

# Chapter 16

## Aquatic Macroinvertebrates of the Drava River and Its Floodplain



Arnold Móra and Zoltán Csabai

**Abstract** Due to the untouched and almost pristine conditions of the Drava region, to date 438 species belonging to various aquatic macroinvertebrate animal groups have been recorded from the Drava and its floodplain. Therefore the aquatic fauna of this area is among the richest in Hungary. The most unique species of the Drava is the caddisfly *Platyphylax frauenfeldi*, since its population along the river might be the last in the world. The occurrence of many rare, Natura 2000, protected or strictly protected species enhances the nature conservation value of the region. Unfortunately, the large number of non-indigenous species indicates the vulnerability of natural assemblages devastated by aquatic invasions. Moreover, the aquatic macroinvertebrate assemblages are vulnerable, and might be threatened by any unconsidered human action, especially measures of river regulation, since the change or loss of habitats might cause serious damage to the populations of rare species.

**Keywords** Diversity · Natura 2000 · Protected species · Invasive species  
*Platyphylax frauenfeldi* · *Graphoderus bilineatus*

### 16.1 Introduction

The lower Drava River has been a national border for a millennium. Access to the river and its floodplain was particularly strictly restricted in the second half of the 20th century, during the time of the Cold War. This might be the reason why this area remained nearly untouched and almost pristine with high habitat heterogeneity and preserved one of the most diverse biota in Europe. On the other hand, the area

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was not accessible for scientists either in this period and, consequently, its diverse biota remained unknown for a long time. Modern studies on the fauna of Drava and its floodplain started in the 1990s, in connection with the establishment of the Danube–Drava National Park in Hungary (Uherkovich 1995, 1998). During these works, nearly all aquatic invertebrate groups were taken into consideration, however, in many cases only sporadic data were provided. Later monitoring continued (Ábrahám 2005; Purger 2008) and many further collections were carried out for certain groups (see below). These studies have revealed a very rich macroinvertebrate fauna for the Drava and its floodplain water bodies.

## 16.2 Diversity of Aquatic Macroinvertebrates

To date 438 species belonging to various aquatic macroinvertebrate animal groups (e.g. molluscs, leeches, crustaceans, and insects) have been recorded from the Drava and its floodplain (Table 16.1). Due to the high number of species, the aquatic fauna of this area is among the richest in Hungary.

The first compilation of mollusc fauna of Drava and its floodplain area was published by Varga (1995). Based on former literature data, materials deposited in public and private collections and recent field works, he mentioned some 30 aquatic species to occur along the Drava. The extension of this work provided further data (Varga and Uherkovich 1998). Unfortunately, the intensive collections ended at that time, and later only sporadic data were published from the river itself (e.g., Héra 2005; Juhász et al. 2006a; Czirok et al. 2008; Horvai et al. 2012) and from its floodplain area (Purger 2013; Csabai et al. 2015a). Based on these results, the mollusc fauna proves to be very diverse with 36 aquatic snails and 16 bivalves, especially that of the Drava from where 47 species (31 snails and 16 bivalves) are known. The mollusc fauna of the floodplains is poorer or lesser known with 29 species (25 snails and 4 bivalves). The majority of the species are common in Hungary, but species valuable for nature conservation are remarkably represented too, as many rare species (e.g. *Amphimelania holandrii*, *Anisus vorticulus*, *Fagotia daudebartii*, *Theodoxus danubialis*, *Sphaerium rivicola*, *Pseudanodonta complanata*, *Unio crassus*) have been found in the Drava (Fig. 16.1).

The Annelida fauna of the Drava and its floodplain is poorly studied, and only the leeches (Hirudinea) were included in the investigations. Based on the sporadic data (Juhász et al. 2006b; Nesemann 1998; Czirok et al. 2008; Horvai et al. 2012) only 16 leech species are known from the area, 11 species from the river and 8 species from the floodplains.

Only sporadic data are known on the macroscopic crustacean fauna of both the Drava (Juhász et al. 2006c; Czirok et al. 2008; Borza 2011; Borza et al. 2011; Horvai et al. 2012) and its floodplain (Forró and Meisch 1998; Purger 2013; Csabai et al. 2015a). However, the fauna is relatively diverse with 16 species. The majority of the species were found in the Drava, but the two Branchiopoda species (the fairy shrimp *Branchipus schaefferi* and the tadpole shrimp *Triops cancriformis*) occur only in the

**Table 16.1** List of aquatic macroinvertebrate species known from the Drava River and its floodplain

	Drava	Floodplain
<b>MOLLUSCA</b>		
<b>GASTROPODA</b>		
Acroloxidae		
<i>Acroloxus lacustris</i> (Linnaeus, 1758)	x	x
Bithyniidae		
<i>Bithynia tentaculata</i> (Linnaeus, 1758)	x	x
Hydrobiidae		
<i>Potamopyrgus antipodarum</i> (Gray, 1843) <sup>Ni</sup>	x	
Lithoglyphidae		
<i>Lithoglyphus naticoides</i> (C. Pfeiffer, 1828) <sup>Ni</sup>	x	
Lymnaeidae		
<i>Galba truncatula</i> (O.F. Müller, 1774)	x	x
<i>Lymnaea stagnalis</i> (Linnaeus, 1758)	x	x
<i>Radix auricularia</i> (Linnaeus, 1758)	x	x
<i>Radix balthica</i> (Linnaeus, 1758)	x	x
<i>Radix labiata</i> (Rossmassler, 1835)		x
<i>Stagnicola corvus</i> (Gmelin, 1791)	x	
<i>Stagnicola palustris</i> (O.F. Müller, 1774)	x	x
<i>Stagnicola palustris</i> complex		x
Melanopsidae		
<i>Amphimelania holandrii</i> (C. Pfeiffer, 1828) <sup>a</sup>	x	
<i>Fagotia daudebartii</i> (Prevost, 1821) <sup>a</sup>		x
Neritidae		
<i>Theodoxus danubialis</i> (C. Pfeiffer, 1828) <sup>a</sup>	x	
<i>Theodoxus fluviatilis</i> (Linnaeus, 1758) <sup>Ni</sup>	x	
<i>Theodoxus transversalis</i> (C. Pfeiffer, 1828) <sup>a, N2000</sup>	x	
Physidae		
<i>Haitia acuta</i> (Draparnaud, 1805) <sup>Ni</sup>	x	x
<i>Physa fontinalis</i> (Linnaeus, 1758)	x	x
Planorbidae		
<i>Ancylus fluviatilis</i> (O.F. Müller, 1774)	x	
<i>Anisus septemgyratus</i> (Rossmassler, 1835)	x	x
<i>Anisus spirorbis</i> (Linnaeus, 1758)	x	
<i>Anisus vortex</i> (Linnaeus, 1758)	x	x
<i>Anisus vorticulus</i> (Troschel, 1834) <sup>a, N2000</sup>	x	x
<i>Ferrissia fragilis</i> (Tryon, 1863) <sup>Ni</sup>		x
<i>Gyraulus albus</i> (O.F. Müller, 1774)	x	x
<i>Gyraulus laevis</i> (Alder, 1838)	x	
<i>Hippeutis complanatus</i> (Linnaeus, 1758)	x	x

(continued)

**Table 16.1** (continued)

	Drava	Floodplain
<i>Planorbarius corneus</i> (Linnaeus, 1758)	x	x
<i>Planorbis carinatus</i> (O.F. Müller, 1774)		x
<i>Planorbis planorbis</i> (Linnaeus, 1758)	x	x
<i>Segmentina nitida</i> (O.F. Müller, 1774)	x	
Valvatidae		
<i>Borysthenia naticina</i> (Menke, 1845) <sup>a</sup>	x	
<i>Valvata cristata</i> (O.F. Müller, 1774)	x	x
<i>Valvata piscinalis</i> (O.F. Müller, 1774)		x
Viviparidae		
<i>Viviparus acerosus</i> (Bourguignat, 1862)	x	x
<i>Viviparus contectus</i> (Millet, 1813)	x	x
<b>BIVALVIA</b>		
Corbiculidae		
<i>Corbicula fluminea</i> (O.F. Müller, 1774) <sup>Ni</sup>	x	
Dreissenidae		
<i>Dreissena polymorpha</i> (Pallas, 1771) <sup>Ni</sup>	x	
Sphaeriidae		
<i>Musculium lacustre</i> (O.F. Müller, 1774)	x	x
<i>Pisidium amnicum</i> (O.F. Müller, 1774)	x	
<i>Pisidium henslowanum</i> (Sheppard, 1823)	x	
<i>Pisidium subtruncatum</i> (Malm, 1855)	x	
<i>Pisidium supinum</i> (A. Schmidt, 1851)	x	
<i>Sphaerium corneum</i> (Linnaeus, 1758)	x	x
<i>Sphaerium rivicola</i> (Lamarck, 1818)	x	
Unionidae		
<i>Anodonta anatina</i> (Linnaeus, 1758)	x	x
<i>Anodonta cygnea</i> (Linnaeus, 1758)	x	x
<i>Anodonta woodiana</i> (Lea, 1834) <sup>Ni</sup>	x	
<i>Pseudanodonta complanata</i> (Rossmassler, 1835) <sup>a</sup>	x	
<i>Unio crassus</i> (Philipson, 1788) <sup>a, N2000</sup>	x	
<i>Unio pictorum</i> (Linnaeus, 1758)	x	
<i>Unio tumidus</i> (Philipson, 1788)	x	
<b>ANNELIDA</b>		
<b>HIRUDINEA</b>		
Glossiphoniidae		
<i>Alboglossiphonia heteroclita</i> (Linnaeus, 1761)		x
<i>Alboglossiphonia hyalina</i> (O.F. Müller, 1774)		x
<i>Glossiphonia complanata</i> (Linnaeus, 1758)	x	x
<i>Glossiphonia nebulosa</i> (Kalbe, 1964)		x
<i>Glossiphonia paludosa</i> (Carena, 1824)	x	

(continued)

