Dataset Development of Poyang Lake Herbivorous Wintering Waterbird Droppings and *Carex cinerascens* Kükenth. Decomposition (2017)

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Abstract: Based on a litterbag decomposition experiment on *Carex* litter and an additive experiment with droppings from herbivorous wintering waterbirds conducted in 2017 on the beaches of Poyang Lake, this study systematically collected data on wetland organic matter decomposition and carbon, nitrogen, and phosphorus cycling. This work led to the construction of the Dataset of Poyang Lake herbivorous wintering waterbird droppings and *Carex cinerascens* Kükenth. decomposition. The results indicated that the addition of bird droppings significantly accelerated the decomposition of *Carex* litter. In the mixed treatment, the residual rates of dry matter, lignin, and cellulose of *Carex* (66.80%, 61.03%, and 44.54% respectively after 150 days) were significantly lower than those in the single *Carex* treatment (71.96%, 69.97%, and 62.53%). Furthermore, the nutrient release rates (Relative Return Index) of carbon, nitrogen, and phosphorus (42.73%, 53.95%, and 14.65% respectively) were significantly higher than those in the single *Carex* treatment (34.91%, 17.96%, and 5.7%). The bird droppings themselves decomposed slowly but exhibited high nitrogen and phosphorus release characteristics. This suggests that wintering waterbirds, through excretory activities that input allochthonous nutrients and microbial communities, likely promote the decomposition of structural components (cellulose, lignin) of *Carex* and the net release of carbon, nitrogen, and phosphorus. This is achieved by altering substrate composition, enhancing nutrient availability, and stimulating microbial activity, thereby profoundly influencing wetland material cycling processes and carbon pool dynamics. The dataset includes: (1) geo-location information of the sample plots; (2) dry matter decomposition rate of samples; (3) lignin decomposition data; (4) cellulose decomposition data; (5) total carbon return; (6) total nitrogen return; and (7) total phosphorus return. It provides a key scientific basis for revising global carbon models and the managing of wetland ecosystems.

Keywords: dry matter; lignin; cellulose; carbon, nitrogen, phosphorus; Poyang Lake; waterbirds

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Received: 11-08-2025; **Accepted:** 29-10-2005; **Published:** 24-12-2025

Foundations: Jiangxi Province (JXBC-GC20231009); National Natural Science Foundation of China (41971133)

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Data Citation: [1] Zhang, Q. J., Xia, S. X., Wu, D. L., *et al*. Dataset development of Poyang Lake herbivorous wintering waterbird droppings and *Carex cinerascens* Kükenth. decomposition (2017) [J]. *Journal of Global Change Data & Discovery*, 2025, 9(4): 427–435. https://doi.org/10.3974/geodp.2025.04.07.

[2] Zhang, Q. J., Xia, S. X., Wu, D. L., *et al*. Dataset of Poyang Lake herbivorous wintering waterbird droppings and *Carex cinerascens* Kükenth. decomposition [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2025. https://doi.org/10.3974/geodb.2025.09.02.V1.

DOI: https://doi.org/10.3974/geodp.2025.04.07

Dataset Availability Statement:

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: https://doi.org/10.3974/geodb.2025.09.02.V1.

1 Introduction

Litter decomposition is a core process driving organic matter mineralization, which plays a key regulatory role in global carbon fluxes and ecosystem material cycling[1,2]. Wetlands, as highly productive ecosystems, lead to the continuous accumulation of wet plant (e.g., *Carex*) litter due to their flooded anaerobic environment, forming important carbon and nitrogen storage pools[3–5]. Decomposition directly regulates nutrient turnover efficiency, soil fertility maintenance, and biological community construction[6]. Even minor changes in its rate can significantly disrupt the release-accumulation balance of carbon, nitrogen, and phosphorus elements, triggering regional to global-scale responses in carbon and nitrogen pool dynamics[7,8].

