

## First Record of Eurasian Spoonbills *Platalea leucorodia* feeding on Branchiopoda in a temporary wetland

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**Abstract** - The diet of the Eurasian Spoonbill *Platalea leucorodia* is poorly documented with only the most common prey groups known, namely small fishes, amphibians, reptiles, crustaceans, molluscs, worms, leeches and plant material. Here, three small crustaceans, Branchiopoda *Triops cancriformis* (Notostraca), *Chirocephalus diaphanus* (Anostraca), and *Cyzicus tetracerus* (Spinicaudata) are documented as prey of the Eurasian Spoonbill in a temporary wetland near the San Teodoro salt pan (Marsala, western Sicily). These observations provide a new insight into the foraging ecology of the species, showing its extreme opportunism in targeting small prey when feeding in a temporary wetland system.

**Keywords:** *Triops*, Notostraca, Anostraca, Spinicaudata, foraging, western Sicily

The diet of the Eurasian Spoonbill, *Platalea leucorodia*, is poorly known (see Tab. 1). Commonly recognized prey include small fishes, amphibians, reptiles, crustaceans, clams, worms, leeches and plant materials (Cramp & Simmons 1977). However, among crustaceans, the only prey recorded till now have been the Malacostraca, (*Procambarus clarkii*, *Carcinus maenas*, *Crangon crangon*) and some species of the Palaemonidae (Tinbergen 1933, Kemper 1986a, 1986b, Aguilera et al. 1996, Wintermans & Wymenga 1996, Altenburg & Wymenga 1997, Veen et al. 2012, Jouta et al 2018, Enners et al. 2020). Additionally, in Europe, among the freshwater crustaceans, three alien species, namely the *Procambarus clarkii*, the *Orconectes limosus* (originating from North America), and the *Macrobrachium sintangense* (from south-east Asia), have been identified as a Spoonbill's prey. Here, for the first time, we document that

Eurasian Spoonbills prey on tiny crustaceans living in small temporary wetlands – a habit that suggests an opportunistic ability of the documented birds to benefit from the dense fauna present in such extreme sites.

On the 27<sup>th</sup> of February 2017, six Eurasian Spoonbills in pre-breeding migration were observed feeding in a temporary freshwater wetland (37°54'38"N 12°28'07"E), near the San Teodoro salt pan (Marsala, Sicily), a site where fish fauna is clearly absent. At the time of our observation the wetland occupied an area of approximately fifty square meters (50 m<sup>2</sup>). However, based on the distribution of the hygrophilous vegetation, we estimate that the wetland originally occupied an area of approximately one hectare (10000 m<sup>2</sup>). After 30 minutes of surveillance the Eurasian Spoonbills flew away providing an opportunity to assess their prey options in this novel

environment. Direct observation of the fauna in the feeding areas was performed, a method that is arguably the most used (Tab 1, Kemper 1986a, 1986b, van Wetten & Wintermans 1986a, 1986b) although other more invasive techniques are also employed, such as visual observations of ingested items (van Wetten & Wintermans 1986a, 1986b) or examination of the stomach content of a dead Spoonbill (Tinbergen 1933). Samples of the fauna populating the same areas where birds were feeding were immediately collected with a fine-meshed aquarium net, resulting in 12 samples. The samples were preserved in an ethanol-water solution (90% by volume) and identified using optical microscopy according Alonso (1996), before being stored in the F. Marrone collection at the Department of Biological, Chemical and Pharmaceutical Sciences and Technologies, University of Palermo (Italy).

