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Teratological deformations of *Hyalomma* Koch, 1844 ticks in taxonomical studies (*Acari*: *Ixodida*: *Ixodidae*)

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Abstract. Various kinds of morphological anomalies were found in *Hyalomma* ticks collected from nature and reared under laboratory conditions. Most frequently local anomalies within taxonomically important features of gnathosoma and idiosoma may complicate or prevent faunistic studies. They are oligomely, atrophy, polymely, heterosymely, symely, schistomely, ectomely, heteromorphose of hypostome, of palps, of chelicerae and basis capituli. Similar teratological changes occur also in legs of *Hyalomma*. Ventral and dorsal shields as well as spiracular plates in adults undergo reduction, fusion or deformation. General anomalies (changes in body shape, asymmetry, nanism, gynandromorphism, duplication) may also cause diagnostic mistakes but their importance for taxonomic work is small. Various anomalies of chaetotaxy and of other morphological features in larvae of the genus *Hyalomma* are also presented.

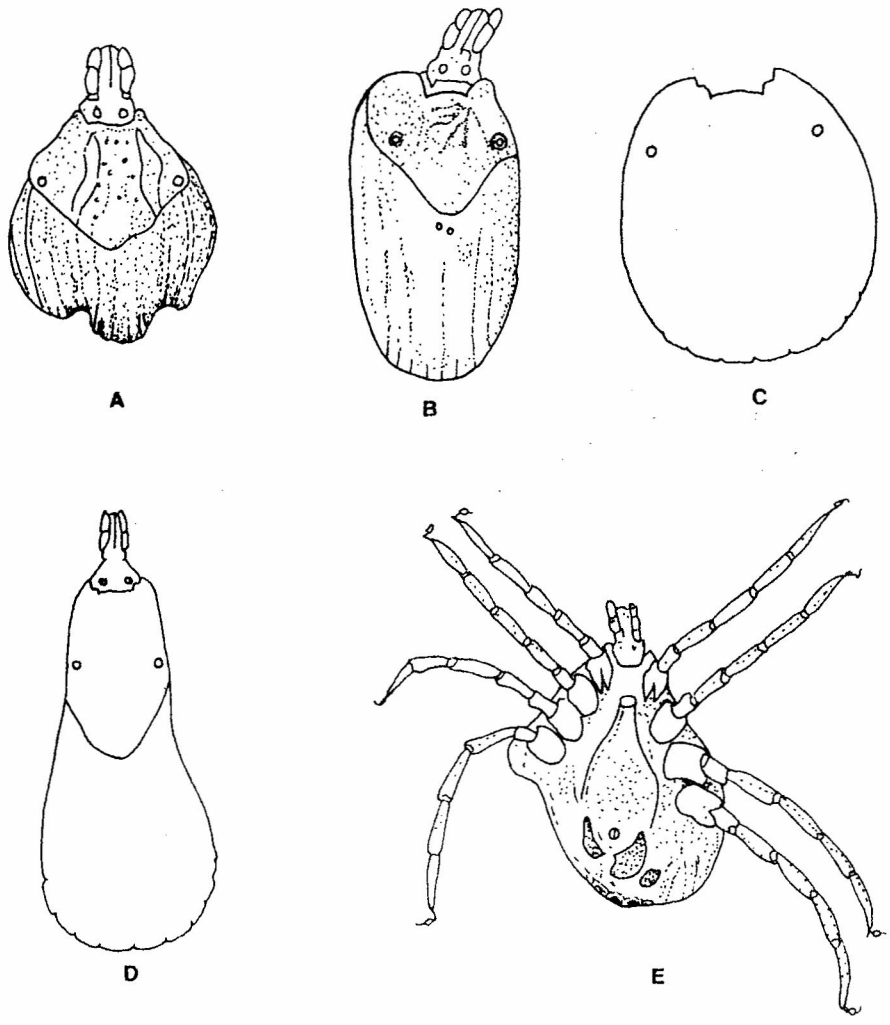
Key words: acarology, taxonomy, morphology, teratology, *Ixodida*.

