

Fig News



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Fig News



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FROM THE EDITORS

It has been pretty hectic the last 3 months (with field work in Madagascar and Indonesia), but we have more or less managed to maintain our bi-annual printing schedule, as this issue of *Fig News* more or less coinciding with the first anniversary of the newsletter. We have material in hand to fill the next couple of issues, but are still short of "current events", notices such as field trip notes, etc. Prospective correspondents please take note!

Eagle-eyed readers will note that there are now two addresses for *Fig News* correspondence. This is due to the imminent departure of SGC to the frozen north (Yorkshire, England). Production of the newsletter will, nonetheless, continue to be in South Africa for the immediate future (production costs are lower here).

We wish Daniel Lachaise a speedy recovery from his current illness.

TONY WARE & STEVE COMPTON

CONFERENCE NOTICE

Forest Remnants in the Tropical Landscape: Benefits and Policy Implications. Smithsonian Institution, Washington DC. September 10 & 11, 1992.

Discussion topics will address the following issues: What types of species, ecological services, and forest products can be protected in forest fragments? What role can forest remnants play in habitat regeneration? Why do forest remnants shrink and disappear? etc.

Contact: Smithsonian Institution, Office of Conference Services, POBox 80343, Baltimore, MD 21280-0343.

LETTERS

ZDENEK BOUCEK writes:

At the moment I am trying to finish my study of the genera of the Neotropical Agaonidae (*s. lato*), which has become complicated because of continuing discoveries of Old World genera introduced and established in the American countries. So far there are only 2 new genera (both outside Agaoninae) and there are no Sycoecinae.

JORGE E. RAMOS writes:

En Columbia no se obtiene facil dinero para investigar en Fig, razón por la cual pregunto a Ud. si podrian financiar investigación del Fig. *Fig News* podria publicar mis trabajos en Espanol? Donde poder enviar *Ficus* spp. para identificar? especialmente las especies colombianas. A quien enviar los *Pegoscapus* spp. para obtener identificación? Necesito financiación para hacer un estudio taxonómico de los *Ficus* spp. del valle del Cauca (Colombia).

(If you are able to help please write: Address Director Herbario CUVC, Universidad del Valle, Apartado Aerea 25360, Cali, Colombia)

RESEARCH NEWS

RESEARCH IN PANAMA:

Allen Herre has given us an impressive synopsis of the fig research currently going on in Panama. The major projects are:

1. Effects of nematode parasites on fig wasps (Allen Herre)
2. Molecular genetics of nematodes, wasps and figs (Allen Herre, Carlos Machado, Eldredge Bermingham and Donald Windsor)
3. Detailed phenologies of figs (Adalberto Gomez)
4. Water relations in different fig species (Sandra Patino)
5. Paternity analysis of fig crops using protein electrophoresis (John Nason)
6. Detailed studies of disperser behaviour (Ruth Hamilton)
7. *Ficus paraensis* - *Azteca* ant associations (Laura Schneider)
8. Fig demographics and bat associations (Charles Handley, Elisabeth Kalko)

FIELD STATION OPTIONS:

Hugh Spencer has provided the following information on The Cape Tribulation Tropical Research Station in Australia.

The research and educational facility is situated 140 km N of Cairns on the Coral Sea Coast of northern Queensland adjacent to Australia's World Heritage rainforest and conducts research of the Australian lowland wet tropics. Diverse coral fauna is to be found in the nearby Great Barrier Reef.

Researchers considering projects in the Australian lowland wet tropics are encouraged to contact the station. The past lack of research of the Australian wet tropics means that there are unlimited opportunities. Some long-term research programs on the ecology of the lowland tropical rainforest are in progress. These focus on seed dispersal and pollination, including cluster figs and their pollinators, and on the blossom and fruit bats in the area. The Field Study Centre offers scholarships for post-graduate studies (MSc/PhD) in subject areas relevant to the aims of the centre.

For more information contact the Director, Cape Tribulation Tropical Research Station, Private Mail Box 5, Cape Tribulation via Mossman, Queensland 4873, Australia. Fax 070 980 047/ Attention - Field Study Centre.

