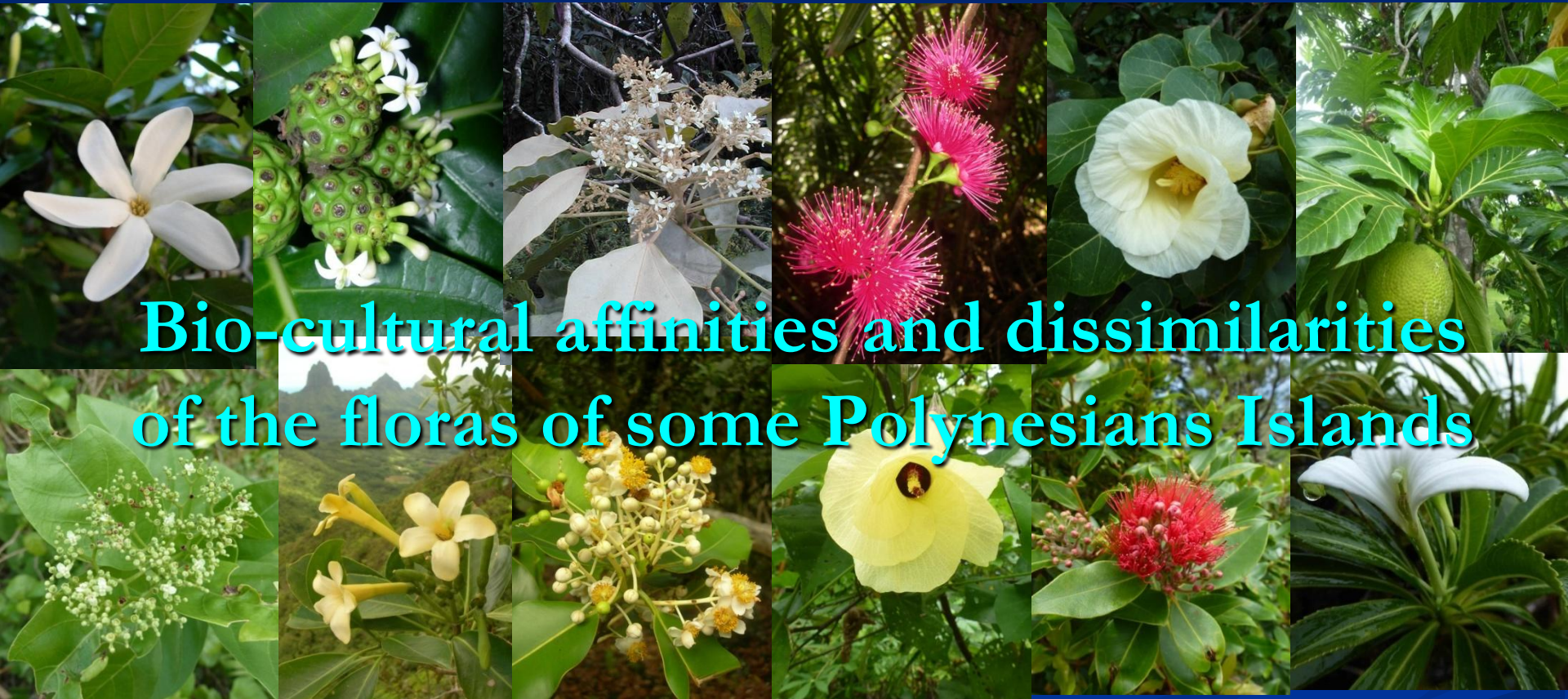


# From the West to the far East :



Bio-cultural affinities and dissimilarities  
of the floras of some Polynesians Islands



