

## A Study on the Status of Waterbirds by Taxon and Seasonal Arrival in the South-West Coast Islands

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### Abstract

*This study surveyed the island located in Sinan-gun and Wando-gun four times, once per season from September 2020 to November 2021 in order to understand the distribution of waterbirds on the island of the southwest coast. As a result of the investigation, a total of waterbirds of 7 orders, 12 families of 50 species, and 3,680 individuals were identified. By taxon, the largest number of species were identified as 11 species of waders, and the number of ducks was the largest with 2,035 individuals. In Bigeum-do Island, where forests are distributed less, the proportion of farmland is large, and tidal flats are widely distributed, the largest number of species and individuals of herons and waders were identified. Ducks and gulls have also been identified in large numbers of individuals in Bigeum-do Island. Most of them are forests and farmland, and the largest number of species and individuals of ducks have been identified in Pyeongil-do Island, where the coast is deep. In addition, Nodae-do Island, Sobyongpung-do, and Daebyeongpung-do Island with monotonous habitats have been identified with fewer species and individuals. As a result, We learned that various types of waterbirds lived in islands with various habitats, and that the preferred habitat was different depending on the characteristics of the taxon group. By season, the largest number of species was identified as 35 in autumn, and the largest number of individuals was identified as 1,681 in winter. Although most of the seasonally identified waterbirds were winter birds, the largest number of species were identified in autumn, and most of the confirmed waterbird migration were identified in the autumn, indicating that waterbirds used the west-south coast islands as an intermediate stopover while traveling.*

**Keywords:** Waterbirds, West-South Coast, Island, Habitat

## 1. INTRODUCTION

Korean west-south coast islands are an area where wetland ecosystems such as tidal flats, estuaries, farmlands, and reservoirs are distributed, and many waterbirds arrive because they have a good environment for resting or feeding activities [1-2]. Korean west-south coast islands have environmental characteristics such as tidal flats and estuaries adjacent to the ocean, and due to the characteristics of being far away from the inland, islands are a good habitat for waterbirds by providing a place for birds to rest or reproduce in the middle of their migration. But wildlife habitats are decreasing as human activity, development and interference

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increase [3-4]. Recently, coastal areas inhabited by various species have been damaged in Korea due to reclamation projects such as securing cultivated land and building new towns. There is a need for a management plan to manage the natural ecosystem of these island coastal areas. Until now, the distribution of waterbirds in the islands of the southwest coast has been continuously conducted, such as [2, 4-6], but it has been mainly limited to unmanned or specific islands. This is significantly lower than the distribution of about 56.9% of the island areas in the country on the southwest coast. Waterbirds choose their own habitat for various reasons, such as food, suitable water depth, and race among species [7]. Therefore, this study aims to find out the distribution status of waterbirds in the islands of the southwest coast, identify the characteristics of clusters by major taxon groups, and use them as basic data for habitat protection and management measures.

## 2. SUBJECTS AND METHODS OF STUDY

### 2.1 Study Area and Survey Period

The research area is Bigeum-do Island, a large island located in Sinan-gun and various types of habitats, and Suchi-do Island, Sangsuchi-do Island, Nodae-do Island, Sangsachi-do Island, and Hasachi-do Island, which are located around it. And also seven areas were investigated on Pyeongil-do Island, Saengil-do Island, Cheongsan-do Island, Maemul-do·Song-do·Gu-do Island, Hwangje-do Island, Cho-do Island, Sobyongpung-do·Daebyeongpung-do Island, which are islands with various types of habitats in the southeast of Wando-gun. The survey period was conducted once per season from September 2020 to November 2021, taking into account the different arrival periods depending on the season, a total of four surveys were conducted.

### 2.2 Study Methods

The survey was conducted with the line census, which investigates the activity radius and ecological characteristics of birds, and the spot census, which investigates the point where bird observation is easy. We used visual and binoculars to identify the species and photographed them with a camera (SONY DSC-RX10) for accurate identification and recording. In order to confirm the characteristics of each taxon group of waterbirds, it was classified into herons, ducks, waders, and other waterbirds were classified into other waterbirds. In order to analyze the waterbird clusters in each area to be investigated, Species diversity and Species richness were obtained and compared. For Species diversity, Shannon's index ( $H'$ ) was used, and for Species richness, the Margalef index ( $Da$ ) was used.

