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A review of knowledge on Dragonflies and Damselflies in the Regional Nature Reserve "Foce Volturno – Costa di Licola"

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Abstract

Based on studies conducted on the Odonata of Campania between the 1980s and 1990s, the Authors have updated the list of species present in the wetlands of the Regional Natural Reserve "Foce Volturno - Costa di Licola", located between the provinces of Caserta and Naples (Campania, Southern Italy). The compilation of the check-list was conducted through bibliographic research in texts and databases, along with new surveys in the sites and initiating citizen science projects. In total, 22 species were recorded (23.1% of Italian species and 39.2% of Campanian species as of 2022), including 7 belonging to the Damselflies and 15 to the Dragonflies. Referring to the regional Odonate fauna list of 1995, 18 species are confirmed (32.14% of those reported in Campania and 18.9% of those reported in Italy as of 2022). In addition to these, *Selysiothemis nigra* and *Brachytron pratense* were sampled by the Authors for the first time in the Reserve area, and *Orthetrum trinacria* was observed by a citizen scientist for the first time at the regional level, data relevant to their national distribution. The contribution provided brings the total number of Odonata species in Campania to 58 and represents the first piece of an ongoing investigation into species richness at the regional scale.

Keywords: Odonata, Wetlands, Campania, Checklist, Volturno.

Introduction

The number of endangered Odonata species globally, according to the latest update of the IUCN Red List as of December 9, 2021, has reached 40.084 species out of a total of 142.577 listed on the IUCN Red List (Kuhn 2021).

The disappearance of Dragonflies is a consequence of the destruction of their habitat, primarily consisting of wetlands that provide essential ecosystem services but are disappearing at a rate three times faster than that of forests (Neri 2021). It is necessary to implement coordinated actions at regional, national, and international levels to prevent these valuable insects from extinction. These organisms are effective bioindicators for assessing anthropogenic disturbances and variations in terrestrial and aquatic ecosystems (Corbet 1980; Mendes et al., 2017; Miguel et al., 2017; Oliveira-Junior & Juen, 2019; Silva et al., 2021a, b). Sampling Odonata is useful for assessing the status of water bodies when the application of the ecological status indices prescribed by the Water Framework Directive (2000/60/EC) is not required (Golfieri et al., 2012).

The high sensitivity of Odonata to environmental changes (Oertli 2008; Rodrigues et al., 2016) is a characteristic attributable to their bifasic life cycle, characterized by an aquatic larval stage and an adult winged stage. This makes them key models in studying impacts or modifications in both aquatic and terrestrial habitats (Oertli 2008; Oliveira-Junior et al., 2013; Carvalho et al., 2018). The quality of sediments in the water influences Odonata populations (Nasirian 2017): contaminants and metals (Cr, Cu, Mn, Zn), associated with coastal and transitional wetland environments (Olsen et al., 1982), can bioaccumulate in the tissues of Odonata species (Nasirian 2017; Jumaat & Ab Hamid, 2023), making them a taxon frequently used in bioindication contexts. The difference in size between the suborders *Zygoptera* and *Anisoptera,* which implies a different selection of their respective habitats, is crucial for identifying disturbances in aquatic systems (Corbet 1999; Remsburg et al., 2008; Calvão et al., 2013; Monteiro-Júnior et al., 2013). Lower temperatures seem to favor a higher percentage of smaller individuals belonging to the *Zygoptera* group, while higher temperatures tend to favor species with larger bodies, belonging to the *Anisoptera* (May 1976; Corbet 1999; Calvão et al., 2013; Carvalho et al., 2013; Calvão et al., 2018). The reduced dispersal capacity of many *Zygoptera* species can make them more dependent on local conditions and therefore more specialized in terms of habitat requirements (Tscharntke et al., 2002). The naturalistic value of these organisms is also derived from the fact that they are the main predators in freshwater ecosystems, both during the larval and adult stages (Sánchez-Herrera & Ware, 2012).

The trend of Odonata communities in Italy is declining, with declining populations outnumbering expanding populations by as much as five times, and with the main threats identified as pollution and habitat loss (Riservato et al., 2014a). Based on this, there is an urgent need to survey species throughout Italy and subsequently monitor the percentage of the global population of each species present in the national territory, in order to identify conservation priorities (Riservato et al., 2014b). With the knowledge of the odonate fauna available at the local level, it is possible to develop management methodologies that will prove useful also at the national scale.

This study aims to summarise investigations on this group of insects, with the first objective being the compilation of an updated and extended check-list covering the entire territory of the Regional Natural Reserve "Foce Volturno - Costa di Licola", in order to verify the presence of species previously reported and report any new ones. Previous knowledge regarding the Odonate fauna of the Protected Area should not be considered exhaustive as contributions related to this area are rather scarce. After an initial study conducted by D'Antonio in 1983 limited to the Variconi area, a check-list was published in 1986 listing 15 species, including *Lestes*

virens vestalis, *Lestes dryas*, *Sympetrum meridionale*, and *Aeshna mixta*. In 1995, D'Antonio published the first and only checklist of Odonata in Campania, reporting a total of 54 species with a *Zygoptera/Anisoptera* ratio of 1:1.3. Although there are historical regional publications for central and southern Italy (Grandi 1957; D'Antonio 1985; Carchini & Rota, 1986), this systematic monitoring represents the first attempt made to accurately evaluate the actual distribution of Odonata in the territory of the Regional Natural Reserve "Foce Volturno - Costa di Licola".

