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Behavioral Characteristics of Little Egrets and Black-crowned Night Herons in Urban Rivers and the Environmental Factors Influencing Them: A Case Study of the Zhangjiabang River in Pudong New Area, Shanghai

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Abstract: Dense urban areas leave waterbirds few options, so many turn to urban rivers as substitute habitats. Their shoreline structure, human activity, noise, vegetation, and microclimate may jointly shape where birds choose to be and how they allocate their time. We therefore carried out fixed-point observations at four sites along the Zhangjiabang River in Pudong New Area, Shanghai. Individual counts, behavior types, behavior durations, locations, and environmental factors were recorded for Little Egrets and Black-crowned Night Herons. Night Herons were recorded in considerably higher numbers than Little Egrets. The two species also differed in how they allocated their time: Night Herons devoted most of their time to standing/waiting and foraging, whereas Little Egrets foraged and walked more, showing a stronger tendency toward active movement. Species and the frequency of major behaviors were significantly associated, indicating clear differences in behavioral composition between the two egret species. The frequencies of major behaviors did not differ significantly across the four observation points. The duration of single bouts of standing/waiting and foraging, however, did differ significantly among sites. Correlation analysis further showed that observation duration was positively correlated with shade proportion and negatively correlated with pedestrian flow and noise. These findings suggest that Little Egrets and Black-crowned Night Herons may share urban river resources by using different behavioral strategies and spaces. Our sample was small. Mornings and evenings were all we could cover, and some environmental data were missing. These conclusions are therefore provisional. More samples and further observations at dawn, dusk, and night would help confirm them.

1. Introduction

1.1 Background

Wetlands provide essential habitat for waterbirds to forage, rest, breed, and escape disturbance. Ardeids respond readily to changes in food resources, water depth, vegetation structure, and human activity. Their numbers, behavior, and use of space can therefore reflect wetland habitat quality to some degree [1-3]. Little Egrets (*Egretta garzetta*) and Black-crowned Night Herons (*Nycticorax nycticorax*) are both common ardeids in Shanghai, though their activity patterns differ. Little Egrets generally forage during daylight, walking and searching along shallow shorelines. Black-crowned Night Herons are more active at dawn, dusk, or night and often perch or wait on trees, bridge piers, and similar structures [4-6]. When the two species forage at different times, in different places, or in different ways, direct competition between them may ease [7,8].

In dense urban areas, urban rivers now count as key substitute habitats for waterbirds. Hardened shorelines, bridges, patchy vegetation, and heavy foot and vehicle traffic can shrink shallow-water foraging areas. These same features can also give birds somewhere to perch and take cover. People and noise at close range can shift bird behavior, leaving birds more alert, quicker to move, and quicker to take off. The Zhangjiabang River corridor runs past housing, roads, shops and offices, green spaces, and bridges. Shoreline condition, vegetation, foot traffic, vehicle flow, and noise all vary a good deal along the river [9]. This makes the river a useful case for comparing how Little Egrets and Black-crowned Night Herons respond to urban conditions that vary from point to point.

1.2 Study Area and Food Resources

The Zhangjiabang River counts as one of the main trunk waterways of Pudong New Area, Shanghai. It runs about 23.6 km from the Huangpu River in the west to the Yangtze estuary in the east. Its functions take in flood control, irrigation and drainage, landscape, and ecology. Along its course, the built environment is complex. Human disturbance intensity, shoreline morphology, vegetation cover, and water surface openness shift from stretch to stretch [9].

Fish feed both Little Egrets and Black-crowned Night Herons. For the study stretch of the Zhangjiabang River, no dedicated fish survey exists. Records of fish communities from major inland waters in Shanghai therefore act only as background. Freshwater cypriniforms dominate Shanghai's inland waters. Common or dominant species take in crucian carp (*Carassius auratus*), common carp (*Cyprinus carpio*), silver carp (*Hypophthalmichthys molitrix*), bighead carp (*Hypophthalmichthys nobilis*), topmouth gudgeon (*Pseudorasbora parva*), false gudgeon (*Abbottina rivularis*), Chinese sleeper (*Odontobutis potamophila*), and dusky tripletooth goby (*Rhinogobius giurinus*) [10]. Ardeids in urban rivers may prey on these fish and their juveniles. No fish sampling took place in this study. Such records therefore cannot offer direct evidence of the fish composition in the study stretch of the Zhangjiabang River.

1.3 Research Progress in China and Abroad

Work on how ardeids use habitat resources usually settles into four areas: foraging behavior, activity rhythms, habitat and microhabitat use, and group and interspecific interactions. Some studies watch individual birds, others survey breeding colonies, and still others track birds by satellite. Each method turns up something different—short-term behavioral choices in some cases, longer-term patterns of space use in others.

1.3.1 Foraging Behavior

Foraging behavior has long been central to ardeid behavioral ecology. Willard [2] looked at several ardeid species and found that they draw on a range of foraging strategies, including standing and waiting, slow walking search, and active pursuit. Which strategy a bird uses hinges on water depth, prey type, and body size. Maccarone and Brzorad [11] reported that more active ardeids can boost their odds of meeting prey by moving often, but this costs more energy. Li Tao et al.[7] further noted that Little Egrets often patrol shallow water, stir the water, and peck at prey. Wooden stakes, bamboo poles, and floating vegetation are where Black-crowned Night Herons tend to lie in wait.

Dimalexis et al.[12] set out to compare how Grey Herons (*Ardea cinerea*), Great Egrets (*Ardea alba*), and Little Egrets forage in Greek wetlands. Aboushiba et al.[13] moved on to five egret species in artificial ponds. Behavioral differences within the same group, these cross-regional studies suggest, need to be understood alongside habitat conditions and species traits. Fasola [14] also asked how ardeid communities make opportunistic use of foraging resources. Active search and sit-and-wait therefore do not stand alone as fixed patterns. Together they make up a set of strategies that shift with water depth, prey availability, competition, and energy costs.

