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**THE WASMANNIA AUROPUNCTATA LINKED KERATOPATHY
(WALK)
HYPOTHESIS**

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THE POLYNESIAN CASE

*HYPOTHESE DE LA KERATOPATHIE
LIEE A WASMANNIA AUROPUNCTATA
LE MODELE POLYNESIEN*

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The Wasmannia Auropunctata Linked Keratopathy (WALK) Hypothesis

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The Polynesian Case

Abstract

The Little Fire Ant, *Wasmannia auropunctata*, is ranked among the World's 100 worst invasive species. Since the early 90's, it is officially established in French Polynesia. The Polynesian government actively fights it since 2005, partially through the mapping of the known colonies. By this process, we discovered that the contaminated areas are also sheltering endemic hearths of Florida keratopathy. We studied 24 cases of keratopathy within the mega-colony settled in the Mahina commune's highs (Tahiti). After control cases search, we pointed that the threatened animals are those living in contact with the ants ($K^2 > 12$ within studied Pets cases). Apart from this predisposing factor, we did not find any other characteristic facilitating this pathology outbreak. We highlighted: 1) symptoms of acute attack such as blepharospasm and whimpering; 2) Topography of injuries shows that the eye median area is the most affected ($p < 0,05$); 3) The most probable etiologic agent of this pathology is *Wasmannia auropunctata*.

A) Introduction

The purpose of this work is the result of several years of collecting data on the Polynesian invasion of *Wasmannia auropunctata*, also known as "Little Fire Ant." Being originally from the island of Tahiti, we were able to account for many disorders associated with the invasion. Among them, we identified an atypical eye problem for which we have tried to find references and treatments. Yet in the literature, if the disease is known, however, its exact etiology was not. Faced with the situation in the field we thought it was clear that a link existed. To highlight this link we decided to structure our comments and to propose them as scientific work.

To understand the situation in which the research is conducted, it is important to first define the problems associated with the invasion of *Wasmannia auropunctata* in French Polynesia. It is difficult to cover all the knowledge about this serious pest, but we will try to identify the main aspects of its biology. These are important for understanding the invasion of the island and the recent appearance of eye damage in domestic animals.

A.1 *Wasmannia auropunctata*, a world known pest

A.1.1 A tramp species

Ants are part of order Hymenoptera, family Formicidae; they are part of ethologically evolved insects presenting eusocial structures.

This structure influences the selection of genes necessary for each individual to perform his "task" in the group. In this behavioral branch, some ants have climbed the summit of adaptation and invasion ability. These ants are commonly grouped under the category of "wandering ants" ("tramp" species), they mostly present nine main features (Passera, 1994):

- Living in areas where ecosystems are disturbed by human activity (plantations, gardens, garbage dumps, houses).
- An ability to massively migrate in response to physical, chemical or trophic variations.
- A uniclonality marked by an absence of aggressive behavior among individuals belonging to cohabiting units on the same territory.
- A strong aggressivity towards other species.
- A real polygyny, each nest includes a significant number of birthing ants.
- The short longevity of queens.
- A continuous release by spin or cuttings: the departure of a group from a protocolony is easy and very fast.
- A small size and monomorphic workers (except among *Pheidole megacephala* and *Solenopsis invicta*).
- Sterility of workers (except among *Lasius neglectus*).

Above all, these features give these species an extraordinary ability to adapt to different terrain they face. For the most part, these species have reached new heights in their evolutionary branch.

Wasmannia auropunctata (Roger, 1863) is one of these wandering ants (Fig. 1a and 1b) belonging to subfamily Myrmicinae. It is native from Central America and South America and has invaded North America, Caribbean islands, Africa and several islands of Oceania (Le Breton, 2003).

A.1.2 A non-standard and competitive reproduction

W. Auropunctata females and males are, each and separately, carriers of a genetic competitive inheritance satisfying the physico-chemical and biological environment.