Study area

The study area concerns the Regional Natural Reserve "Foce Volturno - Costa di Licola," a protected natural area in Campania established since 1993 and covering a total area of approximately 1,425.98 hectares between the province of Caserta and the metropolitan city of Naples (Fig. 1). The Natural Reserve is managed by the regional authority of the same name and stretches along the Domitian Coast starting from the right bank of the River Volturno to the old mouth of Lake Patria. The protected territory spans the Municipalities of Castel Volturno, Villa Literno, and Giugliano in Campania, including a vast mosaic of habitats.

The importance of this Reserve is evidenced by the presence of four Sites of Community Importance established under the "Habitat" Directive 92/43/EEC: Lake Patria (IT8030018), Variconi Oasis (IT8010028), Pine forest of Castel Volturno and Patria (IT8010020 and IT8010021).

The Variconi area is also a Special Protection Area (ZPS IT8010018) under the "Birds" Directive 79/409/CEE and a Ramsar Wetland Site (3IT050) established under the Ramsar Convention of 1971.

In addition to this network of protected areas, there is the naturalistic value of the Wetland Area of "Soglitelle" and the mouth of the Volturno River, environments belonging to the Natura 2000 Network established under Directive 92/43/EEC "Habitat" with the aim of preserving the species and habitats for which the sites have been identified.

The diversity of habitats within the entire Protected Area (Fig. 2), including low sandy shores, Mediterranean scrubland, and wooded areas (Habitat Italia, 2023), promotes the presence of rich biodiversity.

The Wetland Area of Variconi consists of a complex of backdune ponds and flooded meadows located on the left side of the Volturno River mouth, covering an area of 303 hectares. The brackish waters present in the Wetland Area greatly influence the nature of these environments, colonized by halophilic herbaceous vegetation mixed with fragments of Mediterranean scrubland (de Filippo 2020).

Lake Patria, formerly known as *Literna Palus*, is the largest brackish basin of volcanic origin in Campania. The protected area extends for approximately 507 hectares, and the lake is fed by both freshwater streams and a cemented channel connecting it to the sea, introducing saltwater. The vegetation in the area is characterized by the presence of juniper and myrtle scrubland and mastic shrubs (de Filippo 2020).

The Pine forest of Castel Volturno (90 hectares) and the Pine forest of Patria (313 hectares), coastal dune territories of recent formation, are mainly composed of pine trees planted in the 1950s, as well as patches of psammophilic vegetation and Mediterranean scrubland environments (de Filippo 2020).

The Regi Lagni are a network of mostly artificial straight canals, resulting from a canalization project carried out in 1610 to drain the waters of a marshy territory extending approximately 100.000 hectares from the Domitio Coast to the Volturno basin. In 1999, the area was recognized as an artificial water body through legislative decree no.152 and underwent environmental requalification and

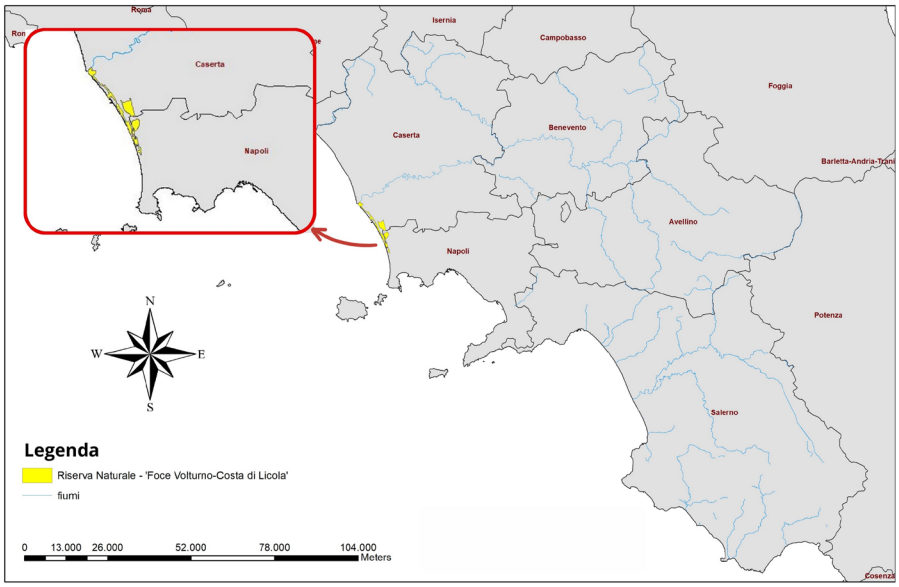

Figura 1. Area of the Regional Natural Reserve "Foce Volturno - Costa di Licola".

