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# Journal of Threatened Taxa

10.11609/jott.2023.15.8.23631-23826
www.threatenedtaxa.org

26 August 2023 (Online & Print)
15(8): 23631-23826
ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

Open Access

ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher
**Wildlife Information Liaison Development Society**
www.wild.zooreach.org

Host
**Zoo Outreach Organization**
www.zooreach.org

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**Cover: Coromandal Sacred Langur *Semnopithecus priam* - made with acrylic paint. © P. Kritika.**

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 August 2023 | 15(8): 23675–23680

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

https://doi.org/10.11609/jott.8263.15.8.23675-23680

#8263 | Received 09 November 2022 | Final received 12 August 2023 | Finally accepted 14 August 2023

OPEN ACCESS

COMMUNICATION

# Preference of *Helopsaltes pleskei* (Taczanowski, 1890) (Aves: Passeriformes: Locustellidae) on uninhabited islets (Chengdo, Jikgudo, and Heukgeomdo) in South Korea as breeding sites

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**Abstract:** This study was conducted to investigate the habitat and breeding status of the Pleske's 22 Grasshopper Warbler *Helopsaltes pleskei* inhabiting unmanned coastal islets (Cheongdo, Jikgudo and Heukgeomdo) on the Jeju Chuja Marine Provincial Park in South Korea. A total of 13 nesting sites were observed between April 2019 and April 2021. On Cheongdo Islet, nests were located as follows: four in *C. japonica*, one in *P. thunbergii*, and one in *Eurya emarginata*. On Jikgudo Islet, four nests were distributed with two in *C. japonica*, one in *P. thunbergii*, and one in *E. macrophylla*. Meanwhile, on Heukgeomdo islet, three nests were located, all in *C. japonica*. During the study period, 36 individuals were observed: 14 in Cheongdo, 10 in Jikgudo and 12 in the Heukgeomdo Islets. Most nesting sites were located in the bushy areas of the inner islets. Thus, birds tended to select nesting locations in response to predation and microclimates to increase reproductive rates and maximize offspring survival. This study highlights the importance of unmanned islands (islets) and the presence of bushy shrubs as important nesting and hiding sites for the ecologically vulnerable Pleske's Grasshopper Warbler.

**Keywords:** Defence mechanism, habitat environment, Korean Peninsula, Pleske's Grasshopper Warbler, Red List species, vegetation.

**Editor:** H. Byju, Coimbatore, Tamil Nadu, India.

**Date of publication:** 26 August 2023 (online & print)

**Citation:** Jeong, Y-H., S-H. Choi, S-M. Park, J-W. Lee & H-S. Oh (2023). Preference of *Locustella pleskei* (Taczanowski, 1890) (Aves: Passeriformes: Locustellidae) on uninhabited islets (Chengdo, Jikgudo, and Heukgeomdo) in South Korea as breeding sites. *Journal of Threatened Taxa* 15(8): 23675–23680. https://doi.org/10.11609/jott.8263.15.8.23675-23680



**Funding:** None.

**Competing interests:** The authors declare no competing interests.

**Author details:** Young-Hun Jeong and Sung-Hwan Choi are doctoral candidates specializing in ecology at Jeju National University. Young-Hun Jeong's research centers on the circadian rhythms of mammals and birds, and he is actively involved in bird monitoring and habitat surveys. Sung-Hwan Choi delves into the impact of alien species on the uninhabited islands of Jeju, emphasizing the ecological changes these species induce. Dr. Seon-Mi Park serves as a postdoctoral researcher at Jeju National University. Renowned for her expertise in molecular and animal ecology, she has published extensively in international academic journals, primarily focusing on invasive animal species. Dr. Jun-Won Lee has undertaken comprehensive research on the rodents of Jeju Island, earning his doctoral degree from Jeju National University. Professor Hong-Shik Oh has made seminal contributions to the field of ecology in South Korea. His areas of expertise encompass wildlife ecology, molecular ecology, genetics, and conservation biology.

**Author contributions:** YHJ drafted the original manuscript, while both YHJ and SHC conceptualized the study and designed the field methodology. YHJ, SHC, SMP, and JWL conducted the field study, collecting data, and performing the analysis. HSO reviewed and provided edits to the original manuscript.

