# Threats on Pacific islands: the spread of the Tramp Ant *Wasmannia auropunctata* (Hymenoptera: Formicidae)

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## INTRODUCTION

SINCE Elton (1958) highlighted the problem of biological invasions, numerous studies have established their importance in the structural evolution of natural communities, in particular insular communities. Because of their isolation, islands are regarded as natural evolution laboratories which are characteristically very fragile once the boundary is disturbed (McArthur and Wilson 1967; Williamson 1981; McDonald and Cooper 1995). This fragility is illustrated by the high proportion of species extinctions observed in islands: since 1600, more than 75% of monitored disappearances have been registered in islands (Goombridge 1992). Invasions are not an abnormality in the evolutionary process, but an increase in their rate could lead to a dramatic homogenization of fauna and flora.

The Pacific Ocean, sometimes referred as the "insular continent", possesses a large number of habitats of high endemism. Conservation of biological diversity on these islands is delicate due to the continual disturbance of the isolation barrier by humans who arrive with other alien species. For instance, dispersal of *Rattus exulans* L. is strongly linked to that of Polynesian navigators (Roberts 1991). Some invasions have exhibited a startling rapid expansion in the whole region; the land snail *Achatina fulica* (Bowdich) between 1930 and 1970 (Eldredge 1992), and the Leucaena Psyllid *Heteropsylla cubana* (Crawford) in the 1980s (Chazeau 1987) being two such examples. Other invaders such as ants have been more discrete in the initial phase, although some have nevertheless become pests in the tropical belt where they have been spread by humans. Many of these ant pests are "tramp species" which are characterized by polygyny, uni-coloniality associated with a high level of interspecific agressivity, and propagation by budding without a nuptial flight (Hölldobler and Wilson 1990; Passera 1994). A notable example of a tramp species is the small (1.5 mm) Myrmicine ant *Wasmannia auropunctata* (Roger), which originates from tropical America.

## INVASION OF THE GALAPAGOS

Accidentally introduced between 1924 and 1934 to Santa Cruz island (Kastadalen 1964 in Silberglied 1972), *W. auropunctata* has spread with human expansion over most of the Galapagos archipelago: San Cristobal, Santiago, Isabella, Floreana, Pinzon and Marchena (Abedrabbo 1994). This species possesses biological traits which have enabled it to colonize a wide range of habitats and its expansion in the archipelago appears to be only limited, both altitudinally and geographically, by high temperatures and low humidities or by low temperatures and high humidities (Clark *et al.* 1982; Lubin 1984). The success of *W. auropunctata* in invading habitats has led to its predominance in certain arthropod communities: in regions where it establishes it often reaches higher number than other Formicidae in the same area. Hölldobler and Wilson (1994) describe the invasive nature of *W. auropunctata* as "famous for its dense populations . . . forming in many places a living blanket of ants". Part of the native fauna is excluded, with at least 17 ant species affected by the invader (with cohabitation only possible along the margins of the invaded zones) and only four hypogeic ant species are able to subsist in heavily infested areas, due to their non-overlapping habits. At least one species of scorpion and two species of Theridiidae are totally excluded and an ant eating Thomisidae, a species of centipede and certain Tenebrionidae are becoming rarer due to predation by *W. auropunctata*. In addition, a lower abundance and diversity of flying and tree-dwelling insects is found in invaded zones than in non-infested zones. In contrast, several groups appear to benefit from this invasion, including an Oonopidae spider (inquiline of ant nests) and several honeydew producing Homopteran species, especially Coccidae (Silberglied 1972; Lubin 1984). In spite of control measures, *W. auropunctata* remains a major problem in the Galapagos (Ulloa-Chacon and Cherix 1994).

## INVASION IN NEW CALEDONIA

The recent introduction and subsequent expansion of *W. auropunctata* in New Caledonia

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has resulted in possibly the most dangerous pest ever introduced in this archipelago. Recorded for the first time in 1972 (Fabres and Brown 1978), human activity led to its progressive invasion of the main island, the Loyalty Islands, the Isle of Pines and even the isolated uninhabited island of Walpole. Before its arrival, New Caledonia was devoid of painful terrestrial stinging arthropods. However, this species is now such a well-known stinging pest that local people call it the "electric ant". The "Little Fire Ant" is another vernacular name used worldwide to describe the painful nature of this species. Initially, *W. auropunctata* was confined to urban and rural areas (fields, gardens, pasture and traditional houses). However, the present day distribution includes a wide range of natural habitats: sclerophyll dry forest, rainforest on ultramafic substrates, rainforest on acid substrates, rainforest on calcareous substrates and "maquis minier" (heath land) (Guilbert *et al.* 1994; Jourdan, in press. Electric ants were previously restricted to the plains, but have now invaded higher altitudes; having been recorded at 400 m in the southern part of the island (Mts Koghis) and around 600 m in the north-east (Mt Panié). Preliminary results from current research on the impact of *W. auropunctata* on the fauna of New Caledonia show a partial exclusion of the native ant fauna and a decrease in the reptile populations in heavily invaded sections of the sclerophyll dry forest (Jourdan, in prep.). Other terrestrial groups, such as mygalomorph Barychelidae, several arachnid araneomorphs (Gnaphosidae, Salticidae . . .) and certain Carabidae also appear to be affected (Jourdan, in prep.). Of the canopy invertebrates, pseudoscorpions are excluded from invaded areas (Guilbert, pers. comm.). In contrast, *W. auropunctata* invasion benefit honeydew producing Homoptera as witnessed by the population explosion of Coccidae throughout the savannah regions of the main island following the establishment of *W. auropunctata.* The most affected natural habitats are sclerophyll forests, which form a discontinuous chain of isolated relictual patches (3% of its former range) separated by extensive savannah (Bouchet *et al.* 1995). In heavily infested sclerophyll forests, up to 60% of overall arthropods collected from the canopy by chemical knockdown are Little Fire Ants (Guilbert and Chazeau, pers. comm.) and up to 6 nests/m$^2$ were observed at the ground level. *W. auropunctata* is continuing to expand its range throughout New Caledonia, and its expansion seems only limited by extreme local microclimatic conditions, especially by arid conditions as witnessed on the west coast, where *W. auropunctata* is never observed in *Acacia spirorbis* formations (derivated from natural sclerophyll forest after bush fires), which is one of the hottest and driest habitats in New Caledonia.