Figura 2. Part of the territory of the Reserve: a) the backdune pond of Variconi, b) a glimpse of the landscape in the Wetland Area of "Le Soglitelle," c) Lake Patria, d) the mouth of the Regi Lagni.

remediation in 2009, with the consequent closure and reclamation of many canals.

The wetland area of "Soglitelle" is the site that most recently became part of the Protected Area of the Regional Natural Reserve "Foce Volturno-Costa di Licola". The area consists of a complex of artificial reservoirs created for hunting purposes in the 1970s, seized by the Carabinieri and declared protected in 2006 by the Campania Region, thanks to the efforts of LIPU (Italian League for Bird Protection). A surface area of 100 hectares of land has been expropriated starting from 2012. The reservoirs within this extensive flat surface area

are partly fed by artesian wells, connected to canals that intersect them transversely, all flowing into the larger Vena Canal that runs longitudinally through the site.

Materials and Methods

Knowledge about Odonata in the Reserve was updated by comparing the species list obtained in this study with local and regional check-lists developed respectively in 1986 in the Wetland Area of Variconi and in 1995 in Campania by D'Antonio (D'antonio 1986, 1995). This analysis was supplemented by comparing the obtained check-list with the Atlas of Italian dragonflies (2014), with the Standard Forms of the ZSC of the Natura 2000 Network, and with the most recent check-lists of Odonata in Italy and Campania (2022) obtained from the Odonata.it website, to verify the presence of species sampled by the Authors at the local, regional, and national levels.

Further investigation was conducted using citizen science, particularly with data collected as part of the "Biodiversity RNR Foce Volturno-Costa di Licola" iNaturalist Project, launched by the Fauna Monitoring Station "i Variconi" and "le Soglitelle" (SMFVS) with the aim of determining the check-list of Odonata of the Reserve by updating the species list and identifying the sites of the Reserve most affected by the presence of Odonata.

In addition to bibliographic analyses and contributions from various collaborators through the citizen science platform iNaturalist, field surveys were conducted by volunteer operators of the SMFVS through systematic samplings in the semi-submerged areas of the Reserve. The sampling methodology included: temporary capture of adult specimens with an entomological net, observation and identification with the aid of a camera, and subsequent release of specimens into nature. Field surveys were conducted during the primary activity season of adults, from June to October, to cover the flight periods of all species.

The collected and documented samples were identified based on keys provided by Klaas-Douwe B. Dijkstra and Asmus Schröter (2021). For systematic order, the taxonomy of La Porta et al. (2023) was used. The Atlas of Italian dragonflies by Riservato et al. (2014) was used as a reference for zoogeographical studies.

Results

The conducted samplings reveal the presence of 18 species (Fig. 3), including 4 belonging to the suborder *Zygoptera* (*Calopterygidae*, *Lestidae, Coenagrionidae*) and 14 to the suborder *Anisoptera* (*Aeshnidae*, *Libellulidae*). Below is the list of the 18 species observed during the surveys conducted in 2023 in the area of the Regional Natural Reserve (Tab. 1).

To this list, Coenagrion mercuriale, Ceriagrion tenellum, Aeshna isosceles, and Sympecma fusca are added as species present in the sites of Lake Patria and Variconi, as reported in the Standard Forms of the ZSC (2019), reaching a total richness of 5 families and 22 species present in the Reserve. Among all those surveyed (Fig. 4), Coenagrion mercuriale is included in Annexes II and IV of the Habitats Directive (92/43/CEE) and is considered "near threatened" (NT) in the IUCN Red List of Italian Dragonflies (Riservato et al., 2014), while for all other species, the status is considered "least concern" (LC).

The Atlas of Italian Dragonflies (2014) also reports among the species surveyed in the study area in the 1990s: Cordulegaster trinacriae (the only Italian endemic species and included in Annexes II and IV of the Habitats Directive, 92/43/CEE), Calopteryx haemorrhoidalis, Lestes virens, Lestes dryas, Platycnemis pennipes, Coenagrion puella, Erythromma lindenii, Aeshna affinis, Anax ephippiger, Cordulegaster trinacriae,