More than 30% of plant photosynthetic carbon fixation is stored in cellulose and lignin, whose decomposition rates profoundly regulate the carbon cycle process[7]. As recalcitrant structural components, their content (especially lignin) is often negatively correlated with the overall litter decomposition rate[8]. Lignin inhibits biodegradation by enhancing cell wall resistance and is primarily decomposed by extracellular enzymes secreted by fungi[9]. Although cellulose dominates the degradation process in the early stages of decomposition, its main body is physically protected by lignin and can only be effectively utilized by microorganisms after lignin decomposition[10–12].

The dominant *Carex* species on the Poyang Lake (China's largest freshwater lake) beach exhibit unique phenological rhythms: they sprout after water recedes in autumn, and the aboveground parts gradually wither in winter; they undergo secondary sprouting the following spring, until the aboveground parts die and begin decomposition during the flooding period in April[13]. This phenological process is highly synchronized with the habitat period of wintering waterbirds (especially herbivorous Anseriformes), providing them with key food resources[14], making this wetland a core hub of the East Asian-Australasian Flyway[15]. Annually, over 400,000 wintering waterbirds visit the area, with Anseriformes accounting for more than 50% of the population[16,17]. This large bird population inputs allochthonous nutrients and microbial communities into the wetland through excretory activities[18], potentially accelerating the biogeochemical cycles of carbon, nitrogen, and phosphorus[19–21].

Based on a controlled decomposition bag experiment (with 3 treatments: *Carex* litter, bird droppings, and a *Carex*-droppings mixture) conducted from January to June 2017, the authors systematically quantified the residual amounts, residual rates, and instantaneous decay coefficients of dry matter, lignin, and cellulose, as well as the percentages of total carbon, total nitrogen, and total phosphorus in dry matter, residual amounts, and Relative Return Indices. By analyzing these indicators, the study aims to reveal: the differences in the dynamics of carbon, nitrogen, and phosphorus release during the decomposition of droppings from herbivorous wintering waterbirds and beach *Carex* litter; and the regulatory effect of the addition of bird droppings on the decomposition process of *Carex* litter. The research results will deepen the understanding of wetland material cycling mechanisms, provide empirical data support for the revision of global carbon models, and offer a scientific basis for formulating adaptive wetland management strategies.

2 Metadata of the Dataset

The metadata for the Dataset of Poyang Lake herbivorous wintering waterbird droppings and *Carex cinerascens* Kükenth. decomposition[22], including the title, authors, geographical region, data format, data size, data files, etc., is summarized in Table 1.

Table 1 Metadata summary of the Dataset of Poyang Lake herbivorous wintering waterbird droppings and *Carex cinerascens* Kükenth. decomposition

Item	Description
Dataset full name	Dataset of Poyang Lake herbivorous wintering waterbird droppings and *Carex cinerascens* Kükenth. decomposition
Dataset short name	DecompositionPoyangLake
Authors	Zhang, Q. J., Meteorological Observation Centre, China Meteorological Administration, zhangqj@cma.gov.cn Xia, S. X., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, xiasx@igsnrr.ac.cn Wu, D. L., Meteorological Observation Centre, China Meteorological Administration, wudongli666@126.com Duan, H. L., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, duanhl@igsnrr.ac.cn Yu, X. B., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, yuxb@igsnrr.ac.cn
Geographical region	Poyang Lake
Year	2017–2018
Data format	.shp, .xlsx
Data size	96.4 KB
Data files	(1) Sample site location information; (2) Dry matter decomposition data; (3) Lignin decomposition data; (4) Cellulose decomposition data; (5) Total carbon return; (6) Total nitrogen return; (7) Total phosphorus return
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	(1) *Data* are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use *Data* subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute Data subject to written permission from the GCdataPR Editorial Office and the issuance of a *Data* redistribution license; and (4) If *Data* are used to compile new datasets, the “ten percent principal” should be followed such that *Data* records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[23]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS, GEOSS, PubScholar, CKRSC