INTRODUCTION

Morphological anomalies are known in various species of the families *Argasidae* and *Ixodidae*. However, they are most frequent in members of phylogenetically young genera (Buczek 1994), among others in *Hyalomma* Koch, 1844.

The ticks of this genus show poor interspecific differentation and great interpopulation variability of specific features (Hoogstraal 1956). Species identification of different developmental stages of *Hyalomma* is thus particularly troublesome. Still greater diagnostic difficulties may appear when identifying specimens with morphological anomalies within taxonomically important structures.

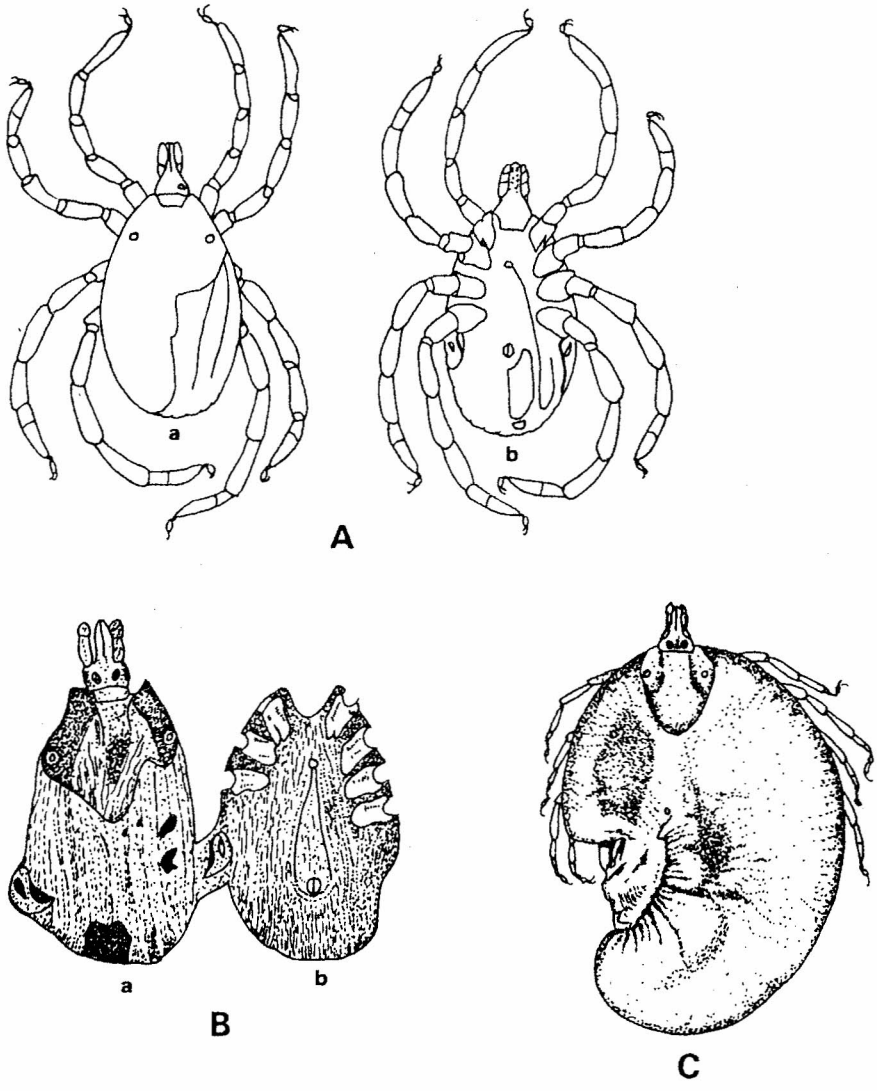
In *Hyalomma,* comprising about 30 species and subspecies widespread in the Palearctic, Oriental and Afrotropical regions, general (changes in body shape, asymmetry, duplication, nanism, gigantism and gynandromorphism) and local anomalies (changes in the shape of gnatosoma, of legs, of chitin structures, of grooves, of festoons) may occur.