RESEARCH PROFILES

Zdenek Boucek: Fig-related Bibliography

1. 1981. Boucek, Z., Watsham, A. and Wiebes, J.T. The fig wasp fauna of the receptacles of *F. thonningii* (Hymenoptera, Chalcidoidea). *Tijd. Ent.* 124, 149-233.
2. 1988. Agaonidae. In: *Australian Chalcidoidea (Hymenoptera)*. C.A.B. International, Wallingford, Oxon, U.K. pp156-209.
3. 1991. The identity of *Dynatagmus* Mayr (Hym., Agaonidae, Sycophagnae). *Entomol. Mon. Mag.* 127, 190.

Interests

Fig biology but in particular their taxonomy; Chalcidoidea in general.

H.C. Godfray: Fig-related Bibliography

1. 1988. Virginity in haplodiploid populations: a study on fig wasps. *Ecol. Ent.* 13, 283-291.
2. 1991. Grafen, A. and Godfray, H.C.J. Vicarious selection explains some paradoxes in dioecious fig/pollinator systems. *Proc. Roy. Soc. B* 245, 73-76.

Interests

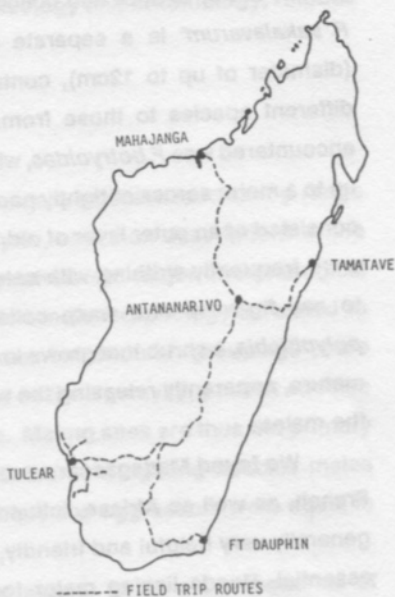
Theoretical issues concerning fig wasp biology, their evolution and community structure; general population biology and behavioural ecology (especially parasitoids).

T.N. Vijayakumar: Interests

Interactions between fig plants and frugivorous birds and the fruiting phenology of *Ficus* plants. He intends to continue to do a detailed analysis of fruiting and fruit characteristics of figs and their influence on fig resource utilisation by aves and other wild animals.

FIELD TRIP TO MADAGASCAR - 1992

After two years of fund raising, we embarked on a six week figging expedition to Madagascar in May. The team consisted of Tony Ware, Steve Compton, Sally Ross and Costas Zachariades, all from Rhodes University. With the capital city of Madagascar, Antananarivo, as our base, we undertook a number of field trips, which covered a good proportion of the island's habitat types, ranging from primary rainforest to arid spiny forest. Of the 25 recognised fig species in Madagascar (21 are endemic to Madagascar and the Comores) we collected wasps from approximately 16 species. Tentative identifications of the tree species are: *F. antandronarum*, *F. botryoides*, *F. brachyclada*, *F. grevei*, *F. humbertii*, *F. lutea*, *F. madagascariensis*, *F. marmorata*, *F. menabeensis*, *F. pachyclada*, *F. polyphlebia*, *F. rubra/reflexa*, *F. sycomorus*, *F. "sakalavarum"*, *F. tiliifolia*, and *F. trichopoda*. In addition we collected herbarium samples, leaf and wasp material for DNA studies, material for pollen studies and data on ant-homopteran interactions. Of particular interest from the phylogenetic angle were *F. humbertii* and *F. menabeensis*, as they belong to the mainly Asian section



Conosycea (subgenus *Urostigma*), which is not found in mainland Africa.

We did considerably better on open country fig species than on forest figs - much easier to spot and collect figs from the former! We are convinced that *F. sakalavarunt* is a separate species to *F. sycomorus*, with its huge figs (diameter of up to 12cm), containing thousands of wasps which are clearly different species to those from *F. sycomorus*. One of the more bizarre figs encountered was *F. botryoides*, with long lanceolate leaves and huge outgrowths up to a meter across of tightly packed figs on the trunks. These fig masses often consisted of an outer layer of old, rotting figs covering a core of young figs, and were frequently writhing with caterpillars, ants and homopterans - a challenge to any fig-wasp and wasp collector! Also of interest were the figs of *F. polyphlebia*, a shrub that grows in torrential streams. The figs split open as they mature, apparently releasing the wasps before exit tunnels need to be made by the males.