3 Methods

3.1 Area of Data Collection

This dataset was sourced from field collection in Baisha Lake, a typical dish-shaped lake within the Poyang Lake Nanjishan Wetland National Nature Reserve (Figure 1). The reserve is located in the frontal delta area of southern Poyang Lake, where 3 tributaries of the Ganjiang River flow into the lake. The ground elevation ranges between 12 and 16 m (Wusong Elevation System). It belongs to a typical subtropical monsoon climate zone, characterized by hot, rainy summers and cold, dry winters. Influenced by the seasonal water level fluctuations of Poyang Lake, the reserve exhibits distinct alternating hydrological patterns of high-water season (generally April to September) and low-water season (generally October to March the following year): during the high-water season, most of the grassy meadows are submerged; as the low-water season arrives, water levels drop, revealing a river-lake intertwined beach landscape[24,25]. This periodic hydrological variation shapes the fertile soil and favorable hydrothermal conditions of the beach shallows, fostering diverse hygrophytic and aquatic vegetation, with *Carex*, *Triarrhena lutarioriparia*, and *Phragmites australis* dominating the community[26,27]. Among them, *Carex* is the most widely distributed dominant plant in Poyang Lake, covering the beaches from the lakeshore to the waterline, hence it was selected as the representative beach plant for this study. *Carex* has a unique growth cycle: "Autumn grass" sprouts after water recedes in September, growing until December–March the following year when the aboveground parts wither; "Spring grass" sprouts beside the incompletely dead autumn grass after January, growing until April when submerged by lake water, ultimately dying, becoming dormant, and decomposing underwater[28]. The aforementioned ecological mechanisms provide essential habitat and food for many rare wintering waterbirds, thereby maintaining the region's rich avian diversity. Consequently, the Poyang Lake wetland is known as the "Kingdom of the Siberian Crane" and the "Paradise for Migratory Birds", establishing its ecological status as one of Asia's most important wintering grounds for migratory birds.

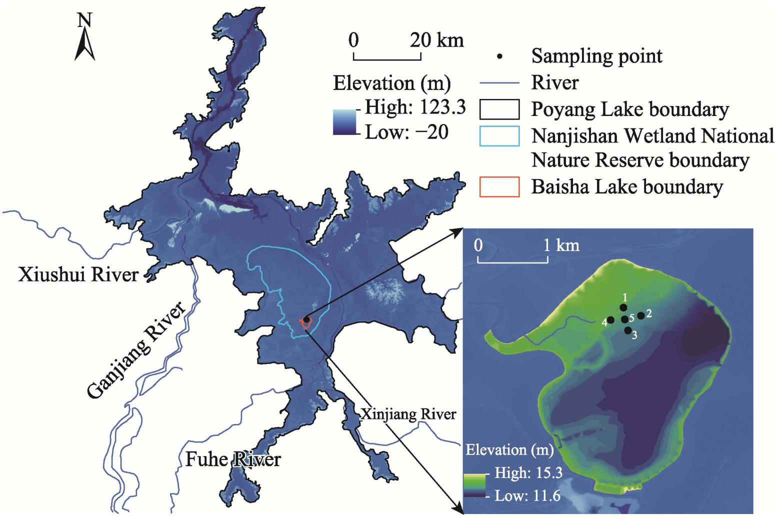

Figure 1 Location map of sampling points in the Poyang Lake wetland

3.2 Field Experiment

3.2.1 Plot Setup and Sample Preparation

In late January 2017, based on preliminary surveys of wetland vegetation and waterbird habitats, this study established 5 fixed plots (approximately 50 m apart) within Baisha Lake in the Nanjishan Wetland Reserve. Plot selection was primarily based on the following principles: minimal human disturbance, frequent activity of herbivorous waterbirds, dense bird droppings traces, and well-developed vegetation. The selected beach was about 200 m from the waterline, dominated by *Carex cinerascens* Kükenth., with vegetation coverage of 80%–90%, plant height of 40–60 cm, and abundant bird droppings visible on the ground and plants. 1 decomposition experiment point was set up within each plot, totaling 5 replicates.

