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LISTS OF SPECIES

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Checklist of benthic macroinvertebrates of the Lago Pratignano (northern Apennines, Italy): an extremely rich ecosystem

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Abstract: A checklist of the macroinvertebrates fauna of the Lago Pratignano is presented here. The Lago Pratignano is a small, natural water body of the high (1,307 m above sea level) Northern Apennines, Italy. It represents an important site for the conservation of endangered flora and amphibians, and its importance for the conservation of the macroinvertebrate fauna is highlighted. The 82 taxa recorded make it an extremely rich habitat. The most represented group was Diptera, with 31 taxa, followed by Coleoptera, with nine, and Oligochaeta and Arachnida, each with eight taxa. Other groups are present in lower numbers. Despite the scant attention to theP study of the macroinvertebrates of small lentic habitats in the Northern Apennines, their importance for the conservation of the invertebrate fauna and the high contribution they give to the biodiversity is highlighted here.

Key words: biodiversity; ponds; macrozoobenthos community; Parco del Frignano; Modena

INTRODUCTION

Ponds offer a wide variety of habitats (Davies et al. 2008), represent important hotspots for biodiversity (EPCN 2008), and compared to all other water body types, they support more unique and rare species (Williams et al. 2004). These ecosystems contribute significantly to biological diversity (Ruggiero et al. 2005); altogether, they host a larger number of species than rivers, lakes or streams (Williams et al. 2004). Despite their high ecological value, they are nowadays the most vulnerable and threatened water ecosystems, yet they still receive scant attention in political and legislative spheres (EPCN 2008). The macroinvertebrate community contributes to this biodiversity with its species playing essential roles in different key processes of these ecosystems (Reice and Wohlenberg 1993). Therefore, they have been chosen by the Directive 2000/60/EC (Water Framework Directive) as indicators of the ecological status of waterbodies (CEC 2005).

Local and national authorities protect most of the mountain areas along the Apennines in Italy, but the few natural ponds are still under threat even if they are within natural parks (Solimini et al. 2008). Some information on the macrozoobethic community of small water bodies is present for Europe (Boix et al. 2001; Sahuquillo et al. 2007; Oertli et al. 2008; Céréghino et al. 2012; Guareschi et al. 2012; Novikmec et al. 2015). In Italy, there are data for alpine mountains ponds (Boggero et al. 2005; Boggero and Lencioni 2006; Füreder et al. 2006; Maiolini et al. 2006; Steingruber et al. 2013) and for lowland ponds (Solimini et al. 2005; Della Bella et al. 2005; Della Bella and Mancini 2009). However, only scattered information is available for the central Apennines Mountains (Solimini et al. 2008) and none for the northern and southern parts. The northern part of the Apennines is located between two different phytogeographic regions: the Euro-Siberian region to the north and the Mediterranean region to the south (Alessandrini et al. 2003). This area at the boundary between two different phytogeographic regions should be investigated: high-altitude aquatic ecosystems may be more sensitive to global climate change than aquatic ecosystems at lower elevations (Theurillat and Guisan 2001) and could be more quickly affected by climate change.

As at the national level, data on these water bodies in the province of Modena are scattered. There are several publications on the macroinvertebrates of the lowlands (Ansaloni and Prevedelli 2008; Ansaloni et al. 2009, 2010, 2014) but none on the macroinvertebrates of the high Apennines. Only studies on plankton (Moroni 1962), vegetation (Accorsi et al. 1981), amphibians (Sala et al. 1996), physico-chemical parameters of the waters (Boraldi et al. 2005) and single groups of macroinvertebrates (Rocchi 2009) are available.

The importance of the Lago Pratignano for the richness and the peculiarity at a regional scale level of its flora and fauna has already been highlighted by Accorsi et al. (1982), Mazzoldi et al. (2009) and Alessandrini et al. (2010). However, no studies on the macroinvertebrate community of this pond have been published. The aim of this paper is to highlight the richness of the macroinvervetebrate community in this pond, to show seasonal variations, and to create a baseline of information for the conservation and the possible future management of this valuable habitat. Furthermore, this study adds to the basic knowledge on these habitats, which are still barely known in the northern Apennines.