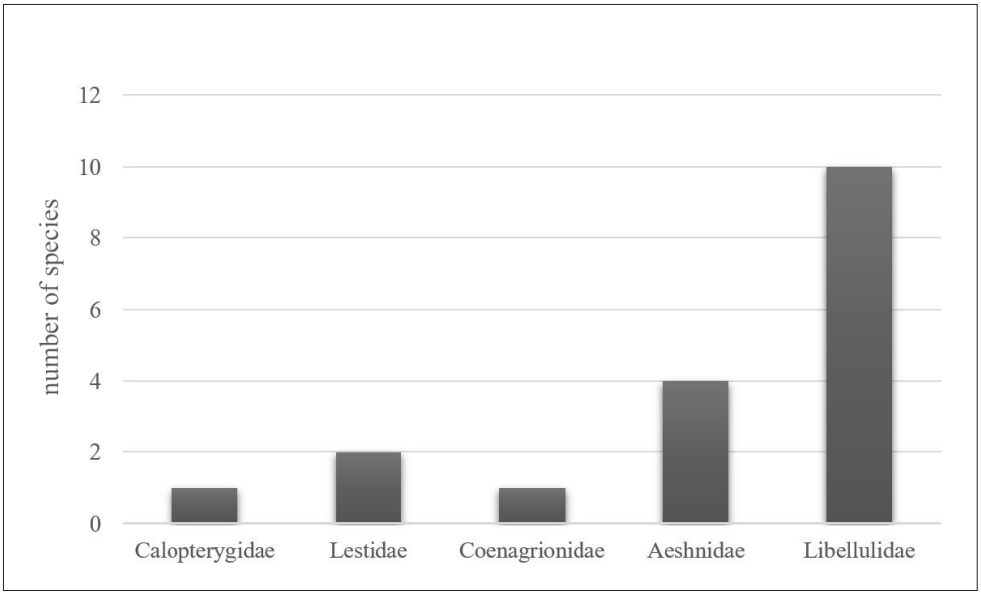

Figura 3. The number of species surveyed in the area of the Regional Natural Reserve by family.

Tabella 1. List of species surveyed during the surveys conducted in 2023 in the Reserve.

Tassonomia	Genere	Specie	Nome Italiano
Zygoptera			
Calopterygidae	*Calopteryx*	*splendens*	Splendente comune
Lestidae	*Lestes*	*barbarus*	Verdina barbara
	Chalcolestes	*viridis*	Verdina maggiore
Coenagrionidae	*Ischnura*	*elegans*	Codazzurra comune
Anisoptera			
Aeshnidae	*Aeshna*	*mixta*	Dragone autunnale
	Anax	*imperator*	Imperatore comune
		parthenope	Imperatore minore
	Brachytron	*pratense*	Dragone peloso
Libellulidae	*Orthetrum*	*brunneum*	Frecciazzurra celeste
		cancellatum	Frecciazzurra puntanera
		coerulescens	Frecciazzurra minore
		trinacria	Frecciazzurra meridionale
	Crocothemis	*erythraea*	Frecciarossa
	Sympetrum	*fonscolombii*	Cardinale venerosse
		meridionale	Cardinale meridionale
		striolatum	Cardinale striato
	Trithemis	*annulata*	Obelisco violetto
	Selysiothemis	*nigra*	Freccianera

Libellula depressa, Libellula fulva, Orthetrum nitidinerve, Sympetrum sanguineum.

Among the various sampling sites within the area of the Regional Natural Reserve "Foce Volturno - Costa di Licola," the wetland area of "Soglitelle" emerged as the area with the highest species abundance (Fig. 5).

Regarding the biogeography of the species recorded in the study area, the majority of the Odonata characterizing the Regional Natural Reserve "Foce Volturno - Costa di Licola" were found to be species with Palearctic

Figura 4. Some of the species surveyed: a) *Aeshna mixta*; b) *Crocothemis erythraea*; c) *Orthetrum cancellatum*; d) *Lestes barbarus*; e) *Sympetrum fonscolombii*.

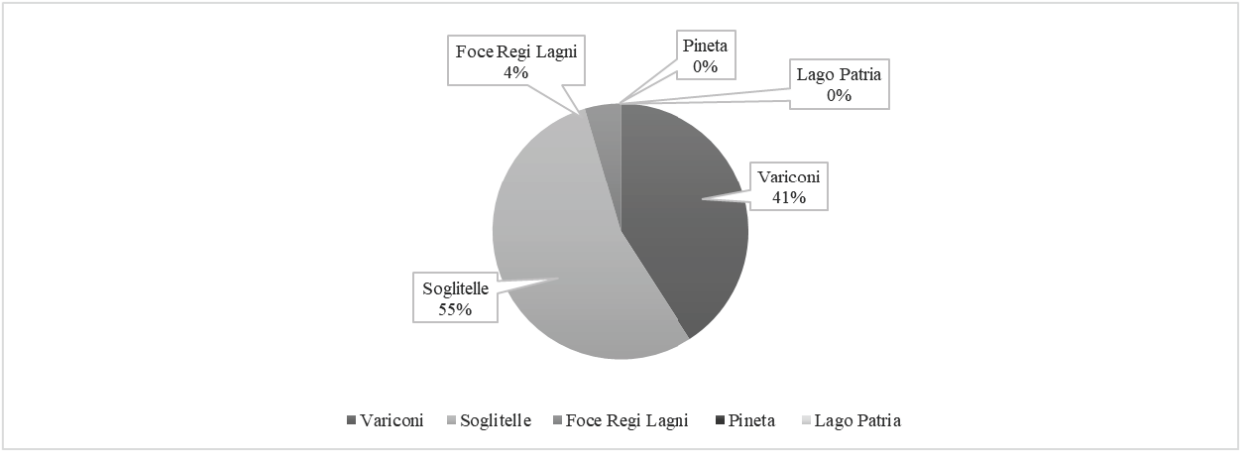

Figura 5. Species richness of Odonata found in the various sampling sites.

distribution (Fig. 6).

