Data Article

Data exploration on diet, and composition, energy value and functional division of prey items ingested by White Storks *Ciconia ciconia* in south-western Poland: Dietary variation due to land cover, reproductive output and colonial breeding

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**Abstract**

The dataset presented in this data paper supports “Linking land cover satellite data with dietary variation and reproductive output in an opportunistic forager: Arable land use can boost an ontogenetic trophic bottleneck in the White Stork *Ciconia ciconia*” (Orłowski et al. 2019) [1]. Analysis of data on diet and prey composition based on an investigation of 165 pellets of White Storks *Ciconia ciconia* sampled from 52 nests showed that their diet was based primarily on ‘eurytopic prey’ (embracing taxa from grassland and a variety of non-cropped habitats), the biomass contribution of which in the diet was disproportionately (3–4-fold)
higher than the percentage of available corresponding habitats. Similarly, prey items from water/wetland sites prevailed over the availability of corresponding habitats. The opposite pattern characterized prey taxa from arable habitats and forests, the contribution of which was lower than the availability of the corresponding habitats. The total energy content per pellet (calculated by summing the energy content of all individual prey items across one specific prey group) was the most strongly correlated with the biomass of Orthoptera, thereafter with that of mammals, other vertebrates, earthworms and other invertebrates, but not with the biomass of Coleoptera. White Storks from nests of low productivity pairs (i.e. with 1–2 fledglings) consumed a significantly (up to two-fold) higher biomass of Coleoptera, Orthoptera and all invertebrates, which also translated into a higher total biomass and a higher total energy content compared to the diet of high-productivity pairs (i.e. with 3–4 fledglings). Our data, in particular those relating to energy content in a variety of invertebrate taxa, and their body mass and functional division in terms of habitat preferences should be useful for other researchers to calculate energy budgets of predatory animals living in agricultural landscapes in Europe.

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Specifications table

| Subject area          | Ecology, Biological Sciences |
|-----------------------|------------------------------|
| More specific subject area | Foraging and Dietary Ecology |
| Type of data          | Tables and Figures           |
| How data was acquired | Through field work and laboratory work |
| Data format           | Raw, filtered and analysed   |
| Experimental factors  | Investigation of 165 pellets of White Storks Ciconia ciconia sampled from 52 nests in June and July 2012 in 39 villages in south-western Poland. |
| Experimental features | The identification of each prey items consumed along with their dry weights and eco-morphological characteristics: energy content (expressed in kJ) and functional division in terms of habitat preferences. |
| Data source location  | Turew, SW Poland, Research Station of Institute of Agricultural and Forest Environment, Polish Academy of Sciences |
| Data accessibility    | The data are given in this article |
| Related research article | G. Orłowski, J. Karg, L. Jerzak, M. Bocheński, P. Profus, Z. Książkiewicz-Parul ska, K. Zub, A. Ekner-Grzyb, J. Czarnecka, Linking land cover satellite data with dietary variation and reproductive output in an opportunistic forager: Arable land use can boost an ontogenetic trophic bottleneck in the White Stork Ciconia ciconia. Sci. Tot. Environ. 646 (2019) 491–502. |
**Value of the data**

- The data presents the functional classification of prey items into four major habitat categories: (i) arable, (ii) grassland/non-cropped (= marginal habitats = eurytopic prey), iii) forest; and iv) water/wetland and could be used by others researchers.
- For each prey taxa the data on energy content based on ash-free dry mass is given and this data could be re-used in other studies.
- The data in this article, in particular those on energy content in a variety of invertebrate taxa, and their body mass and functional division in terms of habitat preferences, should be useful for other researchers to calculate energy budgets of predatory animals.

1. **Data**

The data presented here were the basis for the article by Orłowski et al. [1]. The dataset of this article provides detailed information on dietary composition of 165 pellets of White Storks collected in June and July 2012 from 52 nests in 39 villages in south-western Poland (Figs. 1–4, Tables 1–5). The data describes basic dietary indices relating to prey items consumed, including the biomass contribution of invertebrate and vertebrate prey (Figs. 2 and 3, Tables 1–5).

The average mass of one individual prey item calculated across all identified prey (n = 20 561; Table 2) was 286 mg (95% C.I. = 269–302 mg), while the average mass of one individual prey item per pellet (n = 165) and per nest (n = 52) was 445 mg (95% C.I. = 384–510 mg) and 399 mg (95% C.I. = 335–462 mg), respectively. The total biomass (dry mass) of all prey consumed was 5869 g (Table 2).

1.1. **Data on overall diet composition and prey composition in White Storks**

The most numerous prey group both by number and biomass was Orthoptera (59.5% and 35.6%, respectively). The following ranking for invertebrate prey items in descending order of their quantitative contribution to the diet was: earthworms (19.5% by number and 16.4% by biomass), Coleoptera (16.2% and 7.3%) and other invertebrates (3.5% and 0.4%). Small mammals and other vertebrates (i.e. fish, reptiles and birds) constituted only 0.7% and 0.6% of all prey items consumed, but the contribution of their biomass was disproportionately high at 24.8% and 15.2%, respectively (Table 2).

With regard to the functional division of prey, the diet of White Storks was based primarily on ‘eurytopic prey’ (embracing taxa from grassland and a variety of non-cropped habitats), the biomass contribution of which in the diet was disproportionately (3–4-fold) higher than the percentage of available corresponding habitats (Fig. 2). Similarly, the prey from water/wetland sites prevailed over the availability of corresponding habitats (Fig. 2). The opposite pattern characterized prey taxa from arable habitats and forests, the contribution of which was lower than the availability of the corresponding habitats (Fig. 2).

On average (confidence interval = C.I.) per 1 nest (n = 52), invertebrate prey and vertebrate prey respectively made up 58% (95% C.I. = 52–64%) and 42% (95% C.I. = 36–48%) of the biomass consumed.

The total energy content per pellet (calculated by summing the energy content of all individual prey items across one specific prey group) was the most strongly correlated with the biomass of Orthoptera (Pearson r = 0.801, P < 0.0001), thereafter with that of mammals (r = 0.361, P < 0.0001), other vertebrates (r = 0.234, P = 0.002), earthworms (r = 0.214, P = 0.006) and other invertebrates (r = 0.181, P = 0.020), but not with the biomass of Coleoptera (r = 0.024, P = 0.756) (see also Table 3).

Across the 52 nests analysed the diet was based primarily on prey items attributed to the grassland/non-cropped habitat category collectively referred to as ‘eurytopic prey’, and their biomass contribution to the diet was significantly (indexed via the t-test) – 3–4-fold – and disproportionately higher than the percentage of available corresponding habitats at each of the three distances (1 km, 15 km, 25 km).
Fig. 1. (A) General map showing the distribution of 52 nests (black dots) of White Storks clustered within five sub-plots (between 373 and 764 km² in area) in south-western Poland where pellets were sampled for dietary analysis; (2) border of five subplots, (3) forest, (4) water/hydrographic network, (5) other land cover types. (B) The land cover types representing the class 3 of the Corine Land Cover classification. (C) The hydrographic networks around the sub-sample of nests, a circle of 1 km radius. (D) Land use around a nest of a high-productivity pair with three fledglings at the time the young were ringed (Photo credit: Adam Dmoch/www.birdwatching.pl). (E) An adult foraging on earthworms (Photo credit: Marcin Lenart/www.birdwatching.pl).
2.5 km and 5 km) around the nests (Fig. 2). Similarly, the contribution of prey items from water/wetland sites prevailed significantly –2–5-fold – over the availability of corresponding habitats (Fig. 2). The opposite pattern characterized prey taxa from arable habitats, the contribution of which was markedly –3–5-fold – lower than the availability of corresponding habitats. Lastly, the contribution of the prey category attributed to forest habitats was similar to that of the availability of these habitats measured at the distance of 1 km around nests, but was significantly –2–3-fold – lower than the availability of forests at the other two distances (Fig. 2).

