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PERLODIDAE (PLECOPTERA) OF WISCONSIN¹

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The family Perlodidae is one of the most abundant and widespread in the order Plecoptera. These stoneflies occur in a wide variety of clean-water habitats and as indicator organisms have potential for assessing water quality. Studies of this family in Wisconsin prior to 1965 were limited to occasional collections reported by Needham and Claassen (1925) and Frison (1935, 1937, 1942). In 1965 and 1966 a survey of the Wisconsin River and its tributaries yielded nymphs of 11 species of *Isoperla* (W. Hilsenhoff, unpublished report), and later, nymphs and adults of 9 species were found in the Pine-Popple River (Hilsenhoff and Narf 1972). Between 1966 and 1971 additional Perlodidae were collected throughout the state by several persons, many of them by Arvin Krueger while surveying the mayfly fauna of Wisconsin (Krueger 1969).

In 1969 we initiated a study to determine the distribution, abundance, and life cycles of Perlodidae in Wisconsin and revise keys to species. All previously collected specimens were studied and an intensive sampling program was initiated in nine 24-mile square sampling areas. These areas (represented by squares in Figs. 1-3) were selected as representative of the state on the basis of geographical location, soil type, geology, vegetative cover, and land use, and are described in detail by Billmyer (1971). Five of the areas were sampled in the fall of 1969, and in the spring of 1970 all areas were intensively sampled during three or more periods from March through July. Two species of *Isogenus* and 12 species of *Isoperla* were collected. These are listed below along with references to 1) original description, 2) most recent catalog including that species, 3) references used to identify the species, 4) first usage of different species names, 5) synonymy when needed, and 6) papers published since the last catalog that contain taxonomic or biological information.

ISOGENUS Newman 1833

Because of the similarity among species of *Isogenus* we have followed the Ricker (1952) classification rather than that of Illies (1966).

Isogenus frontalis

1838 *Isogenus frontalis* Newman:178

1942 *Isogenus frontalis* Frison:290 (synonymy and drawings of male, female, and nymph)

1943 *Isogenoides hudsonicus* Hanson:662

1952 *Isogenus (Isogenoides) frontalis* Ricker:108 (key)

1966 *Isogenoides frontalis* Illies:365 (catalog)

Isogenus olivaceus

1852 *Perla olivacea* Walker:144

1876 *Perla sulcata* Provancher:213

1942 *Hydroperla olivacea* Frison:296 (drawings of male and nymph, and description of nymph)

1943 *Isogenoides olivaceus* Hanson:663 (drawings and descriptions of male and female)

1952 *Isogenus (Isogenoides) olivaceus* Ricker:114 (key and synonymy)

1966 *Isogenoides olivaceus* Illies:365 (catalog)

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ISOPERLA Banks 1906

Isoperla bilineata

- 1823 *Sialis bilineata* Say:165
 1925 *Isoperla bilineata* Needham and Claassen:154 (descriptions and drawings of male and female)
 1935 *Isoperla bilineata* Frison:437 (description of nymph, and drawings of male, female, and nymph)
 1952 *Isoperla bilineata* Harden and Mickel:39 (keys)
 1966 *Isoperla bilineata* Illies:396 (catalog)

Isoperla clio

- 1839 *Isogenus clio* Newman:86
 1935 *Isoperla confusa* Frison:441 (drawings and descriptions of male, female, and nymph)
 1952 *Isoperla clio* Ricker:143 (synonymy)
 1966 *Isoperla clio* Illies:398 (catalog)
 1966 *Isoperla clio* Minshall and Minshall:340 (biology)

The name *clio* has caused much confusion, having been used for both *I. clio* and *Isoperla marlynia*. The problem developed when Needham and Claassen (1925) misidentified some *I. marlynia* females and called them *Clio perla clio*. The mistake was perpetuated by Claassen (1931). His *I. clio* nymphs were really *I. marlynia*. When Frison (1935) collected the true Newman *I. clio* he found it to be quite different from the species Claassen (1931) was calling *I. clio*, so he described it as a new species, *Isoperla confusa*. Had he had Newman's *I. clio* types he probably could have corrected the error at that time. Frison (1935) went on to call specimens that were the true *I. marlynia*, *I. clio*, because all he had were nymphs that fit descriptions of the species Claassen (1931) had erroneously called *I. clio*. Frison (1942) straightened out the *I. clio*'s that were truly *I. marlynia* when he studied Needham and Claassen's types and presented a synonymy. He let his own *I. confusa* stand because he did not have Newman's types to examine and Ricker (1938) had erroneously published a statement that Newman's types were from Canada. Frison (1942) did not think it likely that the Newman *I. clio* from Canada and his *I. confusa* from Illinois and Indiana were the same species. Ricker (1952) corrected his 1938 error and said that the Newman types were not from Canada but from Georgia. He did not mention that he studied Frison's *I. confusa* types, but stated "Large size and the terminal ridges of the 10th tergite distinguish *clio* and *confusa* equally, and are not found in other eastern Isoperlae." He went on to synonymize *I. confusa* to *I. clio*.