The key historical factor that shaped the Odonate fauna of the Palearctic coincides with the periods of glaciation, during which the northern regions were uninhabitable except for the hardiest of odonates, while in the South, greater diversity was confined to a small number of refuges. The most recent glacial period ended approximately 11.700 years ago, from which it is estimated that in most of the Palearctic, the Odonate fauna consists of species that arrived only in the last approximately 10.000 years (Kalkman et al., 2022).

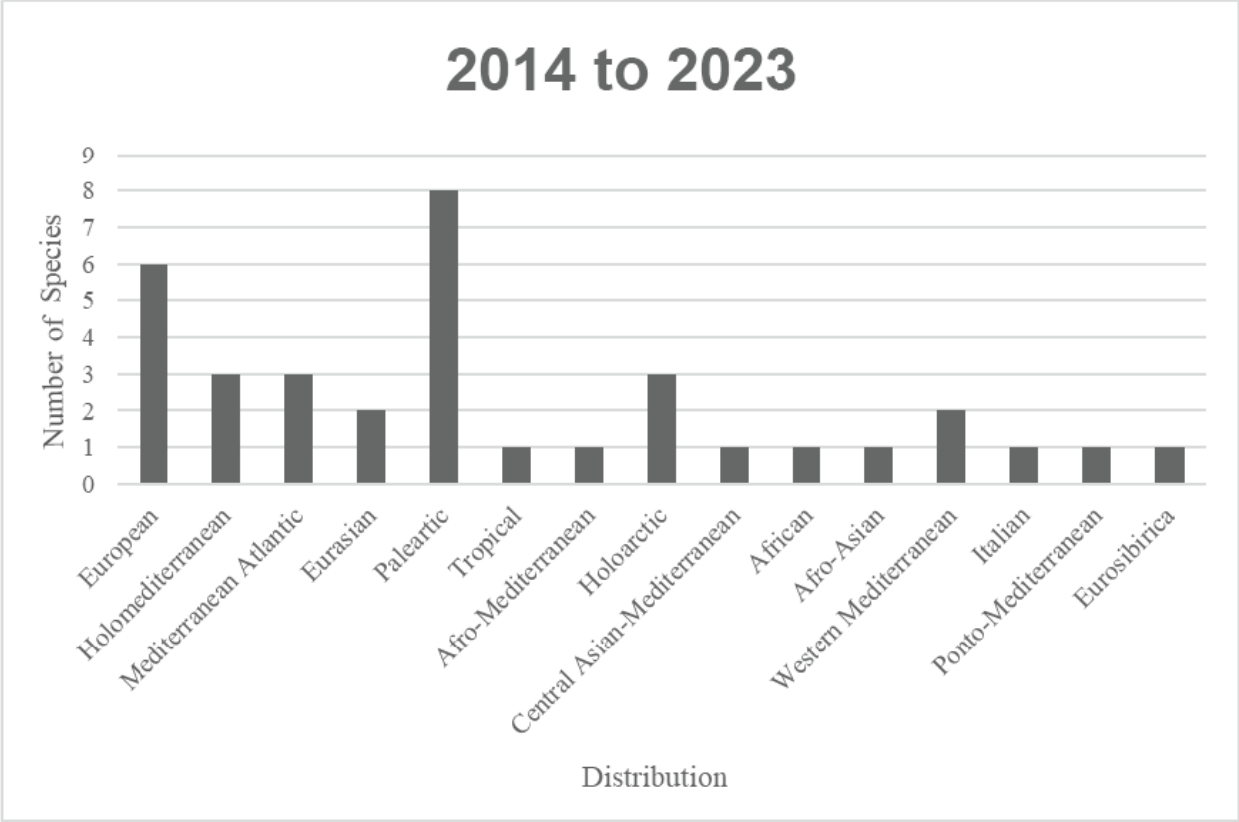

Figura 6. Distribution of the species surveyed throughout the entire area of the RNR from 2014 to 2023.

Discussion

The current distribution of Odonata reflects millions of years of geographic isolation, dispersion, and adaptation to climatic variations, contributing to speciation phenomena and endemism (Samways 1992, 2006). In a globally warming climate, changes in the current biogeography of Odonata are predicted. It is hypothesized that this process will lead to the loss of high-altitude habitat requirements, disadvantaging some specialist individuals (Samways 1992; Stevens & Bailowitz, 2009), while favoring the expansion to higher latitudes of tropical taxa adapted to warmth (Samways 2006). Anisoptera are generally much stronger fliers than damselflies, and most migratory taxa belong to the superfamily *Libelluloidea*. An analysis of biogeographic patterns for the Palearctic region has shown that the biogeographic patterns of *Anisoptera* reflect historical events of vicariance and dispersion, while *Zygoptera*, with relatively limited dispersal, show distributions that appear to reflect more the effect of climate (Heiser & Schmitt, 2010).

