



Veterinary Services

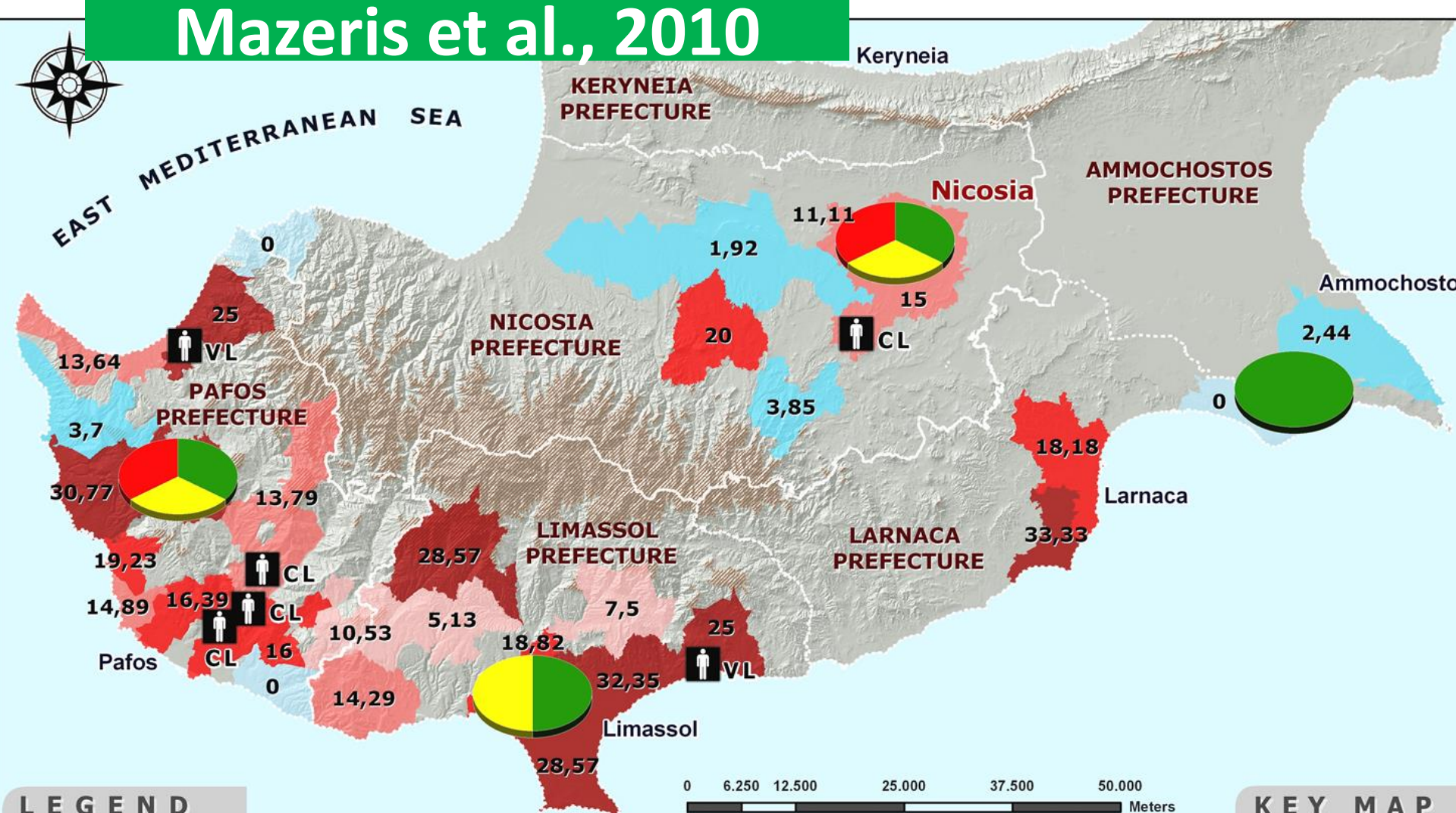
State Veterinary Laboratories – Laboratory for Animal Health – Virology Section

