

Acarid Phylogeny and Evolution: Adaptation in Mites and Ticks

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Observations on the spread of *Pyemotes ventricosus* (Prostigmata: Pyemotidae) in houses in Umbria, Central Italy

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Key words: dermatitis, ecology, population dynamics.

Abstract: The spread of *Pyemotes ventricosus* (Newport, 1850) was observed during three years in 460 houses where dermatoses of environmental origin were reported. The period of highest mite spread was from May to August. This parasitic infestation was among the most important causes of human dermatitis in summer.

Introduction

Pyemotes ventricosus (Newport, 1850) is a prostigmatic mite. It may also be accidentally parasitic on man (Hewitt *et al.* 1976; Rycroft and Kennedy 1981; Betz *et al.* 1982; Kunkle and Greiner 1982; Hanks *et al.* 1992; Principato and Polidori 1993; Letchford *et al.* 1994; Principato 1998; Grob *et al.* 1998). Although the systematics of this mite are known and its presence is frequently reported in food stores, with repeated episodes of human dermatitis, very little is known about its frequency and indoor spread and the possible risks for people and domestic animals. The aim of this survey has been, therefore, to determine the period of the maximum development of this pest, related to the outbreak of serious dermatoses, and to establish the main places of its development.

Materials and Methods

The direct examination of indoor dust from 460 Umbrian human dwellings, from which an intense pruritic papular eruption was reported, was continued during three years. Dust was collected by sweeping the floor of the houses carefully. The mites were extracted through flotation with NaCl, observed through a stereomicroscope, isolated with a thin needle and mounted on a slide in Berlese solution. Mites were then counted and identified to species.

Results

P. ventricosus was the fourth most frequent mite in dwellings after *Dermatophagoides pteronyssinus*, *D. farinae* and *Glycyphagus domesticus*, and the second most important acarine cause of human dermatitis after *G. domesticus* (fig. 1).

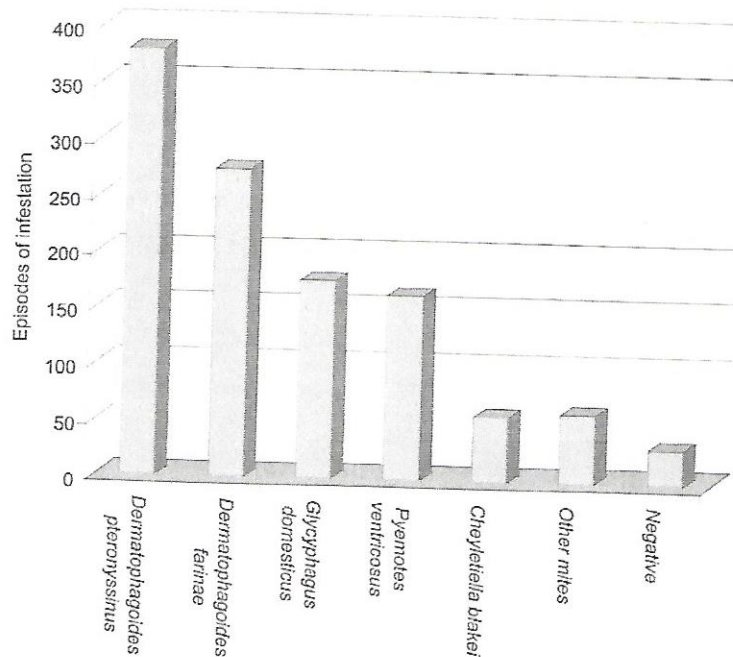


Fig. 1 - Frequency of infestations in the 460 dwellings examined.

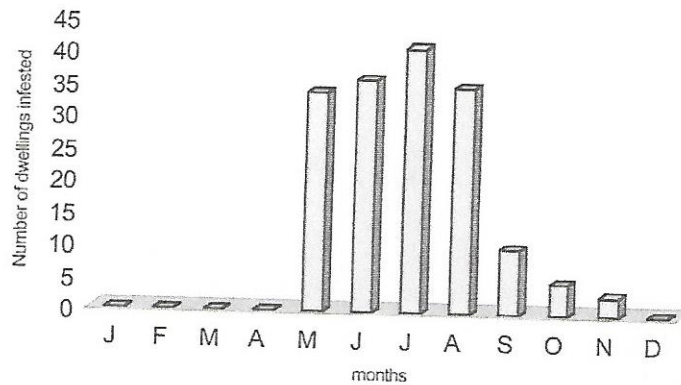


Fig. 2 - Occurrence of *Pyemotes ventricosus* during three years in 460 dwellings.