1.3.2 Activity Rhythms

Little Egrets and Black-crowned Night Herons run on very different schedules. In Qingpu, Shanghai, satellite tracking showed that Little Egrets and Chinese Pond Herons (*Ardeola bacchus*) moved about during the day and rested at night. Night Herons, by contrast, moved more at night, though the two tracked individuals differed in how much they used farmland, rivers and lakes, and lotus ponds after dark [6]. At the Zhangjiang estuary, Night Herons and Striated Herons (Butorides striata) foraged mostly at dawn and dusk. Little Egrets and Chinese Pond Herons, by contrast, left the roost earlier and returned later. This difference in timing may reduce direct competition for similar food resources [8].

Night Herons are well adapted to nocturnal activity, thanks in large part to their visual system [15]. Their activity rhythms still shift, however, with breeding stage, season, food abundance, and artificial lighting. Daytime or nighttime activity, then, is best treated as a general tendency rather than a strict rule that holds for every individual and every hour. Our observations covered only morning and evening. They allow comparison of the overlap in activity periods between the two species, but not a full picture of their daily rhythms. This is a limitation worth keeping in mind when interpreting the standing and foraging proportions recorded for Night Herons.

1.3.3 Habitat and Microhabitat Use

Ardeids occupy a wide range of habitats, from lakes and rivers to fish ponds, farmland, and constructed wetlands. Preferences differ among species, however, with respect to open water, shallow shorelines, vegetation, and artificial structures. Little Egrets tend to use shallow water that allows walking and active search. Black-crowned Night Herons more often use woodland, bridge piers, wooden stakes, floating debris, and riparian vegetation as perching structures [6,7]. In urban settings, artificial structures may act as barriers or as substitute habitat.

Constructed wetlands and the urban built environment therefore do not have purely negative effects. Young[16] showed that fish ponds around Deep Bay, Chinese Hong Kong, are valuable to ardeids. Wong et al.[17] used the foraging flights of breeding ardeids to examine the relationship between nesting areas and nearby wetlands. Fidorra et al.[18] compared how Great Egrets choose between human-influenced and natural wetlands at multiple scales. These studies indicate that assessments of urban rivers need to weigh the resources artificial habitats provide, the connectivity between patches, and the intensity of human disturbance.

1.3.4 Perching and Social Behavior

Foraging is not the only behavior of interest. Standing, resting, preening, vigilance, flight, and interactions with other individuals also reflect how birds allocate energy, maintain plumage, avoid risk, and manage relationships with other species. In urban Zhengzhou, ardeids form mixed-species groups, and some nest-site competition and aggressive displacement have been recorded [3]. Fasola et al.[19] showed that different ardeids can reduce direct conflict by diverging in food and foraging habitat.

Wen Zhenzhong et al.[20] and Zhu Xi et al.[21] examined ardeid communities from the perspectives of interspecific relationships and spatial niche, respectively. Their findings suggest that mixed flocks do not necessarily mean resource use overlaps completely. In Zhengzhou, breeding groups of Black-crowned Night Herons, Little Egrets, and Chinese Pond Herons formed mixed-species groups of varying composition. Nest-site competition and displacement also occurred [3]. Social behavior records can therefore help assess resource competition and disturbance responses. To demonstrate competition or facilitation, however, simultaneous data would be needed on inter-individual distance, the outcomes of interactions, and resource occupancy.

1.4 Gaps in Existing Research

Existing ardeid research has centered largely on nature reserves, lakes, tidal flats, farmland, fish ponds, and large constructed wetlands. Much of this work has been done at the scale of breeding ecology, migration, and broad-scale habitat use. Few studies, by contrast, have carried out continuous fixed-point observations of Little Egrets and Black-crowned Night Herons in urban rivers within highly urbanized areas. Even fewer have recorded behavioral composition, behavior location, and multiple microenvironmental factors at the same time. Work on activity rhythms, foraging strategies, and habitat use has largely proceeded along separate lines. Integrated work on how temperature, shade, pedestrian flow, and noise relate to behavior duration remains limited.

1.5 Study Objectives

To compare how the two species use one urban river, we placed four fixed observation points (A, B, C, and D) along its course. Each stretch met four conditions: both species had been recorded there consistently; the view was fairly open; access was workable; and environmental conditions differed clearly. Point A is an open residential bank with moderate vegetation, where stray cats showed up now and then. Point B lies in a wetland transition zone within a park and has the densest vegetation and the least disturbance from people and vehicles. Point C is a tree-lined stretch beside a road, with plenty of canopy cover and heavy traffic disturbance. Point D is an urban landscape bank full of dense buildings and bridges, with sparse vegetation and the heaviest vehicle flow. These four points cover a fairly continuous stretch of the river, where vegetation, shoreline, and disturbance gradients can be compared.

We compare Little Egrets and Black-crowned Night Herons in numbers, behavioral composition, time allocation, and microhabitat use. We then turn to how the four points differ in environment and behavior terms, assess how temperature, humidity, vegetation cover, shade proportion, pedestrian flow, noise, and distance to water relate to ardeid activity, and discuss whether the two species share urban river resources by splitting time, space, and behavioral strategy.

2. Study Area and Methods

2.1 Overview of the Study Area

A stretch of the Zhangjiabang River in Pudong New Area, Shanghai, served as the study site (Fig. 1–4). Its banks hold residential areas, roads, bridges, green spaces, and public open spaces. Four fixed observation points (A, B, C, and D) went in along the river (Fig. 5). Historical bird records, riverine features, what could be seen, and how easy each spot was to reach all shaped where the four points went. Each point took in about 50 m of shoreline, with an observation radius of roughly 20 m. River width, vegetation structure, and human disturbance all differed noticeably from point to point, leaving a clear environmental gradient along the river. River widths at Points A–D reached 52.5 m, 37.5 m, 35.0 m, and 42.5 m. Vegetation cover stood at about 75%, 90%, 85%, and 55%. Noise at Points A and B came in at 48 dB and 47 dB, well under the 60 dB and 59 dB at Points C and D. Pedestrian flow went from 22 persons/10 min at Point B up to 60 persons/10 min at Point C. Vehicle flow barely registered at Points A and B—6 and 0 vehicles/10 min—yet climbed to 605 and 640 vehicles/10 min at Points C and D. Road traffic and urban activity therefore weighed more heavily on Points C and D.