Recent work of Fournier et al. (2005) were able to demonstrate through analysis of hypervariable genetic markers that this species actually behaves as two sexually opposed sub-species that reproduce by cloning. Namely queens on one side and males on the other. The cytogenetics mechanism is still to be elucidated, but the males probably recur identically with the help of an exclusion mechanism of maternal genome's part. Queens are clones of their mothers, only workers are born genetically different from each other by sexual reproduction. Nevertheless, these workers are sterile, one may doubt about the concept of unique species among *W. Auropunctata*; because males (Fig. 2) and females have genomes that rarely mix and sterile offspring. The original relationship between both sexes allows the establishment of a large amount of queens in a single nest, but also to produce workers from a genetic mix, exceptional in the living known world.

A.1.3 Dangers associated with super-invasive ant species

W. Auropunctata also belongs to a narrower ethological family: the super-invasive. Members of this group are part of the list of 100 most invasive species on the planet (Invasive Species Specialist Group, 2000).

One may define the super-invasive group according to the following criterias (Holweck et al., 2002):

- Unicoloniality
- Omnivorous and trophobiotic diet
- Continuous activity
- High exploration and recruitment ability

This group is composed of six members - including *W. Auropunctata* - with the common characteristic of being first order harmful species. Indeed, the specific ethological properties of these species alone explain their explosive invading capabilities.

The unicoloniality is a prime importance competitive property for the expansion of hunting areas and invasion. *W. Auropunctata*'s workers from different nests do not clash when meeting. On the contrary, it seems as if all nests in a particular geographical area do formed one. This is mainly due to cuticular perfumes (Le Breton, 2003). In terms of invading abilities, the numerical advantage on local faunae is huge.

Alone, the varied and adaptive diet makes it competitive. Yet, the breeding of homopterous insects (mealybugs, aphids) ensures the implementation for the largest nests. It is also observed that the absence of hibernation in tropical areas and the ongoing workers during day and night increases the capacity of expanding the settlements. The formation of "super-colonies" which can cover several hundred hectares (Jourdan, 1997; Le Breton, 2003).

To these advantages we must add that *W. Auropunctata*'s workers have a functional sting with powerful venom – lethal to many insects – extremely irritating to humans.

This plague is well known in several countries at the equatorial areas, tropical and subtropical because it is the cause of serious disturbances of ecosystems, agricultural losses and considerable physical threats (due to venom). Indeed, it may be noted several testimonies of abandoned crop areas because of multiple bites inflicted to the operators. It is why it has received several vernacular nicknames such as "Electric Ant" or more commonly the "Little Fire Ant" (LFA). Eventually, it is a serious biological hazard because it can be spread intentionally or accidentally by human activities such as movement of, equipment, earth-moving machinery, potted plants, and so on.

These characteristics have led the Invasive Species Specialist Group to classify it in the leading group from the official list of the 100 most invasive species on the planet (2000).

A.2 The Polynesian invasion case

A.2.1 French Polynesia framework

French Polynesia is a set of five archipelagos composed of a myriad of islands (118) equivalent of a land area of 4167 km² forming an exclusive economic zone (EEZ) of over 2.5 million km² in the heart of the Pacific Ocean about 6000 km east of Australia; its population represents a community of 256200 inhabitants.

Tahiti is the main administrative centre of French Polynesia, it is also the largest island (1043 sq. km) and most populated (183804 inhabitants in 2002) (National Institute of Statistics and Economic Studies - French Polynesia Statistical Institute, 2002). It is a volcanic island formed by three volcanoes gathered at the Isthmus of Taravao, the center the biggest part of the island is the Caldeira (Fig. 3). The maximum distance between the two farthest points is 45 2241 m. The population occupies only 150 km² mainly on the coastal regions, by the sea or on the heights. The climate is hot and humid all year round.

Pets (cats and dogs) are very numerous, and most have no owner or are neighbourhoods animals; moreover, even among individuals, the number of animals can be very important. There is a very high prevalence of common external parasites (fleas, ticks, gales, moths) and transmitted infectious diseases (feline immunodeficiency virus, Feline leucosis virus ...). There are very few curative and prophylactic controls, given the number of animals, climate and low awareness of treatment stakes among the human population.

In terms of environment control, Polynesia is quite permeable to alien species introduction though a control, yet succinct, was recently established at the borders. In addition, such an extent territory with multiple accesses confines the fighting abilities against any biological agent accidental or illegal introduction. This state of matters has led dozens of animal and plant invasive species to be introduced in Polynesia, among which *W. Auropunctata*.