Isoperla cotta

- 1952 *Isoperla cotta* Ricker:144 (Descriptions of male, female, and nymph, drawings of male and female)
 1966 *Isoperla cotta* Illies:399 (catalog)

Isoperla dicala

- 1942 *Isoperla dicala* Frison:321 (descriptions and drawings of male, female, and nymph)
 1952 *Isoperla dicala* Harden and Mickel:39 (key)
 1966 *Isoperla dicala* Illies:400 (catalog)

Isoperla frisoni

- 1937 *Isoperla truncata* Frison:94 (descriptions and drawings of male, female, and nymph)
 1952 *Isoperla truncata* Harden and Mickel:47 (key)
 1966 *Isoperla frisoni* Illies:402 (new name and catalog)

Isoperla lata

- 1942 *Isoperla lata* Frison:334 (descriptions and drawings of male, female, and nymph)
 1952 *Isoperla lata* Harden and Mickel:40 (key)
 1966 *Isoperla lata* Illies:407 (catalog)

Isoperla marlynia

- 1898 *Chloroperla montana* Banks:199 (in part)
 1925 *Isoperla marlynia* Needham and Claassen:148
 1925 *Clioperla clio* Needham and Claassen:139 (in part, see discussion under *I. clio*)
 1931 *Clioperla clio* Claassen:69 (drawings and description of nymph)
 1935 *Isoperla clio* Frison:439 (drawing and description of nymph)
 1942 *Isoperla marlynia* Frison:330 (synonymy and drawings and descriptions of male, female, and nymph)
 1952 *Isoperla marlynia* Harden and Mickel:42 (key)
 1966 *Isoperla marlynia* Illies:408 (catalog)

Isoperla nana

- 1872 *Chloroperla nana* Walsh:367
 1900 *Chloroperla minuta* Banks:244
 1925 *Isoperla minuta* Needham and Claassen:147 (descriptions and drawings of male and female)
 1935 *Isoperla minuta* Frison:453 (descriptions and drawings of male, female, and nymph)
 1965 *Isoperla nana* Ricker:495 (synonymy)
 1966 *Isoperla nana* Illies:411 (catalog)

Isoperla richardsoni

- 1935 *Isoperla richardsoni* Frison:429 (descriptions and drawings of male, female, and nymph)
 1952 *Isoperla richardsoni* Harden and Mickel:44 (key)
 1966 *Isoperla richardsoni* Illies:417 (catalog)

Isoperla signata

- 1902 *Perlinella signata* Banks:124
 1925 *Isoperla signata* Needham and Claassen:149 (descriptions and drawings of male and female)
 1931 *Isoperla signata* Claassen:75 (description and drawing of nymph)
 1948 *Pictetia bimaculata* Banks:122
 1948 *Isoperla signata* Ricker:409 (synonymy)
 1952 *Isoperla signata* Harden and Mickel:44 (key)
 1966 *Isoperla signata* Illies:419 (catalog)

Isoperla slossonae

- 1911 *Perla slossonae* Banks:335
 1925 *Clioperla annecta* Needham and Claassen:140 (description of female)
 1942 *Isoperla slossonae* Frison:329 (synonymy and drawings and descriptions of male and nymph)
 1952 *Isoperla slossonae* Harden and Mickel:45 (key)
 1966 *Isoperla slossonae* Illies:420 (catalog)

Isoperla transmarina

- 1938 *Chloroperla transmarina* Newman:499
 1908 *Isoperla ventralis* Banks:66
 1925 *Isoperla ventralis* Needham and Claassen:150 (drawing of male)
 1933 *Isoperla fumosa* Neave:235 (drawing of male and female)
 1938 *Isoperla transmarina* Ricker:146 (drawing of female)
 1942 *Isoperla transmarina* Frison:316 (drawing of nymph and synonymy)
 1946 *Isoperla transmarina* Ricker:6 (synonymy)
 1952 *Isoperla transmarina* Harden and Mickel:46 (drawing of nymph and key)
 1966 *Isoperla transmarina* Illies:422 (catalog)

The distribution and abundance of each species of Perlodidae is illustrated in Figs. 1-3. Numbers within each sampling area represent numbers of nymphs, adults, and exuviae collected from October 1969 through August 1970. A dot indicates the species was collected in that county other than from a study area during the above study period.

Table 1 summarizes the number of specimens that were collected and the periods of the year when they occurred. Since exuviae may be present for several weeks after emergence, only the earliest occurrence of exuviae is reported.

Only two species of *Isogenus* were collected in this study, both from the northern part of the state. *I. frontalis* was collected from Sidney Creek in Marinette County and from several streams in northern Bayfield County (Fig. 1). The typical habitat was a cold, rapid, very small (less than 8 ft wide) to medium-sized (30-75 ft wide) stream. *I. olivaceus* was found in similar-sized, cold, rock-bottomed streams, but was rarer and restricted in our study to the Namekagon River in Washburn County and Woods Creek in Florence County (Fig. 1). Collection records (Table 1) suggest that both species have a one-year life cycle with emergence in late May or early June. The eggs apparently hatch almost immediately since identifiable nymphs of *I. frontalis* were found as early as August 17. A third species of *Isogenus* was collected by S. A. Forbes from a small stream near Fontana in southern Wisconsin in 1892 and named *I. varians* (Needham and Claassen 1925), but intensive sampling of this stream yielded no specimens. Frison (1935) examined Illinois specimens identified as *I. varians* by Needham and Claassen and found that *I. fugitans* (Needham and Claassen) 1925 and *I. crosbyi* (Needham and Claassen) 1925 were included. This, coupled with Ricker's (1952) statement that *I. varians* "is a species of large rivers" leads us to conclude that the Fontana collection was perhaps *I. crosbyi*, although that species has not been collected north of central Illinois (Frison 1935).