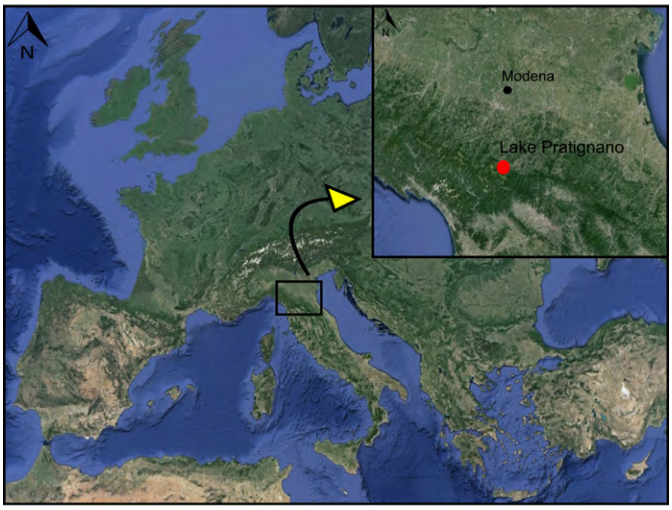


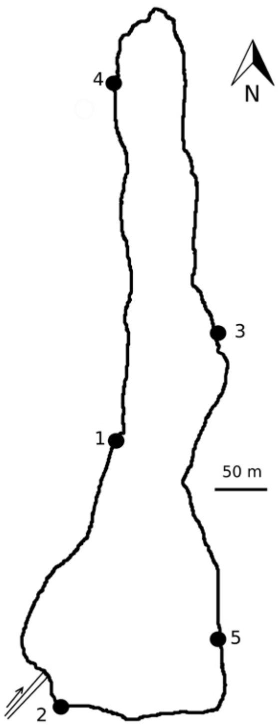
Figure 1. Map of the study area (modified after Google Earth™ Pro 7.1.5.1557).

MATERIALS AND METHODS

Study site

The Lago Pratignano (44°12′39″ N, 010°43′30″ E) is a small, high-altitude water body located at 1,307 m above sea level within the Regional Park of the High Modena Appenines (Parco Regionale dell'Alto Appennino Modenese, Northen Apennines, Italy) and the SCI-SPA IT4040001 "Cimone, Libro Aperto, Lago di Pratignano" of the Natura 2000 network (Figure 1). The Lago Pratignano has a total surface area of about 50,000 m^2; the mean depth is about 2 m and the maximum depth is 4.5 m. Through the year, the water level varies by about 0.4 m. Considering its dimensions and its mean depth, it can be defined as a pond according to the European Pond Conservation Network (EPCN 2008). The pond has a semi-triangular outline that is elongated on a north–south axis. One small tributary flows into the pond at its southern edge and there is no outflow (Figure 2). The presence of water is guaranteed by a broad catchment basin, by the permeability of the surrounding ground and by the presence of a thick covering of ice from December through to the end of March to April. Other morphometric and geological information of the area can be found in Bertacchini et al. (1999). According to Kottek et al. (2006), the climate of the area of the Lago Pratignano is warm temperate and fully humid with warm summers (Cfb type following the Köppen-Geiger climate classification).

Different vegetation typologies are present within the pond (Figure 3). In the southern part, where the pond is deepest, the vegetation is characterized by the presence of the hydrophytes: *Potamogeton natans*, *P. oblongus*, *P. trichoides* and *Myriophyllum spicatum*. Near the shore, where the depth is less than 1 m, *Potamogeton* sp., *Sparganium emersum* and *Ranunculus trichophyllus* subsp. *trichophyllus* are present. The vegetation in the shallows (water 0.8–1 m deep) is characterized by



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Figures 2 and 3. The pond Lago Pratignano. **2:** Map of the Lago Pratignano showing the location of the sampling stations. **3:** View of the pond from sampling station 5.

concentric belts of *Menyanthes trifoliata*, *Carex rostrata* and *Carex versicaria* (from deepest to shallow water). At the margins, a discontinuous formation of *Alopercurus aequalis*, *Eleocharis palustris*, *Oenanthe acquatica* and *Hottonia palustris* is present. Finally, there is a peat bog and associated vegetation that is located at the north end of the pond where, among *Menyanthes trifoliata* and *Phragmites australis*, there is a wide floating pillow of *Sphagnum cuspidatum* and *Sphagnum* sp. It is there that *Drosera rotundifolia, Utricularia australis* and *U. vulgaris* (Alessandrini et al. 2010), three interesting species for the Italian flora, can be found.

