; Dongzhai, Henan Province

^ *Nipponia nippon* ^ 2019~ 2023 7
 w A 1
 20 26~ 2013 34~ 2014
 2001 2021 20~ 2022 7~ 2023
 2004~ A1981 7~ 6~ 133~ A
 1981~ i A i c
 40 b w 400~ i^
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1 **ᵇ**

1.1

$$114^{\circ}26'11'' \text{ E } 31^{\circ}44'36'' \sim 32^{\circ}06'43'' \text{ N } \beta$$

$\hat{\tau}$

1.2

1.2.1

$\hat{A}$

1.2.2

$\hat{1}$ $\hat{114^{\circ}16'48''\text{ E}}$ $31^{\circ}58'05''\text{ N}$
 Ψ $2016\sim$ $\dot{\imath}$
 Σ Ψ
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 $\mathfrak{L}$ π $\mathcal{U}$ Ψ
 β π Ψ
 0° $\mathcal{U}$ Ψ $180^{\circ}\hat{\text{A}}$ $\mathfrak{L}$
 β Oriana 4.01

^ Kovach Computing Services, Wales, UK~

1~ ^ Rayleigh's z test~

$$Z \quad Z > Z_{0.05} \quad \updownarrow \quad P < 0.05$$
$$\beta \quad \dot{\mathbf{i}} \quad \wedge \quad \text{Zar 20}$$
$$2^{\sim} \quad \wedge \quad r^{\sim}$$
$$r \in [0, 1]$$

1996~ Á

movement SA v2.04 beta
 fixed kernel estimation FKE 95%
 50%
 2020
 minimum
 convex polygon MCP

R 4.2.0 R Development Core Team 2021~
sf ^ Pebesma 2018~ ^ smoothr ^ Strimas-
Mackey 2021~ ^