MANOVA revealed significant differences in dietary composition in terms of the biomass of the six major prey groups (earthworms, Orthoptera, Coleoptera and other invertebrates, other vertebrates and mammals) identified in the 52 nests (MANOVA, Wilks’s Lambda, $\lambda_{306,653} = 0.007, P < 0.0001$). However, further post-hoc analysis (yielding a matrix with 1 326 comparisons between pairs of nests for each individual prey group) confirmed that the contribution of two prey groups – small mammals and other invertebrates – did not differ between any pairs of nests, indicating similar exploitation of these prey resources across the entire landscape in which our White Stork population foraged. The biomass contribution of the other four prey groups varied between different nests with variable magnitude. So, the negligible variations between nests observed in the case of biomasses of Coleoptera, other vertebrates and earthworms, which varies significantly merely between 3, 5 and 12 pairs of nests, respectively. The most variable contribution was that of the biomass of Orthoptera, which varied between 55 pairs (from all 1326 possible comparisons) of nests.

The variations in biomass of the major prey groups and individual prey mass for different contributions of grassland and arable land measured within three spatial scales around the nests are visualized in Fig. 3.
Fig. 3. Biomasses of five major prey groups (earthworms; Coleoptera; Orthoptera; other vertebrates; and mammals) and individual prey mass per pellet (n = 165) compared for three spatial scales (extent/radius: 1 km, 2.5 km and 5 km) around White Stork nests and varying in percentages of grassland and arable land.
1.2. Data on reproductive output in relation to colonial breeding and habitat variation

On average, the number of fledglings in solitary nests \((n = 36)\) was nearly 14% higher than in nests with a clumped distribution \((n = 16)\): 2.69 (95% C.I. = 2.45–2.93) vs 2.37 (95% C.I. = 2.04–2.70), respectively; however, this difference was not significant (Mann-Whitney test, \(Z = 1.46, P = 0.145\)), presumably because of the small sample size. This result may be explained in part by the fact that there is significantly less %arable land (within 1 km and 2.5 km) around solitary nests than in the vicinity of clumped nests; in contrast, %grassland was higher and there were more aquatic habitats (mostly within 2.5 km and 5 km) around the clumped nests (Table 4).

MANOVA did not show any significant effect \((P \leq 0.251)\) of the percentage distribution of the eleven land cover types (Fig. 4) or four major habitat categories used for prey classification (i.e. certain land cover types combined; Fig. 2) influencing the number of nestlings in the nest. However, inspection of the distribution of the percentage of the four major land cover types around nests with different numbers of fledglings yielded a single, clear pattern: this tallied only in part with our initial prediction. So, %arable land consistently decreased with the number of fledglings across all three distances (1, 2.5 and 5 km) around nests, whereas %forest exhibited the opposite pattern, this percentage increasing along with the number of fledglings (Fig. 4). Furthermore, we found that in
principle, there were no differences between the nests of low productivity pairs (1–2 fledglings) and those of high productivity pairs (3–4 fledglings) in any of the landscape traits analysed (Table 4).

We found marginally significant differences (both at $P = 0.08$) for two dietary indices, the biomasses of five major prey groups and number of prey taxa, between nests with different numbers of fledglings (Table 5, Fig. 4).

White Storks from the nests of low productivity pairs (i.e. with 1–2 fledglings) consumed a significantly (up to two-fold) higher biomass of Coleoptera, Orthoptera and all invertebrates, which also translated into a higher total biomass and a higher total energy content compared to the diet of high-productivity pairs (Table 5).

2. Experimental design, materials and methods

As the majority of nestling mortality occurs during the first 20 days after hatching [2–4], we considered the number of fledglings present in a nest at the time of ringing to be a proxy of the productivity of a breeding pair of White Storks (hereafter ‘reproductive output’).

The estimates of earthworm biomass were based on a soil mass of 192 mg per 1000 chaetae (for more details see also Orłowski et al. [5]). For each pellet, the number of prey items representing each invertebrate taxon was established from the numbers of fragments of chitinous body parts (according to [6,7]). Here, we added two new eco-morphological characteristics for each individual prey item: (1) energy content (expressed in kJ) and (2) functional division in terms of habitat preferences (Table 2). The energy content (ash-free dry mass, AFDM) in prey items of White Storks (see Table 2) followed [8,9], where previous data for specific (or related) prey taxa were used (after [10–14]).

Table 1

| Major land cover types (class 2 of the Corine Land Cover classification) | Distance around nests (total area within a given distance) |
|---|---|
| Land cover type, hydrographic trait | Class 2 of Corine Land Cover classification | 1 km (314.1 ha) | 2.5 km (1931.4 ha) | 5 km (7725.4 ha) |
| Urban fabric (ha) | 11 | 27.90 (± 3.47) | 67.53 (± 10.41) | 337.64 (± 27.91) |
| Industrial, commercial and transport units (ha) | 1.2 | 0 | 3.90 (± 1.88) | 123.02 (± 21.92) |
| Mine, dump and construction sites (ha) | 1.3 | 2.09 (± 1.71) | 6.74 (± 3.70) | 41.64 (± 7.63) |
| Artificial non-agricultural vegetated areas (ha) | 1.4 | 0.15 (± 0.15) | 14.25 (± 3.17) | 7752 (± 16.47) |
| Arable land (ha) | 2.1 | 188.3 (± 12.2) | 915.4 (± 57.7) | 2849.9 (± 184.1) |
| Grassland, pasture (ha) | 2.3 | 35.9 (± 6.0) | 248.9 (± 27.0) | 875.7 (± 74.3) |
| Heterogeneous agricultural areas (ha) | 2.4 | 7.57 (± 2.30) | 88.24 (± 9.06) | 280.33 (± 17.57) |
| Forests (ha) | 2.5 | 49.6 (± 8.8) | 534.0 (± 59.3) | 2894.6 (± 187.6) |
| Shrub and/or herbaceous vegetation associations (ha) | 3.2 | 1.34 (± 0.75) | 11.74 (± 3.44) | 96.19 (± 11.43) |
| Inland wetlands (ha) | 4.1 | 0 | 0.45 (± 0.33) | 10.23 (± 4.50) |
| Inland waters (ha) | 5.1 | 1.25 (± 0.64) | 40.17 (± 5.60) | 138.25 (± 14.18) |
| Watercourses (m) | – | 9859.6 | 52,118.6 | 164,602.7 |
| Shoreline of water bodies (m) | – | 1994.4 | 16,103.7 | 57922.6 |
| Inland waters and large rivers (ha) | – | 3.40 (± 0.92) | 53.68 (± 6.59) | 199.76 (± 20.15) |
List of all the prey items (n = 20,561) representing six major prey groups (earthworms; Orthoptera; Coleoptera; other invertebrates; fish, reptiles and birds = other vertebrates; and mammals) taken by breeding White Storks *Ciconia ciconia* and identified in 165 pellets sampled in south-western Poland in 2012; individual dry masses of insects and certain invertebrates after and Karg, unpubl; estimate of earthworms consumed from [5]. The habitat preferences of the prey taxa are based on extensive ecological studies on various invertebrate groups carried out in the study area since 1960. (following:) non (non-agricultural/eurytopic including grassland), arable, wet (wetland/water), for (forest). (A) For sources of information on energy content based on ash-free dry mass (AFDM; 18–22), see also the bottom of the table.

