N O T E

Macroinvertebrate Occurrence in *Chlidonias niger* (Charadriiformes: Laridae) Nests in East-Central Poland[1]

Artur Golawski[2], Izabela Hajdamowicz, and Sylwia Golawska

Siedlce University of Natural Sciences and Humanities, Faculty of Natural Science, Institute of Biology, Prusa 12, 08-110 Siedlce, Poland

J. Entomol. Sci. 52(3): 288–292 (July 2017)

Key Words breeding refuge, Coleoptera, Diptera, oxbow lake, water soldier

Many publications report the invertebrate fauna of nests of birds, which provide a seasonally rich source of organic material in a sheltered habitat, thus providing ecological opportunities for a diversity of species. Most studies are on the nests of terrestrial birds (Karasawa and Hijii 2006, Biodivers. Conserv. 15: 4533–4553; Oppliger et al. 1994, Behav. Ecol. 5: 130–134; Saino et al. 2002, Oecologia 133: 139–145), but little information has been published on macroinvertebrates in the nests of aquatic birds (Coulson et al. 2009, Polar Biol. 32: 1041–1046; Tajovsky et al. 2001, Eur. J. Soil Biol. 37: 321–323), which are largely limited to species that construct nests in dry sites using feathers or dried plant matter. Hence, there is no information on invertebrates inhabiting nests constructed on a moist substrate from rotting vegetation, such as those made by terns of the genus *Chlidonias*.

Black terns, *Chlidonias niger* (L.) (Charadriiformes: Laridae), construct their nests from fragments of leaves of aquatic plants, very often of water soldier (*Stratiotes aloides* L.) (Golawski et al. 2016, Aquat. Ecol., doi: 10.1007/s10452-016-9613-0), a pleustonic species in the family Hydrocharitaceae, whose range of distribution includes central, eastern, and northern Europe and central Asia (Cook and Urmi-Konig 1983, Aquat. Bot. 16: 213–249). Water soldier is a convenient habitat for invertebrates, serving both as shelter and food resource (Obolewski 2005, Oceanol. Hydrobiol. Stud. 34: 37–54; Tarkowska-Kukuryk 2006, Pol. J. Ecol. 54: 441–451). The epiphytic fauna of water soldier consists mainly of chironomid (Diptera: Chironomidae) larvae, but varied assemblages of animals have been reported from this microhabitat (Tarkowska-Kukuryk 2006; Obolewski and Strzelczak 2009, Ecohydrol. Hydrobiol. 9: 257–267). Black terns build their nests on a mat of floating water soldier leaves, which decay over time. The underside of the nest is submerged and, as it slowly sinks into the water, the birds add fresh

[1]Received 01 February 2017; accepted for publication 01 May 2017.
[2]Corresponding author (email: artur.golawski@uph.edu.pl).

leaves to the upper surfaces. The leaves in various stages of decomposition thus provide a habitat for different assemblages of species than has been previously described for live water soldier plants. To date, however, the differences between these assemblages have not been reported in the literature. The aim of this research was, therefore, to describe the macroinvertebrate assemblages inhabiting nests of black terns and to compare these assemblages with those inhabiting live water soldier.

The study area is in the valley of the River Bug in east-central Poland, which is characterized by many oxbow lakes that support vegetative growth, including water soldier (Golawski et al. 2016). The Bug Valley is a permanent breeding site of black terns, and the oxbows covered with water soldier are typical nesting habitats of these birds (an estimated 420 breeding pairs at this time of this study) (Golawski et al. 2015, Wilson J. Ornithol. 127: 52–58). The predominant vegetation in the oxbow lake for this investigation was water soldier, which covered approximately 70% of its 33-ha surface. Clumps of other water plants occupied much smaller areas, around 5% of the total surface.

