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# NEW DATA ON THE DIET OF WHITE STORK *Ciconia ciconia* IN CALABRIA (SOUTHERN ITALY)

## Novi podatki o prehrani bele štorklje *Ciconia ciconia* v Kalabriji (južna Italija)

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The diet of a nesting pair of White Storks *Ciconia ciconia* in a rural area of Calabria (southern Italy) has been studied. The nest was located on top of a high-tension pylon. The authors identified 1421 prey items in 37 pellets, the main prey being insects, which accounted for 97.7% of prey items. Vertebrates constituted only 2.3%. Orthoptera accounted for 64% of all insects and 62.5% of total prey items, and were present in 81% of the pellets. Other insects (35.1% of prey items) were present in 75.6% of the pellets and included Dermaptera, Hymenoptera, Heteroptera and Coleoptera.

**Key words:** White Stork, *Ciconia ciconia,* diet, Calabria, southern Italy
**Klju~ne besede:** bela štorklja, *Ciconia ciconia,* prehrana, Kalabrija, južna Italija

### 1. Introduction

The White Stork *Ciconia ciconia* is a widespread Palearctic species that underwent a significant population decline in the 1970's, particularly in western Europe (SNOW & PERRINS 1998). It has experienced a recent, slight increase throughout its range (BIRDLIFE INTERNATIONAL 2004), including the re-colonisation of countries from which it disappeared as a breeder during the last century. This increase is due in part to numerous reintroduction projects, rather than to natural range expansions (CANZIANI & PALUMBO 2004).

The number of breeding pairs is also increasing in Italy, particularly in certain parts of northern Italy and in Sicily (CANZIANI & PALUMBO 2004, GÜSTIN 2004, BELARDI *et al.* 2005), and breeding started in Calabria also in the 1990's (CAPALBO 1993 & 1995, GUSTIN *et al.* 1995, SOTTILE 2003), where there are currently only three known breeding pairs (SANTOPAOLO *et al.* 2006).

Among the causes likely to have led to the species earlier becoming rarer throughout its range, a key role has probably been played by the intensification of agriculture, along with widespread urbanization and the loss of extensive foraging areas (DALLINGA & SCHOENMAKERS 1987, GORIUP & SCHULZ 1991, TSACHALIDIS & PAPAGEORGIOU 1996, JOHST *et al.* 2001). Climate change on the wintering grounds has also contributed as a negative factor on trophic resources (TUCKER & HEATH 1994, SCHULZ 1999).

The species is an opportunist (SNOW & PERRINS 1998, ETIENNE & CAURRETTE 2002) and its diet was described in detail for many European regions (CRAMP & SIMMONS 1977, SCHULZ 1998).

In Italy, information on diet is generally scarce, and mostly concerns northern areas (BOANO 1981 & 1992), rather than the south (MIRAGLIA *et al.* 2003).

In this work, we present the results of a study on the diet of a single nesting pair of White Storks in a rural area of Calabria (southern Italy).

### 2. Study area

The nesting site of the pair whose diet was studied is located along the Crati river (municipality of Luzzi, Cosenza — 39°28'N, 16°14'E).

Crati is the principal Calabrian river and flows in a typical fluvial plain, whose landscape is characterized by a mosaic of cultivated land with arboreal crops (olive groves, citrus groves, peach orchards and poplar woods), uncultivated land, strips of *Quercus virgiliana*

**Table 1:** Diet of a single pair of White Storks *Ciconia ciconia* in Calabria (Southern Italy); 37 whole pellets were analysed (number of prey, % of prey, number of pellets with each taxon and % of pellets containing each taxon). The pellets were collected near the nest and dry dissected.

**Tabela 1:** Prehrana gnezdečega para belih štorkelj *Ciconia ciconia* v Kalabriji (južna Italija), ugotovljena z analizo 37 izbljuvkov (število enot plena, % enot plena, število izbljuvkov s posameznim taksonom, procent izbljuvkov s posameznim taksonom). Izbljuvki so bili nabrani v bližini gnezda in analizirani s suhim postopkom.