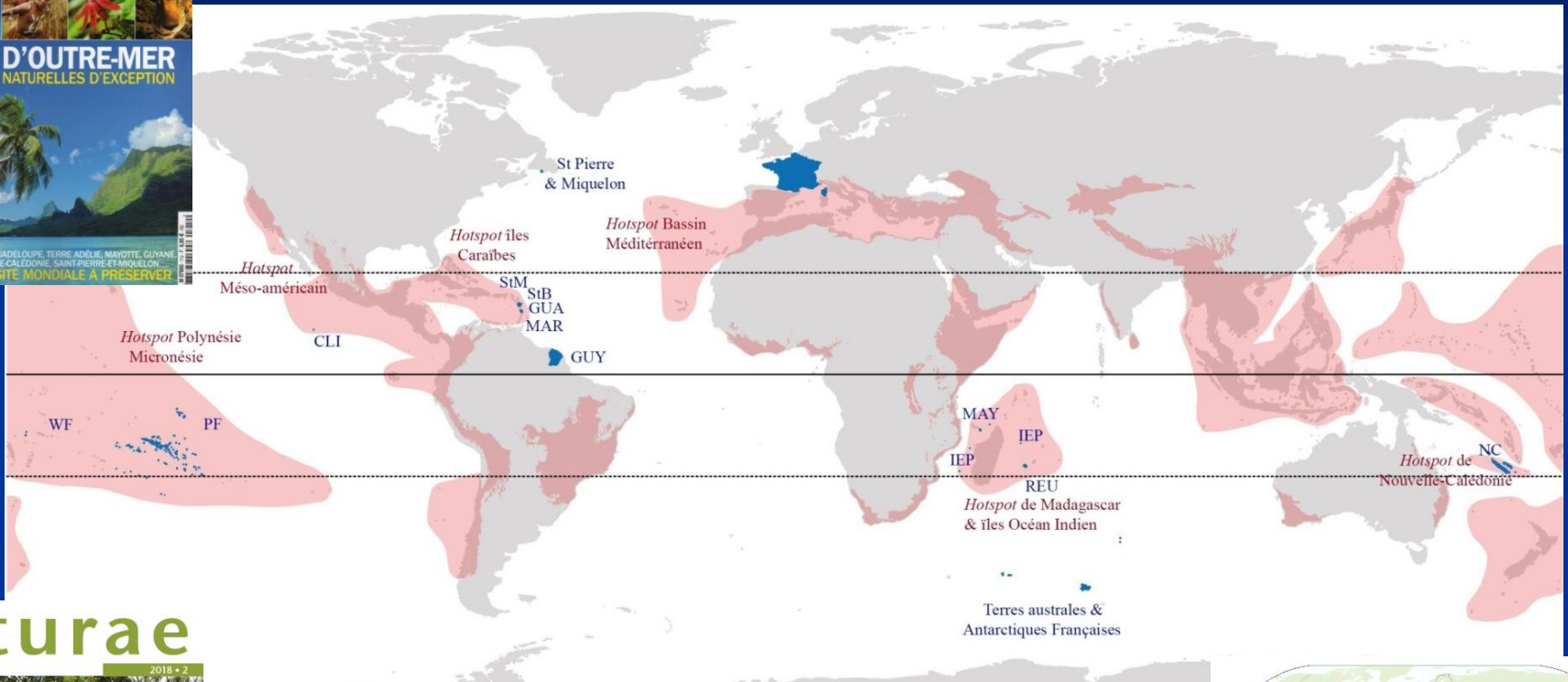
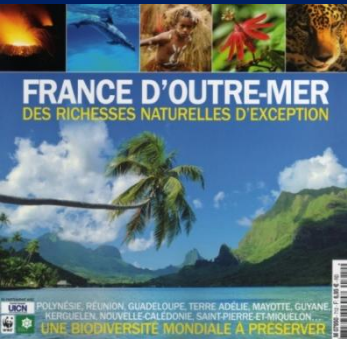
Jean-Yves Hiro MEYER (Dr.)

Délégation à la Recherche, Government of French Polynesia, Tahiti

[jean-yves.meyer@recherche.gov.pf](mailto:jean-yves.meyer@recherche.gov.pf)

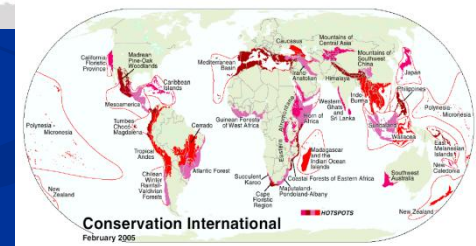


# The French Overseas Island Territories



- 11 tropical island territories in 3 oceans
- 5 of the 36 “biodiversity hotspots”
- 4% of France, 70% of its terrestrial endemic flora and fauna

(Meyer *et al.* 2018. *Naturaee*)



# Introduction: « The Polynesian Triangle »



(Taiwan, 2016)

(Nuku Hiva, 2012)

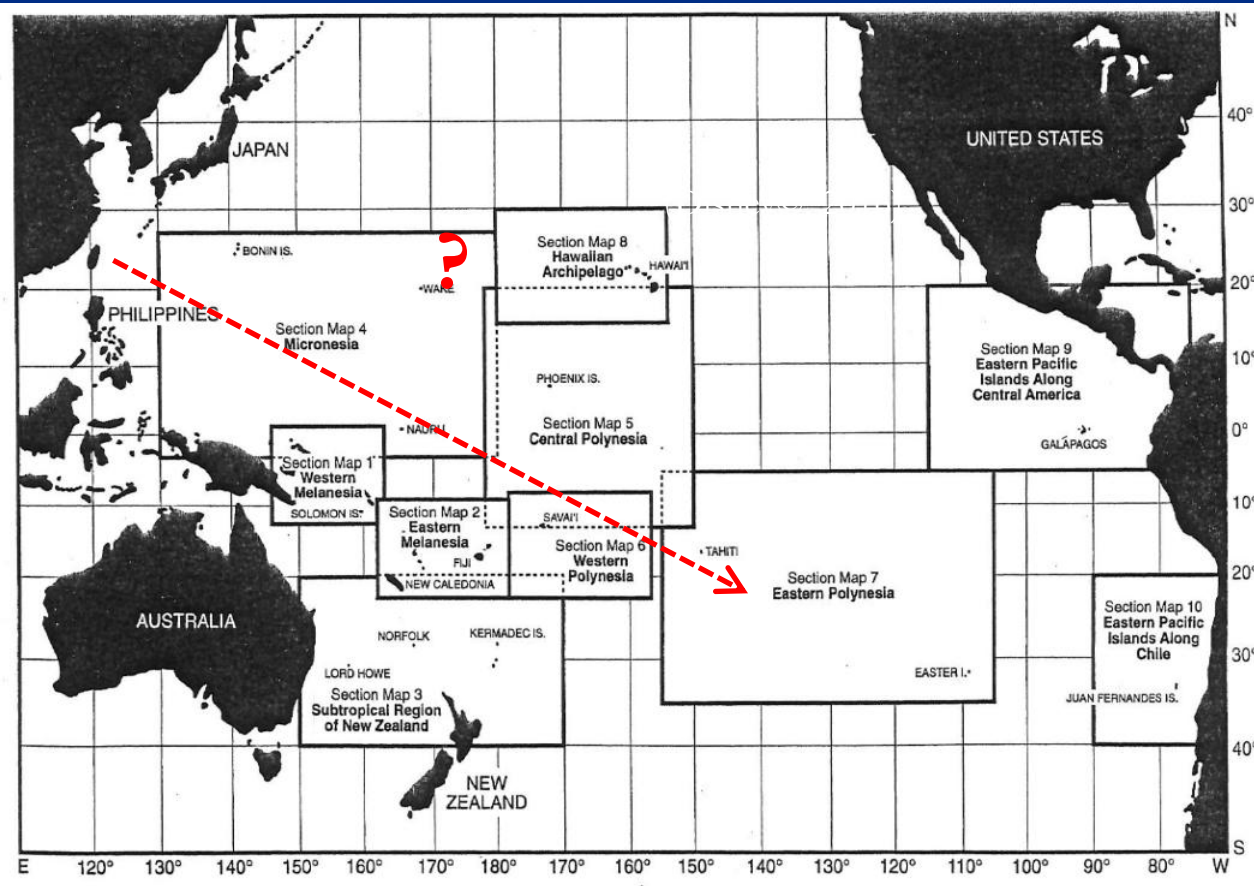
(Aotearoa, 2010)