The samples consisted of smalls crustaceans belonging to the genus *Triops* (N = 3), *Chirocephalus* (N = 6), *Cyzicus* (N = 2) and 1 larva of a damselfly *Ichnura genei*. Consequently, the most abundant prey available for the Spoonbills were Branchiopoda (i.e., crustaceans), which had likely concentrated in the flooded area upon drought-action. The precise composition of the crustaceans included Notostraca *Triops cancriformis* (up to 70 mm in length excluding cercopods), Anostraca *Chirocephalus diaphanus* (up to 42 mm in length) see Fig. 1A, and Spinicaudata *Cyzicus tetracerus* (up to 20 mm in length) see Fig. 1B (F. Marrone, *pers. comm.*). Importantly, much smaller branchiopods with lengths between 1-4 mm such as *Pleuroxus letourneuxi*, *Coronatella elegans*, *Macrothrix hirsuticornis* and *Ceriodaphnia cf. quadrangula* (Anomopoda), as well as ostracods and unidentified cyclopoid copepods (F. Marrone, *personal observation*), had been previously sampled in the same pond a year earlier. This result further corroborates our idea that a rich fauna of Branchiopoda populates the site of our observations. Although there is no direct evidence that the Branchiopoda have been preyed on by the Spoonbills, they were the only possible prey discovered in the pond during the observation

period. Spoonbills are regularly present nearby the observation site during migration and winter (mean number: 30, range: 1-105 individuals between Jan 2013-May 2020, 77 pers. obs.) (Ientile et al. 2020, Zenatello et al. 2014). However, they have never been observed before feeding in temporary wetlands, where other species such as Redshank *Tringa totanus*, Great Egret *Casmerodius albus*, Curlew *Numenius arquata*, Common Snipe *Gallinago gallinago*, small flocks of Golden Plover *Pluvialis apricaria* and Northern Lapwing *Vanellus vanellus* are instead commonly present. This is also consistent with previously reported observations (Horv ath et al. 2013). Indeed, the presence of crustacean subphylum, specifically of the Branchiopoda class, in the diet of some birds, including those mentioned above, has been already proven. Among the thirty-two waterbird species that potentially feed on Anostraca and/or zooplankton, the Curlew and the Common redshanks *Tringa totanus* – the most frequent wader – are two representative examples observed in some European soda pans (Horv ath et al. 2013).

More recently, on the 26<sup>th</sup> of March 2018, we observed two Spoonbills, during pre-breeding migration feeding, in a temporary freshwater pond (37°56'23"N 12°35'23"E) near the water reservoir of Paceco (Sicily). The maximum extent of this reservoir, based on the distribution of the hygrophilous vegetation, is estimated at half a hectare (5000 m<sup>2</sup>). The behavior of the two Spoonbills when feeding, namely quickly skimming the water surface, suggested ingestion of small prey rather than larger animals, such as amphibians or reptiles, which usually require longer ingestion times (Pigniczki 2017.). This is consistent with the main fauna of Branchiopoda observed in this pond that, similar to the San Teodoro salt pan, included cladocerans *Daphnia magna* and *Simocephalus* sp., as well as ostracods and unidentified cyclopoid copepods (F. Marrone, *pers. comm.*).

The open question is what does influence the Spoonbills to explore such “extreme” sites for feeding? It is therefore suggested that Spoonbills, like other predatory water birds (e.g., the Ardeidae),

