

**FIELD-TRIP REPORT TO THE COOK ISLANDS
(RAROTONGA ATIU, MANGAIA), 22 Sept.-6 Oct. 2009:
Native and alien plants of the modern and fossil vascular flora**

by

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Project background and objectives

This research project, submitted under the title "*Identifying native and alien plants of the modern and the fossil vascular flora to document human impacts on Pacific island biodiversity*" (Research permit issue #15/09), is part of a larger research program conducted by Dr. Matthew PREBBLE, Dr. Nicholas PORCH (Australian National University, Canberra, Australia), and Dr. Janet WIMSHURST (Landcare Research, Lincoln) and funded by the Australian Research Council, Australian Government. The aims of this program are: (1) to collect insect and plant fossils in sediment cores; (2) to document rat predation on seeds of fossil and modern plants; and (3) to assess the human past and modern impacts on terrestrial biodiversity in Pacific Islands, especially in the Australs (French Polynesia) and the Cook Islands.

As a field botanist, plant ecologist and conservation biologist, with more than 15 years expertise on the vascular flora of French Polynesia, particularly in the Austral Islands, and on invasive alien plants and weeds management in the Indo-Pacific islands, my goal was to contribute to the collection and identification of the native and endemic vascular plants species (flowering plants and ferns) as well as the non-native (or alien) species introduced by the prehistoric Polynesians or by the Europeans in more recent times.

Trip itinerary

- 22 Sept. Departure Tahiti, arrival Rarotonga
- 24 Sept. Departure Rarotonga, arrival Atiu
- 01 Oct. Departure Atiu, arrival Rarotonga
- 03 Oct. Departure Rarotonga, arrival Mangaia
- 05 Oct. Departure Mangaia , arrival Rarotonga
- 06 Oct. Departure Rarotonga, arrival Tahiti

Material and methods

Extensive plant surveys were conducted in all vegetation types (coastal vegetation, makatea and inland forests) on 'Atiu during 6 full days of field work, coastal vegetation and makatea forests on Mangaia (2 days), valley and montane forests (trail to Te Manga summit) on Rarotonga (one day).

For the most relevant plant species (i.e. the most common and endemic native species, some rare endemics, and some weeds), flowering or fruiting stems, open flowers and/or seeds were collected, as voucher/reference specimens. All plant specimens were pressed (using a "plant press"), dried (using a "bulb dryer"), and identified on the field.

Dried plant specimens were send to the Australian National University in Canberra (Australia) for processing and labeling (c/o Dr. M. PREBBLE, Australian National University, Dept. Archaeology and Natural History, Research School of Pacific & Asian Studies, The Australian National University, Canberra, ACT 0200, Australia) then to the Landcare Research Allan Herbarium in Christchurch [CHR], New Zealand (c/o Dr. W. SYKES) to be stored and preserved as reference material. Seeds will be stored in the seed collection at the Landcare Research Allan Herbarium, and pollen in the pollen reference collection at Landcare Research.

Some leaf material (a couple of young leaves) was collected and dried in silicagel (stored at the Délégation à la Recherche, Tahiti) for future phylogenetic studies in order to understand the affinities of the native flora of the Cook Islands, in particular with the Australs and other archipelagos in French Polynesia (Gambier, Marquesas, Society and Tuamotu).

Plant scientific names were those according to the “Cook Is. Biodiversity and Natural Heritage Database” (G. McCORMACK, pers. com. 2009). It must be noted that some of these names are different from the one used in the Austral Islands and in French Polynesia (www.herbier-tahiti.pf), and that a common “taxonomic reference” for the flora of Eastern Polynesia should be set up.

Main results

Most observations on the native and alien flora of the island of ‘Atiu were synthesized in a draft paper written in collaboration with the botanist Bill SYKES from Landcare Research, New Zealand (*cf.* APPENDIX).

Native flora

During this relatively short field-trip (a total of 9 days of field work) but with extensive surveys, some “new island records” for the native flora were discovered:

On ‘Atiu, we found:

- the small epiphytic fern *Vittaria cf. rigida* (Vittariaceae) –a species common on Mangaia- in the center of the makatea forest dominated by large *Barringtonia asiatica*;
- the shrub *Ximения americana* (Olacaceae) -a species that was never recorded in the Southern group of the Cook Is. before (G. McCORMACK, W. SYKES, pers. com. 2009)- in the centre of an open makatea forest with *Pandanus* sp. clumps;

On Mangaia, we found the small epiphytic orchid *Trachoma societatis* (syn. *Tuberolabium papuanum*) which was only known from Rarotonga.

