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The distribution and occurrence frequency of Gomphidae (Odonata: Gomphidae) in river Gauja

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Abstract

The article contains data on four gomphid dragonfly species known in Latvia – *Gomphus flavipes*, *Gomphus vulgatissimus*, *Onychogomphus forcipatus*, *Ophiogomphus cecilia* and the latest data on their distribution, occurrence frequency and density of individuals. Gomphidae were obtained from macrozoobenthos samples in 1998. In total 280 quantitative und 65 qualitative samples were collected in the River Gauja from the town Taurene upstream to below Carnikava. For complete analyses, the observations of adult individuals used – bibliography, unpublished (personal) observations and data from 1933 to 2005. Three species of Gomphidae – *G. vulgatissimus*, *O. forcipatus* and *O. cecilia* were recorded. Data with regard to observations of larvae/exuviae/imago stages showed that all gomphid species are encountered in throughout Latvia. *G. flavipes* is infrequent for Latvia and this species has been recorded only in the Gauja. The occurrence frequency of gomphid was 13.2 % of obtained samples. *G. vulgatissimus* was found in 10 % of samples, *O. forcipatus* in 5 %, *O. cecilia* in 0.7 %. Ecological analysis of bottom substrate showed that *O. forcipatus* prefers a hard substrate situated in the rhitral stretches or in the rapids. The density of *G. vulgatissimus* reached 0.919 ind. m^{-2}, and *O. forcipatus* 0.514 ind. m^{-2}.

Key words: distribution, Gomphidae, occurrence frequency, Odonata, River Gauja.

Introduction

There are four gomphid dragonfly species known in Latvia: *Gomphus flavipes* (Charpentier, 1825), *Gomphus vulgatissimus* (Linnaeus, 1758), *Onychogomphus forcipatus* (Linnaeus, 1758) and *Ophiogomphus cecilia* (Geoffroy, in Fourcroy, 1785). All, except *G. flavipes*, are distributed throughout Latvia (Spuris 1956), although the frequency of their occurrence varies. *G. vulgatissimus* and *O. forcipatus* are considered as widespread and common (Spuris 1956; Spuris 1993). *O. cecilia* is also widespread but has been considered to be rare (Spuris 1993). Recent investigations indicate that it is either more common than previously thought or has increased in numbers (Kalniņš, Inberga-Petrovska 2005). *G. flavipes* is also a fairly rare species but is found in various regions of Latvia (Spuris 1956; Spuris 1993).

In to the literature (Spuris 1956; Askew 1988; Spuris 1993), habitats occupied by dragonfly larvae are usually described in general, with insufficient information on the microhabitats occupied by the larvae, their frequency and density of individuals. Fragmentary data are found in some records of zoobenthos investigations (Spuris 1953; Spuris 1966; Balode et al. 1981; Cimdin et al. 1989; Parele 2001) and regarding fish feeding (Mitans 1971). However, these records also present only general information about the

frequency of dragonfly larvae and their specific habitats, or they do not identify individual species.

For many species, including dragonflies, when a trend of decreasing numbers has been observed, it is important to have more information about these species, including their habitats and occurrence frequency. This knowledge may help to explain the change and avert decline for species especially regarding the rare species *O. cecilia* (Sahlen et al. 2004) and *G. flavipes* (Schmidt 1977). *O. cecilia* is included in the Red Data Book of Latvia in the 3rd category, as a rare species with no threat of extinction. This species is encountered in small numbers or in limited areas and specific sites that may probably disappear. Therefore they require protection (Spuris 1998). To ensure protection, this species is included in the Regulations of Cabinet of Ministers No. 396 (14.11.2000.) "List of specially protected species and limited available specially protected species". *O. cecilia* is also included in Appendix II of the Bern-Convention 1979 and Appendix II, IV of the Habitat and Species Directive (EU Directive 1992).