Twelve species of *Isoperla* were collected in Wisconsin from a variety of streams. All had a one-year life cycle with emergence of adults from mid-April through June, depending on the species. *I. slossonae*, *I. signata*, and *I. clio* were the first to emerge, emergence beginning in mid-April and progressing through May. *I. nana* also emerged fairly early, its emergence period being confined to the month of May. Several species (*I. bilineata*, *I. lata*, *I. marlynia*, *I. richardsoni*, and *I. transmarina*) emerged mostly from mid-May to mid-June, while *I. cotta*, *I. dicala*, and *I. frisoni* were the last to emerge, their emergence period extending from late May to the end of June. Emergence was generally two to three weeks earlier in the southern counties than in the far north. No newly-hatched *Isoperla* nymphs were collected during the spring and early summer, and we suspect that

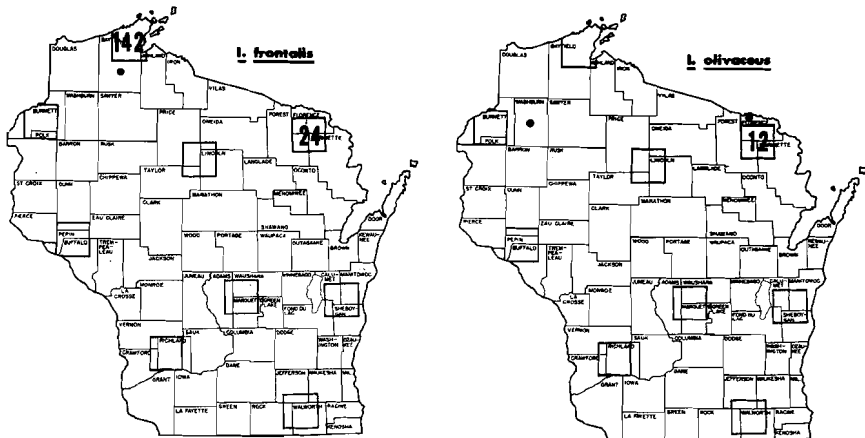


Fig. 1. Distribution of *Isogenus frontalis* and *I. olivaceus* in Wisconsin. Dots represent county records and numbers are totals collected in one year from each 576 square mile sampling area.

Table 1. Occurrence of nymphs, adults, and first exuviae of Perlodidae in Wisconsin.

Species	Number of Streams	Nymphs		Males		Females		Exuviae		Number Reared
		No.	Dates	No.	Dates	No.	Dates	No.	Date	
<i>Isogenoides frontalis</i>	13	74	8/17-5/26	0		3	6/6	96	6/6	58
<i>I. olivaceus</i>	2	14	11/18-5/3	0		0		11	6/21	0
<i>Isoperla bilineata</i>	10	66	11/22-5/27	101	5/22-6/25	190	5/22-6/25	24	5/15	6
<i>I. clio</i>	26	184	9/3 -5/28	2	5/15-5/28	0		14	4/25	3
<i>I. cotta</i>	67	422	9/13-7/7	6	5/28-6/25	4	6/4 -7/7	186	6/4	10
<i>I. dicala</i>	52	168	3/27-6/20	42	6/3- -6/29	47	6/4 -8/27	8	6/9	0
<i>I. frisoni</i>	55	312	5/5 -6/20	15	5/28-7/15	20	5/28-7/8	37	5/13	0
<i>I. lata</i>	26	66	10/3 -5/27	0		0		38	6/5	7
<i>I. marlynia</i>	15	120	10/2 -5/3	2	5/28	1	5/28	7	6/25	14
<i>I. nana</i>	10	101	4/23-5/27	2	5/9 -5/16	2	5/16	0		0
<i>I. richardsoni</i>	16	169	3/28-6/7	8	5/23-5/30	19	5/23-7/15	48	5/3	0
<i>I. signata</i>	152	1744	10/16-6/5	21	5/15-6/29	35	5/15-7/15	462	4/19	36
<i>I. slossonae</i>	115	461	8/25-6/7	0		5	5/9 -6/7	93	4/11	63
<i>I. transmarina</i>	146	1540	9/8 -6/20	12	5/22-6/10	16	5/22-7/7	145	5/2	63

most species spend the summer months as eggs, which hatch late in the summer or early in the fall. Nymphs of all but four species were collected in October, and two of these (*I. dicala* and *I. richardsoni*) were probably present at that time but too small to identify. Nymphs of *I. frisoni* and *I. nana*, however, were never collected before late-April, suggesting that these species wintered as eggs.

Although *Isoperla* nymphs were found in all types of streams, most species had rather specific requirements with respect to stream size. *I. clio* and *I. nana* occurred only in small (8-30 ft wide) or very small streams, some of which occasionally became dry in late summer. *I. clio* was found only in clear, cold streams while *I. nana* habited somewhat organically enriched streams. Frequently no other perlotid was found in streams inhabited by *I. clio* or *I. nana*. *I. cotta*, *I. lata*, *I. slossonae*, and *I. transmarina* were found primarily in small to medium-sized streams, the latter species occurring in larger streams as well. *I. frisoni* and *I. dicala* preferred somewhat larger streams than the above species, although they were commonly collected from medium-sized streams and rarely from small streams. *I. bilineata*, *I. richardsoni*, and *I. marlynia* were species of the larger rivers (more than 75 ft wide). *I. bilineata* and *I. marlynia* frequently occurred with *I. richardsoni* but were never found together, the former occurring commonly only in the largest rivers. *I. signata* was the least specific with respect to habitat requirements, being collected from small as well as very large streams.

