

## Research on the Time Allocation of Spring Behavior of *Gallinula Chloropus* in Nanjing Xuanwu Lake

Jie Wang<sup>1</sup>, Xiao Ruan<sup>2</sup>, Chenling Zhang<sup>2\*</sup>, Jian Wang<sup>1</sup>

<sup>1</sup>(Jiangsu Agri-animal Husbandry Vocational College, China)

<sup>2</sup>(Jiangsu Second Normal University, China)

Corresponding Author: Chenling Zhang

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**Abstract:** In order to find out the influence factors of the time allocation of *Gallinula Chloropus*'s behavior, and provide valuable information for the environmental impact of bird ecology and migration of migratory birds, from March 2016 to April, using the instantaneous scanning sampling method, the author obtained the behavioral data of *Gallinula Chloropus* for 30 days to study and analyze time allocation of *Gallinula Chloropus*'s behavior. The results showed that the wintertime activities of *Gallinula Chloropus* during the day were included predation (47.90%), resting(25.95%),exercise(18.42%),preening(3.33%),vigilance(2.97% )and fighting(1.43 %), and the time allocation of spring behavior of *Gallinula Chloropus* has the change of daily rhythm, but also influenced by its own factors and environmental factors.

**Keywords:** XuanWu Lake; *Gallinula Chloropus*; Activity observation; Time allocation

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### I. Introduction

*Gallinula Chloropus* are rallidae of gruiformes. *Gallinula Chloropus* are widely distributed in the east, south, southwest Hainan Island, Taiwan and southeastern of Tibet in most regions of China, and in 32 ° north latitude in winter. They are common in Japan, India, Sri Lanka and Burma, often appearing in the plains and mountain waters, swamps or reeds, and they have been regarded as the common protection migratory birds by China and Japan government. *Gallinula Chloropus* are migratory birds in Nanjing area, but in recent years in the middle and lower reaches of the Yangtze River region there has been a gradual emergence of the wintering population of *Gallinula Chloropus*.

Most of the domestic studies on *Gallinula Chloropus* focus on breeding ecology. Qi Dongming studied the *Gallinula Chloropus*'s choice of spring habitat in Qionghai wetland in April and May 2014, and the results showed that the factors affecting the selection of spring habitat were mainly concealed, the amount of food and the degree of interference [1]. From 2014 to 2015, Ma Yugong is dedicated to study nesting, spawning, hatching process and measuring the growth indicators of *Gallinula Chloropus* in chick stage of the *Gallinula Chloropus* in Xuzhou, Jiangsu Province, Yunlong Lake, and the results of the survey indicate that *Gallinula Chloropus* regard large emergent plants waters near the shore, as main living area all year round [2]. Yuan Ziyang observed the behavior of *Gallinula Chloropus* in Fangshan Scenic Spot in Jiangning District of Nanjing, and further proved that foraging behavior was the most important behavior of black pheasant breeding period [3].

This paper is to study the time allocation of spring behavior of *Gallinula Chloropus*, which can provide reliable scientific data for the study of the ecology of the waterfowl behavior ecology and the migrating environment of migratory birds, so as to improve and develop the study of waterfowl behavior patterns.

The study area is located in Xuanwu Lake of Nanjing (118.79431 E, 32.07479 N). The lake is diamond shaped, about 10 km circumference, covering an area of 437 hectares, and the surface of the water is about 368 hectares. There are five islands in the lake, which divides the lake into four large. Nanjing is a subtropical humid climate, annual average temperature 15.3 °C annual rainfall 1106.5 mm, the middle of June to the early July for the plum rainy season. Temperature there is generally around 35 °C in July and August.

### II. Research Methods

#### A. Experimental methods

*Gallinula Chloropus* like cluster activities, so it is easier to find the study object. To facilitate their behavior as observation research, from March 13, 2016 to April 13, 2016, the study does a preparatory observation to make the *Gallinula Chloropus* habituation to harmless stimulation, familiar with and master the law of their day activities and build behavior spectrum. From March 13, 2016 to April 13, 2016, formal observation began, and we did a round-the-clock observation for 30 consecutive days in Nanjing Xuanwu Lake with high-power telescope. This experiment uses an instantaneous scanning sampling method, every 5 minutes

to conduct a sampling behavior to see the behavior of *Gallinula Chloropus* prevail, observing and recording their behavior 12 times per hour, every morning as early as 8:00 Activities to 16:00 due to rest, due to weather changes, a total of scanning 2524 times. At the same time, the local temperature, wind speed, weather (overcast, sunny, rainy, etc) were recorded every two hours, a total of 150 records. The results are sorted and summarized using Microsoft Excel for data processing.