1. Deformed body shape and asymmetry. A, B. *Hyalomma anatolicum* females (PERVOMAISKY 1954); C. *Hyalomma marginatum marginatum* male (BUCZEK 1994); D. *Hyalomma m. marginatum* female (BUCZEK 1994); E. *Hyalomma anatolicum* male (PERVOMAISKI 1954)

GENERAL ANOMALIES

Changes in the body shape and asymmetry of body in adults and nymphs of *Hyalomma* were found in specimens collected from nature (NUTTALL 1914, ROBINSON



2. Some forms of gynandromorphism. A. Partially symmetrical gynandromorphism in *Hyalomma m. marginatum*, a- dorsal view, b- ventral view (BUCZEK 1994); B. Mosaic gynandromorphism in *Hyalomma anatolicum anatolicum* (parts of male scutum on female alloscutum), a- dorsal view, b- ventral view (PERVOMAISKY 1950); C. Partially asymmetrical gynandromorphism in *Hyalomma detritum damascenium* (SCHULZE 1936)

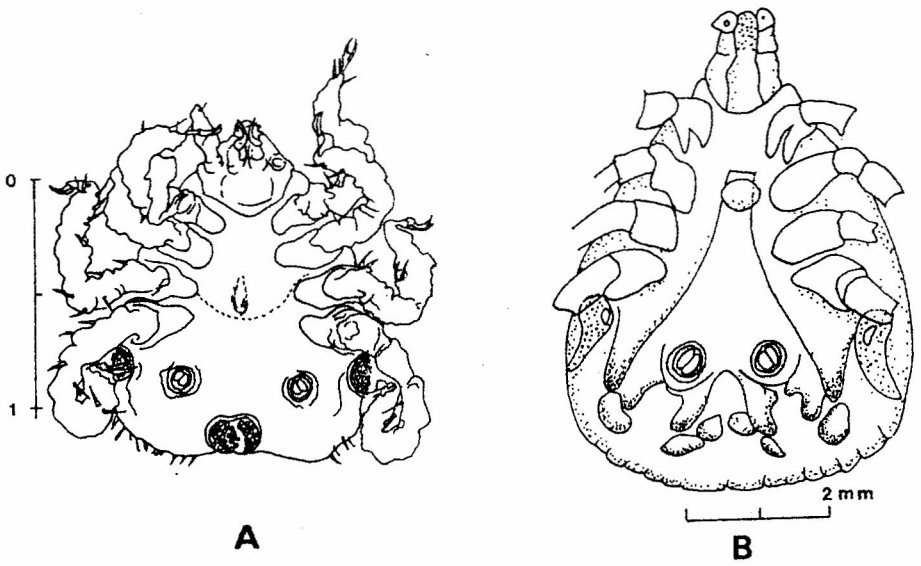
1920, SCHULZE 1933, 1936, DESPORTES 1938, PAVLOVSKY 1940, FELDMAN-MUHSAM 1950) and reared under laboratory conditions (DELPY 1936, FELDMAN-MUHSAM 1950, PERVOMAISKY 1950, 1954, BUCZEK 1994) (fig. 1). Such anomalies usually do not complicate morphological studies. Only in the case of strong deformation of a body part with taxonomically important morphological features or when such an anomaly is combined with local anomalies, the identification may prove impossible.

Idiosoma of *Hyalomma* adults has the following features of diagnostic significance: shape and size of body, shape, proportions and punctations of *scutum*, presence of eyes on *scutum*, position of lateral, posteromedian, paramedian grooves on the dorsal surface, and position of anal groove on the ventral surface, presence of festoons on the posterior margin of body, structure of genital apron in females, shape and position of ventral shields in males (FELDMAN-MUHSAM 1954, HOOGSTRAAL 1956, KAISER & HOOGSTRAAL 1964).