(Trejaut *et al.* 2005, *PLoS Biology*)

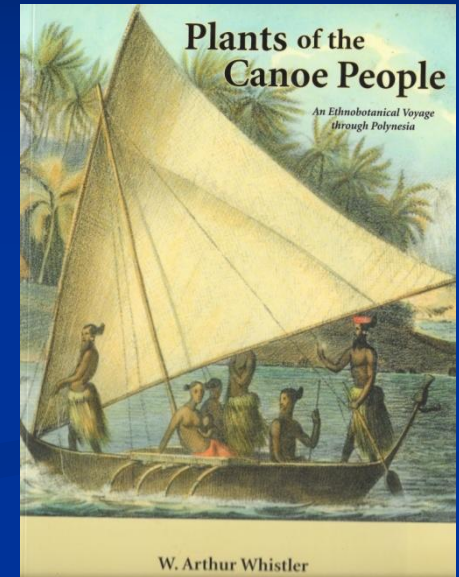
(Rapa Nui, 2012)



# Plant bio- and phylo-geography *versus* Ethnobotany



(Mueller-Dombois & Fosberg 1998, *Vegetation of the Tropical Pacific Islands*)



(Whistler, 2009)



« The transported landscape » (Kirch, 1984)



# Native flora and plant endemism in Pacific Islands

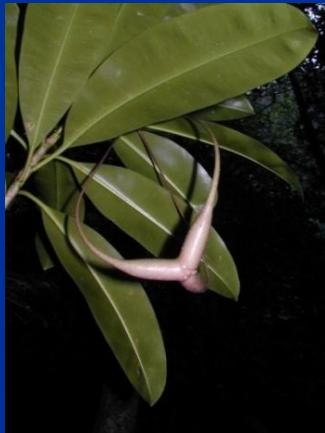
Archipelago (area)	Native flowering plants	Endemic flowering plants (%)	Endemism (%)	Endemic genera
Fiji (18,250 km <sup>2</sup> )	1,302	799	61	6
Hawaii (16,880 km <sup>2</sup> )	966	859	89	32
Galápagos (7,900 km <sup>2</sup> )	233	241	51	7
<b>New Caledonia (19,060 km<sup>2</sup>)</b>	<b>3,063</b>	<b>2,448</b>	<b>80</b>	<b>100</b>
<b>French Polynesia (3,520 km<sup>2</sup>)</b>	<b>659</b>	<b>478</b>	<b>72</b>	<b>10*</b>
<b>Wallis et Futuna (142 km<sup>2</sup>)</b>	<b>297</b>	<b>7?</b>	<b>2</b>	<b>0</b>
Rapa Nui (166 km <sup>2</sup> )	30	7?	24	0

(Data compiled from Meyer, 2004, 2013, 2017; \*including Southeastern Polynesian endemic genera)

# Native plants of French Polynesia

	Total	Indigenous species	Endemic species	Endemism
Vascular flora	881	335	546	62%

( Florence *et al.* 2007, « Nadeud » Plant Database)



*Lepinia taitensis*  
(endemic species)



*Sclerotheca*  
(SE Polynesia endemic genus)



*Fitchia*  
(SE Polynesia endemic genus)



*Oparanthus*  
(French Polynesia endemic genus)

*Pacifigeron*  
(Rapa endemic genus)





# Introduced plants in French Polynesia

	Polynesian (« Aboriginal ») introductions	European (« Modern ») introductions	Naturalized species
<b>Alien vascular flora</b>	ca. 30 intentional + 50 accidental (« weeds »)*	> 1700**	> 590**

