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INTRAURBAN NEAR-WATER AREAS AND THEIR ROLE IN DISTRIBUTION OF TICKS (ACARI, IXODIDAE) IN MEGAPOLIS THE EXAMPLE OF KYIV

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Intraurban Near-Water Areas and Their Role in Distribution of Ticks (Acari, Ixodidae) in Megapolis the Example of Kyiv. Nebogatkin I. V. — In 2002–2009, we studied 12 islands within the city of Kyiv, and found four indigenous species of ticks (*Dermacentor reticulatus* Fabricius, 1794; *Ixodes ricinus* Linnaeus, 1758; *I. apronophorus* Schulze, 1924; *Rhipicephalus rossicus* Jakimov et Kohl-Jakimova, 1911) and one invasive species (*Hyalomma marginatum* Koch, 1844). For A–E-gradient, established by man's impact degree, we revealed atypical distribution of species: their majority is noted in two pole areas — where the man impact is maximum and minimum. The investigated near-water areas are a kind of survival areas and sources of ixodides diversity in megalopolis.

Key words: ticks, islands, Kyiv.

Внутригородские участки околводных территорий и их роль в распространении иксодовых клещей (Acari, Ixodidae) в мегаполисе на примере Киева. Небогаткин И. В. — Исследовано 12 островов, расположенных в черте г. Киева в 2002–2009 гг., где обнаружено четыре коренных вида иксодовых клещей (*Dermacentor reticulatus* Fabricius, 1794; *Ixodes ricinus* Linnaeus, 1758; *I. apronophorus* Schulze, 1924; *Rhipicephalus rossicus* Jakimov et Kohl-Jakimova, 1911) и один — заносной (*Hyalomma marginatum* Koch, 1844). Выявлено нетипичное для А–Е-градиента, выделенного по степени антропогенизации, распределение видов: наибольшее количество отмечено в 2 полюсных зонах — на максимально и минимально подверженных антропогенному влиянию. Исследованные околводные территории служат своеобразными зонами переживания неблагоприятных факторов и источниками, пополняющими иксодидами видовое разнообразие мегаполиса.

Ключевые слова: иксодовые клещи, острова, Киев.

Studying ticks in Kyiv urban environment (Akimov, Nebogatkin, 1999; Akimov, Nebogatkin, 2002) is impossible without investigating of intraurban near-water areas: islands, shores of lakes and rivers, and beaches. The area of inland water bodies (rivers and streams, lakes, ponds, abandoned sandpits and technical sedimentation basins) in Kyiv is 6.7 ha, i. e. approximately 8 % of entire city area. Even in the heart of modern Kyiv there are 10 large and many small islands (about 3, 000 ha) formed by arms of the Dnipro and Desna rivers. Some of these islands (Murom, Trukhanov, Dolobetsky, Venice) are turned into recreation areas, some others are almost undeveloped (Lopuhovaty, Olgin, Dykiy), in Zhukov island some natural vegetation is kept, also there are greatly developed areas (Galerniy) and fully man-made — Rusanovsky. The whole near-water area consists of intrazonal parts with different degree of man's impact, in great majority covered with different plants and is the recreation zones for Kyiv citizens and guests. The latter circumstance provides fairly good conditions for living of ticks: moisture, vegetation, feeders for larval stages (small mammals, etc.). The aim of this work is identification patterns of ticks' distribution and their biological characteristics in near-water areas in megalopolis — the city of Kyiv.

Material and methods

This work was performed in 2002–2009 in Kyiv. There were 478 site visits, examined coasts of 24 lakes and 12 islands, and 15 beaches. During collections on flag, collector, tamponing burrows, examination of

Table 1. The distribution of islands by the degree of man's impact
Таблица 1. Распределение островов по степени антропогенизации

Islands	Score	Number of ticks collected	Number of site visits	Number of species
Rusanovskiy	1	60	23	3
Veneysianskiy		119	53	
Trukhanov	2	215	61	2
Dolobetskiy	3	32	16	2
Muromets		58	11	
Zhukov	4	49	10	2
Bezymyanniy 1	5	25	3	4*
Bezymyanniy 2		87	7	
Bezymyanniy 3		14	4	
Lopukhovatiy		184	11	
Kozachiy		111	10	
Olgin		133	8	
Totally	1087	217	5	

* Including larval stage of *R. rossicus* found on yellow-necked mouse (*Sylvemus flavicolis* Melchior) caught on Kozachiy island.

nests' substrates, and combing about 157 carcasses of small mammals, we examined about 1, 087 specimens of ticks from five species: *Dermacentor reticulatus* Fabr., *Ixodes ricinus* L., *I. apronophorus* Sch. and *Hyalomma marginatum* Koch., *Rhipicephalus rossicus* Jak. et K-Jak. Ticks obtained during examination of cattle, sheep, dogs and cats were not considered.