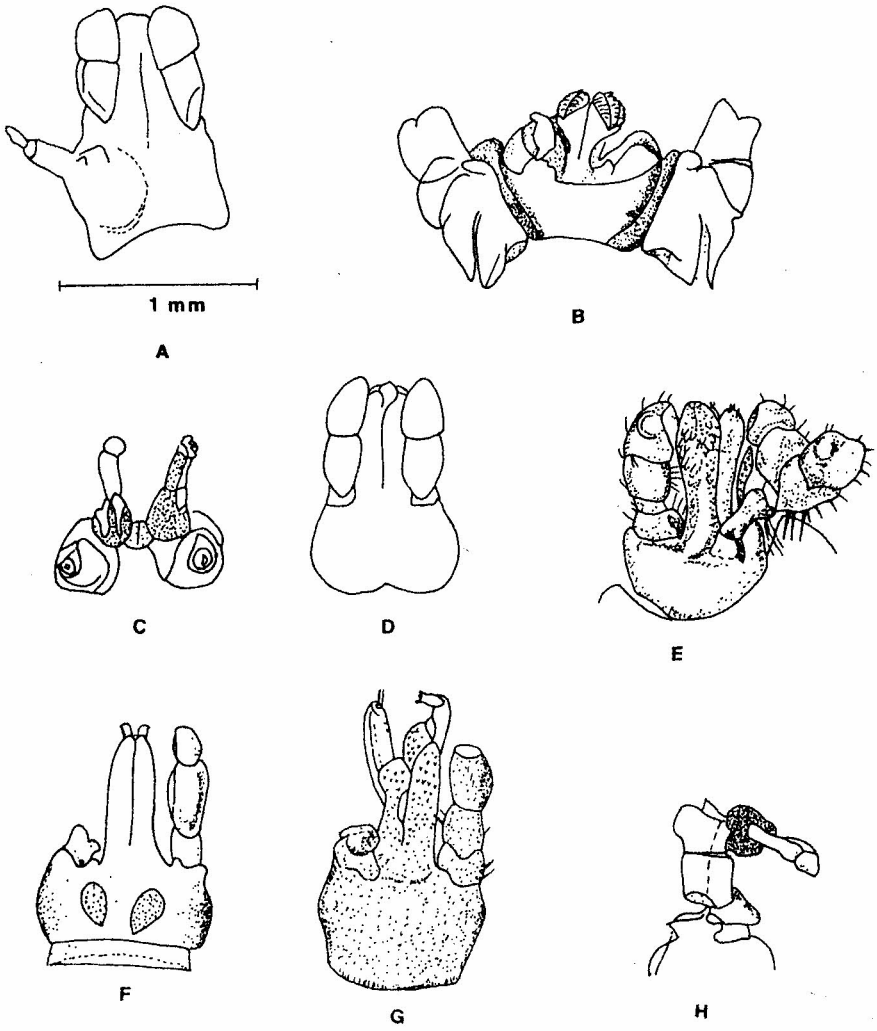
Nanism was observed in various members of *Hyalomma*, e.g. *Hyalomma asiaticum caucasicum*, *Hyalomma asiaticum asiaticum*, *Hyalomma anatolicum* (PERVOMAISKY 1954), *Hyalomma marginatum marginatum* (BUCZEK 1994).

Among various forms of gynandromorphism (fig. 2) (cf. BUCZEK 1993), mixed gynandromorphism and total mosaic gynandromorphism may cause the greatest difficulties in identification.

Double structures may appear in various parts of the body (fig. 3). These teratological changes are of little importance for taxonomy.



3. Duplication of structures. A. Double anus and additional spiracular plate in nymph of *Hyalomma mauritanicum* (DESPORTES 1938); B. Double anus and ventral shields in male of *Hyalomma dromedarii* (CAMPANA-ROUGET 1959)