| Taxa / Takson | Number of prey items / [tevilo enot plena | % of prey items/ % enot plena | No. of pellets with each taxon/ [t. izbljuvkov s posameznim taksonom | % of pellets with each taxon/ % izbljuvkov s posameznim taksonom |
|---|---|---|---|---|
| Gastropoda | 1 | 0.07 | 1 | 2.70 |
| Insecta unknown / neznano | 38 | 2.67 | 7 | 18.92 |
| Ortoptera indet. | 888 | 62.49 | 30 | 81.08 |
| Dermaptera indet. | 4 | 0.28 | 2 | 5.41 |
| *Forficula* sp. | 9 | 0.63 | 7 | 18.92 |
| Hymenoptera | | | | |
| Apoidea indet. | 2 | 0.14 | 2 | 5.41 |
| Formicidae indet. | 90 | 6.33 | 20 | 54.05 |
| Coleoptera indet. | 125 | 8.80 | 26 | 70.27 |
| Tenebrionidae indet. | 31 | 2.18 | 19 | 51.35 |
| Carabidae indet. | 42 | 2.96 | 21 | 56.76 |
| *Amara* sp. | 1 | 0.07 | 1 | 2.70 |
| *Chlaenius* cfr. *spoliatus* | 5 | 0.35 | 5 | 13.51 |
| *Chlaenius* sp. | 6 | 0.42 | 6 | 16.22 |
| *Campalita maderae* | 1 | 0.07 | 1 | 2.70 |
| *Omophrom limbatum* | 4 | 0.28 | 3 | 8.11 |
| Scarabeidae indet. | 33 | 2.32 | 23 | 62.16 |
| *Fillomorpha* sp. | 1 | 0.07 | 1 | 2.70 |
| *Orictes nasicornis* | 2 | 0.14 | 2 | 5.41 |
| Coccinellidae indet. | 5 | 0.35 | 4 | 10.81 |
| Chrisomelidae indet. | 43 | 3.03 | 22 | 59.46 |
| Curculionidae indet. | 8 | 0.56 | 7 | 18.92 |
| Cucujidae indet. | 3 | 0.21 | 3 | 8.11 |
| *Clinidium* sp. | 1 | 0.07 | 1 | 2.70 |
| Heteroptera indet. | 16 | 1.12 | 10 | 27.03 |
| Pentatomidae indet. | 27 | 1.90 | 16 | 43.24 |
| *Nezara viridula* | 1 | 0.07 | 1 | 2.70 |
| *Elia rostrata* | 1 | 0.07 | 1 | 2.70 |
| Total insects / Skupno žuželke | 1388 | 97.68 | 28 | 75.68 |
| Fish / Ribe | 10 | 0.73 | 10 | 27.03 |
| Reptiles / Plazilci | 3 | 0.21 | 2 | 5.41 |
| Birds / Ptice | 1 | 0.07 | 1 | 2.70 |
| Mammals / Sesalci | 6 | 0.44 | 5 | 13.51 |
| Vertebrates / vreten~arji indet. | 13 | 0.92 | 13 | 35.13 |
| Total vertebrates / Skupno vreten~arji | 33 | 2.32 | 26 | 70.27 |
| Plant / Rastline | | | 25 | 67.57 |
| Inorganic garbage / Neorganski odpadki | | | 10 | 27.03 |
| Total / Skupaj | 1421 | 100% | | |

woods and arboreal riparian vegetation (*Alnus glutinosa, Populus* sp., *Salix* sp.). The nest was located on the top of a high-tension pylon, a structure often used by White Storks for nest-building (TSACHALIDIS & PAPAGEORGIOU 1996), also in Italy (BELARDI *et al.* 2005). The pair reached the study area in April. Three eggs were laid in the first ten days of May and chicks hatched in the first days of June; three fledglings fledged in the second half of August.

## 3. Methods

Between July and August 2004, we collected 37 whole pellets near the nest (the data are therefore restricted to this period although the total breeding period was May — August). Pellets were dry dissected and the prey remnants were identified on the basis of reported diagnostic characters (BARBRAUD & BARBRAUD 1998) or by comparison with reference material from other Calabrian sites, preserved in the collections of the Museo di Storia Naturale ed Orto Botanico, University of Calabria.

Orthoptera were identified, thanks to the characteristic of mandibles and other insect remains of the exoskeleton (head, legs, elytrons, wings, mandibles). Vertebrates were identified through the presence of scales, feathers and hair. Recovery of bones is generally rather unusual and limited to splinters. These are barely recognizable after being altered by White Storks' digestive systems, which are particularly acid and often completely dissolve bone fragments (SCHULZ 1998).