Higher population density of *P. ventricosus* was detected from May to August; from September to November, the density decreased to zero (fig. 2).

The gravid females of this species were frequently observed in June and by September some males, which were usually rare, were also found (fig. 3).

Even when the number of mites isolated through the direct examination of indoor dust

was low, it was always associated with an episode of human dermatitis. The people affected soon recovered after they were given a specific environmental treatment. Furthermore, *P. ventricosus* did not appear to depend on particular temperatures or humidities in the house, since it was isolated, on its own or together with other mites that need a high RH rate or with mites found at 45-55% RH. The main

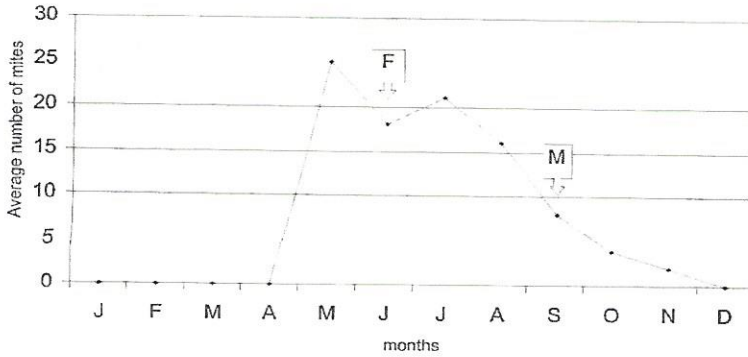


Fig. 3 - *Pyemotes ventricosus*: average number of mites removed by the direct examination of indoor dusts. F, Females; M, Males.

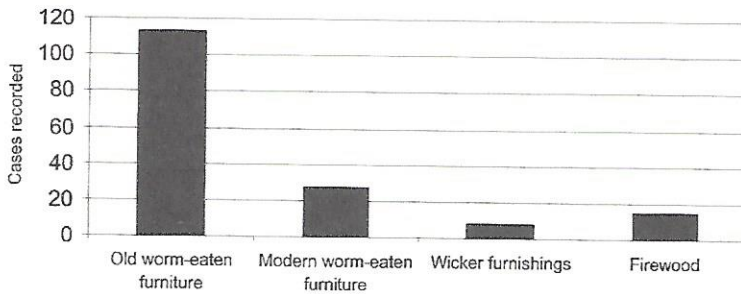


Fig. 4 - *Pyemotes ventricosus*: origin of infestation.

origin of infestations was furniture, both new and old, such as wicker objects infested by the beetle *Anobium punctatum* and also of firewood, which in many cases had remained in the room since the previous winter (fig. 4).

The dermatitis by *P. ventricosus* was reported mainly on man and there were only 3.6% cases when it was observed in dogs living in those houses, showing cutaneous eruptions on their abdomen and the insides of their thighs. The resultant distribution of lesions on humans was characteristic, since they occurred not only on the trunk and the arms, but also in the neck and in the areas tightened by the elastics of clothes. Furthermore, some lesions appeared in small groups and were intensely pruritic.

Discussion and conclusions

We found that human infestations by *P. ventricosus* are very frequent in the spring-summer period in Umbrian houses. Mites showed a clear periodic occurrence, with gravid stages occurring mainly in June-July. In September most of the mites isolated were dead and the infestation decreased in October-November, as did the cases of dermatitis. The most serious episodes were observed in the reproductive period of the mites and in particular when the parasites came from furniture eaten by larvae of hylophagous beetles, but only when they were present. The anamnesis seemed extremely confused, since the patients attested to the outbreak of lesions in quite different conditions, even outdoors, in their cars or while they were

having a shower. Actually, this anamnestic diversity leads to the suspicion of infestation by *P. ventricosus*, for this mite causes lesions some hours after its bite and when people are engaged in different activities. We never found any correlation between the presence of *P. ventricosus* and *Plodia interpunctella* (Lep. Phycitidae) in the houses, a moth that frequently infests farinaceous foods in larders or cupboards. However we always reported the presence of this mite in association with woodworms, in order to isolate the parasite a few times even under the beetle's elytra (Principato and Polidori 1993). As for the lesions observed on domestic animals, we think they could be caused by *P. ventricosus*; Kunkle and Greiner (1982) reported papular eruption due to *Pyemotes* sp. in 12 horses, thus recording cases of dermatitis in animals. Infestations were eliminated and complete recovery was obtained after the removal of the worm-eaten furniture, wherein the mites had developed. Good results were obtained but only temporarily after moth control that was associated with another treatment of the whole flat or house by fumigation. In consideration of the high spread of this mite in Umbrian houses and its pathogenic action on man, we think it is important to deepen the study of its biology and its adaptability with further research.