3.2.2 Decomposition Experiment

The litterbag method was used. Decomposition bags were made of 100-mesh (aperture

0.15 mm), 15 cm×20 cm white nylon mesh, preventing sample loss while allowing microbial activity.

(1) *Carex* litter preparation: Senescent *Carex* leaves were collected near the plots, rinsed with deionized water, cut into 10 cm segments and mixed (to eliminate size effects). They were then oven-killed at 120 ℃ for 1 hour and oven-dried at 60 ℃ to constant weight.

(2) Bird droppings sample preparation: Fresh goose droppings (<24 h) were collected from the plots. They were oven-dried at 60 ℃ to constant weight.

(3) Initial nutrient measurement: 10.00 g of dried samples (6 replicates each for *Carex* and droppings) were taken to determine initial nutrients.

(4) Bag loading treatment: The remaining samples were loaded into bags according to the following 3 treatments: pure bird droppings (10 g), pure *Carex* litter (10 g), mixed treatment (*Carex* 5 g+bird droppings 5 g). A total of 105 decomposition bags were prepared.

3.2.3 Field Deployment and Sampling

Decomposition bags were deployed strictly according to the experimental design, placing 7 bags at each of the 5 points, covering all 3 treatments. During fixation, PVC pipes were used to secure the bags close to the ground, ensuring they did not shift or interfere with each other, while protecting the integrity of the native litter layer. Samples were scheduled for retrieval on the 5th, 15th, 30th, 60th, 90th, 120th, and 150th days after deployment. However, the experiment was terminated early due to flooding of the plots in June that year, leading to a drastic change in the hydrological background.

3.3 Laboratory Experiments

Retrieved decomposition bags were cleaned in the laboratory (removing soil, algae, etc.). *Carex* residues in the mixed treatment samples were separated. All samples were oven-dried at 60 ℃ to constant weight, and the residual dry weight was measured. Samples were ball-milled (particle size 0.06 μm) and sealed in numbered polyethylene bags for testing.

The content of lignin and cellulose was determined referring to the method by Zhang, *et al*.[29]. The total carbon and total nitrogen content in the samples were measured using an elemental analyzer (Vario Max CN, Elementar Analysensysteme GmbH, Germany). Total phosphorus content was determined by inductively coupled plasma optical emission spectrometry (ICP-OES, Optima 5300 DV, Perkin-Elmer, America).

3.4 Data Processing and Analysis

The sample residual rate was calculated using the following Equation[13]:

$$R_t = \frac{W_t}{W_0} \times 100\% \tag{1}$$

where, R_t represents the residual rate at time t, W_t and W_0 are the sample mass at time t and the initial mass, respectively, in grams (g), and t is the decomposition time in days (d).

The instantaneous decay rate (k) was calculated using the Olson negative exponential decay model:

$$W_t = W_0 e^{-kt} \tag{2}$$

Transformed to:

$$k = -\frac{1}{t} \times \ln \frac{W_t}{W_0} \tag{3}$$

where, k represents the instantaneous decomposition rate at time t, A larger k value indicates a faster decomposition rate.

Furthermore, the Relative Return Index (RRI) was introduced to assess the release or accumulation state of elements, calculated as:

$$RRI_t = \frac{W_0 \times C_0 - W_t \times C_t}{W_0 \times C_0} \times 100\% \quad (4)$$

where, C_t and C_0 represent the concentration of an element at time t and the initial time, respectively. For ease of expression, the RRI for total carbon, total nitrogen, and total phosphorus are denoted as CRRI, NRRI, and PRRI, respectively. A positive RRI value indicates net release of the element during decomposition, while a negative value indicates net accumulation.

4 Data Results

4.1 Dataset Composition

The dataset consists of sample site location information (.shp) and 1 Excel file. The Excel file includes 6 sheets, named Dry Matter, Lignin, Cellulose, Total Carbon, Total Nitrogen, and Total Phosphorus, respectively. These sheets contain monitoring data for these 6 indicators from 5 replicate samples on the 5th, 15th, 30th, 60th, 90th, 120th, and 150th days of the decomposition experiment, including measured values, mean values, and standard deviations. Detailed data descriptions for each indicator are shown in Table 2.