Point A is an open-bank habitat. Its water surface was the widest, roughly 52.5 m across, and vegetation cover reached about 75%, split into roughly 30% trees, 10% shrubs, and 60% herbaceous plants. Low herbaceous plants took over, with few tall trees nearby. Quiet villa residential areas fill most of both banks. Noise hovered around 48 dB, pedestrian flow around 38 persons/10 min, and vehicle flow around 6 vehicles/10 min—enough to place overall human disturbance at a moderate level. Stray cats also turned up often here, around one per 10 m on site, and three were logged during the quantitative survey. These cats may add another source of disturbance from terrestrial animals.

Point B can be described as a wetland transition habitat that retains a relatively natural character. The river runs through a park, about 37.5 m wide, with vegetation cover of about 90%, the highest of the four points; trees, shrubs, and herbaceous plants accounted for roughly 30%, 10%, and 60%. Dense grass and shrub vegetation covers both banks, providing good cover. Noise level at Point B was about 47 dB, the lowest of the four points; pedestrian flow was about 22 persons/10 min, also the lowest among them, and no motor vehicles were recorded during observations. Of the four points, Point B thus has the highest vegetation cover and the lowest traffic and human disturbance.

Point C can be described as a tree-lined riverbank habitat. A road runs along one side, a park along the other, so the two banks look quite different. At about 35.0 m wide, the river here was the narrowest of the four points. Vegetation cover overall came to about 85%, with trees at 55%—higher than at any other point—and shrubs and herbaceous plants at about 15% and 30%. Trees grew thicker on the park side. The side facing the road carried less vegetation. Point C also saw higher levels of disturbance: noise reached about 60 dB, the highest of the four points; pedestrian flow ran about 60 persons/10 min, also the highest; and vehicle flow came to about 605 vehicles/10 min. Anglers and boaters also turned up. Point C thus pairs fairly heavy vegetation cover with strong traffic disturbance.

Point D is an urban landscape riverbank habitat. Buildings sit thick around it. Its banks are highly artificialized. The river width was about 42.5 m, and vegetation cover was about 55%, the lowest of the four points; trees, shrubs, and herbaceous plants accounted for roughly 35%, 15%, and 50%. Point D had fewer trees and less continuous vegetation than Points B and C, and open hard surfaces and urban buildings played a larger role there. Noise level was about 59 dB, pedestrian flow about 47 persons/10 min, and vehicle flow about 640 vehicles/10 min, the highest among the four points. Disturbance sources included buildings, crowds, vehicles, and boats. Of the four observation points, Point D thus has the strongest urbanization and traffic disturbance and the lowest vegetation cover.