## 3. RESULTS

### 3.1 Distribution of Waterbirds in the South-West Coast Islands

As a result of the investigation, a total of waterbirds of 7 orders, 12 families of 50 species, 3,680 individuals were identified, and the species diversity( $H'$ ) was 2.39, and the species richness( $Da$ ) was 5.97. By classification group, the largest number of waders was identified with 11 species, followed by 10 species of herons, 9 species of ducks, and 8 species of birds of raptors, etc. The population was the largest with 2,035 confirmed ducks, followed by herons, gulls, and cormorants, etc. By season, 35 species of waterbirds were identified in the autumn, followed by winter, spring, summer. The population was the highest with 1,681 confirmed in winter, followed by autumn, spring, and summer.

### 3.2 Distribution of Waterbirds in the South-West Coast Islands each Taxon

As shown in Table 1, the number of herons identified in 16 islands on the south-west coast is 542 of 10 species. As a result of cluster analysis, the Species diversity ( $H'$ ) was calculated as 1.28, and the Species richness ( $Da$ ) was calculated as 1.43. The herons identified by island 7 species in Bigeum-do Island, 5 species in Sangsachi-do Island and Pyeongil-do Island, 4 species in Hasachi-do Island, and Cheongsan-do Island, etc. The population was identified in the order of 212 on Bigeum-do Island, 164 on Pyeongil-do Island, and 33 on Cheongsan-do Island, etc. Species diversity ( $H'$ ) was the highest in Bigeum-do Island, followed by Sangsachi-do Island, Suchi-do Island, Sangsuchi-do Island, etc. Species richness ( $Da$ ) was the highest in Sangsachi-do Island, followed by Bigeum-do Island, Maemul-do·Song-do·Gu-do-do Island, Hasachi-do Island, Cho-do Island, etc.

**Table 1. Status of heron communities in 16 island on the south-west coasts**

	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	Total
No. of species	7	3	3	2	5	4	5	2	4	3	-	2	1	10
No. of populations	212	22	18	5	17	24	164	27	33	7	-	9	4	542
$H'$	1.47	1.06	0.96	0.50	1.23	1.11	0.73	0.42	0.75	1.08	-	0.64	-	1.28
$Da$	1.12	0.65	0.69	0.62	1.41	0.94	0.78	0.30	0.86	1.03	-	0.87	-	1.43

As shown in Table 2, the number of ducks identified in 16 islands on the south-west coast is 2,035 of 9 species. As a result of cluster analysis, the Species diversity ( $H'$ ) was calculated as 0.99, and the Species richness ( $Da$ ) was calculated as 1.05. The ducks identified by island 7 species in Pyeongil-do Island, 5 species in Suchi-do Island, 5 species in Pyeongil-do Island, 3 species in Hasachi-do Island, and Bigeum-do Island, etc. The population was identified in the order of 627 on Pyeongil-do Island, 528 on Sangsuchi-do Island, 393 on Bigeum-do Island, etc. Species diversity ( $H'$ ) was the highest in Pyeongil-do Island, followed by Bigeum-do Island, Suchi-do Island, Saengil-do Island, etc. Species richness ( $Da$ ) was the highest in Pyeongil-do Island, followed by Suchi-do Island, Saengil-do Island, Cheongsan-do Island, etc.

**Table 2. Status of duck communities in 16 island on the south-west coasts**

	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	Total
No. of species	3	5	2	-	1	3	7	2	2	-	-	-	-	9
No. of populations	393	152	528	-	3	63	627	76	193	-	-	-	-	2,035
$H'$	0.80	0.79	0.02	-	-	0.50	1.33	0.65	0.47	-	-	-	-	0.99
$Da$	0.33	0.80	0.16	-	-	0.48	0.93	0.23	0.19	-	-	-	-	1.05

As shown in Table 3, the number of waders identified in 16 islands on the south-west coast is 148 of 11 species. As a result of cluster analysis, the Species diversity ( $H'$ ) was calculated as 1.57, and the Species richness ( $Da$ ) was calculated as 2.00. The waders identified by island 9 species in Bigeum-do Island, 4 species in Hasachi-do Island, etc. The number of populations was confirmed to be 108 on Bigeum-do Island, and less than 10 on the rest of the island. Species diversity ( $H'$ ) was the highest in Bigeum-do Island, Hasachi-do Island, followed by Suchi-do Island, Hwangje-do Island, etc. Species richness ( $Da$ ) was the highest in Bigeum-do Island, followed by Hasachi-do Island, Cheongsan-do Island, Hwangje-do Island, etc.

