Inventory of Thysanoptera Collected from French Polynesia[1]

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Abstract: A survey for Thysanoptera was conducted in the Society (Tahiti, Moorea, and Raiatea), Marquesas (Hiva Oa, Nuku Hiva, Ua Huka, and Ua Pou), and Austral islands (Rurutu and Tubuai) archipelagos in French Polynesia from September 2003 to November 2005. At least 55 thrips species in 36 genera and three families were identified from 823 slide-mounted specimens that were collected from 61 host plants in 33 families. Twelve species are considered to be important pests. The greatest diversity of species, 43 (77%), was collected from the Society Islands, with 60% being recorded from Tahiti alone. Species diversity was intermediate in the Marquesas Islands at 43% (24 species collected), with 35% or 19 species being recorded from Nuku Hiva. Lowest diversity was recorded for the Austral Islands, with 38% or 21 species being found in that archipelago. Less than 10% of collected species are likely to be native, with the majority of identified thrips (>90%) in French Polynesia representing a high diversity of exotic species (leaf, flower, and fungus feeders, and four predatory species) that have successfully infiltrated other island groups in the South Pacific. Survey results and subsequent estimates of thrips species diversity in French Polynesia should be interpreted with caution due to uncontrolled variation in sampling intensity that was affected by survey duration, time of year, and visitation frequency to islands.

Many aspects of thrips (Thysanoptera) biology predispose this group of insects to an invasive lifestyle. Thrips are typically small, secretive insects that often exhibit high ubiquity, vagility (natural and human-assisted), and polyphagy (Morse and Hoddle 2006). These biological characteristics have assisted invasion into depauperate island ecosystems (Mound and Walker 1987) and species-rich continental complexes (Hoddle et al. 2004). For example, it is estimated that approximately 100% of thrips species in the small South Pacific island of Kiribati are exotic (Mound and Walker 1987), and in California, which has a diverse native thrips fauna, approximately 20% of recorded species are exotic (Hoddle et al. 2004). In New Zealand, ~45% of recorded terebrantian thrips are exotic (Mound and Walker 1982, Mound 2006). Inventories of Thysanoptera have been prepared for several island groups in the South Pacific, including New Caledonia (Bournier and Mound 2000), New Zealand (Mound and Walker 1982), Lord Howe Island (Mound 1998), Vanuatu, Kiribati, and Fiji (Mound and Walker 1987). These inventories clearly demonstrate that South Pacific islands have been successfully invaded by a multitude of incursive species that originated from Europe, Australia, and the Old and New World tropics. At time of writing, a thrips species list was lacking for French Polynesia. Consequently, the purpose of work presented here was to construct a preliminary inventory of Thysanoptera for this highly isolated group of island archipelagos in the far eastern South Pacific Ocean and to use survey results to determine the number of exotic and native thrips species for comparison with other South Pacific islands.

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TABLE 1

Thrips Species Collected and Host Substrate Records for Nine Islands in Three Island Groups in French Polynesia

Species Name	Society Islands			Marquesas Islands				Austral Islands		Host Substrate Records[a]
	Tahiti	Moorea	Raiatea	Hiva Oa	Nuku Hiva	Ua Huka	Ua Pou	Rurutu	Tubuai	
Flower feeding thrips										
**Frankliniella occidentalis* (Pergande)	X									19
**Frankliniella schultzei* (Trybom)	X			X	X	X	X	X	X	3,5,6,11,13,19,23,31,32,37,38,40,43,44,46,48,57,58
Frankliniella sp. *minuta* group	X									43
Haplothrips gowdeyi (Franklin)	X	X	X					X	X	1,3,9,10,20,23,27,28,37,38,42,47,52,53,56,59
**Megalurothrips usitatus* (Bagnall)			X					X		18,32,52
Microcephalothrips abdominalis (Crawford)	X									57
**Neohydatothrips samayunkur* Kudo	X		X							53,57
Pseudanaphothrips araucariae Mound & Palmer	X									37,43
Thrips florum Schmutz	X									31
Thrips hawaiiensis (Morgan)	X		X							12,35
**Thrips palmi* Karny	X			X	X			X	X	3,11,13,20,36,37,54
Thrips parvispinus (Karny)	X									12
#Thrips rapaensis (Moulton)	X									
Thrips safrus Mound & Masumoto	X		X							43,52
#Thrips sp. 1	X	X	X		X	X	X	X		8,12,18,23,25,28,31,32,34,35,40,42,43,44,45,48
Thrips sumatrensis Priesner	X									45
**Thrips tabaci* Lindeman	X							X		3,28,32
Leaf feeding thrips										
Asprothrips seminigricornis (Girault)	X					X		X		11,44,50
Biltothrips minutus (Bhatti)			X							16,41
**Chaetanaphothrips orchidii* (Moulton)	X				X	X				46,55,60,61
**Chaetanaphothrips signipennis* (Bagnall)				X						13