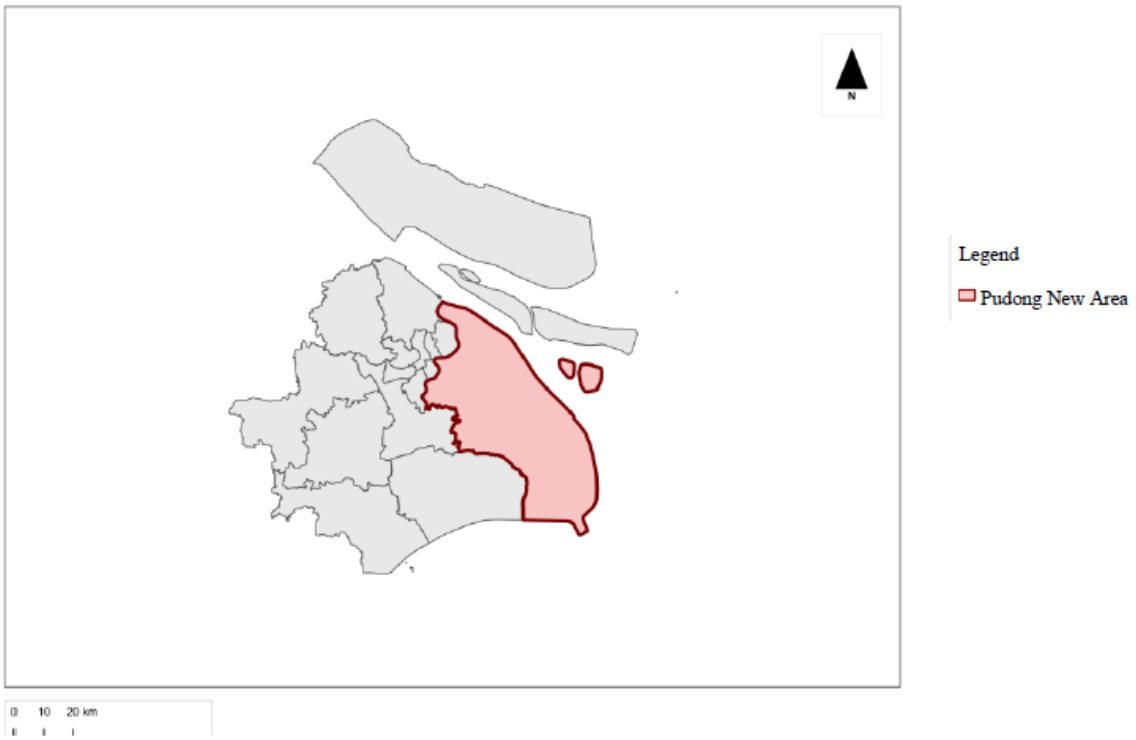


Fig. 1 Location of Pudong New Area in Shanghai

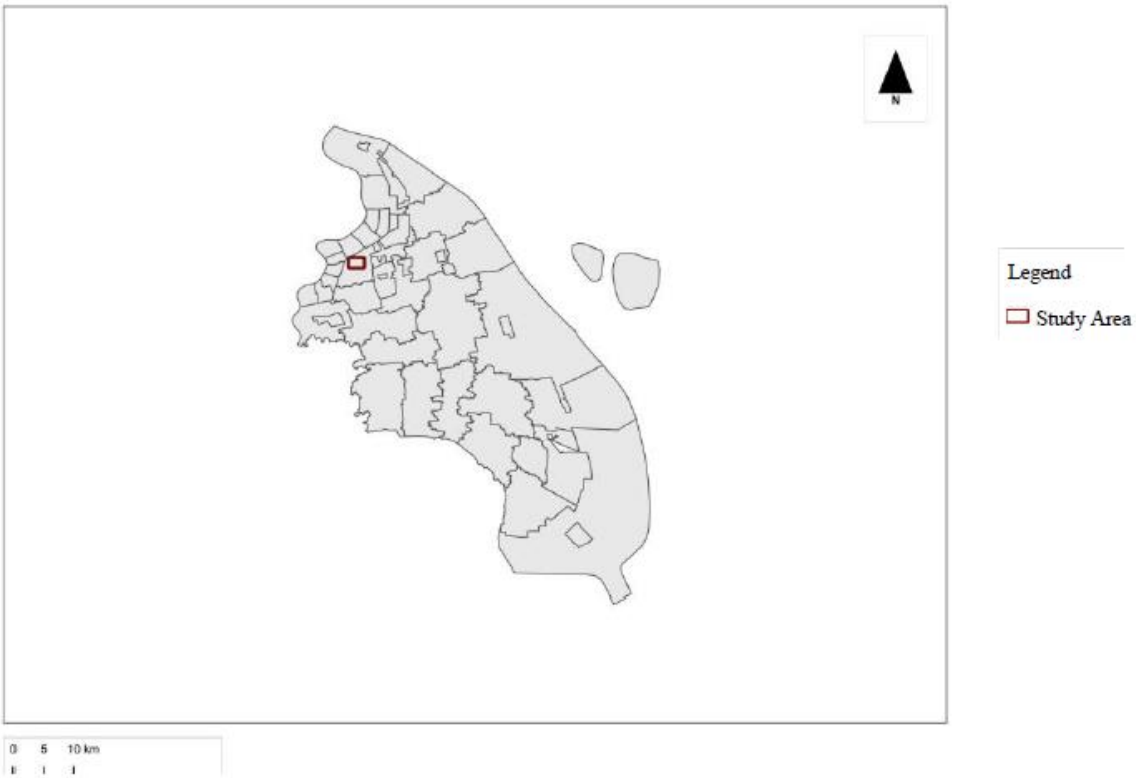
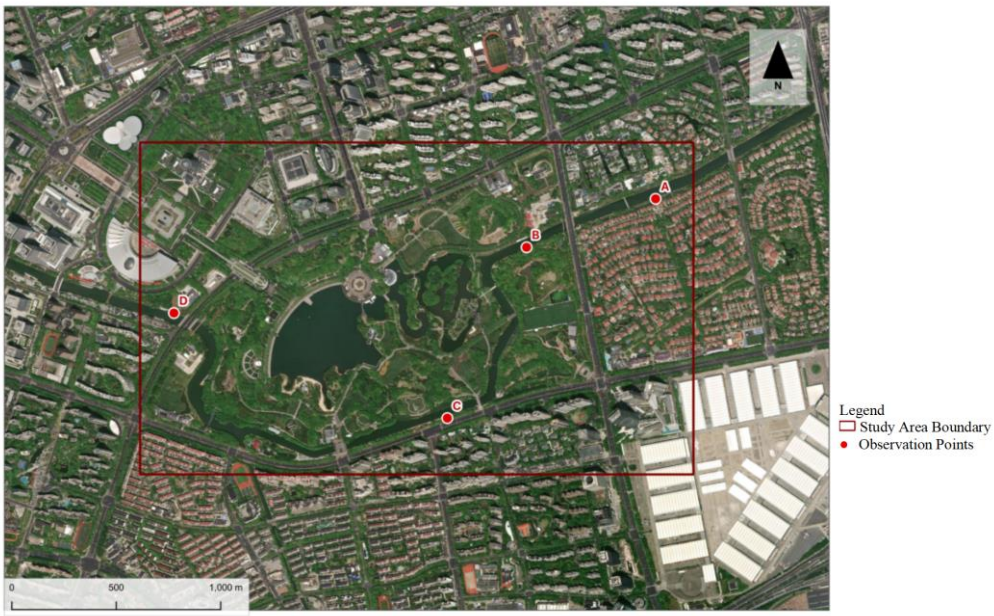


Fig. 2 Location of the Study Area in Pudong New Area



Note: A–D indicate the bird behavior observation points established in this study. Basemap: Esri World Imagery; point data: field survey.

Fig. 3 The Study Area and the Distribution of Observation Points for Little Egrets and Black-crowned Night Herons

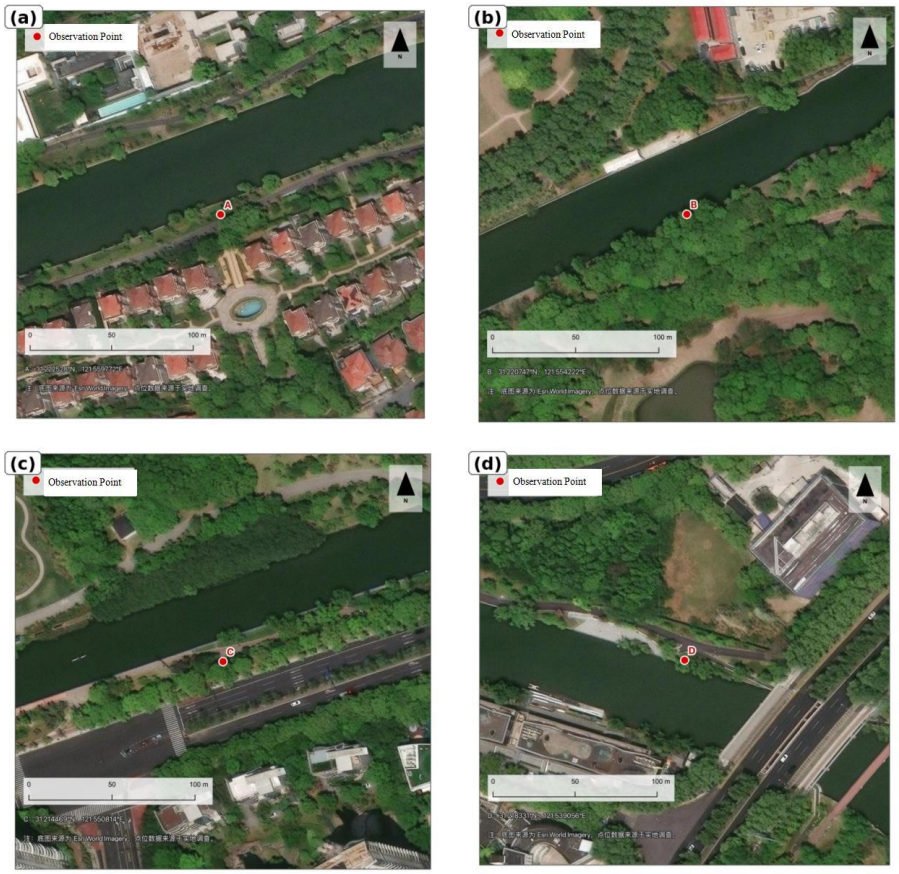


Fig. 4 Satellite Imagery of the Four Observation Points (A–D): (a) Point A; (b) Point B; (c) Point C; (d) Point D