**Table 16.1** (continued)

	Drava	Floodplain
<i>Helobdella stagnalis</i> (Linnaeus, 1758)	x	x
<i>Hemiclepsis marginata</i> (O.F. Müller, 1774)		x
Piscicolidae		
<i>Caspiobdella fadejewi</i> (Epshtein, 1961)	x	
<i>Piscicola geometra</i> (Linnaeus, 1758)	x	
<i>Piscicola haranti</i> (Jarry, 1960)	x	
Haemopidae		
<i>Haemopsis sanguisuga</i> (Linnaeus, 1758)		x
Erpobdellidae		
<i>Dina punctata</i> (Johansson, 1927)	x	
<i>Erpobdella octoculata</i> (Linnaeus, 1758)	x	x
<i>Erpobdella nigricollis</i> (Brandes, 1900)	x	
<i>Erpobdella vilnensis</i> (Liskiewicz, 1925)	x	
<i>Trocheta cylindrica</i> (Örley, 1886)	x	
<b>CRUSTACEA</b>		
<b>AMPHIPODA</b>		
Corophiidae		
<i>Chelicorophium curvispinum</i> (G.O. Sars, 1895) <sup>Ni</sup>	x	
<i>Chelicorophium sowinskyi</i> (Martynov, 1924) <sup>Ni</sup>	x	
Gammaridae		
<i>Dikerogammarus bispinosus</i> (Martynov, 1925) <sup>Ni</sup>	x	
<i>Dikerogammarus haemobaphes</i> (Eichwald, 1841) <sup>Ni</sup>	x	
<i>Dikerogammarus villosus</i> (Sowinsky, 1894) <sup>Ni</sup>	x	
<i>Gammarus fossarum</i> (Koch, 1835)	x	
<i>Gammarus roeselii</i> (Gervais, 1835)	x	x
<i>Niphargus valachicus</i> (Dobreaanu & Manolache, 1933)	x	x
<i>Synurella ambulans</i> (Müller, 1846) <sup>Ni</sup>	x	
<b>DECAPODA</b>		
Astacidae		
<i>Astacus leptodactylus</i> (Eschscholtz, 1823) <sup>a</sup>	x	
<i>Pacifastacus leniusculus</i> (Dana, 1852) <sup>Ni</sup>	x	
<b>ISOPODA</b>		
Asellidae		
<i>Asellus aquaticus</i> (Linnaeus, 1758)	x	x
Janiridae		
<i>Jaera sarsi</i> (Valkanov, 1936) <sup>Ni</sup>	x	
<b>MYSIDA</b>		
Mysidae		
<i>Limnomysis benedeni</i> (Czerniavsky, 1882) <sup>Ni</sup>	x	
<b>ANOSTRACA</b>		

(continued)

**Table 16.1** (continued)

	Drava	Floodplain
Branchipodidae		
<i>Branchipus schaefferi</i> (Fischer, 1834)		x
NOTOSTRACA		
Triopsidae		
<i>Triops cancriformis</i> (Bosc, 1801)		x
<b>CHELICERATA</b>		
ARANEAE		
Cybaeidae		
<i>Argyroneta aquatica</i> (Clerck, 1757) <sup>a</sup>		x
<b>INSECTA</b>		
EPHEMEROPTERA		
Ametropodidae		
<i>Ametropus fragilis</i> (Albarda, 1878) <sup>a</sup>	x <sup>L</sup>	
Baetidae		
<i>Baetis alpinus</i> (Pictet, 1843)	x	
<i>Baetis buceratus</i> (Eaton, 1870)	x <sup>L</sup>	
<i>Baetis fuscatus</i> (Linnaeus, 1761)	x <sup>L</sup>	
<i>Baetis pentaplebodes</i> (Ujhelyi, 1966)	x <sup>L</sup>	
<i>Baetis rhodani</i> (Pictet, 1843)	x <sup>L</sup>	
<i>Baetis tracheatus</i> (Keffermüller & Machel, 1967)	x <sup>L</sup>	
<i>Baetis vardarensis</i> (Ikonomov, 1962)	x <sup>L</sup>	
<i>Baetis vernus</i> (Curtis, 1834)	x <sup>L</sup>	
<i>Centroptilum luteolum</i> (Müller, 1776)	x <sup>L</sup>	
<i>Cloeon dipterum</i> (Linnaeus, 1761)	x <sup>L</sup>	x <sup>L</sup>
<i>Procloeon bifidum</i> (Bengtsson, 1912)	x <sup>L</sup>	
<i>Procloeon macronyx</i> (Kluge & Novikova, 1992)	x <sup>L</sup>	
<i>Raptobaetopus tenellus</i> (Albarda, 1878)	x <sup>L</sup>	
Caenidae		
<i>Cercobrachys minutus</i> (Tshernova, 1952)	x <sup>L</sup>	
<i>Caenis horaria</i> (Linnaeus, 1758)	x <sup>L</sup>	x
<i>Caenis luctuosa</i> (Burmeister, 1839)	x <sup>L</sup>	
<i>Caenis macrura</i> (Stephens, 1835)	x <sup>L</sup>	
<i>Caenis pseudorivulorum</i> (Keffermüller, 1960)	x <sup>L</sup>	
<i>Caenis robusta</i> (Eaton, 1883)	x	x <sup>L</sup>
Ephemerellidae		
<i>Ephemerella ignita</i> (Poda, 1761)	x <sup>L</sup>	
<i>Ephemerella notata</i> (Eaton, 1887)	x	
Ephemeridae		
<i>Ephemera danica</i> (Müller, 1764)	x <sup>L</sup>	
<i>Ephemera glaucops</i> (Pictet, 1843)	x	

(continued)

**Table 16.1** (continued)

	Drava	Floodplain
<i>Ephemera vulgata</i> (Linnaeus, 1758)	x <sup>L</sup>	
<b>Heptageniidae</b>		
<i>Epeorus assimilis</i> (Eaton, 1885)	x <sup>L</sup>	
<i>Heptagenia coeruleans</i> (Rostock, 1877)	x <sup>L</sup>	
<i>Heptagenia flava</i> (Rostock, 1977)	x <sup>L</sup>	
<i>Heptagenia sulphurea</i> (O.F. Müller, 1776)	x <sup>L</sup>	x <sup>L</sup>
<b>Leptophlebiidae</b>		
<i>Habrophlebia fusca</i> (Curtis, 1834)	x <sup>L</sup>	
<i>Paraleptophlebia submarginata</i> (Stephens, 1835)	x <sup>L</sup>	
<b>Oligoneuriidae</b>		
<i>Oligoneuriella pallida</i> (Hagen, 1855) <sup>a</sup>	x <sup>L</sup>	
<i>Oligoneuriella rhenana</i> (Imhoff, 1852) <sup>a</sup>	x	x
<b>Potamanthidae</b>		
<i>Potamanthus luteus</i> (Linnaeus, 1767)	x <sup>L</sup>	
<b>Siphonuridae</b>		
<i>Siphonurus lacustris</i> (Eaton, 1870)	x <sup>L</sup>	
<b>ODONATA</b>		
<b>Lestidae</b>		
<i>Chalcolestes viridis</i> (Vander Linden, 1825)		x
<i>Lestes barbarus</i> (Fabricius, 1798)	x <sup>L</sup>	x
<i>Lestes dryas</i> (Kirby, 1890) <sup>a</sup>		x
<i>Lestes sponsa</i> (Hansemann, 1823)	x	x <sup>L</sup>
<i>Lestes virens</i> (Charpentier, 1825)	x	x <sup>L</sup>
<i>Sympecma fusca</i> (Vander Linden, 1820)	x	x <sup>L</sup>
<b>Calopterygidae</b>		
<i>Calopteryx splendens</i> (Harris, 1782)	x <sup>L</sup>	x <sup>L</sup>
<i>Calopteryx virgo</i> (Linnaeus, 1758) <sup>a</sup>	x <sup>L</sup>	x
<b>Platycnemididae</b>		
<i>Platycnemis pennipes</i> (Pallas, 1771)	x <sup>L</sup>	x <sup>L</sup>
<b>Coenagrionidae</b>		
<i>Coenagrion ornatum</i> (Selys, 1850) <sup>a</sup> , N2000	x <sup>L</sup>	x <sup>L</sup>
<i>Coenagrion puella</i> (Linnaeus, 1758)	x <sup>L</sup>	x <sup>L</sup>
<i>Coenagrion pulchellum</i> (Vander Linden, 1825)	x	x <sup>L</sup>
<i>Coenagrion scitulum</i> (Rambur, 1842) <sup>a</sup>		x
<i>Enallagma cyathigerum</i> (Charpentier, 1840)	x <sup>L</sup>	x
<i>Erythromma najas</i> (Hansemann, 1823)	x	x <sup>L</sup>
<i>Erythromma viridulum</i> (Charpentier, 1840)	x	x <sup>L</sup>
<i>Ischnura elegans</i> (Vander Linden, 1820)	x <sup>L</sup>	x <sup>L</sup>
<i>Ischnura pumilio</i> (Charpentier, 1840)		x
<i>Pyrrhosoma nymphula</i> (Sulzer, 1776)		x <sup>L</sup>

(continued)