| Prey group/taxa | Habitat preference | Number of pellets in which a prey taxon was present | Total number of prey items | Individual dry mass (mg) | Energy content per individual (kJ) |
|-----------------|--------------------|---------------------------------------------------|---------------------------|--------------------------|----------------------------------|
| **EARTHWORMS**  |                    |                                                   |                           |                          |                                  |
| *Lumbricidae* sp. | non                | 152                                               | c. 4004                   | 240                      | 4.76 a                           |
| **ORTHOPTERA**   |                    |                                                   |                           |                          |                                  |
| *Chorthippus* sp. | non                | 139                                               | 6066                      | 40.6                     | 0.91                             |
| *Metrioptera*     | non                | 138                                               | 5360                      | 134.6                    | 3.03                             |
| *Tettigonia* sp.  | non                | 96                                                | 760                       | 1498.3                   | 32.74                            |
| *Gryllus* campestris | non           | 38                                                 | 49                        | 81.2                     | 1.83                             |
| *Gryllotalpa* gryllotalpa | non | 8                                                  | 11                        | 90.0                     | 2.02                             |
| Orthoptera sp.    | non                | 1                                                  | 1                         | 85.5                     | 1.87                             |
| **COLEOPTERA**    |                    |                                                   |                           |                          |                                  |
| *Silpha* sp.      | non                | 108                                               | 545                       | 26.0                     | 0.60                             |
| *Geotrupes* sp.   | non                | 136                                               | 452                       | 156.1                    | 3.61                             |
| *Pterostichus* sp.| non                | 124                                               | 366                       | 54.2                     | 1.25                             |
| *Silpha* obscura  | non                | 46                                                | 261                       | 42.0                     | 0.97                             |
| *Carabus* cancelatus | non           | 117                                               | 227                       | 125.8                    | 2.91                             |
| *Poecilus* sp.    | arable             | 86                                                 | 188                       | 26.1                     | 0.60                             |
| *Hydrochara* caraboides | wet    | 62                                                 | 138                       | 29.0                     | 3.61                             |
| *Coleoptera* sp.  | wet                | 62                                                 | 128                       | 10.0                     | 0.23                             |
| *Zabrus* tenebrioides | wet            | 6                                                   | 116                       | 63.0                     | 0.20                             |
| *Amphimallon* solstitialis | non | 20                                                  | 92                        | 225                      | 5.21                             |
| *Rhanthus* sp.    | wet                | 54                                                 | 70                        | 58.7                     | 1.36                             |
| *Elateridae* (larvae) | non        | 12                                                  | 60                        | 6.0                      | 0.15                             |
| *Selatosomus* sp. | arable             | 35                                                 | 53                        | 21.0                     | 0.49                             |
| *Ophonus* sp.     | arable             | 37                                                 | 48                        | 8.5                      | 0.20                             |
| *Agriotes* sp.    | arable             | 35                                                 | 42                        | 9.7                      | 0.22 a                           |
| *Cetonia* sp.     | arable             | 32                                                 | 41                        | 91.5                     | 2.12                             |
| *Amara* sp.       | arable             | 25                                                 | 33                        | 8.5                      | 0.20                             |
| *Curculionidae*   | arable             | 21                                                 | 31                        | 2.8                      | 0.06                             |
| *Agabus* sp.      | wet                | 23                                                 | 29                        | 17.0                     | 0.39 a                           |
| *Calathus* sp.    | wet                | 16                                                 | 28                        | 17.0                     | 0.39                             |
| *Phyllopertha* sp.| arable             | 6                                                  | 22                        | 17.4                     | 0.40                             |
| *Staphylinus* sp. | arable             | 16                                                 | 20                        | 32.8                     | 0.76                             |
| *Bembidion* sp.   | arable             | 12                                                 | 17                        | 1.2                      | 0.03                             |
| *Histeridae*      | non                | 5                                                  | 17                        | 3.9                      | 0.09                             |
| *Otiorrhynchus* sp.| arable             | 16                                                 | 17                        | 37.3                     | 0.86                             |
| *Carabus auratus* | non                | 16                                                 | 16                        | 125.8                    | 2.91                             |
| *Carabus violaceus* | for              | 14                                                 | 14                        | 133.7                    | 3.09                             |
| *Trax* sp.        | non                | 7                                                  | 13                        | 30.1                     | 0.70                             |
| *Colymbetes* sp.  | arable             | 8                                                  | 11                        | 9.7                      | 0.22                             |
| *Necrophorus* sp. | non                | 10                                                 | 11                        | 265.9                    | 6.15                             |
| *Chrysomelidae*   | non                | 8                                                  | 10                        | 7.2                      | 0.17                             |
| *Sitona* sp.      | arable             | 10                                                 | 10                        | 4.7                      | 0.11                             |
| *Elateridae*      | non                | 5                                                  | 9                         | 13.8                     | 0.32                             |
| *Helophorus* sp.  | wet                | 9                                                  | 9                         | 0.3                      | 0.01                             |
| *Hydrous* piceus   | wet                | 6                                                  | 9                         | 1293                     | 16.62                            |
| *Selatosomus* latus| arable            | 7                                                  | 9                         | 9.7                      | 0.22                             |
| *Staphylinidae*   | non                | 8                                                  | 9                         | 1.8                      | 0.04                             |
| *Staphylinus* cesareus | non     | 7                                                  | 8                         | 10.0                     | 0.23                             |
| *Ceurorrhynchus* sp.| arable            | 6                                                  | 7                         | 0.8                      | 0.02                             |
| *Philonthus* sp.  | arable             | 7                                                  | 7                         | 1.4                      | 0.03                             |
| *Cicindella* sp.  | for                | 5                                                  | 6                         | 8.5                      | 0.20                             |
| *Hydrophilidae*   | wet                | 3                                                  | 6                         | 1.0                      | 0.02                             |
| Prey group/taxa | Habitat preference in which a prey taxon was present | Number of pellets | Total number of prey items | Individual dry mass (mg) | Energy content per individual (kJ) |
|-----------------|------------------------------------------------------|------------------|---------------------------|-------------------------|----------------------------------|
| Typhaeus typhoeus | for | 4 | 6 | 156.1 | 3.61 |
| Anomala sp. | arable | 4 | 5 | 40.2 | 0.93 |
| Carabus coriaceus | for | 4 | 5 | 1099 | 25.43 |
| Coleoptera (larvae) | non | 4 | 5 | 6.0 | 0.15 |
| Dorcus parallelipipedus | for | 5 | 5 | 251.6 | 5.81 |
| Buprestidae | non | 3 | 4 | 5.4 | 0.12 |
| Coccinella septempunctata | non | 4 | 4 | 13.7 | 0.32 |
| Hydaticus sp. | wet | 3 | 4 | 13.7 | 0.32 |
| Hydroporus sp. | wet | 3 | 4 | 13.7 | 0.32 |
| Onthophagus sp. | non | 3 | 4 | 9.7 | 0.22 |
| Phyllobius sp. | arable | 3 | 4 | 3.7 | 0.08 |
| Apion sp. | arable | 3 | 3 | 0.5 | 0.01 |
| Catops sp. | non | 1 | 3 | 1.1 | 0.03 |
| Coreus marginatus | non | 3 | 3 | 37.2 | 0.86 |
| Cryptopleurum sp. | non | 3 | 3 | 0.5 | 0.01 |