Data collection

The sampling of macrozoobenthos was performed in spring, summer and autumn 1999 and in summer 2006. All ice-free seasons were sampled to detect possible differences and to record all the biodiversity present in the pond. No samples were taken during winter because of ice on the pond. The summer sampling was repeated in 2006 as it resulted that the biodiversity was richest in that season after the first campaign of 1999. Five sampling sites (St. 1, St. 2, St. 3, St. 4 and St. 5) were selected to cover all the different substrates and littoral vegetation types (Figure 2). Station 4 was sampled only in spring 1999 because this area dried during the summer of 1999 and 2006 and autumn of 1999; station 2 was not sampled in autumn of 1999 for the same reason. The relative dominance of the different substrates and littoral vegetation types were considered so as to equally distribute the sampling effort over all habitat types. No quantitative samples could be taken because of the variability of the substrate (from mud to sand and from organic deposits to submerged grassland) and because of the presence of the submerged vegetation that could be sampled only with a dip net.

At each sampling site the main physico-chemical parameters were recorded seasonally. Data included water temperature, pH, conductivity, dissolved oxygen and percent oxygen saturation that were recorded by a portable instrument.

Zoobenthos samples were taken from the littoral zone to a maximum depth of 0.5 m using a dip net (25 × 25 cm wide; 250 µm mesh size) according to Storey et al. (1991). Collections were made under permit (Prot. n. 677) from the Director of the Regional Park of the High Modena Appenines. Specimens were preserved in 5% formalin. In the laboratory, animals were processed through a series of sieves (5, 2, 1 and 0.5 mm mesh size), preserved in 70% ethanol and then sorted. Hydrachnidia were preserved in Koenike's fluid, clarified in Andre's fluid and mounted in Hoyer's medium for identification. The identification took place under a stereomicroscope or a microscope to the lowest possible taxonomic level. The word *taxa* was used in the results and discussion paragraphs to relate different groups to the lowest taxonomic level.

The identification of Leptolida was based on the Campbell (1989) classification. The identification of other taxa were based on keys provided by Girod et al. (1980; Mollusca), Brinkhurst and Jamieson (1971; Oligochaeta), Minelli (1977; Irudinea), Argano (1979; Isopoda), Carchini (1983; Odonata), Belfiore (1983; Ephemeroptera), Consiglio (1980; Plecoptera), Tamanini (1979; Heteroptera), Franciscolo (1979; Coleoptera), Moretti (1983; Trichoptera), Campaioli et al. (1999; Lepidoptera), Rivosecchi (1984; Diptera Ceratopogonidae and Chaoboridae), Nocentini (1985; Diptera Chironominae), and Ferrarese (1983; Diptera Tanypodinae), Rossaro (1982; Diptera Orthocladiinae). The identification of Hydrachnidia was based mainly on Viets (1936) and Lundblad (1967). The nomenclature was uniformed and updated following Fauna Europea (de Jong et al. 2014).

All the identified material is available for study as alcohol-preserved samples or permanent slide collections in the Department of Life Sciences at the University of Modena and Reggio Emilia.

RESULTS

The values of the measured physico-chemical parameters are shown in Table 1. The strongest variations were found in water temperature. It ranged from 4.5°C in spring 1999 at site 1, to 20.5°C at site 2 in summer 2006. Oxygen had low concentration but presented seasonal variations: its maximum value was reached in spring 1999 with 8 mg·l^{-1} (site 4) and a saturation of 80% at site 4; its minimum value was reached in summer 2006 when the oxygen concentration was 0.4 mg l^{-1} at site 5 with a saturation of 6%. The pH values resulted relatively homogeneous, both in space and time. The maximum value of 7.16 was recorded at site 4 in spring 1999 and minimum of 5.18 recorded at site 1 in summer 1999.

Table 1. Physico-chemical parameters of the pond Lago Pratignano recorded during the samplings.