2.2 Study Species

This study looks at two ardeids: the Little Egret and the Black-crowned Night Heron. Adult Little Egrets are all white, with a black bill and tarsi and yellowish toes. Males weigh about 350–500 g and measure 584–642 mm in total length. Females weigh about 350–480 g and measure 510–580 mm. Black-crowned Night Herons are stockier than Little Egrets. Adults carry a blackish-blue crown and mantle, greyish-white wings and body, and red irises [4,5]. In the field, birds were distinguished by body size, plumage color, bill and leg features, and posture. Adults and juveniles were noted whenever conditions allowed. Records that could not be reliably assigned to a species, age class, or behavior were left out of the relevant comparisons.

2.3 Survey Dates and Observation Routes

Data collection ran on seven days: 25 and 26 June, 6–8 July, 13 July, and 15 July 2026. Morning observations covered 08:30–11:01 and evening observations 17:12–19:36. Each day, the four points were visited in sequence along the D–C–B–A route or a preset fixed route. At each point, target birds visible at the time were recorded, together with their behavior and the surrounding environmental conditions. Weather, bird visibility, and disturbance at the site varied on some days, so both the actual recording time and the number of records differed among the points.

2.4 Bird Counts and Behavioral Observations

We combined fixed-point observation with continuous focal-individual sampling. For each observation, we recorded the species, number of individuals, age class, behavior type (Table 1), behavior location, and the start and end times of each behavior, from which duration was calculated. When one individual performed several behaviors in a row, each was recorded on its own. The moment of each transition marked the boundary. Any raw record with more than one behavior code (hereafter, multi-code records) was split into single-behavior records during data processing. The original duration was then divided equally across them. This procedure facilitates comparisons of behavioral time allocation, but it may over- or underestimate the actual duration of certain behaviors, so the results are interpreted as exploratory.

Table 1 Behavioral Categories and Operational Definitions for Little Egrets and Black-crowned Night Herons

Behavior type	Operational definition	Recording mode
Foraging (F)	Actively searching for, waiting to capture, chasing, or pecking at potential food	Duration
Walking (W)	Moving on the bank, at the water's edge, or on other substrates without any clear prey-capture action	Duration
Standing/waiting (ST)	Maintaining an upright posture without evident locomotion, preening, or prey-capture action	Duration
Resting (R)	Neck retracted, eyes closed, or remaining motionless for extended periods, indicating a resting state	Duration
Preening (P)	Using the bill to arrange or clean the plumage	Duration
Flying (FLY)	Leaving the original position and continuing in flight	Duration/event
Social behavior (S)	Chasing, displacing, or otherwise clearly interacting with conspecific or heterospecific individuals	Duration/event
Unknown (U)	Behavior that cannot be assigned to the above categories but is retained in the records	Text note

2.5 Behavior Locations and Microhabitat Classification

Behavior locations were recorded during each observation and classified by riverine environment: bank or shore, nearshore water, mid-channel water, shoreline vegetation, trees, bridge piers or bridge structures, artificial revetment, and other types. Each time an individual moved during an observation, a new location was recorded.

2.6 Environmental Factor Recording

Environmental factors recorded included air temperature (℃), relative humidity (%), noise level (dB), vegetation cover (%), shade proportion (%), pedestrian flow (persons/10 min), distance to water (m), and the type of disturbance observed. For noise, the mean of the upper and lower bounds of the original range was used. Pedestrian flow was counted as the number of people passing within 10 min. Disturbance was classified based on field descriptions into dogs, runners, vehicles, construction, fishing, boats, cats, and photography—or recorded as having no clear disturbance.

2.7 Data Processing and Standardization

Raw data were organized by date, observation period, point, focal individual, and species. For behavioral frequency, each behavior derived from a split record counted as one event. Behavioral time used the apportioned duration obtained after splitting. For within-species behavioral time proportion, the apportioned duration of a given behavior was divided by the species' total valid apportioned duration. Within-point behavioral time proportion used the same formula, with the point's total valid apportioned duration as the denominator. Environmental data that were missing were not included in calculations of means or in correlation analyses.

2.8 Statistical Analysis

We first summarized the number of records, cumulative number of individuals, behavioral frequencies, and behavioral time proportions for the two ardeid species using descriptive statistics. Chi-square tests of independence checked whether species and point were linked to the frequency of major behaviors. Because single-bout durations were skewed and sample sizes differed among the four points, Kruskal–Wallis tests were used to compare standing/waiting and foraging durations across Points A–D. Spearman's rank correlation was used to assess relationships between environmental factors and the duration of individual records. Significance was set at $p < 0.05$.

3 Research results

3.1 Data Overview and Species Records

Across the seven observation days, we obtained 192 raw records, which were split into 287 single-behavior records and totaled about 21.33 h of apportioned observation time (Table 2). Black-crowned Night Herons accounted for 149 raw records, a cumulative individual count of 157, and about 18.87 h of recording time. Little Egrets yielded 43 raw records, 44 cumulative individual records, and about 2.45 h of recording time. In this observation period, Black-crowned Night Herons had more records and longer cumulative observation time than Little Egrets.