Materials and methods

Study area

Gauja is one of the largest rivers in Latvia. It's length is 452 km with a fall of 234.5 m (0.5 m km^{-1}) and a basin of 8.9 thousand km^2. Yearly water discharge 2.2 km^3 (average flow rate - 69.7 m^3 s^{-1}). Due to variation of water level, stream rate and features of flow, the River Gauja could be characterized as a very heterogeneous watercourse. It deposits 560 thousand metric tons of sediments per year, which is more than any another river in Latvia. About 30 % of its basin is covered by forests, 5 % – by bogs. The volume of flow rate of the river Gauja in spring periods reaches 870 m^3 s^{-1} compared to only 6 m^3 s^{-1} in winter. Its average flow rate is 0.2 ÷ 0.4 m s^{-1} but reaches 0.6 ÷ 0.8 m s^{-1} in some places. In the upper course the River Gauja flows through several lakes and millponds. In the region of the Augšgauja lowland the riverbed is 10 to 20 m wide with variable depth from 0.4 to 2 m. The riverbed is sandy, gravely; occasionally muddy, pebbly or with small boulder rapids. Below Rēveļi it flows through the lowlands of Melnupe and Lejasciems. In this region the riverbed reaches 20 to 30 m in width and its depth is 0.4 ÷ 1.5 m in rhitral and 2.5 m in the potamal stretches. Until Lejasciems the riverbed is mainly sandy or gravely, rarely pebbly or with boulder rapids. Below outflow of the Tirziņa the Sikšņu rapids begin, which are over 4 km in length. From the Sikšņu rapids until Vireši the river falls 14 m in a length of 11 km (1.3 m km^{-1}). There are dolomite outcrops in the riverbed and on the banks. In the Trikātas rising the riverbed is sandy and rough, with sandbanks and deep pools, the banks are steep and easily eroded and occasionally have collapsed. There are many oxbows. The width of the river is 30 to 80 m. The biggest rapids are the Strenču rapids, where the river depth is mainly 1.8 ÷ 2.2 m but it does reach 3 m. Below the Abula outflow (above Valmiera) until Murjāņi the River Gauja flows through its old valley. The riverbed is 60 to 120 m wide with abrupt changes in depth (from 0.3 ÷ 1 m to 5 ÷ 7 m). The riverbed is mainly sandy, occasionally gravely and pebbly, but in some places there are boulder rapids (Valmieras, Kazu, Raiskuma, Rakšu, Ķūķu rapids). In the old valley the river collects much creek and spring water. Below Murjāņi it flows through the Rīga sandy lowland. In this stretch the riverbed of Gauja is sandy or gravely. It's width is 70 to 300 m, in the Gauja outflow area even more, and its depth is 2 m (Avotiņa 1995).

Sampling procedures and data analysis

Gomphidae larvae were collected during implementation of the project „Establishment of long-term pollution in water of Gauja" in 1998 (Kalniņš 2000). In total 280 quantitative samples of macrozoobenthos were collected at 32 sampling sites in the river Gauja from the town of Taurene upstream to Carnikava. The sampling sites were mainly above and below large (> 500 citizens) populated areas. Standardized methods were used for collecting and processing the Gomphoidae material (Standart… 1992). At each sampling site two to four quantitative macrozoobenthos samples were collected (by both river banks and in the middle part of river). At most of sites samples were collected in three seasons – spring, summer and autumn. An Ekmans-Berdge type grab (0.025 m^2) was used for collecting quantitative samples. The obtained densities were calculated for 1 m^2. One to two qualitative samples were collected at sampling sites using a hidrobiological hand-net. In total 65 qualitative samples were obtained. Each sample was sorted by rinsing using a sieve (pore size 1 × 1 mm). The benthos organisms were sorted in the laboratory. Data on water temperature (T °C), soil type and composition of soil, flow rate and the depth as well as vegetation of biotope were recorded.

For analysis, the following data were also included:

(i) observation data on adult individuals from literature, unpublished (personal) observations and data from 1933 to 2005; all data were entered into a data base of dragonfly distribution in Latvia (maintained by the author);

(ii) data collected by the author for *O. cecilia* adults on $29^{th} \div 30^{th}$ of July 2003 in the River Gauja valley between the towns Cēsis and Sigulda (45 km stretch), based on accounts of all adult individuals counted from a boat. The counts were made during clear and sunny weather, which is optimal for adult dragonfly activity, from 11 AM till 16 PM. Observations of each individual were recorded using GPS and entered on maps. To describe the potential feeding ground of dragonflies (especially *O. cecilia*) outside the watercourse, additional open habitats by the river were inspected;

(iii) information obtained by the author during the projects "Protection and management of the Northern Gauja valley" (LIFE project) and „Cross boundary river habitats as corridors for protected species migration – monitoring and management strategy" regarding the distribution and occurrence of habitats and dragonflies in the River Gauja.

In the above mentioned projects, rich Odonata material was collected. In total, in a ~100 ÷ 150 km long section of the River Gauja, both left and right banks (including boating) were inspected. In most cases, adult individuals were recorded, but also larvae and exuviae as well.