**Table 16.1** (continued)

	Drava	Floodplain
<b>Aeshnidae</b>		
<i>Aeshna affinis</i> Vander (Linden, 1820)		x <sup>L</sup>
<i>Aeshna cyanea</i> (Müller, 1764)		x
<i>Aeshna grandis</i> (Linnaeus, 1758)		x
<i>Aeshna isocelus</i> (Müller, 1767) <sup>a</sup>		x <sup>L</sup>
<i>Aeshna mixta</i> (Latreille, 1805)	x	x <sup>L</sup>
<i>Aeshna viridis</i> (Eversmann, 1836) <sup>b</sup> , N2000		x <sup>L</sup>
<i>Anax imperator</i> (Leach, 1815)	x <sup>L</sup>	x <sup>L</sup>
<i>Anax parthenope</i> (Selys, 1839)		x
<i>Brachytron pratense</i> (Müller, 1764)		x <sup>L</sup>
<b>Gomphidae</b>		
<i>Gomphus flavipes</i> (Charpentier, 1825) <sup>a</sup> , N2000	x <sup>L</sup>	x <sup>L</sup>
<i>Gomphus vulgatissimus</i> (Linnaeus, 1758) <sup>a</sup>	x <sup>L</sup>	x
<i>Onychogomphus forcipatus</i> (Linnaeus, 1758) <sup>a</sup>	x <sup>L</sup>	
<i>Ophiogomphus cecilia</i> (Fourcroy, 1785) <sup>a</sup> , N2000	x <sup>L</sup>	
<b>Corduliidae</b>		
<i>Cordulia aenea</i> (Linnaeus, 1758)	x <sup>L</sup>	x <sup>L</sup>
<i>Epiheca bimaculata</i> (Charpentier, 1825) <sup>a</sup>		x <sup>L</sup>
<i>Somatochlora flavomaculata</i> (Vander Linden, 1825) <sup>a</sup>	x <sup>L</sup>	x <sup>L</sup>
<i>Somatochlora metallica lmeridionalis</i>		x <sup>L</sup>
<b>Libellulidae</b>		
<i>Crocothemis erythraea</i> (Brullé, 1832)		x <sup>L</sup>
<i>Leucorrhinia caudalis</i> (Charpentier, 1840) <sup>b</sup> , N2000		x <sup>L</sup>
<i>Leucorrhinia pectoralis</i> (Charpentier, 1825) <sup>b</sup> , N2000		x <sup>L</sup>
<i>Libellula depressa</i> (Linnaeus, 1758)	x	x <sup>L</sup>
<i>Libellula fulva</i> (Müller, 1764) <sup>a</sup>		x <sup>L</sup>
<i>Libellula quadrimaculata</i> (Linnaeus, 1758)	x	x <sup>L</sup>
<i>Orthetrum albistylum</i> (Selys, 1848)		x <sup>L</sup>
<i>Orthetrum brunneum</i> (Fonscolombe, 1837) <sup>a</sup>	x	x
<i>Orthetrum cancellatum</i> (Linnaeus, 1758)	x	x
<i>Orthetrum coerulescens</i> (Fabricius, 1798)		x <sup>L</sup>
<i>Sympetrum depressiusculum</i> (Selys, 1841) <sup>a</sup>		x
<i>Sympetrum flaveolum</i> (Linnaeus, 1758)	x	x <sup>L</sup>
<i>Sympetrum fonscolombii</i> (Selys, 1840)		x
<i>Sympetrum meridionale</i> (Selys, 1841)	x	x
<i>Sympetrum sanguineum</i> (Müller, 1764)	x <sup>L</sup>	x
<i>Sympetrum striolatum</i> (Charpentier, 1840)		x
<i>Sympetrum vulgatum</i> (Linnaeus, 1758)	x <sup>L</sup>	x <sup>L</sup>
<b>PLECOPTERA</b>		
<b>Chloroperlidae</b>		

(continued)



**Table 16.1** (continued)

	Drava	Floodplain
<i>Isoptena serricornis</i> (Pictet, 1841) <sup>a</sup>	x <sup>L</sup>	
<i>Xanthoperla apicalis</i> (Newman, 1836)	x <sup>L</sup>	x <sup>L</sup>
Leuctridae		
<i>Leuctra nigra</i> (Olivier, 1811)	x <sup>L</sup>	
Nemouridae		
<i>Nemoura cinerea</i> (Retzius, 1783)	x <sup>L</sup>	
HETEROPTERA		
Aphelocheiridae		
<i>Aphelocheirus aestivalis</i> (Fabricius, 1794)	x	
Nepidae		
<i>Nepa cinerea</i> (Linnaeus, 1758)	x	x
<i>Ranatra linearis</i> (Linnaeus, 1758)	x	x
Naucoridae		
<i>Ilyocoris cimicoides</i> (Linnaeus, 1758)	x	x
Notonectidae		
<i>Notonecta glauca</i> (Linnaeus, 1758)	x	x
<i>Notonecta lutea</i> (Müller, 1776) <sup>a</sup>		x
<i>Notonecta viridis</i> (Delcourt, 1909)		x
Pleidae		
<i>Plea minutissima</i> (Leach, 1817)	x	x
Corixidae		
<i>Callicorixa praeusta</i> (Fieber, 1848)		x
<i>Corixa affinis</i> (Leach, 1817)		x
<i>Corixa punctata</i> (Illiger, 1807)		x
<i>Hesperocorixa linnaei</i> (Fieber, 1848)		x
<i>Hesperocorixa sahlbergi</i> (Fieber, 1848)		x
<i>Micronecta griseola</i> (Horváth, 1899)	x	x
<i>Micronecta scholtzi</i> (Fieber, 1860)	x	
<i>Sigara falleni</i> (Fieber, 1848)	x	x
<i>Sigara fossarum</i> (Leach, 1817)		x
<i>Sigara lateralis</i> (Leach, 1818)		x
<i>Sigara nigrolineata</i> (Fieber, 1848)		x
<i>Sigara striata</i> (Linnaeus, 1775)	x	x
Hydrometridae		
<i>Hydrometra gracilentata</i> (Horváth, 1899)		x
<i>Hydrometra stagnorum</i> (Linnaeus, 1758)	x	x
Hebridae		
<i>Hebrus pusillus</i> (Fallén, 1807)	x	x
Mesoveliidae		
<i>Mesovelia furcata</i> (Mulsant & Rey, 1852)		x

(continued)

**Table 16.1** (continued)

	Drava	Floodplain
<i>Mesovelia thermalis</i> (Horváth, 1915)		x
Veliidae		
<i>Microvelia buenoi</i> (Drake, 1920)		x
<i>Microvelia pygmaea</i> (Dufour, 1833)		x
<i>Microvelia reticulata</i> (Burmeister, 1835)		x
Gerridae		
<i>Aquarius najas</i> (De Geer, 1773) <sup>a</sup>	x	
<i>Aquarius paludum</i> (Fabricius, 1794)	x	x
<i>Gerris argentatus</i> (Schummel, 1832)	x	x
<i>Gerris asper</i> (Fieber, 1861)	x	
<i>Gerris lacustris</i> (Linnaeus, 1758)	x	x
<i>Gerris odontogaster</i> (Zetterstedt, 1838)	x	x
<i>Gerris thoracicus</i> (Schummel, 1832)		x
COLEOPTERA		
Haliplidae		
<i>Haliplus flavicollis</i> (Sturm, 1834)		x
<i>Haliplus fluvialis</i> (Aubé, 1836)		x
<i>Haliplus furcatus</i> (Seidlitz, 1887)		x
<i>Haliplus heydeni</i> (Wehncke, 1875)		x
<i>Haliplus immaculatus</i> (Gerhardt, 1877)		x
<i>Haliplus obliquus</i> (Fabricius, 1787)	x	
<i>Haliplus ruficollis</i> (De Geer, 1774)		x
<i>Peltodytes caesus</i> (Duftschmid, 1805)		x
Noteridae		
<i>Noterus clavicornis</i> (De Geer, 1774)		x
<i>Noterus crassicornis</i> (Müller, 1776)	x	x
Dytiscidae		
<i>Acilius canaliculatus</i> (Nicolai, 1822)		x
<i>Acilius sulcatus</i> (Linnaeus, 1758)		x
<i>Agabus bipustulatus</i> (Linnaeus, 1767)		x
<i>Agabus undulatus</i> (Schrank, 1776)		x
<i>Bidessus nasutus</i> (Sharp, 1887)		x
<i>Clemnius decoratus</i> (Gyllenhal, 1808)		x
<i>Colymbetes fuscus</i> (Linnaeus, 1758)		x
<i>Cybister lateralimarginalis</i> (De Geer, 1774)		x
<i>Deronectes latus</i> (Stephens, 1829)	x	
<i>Dytiscus circumflexus</i> (Fabricius, 1801)		x
<i>Dytiscus dimidiatus</i> (Bergsträsser, 1778)		x
<i>Dytiscus marginalis</i> (Linnaeus, 1758)		x
<i>Graphoderus austriacus</i> (Sturm, 1834)		x

(continued)

**Table 16.1** (continued)

	Drava	Floodplain
<i>Graphoderus bilineatus</i> (De Geer, 1774) <sup>b, N2000</sup>		x
<i>Graphoderus cinereus</i> (Linnaeus, 1758)		x
<i>Graptodytes granularis</i> (Linnaeus, 1767)		x
<i>Graptodytes pictus</i> (Fabricius, 1787)		x
<i>Hydaticus grammicus</i> (Germar, 1830)		x
<i>Hydaticus seminiger</i> (De Geer, 1774)		x
<i>Hydaticus transversalis</i> (Pontoppidan, 1763)		x
<i>Hydroglyphus geminus</i> (Fabricius, 1792)	x	x
<i>Hydroporus angustatus</i> (Sturm, 1835)	x	x
<i>Hydroporus dorsalis</i> (Fabricius, 1787)		x
<i>Hydroporus palustris</i> (Linnaeus, 1761)		x
<i>Hydroporus planus</i> (Fabricius, 1781)		x
<i>Hydroporus striola</i> (Gyllenhal, 1827)	x	x
<i>Hygrotus impressopunctatus</i> (Schaller, 1783)		x
<i>Hygrotus inaequalis</i> (Fabricius, 1776)		x
<i>Hygrotus versicolor</i> (Schaller, 1783)		x
<i>Hyphydrus ovatus</i> (Linnaeus, 1761)	x	x
<i>Ilybius ater</i> (De Geer, 1774)	x	x
<i>Ilybius fenestratus</i> (Fabricius, 1781)		x
<i>Ilybius fuliginosus</i> (Fabricius, 1792)		x
<i>Ilybius quadriguttatus</i> (Lacordaire, 1835)		x
<i>Laccophilus hyalinus</i> (De Geer, 1774)	x	
<i>Laccophilus minutus</i> (Linnaeus, 1758)		x
<i>Laccophilus poecilus</i> (Klug, 1834)		x
<i>Liopterus haemorrhoidalis</i> (Fabricius, 1787)		x
<i>Platambus maculatus</i> (Linnaeus, 1758)	x	x
<i>Porhydrus lineatus</i> (Fabricius, 1775)		x
<i>Rhantus bistratus</i> (Bergsträsser, 1778)		x
<i>Rhantus consputus</i> (Sturm, 1834)		x
<i>Rhantus exsoletus</i> (Forster, 1771)		x
<i>Rhantus frontalis</i> (Marshall, 1802)		x
<i>Rhantus grapii</i> (Gyllenhal, 1808)		x
<i>Rhantus latitans</i> (Sharp, 1882)		x
<i>Rhantus suturalis</i> (MacLeay, 1825)		x
Gyrinidae		
<i>Gyrinus colymbus</i> (Erichson, 1837)		x
<i>Gyrinus substriatus</i> (Stephens, 1828)		x
<i>Orectochilus villosus</i> (Müller, 1776)	x	
Hydraenidae		
<i>Hydraena palustris</i> (Erichson, 1837)	x	