| Cytilus sericeus | non | 3 | 3 | 5.2 | 0.12 |
| Dytiscidae (larvae) | wet | 3 | 3 | 6.0 | 0.15 |
| Dytiscus (larvae) | wet | 3 | 3 | 12.0 | 0.29 |
| Hydrobius sp. | wet | 3 | 3 | 0.3 | 0.01 |
| Liparus sp. | for | 3 | 3 | 119.1 | 2.76 |
| Ontholestes sp. | non | 2 | 3 | 16.1 | 0.37 |
| Oxytelus sp. | arable | 2 | 3 | 0.3 | 0.01 |
| Prosternon tessellatum | non | 3 | 3 | 48.0 | 1.11 |
| Silphidae | non | 1 | 3 | 145.9 | 3.38 |
| Carabus sp. | non | 2 | 2 | 125.8 | 2.91 |
| Cassida sp. | non | 2 | 2 | 12.0 | 0.28 |
| Cercyon sp. | arable | 2 | 2 | 1.1 | 0.03 |
| Dytiscus sp. | wet | 2 | 2 | 551 | 12.75 |
| Hister sp. | non | 2 | 2 | 7.0 | 0.16 |
| Lathrobius sp. | non | 2 | 2 | 1.6 | 0.04 |
| Oulema melanopus | arable | 2 | 2 | 3.4 | 0.08 |
| Propylaea 14-punctata | non | 2 | 2 | 3.2 | 0.07 |
| Psyllodes chrysoscelpha | arable | 2 | 2 | 1.8 | 0.04 |
| Scarabaeeidae | non | 2 | 2 | 84.8 | 1.96 |
| Spondylis buprestoides | for | 2 | 2 | 125.8 | 2.91 |
| Acilus sp. | non | 1 | 1 | 125.8 | 2.91 |
| Anthicus sp. | non | 1 | 1 | 0.5 | 0.01 |
| Aphodius sp. | arable | 1 | 1 | 6.7 | 0.16 |
| Carabidae | non | 1 | 1 | 23.6 | 0.55 |
| Chaetocnema sp. | arable | 1 | 1 | 0.9 | 0.02 |
| Chalcophora mariana | for | 1 | 1 | 572.8 | 13.25 |
| Coccinellidae | non | 1 | 1 | 4.4 | 0.10 |
| Corticarina sp. | non | 1 | 1 | 0.2 | 0.005 |
| Curculio sp. | non | 1 | 1 | 37.3 | 0.86 |
| Dytiscidae | wet | 1 | 1 | 12.0 | 0.28 |
| Glischrichius sp. | non | 1 | 1 | 4.5 | 0.10 |
| Graphoderes sp. | arable | 1 | 1 | 73.6 | 1.70 |
| Hydaticus sp. | wet | 1 | 1 | 13.7 | 0.32 |
| Hydrophilidae (larvae) | wet | 1 | 1 | 1.0 | 0.30 |
| Hylobius sp. | arable | 1 | 1 | 37.3 | 0.86 |
| Malachius sp. | non | 1 | 1 | 2.2 | 0.05 |
| Necrodes sp. | non | 1 | 1 | 265.9 | 6.15 |
| Nitidulidae | arable | 1 | 1 | 1.5 | 0.03 |
| Oryctes nasicornis | for | 1 | 1 | 1145.6 | 26.51 |
| Potamonectes sp. | wet | 1 | 1 | 8.5 | 0.20 |
| Protaetia aeruginosa | non | 1 | 1 | 440 | 10.18 |
| Tenebrio laticollis | non | 1 | 1 | 8.5 | 0.20 |
| Xylodrepa sp. | non | 1 | 1 | 26.0 | 0.60 |
| Prey group/taxa          | Habitat preference | Number of pellets in which a prey taxon was present | Total number of prey items | Individual dry mass (mg) | Energy content per individual (kJ) |
|-------------------------|--------------------|-----------------------------------------------------|-----------------------------|--------------------------|-----------------------------------|
| **OTHER INVERTEBRATES** |                    |                                                     |                             |                          |                                   |
| Lasius sp.              | non                | 81                                                  | 316                         | 0.6                      | 0.014                             |
| Ichneumonidae           | non                | 34                                                  | 57                          | 2.4                      | 0.06                              |
| Coreus sp.              | non                | 31                                                  | 46                          | 37.2                     | 0.86                              |
| Myrmica sp.             | non                | 25                                                  | 46                          | 1.2                      | 0.03                              |
| Forficula sp.           | non                | 21                                                  | 40                          | 11.7                     | 0.27                              |
| Mollusca                | non                | 32                                                  | 33                          | 200                      | 3.56                              |
| Lepidoptera (larvae)    | non                | 23                                                  | 28                          | 8.2                      | 0.20                              |
| Diptera (larvae)        | non                | 10                                                  | 19                          | 5.5                      | 0.12                              |
| Araneae                 | non                | 11                                                  | 13                          | 4.3                      | 0.10                              |
| Nabis sp.               | non                | 9                                                   | 11                          | 2.0                      | 0.05                              |
| Formica sp.             | non                | 7                                                   | 11                          | 1.2                      | 0.03                              |
| Odonata: Zygoptera     | wet                | 6                                                   | 10                          | 137.6                    | 3.13                              |
| Nematoda                | non                | 4                                                   | 9                           | 3.0                      | 0.06                              |
| Aelia acuminata         | arable             | 8                                                   | 8                           | 14.3                     | 0.33                              |
| Tentredinimidae         | non                | 6                                                   | 8                           | 9.6                      | 0.22                              |
| Eurygaster maura       | arable             | 5                                                   | 7                           | 36.3                     | 0.84                              |
| Insecta (larvae)        | non                | 4                                                   | 6                           | 10.0                     | 0.24                              |
| Dolicoris sp.           | non                | 6                                                   | 6                           | 26.6                     | 0.61                              |
| Pentatomimidae          | arable             | 4                                                   | 6                           | 26.2                     | 0.62                              |
| Viviparus viviparus    | wet                | 3                                                   | 3                           | 350                      | 6.23                              |
| Heteroptera             | non                | 3                                                   | 3                           | 2.0                      | 0.05                              |
| Diplodopa              | non                | 2                                                   | 2                           | 66.8                     | 1.55                              |
| Chartoscirta sp.       | wet                | 2                                                   | 2                           | 0.8                      | 0.02                              |
| Apidae                 | non                | 2                                                   | 2                           | 19.8                     | 0.45                              |
| Apoidea                | non                | 2                                                   | 2                           | 19.8                     | 0.45                              |
| Bombus sp.             | non                | 2                                                   | 2                           | 50.7                     | 1.15                              |
| Panorpa sp.            | non                | 2                                                   | 2                           | 504.5                    | 0.21                              |
| Helix pomatia           | non                | 2                                                   | 2                           | 900.                      | 16.02                             |
| Orconestes limosus     | wet                | 1                                                   | 1                           | 5000                     | 75.15                             |
| Diptera                | non                | 1                                                   | 1                           | 2.0                      | 0.04                              |
| Graphosoma italicca    | non                | 1                                                   | 1                           | 39.5                     | 0.91                              |
| Lygaeidae              | non                | 1                                                   | 1                           | 1.3                      | 0.03                              |
| Lygus sp.              | non                | 1                                                   | 1                           | 2.0                      | 0.05                              |
| Auchenorrhynchina sp.   | non                | 1                                                   | 1                           | 2.4                      | 0.06                              |
| Andrena sp.            | non                | 1                                                   | 1                           | 8.8                      | 0.20                              |
| Apis mellifera         | non                | 1                                                   | 1                           | 21.4                     | 0.49                              |
| Eumenidae              | non                | 1                                                   | 1                           | 4.8                      | 0.11                              |
| Camponotus sp.         | non                | 1                                                   | 1                           | 1.2                      | 0.03                              |
| Selenopsis sp.         | arable             | 1                                                   | 1                           | 1.2                      | 0.03                              |
| Vespula sp.            | non                | 1                                                   | 1                           | 25.7                     | 0.59                              |
| Lepidoptera (eggs)     | non                | 1                                                   | 1                           | 0.5                      | 0.01                              |
| Chrysopa (larvae)      | non                | 1                                                   | 1                           | 3.0                      | 0.07                              |
| Mollusca (large)       | non                | 1                                                   | 1                           | 1000                     | 17.8                              |