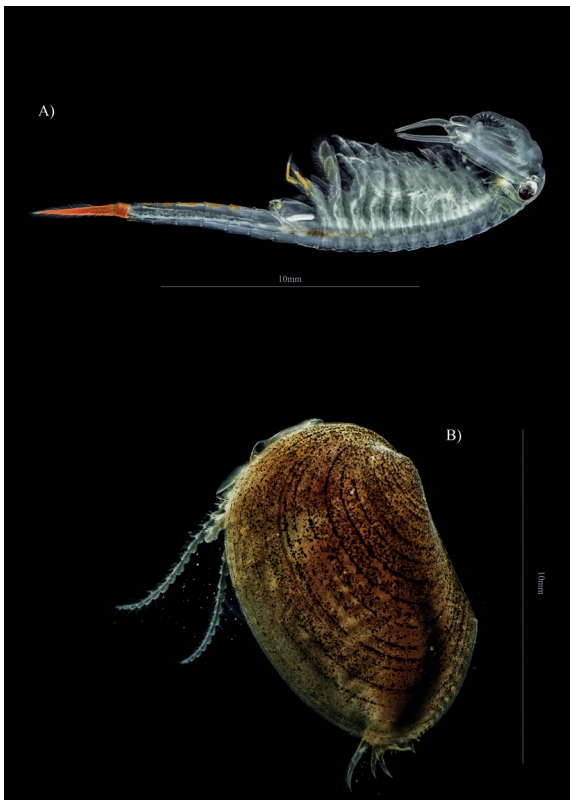
exploit these extreme sites as the dense concentration of prey, even if small in size (Fasola et al. 1993, Fasola 1994, Fasola & Cardarelli 2014, Kazantzidis & Goutner 2005) make it a convenient feeding site. In fact, Spoonbills have never been observed in this temporary wetland when it has been extensively flooded, thus indicating that the use of such freshwater ponds, and the predation of Branchiopoda, can be strongly opportunistic and linked to water levels. This explanation is also consistent with the substantial number of observations (465 instances) carried out over eight years (from 2013 to 2020) which showed Spoonbills foraging almost exclusively in tidal lagoons (Stagnone di Marsala), saltmarshes, salt pans, and water reservoirs within the province of Trapani (S. Surdo *personal observations*).

These observations clearly highlight the key role of temporary ponds for migratory birds. Wetland

birds such as herons, waterfowls and waders, may indeed profit from temporary ponds for feeding on local crustacean assemblages (Fasola 1994, Boros et al. 2006) and for wintering or stepping stone sites (Grillas & Roché 1997, Horvath et al. 2013, Troia et al. 2016). On the other hand, migratory birds represent important vectors for the long-range dispersal of the resting stages of Branchiopoda's biota (Green et al 2002, Figuerola et al. 2003, Incagnone et al. 2015), thus allowing them to colonize new water catchments.

Although the Ramsar Convention (Ramsar 2002) has recently acknowledged the importance of temporary ponds, political recognition of these wetlands as a crucial part of water environment remains elusive throughout European Union (EU). The Mediterranean Temporary Ponds, like those used by Spoonbills for opportunistic foraging, is a clear example. Although listed as "priority habitats" in the EU "Habitats Directive" (code 3170), the Mediterranean Temporary Ponds are often overlooked and exposed to perturbations and total destruction (Grillas et al. 2004, Schwartz & Jenkins 2000). A various range of anthropogenic activities, such as intense agriculture, land abandonment, fires, overgrazing, introduction of exotic species and climate changes, (Grillas et al. 2004, Zacharias et al. 2007) has resulted in a large percentage of the Mediterranean Temporary Ponds disappearing in recent years (Marrone & Mura 2006, Marrone et al 2006, Naselli Flores & Marrone 2019, Rhazi et al. 2012).

The relevance of temporary water ponds is even more evident under the climate change scenario we are facing; the optimal foraging habitat for wetland birds could disappear, forcing them to look for alternative areas such as the Mediterranean Temporary Ponds that, as our observations clearly indicate, might provide new/alternative food resources. As such, the fragile ecosystem of the wetlands should be preserved and protected against anthropogenic activities. In this regard, we hope that in the near future the temporary water ponds of this work might become a protected natural area.



**Figure 1** *Chirocephalus diaphanus* (A) and *Cyzicus tetracerus* (B) sampled on the 27th of February 2017 in a temporary freshwater wetland (Photo by Alessandro Barra).