	Spring 1999					Summer 1999				Autumn 1999			Summer 2006			
	St. 1	St. 2	St. 3	St. 4	St. 5	St. 1	St. 2	St. 3	St. 5	St. 1	St. 3	St. 5	St. 1	St. 2	St. 3	St. 5
Temperature [°C]	14.40	14.50	13.90	13.40	14.30	19.20	19.00	17.70	19.20	4.50	5.90	7.10	17.50	20.50	18.50	19.60
Dissolved oxygen [mg·l^{-1}]	4.00	3.70	2.50	8.00	5.40	4.00	4.80	1.40	5.40	5.50	4.30	3.90	1.30	2.80	0.60	0.40
Dissolved oxygen sat. [%]	42.00	37.00	25.00	80.00	31.00	45.00	49.00	18.00	60.00	47.00	41.00	35.00	18.00	43.00	9.00	6.00
pH	6.30	7.10	6.50	7.16	7.10	5.18	6.10	6.30	6.50	6.30	7.20	6.40	5.44	5.82	5.93	6.17
Conductivity [µS·cm^{-1}]	73.00	75.00	75.00	45.00	70.00	67.00	62.00	58.00	58.00	65.00	36.00	45.00	61.40	68.60	107.70	69.60

Table 2. Checklist of benthic macroinvertebrates of the pond Lago Pratignano. Plus sign indicate presence of taxa at sampling stations.

				Spring 1999					Summer 1999				Autumn 1999			Summer 2006				
Class	Order	Family		St. 1	St. 2	St. 3	St. 4	St. 5	St. 1	St. 2	St. 3	St. 5	St. 1	St. 3	St. 5	St. 1	St. 2	St. 3	St. 5	Voucher's number
Leptolida	Capitata	Hydridae	*Hydra (Chlorohydra) viridissima* Pallas, 1766						+											LABE_PR99001
Gastropoda	Pulmonata	Lymnaeidae	*Radix labiata* (Rossmassler, 1835)			+		+		+	+		+	+	+	+				LABE_PR99101/LABE_PR06101
	Neotaenioglossa	Bithyniidae	*Bithynia tentaculata* (Linnaeus, 1758)	+																LABE_PR99102
Oligochaeta	Tubificida	Naididae	*Homochaeta naidina* Bretscher, 1896		+	+			+			+				+	+		+	LABE_PR99201/LABE_PR06201
			Homochaeta setosa (Moszynski, 1933)		+	+			+											LABE_PR99202
			Nais communis Piguet, 1906														+			LABE_PR06202
			Pristina (Pristinella) bilobata (Bretscher, 1903)													+	+			LABE_PR06203
		Enchytraeidae	Enchytraeidae indet.													+	+			LABE_PR06204
	Haplotoxida	Haplotoxidae	Haplotaxidae indet.													+	+			LABE_PR06205
	Lumbriculida	Lumbriculidae	*Lumbriculus variegatus* (Müller, 1774)													+		+		LABE_PR06206
			Lumbriculus sp.													+				LABE_PR06207
Hirudinea	Arhynchobdellida	Erpobdellidae	*Dina lineata* (Müller, 1774)							+										LABE_PR99301
			Erpobdella testacea (Savigny, 1820)		+	+	+		+	+	+		+	+	+	+	+	+	+	LABE_PR99302/LABE_PR06301
	Rhynchobdellida	Glossiphoniidae	*Glossiphonia* sp.															+		LABE_PR06302
			Helobdella stagnalis (Linnaeus, 1758)								+					+	+	+	+	LABE_PR99303/LABE_PR06303