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As time goes by: a profile of Italian acarology

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Key words: acarologists, research lines, Italy, historical review.

Abstract: A profile of the Italian acarology from the beginning up to now is reported. For each acarologist are mentioned news about the work and the field of interest.

There was scarce and fragmentary information on acarology in the past and scientists dealing with it were very few. At the beginning there were no scholars involved with mites "full time", as they usually were naturalists that seldom dealt with mites. The reasons why the development of acarology was delayed as a science, if compared to the development of entomology, were mainly two. The first one is doubtless the size of mites: too small to be detected at that time; the second and most important one was the existence of natural balance: no pesticides, no phospho-organic compounds were known and, of course, applied and, as a consequence, nature was able to balance everything without any intervention on the part of man. Mites existed, but they could not 'show off' as biological equilibrium did not allow them to damage plants and animals noticeably.

But as soon as mites began attacking people, causing them damage, scientists started to study

them finally discovering such tiny individuals: the "general naturalist" at last encountered mites!

Acarology in the past

17th century

The first scientist who came across mites without having any knowledge of them, was **Battista Ferrari** (1584-1655). He was a botanist and in his book "Hesperides sive de malorum aureorum cultura et uso, Liber Quatuor", dated 1646 (fig. 1), described various new species of *Citrus*, drawing fruits, which seem to be attacked by the citrus bud mite (*Aceria sheldoni*). It should be said, however, that citrus plants exist in nature which naturally produce abnormal, digitate fruits, but if we consider Ferrari's description of one of them, i.e. Limon a Rio, Rivo (fig. 2), we can say that this lemon plant was not a new species, but a plant infested by citrus bud mite. We can say

families, genera and species of oribatid mites; she deepens their paleontology and evolution. **Massimo Migliorini** (1960) got his degree discussing a thesis on oribatid mites living in the North-Eastern parts of Sicilia and still continues to deepen the subject of his thesis. He is included in Bernini's research programs.

Only a few people used to work on Ixodidae and some of them have retired. We would like to mention **Lorenzo Sobrero** (1923), who was the Head of the Istituto Sperimentale Zooprofilattico di Puglia and Basilicata and was fundamentally a helminthologist. Since 1975 he was, however, interested in Ixodidae and gave us interesting contributions on their taxonomy. At present he is retired and is no longer working on mites.

Enrico Stella (1934) worked at the parasitology laboratory of the Istituto Superiore di Sanità. His studies have contributed to the knowledge of Ixodidae surveyed in the parks of Circeo, Gargano and Castelporziano and of the seasonal distribution of some species. He has also studied the biology of *Hyalomma marginatus*, under laboratory conditions to understand the causes which determine the dispersion of this species in natural conditions. He has also the merit to have pointed out the existence of *Haemophysalis concinnae* in Italy. He is retired. Also **Maria Grazia Petrelli** (1935) worked at the Istituto Superiore di Sanità and was interested in both Ixodidae and Macrochelidae. She studied various biological parameters of some species and analyzed the distribution of ticks, drawing a map of the territorial areas in relation to host animals. At present she has retired.

Another scholar who has retired but is still working on Hydracnidae is **Anna Maria Boccantini** (1934) who worked at the Istituto di Microbiologia of Pallanza (Novara). She has produced interesting contributions on fresh water mites, mainly Porohalacaridae and Hydracnidae, even if she is not a true acarologist.

Michele Maroli (1943) is the Head of the Sezione di Biologia, Sistematica ed Ecologia dei

Vettori at the Istituto Superiore di Sanità (Roma). His research lines focus on arthropods of medical importance and mainly on their role as vectors of pathogens in Italy and in other Mediterranean countries. As far as mites are concerned he has enlarged our knowledge on dust mites (Pyroglyphidae), whose biology and distribution he has ascertained, and ticks (Ixodidae) and their distribution; he has studied the infection caused by *Ixodes ricinus* in a natural park in Central Italy by means of PCR, demonstrating co-infection by *Borrelia* spp. and *Ehrlichia* spp.