(continued)

**Table 16.1** (continued)

	Drava	Floodplain
<i>Hydraena riparius</i> species group		x
<i>Limnebius atomus</i> (Duftschmid, 1805)		x
<i>Limnebius papposus</i> (Mulsant, 1844)		x
<i>Ochthebius minimus</i> (Fabricius, 1792)		x
Spercheidae		
<i>Spercheus emarginatus</i> (Schaller, 1783)		x
Hydrochidae		
<i>Hydrochus crenatus</i> (Fabricius, 1792)		x
<i>Hydrochus elongatus</i> (Schaller, 1783)		x
<i>Hydrochus flavipennis</i> (Küster, 1852)		x
<i>Hydrochus megaphallus</i> (van Berge Henegouwen, 1988)		x
Helophoridae		
<i>Helophorus aquaticus</i> (Linnaeus, 1758)		x
<i>Helophorus brevipalpis</i> (Bedel, 1881)		x
<i>Helophorus granularis</i> (Linnaeus, 1761)		x
<i>Helophorus griseus</i> (Herbst, 1793)		x
<i>Helophorus minutus</i> (Fabricius, 1775)		x
<i>Helophorus montenegrinus</i> (Kuwert, 1886)		x
<i>Helophorus nubilus</i> (Fabricius, 1776)		x
<i>Helophorus paraminutus</i> (Angus, 1986)		x
Hydrophilidae		
<i>Anacaena globulus</i> (Paykull, 1798)		x
<i>Anacaena limbata</i> (Fabricius, 1792)		x
<i>Anacaena lutescens</i> (Stephens, 1829)		x
<i>Berosus frontifoveatus</i> (Kuwert, 1890)		x
<i>Berosus luridus</i> (Linnaeus, 1761)		x
<i>Berosus signaticollis</i> (Charpentier, 1825)		x
<i>Cercyon convexiculus</i> (Stephens, 1829)	x	x
<i>Coelostoma orbiculare</i> (Fabricius, 1775)		x
<i>Cymbiodyta marginella</i> (Fabricius, 1792)		x
<i>Enochrus affinis</i> (Thunberg, 1794)		x
<i>Enochrus bicolor</i> (Fabricius, 1792)		x
<i>Enochrus coarctatus</i> (Gredler, 1863)	x	x
<i>Enochrus melanocephalus</i> (Olivier, 1792)		x
<i>Enochrus ochropterus</i> (Marsham, 1802)		x
<i>Enochrus quadripunctatus</i> (Herbst, 1797)		x
<i>Enochrus testaceus</i> (Fabricius, 1801)		x
<i>Helochares lividus</i> (Forster, 1771)		x
<i>Helochares obscurus</i> (Müller, 1776)		x
<i>Hydrobius fuscipes</i> (Linnaeus, 1758)		x

(continued)

**Table 16.1** (continued)

	Drava	Floodplain
<i>Hydrochara caraboides</i> (Linnaeus, 1758)	x	x
<i>Hydrochara flavipes</i> (Steven, 1808)		x
<i>Hydrophilus aterrimus</i> (Eschscholz, 1822)		x
<i>Hydrophilus piceus</i> (Linnaeus, 1758)		x
<i>Laccobius bipunctatus</i> (Fabricius, 1775)		x
<i>Laccobius gracilis</i> (Motschulski, 1855)		x
<i>Laccobius minutus</i> (Linnaeus, 1758)		x
<i>Laccobius simulatrix</i> (Orchymont, 1932)		x
<i>Limnoxenus niger</i> (Zschach, 1788)		x
Dryopidae		
<i>Dryops anglicanus</i> (Edwards, 1909)		x
Elmidae		
<i>Macronychus quadrituberculatus</i> (Müller, 1806) <sup>a</sup>	x	
<i>Limnius volckmari</i> (Panzer, 1793)	x	
MEGALOPTERA		
Sialidae		
<i>Sialis lutaria</i> (Linnaeus, 1758)	x <sup>L</sup>	x <sup>L</sup>
NEUROPTERA		
Sisyridae		
<i>Sisyra fuscata</i> (Fabricius, 1793)	x	x
<i>Sisyra terminalis</i> (Curtis, 1854)	x	x
TRICHOPTERA		
Rhyacophilidae		
<i>Rhyacophila dorsalis</i> (Curtis, 1834)	x	
Glossosomatidae		
<i>Agapetus laniger</i> (Pictet, 1834)	x <sup>L</sup>	
<i>Glossosoma boltoni</i> (Curtis, 1834)	x	
Hydroptilidae		
<i>Agraylea sexmaculata</i> (Curtis, 1834)	x	x
<i>Hydroptila angustata</i> (Mosely, 1939)	x	
<i>Hydroptila forcipata</i> (Eaton, 1873)	x	x
<i>Hydroptila lotensis</i> (Mosely, 1930)	x	
<i>Hydroptila sparsa</i> (Curtis, 1834)	x	x
<i>Hydroptila vectis</i> (Curtis, 1834)	x	
<i>Ithytrichia lamellaris</i> (Eaton, 1873)	x	
<i>Orthotrichia angustella</i> (McLachlan, 1865)	x	
<i>Orthotrichia costalis</i> (Curtis, 1834)	x	
<i>Orthotrichia tragetti</i> (Mosely, 1930)	x	x
<i>Oxyethira falcata</i> (Morton, 1893)	x	
<i>Oxyethira flavicornis</i> (Pictet, 1834)	x	x

(continued)

**Table 16.1** (continued)

	Drava	Floodplain
Hydropsychidae		
<i>Hydropsyche angustipennis</i> (Curtis, 1834)	x <sup>L</sup>	x
<i>Hydropsyche bulbifera</i> (McLachlan, 1878)	x <sup>L</sup>	
<i>Hydropsyche bulgaromanorum</i> (Malicky, 1977)	x <sup>L</sup>	x
<i>Hydropsyche contubernalis</i> (McLachlan, 1865)	x <sup>L</sup>	x
<i>Hydropsyche incognita</i> (Pitsch, 1993)	x <sup>L</sup>	
<i>Hydropsyche modesta</i> (Navás, 1925)	x <sup>L</sup>	x
<i>Hydropsyche ornatula</i> (McLachlan, 1878)	x <sup>L</sup>	x
<i>Hydropsyche pellucidula</i> (Curtis, 1834)	x <sup>L</sup>	x
<i>Hydropsyche siltalai</i> (Döhler, 1963)	x	
Polycentropodidae		
<i>Cyrnus crenaticornis</i> (Kolenati, 1859)	x	x
<i>Cyrnus trimaculatus</i> (Curtis, 1834)	x	x
<i>Holocentropus dubius</i> (Rambur, 1842)	x	x
<i>Holocentropus picicornis</i> (Stephens, 1836)	x	
<i>Neureclipsis bimaculata</i> (Linnaeus, 1758)	x <sup>L</sup>	x
<i>Plectrocnemia conspersa</i> (Curtis, 1834)	x	
<i>Polycentropus irroratus</i> (Curtis, 1835)	x	
Psychomyiidae		
<i>Lype phaeopa</i> (Stephens, 1836)	x	x
<i>Lype reducta</i> (Hagen, 1868)	x <sup>L</sup>	x
<i>Psychomyia pusilla</i> (Fabricius, 1781)	x <sup>L</sup>	x
Ecnomidae		
<i>Ecnomus tenellus</i> (Rambur, 1842)	x	x
Phryganeidae		
<i>Agrypnia varia</i> (Fabricius, 1793)	x	x
<i>Phryganea bipunctata</i> (Retzius, 1783)		x
<i>Phryganea grandis</i> (Linnaeus, 1758)	x	x
<i>Trichostegia minor</i> (Curtis, 1834)	x	x
Brachycentridae		
<i>Brachycentrus subnubilus</i> (Curtis, 1834)	x <sup>L</sup>	
Limnephilidae		
<i>Anabolia furcata</i> (Brauer, 1857)	x <sup>L</sup>	x
<i>Chaetopteryx fusca</i> (Brauer, 1857)	x	
<i>Chaetopteryx major</i> (McLachlan, 1876)	x	
<i>Glyphotaelius pellucidus</i> (Retzius, 1783)	x	x
<i>Grammotaulius nigropunctatus</i> (Retzius, 1783)	x	x
<i>Halesus tessellatus</i> (Rambur, 1842)	x <sup>L</sup>	x
<i>Limnephilus affinis</i> (Curtis, 1834)	x	x
<i>Limnephilus auricula</i> (Curtis, 1834)	x	x

(continued)

**Table 16.1** (continued)

	Drava	Floodplain
<i>Limnephilus bipunctatus</i> (Curtis, 1834)	x	x
<i>Limnephilus decipiens</i> (Kolenati, 1848)	x	
<i>Limnephilus extricatus</i> (McLachlan, 1865)	x	
<i>Limnephilus flavicornis</i> (Fabricius, 1787)	x	x
<i>Limnephilus griseus</i> (Linnaeus, 1758)	x	x
<i>Limnephilus incisus</i> (Curtis, 1834)	x	
<i>Limnephilus lunatus</i> (Curtis, 1834)	x	x
<i>Limnephilus rhombicus</i> (Linnaeus, 1758)	x	x
<i>Limnephilus vittatus</i> (Fabricius, 1798)	x	x
<i>Micropterna lateralis</i> (Stephens, 1837)	x	
<i>Platyphylax frauenfeldi</i> (Brauer, 1857) <sup>b</sup>	x	
<i>Potamophylax luctuosus</i> (Piller & Mitterpacher, 1783)	x	
<i>Potamophylax rotundipennis</i> (Brauer, 1857)	x <sup>L</sup>	x
<i>Stenophylax meridionalis</i> (Malicky, 1980)		x
<i>Stenophylax permistus</i> (McLachlan, 1895)	x	x
Lepidostomatidae		
<i>Crunoecia irrorata</i> (Curtis, 1834)	x	
Goeridae		
<i>Goera pilosa</i> (Fabricius, 1775)	x <sup>L</sup>	x
<i>Silo nigricornis</i> (Pictet, 1834)	x	
<i>Silo piceus</i> (Brauer, 1857)	x <sup>L</sup>	
Leptoceridae		
<i>Adicella syriaca</i> (Ulmer, 1907)	x	
<i>Athripsodes albifrons</i> (Linnaeus, 1758)	x	
<i>Athripsodes aterrimus</i> (Stephens, 1836)	x	x
<i>Athripsodes cinereus</i> (Curtis, 1834)	x	
<i>Ceraclea alboguttata</i> (Hagen, 1860)	x	x
<i>Ceraclea annulicornis</i> (Stephens, 1836)	x	
<i>Ceraclea aurea</i> (Pictet, 1834)	x	
<i>Ceraclea dissimilis</i> (Stephens, 1836)	x <sup>L</sup>	x
<i>Ceraclea riparia</i> (Albarda, 1874)	x	
<i>Ceraclea senilis</i> (Burmeister, 1838)	x	x
<i>Leptocerus tineiformis</i> (Curtis, 1834)	x	xL
<i>Mystacides azureus</i> (Linnaeus, 1761)	x <sup>L</sup>	x
<i>Mystacides longicornis</i> (Linnaeus, 1758)	x	
<i>Mystacides niger</i> (Linnaeus, 1758)	x	
<i>Oecetis furva</i> (Rambur, 1842)	x <sup>L</sup>	x
<i>Oecetis lacustris</i> (Pictet, 1834)	x	x
<i>Oecetis notata</i> (Rambur, 1842)	x <sup>L</sup>	x
<i>Oecetis ochracea</i> (Curtis, 1825)	x	x