Field observations were conducted in May–July 2010, during which time 75 breeding pairs of black terns were observed. Twenty-five of their nests were selected at random and removed once the chicks were at least 1 week old and no longer returned to them. The fate of the clutches/broods was closely monitored for the purposes of other studies (Golawski et al. 2016). The top 5 cm of the nests were removed—this thickness ensured that the water soldier leaves would be in various stages of decay. The material was placed in airtight plastic containers and transported to the laboratory within 2 h of collection, where invertebrates were removed from the plants (Obolewski and Strzelczak 2009) and preserved in 96% ethanol. Macroinvertebrates (only >1 mm) were identified and counted under a binocular microscope (10×). The specimens were separated into taxonomic families; only 0.8% of them were identifiable to generic level. Live water soldier plants ($n = 4$) collected on 30 June 1 m from the tern nests were examined in the same manner in order to compare the macroinvertebrate fauna inhabiting live water soldier plants versus those in tern nests. This comparison was expressed as the percent abundance of the various classes. The *G* test (Sokal and Rohlf 2001, Pp. 686–715, Biometry, 3rd ed., Freeman and Co., New York) was used to compare the proportions of the classes of macroinvertebrates in black tern nests compared to live water soldier plants. Only results with a probability of $\alpha \leq 0.05$ were considered to be statistically significant.

A total of 1,928 macroinvertebrates from six classes were found in the 25 black tern nests (Table 1). Gastropoda and Insecta were present in all nests. The frequency of the other classes did not exceed 52%. The dominant classes were Gastropoda (43.8% of specimens), of which as many as 85% were Lymnaeidae, and Insecta (49.1% of specimens), of which Coleoptera made up 23.3% (67% in the larval or pupal stage) and Diptera 75.7% (all in the larval or pupal stage). The proportion of the other classes was 7.1% (Table 1).

A total of 154 specimens from four classes—Gastropoda, Hirudinea, Insecta, and Malacostraca—were recorded on the live water soldier plants taken on 30 June and 142 specimens from the same four classes in the four nearby tern nests. Insecta (45.8% of all the animals) and Gastropoda (36.6%) were dominant in the nests; in contrast, the dominant classes on live water soldier were Hirudinea

Table 1. Numbers and percentages of macroinvertebrates in nests of black tern (*Chlidonias niger* L.) and on live water soldier (*Stratiotes aloides* L.).

			Specimens	
Class	**Order**	**Family**	**Number**	**%**
Nests of black tern, $n = 1928$				
Arachnida	Acari	Unidentified	5	0.3
	Araneae	Linyphiidae	5	0.3
		Lycosidae	4	0.2
Bivalvia	Veneroida	Sphaeriidae	1	0.1
Gastropoda	Basomatophora	Acroloxidae	1	0.1
		Lymnaeidae	716	37.1
		Physidae	1	0.1
		Planorbidae	125	6.5
	Prosobranchia	Bithyniidae	1	0.1
Hirudinea	Arhynchobdellida	Erpobdellidae	33	1.7
	Rhynchobdellida	Glossiphoniidae	69	3.6
Insecta	Coleoptera	Dytiscidae	3	0.2
		Hydrophilidae	110	5.7
		Noteridae	1	0.1
		Scirtidae	91	4.7
		Staphylinidae	4	0.2
		Unidentified	13	0.7
	Diptera	Ceratopogonidae	1	0.1
		Culicidae	11	0.6
		Ephydridae	23	1.2
		Psychodidae	3	0.2
		Stratiomyidae	198	10.3
		Syrphidae	465	24.1
		Tabanidae	7	0.4
		Trichoceridae	2	0.1
		Unidentified	7	0.4
	Hemiptera	Saldidae	6	0.3
		Unidentified	1	0.1
	Odonata	Unidentified	1	0.1

Table 1. Continued.

Class	Order	Family	Specimens	
			Number	%
Malacostraca	Isopoda	Asellidae	20	1.0
Live water soldier, $n = 154$				
Gastropoda	Basomatophora	Acroloxidae	14	9.1
		Lymnaeidae	19	12.3
		Planorbidae	7	4.5
	Prosobranchia	Viviparidae	2	1.3
Hirudinea	Arhynchobdellida	Erpobdellidae	49	31.8
	Rhynchobdellida	Glossiphoniidae	10	6.5
Insecta	Coleoptera	Curculionidae	1	0.6
		Scirtidae	6	3.9
	Diptera	Chironomidae	2	1.3
		Stratiomyidae	1	0.6
	Ephemeroptera	Caenidae	4	2.6
	Odonata	Coenagrionidae	1	0.6
		Unidentified	1	0.6
	Trichoptera	Phryganeidae	1	0.6
Malacostraca	Isopoda	Asellidae	36	23.4

(38.3%), Gastropoda (27.3%), and Malacostraca (23.4%) (Fig. 1). There were statistically significant differences between the percentages of the animals from these four classes ($G = 56.8$; df $= 3$; $P < 0.0001$).

