

**THE LARVAE OF THE *TARNETRUM* SUBGENUS OF
SYMPETRUM, WITH A DESCRIPTION OF THE LARVA OF
SYMPETRUM NIGROCREATUM CALVERT
(ODONATA : LIBELLULIDAE)**

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The subgenus *Tarnetrum* consists of several large *Sympetrum* species of the Nearctic and Neotropical regions. Larval structure indicates that four species — *Sympetrum corruptum*, *S. illotum*, *S. madidum* and *S. nigrocreatum* — belong to this group. The large size of the larvae of these species, their reduced lateral spines and the lack of abdominal dorsal hooks separate them from the larvae of other *Sympetrum* species. The differences among the larvae of the *Tarnetrum* group have not been analyzed adequately. In this paper, these differences are diagnosed, and a key separating the species is presented.

In addition, variation within a single species, *S. illotum*, is recorded. Larvae from the northern part of the range (northwestern United States) are compared with specimens from the south (southern Mexico and Costa Rica). Measurements of several diagnostic characters (metafemur, lateral abdominal spine length, etc.) are significantly larger in the northern specimens.

The larva of *S. nigrocreatum* is described from specimens collected in Costa Rica.

INTRODUCTION

NEEDHAM & WESTFALL (1955) included *Sympetrum corruptum* Hagen and *S. illotum* Hagen in the genus *Tarnetrum*, the main criteria for the separation of adults from *Sympetrum* being the presence of an accessory transverse carina on abdominal segment 4 and two rows of cells between IR3 and Rsp1. Several authors, including GLOYD & WRIGHT (1959), KORMONDY (1958, 1960) and WAL-

KER & CORBET (1975) questioned the generic rank of *Tarnetrum* and reduced it to a subgenus within *Sympetrum*. Moreover, Walker and Corbet included *S. madidum* (Hagen) in the subgenus on the basis of genitalia and venation characters. CANNINGS (1981) supported this placement of *S. madidum* showing that the larva is typical of the *Tarnetrum* group. Dennis Paulson (pers. comm.), however, notes that the penis structure of *S. madidum* is closer to that found in *S. pallipes* and *S. obtrusum* than in *S. illotum* or *S. corruptum*. Evidently the adult as well as the larva (CANNINGS, 1981) seems in some important ways to be intermediate between the subgenera *Sympetrum* and *Tarnetrum*.

With the discovery of the larva of *S. nigrocreatum* Calvert in Costa Rica by Dennis Paulson, the larvae of four *Sympetrum* (*Tarnetrum*) species are known. *S. villosum* Ris from Chile and Argentina belongs to this group (Dennis Paulson, pers. comm.), but its larva has not been described. According to CALVERT (1920), *S. dilatatum* Calvert from Saint Helena is the only other *Sympetrum* species possessing an accessory transverse carina on the fourth abdominal tergite. Its placement in *Tarnetrum* is questionable without further study, and its larva likewise has not been described.

CANNINGS (1981) constructed a key separating the larvae of *Sympetrum corruptum*, *illotum* and *madidum*, but was hampered by the lack of good descriptions of the larva of *S. illotum* in particular. In the present study, good comparative data have been assembled on all the known larvae of the North American species of the *Tarnetrum* group (including for the first time, *S. nigrocreatum*).

DIFFERENTIATION OF *SYMPETRUM* (*TARNETRUM*) LARVAE

Material examined. Specimens located in following collections: British Columbia Provincial Museum (BCPM), D.R. Paulson Collection (DRP), and R.W. Garrison Collection (RWG).

All larvae and exuviae are attributable to the final instar. Exuviae not designated by the word "reared" were not associated with adults.

Sympetrum corruptum. BRITISH COLUMBIA: Vernon, 2 exuviae, 9. IX. 1976, R.A. Cannings (BCPM). WASHINGTON: Spokane Co., Turnbull N.W.R., Kepple L., 1 exuvia, 1. IX. 1968, 1 exuvia, 2. IX. 1968, Big McDowell L., 1 exuvia, 31. VIII. 1968, D.R. and M.L. Paulson (DRP). NEW MEXICO: Hidalgo Co., San Simon Marshes, 1 exuvia, 27. VI. 1961, D.R. Paulson (DRP).