(continued)

**Table 16.1** (continued)

	Drava	Floodplain
<i>Oecetis tripunctata</i> (Fabricius, 1793)	x	
<i>Setodes punctatus</i> (Fabricius, 1793)	x <sup>L</sup>	x
<i>Setodes viridis</i> (Fourcroy, 1785)		x
<i>Triaenodes bicolor</i> (Curtis, 1834)		x
<i>Triaenodes simulans</i> (Tjeder, 1929)	x	
Sericostomatidae		
<i>Notidobia ciliaris</i> (Linnaeus, 1761)		x
DIPTERA		
Culicidae		
<i>Aedes cinereus</i> (Meigen, 1818)		x
<i>Aedes rossicus</i> (Dolbeskin et al., 1930)		x
<i>Aedes vexans</i> (Meigen, 1830)		x
<i>Anopheles claviger</i> (Meigen, 1804)		x
<i>Anopheles hyrcanus</i> (Pallas, 1771)		x
<i>Anopheles maculipennis</i> (Meigen, 1818)		x
<i>Anopheles messeae</i> (Falleroni, 1926)		x
<i>Coquillettidia richiardii</i> (Ficalbi, 1889)		x
<i>Culex modestus</i> (Ficalbi, 1890)		x
<i>Culex pipiens</i> (Linnaeus, 1758)		x
<i>Culex territans</i> (Walker, 1856)		x
<i>Culiseta annulata</i> (Schrank, 1776)		x
<i>Ochlerotatus annulipes</i> (Meigen, 1830)		x
<i>Ochlerotatus cantans</i> (Meigen, 1818)		x
<i>Ochlerotatus caspius</i> (Pallas, 1771)		x
<i>Ochlerotatus excrucians</i> (Walker, 1856)		x
<i>Ochlerotatus flavescens</i> (Müller, 1764)		x
<i>Ochlerotatus geniculatus</i> (Olivier, 1791)		x
<i>Ochlerotatus sticticus</i> (Meigen, 1838)		x
<i>Uranotaenia unguiculata</i> (Edwards, 1913)		x
Simuliidae		
<i>Simulium erythrocephalum</i> (De Geer, 1776)	x <sup>L</sup>	
<i>Simulium ornatum</i> species group	x <sup>L</sup>	
<i>Simulium reptans</i> (Linnaeus, 1758)	x <sup>L</sup>	
Chironomidae		
<i>Chernovskiiia macrocera</i> (Saether, 1977)	x <sup>L</sup>	
<i>Chernovskiiia orbicus</i> (Townes, 1945)	x <sup>L</sup>	
<i>Chironomus acutiventris</i> (Wülker, Ryser et Scholl, 1983)	x <sup>L</sup>	
<i>Chironomus nuditarsis</i> (Keyl, 1961)		x <sup>L</sup>
<i>Chironomus plumosus</i> agg.		x <sup>L</sup>
<i>Chironomus tentans</i> (Fabricius, 1804)		x <sup>L</sup>

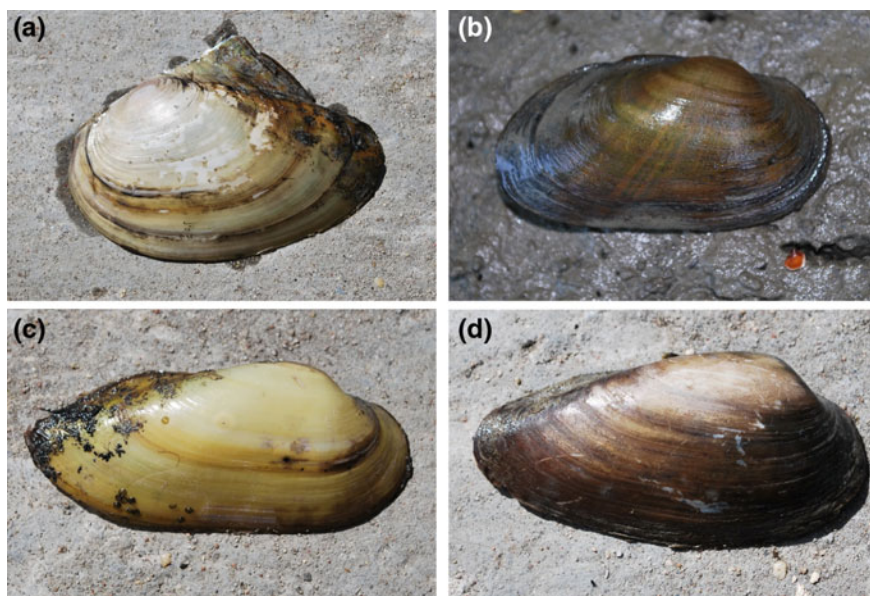
(continued)



**Table 16.1** (continued)

	Drava	Floodplain
<i>Cladotanytarsus vanderwulpi</i> (Edwards, 1929)	x <sup>L</sup>	
<i>Corynoneura scutellata</i> (Winnertz, 1846)		x <sup>L</sup>
<i>Cricotopus vierriensis</i> (Goetghebuer, 1935)	x <sup>L</sup>	
<i>Cryptochironomus rostratus</i> (Kieffer, 1921)	x <sup>L</sup>	
<i>Guttipelopia guttipennis</i> (van der Wulp, 1861)		x <sup>L</sup>
<i>Macropelopia nebulosa</i> (Meigen, 1804)		x <sup>L</sup>
<i>Monopelopia tenuicalcar</i> (Kieffer, 1918)		x <sup>L</sup>
<i>Orthocladius glabripennis</i> (Goetghebuer, 1921)	x <sup>L</sup>	
<i>Orthocladius oblidens</i> (Walker, 1856)	x <sup>L</sup>	
<i>Parachironomus gracilior</i> (Kieffer, 1918)		x <sup>L</sup>
<i>Paratendipes albimanus</i> (Meigen, 1818)	x <sup>L</sup>	
<i>Potthastia longimanus</i> (Kieffer, 1922)	x <sup>L</sup>	
<i>Rheocricotopus chalybeatus</i> (Edwards, 1929)	x <sup>L</sup>	
<i>Tanypus kraatzi</i> (Kieffer, 1912)		x <sup>L</sup>

L collected also as larvae; E collected also as exuviae; <sup>a</sup>protected in Hungary; <sup>b</sup>strictly protected in Hungary; N2000, Natura 2000 species; Ni, Non-indigenous species in Hungary



**Fig. 16.1** Typical native large-sized unionid mussels (Bivalvia: Unionidae) of the Drava. **a** *Anodonta anatina*, **b** *Unio crassus*, **c** *Unio pictorum*, **d** *Unio tumidus* (photos by Arnold Móra)

floodplain area, and both of them develop in temporary small water bodies. Other crustaceans occurring in the Drava and the floodplains belong to Malacostraca. Unfortunately, only 5 out of 14 malacostracan species are native (*Asellus aquaticus*, *Gammarus fossarum*, *G. roeselii*, *Niphargus valachicus*, *Astacus leptodactylus*), indicating the vulnerability of the natural assemblages of the river.

The only aquatic spider species, *Argyroneta aquatica*, can be found in the vegetated water bodies of the Drava floodplain (e.g., Csabai et al. 2015a). The species is regarded as an indicator of good water quality, partly this is the reason why it is protected for many years.

Insects represent the most diverse group along the Drava. In some groups (e.g. Odonata, Ephemeroptera, Trichoptera) only the larvae live in the water and adults may move for a long distance from their breeding places. Accordingly, when only adults of these groups were collected, we do not know if the specimens developed in the Drava or in its floodplains. In these cases the fauna of the river and the floodplain cannot be separated from each other. It is only possible if the ecological requirements of the species are well known and clearly classify them to either fast-flowing or standing waters.

The first information on the mayfly (Ephemeroptera) fauna of the area can be found in Sziráki (1995). His work contained some data based on investigation of adults collected in the early 1990s. Further adult data were published in Sziráki (1998) and Bauerfeind et al. (2005). Later the studies focused on larvae, and despite the sporadic collections, a high number of species was found in the Drava (Kovács et al. 1998, 1998–99, 1999a, 2003; Kovács 2005, 2006a, 2009a, 2011; Czirik et al. 2008; Horvai et al. 2012). Until now 35 mayfly species have been found in the river, but four of them (*Baetis alpinus*, *Ephemera glaucops*, *Ephemerella notata*, *Oligoneuriella rhenana*) were collected only as adults in the 1990s (Sziráki 1995) and no further data are available. Most of the species are common and widespread in Hungary, but some interesting species also occur. For example, *Ametropus fragilis*, *Procloeon macronyx* and *Cercobrachys minutus* are rare, but typical psammophilous species in larger rivers (Kovács 2011). *Oligoneuriella pallida* and *O. rhenana* are among the rare mayfly species in Hungary (Kovács et al. 1999a).