**B. Behavior records**

Record the weather, temperature, illumination, etc. at the beginning and the end of the day, and record the behavior of *Gallinula Chloropus* during the observation period [4].

Exercise, including walking, running, swimming, low altitude flight and other acts; Resting, including sleeping, nap or restless, not including the resting of brooding or feeding; Predation, including foraging, pecking, beating with food, feeding, swallowing and drinking water; Preening, including preening by using pecking, bathing, shampoo, applying grease, scratching the head and neck with claws, pecking feet with the beaks, shaking the wings, and kicking the wings, etc.; Fighting, mainly to capture (or defend) food or food points; Vigilance, including feeding vigilance, drinking vigilance, preening and applying grease vigilance, walking vigilance, *Gallinula Chloropus* raise their heads when vigilance, scanning the surrounding environment, and there is a very clear head rotation action.

For the accuracy of the observation, the observation time is set to 8: 00-16: 00 according to the natural conditions during the observation period. First count the total number of occurrences of each day, and then calculate the total number of behaviors during the observation period, and the data is made into a table (see chapter iii), and use Excel to map.

**C. Data collection**

From March 16, 2016 to April 13, 2016, in the Xuanwu Lake, the *Gallinula Chloropus* were observed continuously for 30 days, and the data of the observation period were recorded with the method of instantaneous scanning sampling[5], a total of 2524 data obtained (due to weather condition ,the study didn't begin at 8 o'clock every day). In order to give an intuitive understanding of this study, the data on the behavioral time allocation data observed in the Xuanwu Lake on March 16 with the instantaneous scanning sampling method (see Table 1) and the focus sampling method are shown in Table 1 below:

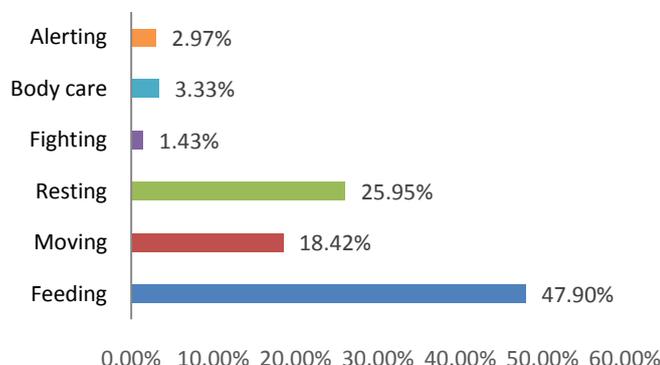
**Table 1.** List of occurrences of behavior for 30 consecutive days

Date	Feeding	Moving	Resting	Fighting	Body-care	Alerting
16-Mar	53	17	20	1	3	2
17-Mar	51	18	20	2	2	3
18-Mar	48	20	23	1	1	3
19-Mar	37	15	22	1	3	2
20-Mar	42	13	14	1	5	3
21-Mar	41	12	18	2	4	4
22-Mar	47	17	22	1	5	4
23-Mar	35	17	18	1	3	1
24-Mar	33	14	22	1	6	3
25-Mar	53	18	19	2	2	2
26-Mar	31	10	19	1	5	4
27-Mar	35	11	15	1	6	3
28-Mar	49	17	19	1	2	2
29-Mar	43	16	27	1	2	2
30-Mar	43	19	17	2	3	3
31-Mar	45	17	29	1	2	2
1-Apr	35	13	21	1	3	3
2-Apr	46	18	22	2	2	2
3-Apr	33	14	22	1	4	3
4-Apr	48	19	24	1	2	2
5-Apr	43	18	27	1	1	3
6-Apr	41	19	26	1	2	2
7-Apr	44	18	20	2	2	3
8-Apr	35	13	27	1	3	2
9-Apr	39	17	34	1	1	3
10-Apr	31	13	28	1	4	1
11-Apr	41	17	30	2	1	3
12-Apr	48	16	24	1	2	2
13-Apr	39	19	26	1	3	3
Total	1209	465	655	36	84	75

### III. Results And Analysis

#### A. Analysis of various behaviors of Gallinula Chloropus for 30 days

We arranged the 30 days behavior of the *Gallinula Chloropus*, scanning a total of 2524 times of their behavior, including feeding 1209 times, exercise 465 times, resting 655 times, fight 36 times, preening 84times and vigilance 75times (Figure 1).