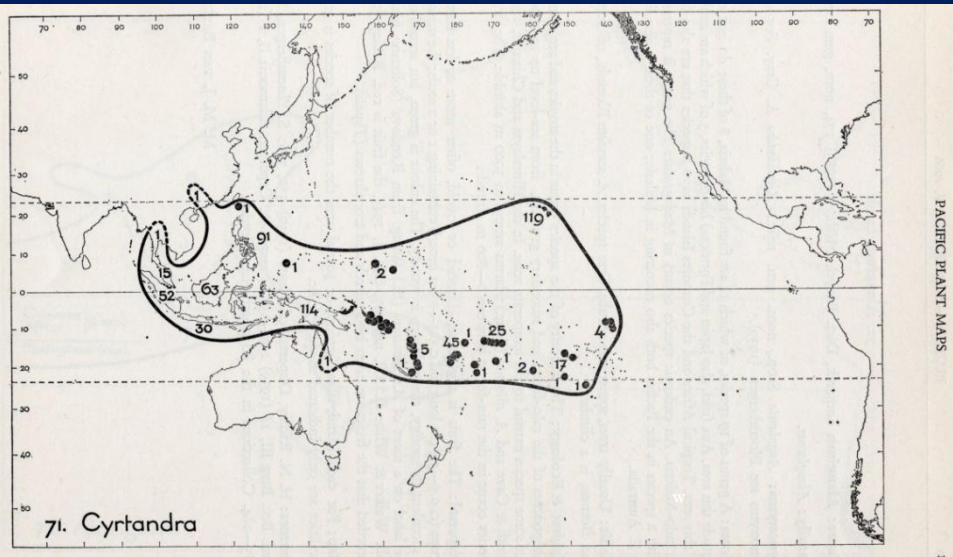
(\*Florence 1987, Whistler 1991;\*\*Fourdrigniez & Meyer 2008)



Sydney  
Parkinson  
(Tahiti in  
1769)



# Gradient of plant diversity



Dispersal by frugivorous birds: *Ducula*, *Ptilinopus* (Columbidae) ?



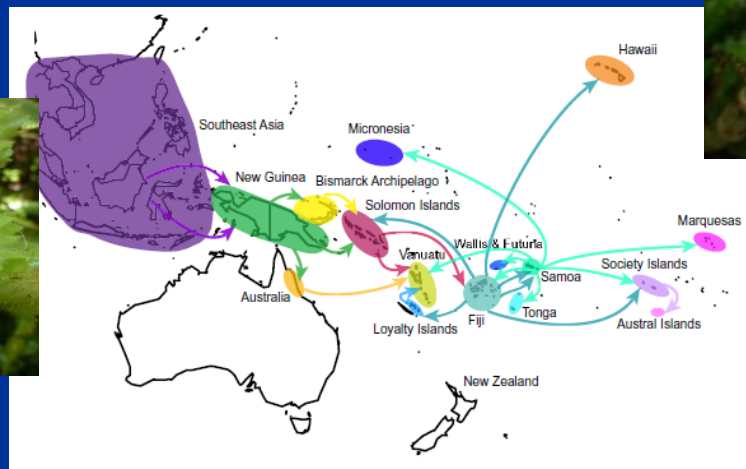
Futuna



Society



Fiji



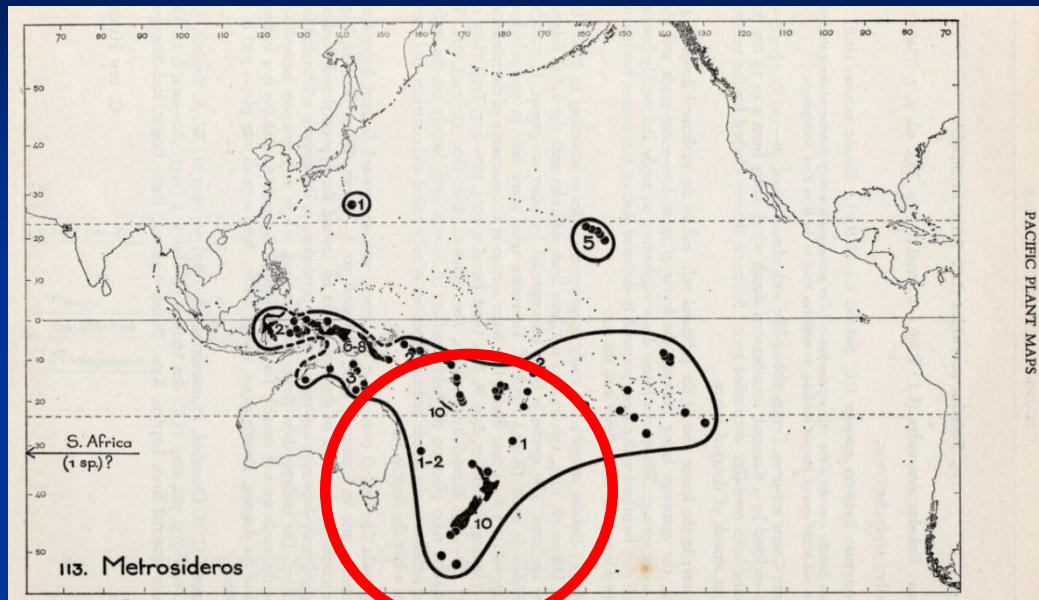
Marquesas



Austral



# Center of plant diversification



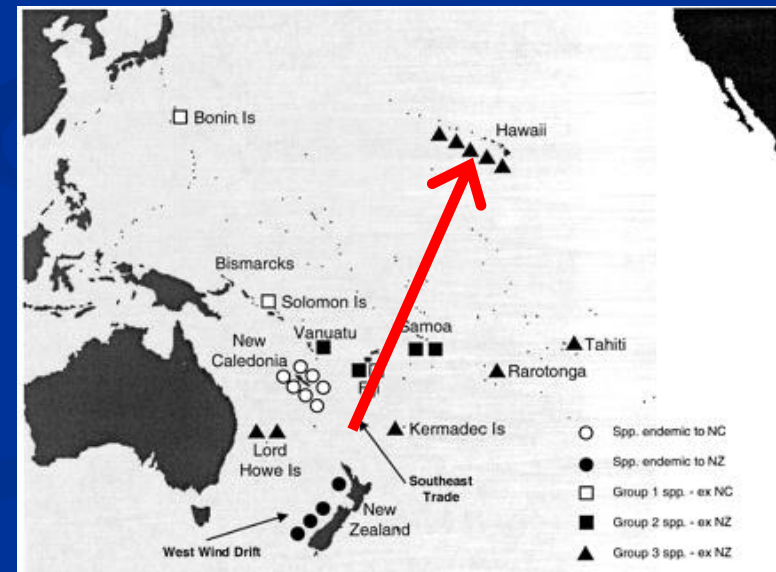
*Metrosideros polymorpha* (Maui, “ohi’a lehua”)