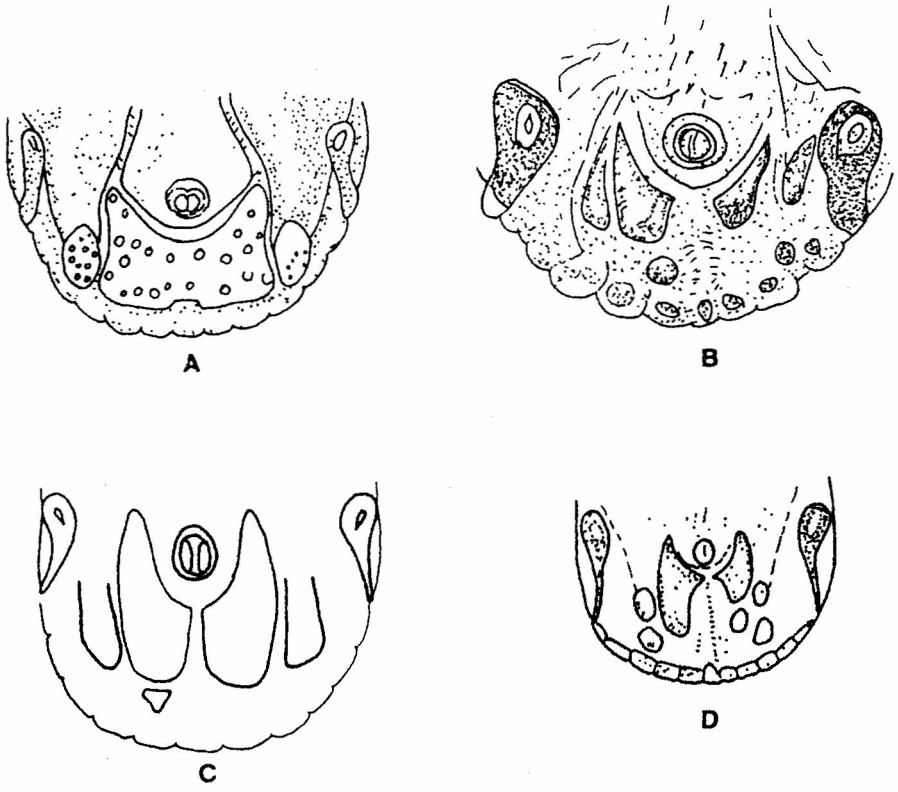


4. Anomalies of gnathosoma. A. additional appendix on basis capituli of *Hyalomma savignyi* (FELDMAN-MUHSAM 1950); B. Deformation of basis capituli, hypostome and palpi in *Hyalomma dromedarii* (DELPY 1936); C. Atrophy of palp and ectopy of chelicerae in *Hyalomma dromedarii* (DELPY 1936); D. Appendix on chelicera envelopes in *Hyalomma m. marginatum* (BUCZEK 1994); E. Multiple schistomely of palp in *Hyalomma dromedarii* (PAVLOVSKY 1940); F. Atrophy of left palp in *Hyalomma anatolicum* (PERVOMAISKY 1954); G. Atrophy of right palp, deformed hypostome and chelicerae in *Hyalomma dromedarii* (PERVOMAISKY 1954); H. Deformation of the third palpal segment in *Hyalomma dromedarii* (DELPY 1936)

LOCAL ANOMALIES

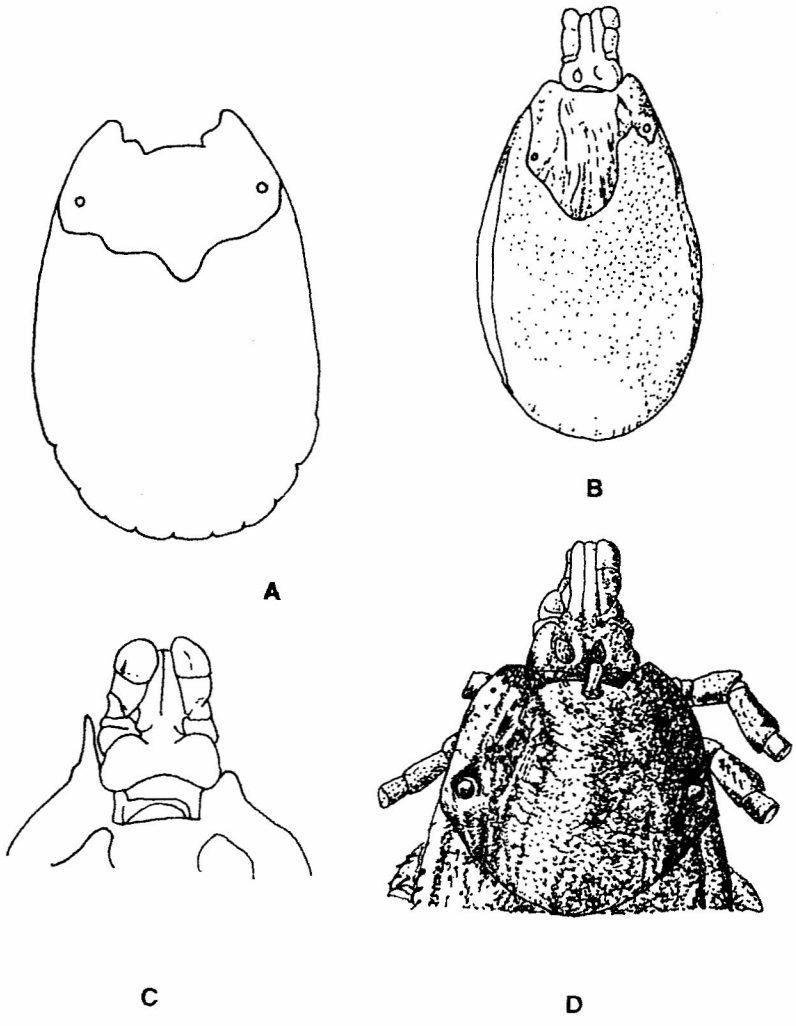
Most identification mistakes result from local anomalies within gnathosoma and idiosoma: polymely (supernumerary structures), atrophy (reduction of appendage lengths), oligomely (complete absence of appendages), heterosymely (fusion of appendages on the same side of idiosoma), symely (fusion of appendages on opposite sides of idiosoma), schistomely (bifurcation of appendages), ectomely (changes in position of leg insertion), heteromorphy (deformations of leg segments), disturbances in joint and leg segment structure, cyclopy (reduction of eyes number).