The distribution of *Isoperla* in Wisconsin was not uniform (Figs. 2-3), the preponderance of species and the bulk of the individuals being collected from the northwestern three-fourths of the state. The southeastern fourth of the state contained mostly organically enriched streams that were not suitable habitat for Perlodidae. The most abundant and widely distributed perlotids in Wisconsin were *I. signata* and *I. transmarina*, the former occurring statewide and the latter in all but the southeast corner (Fig. 3). *I. slossonae* was also widespread and common, with a distribution very similar to *I. transmarina* (Fig. 3). Distribution records for *I. bilineata*, *I. richardsoni*, and *I. marlynia* are more poorly defined than for other species because of difficulties encountered in adequately sampling their large river habitat. The distribution of the latter, however, appears to be statewide (Fig. 3) while *I. richardsoni* was not found in the southern third or extreme north (Fig. 3). *I. bilineata* may be confined to the southern two-thirds of the state (Fig. 2), since intensive collecting of typical habitat in the St. Croix and Yellow Rivers in Burnett County, and the lower Pine River in Florence County yielded no specimens. Populations of *I. lata* and *I. cotta* appeared to be confined to the northeastern third of Wisconsin, although a few *I. cotta* were also collected from Otter Creek in Sauk County (Fig. 2). Other northern species were *I. frisoni*, which was not found in the southern third of the state (Fig. 2), and *I. dicala*, which was confined to the northwestern two-thirds of the state (Fig. 2). The only species found in southeastern Wisconsin but not in the north was *I. nana* (Fig. 3). *I. clio* was found in southern Wisconsin streams, and in central Wisconsin as far north as Price and Oneida Counties (Fig. 2). These latter records constitute a significant northward extension of the known range of this southern species (Illies 1966).

Intensive sampling within the nine study areas and numerous collections from streams in other areas of the state make it unlikely that any species occurring in substantial numbers was overlooked. It is quite possible, however, that rare species or species with extremely localized distribution may not have been collected. *Arcynopteryx compacta* (MacLachlan) 1872 and *Isogenus krumholzi* Ricker 1952 probably occur in northern Wisconsin and have not yet been collected. The former has been collected in Upper Michigan from Lake Superior (Ricker 1964), a habitat we did not sample, while the latter was collected from streams in northwestern Lower Michigan and northeastern Minnesota (Ricker 1952). Only the male of *I. krumholzi* is known, and it can be distinguished from *I. frontalis* by a pair of short, acute lobes projecting posteriorly from the supra-anal process. *Isogenus doratus* (Frison) 1942, *I. nalatus* (Frison) 1942, and *I. varians* have all been found in southern Michigan, and *I. crosbyi* and *I. fugitans* were collected in central Illinois. All could occur in southern Wisconsin, but extensive sampling of unpolluted streams in this area has produced no specimens. Keys by Ricker (1952) can be used to separate these species of *Isogenus*.