*Metrosideros kermadecensis*  
(Kermadec, New Zealand, “rata”)



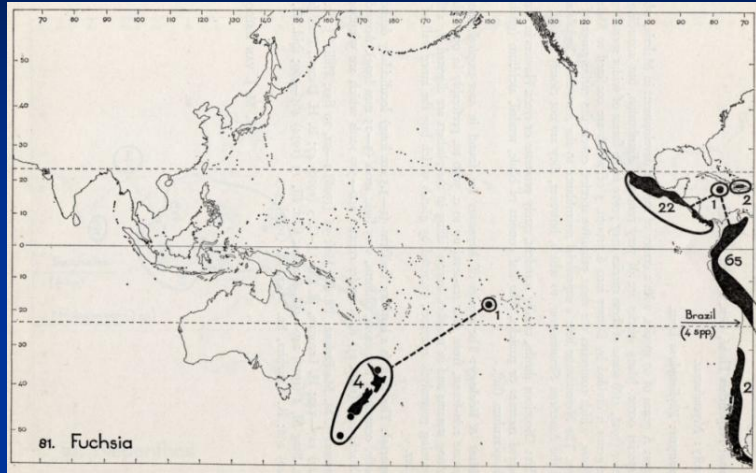
*Metrosideros collina* var. *collina*  
(Tahiti, “puarata”)



(Wright *et al.* 2000. *PNAS*)



# Taxa with peculiar distributions



(Van Steenis & Van Balgooy 1966. *Pacific Plant Areas*)



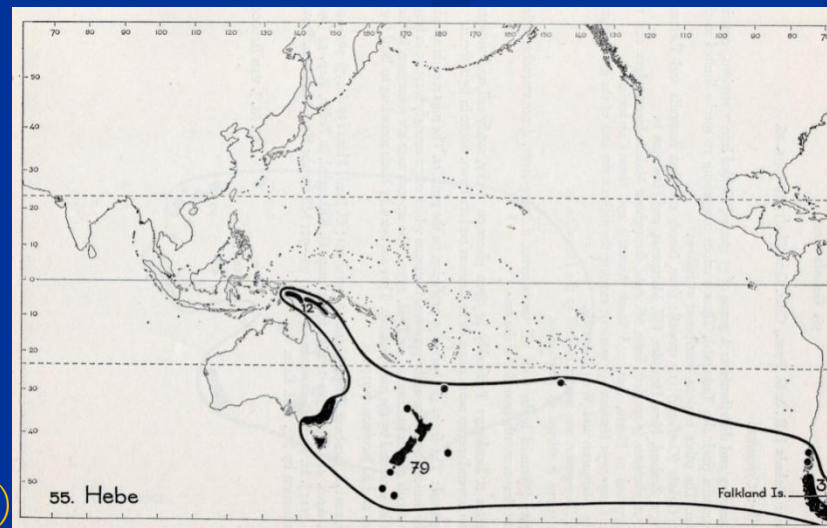
*Fuchsia cyrtandroides* (Tahiti)



*Fuchsia magellanica*  
(La Réunion)



*Hebe stricta* (New Zealand)



(Garnock-Jones, 1976. *NZ J. Botany*)