Table 2 Measured indicators and their statistics

Indicator	Calculated statistics			
Dry Matter	Residual Amount (g)	Residual Rate (%)	Instantaneous Decay Coefficient	Dry Matter
Lignin	Percentage of Dry Matter Residual Amount (%)	Residual Amount (g)	Instantaneous Decay Coefficient	Residual Rate (%)
Cellulose	Percentage of Dry Matter Residual Amount (%)	Residual Amount (g)	Instantaneous Decay Coefficient	Residual Rate (%)
Total Carbon	Percentage of Dry Matter Residual Amount (%)	Residual Amount (g)	Relative Return Index (%)	Total Carbon
Total Nitrogen	Percentage of Dry Matter Residual Amount (%)	Residual Amount (g)	Relative Return Index (%)	Total Nitrogen
Total Phosphorus	Percentage of Dry Matter Residual Amount (%)	Residual Amount (g)	Relative Return Index (%)	Total Phosphorus

4.2 Data Results

The initial contents of lignin, cellulose, total carbon, total nitrogen, and total phosphorus in the *Carex* and bird droppings samples are shown in Table 3. The dynamic changes in dry matter, lignin, cellulose, total carbon, total nitrogen, and total phosphorus during the decomposition process are shown in Figure 2.

Table 3 Initial content of lignin, cellulose, total carbon, total nitrogen, and total phosphorus in *Carex* and bird droppings samples

Indicator	*Carex* sample（n=6）		Bird droppings sample（n=6）	
	Mean	Standard deviation	Mean	Standard deviation
Total Carbon (%)	43.080^a	0.277	36.820^b	1.308
Total Nitrogen (%)	1.150^a	0.060	1.330^b	0.072
Total Phosphorus (‰)	0.970^a	0.019	2.440^b	0.093
Carbon/Nitrogen	37.460^a	0.001	27.680^b	0.001
Lignin (%)	8.040^a	0.328	4.890^b	0.425
Cellulose (%)	8.760^a	0.581	7.860^b	0.682

Note: Significant differences between means were tested using Tukey's Honest Significant Difference test. Different letters following the data indicate significant differences between the two sample types.

As shown in Figure 2a–2c, during the 5–150-d decomposition period, the residual rates of dry matter, lignin, and cellulose differed significantly among the 3 sample types (*Carex*, bird droppings, *Carex* in mixture). Throughout the decomposition process, the dry matter and lignin residual rates were always lowest for the *Carex* in the mixture, followed by pure *Carex*, and highest for bird droppings.