A.2.2 history of *Wasmannia auropunctata* invasion in Tahiti

We know now that the species was listed in Polynesian wildlife in the 1990s (Jourdan Pers. comm., 2004), and it is now 2 years since the invasion is mapped, monitored and actively fought with appropriate chemicals to his lifestyle.

This ant has several advantages compared to local wildlife, which allows it a rapid advance in undergrowth. New Caledonia's example proves that it is perfectly capable of covering several hundred square kilometres without being disturbed by the local wildlife (Jourdan, 1997; Le Breton et al, 2003). Tropical islands protected and rich in fragile endemic species are a greenfield site ideal for the spread of these invasive species. But given its small size, rivers and roads are obstacles to its expansion. Unfortunately in tropical forest areas, many large trees provide an ideal support to cross those barriers, without counting poles and electric cables enabling it to cross obstacles. It is found mainly on the underside of trees or shrubs leaves where it grows its homopterous herds.

Historically, the fight has started because of the aggressive nature of the ant; some dwellings in infested area were turn into veritable ant nests (Fig. 4). This ant is hardly aggressive in the strict sense, but trapped against the skin under clothing or bed sheets, it attacks immediately. It should also be recorded that the presence of this ant in a garden may make it impossible to work in gardening, as well as New Caledonia's invaded coffee

plantations have been gradually abandoned because of the incessant bites. The adverse effects on the skin are not only a local inflammation, but also an intense burning sensation lasting at least forty-five minutes (Fig. 5). In some cases, infections can last for several weeks, which could suggest subcutaneous injection of biological resistant agents during the sting. In the current state of research, it is known no predator, no parasite and no disease. Fighting it, the most effective molecule known is Hydramethylnon whose pharmaceutical and chemical representative is Amdro®. It is a bait consisting of broken corn grain, oil bathed (soybean, peanut) and Hydramethylnon. This mixture has the property to attract ants and do kill after a while in the body of the latter, by blocking the transport of mitochondrial electrons causing lethargy then a fatal respiratory arrest in insects that ingested it. This is a systemic insecticide, that the workers relate to the nest and helps eliminate birthing ants directly. It is important to note that this product is destroyed by ultraviolet light exposure and humidity which makes it not very persistent in nature. Unfortunately, if that is its greatest ecological asset, it is also its greatest weakness in humid tropical environments such as the Polynesian territory. So if its effectiveness is true, there are drastic conditions for its application (at least 48 hours without rain and never in the middle of the day).

A.2.3 Mapping the Polynesian invasion

To highlight the limits of Polynesian colonies, we followed the example of Hawaii which also faces an invasion of *W. Auropunctata*. We therefore used the protocol described by the College of Tropical Agriculture and Human Resources (2006) to delineate the invaded areas on Tahiti island (Fig. 6).

This protocol is done in 4 key steps:

1. Retrieving small lollipop sticks or ice cream that is slightly covered of peanut butter (essentially very attractive for these ants).
2. Have these baits points location set through a satellite coordinates reader (GPS, Global Positioning System standard benchmarks for WGS_84 coordinates).
3. Reading and immediate preservation of bait covered with ants in plastic bags sealed GPS recording of each test.
4. The bags are kept in refrigerator 20 minutes to kill ants, and then reviewed, as required under a binocular magnifying glass for accurate identification of collected ants.

The work was carried out in several successive waves, by several actors in the fight against the invasion: men of the *Marine Infantry Regiment of Pacific* (Polynesia, RIMaP / P), led by the *Department of Environment* and the law 1901 association, *Fenua Animalia*. Also with the help of the environment study department *Tai Pae Pae Uta*, and the urban planning study *Geomatrix* to do GIS maps (Geographical Informatics System). People involved have travelled suspected areas by laying baits in strategic locations to determine the best boundaries of the 2007 invasion. The coordinates collected were compiled for a mapping of all these tests with the software ArcGIS 9 ®. To do this, the authors of this work (the *Department of Environment*, the provider *Géomatrix* and Mr. Eric Loeve) have merged Ordnance Survey maps at the 5000th and recent aerial photographs (Cartographic resources 2004-2006 of the Ministry for Urban Development of French Polynesia) with collected items. For most of the ridden areas, it is residential areas often in extension work on hillsides or in the direction of ridges, and therefore carries a high probability of release by earth-moving machinery. There are also ants in other territories. Furthermore, the important trade in ornamental plants in Tahiti has also spread via earth originating from invaded commune. It is not intended to exclude the presence of unknown colonies as areas of tropical forest are difficult to explore, especially on ridges sides or deep into valleys. This is particularly true because all the mechanisms of its natural release have not yet been identified: Some colonies