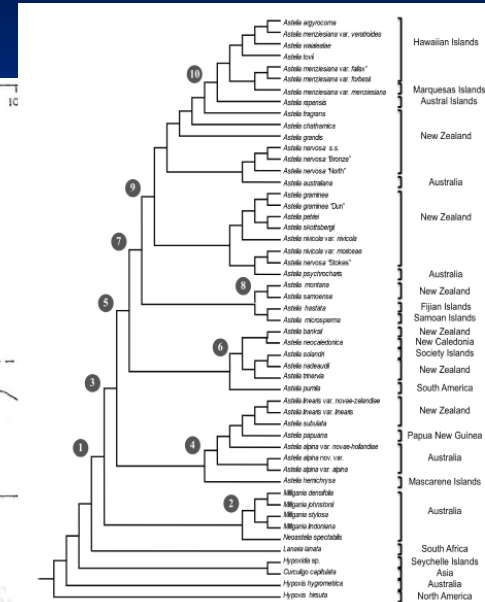
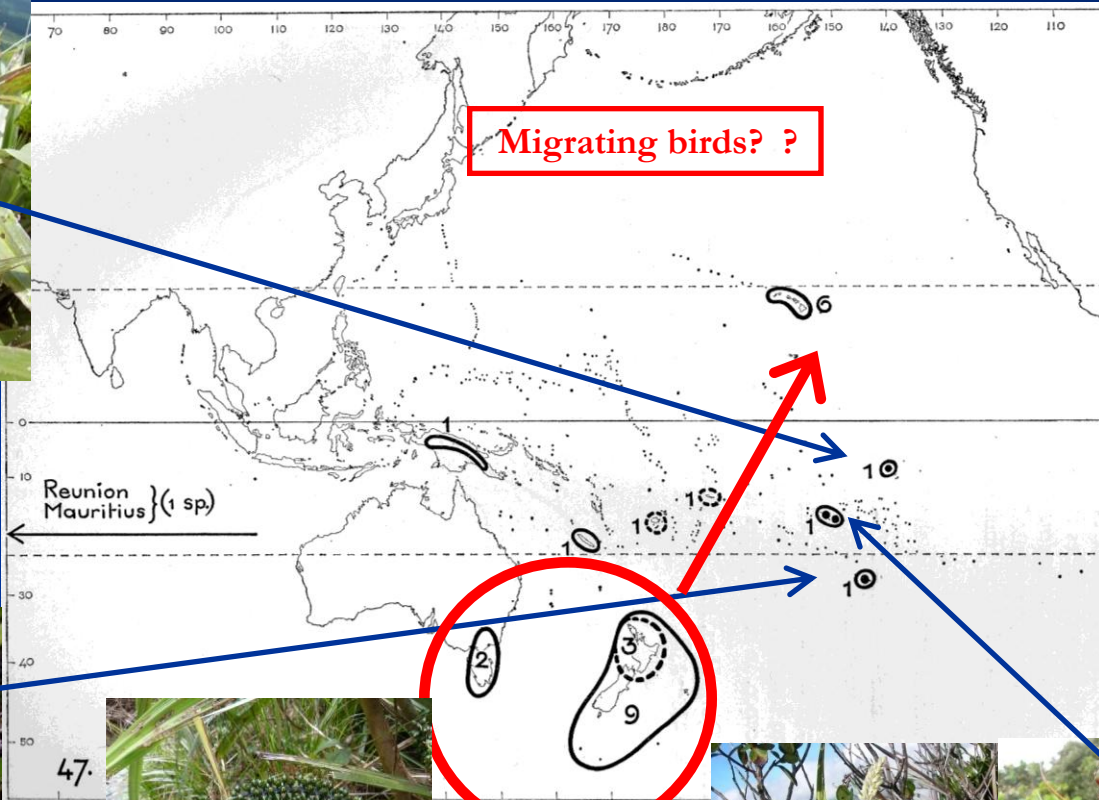
*Hebe rapensis* (Rapa)



# Taxa with disjunct areas



*Astelia tovii*  
(Marquesas)



*Astelia rapensis* (Rapa)



(New Zealand)



*Astelia nadeaudii*  
(Society)

(Birch 2011,  
PhD Thesis;  
Birch & Keeley  
2013. *J. Biogeography*)

*Lycium sandwicense* (Solanaceae) : Japan, Tonga, Austral Is., Rapa, Mangareva, Pitcairn, Rapa Nui, Hawaii, Juan Fernandez...

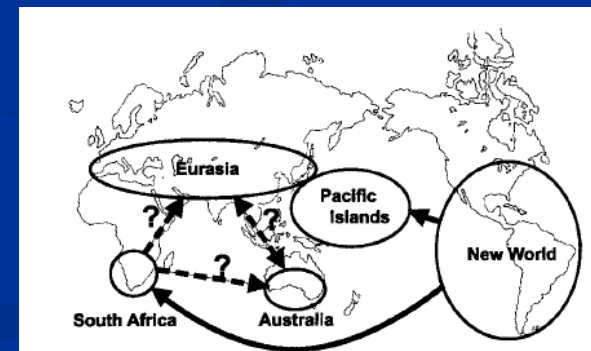
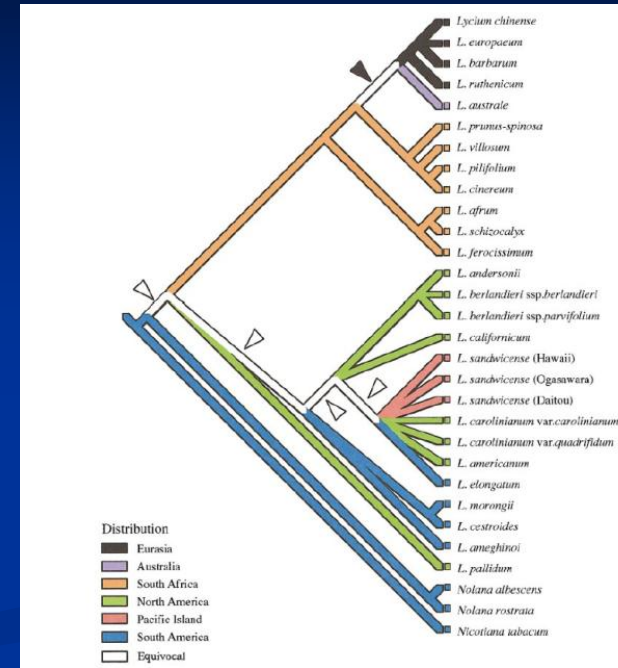
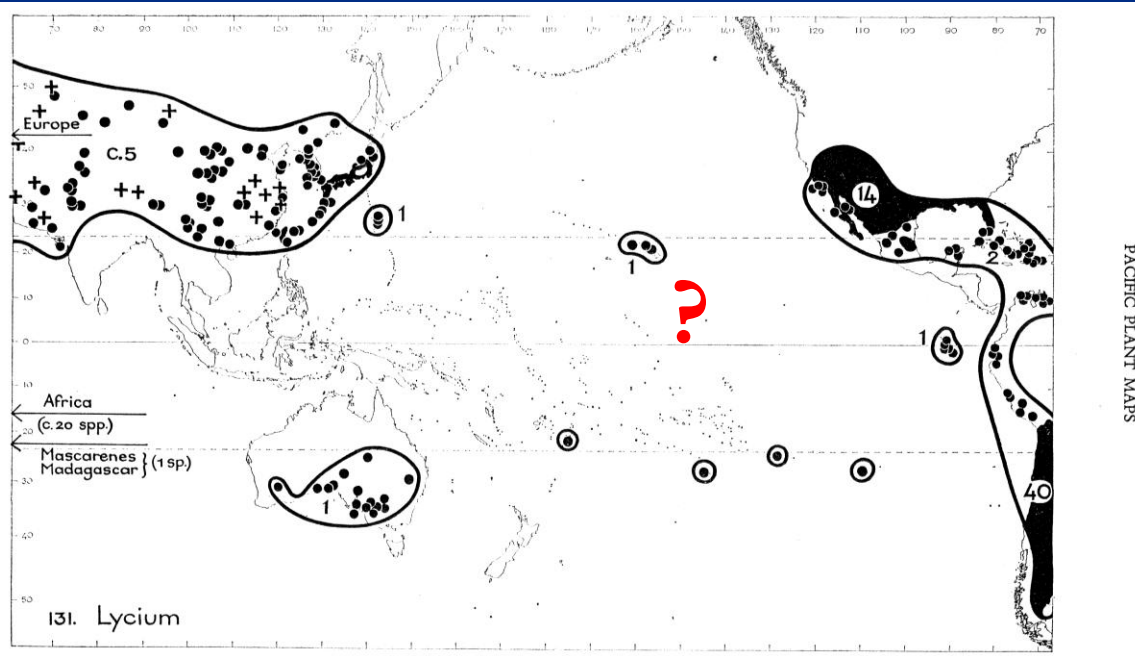