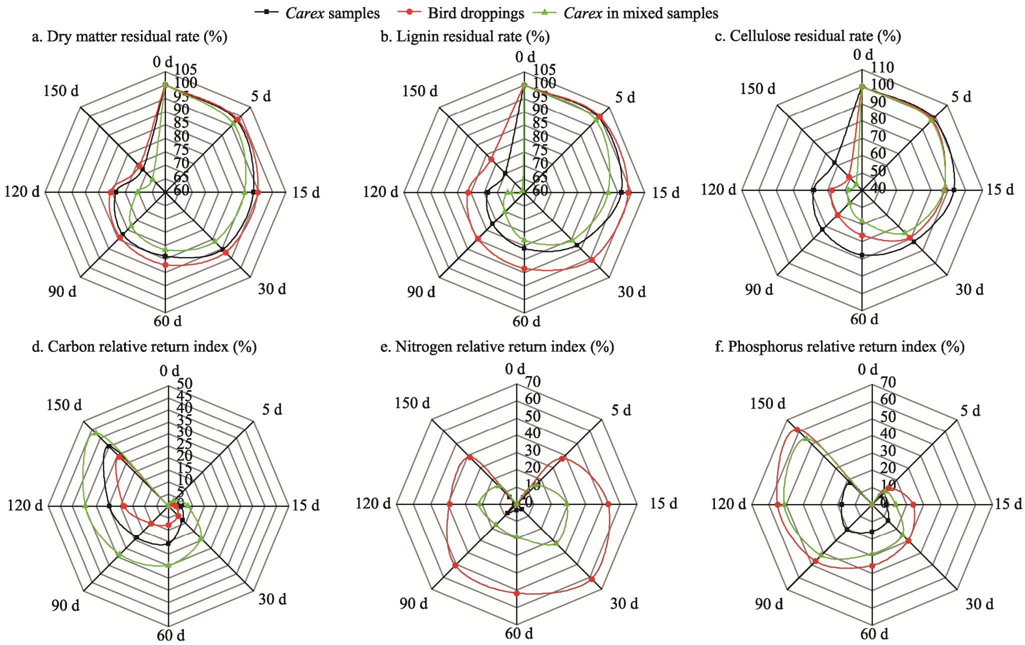

Figure 2 Dynamic changes in dry matter, lignin, cellulose, total carbon, total nitrogen, and total phosphorus during the decomposition of the three sample types

After 150 days of decomposition, the dry matter residual rate was: *Carex* in mixture (66.80%) < pure *Carex* (71.96%) < bird droppings (73.80%); the lignin residual rate was: *Carex* in mixture (61.03%) < pure *Carex* (69.97%) < bird droppings (77.40%). Throughout the decomposition process, the cellulose residual rate was always lowest for the *Carex* in the mixture, followed by bird droppings, and highest for pure *Carex*. After 150 days of decomposition, the cellulose residual rate was: *Carex* in mixture (44.54%) < bird droppings (50.83%) < pure *Carex* (62.53%).

The results of the decomposition experiment (5–150 days) showed (Figure 2d–2f) that the RRI for total carbon, total nitrogen, and total phosphorus differed dynamically among the 3 sample types. The release intensity of total carbon showed a clear hierarchical order: the lowest return index was for bird droppings, followed by pure *Carex*, and highest for the *Carex* in the mixture, a pattern that persisted throughout the decomposition stage. After 150 days of decomposition, the total carbon return index was: bird droppings (28.9%) < pure *Carex* (34.91%) < *Carex* in mixture (42.73%). Throughout the decomposition stage, the total nitrogen and total phosphorus return indices were always lowest for pure *Carex*, followed by the *Carex* in the mixture, and highest for bird droppings. After 150 days of decomposition, the total nitrogen return index was: pure *Carex* (17.96%) < *Carex* in mixture (53.95%) < bird droppings (61.63%); the total phosphorus return index was: pure *Carex* (5.7%) < *Carex* in mixture (14.65%) < bird droppings (38.48%).

5 Discussion and Conclusion

Based on the decomposition bag experiment and bird droppings addition test conducted from January to June 2017, authors systematically analyzed the decomposition characteristics of 3 sample types: *Carex* litter, bird droppings, and the *Carex*-droppings mixture. The study measured the residual amount, residual rate, and instantaneous decay coefficient of dry matter, lignin, and cellulose; simultaneously, it analyzed the percentage in dry matter, residual amount, and RRI of total carbon, total nitrogen, and total phosphorus. This dataset can be used to study the dynamics of carbon, nitrogen, and phosphorus release during the decomposition of droppings from herbivorous wintering waterbirds and typical beach wetland plant litter in Poyang Lake, as well as the impact of bird droppings addition on the decomposition process of *Carex* litter.

The research results indicate: (1) Bird droppings addition significantly promoted *Carex* decomposition. The residual rates and decomposition rates of dry matter, cellulose, and lignin of *Carex* litter and that in the mixture showed extremely significant differences. Throughout the decomposition process, the residual rate of *Carex* in the mixture was always lower than that of the single *Carex* sample, while the decomposition rate was always higher, indicating that bird droppings addition had a continuous and significant promoting effect on *Carex* decomposition. (2) Element release patterns and return. Carbon, nitrogen, and phosphorus elements overall exhibited a net release pattern. The carbon, nitrogen, and phosphorus return indices for the *Carex* in the mixture were significantly higher than those for the single *Carex* sample, indicating that bird droppings addition also significantly promoted the release and return of nutrient elements from *Carex*. (3) Analysis of promotion mechanisms. The addition of bird droppings likely promotes the decomposition of cellulose and lignin in *Carex* litter by altering the original component ratio of the litter, increasing nutrient availability in the environment, enhancing microbial colonization capacity, and stimulating the production of extracellular degrading enzymes[20,21].