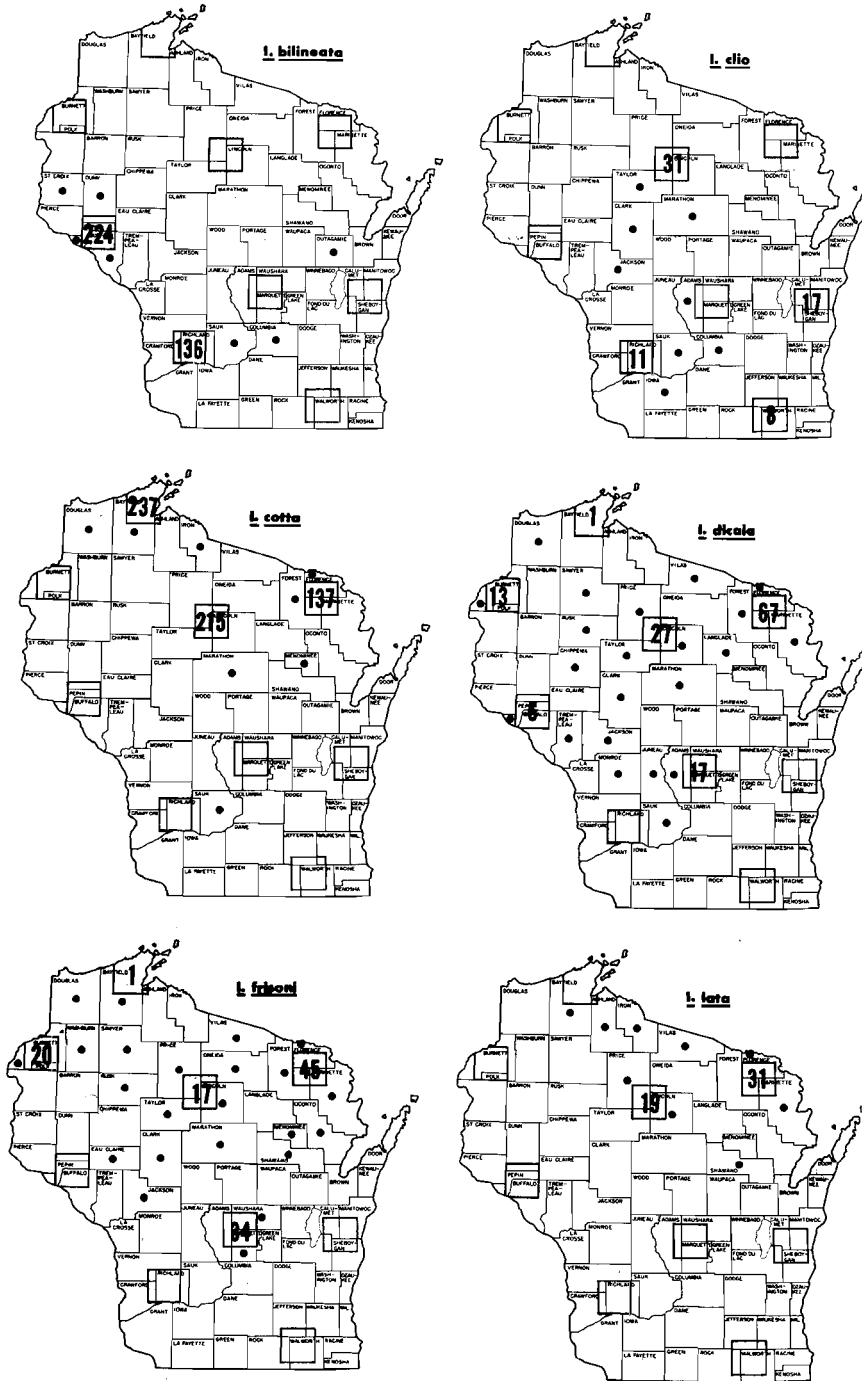


Fig. 2. Distribution of *Isoperla bilineata*, *I. clio*, *I. cotta*, *I. dicala*, *I. frisoni*, and *I. lata* in Wisconsin. Dots represent county records and numbers are totals collected in one year from each 576 square mile sampling area.

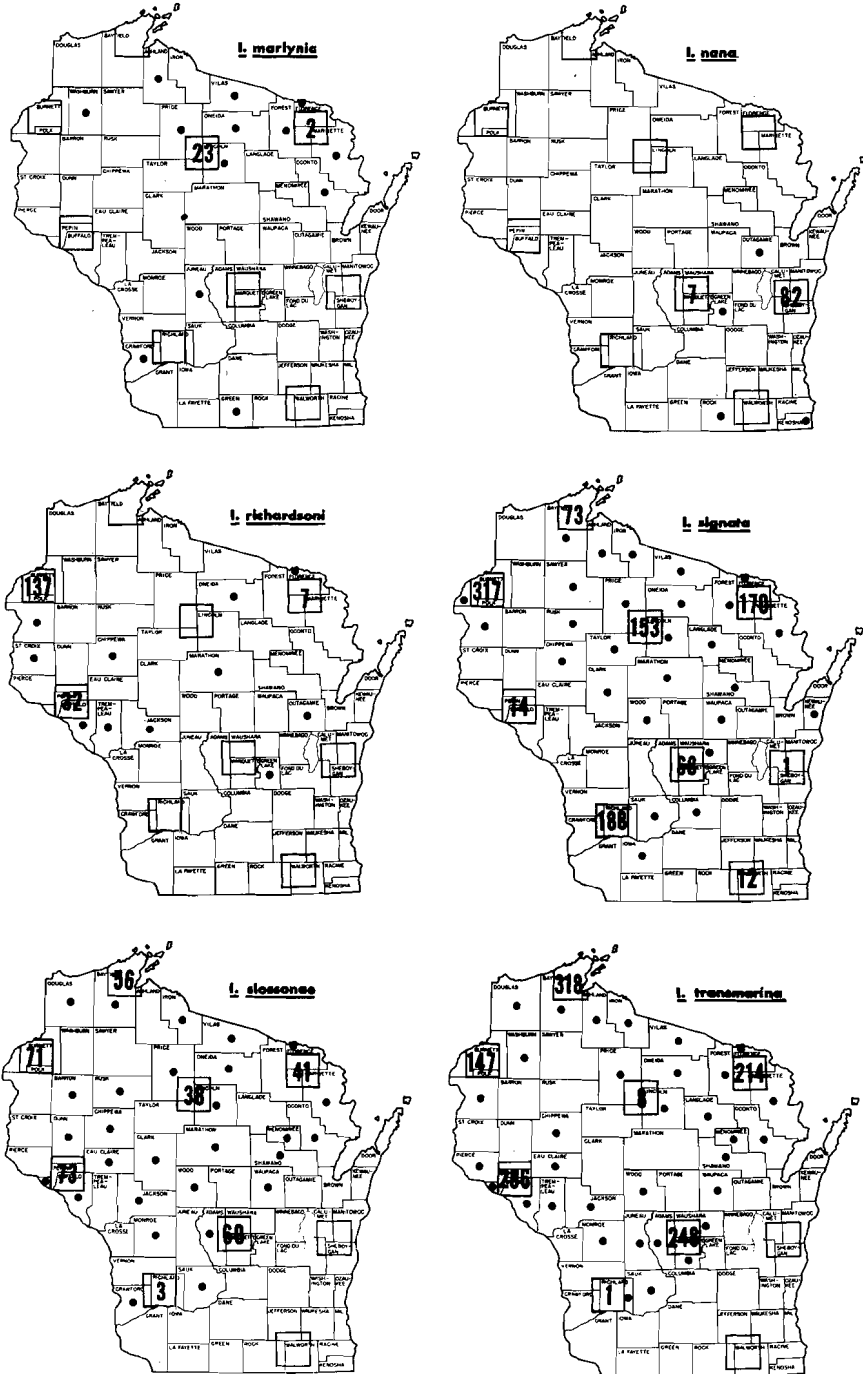


Fig. 3. Distribution of *Isoperla marlynia*, *I. nana*, *I. richardsoni*, *I. signata*, *I. slossonae*, and *I. transmarina* in Wisconsin. Dots represent county records and numbers are totals collected in one year from each 576 square mile sampling area.