**Table 3. Status of wader communities in 16 island on the south-west coasts**

	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	Total
No. of species	9	1	1	-	1	4	1	1	2	-	2	-	-	11
No. of populations	108	1	4	-	6	9	9	2	4	-	5	-	-	148
$H'$	1.27	-	-	-	-	1.27	-	-	0.69	-	0.67	-	-	1.57
$Da$	1.71	-	-	-	-	1.37	-	-	0.72	-	0.62	-	-	2.00

In 13 areas of the islands on the south-west coast, 955 of 20 species of other waterbirds were identified, except for herons, ducks, and waders. Among them, the largest number of species were identified in Cheongsan-do Island, and the least number of species were identified in Sangsachi-do Island. The largest number of species were identified in Cheongsan-do Island in grebes and cormorants, Cheongsan-do Island and Cho-do Island in raptors, and Pyeongil-do Island in gulls. Among them, the largest number of populations were identified in Bigeum-do Island, and the least number of populations were identified in Nodae-do Island. The largest population was found in Cheongsan-do Island for grebes, Pyeongil-do Island for cormorants, and Bigeum-do Island for birds of raptors, coots, and gulls.

### 3.3 Distribution of Waterbirds in the South-West Coast Islands each Season

As shown in Table 4, there are 782 waterbirds of 28 species identified in spring in 16 islands on the south-west coast. As a result of cluster analysis, the Species diversity ( $H'$ ) was calculated as 1.92, and the Species richness ( $Da$ ) was calculated as 4.05. The waterbirds identified by island 14 species in Bigeum-do Island, 10 species in Hasachi-do Island, 8 species in Suchi-do Island, etc. The population was identified in the order of 382 on Bigeum-do Island, 122 on Suchi-do Island, 88 on Pyeongil-do Island, etc. Species diversity ( $H'$ ) was the highest in Bigeum-do Island, followed by Hasachi-do Island, Sangsachi-do Island, Cheongsan-do Island, etc. Species richness ( $Da$ ) was the highest in Bigeum-do Island, followed by Hasachi-do Island, Sangsachi-do Island, Cheongsan-do Island, etc.

**Table 4. Status of waterbird communities in 16 island on the south-west coasts in spring**

	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	Total
No. of species	14	8	5	2	7	10	7	4	7	3	1	3	3	28
No. of populations	382	122	26	3	22	72	86	9	38	4	2	6	10	782
$H'$	1.72	1.03	0.85	0.64	1.36	1.48	1.17	1.21	1.35	1.04	-	0.87	0.94	1.92
$Da$	2.19	1.46	1.23	0.91	1.94	2.10	1.35	1.37	1.65	1.44	-	1.12	0.87	4.05

As shown in Table 5, there are 362 waterbirds of 14 species identified in summer in 16 islands on the south-west coast. As a result of cluster analysis, the Species diversity ( $H'$ ) was calculated as 1.64, and the Species richness ( $Da$ ) was calculated as 2.21. The waterbirds identified by island 9 species in Bigeum-do Island, 6 species in Sangsachi-do Island, 6 species in Hasachi-do Island, etc. The population was identified in the order of 151 on Bigeum-do Island, 101 on Pyeongil-do Island, 24 on Hasachi-do Island, etc. Species diversity ( $H'$ ) was the highest in Sangsachi-do Island, followed by Cheongsan-do Island, Hasachi-do Island, Sangsuchi-do Island, etc. Species richness ( $Da$ ) was the highest in Sangsachi-do Island, followed by Bigeum-do Island, Hasachi-do Island, Hwangje-do Island, etc.

**Table 5. Status of waterbird communities in 16 island on the south-west coasts in summer**

	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	Total
No. of species	9	3	4	1	6	5	4	4	4	1	2	2	2	14
No. of populations	151	16	18	1	10	24	101	14	15	1	2	6	3	362
$H'$	1.01	0.78	1.29	-	1.61	1.30	1.17	1.23	1.31	-	0.69	0.45	0.64	1.64
$Da$	1.59	0.72	1.04	-	2.17	1.26	0.65	1.14	1.11	-	1.44	0.56	0.91	2.21

As shown in Table 6, there are 855 waterbirds of 35 species identified in autumn in 16 islands on the south-west coast. As a result of cluster analysis, the Species diversity ( $H'$ ) was calculated as 2.62, and the Species richness ( $Da$ ) was calculated as 5.04. The waterbirds identified by island 12 species in Pyeongil-do Island, 8 species in Saengil-do Island, 6 species in Hasachi-do Island, etc. The population was identified in the order of 176 on Pyeongil-do Island, 239 on Bigeum-do Island, 145 on Cheongsan-do Island, etc. Species diversity ( $H'$ ) was the highest in Bigeum-do Island, followed by Pyeongil-do Island, Hasachi-do Island, Saengil-do Island, etc. Species richness ( $Da$ ) was the highest in Pyeongil-do Island, followed by Bigeum-do Island, Cheongsan-do Island, Hasachi-do Island, etc.

