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The "Prosperous" species of the Palaearctic Tabanidae (Diptera)

by R. V. Andreeva

Abstract. A review of the Palaearctic horse-flies with an increased viability has been carried out. A study of ecology, phenology and distribution of these species at both adult and larval stages allowed to clarify certain particular features contributed the evolutionary formation of their unusual characteristics.

Key words. Diptera-Tabanidae-adult-larvae-distribution-ecology-evolution

Introduction

In view of practical importance and theoretical interest, knowledge of the horse-flies, an active component of the blood-sucking insects, still remains incomplete and is to be continued. This communication contains results of a complex research of the most widely distributed and harmful species of the Palaearctic horse-flies at both adult and larval stages, never discussed hitherto. The widely distributed organisms with an extended imaginal life span called "prosperous species" by OLSUFJEV (1977) and "generalists" by MARKOV & SOLOVJEV (1995) apparently are not exclusive among different insect families, however the information about them is rather poor.

Among Palaearctic horse-flies, different students recognised species with total flight period duration of 2–4 months, and in certain Central Asian representatives up to 6 months, at average flight period 25±5 days (LUTTA, 1970; KADYROVA, 1975; OLSUFJEV, 1977). More than a third of these long-living species have extended trans-zonal ranges, the others belong to different ecological-faunistic complexes with their ranges also extended over the vast areas.

These species are active blood-suckers dominant in abundance over the main part of their ranges. Most of them are the vectors of tularaemia, trypanosomiasis, anthrax and other hazardous human and animal transmissive diseases.

In order to elucidate the conditions contributed evolutionary appearance of such extraordinary characteristics in a part of the species representing ca. 13 % of the Palaearctic tabanid fly fauna a study of their ecology and development peculiarities has been carried out.

Material and discussion

The life cycle of the most horse-fly species of the genera *Tabanus* L., *Hybomitra* END., *Philipomyia* OLS. and *Atylotus* O.S. takes 2 years. In tundra and taiga zones this period extends up to three (rarely more) years, since it is known that in certain species the larval development period can be extended under adverse environment conditions. The smaller-sized representatives of the genera *Chrysops* MG. and *Haematopota* MG. as well as some other temperate and southern climatic zone species have a chance to conclude their development within one year.

The main part of the horse-fly life cycle time (more than 90%) is accounted for by larval growth and development. The longer is individual development of an organism, the more significant is the influence of the environment factors it exposed to, the heavier is so-called "environmental load" (VAN VALLEN, 1973). Due to the high plasticity the larvae of different representatives of the family are adapted to the habitats considerably diversified with respect to their physical parameters. As a result of long-term exposure to various environmental factors, especially during global landscape-climatic changes of the earth surface, the appropriate larval physiological features and morphological structure have changed during evolution. Their characteristics along with species-preferred habitat type were accepted as a basis for classification of the horse-fly larvae different life-forms (ANDREEVA, 1982; 1989). Among other families of the dipteran insects the Tabanidae occupy one of the leading positions by the life-form diversity.

The horse-fly species belonging to the "prosperous" group by their abundance and spatial distribution are those with hemihydrobiont morpho-ecological type larvae. This is determined by the humidity and substrate structure condition maximal diversity and vegetation characteristics the insects can find on the ground and water border. An advantage of development under reliable and diversified humidity conditions, substrate structure and temperature fluctuations have resulted in fact that larvae of ca. 44% of Palaearctic horse-fly species are hemihydrobionts. This was promoted by the availability over a huge cold and moderate climate territory of extensive marshy areas formed during repeated climatic changes during the Pleistocene. The abilities of the larval development prolongation on the north under reduced vegetation season apparently related with relatively recent evolutionary age of the most type representatives and their possibility to use the zonal translocations in the south have allowed horse-flies of this morpho-ecological type to occupy all landscape zones suitable for their life excluding alpine zone.

The distribution of species with larvae belonging to transitional morpho-ecological class from edaphobiont to hemihydrobiont forms in many respects are coincident with hemihydrobionts, but differ from latter that they inhabit the soil sites distant from border of water or live near lower situated areas. "Prosperous" horse-flies of this morpho-ecological type are represented by the members of genus *Haematopota* MG. Similarity of most morphological characters at both adult as larval stages of this genus representatives in the world fauna and their distribution suggests an assumption of these taxa to be relatively young in evolution (FAIRCHILD, 1966).

Evolutionary development of morpho-ecological types like mountain edaphobiont, psammobiont, deserted–steppe and foothill rheophil occurred parallel to the appropriate landscapes formation. In the Early Miocene intensification of orogenetic processes in the Middle and Central Asia, and uplift of Taurus and Zagroz mountain ranges, and also Iranian Plateau gave rise to the climate aridisation and formation of desert–steppe and desert areas, not characteristic for the Ancient Mediterranean territory before. These changes promoted the occurrence of qualitatively new faunal elements among which were above mentioned horse-fly larval life-forms. It should be pointed out, that significant daily temperature drops characteristic for continental climate of Asian area apparently have a profound impact on the rates of species formation evolution tempo (ZAAR *et al.*, 1989). This is probably one of the factors explaining quantitative prevalence of representatives in composition of "prosperous" species in Asian fauna (see Table: deserted–steppe, foothill, mountain–forest, mountain and alpine fŕunistic complexes).