**Acknowledgements:** The author is grateful to the traditional healers and other knowledgeable ethnic people of the studied area who have participated in the field survey and provided valuable information of ethnomedicinal pteridophytes. The author is also grateful to the Principal, A.B.N. Seal College, Cooch Behar, for providing necessary facilities. This work is supported by the grant (Memo No: 682/(Sanc.)/BT/ST/P/S&T/2G-01/2020 dated 04/01/2021) from the Department of Science & Technology and Biotechnology (DSTBT), Government of West Bengal, under the Research and Development Programmes scheme named as Gobeshonay Bangla. The author is sincerely indebted to the anonymous reviewers and subject editor for providing valuable suggestions. Sincere thanks to Mr. C.R. Fraser-Jenkins, Kathmandu, Nepal, and Cascais, Portugal, for his support in the identification of the species and valuable suggestions during revision of the manuscript.

## INTRODUCTION

Pleske's Grasshopper Warbler *Helopsaltes pleskei* is a species of Passeriformes, and is 17 cm long, with a greyish brown or olive brown back and white belly (Birdlife International 2001). The light brownish-white eyebrow line is unclear, the tail is round and small white spots at the end are observed and the legs are pale apricot (Fujita et al. 2005). Its appearance is similar to that of *Locustella ochotensis* and it feeds on insects, spiders, and gastropods (Lee et al. 2020). The Pleske's Grasshopper Warbler lays three to six eggs in reed fields, bamboo forests, and shrubberies around the coast between mid-May and August and builds rice bowl-shaped nests on shrub stems such as that of *Camellia japonica* and *Pittosporum tobira* (Brazil 2009).

The Pleske's Grasshopper Warbler is an extremely rare bird, with an estimated 2,500–10,000 individuals remaining worldwide. It is an internationally protected species classified as 'Vulnerable' (VU) as per the IUCN Red List and is also designated as belonging to endangered wildlife class II in South Korea (NIBR 2019). It breeds locally on the islands and coasts of far east Russia, Japan, and China, including the Korean Peninsula. Vietnam and Hong Kong are migratory locations (Qiao et al. 2006). Its habitat is usually an area in the shrubberies or wetlands located in temperate and subtropical climates, and fewer than 100 pairs of Pleske's Grasshopper Warblers are estimated to breed in Korea (Birdlife International 2001). It breeds mainly on uninhabited islands such as Hongdo, Chilbaldo and Sasudo Islets in South Korea (Choi et al. 2017). Habitat reduction and loss due to development are the main factors that have led to a decrease in the population of the Pleske's Grasshopper Warblers; however, no specific basis for this population reduction has been revealed yet (Takaki et al. 2001).

The records of this species were majorly based on past reports, and no field surveys have been conducted since 2016. Such information gaps also have significant conservation implications as they critically undermine the efforts in biodiversity conservation (Geijzendorffer et al. 2016). Hence, this study was conducted to identify nest structure and habitat characteristics and to provide the basic data for the protection of the threatened Pleske's Grasshopper Warblers.

## MATERIALS AND METHODS

### Study area

Chujado Island (33°56'94.7" N & 126°20'41.0" E) belongs to Jeju City, Jeju Special Self-Governing Province, South Korea (You et al. 2010). Near Chujado Island, there are 38 uninhabited islets, including Cheongdo, Jikgudo, and Heukgeomdo Islets. Among them, we selected the Cheongdo, Jikgudo, and Heukgeomdo Islets as study sites, and they can be accessed through ships (Figure 1). In the Cheongdo Islet, 62% of the total area (240,860.1 $m^2$) covered with vegetation is located on the central part of the islet, and 38% of the total area is covered by rocky land with exposed rocks. The covered area of Jikgudo Islet (240,318.4 $m^2$) is 62.7% of the total area, and the rocky land with exposed rocks occupies 37.3% of the total area (Korea National Park Service 2019). Of the total area (244.266.3 $m^2$) of the Heukgeomdo Islet, 72% of the area is covered with vegetation and is located on the central part of the islet, and 28% of the area is covered by rocky land. The climatic conditions of Chujado Island are characteristic of the southern west coast type of the Korean climatic zone, with an average annual temperature of 13.8° C and annual precipitation of 1,391 mm.

### On-site investigations

We performed on-site investigations from April 2019 to April 2021 in the uninhabited Cheongdo, Jikgudo, and Heukgeomdo Islets. A line census method was used with binoculars (Swarovski, 10 × 42 BA, Austria) for individual investigation. Two people were grouped to identify the species and population. We visited the breeding sites during the breeding season (early May to end of August) to mark the nesting areas using a GPS MAP 64s (Garmin International, Kansas, USA).