**Table 6. Status of waterbird communities in 16 island on the south-west coasts in autumn**

	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	Total
No. of species	16	4	5	4	4	6	17	8	12	5	4	5	2	35
No. of populations	239	11	14	7	6	12	276	55	145	20	17	16	37	855
$H'$	2.11	1.29	1.40	1.28	1.33	1.70	2.04	1.67	1.48	1.37	1.14	1.32	0.21	2.62
$Da$	2.74	1.25	0.52	1.54	1.67	2.01	.85	1.75	2.21	1.34	1.06	1.44	0.28	5.04

As shown in Table 7, there are 1,681 waterbirds of 31 species identified in winter in 16 islands on the south-west coast. As a result of cluster analysis, the Species diversity ( $H'$ ) was calculated as 2.08, and the Species richness ( $Da$ ) was calculated as 4.04. The waterbirds identified by island 18 species in Bigeum-do Island, 15 species in Pyeongil-do Island, 12 species in Cheongsan-do Island, etc. The population was identified in the order of 503 on Sangsuchi-do Island, 451 on Pyeongil-do Island, 269 on Bigeum-do Island, etc. Species diversity ( $H'$ ) was the highest in Bigeum-do Island, followed by Pyeongil-do Island, Suchi-do Island, Cheongsan-do Island, etc. Species richness ( $Da$ ) was the highest in Bigeum-do Island, followed by Suchi-do Island, Pyeongil-do Island, Saengil-do Island, etc.

**Table 7. Status of waterbird communities in 16 island on the south-west coasts in winter**

	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	B5	B6	B7	Total
No. of species	18	11	4	2	5	7	15	11	12	3	4	5	3	31
No. of populations	269	60	503	2	7	35	451	95	192	15	8	35	9	1,681
$H'$	2.35	1.90	0.04	0.69	1.55	1.43	1.95	1.73	1.88	0.97	1.32	0.99	1.06	2.08
$Da$	3.04	2.44	0.48	1.44	2.06	1.69	2.29	2.20	2.09	0.74	1.44	1.13	0.91	4.04

Bigeum-do Island is the most frequently identified island of waders and herons. Bigeum-do Island has various wetland ecosystems such as tidal flats, estuaries, and rice paddies and is widely distributed. Pyeongil-do Island is the island where ducks have been most frequently identified. In Pyeongil-do Island, agricultural

land and forests are widely distributed, and most of the coasts have high water levels. On the other hand, Nodae-do Island, Sobyongpung-do, and Daebyeongpung-do Island, where a small number of waterbirds have been identified, have simple habitats. The wader inhabits mudflats and coasts, eating aquatic insects, and the heron inhabits agricultural land, rivers, and mudflats, and eats fish, amphibians, and aquatic insects [8-9]. Ducks mainly use agricultural land as an eating area around the water system, and the preferred depth of water varies depending on the food they eat because they rest and eat in the water system [2, 10]. Wild birds choose a habitat that is close to food, and the daily movement of wild birds occurs due to various factors such as the type and amount of food, temperature, obstruction factors, and distance [2]. This study confirmed that the diversity of wetland ecosystems in the island became the diversity of waterbirds, and it was found that the preferred habitat was determined by the characteristics of the taxon group. Unlike most of the waterbirds in Korea are winter migratory birds, the largest number of species was confirmed with 35 species in autumn. The southwest coast of Korea corresponds to the East Asian-Australasian Flyway [9], and this result seems to have been achieved because many species pass through in spring and autumn, when migratory birds move. In this study 7 of 11 species of waders were identified in the autumn, and all the waterbirds with the migratory arrival type were waders, indicating that the waders used the survey area as an intermediate stop while travelling. The reason why most of the waterbirds identified in spring and autumn have not been identified as sandal swarms is that the survey area seems to have caused a difference as it includes other habitats such as agricultural land and reservoirs.

#### 4. CONCLUSIONS

Through this study, we learned the habitat selection by taxon group and the status of seasonal arrival by the distribution of waterbirds inhabiting the island area of the south-west coast. This can predict the distribution of waterbirds according to habitat and season and can contribute to more accurately predicting the impact of the development of reclamation projects on the wetland ecosystem. However, in addition to the current status of waterbirds, there was a limit to grasping other characteristics such as changes in the waterbird cluster and movement routes. If a continuous investigation is conducted in the future, it will be possible to grasp the clear characteristics of the waterbird cluster through the accumulated data. Because waterbirds determine their habitats according to their resting and eating characteristics, the development of the southwest coast area causes environmental changes and causes disturbances. In order to minimize the impact of development on the wetland ecosystem, it is necessary to plan effective protection and management measures by conducting professional and continuous monitoring of the habitats and arrival times currently used by waterbirds.

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