Distribution of Odonata was mapped using a grid of 5 × 5 km squares in the Baltic grid system on a Transverse Mercator projection (TM-1993) of Latvia. The current map is based on satellite maps available for Latvia (scale 1:50 000), published in 1999 - 2000. This map is graduated in 1 × 1 km (= 1 km^2) squares and the border of 5 × 5 km squares coincide with every fifth km line. In total, the terrestrial territory of Latvia includes 2785 squares (some squares are not complete). The River Gauja crosses 70 different squares; some of them contains only ~ 1-km-long river stretches. Samples were obtained in 32 sites (= 30 5 × 5 km squares; Fig. 1). In preparing Odonata occurrence maps, data from the author's data base were used. In total, data on Latvia's Odonata are available for 481 map squares.

Density of individuals was calculated from the total number of collected samples and from the number of samples containing gomphid larvae. Estimates of the density of gomphid larvae in the River Gauja were made in general and in optimum/sub-optimum habitats for each species.

Results and discussion

Distribution

Three species of gomphid larvae were found in the River Gauja – *G. vulgatissimus*, *O. forcipatus* and *O. cecilia* while *G. flavipes* has been recorded in the literature (Spuris 1956), it was not found in this study, confirming that it is a rare species in Latvia and that this information is not based on incomplete knowledge. Other Gomphidae were present in 21 squares (sampling sites). *G. vulgatissimus* was recorded in 20 squares, *O. forcipatus* - in eight squares (Fig. 2), but *O. cecilia* larvaes in five squares. Therefore, it can be concluded that *G. vulgatissimus* is a widely distributed species in the Gauja. *O. forcipatus* was established frequently in upper reaches, and in the sections of overfalls. However, it is presumed that the species is encountered in other sections as well as in the middle part of Gauja and in the lower reaches. *O. cecilia* and *G. flavipes* are more locally distributed species. The position of the latter being derived from the data in the literature (Spuris 1956; Spuris 1993). *O. cecilia* larvae were distributed in all river lengths. A total of 48 adult individuals *O. cecilia* were recorded (between three and nine individuals in any one 5 × 5 km square or 0.9 individuals per 1 km) during the count from Cēsis to Sigulda in 2003, showing that the species is distributed in the River Gauja more widely (Fig. 3) than indicated

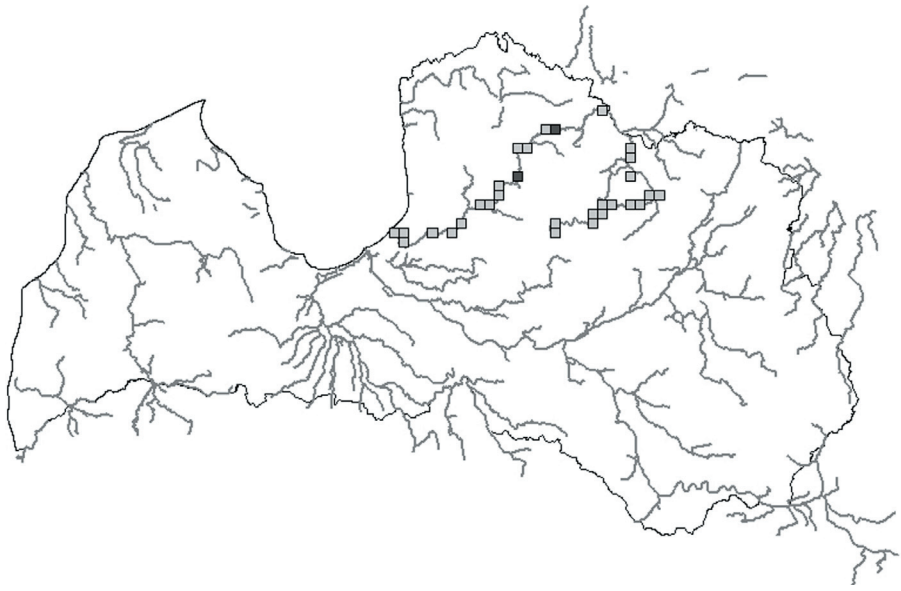

Fig. 1. Quantitative and qualitative macrozoobenthos sampling sites (5 × 5 km squares) in the River Gauja from Taurene upstreams to Carnikava downstreams in 1998 (grey squares – one sampling site in square; black squares – two sampling sites in square).