Sympetrum illotum. WASHINGTON: Snohomish Co., 1 mi E Cathcart, 2 exuviae (reared), 1 larva, 3. V. 1972, D.R. Paulson; King Co., Seattle, UW herb garden, 1 larva, 6. IV. 1971, D.R. Paulson (DRP). CALIFORNIA: Marin Co., Alpine L., 4 larvae, 7. IV. 1979, R.W. and J.A. Garrison (RWG). MEXICO: Michoacan, 1.8 mi ESE Ciudad Hidalgo, 1 exuvia (reared), 18. VIII. 1965, D.R. Paulson; Oaxaca, 1.9 mi S Guelatao, 2 exuviae (reared), 5. VIII. 1965, D.R. Paulson (DRP). COSTA RICA: Cartago Prov.,

Tapanti, 1 exuvia (reared), 17. VIII. 1966, D.R. and M.L. Paulson, 16. V. 1967, 1 exuvia, M.L. Paulson; San Jose Prov., San Jose, Parque Bolivar, 1 exuvia, 3. IX. 1967, D.R. and M.L. Paulson; Balneario Patarra, 1 exuvia, 3. IV. 1967, D.R. and M.L. Paulson; Heredia Prov., Varablanca, 1 exuvia, 2. X. 1966, D.R. and M.L. Paulson; 2 exuviae, 30. IV. 1967, D.R. Paulson (DRP).

Sympetrum madidum. BRITISH COLUMBIA: Langford, 10 larvae, 3. VI. 1978, R.A. Cannings, (BCPM).

Sympetrum nigrocreatum. COSTA RICA: Cartago/San Jose Prov., 3.1 mi E La Trinidad, 1 exuvia (reared), 11 larvae, 22. VI. 1967, M.L. Paulson (DRP).

KEY TO THE FINAL INSTAR LARVAE OF NORTH AMERICAN
SYMPETRUM (*TARNETRUM*) SPECIES

- 1 Dorsal hooks present on abdomen *Sympetrum* (*Sympetrum*)
- Dorsal hooks absent *Sympetrum* (*Tarnetrum*) 2
- 2 Length of metafemur 5.9 mm or more; epiproct 1.5 mm or more; cercus 0.9 mm or more; palpal setae in main series 13 or more on each side (usually 13 or 14). *corruptum*
- Metafemur 5.8 mm or less; epiproct 1.4 mm or less; cercus less than 0.9 mm; palpal setae in main series 13 or fewer (usually 10 or 11) 3
- 3 Length of epiproct 1.3 mm or more; paraproct 1.6 mm or more; cercus length less than 0.45 times that of paraproct *madidum*
- Epiproct 1.25 mm or less, paraproct less than 1.6 mm; cercus length more than 0.50 times that of paraproct. 4
- 4 Head width 5.4 mm or less; width of unflattened prementum at articulation of palps 4.7 mm or less; lateral spine on segment 9 usually more than 0.25 mm; this spine usually 0.2 times or more the lateral length of the segment including the spine; palpal setae 9-11, usually 10. *illotum*
- Head width 5.5 mm or more; width of unflattened prementum at articulation of palps 4.8 mm or more; lateral spine on segment 9 less than 0.25 mm, this spine less than 0.2 times the lateral length of the segment; palpal setae 11-12, usually 11 *nigrocreatum*

GEOGRAPHIC VARIATION IN *SYMPETRUM ILLOTUM* LARVAE

With data available for *S. illotum*, it was possible to compare larval characters over a wide latitudinal range. Specimens from the U.S. northwest were compared with those from southern Mexico and Costa Rica; the minimum and maximum distances between specimen localities for the two groups are 3000 km (20° lat.) and 5700 km (37° lat.). Few or no such comparisons of distant populations of larvae of widely ranging species have previously been made (Dennis Paulson, pers. comm.).

Larvae from the northern part of the range showed significantly larger measurements in lengths of metafemur, hindwing sheath, epiproct, paraproct, cercus, segment-8 lateral spine and segment-9 lateral spine (Table II). Head width was the only measurement made that was not significantly different between the populations. The numbers of palpal and premental setae and the three ratios calculated also did not differ significantly from north to south.