Of the species of *Isoperla* collected in neighboring states, none appear likely to be found in Wisconsin. *I. longiseta* Banks 1906 is a prairie species that occurs east to Ames, Iowa with single females also having been collected at St. Paul, Minnesota and Quincy, Illinois (Frison 1942). Harden and Mickel (1952) did not find it in Minnesota. The *I. montana* (Banks) 1898 reported from Minnesota (Needham and Claassen 1925) was probably another species. This is a species of the eastern mountains and Ricker (personal communication) suggests that it probably does not occur west of Ontario. *I. conspicua* Frison 1935 (Illinois), *I. emarginata* Harden and Mickel 1952 (Minnesota), and *I. maxana* Harden and Mickel 1952 (Minnesota) were all described from single specimens and their status is uncertain. We also feel that *I. orata* Frison 1942 does not occur in Wisconsin, but its separation from *I. cotta* is based mainly on color pattern and is not always certain. All Wisconsin adults we have examined have the large dark mark anterior to the median ocellus, which is typical of *I. cotta*. Furthermore, the range of *I. orata* as reported by Frison (1942) was confined to mountainous regions from Vermont to Tennessee, although Ricker (1952) reports that ranges of *I. cotta* and *I. orata* overlap in Quebec, Ontario, and Michigan.

The following keys include only those species that we collected in Wisconsin.

KEY TO PERLODIDAE NYMPHS IN WISCONSIN

- 1a. Submental gills present *Isogenus* 2
- 1b. Submental gills absent *Isoperla* 3
- 2a. Abdominal terga with transverse pale bands just behind middle of each segment; male with long, curled genital lash *I. olivaceus*
- 2b. Abdominal terga lighter posteriorly, but without pale bands near middle of each segment; males without a genital lash *I. frontalis*
- 3a. Second tooth of lacinia absent (Fig. 4J) *I. nana*
- 3b. Second tooth of lacinia present 4
- 4a. Truncate distal end of lacinia covered with a dense brush of setae (Fig. 4H); abdominal marking, if present, longitudinal and never transverse *I. lata*
- 4b. Lacinia variable but without a dense brush of setae distally 5
- 5a. Lacinia with a tuft of setae below second tooth (Figs. 4E,G,K) 6
- 5b. Lacinia with setae scattered below second tooth, none clustered in a tuft 8
- 6a. First tooth of lacinia about as long as outer edge of ovate basal portion of lacinia (Fig. 4E); no paired dark spots on abdominal or thoracic terga *I. cotta*
- 6b. First tooth of lacinia much shorter than outer edge of elongate basal portion (Figs. 4G,K); paired dark spots on either abdominal or thoracic terga 7
- 7a. Eight dark spots on each abdominal tergum; thoracic terga mottled with light and dark areas; dark bar on anterior portion of front-clypeus enclosing a light area just anterior to median ocellus *I. richardsoni*
- 7b. Dark spots absent from abdominal terga; each thoracic tergum pale with paired dark spots; no dark bar on anterior portion of fronto-clypeus *I. frisoni*
- 8a. Abdominal terga transversely banded or pale anteriorly and dark posteriorly, especially on posterior terga (telescoping of segments may give false appearance of banding), rarely dark nymphs are evenly colored, but dark pigment extends ventrally well down onto posterior margin of 9th sternum 9
- 8b. Abdomen with longitudinal stripes, light spots, or evenly-colored; if evenly-colored, dark pigment does not extend onto 9th sternum 10
- 9a. Distal end of lacinia truncate with several strong setae (Fig. 4I) *I. marlynia*
- 9b. Distal end of lacinia not at all truncate, with only a few strong setae on margin (Fig. 4L) *I. signata*
- 10a. Large, quadrate, nearly square light area anterior to median ocellus; dark bands on femur and tibia near their articulation *I. slossonae*