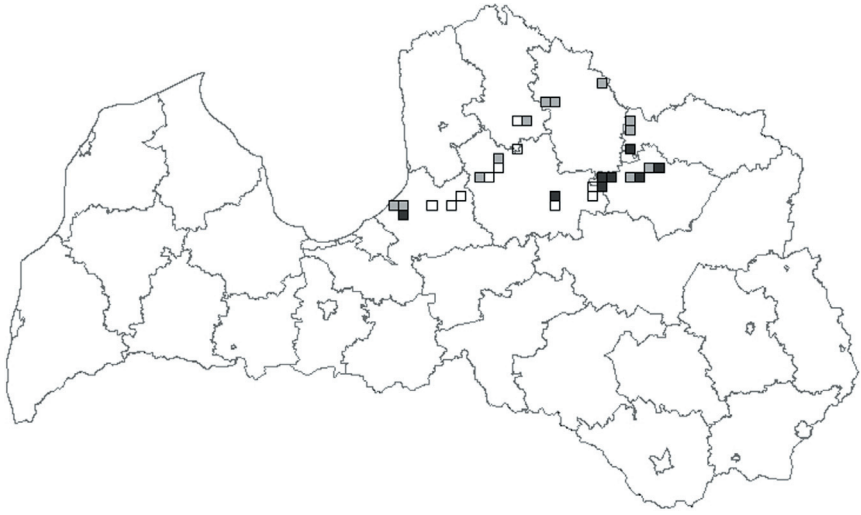

Fig. 2. The distribution of *G. vulgatissimus* and *O. forcipatus* in quantitative and qualitative samples of macrozoobenthos collected in the River Gauja from Taurene upstreams to below Carnikava in 1998 (white squares – sampling sites; grey squares – localities with *G. vulgatissimus* larvae; black squares – localities with *G. vulgatissimus* and *O. forcipatus* larvae).

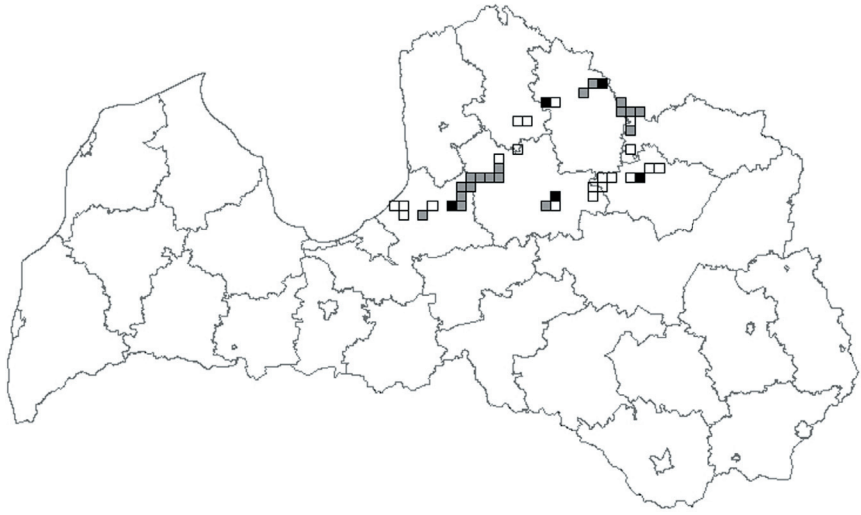

Fig. 3. The distribution of *O. cecilia* in quantitative and qualitative samples of macrozoobenthos collected in the River Gauja from Taurene upstream to below Carnikava in 1998 (white squares – sampling sites; black squares – localities with larvae; grey squares – localities with imago).

by larval counts. For example, larvae were only found in this section of the river near Sigulda. Although the adult count was performed during the period of maximum flight (Hammond 1983), it is known that a considerable proportion of adult individuals feeding