Table 2 Overview of Observation Records for Little Egrets and Black-crowned Night Herons

Species	Raw records	Cumulative individual count	Total recording duration (h)
Black-crowned Night Heron	149	157	18.87
Little Egret	43	44	2.45

3.2 Behavioral Composition and Time Allocation of the Two Ardeid Species

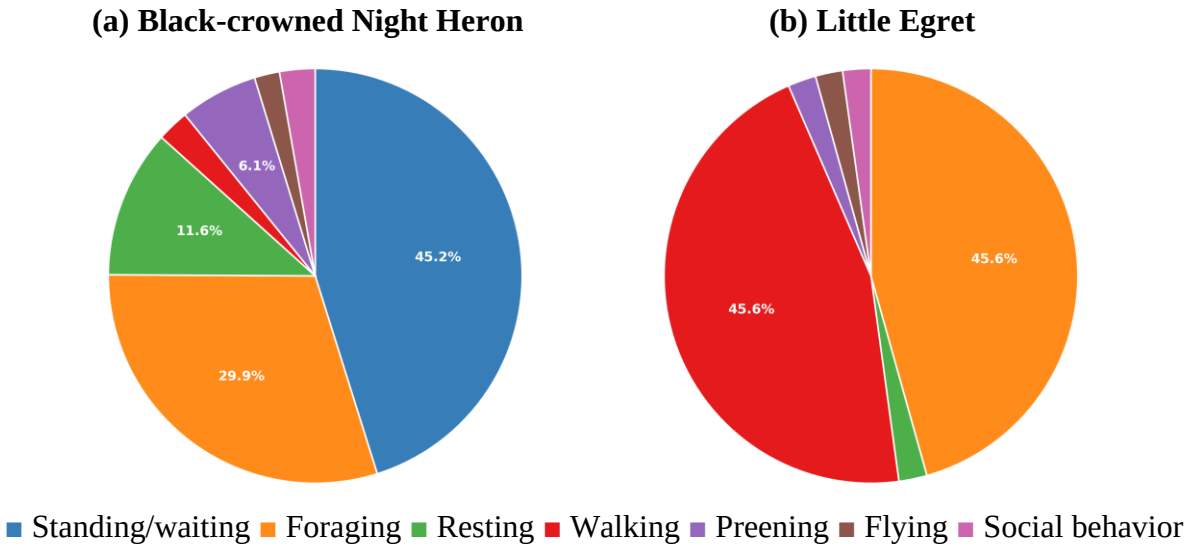


Fig. 5 Time Allocation of Seven Major Behaviors for Little Egrets and Black-crowned Night Herons (based on apportioned duration)

Black-crowned Night Herons spent most of their behavioral time standing/waiting (45.2%) and foraging (29.9%) (Fig. 6). Resting (11.6%) and preening (6.1%) made up most of the remainder. Little Egrets, by contrast, devoted most of their time to foraging and walking, each accounting for 45.6%, and no standing/waiting was recorded for this species. Species and the frequency of major behaviors showed a significant association ($\chi^2 = 73.64$, df = 6, $p < 0.001$), pointing to a clear difference in behavioral composition between the two species. Some behavior categories had low expected frequencies. This result therefore mainly reflects an overall difference. With larger samples, low-frequency categories could be combined, or exact tests applied instead.

3.3 Behavioral Differences among Observation Points

The frequencies of major behaviors showed no significant difference across Points A–D ($\chi^2 = 18.50$, df = 15, $p = 0.237$). Behavioral time composition, however, varied noticeably among the four points (Fig. 7). Standing/waiting was highest at Point D, foraging and walking were relatively high at Point B, and at Point C both foraging and standing/waiting made up substantial proportions. Kruskal–Wallis tests showed that the apportioned duration of single bouts of standing/waiting differed significantly among the four points ($H = 29.40$, df = 3, $p < 0.001$). The same held for foraging ($H = 11.27$, df = 3, $p = 0.010$). These results suggest that observation point may affect how long individuals stay and how long their behaviors last. Other factors may also play a part, including river width, vegetation, shade, pedestrian flow, noise, and species composition at each point.

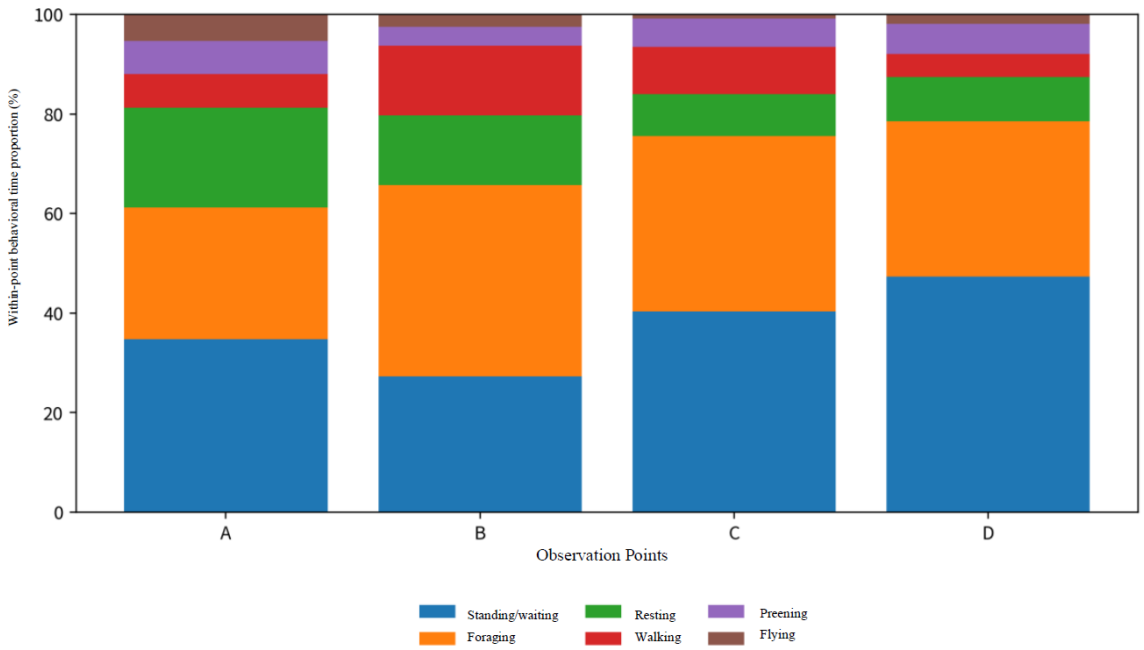


Fig. 6 Behavioral Time Composition at Each of the Four Observation Points (A–D)