The shape of basis capituli and the hypostome, the number of rows and files of hypostomal teeth, the shape of palpi, the structure of chelicerae, the shape of area porosae are the characters of gnathosoma normally used to distinguish species of *Hyalomma*.



5. Anomalies of ventral shields in males. A. Fusion of shields in *Hyalomma kumari* (SHARIF 1930); B. Asymmetry in *Hyalomma sp.* (SHARIF 1930). C. Lack of left subanal shield in *Hyalomma m. marginatum* (BUCZEK 1994); D. Change in shape and number of shields in *Hyalomma dromedarii* (PERVOMAISKY 1954)

Various kinds of anomalies may appear in gnathosoma (fig. 4). For example, atrophy of hypostome was observed in *Hyalomma anatolicum* (PERVOMAISKY 1954) and *Hyalomma dromedarii* (DELPY 1936), double hypostome in *Hyalomma dromedarii* (PAVLOVSKY 1940), asymmetry of hypostome in *Hyalomma savignyi* (= *Hyalomma*



6. Anomalies of scutum in females. A. Changed shape of posterior margin in *Hyalomma m. marginatum* BUCZEK 1994); B. Changed form in *Hyalomma anatolicum* (PERVOMAISKY 1954); C. Abnormal size of left scapula in *Hyalomma asiaticum* (DELPY 1936); D. Additional appendix on scutum in *Hyalomma dromedarii* (ALFEEV 1948)

marginatum) (PAVLOVSKY 1940), polymely in *Hyalomma savignyi* (FELDMAN-MUHSAM 1950) and *Hyalomma anatolicum* (PERVOMAISKY 1954). Deformed palpi and their appendices were described in *Hyalomma m. marginatum* (BUCZEK 1994) and *Hyalomma anatolicum* (PERVOMAISKY 1954). Partially divided palpi occurred in *Hyalomma dromedarii* (PAVLOVSKY 1940).