This dataset deepens the understanding of the wetland plant litter decomposition process, and helps elucidate the ecological role of wintering waterbirds in wetland litter decomposition and carbon, nitrogen, and phosphorus cycling, and provides a scientific basis and data support for optimizing habitat restoration and wetland management strategies for waterbirds in Poyang Lake.

Author Contributions

Zhang. Q. J. designed and implemented the field experiment, was responsible for sample collection, laboratory analysis, data processing, and data paper writing; Xia, S. X. and Duan, H. L. guided and assisted in the field experiment design and sample collection; Wu, D. L. guided data quality control and data paper writing; Yu, X. B. provided overall design for the dataset development, and guided and supervised the experiment implementation.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Berg, B., Mcclaugherty, C. Plant Litter: Decomposition, Humus Formation, Carbon Sequestration [M]. New York: Springer Berlin Heidelberg, 2014.

[2] Górski, A., Błońska, E., Lasota, J. Decomposition rate and property changes of deadwood across an altitudinal gradient: a case study in the Babia Góra Massif, Poland [J]. *Scientific Reports*, 2025, 15(1): 28160. https://doi.org/10.1038/s41598-025-14019-7.

[3] Matthews, E., Fung, I. Methane emission from natural wetlands: global distribution, area, and environmental characteristics of sources [J]. *Global Biogeochemical Cycles*, 1987, 1(1): 61–86.

[4] Roehm, C. Respiration in Wetland Ecosystems [M]. New York: Oxford University Press, 2005.

[5] Yang, T. W., Sun, J. J., Li, Y. F., *et al*. Impact of climate-induced water-table drawdown on carbon and nitrogen sequestration in a *Kobresia*-dominated peatland on the central Qinghai-Tibetan Plateau [J].

