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DEVELOPMENT OF THE TICK IXODES LAGURI OL. IN THE NESTS OF THE EUROPEAN SUSLIK CITELLUS CITELLUS (L.)

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Abstract. In field and laboratory conditions new data were obtained concerning the life cycle of the nidicolous tick *Ixodes laguri*. The development of this tick was studied in experimental nests of the European suslik and a two-year cycle of *I. laguri* was demonstrated. However, the materials obtained indicate that a longer cycle may be anticipated.

Ixodes laguri Olenev, 1929 belongs to typical nidicolous tick species. Information about the bionomy of this species is incomplete at present. From literature only two localities of its occurrence are known in Czechoslovakia: Jablonov n. T. (Rosický 1953) and Dvorníky (Černý 1960). From the latter locality the subspecies *I. laguri slovacicus* Černý, 1960 was described and listed with the hitherto known *I. l. laguri* Olenev, 1929, *I. l. colchicus* Pomerantsev, 1946, and *I. l. armeniacus* Pomerantsev et Kirschenblat, 1946. No data have been published in Czechoslovakia on the bionomy of *I. laguri*. Its only host mentioned is *Citellus citellus*.

Our investigations described below have yielded new information about the development of this species both in field and laboratory conditions.

MATERIAL AND METHODS

The initial material used in our field experiments originated from the nests of susliks in free nature (eastern part of Czechoslovakia), collected in the spring period during the years 1973—1976. The experiments were started in May 1974 using simulated suslik nests (Plates I, II), (Daniel et al. in press) in which engorged nymphs were released. Experiments with rearing the ticks in boxes were started in April 1975, when boxes with engorged females were planted in the nests, and in April 1976, when boxes with engorged larvae and nymphs were planted, intending to complete the development until the latest possible stage permitted by the conditions. A total of 20 females, 114 nymphs and 78 larvae were studied in boxes.

In addition to our field studies on the *I. laguri* development also laboratory investigations were carried out. Standard conditions of microclimate were created on the basis of previous exact continuous measurements of microclimate in the nests of susliks. The resultant 15—17 °C were considered as the mean temperature of nest inhabited by susliks, relative humidity being 90 %.

The ticks were kept in thermostats where the above mentioned temperature and humidity were maintained. All unengorged developmental tick stages were allowed to feed on white mice, in caps attached to their backs, in thermostats. The adults were allowed to feed in pairs, the nymphs in pools of maximally 20 specimens, the larvae in indefinite number (one egg batch per four mice). In all stages the mortality during feeding was higher than in current external tick species reared in our laboratory. All stages were most sensitive to lower humidity. Whenever the humidity during feeding dropped to less than 90 %, the attached ticks dessicated and died.

RESULTS

Experimental field studies

The results obtained in the experimental field studies on *I. laguri* are given in Fig. 1. The greatest losses in the experiment were noted in larvae. Out of 78 engorged specimens only one nymph moulted (1.3 %). A better result was achieved in nymphs.

Out of 114 specimens 20 females and 15 males moulted (30.7 %). The nest environment was most favourable to engorged females. Out of 20 specimens 16 (80 %) oviposited and larvae hatched from 13 egg batches (65 %), two batches being destroyed due to the damage inflicted by a suslik to the box covering, and probably would yield larvae.