Although dragonflies and damselflies are among the most attractive and, thus, the most investigated insect groups, the first studies on the Odonata fauna along the Drava were completed only in the 1990s (Tóth 1995a, 1998). The results of these studies and a later monitoring work (Tóth 2005) were summarized in Tóth (2010), along with many new data based on the investigation of larvae, exuviae and adults. In addition, larvae and exuviae of Odonata were sporadically collected both in the river (Kovács et al. 2004; Müller et al. 2006; Czirik et al. 2008; Horvai et al. 2012) and in its floodplain (Purger 2013; Csabai et al. 2015a). Based on these works, the Odonata fauna of the Drava region is well known. However, since these studies covered a limited geographical area along the river, the distribution of Odonata species in the region is not fully revealed. Similarly to other larger rivers in Hungary, the most typical dragonflies in the Drava are riverine dragonflies (Gomphidae) and demoiselles (Calopterygidae). Since these species are intolerant to pollution and indicators of good water quality, the occurrence of all four Hungarian species of



**Fig. 16.2** All four Hungarian riverine dragonfly (Odonata: Gomphidae) species can be found in the Drava (**a–b** *Gomphus flavipes*, **c–d** *Gomphus vulgatissimus*, **e–f** *Onychogomphus forcipatus*, **g–h** *Ophiogomphus cecilia*; **a, c, e, g** adult males, **b, d, a, h** exuviae; photos by Arnold Móra)

Gomphidae (Fig. 16.2) in the river is remarkably important for nature conservation (see Jakab and Dévai 2008). Both Hungarian demoiselles occur in the Dráva, but the Beautiful Demoiselle (*Calopteryx virgo*) is much less common than its widely

distributed sister species Banded Demoiselle (*C. splendens*). Other species can occasionally be found in rivers too, especially in slower-flowing and vegetated reaches. Accordingly, altogether 30 dragonfly and damselfly species were recorded from the Drava, but 13 of them were observed only as adults and might not develop in the river. The other 17 species were collected as larvae and/or exuviae too. Besides the ubiquitous species (e.g. *Platycnemis pennipes*, *Ischnura elegans*, *Anax imperator*, *Cordulia aenea*, *Sympetrum sanguineum*), some rare species (e.g. *Coenagrion ornatum*, *Somatochlora flavomaculata*) also occur in the river. With 51 species, many are rare and valuable (e.g. *Lestes dryas*, *Coenagrion scitulum*, *Aeshna viridis*, *Epitheca bimaculata*, *Leucorrhinia caudalis*, *L. pectoralis*, *Sympetrum depressiusculum*), the Odonata fauna of the floodplains is much more diverse.

The Hungarian section of the Drava mainly crosses lowlands, unfavourable environments for many stonefly (Plecoptera) species. Moreover, only very sporadic collections of stoneflies were performed along the river (Kovács et al. 2002; Kovács 2006b, c, 2009b, 2011; Horvai et al. 2012). Accordingly, only four Plecoptera species were recorded from the area. Three of them (*Leuctra nigra*, *Nemoura cinerea*, *Xanthoperla apicalis*) are common in Hungary, while the fourth, *Isoptena serricornis*, is a very rare species with only three known localities in the country (Kovács 2011).

Despite the sporadic collections, the aquatic and semi-aquatic Heteroptera (Nepomorpha, Gerromorpha) fauna of the area proved to be relatively diverse with 35 species (18 from Drava and 31 from the floodplain). The majority of the species are widespread and common in both running and standing waters of Hungary, including the Drava (e.g., Kondorosy and Földessy 1998; Soós et al. 2009a; Kálmán et al. 2011), but some interesting and rare species also occur in the area. *Aphelocheirus aestivalis* occurs exclusively in running waters and was found both in the main channel (Kiss et al. 2006; Czirik et al. 2008; Horvai et al. 2012) and its side-arms (Purger 2013). The occurrence of three rare species, *Notonecta lutea*, *Sigara fossarum* and *Mesovelia thermalis*, is important from a faunistical point of view. All these species were collected in oxbow lakes, where *M. thermalis* is apparently common (Kálmán et al. 2011; Csabai et al. 2015a), while other two species are very rare: *N. lutea* was collected in two oxbows (Kálmán et al. 2011) and *S. fossarum* was only found at a single locality (Csabai et al. 2015a).

Generally, with few exceptions, aquatic Coleoptera species are related to standing rather than running waters. This fact is also reflected in the local fauna: only 17 Coleoptera species were found in the Drava, while 104 species were recovered from floodplain oxbows, ponds and marshes. The aquatic beetle fauna of the area, however, is relatively poorly known: since the first compilation (Gidó and Szél 1998), no studies focused on aquatic beetles and only a single sampling campaign was directed at beetles in the floodplains (Kálmán et al. 2011). Additional information is available on the occurrence of species of nature conservation value, i.e. *Graphoderus bilineatus* (Csabai et al. 2015b) and *Macronychus quadrituberculatus* (Kovács et al. 1999b; Kovács and Merkl 2005). Sporadic data have been published from studies concerning a larger area of Hungary (Ködöböcz et al. 2006; Csabai et al. 2009) or arose from various assessment studies of ecological status

(Czirok et al. 2008; Horvai et al. 2012; Purger 2013; Csabai et al. 2015a). Most of the species known from the Drava are common in Hungary, but some interesting species also occur in the river. The Hairy Whirligig Beetle, *Orectochilus villosus*, and the riffle beetle *Macronychus quadrituberculatus* were considered as very rare species for a long time, but they both are relatively widespread in the running waters of Hungary. One of the most important faunistical results is the occurrence of the diving beetle *Deronectes latus* in the Drava, since this is the second Hungarian locality for this species (see Csabai et al. 2009).

Alderflies (Megaloptera: Sialidae) and spongeflies (Neuroptera: Sysiridae) are among the smallest insect families containing aquatic species. A single sialid species, *Sialis lutaria*, was recorded from the Drava and its floodplains, where the larvae can be found in standing and running water bodies (Ábrahám 1995, 1998; Horvai et al. 2012; Csabai et al. 2015a), in sediments with high organic matter content. The feeding of spongeflies larvae is special as they parasitize freshwater sponges. From this family, two species, *Sysira fuscata* and *Sysira terminalis*, are known to occur along the Drava (Ábrahám 1995, 1998).

The first data on the occurrence of caddisflies (Trichoptera) along the Drava came from a collection of adults by light trap at the very end of the 1980s (Uherkovich and Nógrádi 1992). Due to continuous collections of adults (Nógrádi and Uherkovich 1995, 1998; Nógrádi 2001; Uherkovich 2005), the Trichoptera fauna of the area became one of the best known in Hungary with 91 species. However, a large part of the collected species typically live in standing waters, and most probably developed in different water bodies of the floodplain instead of the river, e.g. larvae of *Leptocerus tineiformis* were collected only in oxbow lakes (Csabai et al. 2015a). However, based on sporadic collections of larvae, 23 species are known to occur in the Drava (Móra et al. 2006; Czirok et al. 2008; Szitta et al. 2009; Horvai et al. 2012). In the river, the caddisfly assemblages are dominated by species typical of larger rivers, like *Agapetus laniger*, *Hydropsyche* spp., *Neureclipsis bimaculata*, *Psychomyia pusilla*, *Brachycentrus subnubilus*, *Ceraclea dissimilis*, *Oecetis notata*, *Setodes punctatus*. Besides them, rare species in Hungary also occur along the Drava (e.g. *Hydroptila vectis*, *Platyphylax frauenfeldi*, *Silo nigricornis*, *Ylodes simulans*). Some of the rare species, e.g. *Silo piceus* and *Adicella syriaca*, became relatively common in the region in the early 2000s (Uherkovich and Nógrádi 2005).

One of the most diverse orders of insects is Diptera, with a plenty of species developing in aquatic habitats. Unfortunately, the aquatic Diptera were almost neglected during the studies on the fauna of the Drava region. To date, larvae of three black fly taxa (Simuliidae: *Simulium erythrocephalum*, *S. reptans*, *S. ornatum* species group) were only recorded from the river (Horvai et al. 2012). In a recent study, larvae and exuviae of 11 non-biting midge (Chironomidae) taxa were collected from the river, among them typical species that are characteristic for larger sandbed rivers, like *Chernovskiiia macrocera*, *C. orbicus*, *Chironomus acutiventris*, *Cladotanytarsus vanderwulpi*, *Cricotopus vierriensis*, *Cryptochironomus rostratus*, *Orthocladius oblidens*, *O. glabripennis*, *Paratendipes albimanus*, *Potthastia longimanus*, *Rheocricotopus chalybeatus* (own unpublished data). However, the

aquatic Diptera fauna (including these two families) of the Drava remained nearly completely unknown. Similarly to the river, the aquatic Diptera fauna of the floodplains is very poorly described, and mainly the families of medical and veterinary importance were studied, i.e. mosquitoes (Culicidae) and horseflies (Tabanidae). Tóth (1995b) reported the occurrence of 21 mosquito species based on collections of adults. Horseflies were studied extensively in both Croatian and Hungarian parts of the floodplain, with a result of the occurrence of 42 species (summarized in Majer and Krčmar 2006), but there are only some species whose larvae develop in water, so they are considered as aquatic macroinvertebrates only to some extent. It is not clearly known which species prefer the water against moist soil for early stage development. Therefore, the Tabanid species have not been listed in the appendix. Additionally, nine chironomid taxa were collected in an oxbow of the Drava (Csabai et al. 2015a), among them species characteristic for standing waters with dense vegetation (e.g., *Chironomus tentans*, *Corynoneura scutellata*, *Guttipelopia guttipennis*, *Monopelopia tenuicalcar*, *Parachironomus gracilior*, *Tanytus kraatzi*).