## DISCUSSION

*W. auropunctata* has achieved a similar success in two different oceanic insular environments: a recent volcanic archipelago with relatively few plant communities (Galapagos islands) and an old continental island with diverse plant communities (New Caledonia). This success is in strong contrast to that observed in its original range, where it never dominates the communities (Panama: Levings and Franks 1982; Costa Rica: Tennant 1994) except in tree crop plantations, especially cocoa (Brazil: Majer *et al.* 1994) or on large continents where it has been introduced and has only a localized impact (Florida in North America, Cameroon, in Africa). In general, the consequences of invasions on insular environments are more pronounced than in large continents which could be due to their smaller area and the fact that insular regions possess disharmonic faunas which lack entire groups, especially representatives of higher trophic levels (Simberloff 1995). Insular regions of the Pacific are depauperate in Formicidae when compared to the rest of the tropics. For instance, Wilson (1987) recorded 26 ant genera and 43 ant species on a single tree in the Peruvian Amazon forest, which is more than the entire Galapagean ant fauna of 29 species (14 native species and 4 endemic ones: Lubin 1984). In Polynesia, Wilson and Taylor (1967) indicate that prior to human arrival, native ants were absent east of a line New Zealand/Rotuma/Samoa/Tonga. In New Caledonia, the ant fauna counts about 100 recorded species (Taylor 1987), and it is characterized by a high level of endemism (about 65%) and many primitive traits: one Myrmeciinae, four species of Cerapachyinae and at least 35 species of Ponerinae. Nevertheless, Guilbert *et al.* (1994) have shown that for a New Caledonian rainforest canopy, ants represent only 1% of the total trophic guilds, compared with 19% in Bornean rainforest (Stork 1987). Ecological niches which would otherwise be occupied by Formicidae in the tropical belt, appear to be only partially occupied, or occupied by other arthropods, in the insular Pacific. This might be the reason for the spectacular spread of *W. auropunctata* in the invaded areas. Little Fire Ants may invade these potentially vacant niches, exploit the available resources and exclude native ants and other arthropods. Their spread may be favoured by their "tramp species" attributes, specifically mass recruitment, their capacity to exploit phytophagous Homoptera, their unicolonial societies, their continual activity (24 hours a day) and their aggressive predatory behaviour associated with their capacity to use repulsive pheromones in monopolising a resource (Howard *et al.* 1982). Thus entire guilds are replaced by one opportunistic species, which tends to take over the entire potential ecological niche of Formicidae and endanger the fragile equilibrium of insular communities. The absence

of competitors, predators or parasites from its area of origin may further assist in its invasive success.

## CONCLUSION

Contrary to solitary invaders, the sociality of ants induces a delay in population establishment: the time of larval development is long, and only a certain proportion of individuals are reproducers which are capable of establishing new colonies. Once the species is well established, however, its noxious nature becomes apparent. By possessing the characteristics of a "tramp species", *W. auropunctata* is potentially able to establish throughout the entire tropical Pacific region. It is already recorded in Wallis and Futuna (Gutierrez 1981) in similar plague proportions to that encountered in New Caledonia, and in the Solomon Islands (Ikin 1984 in Ulloa Chacon and Cherix 1994).

Other displaced tramp species may also alter insular Pacific faunas (e.g., *Pheidole megacephala* (Fabricius) and *Linepithema humile* (Mayr) in Hawaii (Cole *et al.* 1992)), but the amplitude and rate of their spread seem lower than that of the Little Fire Ant. *W. auropunctata* represents a visible threat to biological conservation in the whole Pacific region. It endangers the fragile equilibrium of insular ecosystems which are not equipped for the arrival of such a competitor. In addition, the painful sting of this species has an economic impact on agricultural productivity and public health. The social nature of *W. auropunctata* reduces the likelihood of finding a predatory organism to control it. No successful form of biological control exists for Formicidae (Mann 1994) and other methods of controlling invasive ants offer little hope, witness the 40 year stalemate in the control of *Solenopsis invicta* Buren in the USA (Mann 1994).

### What can be done?

The decrease in biological diversity and transformation of invaded communities raise important questions relating to the evolution of island faunas, the dynamic processes of biodiversity and the maintenance of natural communities in a long-term perspective. However, its spread through fragile island ecosystems is a serious concern for the conservation of biodiversity and urgent measures are needed to answer this problem.

Based on current knowledge, the best method of control is to prevent the dissemination of this pest. A more concerted effort in screening by the quarantine services in insular countries may halt the expansion of *W. auropunctata* and restore the isolation barrier interrupted by human colonization. These retarding methods may permit sufficient time for further advances in the study of its biology and the discovery of a natural control in its original environment.

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