were discovered (*Ahonu* top) beyond all known wildcard patterns of release. The largest colony is located Tahitian listed in the residential hills of the town of Mahina. Satellite views modelling of the area was conducted from Google Earth ® software (Fig. 7).

A.2.4 "Florida spots" in Polynesia

Initial observation of these original lesions occurred in the cat in 2002. Owners reported the presence of white ocular "tasks", within limited geographical areas.

To picture the discovery of these lesions, it is important to clarify that there is no refuges from any Society for Animal Protection in Polynesia, abandoned animals collected by volunteers. For some volunteers one can sometimes find dozens of "adopted" animals by the family (*Fenua Animalia* Association, Pers. comm.). These shelters are usually private homes with a garden allowing animals – which are generally not confined – to come and go depending on the degree of their exploratory behaviour. It is first these volunteers who have been made aware of the impact of these lesions in dogs and cats populations. These individuals have observed in the eyes of their cats unusual lesions appearing as white tasks on the surface of the cornea (Fig. 8). Veterinarian consultations led to a primary exclusion diagnosis of viral keratitis according to the wide prevalence of feline leukosis in French Polynesia. The prescription of antivirals did nothing. It was then that some aware owners noticed the same type of lesions in dogs (Fig. 9), signing an indiscriminating cause or agent concerning the attained species.

Mostly, primary lesions are invisible to an unsuspecting audience (Fig. 10), which may explain that most animals are presented and suffering extensive injuries. The references to such injuries reported “Florida spots”, “Florida keratitis/keratopathy” or “tropical keratopathy” (Roze et al, 2004). The disease seeming fairly limited in terms of geographic areas on the island of Tahiti, we legitimately thought of an endemic problem such as to a single contaminated residential sector, we had more than 20 attained animals. Moreover, identically to the literature listed cases, the most affected animals are those living mainly outdoor while the indoors and sedentary animals have little or no clinical signs. Finally, in those residential areas of *Mahina* hills were recorded the most important cases of *W. Auropunctata* domestic invasions.

Therefore, in order to better define the potential treatment and prophylaxis against this eye disorder, and given many literature quotes available referring to problems associated with this ant stings, we tried to explore the possibility of a link between eye injuries in domestic animals and the presence of *W. Auropunctata*.

A.3 Assumption of a *Wasmannia auropunctata* linked keratopathy (WALK)

A.3.1 The Florida keratopathy or tropical keratopathy

The condition known as Florida keratopathy, "Florida spots" or tropical keratopathy (Moore, 2005), is currently still ill-defined, and only its classic eye symptoms are documented, but its exact etiology remains unknown. Veterinarian Dr. Moore, in his inventory of eye damage in cats, defined as a pathological entity belonging to the group of non-ulcerative keratopathy. The entity is characterized by multifocal opacities circumscribed in earlier stroma observed in cats and dogs; these injuries vary in size and color (gray and white), they can have a velvety appearance with cottony, they are more dense in the center in

suburb (Fig. 11). Patients seem to show any discomfort or pain evident when the lesions are discussed, and these lesions did not respond to conventional treatment (antibiotics, antifungal agents, or steroids). No officers were isolated from these injuries, except for a dog where an unknown body resembling a mycoplasma could be highlighted.

In Martinique, the veterinary surgeon Roze and his staff are registered and lesions known as "Florida spots" (2004), reported their findings in non-ulcerative lesions of 1 to 11 mm in diameter, not observed in painful animals living on the outside. The lesions appear lower when the animals are in Europe. In addition, all cases in the territory french metropolitan reportedly stayed in endemic areas of tropical keratopathy. The fact remains that, for all the cases observed in the current literature, the primary cause of injury is unknown, although several hypotheses are advanced (fungus, atypical bacterial keratitis...). The question remains as to the absence of inflammation.