ArcMap 10.7 ESRI

www.webmap.cn DOI: 10.11769/

GlobeLand30 30 m ASTER
www.gscloud.cn

$$\frac{\text{GDEM 30 m}}{0.05} = \frac{\hat{A}}{\bar{w}} \pm P$$

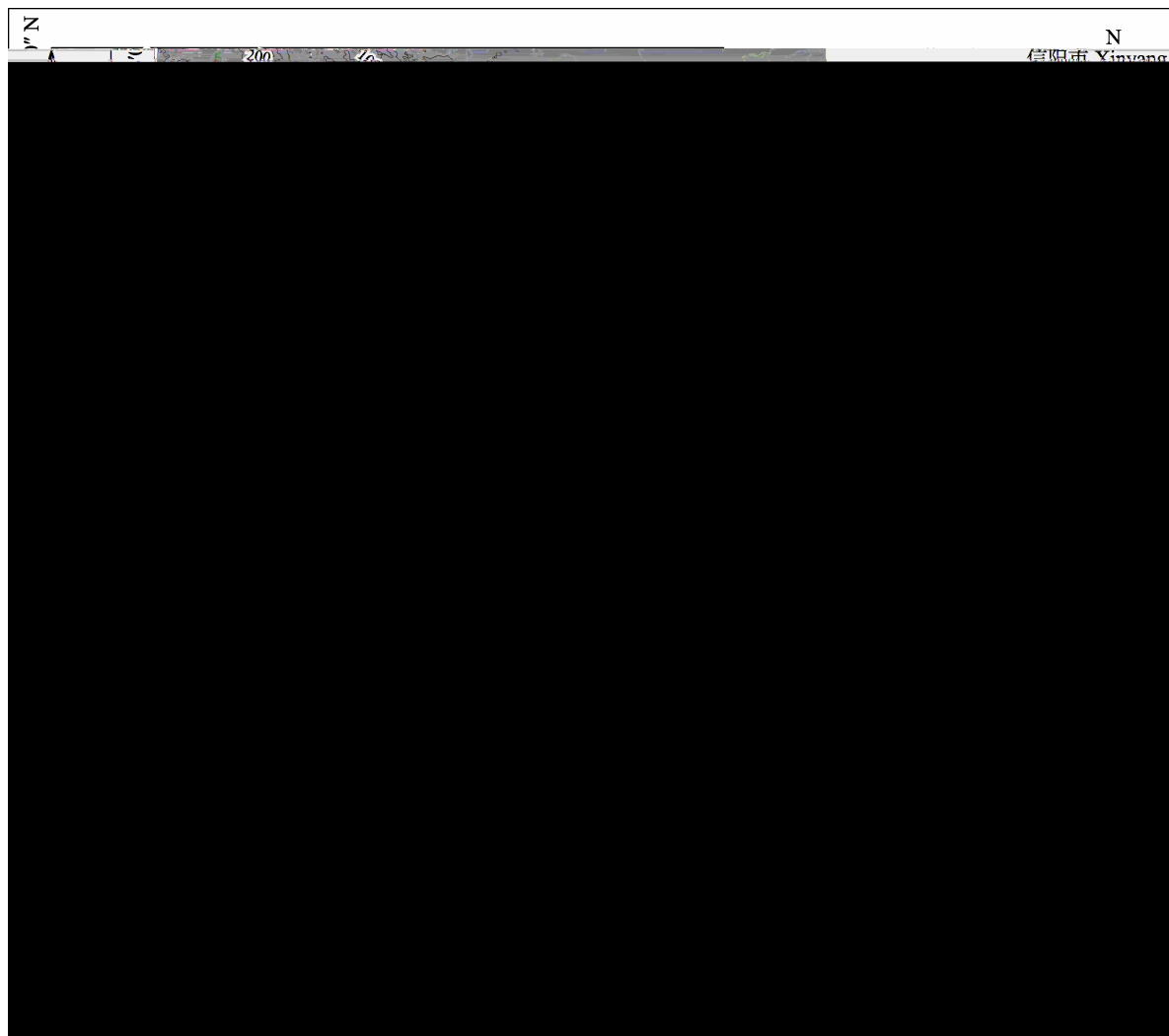
Mean $\pm$ SD $\hat{A}$

2.1

$$\Delta = 84 \pm 12.82 \pm 14.11 \text{ km} \quad n = 84 \quad \hat{A} = 1$$

β $\dot{\gamma}$ τ 2.72
km β t_b
 t_b 82.76 km β

20 km ^ 81 vs. 84^ 2~ Â



1 2014 2022

Fig. 1 The nest distribution of the reintroduced Crested Ibis population in Dongzhai from 2014 to 2022

^ The red dotted line represents the tendency of nest sites to be concentrated.

$r = 0.355$
 ^ Rayleigh's z test $Z = 10.60$ $P < 0.01$
 $\hat{\mu} = 138.99 \pm 82.44^\circ$
 $n = 84$
 2.2
 549.66 km^2
 475.23 km^2
 74.43 km^2
 $4 \sim 5$
 2014 2022
 $\hat{\mu}$

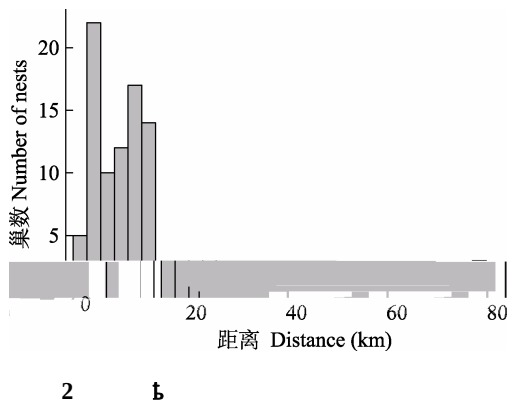


Fig. 2 The frequency distribution histogram of the distance between the nest site and the release site

2.3

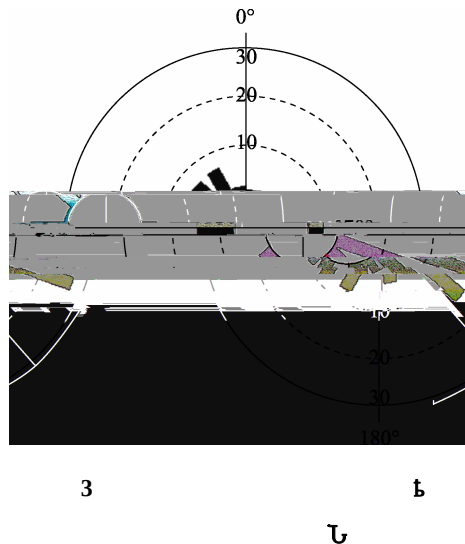


Fig. 3 The relative direction between the nest and the release site for the reintroduced Crested Ibis population in Dongzhai