All investigated islands were scored by the degree of man's impact as follows: 1 point — recreation area, developed beaches with cover of infrastructure for recreation industry about 75 % of the area; 2 points — recreation area, developed beaches with cover of infrastructure for recreation industry for more than 50 % of the area; 3 points — recreation area, developed beaches with cover of infrastructure for recreation industry for more than 25 % of the area; 4 points — area is used for the rest with cooking, post-industrial sites; 5 points — area is used for fishing and semiorganized recreation (table 1). In such a way we defined A–E-gradient, i. e. gradient of transition from a forest through perennial grassland community to rocky landscape (Klausnitzer, 1980). When analyzing material, we used the following quantitative measures: index of abundance (IA), and infection index (II) (Tularemia, 1954), index of dominance — proportion (%) of abundance of species studied to the total abundance of all species compared (Klausnitzer, 1980).

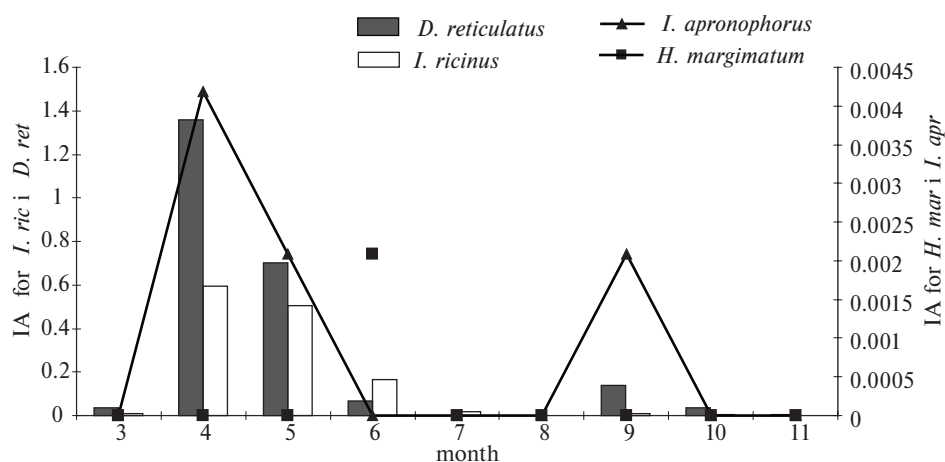


Fig. 1. Annual activity (by months) of *D. reticulatus* and *I. ricinus* on the left axis, and *I. apronophorus* and *H. marginatum* of the right axis, in 2002–2009.

Рис. 1. Среднегодовая активность по месяцам *D. reticulatus* и *I. ricinus* на левой оси и *I. apronophorus* и *H. marginatum* на правой оси в 2002–2009 гг.

Results and discussion

Our investigations have resulted in average annual graphs of ixodides activity by months on islands represented at biaxial graph (fig. 1).

According to figure 1, natural activity was noted in three species — *D. reticulatus*, *I. ricinus*, *I. apronophorus*, and *H. marginatum* which is definitely invasive. The peak of activity detected in April was unusual and required further analysis. Figures 2 and 3 show the largest contribution to inter-annual seasonal activity in April of data obtained for *D. reticulatus* in 2003, and *I. ricinus* in 2004. In 2005 and 2006 IO decreased, and rose again by the end of the decade.

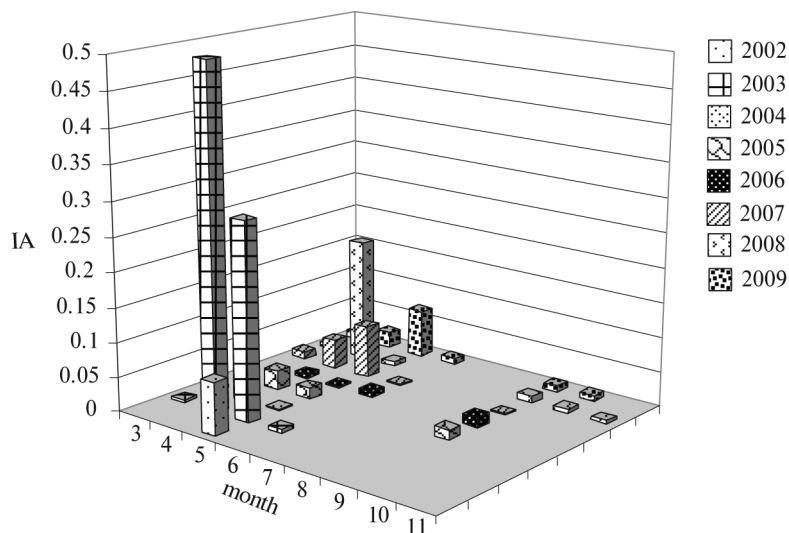


Fig. 2. Seasonal activity of *D. reticulatus* in 2002–2009.