A.3.2 The observations of eye injuries in infested areas

References observations on the ground are numerous and have long suspected a link between different pathologies and this ant bites. Apart from the local rumours about this ant "electric" or "Little Fire Ant" can be seen in the literature few comments of some of the risks associated with bites:

- In Gabon, *W. Auropunctata* was introduced voluntarily to control certain populations Hemiptera threatening crops. Mention is made of elephant (*Loxodonta africana cyclotis*) suffering from progressive blindness in areas overrun (Lopé, Petit Loango, Wonga Wongué). In addition there are ants in the hair of cats suffering from these opacities, the veterinarian William Karesh (*Wildlife Conservation Society*) concluded at the time of traumatic lesions probably due to bites (Wetterer *et al.*, 1999).
- In the Galapagos Islands, it is reported the devastating impact on the diversity of arthropods endemic, as well as large reptiles. Reproduction of turtles (*Geochelone elephantopus*) is threatened because of predation on eggs and bites at the cloaca and eyes of the layers (Silberglie, 1972; Lubin, 1984).
- In New Caledonia (Grande-Terre and the Loyalty Islands), invaded areas cover several thousand hectares, within which have reported, among packs of stray dogs, eye damage very important.
- For the Vanuatu Islands, the invasion is underway, with injuries related to florida spots among cats (Wetterer, pers. comm., 2007)
- In the Solomon Islands, are reported in this ecosystem also invaded the possibility of eye damage linked to *W. Auropunctata* in cats (Pacific ant prevention plan, 2004)

It was through observation of Polynesian cases, relatively recents, presenting these new and atypical lesions, literature and field observations that we checked the hypothesis of a link between the invasion of *W. Auropunctata* and this keratopathy. In order to do that, the hypothesis was examined in a series of animals within a defined area invaded to try to identify a possible link between the simultaneous presence of lesions and ants.

B) Materials and Methods

B.1 Study of a clinical cases serie in the invaded area

The analysis involves the island of Tahiti in July 2006, and especially the mega-settlement in the town of Mahina (Fig. 12a). We have been able to examine 36 animals (Appendix I) in the residential area “*Supermahina / Mahinarama / Opaerahi*” (Fig. 12b) among which 24 were manifesting “Florida spots”. The sample consists in 16 dogs and 20 cats. To study the data we chose to test two parameters:

- The presence of characteristic lesions
- The presence of *W. Auropunctata* in the immediate environment

The animals were selected according to two criteria; 1) calls for owners of an animal attained on the one hand and 2) examination of other animals of the family and the neighbourhood on the other hand. The houses visited are located on a map of the residence (Fig. 13).

It was considered that, for dogs living in a fenced field and whose owners are doing the treatment against ants in their garden, the environment could be considered as not a part of the invaded area. Similarly, for cats living exclusively inside of a house, they have no contact with an area invaded, knowing that houses insides are better protected against the ant by their owners.

The data were studied by contingency between the presence of an ant and the presence of ocular lesions. The figures are compared with a Chi-square test.

B.2 Ophthalmic examination of animals affected

B.2.3 Symptomatology

Each animal underwent a general review and a thorough eye lesions examination with a photograph of most animals; corneas were observed with the portable slit lamp (Neitz SP). For each of the animals, we set out two maps lesions at the eye:

- 1) In four quadrants: Nasal, Superior, Untersee and Temporal (Fig. 14a)
- 2) In three zones: Superior, middle and bottom. We defined the limits of these zones by two lines passing through the visible top and bottom edges of the third eyelid. Those parallels unite the nasal and temporal angles (Fig. 14b).

Each of these divisions is given a grade (Appendix II) ranging from 0 (no damage) to 4 (over 75% of damage). The averages of each division are compared with an ANOVA (Annex IIIa and IIIb).