Dendrothripoides innoxius (Karny)				X	X				46
Dolichothrips sp. 1	X								60
Dolichothrips flavipes (Moulton)	X	X	X	X	X		X	X	2,6,8,9,12,26,34,37,48,49,57
**Echinothrips americanus* Morgan	X								57
Elixothrips brevisetis (Bagnall)		X			X	X		X	1,11,15,22,30,46
**Heliothrips haemorrhoidalis* (Bouche)	X		X			X		X	32,40,48,60
Liothrips sp. 1	X								33
Rhamphothrips pandens Sakimura	X		X			X	X	X	11,18,25,32,34,36,44,52,57
**Scirtothrips dorsalis* Hood	X	X							2,6,8,51,57
Scirtothrips sp. 1		X							2
#Scirtothrips sp. nr. *australiae* Hood	X								50,61
#Scirtothrips sp. nr. *dobroskyi* Moulton			X						48,53
#Scirtothrips sp. nr. *inermis* Priesner	X					X			21,28,32,43,60,61
**Selenothrips rubrocinctus* (Giard)	X	X	X		X	X	X	X	2,3,17,18,29,32,39,40,48,50,57
#Trichromothrips oahuensis (Nakahara)								X	11
Trichromothrips trifasciatus (Priesner)	X					X			11
Tusothrips sumatrensis (Karny)								X	27,56
Grass feeding thrips									
Anaphothrips swezeyi Moulton		X		X	X			X	32
Arorathrips mexicanus (Crawford)	X				X		X	X	28,32
Caliothrips striatopterus (Kobus)	X								43
Edissa sp. nr. *steinerae* Mound			X						16
Plesiothrips perplexus (Beach)		X						X	32,42
Fungus feeding thrips									
Azaleothrips indonesiensis Okajima								X	24
Hoplandrothrips sp.					X				43,55
Nesothrips brevicollis (Bagnall)				X	X			X	6,13,42
#Nesothrips lativentris (Karny)			X		X				3,13,32
Nesothrips sp. 1					X				48

TABLE 1 (continued)

Species Name	Society Islands			Marquesas Islands				Austral Islands		Host Substrate Records[a]
	Tahiti	Moorea	Raiatea	Hiva Oa	Nuku Hiva	Ua Huka	Ua Pou	Rurutu	Tubuai	
Pygmaeothrips angusticeps (Hood)			X							7
Stephanothrips occidentalis Hood & Williams								X		11
Predatory thrips										
Aleurodothrips fasciapennis (Franklin)	X		X		X			X		4,14,31,40
Franklinothrips vespiformis (Crawford)				X	X	X	X			13,20,25,46
Karnyothrips melaleucus (Bagnall)	X		X	X	X	X				32
Scolothrips asura Ramakrishna & Margabandhu					X					48,54
Unknown feeding habit										
Genus indeterminate					X					46

[a] Numbers in host substrate records correspond to sampled material listed in Table 2.
* Pest species attacking agricultural crops and ornamental plants.
# Thrips species possibly native to French Polynesia and other areas of the South Pacific.

MATERIALS AND METHODS

Island Surveys for Thrips

Three island groups were surveyed in French Polynesia for thrips: (1) the Society Islands: Tahiti surveyed September 2003, 2004, and November 2005; Moorea surveyed September 2003 and 2004, and Raiatea surveyed September 2004. (2) The Marquesas Islands: Hiva Oa, Nuku Hiva, Ua Huka, and Ua Pou were all surveyed in November 2005. (3) The Austral Islands: Rurutu and Tubuai were surveyed in September 2004.