### Nest environment

Breeding nests were identified using binoculars (Swarovski, 10 × 42 BA, Austria) and a field scope (Swarovski, 20 × 60), and photographs were taken using a camera (Canon EF 500 mm, Canon, Japan). An unmanned sensor camera (Bushwhacker, ROBOT D30, Shenzhen, China) was used to continuously photograph the nest when Pleske's Grasshopper Warblers started building the nests (Image 1). The unmanned sensor camera was installed more than 10 m from the breeding nest to prevent it from interfering with breeding. To measure nesting tree height, and nest diameter, we used a digital distance meter (Digital Range Finder; Leica DISTOTM X10; Mitutoyo, unit 0.05 mm)

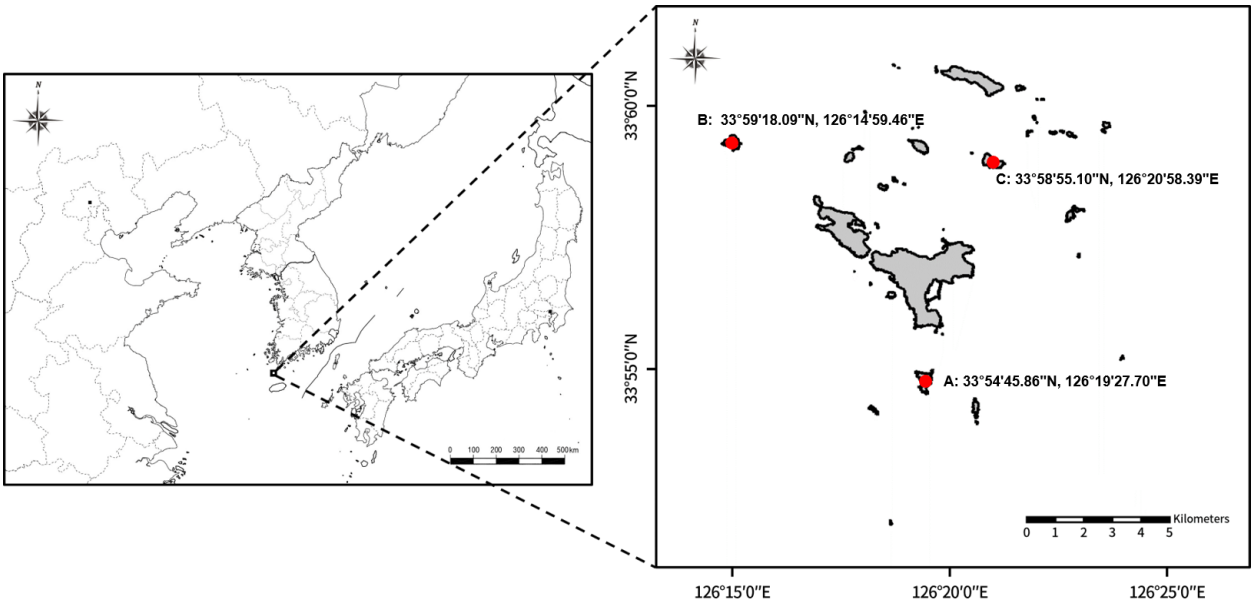


**Figure 1. Distribution of the Pleske's Grasshopper Warbler breeding sites on unmanned islets (Cheongdo, Jikgudo, and Heukgeomdo) around Chuja Island, South Korea: A— Cheongdo I B—Jukgudo I C—Heukgeomdo.**

### Vegetation Colony

We investigated the vegetation status (colony structure) by selecting vegetation points such as trees, sub-trees, shrubs, and herbaceous layers. Furthermore, we investigated the vegetation dominance rate using the Braun-Blanquet cover-abundance scale (Wikum & Shanholtzer 1978).

## RESULTS

### Habitat status

The nesting sites of the Pleske's Grasshopper Warblers were identified in three islets: Cheongdo, Jikgudo, and Heukgeomdo. On Cheongdo Islet, nests were located as follows: four in *C. japonica*, one in *P. thunbergii*, and one in *Eurya emarginata*. On Jikgudo Islet, four nests were distributed with two in *C. japonica*, one in *P. thunbergii*, and one in *E. macrophylla*. Meanwhile, on Heukgeomdo islet, three nests were located, all in *C. japonica*. A total of 14, 10, and 12 individuals were found in Cheongdo, Jikgudo and Heukgeomdo Islets, respectively. The Pleske's Grasshopper Warblers in the study area started breeding in early May and began vocalizing to secure territory, and individuals incubated until the end of July. The areas of vegetation of Cheongdo Islet were 45% grassland, 16.9% forest land, and 0.1% shrubland (Figure 2). The main colonies that made up the forestland were *P. thunbergii* (8.1%) followed by *E. emarginata* (7.3%). *C. japonica* formed small colonies. *P. thunbergii* is widely distributed on the southeastern slope and *C. japonica* is mainly distributed on the northern slope (Korea National Park Service 2019). The areas of vegetation of Jikgudo Islet were 25.1% grassland, 31.0% forestland, and 6.6% shrubland. The main colonies that made up the forestland were *E. emarginata* (12.8%) followed by *C. japonica* (11.1%). *P. thunbergii* formed small colonies. *E. emarginata* was distributed from the northern slope to the eastern slope, and *C. japonica* formed on the central and southwestern slopes of this islet. The areas of vegetation of Heukgeomdo Islet were 34.3% forestland, 33.6% grassland, and 6.6% shrubland. The main colonies that made up the forestland were *P. thunbergii* (17.1%) and *C. japonica* (16.4%). *Celtis sinensis* and *Rhus javanica* formed small colonies.