We found Madagascar a really fascinating country, with strong Asian and French, as well as African, influences in the people and culture. People were generally very helpful and friendly, but a basic knowledge of French is virtually essential. Roads linking major towns were often good, but many areas are accessible only by air or with a 4X4 vehicle. Public transport is plentiful (taxi-brousse, train, bus, air) and vehicles can be hired in the major centres. With a few exceptions, there appears to be little natural vegetation or wildlife remaining close to major routes - the richest areas are often very inaccessible. In order to conduct research and collect or export material, it is necessary to draw up an collateral agreement with the relevant Madagascan authority - a condition ensuring that Madagascar also benefits from the research in some way.

We would like to thank everyone in Madagascar and South Africa who assisted us both before and during the field trip, in particular Pete Phillipson and Simon Malcomber of the Missouri Botanical Gardens, and Evariste Randrianasolo and other staff at the Parc Botanique et Zoologique de Tsimbazaza. Funding was provided by Rhodes University and the Anglo-American Chairman's Fund.

Costas Zachariades

THESIS ABSTRACTS

STEPHANIE VINCENT (1991). Department of Zoology and Entomology, Rhodes University, Grahamstown 6140, South Africa.

Polymorphism and fighting in male fig wasps.

Male fig wasps (Hymenoptera: Chalcidoidea) exhibit a fascinating range of morphology and behaviour. A cluster analysis, based on descriptions of the males of several hundred species, distinguished six major morphological groups. Behavioural observations suggest that male morphology is related to the levels of inter-male aggression. Three behavioural groupings were identified. Fighting species generally mated in the fig cavity, pacifist species mated in the females' galls or outside the figs. Mating sites are thus the primary determinants of male morphology and behaviour. In fighting species males were larger than their females, whereas pacifists and aggressors were equal in size or small than conspecific females.

The large males in fighting fig wasps appear to be a consequence of sexual selection, because larger males tended to win fights. Within a species there were no differences in the size of the galls that produced males and females, even in species where sexual size differences were present, suggesting that there is a heritable component to wasp size. No alternate advantages for smaller males were detected. Although fights were sometimes fatal, damage was not always a consequence of fighting behaviour and was recorded in both fighting and pacifist species.

Sex ratios in several species were more female biased at higher population densities. Sex ratios of species with 'internally' ovipositing species were heavily biased, but approached 1:1 in more outbred species with 'externally' ovipositing females. Levels of matedness, among females ranged from 73% to 99%. No evidence for sperm exhaustion was obtained.

Species of *Philotrypesis* with both winged and flightless males were present only in southern African *Ficus* species from subsections *Platyphyllae* and *Chlamydodora*. No species had only winged males. The flightless males

of some *Philotrypesis* species were themselves polymorphic. In one polymorphic *Philotrypesis* species, winged males were found to be rare at high densities, but common at low densities.

Digitata and *religiosa* males of *Otiesella* differed in coloration, size and behaviour. *Digitata* males were aggressors while *religiosa* males were fighters. *Digitata* males escaped from the figs whereas *religiosa* males remained inside the figs, perhaps because only *digitata* males were attracted to light. Proportionally more *digitata* than *religiosa* males were present in low density populations and females were found to respond differently to the two morphs.

SIMON VAN NOORT (1992). Department of Zoology and Entomology, Rhodes University, Grahamstown 6140, South Africa (Present address: South African Museum, Cape Town, South Africa).