Items were identified assuming the minimum number of specimens of each taxon, which for insects is equal to the highest number of single exoskeleton parts that are most representative of the taxon in question.

For vertebrates, since the number of individuals is not quantifiable on the basis of tegumental remains, we only considered one individual for each pellet in which the taxon was present.

We express the composition of diet in terms of: i) number of prey items and percentage for each taxon; *ii)* percentage of pellets in which each taxon was present.

## 4. Results

We identified 1421 prey items (Table 1). The main prey of White Stork were insects, which accounted for 97.6% of prey items.

Orthoptera accounted for 64% of all insects and 62.5% of total prey items, and were present in 81% of the pellets. In July and August when the weather was very hot and dry (temperature max. 40°C in July and more than 40°C in August), grasshoppers may have been one of the few food resources available in large numbers. Other insects (35.1% of prey items) were present in 75.6% of the pellets and they included Dermaptera, Hymenoptera, Heteroptera and Coleoptera.

Fish (30.3%) and mammals (18.2%) accounted for an important fraction of vertebrates in the White Storks' diet, whereas only one unfledged bird and three snakes (Colubridae, Reptiles) of small to medium size were found. The presence of plant material (present in 67.6% of pellets) is also significant.

## 5. Discussion

The diet of White Stork can change significantly with the abundance of different prey items, season and geographical area, so the percentage of mammals, insects, aquatic animals or worms can change between sites, across the breeding season and with weather conditions (SACKL 1987, PINOWSKA & PINOWSKI 1989, PINOWSKI *et al.* 1991, MUŽINIC & RASAJSKI 1992, SCHULZ 1998, JOHST *et al.* 2001, TSACHALIDIS & GOUTNER 2002).

In our study area the proportions of Gastropoda and vertebrates were low (0.07% and 2.3% respectively), but the use of pellets to characterise the diet of White Storks may be misleading, because some prey items do not leave identifiable remains, since they are readily digestible (MUŽINIC & RASAJSKI 1992, ETIENNE & CARRUETTE 2002). For example, amphibian remnants in pellets were not found, but the remnants of aquatic (fish) and riparian animals *(Chlaenius* spp., *Campalita maderae, Omophrom limbatum)* were found. In the previous year in our study area the same pair, which used the same nest, was observed to capture amphibians (MIRAGLIA *et al.* 2003).

It is likely that some small, unrecognizable bone fragments belonged to individuals of this taxonomic group. Observations on pellets and fresh material from the same nests can lead to very different results (DE BARROS & MOURA 1989); however, in this study it was impossible to collect other information (prey remains, direct observations) without causing disturbance and jeopardising the nesting.

In 27% of cases, plastic, paper and cloth remnants were found. Recent studies have highlighted the ingestion of plastic or rubbish by White Storks, probably due to rubbish tips being used as foraging grounds (MARTINEZ RODRIGUEZ 1995, TORTOSA *et al.* 2002, PERIS 2003) as well as nearby urban areas (MARTINEZ RODRIGUEZ 1995).

Although White Storks are carnivorous, they may ingest plant matter accidentally (BAUDOIN 1973, ETIENNE & CARRUETTE 2002), unless the plants are important for the production of pellets (probably the case in our study area) (ETIENNE & CARRUETTE 2002). In this study an exceptionally high percentage (67.6%) of pellets contained plant remains, and 24% of them were made up exclusively of such remains.

The predominance of insects, especially Orthoptera, in the White Stork's diet of our study area confirms results obtained in other Mediterranean areas characterised by dry, cultivated environments (MELENDRO *et al.* 1977, CRAMP & SIMMONS 1977, DALLINGA & SCHOENMAKERS 1987, DE BARROS & MOURA 1989, PINOWSKA & PINOWSKI 1989, MUŽINIC & RASAJSKI 1992, BOUKHAMZA *et al.* 1995, BARBRAUD & BARBRAUD 1998, TSACHALIDIS & GOUTNER 2002). It confirms the considerable adaptability of this species to prey abundance and availability.