Sand flies surveillance in Cyprus

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Previous sand fly surveys in Cyprus

- Adler 1946 **7 *Phlebotomus* spp.; 3 *Sergentomyia* spp.**
- Minter & Eitrem 1989 **4 *Phlebotomus* spp.; 3 *Sergentomyia* spp.**
- Depaquit et al., 2001 **8 *Phlebotomus* spp.; 3 *Sergentomyia* spp.**
- Demir et al., 2010 **9 *Phlebotomus* spp.; 3 *Sergentomyia* spp.**
- Mazeris et al., 2010 **7 *Phlebotomus* spp.**



Sampling of sand flies was carried out from May to October 2006. Live sand flies were collected by CDC light traps from 20 villages with and without human and/or dog cases.

TABLE 1
The *Phlebotomus* species found in the 20 villages studied

Village	Prefecture	<i>P. papatasi</i>	<i>P. tobbi</i>	<i>P. galilaeus</i>	<i>P. sergenti</i>	<i>P. alexandri</i>	<i>P. mascittii</i>	<i>P. economidesi</i>
Chrysochous*	Pafos	†	†	†	‡	‡	‡	‡
Polis Chrysoch*	Pafos	†	†	†	†	‡	‡	‡
Pelathousa*	Pafos	†	†	‡	†	‡	‡	‡
Makounta*§	Pafos	†	†	†	‡	‡	‡	‡
Ag. Georgios*§	Pafos	†	†	†	†	‡	‡	‡
Anarita*	Pafos	†	†	†	‡	‡	‡	‡
Dora*	Limassol	†	†	‡	‡	‡	‡	†
Ipsonas*	Limassol	†	†	‡	‡	‡	‡	‡
Pissouri*	Limassol	†	†	‡	‡	†	‡	‡
Kantou*	Limassol	†	†	‡	†	‡	‡	‡
Kolossi*	Limassol	†	†	‡	‡	‡	‡	‡
Agioi Trimithias	Nicosia	†	‡	‡	‡	‡	‡	‡
Akaki	Nicosia	‡	‡	†	‡	‡	‡	‡
Kokkinotrimithia	Nicosia	†	†	‡	‡	‡	‡	‡
Nicosia*	Nicosia	†	†	†	‡	‡	†	‡
Paliometochos	Nicosia	†	†	‡	‡	‡	‡	‡
Sotira	Ammochostos	†	‡	‡	‡	‡	‡	‡
Xylofagou	Ammochostos	†	‡	‡	‡	‡	‡	‡
Paralimni	Ammochostos	†	‡	‡	‡	‡	‡	‡
Aradippou	Larnaca	‡	‡	‡	‡	‡	‡	‡

* Presence of CanL cases in the area.

† Presence of species.

‡ The species was not captured during this study.

§ Presence of a human case (see also Figure 2).

List of the species reported from Cyprus up to 2006

<i>P. papatasi</i>	<i>P. neglectus</i>
<i>P. tobbi</i>	<i>P. kyreniae</i>
<i>P. galilaeus</i>	<i>P. jacusieli</i>
<i>P. sergenti</i>	<i>S. azizi</i>
<i>P. alexandri</i>	<i>S. minuta</i>
<i>P. mascittii</i>	<i>S. fallax</i>
<i>P. economidesi</i>	

Sand flies and *Leishmania*

Είδη Φλεβοτόμων	Είδη <i>Leishmania</i> που μεταδίδουν	Adler, 1946	Minter & Eitrem, 1989	Leger et al., 2000; Depaquit et al., 2001	Mazeris et al., 2010
		1944	1971-1984, 1985	1993, 1998-1999	2006
Γένος <i>Phlebotomus</i>					
<i>P. papatasi</i>	<i>L. major</i>	+	+	+	+
<i>P. sergenti</i>	<i>L. tropica</i>	+	+	+	+
<i>P. jacusieli</i>	-	-	-	+	-
<i>P. alexandri</i>	<i>L. donovani</i> , <i>L. infantum</i>	+	-	+	+
<i>P. tobbi</i>	<i>L. infantum</i>	+	+	+	+
<i>P. kyreniae</i>	-	+	-	-	-
<i>P. galilaeus</i>	<i>L. donovani</i> , <i>L. infantum</i>	+	+	+	+
<i>P. mascittii</i>	-	+	-	+	+
<i>P. economidesi</i>	-	-	-	+	+
Γένος <i>Sergentomyia</i>					
<i>S. fallax</i>	-	+	+	+	-
<i>S. azizi</i>	-	+	-	+	-
<i>S. minuta</i>	-	+	+	+	-
<i>S. antennata</i> gp.	-	-	+	-	-