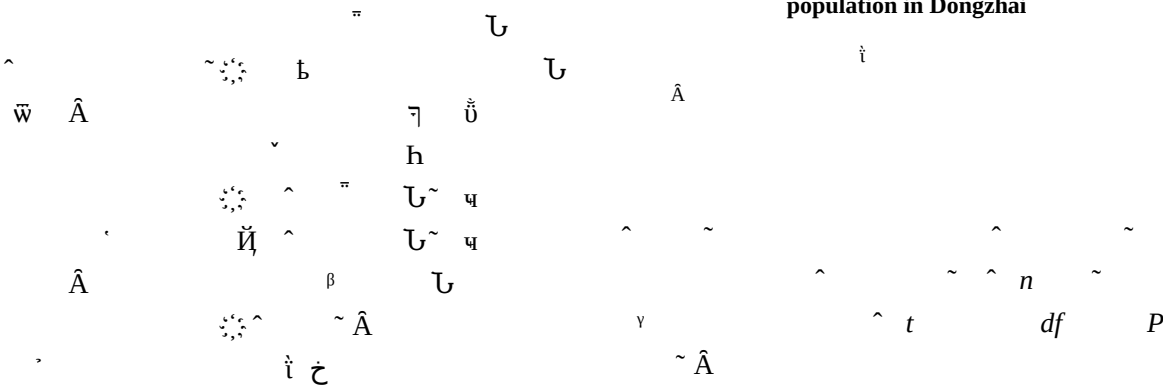
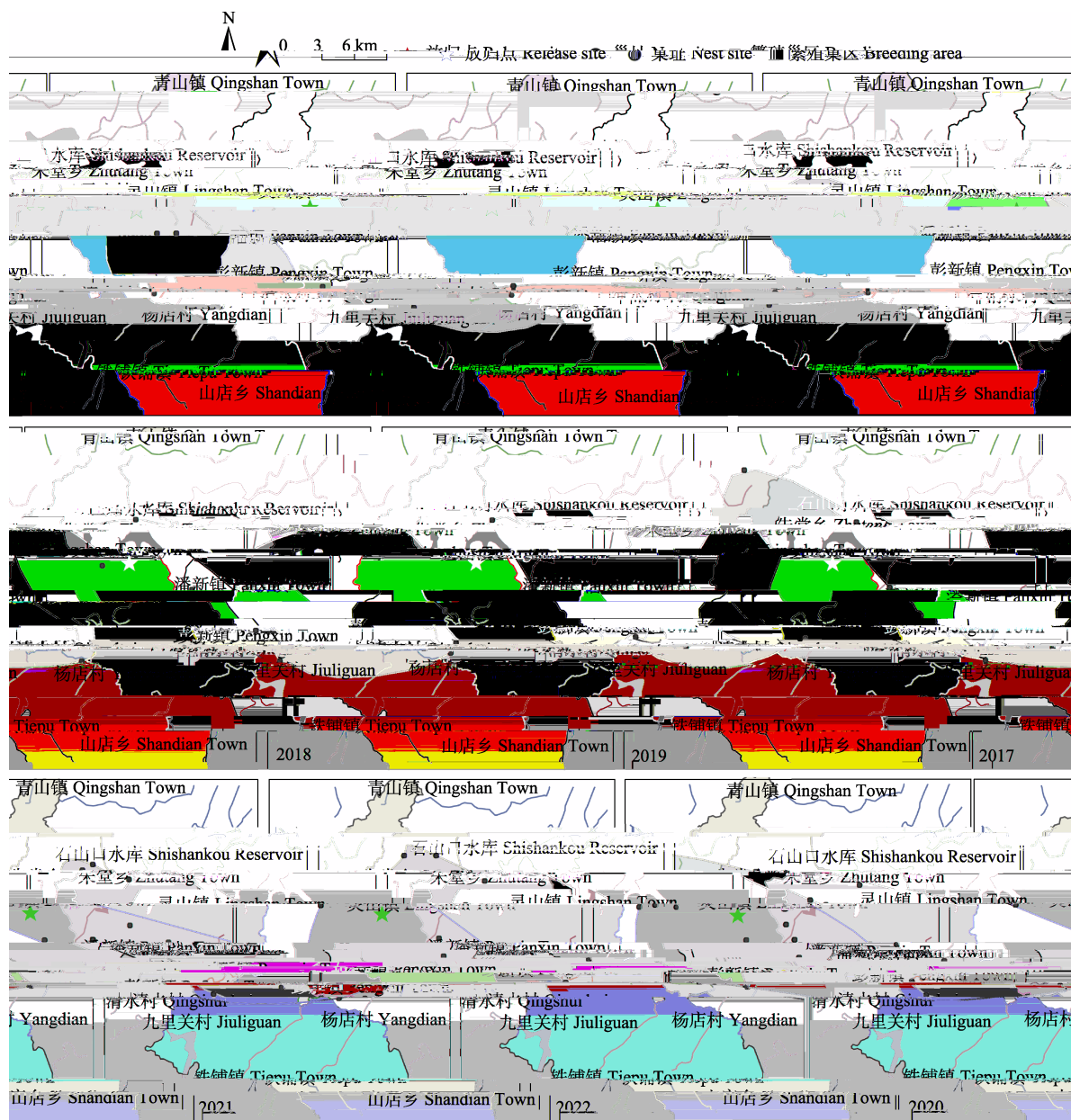
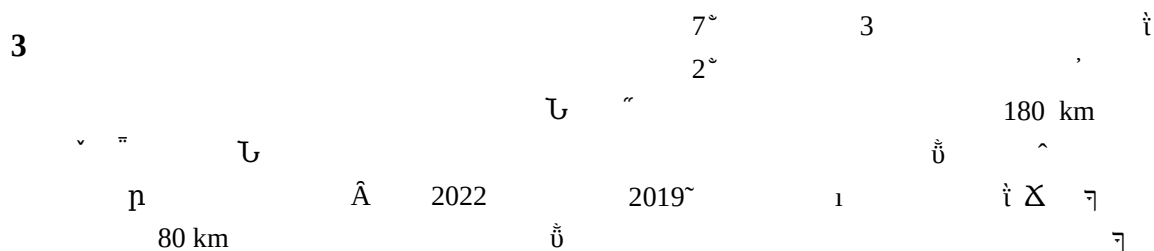