Рис. 2. Сезонная активность *D. reticulatus* в 2002–2009 гг.

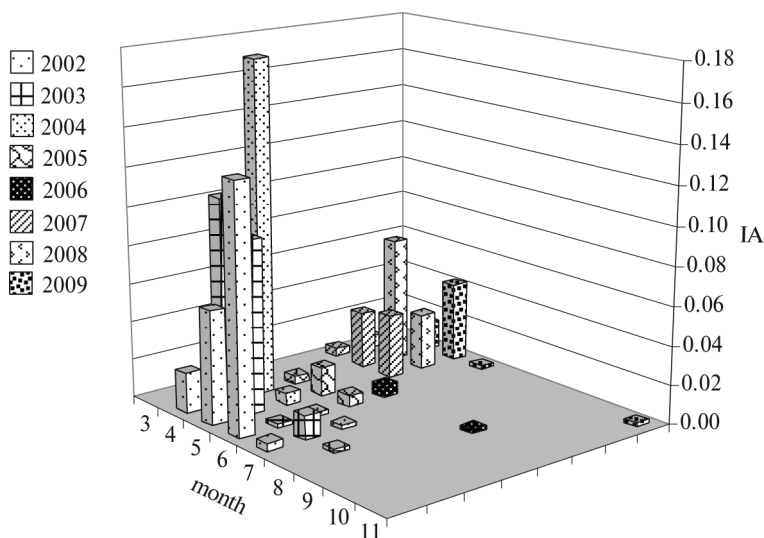


Fig 3. Seasonal activity of *I. ricinus* in 2002–2009.

Рис 3. Сезонная активность *I. ricinus* в 2002–2009 гг.

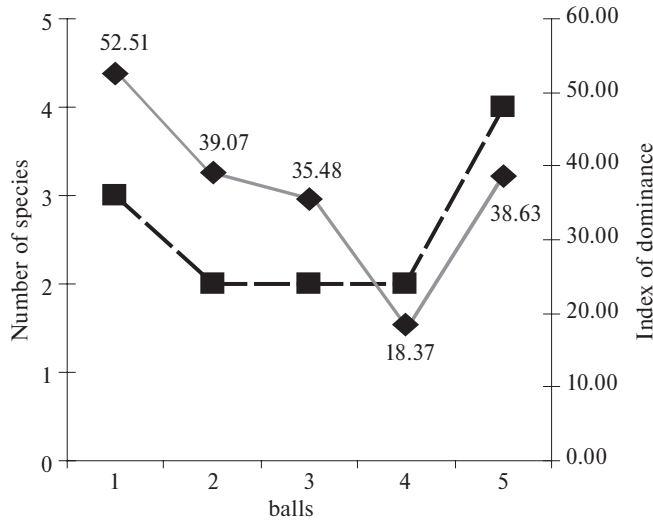


Fig. 4. The number of species and values of dominance index on islands within the city of Kyiv (distribution by the degree of man’s impact).

Рис. 4. Количество видов и значения индексов доминирования (представлено значениями) на островах г. Киева (распределение по степени антропогенизации).

When analyzing the ticks’ distribution and their affinity to Kyiv islands, in five selected areas (by points) we revealed atypical for this gradient distribution of species: their majority is noted in two pole areas — where man impact is maximum and minimum (fig. 4). This may be due to the findings of invasive species *H. marginatum* in the man-made island Rusanivskiy that immediately changed the number of species in area with maximum anthropogenic environmental changes.

The values of dominance index are similarly increased on islands with maximum anthropogenic impact, reduced in proportion to the size of affected sites, and increased again on islands with minimum man’s impact. Such changes in index are due to increased

