The possible impact of the climate change on the Trans-Arax plague focus

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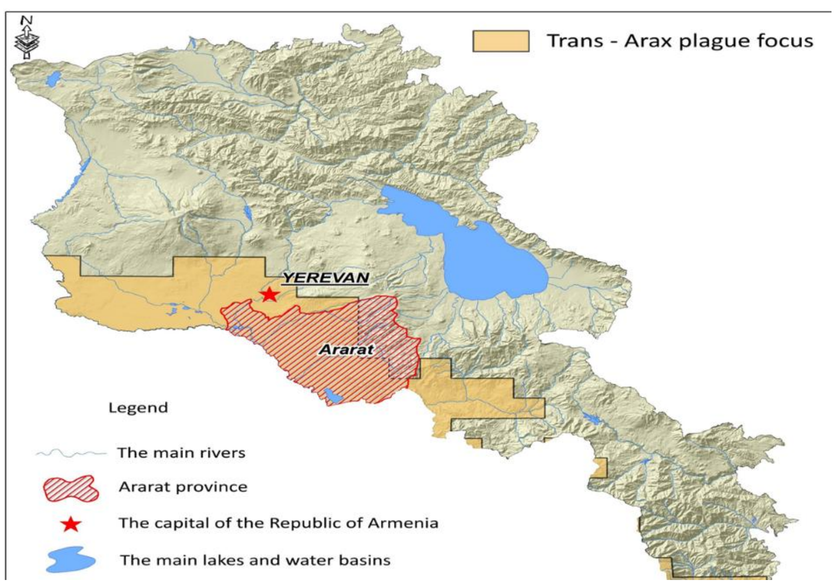
Introduction.

The polyhostal, polyvector Trans-Arax plague focus (TAPF) in Armenia covers semi-deserts, dry mountain steppes, and mountain steppes with a total territory of 450,000 hectares (Fig. 1). The major carriers of the plague in the TAPF are rodents Vinogradov’s jird (Meriones vinogradovi) and the Persian jird (Meriones persicus), while the main vectors are fleas Xenopsilla conformis and Ctenophtalmus iranus. The objective of this survey is to observe the density dynamics of carriers and vectors of plague over the last 5 years, clarify the influence of climactic conditions on carrier and vector density dynamics, and estimate biological risks in region.

Figure 1. Map of the Trans-Arax Plague Focus.



Materials and Methods.

Gero-type traps and live traps were used for trapping Vinogradov’s jirds, and aspirators were used to trap *X. conformis* and *C. iranus* in three regions of Ararat Province, located within the TAPF. Trapping locations were selected based on vector and carrier density About 500-600 mammals and 700-800 vectors were trapped annually in early spring and late autumn. Trapping location coordinates and type of material collected were entered into the Reference Laboratory’s database of TAPF data. Blood and tissue samples from collected organisms were tested to identify *Yersinia pestis* (polymerase chain reaction, indirect immunofluorescence assay, classical bacteriological method, infection bioassays, microscopy, etc.). The SPSS Statistics program was used to analyze the correlations between temperature and vector density.

Results.

Density of both carriers and vectors depended on climate conditions (Table 1): Vinogradov's jirds and their associated vectors increased in density in the seasons following hot summer and warmer winter conditions (spring and autumn, respectively). As shown in Table 2, summer 2017 was particularly warm (absolute high temperature of +42.5°C) and dry (absolute absence of precipitation). High summer temperatures were strongly correlated with X. conformis density (correlation coefficient=0.93, p-value <0.01). Of all the carrier and vector samples tested from 2013-2017, zero were positive for Y. pestis.

Table 1. Density of M. vinogradovi, X. conformis, and C. iranus per hectare, by year and season.

	2013		2014		2015		2016		2017	
	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn
M. vinogradovi	-	2,8	6,15	3,3	3,05	2,3	3,1	4,1	5,8	19,3
X. conformis	2,8	5,2	5,9	3,1	10,3	8,7	6,9	8,1	24,3	47,7
C. iranus	10,4	17.6	11,3	4,7	5,3	3,7	2	3	30,5	65,5

Table 2. Average temperature, by year and season

	2013	2014	2015	2016	2017
spring	+17,2	+14,3	+15,5	+13.4	+9,3
summer	+24,3	+27,5	+30	+26	+37
autumn	+10,2	+8,4	+11,2	+9.1	+14,4
winter	-12,2	-13,5	-9,1	-10.6	-6,3

Conclusions.

Notable increases in the densities of both carriers and vectors of plague in the spring and autumn of 2017 directly followed an unusually mild winter and warm summer that year. The TAPF of Armenia is mainly located in Ararat valley, where most of the population spends the year working in the fields, where direct contact with both carriers and vectors of plague is possible. Additionally, Ararat province is located within the boundaries of greater Yerevan, which increases the epidemiological and epizootological danger to the capital and its population. While none of the tested isolates were positive for Y. pestis, systematic epizootological studies should be carried out to track the density of and Y. pestis prevalence among plague carriers and vectors to allow a timely forecast of the epizootological situation.