Fig. 4 The nesting area of the reintroduced Crested Ibis population in Dongzhai



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Fig. 5 The breeding areas (grey area) of the reintroduced Crested Ibis population in Dongzhai from 2014 to 2022



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| spatial vector data. The R Journal, 10 (1): 439–446. | , , . 2019. |
| R Development Core Team. 2022. R: A language and environment for statistical computing version 4. 1. 3 Vienna, Austria: R Foundation for Statistical Computing. [R/OL]. [2022-08-01]. https://www.r-project.org/ . | , , . 2019. 54(8): 7–9. |
| Strimas-Mackey M. 2018. Smoothr: Smooth and tidy spatial features. R Package Version 0. 1. 0. [R/OL]. [2022-08-01]. https://CRAN.R-project.org/package=smoothr/ . | Ç . 2004. , 1–388. |
| Wang F, Li M, Zhang Y S, et al. 2021. Post-release dispersal and breeding site suitability of reintroduced populations of the Crested Ibis in Shaanxi Province, China. Restoration Ecology, 29(5): e13383. | Ç , ↔ . 2007. 42(3): 1–5, 63. |
| Ye Y X, Santoro S, Song Z T, et al. 2023. Dispersal patterns of the endangered Crested Ibis suggest high breeding densities drive natal dispersal. Ornithological Applications, 125(1): duac042. | , , , . 2016. 1 |
| Yu X P, Xi Y M, Lu B Z, et al. 2010. Post fledging and natal dispersal of Crested Ibis in the Qinling Mountains, China. The Wilson Journal of Ornithology, 122(2): 228–235. | , . 51(10): 53–56. |
| Zar J H. 1996. Biostatistical Analysis. 3rd ed. Englewood Cliffs, New Jersey: Prentice Hall. | , , Ç , . 2002. b |
| Zar J H. 2007. Biostatistical Analysis. 5th ed. Englewood Cliffs, New Jersey: Prentice Hall. | , . 48(6): 725–732. |
| | ↔ . 1981. ð . 27(3): 273. |
| | , , , , . 2021. |
| | Ç . 40(6): 184–190. |
| | ¥ , , . 2001. . " : , 107. |
| | , , , . 2020. |
| | , . 56(11): 143–150. |
| | , , , . 2020. |
| | , . 41(1): 84–89. |
| | , , , . 2022. |
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| | ¶ . 57(3): 455–461. |
| | . 2020. ^ <i>Nipponia nippon</i> ~ |
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