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## 6. Povzetek

Predstavljeni so rezultati {tudije o prehranjevanju gnezde~ega para belih {torkelj *Ciconia ciconia* v podeželskem delu Kalabrije (južna Italija). Gnezdo je bilo zgrajeno vrh droga visokonapetostne elektri~ne napeljave. Avtorji ~lanka so identificirali 1421 enot plena v 37 izbljuvkih. Glavni plen belih {torkelj so bile žuželke s kar 97.7% enot plena, medtem ko so vreten~arji sestavljali le 2.4% njihovega plena. Ravnokrilci Orthoptera, ki so sestavljali 64% vseh žuželk in 62.5% vseh enot plena, so bili najdeni v 81% izbljuvkov. Druge žuželke (35.1% enot plena), ki so jih sestavljali kožekrilci Dermaptera, strigalice Hymenoptera, stenice Heteroptera in hro{~i Coleoptera, so bile ugotovljene v 75.6% izbljuvkov.

## 7. References

BARBRAUD, C. & BARBRAUD, J.C. (1998): Le regime alimentarie des poussins de Cigogne blanche *Ciconia ciconia,* en Charente-Maritime: importance des insectes. - Alauda 65: 259-262.

BAUDOIN, G. (1973): Analyse de pelotes de rejection des Cicognes *(Ciconia ciconia)* nicheuses a Hachy en 1972. - Aves 10: 113-121.

BELARDI, M., CANZIANI, M. & DIMITOLO, G. (2005): La Cicogna bianca. Storia di un ritorno. Conoscere il parco No. 3. - Parco Adda Sud, Lodi.

BIRDLIFE INTERNATIONAL (2004): Birds in Europe: population estimates, trends and conservation status. - BirdLife International, Cambridge.

BOANO, G. (1981): La Cicogna bianca in Piemonte. Presenza, nidificazione e problemi di conservazione. - Riv. Piem. St. nat. 2: 59-70.

BOANO, G. (1992): Cicogna bianca *Ciconia ciconia.* pp. 216-225 In: BRICHETTI, P., DE FRANCESCHI, P. & BACCETTI, N. (eds.): Fauna d'Italia XXIX. Aves I. - Edizioni Calderini, Bologna.

BOUKHAMZA, M., RIGHI, M., DOUMANDJI, S. & HAMDINE, W. (1995): Le regime alimentare de la Cigogne blanche *Ciconia ciconia* dans une region de Kabylie (Algerie). - Alauda 63: 199-207.

CANZIANI, M. & PALUMBO, G. (2004): Piano d'Azione Nazionale sulla Cicogna bianca *Ciconia ciconia.* pp. 547-572 In: GARIBOLDI, A., ANDREOTTI, A. & BOGLIANI, G. (eds.): La conservazione degli Uccelli in Italia. Strategie ed azioni. - Oasi Alberto Perdisa, Bologna.

CAPALBO, P. (1993): Nidificazione di Cicogna bianca, *Ciconia ciconia,* in Calabria. - Riv. Ital. Orn. 63: 108-109.

CAPALBO, P. (1995): Seconda nidificazione di Cicogna bianca, *Ciconia ciconia,* in Calabria. - Suppl. Ric. Biol. Selvaggina XXXII: 611-612.

CRAMP, S. & SIMMONS, K.E.L. (1977): The Birds of the Western Palearctic. Vol. 1. - Oxford University Press, Oxford.

DALLINGA, J.H., & SCHOENMAKERS, S. (1987): Regional differences in the number of White Storks *(Ciconia c. ciconia)* in relation to food resources. - Colonial Waterbirds 10: 167-177.

DE BARROS, P. & MOURA, D. (1989): Breeding, feeding and mortality factors in White Stork *Ciconia ciconia* populations nesting in Portugal in 1985. pp. 405-414 In: RHEINWALD, R., OGDEN, J. & SCHULZ, H. (eds.): White Stork. Status and conservation. Proceedings of the First International Stork Conservation Symposium, Walsrode, 14-19 October 1985. Dachverband Deutscher Avifaunisten. - Rheinischer Landwirtschafts-Verlag, Bonn.

ETIENNE, P. & CARRUETTE, P. (2002): La cicogne blanche. - Delacaux et Nieslé, Paris.

GORIUP, P.D. & SCHULZ, H. (1991): Conservation management of the White Stork: an international need and opportunity. - ICBP Technical Publication 12: 97-127.

GÜSTIN, M., DI GIORGIO, A., PALUMBO, G. & LUPOLI, A. (1995): Nidificazione di Cicogna bianca, *Ciconia ciconia,* in Calabria. - Riv. Ital. Orn. 64: 171-172.

GÜSTIN, M. (2004): Censimento della popolazione italiana nidificante di Cicogna bianca *Ciconia ciconia.* - Picus 30 (2): 140.