3.4 Environmental Factors and Behavior Duration

Table 3 Spearman's Rank Correlations between Environmental Factors and the Duration of Individual Records

Environmental factor	n	Spearman ρ	p	Significant
Temperature	39	0.139	0.398	No
Humidity	39	0.041	0.806	No
Vegetation cover	39	0.306	0.058	No
Shade proportion	39	0.378	0.018	Yes
Pedestrian flow	39	-0.416	0.008	Yes
Distance to water	39	0.111	0.499	No
Mean noise	126	-0.287	0.001	Yes

Among the 39 records with relatively complete quantitative environmental data (Table 3), shade proportion was weakly to moderately positively correlated with record duration ($\rho = 0.378$, $p = 0.018$), whereas pedestrian flow showed a moderate negative correlation ($\rho = -0.416$, $p = 0.008$). Of the 126 records with noise measurements, mean noise showed a weak negative correlation with record duration ($\rho = -0.287$, $p = 0.001$). Temperature, humidity, and distance to water showed no significant correlation with record duration. Vegetation cover showed a positive trend, though it fell short of the 0.05 significance level. Shade appears to favor longer stays. Heavier pedestrian traffic and noise, by contrast, tend to shorten them. These correlations do not prove causation, and species, observation point, and behavior type may all confound the results.

3.5 Flight Responses under Different Disturbance Types

We used the presence of flying in a raw record as a simple indicator of response. Flight response rates differed among disturbance types (Fig. 7). Records involving boats, runners, photography, vehicles, and dogs had relatively high flight response rates. Angling records had relatively low rates.

Sample sizes were uneven across disturbance types, and some records contained more than one disturbance. These results are therefore descriptive only and cannot be used to infer causal effects of different disturbance types.

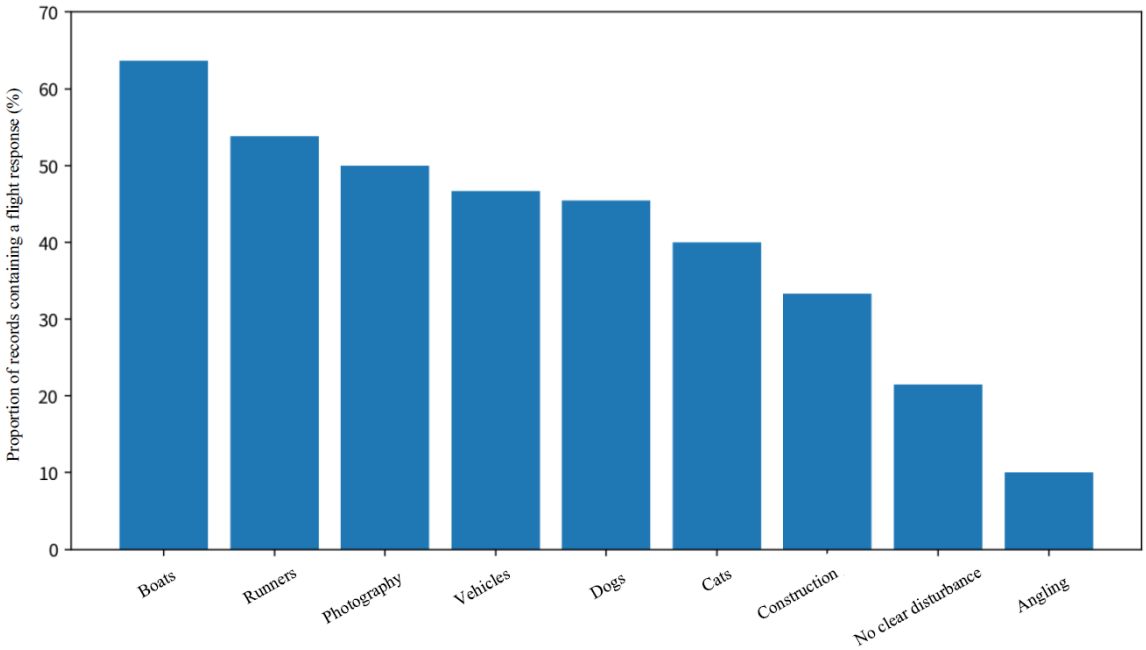


Fig. 7 Proportion of Records Containing a Flight Response under Different Disturbance Types

4. Discussion

4.1 Differences in Behavioral Strategy between Little Egrets and Black-crowned Night Herons

In this study, Black-crowned Night Herons spent most of their behavioral time standing/waiting (45.2%) and foraging (29.9%), whereas Little Egrets divided most of theirs between foraging and walking, each at 45.6%. This difference points to a greater reliance by Little Egrets on active movement and continuous search when using shallow-water food resources during the observation periods and within the study stretch. Black-crowned Night Herons, by contrast, more often waited for prey to come to them. Energy is invested differently under the two strategies. Active search may put birds in touch with more prey, but it burns more energy. Waiting takes less movement, but what a bird gets out of waiting hinges more on where it perches and how often prey pass by.

Earlier work lines up with much the same direction. Willard [2] noted that standing and waiting, walking search, and active pursuit in ardeids shift with water depth, prey type, and body size. Li Tao et al.[7] studied Little Egrets and Black-crowned Night Herons at Yuantouzhu on Taihu Lake. The two species, they reported, put banks, lake surfaces, and artificial structures to different uses. Maccarone and Brzorad [11], in their work on other ardeids, further showed that more active foraging may boost the odds of finding prey but also drives up energy expenditure. These studies offer a handy yardstick for reading the “walking–foraging” mix in Little Egrets and the “standing–foraging” mix in Black-crowned Night Herons. Other regions' findings cannot stand as direct mechanistic evidence for the Zhangjiabang River, since species, habitats, and observation scales all differ.

The absence of standing/waiting in Little Egrets here does not mean the species never does it. Little Egrets yielded just 43 raw records and about 2.45 h of cumulative observation time, far fewer than the 149 records and about 18.87 h for Black-crowned Night Herons. Splitting multi-code records and apportioning their durations equally may also have skewed the proportions of low-frequency

behaviors. The time allocation given here captures this sample's behavioral composition. It does not reflect either species' full daily activity budget.