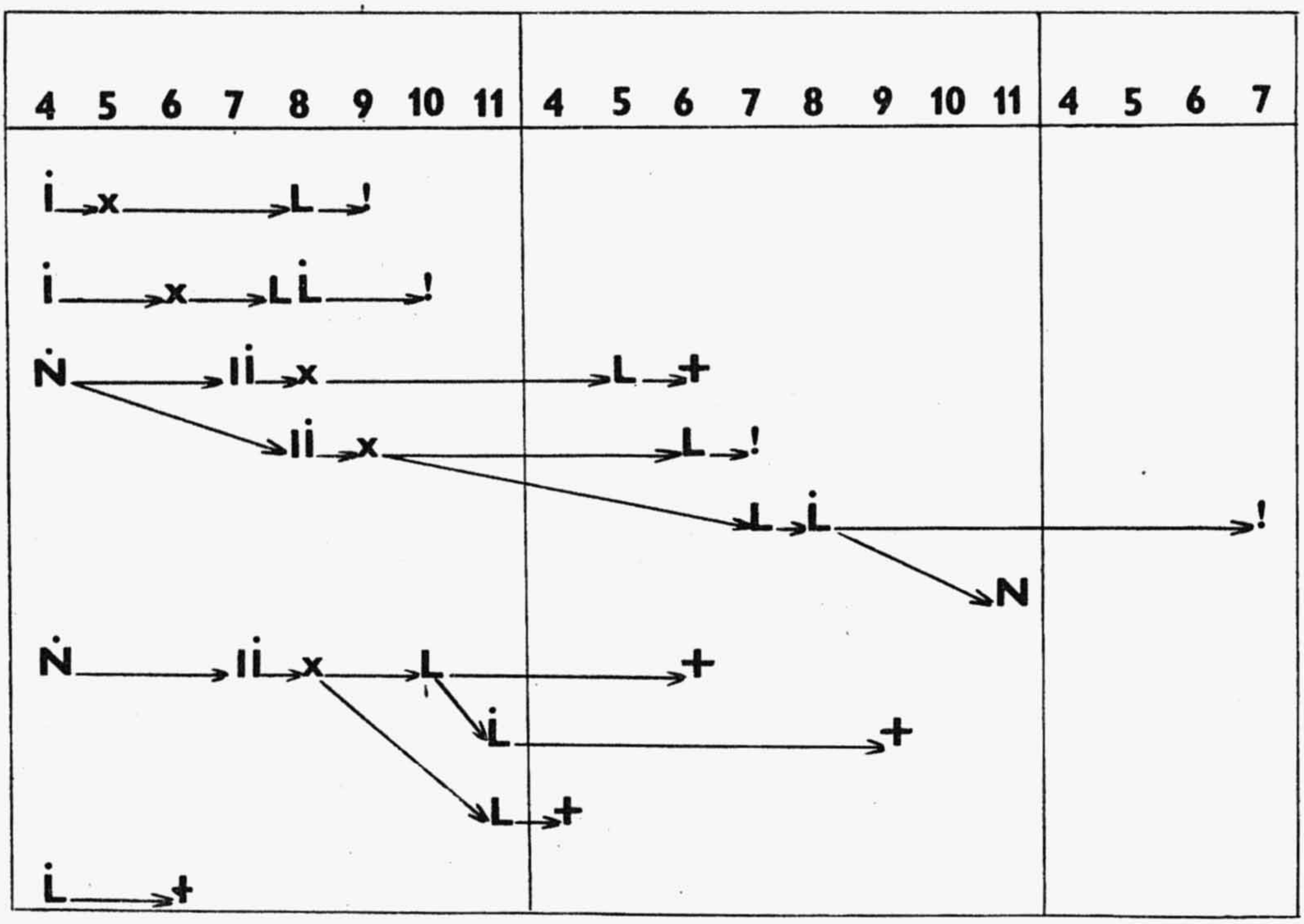

Fig. 1. The development of *I. laguri* studied in the field experiment. LNI — hungry larvae, nymphs and females, L̇Ṅİ — engorged larvae, nymphs and females, X — egg batch, + death, ! — destroyed by the suslik.

From females engorged in April the eggs were harvested in May—June and the larvae hatched from these in August; from females engorged in July the eggs were harvested in August and the larvae from these hatched in October—November of the current year and in May of the following year; from females engorged in August the eggs were found in September and the larvae from these hatched in June and July of the following year.

The only nymph moulted in November, originating from larvae engorged in August. From nymphs engorged in April the adults moulted in July and August of the current year. In the field experiment the eggs, hungry and engorged larvae hibernated with best results.

Just as in other tick species studied by us (*Ixodes ricinus, Dermacentor reticulatus*) larvae were the most sensitive to environmental conditions. Our experiment showed that among the factors unfavourably influencing the developmental process of ticks was e.g. their contact with excrements or urine of susliks.

The ticks released in the suslik nest at the stage of engorged nymphs (15 specimens) in April, reached the stage of hungry larva and unfed nymph (only one L and two N found) by November of the following year. This fact fully corresponds with the development of *I. laguri* observed in boxes. In the second case (when 21 engorged nymphs were planted) no ticks were found in the nest at the end of the following year.

Laboratory studies on the *I. laguri* development

While the adults were feeding it was found that the first females, which engorged to repletion, dropped off within five days; the females, which continued laying fertile eggs, fed as long as 11 days. It often happened that some females were attached to the mouse for a longer period, but no one produced viable progeny after such a long time of feeding. Whenever hungry females were planted together with males on a rabbit they died without attaching themselves. Females started to oviposit not before the fifth day after detachment from the host, after 13 days at the latest. The eggs finally matured and larvae started to hatch within 28—40 days from the beginning of oviposition.

Larvae allowed to feed in laboratory from August through November fed minimally three, maximally six days. Hungry larvae which were not given an opportunity to engorge, survived as long as 52 days. Engorged larvae, feeding in September—October, metamorphosed into hungry nymphs not before 28th day; whenever they fed in November, some larvae metamorphosed into nymphs after six weeks, but in most of them a diapause occurred despite constant conditions of the experiment and nymphs appeared only after 5—6 months.