Thrips were sampled by beating selected foliage, flowers, grass, deadwood, and fungi over a white plastic beat tray, and dislodged thrips were collected with a fine paintbrush and placed in labeled vials of 95% ethanol for identification. If the identity of sampled plants was unknown, digital photos were taken for later identification and cross-referenced to collection vials. Surveys were conducted in urban, agricultural, and undisturbed natural areas, and GPS coordinates of all sampling locations that yielded material were recorded.

Preparation of Material for Identification

All collected material was macerated in 5% NaOH and subjected to dehydration in an ethanol series and clove oil before being mounted onto glass slides in Canada balsam. (See Mound and Marullo [1996] and Moritz et al. [2001] for details on slide mounting thrips.)

Deposition of Slide-Mounted Specimens

Slide-mounted specimens were identified using published keys (e.g., Mound 1999, Moritz et al. 2001 [and references therein], Hoddle and Mound 2003). Species identity was confirmed by comparison with already identified slide-mounted material held at the Australian National Insect Collection and the University of California, Riverside. Identified material has been deposited in the Entomology Museum at the University of California, Riverside; the Australian National Insect Collection, Canberra; and the Bishop Museum, Honolulu, Hawai'i.

RESULTS AND DISCUSSION

Over the course of this survey 823 thrips were slide mounted and identified. The total number of species identified was 55 from 36 genera and three families (Thripidae, Phlaeothripidae, and Aeolothripidae), with more than 90% (46 species) of identified material being considered exotic to French Polynesia (Table 1). Material was collected from 61 different host substrates (i.e., flowers, leaves, grass, dead plant material, and fungi), and 33 plant families were sampled (Table 2).

Only a few of these species (<10%) seem likely to be native to French Polynesia or even to other parts of the Pacific. *Thrips rapaensis*, *Trichromothrips oahuensis*, and *Nesothrips lativentris* are all considered native to the Pacific region, and this is possibly true of *Thrips* sp. 1, *Scirtothrips* sp. nr. *australiae*, *Scirtothrips* sp. nr *dobroskyi*, and *Scirtothrips* sp nr. *inermis*. These *Scirtothrips* species may warrant closer investigation because two of them were found most commonly at high altitude on native plants in relatively undisturbed areas on Tahiti. However, further survey work and complementary DNA analyses on the South Pacific members of *Thrips* and *Scirtothrips* are needed to confirm the endemism of these species. More than 25 of the recorded species are derived from the fauna of the Old World tropics, with five species probably originating from Australia and eight from the New World tropics. In contrast, only the cosmopolitan species *Thrips tabaci* is of European origin. At least 12 species are serious pests on crops and ornamental plants in various parts of the world (Table 1). The survey revealed at least four species of exotic generalist predatory thrips that attack a diverse range of arthropod pests including mites (*Scolothrips asura*), immature scales and whiteflies (*Aleurodothrips fasciapennis* and *Karnyothrips melaleucus*), and thrips (*Franklinothrips vespiformis*).

The greatest diversity of thrips was found in the Society Islands, where 77% (43 species) of species were found, and 60% (33 species)