Table I
 Comparison of selected characters of *Sympetrum (Tarnetrum)* larvae (mean and S.E., with range in parenthesis; measurements in mm)

Character	<i>corruptum</i> (n = 6)	<i>illotum</i> (n = 18)	<i>medium</i> (n = 10)	<i>nigrocreatum</i> (n = 12)
Total length	19.6 ± 0.49 (18.3 - 21.0)	17.8 ± 0.25 (16.3 - 20.0)	19.0 ± 0.26 (17.8 - 20.3)	19.9 ± 0.16 (19.0 - 21.0)
Head width	5.7 ± 0.66 (5.4 - 5.8)	5.2 ± 0.03 (5.0 - 5.4)	5.3 ± 0.03 (5.2 - 5.5)	5.7 ± 0.03 (5.5 - 5.8)
Premetum (unflattened) width	4.5 ± 0.03 (4.5 - 4.7)	4.4 ± 0.03 (4.2 - 4.7)	4.4 ± 0.03 (4.3 - 4.6)	5.0 ± 0.03 (4.8 - 5.1)
Premental setae (no. on one side, including small medial setae)	18.0 ± 0.45 (17 - 20)	13.8 ± 0.20 (12 - 15)	15.3 ± 0.30 (13 - 18)	15.4 ± 0.25 (14 - 18)
Palpal setae (no. in main series)	13.5 ± 0.22 (13 - 14)	10.1 ± 0.09 (9 - 11)	11.4 ± 0.23 (10 - 13)	11.3 ± 0.13 (11 - 12)
Hindwing sheath length	6.5 ± 0.08 (6.3 - 6.8)	5.7 ± 0.06 (5.3 - 6.0)	5.7 ± 0.07 (5.3 - 6.1)	6.4 ± 0.06 (5.8 - 6.5)
Metafemur length	6.2 ± 0.06 (5.9 - 6.3)	5.2 ± 0.06 (4.7 - 5.5)	5.5 ± 0.05 (5.3 - 5.7)	5.6 ± 0.04 (5.3 - 5.8)
Epiproct length	1.59 ± 0.02 (1.52-1.65) *	1.09 ± 0.03 (0.89 - 1.25)	1.30 ± 0.02 (1.30 - 1.40)	1.19 ± 0.01 (1.16 - 1.22)
Paraproct length	1.90 ± 0.03 (1.82 - 2.00)	1.37 ± 0.03 (1.16 - 1.56)	1.80 ± 0.03 (1.60 - 1.90)	1.49 ± 0.01 (1.42 - 1.58)
Cercus length	0.94 ± 0.02 (0.90 - 1.00)	0.78 ± 0.02 (0.66 - 0.89)	0.70 ± 0.02 (0.60 - 0.80)	0.83 ± 0.001 (0.83 - 0.84)
Ratio of cercus: paraproct	0.49 ± 0.01 (0.47 - 0.51)	0.57 ± 0.01 (0.53 - 0.62)	0.40 ± 0.01 (0.37 - 0.44)	0.56 ± 0.01 (0.53 - 0.58)
Lateral spine (seg. 8) length	0.16 ± 0.01 (0.13 - 0.17)	0.16 ± 0.01 (0.08 - 0.23)	0.23 ± 0.01 (0.17 - 0.26)	0.14 ± 0.01 (0.10 - 0.17)
Ratio of lateral spine (seg. 8): length seg. 8	0.11 ± 0.01 (0.09 - 0.12)	0.12 ± 0.01 (0.08 - 0.15)	0.17 ± 0.01 (0.13 - 0.18)	0.10 ± 0.01 (0.07 - 0.12)
Lateral spine (seg. 9) length	0.28 ± 0.01 (0.25 - 0.30)	0.35 ± 0.01 (0.23 - 0.43) **	0.43 ± 0.01 (0.40 - 0.50)	0.22 ± 0.01 (0.18 - 0.23)
Ratio of lateral spine (seg. 9): length seg. 9	0.16 ± 0.01 (0.14 - 0.17)	0.20 ± 0.01 (0.16 - 0.23) **	0.25 ± 0.01 (0.23 - 0.28)	0.14 ± 0.01 (0.11 - 0.19)

* Measurements of epiproct, paraproct and cercus in description given by MUSSER (1962) are so large as to almost certainly be in error.

