MINI REVIEW

Inventory and update on argasid ticks and associated pathogens in Algeria

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Abstract

Argasid ticks include vectors of relapsing fevers caused by *Borrelia* spp. in humans, and they can transmit arboviruses and other bacterial pathogens. Knowledge about soft ticks (*Ixodida: Argasidae*) in Algeria is incomplete, and distribution data need to be updated. Here we report a series of entomologic investigations that we conducted in five different areas in Algeria between 2012 and 2015. Ticks were identified by entomologic keys and molecular tools (16S rRNA gene). Six distinct species belonging to two genera were identified, including *Ornithodoros capensis* s.s., *Ornithodoros rupestris, Ornithodoros occidentalis, Ornithodoros erraticus, Ornithodoros sonrai* and *Argas persicus.* The present study highlights the distribution of soft ticks, the establishment of an update inventory with nine species and associated pathogens detected in argasid ticks in Algeria.

Keywords: Argasid, *Borrelia*, *Ornithodoros*, *Rickettsia*
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Introduction

Argasid ticks are distributed worldwide and can be considered cosmopolitan because they can be found throughout the world, with the exception of places showing extreme conditions, and are of great medical and veterinary interest, leading to the direct damage they cause to their hosts. They are highly specialized obligate haematophagous ectoparasites parasitizing rodents, birds, humans, livestock and companion animals. They colonize peridomestic settings and inhabit burrows, nests, caves and cavities. Ticks of the *Ornithodoros* genus are known to be vectors of relapsing fever borreliae in humans [1]. Argasid ticks can also naturally transmit arboviruses [2]. These arthropods comprise four genera and about 185 species, among which three genera are represented by a large range of species: *Carios* (87 species), *Argas* (57 species) and *Ornithodoros* (36 species). The fourth genus (*Otobius*) is classified by three species. This taxonomy and diversity might evolve with the use of molecular tools [3].

In Algeria, only few studies concerning argasid ticks have been performed, including the first molecular detection of *Borrelia crocidurae* in *Ornithodoros sonrai* [4], the detection of a novel *Rickettsia* sp. (*Ornithodoros capensis* s.s., *Ornithodoros erraticus, Ornithodoros rupestris*) [5], the detection of relapsing fever *Borrelia* spp., *Bartonella* spp. and *Anaplasmataceae* bacteria [6] and the first report of *Ornithodoros capensis* s.s. in Algiers [7]. Knowledge about soft ticks in Algeria is currently

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incomplete. Some scientific contributions provided information on the species occurring on the island [5], but now some reports contain data that need to be updated. The present report aims to highlight the distribution of soft ticks in Algeria and the establishment of an updated inventory.

Materials and methods

This study was carried out from May 2012 to October 2015 in five different sites in Algeria. We performed several series of sampling in three northern coastal areas (Algiers, 36° 44′00″ N 3°21′00″ E; Mostaganem, 35°53′39″ N 0°05′25″ E; El Tarf, 36° 42′2″ N 8°18′50″ E), one from the highlands (M'sila, 35° 35′13″ N 4°40′08″ E) and one from the south (Tamanrassat, 22° 47′6″ N 5° 31′22.001″ E).

Ticks were sampled in diverse natural or human-impacted habitats. In this study, we prospected rodent burrows, nests of the yellow-legged gull (*Larus michahellis*) seabird and animal shelters (poultry) to collect argasid ticks. In rodent burrows, we introduced a flexible tube inside and aspirated their contents using a portable petrol-powered aspirator [4]. Ticks from seabird nests were collected after the nesting period; the nests were recovered when the chicks left their nests [5]. The seabird nests were collected between the ratchets in the Agueli Island (Algiers). The nests were placed in individual bags to avoid parasite loss, and soft ticks were collected [5]. From poultry, ticks were collected from inside wall cracks with entomologic forceps [6].

After collection, ticks were immediately stored in ethanol (one tube per positive burrow, nest, or poultry) and forwarded thereafter to the laboratory of medical entomology (IHU Mediterranée Infection), Marseille, France. Firstly, ticks were identified by morphologic criteria with standard taxonomic keys [8]. Secondly, each specimen was rinsed twice in distilled water for 10 minutes and dried on sterile filter paper; handling was performed in a laminar flow biosafety cabinet [5]. Ticks were individually crushed in sterile Eppendorf tubes. Total DNA was extracted in a final volume of 200 µL from half of each ectoparasite using the QIAamp Tissue Kit (Qiagen, Hilden, Germany) by Qiagen-BioRobot EZ1 [5], according to the manufacturer's instructions [9]. Genomic DNA was stored at −20°C under sterile conditions. Once DNA had been extracted, ticks were also identified by 16S rRNA gene sequencing, as described elsewhere [4].