### Nesting environment

The 13 Pleske's Grasshopper Warbler nests observed in this study, were nested in *P. thunbergii* and *C. japonica*. The warblers built nests inside coniferous trees, whereas they built nests in relatively large leaves in lush, broad-leaved evergreen trees.

In Cheongdo Islet, the nest height, nesting tree height and nest cup diameter were 1.69 ± 0.13 m (range: 1.48–1.85 m), 3.73 ± 1.21 m (range: 2.89–4.12 m) and 10.01 ± 0.32 cm (range 9.71–10.45 cm), respectively (Table 2). In Jikgudo Islet, the nest height, nesting tree height and nest cup diameter were 1.41 ± 0.07 m (range: 1.33–1.51 m), 3.01 ± 0.13 m (range: 2.85–3.13 m) and 9.83 ± 0.33 (range: 9.58–10.33), respectively. In Heukgeomdo

**Table 1. Nest tree preference and the number of Pleske's Grasshopper Warblers on the South Korean study sites.**

| Study site | No. of individuals | No. of trees used for nesting and breeding | | | |
|---|---|---|---|---|---|
| | | *Pinus thunbergii* | *Eurya emarginata* | *Camellia japonica* | *Elaeagnus macrophylla* |
| Cheongdo | 14 | 1 | 1 | 4 | |
| Jikgudo | 10 | | | 2 | 1 |
| Heukgeomdo | 12 | | | 3 | |

**Table 2. Dimensions of the nest height, nesting tree height, and nest cup diameter of the South Korean breeding sites of Pleske's Grasshopper Warblers.**

| Division \ Nest location | Cheongdo | | Jikgudo | | Heukgeomdo | |
|---|---|---|---|---|---|---|
| | Value | Range | Value | Range | Value | Range |
| Nest height (m*) | 1.69 ± 0.13 | 1.48–1.85 | 1.41 ± 0.07 | 1.33–1.51 | 1.34 ± 0.18 | 1.19–1.63 |
| Nesting tree height (m*) | 3.73 ± 1.21 | 2.89–4.12 | 3.01 ± 0.13 | 2.85–3.13 | 3.10 ± 0.28 | 2.77–3.53 |
| Nest cup diameter (cm*) | 10.01 ± 0.32 | 9.71–10.45 | 9.83 ± 0.33 | 9.58–10.33 | 9.3 ± 0.44 | 8.56–9.69 |