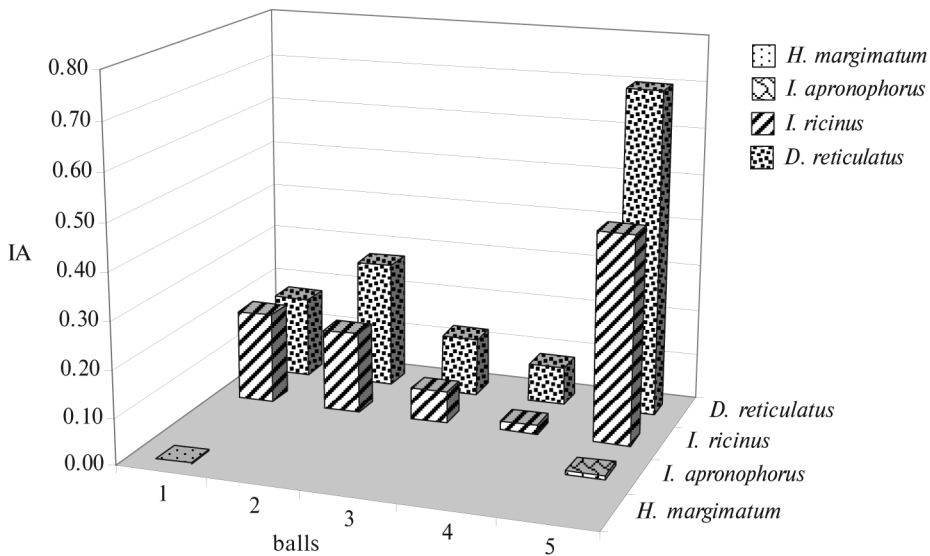


Fig 5. Values of index of abundance for ixodides in different areas on islands within the city of Kyiv (distribution by the degree of man’s impact).

Рис 5. Показатели численности индекса обилия иксодид в разных зонах на островах г. Киева (распределение по степени антропогенизации).

Table 2. Values of indexes of infestation for sexually immature phase of tick development on small mammals examined on Cossack Island

Таблица 2. Индексы зараженности неполовозрелых фаз развития на осмотренных мелких млекопитающих, отловленных на Казачьем острове

Species	Mammals totally	<i>Mus musculus</i>	<i>Sylvaemus flavicollis</i>	<i>Sylvimus sylvaticus</i>	<i>Apodemus agrarius</i>	<i>Microtus arvalis</i>	<i>Pitymys subterraneus</i>	<i>Crocidura suaveolens</i>	<i>Sorex araneus</i>	<i>Sorex minutus</i>
Combed mammals	45	2	7	3	2	11	3	3	8	6
Of them, with ticks	17	0	7	1		3	1	1	2	2
Infection index	38	0	100	33	0	27	33	33	25	33
<i>I. ricinus</i>	0.58		0.38	0.04		0.07	0.02	0.02	0.02	0.02
<i>D. reticulatus</i>	0.24		0.13			0.04			0.04	0.02
<i>R. rossicus</i>	0.04		0.04							

proportion of eudominant — *I. ricinus* on islands with maximum anthropogenic impact, whereas natural islands may be generally considered as ticks' reservoirs in the city.

Such patterns were confirmed with other (IA) data for ticks in different zones (fig. 5). The highest IA values were found on islands with minimum anthropogenic impact, and the lowest ones were in transition zones.

Records of tick numbers on small mammals in the areas studied as rests of the natural city areas were held in November, 2009. When collected on a flag in autumn 2009, *I. ricinus* was not found, but in combing mammals it was dominant, twice (!) exceeding the number of *D. reticulatus* (table 2). This table shows that the highest IA of ixodides larval stages was on mice from the genus *Sylvaemus* — 100 (!).

When combing yellow-necked mouse in November, 2009, larval ticks from the genus *Rhipicephalus* Koch were found, and identified as *R. rossicus* — the first record of ticks from this genus on the islands, and on the Cossack Island ticks from three ixodide species were proved to live.

Thus, explorations of Kyiv intra-coastal areas for presence of ticks there show that such areas can play significant role in general situation with ixodide ticks in the city. The degree of anthropogenic transformation of individual objects — islands or other wetland areas — affects to some extent the ixodides diversity, number and dominance of individual species. Nevertheless, the most favourable recreation areas in coastal zones are as hazardous for tick attacks as semi-wild or wild areas used for fishing only. At the same time, in many areas comes into play absolutely strange for urban environment pyrogenic factor — mass burning of grass on large areas led to destruction and impoverishment in flora and fauna, increased plant height improving conditions for active tick attacks to feeders of different size.

In general, we may note that in developed recreational near-water areas with relatively high ixodides abundance (3 species with invasive *H. marginatum*) the dominant *I. ricinus* is the most likely attacking species being the most hazardous for humans. In other, less anthropogenically transformed wetland areas, the dominance of one species is not so pronounced.

The investigated near-water areas are not only survival zones for ticks, but also sources for enriching diversity of studied bloodsucker species in megalopolis.

Conclusions

1. In 2002–2009, we studied 12 islands within the city of Kyiv where discovered four indigenous ticks species (*D. reticulatus*, *I. ricinus*, *I. apronophorus*, *R. rossicus*), and one invasive species (*H. marginatum*).

2. For A–E-gradient, established by man's impact degree, we revealed atypical distribution of species: their majority is noted in two pole areas — where man impact is maximum and minimum.

3. In developed recreational near-water areas, *I. ricinus* is the most likely attacking species being the most hazardous for humans.

4. The investigated near-water areas are not only survival zones for ticks, but also sources for enriching diversity of studied bloodsucker species in megalopolis.

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