The Systematics and Phylogenetics of the Sycoecinae (Agaonidae, Chalcidoidea, Hymenoptera)

The Sycoecinae are a distinct and well-defined subfamily of old world fig wasps (Agaonidae, Chalcidoidea, Hymenoptera), exclusively associated with the figs of *Ficus* species (Moraceae). The most likely sister group of the Sycoecinae was determined to be the Sycoryctini (Sycoryctinae) based largely on synapomorphies of the underside of the head. 67 sycoecine species and 3 subspecies were recognised and included in the phylogenetic analysis of the subfamily. This analysis clearly delimited six genera (four African and two extra-African), although the phylogenetic relationships between the genera were not strongly supported and remain flexible. Comparisons of the phylogeny of the Sycoecinae with the classifications of the Agaoninae and their host fig trees (*Ficus*, Moraceae) suggest a degree of cospeciation *sensu lato*.

Numerous homoplasies were detected within the Sycoecinae, some of which were shared by another group of fig wasps that also enter the figs to oviposit, The Agaoninae. The anatomy of the figs apparently provides strong selection pressures that have resulted in both parallelisms and convergences

within and between the two subfamilies.

Among the 67 species and 3 subspecies that were recognised, 43 species and 2 subspecies are described as new. The males of three previously recognised species are also described for the first time. One generic and two specific synonyms are established, together with five new combinations. Keys are provided to the genera and species, for both sexes.

GUIDO GRANDI (1886-1970)

Guido Grandi was born 3 March 1886 in Vigevano near Bologna and graduated at the University of Bologna in 1911. He then became a research assistant at the University of Naples-Portici. Twelve years later he was nominated Associate Professor and in 1926 Professor of the Entomology Chair at the University of Bologna. After retirement in 1962 he was nominated Professor Emeritus. He died 10 December, 1970.

He was author of over 250 scientific publications which included comprehensive monographs on insect physiology, ecology and ethology. One of the most productive research effort of his career was his pioneering study of fig insects where he published nearly 60 papers on their taxonomy and ecology.

FICUS RELATED BIBLIOGRAPHY:

1. 1916. Gli Agaonini raccolti nell'Africa occidentale dal Prof. F. Silvestri. *Boll. Lab. Zool. gen. agr., Portici* 10, 121-286.
2. 1916. Nota su due Agaonini (Hymenoptera Chalcididae) dell'Australia. *Boll. Lab. Zool. gen. agr., Portici* 11, 145-149.
3. 1916. Contributo alla conoscenza degli Agaonini (Hymenoptera Chalcididae) di Ceylon e dell'India. *Boll. Lab. Zool. gen. agr., Portici* 11, 183-234.
4. 1917. Contributo alla conoscenza degli Agaonini (Hymenoptera Chalcididae) di Giava. *Boll. Lab. Zool. gen. agr., Portici* 12, 1-60.
5. 1917. Contributo alla conoscenza degli Agaonini (Hymenoptera Chalcididae) dell'Eritrea e dell'Uganda. *Boll. Soc. ent. ital.* 48, 1-42.

6. 1919. Contributo alla conoscenza degli Agaonini (Hymenoptera Chalcididae) dell' America. Agaonini di Costa Rica. *Boll. Lab. Zool. gen. agr., Portici* 13, 15-56.
7. 1920. Studio morfologico e biologico della *Blastophaga psenes* L. *Boll. Lab. Zool. gen. agr., Portici* 14, 63-204.
8. 1920. Descrizione di una nuova *Blastophaga* a maschi completamente astomi e di una nuova *Julianella* di Costa Rica. *Boll. Lab. Zool. gen. agr., Portici* 14, 251-264.
9. 1921. Recherche sul gen. *Philotrypesis* Forst. (Hymenoptera Chalcididae). *Boll. Lab. Zool. gen. agr., Portici* 15, 33-190.
10. 1921. Diagnosi preliminari di Imenotteri dei fichi. *Annali Mus. civ. Stor. nat. Genova ser. 3,9*, 304-316.
11. 1922. Agaonini e Sycophagini della Malesia e del Giappone (Hymenoptera Chalcididae). *Boll. Lab. Zool. gen. agr., Portici* 15, 205-222.
12. 1922. Ricostruzione e morfologia comparata dei generi *Otitesella* Westw., *Sycobiella* Westw. ed affini. *Boll. Lab. Zool. gen. agr., Portici* 16, 1-58.
13. 1923. Gli insetti dei caprifichi. Conoscenze ed incognite della loro storia naturale. *Riv. Biol.* 5, 69-90.
14. 1923. Identification of some fig-insects (Hymenoptera) from the British Museum (Natural History). *Bull. Ent. Res.* 13, 295-299.
15. 1923. Imenotteri dei fichi della fauna olartica e indo-malese. *Annali Mus. civ. Stor. nat. Genova* 51, 101-108.
16. 1923. *Neosychochyla omeomorpha* Grnd. e sua importanza biologica. *Boll. Lab. Zool. gen. agr., Portici* 17, 108-130.
17. 1924. Agaonini e Sycophagini olartici e indomalesi. *Boll. Lab. Zool. gen. agr., Portici* 18, 1-31.
18. 1924. Un nuovo Agaonino dell'Isola Maurizio. *Boll. Soc. ent. ital.* 56, 81-87.
19. 1925. Biologia, morfologia e adattamento negli insetti dei fichi. *Atti Soc. ital. Sci. nat.* 63, 288-311.
20. 1925. Morfologia del gen. *Tetrapus* Mayr e descrizione di una nuova specie della Costa Rica. *Boll. Soc. ent. ital.* 57, 1-13.
21. 1926. Hymenopteres sycophiles recoltes a Sumatra et a Java par E. Jacobson. *Treubia* 8, 352-364.