This study has returned the expected results regarding species already reported for the territory of the Regional Natural Reserve "Foce Volturno - Costa di Licola" (Guglielmi et al., 2024), with the addition of another 3 species surveyed and not reported in the previous contributions by D'Antonio C. (1986, 1995). The samplings carried out in the various sites of the Reserve allowed the finding of a specimen of *Selysiothemis nigra* in the wetland area of Soglitelle. This species can be observed from mid-May to September, with sporadic and not abundant populations in the national territory, but with an increasing trend suggesting an expansion in the near future (www.iucn.org). Its presence had already been detected by

Figura 7. *Orthetrum trinacria* specimen photographed at Foce Regi Lagni (Photo: Pasquale Liccardo).

Janni et al. (2013) during surveys conducted in the province of Caserta starting from 2005 but is reported as a new species compared to the local odonate fauna of the Regional Natural Reserve "Foce Volturno - Costa di Licola." The Soglitelle wetland area emerged as the most important in terms of species richness at the local level and is probably a hot spot for dragonfly conservation at the regional scale.

In the territory of Variconi, *Brachytron pratense* was found, observable from April until the end of June, and although populations are fragmented, they show a stable trend in the national territory (www.iucn.org). The species had never been reported in Campania before. At the Foce Regi Lagni, the presence of *Orthetrum trinacria* was documented for the first time in the region, thanks to the contribution provided by a citizen scientist. This species can be observed from June to October in stagnant water basins. Its discovery could represent a significant event since the species in Italy was significantly present only in Sicily, Sardinia, and recently found in Calabria (www.iucn.org).

In addition to these three reports, it is also noted among the specimens surveyed the discovery of species listed in the 1995 Campania check-list but not included in the previous local Variconi check-list of 1986: *Orthetrum brunneum*, *Orthetrum cancellatum*, *Orthetrum coerulescens*, and *Trithemis annulata*.

Based on the data provided by this research, the presence of some species observed continuously over the years is confirmed. Considering that the 22 species of Odonata found belong to the different suborders *Zygoptera* and *Anisoptera*, and thus have differentiated ecological needs, it can be stated that the area of the Regional Natural Reserve "Foce Volturno – Costa di Licola" presents a significant biogenetic richness and diversity of environments, indicative of important naturalistic value.

This contribution provides an updated overview of the odonatofauna of the Protected Area, with the perspective of further multi-year sampling aimed at assessing the trends of the populations of the recorded species and possible management interventions to be implemented in case the presence of endangered species is detected. The surveys can also be used as a baseline study in future assessments of aquatic ecosystems. Understanding the ecological dynamics of these organisms can provide useful information for the development of effective conservation and management decision-making processes (Mendes et al., 2017), mostly aimed at maintaining a high level of habitat naturalness.

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Author contributions

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References

Calvão L.B., Vital M.V.C., Lima-Filho G.F., Oliveira-Junior J.M.B., Pinto N.S., De M.P.J. (2013). Thermoregulation and microhabitat choice in Erythrodiplax latimaculata Ris males (Anisoptera: Libellulidae). *Odonatologica*, **42,** 97–108.

Calvão L.B., Juen L., Oliveira-Junior J.M.B., Batista J.D., De MPJ (2018). Land use modifies Odonata diversity in streams of the Brazilian Cerrado. *Journal of Insect Conservation* **22**, 675–685. https://doi.org/10.1007/s10841-018-0093-5.

Carchini G., Rota E. (1986). Attuali conoscenze sulla distribuzione degli odonati dell'Italia meridionale. *Biogeographia*, **10**, 629–684.

Carvalho F.G., Pinto N.S., Oliveira Junior J.M.B., Juen L. (2013). Effects of marginal vegetation removal on Odonata communities. *Acta Limnolologica Brasiliensa*, **25**, 10–18.

Carvalho F.G., Oliveira Roque F., Barbosa L., Assis Montag L.F., Juen L. (2018). Oil palm platation is not a suitable environment for most forest specialist species of Odonata in Amazonia. *Animal Conservation*, **21***,* 526–533. https://doi.org/10.1111/acv.12427

Corbet P. S. (1980). Biology of Odonata. *Annual Review of Entomology*, **25,** 189–217. https:// doi. org/ 10. 1146/ annur ev. en. 25. 010180. 001201.

Corbet P.S. (1999). Dragonflies: behavior and ecology of Odonata. *Comstock Publ. Assoc, Ithaca, NY*, xxxii + 829 pp.

D'Antonio C. (1985). Attuali conoscenze sul popolamento odonatologico della Campania (III contributo alla conoscenza degli Odonati). *Bollettino della Società dei naturalisti in Napoli*, **94***,* 187-201.