Aracnida	Prostigmata	Limnesiidae	*Limnesia undulata* (Müller, 1776)	+	+		+	+	+	+	+	+	+	+	+		+	+	+	LABE_PR99401/LABE_PR06401
		Unionicolidae	*Neumania (Neumania) deltoides* (Piersig, 1894)						+	+	+	+			+	+	+		+	LABE_PR99402/LABE_PR06402
		Pionidae	*Hydrochoreutes krameri* Piersig, 1896						+	+	+						+			LABE_PR99403/LABE_PR06403
			Piona (Dispersipiona) conglobata (Koch, 1836)						+	+	+	+		+	+		+		+	LABE_PR99404/LABE_PR06404
		Arrenuridae	*Arrenurus (Megaluracarus) buccinator* (Müller, 1776)				+													LABE_PR99405
			Arrenurus (Arrenurus) cuspidator (Müller, 1776)					+												LABE_PR99406
			Arrenurus (Megaluracarus) cylindratus Piersig, 1896				+													LABE_PR99407
			Arrenurus n.d.	+				+			+	+	+				+	+		LABE_PR99408/LABE_PR06405
Malacostraca	Isopoda	Asellidae	*Asellus aquaticus* (Linnaeus, 1758)			+	+	+			+		+	+		+	+	+		LABE_PR99501/LABE_PR06501
Insecta	Ephemeroptera	Baetidae	*Cloeon cognatum* Stephens, 1836	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	LABE_PR99601/LABE_PR06601
	Odonata	Lestidae	*Lestes viridis* (Vander Linden, 1825)											+	+					LABE_PR99602
		Coenagrionidae	*Coenagrion puella* (Linnaeus, 1758)	+	+	+		+		+			+	+	+				+	LABE_PR99603/LABE_PR06602
		Aeshnidae	*Anax imperator* Leach, 1815													+	+			LABE_PR06603
		Libellulidae	*Libellula depressa* Linnaeus, 1758								+				+			+	+	LABE_PR99604/LABE_PR06604
			Libellula quadrimaculata Linnaeus, 1758										+	+	+					LABE_PR99605
	Plecoptera	Nemouridae	*Nemoura cinerea* (Retzius, 1783)	+	+															LABE_PR99606
	Hemiptera	Nepidae	Nepa cinerea Linnaeus, 1758								+				+		+			LABE_PR99607/LABE_PR06605
		Gerridae	*Gerris (Gerris) lacustris* (Linnaeus, 1758)		+															LABE_PR99608
			Limnoporus rufoscutellatus (Latreille, 1807)								+									LABE_PR99609
			Gerris (Gerriselloides) asper (Fieber, 1860)													+		+	+	LABE_PR06606
			Gerris sp.							+		+	+							LABE_PR99610
		Corixidae	*Sigara (Subsigara) fossarum* (Leach, 1817)													+	+		+	LABE_PR06607
		Notonectidae	*Notonecta (Notonecta) glauca* Linnaeus, 1758																+	LABE_PR06608
	Coleoptera	Haliplidae	*Haliplus* sp.	+	+				+								+	+		LABE_PR99611/LABE_PR06609
		Dytiscidae	Hydroporinae indet.						+	+	+					+		+		LABE_PR99612/LABE_PR06610
			Graphoderus sp.						+	+		+						+	+	LABE_PR99613/LABE_PR06611
			Dytiscus sp.							+	+							+		LABE_PR99614/LABE_PR06612