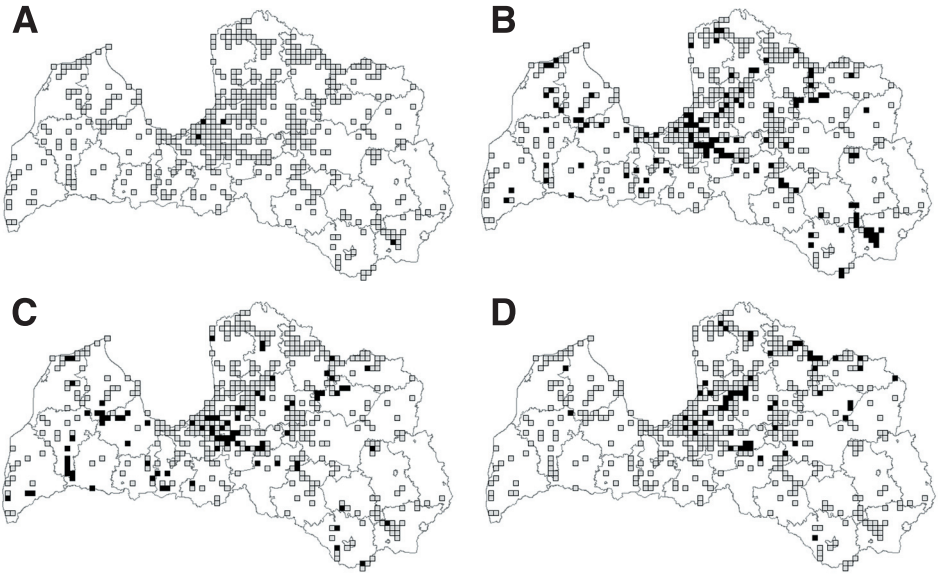

Fig. 4. The distribution of Gomphidae in Latvia (grey squares – all odonate records (n = 481); black squares – species records) on 2005. A, *G. flavipes*; B, *G. vulgatissimus*; C, *O. forcipatus*; D, *O. cecilia*. Observation data from literature, unpublished and personal observations data from 1933 to 2005; these data are entered into the data base of dragonfly distribution in Latvia (maintained by the author)..

outside of the river zone, in meadows near the river, at oxbows and other open habitats, hence the real number of individuals may be greater.

Comparing observations of gomphid larvae in the River Gauja with observations of larvae/adults throughout Latvia (author's data base on dragonfly distribution), it is clear that the above conclusion about the distribution of the species is only partly true. Species of gomphid occur throughout most of Latvia (Fig. 4). However there are differences between the distributions of the species. *G. flavipes* is the most rarely observed gomphid in Latvia found in only four squares – in the central and eastern parts of Latvia. This can probably be explained by its location in the Northern border of occurrence area of the species (Askew 1988). However it is known in more northern areas in Estonia (Ruusma 1995; Kalkman et al. 2002). Although the related species, *G. vulgatissimus*, is the most widely spread gomphid species in the country (120 squares). *G. vulgatissimus* is widespread in big rivers – Daugava and Gauja, less in the small or middle-sized rivers – Abava, Ogre and others. Since the species occurs in other regions of Latvia, there would be reason to suppose, that the species would be more widely occurred, but the less amount of the fields in other regions it is possible to explain by the less amount of inspected *O. forcipatus* is established in 88 squares, which largely coincides with current thought about the distribution of the species. This species is found throughout Latvia, but it occurrs in rapid sections of rivers, for example in the river Venta which has many rapid river sections. Potentially lower occurrence of this species is due to lack of the optimum habitats for this species (rhitral type streams covered by gravel-pebble-cobble bottom). *O. cecilia* showed large scale differences in its distribution. Although larvae were found in only five squares

Table 1. Number and occurence of gomphid larvae in quantitative samples of macrozoobenthos collected in the River Gauja from Taurene upstream to below Carnikava in 1998

Species	Total number of samples with	Total number of specimens	Ratio of all (n = 280) samples (%)	Ratio of samples (n = 37) with Gomphidae (%)
G. vulgatissimus	28	34	10.0	75.6
O. forcipatus	14	19	5.0	37.8
O. cecilia	2	2	0.7	5.4

in the River Gauja, adult individuals were observed in all rivers (23 squares) and in other sites (34 squares). Moreover, it should be noted that observations of adult individuals on the River Gauja in five squares between Gaujiena and Zīle are also referable to Estonia (cross-border river habitats).

Hence, it can be presumed that all gomphids, except *G. flavipes,* are distributed widely.

Occurrence frequency

Only quantitative data for the larvae were used for analysis of occurrence frequency. Overall, gomphid larvae were found in 37 samples from 18 sites of the Gauja. *G. vulgatissimus* larvae were present in 28 samples from all of these 18 sites, *O. forcipatus* larvae in 14 samples from eight sites and *O. cecilia* in two samples from two sites (Table 1). The presence of two larvae of *O. cecilia* in two samples indicates its rareness which was confirmed by observations of adults: *G. vulgatissimus* and *O. forcipatus* adult individuals were observed in the River Gauja in comparatively greater numbers and more often than those of *O. cecilia*.

The occurrence frequency of the different species can be explained by abiotic and biotic factors (Korkeamäki, Suhonen 2002). Gomphid larvae were typical for rhitral sections without macrophytes and a bottom is characterized by gravel. The bottom substratum was divided into components for each sample: sand, gravel, pebbles, cobbles, mud, detritus and macrophytes. In 11 % of the samples the substrate was uniform, in 49 % there were two components, in 32 % three components, and in 8 % four components. Sand occurred most

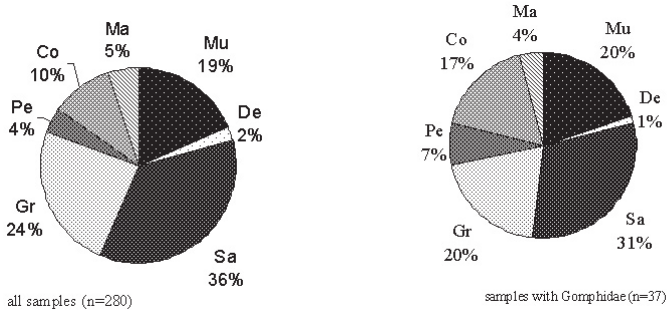

Fig. 5. Division of substratum by components of samples. Sa, sand; Gr, gravel; Pe, pebbles; Co, cobbles; Mu, mud; De, detritus; Ma, macrophytes.