The native *Vitex trifolia* (Verbenaceae), *Portulaca lutea* (Portulacaceae), *Terminalia samoensis* (Combretaceae), and *Nesogenes euphrasioides* (Nesogenaceae) reported in the Cook Islands Biodiversity Database (<http://cookislands.bishopmuseum.org>) as present on ‘Atiu, were not found despite extensive searches in almost all the coastal areas around the island.

The abundance and distribution of some of the native species considered as rare in the past were re-assessed: e.g. on ‘Atiu, the small tree *Allophylus timoriensis* is much more common on makatea cliffs as well as the small epiphytic orchid *Taeniophyllum*

fasciola, the terrestrial fern *Davallia epiphylla* (Davalliaceae) in the makatea forest, the coastal shrub *Suriana maritima* (Simaroubaceae) on the north side of the island, and the wetland grass *Paspalum vaginatum* (Poaceae) near Lake Roto.

The native large tree *Rhus taitensis* (Anacardiaceae), abundant in pre-human times then considered extinct after Polynesian occupation (M. PREBBLE, pers. com. 2009) was apparently re-planted in the 1950's (G. McCORMACK, pers. com. 2009). It is currently found along the main road between the airport and the village, and seems to be naturalized on the island, with some seedlings and saplings observed in the makatea native forest near Lake Roto.

Table 1. List of native vascular plants collected on Rarotonga, Atiu, and Mangaia (Cook Islands) during the field expedition (24 Sept.-05 Oct. 2009)

Cook Islands origin status: N=Native ; E=Endemic, P=Polynesian (se, s), ck=Cooks (eg.

NEPck1=Native, Endemic of Polynesia, Endemic of Cooks, on one island).

Plant material: HS = dry herbarium specimen ; SI = leaf in silicagel ; FR = fruit and/or seed

Island: RARO = Rarotonga ; ATI = Atiu ; MAN = Mangaia

| Family | Scientific name | Status | Plant material | Island |
|--------------------|------------------------------------|--------|----------------|-----------|
| ANGIOSPERMS | | | | |
| AMARANTHACEAE | <i>Achyranthes cf. velutina</i> | NEsP | HS | ATI |
| ANACARDIACEAE | <i>Rhus tahitensis</i> | N | HS, SI | ATI |
| APOCYNACEAE | <i>Alyxia stellata</i> | N | HS, SI | MAN |
| ASTERACEAE | <i>Fitchia speciosa</i> | NEPck1 | HS, FR | RARO |
| ASTERACEAE | <i>Wollastonia biflora</i> | N | HS | ATI |
| BRASSICACEAE | <i>Lepidium bidentatum</i> | N | HS, SI | ATI |
| CAESALPINIACEAE | <i>Caesalpinia major</i> | N | FR | MAN |
| CONVOLVULACEAE | <i>Operculina turpethum</i> | N | HS | ATI |
| CUNONIACEAE | <i>Weinmannia samoensis</i> | NEsP | HS, SI | RARO |
| CYPERACEAE | <i>Eleocharis geniculata</i> | N? | HS | ATI |
| CYPERACEAE | <i>Fimbristylis cymosa</i> | N | HS | ATI |
| ELAEOCARPACEAE | <i>Elaeocarpus tonganus</i> | NEsP | HS, SI | ATI |
| EUPHORBIACEAE | <i>Bischofia javanica</i> | N | HS, SI, FR | RARO |
| EUPHORBIACEAE | <i>Chamaesyce fosbergii</i> | NEPse | HS | ATI |
| EUPHORBIACEAE | <i>Glochidion sp.</i> | NPEse | HS, FR | ATI |
| EUPHORBIACEAE | <i>Homalanthus moerenhoutianus</i> | NEP | HS, SI | RARO |
| EUPHORBIACEAE | <i>Macaranga harveyana</i> | N | HS | RARO |
| EUPHORBIACEAE | <i>Phyllanthus societatis</i> | N | HS, SI | ATI |
| FABACEAE | <i>Abrus precatorius</i> | N? | HS | ATI |
| FABACEAE | <i>Canavalia cathartica</i> | N | HS | ATI |
| FLACOURTIACEAE | <i>Homalium acuminatum</i> | NEPck2 | HS, FR, SI | MAN |
| FLACOURTIACEAE | <i>Xylosma suaveolens</i> | NEPse | HS, SI | ATI |
| GENIOSTOMACEAE | <i>Geniostoma sykesii</i> | NEPck2 | HS, SI | RARO, MAN |
| GOODENIACEAE | <i>Scaevola cf. taccada</i> | N | HS | ATI |
| LAURACEAE | <i>Cassytha filiformis</i> | N | HS | ATI |
| LAURACEAE | <i>Hernandia moerenhoutiana</i> | N | HS, SI | ATI |
| LOGANIACEAE | <i>Fagraea berteriana</i> | N | HS | ATI |

