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From larval ecology to distribution pattern: a case study in three swallowtail butterflies

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The immature stages are the most vulnerable parts in the life cycle of a butterfly due to their low mobility (Porter 2002, Fartmann 2004). Hence, the larval ecology is often the key to the understanding of a species' distribution and abundance. We studied the larval habitat preferences of two east Asian swallowtail butterflies (*Papilio maackii* and *P. xuthus*) and the Eurasian *P. machaon* and their implications for distribution patterns.

The study area of about 7.5 km² is located in the Lazovsky State Nature Reserve in the southern Sikhote Alin mountains (Primorsky Krai, Russian Far East, 134°E/43°N) at an elevation between 500 to 700 m a.s.l. The region is affected by a monsoon climate with warm, humid summers and cold, dry winters (Chochrjakow & Schochrin 2002).

In summer 2003, during the flight period of *P. xuthus*, *P. machaon* und *P. maackii*, potential larval host plants on the gravel banks of the rivers Kyevka and Tchornaya were checked systematically for eggs and larvae. The following parameters were measured: total height and diameter of the focal plant, coverage of herbs, stones, gravel and open soil 50 cm around the host plant, as well as the average height of herbs around the focal plant (Anthes *et al.* 2003, Fartmann 2004). Additionally, we determined the oviposition height of the eggs and the residence height of the larvae, respectively, above ground. To describe the microclimate at the oviposition sites the potential insolation duration per day in August was measured with a horizontoscope according to Tonne (1954).

We found a total of 22 preimaginal stages of *P. xuthus*, 43 of *P. machaon* and 109 of *P. maackii,* respectively. All three study species use habitats with a high coverage of gravel (median = 40%) and stone (median = 49%) with only slight grass coverage (median = 10%). *Papilio xuthus* deposited its eggs on *Phellodendron amurense* (Rutaceae). Larvae of *P. machaon* were found on three species of Apiaceae. *Papilio maackii* used all four plant species. *Papilio xuthus* preferred prominent *Phellodendron amurense* plants, but eggs were laid a little bit below the height of the surrounding vegetation (Table 1). For oviposition *P. machaon* chose host plants with nearly the same height as the surrounding vegetation. Egg-laying took place on leaves below the height of adjacent plants.

The proportion of gravel and stone differed between the habitats of *P. xuthus* and *P. machaon*: The oviposition sites of *P. xuthus* offered more gravel than stone unlike those of *P. machaon* (Table 1). When *P. maackii* used *Phellodendron amurense* as host plant, the larval habitats resemble

Table 1. Habitat parameters (medians) of the egg-laying/larval habitats of the three swallowtail butterflies. "Collectiv" represents the combined medians of Apiaceae and *Phellodendron amurense*.

	Cover [%]				**Height [cm]**		**Plant Vitality [cm]**		**Insolation duration [h]**	
	Bare ground	Gravel	Stones	Herbs/ grasses	Turf	Oviposition	Height	Diameter		
Phellodendron amurense										
P. xuthus	0	50	40	10	25	24	34	32	8	n = 11
P. maackii	**0**	**50**	**45**	**10**	**25**	**22**	**30**	**23**	**10**	n = 56
Collectiv										
P. maackii	0	30	45	10	25	19	27	32	9	
Apiaceae										
P. maackii	**5**	**20**	**50**	**10**	**23**	**16**	**23**	**35**	**8**	n = 52
P. machaon	30	40	50	10	20	15	21	31	8	n = 28

those of *P. xuthus*. If Apiaceae were the host plants of *P. maackii*, the habitats were similar to those of *P. machaon*.

In the highly dynamic flood plains *P. maackii* has a strategic advantage over its congeners *P. xuthus* and *P. machaon*. Using various host plants of different plant families (Rutaceae, Apiaceae) and therefore colonising a wider array of habitats can be interpreted as a risk-spreading strategy. The choice of host plants involves different ecological, especially microclimatic, conditions. With this strategy *P. maackii* obtained higher reproductive success showing higher abundances and a larger distribution on the landscape level compared to *P. machaon* and *P. xuthus*. The rarity of the other two species is probably the result of their host plant specialization on only one host plant family in combination with their narrower microclimatic preferences. *Papilio xuthus,* the one with the most specific ecological niche, was by far the rarest swallowtail butterfly in the study area.

REFERENCES

Anthes, N., Fartmann, T., Hermann, G. & Kaule, G. (2003) Combining larval habitat quality and metapopulation structure – the key for successful management of prealpine *Euphydryas aurinia* colonies. Journal of Insect Conservation 7, 175–185.

Chochrjakow, S. A. & Schochrin, W. P. (2002) Amphibien, Reptilien, Vögel und Säugetiere des Lasowski Sapowednik (Primorski Krai, Russland). Eine kommentierte Artenliste.

Ebert, G. & Rennwald, E. (1991) Die Schmetterlinge Baden-Württembergs. Band 1, Tagfalter I. Verlag Eugen Ulmer.

Fartmann, T. (2004) Die Schmetterlingsgemeinschaften der Halbtrockenrasen-Komplexe des Diemeltales. Biozönologie von Tagfaltern und Widderchen in einer alten Hudelandschaft. Abhandlungen aus dem Westfälischen Museum für Naturkunde 66, 1–256.

Porter, K. (2002) Eggs and egg-laying. In: Dennis, R. L. H. (ed.), The Ecology of Butterflies in Britain. Pp. 46-72. Oxford University Press, Oxford.

Tonne, F. (1954) Besser bauen mit Besonnungs- und Tageslicht-Planung. Hofmann, Schorndorf.