Most importantly, our data indicate that the macroinvertebrate fauna in the tern nests differed from that on the water soldier plants growing in the oxbows of the River Bug. The nests supported proportionately more Gastropoda and Insecta (making up 82.4% of all the animals found in them), whereas there were proportionately more Hirudinea and Malacostraca (61.7% of all the animals) in the live plants. The rotting vegetation (water soldier) from which the terns built their nests turned out to be very important to two orders of insects—Diptera and Coleoptera—as this was their breeding habitat: all the Diptera and two-thirds of the Coleoptera found in them were in either the larval or the pupal stage. Moreover, most of the Gastropoda in the nests were small (young) individuals from the families Lymnaeidae and Planorbidae. The decaying vegetation in the nests provided food for the macroinvertebrates, especially the Diptera, and probably also shelter. The leaves of live water soldier are a significant substrate for larvae of dipteran leaf

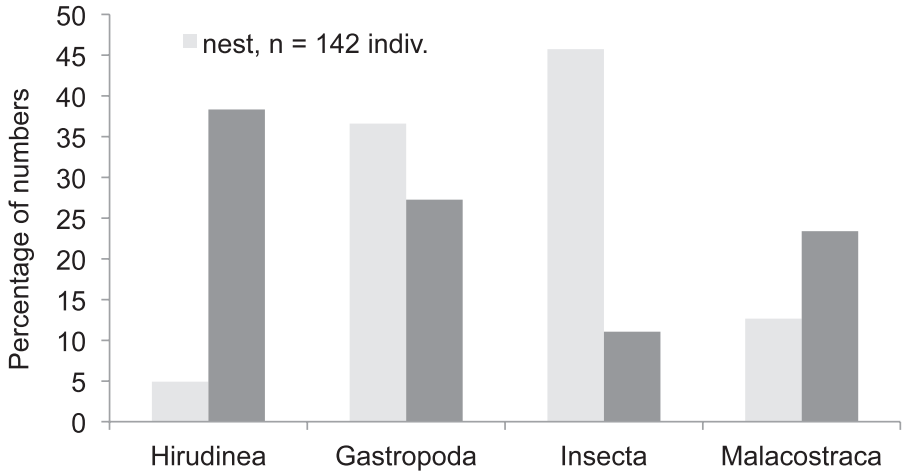

Fig. 1. Numbers of the various classes of macroinvertebrates in nests of the black tern (*Chlidonias niger* L.) and on live water soldier (*Stratiotes aloides* L.).

miners (Obolewski 2005), especially Chironomidae, which may be the dominant groups of animals occurring there (Tóth et al. 2008, Bol. Mus. Munic. Funchal 13: 169–175). This was also the case in the present study, but only on live water soldier; the main families of flies represented on the decaying leaves were Ephydridae, Stratiomyidae, Syrphidae, and Tabanidae (making up a total of 35.9% of all the invertebrates). These four dipteran families have not yet been found on live water soldier in Poland (Obolewski and Strzelczak 2009). The water soldier that terns use to construct their nests thus enables the development of flies from several other families that breed in the nests. Also noteworthy is the large number of Coleoptera from the families Dytiscidae, Hydrophilidae, Scirtidae, and Staphylinidae (6.4% of all the animals) recorded in the nesting material. Most of the Coleoptera were present as larvae. There were few Coleoptera adults observed, however, presumably because they are mobile and might avoid detection with the methods employed. Representatives of other classes were also found in other localities, for example, the families Erpobdellidae and Glossiphoniidae from the Hirudinea (Obolewski 2005; Obolewski and Strzelczak 2009).

Acknowledgments. We thank Peter Senn for the language corrections. Emilia Mroz and Zbigniew Kasprzykowski provided invaluable assistance during the surveys. This study was financially supported by the Siedlce University of Natural Sciences and Humanities.