| | | | | |
|------------------|----------------------------------|--------|------------|-----------|
| LORANTHACEAE | <i>Korthalsella platycaula</i> | N | HS | MAN |
| LYTHRACEAE | <i>Pemphis acidula</i> | N | HS | ATI |
| MELASTOMATACEAE | <i>Melastoma denticulatum</i> | N | HS | RARO |
| MIMOSACEAE | <i>Schleinitzia insularum</i> | N | HS | ATI |
| MORACEAE | <i>Ficus prolixa</i> | N | HS, FR | ATI |
| MORACEAE | <i>Streblus anthropophagorum</i> | N | HS, SI | RARO, MAN |
| MYOPORACEAE | <i>Myoporum wilderi</i> | NEPck2 | SI | MAN |
| MYRTACEAE | <i>Eugenia reinwardtiana</i> | N | HS | ATI |
| NYCTAGINACEAE | <i>Boerhavia tetrandra</i> | N | HS | ATI |
| NYCTAGINACEAE | <i>Pisonia grandis</i> | N | HS | ATI |
| NYCTAGINACEAE | <i>Pisonia umbellifera</i> | N | HS, SI | ATI |
| OLEACEAE | <i>Jasminum didymum</i> | N | HS, FR | ATI |
| ORCHIDACEAE | <i>Oberonia equitans</i> | N | HS | MAN |
| ORCHIDACEAE | <i>Taeniophyllum fasciola</i> | N | HS | ATI |
| ORCHIDACEAE | <i>Trachoma papuanum</i> | N | HS, SI | MAN |
| PANDANACEAE | <i>Pandanus cf. arapepe</i> | NEPck2 | SI, FR | ATI |
| PIPERACEAE | <i>Peperomia pallida</i> | NEPs | HS | ATI |
| POACEAE | <i>Isachne distichophylla</i> | NEPe | HS | RARO |
| POACEAE | <i>Paspalum vaginatum</i> | N | HS | ATI |
| RHAMNACEAE | ? <i>Ventilago vitiensis</i> | N | HS, SI | MAN |
| RUBIACEAE | <i>Cyclophyllum barbatum</i> | N | HS, SI | ATI |
| RUBIACEAE | <i>Hedyotis foetida</i> | N | HS, SI | ATI |
| RUBIACEAE | <i>Geophila repens</i> | N | HS | ATI |
| RUBIACEAE | <i>Morinda myrtifolia</i> | N | HS | ATI |
| RUBIACEAE | <i>Ixora triflora</i> | NEPse | HS, SI | RARO |
| RUBIACEAE | <i>Psychotria whistleri</i> | NEPck2 | HS, SI | RARO |
| RUBIACEAE | <i>Timonius polygamus</i> | N | HS | ATI |
| SAPINDACEAE | <i>Allophylus timoriensis</i> | N | HS, SI | ATI |
| SAPOTACEAE | <i>Pouteria grayana</i> | N | HS, SI, FR | RARO |
| SIMAROUBACEAE | <i>Suriana maritima</i> | N | HS | ATI |
| TILIACEAE | <i>Corchorus torresianus</i> | N | HS, SI | ATI |
| TILIACEAE | <i>Triumfetta procumbens</i> | N | HS | ATI |
| ULMACEAE | <i>Celtis pacifica</i> | NEPse | HS, SI | ATI |
| URTICACEAE | <i>Cypholophus macrocephalus</i> | N | HS, SI | RARO |
| URTICACEAE | <i>Procris pedunculata</i> | N | HS | ATI |
| XIMENIACEAE | <i>Ximenia americana</i> | N | HS, SI | ATI |
| FERNS | | | | |
| ADIANTACEAE | <i>Pteris tripartita</i> | N | HS | RARO |
| ASPIDACEAE | <i>Tectaria cf. jardinii</i> | NEPse | HS | ATI |
| ASPLENIACEAE | <i>Asplenium cf. robustum</i> | N | HS | ATI |
| BLECHNACEAE | <i>Blechnum orientale</i> | N | HS | ATI |
| CYATHEACEAE | <i>Cyathea sp.</i> | | HS | RARO |
| DAVALLIACEAE | <i>Davallia solida</i> | N | HS | ATI |
| DAVALLIACEAE | <i>Davallia epiphylla</i> | N | HS | ATI |
| DAVALLIACEAE | <i>Humata banksii</i> | N | HS | MAN |
| OPHIOGLOSSACEAE | <i>Ophioglossum pendulum</i> | N | HS, SI | ATI |
| PSILOTACEAE | <i>Psilotum nudum</i> | N | HS | ATI |
| THELYPTERIDACEAE | ? <i>Amphineuron opulentum</i> | N | HS | ATI |
| THELYPTERIDACEAE | <i>Christella cf. dentata</i> | N | HS | ATI |
| THELYPTERIDACEAE | <i>Sphaerostephanos invisus</i> | N | HS | ATI |
| VITTARIACEAE | <i>Vittaria rigida</i> | N | HS | ATI |