22. 1927. Hymenopteres sycophiles recoltés aux Phillipines par C.F. Baker. I. Agaonini. *Philipp. J. Sci.* 33, 309-329.
23. 1927. Una nuova specie di *Blastophaga* del Giappone. *Boll. Soc. ent. ital.* 59, 18-24.
24. 1927. Imenotteri sicofili raccolti dal Prof. F. Silvestri nell'Indocina, nella Cina, nella penisola Malacca e a Formosa. I. Agaonini. *Boll. Lab. Zool. gen. agr., Portici* 20, 169-188.
25. 1928. Hymenopteres sycophiles recoltés dans l'Inde par le Frere E. Gombert. *Bull. Soc. Zool. France* 53, 69-82.
26. 1928. Due specie di *Blastophaga* delle Isole figi ed istituzione di un nuovo sottogenere. *Boll. Lab. Ent. R. Ist. sup. agr. Bologna* 1, 65-70.
27. 1928. Un nuovo genere e quattro nuove specie di imenotteri sicofili di Sumatra. *Boll. Lab. Ent. R. Ist. sup. agr. Bologna* 1, 71-89.
28. 1928. Revisione critica degli Agaonidi descritti da Gustavo Mayr. *Boll. Lab. Ent. R. Ist. sup. agr. Bologna* 1, 107-210.
29. 1928. Catalogo ragionato degli Agaonidi di tutto il mondo descritti fino ad oggi. *Boll. Lab. Ent. R. Ist. sup. agr., Bologna* 1, 211-235.
30. 1929. Studio morfologico e biologico della *Blastophaga psenes* L., 2 edizione riveduta. *Boll. Lab. Ent. R. Ist. sup. agr. Bologna* 2, 1-147.
31. 1929. Aggiunte e modificazioni al catalogo ragionato degli Agaonidi di tutto il mondo descritti fino ad oggi. *Boll. Lab. Ent. R. Ist. sup. agr. Bologna* 2, 189-191.
32. 1930. Monografia del gen. *Philotrypesis* Forst. *Boll. Lab. Ent. R. Ist. sup. agr. Bologna* 3, 1-181.
33. 1931. Agaonidae-Chalcidoidea. In: *Resultats scientifiques du voyage aux Indes Orientales Meerlandaises de LL. AA. RR. le Prince et la Princesse Leopold de Belgique. Mem. Mus. R. Hist. nat. Belg. hors s.4, n.5, 5-7.*
34. 1931. Agaonini raccolti da W. Greenwood nelle isole figi. *Boll. Lab. Ent. R. Ist. sup. agr. Bologna* 4, 8-11.
35. 1934. Nuovi Agaonidi (Hymenoptera-Chalcidoidea) della fauna neotropica. *Boll. Lab. Ent. R. Ist. sup. agr. Bologna* 7, 186-197.
36. 1934. Catalogo ragionato degli Agaonidi di tutto il mondo descritti fino ad oggi (2 edizione). *Boll. Lab. Ent. R. Ist. sup. agr. Bologna* 7, 214-240.

