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The Persian tick, *Argas persicus* (Ixodida: Argasidae) in Kalmykia (Russia)

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The world fauna of ticks from the family Argasidae Koch, 1844 includes 193 species, with current disputes concerning the total number of genera in this family and no final consensus on the assigned genera of about 133 species (Horak *et al.* 2002; Guglielmone *et al.* 2010). The tick genus *Argas* Latreille, 1796 is found in areas with temperate and warm climates, with only some species living on sites that sporadically reach 50 °C in the forest-steppe zone from the northern hemisphere (Filippova 1966; Swai *et al.* 2007).

The epidemiological significance of ticks of the genus *Argas* has been known since 1897, as this genus includes at least 61 species of ticks parasitizing birds and bats (Filippova 1966) and is capable of hosting and transmitting several bacterial diseases such as salmonellosis and aegyptianellosis (Bedford and Coles 1933; Oyoun and Abdel-Shafy 2007; Hosseini-Chegeni *et al.* 2020; Duan *et al.* 2022). Pathogenicity associated with bacterial infections by the genus *Aegyptianella* Carpano, 1929 has been found mainly in poultry such as turkeys, domestic ducks and chickens. Clinical signs often include anorexia, diarrhea, and paralysis. Pathological changes of a similar etiology have been found in some wild birds, such as Falconiformes Sharpe, 1874 that have been in contact with the Persian tick *Argas persicus* (Oken, 1818) in their wild habitats (Tarello 2006). The widespread Persian tick (*A. persicus*) parasitizes chickens and other poultry, feeding on blood at night and hiding in the cracks of buildings during the day. In Mosul (Iraq), the Persian tick accounted for 6.8% of the total number of ectoparasites collected from chickens (Al-Saffar and Al-Mawla 2008). High loads of *A. persicus* often leads to poultry death, both from a large blood loss and from infectious diseases transmitted by the ticks. *Argas persicus* is a vector for spirochetosis, rickettsiae, some other bacteria and hemoparasites in wild birds and poultry (Hosseini-Chegeni *et*

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al. 2017; Duan *et al.* 2022). Sometimes *A. persicus* even attacks humans, causing painful bites and being able to live in people's houses (Filippova 1966).

The Persian tick has a potential to increase its original wide distribution even more due to current global changes in temperature, given that its optimal development temperature is 28–30 °C at 65–70% RH, with a lower temperature limit of 20 °C. Early in its life cycle, the larva feeds on blood for 3–10 days, with subsequent second and third nymphal stages feeding for shorter periods and adult females being able to lay eggs without feeding (Filippova 1966). Therefore, it represents a considerable epidemiological threat to poultry and wild bird populations, making it necessary to constantly monitor the number, distribution and parasitic activity of *A. persicus* and other species of this tick genus. Here, we present a summary of monitoring of *A. persicus* ticks collected from several bird species during four years in the Republic of Kalmykia, Russia.

Ticks were collected from private farms in the Priyutnoye village, Priyutnensky district of the Republic of Kalmykia (Russia) from 2012 to 2016 as part of a continuous project monitoring bird ectoparasites (Tables 1, 2).

Table 1. Number of the examined birds per species in each sampled year.

Bird species	**2012**	**2013**	**2015**	**2016**	**Total**
Pelecanus crispus Bruch, 1832	-	-	28	-	28
Larus cachinnans Pallas, 1811	-	-	-	528	528
Upupa epops L., 1758	1	-	-	-	1
Hirundo rustica L., 1758	1	-	-	-	1
Lanius minor Gmelin, 1788	2	-	-	-	2
Lanius collurio L., 1758	1	-	-	-	1
Panurus biarmicus (L., 1758)	-	-	57	-	57
Sturnus roseus (L., 1758)	46	-	73	-	119
Sylvia borin (Boddaert, 1783)	5	-	-	-	5
Sylvia communis Latham, 1787	3	-	-	-	3
Phylloscopus trochilus (L., 1758)	17	-	-	-	17
Phylloscopus collybita (Vieillot, 1817)	4	-	-	-	4
Acrocephalus arundinaceus (L., 1758)	-	-	-	17	17
Acrocephalus scirpaceus (Herman, 1804)	-	-	-	25	25
Acrocephalus palustris (Bechstein, 1798)	-	-	-	1	1
Acrocephalus schoenobaenus (L., 1758)	-	-	-	3	3
Acrocephalus agricola (Jerdon, 1845)	-	-	-	8	8
Lusciniola melanopogon (Temminck, 1823)	-	-	3	-	3
Locustella luscinioides (Savi, 1824)	-	-	-	5	5
Cettia cetti (Temminck, 1823)	-	-	-	3	3
Erithacus rubecula (L.,1758)	-	-	-	1	1
Phoenicurus phoenicurus (L., 1758)	15	-	-	-	15
Oenanthe oenanthe (L., 1758)	4	-	-	-	4
Turdus philomelos Brehm, 1831	1	-	-	-	1
Passer domesticus (L., 1758)	223	-	22	-	245
Fringilla coelaebs (L., 1758)	1	-	-	-	1
Emberiza schoeniclus (L., 1758)	-	-	-	2	2
Gallus domesticus (L., 1758)	2	1	1	2	6
Meleagris gallopavo (L., 1758)	1	-	-	1	2
Gallus domesticus (L., 1758) (juvenile)	-	-	-	4	4

Table 2. Abundance of collected mites per bird species sampled on each year.