Hungry nymphs also fed on white mice. The duration of feeding varied between 4 and 7 days. During each feeding a relatively high mortality was observed. In some pools only 9 %, maximally 25 % of planted nymphs engorged. The engorged nymphs metamorphosed into adults within 33—42 days.

All nymphs studied fed in the first half of the year, and this fact explains the missing diapause in their development, namely the diapause described in this developmental stage by Bozhenko and Shevchenko (1953). The authors reported that the diapause used to occur in nymphs which had fed at the beginning of September. In our laboratory conditions we noted a development delay at the stage of engorged larva only in specimens which had engorged in November, while the larvae engorging in September and October developed in the normal period. Unlike the results of mentioned authors, our experiments yielded a shorter pre-ovipositional period (5—13 days against 8—22 days)

DISCUSSION

Taking into account the data obtained while rearing *I. laguri* in field conditions and while investigating the suslik nests, we may attempt to outline the course of this species life cycle. On the basis of particular stages ascertained by us, only one variant of life cycle, namely that of two years' duration, may be outlined (Fig. 2a). Females, which moult in mid-summer, feed in April of the following year, oviposit in May, larvae hatch and feed in August, nymphs moult in November, hibernate in a hungry state, feed in April and adults moult in July. However, other variants may also be taken into account.

If we admit that females are capable to stay hungry for a year, which seems to be possible, the whole life cycle may take three years (Fig. 2b). Theoretically also other variants are possible between the two mentioned above, e.g. a variant, in which females can endure hunger for a long time and larva is capable to metamorphose into nymph and nymph into adult in the final year of development (Fig. 2c). The one-year variant is improbable in the conditions of Czechoslovakia (Fig. 2d). It would require an early spring moulting of nymphs originating from larvae engorged in late autumn, this fact being in contrary to our observations.

The tick activity under Central-European conditions evidently follows a similar pattern in Moldavia (Uspenskaya 1963) where susliks awake from hibernation and larvae, nymphs as well as adults occur from the spring. Different results are reported from the Don region by Bozhenko and Shevchenko (1956), where larvae appear in nature only from mid-May. Another discrepancy between the data of these authors and our results is the hibernation capability of engorged larvae (54 % in our experiments).

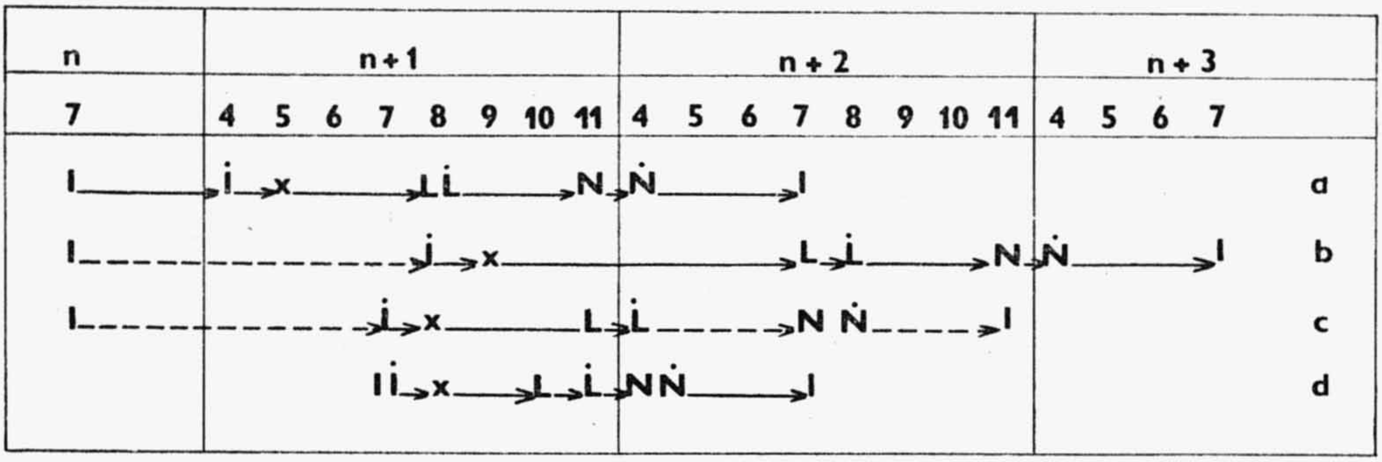

Fig. 2. A diagram of the *I. laguri* life cycle in conditions of Czechoslovakia. a — proved, b, c — possible, d — improbable. Solid line — proved course, broken line — unproved course.