EDENext project (2011-2013)

1st station:

Nicosia has a hot subtropical semi-arid climate with long, hot and dry summers with relatively wet and mild winters.

Geri, Psimolofou: animal husbandry and agriculture area. A dry river crosses Psimolofou while its irrigation needs are covered from the nearby dam

2nd station:

Paphos:

Steni, Salamiou, Anarita:

There is a Mediterranean climate with great amounts of precipitation mainly occurring from November to March in all area. It almost never rains in the summer months. In August and September, humidity measurements can go up to 90%. A dry river crosses also Steni while its irrigation needs are covered from the nearby dam. Lots of gardens full of flowers and vegetables are found in the villages. It is also surrounded by citrus trees, olives, cereals and a goats and sheep farms. Especially, in Steni fruit bats have recently been found in a cave and most of the hen coops have been removed from the village but pigeons are flying freely around.

Collection Strategy

- Collections of sand flies were made for 3 years (April to October 2011-2013)
- 2 nights every month on same dates with CDC light traps and for the whole 2 day period with sticky traps
- Most of the captures were done in animal inhabited biotopes



Collection tools



Anemometer



CDC light trap



Data Logger

Traps

Light traps



Sticky traps



Finding sand flies

Microclimate

- Areas that have temperatures above 15.6°C.
- Humidity is an important factor for egg survival.
- Rainfall followed by reductions in sand fly numbers as excess precipitation reduces the amount of suitable diurnal resting sites for adult insects and limits adult flight activity, as well as killing immature stages .

Habitat

- Warm, humid and tropical climates, usually in savannah and semi-desert vegetation habitats. They are able to colonise rural, peri-urban and urban areas. Sand flies require a humid microclimate in order for their eggs to develop and larvae need a cool, moist habitat with decaying debris. Adult sand flies often inhabit rock crevices, caves, and rodent burrows, and in peridomestic settings rest in cool, dark and humid corners of animal shelters or human dwellings. Both rodent burrows and peridomestic areas provide ready access to bloodmeals in addition to shelter from the elements.

Host

- Humans, livestock, dogs, urban and wild rodents, reptiles, amphibians, and birds. However, in urban and peri-urban settings humans and domestic dogs are the main targets for sand flies.

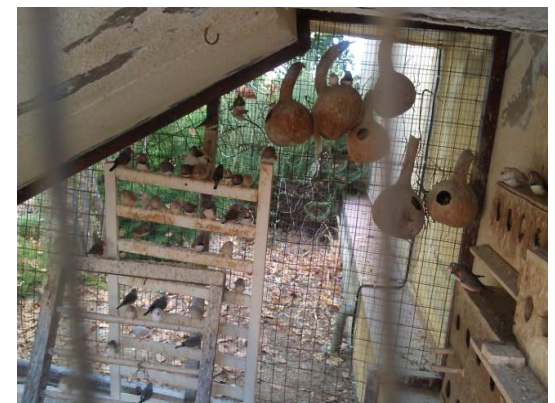
Choosing trapping areas

LT1: Village house on the hill, lots of trees, vegetables and flowers around, a greenhouse by net but not in use, animal presence: 2 dogs.



Choosing trapping areas

LT2: Birdhouse (small parrots) under the stairs of the village house, plants and trees around, near car parking, mice presence near the food of the parrots.



LT3: Backyard of village house with many trees and pigeons around.



Choosing trapping areas

LT4: Small hennerly, 2 - 3 months of the year there are rabbits in the same place, croft of citrus trees and vegetables around, in a small distance: a small creamery and the house of the owner of the hennerly, cars and machines, 2 tied dogs.