Results

In this investigation, rodent burrows, nests of seabirds and several poultries were prospected. In total, 300 ticks were collected from five sites located in three different bioclimatic zones of Algeria (Algiers, El Tarf, M'sila, Mostaganem and Tamanrassat). All collected ticks were identified by entomologic keys, and 15 individual of each species were confirmed by molecular tools (Table 1). Six distinct species belonging to two genera were identified, including *Ornithodoros capensis* s.s., *Argas persicus, Ornithodoros rupestris, Ornithodoros occidentalis, Ornithodoros erraticus* and *Ornithodoros sonrai* (Fig. 1).

Discussion

This report emphasizes the first inventory of argasid ticks fauna, geographical distribution and update of their associated pathogens in Algeria. These data show that at least nine species of *Argasidae* are currently present in Algeria.

Ticks are widespread globally, and their ecoepidemiology is closely related to environmental conditions. They are among the most competent and versatile arthropod vectors of pathogens. Tick-borne infectious diseases are a growing and serious world health problem, and a major obstacle for animal health and production [10]. They are currently considered to be second only to mosquitoes as vectors of human infectious diseases worldwide, and they play a primary role for animals in the process of diseases transmission because they are vectors of a large variety of human and animal pathogens [11].

Tick species can be grouped in two families of medical significance: the *Argasidae,* or soft ticks, and the *Ixodidae,* or hard ticks. Hard ticks are the main ticks acting as vectors of human diseases, but soft ticks are also known to transmit agents of human neglected infectious diseases [1]. Argasid ticks comprise four genera and about 185 species, among which three genera are represented by a large range of species: *Carios* (87 species), *Argas* (57 species) and *Ornithodoros*

TABLE 1. Total number of argasid ticks collected and identified in Algeria

Study site	No. of hosts and place prospected	No. of soft ticks collected	Species identified	GenBank accession no.
Mostaganem, (west)	15 rodent burrows	60, 20	*Ornithodoros, rupestris, Ornithodoros occidentalis*	KC311545.1, KC311536.1
Tamanrassat, (south)	6 poultry	69	*Argas persicus*	GU451248.1
El Tarf (east)	9 rodent burrows	61	*Ornithodoros, erraticus*	KC311540.1
Algiers (centre)	20 yellow-legged gull nests	58	*Ornithodoros capensis* s.s.	KP776644.1
M'sila (east highlands)	4 rodent burrows	32	*Ornithodoros, sonrai*	KC311525.1

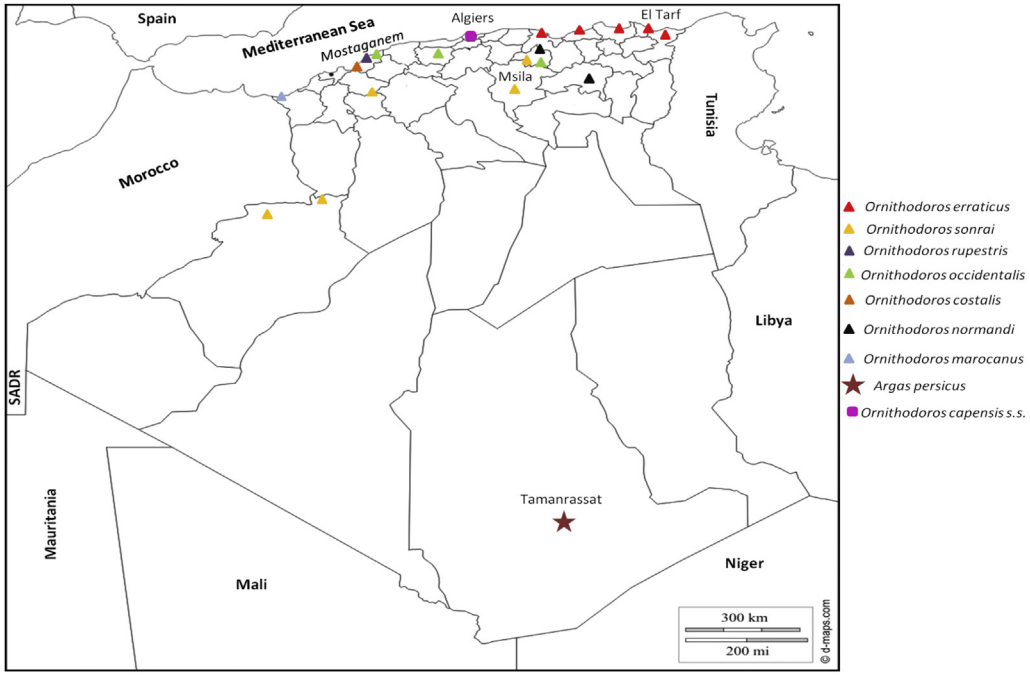

FIG. 1. Update of geographical distribution of argasid ticks inventoried in Algeria.