**FISH, REPTILES AND BIRDS**

| Anguis fragilis       | for                | 92                                                  | 95                          | 6750                     | 132.84                             |
| Aves (small Passeriformes) | non            | 10                                                  | 11                          | 8200                     | 191.22                             |
| Pisces               | wet                | 5                                                   | 6                           | 5000                     | 110.75                             |
| Carassius carassius   | wet                | 2                                                   | 2                           | 5000                     | 100.68                             |
| Lacerta sp.           | non                | 1                                                   | 1                           | 2700                     | 53.14                              |
| Natrix natrix        | wet                | 1                                                   | 1                           | 24,300                   | 478.22                             |

**MAMMALS**

| Microtus arvalis      | arable             | 80                                                  | 81                          | 6080                     | 130.21                             |
| Talpa europaea        | non                | 38                                                  | 39                          | 19,520                   | 429.97                             |
| Apodemus sp.          | non                | 8                                                   | 8                           | 6400                     | 144.56                             |
| Arvicola amphibius    | wet                | 7                                                   | 7                           | 26,560                   | 585.04                             |
We applied the functional division of the individual prey species/taxa, in terms of their habitat preferences (see Table 2), in part basing this classification on our previous detailed per-taxon habitat assignment [15]. Specifically, we classified the individual prey species/taxa into four major habitat categories, taking into account their relationship with the landscape and agricultural activities as the habitat of their development and their association with crop or non-crop habitats [15]. The habitat preferences of prey taxa were based on extensive ecological studies of various invertebrate groups in agricultural regions of south-western Poland after 1960 (16–21; summarized in [15]). This yielded four groups of prey from i) non-agricultural/marginal habitats including grassland, ii) crop fields/arable land, iii) wetland and aquatic habitats, and iv) forest and woodland habitats (Table 1).

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2.1. Statistical analysis

The aim of our analysis of data in Fig. 2 was to assess whether the percentage distribution of the biomasses of four functional prey groups representing taxa from major habitat categories (arable; eurytopic = grassland/non-cropped; forest; and waters/wetland) was utilized in proportion to the availability of the corresponding habitats measured at three different distances (1 km, 2.5 km and 5 km) around the same 52 White Stork nests. The corresponding background of available habitats is a synthetic measure combining land cover classes with a similar structure: arable (Arable land + Heterogeneous agricultural areas), grassland/non-cropped (Urban fabric + Industrial, commercial and transport units + Mine, dump and construction sites + Grassland, pasture + Shrub and/or herbaceous vegetation associations), forest (Forests + Artificial non-agricultural vegetated areas) and water/wetland (Inland wetlands + Inland waters and large rivers) (Table 1; Fig. 1; see also [1]). The percentage distribution of individual prey groups vs available habitat background (Fig. 2) was compared with using the t-test for dependent samples.

Finally, since previous findings on behavioural limitations resulted from colonial breeding leading to decreased reproductive output in White Storks, we compared using the Mann-Whitney test, the landscape traits and dietary indices between nests of low productivity pairs (1–2 fledglings; n = 21 nests) and nests of high productivity pairs (3–4 fledglings; n = 31 nests); and (2) between solitary nests (n = 36) and nests in an aggregation (n = 16; Table 4; Table 5). However, results of the latter
Table 3
All the statistically significant ($P \leq 0.05$) results of the Spearman rank correlation coefficient ($r_s$) testing the relationships between the various dietary indices determined for 165 pellets and landscape/habitat variables (i.e. area of individual land cover type expressed in ha or length of hydrographic networks expressed in m) measured at three spatial scales (1 km, 2.5 km and 5 km) around 52 White Stork nests in south-western Poland; $P$-values in bold meet the threshold of Bonferroni’s correction at $\alpha \leq 0.0036$ ($k = 14$).

