ANNUAL DEVELOPMENT OF *LIBELLULA QUADRIMACULATA* L. IN A NEWLY SETUP POND (ANISOPTERA: LIBELLULIDAE)

While studying the colonization of newly setup ponds by dragonflies, I was able to gather additional data on the minimum time period of the larval stage of *L. quadrimaculata* under natural conditions.

At the end of September 1981, a new pond was created in an unused meadow north of Rieseberg, 15 km E of Brunswick, Fed. Rep. Germany (52° 18'15"N, 10°47'10"E), and was left to natural succession. The pond is situated on the north side of a forest, in the depression of a brook. In 1982, the emergent vegetation was represented by *Glyceria fluitans* only, growing all over the water surface. Since 1983, vegetation has developed around the shores of the pond consisting of *Juncus articulatus, J. effusus* and *Ranunculus flammula.*

The initial dragonfly colonization was observed in 1982 (A. MARTENS, 1983, *Braunschw. naturk. Schr.* 1: 591-601). Since that time the study has been carried on. The exuviae were identified according to U. FRANCKE (1979, *Stuttgart. Beitr. Naturk.* (A) 333: 1-17), considering the characteristic crenation of the lateral palps as discussed by F. RIS (1911, *Mitt. schweiz. ent. Ges.* 12: 25-41), A.E. GARDNER (1953, *Ent. Gaz.* 4: 175-201) and R. WELLINGHORST & W. MEYER (1979,

Dt. ent. Z. (NF) 26: 271-274, 2 pls excl.).

Adults of *L. quadrimaculata* were observed at the pond since 1982, and their reproductive behaviour could be seen frequently. In 1983, a total of 44 exuviae of this species were collected on 7 occasions between May 21 and July 5 from the northern and western shore. Several specimens were observed in metamorphosis. In 1984 and 1985, *L. quadrimaculata* developed successfully in the pond.

The annual flight period of *L. quadrimaculata* ranges from early May to mid-August (H. SCHIEMENZ, 1953, *Die Libellen unserer Heimat*, Urania, Jena). As far as I know, in Central Europe adults have never been observed in late September. The pond was created at the end of September 1981, thus it could not have been colonized in the same year. Since adults appeared at the earliest in 1982 and exuviae first were found in 1983, the specimens of *L. quadrimaculata* must have developed within a single year.

These data are in contradiction to those hitherto published. C. WESENBERG-LUND (1914, *Int. Revue ges. Hydrobiol. Hydrogr.* 6.: 155-228, 373-422) without giving any evidence, supposed that the Danish members of the genus *Libellula* need two years of development. He was unable to identify larvae and did not try to rear them. P. MÜCHNBERG (1931), *Abh. Ber. naturw. Abt. Grenzmärk. Ges. Erforsch. Pflege Heimat Schneidemühl* 6: 128-144) published studies on the duration of larval life in some Libellulidae. His data for *L. quadrimaculata* based on the comparison of larval sizes, were collected only in the autumn. Although no significant size-groups could be recognized, he distinguished two year-classes in accordance with research of A. PORTMANN (1921, *Die Odonaten der Umgebung von Basel*, Inaug. Diss. Univ. Basel). The latter had found larvae of two different sizes of *L. depressa* L. in late autumn, and deduced two age-groups. P.-A. ROBERT (1958, *Les libbelules (odonates)*, Delachaux & Niestlé, Neuchâtel-Paris) found relatively long intervals between hatches in larger instars, and supposed that *L. quadrimaculata* could be bi- or probably triannual. Münchberg and Robert failed in rearing *L. quadrimaculata* from eggs. P.S. CORBET (1960, *in:* P.S. Corbet, C. Longfield & N.W. Moore, *Dragonflies*, Collins, London) wrote that the species usually needs more than two years for development in Britain.

Several papers have been published dealing with variation in duration of anisopteran development, even in one and the same population (e.g. P.S. CORBET, 1957, *J. Anim. Ecol.* 26: 1-69; D.M. JOHNSON, 1986, *Odonatologica* 15: 81-90). I have found *L. quadrimaculata* to complete a univoltine life-history, though not necessarily obligatory for this species. Based on the data presented, a triannual development seems improbable.

In 1983, exuviae of *L. depressa* and *Orthetrum cancellatum* (L.) were also collected from the same pond, reflecting an annual development under natural conditions. Consequently, for these species a univoltine life-history could also be assumed.

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