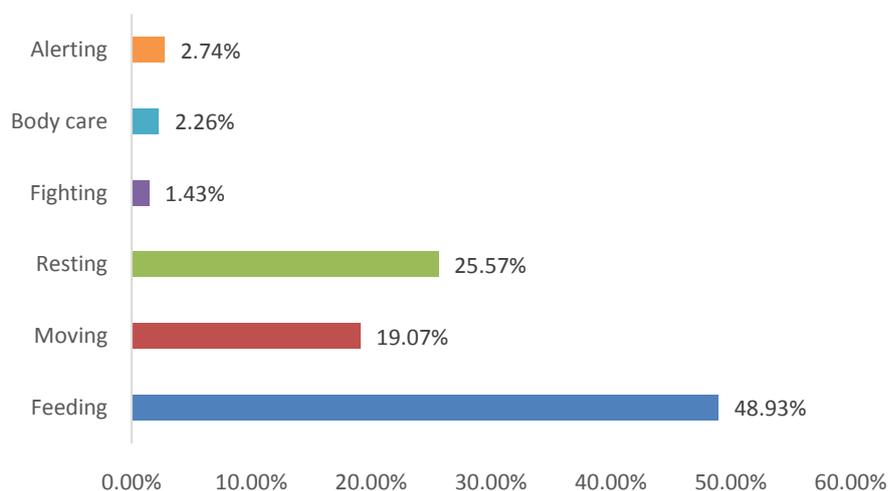


**Figure 1.** Schematic diagram of the proportion of various acts of *Gallinula Chloropus*

The activities of *Gallinula Chloropus* during the day were included predation (47.90%), exercise (18.42%), preening (3.33%), resting (25.95%), vigilance (2.97%) and fighting (1.42%). Due to the abundant food supply and in the non-breeding season, there is less competition in the interspecies, and the time allocation of *Gallinula Chloropus*'s behavior is mainly based on feeding and resting. Increasing the rest time and reducing the movement time helps to conserve energy and store more energy for breeding.

#### B. Analysis of various behaviors of Gallinula Chloropus on sunny days

We observed the *Gallinula Chloropus* for 30 days, and found out that sunny and rainy days of the time allocation of *Gallinula Chloropus*'s behavior is very different, of which 19 days is sunny. We arranged the 19 sunny days behavior of the *Gallinula Chloropus*, scanning a total of 1678times of their behavior, including feeding 821 times, exercise 320 times, resting 429 times, fight 24times, preening 38 times and vigilance46 times (Figure 2).



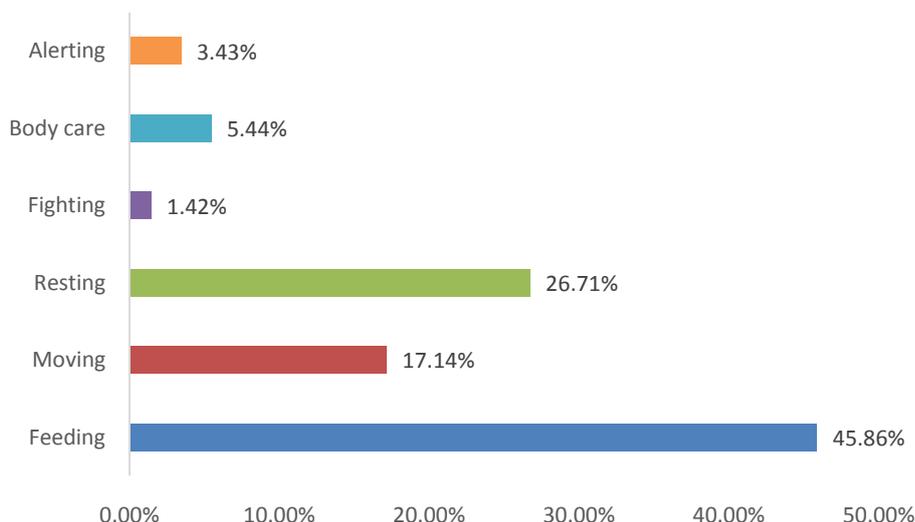
**Figure 2.** The proportion of various behaviors of *Gallinula Chloropus* in sunny days

The activities of *Gallinula Chloropus* during the day were included predation (48.93%), resting (25.57%), exercise (19.07%), preening (2.26%), vigilance (2.74%) and fighting (1.43%) on sunny days. The time preening and exercise is slightly reduced on sunny days.