Alien flora

As for the native flora, some “new island records” were recorded, especially weedy herbs, e.g. *Phyllanthus tenellus* (Euphorbiaceae) common along roadsides, and ornamental plants -with showy flowers or leaves- planted in gardens, e.g. *Thunbergia laurifolia* and *Hemigraphis alternata* (Acanthaceae), *Dissotis rotundifolia* (Melastomataceae), *Turnera ulmifolia* (Turneraceae), *Clerodendrum quadriloculare* and *Duranta erecta* (Verbenaceae), as well as the fern *Adiantum trapeziforme* (Adiantaceae). These ornamental plants are known to be naturalized or invasive in other Pacific islands, thus can be considered as potential invaders. The distribution and abundance of some weedy species were re-assessed: e.g. the small herb *Ruellia postrata* (Acanthaceae) is very common along roadsides, whereas the thorny shrub *Lantana camara* (Verbenaceae) has declined with the positive impact of an introduced biological control agent.

Table 2. List of vascular alien plants collected on Atiu (Cook Islands).

Cook Islands origin status: R=Recent Intro, A=Polynesian Intro, W=wild/naturalized, D=domestically maintained

Plant material: HS = dry herbarium specimen ; SI = leaf in silicagel ; FR = fruit and/or seed

Island: RARO = Rarotonga ; ATI = Atiu ; MAN = Mangaia

| Family | Scientific name | Status | Plant material | Island |
|--------------------|---------------------------------|--------|----------------|--------|
| ANGIOSPERMS | | | | |
| ASTERACEAE | <i>Ageratum conyzoides</i> | RW | HS | ATI |
| ASTERACEAE | <i>Elephantopus mollis</i> | RW | HS | ATI |
| ASTERACEAE | <i>Emilia sonchifolia</i> | RW | HS | ATI |
| ASTERACEAE | <i>Synedrella nodiflora</i> | RW | HS | ATI |
| ASTERACEAE | <i>Vernonia cinerea</i> | RW | HS | ATI |
| CYPERACEAE | <i>Cyperus difformis</i> | RW | HS | ATI |
| POACEAE | <i>Oplismenus cf. hirtellus</i> | RW | HS | ATI |
| TILIACEAE | <i>Triumfetta rhomboidea</i> | RW | HS | ATI |
| LILIACEAE | <i>Asparagus plumosus</i> | RW | HS | ATI |
| VERBENACEAE | <i>Gmelina arborea</i> | RW | HS | ATI |

Conclusions

The main results of this short field trip demonstrate that the complete inventory of the native and alien flora of the two islands of ‘Atiu and Mangaia is not finished, and can be improved by more field surveys, especially in remote areas or habitats difficult to access (e.g. sea cliffs, makatea dense forest). There is no doubt that other

native or even endemic plants can be discovered on the large island of Mangaia in the native forests remnants, despite the high level of human disturbances. A similar field trip should be organized on Mitiaro and Mauke, if funding support is available. We also recommend that a local (Cook islander) botanist/plant ecologist is trained and hired by the Cook Is. Government to be able to conduct future field surveys, in order to document the news changes in the vegetation, and help develop conservation programs such as weed control, habitat restoration projects, species recovery plans, in collaboration with the local authorities on the different islands. Local capacity building is indeed a key element to improve the conservation of the unique but fragile island ecosystems of Eastern Polynesia, such as the Cook Islands or French Polynesia.

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APPENDIX: Draft paper on the vegetation and flora of 'Atiu by W.R. SYKES & J.-Y. MEYER