FIG. 5. The dispersal routes of *Lycium* estimated in this study.



(Rurutu, Austral Is.)

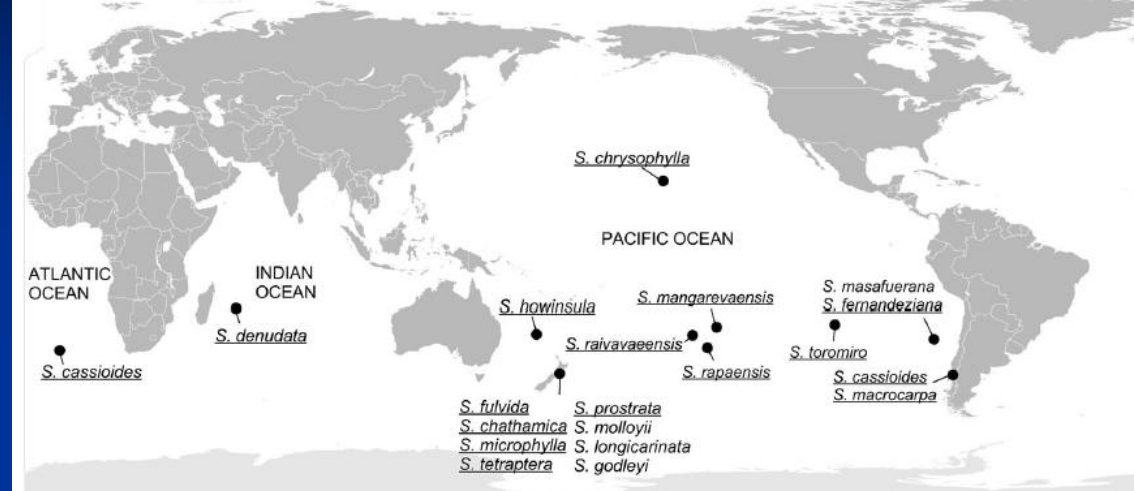
(Rapa)

(Rapa Nui)

(Fukuda *et al.* 2011. *Molecular Phylogenetics & Evolution*)



# Endemic *Sophora* (Fabaceae)



(Shepherd & Heenan 2017, New Zealand Journal of Botany)



*Sophora raivavaeensis* (Raivavae)

*Sophora chrysophylla* (Hawai'i)



*Sophora denudata* (La Réunion)



*Sophora tetraptera* (New Zealand, “kowhai”)



*Sophora toromiro* (Rapa Nui)