Choosing trapping areas

LT5: Arches in a tunnel under the road of the village, it is the end of canyon of the area, swallows in the spring months and their nests on the walls, concrete wall with holes outside the tunnel, water in the floor.



Choosing trapping areas

LT6: Sylvatic area at the end of the canyon, lots of plants, pigeons, rocks and water, concrete wall with holes around, in the middle of 2013 the municipality cleaned this part.



LT7: Hole created by house walls, lots of rusty irons in the root of a big tree, a concrete wall with holes opposite, a tavern nextdoor and the main road of the village.



Choosing trapping areas

LT9: Old village house, not habitable, rocks and holes around, old mulberry with cavity on its bole.



LT10: Hennery in a sheep and goats farm up on a small hill, old woods and litter around, old tree inside the hennery, lots of straw around, machines.



The best trapping site in CL patient's house



The best trapping site in Steni

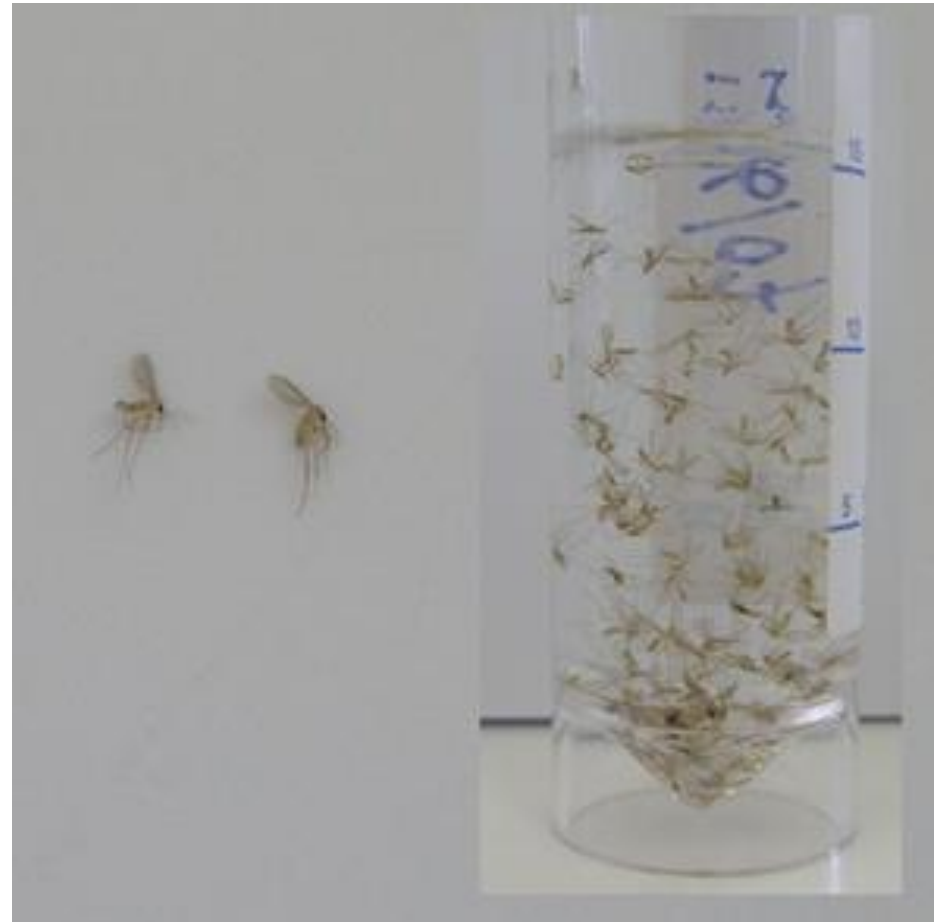


Collection of sand flies

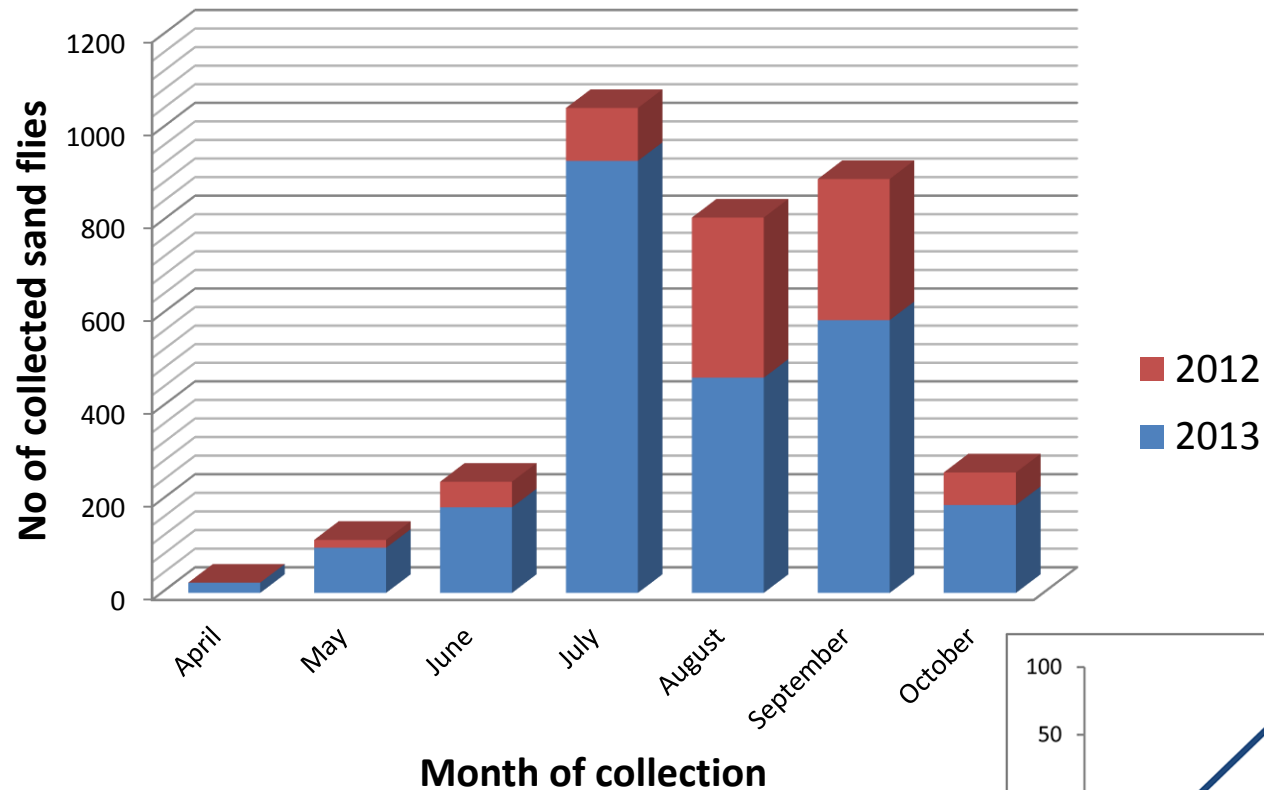


Processing and identification of sand flies

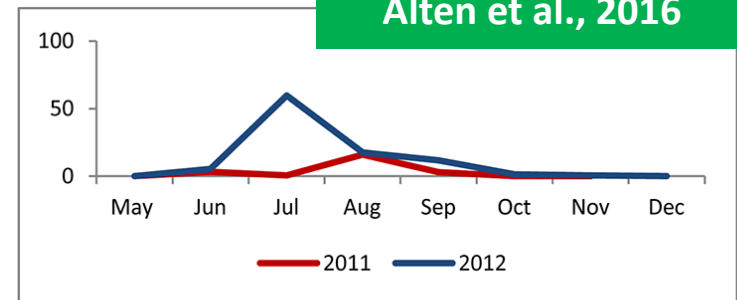
- Collected sand flies were preserved in 70% Ethanol pending species identification
- Species identification was performed morphologically using published keys in the University of Crete