4.2 Temporal and Spatial Niche Differentiation

Little Egrets and Black-crowned Night Herons may differ in ways that point to a wider niche differentiation. Niche differentiation does not have to be spatial. It can also show up in activity time, food resources, and foraging mode. Satellite tracking in Qingpu, Shanghai, showed that Little Egrets were up and about mainly during the day, while Black-crowned Night Herons stayed active at dawn, dusk, and night [6]. Our morning observations ran from 08:30 to 11:01, and evening observations from 17:12 to 19:36. These windows captured only part of the activity overlap between the two species, not the whole night. The higher standing/waiting share in Black-crowned Night Herons may therefore reflect an ambush foraging strategy—or it may simply come from resting by day and waiting for night.

The spatial results were mixed. Major behavior frequency showed no significant difference among the four points ($p = 0.237$). The apportioned duration of single bouts of standing/waiting and foraging, however, did differ significantly from point to point. In this sample, whether a behavior occurred did not divide clearly across points. Once a behavior did occur, its duration may have shifted with local conditions. Standing/waiting accounted for a higher proportion at Point D, foraging and walking were relatively higher at Point B, and Point C showed relatively high proportions of both. These patterns may trace back to shoreline structure, cover, artificial perching structures, and human disturbance. They may also stem from different species mixes across points.

Fasola et al.[19] examined what several ardeid species ate across their Italian breeding ranges. Their work showed that differences in food composition and foraging habitat can shrink resource overlap between species. What we saw here in time, space, and behavior fits with that idea. It falls short, though, of showing that Little Egrets and Black-crowned Night Herons avoid competition through niche differentiation. We did not measure prey composition, capture success, or resource overlap directly, nor did we systematically record what happened when the two species showed up together. A more direct test of the coexistence mechanism would need time-specific resource use, microhabitat selection indices, and records of interspecific encounters.

4.3 Effects of Urban Environmental Factors

Exploratory work showed that record duration rose with shade proportion ($\rho = 0.378$, $p = 0.018$) and fell with pedestrian flow ($\rho = -0.416$, $p = 0.008$), and dropped slightly as mean noise climbed ($\rho = -0.287$, $p = 0.001$). These trends fit what urban rivers would predict. Shade may hold birds longer by cutting heat exposure, offering cover, or making perches more comfortable. Busy foot traffic and constant noise, on the other hand, may leave birds jittery and push them to leave sooner or move on.

These correlations, though, cannot be read as causal effects. Shade, vegetation cover, point, time period, and temperature may all overlap. Point C, for instance, has plenty of trees and heavy traffic disturbance, while Point D has little vegetation cover and heavy vehicle flow. Univariate Spearman analysis cannot separate these factors, and it does not control for species or behavior type. Resting Black-crowned Night Herons tend to generate longer records. Little Egrets, by contrast, move actively and may leave the observation range sooner. Differences in "stay duration" may therefore partly reflect how observable a behavior is.

Flight response rates under different disturbance types provide supporting evidence for this interpretation, though the evidence remains descriptive. Records involving boats, runners, photography, vehicles, and dogs had relatively high proportions of flight behavior. Those involving angling had relatively low proportions. Sample sizes varied across disturbance categories, and one

record could hold more than one disturbance. A bird that does not fly is not necessarily unaffected. They may also respond by increasing vigilance, stopping foraging, or shortening their stay. City birds may grow a bit used to routine traffic over time. How they respond to any given disturbance may hinge on distance, speed, suddenness, and predictability.

These findings point to several management steps. Keeping continuous shoreline vegetation and shaded patches along urban rivers is one. Another is to maintain an adequate buffer distance between commonly used perches and footpaths or photography spots. For construction, boats, and heavy recreation, the priority should be cutting sudden close-range disturbance during likely active periods such as dawn and dusk. Human activity should not be treated as having the same effect everywhere. These suggestions come from short-term correlational analyses. How far they hold is still unclear. Determining the extent to which they hold would require longer-term observations across more river stretches, together with standardized disturbance distances.

4.4 Future Prospects

Three things limit this study: sample size, temporal coverage, and data completeness. The survey covered only seven days, and the number of records varied unevenly across dates, points, and time periods; the same individual may have been recorded more than once. Little Egrets were far outnumbered by Black-crowned Night Herons, and no full nighttime observations were made. Low-frequency behavior proportions and inferences about the temporal niche of the two species are therefore open to chance. The equal apportioning of duration for multi-code records also cannot fully reconstruct actual behavioral transitions and durations. Apart from noise, most environmental analyses rested on only 39 relatively complete records. Univariate correlations cannot control for species, point, date, and time period all at once. Food resources were taken from regional data for Shanghai rather than from sampling in the Zhangjiabang River. The present results should therefore be treated as exploratory.

Later work could spread stratified sampling across more days and extend coverage to early morning, dusk, and night. Logging temperature, humidity, and noise continuously, along with timing each behavior or reviewing video, would firm up data completeness. Water depth, shallow-water width, shoreline structure, fish and other prey densities, and the reasons focal individuals leave the field of view also need recording. With enough samples, generalized linear models or mixed-effects models could pull species, point, time period, date, and environmental factors into one framework. That would allow environmental effects, behavioral differences, and bias from repeated observations to come apart more reliably.

5. Conclusion

Seven days of behavioral records from the Zhangjiabang River hint that Little Egrets and Black-crowned Night Herons behave quite differently in this urban river. Black-crowned Night Herons spent most of their time standing/waiting and foraging, whereas Little Egrets mainly foraged and walked, suggesting that the two species use food resources through different strategies—active search in Little Egrets, sit-and-wait ambush in Black-crowned Night Herons. Major behavior frequencies did not differ significantly across the four observation points. Standing/waiting and foraging durations, however, varied significantly from point to point. Records with more shade were associated with longer stays, while higher pedestrian flow and noise were associated with shorter stays. Behavioral strategy, spatial conditions, and human disturbance may all come into play in how the two species use urban rivers. Larger samples and more thorough environmental quantification would allow further testing of the temporal–spatial niche differentiation of the two species and their mechanisms of urban adaptation.

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