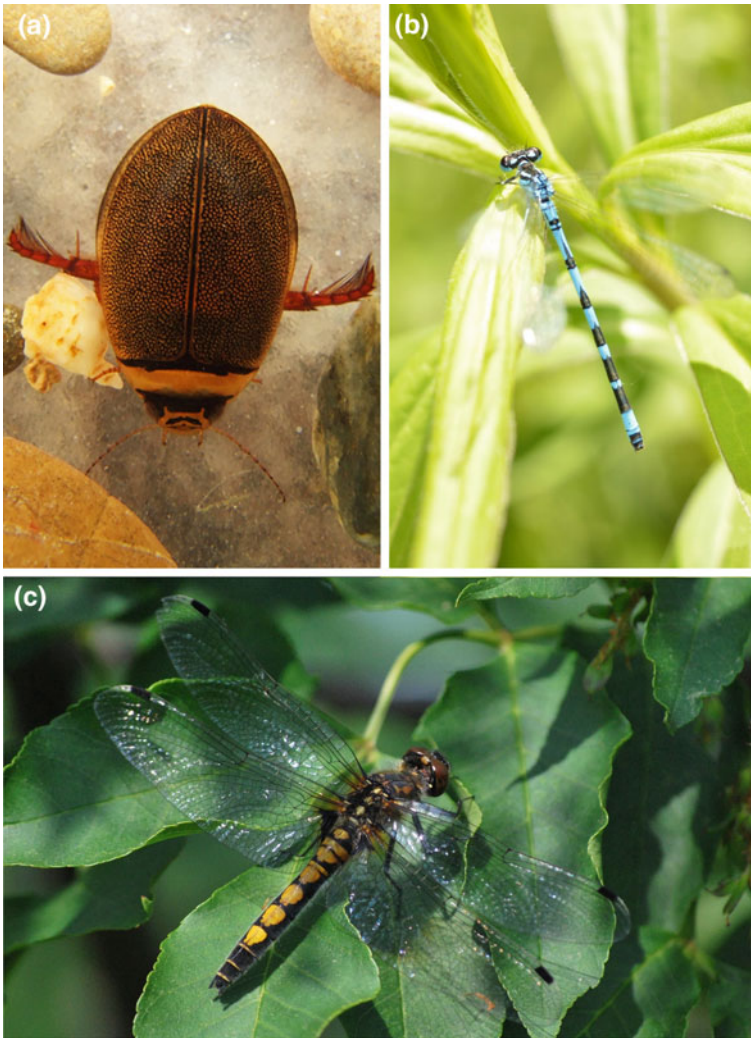
### 16.3 Species of Nature Conservation Interest

The most unique and valuable species of the Drava is the caddisfly *Platyphylax frauenfeldi*. The population of this large-sized species along the Drava might be the last one in the world (Malicky et al. 2002). Some time ago *P. frauenfeldi* was present in a relatively large part of Europe from France to the Danube region—although always rare and in very scattered distribution. The species exclusively live/lived in unregulated and non-polluted larger rivers, like the Aare, Danube, Drava, Enns, Inn, Mura and Rhône (Malicky et al. 2002), but nearly all habitats of *P. frauenfeldi* have been lost in Europe. Although in Hungary there are older records from many sites along the rivers Kerka, Mura and Drava (Uherkovich and Nógrádi 1997; Uherkovich 2004), the species has not been recovered for 15 years. All information on its recent distribution suggests that the remnant Hungarian population of *P. frauenfeldi* is small and therefore vulnerable. Because of its vulnerability, the species is strictly protected in Hungary, but not listed in either the Habitat Directive (Council of the European Union 2013) or the IUCN Red List (IUCN 2017). The future of *P. frauenfeldi* is uncertain, and any unconsidered human action (e.g. any measures of river regulation, heavy industrial activities) might lead to its extinction. In lack of knowledge on the life cycle of the species, the possibilities of its protection are very limited. The flight season lasts from October to November, with a peak in late October (Uherkovich and Nógrádi 1997). The larval biology is completely unknown, since no larvae have been collected in the nature; however, larvae were described based on reared specimens (Malicky et al. 2002).

The dytiscid beetle *Graphoderus bilineatus* (Fig. 16.3a) is a charismatic species for conservation. It has been granted special conservation status, is a Natura 2000 species of community interest, and strictly protected in Hungary. According to the

IUCN Red List of Threatened Species (IUCN 2017), its status is ‘Vulnerable’ and it also has been included in the Berne Convention, annexes II and IV of the Habitats Directive and in CORINE lists. In Hungary, the species has two restricted distribution areas: 1. along the Upper Tisza River and in the Bodrog River floodplain (Northeast-Hungary) and 2. along the Lower Danube and in the eastern Drava region (Southwest-Hungary). The latter units merge into a single contiguous area at the confluence of these rivers, at Kopački Rit, Croatia (Haraszthy 2014; Csabai 2015b). Along the eastern Drava, six different localities of the species became known from a long section (133–70 rkm) within the period 2012–2014 (Csabai et al. 2015b). Summing up our knowledge on its ecology, in Hungary the species is exclusively linked to small water bodies, gravel pits, ponds, and oxbow lakes within the floodplains of medium-sized and large rivers. While in the floodplains of Tisza, Bodrog and Danube, it mainly occurs in densely vegetated eu- or hypertrophic water bodies, along the Drava it prefers active side-arms and small ponds with less vegetation (Haraszthy 2014). All known localities are in the active floodplain, occasionally or regularly connected to the rivers for a while, inundated, and refreshed during floods.

In addition to *Graphoderus bilineatus*, many further aquatic macroinvertebrate species occurring along the Dráva can be found among the ‘species of community interest whose conservation requires the designation of special areas of conservation’ (Annex II) and ‘species of community interest in need of strict protection’ (Annex IV) that are listed in the latest consolidated version of the Habitat Directive (Council of the European Union 2013). These species are considered important for nature conservation, and all are protected or strictly protected in Hungary. The Lesser Ramshorn Snail (*Anisus vorticulus*), although widely distributed in Hungary, is threatened by loss of its habitats (Haraszthy 2014). Fortunately, a viable population can be found in the standing waters of the Drava floodplain (Csabai et al. 2015a; Varga and Uherkovich 1998). Only an old reference from times before 1933 is known (Varga and Uherkovich 1998) for the Striped Nerite (*Theodoxus transversalis*) from the Drava, and according to recent studies, this species disappeared from the river (see Haraszthy 2014). Similarly to other larger Hungarian rivers, a strong population of Thick Shelled River Mussel (*Unio crassus*) (Fig. 16.1b) lives in the Drava. *Unio crassus* is among the endangered (EN) species (IUCN 2017), and the Hungarian populations are important in its conservation. Most of the Hungarian Natura 2000 species belong to Odonata. The Ornate Bluet (*Coenagrion ornatum*) (Fig. 16.3b) is a near threatened (NT) damselfly showing decreasing population trend in Europe (Boudot and Kalkman 2015). Fortunately, it is still moderately frequent in Hungary. Larvae of the species were collected in both the Drava and the floodplain (see Tóth 2010), suggesting that there is a viable population along the river. The occurrence of Green Hawker (*Aeshna viridis*) is almost completely confined to large fields of Water Soldier (*Stratiotes aloides*) since the larvae develop among the leaves of this plant. The populations show a decreasing trend, and the species is regarded as near threatened in Europe (Boudot and Kalkman 2015). The survival of the population found in the floodplains of the Drava (Tóth 2010) largely depends on the presence of *S. aloides*, which is strongly related to the good ecological state of the oxbows. The



**Fig. 16.3** Natura 2000 species occurring in the Drava floodplain. **a** *Graphoderus bilineatus*, **b** *Coenagrion ornatum*, **c** *Leucorrhinia pectoralis* (photos: **a** by Nataša Turić, **b**, **c** by Arnold Móra)

River Clubtail (*Gomphus flavipes*) (Fig. 16.2a, b) is a characteristic species for larger lowland rivers. It has strong populations in Hungarian rivers, and it occurs all along the Hungarian Drava section (Jakab and Dévai 2008). Although *G. flavipes* suffered a very severe decline in the 19th and 20th centuries, and was regarded as one of the most threatened species in Europe, at present the populations show an increasing trend and the species is not threatened at present. However, declining water quality and improper river management can negatively influence the populations. The Green



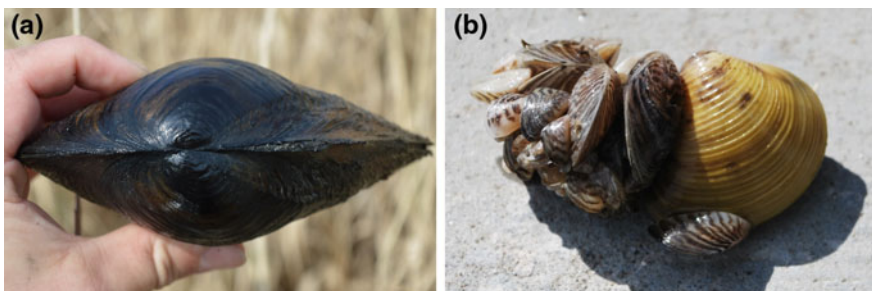
Snaketail (*Ophiogomphus cecilia*) (Fig. 16.2g, h) also suffered a severe decline in the past, but a recovery started in the 1990s, and now the species is in the least concern (LC) category (Boudot and Kalkman 2015). In contrast, the Hungarian populations of *O. cecilia* are regarded as vulnerable, due to loss of habitat (Haraszthy 2014). In the Drava, a strong population of this species can apparently be found, suggested by the fact that larvae were collected during all samplings carried out on the river (e.g. Kovács et al. 2004; Müller et al. 2006; Czirik et al. 2008; Tóth 2010; Horvai et al. 2012). The European populations of Lilypad Whiteface (*Leucorrhinia caudalis*) showed a remarkable decline in the 20th century and the species became extinct in many countries of Europe. A recovery started in the 2000s, and now the species shows stable population trends (Boudot and Kalkman 2015). In Hungary *L. caudalis* is a rare species which is threatened by the eutrophication of its habitats. Along the Drava it prefers mesotrophic small standing waters (Tóth 2010). Although the Yellow-spotted Whiteface (*Leucorrhinia pectoralis*) (Fig. 16.3c) is in the least concern (LC) category, its populations are declining in Europe (Boudot and Kalkman 2015) and probably in Hungary too. This species can be found in some oxbows of the Drava (see Tóth 2010), but the size of the population, varying remarkably from year to year, can hardly be assessed in lack of long-term monitoring.