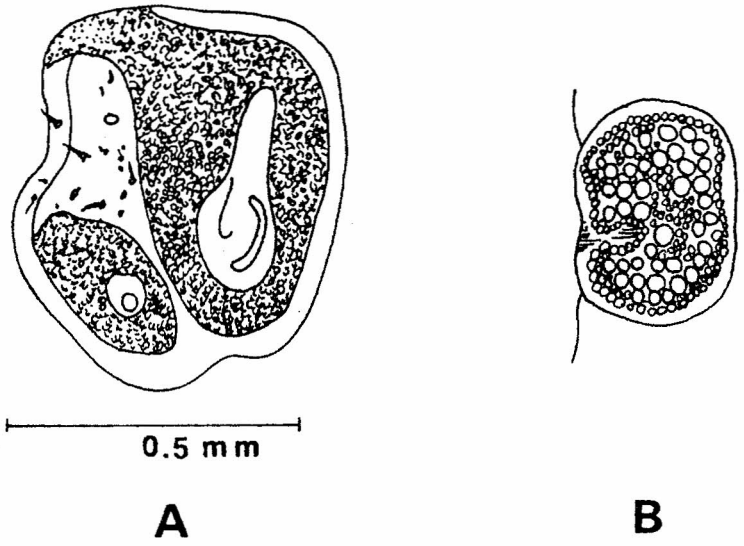
Chelicerae may undergo similar teratological changes (DELPY 1936, PERVOMAISKY 1954). Some anomalies may develop simultaneously in gnathosoma (DELPY 1936, SCHULZE 1950, PERVOMAISKY 1954). In some specimens of *Hyalomma*, e.g. in *Hyalomma detritum* (PAVLOVSKY 1940), the whole gnathosoma may be absent.

Area porosa located on the dorsal side of the basis capituli of female *Ixodidae* has a species-specific shape and structure. It may undergo deformations and quantitative changes (DELPY 1936, FELDMAN-MUHSAM 1950).

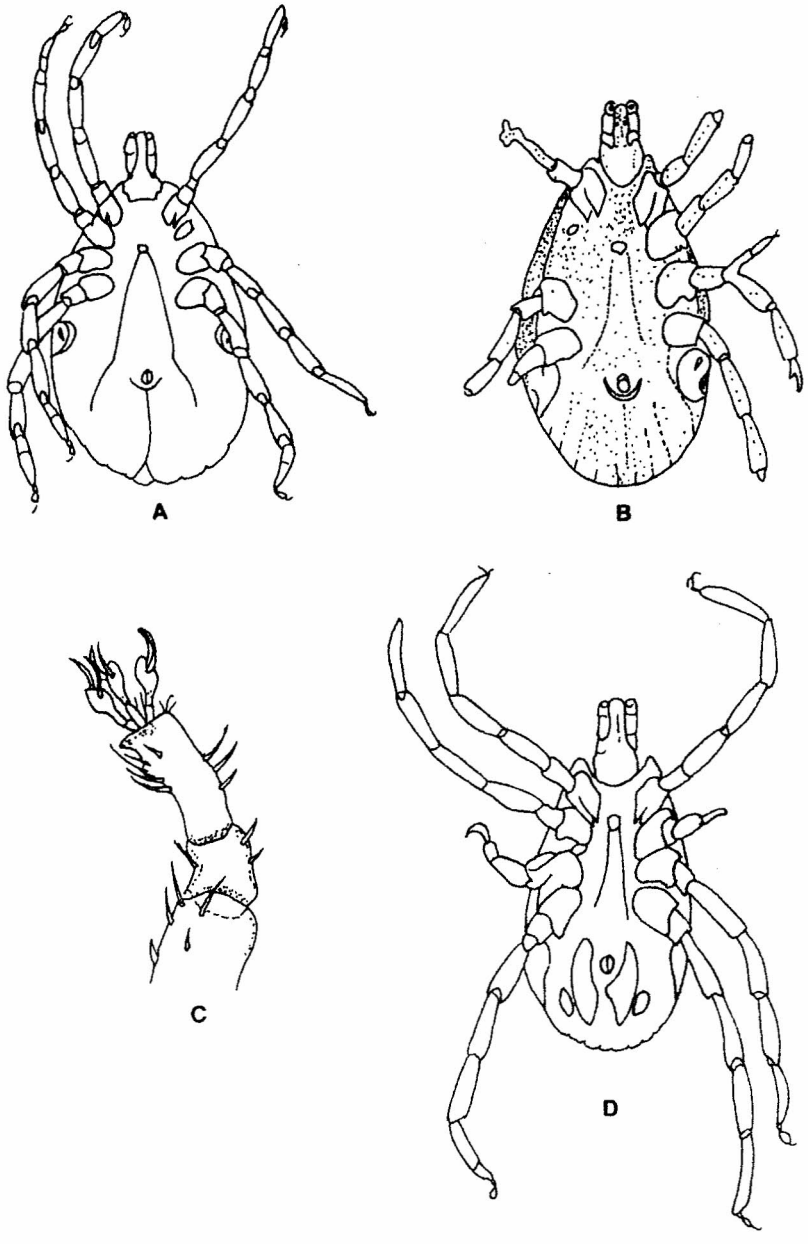
The shape, size and proportions of the chitin structures are valuable classification criteria at the specific, generic and family levels. Therefore, the changes within these ventral and dorsal shields are anomalies of particular importance.