Table 2. Information in literature regarding habitat and substrate preferences of gomphid larvae in Europe and Latvia

Data source	*G. flavipes*	*G. vulgatissimus*	*O. forcipatus*	*O. cecilia*
Askew 1998	Running waters, sandy banks along the lower courses of large rivers	Slow-flowing, meandering rivers and large streams with muddy beds, occacionaly with large lakes	Rivers and lakes with clear water	Running waters, sandy banks along the lower courses of large rivers
Spuris 1956	Soft clay or clay-sand bottom with little mud layer in non-vegetated places	In rapid or slow flowing river overfalls. Rarely in lakes	In fast-flowing rivers with sandy or pebbly bottom	Small streams and creeks with sandy bottom in places with sparse or no vegetation
Spuris 1993	In sandy places of large rivers	In medium, rapid and slow flowing rivers, in sandy or pebble places, very rarely in large lakes	In rapid or medium/ rapid flowing water, in medium/large rivers, in pebble and cobble bottom	In slowly and medium/rapid flowing streams and in small, poorly vegetated rivers with sandy - mud bottom
Gauja (current study)	Larvae not found	In medium or slow flowing river sections with sandy - mud, rarely gravel, bottom	In rapid or medium flowing river sections with gravel - pebble - cobble bottom	Sand or gravel bottom with mud

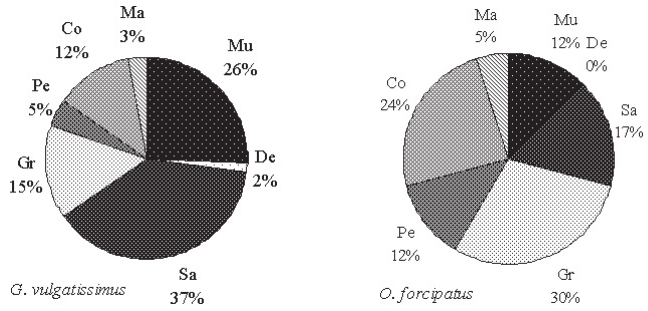

Fig. 6. Preference of *G. vulgatissmus* and *O. forcipatus* for substratum types based on number of collected individuals in the River Gauja. Sa, sand; Gr, gravel; Pe, pebbles; Co, cobbles; Mu, mud; De, detritus; Ma, macrophytes.

frequently (in 36 % of the samples), gravel was found in 24 %, mud in 19 % and cobbles in 10 %. The other components were represented in only a relatively small number of samples: 5 % contained macrophytes, 4 % pebbles and 2 % detritus. These proportions coincide with the habitat types found in the River Gauja in general (Kalniņš 2005). Comparing the

Table 3. Total density of gomphidae larvae in the River Gauja and in habitats for gomphid species in quantitative samples of macrozoobenthos collected in the River Gauja from Taurene upstream below to Carnikava in 1998

Species	Number of larvae in 1 m² (all samples)	Number of larvae in 1 m² (samples with Gomphidae)	Theoretical area (m²) for one larva (all samples)	Theoretical area (m²) for one larva (samples with Gomphidae)
All Gomphidae	0.19	1.48	5.1	0.7
G. vulgatissimus	0.12	0.91	8.2	1.1
O. forcipatus	0.06	0.51	14.7	1.9
O. cecilia	0.007	0.05	-	-

proportions of substrates found in the samples containing gomphid larvae with those in all samples showed a preference (Fig. 5) for hard substrate (pebble and cobble) especially regarding *O. forcipatus* larvae (42 %; Fig. 6) in regions of the river with rapids or water falls. Habitat characteristics given by different authors (Table 2) reflect the size of the rivers, and the habitats or substrata inhabited by the larvae mentioned rarely. There is general agreement between the adult distribution information found in this project and that in the literature (Spuris 1953; Askew 1988; Spuris 1993), and this is clearly very useful information with regard to locating adults. However, it does not allow any evaluation of the significance of habitats and substrata for individual species. For example, in places where *O. cecilia* larvae were found in the River Gauja and in other watercourses as well (Kalniņš, Inberga-Petrovska 2005), an obligatory component of the substrate was a thin mud layer above sand also in places where qualitative samples were collected. This indicates this microhabitat as important habitat for disguising the larvae to enable them to catch prey.