Summing up, we may say that a two-year-cycle of *I. laguri* was proved by our studies, but a longer cycle is not excluded. The materials available show that the hatching of larvae is not associated with only one particular season of the year, as e.g. in *I. ricinus*, but takes place from May to November, and a rather similar situation may be also anticipated in the metamorphosis of engorged larvae. Particular variants of life cycles obviously overlap in nature.

It becomes evident, that the nidicolous tick *I. laguri* became adapted to environmental conditions characterized by temperature and humidity varying within a small range and by a long-term constant presence of host, which promoted its shorter life cycle, if compared with that of the free-living species, represented e.g. by *I. ricinus*.

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РАЗВИТИЕ КЛЕЩА *IXODES LAGURI OL.* В ГНЁЗДАХ ЕВРОПЕЙСКОГО СУСЛИКА *CITELLUS CITELLUS* (L.)

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Резюме. В полевых и лабораторных условиях получены новые данные о жизненном цикле клеща *Ixodes laguri* — обитателя гнёзд сусликов. Развитие этого клеща изучено в экспериментальных гнёздах суслика и выявлен двухлетний цикл клеща *I. laguri*. Однако, судя по полученным материалам и более длительный цикл весьма возможен.

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SPECIES OF THE FAMILY DOLICHOPODIDAE AS ENEMIES OF MOSQUITO AND BLACKFLY LARVAE AND ADULTS

Terrestrial predacious insects play a certain role in reducing the number of blood-sucking Diptera, primarily their larvae. There exists a number of papers dealing with this problem, pointing out some species of the family Dolichopodidae as natural enemies of blood-sucking Diptera.

Unnamed species of the family Dolichopodidae are indicated as predators of mosquito larvae by Atkinson (J. Trop. Med. Hyg. 12: 255—256, 1909), Howard et al. (Washington Carnegie Inst. 1: 156—179, 1912) and Christophers (Cambridge Univ. Press, pp. 739, 1960). Bishop and Hart (J. N. Y. Ent. Soc. 39: 151—157, 1931) mention 4 species of the genus *Dolichopus* from Colorado, observed while catching mosquito larvae on the water surface both in nature and in laboratory. Likewise Williams in his paper on ecology of Hawaian water-loving Diptera indicates (Proc. Hawaian Ent. Soc. 10: 281—315, 1939) adults and larvae of the family Dolichopodidae as important predators of mosquitoes. Travis (Proc. Entomol. Soc. Wash. 49: 20—21, 1947) describes mosquito larvae hunted by the species *Paraclius germanus* Parent in Quam in the South Pacific and Darrow (Amer. J. Hyg. 50: 207—235, 1949) gives a picture of *Thinophilus* species devouring mosquitoe larvae. Collart (Rev. Zool. Afr. 15: (Suppl.) 31—32, 1927) mentions as predator of mosquito larvae *Pelastoneurus collarti* Curran in Congo (Kinshasa). Laing and Welch (Proc. Entol. Soc. Ontario 93: 89—90, 1963) report from Canada the species *Dolichopus gratus* Lw. hunting mosquito larvae in experimental water reservoirs. The last mentioned authors, as well as Bishop and Hart (1931), also give some data on the number of mosquito larvae liquidated by predacious flies in a concrete period of time. Among papers of European authors noteworthy is the study of Smith and Empson (Brit. J. Anim. Behav. 3: 32—34, 1955) in which the authors briefly mention the current species *Poecilobothrus nobilitatus* (L.) in Central Europe and describe the manner in which its adults hunt larvae of *Culex pipiens* L. The same species was reported as predator of mosquito larvae by Brocher (Ann. Biol. lac. 13: 75—76, 1924). There are several records from the southern part of the European USSR by Negrobov (Ref. dokl. IV. Nauch. konf. molodykh uchenykh-biol., Izd. Moskov. Univ., pp. 75—76, 1966) concerning species of the family Dolichopodidae which play a role in checking the increase of mosquito populations. The species mentioned, are also abundant in Central Europe, or they are species closely related to those occurring here. They are primarily species of the genera *Poecilobothrus*, *Hydrophorus*, *Tachytrechus*, *Dolichopus* and *Campsicnemus*. The remaining group of papers, dealing with predators of mosquitoes from the family Dolichopodidae, contain the up-to-date studies of Service (Bull. Wld. Hlth. Org. 45: 169—180, 1971, Proc. Symp. Univ. Alberta, Edmonton, pp. 125—132, 1973a, Bull. Ent. Res. 62: 359—369, 1973b, J. Med. Ent. 10: 503—510, 1973c) who investigated the predators by precipitin test. This author mentions species of the family Dolichopodidae not only as predators of larvae, but also of mosquito imagoes hatching at the moment. To our conditions most important is Service's paper (1973c)