**Table 1.** Summary of studies analyzing diet of Eurasian spoonbill *Platalea leucorodia*

Type	Class or Order	Family	Prey*	Based on	Reference
Fishes	Pleuronectiformes	Pleuronectidae	<i>Pleuronectes platessa</i>	Regurgitates	Jouta et al. 2018
			<i>Pleuronectidae</i>	Isotope tracers	El-Hacen 2014
			<i>Platichthys flesus</i>	Faecal material	Veen et al. 2012
		Bothidae	Bothidae	Faecal material	Veen et al. 2012
		Percidae	Percidae	Isotope tracers	El-Hacen 2014
	Gobiiformes	Gobiidae	<i>Solea</i> sp., <i>Microchirus</i> sp., <i>Solea senegalensis</i> ,	Regurgitates, Stomach contents, Faecal material	Aguilera et al. 1996, Veen et al. 2012
			<i>Pomatoschistus microps</i> ; <i>P. minutus</i>	Regurgitates	Jouta et al. 2018; Enners et al. 2020
			<i>Gobius paganellus</i>	Faecal material	Veen et al. 2012
	Gasterosteiformes	Gasterosteidae	<i>Pungitius pungitius</i>	Regurgitates, Visual identification, Stomach contents	Jouta et al. 2018; Wetten & Wintermans 1986a, Petrescu 1999
			<i>Gasterosteus aculeatus</i>	Regurgitates, Visual identification, Isotope tracers	Jouta et al. 2018, Enners et al. 2020, Wetten & Wintermans 1986a, El-Hacen 2014, Boileau et al. 2002
	Osmeriformes	Osmeridae	<i>Osmerus eperlanus</i>	Regurgitates	Jouta et al. 2018, Enners et al. 2020
	Cypriniformes	Cyprinidae	<i>Rutilus rutilus</i>	Regurgitates	Jouta et al. 2018
		Cobitidae	<i>Cobitis</i> sp.	Stomach contents	Petrescu 1999
		Cyprinidae	<i>Rhodeus</i> sp.	Stomach contents	Petrescu 1999
	Cyprinodontiformes	Fundulidae	<i>Carassius carassius</i>	Visual identification	Pigniczki 2008
<i>Fundulus</i> sp.			Regurgitates, Stomach contents	Aguilera et al. 1996	
Atheriniformes	Atherinidae	<i>Atherina boyeri</i>	Regurgitates, Stomach contents	Aguilera et al. 1996	
		<i>Atherina</i> sp.	Faecal material	Veen et al. 2012	
Batrachoidiformes	Batrachoididae	<i>Halobatrachus didactylus</i>	Faecal material	Veen et al. 2012	
Cichliformes	Cichlidae	<i>Saratherodon melanotheron</i> , Cichlidae	Faecal material	Veen et al. 2012	
Labriformes	Labridae	Labridae	Faecal material	Veen et al. 2012	
Perciformes	Gerreidae	<i>Eucinostomus melanopterus</i>	Faecal material	Veen et al. 2012	
	Moronidae	<i>Dicentrarchus punctatus</i>	Faecal material	Veen et al. 2012	