Continued

Table 2. *Continued.*

Class	Order	Family		Spring 1999					Summer 1999				Autumn 1999			Summer 2006				Voucher's number
				St. 1	St. 2	St. 3	St. 4	St. 5	St. 1	St. 2	St. 3	St. 5	St. 1	St. 3	St. 5	St. 1	St. 2	St. 3	St. 5	
			Laccophilus poecilus Klug, 1834	+												+		+	+	LABE_PR99615/LABE_PR06613
		Helophoridae	*Helophorus* spp.			+											+	+		LABE_PR99616/LABE_PR06614
		Hydrochidae	*Hydrochus* sp.											+		+		+	+	LABE_PR99617/LABE_PR06615
		Hydrophilidae	*Enochrus* sp.													+		+	+	LABE_PR06616
	Tricoptera	Limnephilidae	*Limnephilus auricula* Curtis, 1834	+	+			+												LABE_PR99618
			Limnephilus bipunctatus Curtis, 1834	+	+			+		+		+				+				LABE_PR99619/LABE_PR06617
			Limnephilus marmoratus Curtis, 1834	+	+		+	+		+		+	+		+					LABE_PR99620
			Limnephilus vittatus (Fabricius, 1798)	+	+	+	+				+	+								LABE_PR99621
		Phryganeidae	*Agrypnia varia* (Fabricius, 1793)	+									+							LABE_PR99622
	Lepidoptera	Crambidae	*Elophila nymphaeata* (Linnaeus, 1758)	+	+	+			+		+		+	+	+	+			+	LABE_PR99623/LABE_PR06618
	Diptera	Ceratopogonidae	*Bezzia* sp.						+	+	+	+				+	+	+	+	LABE_PR99624/LABE_PR06619
			Forcipomyia sp.													+		+		LABE_PR06620
		Chironomidae	*Chironomus* sp.						+	+	+	+			+					LABE_PR99625
			Chironomus (Chironomus) plumosus (Linnaeus, 1758)			+			+	+	+	+		+	+	+	+	+	+	LABE_PR99626/LABE_PR06621
			Cladopelma sp.														+			LABE_PR06622
			Dicrotendipes spp.						+	+	+	+	+	+	+	+	+	+	+	LABE_PR99627/LABE_PR06623
			Endochironomus spp.													+		+	+	LABE_PR06624
			Endochironomus tendens (Fabricius, 1775)	+														+	+	LABE_PR99628/LABE_PR06625
			Glyptotendipes sp.	+													+		+	LABE_PR99629/LABE_PR06626
			Micropsectra sp.															+	+	LABE_PR06627
			Parachironomus sp.	+	+	+		+	+	+	+	+				+	+	+	+	LABE_PR99630/LABE_PR06628
			Kiefferulus (Kiefferulus) tendipediformis (Goetghebuer, 1921)						+											LABE_PR99631
			Polypedilum sp.														+		+	LABE_PR06629
			Tanytarsus sp.						+		+					+	+	+	+	LABE_PR99632/LABE_PR06630
			Corynoneura sp.													+		+		LABE_PR06631
			Cladotanytarsus sp.						+		+	+								LABE_PR99633
			Paratanytarsus spp.		+			+	+	+	+									LABE_PR99634
			Procladius sp.						+	+	+	+	+	+	+	+	+	+	+	LABE_PR99635/LABE_PR06632
			Tanypus (Tanypus) kraatzi (Kieffer, 1912)						+		+	+								LABE_PR99636
			Tanypus sp.													+	+	+	+	LABE_PR06633
			Tvetenia calvescens (Edwards, 1929)	+	+			+	+	+	+	+				+			+	LABE_PR99637/LABE_PR06634
			Cricotopus (Isocladius) sylvestris (Fabricius, 1794)													+	+		+	LABE_PR06635
			Natarsia sp.													+	+	+	+	LABE_PR06636
			Psectrotanypus varius (Fabricius, 1787)													+		+		LABE_PR06637
		Chaoboridae	*Chaoborus (Chaoborus) crystallinus* (De Geer, 1776)													+	+	+		LABE_PR06638
			Chaoborus (Chaoborus) flavicans (Meigen, 1830)						+		+	+				+	+	+		LABE_PR99638/PR06639
		Dixidae	*Dixella* sp.													+		+	+	LABE_PR06640
		Psychodidae	*Psychoda* sp.													+				LABE_PR06641
		Stratiomyidae	*Odontomyia* sp.													+				LABE_PR06642

Conductivity ranged from 107.70 μS cm^{-1} and 36.00 μS cm^{-1} evidencing a gradual decreasing of the values from spring to autumn in all the sampling sites.

A total of 82 different taxa divided in four phyla, belonging to seven classes, 18 orders and 39 families (Table 2) were recorded during the samplings. The richest group was Diptera with 31 taxa, followed by Coleoptera with nine taxa, Oligochaeta and Arachnida with eight taxa. Odonata and Trichoptera were represented by five taxa, Hirudinea by four, Gastropoda by two and Malacostraca, Ephemeroptera, Plecoptera and Leptolida were each represented by one taxon.

During the spring of 1999, 31 taxa were recorded, 40 taxa were recorded during the summer of 1999, while 22 taxa during autumn 1999. In summer 2006, a total of 59 taxa were found. Summer resulted the most reach season in terms of biodiversity collected.