| Land cover/habitat/extent | N prey items | Total prey biome | Ind. prey mass | N taxa | Energy content per prey item | Total energy content | Biomass %biomass Earth Cole Orth Other | %biomass Earth Cole Orth Other | Biomass %biomass Invert Verte Invert Verte |
|---------------------------|-------------|------------------|----------------|--------|----------------------------|---------------------|----------------------------------------|----------------------------------------|----------------------------------------|
| **Urban fabric n fabric** |             |                  |                |        |                            |                     |                                        |                                        |                                        |
| 1 km                      | -0.160      |                  |                |        |                            |                     | 0.217 0.272 0.252 -0.328 -0.192       |                                        |                                        |
| 2.5 km                    |             |                  |                |        |                            |                     | 0.265 0.193 -0.159 0.268 0.184 -0.174 | 0.184 0.166 0.164                     |                                        |
| 5 km                      | -0.170      |                  |                |        |                            |                     | 0.176 0.223 0.158 0.173 0.178          |                                        |                                        |
| **Industrial, commercial and transport units** |             |                  |                |        |                            |                     |                                        |                                        |                                        |
| 2.5 km                    | 0.170       |                  |                |        |                            |                     |                                        |                                        |                                        |
| 5 km                      | **0.278**   | **-0.244**       | -0.197         |        |                            |                     | 0.176 0.223 0.158 0.173 0.178          |                                        |                                        |
| **Artificial non-agricultural vegetated areas** |             |                  |                |        |                            |                     |                                        |                                        |                                        |
| 1 km                      | -0.209      | 0.219            | -0.208         |        |                            |                     | 0.257 0.158 -0.256 -0.230 0.228 -0.259 | -0.163 -0.179 0.158 -0.160            |                                        |
| 2.5 km                    |             |                  |                |        |                            |                     | 0.198 0.183 -0.161 0.205 -0.166 -0.208 |                                        |                                        |
| 5 km                      | 0.204       | -0.186           |                |        |                            |                     | 0.213 0.216 -0.169 0.185 0.192 -0.187 | 0.215 0.203 -0.179 **0.230** -0.229  |                                        |
| **Arable land**           |             |                  |                |        |                            |                     |                                        |                                        |                                        |
| 1 km                      | -0.184      | -0.159           |                |        |                            |                     | 0.264 0.235 -0.188 -0.194 0.331 -0.241 | -0.241                                  |                                        |
| 2.5 km                    |             |                  |                |        |                            |                     |                                        |                                        |                                        |
| 5 km                      | **-0.324**  | **-0.278**       | **-0.353**     |        |                            |                     |                                        |                                        |                                        |
| **Grassland, pastures**   |             |                  |                |        |                            |                     |                                        |                                        |                                        |
| 2.5 km                    |              |                  |                |        |                            |                     | -0.184                                  |                                        |                                        |
| 5 km                      |              |                  |                |        |                            |                     | -0.171                                  |                                        |                                        |
| **Heterogeneous agricultural areas** |             |                  |                |        |                            |                     |                                        |                                        |                                        |
| 1 km                      | -0.155      | 0.178            | 0.169          |        |                            |                     | 0.252 -0.216 **0.241** -0.254 -0.193 | 0.203 -0.204                          |                                        |
| 2.5 km                    |             |                  |                |        |                            |                     |                                        |                                        |                                        |
| 5 km                      | **0.274**   | **-0.304**       |                |        |                            |                     |                                        |                                        |                                        |
| **Other**                 |             |                  |                |        |                            |                     |                                        |                                        |                                        |

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|                         | 1 km     | 2.5 km    | 5 km   |
|-------------------------|----------|-----------|--------|
| **Forests**             | 0.203    | **-0.312**| 0.203  |
|                         | 0.171    | **-0.317**| 0.206  |
|                         | 0.200    | **-0.300**| 0.248  |
|                         | 0.188    | **-0.252**|        |
|                         | 0.179    | **-0.215**|        |
|                         | 0.197    | **0.252** |        |
|                         | -0.215   | **-0.278**|        |
|                         | 0.201    | **0.247** |        |
|                         | 0.155    | **0.231** |        |
| **Shrub and/or herbaceous vegetation associations** |         |          |        |
|                         | -0.200   | **-0.222**| -0.208 |
|                         | -0.222   | **-0.178**| -0.188 |
|                         | 0.179    | **-0.250**| 0.181  |
|                         | 0.171    | **0.171** |        |
|                         | 0.181    |          |        |
| **Inland wetland**      |          |           |        |
|                         | 0.254    | 0.190     | 0.216  |
|                         | -0.174   | 0.174     | -0.173 |
|                         | 0.192    | -0.226    | 0.196  |
|                         | -0.161   | -0.187    | 0.157  |
| **Inland water**        |          |           |        |
|                         | -0.208   | **0.237** | 0.194  |
|                         | 0.180    | 0.189     |        |
|                         | 0.209    | -0.183    |        |
|                         | 0.178    | -0.176    |        |
|                         | 0.165    | -0.156    |        |
| **Watercourses (length)** |          |           |        |
|                         | 0.191    |           |        |
|                         | 0.214    | -0.219    |        |
|                         | 0.237    | -0.200    |        |
| **Shoreline of water bodies (length)** |         |          |        |
|                         | -0.153   | -0.160    |        |
|                         | -0.162   | -0.166    |        |
|                         | 0.196    | -0.199    |        |
|                         | -0.196   | -0.206    |        |
| **Water bodies and large rivers (surface area)** |         |          |        |
|                         | -0.291   | -0.200    |        |
|                         | 0.187    | -0.247    |        |
|                         | 0.208    | -0.287    |        |
|                         | 0.176    | -0.246    |        |
|                         | -0.153   | -0.238    |        |
Table 4
Comparison of landscape/habitat traits measured at three spatial scales for White Stork nests grouped into (A) pair productivity: low (1–2 fledglings; n = 21) and high (3–4 fledglings; n = 31), and (B) colonial breeding: solitary nests (n = 36) versus nests in aggregations (i.e. clumped distribution = more than one nest in an individual locality/village; n = 16); statistically significant results are shown in bold.

(A) Pair productivity

| Land cover type, hydrographic feature (unit) | 1–2 fledglings | 3–4 fledglings | Mann-Whitney test |
|--------------------------------------------|----------------|----------------|-------------------|
| **SPATIAL SCALE: 1 km**                   |                |                |                   |
| Urban fabric (ha)                          | 26             | 29             | -0.55             | 0.585             |
| Mine, dump and construction sites (ha)     | 0.0            | 3.5            | -1.18             | 0.240             |
| Artificial non-agricultural vegetated areas (ha) | 0.00          | 0.26           | -0.82             | 0.410             |
| Arable land (ha)                           | 197            | 183            | 0.49              | 0.621             |
| Grassland, pasture (ha)                    | 39             | 34             | 0.23              | 0.821             |
| Heterogeneous agricultural areas (ha)      | 4.1            | 9.9            | -1.04             | 0.299             |
| Forests (ha)                               | 44.6           | 52.9           | -0.84             | 0.398             |
| Shrub and/or herbaceous vegetation associations (ha) | 3.2            | 0.1            | 1.51              | 0.130             |
| Inland wetlands (ha)                       | 0.0            | 0.0            | -                | -                 |
| Inland waters (ha)                         | 0.9            | 1.5            | -0.37             | 0.712             |
| Watercourses (m)                           | 11,554         | 8712           | 2.25              | 0.025             |
| Shoreline of water bodies (m)              | 1629           | 2242           | -1.78             | 0.075             |
| Inland waters and large rivers (ha)        | 2.5            | 4.0            | -1.69             | 0.091             |

**SPATIAL SCALE: 2.5 km**

| Urban fabric (ha)                          | 54             | 77             | -0.85             | 0.396             |
| Mine, dump and construction sites (ha)     | 2.5            | 4.9            | 0.53              | 0.596             |
| Artificial non-agricultural vegetated areas (ha) | 5              | 8              | -0.34             | 0.737             |
| Arable land (ha)                           | 905            | 922            | -0.08             | 0.933             |
| Grassland, pasture (ha)                    | 286            | 224            | 1.32              | 0.186             |
| Heterogeneous agricultural areas (ha)      | 94             | 84             | 0.52              | 0.601             |
| Forests (ha)                               | 494            | 561            | -0.33             | 0.744             |
| Shrub and/or herbaceous vegetation associations (ha) | 21            | 5              | 1.50              | 0.133             |
| Inland wetlands (ha)                       | 0.4            | 0.5            | 0.25              | 0.801             |
| Inland waters (ha)                         | 50             | 33             | 1.51              | 0.131             |
| Watercourses (m)                           | 58,670         | 47,681         | 1.87              | 0.061             |
| Shoreline of water bodies (m)              | 17,508         | 15,153         | 0.62              | 0.532             |
| Inland waters and large rivers (ha)        | 64             | 47             | 0.96              | 0.337             |