Giorgio Canestri-Trotti (1945), a professor of Parasitology, works at the Dipartimento di Biologia Animale e Umana of University of Torino. He has published papers on *Neotrombicula autumnalis*, *Cheyletiella yasguri* and *Argas reflexus* and has collected abundant material in Northern Italy (Emilia-Romagna, Veneto, Trentino Alto Adige and Friuli Venezia Giulia) as far as the fauna of Ixodid mites is concerned, and has built a list of those mites. He also studied the ixodid fauna in Boscone della Mesola in Ferrara. His future plans focus on surveying and studying the Ixodid fauna of Ferrara where previous verifications for the presence of *Borrelia* (Lyme disease) have been carried out. He is studying the above mentioned mites mainly from a parasitological point of view.

Salvatore Giannetto (1950) is professor of Veterinary parasitology in the University of Messina. His activity is addressed towards parasitology and zoology especially from a veterinary-medical point of view. In particular he has studied the following families: Ixodidae, Trombiculidae and Pyroglyphidae.

Another scientist interested in mites, also from a veterinary-medical point of view, is **Mario Principato** (1955) who works at the Faculty of Medicine at the Dipartimento di Scienze Biopatologiche Veterinarie of the University of Perugia. He started his activity working on ticks and focused then on various mites which cause damage to animals and people, particularly mites such as *Epidermoptes bilobatus*, *Knemidokoptes*

pilae, *Notoedres muris* and, *Psoroptes* sp., which cause various types of itches in many animal species. More recently he studied *Demodex* sp., and *Glyciphagus* sp., which cause people a particular dermatitis. He is also involved in studying house mites and has demonstrated a method to verify their presence. He has recently established (in 1999) the link between *Glyciphagus domesticus* and the presence of structural anomalies which is so evident that he considers such a species as an indicator of the health status of a particular environment.

There are some scientists who used to work with mites, but are no longer dealing with them. This is the case of **Alfio Nucifora** (1932), an entomologist at the Dipartimento di Scienze e Tecnologie Fitosanitarie in the University of Catania, who was also interested in agricultural acarology especially in the control of some eriophyoids and tetranychids associated with citrus and fruit trees. His most important result was the revision of tarsonemid mites carried out together with R.E. Beer from the USA, where they described and illustrated many species in a very clear way. Since then he has no longer produced papers on mites. The same may be said about **Rita Arcidiacono** (1934) who works at the Istituto Policattedra di Biologia Animale in the University of Catania, where, besides other subjects, she used to study the distribution of oribatid mites and their seasonal fluctuations. She also studied oribatids from the fossil dunes along the coast of Gela (Sicilia). Unfortunately she has abandoned acarology.

In Firenze at the Istituto di Zoologia of Firenze University, **Giuseppe Messana** (1944) started studying fresh water Hydracarina collecting some of these mites in Somalia and Zaire and later on he moved his interest towards interstitial mites (Hydracarinae). Unfortunately at present he is no longer interested in mites as his main interest is now biospeleology.

In the list of those who have abandoned acarology, we have to mention also **Vincenzo**

Vomero (1947) who now works on other topics which do not involve mites; but deep in his heart, he is still in love with mites as he still keeps in contact with other acarologists even if he has no time to be deeply involved with our tiny creatures. It is really a pity as his research lines were numerous and interesting: evolutionary systematics in parasitic mites (Myobiidae and Canestriniidae); ecological researches in soil mites of tropical and temperate forests; research on host/parasite relationships, on the parasitic specificity and on mites living in caves in Mexico and Guatemala. However, a metal model of *Sarcoptes scabiei* at the entrance of the Museo civico in Roma, where he is working, still reminds us of his love for mites.

Bruno Cicolani (1947) began his activity in 1972 as a Professor of Ecology at the Laboratorio di Acarologia ed Ecologia in the University of L'Aquila. He worked on a research program called "Ecology and ethology of Macrochelidae". His research now follows two lines: the first one is his first love, Macrochelidae analyzed from a morphological, biological and ecological point of view, and the other one concerns water mites (Hydrachnidia) whose systematics, biology and ecology he studies too; moreover he also deals with water mites and the biomonitoring of aquatic ecosystems. Cicolani is partly cooperated by **Antonio Di Sabatino** (1960), a researcher in ecology at the same university; he is also interested in water mites (Hydrachnidia) as far as biology, ecology and systematics are concerned, but also in their biodiversity and ecological importance in spring habitats and their role as indicators of environmental quality. He also studies taxonomy, distribution and ecology of mites belonging to the Torrenticolidae family in the Mediterranean area.

Other scientists who work on water mites are Morselli and Mari, both operating at the University of Modena. **Ivano Morselli** (1940) is mainly interested in the taxonomy and ecology of Halarcaridae and Hydrachnidae. He identified more than