37. 1935. Studio morfologico e biologico della *Blastophaga psenes* L. Avvertimento. *Boll. Lab. Ent. R. Ist. sup. agr. Bologna* 7, 210.
38. 1936. Agaonini raccolti dal Prof. F. Silvestri nell'America del sud. *Boll. Lab. Zool. gen. agr., Portici* 30, 1-8.
39. 1936. L'evoluzione dei ricettacoli del *Ficus carica* L. in rapporto con l'insetto pronubo (*Blastophaga psenes* L.) e con la coltivazione. *Mem. R. Accad. Sci. Ist. Bologna Cl. Sci. fis.* s. IX, 3, 109-122.
40. 1938. Una nuova specie di *Blastophaga* delle Isole Marquesas. *Bull. Bernice P. Bishop Mus.* 142, 199-201.
41. 1938. Nuovi Agaonidi (Hymenoptera-Chalcidoidea) raccolti nel Brasile dal prof. F. Silvestri. *Boll. Ist. Ent. R. Univ. Bologna* 10, 44-69.
42. 1938. Il *Ficus carica* L., la sua biologia, la sua coltivazione e i suoi rapporti con l'insetto pronubo (*Blastophaga psenes* L.). *Boll. Ist. Ent. R. Univ. Bologna* 10 223-280.
43. 1941. Catalogo ragionato degli Agaonidi di tutto il mondo descritti fino ad oggi (3 ed.). *Boll. Ist. Ent. R. Univ. Bologna* 13, 1-28.
44. 1952. Le agaonine della tribu dei Sicofagini e l'importanza del loro comportamento per la biologia generale. *Rc. Sess. Accad. Sci. Ist. Bologna, Cl. Sci. fis., n.s.56*, 50-53.
45. 1952. Insetti dei fichi senegalesi. *Boll. Ist. Ent. Univ. Bologna* 19, 31-45.
46. 1952. Insetti dei fichi messicani, malesi ed australiani. *Boll. Ist. Ent. Univ. Bologna* 19, 47-67.
47. 1952. Catalogo ragionato delle agaonine di tutto il mondo descritte fino ad oggi (4 edizione). *Boll. Ist. Ent. Univ. Bologna* 19, 69-96.
48. 1955. Insetti dei fichi (Hymenoptera-Chalcididae) dell'Africa Australe. *Boll. Ist. Ent. Univ. Bologna* 21, 85-106.
49. 1955. Scoptera del mashio del gen. *Lipothymus* Grandi e stato odierno delle nostre conoscenze sulla dei Sycophagini (Hymenoptera-Chalcididae). *Rc. Accad. Sci. Ist. Bologna Cl. Sci. fis., s. XI*, 2, 94-103.
50. 1955. Catalogo ragionato delle agaonine del mondo descritte fino ad oggi (5 edizione). *Boll. Ist. Ent. Univ. Bologna* 21, 107-139.

51. 1958. Gli imenotteri calcidoidei evolventisi nei siconi dei fichi. Vita, simbiosi ed adattamenti morfologici. Discorso tenuto al politecnico di Zurigo, in occasione del centenario della Società Entomologica Svizzera, il 13 aprile 1958. *Mitt. Schweiz. ent. Ges.* **31**, 155-167. Reproduced in: *Boll. Ist. Univ. Bologna* **23**, 167-179.
52. 1961. Le mirabili simbiosi intercorrenti fra gli "Insetti dei Fichi" e le loro piante ospiti. *Natura e Montagna ser.II*, **i**, 14-18.
53. 1961. The hymenopterous insects of the superfamily Chalcidoidea developing within the receptacles of figs. Their life-history, symbiosis and morphological adaptation. *Boll. Ist. Ent. Univ. Bologna* **26**, 1-13.
54. 1963. Una nuova specie di *Ceratosolen* Mayr dell'Africa occidentale (Hymenoptera Chalcidoidea). *Boll. Ist. Ent. Univ. Bologna* **26**, 231-238.
55. 1963. Istituzione di un nuovo sottogenere di *Blastophaga* Grav. (Hymenoptera-Chalcidoidea). *Boll. Ist. Ent. Univ. Bologna* **26**, 239-240.
56. 1963. Catalogo ragionato degli Agaonidi del mondo descritti fino a oggi (6 Ed.). *Boll. Ist. Ent. Univ. Bologna* **26**, 319-373.
57. 1964. Descrizione del maschio di un *Ceratosolen* Mayr (Hymenoptera, Chalcidoidea, Agaonidae), rinvenuto in Africa (Costa d'Avorio). *Boll. Ist. Ent. Univ. Bologna* **27**, 71-75.
58. 1967. La vita straordinaria degli "Insetti dei Fichi". *Scientia* **61**, 1-7.