**SPATIAL SCALE: 5 km**

| Urban fabric (ha)                          | 338            | 337            | -0.07             | 0.941             |
| Mine, dump and construction sites (ha)     | 166            | 94             | 1.20              | 0.229             |
| Artificial non-agricultural vegetated areas (ha) | 46            | 38             | 0.79              | 0.428             |
| Arable land (ha)                           | 2585           | 3030           | -0.81             | 0.417             |
| Grassland, pasture (ha)                    | 1036           | 767            | 1.71              | 0.088             |
| Heterogeneous agricultural areas (ha)      | 290            | 274            | 0.55              | 0.582             |
| Forests (ha)                               | 2880           | 2905           | -0.33             | 0.744             |
| Shrub and/or herbaceous vegetation associations (ha) | 119           | 81             | 1.73              | 0.085             |
| Inland wetlands (ha)                       | 12             | 9              | 0.28              | 0.780             |
| Inland waters (ha)                         | 158            | 125            | 1.13              | 0.259             |
| Watercourses (m)                           | 175,753        | 157,049        | 1.41              | 0.159             |
| Shoreline of water bodies (m)              | 63,580         | 54,090         | 1.04              | 0.301             |
| Inland waters and large rivers (ha)        | 231            | 179            | 1.13              | 0.259             |

(B) Colonial breeding

| Land cover type, hydrographic feature (unit) | Solitary | Aggregation | Mann-Whitney test |
|--------------------------------------------|----------|-------------|-------------------|
| **SPATIAL SCALE: 1 km**                    |          |             |                   |
| Urban fabric (ha)                          | 27       | 31          | -1.50             | 0.133             |
| Mine, dump and construction sites (ha)     | 3.0      | 0.0         | 0.95              | 0.341             |
| Artificial non-agricultural vegetated areas (ha) | 0.2      | 0.2         | 0.67              | 0.505             |
| Arable land (ha)                           | 161      | 251         | -3.33             | 0.001             |
| Grassland, pasture (ha)                    | 40       | 28          | 0.37              | 0.711             |
## (B) Colonial breeding

| Land cover type, hydrographic feature (unit) | Solitary | Aggregation | Mann-Whitney test |
|---------------------------------------------|----------|-------------|------------------|
| Average | SE | Average | SE | Z | P-value |
| Heterogeneous agricultural areas (ha)       | 10.8 | 3.2 | 0.3 | 0.3 | 2.06 | 0.039 |
| Forests (ha)                                | 70 | 11 | 5 | 3 | 4.41 | 0.000 |
| Shrub and/or herbaceous vegetation associations (ha) | 1.9 | 1.1 | 0.0 | 0.0 | 1.37 | 0.170 |
| Inland wetlands (ha)                         | 0.0 | 0.0 | 0.0 | 0.0 | – | – |
| Inland waters (ha)                           | 1.8 | 0.9 | 0.0 | 0.0 | 1.72 | 0.086 |
| Watercourses (m)                             | 8015 | 655 | 14,010 | 1511 | -3.83 | 0.000 |
| Shoreline of water bodies (m)                | 2479 | 459 | 904 | 178 | 1.09 | 0.275 |
| Inland waters and large rivers (ha)          | 4.5 | 1.3 | 0.9 | 0.1 | 0.93 | 0.351 |
| **SPATIAL SCALE: 2.5 km**                    |         |         |         |         |   |   |
| Urban fabric (ha)                            | 80 | 14 | 40 | 10 | 2.22 | 0.026 |
| Industrial, commercial and transport units (ha) | 4.9 | 2.7 | 1.6 | 0.7 | -1.90 | 0.057 |
| Mine, dump and construction sites (ha)       | 9.7 | 5.3 | 0.0 | 0.0 | 0.95 | 0.341 |
| Artificial non-agricultural vegetated areas (ha) | 3.0 | 1.6 | 39.7 | 5.9 | -4.12 | 0.000 |
| Arable land (ha)                             | 827 | 75 | 1114 | 58 | -2.54 | 0.011 |
| Grassland, pasture (ha)                      | 212 | 34 | 332 | 37 | -2.52 | 0.012 |
| Heterogeneous agricultural areas (ha)        | 70 | 10 | 129 | 13 | -2.87 | 0.004 |
| Forests (ha)                                 | 684 | 73 | 197 | 18 | 3.69 | 0.000 |
| Shrub and/or herbaceous vegetation associations (ha) | 15.5 | 4.7 | 3.4 | 3.1 | 1.41 | 0.159 |
| Inland wetlands (ha)                         | 0.7 | 0.5 | 0.0 | 0.0 | 0.32 | 0.751 |
| Inland waters (ha)                           | 25 | 6 | 75 | 8 | -3.87 | 0.000 |
| Watercourses (m)                             | 43,426 | 3048 | 71,678 | 4686 | -3.99 | 0.000 |
| Shoreline of water bodies (ha)               | 13,480 | 1959 | 22,008 | 1719 | -3.19 | 0.001 |
| Inland waters and large rivers (ha)          | 36 | 7 | 93 | 9 | -3.61 | 0.000 |
| **SPATIAL SCALE: 5 km**                      |         |         |         |         |   |   |
| Urban fabric (ha)                            | 288 | 34 | 449 | 39 | -3.03 | 0.002 |
| Industrial, commercial and transport units (ha) | 66 | 21 | 252 | 37 | -3.39 | 0.001 |
| Mine, dump and construction sites (ha)       | 30 | 10 | 68 | 9 | -3.35 | 0.001 |
| Artificial non-agricultural vegetated areas (ha) | 22 | 10 | 204 | 30 | -3.65 | 0.000 |
| Arable land (ha)                             | 3011 | 236 | 2487 | 263 | 1.19 | 0.234 |
| Grassland, pasture (ha)                      | 652 | 75 | 1378 | 84 | -4.46 | 0.000 |
| Heterogeneous agricultural areas (ha)        | 252 | 20 | 343 | 30 | -2.78 | 0.006 |
| Forests (ha)                                 | 3208 | 237 | 2189 | 213 | 2.48 | 0.013 |
| Shrub and/or herbaceous vegetation associations (ha) | 84 | 15 | 123 | 11 | -2.26 | 0.024 |
| Inland wetlands (ha)                         | 148 | 6.4 | 0.0 | 0.0 | 0.95 | 0.341 |
| Inland waters (ha)                           | 96 | 14 | 233 | 19 | -4.52 | 0.000 |
| Watercourses (m)                             | 150,451 | 9153 | 196,445 | 7582 | -3.07 | 0.002 |
| Shoreline of water bodies (m)                | 45,715 | 4452 | 85,391 | 5370 | -4.40 | 0.000 |
| Inland waters and large rivers (m)           | 134 | 17 | 349 | 29 | -4.62 | 0.000 |
Table 5
Comparison of dietary indices/variables of breeding White Storks (A) among nests with low productivity (1–2 fledglings; \( n = 66 \) pellets) and high productivity (3–4 fledglings; \( n = 99 \) pellets) pairs and (B) among solitary nests (\( n = 125 \) pellets) and nests in an aggregation (i.e. more than one nest in an individual locality/village; \( n = 40 \) pellets); statistically significant results are shown in bold. Note: Thirty-two pellets were collected from 12 nests in Kłopot, a village supporting one of the largest White Stork colonies in Poland, see [1].