Collected sand flies / month in Steni

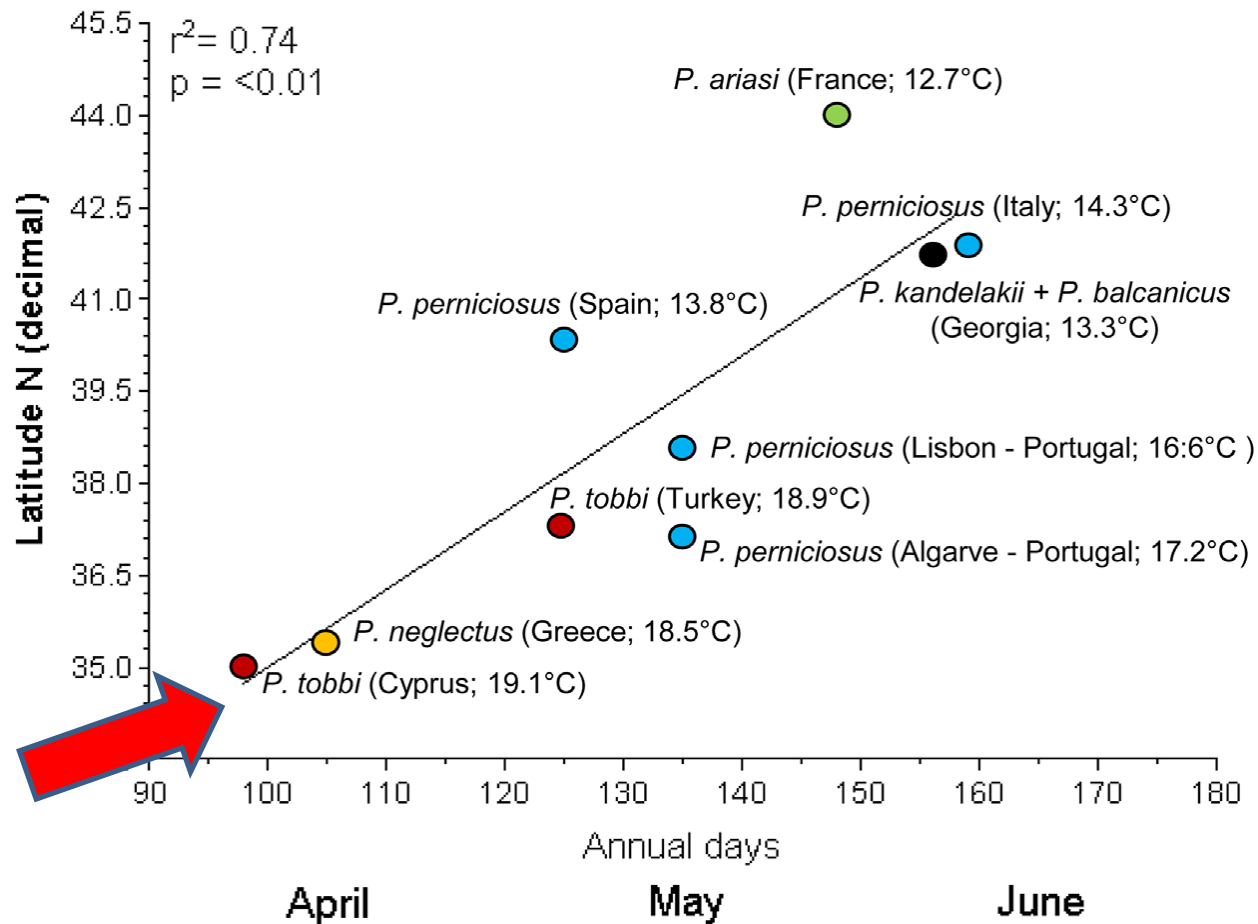


Alten et al., 2016



P. tobbi, Cyprus

Average annual temperature



List of the species reported after 5 years from Cyprus

Year	Month	P. neglectus			P. papatasi			P. tobbi			P. galilaeus			P. sergenti			Sergentomyia spp		
		Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
2012	April	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	May	0	0	0	1	0	1	4	3	7	1	2	3	0	0	0	2	2	4
	June	0	0	0	3	3	6	3	4	7	0	1	1	0	0	0	26	12	38
	July	0	0	0	1	5	6	15	8	23	0	1	1	0	0	0	34	32	66
	August	0	0	0	81	108	189	38	29	67	8	6	14	0	0	0	43	15	58
	September	0	0	0	78	66	144	68	28	96	15	9	24	0	1	1	12	16	28
	October	0	0	0	20	29	49	10	7	17	0	0	0	0	0	0	3	1	4
	November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	184	211	395	138	79	217	24	19	43	0	0	0	120	78	198
2013	April	0	0	0	1	5	6	9	5	14	2	0	2	0	0	0	0	0	0
	May	0	0	0	1	5	6	57	21	78	8	5	13	0	0	0	12	17	29
	June	2	1	3	9	14	23	13	11	24	3	1	4	0	2	2	57	61	118
	July	0	0	0	35	58	93	97	28	125	8	5	13	1	2	3	347	294	641
	August	0	0	0	56	74	130	20	15	35	3	1	4	0	0	0	132	117	249
	September	0	0	0	67	92	159	117	91	208	8	5	13	3	3	6	37	71	108
	October	0	0	0	57	62	119	15	19	34	1	1	2	0	0	0	10	7	17
	November	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	7	17
	Total	2	1	3	226	310	536	328	190	518	33	18	51	4	8	12	605	574	1179
																			117

Sand flies species in each sampling area

Phlebotomus

Village	Prefecture	<i>P. galilaeus</i>	<i>P. neglectus</i>	<i>P. papatasi</i>	<i>P. tobbi</i>	<i>P. perniciosus</i>	<i>P. sergenti</i>	<i>P. similis</i>	<i>P. perfiliewi</i>
Anarita	Paphos	✓		✓	✓				
Geri	Nicosia			✓	✓	✓	✓	✓	
Psimolofou	Nicosia			✓	✓				
Salamiou	Paphos	✓		✓	✓		✓		
Steni	Paphos	✓	✓	✓	✓	✓	✓	✓	✓

L. infantum

L. tropica

Sergentomyia

Village	Prefecture	<i>S. dentata</i>	<i>S. minuta</i>	<i>S. fallax</i>	<i>S. theodori</i>
Anarita	Paphos	✓	✓		
Geri	Nicosia		✓		
Psimolofou	Nicosia	✓			