Communications Earth & Environment, 2025, 6: 188. https://doi.org/10.1038/s43247-025-02168-6.
[6] Xiong, S. J., Christer, N. The effects of plant litter on vegetation: a meta-analysis [J]. *Journal of Ecology*, 1999, 87(6): 984–994.
[7] William, D., Reddy, K. Litter decomposition and nutrient dynamics in a phosphorus enriched Everglades Marsh [J]. *Biogeochemistry*, 2005, 75(2): 217.
[8] Davis, S., Corronado-molina, C., Childers, D., *et al*. Temporally dependent C, N, and P dynamics associated with the decay of rhizophora mangle L. leaf litter in oligotrophic mangrove wetlands of the Southern Everglades [J]. *Aquatic Botany*, 2003, 75(3): 199–215.
[9] Schwarz, W. H. The cellulosome and cellulose degradation by anaerobic bacteria [J]. *Applied Microbiology and Biotechnology*, 2001, 56(5): 634.
[10] Berg, B., Laskowski, R. Litter fall [J]. *Advances in Ecological Research*, 2005, 38(38):19–71.
[11] Swift, M., Heal, O., Anderson, J. Decomposition in Terrestrial Ecosystems [M]. Oxford: Blackwell Scientific, 1979.
[12] Pauly, M., Keegstra, K. Cell-wall carbohydrates and their modification as a resource for biofuels [J]. *The Plant Journal*, 2008, 54(4): 559–568.
[13] Zhang, Q. J., Yu, X. B., Hu, B. H. Study on the distribution characteristics of plant communities in the Nanji Wetland of Poyang Lake [J]. *Resources Science*, 2013, 35(1): 42–49.
[14] Guan, L., Wen, L., Feng, D. D., *et al*. Delayed flood recession in central Yangtze floodplains can cause significant food shortages for wintering geese: results of Inundation experiment [J]. *Environmental Management*, 2014, 54(6): 1331–1341.
[15] Xia, S. X., Liu, G. H., Yu, X. B., *et al*. Habitat evaluation for wintering waterbirds in Poyang Lake [J]. *Journal of Lake Sciences*, 2015, 27(4): 719–726.
[16] Tu, Y. G., Yu, C. H., Huang, X. F., *et al*. Distribution and quantity of wintering geese and ducks in Poyang Lake region [J]. *Acta Agriculturae Universitatis Jiangxiensis*, 2009, 31(4): 760–764+771.
[17] Manny, B., Johnson, W., Wetzel, R. Nutrient additions by waterfowl to lakes and reservoirs: predicting their effects on productivity and water quality [J]. *Hydrobiologia*, 1994, 279–280(1): 121–132.
[18] Chaichana, R., Leah, R., Moss, B. Birds as eutrophicating agents: a nutrient budget for a small lake in a protected area [J]. *Hydrobiologia*, 2010, 646(1): 111–121.
[19] Hahn, S., Bauer, S., Klaassen, M. Quantification of allochthonous nutrient input into freshwater bodies by herbivorous waterbirds [J]. *Freshwater Biology*, 2010, 53(1): 181–193.
[20] Zhang, Q. J., Zhang, G. S., Wan, S. X., *et al*. Effects of droppings from herbivorous wintering waterbirds on decomposition process and carbon, nitrogen, phosphorus release of *Carex* litter in beach wetland of Poyang Lake [J]. *Journal of Lake Sciences*, 2019, 31(3): 814–824.
[21] Zhang, Q. J., Zhang, G. S., Yu, X. B., *et al*. How do droppings of wintering waterbird accelerate decomposition of *Carex cinerascens* Kükenth. litter in seasonal floodplain Ramsar Site? [J]. *Wetlands Ecology and Management*, 2021, 29(4): 581–597. DOI: 10.1007/s11273-021-09804-w.
[22] Zhang, Q. J., Xia, S. X., Wu, D. L., *et al*. Dataset of Poyang Lake herbivorous wintering waterbird droppings and *Carex cinerascens* Kükenth. decomposition [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2025. https://doi.org/10.3974/geodb.2025.09.02.V1.
[23] GCdataPR Editorial Office. GCdataPR data sharing policy [OL]. https://doi.org/10.3974/dp.policy.2014.05 (Updated 2017).
[24] Liu, X. Z., Hu, B. H. Comprehensive Scientific Survey of Jiangxi Nanjishan Wetland Nature Reserve [M]. Beijing: China Forestry Publishing House, 2005.
[25] Editorial Committee of "Poyang Lake Research". Poyang Lake Research [M]. Shanghai: Shanghai Science and Technology Press, 1988.
[26] Wang, Y. Y., Yu, X. B., Zhang, L., *et al*. Seasonal variability in baseline δ^{15}n and usage as a nutrient indicator in Lake Poyang, China [J]. *Journal of Freshwater Ecology*, 2013, 28(3): 365–373.
[27] Zhang, Q. J., Yu, X. B., Qian, J. X., *et al*. Distribution characteristics of dominant plant communities and soil organic matter and nutrients in the Nanji Wetland of Poyang Lake [J]. *Acta Ecologica Sinica*, 2012, 32(12): 3656–3669.
[28] Zhang, Q. J., Yu, X. B., Zhang, G. S. Decomposition process and carbon and nitrogen isotope fractionation characteristics of litter from three dominant plants in Poyang Lake wetland [J]. *Journal of Lake Sciences*, 2023, 35(5): 1694–1704.
[29] Zhang, G. S., Yu, X. B., Xu, J. Effects of environmental variation on stable isotope abundances during typical seasonal floodplain dry season litter decomposition [J]. *Science of the Total Environment*, 2018, 630(1): 1205–1215.