D'Antonio C. (1986). Ricerche faunistiche nell'Oasi dei Variconi (Foce del fiume Volturno - Caserta). I. Gli Odonati. *Bollettino Associazione Romana di Entomologia* **40**, 1-7.

D'Antonio C. (1995). Gli Odonati della Campania (Odonata). *Bollettino Associazione Romana di Entomologia,* **127**(2), 103-116.

De Filippo G. (2020). Piano d'ambito regionale. Studio di incidenza sui siti Natura 2000 - Integrato alla VAS. https://www.enteidricocampano.it/wp-content/uploads/2021/12/Allegato-5-Relazione-per-la-VINCA.pdf

Dijkstra Klaas-Douwe B., Schröter A. (2021). Libellule d'Italia e d'Europa. *Ricca Editore,* Roma*,* 336 pp.

FormulariStandarddelleZSCinCampania(2019): https://download.mase.gov.it/Natura2000/Materiale%20Designazione%20ZSC/Campania/02_Formulari%20Standard/

Golfieri B., Hardersen S., Maiolini B. (2013). Odonati come indicatori ecologici del corridoio fluviale: risultati preliminari relativi a fiumi alpini italiani. *Conference Paper*, VI Convegno "Le Libellule in Italia", Trevi 16-17 marzo 2013.

Grandi G. (1957). Campagna di ricerche dell'Istituto di Entomologia dell'Università di Bologna nel Parco Nazionale d'Abruzzo. I. Sguardo d'insieme ai risultati della Campagna. Boll. Ist. Ent. Univ. Bologna 23, p. 133.

Guglielmi M., de Filippo G., Elicio F., Usai A. (2024). Revisione delle conoscenze sulle Libellule e Damigelle nella Riserva Naturale Regionale "Foce Volturno - Costa di Licola". Riassunti del XIV Convegno Nazionale "Le Libellule in Italia", p. 6., Oasi di Pantanello (Cisterna di Latina), 20-21 Aprile 2024. Habitat Italia (2023). Manuale Italiano di interpretazione degli habitat della Direttiva 92/43/CEE. http://vnr.unipg.it/habitat/

Heiser M., Schmitt T. (2010). Do different dispersal capacities influence the biogeography of the western Palearctic dragonflies (Odonata)? *Biological Journal of the Linnean Society*, **99**, 177–195.

IUCN Italia. https://www.iucn.it/

Janni O., Corso A., Capobianco G. (2013). Nuove scoperte odonatologiche dalla provincia di Caserta, p. 32, *Conference Paper*, VI Convegno "Le Libellule in Italia", Trevi 16-17 marzo 2013.

Jumaat A.H., Ab Hamid S. (2023). Monitoring Heavy Metal Bioaccumulation in Rivers Using Damselflies (Insecta: Odonata, Zygoptera) as Biological Indicator. *Sains Malaysiana*, **52**(2), 321-331.
http://doi.org/10.17576/jsm-2023-5202-01

Kalkman V.J., Boudot J.P., Futahashi R., Abbott J.C., Bota-Sierra C.A., Guralnick R., Bybee S.M., Ware J., Belitz M.W. (2022). Diversity of Palaearctic Dragonflies and Damselflies (Odonata). *Diversity* **14**, no. 11, 966. https://doi.org/10.3390/d14110966

Kuhn W. (2021). IUCN Redlist: over 6000 dragonfly species assessed. Worldwide Dragonfly Association. https://worlddragonfly.org/iucn-redlist-over-6000-dragonfly-species-assessed/

La Porta G., Landi F., Leandri F., Assandri, G. (2023). The new Checklist of the Italian Fauna: Odonata. *Biogeographia – The Journal of Integrative Biogeography,* **38**(1), 1-14. http://dx.doi.org/10.21426/B638158781 Retrieved from https://escholarship.org/uc/item/72f1309t

May M.L. (1976). Thermoregulation in adaptation to temperature in dragonflies (Odonata: Anisoptera). *Ecological Monographs*, **46,** 1–32.

Mendes T. P., Oliveira-Junior J. M. B., Cabette H. S. R., Batista J. D., Juen L. (2017). Congruence and the biomonitoring of aquatic ecosystems: Are odonate larvae or adults the most effective for the evaluation of impacts. *Neotropical Entomology,* **46,** 631–641. https:// doi. org/ 10. 1007/ s13744- 017- 0503-5.

Miguel T. B., Oliveira-Junior J. M. B., Ligeiro R., Juen L. (2017). Odonata (Insecta) as a tool for the biomonitoring of environmental quality. *Ecological Indicators,* **81,** 555–566. https:// doi. org/ 10. 1016/j. ecoli nd. 2017. 06. 010.

Monteiro-Júnior C.S., Couceiro S.R.M., Hamada N., Juen L. (2013). Effect of vegetation removal for road building on richness and composition of Odonata communities in Amazonia, Brazil. *International Journal of Odonatology,* **16,** 135–144.