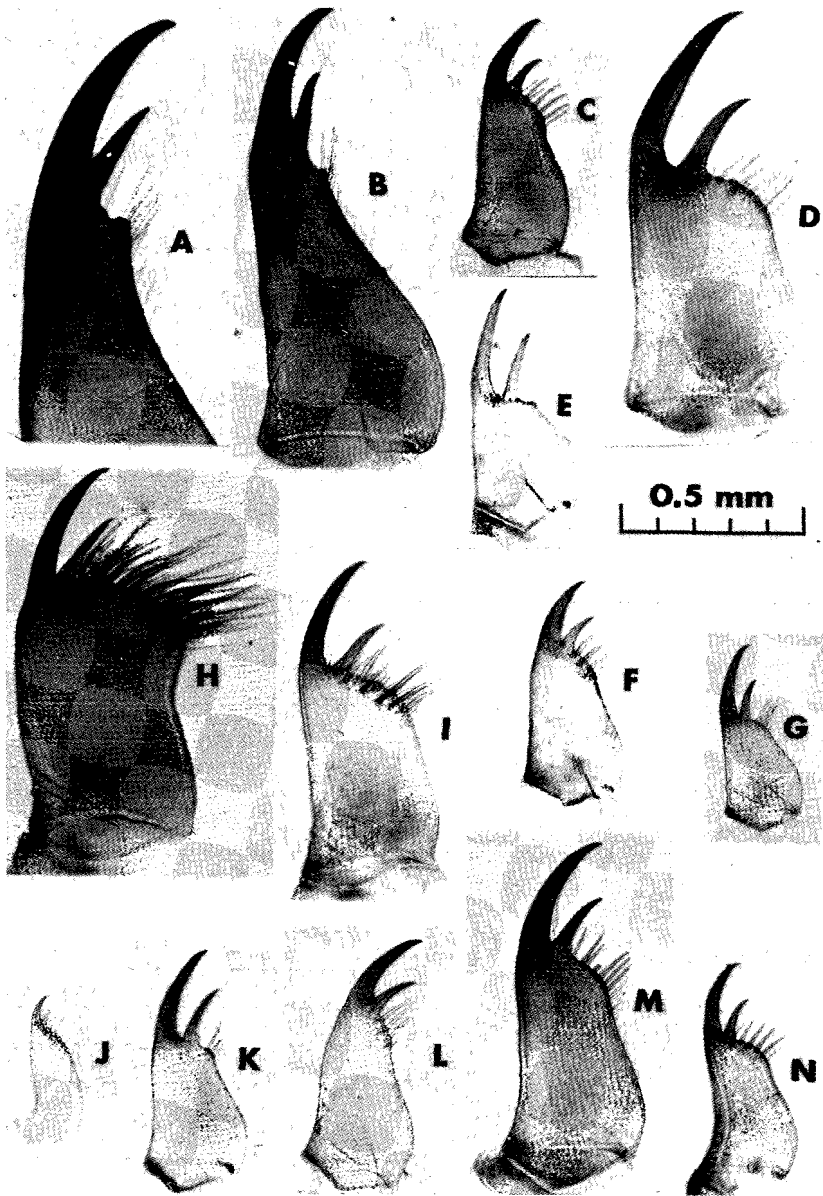


Fig. 4. Ventral view of right lacinia of nymphs of A. *Isogenus frontalis*, B. *I. olivaceus*, C. *Isoperla bilineata*, D. *I. clio*, E. *I. cotta*, F. *I. dicala*, G. *I. frisoni*, H. *I. lata*, I. *I. marlynia*, J. *I. nana*, K. *I. richardsoni*, L. *I. signata*, M. *I. slossonae*, and N. *I. transmarina*.

- 10b. Light area anterior to median ocellus, if present, rounded or W-shaped; no dark bands on femur and tibiae near their articulation 11
- 11a. Distinct W-shaped pale area anterior to median ocellus, extending almost to antennae, and often posteriorly to lateral ocelli and compound eyes; abdominal terga each with eight white spots or solidly colored *I. clio*
- 11b. Pale area near median ocellus rounded, indistinct, or absent, but never distinctly W-shaped; abdominal terga with longitudinal stripes except on very immature nymphs 12
- 12a. Pale mark immediately anterior to median ocellus indistinct or lacking; numerous conspicuous freckle-like spots on abdomen, especially on posterior sterna; dark longitudinal abdominal stripes with very narrow pale borders *I. dicala*
- 12b. Distinct pale mark immediately anterior to median ocellus; conspicuous freckle-like spots absent; longitudinal stripes, if present, with wide pale borders 13
- 13a. Wing pads with dark, conspicuous setae; veins in wing pads colored similarly to background; dark spots on abdominal terga lacking or inconspicuous . *I. transmarina*
- 13b. Wings pads with pale, inconspicuous setae; pale veins visible in dark-colored areas of wing pads; 8 dark spots on each abdominal tergum *I. bilineata*

KEY TO PERLODIDAE ADULTS IN WISCONSIN

- 1a. Submental gills present *Isogenus* 2
- 1b. Submental gills absent *Isoperla* 5
- 2a. Eighth abdominal sternum unmodified; conspicuous supra-anal process . . . males 3
- 2b. Eighth abdominal sternum produced posteriorly as a subgenital plate; no supra-anal process females 4
- 3a. Supra-anal process short with an apical hood directed posteriorly *I. frontalis*
- 3b. Supra-anal process a long, coiled lash *I. olivaceus*
- 4a. Subgenital plate with a shallow, broadly V-shaped notch *I. olivaceus*
- 4b. Subgenital plate with a deep U-shaped notch *I. frontalis*
- 5a. Small insects, less than 6mm long; head mostly dark *I. nana*
- 5b. Larger, more than 7mm long; if near 7mm, head mostly light 6
- 6a. Ninth abdominal sternum produced, mostly or entirely concealing tenth; eighth sternum slightly produced or with a small lobe in middle of posterior margin . . males 7
- 6b. Ninth abdominal sternum not produced, tenth visible; eighth sternum broadly rounded to strongly produced as a subgenital plate females 17
- 7a. Recessed lobe of 8th abdominal sternum twice as long as wide. *I. dicala*
- 7b. Recessed lobe of 8th abdominal sternum as wide as or wider than long 8
- 8a. Subanal lobes sclerotized, dark, recurved upward and often forward above 10th tergum 9
- 8b. Subanal lobes not sclerotized, pale (except occasionally at tip), and if recurved not extending forward above 10th abdominal tergum 13
- 9a. Large pale mark immediately anterior to median ocellus almost square, concave in front and slightly convex behind; recessed lobe on 8th abdominal sternum more than 1/2 as wide as segment and paler than sternum *I. slossonae*
- 9b. Pale mark anterior to median ocellus, if present, not almost square; recessed lobe on 8th sternum less than 1/3 as wide as segment 10
- 10a. Ninth abdominal sternum distinctly longer than wide; subanal lobe recurved over 10th abdominal tergum; abdominal sterna dark *I. lata*
- 10b. Ninth abdominal sternum as wide as or wider than long; subanal lobe may or may not be recurved over 10th tergum; abdominal sterna pale (may be dark laterally) . . 11
- 11a. Subanal lobes past bend long and extremely slender, about as long as basal portion and often recurved forward over 10th tergum *I. marlynia*
- 11b. Portion of subanal lobes past bend much shorter than basal portion, pointed dorsad, and usually not recurved forward over 10th tergum 12