A list of "prospering" horse-fly species with life cycle duration and morpho-ecological types of the larvae

Faunistic complex	Species	Life cycle duration	Morpho-ecological type
Trans-zonal	*H. lapponica* WAHLB.	2–3	bryobiont
	H. bimaculata MACQ., *H. ciureai* SEG., *T. autumnalis* L., *T. bromius* L.	1–2	hemihydro-biont
	Ch. pictus MG., *Ch. relictus* MG., *Ch. caecutiens* L., *Ch. flavipes* MG.,	1	
	H. pluvialis L., *H. italica* MG.	1	transitional f.
Forest-steppe	*T. quatuornotatus* MG.	2	edaphobiont
Deserted steppe, foothill	*T. golovi* OLS., *T. filipjevi* OLS.,	1–2	rheophil
	T. leleani AUST.	0.8–1.5	rheophil
	T. spectabilis LW., *T. laetetinctus* BECK., *T. bromius flavofemoratus* STROBL.,	1–2	hemihydrobiont
	T. sabuletorum LW.,	1	edaphobiont
	H. erberi BR., *H. peculiaris* SZIL.	1	hemihydrobiont
	H. (S). acuminata LW.	1–2	hydrobiont
	A. pulchellus LW., *Ch. italicus* MG.	1	hydrobiont
	H. pallens LW.	1	transitional f.
Mountain-forest	*T. semenovi* OLS.,	1–2	hemihydrobiont
	H. turkestana SZIL., *H. bactriana* OLS.,	1	transitional f.
	Ph. aprica MG.	2	edaphobiont
Mountain	*H. hunnorum* SZIL., *H. semipollinosa* OLS.	2	edaphobiont
alpine	*H. tatarica* PORTSCH., *H. shnitnikovi* OLS.	2	transitional f.

This way, the common feature for the species given in the table are relative evolutionary youth. The evolutionary adaptation of organisms to changing environment conditions results in genetic population heterogeneity (KONIKOV & TCHERNYSHOVA, 1966). This property, historically developed and genetically fixed, provides survival of these insects under extremal conditions due to ability of a brood to different growth rates. Different life cycle duration characteristic not only for the progeny of one species but also for individuals developing from the same egg-cluster, has been found in some insects a long time ago. The author observed unequal development rates of the normal larvae *T. autumnalis* L., *T. bromius* L., *H. ciureai* SEG., *H. muehlfeldi* BR., *Ch. relictus* MG. and *H. pluvialis* L. at laboratory rearing under optimal temperature 26–27 °C. The differences in the larval development rate of these species result in non-simultaneous maturity and emergence during vegetation season that extends the total adult flight and consequently the reproduction period. In southern areas the time range between the first and the last oviposition may reach 4 months (fig.1). In the larval associations of such "prosperous" species, especially those with biennial life cycle, the larvae are represented by the different age groups practically at any time of the year. At the same time, the synchronous emergence horse-fly larval association consists of individuals of more or less similar age for annual life cycle species and of the individuals of two ages (difference in one year) for biennial life cycle species.

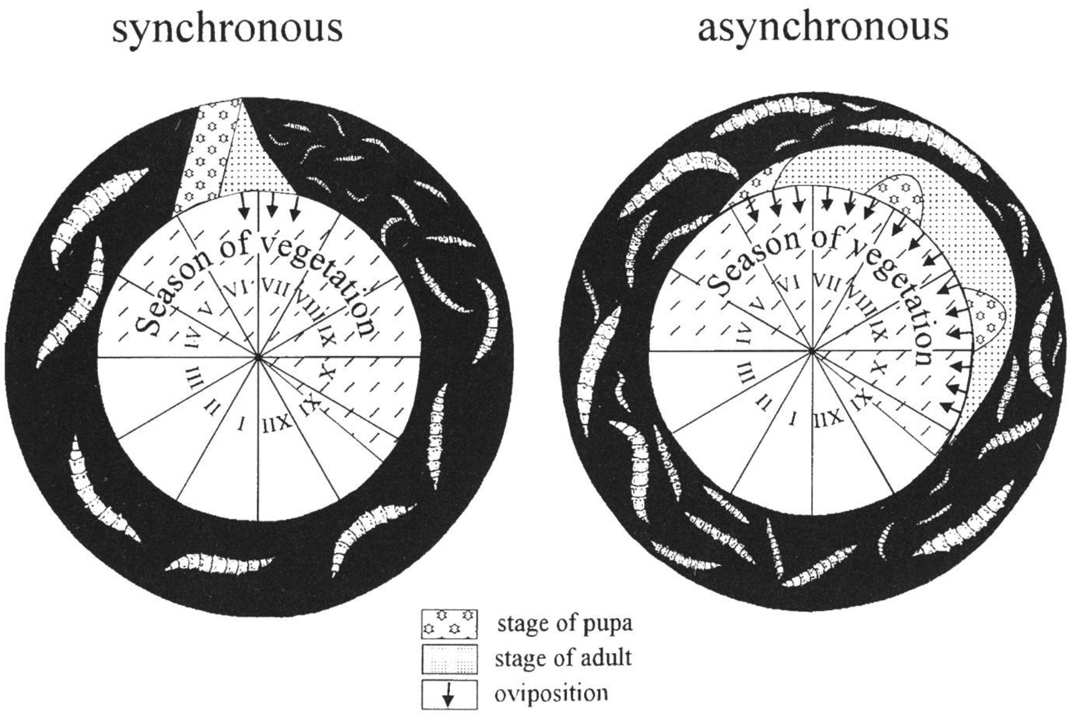

Fig. 1. Life cycle of horse-flies with synchronous period of emerging.

The above facts show that the upgrading functional systems of an organism ensuring high larval stage physiological liability, were of a vital importance in formation and recent distribution of the Tabanidae.

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