(36 species). The fourth genus (*Otobius*) is represented by three species. The distribution of each particular species of soft ticks is more limited, but it may be more geographically extensive, depending on many factors such as the adaptability of each species to new conditions and ecologic environments, the dissemination of immature phases by migratory birds around the world, and the ability of adult specimens to infest different animal hosts. Therefore, theories of expanding argasid ticks through the world and dissemination of their associated pathogens ought not be excluded [12]. Their phylogeny is considered as controversial, with the genus-level classification of the family *Argasidae* being much less settled than that of the *Ixodidae* [8]. This classification of argasids might evolve with the use of molecular tools [3].

In Algeria, only few epidemiologic studies in the interest of these vectors have been conducted, as previously described, listing nine species of argasid ticks and several associated pathogens [4–7]. Nowadays, the argasid species on Algerian territory comprise nine species in different localities: *Ornithodoros erraticus, Ornithodoros sonrai, Ornithodoros rupestris, Ornithodoros costalis, Ornithodoros occidentalis, Ornithodoros marocanus, Ornithodoros normandi, Ornithodoros capensis* s.s. and *Argas persicus*. In our study, six species (Table 1) were collected and identified in three different bioclimatic zones (coastal, highlands and south) (Fig. 1): *Ornithodoros sonrai* from the highlands; *Ornithodoros rupestris, Ornithodoros occidentalis, Ornithodoros erraticus* and *Ornithodoros capensis* s.s. from coastal areas; and *Argas persicus* from the south (Tamanrassat). Argasid ticks of the genus *Ornithodoros* include vectors of relapsing fevers caused by *Borrelia* spp. in humans [13]. Each of the tick vectors collected is mostly geographically restricted in its habitat and is considered to be a specific vector of different pathogens, as previously described [4–7]; they colonize peridomestic settings and burrows, caves, and cavities under outcroppings. *Ornithodoros capensis* s.l., a soft tick of seabirds, infests the nests of the yellow-legged gull (*Larus michahellis*) along the coasts of Algeria [5,7]. This seabird-associated tick is known as a reservoir of pathogenic bacteria of medical importance found worldwide [14].

A novel *Rickettsia* sp. has been detected in *Ornithodoros capensis* s.l. in Algeria [5]. The fowl tick *Argas persicus* is considered native in Turanian–Central Asia as a tick of arboreal nesting birds, with excellent adaptation and coexistence with domestic fowl. Probably via human transport, it has spread throughout the world, where it cohabits exclusively in association with domestic fowl [15]. Their bites to humans are painful, often with toxic aftereffects, but such attacks on humans are rare and occur only in extreme conditions [16]. The fowl tick has been previously described morphologically in the Mediterranean basin and in Algeria [8]. As demonstrated by recent reported cases, the potential role of this tick as a pathogen vector, especially in the case of severe infestations,

makes this species of great public health concern and an invasive species to control [17].

Some arboviruses have been identified in *Argas* spp. ticks [18], including West Nile virus [19] and Issyk-Kul fever virus [20]. Because the main hosts of *Argas* spp. ticks are birds, more research is necessary to learn the role of tick-infested migratory birds because distributors of emerging arthropod-borne viral and bacterial diseases worldwide, including areas such as Algeria, are concerning. The recent findings on the monitoring of soft ticks in Algeria indicated that *Borrelia crocidurae* has been detected with 2.5% prevalence in *Ornithodoros sonrai* [4], a novel *Rickettsia* sp. has been found in (*Ornithodoros capensis* s.s., *Ornithodoros rupestris, Ornithosoros erraticus*) [5] and the last series of bacterial agents (*Borrelia* spp., *Bartonella* spp., *Anaplasma* spp.) has been detected in argasid ticks collected from different localities [6]. However, further investigation should be carried out to clarify this situation.

In conclusion, these findings constitute the only recent records about soft ticks to date, with nine species in Algeria (Fig. 1). As indicated above, each argasid tick species needs particular conditions and biotopes for its development, which helps explain and determine their geographic distribution and the pathogens they transmit [1]. Accurate knowledge of the distribution of argasid ticks and their monitoring are important to define risk areas for tick-borne diseases and to establish adequate measures for tick control and the prevention of tick-borne disease. In this context, continuous tick surveillance emerges as a permanent need in Algeria. Finally, we recognize that the broadening of knowledge about the distribution of the *Argasidae* in all areas of Algeria is needed; this will be the focus of our future work. In this context, the development of new methods and emerging tools for systematic soft tick surveillance would help monitor soft tick occurrence and help predict their distribution and evolution.

Conclusion

We have expanded the understanding of the repertoire of argasid ticks and tick-borne pathogens detected in these arthropods in Algeria. Our findings will help human and veterinary clinicians enlarge the spectrum of pathogens to be considered in differential diagnoses. Further work is needed to map tick and borreliae distribution in relation to environmental and climatic characteristics.

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Conflict of Interest

None declared.

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