The species were not found in all suitable habitats (in river stages with moderate or slowly flow with sandy-mud, rarely gravely ground). It is possible that there are other limiting factors. Information about the density of individuals and the area of occupancy of one individual are important. On the basis of this information it can be concluded that slow flowing, sandy river regions provide more optimum habitat for *G. vulgatissimus* than rapid flowing, pebbly river regions.

Density of individuals

The density of gomphid larvae was given for the River Gauja in general and in optimum/sub-optimum habitats for each species. In addition a theoretical 'individual' area was calculated (Table 3). Clearly the greatest density of individuals and the smallest unit area per individual were established for *G. vulgatissimus*. A rather smaller density of individuals and an individual area of more than 50 % were estimated for *O. forcipatus*. However, considering that *O. forcipatus* is a more specialized species occupying rhitral stretches of the river, the density of larvae for both species were calculated using samples with *O. forcipatus* (n = 14). The relationship between densities of individuals and flow rate is opposite for these two species: the total density of *G. vulgatissimus* was 0.91 individuals per m² compared to only 0.42 individuals per m² in faster flowing water, while the total density of *O. forcipatus* was 0.51 individuals per m² compared to 1.35 individuals per m²

in faster flowing water. Similarly, the area occupied by a larva of *G. vulgatissimus* in faster flowing water was 2.3 m^2 (average 1.1 m^2) compared to 0.7 m^2 (average 1.9 m^2) for *O. forcipatus*. The density of individuals of *O. cecilia* was very low with a large area occupied by a single individual but, as it was found in only two samples, a reliable value could not be calculated.

To avoid potentially inaccuracies due to larval aggregations, the dragonfly densities within a sample were examined. No indication of aggregation was found with just over 65 % of the samples in which *G. vulgatissimus* occurred containing a single larva and over 70 % for *O. forcipatus* larvae. In only two of the samples containing *G. vulgatissimus* and one of those containing *O. forcipatus* were three larvae obtained (about 6 % and 7 % respectively).

The information obtained about *O. cecilia* was limited, which confirmes the relative rarity of this species. It was only found in two samples with a large area of occupancy by an individual. However, this limited data means that little or nothing can be inferred about the factors determining the density of individuals.

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References

Askew R. 1988. *The Dragonflies of Europe*. Harley Books, Colchester, Essex. 287 p.

Avotiņa R. 1994. Gauja. Headword in encyclopedia: Latvijas daba. Rīga, Latvijas enciklopēdija, pp. 96–98. (In Latvian)

Balode M., Gaile M., Zandmane A., Zvaigzne M., Zvaigzne M., Zembaha R., Kačalova O., Kumsare A., Liepa R., Matisone M., Melberga A., Parele E., Rodinov V., Cimdin P., Cukurs T. 1981. *Hydrobiological Regime of Small Rivers Under Conditions of Anthropogenic Influence*. Rīga, Zinātne. 167 p. (In Russian)

Cimdin P., Rodinov V., Melberga D., Springe G., Melberga A., Rudzroga A., Druvietis I., Liepa R., Parele E., Kačalova O., Zvirgzds A., Urtans A., Zarubov A. 1989. *Biocenotical Structure of the Small-Sized Rivers: Salaca River Basin*. Rīga, Zinātne. 211 p. (In Rusian)

EU directive. 1992. Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora. *Official Journal of the European Communities*: 1–750.

Hammond C.O. 1983. *The Dragonflies of Great Britain and Ireland*. Harley Books. 116 p.

Kalkman V.J., Van Duinen G.A., Esselink H., Kuper J.T. 2002. New records of Odonata from Estonia, with notes on breeding in the Baltic sea and on species assemblages of raised bog systems. *Notul. Odonatol.* 5: 117–128.

Kalniņš M. 2000. Water insect fauna of the River Gauja. *DPU 8. ikgadējās zinātniskās konferences rakstu krājums*. Daugavpils, Saule, pp. 26–28. (In Latvian. Gaujas ūdens kukaiņu fauna)

Kalniņš M., Inberga-Petrovska S. 2005. Distribution and ecology of dragonflies *Aeshna viridis* (Eversmann, 1835) and *Ophiogomphus cecilia* (Fourcroy, 1785) in Latvia. 3rd International

Conference "Research and Conservation of biological diversity in Baltic region". Book of Abstracts. Daugavpils University, Daugavpils, Latvia, pp. 68–69.