#### C. Analysis of various behaviors of Gallinula Chloropus on rainy days

The behavior time distribution of black water chicken (*Gallinula Chloropus*) is different in sunny and rainy days. The study has arranged the 19 sunny days behavior of the *Gallinula Chloropus* above, and now we

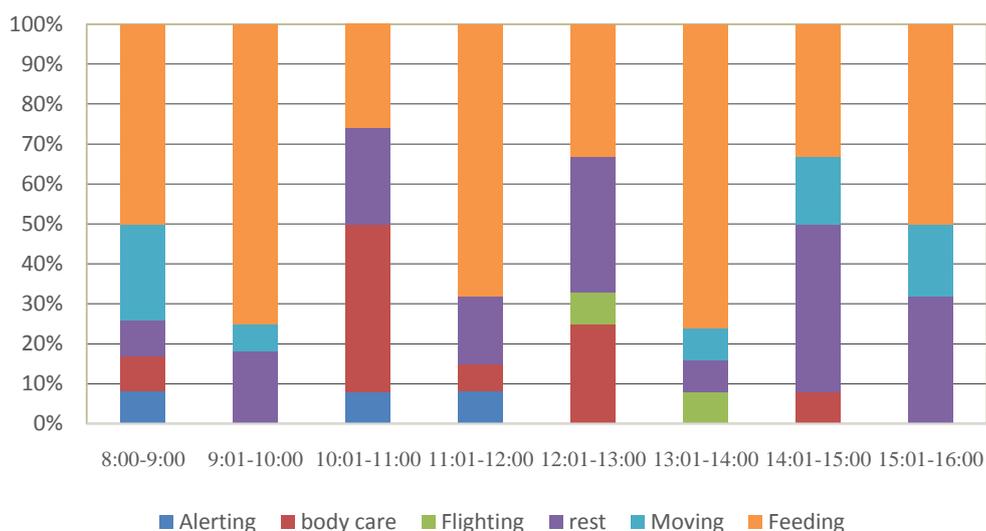
arranged the 11 rainy days behavior of the *Gallinula Chloropus*, scanning a total of 846 times of their behavior, including feeding 388 times, exercise 145 times, resting 226 times, fight 12 times, preening 46 times and vigilance 29 times, and now the number of occurrences of various acts were sorted into Figure 3. From the picture below, we can figure out that the activities of *Gallinula Chloropus* during the day were included predation (45.86%), resting(26.71%), exercise(17.14%), preening(5.44%), vigilance(3.43%)and fighting(1.42%) on rainy days. The time allocation of *Gallinula Chloropus*'s behavior in the rainy day is much different from that of the sunny day, the time for preening greatly increased, for feeding and exercise reduced.



**Figure3.** The time allocation of *Gallinula Chloropus*'s behavior in the rainy day

**D. Analysis of various behaviors of *Gallinula Chloropus* throughout the day**

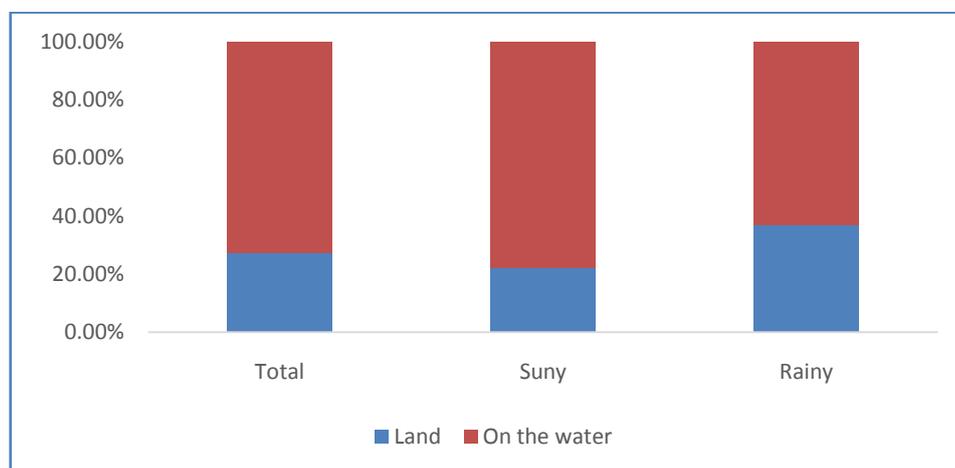
In the 30 days observation of the *Gallinula Chloropus*, the time allocation of *Gallinula Chloropus*'s behavior is different on sunny and rainy days, and the time allocation for the different behavior in a day is different, too. Based on the data, and the statistical collation indicate the feeding behavior occurred at three time periods of 9: 00-10: 00, 11: 00-12: 00 and 13: 00-14: 00; the time period of 10:00-11:00 is the peak of exercise; at the time periods of 12:00-13:00 and 14:00-16:00, the relatively more common behavior of *Gallinula Chloropus* is rest (figure 4).