(A) Pair productivity

| Dietary index/variable (unit) | 1–2 fledglings | 3–4 fledglings | Mann-Whitney test |
|------------------------------|---------------|---------------|------------------|
|                             | Average | SE   | Average | SE   | Z      | P-value |
| Biomass of earthworms (mg d.w.) | 5379.0   | 882.0 | 5997.0  | 782.0 | -0.43  | 0.670   |
| Biomass of Coleoptera (mg d.w.) | 3773.0   | 1275.0 | 1811.0  | 157.0 | 1.99   | 0.046   |
| Biomass of Orthoptera (mg d.w.) | 18,349.0 | 2215.0 | 9074.0  | 1402.0 | 4.21   | 0.000   |
| Biomass of other invertebrates (mg d.w.) | 1213.0   | 22.6  | 143.8   | 55.4  | 1.78   | 0.075   |
| Biomass of other vertebrates (mg d.w.) | 5967.0   | 611.0 | 5103.0  | 510.0 | 1.35   | 0.177   |
| Biomass of mammals (mg d.w.) | 7719.0   | 1115.0 | 9361.0  | 1267.0 | -0.12  | 0.904   |
| %biomass of earthworms | 13.9     | 2.3   | 20.9    | 2.6   | -1.77  | 0.077   |
| %biomass of Coleoptera | 8.3      | 1.4   | 6.9     | 0.6   | -0.05  | 0.963   |
| %biomass of Orthoptera | 39.2     | 3.3   | 24.2    | 2.3   | 3.55   | 0.000   |
| %biomass of other invertebrates | 0.3      | 0.1   | 0.5     | 0.1   | -0.09  | 0.775   |
| %biomass of other vertebrates | 17.0     | 2.1   | 17.5    | 1.8   | 1.44   | 0.149   |
| %biomass of mammals | 21.4     | 2.8   | 30.1    | 3.1   | -0.12  | 0.904   |
| Number of prey items | 149.0    | 12.1  | 108.2   | 10.2  | 3.22   | 0.001   |
| Total biomass of prey (mg d.w.) | 41,307.0 | 2620.0 | 31,489.0 | 2067.0 | 3.26   | 0.001   |
| Individual prey mass (mg d.w.) | 397.0    | 40.7  | 481.8   | 45.6  | -0.60  | 0.545   |
| Number of prey taxa | 16.3     | 0.6   | 14.5    | 0.5   | 2.14   | 0.032   |
| Biomass of all invertebrates (mg d.w.) | 27,622.0 | 2610.0 | 17,025.0 | 1803.0 | 4.00   | 0.000   |
| Biomass of all vertebrates (mg d.w.) | 13,685.0 | 1308.0 | 14,464.0 | 1353.0 | 0.30   | 0.761   |
| %biomass of all invertebrates | 38.3     | 3.3   | 47.6    | 3.1   | -1.94  | 0.052   |
| %biomass of all vertebrates | 61.7     | 3.3   | 52.4    | 3.1   | 1.94   | 0.052   |
| Energy content per 1 prey item (kJ) | 9.7     | 0.8   | 7.4     | 1.0   | -2.62  | 0.009   |
| Total energy content (kJ) | 419.0    | 53    | 663.0   | 44    | 2.97   | 0.003   |

(B) Colonial breeding

| Dietary index/variable (unit) | Solitary | Aggregation | Mann-Whitney test |
|------------------------------|----------|-------------|------------------|
|                             | Average | SE   | Average | SE   | Z      | P-value |
| Biomass of earthworms (mg d.w.) | 4311.0 | 557.0 | 10,245.0 | 1478.0 | -3.84  | 0.000   |
| Biomass of Coleoptera (mg d.w.) | 2876.0 | 685.0 | 1720.0  | 188.0  | 0.68   | 0.494   |
| Biomass of Orthoptera (mg d.w.) | 12,260.0 | 1493.0 | 14,418.0 | 2380.0 | -1.66  | 0.096   |
| Biomass of other invertebrates (mg d.w.) | 103.0  | 18.0  | 234.0   | 131.0  | -1.27  | 0.205   |
| Biomass of other vertebrates (mg d.w.) | 5647.0 | 407.0 | 4828.0  | 1002.0 | 1.61   | 0.108   |
| Biomass of mammals (mg d.w.) | 9088.0  | 900.0 | 7504.0  | 2317.0 | 2.08   | 0.038   |
| %biomass of earthworms | 14.5     | 1.9   | 28.9    | 4.1   | -3.53  | 0.000   |
| %biomass of Coleoptera | 8.20     | 0.85  | 5.19    | 0.70   | 1.97   | 0.049   |
| %biomass of Orthoptera | 29.6     | 2.3   | 32.6    | 3.7   | -0.91  | 0.364   |
| %biomass of other invertebrates | 0.37    | 0.06  | 0.46    | 0.18   | -0.57  | 0.566   |
| %biomass of other vertebrates | 18.04    | 1.47  | 15.02   | 3.22   | 1.70   | 0.090   |
| %biomass of mammals | 29.34    | 2.49  | 17.84   | 4.35   | 2.71   | 0.007   |
| Number of prey items | 114.1    | 8.8   | 156.8   | 17.2   | -2.62  | 0.009   |
| Total biomass of prey (mg d.w.) | 34,286.0 | 1960.0 | 38,950.0 | 3054.0 | -1.54  | 0.125   |
| Individual prey mass (mg d.w.) | 479.0   | 39.0  | 350.0   | 45.0   | 2.02   | 0.043   |
| Number of prey taxa | 15.0     | 0.5   | 15.9    | 0.7   | -0.3   | 0.798   |
| Biomass of all invertebrates (mg d.w.) | 19,550.0 | 1776.0 | 26,619.0 | 3079.0 | -2.67  | 0.008   |
| Biomass of all vertebrates (mg d.w.) | 14,735.0 | 1026.0 | 12,332.0 | 2353.0 | 2.03   | 0.042   |
| %biomass of all invertebrates | 52.6     | 2.6   | 67.1    | 4.7   | -2.69  | 0.007   |
| %biomass of all vertebrates | 47.4     | 2.6   | 32.9    | 4.7   | 2.69   | 0.007   |
| Energy content per 1 prey item (kJ) | 9.7      | 0.8   | 7.4     | 1.0   | 1.46   | 0.145   |
| Total energy content (kJ) | 706.0    | 40.0  | 823.0   | 66.0   | 0.09   | 0.089   |
analysis due to non-random sampling design (i.e. the true density of 'solitary' and 'colonial' nests is unknown) should be treated with caution.

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Transparency document. Supporting information

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