(Kindly translated by Renzo Perissinotto from the full bibliography by Goidanich, A. (1971). Uno scienziato, un maestro, un uomo: *Guido Grandi*. Pubblicazione No. 156 del Centro di studio di Entomologia alpina e forestale del Consiglio Nazionale delle Ricerche)

BOOK PREVIEW

(Now in press and should be available shortly)

Berg, C.C. and Wiebes, J.T. African fig trees and fig wasps:
(Verhandelingen der Koninklijke Nederlandse Akademie van Wetenschappen.
Afr. Natuurkunde, Tweede Reeks.)

Figs (*Ficus*) and the pollinating fig insects (Agaoninae) form an unbreakable unity. It is true that individual fig trees can grow, but for their

propagation pollinators are indispensable. Outside the fig inflorescence, the pollinators live at the most for a few days and they can only reproduce within the figs.

Ficus is one of the most diverse plant genera with regard to habit, life-form and growth-form. In the Ethiopian region (Africa and Madagascar) 105 species are recognised, a number somewhat smaller than the estimated number (125-150) for the Neotropics, and about one-fifth of that for the Asian-Australasian region.

The pollinators are generally specific to their host fig. All 81 species recorded from the Ethiopian region are treated in the present study and their host relations discussed. Moreover, a survey is presented of all other hymenoptera reared from the figs: mostly parasitoids and commensals of the Agaoninae.

The book is a compilation of data accumulated through preparation of treatments for regional floras and revisions of Agaonine genera, supplemented by unpublished descriptions and data. It presents a synopsis of our knowledge, and allows students to identify the figs and wasps that they find in Africa.

RECENT PUBLICATIONS

- Benzing, D.H. (1991). Myrmecotrophy: origins, operation, and importance. In: *Ant-Plant Interactions* (Eds Huxley, C.R. and Cutler, D.F.). Oxford University Press, London. pp. 353-373. (Pearl bodies in *F. paraensis* and seed attractiveness to ants).
- Berg, C.C. (1991). Moraceae. In: *Flora Zambesiaca* 9 (6) (Eds Launert, E. and Pope, G.V.)
- Bronstein, J.L. and Patel, A. (1992). Causes and consequences of within-tree phenological patterns in the Florida strangling fig, *Ficus aurea* (Moraceae). *Am. J. Bot.*, 79, 41-48.
- Compton, S.G. (1992). Moraceae New records of *Ficus* species and their pollinators on Grande Comore. *Bothalia* 22, 46-47.