Nasirian H., Irvine K.N. (2017). Odonata larvae as a bioindicator of metal contamination in aquatic environments: application to ecologically important wetlands in Iran. *Environmental Monitoring and Assessment* **189**, 436. DOI 10.1007/s10661-017-6145-6

Neri V. (2021). Le libellule stanno scomparendo, insieme alle zone umide. *LifeGate*, 10 dicembre 2021, https://www.lifegate.it/libellule-estinzione-zone-umide-iucn

Oertli B. (2008). The use of dragonflies in the assessment and monitoring of aquatic habitats, pp 79–95. In: *Model Organisms*

for Ecological and Evolutionary Research. Cordoba-Aguilar A (ed). Oxford University Press, Oxford.

Oliveira-Junior J. M. B., Juen L. (2019). The Zygoptera/Anisoptera ratio (Insecta: Odonata): A new tool for habitat alterations assessment in amazonian streams. *Neotropical Entomology*, **48,** 552–560. https:// doi. org/ 10. 1007/s13744- 019- 00672-x.

Oliveira-Junior J.M.B., Silva-Pinto N.S., Cabette H.S.R., Juen L. (2013). As variações na comunidade de Odonata (Insecta) em córregos podem ser preditas pelo Paradoxo do Plâncton? Explicando a riqueza de espécies pela variabilidade ambiental. *EntomoBrasilis*, **6**, 1–8.

Olsen C.R., Cutshall N.H., Larsen I.L. (1982). Pollutant-particle associations and dynamics in coastal marine environments: a review. *Marine Chemistry*, **11,** 501- 533.

Remsburg A.J., Olson A.C., Samways M.J. (2008). Shade alone reduces adult dragonfly (Odonata: Libellulidae) abundance. *Journal of Insect Behaviour,* **21,** 460–468.

Riservato E., Fabbri R., Festi A., Grieco C., Hardersen S., Landi F., Utzeri C., Rondinini C., Battistoni A., Teofili C. (2014a). Lista Rossa IUCN delle libellule Italiane. *Comitato Italiano IUCN e Ministero dell'Ambiente e della Tutela del Territorio e del Mare, Roma*.

Riservato E., Festi A., Fabbri R., Grieco C., Handersen S., La Porta G., Landi F., Siesa M.E., Utzeri C. (2014b). Odonata - Atlante delle libellule italiane – preliminare. Società Italiana per lo Studio e la Conservazione delle Libellule. Edizioni Belvedere. Latina, "le scienze" (17), 224 pp.

Rodrigues M.E., Roque F.O., Quintero J.M.O., Pena J.C.C., Sousa D.C., De Marco P. (2016). Nonlinear responses in damselfly community along a gradient of habitat loss in a savanna landscape. *Biological Conservation*, **194,** 113–120.

Samways M.J. (1992). Dragonfly conservation in South Africa: a biogeographical perspective. *Odonatologica*, **21**, 165–180.

Samways M.J. (2006). National Red List of South African dragonflies (Odonata). *Odonatologica,* **35**, 341–368.

Sánchez-Herrera M., Ware J.L. (2012). Biogeography of Dragonflies and Damselflies: Highly Mobile Predators, *Global Advances in Biogeography, Dr. Lawrence Stevens (Ed.),* ISBN: 978-953-51-0454-4, InTech, Available from: http://www.intechopen.com/books/global-advances-in-biogeography/biogeography-ofdragonflies-and-damselflies-the-highly-mobile-predators-

Silva L. F. R., Castro D. M. P., Juen L., Callisto M., Hughes R. M., Hermes M. G. (2012a). Functional responses of Odonata larvae to human disturbances in neotropical savanna headwater streams. *Ecological Indicators*, **133,** 108367. https:// doi. org/ 10. 1016/j. ecoli nd. 2021. 108367.

Silva L. F. R., Castro D. M. P., Juen L., Callisto M., Hughes R. M., Hermes M. G. (2012b). A matter of suborder: are Zygoptera and Anisoptera larvae influenced by riparian vegetation in Neotropical Savanna streams? *Hydrobiologia,* **848,** 4433–4443. https:// doi. org/ 10. 1007/s10750- 021- 04642-6.

Stevens L.E., Bailowitz R.A. (2009). Odonata Biogeography in the Grand Canyon Ecoregion, Southwestern USA. *Annals of the Entomological Society of America,* **102** (2), 261-274.

Tscharntke T., Steffan-Dewenter I., Kruess A., Thies C. (2002). Contribution of small habitat fragments to conservation of insect communities of grassland-cropland landscapes. *Ecological Applications*, **12**, 354–363.

Utzeri C., D'Antonio C. (2005). Insecta Odonata. In: Ruffo, S. & Stoch, F. (ed.s), Check-list e distribuzione della fauna italiana., *Memorie del Museo Civico di Storia Naturale di Verona,* 2 serie, p. 131.

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