TABLE 2

Host Substrates from Which Thrips Were Collected in Table 1

No.	Plant Name	Family	No.	Plant Name	Family
1	*Ageratum conyzoides*	Asteraceae	32	Grass	Poaceae
2	*Albizia julibrissin*	Fabaceae	33	*Hibiscus rosa-sinensis*	Malvaceae
3	*Allium cepa*	Alliaceae	34	*Hibiscus tiliaceus*	Malvaceae
4	*Annona muricata*	Annonaceae	35	*Inocarpus fagifer*	Fabaceae
5	*Blechnum* sp.	Blechnaceae	36	*Lactuca sativa*	Asteraceae
6	*Bougainvillea spectabilis*	Nyctaginaceae	37	*Lantana camara*	Verbenaceae
7	*Bracket fungi*	Basidiomycota	38	*Leonurus sibiricus*	Lamiaceae
8	*Caesalpinia pulcherrima*	Caesalpiniaceae	39	*Leptopteris* sp.	Osmundaceae
9	*Cananga odorata*	Annonaceae	40	*Mangifera indica*	Anacardiaceae
10	*Capsella bursa-pastoris*	Brassicaceae	41	*Manihot esculenta*	Euphorbiaceae
11	*Capsicum annuum*	Solanaceae	42	*Mariscus javanicus*	Cyperaceae
12	*Carica papaya*	Caricaceae	43	*Metrosideros collina*	Myrtaceae
13	*Citrullus lanatus*	Cucurbitaceae	44	*Morinda citrifolia*	Rubiaceae
14	*Citrus* sp.	Rutaceae	45	*Musa* sp.	Musaceae
15	*Codiaeum* sp.	Euphorbiaceae	46	*Ocimum basilicum*	Lamiaceae
16	*Colocasia esculenta*	Araceae	47	*Passiflora foetida*	Passifloraceae
17	*Cosmos bipinnatus*	Asteraceae	48	*Persea americana*	Lauraceae
18	*Crotalaria pallida*	Fabaceae	49	*Pometia pinnata*	Sapindaceae
19	*Cucurbita pepo*	Cucurbitaceae	50	*Psidium* sp.	Myrtaceae
20	*Cucurbita* sp.	Cucurbitaceae	51	*Ricinus communis*	Euphorbiaceae
21	*Cyathea* sp.	Cyatheaceae	52	*Rosa* sp.	Rosaceae
22	*Cyclophyllum barbatum*	Rubiaceae	53	*Sida rhombifolia*	Malvaceae
23	*Datura* sp.	Solanaceae	54	*Solanum melongena*	Solanaceae
24	Deadwood		55	*Sphagneticola trilobata*	Asteraceae
25	*Dodonea* sp.	Sapindaceae	56	*Synedrella nodiflora*	Asteraceae
26	*Dodonea viscosa*	Sapindaceae	57	*Tagetes* sp.	Asteraceae
27	*Elephantopus mollis*	Asteraceae	58	*Thevetia peruviana*	Apocynaceae
28	*Emilia fosbergii*	Asteraceae	59	*Urena lobata*	Malvaceae
29	*Euphorbia pulcherrima*	Euphorbiaceae	60	*Vaccinium cereum*	Ericaceae
30	Fern		61	*Weinmannia* sp.	Cunoniaceae
31	*Gardenia tahitiensis*	Rubiaceae			

were collected from Tahiti alone. The adjacent island of Moorea, separated from Tahiti by about 17 km of open ocean, had just nine thrips species (16%) recorded from surveys. The Marquesas Islands are 1,400 km northeast of Tahiti, and numbers of recorded species in this archipelago were intermediate, with 24 species (43%) being recorded across the four surveyed islands. The most heavily inhabited island in the Marquesas, Nuku Hiva, had 19 species (35%) of thrips. The Austral Islands 600 km southwest of Tahiti had the lowest recorded number of thrips species at 38% (21 species). These data suggest that the most heavily inhabited island group, the Society Islands, and in particular the commercial hub of French Polynesia, Tahiti, have the greatest number of adventive thrips species. This result may be strongly correlated with human activity, especially trade and tourism, which involve large-scale movement of produce and live plants. This supposition is supported by collection data from Nuku Hiva, which has the highest human visitation rate and resident population as well as the highest thrips diversity in the Marquesas Islands. Interisland plant movement is relatively unregulated in French Polynesia and has been suspected of facilitating the rapid long-distance movement of invasive insect pests. Hence even remote island groups in French Polynesia are likely to acquire invasive insect pests relatively quickly (Grandgirard et al. 2006).

As a caveat to this work, survey results and subsequent estimates of thrips species diver-

sity in French Polynesia should be interpreted with caution due to uncontrolled variation in sampling intensity that was affected by survey duration, time of year, and visitation frequency to islands. For example, survey duration for Tubuai in the Australs was approximately 1 hr in the immediate vicinity of the airport and occurred because of an unplanned stopover to collect additional passengers. Native vegetation on Moorea was poorly sampled due to time constraints. Raiatea and all islands in the Marquesas and Austral archipelagos were each sampled once for only 3–5 days. The Society Islands were sampled most frequently and heavily at the end of the dry winter period mainly during September. Thrips species composition may be substantially different during the hotter, wetter months (i.e., November through April), and differences between island groups over the course of these seasons will likely exist due to large latitudinal differences.

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