- Compton, S.G. and Robertson, H.G. (1991). Effects of ant-homopteran systems on fig-figwasp interactions. In: *Ant-Plant Interactions* (Eds Huxley, C.R. and Cutler, D.F.). Oxford University Press, London. pp. 120-130.
- Daniels, J.D. and Lawton, R.O. (1991). Habitat and host preferences of *Ficus crassiuscula*, a neotropical strangling fig of the lower-montane rain forest. *J. Ecol.* **79**, 129-141.
- Grafen, A. and Godfray, H.C.J. (1991). Vicarious selection explains some paradoxes in dioecious fig/pollinator systems. *Proc. Roy. Soc. B* **245**, 73-76.
- Hawkins, B.A. and Compton, S.G. (1992). African fig wasp communities: undersaturation and latitudinal gradients in species richness. *J. Anim. Ecol.* **61**, 361-372.
- Kristiansen, K. (1992). Micropropagation of *Ficus benjamina* clones. *Plant, Cell and Organ Culture* **28**, 53-58.
- Lambert, F. (1991). The conservation of fig-eating birds in Malaysia. *Biol. Conser.* **58**, 31-40.
- * Lambert, F.R. and Marshall, A.G. (1991). Keystone characteristics of bird-dispersed *Ficus* in a Malaysian lowland rain forest. *J. Ecol.* **79**, 793-809.
- Lin, T.-P., Feng, T.-Y., Chung, Y.-H. and Lan, C.-L. (1990). Quantification of methyl ester content of pectin by pectinesterase. *Bot. Bull. Academia Sinica* **31**, 273-278.
- Lin, T.-P., Liu, C.-C., Yang, C.-Y., Huang, R.-S., Lee, Y.-S. and Chang, S.-Y. (1990). Morphological and biochemical comparison of syconium of *Ficus awkeotsang* and *Ficus pumila*. *Taiwan. For. Res. Inst. New Series* **5**, 37-43.
- McConnell, J. and Muniappan, R. (1991). Introduced ornamental plants that have become weeds on Guam. *Micronesica*, **3**, 47-49.
- Midya, S. and Brahmachary, R.L. (1991). The effect of birds upon the germination of banyan (*Ficus bengalensis*) seeds. *J. Trop. Ecol.*, **7**, 537-538.
- ✓ Milton, K. (1991). Leaf change and fruit production in six neotropical Moraceae species. *J. Ecol.* **79**, 1-26.

- Paine, T.D. (1992). Cuban laurel thrips (Thysanoptera: Phlaeothripidae) biology in southern California: Seasonal abundance, temperature dependent development, leaf suitability, and predation. *Ent. Soc. Am.*, **85**, 164-171. (Thrips on figs).
- Paine, T.D., Malinoski, M.K. and Robb, K.L. (1991). Reducing aesthetic injury or controlling insect populations: Dilemma of insecticide use against Cuban laurel thrips (Thysanoptera: Phloeothripidae) in landscape-grown *Ficus*. *Ent. Soc. Am.*, **84**, 1990-1795.
- Perrin, H. (1992). Double radiation sur Fagales et sur *Ficus* (Moraceae) du genre *Curculio* (Coleoptera: Curculionidae). *C.R. Acad. Sci. Paris*, t. **314**, Serie III, 127-132.
- Powell, R.J. and Stradlind, D.J. (1991). The selection and detoxification of plant material by fungus-growing ants. In: *Ant-Plant Interactions* (Eds Huxley, C.R and Cutler, D.F.). Oxford University Press, London. pp. 19-41. (Chemical analysis of *Ficus* sp. leaves, fungal growth and fungus-growing ants).
- Ramirez B., W. (1991). Evolution of mandibular appendage in fig wasps (Hymenoptera: Agaonidae). *Rev. Biol. Trop.* **39**, 87-95.
- Schupp, E.W. and Feener, D.H. (1991). Phylogeny, lifeform, and habitat dependence of ant-defended plants in a Panamanian forest. In: *Ant-Plant Interactions* (Eds Huxley, C.R and Cutler, D.F.). Oxford University Press, London. pp. 175-197. (*F. insipida* ant-defended).
- Sohi, A.S. and Mann, J.S. (1990). A new species of genus *Daluana* Ramakrishnan (Cicadellidae: Typhlocybinae: Empoascini) infesting figs at Rishikesh (Uttar Pradesh) India. *Entomon* **15**, 267-269.
- * Strauss-DeBenedetti, S. and Bazzaz, F.A. (1991). Plasticity and acclimation to light in tropical Moraceae of different successional positions. *Oecologia* **87**, 377-387.
- Vines, G. (1992). Hitchhiking pseudoscorpions take beetles for a ride. *New scientist* (18 April), 17. (beetles emerge from rotting fig tree wood)
- Zeh, D.W. and Zeh, J.A. (1992). Dispersal-generated sexual selection in a beetle-riding pseudoscorpion. *Behav. Ecol. Sociobiol.* **30**, 135-145. (Beetles use newly decaying *Ficus* for mating and oviposition).