		Sparidae	<i>Diplodus sargus</i> , Sparidae	Faecal material	Veen et al. 2012
		Polynemidae	<i>Galeoides decadactylus</i>	Faecal material	Veen et al. 2012
		Sciaenidae	<i>Umbrina</i> sp.	Faecal material	Veen et al. 2012
		Percidae	<i>Perca fluviatilis</i>	Regurgitates	Jouta et al. 2018
	Mugiliformes	Mugilidae	Mugilidae	Faecal material	Veen et al. 2012
Shrimps	Decapoda	Palaemonidae	Palaemonidae, <i>Palaemonetes varians</i>	Regurgitates, Visual identification, Stomach contents; Isotope tracers, Faecal material	Aguilera et al 1996, Boileau et al. 2002, El-Hacen 2014, Veen et al. 2012
		Crangonidae	<i>Crangon crangon</i>	Stomach contents, Regurgitates, Isotope tracers	Tinbergen 1933, Jouta et al. 2018, Enners et al. 2020, El- Hacen 2014
Crabs		Portunidae	<i>Carcinus maena</i>	Regurgitates, stomach contents	Aguilera et al. 1996
Crayfish		Astacidae	<i>Astacus leptodactylus</i>	Stomach contents	Petrescu 1999
		Cambaridae	<i>Procambarus clarki</i>	Regurgitates, Stomach contents	Aguilera et al. 1996
Frogs	Anura	Bombinatoridae	<i>Bombina bombina</i>	Visual identification	Kalotás 2003
		Ranidae	<i>Pelophylax ridibundus</i>	Visual identification	Pigniczki 2017
			<i>Rana</i> sp.	Visual identification	Pigniczki 2008
Reptiles	Squamata		Squamata		Cramp & Simmons 1986
Isopods	Isopoda		Isopoda	Regurgitates, stomach contents	Aguilera et al. 1996
Aquatic Insects	Odonata		Odonata (dragonflies)		Cramp & Simmons 1986
	Orthoptera		Orthoptera (locusts)		Cramp & Simmons 1986
	Hemiptera		Hemiptera, <i>Naucoris</i> sp.	Regurgitates, stomach contents	Cramp & Simmons 1986 Aguilera et al. 1996, Petrescu 1999
	Coleoptera	Dytiscidae	<i>Acilius</i> sp., <i>Colymbetes</i> sp.	Regurgitates, Stomach contents	Cramp & Simmons 1986, Aguilera et al. 1996, Petrescu 1999
	Diptera		Diptera (flies)		Cramp & Simmons 1986
	Trichoptera		Trichoptera (caddisflies)		Cramp & Simmons 1986
Spiders	Arachnida		Arachnida	Regurgitates, stomach contents	Aguilera et al. 1996
Aquatic Molluscs	Bivalvia		<i>Tellina</i> sp; Bivalvia	Regurgitates, stomach contents	Cramp & Simmons 1986, Aguilera et al. 1996
Snails	Gastropoda		Gastropoda	Regurgitates, stomach contents	Aguilera et al. 1996
	Littorinimorpha	Hydrobiidae	<i>Hydrobia ulvae</i>	Faecal material	Veen et al. 2012
Worms	Errantia	Nereididae	<i>Nereis</i> sp.	Faecal material, Regurgitates	Veen et al. 2012, Enners et al. 2020