Salamiou	Paphos	✓	✓		
Steni	Paphos	✓	✓	✓	✓

*Syrian
imigrants*

Sand flies species in each sampling area

The areas in which the different species were more recurrent could be explained by their trophic preferences (the presence of mammals and birds) and the environmental characteristics.

An island ecosystem is a very particular one and difficult to compare to large inland landscapes. Small island size may allow sand flies to locate their meal sources in different microenvironments during evenings.

The distribution of the phlebotomine sand flies is highly depending on:

local environmental factors

Precipitation

temperature

physical factors

geographical barriers

habitat availability

biotic factors

distribution and abundance of the vertebrate hosts

Control?

Control is tailored to the local situation

Insecticides

Such as pyrethroids, and residual spraying of houses and animal shelters in peridomestic environments.

Application of insecticides to outdoor resting sites (if known).

Control of immature stages is difficult as the breeding sites of most species are unknown.

Resistance to several insecticides has been reported in some sand fly species.

Personal protection

Protective clothing, insect repellents and insecticide-impregnated bed nets.

Habitat modification

Resurfacing walls to cover cracks and holes, demolition and removal of uninhabited buildings and removal of organic waste and unwanted vegetation discourage sand fly breeding.

Destruction of the habitat of reservoir hosts, such as rodents that enable sand fly populations to become established.

Reservoir control

Dogs and rodents.

Deltamethrin-impregnated dog collars for preventing sand fly bites.

Spot-on and spray insecticide formulations can be applied to reduce biting.

Biological

Bacillus sphaericus have been shown to reduce survival and fecundity of phlebotomine sand flies in sugar solutions.

Thank you