Kalniņš M. 2005. Running freshwater habitats in the Gauja National Park. Ģeogrāfija, ģeoloģija, vides zinātne: Referātu tēzes. Rīga, Latvijas Universitāte, pp. 205–207. (In Latvian. Tekošo saldūdeņu biotopi Gaujas nacionālajā parkā)

Korkeamäki E., Suhonen J. 2002. Distribution and habitat specialization of species affect local extinction in dragonfly *Odonata* populations. *Ecography* 25: 459–465.

Mitāns A. 1971. *Comparative Characteristics of Salmon Fries Subsistence Conditions: Feeding, Growth in the Rivers of Latvia*. Rīga, Zinātne. 54 p. (In Russian)

Parele E. 2001. The fauna of zoobenthos of River Daugava from Līvāni to Pļaviņas. LU 59. zinātniskā konference. Ģeogrāfija, ģeoloģija, vides zinātne: Referātu tēzes. Rīga, Latvijas Universitāte, pp. 128–131. (In Latvian; Daugavas zoobentosa fauna posmā Līvāni – Pļaviņas)

Ruusmaa J. 1995. Distribution and occurrence of odonata in Estonia. Eesti-Liik, pp. 1–4. (In Estonian)

Sahlén G., Bernard R., Rivera A.C., Ketelaar R., Suhling F. 2004. Critical species of Odonata in Europe. *Int. J. Odonatol.* 7: 385–398.

Schmidt, Eb. 1977. Ausgestorbene und bedrohte Libellenarten in der Bundesrepublik Deutschland. *Odonatologica* 6: 97–103.

Spuris Z. 1998. *Red Data Book of Latvia. Rare and Threatened Species of Plants and Animals.* Volume 4. Invertebrates. Rīga. 388 p.

Spuris Z. 1953. On Latvia SSR lake base-habitat significant animal species and their distribution. *Latvijas PSR ZA Vēstis* 9: 67–82. (In Latvian. Par Latvijas PSR ezeru pamatbiotopu svarīgākām dzīvnieku sugām un to izplatību)

Spuris Z. 1956. *Dragonflies of Latvian SSR.* Zinātne, Rīga. 96 p. (In Russian)

Spuris 1966. Six new and some rare caddishflies species for fauna of Latvia. *Latvijas Entomologs* 11: 8–97. (In Russian)

Spuris Z. 1993. *Identification Key to the dragonflies (Odonata) of Latvia.* Zinātne, Rīga. 67 p. [In Latvian. Latvijas spāru (Odonata) noteicējs]

Standart Methods for the Examination of Water and Wastewater. 1992. 18th edition, APHA, AWWA, WPCF. Washington. 839 p.

Upjuspāru Gomphidae (Odonata: Gomphidae) izplatība un sastopamības biežums Gaujā

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Kopsavilkums

Rakstā apkopota informācija par Latvijā sastopamo upjuspāru Gomphidae sugu: dzeltenkāju upjuspāres *Gomphus flavipes*, melnkāju upjuspāres *Gomphus vulgatissimus*, knaibļspāres *Onychogomphus forcipatus* un zaļās upjuspāres *Ophiogomphus cecilia* izplatību, sastopamības biežumu un indivīdu blīvumu. Pētījuma pamatā izmantots 1998. gadā Gaujā no Taurenes augštecē līdz Carnikavai lejtecē ievāktais makrozoobentosa materiāls (280 kvantitatīvie un 65 kvalitatīvie paraugi). Pilnīgākai datu analīzei izmatoti arī pieaugušo indivīdu novērojumi – literatūras dati, nepublicēti novērojumi par laika periodu no 1933. līdz 2005. gadam. Pētījumu laikā Gaujā konstatētas trīs upjuspāru sugas – *G. vulgatissimus*, *O. forcipatus* un *O. cecilia*. Apvienojot Gaujas pētījuma datus ar kāpuru/eksuviju/imago stadiju novērojumiem par visu Latvijas teritoriju, ir redzams, ka visas upjuspāru sugas ir sastopamas gandrīz visā Latvijas teritorijā. Tai skaitā, arī *G. flavipes* ir konstatēta Gaujā, bet tā ir Latvijā retāk sastopamā upjuspāru suga. Pēc sastopamības biežuma upjuspāres konstatētas 13.2 % paraugu. *G. vulgatissimus* konstatēta 10 % paraugu, *O. forcipatus* – 5 %, *O. cecilia* – 0.7 %. Analizēts paraugos pārsāvēto grunts substrātu sadalījums pa komponentiem. *O. forcipatus* vērojama izteikta saistība ar cietajām gruntīm upju straujteču vai krāču posmos. Analizēts arī kāpuru blīvums. Konstatēts, ka *G. vulgatissimus* blīvums sasniedz 0.919 indivīdus uz m^2, savukārt *O. forcipatus* – 0.514.