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## REFERENCES

- Aguilera E., Ramo C. & de le Court C., 1996. Food and feeding sites of the Eurasian spoonbill *Platalea leucorodia* in Southwestern Spain. *Colon. Waterbirds* 19: 159-166. <https://doi.org/10.2307/1521960>
- Altenburg W. & Wymenga E., 1997. Voedsel voor lepelaars. Birdlife. Netherlands, Zeist, pp. 32.
- Alonso M., 1996. Crustacea, Branchiopoda. In: Fauna Iberica. M.A. Ramos et al. (ed.). Vol. 7. Museo Nacional de Ciencias Naturales, CSIC, Madrid.
- Bagella S., Gascón S., Filigheddu R., Cogoni A. & Boix D., 2016. Mediterranean Temporary Ponds: new challenges from a neglected habitat. *Hydrobiologia* 782: 1–10. <https://doi.org/10.1007/s10750-016-2962-9>
- Boileau N., Caupenne M. & Le Campion T., 2002. Ecologie alimentaire de la Spatule blanche *Platalea leucorodia* en migration postnuptiale dans le marais de Brouage (Charente-Maitime). *Annales de la Société des Sciences Naturelles de Charente-Maritime* 9: 205-218.
- Boros E., Bánfi Sz. & Forró L., 2006. Anostracans and microcrustaceans as potential food sources of waterbirds on sodic pans of the Hungarian plain. *Hydrobiologia* 567: 341–349.
- Cramp S. & Simmons K.E.L., 1986. Handbook of the birds of Europe, the Middle East and North Africa. Vol. 1. Ostrich to ducks. Oxford University Press, London, NY, pp. 200–207.
- El-Hacen E.H.M., Piersma T., Jouta J., Overdijk O. & Lok T., 2014. Seasonal variation in the diet of Spoonbill chicks in the Wadden Sea: a stable isotopes approach. *J. Ornithol.* 155: 611–619. doi 10.1007/s10336-014-1043-y
- Enners L., Guse N., Schwemmer P., Chagas A.L.J., Voigt C. C. & Garthe S., 2020. Foraging ecology and diet of Eurasian spoonbills (*Platalea leucorodia*) in the German Wadden Sea. *Estuar. Coast. Shelf Sci.* 233: 1-8. doi: 10.1016@j.ecss.2019.106539
- Fasola M., Rosa P., Canova L., 1993. Diets of squacco herons, little egrets, night, purple and grey herons, in their Italian breeding range. *Terre Vie* 48: 35–47.
- Fasola M., 1994. Opportunistic use of foraging resources by heron communities in southern Europe. *Ecography* 17: 113–123. <https://doi.org/10.1111/j.1600-0587.1994.tb00083.x>
- Fasola M. & Cardarelli E., 2015. Long-term changes in the food resources of a guild of breeding Ardeinae (Aves) in Italy, *Ital. J. Zool.* 82: 238-250. doi: 10.1080/11250003.2014.966256
- Figuerola, J., Green, A.J., & Santamaria, L., 2003. Passive internal transport of aquatic organisms by waterfowl in Doñana, south-west Spain. *Glob. Ecol. Biogeogr.* 12: 427–436.
- Green A.J., Figuerola J & Sánchez M. I., 2002. Implications of waterbird ecology for the dispersal of aquatic organisms. *Acta Oecologica* 23: 177–189.
- Grillas P. & Roché J. 1997. Vegetation of temporary marshes, ecology and management. Conservation of Mediterranean Wetlands. Med Wet. Station Biologique de la Tour du Valat, Arles.
- Grillas P., Gauthier P., Yaverkovski N. & Perennou C., 2004. Mediterranean Temporary Pools 1. Station Biologique de la Tour du Valat, Arles.
- Horváth, Z., Vad, C.F., Vörös, L. & Boros, E., 2013. The keystone role of anostracans and copepods in European soda pans during the spring migration of waterbirds. *Freshw. Biol.* 58: 430-440. doi:10.1111/fwb.12071
- lentile R., Surdo S. & Iapichino C., 2020. The Eurasian Spoonbill *Platalea leucorodia* in Sicily between 1972 and 2018, distribution and ecology pp. 339-347. In: La Mantia T., Badalamenti E., Carapezza A., Lo Cascio P. & Troia A. (ed.), Life on islands. Biodiversity in Sicily and surrounding islands. Studies dedicated to Bruno Massa. Danaus, Palermo.
- Incagnone G., Marrone F., Barone R., Robba L. & Naselli Flores L., 2015. How do freshwater organisms cross the “dry ocean”? A review on passive dispersal and colonization processes with a special focus on temporary ponds. *Hydrobiologia* 750: 103–123. <https://doi.org/10.1007/s10750-014-2110-3>
- Jouta J., de Goeij P, Lok T, Velilla E., Vamphuyzen C.J., Leopold M., van der Veer H.W., Olf H., Overdijk O. & Piersma T., 2018. Unexpected dietary preferences of Eurasian Spoonbills in the Dutch Wadden Sea: spoonbills mainly feed on small fish not shrimp. *J. Ornithol.* 159: 839–849. <https://doi.org/10.1007/s10336-018-1551-2>