Bird species	2012	2013	2015	2016
Pelecanus crispus Bruch, 1832	-	-	-	-
Larus cachinnans Pallas, 1811	-	-	-	-
Upupa epops L., 1758	5	-	-	-
Hirundo rustica L., 1758	-	-	-	-
Lanius minor Gmelin, 1788	-	-	-	-
Lanius collurio L., 1758	-	-	-	-
Panurus biarmicus (L., 1758)	-	-	-	-
Sturnus roseus (L., 1758)	257	471	-	-
Sylvia borin (Boddaert, 1783)	-	-	-	-
Sylvia communis Latham, 1787	-	-	-	-
Phylloscopus trochilus (L., 1758)	-	-	-	-
Phylloscopus collybita (Vieillot, 1817)	-	-	-	-
Acrocephalus arundinaceus (L., 1758)	-	-	-	-
Acrocephalus scirpaceus (Herman, 1804)	-	-	-	-
Acrocephalus palustris (Bechstein, 1798)	-	-	-	-
Acrocephalus schoenobaenus (L., 1758)	-	-	-	-
Acrocephalus agricola (Jerdon, 1845)	-	-	-	-
Lusciniola melanopogon (Temminck, 1823)	-	-	-	-
Locustella luscinioides (Savi, 1824)	-	-	-	-
Cettia cetti (Temminck, 1823)	-	-	-	-
Erithacus rubecula (L.,1758)	-	-	-	-
Phoenicurus phoenicurus (L., 1758)	-	-	-	-
Oenanthe oenanthe (L., 1758)	-	11	-	-
Turdus philomelos Brehm, 1831	-	-	-	-
Passer domesticus (L., 1758)	1132	87	-	-
Fringilla coelaebs (L., 1758)	-	-	-	-
Emberiza schoeniclus (L., 1758)	-	-	-	-
Gallus domesticus (L., 1758)	131	58	31	70
Meleagris gallopavo (L., 1758)	-	-	-	
Gallus domesticus (L., 1758) (juvenile)	-	-	-	1249

For four years, chicken coops and utility rooms were examined for the presence of ticks. In 2014, we surveyed newly hatched chicks after four individuals died on their fourth day of age without our intervention. Their corpses were placed in individual containers and the larvae emerging from them were collected. In March 2016, the tick inventory was performed before the regular acaricide treatment on these farms to register the regular abundance of ticks.

In 2012–2016 years, ticks were also collected from wild birds captured using mist nets (14 mm mesh size) placed next to the farms. Some wild birds were captured inside rookeries. Captured birds were placed in cloth bags, put on a bolognese collar and placed in a container with ethyl acetate for 10–20 minutes depending on the bird size, with bigger birds spending longer times. The material that had fallen from the birds, including louse flies, fleas and ticks, was fixed in 96% alcohol.

We sampled 1242 individual birds belonging to two domestic and 27 wild species (Table 1). We found 290 adult ticks on domestic birds and 1963 adult ticks on wild birds. For immature ticks, we found a total of 1249 ticks of the first instars on four young chickens (counts per individual: 317, 278, 411, 243) but did not survey for immature ticks on wild birds (Table 2). We collected a total of 2759 ticks of different age stages in seven buildings including chicken coops and sheds during the four reported years (counts per year: 2012–380 ticks, 2014–935 ticks, 2015–871 ticks, and 2016–573 ticks).

Our results show that despite the regular acaricide treatment of farms, tick presence was extremely high except for small sporadic reductions. We recorded high loads of tick larvae on chickens, which likely attached to them from the farm soil and ground. Among wild bird species, the highest tick load was found on the synanthropic species *Sturnus roseus*; and *Passer domesticus* L., 1758, which may act as tick reservoirs and vectors between wild bird populations and human buildings.

According to Filippova (1966) there are eight species of *Argas* ticks on the territory of the USSR: *A. reflexus* (Fabricius, 1794); *A. macrostigmatus* Filippova, 1961; *A. vulgaris* Filippova, 1961; *A. latus* Filippova, 1961; *A. tridentatus* Filippova, 1961; *A. persicus*, *A. beklemishevi* Pospelova-Shtorm, Vasilyeva & Semashko, 1963; *A. vespertilionis* (Latreille, 1796), with seven of them feeding on birds and one species feeding on bats. Specifically, the Persian tick *A. persicus* is known to host salmonellosis pathogens such as *Salmonella gallinarum* and *S. typhimurium* for a long time (Floyd and Hoogstral 1956; Glukhov and Novikov 1974; Chirov 1979). Further research should test for bacterial infections associated with the presence of *A. persicus* in poultry buildings and nearby wild bird populations.

The economic importance of tick infestation is extremely relevant, particularly for tick species such as *A. persicus* which can host important microbial pathogens. Regions where farming is an important economic activity such as Kalmykia can be heavily impacted by disease outbursts. Our results show that domestic and wild birds can host high numbers of ticks and their close proximity increases the probability of exchanging ticks. We found that various birds from non-migratory species (*Passer domesticus*; *Streptopelia decaocto* (Frivaldszky, 1838); *Columba livia* L., 1758), long-distance migration species (*Upupa epops*; *Hirundo rustica*; *Lanius minor*; *Oenanthe oenanthe*) and nomadic species (*Sturnus roseus*) actively nest on farms. All of them come to contact with poultry during their nesting season and likely exchange ticks with them, as we confirmed that ticks heavily colonize wall crevices on buildings. High densities of domestic birds in farms can facilitate local disease spread via ticks as disease vectors, and in turn ticks can travel via wild birds to wider regions during avian natural movement patterns such as migration. It is crucial to continue with regular monitoring of tick abundances in farms, investigating the effectiveness of periodic acaricides treatments on tick abundances in local buildings and nearby wild bird populations, especially synanthropic species.

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