Besides the Natura 2000 species, a relatively large number of other nationally protected species belonging to various taxonomical groups occur along the Dráva. Protected aquatic snails (*Amphimelania holandrii*, *Borysthenia naticina*, *Fagotia daudebartii*, *Theodoxus danubialis*) are not frequent but characteristic species in the running waters of Hungary. The Depressed River Mussel (*Pseudanodonta complanata*) lives in both running and standing waters. It is threatened by pollution and eutrophication of waters, and listed among the vulnerable species (IUCN 2017). The Narrow-clawed Crayfish (*Astacus leptodactylus*) used to be very common in Hungarian waters once, but, mainly because of water pollution and the appearance of invasive crayfish species, it shows a decreasing population trend. The Water Spider (*Argyroneta aquatica*) is not rare in Hungarian water bodies with a dense aquatic vegetation. The protected mayflies (*Ametropus fragilis*, *Oligoneuriella pallida*, *O. rhenana*) and stoneflies (*Isoptena serricornis*) occurring in the Drava are seldom recovered riverine species in Hungary. Among the protected dragonflies and damselflies rare (*Lestes dryas*, *Coenagrion scitulum*, *Epiheca bimaculata*, *Somatochlora flavomaculata*, *Sympetrum depressiusculum*) and rather common (*Aeshna isocetes*, *Libellula fulva*, *Orthetrum brunneum*) species are equally found. Two aquatic and semi-aquatic Heteroptera species are protected in Hungary. *Aquarius najas* is relatively distributed mainly in slow-flowing streams and rivers of Hungary, and was collected only from the Drava (Czirik et al. 2008; Horvai et al. 2012). The distribution of *Notonecta lutea* is sporadic in Hungary (Soós et al. 2009b). It has been recovered from two oxbow lakes along the Drava (Kálmán et al. 2011). The riffle beetle *Macronychus quadrituberculatus* used to be regarded as threatened species near extinction. Therefore, it became protected after its rediscovery in Hungary, but recently it is known from numerous sites along medium-sized and larger Hungarian rivers (Kovács and Merkl 2005).

## 16.4 Non-indigenous Species

One of the major threats in natural water bodies is the invasion of non-native species, which can affect all levels of aquatic ecosystems. However, the ecological impacts of these species are difficult to evaluate, since both negative and positive effects have been reported (Simberloff et al. 2013). Nevertheless, the invasive species are often more competitive than native ones, forcing the latter to abandon their natural habitats. Furthermore, new pathogens are often introduced along with the invasive species, against which the native species are defenseless. The strong competition and the diseases can cause the extinction of populations of native species. These problems may exist in the case of the Drava, where the non-indigenous species are represented mainly by molluscs and crustaceans.

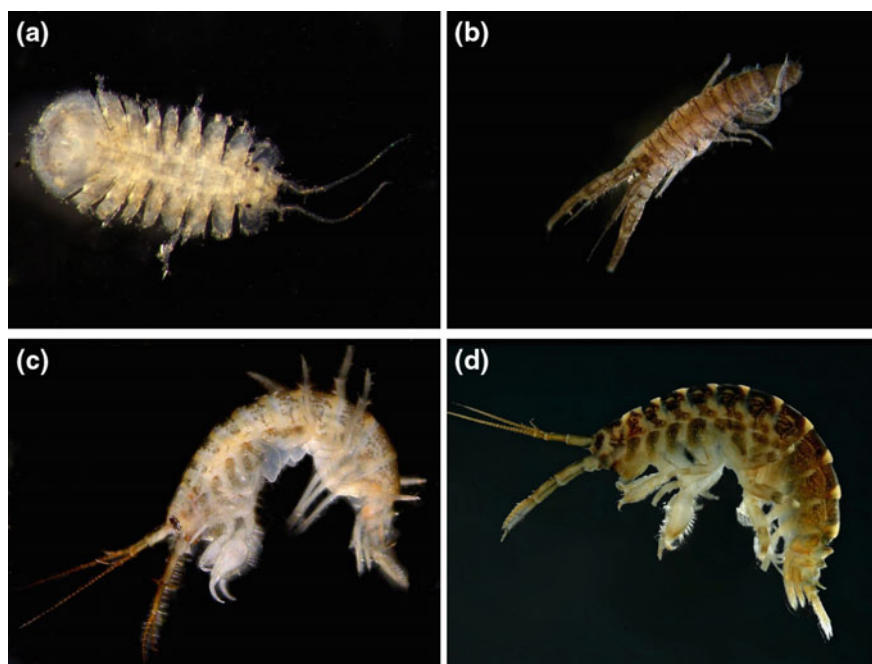
Some invasive aquatic mollusc species, e.g. New Zealand Mud Snail (*Potamopyrgus antipodarum*) from New Zealand and Fragile Ancyloid (*Ferrissia fragilis*) from North America, have well established populations in the Drava, but no direct negative effects on native species or on the river ecosystem were observed. The North American Acute Bladder Snail (*Haitia acuta*) and the Asian Chinese Pond Mussel (*Anodonta woodiana*) (Fig. 16.4a) have become widely distributed in Europe, including Hungary. They can be found in a wide range of aquatic habitats (e.g. in both running and standing waters along the Drava), where they can replace the related native species, i.e. Common Bladder Snail (*Physa fontinalis*) and large unionid mussels. Two bivalves, the Golden Freshwater Clam (*Corbicula fluminea*) from Asia and the Zebra Mussel (*Dreissena polymorpha*) from the Ponto-Caspian region (Fig. 16.4b), often occur in high densities in the Drava, but their impacts can hardly be assessed. The large number of specimens and empty shells can provide substrate and shelter, increasing the density of other macroinvertebrates, but they can strongly modify the quality of the sediment (e.g. chemistry, grain size, organic matter content). They can decrease the quantity of planktonic organisms and increase light penetration by their filter feeding (Sousa et al. 2009). The Zebra Mussels often attach themselves to shells of larger mussels by byssal threads



**Fig. 16.4** Non-indigenous bivalves of the Drava. **a** Chinese Pond Mussel (*Anodonta woodiana*), **b** Zebra Mussels (*Dreissena polymorpha*) attached to the shell of a Golden Freshwater Clam (*Corbicula fluminea*) (photos by Arnold Móra)

(Fig. 16.4b), reducing their ability to move, feed, and breed, and eventually leading to their deaths. This way it can be a threat for native species, especially the large-sized Unionidae (Fig. 16.1), among them the protected *Pseudanodonta complanata* and *Unio crassus*. The River Nerite (*Theodoxus fluviatilis*) is a widely distributed aquatic snail in northern, central and eastern Europe, expanding its area towards the Carpathian Basin, where this species is invasive. It became the most frequent nerite species in the larger rivers of Hungary (in the Drava as well), replacing the native species due to its higher tolerance to pollution (IUCN 2017).

Among the Malacostraca occurring along the Dráva there are more non-native (*Chelicorophium* spp., *Dikerogammarus* spp., *Synurella ambulans*, *Jaera sarsi*, *Limnomysis benedeni*, *Pacifastacus leniusculus*) (Fig. 16.5) than native species (9 out of 14), which indicates that the problems with aquatic invasions are getting more serious in the Dráva. All but one (*P. leniusculus*) species are of Ponto-Caspian origin, extending their range in the Carpathian basin and, in many cases, all over Europe. The very high densities of *Chelicorophium curvispinum* (Fig. 16.5b) and *C. sowinskyi* might have an impact on the ecosystem of the Drava by changing food webs. For example, along with other invasive macroinvertebrate species (e.g. *Dikerogammarus* spp., *Jaera sarsi*, *Limnomysis benedeni*, *Corbicula fluminea*, *Dreissena polymorpha*, *Theodoxus fluviatilis*), they became the main food items in



**Fig. 16.5** Invasive crustacean species of the Drava. **a** *Jaera sarsi*, **b** *Chelicorophium curvispinum*, **c** demon shrimp (*Dikerogammarus haemobaphes*), **d** killer shrimp (*Dikerogammarus villosus*) (photos by Michał Grabowski)

both native and invasive fish diet (Kelleher et al. 1998; Borza et al. 2009). The *Dikerogammarus* species (Fig. 16.5c, d) are strong predators preying on a wide range of aquatic organisms, accordingly they can pose a major threat to native species, as it is suggested by their common names (e.g. killer shrimp for *D. villosus* and demon shrimp for *D. haemobaphes*). It is well documented that after their invasion native and other non-native species retreated from their original habitats to less favourable ones or completely disappeared due to the high predation and competition pressure (Rewicz et al. 2014; Bovy et al. 2015). However, in the case of high habitat heterogeneity, like in the Drava, the co-existence of *Dikerogammarus* species with native and other non-native species is possible by niche partitioning (Kley and Maier 2005). The North American Signal Crayfish (*Pacifastacus leniusculus*) is spreading downstream from the Mura river (Hudina et al. 2009) and appeared in the Hungarian section in the last few years (András Weiperth pers. comm.). This invader is a carrier of crayfish plague fungus (*Aphanomyces astaci*). The Signal Crayfish is resistant to this disease, which is responsible for widespread mortality in native European crayfish populations (Edgerton et al. 2004). Due to the vulnerability of native species to crayfish plague and the high competitive abilities of Signal Crayfish, the population of Narrow-Clawed Crayfish (*Astacus leptodactylus*) is especially threatened in the Drava. Another North American invasive species, the Spiny-Cheek Crayfish (*Orconectes limosus*), spreads upwards from the Danube throughout the Drava (Hudina et al. 2009), but it has not been found in the Hungarian section yet. Although the *A. leptodactylus* and *O. limosus* can co-exist, the latter may be a threat since it is also possibly a vector of crayfish plague (Kozubíková et al. 2009).

## 16.5 Conclusions

Due to the heterogeneous habitat complex hosting diverse aquatic macroinvertebrate assemblages and a high number (39) of protected and strictly protected species, the Drava and its floodplains are among the most valuable and most important Hungarian regions from the point of view of nature conservation. Both the river and its floodplain deserve protection, for which the Danube–Drava National Park provides good frames. However, in case of all aquatic macroinvertebrate groups further studies are needed to achieve a thorough and satisfactory knowledge on the fauna of the river and its surroundings, especially in case of floodplain water bodies, and to explore the exact distribution of the species.

At the same time, the valuable aquatic macroinvertebrate assemblages of the Drava Region are vulnerable, and might be threatened by any unconsidered human action, especially measures of river regulation. The change or loss of habitats might cause serious damage to populations of rare species, or, in extreme cases like that of *Platyphylax frauenfeldi*, might lead to extinction.

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