JOHST, K., BRANDL, R. & PFEIFER, R. (2001): Foraging in a patchy and dynamic landscape: human land use and the White Stork. - Ecological Applications 11: 60-69.

MARTINEZ RODRIGUEZ, E. (1995): El uso de vertederos por la Cigüena Blanca como nuevas fuentes de alimentacion. pp. 159-162 In: BIBER, O., ENGGIST, P., MARTI, C. & SALATHÉ, T. (eds.): Proc. Int. Symp. on the White Stork (western population), Basel.

MELENDRO, J., GISBERT, J. & RODRIGUEZ, A. (1977): Datos sobre la alimentacion de *Ciconia ciconia* - Ardeola 24: 207-209.

MIRAGLIA, G., SANTOPAOLO, R., GÜSTIN, M. & GODINO, G. (2003): Monitoraggio sulle attività al nido di una coppia di Cicogna bianca *Ciconia ciconia* nidificante nella Valle del Crati (CS, Calabria). - Alula 10 (1/2): 81-85.

MUŽINIC, J. & RAŠAJSKI, J. (1992): On food and feeding habits of the White Stork *Ciconia c. ciconia* in the central Balkan. - Ecology of Birds 14: 211-223.

PERIS, S.J. (2003): Feeding in urban refuse dumps: ingestion of plastic objects by the White Stork *(Ciconia ciconia).* - Ardeola 50: 81-84.

PINOWSKA, B. & PINOWSKI, J. (1989): Feeding ecology and diet of the White Stork *Ciconia ciconia* in Poland. pp. 381-396 In: RHEINWALD, R., OGDEN, J. & SCHULZ, H. (eds.): White Stork. Status and conservation. Proceedings of the First International Stork Conservation Symposium, Walsrode, 14-19 October 1985. Dachverband Deutscher Avifaunisten. - Rheinischer Landwirtschafts-Verlag, Bonn.

PINOWSKI, J., PINOWSKA, B., DE GRAAF, R., VISSER, J. & DZIURDZIK, B. (1991): Influence of feeding habitat on prey capture rate and diet composition of White Stork *Ciconia ciconia* (L.). - Studia Naturae 37a: 59-85.

SACKL, P. (1987): Über saisonale und regionale Unterschiede in der Ernährung und Nahrungswahl des Weißstorches *(Ciconia c. ciconia)* im Verlauf der Brutperiode. - Egretta 30: 49-80.

SANTOPAOLO, R., MIRAGLIA, G., GODINO, G., GUSTIN, M. & SALERNO, M. (2006): Incremento della popolazione nidificante di Cicogna bianca, *Ciconia ciconia,* in Calabria. - Riv. Ital. Orn. 76 (2): 179-182.

SCHULZ, H. (1998): *Ciconia ciconia* White Stork. Birds of the Western Palearctic. Update 2: 69-105.

SCHULZ, H. (1999): The world population of the White Stork *(Ciconia ciconia)* - Results of the 5th International White Stork Census 1994/95. pp. 351-365 In: SCHULZ, H. (ed.): Weissstorch im Aufwind? / White Storks on the up? - Proc. Internat. Symp. on the White Stork, Hamburg 1996. - NABU (Naturschutzbund Deutschland e.V.), Bonn.

SNOW, D.W. & PERRINS, C.M. (1998): The Birds of the Western Palearctic. Vol 1. Non Passerines. - Oxford Unversity Press, Oxford, New York.

SOTTILE, F. (2003): Nidificazione di Cicogna bianca, *Ciconia ciconia,* nella Valle del Crati (Cosenza). - Riv. Ital. Orn. 73: 92-93.

TORTOSA, F.S., CABALLERO, J.M. & REYES-LÖPEZ, J. (2002): Effect of rubbish dumps on breeding success in the White Stork in southern Spain. - Waterbirds 25: 39-43.

TUCKER, G.M. & HEATH, M.F. (1994): Birds in Europe. Their conservation status. BirdLife Conservation Series No 3. - BirdLife International, Cambridge.

TSACHALIDIS, E.P. & PAPAGEORGIOU, N. (1996): Distribution, status and breeding of the White Stork *Ciconia ciconia* in Greece. - Avocetta 20: 101-106.

TSACHALIDIS, E.P. & GOUTNER, V. (2002): Diet of the White Stork in Greece in relation to habitat. - Waterbirds 25: 417-423.

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