** Only 2 of 18 specimens show values of less than 0.33 and 0.20 respectively.

Table II
Comparison of southern (Costa Rica and Mexico) and northern (California and Washington) populations of *Sympetrum illotum* larvae (mean and S.E. with range in parentheses; measurements in mm)

Character	South (n = 10)	North (n = 8)	t
Head width	5.2 ± 0.04 (5.0 - 5.4)	5.3 ± 0.04 (5.0 - 5.3)	0.91
Palpal setae (no. in main series)	10.1 ± 0.12 (9 - 11)	10.1 ± 0.15 (9 - 11)	0
Premental setae (no. on one side including small medial setae)	13.7 ± 0.29 (12 - 15)	13.9 ± 0.15 (13 - 15)	0.57
Metafemur length	5.1 ± 0.07 (4.7 - 5.3)	5.3 ± 0.06 (5.0 - 5.5)	2.63**
Hindwing length	5.5 ± 0.06 (5.3 - 6.0)	5.8 ± 0.04 (5.4 - 6.0)	3.23**
Epiproct length	1.03 ± 0.03 (0.89 - 1.16)	1.17 ± 0.06 (1.06 - 1.25)	3.50**
Paraproct length	1.29 ± 0.03 (1.16 - 1.45)	1.48 ± 0.03 (1.28 - 1.58)	5.67**
Cercus length	0.73 ± 0.01 (0.66 - 0.79)	0.84 ± 0.02 (0.79 - 0.89)	5.00**
Ratio of cercus: paraproct	0.57 ± 0.01 (0.54 - 0.61)	0.57 ± 0.01 (0.56 - 0.61)	0
Lateral spine (seg. 8) length	0.14 ± 0.01 (0.08 - 0.17)	0.19 ± 0.01 (0.13 - 0.23)	2.27*
Ratio of lateral spine (seg. 8): length seg. 8	0.12 ± 0.01 (0.08 - 0.15)	0.13 ± 0.01 (0.10 - 0.15)	1.00
Lateral spine (seg. 9) length	0.32 ± 0.01 (0.23 - 0.36)	0.39 ± 0.02 (0.33 - 0.43)	3.18**
Ratio of lateral spine (seg. 9): length seg. 9	0.19 ± 0.02 (0.16 - 0.23)	0.21 ± 0.01 (0.18 - 0.23)	0.77

* $p \leq 0.05$

** $p \leq 0.01$

**SYMPETRUM NIGROCREATUM CALVERT,
FINAL INSTAR LARVA**

Table I shows the major morphological differences among the larvae of the four *Sympetrum (Tarnetrum)* species. The larva of *S. nigrocreatum* is similar to those of other members of *Tarnetrum* in having reduced lateral spines and lacking dorsal hooks. It is, on average, the longest of the larvae (19.9 mm) although the metafemur (5.3-5.8 mm) is shorter than that of *S. corruptum* (5.9-6.3 mm). The width of the unflattened prementum (4.8-5.1 mm) is greater than in the other three species. Palpal setae normally under 11, sometimes 12, while there are usually 15 or 16 premental setae. These counts are most similar to those of *S. madidum*; the species are allopatric.

Lengths of the epiproct (1.16-1.22 mm) and paraproct (1.42-1.58 mm) overlap considerably with those of *S. illotum* (0.89-1.25 mm and 1.16-1.56 mm respectively) but are consistently shorter than those of *S. madidum* (1.30-1.40 mm and 1.60-1.90 mm) and *S. corruptum* (1.52-1.65 mm).

In material examined in this study, *S. nigrocreatum* shows the shortest lateral spines on abdominal segment 9 — all measured less than 0.25 mm. In this context, southern populations of *S. illotum* (i.e. sympatric with *S. nigrocreatum*) overlap least (2 of 18 specimens) with *S. nigrocreatum*. Northern populations of *S. illotum* are reliably separated from *S. nigrocreatum* using lateral spine length.

ACKNOWLEDGEMENTS

I thank Dr DENNIS PAULSON for criticizing the manuscript and for supplying much of the material used in this study, especially specimens of *Sympetrum nigrocreatum*. Dr ROSSER GARRISON kindly loaned specimens of *S. illotum*.

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