- Kalotás Z., 2003. Spoonbill (*Platalea leucorodia*) feeding on Fire-bellied Toad (*Bombina orientalis*). *Aquila* 109-110: 173-174.
- Kazantzidis S. & Goutner V., 2005. The diet of nestlings of three Ardeidae species (Aves, Ciconiiformes) in the Axios Delta, Greece. *Belg. J. Zool.* 135: 165-170.
- Kemper J.H., 1986a. Foraging strategy in the spoonbill, *Platalea leucorodia*. Report 33. Instituut voor Taxonomische Zoölogie, Amsterdam.
- Kemper J.H., 1986b. Voedselbeperking voor de lepelaar van het zwanenwater. *Lev. Nat.* 87: 66-71.
- Marrone F. & Mura G., 2006. Updated status of Anostraca, Notostraca and Spinicaudata (Crustacea Branchiopoda) in Sicily (Italy): review and new records. *Naturalista sicil.* 30: 3-19.
- Marrone F., Barone R. & Naselli Flores L., 2006. Ecological characterization and cladocerans, calanoid copepods and large branchiopods of temporary ponds in a Mediterranean island (Sicily, southern Italy). *Chemistry and Ecology* 22: sup1 S181-S190. doi: 10.1080/02757540600557827
- Naselli-Flores L. & Marrone F., 2019. Different invasibility of permanent and temporary waterbodies in a semiarid Mediterranean Island. *Inland Waters* 9: 411-421. doi: 10.1080/20442041.2019.1653110
- Petrescu A., 1999. Food of some herons, Glossy Ibis and Spoonbill (Aves: Ardeidae and Threskiornithidae) in south-eastern Romania. *Travaux du Museum National d'Histoire Naturelle 'Grigore Antipa'* 41: 393-414.
- Pigniczki C., 2008. Grey Heron (*Ardea cinerea*) and Great Egret (*Ardea alba*) pillaging frogs (*Rana* sp.) and Crucian carp (*Carassius carassius*) from Eurasian Spoonbills (*Platalea leucorodia*). *Aquila* 114-115: 178-179.
- Pigniczki C., 2017. Unique Prey Handling of Eurasian Spoonbill (*Platalea leucorodia*). *Waterbirds* 40: 74-76. <https://doi.org/10.1675/063.040.0111>
- Rhazi L., Grillas P., Saber E.-R., Rhazi M., Brendonck L. & Waterkeyn A., 2012. Vegetation of Mediterranean temporary pools: a fading jewel? *Hydrobiologia* 689: 23-36.
- Schwartz S. S. & Jenkins D. G., 2000. Temporary aquatic habitats: constraints and opportunities. *Aquat. Ecol.* 34: 3-8.
- Tinbergen L., 1933. Lepelaar. *Lev. Nat.* 38: 262.
- Troia A., Adragna F., Campisi P., Dia M. G., Ilardi V., La Mantia T., La Rosa A., Lo Valvo M., Muscarella C., Pasta S., Pieri V., Scuderi L., Sparacio I., Stoch F. & Marrone F., 2016. I pantani di Anguillara (Calatafimi Segesta, Trapani): dati preliminari sulla biodiversità a supporto della tutela del biotopo. *Naturalista sicil.* 40: 171-200.
- van Wetten J.C.J. & Wintermans G.J.M., 1986a. The Food Ecology of the Spoonbill *Platalea leucorodia* 49. *Inst. Tax. Zool., Univ. Amsterdam*, pp. 63.
- van Wetten J.C.J. & Wintermans G.J.M., 1986b. Voedsel-ecologie van de lepelaars van het Zwanenwater en Texel. *Graspieper* 6: 96-109.
- Veen J., Overdijk O. & Veen T., 2012. The diet of an endemic subspecies of the Eurasian Spoonbill *Platalea leucorodia balsaci*, breeding at the Banc d'Arguin, Mauritania. *Ardea* 100: 123-130.
- Wintermans G.J.M. & Wymenga E., 1996. Voedsel voor lepelaars; knelpunten, oplossingsrichtingen en aanbevelingen voor de inrichting en het beheer van voedselgebieden van Lepelaars. Altenburg & Wymenga Ecological Research and Consultancy.
- Zacharias I., Dimitriou E., Dekker A. & Dorsman E., 2007. Overview of temporary ponds in the Mediterranean region: threats, management and conservation issues. *J. Environ. Biol.* 28: 1-9.
- Zenatello M., Baccetti N. & Borghesi F., 2014. Risultati dei censimenti degli uccelli acquatici svernanti in Italia. Distribuzione, stima e trend delle popolazioni nel 2001-2010. ISPRA, Serie Rapporti, 206.

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