Males of *Hyalomma* have 3-4 pairs of ventral shields: 1 pair of anal shields, 1 pair of accessory shields and 1-2 pairs of subanal shields. Ventral shields may be deformed, fused or reduced (SENEVET 1922, SHARIF 1930, DELPY & GOUCHEY 1937, PERVOMAISKY 1954, STARKOFF 1956, BUCZEK 1994). They may be also arranged asymmetrically (WARBURTON & NUTTALL 1909, ROBINSON 1920, FELDMAN-MUHSAM 1950, BUCZEK 1994) (fig. 5).

Dorsal *scutum* of *Hyalomma* bears such characters as the shape of posterior margin of *scutum*, the shape and size of scapulae, punctation of *scutum*, the presence and morphology of eyes.



7. Anomalies of spiracular plates. A. Double plate in *Hyalomma savignyi* (FELDMAN-MUHSAM 1950); B. Deformed plate in *Hyalomma mauritanicum* (DESPORTES 1938)



8. Some kinds of leg anomalies. A. Atrophy of left leg II in *Hyalomma m. marginatum* (BUCZEK 1994); B. Oligomely of right legs II and III in *Hyalomma anatolicum* (PERVOMAISKY 1954); C. Polymely of pulvillus in *Hyalomma sp.* (SHARIF 1930); D. Atrophy of left leg II and right leg III in *Hyalomma anatolicum* (PERVOMAISKY 1954)

9. *Hyalomma m. marginatum* larva. Oligomely of left palp, atrophy of chelicerae, of hypostome and deformation of basis capituli (SEM, 500X) (Buczek, 1994). 10. Gnathosoma: atrophy of chelicerae, additional segments on the left palp; idiosoma: oligomely of left legs II and III, deformation of segments in right leg I (SEM, 250X) (Buczek 1994)

Abnormal formation of dorsal plates was noted in various *Hyalomma* species (fig. 6) (NEUMANN 1899, DELPY 1936, ALFEEV 1948, PERVOMAISKY 1954, BUCZEK 1994).

Morphological anomalies, such as changes in the shape and number, fusion, reduction, absence, appear also within spiracular plates (fig. 7) (ROBINSON 1920, SHARIF 1930, DELPY 1936, FELDMAN-MUHSAM 1950, PERVOMAISKY 1954).

Among various anomalies of legs (fig. 8), deformations of coxae, trochanter and tarsus I are the most important for systematic studies. The shape and size of the spurs on coxae and trochanters, the shape of tarsus I are generic and specific characters of ticks.

Anomalies complicating morphological analysis were found in larvae of *Hyalomma marginatum marginatum* (figs. 9,10) (BUCZEK 1991, 1992, 1994). Chaetotactic features as well as other morphological features (shape of palpi, number of palpal segments, shape of hypostome and basis capituli, structure of coxae and of tarsus I, number of festoons) of diagnostic value were altered in these specimens.

The arrangement of setae on the body, their position relative to other setae and to certain body structures, the number of setae on certain body structures and the nature of these setae are very important diagnostic characters of ixodid larvae. The number of setae on the dorsal surface of tarsus I and their arrangement are also used in taxonomy (GLASHINSKAYA-BABENKO 1949, CLIFFORD & ANASTOS 1960).

In recent years an increasing frequency of tick anomalies has been observed, which may be caused by the increase of environment pollution. Thus, there is a need for studies on tick teratology and on morphology of deformed specimens. The knowledge of different cases of anomalies may limit the number of mistakes, when identifying ticks collected in nature.

I dedicate this review to the memory of Dear Master Professor Jan RAFALSKI who was very much interested in morphological anomalies in animals.

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