B.2.4 Epidemiology

We accounted for the following parameters: species, sex, racial type, presence of anti-ant systemic treatment and geographical location. We try to define an assessment of the common characteristics to patients housing places. For patients whose history was known, it was noted the evolution of lesions according to the owner history. For most patients we

evaluated exploratory behaviour (homebody or not, fenced environment or not). Eventually, one of the owners knew the statutes of his cats against the leucosis feline virus, and feline immunodeficiency virus. These data were added to the inventory.

C) Results

C.1 Study of a clinical cases serie in the invaded area

This approach helps to declare that there is a relationship between the areas overrun by *W. Auropunctata*, and the presence of eye injury.

All dogs subjected to that environment presented lesions, while only a dog living in a fenced and treated area showed lesions (Tabl. Ia). All cats subjected to the invaded environment are attained (Tabl. Ib).

We note that on this sample, 100% of ill dogs live in contact with the ant, 90% of dogs living in a protected environment (Fence and treatment or ant-free enclave) are healthy. Regarding the cats, 94% of cats living in contact with the ants present injuries, 100% of animals living in the protected area are healthy (homobody individuals).

The sample examined thus conclude that the animals presenting florida spots have, for an overwhelming majority, been in contact with the invaded area (Dogs $K^2 = 12.34$; Cats $K^2 = 12.59$).

C.2 Review of cases of Kératopathie Tropicale in Polynesia

C.2.1 Symptomatology

Some animals heavily attained have a difficult assessment of volumes and distances in broad light, but for others there is little visual impairments; the examined animals do not appear to present any evidence of chronic eye pain. However, some animals have shown uni- or bilateral blepharospasms episodes regularly associated with a transient hyperaemia of the palpebral conjunctiva (Fig. 15). The animals which presented a blepharospasm also presented solitary confinement comportment for a variable time after the externalisation of this symptom; from a minimum of twenty minutes (some cats have developed symptoms over two hours). We noticed transient serous ocular flows associated with the phases of blepharospasm in our patients.

Lesions appear as round opacities with various diameter ranges from white to gray. The density of opacities is variable and heterogeneous; it is nevertheless possible to establish a dense centre often associated with a fluffy periphery. Lesions wear many forms, from a discreet halo focused on one point to a frank opacity.

Apart from these opacities, the cornea is perfectly normal, iris and the rest of the eye did not seem to present any pathology. The slit lamp exams reveals that only the anterior segment of the corneal stroma is reached, the epithelium remains intact. We have not recorded abnormal lens.

Among the animals affected, calculating the average for the lesion area it can be seen that:

- The animals are mostly attained bilaterally and equally.
- The animals are affected equally in each quadrant (the averages for each quadrant are not significantly different $p = 0.41$).

- Animals are, on the average, affected in the middle of the eye (the averages for each area are significantly different, $p < 0.05$, Fig. 16).

The lesions have a variable that has been observed among some cats whose history was very detailed:

- *Marinette* (5 years) had no injury until 2002, and in 2004 his two corneas were opacified at 95% (Fig. 17).
- *Tougris* (6 years old in 2004, deceased) had no injury in 2001, when he died (hit by a car) her two corneas were opacified at 95%.
- *Indycat*, *Bilbo*, *Pipistrelle* (same sibling, 2.5 years) have bilateral lesions of variable scope, respectively 75%, 80% and 50% of corneas attained.
- *Minicat* (same sibling, 2.5 years) has only a few points and differs from the other three by the fact that it leaves little home.
- *Mamouchka* (9-10 years) has no visible injury and never goes out of the house.

The trend is fast for animals whose exploration behavior is developed since it takes less than three years so that both eyes are fully attained.

Other notable, 2 cats showed alopecia important due to frenetic licking of the ventral side of the abdomen and hind legs. Both animals showed no signs of external usual parasites, nor any symptoms of allergic dermatitis (Fig. 18).

C.2.2 Epidemiological data description

Analysing the data, it is not possible to identify a link between the injury and the following factors:

- Sex ($0.07 K^2 =$ not significant)
- The status virus in cats regarding cats leukosis ($0.55 K^2 =$ not significant)

Moreover, it seems difficult to say that injuries occur more in terms of a racial type since the animals suffering are of all kinds. Age does not seem to affect either given the evolution of the lesions. It also appears that dogs are, proportionately less affected than cats.