**Figure 4.** The various behaviors of *Gallinula Chloropus* in various hours

### E. Analysis of the different behavior of *Gallinula Chloropus* on land and the surface of water for 30 days

From the 30 days observation, we found that the different behavior of *Gallinula Chloropus* in time allocation is different, and the place where the *Gallinula Chloropus* are located is also changed, the times *Gallinula Chloropus* on land and the surface of water shown in figure 5: According to the figure, 73% time of *Gallinula Chloropus* live on the water, and the rest of the time is on land; Sunny days (78% time living on the water) relative to the rainy (73% time living on the water), *Gallinula Chloropus* have more time to live on the water(Figure 5).



**Figure 5.**The time allocation of *Gallinula Chloropus* on land and on the water for 30 days

## IV. Discussion

Behavioral activities have a certain time allocation and rhythm, which is a characteristic of many birds[7]. The allocation of bird behavior is an adaptation to the living environment and a comprehensive performance that affects all the factors of the animals' behavior, an adaptive mechanism produced in the natural selection, and it is related to food richness, temperature, weather and other factors [8]. Especially in the breeding season, the time allocation strategy of their behavior will be adjusted [9].

*Gallinula Chloropus* breed from May to September each year, so in the spring non-breeding season, the time allocation is mostly used for feeding and resting, and there is a less time for preening and fighting to store energy for breeding. In different seasons, the time allocation of *Gallinula Chloropus*'s behavior is very different. The comparison between Figure.2 and Figure.3 shows that the weather condition has a certain effect on the time allocation of *Gallinula Chloropus*'s behavior, but it is mainly reflected in rainfall. During the raining, the exercise time for *Gallinula Chloropus* decreased (from 19.07% on sunny days decreased to 17.14%), and the rest time increased (25.57% on sunny days increased to 26.71%). Possibly due to rainfall, temperature drop, *Gallinula Chloropus* need more energy and keep warm in the form of reducing exercise time and increasing rest time to save energy.

It can be seen from Figure 4 that feeding behavior occurred at three time periods of 9: 00-10: 00, 11: 00-12: 00 and 13: 00-14: 00. Analysis of the sunshine is better after 8:30 am, and the temperature slowly picks up, so there will be a peak of feeding after 9 o'clock. The time period of 10:00-11:00 is the peak of the exercise, at this time, sunshine better, temperature moderate, and the behavior of predation increased, with the predation time increasing, exercise behavior increasing. The time period of 12: 00-13: 00 and 14: 00-16: 00 is the peak of the resting. Sun illumination is relatively large about 12 o'clock, and *Gallinula Chloropus* spend more time resting; after 14 o'clock temperatures began to slowly fall, so the *Gallinula Chloropus* increased their resting time. Therefore, the time allocation of *Gallinula Chloropus*'s behavior is different in different time periods.

The figure 5 shows that the *Gallinula Chloropus* are on the surface of the water for most of the day time and mostly live in the watery bush, because there are abundant foods in the waterweeds, while the most of the behavior of *Gallinula Chloropus* in the spring is feeding, so most of the time the *Gallinula Chloropus* allocate in the waterweeds.

The effect of human disturbance on the time allocation of *Gallinula Chloropus*'s behavior is serious, and when the vigilance frequency of *Gallinula Chloropus* is high, it is always caused by human intention or unintentional behavior. In the Xuanwu Lake, most of the alert behavior occurs at about two in the afternoon, and this time there are Xuanwu Lake staff going down to the Xuanwu Lake to work. Human interference is extremely unfavorable to *Gallinula Chloropus*, which is not conducive to the energy accumulation.

## V. Conclusion

The behavior of *Gallinula Chloropus* in spring is mainly feeding (47.90%), then resting (25.95%) exercise (18.42%), and the ratios of remaining behaviors are relatively low. There are different patterns of time allocation behavior in the two habitats of *Gallinula Chloropus* on the land and waters. On the land, whether it's sunny or rainy, because most of the *Gallinula Chloropus*'s behavior in the spring is feeding, they allocate most of their time in the waterweeds.

The behavior of *Gallinula Chloropus* is mainly divided into four categories: breeding behavior, feeding behavior, community behavior and spatial behavior. The time distribution of behavior is influenced by many factors, such as season, weather conditions and habitat. The season and habitat are the main factors that affect the time allocation. The time distribution of *Gallinula Chloropus* varies greatly in different seasons. Whether it is sunny or rainy days, *Gallinula Chloropus* spend most of their time on the surface of water, and the amount of human disturbance will directly affect the resting and feeding of *Gallinula Chloropus*.

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