- 12a. Abdominal terga dark with a darker central longitudinal stripe; pale spot between lateral ocelli large, pointed anteriorly; pronotum pale with dark markings *I. transmarina*
- 12b. Middle of abdominal terga pale; pale spot between lateral ocelli, if present, small and ovoid; pronotum predominantly tan with a pale central stripe *I. signata*
- 13a. Tenth abdominal tergum with a median notch; pronotum dark with a wide, pale, central longitudinal stripe; greater than 11mm long *I. clio*
- 13b. Tenth abdominal tergum entire; pronotum pale with dark markings between pale central stripe and pale margins; less than 11mm long 14
- 14a. Basal abdominal terga pale, without dark stripes; "V-mark" connecting ocelli usually indistinct or lacking, if distinct rarely wider than black ocellar spots; subanal lobes pointed and curved dorsad *I. bilineata*
- 14b. Basal abdominal terga with indistinct dark dorsal stripe, or darkly pigmented; "V-mark" distinct and wider than ocellar spots; subanal lobes pointed or blunt . 15
- 15a. Pale area between lateral ocelli poorly defined and usually covering less than half of area between ocellar spots; large dark area on fronto-clypeus separated from anterior ocellus by a narrow U-shaped pale area; subanal lobes bluntly pointed and curved inward *I. cotta*
- 15b. Pale area between lateral ocelli sharply defined and covering most of area between ocellar spots; dark area on fronto-clypeus, if present, broadly or diffusely separated from anterior ocellus; subanal lobes pointed and curved dorsad or rounded 16
- 16a. "V-mark" covers an area inside lateral ocellar spots about equal to width of those spots; dark area anterior to median ocellus; subanal lobes pointed and curved dorsad *I. richardsoni*
- 16b. "V-mark" covers very little or none of the area inside lateral ocellar spots; area anterior to median ocellus pale, except occasionally on anterior margin of fronto-clypeus; subanal lobes triangular, rounded, and projecting posteriorly . . . *I. frisoni*
- 17a. Dark area on dorsum of head encloses a large, almost square (concave in front and slightly convex behind) pale area anterior to median ocellus, and an ovoid area between lateral ocelli *I. slossonae*
- 17b. If present, enclosed pale area anterior to median ocellus never nearly square, but ovoid or transverse 18
- 18a. Pronotum predominantly pale with dark markings between pale central stripe and wide pale margins 19
- 18b. Pronotum predominantly tan or brown with a wide pale central stripe and scattered darker and sometimes pale markings in dark areas 24
- 19a. Eighth abdominal sternum with broadly rounded posterior margin barely projecting over 9th sternum; dark marking connecting ocelli about width of ocellar spots and distinctly U-shaped *I. richardsoni*
- 19b. Posterior margin of 8th abdominal sternum produced as a subgenital plate and projecting over at least 1/3 of 9th sternum; in species with a rounded subgenital plate, dark area connecting ocelli very broad, much wider than ocellar spots . . . 20
- 20a. Basal abdominal terga pale, without dark stripes; subgenital plate sub-triangular, not truncated, and at least half as long as 9th abdominal sternum; "V-mark" connecting ocelli often indistinct or lacking, if distinct rarely wider than black ocellar spots . 21
- 20b. Basal abdominal terga with indistinct dark dorsal stripe or darkly pigmented; subgenital plate, if sub-triangular, about 1/3 length of 9th sternum; distinct "V-mark" or broad dark area connecting ocelli 22
- 21a. Sides of subgenital plate concave just before produced apex; "V-mark" connecting ocelli absent or barely visible anteriorly, rarely distinct *I. dicala*
- 21b. Sides of subgenital plate straight, apex often emarginate; "V-mark" often distinct, occasionally absent *I. bilineata*
- 22a. Sides of subgenital plate sub-parallel before wide truncated apex and at least 2/3 as long as 9th abdominal sternum; "V-mark" distinct and covering very little or none of area inside lateral ocellar spots; area anterior to median ocellus pale, except occasionally on anterior margin of fronto-clypeus *I. frisoni*

- 22b. Sides of subgenital plate, if truncate, not more than 1/2 as long as 9th sternum; a broad dark area connecting ocellar spots, with much pigment inside lateral ocellar spots; extensive dark pigmentation on fronto-clypeus 23
- 23a. Subgenital plate highly variable, narrowly rounded, sub-triangular, or truncate, but not more than half as long as 9th abdominal sternum; pale area anterior to median ocellus ovoid or spear-shaped, often indistinct; pale mark between lateral ocelli large, distinct, and pointed anteriorly *I. transmarina*
- 23b. Subgenital plate broadly rounded, usually emarginate, and about 2/3 as long as 9th sternum, a sharply defined, narrow U-shaped pale area immediately anterior to median ocellus; pale mark between lateral ocelli small and indistinct, or lacking *I. cotta*
- 24a. No pale area between lateral ocelli; large, 14mm or longer *I. clio*
- 24b. Pale mark between lateral ocelli; if mark is diffuse or absent, length less than 12mm. 25
- 25a. Abdominal sterna usually yellow, much lighter than pleural areas; large pale area centered on anterior mesoscutum (occasionally obscure) 26
- 25b. Abdominal sterna brown or tan, about as dark as or darker than pleural region; center of mesoscutum dark *I. lata*
- 26a. Center of at least first two abdominal terga white with a dark central stripe; greater than 12mm long; pale spot between lateral ocelli large, occupying 2/3 area between black ocellar spots; subgenital plate well developed and usually broadly and distinctly emarginate *I. marlynia*
- 26b. First two abdominal terga pale and without a dark central stripe; less than 12 mm long; pale spot between lateral ocelli, if present, small and usually occupying 1/2 or less of area between black ocellar spots; subgenital plate low and rounded, occasionally feebly emarginate *I. signata*

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