D) Discussion

The mega-settlement in the residential area of the hills of Mahina is best described because warnings to the government and public awareness began in the area. In addition, for the moment it is also of the largest colony with the toughest domestic consequences. This explains the number of animals and their care, because it is here that *W. Auropunctata* is the best established. We could also note a few cases of severe trauma in the human population often overwhelmed by the scale of the problem; some people are physically and morally threatened by ants. These observations merely clarify the invasiveness and danger associated with this introduced species.

It is obvious that data analysis is biased because harvesting data we first responded to calls from individuals seeking explanations for the injuries of their animals. The research for witness cases around erodes a little the bias. However, according to data analysis and field experience, we believe there is an obvious link between *W. Auropunctata* and florida spots.

These results also confirm the results already obtained in the literature, affected animals live outside, lesions are rare and their appearance seems linked to endemic areas. In addition, the dogs seem to be less affected than cats in general. This could be explained by the large difference in the treatment and behavior of dogs, they often cannot leave the pen and are of a

size generally greater than cats, so their eyes are less in touch with the low vegetation. As we formerly explained, this ant uses its area of life and breeding to the underside of leaves of trees and shrubs. The assumption that the cats would be more submitted to this pest is consistent in the sense that they are in regular contact with the herbaceous layer on their moves.

We have made a step forward in the characterization of this pathology involving other symptoms in these lesions, whose previous analysis could not state by examining the animals outside their environment and at a distance of the primary causes. The presence of an acute phase of inflammation is a breakthrough that should be added to the symptoms of the disease. In addition, exposure to these ants seems to be able to cause licking alopecia, probably due to bites. It should be noted that only animals that are very reckless towards stinging suffer from the latter symptom.

The sting of the cornea by *W. Auropunctata* is our main hypothesis about the pathogenesis of injuries. This will be a search field in the future, establishing it with certainty. Note that the workers measuring barely a millimeter, it is likely that the stinger cannot move across the cornea, which may explain the absence of damage to the epithelium. We talk about various alternatives to the causing agent: stinger, venom, stinger and venom, contact substance of the cuticle, mechanical injury of the cornea by members of the ant, and the list is not exhaustive.

We may also make an assumption upon the distribution of lesions in the eye. An ant which might fall into the eye – while movements of animals in the bush – could hamper the animal, which in blinking eyes, causing the bite accordingly to the crash of the ant between eyelids. This theory may explain the fact that the injuries are concentrated in the middle of the eye and are more abundant on the lower than on its upper part.

Recently, it should be noted that the emergence of new cases or new lesions appear to be somewhat slowed by efforts to treat invaded areas with hydramethylnon by the government. According to several residents of contaminated territories, the development of these spots on the eyes of animals has greatly slowed down or completely stopped since 2005 and even more since they treat their land regularly on the sidelines of public action. The number of episodes of blepharospasmes would tend to increase or resume immediately after that the treatment is interrupted two or three months (E. Loève, *pers. comm.*).

For example, since 2005, the Polynesian government has launched a series of campaigns. During the first campaign, we assessed the extent of flooded areas over 100 hectares for the only area of Mahina hills. The treatment was conducted on the basis of 7 kg / ha of Amdro® in bush areas by 6 teams of 4 agents. It may be noted that if the colony is still in the area in 2006, it is thinner around dwellings with repeated treatments. However, given the size of the area and intensity of the invasion, it is impossible to predict how long it will take for it to be reduced, which means that treatments must remain intensive and regular.

In order to shed light in the discussion on the current state (2007) in the fight against *W. Auropunctata* in French Polynesia, it should be noted that the detection of affected animals in the town of Arue helped highlighting a new settlement in the *Tefaaroa* valley. This latest data adds to the very strong suspicion that weighs on the relationship between ant and the tropical keratopathy.

The Institute for Research and Development (IRD) in New Caledonia has been studying for several years the ant; some researchers are now examining the venom of *W. Auropunctata* to determine its composition (H. Jourdan, *pers. comm.* 2006). This information coupled with a histopathological examination of the injuries will probably bring even more knowledge of this keratopathy pathogenesis.

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