Taxa found both in 1999 and 2006 were 33, while 23 were exclusively recorded only in 1999 and 26 were exclusively recorded in 2006. Differences have been recorded between the 1999 and summer 2006 samples (Table 1) when taxa not previously recorded were found: Oligochaeta (*Nais communis* Piguet 1906, *Pristina (Pristinella) bilobata* (Bretscher, 1903), Enchytraeidae indet., Haplotaxidae indet. and *Lumbriculus variegatus* (Müller, 1774)), the Diptera *Forcipomyia* sp., *Cladopelma* sp., *Micropsectra* sp., *Polypedilum* sp., *Corynoneura* sp., *Cricotopus (Isocladius) sylvestris* (Fabricius, 1794), *Natarsia* sp., *Psectrotanypus varius* (Fabricius, 1787), *Chaoborus (Chaoborus) crystallinus* (De Geer, 1776), *Psychoda* sp. and other insects as *Gerris (Gerriselloides) asper* (Fieber, 1860), *Sigara (Subsigara) fossarum* (Leach, 1817), *Notonecta (Notonecta) glauca* Linnaeus, 1758 and *Enochrus* sp. On the other hand, in 2006 the presence of *Hydra (Chlorohydra) viridissima* were not confirmed, together with the Odonata *Lestes viridis* (Vander Linden, 1825) and *Libellula quadrimaculata* Linnaeus, 1758, the Plecoptera *Nemoura cinerea* (Retzius, 1783) some Hemiptera and the most part of Tricoptera (Table 2). The dipterans *Cladotanytarsus* sp. and *Paratanytarsus* spp. were not reconfirmed, as was a *Dicrotendipes* sp. attributable to the *lobiger* group. Finally, only two species of gastropods were recorded, *Radix labiata* (Rossmässler, 1835) and *Bithynia tentaculata* (Linnaeus, 1758), despite the prominence of this group in aquatic plants.

DISCUSSION

This contribution to the invertebrate macrofauna of a pond in the northern high Apennines is a first attempt to fill a gap in our knowledge. The high number of taxa identified (82) confirms the importance of the Lago Pratignano for macroinvertebrate biodiveristy in the province of Modena and in the northern Apennines.

Comparing the results with other European systems, the Lago Pratignano was found to be extremely rich in the number of taxa (Boix et al. 2001; Sahuquillo et al. 2007; Oertli et al. 2008; Céréghino et al. 2012; Guareschi et al. 2012; Novikmec et al. 2015); at the same time, comparisons of the results with high-altitude habitats in the Alps (Boggero et al. 2005; Boggero and Lencioni 2006; Steingruber et al. 2013) and in the central part of the Apennines, where Solimini et al. (2008) found 61 taxa in a total of 31 ponds, highlight the richness of Lago Pratignano. These results confirm that the northern Apennines could represent an important area for further in-depth investigations of the macroinvertebrate communities of ponds. Moreover, comparison of Coleoptera from Lago Pratignano to a publication by Mazzoldi et al. (2009) found diversity (30 species) to be greater in this study; two species of Dytiscidae are extremely interesting for their rarity and some individuals belonging to the genus *Helophorus* are now under further study because they could represent a new endemic taxon (Mazzoldi et al. 2009). The possible presence of *Dicrotendipes lobiger* in this study should be further investigated because it is a species that is typical of central and northern Europe and alpine region. There is only one station in the central Apennines, and so, it could be considered as a glacial relict (Nocentini 1985).

Unfortunately, no data are available for other ponds of the same region and no comparisons can be made, but from this first list of species it resulted clear that more effort should be made in studying these systems. The climate of the region, the geographic localization and the low human impact on the area could contribute to the richness and peculiarity of the Lago Pratignano, but without additional data only a hypothesis can be done.

Annual differences in meteorological conditions and a globally changing climate can affect the flora and fauna, and in particular, animals with short life cycles as are typical of most macroinvertebrates. The higher number of taxa in summer compared to spring and autumn is easily ascribable to the region's climate. Differences between 1999 and 2006 are also attributable to the periodicity of some groups: the plecopteran *Nemoura cinerea* and the odonate *Libellula quadrimaculata,* for example, are typically found in spring and rarely in summer. Finally, the low diversity of gastropods could be correlated with the physico-chemical properties of the water and in particular with the relatively low pH. In fact, the values recorded during the samplings vary from 5.18 to 7.16 (Table 1) which are values typically obtained from peat bog habitats (Minelli 2004). Low pH values such as these are not ideal for these organisms.

In conclusion, the contribution of the macroinvertebrate community of high altitude aquatic habitats in the northern Apennines to the biodiversity is here highlighted. The Lago Pratignano resulted to be important not only for its particularly interesting flora and amphibian fauna but also for its rich macroinvertebrate community. The data presented here will be useful in the future to understand the natural transformations of this habitat and the possible alterations caused by the climate change. Furthermore, this work represents a starting point for the study on much-neglected pond habitats in the northern Apennines.

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