*— Standard deviation

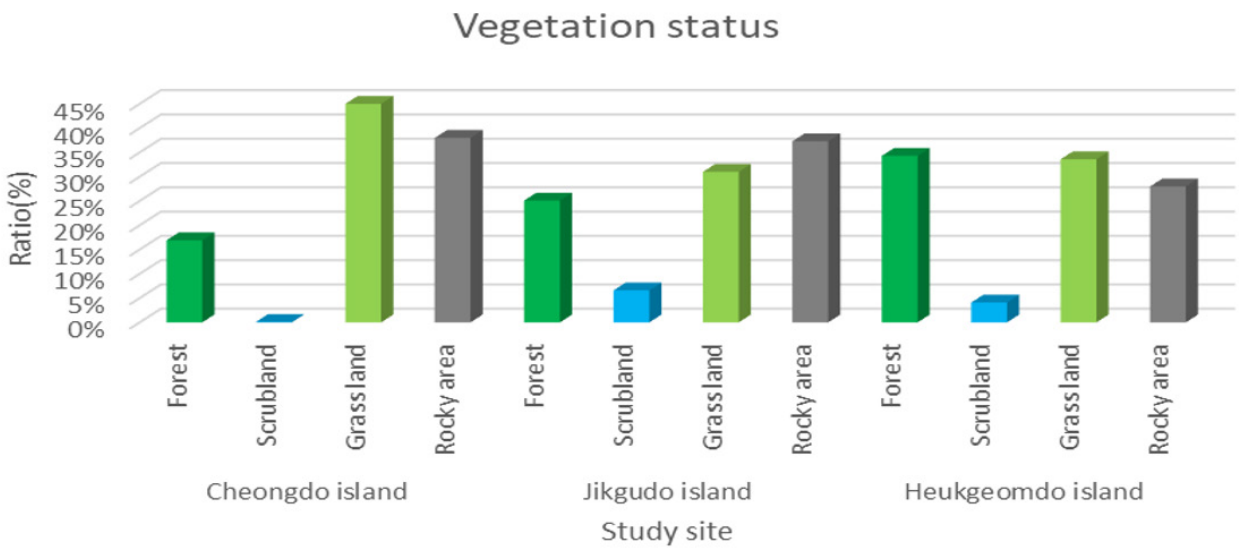


**Figure 2. The ratio of the vegetation in the uninhabited islands of the Chuja Marine Provincial Park: Chengdo, Jikgudo, and Heukgeomdo islets.**

Islet, the nest height, nesting tree height and nest cup diameter were 1.34 ± 0.18 m (range: 1.19–1.63 m), 3.10 ± 0.28 m (range: 2.77–3.53 m) and 9.3 ± 0.44 cm (range: 8.56–9.69 cm), respectively.

## DISCUSSION

In response to predation and microclimate, birds select nesting locations to increase breeding rates and maximize the survival rates of their young (Gómez-Serrano & López-López 2017). Vegetation is crucial for maintaining a thermal environment by controlling the micro-weather conditions, thereby reducing the effects of wind and direct sunlight, while simultaneously hiding the nest to reduce the probability of predation (Kim et al. 2009; Kearns & Rodewald 2013). Particularly, microclimate has a significant impact on the energy efficiency of eggs, young and gonads; therefore, the location, entrance direction and height of nests are adjusted to select microhabitats that are effective for maintaining body temperature and are protected from


**Image 1. Current status of Pleske's Grasshopper Warblers on the study sites: A—song indicating territorial defence l B—nest defence l C, D—nest of Pleske's Grasshopper Warbler on Eurya emarginata tree. © Young Hoon Jeong**

extreme weather factors (Polak 2019). Therefore, it is believed that nesting inside the islet and choosing trees with large and wide leaves, such as that in *C. japonica*, was caused by a defence mechanism to protect young from predatory pressure and to reduce nest exposure from birds of prey, such as the Peregrine Falcon, and by reducing the effects of sea breezes to maintain warmth (Montgomerie & Weatherhead 1988).

Comparing the habitat environments of Pleske's Grasshopper Warbler nests identified so far in Korea and Japan, Nagata (1993) and Park & Seo (2008) observed nests among lush herbs, and Kim et al. (2009) confirmed that nests were built in bushes. Choi et al. (2017) identified potential brooding sites on the steeply sloped areas on the island. In Japan, the Pleske's Grasshopper Warblers arrived between late April and June and began breeding (Takaki et al. 2001), and the warblers in the unmanned island breeding sites in the central and southern regions of South Korea began breeding in May and June (NIBR 2017). In our study area, the Pleske's Grasshopper Warblers arrived in mid-May and began breeding from the end of June through August. These results tend to coincide with the breeding period and ecology of its living in the Japanese archipelago.

To date, the area of distribution of this species is limited to Russia, China, the Korean Peninsula, and Japan. As the latitude rises, breeding records become very rare (BirdLife International 2023). Therefore, except for the migration period, it is believed that this species will move south from Russia and breed in island areas near the Korean Peninsula and Japan. We found that the nest was built in subtrees such as *C. japonica*, *P. thunbergii*, and *E. emarginata*, which was similar to the results of Kim et al. (2009). As a result, Pleske's Grasshopper Warblers can be said to prefer shrubbery as a breeding nest.

Much still needs to be studied about the distribution, abundance, and habitat requirements of this species. Its threatened status and conservation requirements can be clarified by research targeted at the following areas:

(1) monitoring surveys to locate additional populations on islands within the potential breeding range in South Korea; (2) ecological studies at selected breeding sites to determine population and habitat requirements during the breeding season; (3) population studies comparing to past to determine whether there have been changes in the numbers and distribution since the original records; and (4) Capture-recapture surveys to locate populations in potential sites.

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NAAS rating (India) 5.64

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Journal of Threatened Taxa

www.threatenedtaxa.org



**ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)**

**August 2023 | Vol. 15 | No. 8 | Pages: 23631–23826**
**Date of Publication: 26 August 2023 (Online & Print)**
**DOI: 10.11609/jott.2023.15.8.23631-23836**



**Publisher & Host**

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Threatened Taxa