# Floristic similarities in Southeastern Polynesia

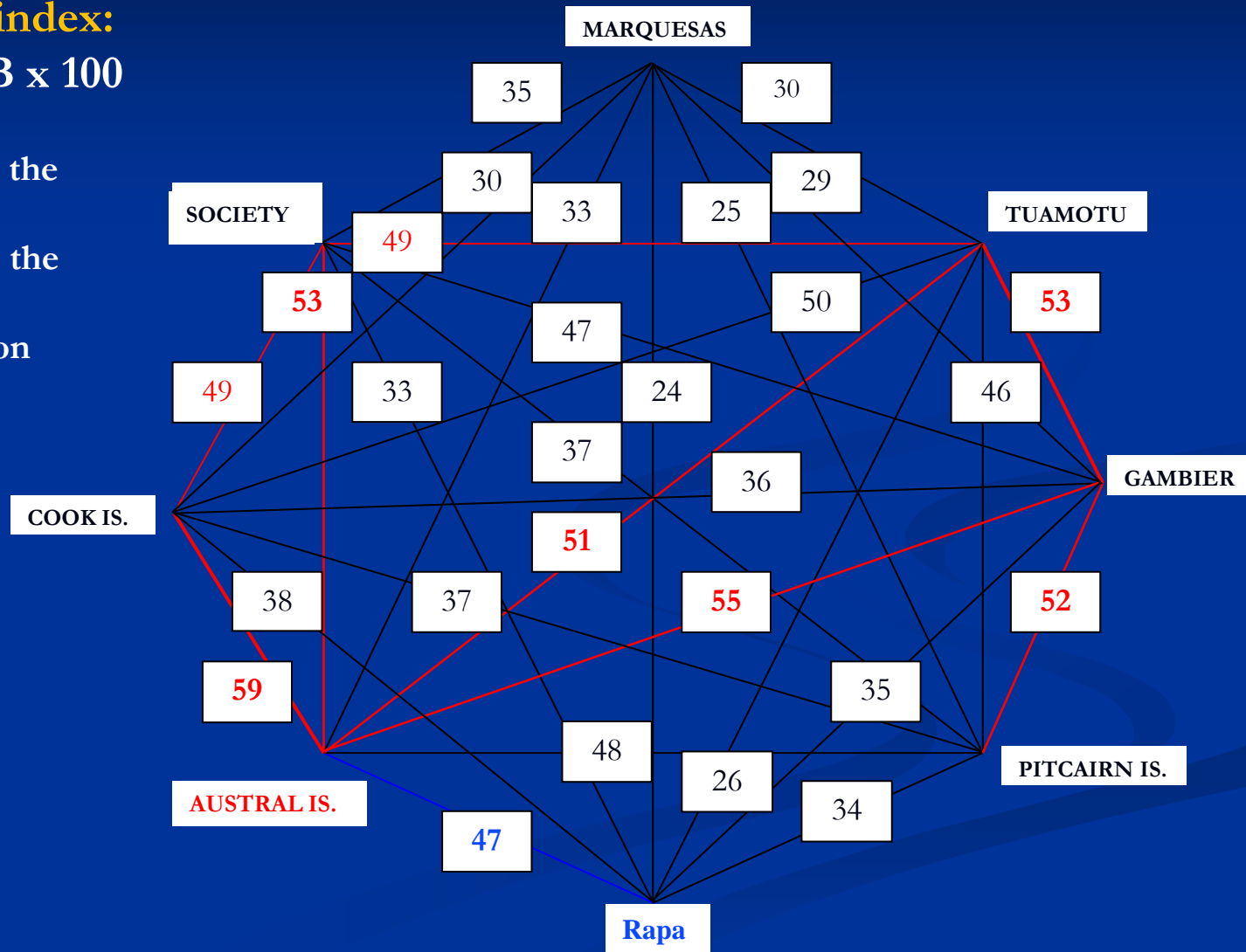
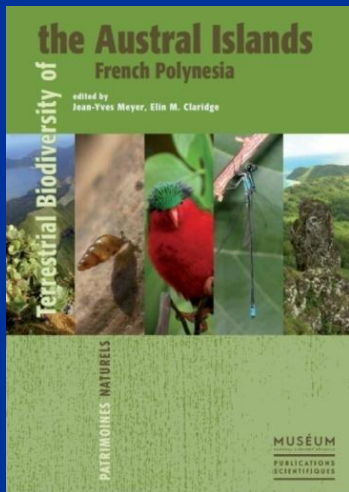
## Kröber Similarity index:

$$S_k = (A+B)C / 2AB \times 100$$

A = species number in the first archipelago

B = species number in the second archipelago

C = number of common species in the two archipelagoes





# Plant speciation and evolutive radiation

## ■ Most speciose genera:

- *Psychotria* = 27+ endemic species

- *Myrsine* = 27 spp.

- *Cyrtandra* = 28 spp.

- *Phyllanthus* = 22 spp.

- *Bidens* = 20+ spp.



*Psychotria* (Rubiaceae)



*Myrsine* (*Rapanea*,  
Primulaceae)



*Cyrtandra* (Gesneriaceae)



*Bidens* (Asteraceae)



*Phyllanthus* (*Glochidion*,  
Phyllanthaceae)



# Plant dispersal & « Taxonomic disharmony »

## ■ Present in Western but absent in Eastern Polynesia

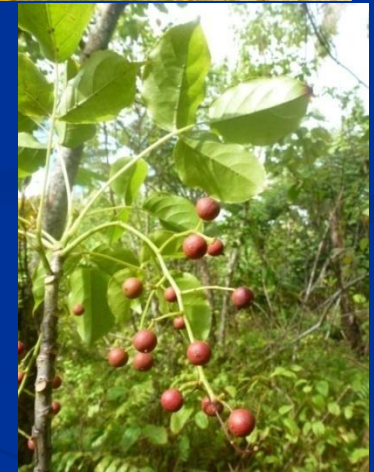
- *Dysoxylum* (Meliaceae)
- *Diospyros* (Ebenaceae)
- *Myristica* (Myristicaceae)
- *Syzygium* spp. (Myrtaceae)
- *Parinari* (Chrysobalanaceae)
- *Ficus* spp. (Moraceae)
- *Sterculia* (Sterculiaceae)
- *Rhizophora*, *Bruguiera* (Rhizophoraceae)





■ **Native in Western Polynesia but introduced in Eastern Polynesia**

- *Gardenia taitensis* (Rubiaceae)
- *Inocarpus fagifer* (Fabaceae)
- *Abrus precatorius* (Fabaceae)
- *Tephrosia purpurea* (Fabaceae)
- *Pometia pinnata* (Sapindaceae)
- *Bischofia javanica* (Phyllanthaceae) ?
- *Sapindus saponaria* (Sapindaceae) ?



(Whistler 1991)



(Dubois *et al.* 2013)



# Eastern Polynesia « missing native taxa »



*Bikkia tetrandra*  
(Rubiaceae)



*Hoya australis* (Apocynaceae)



*Dendrolobium umbellatum* (Fabaceae)



*Appendiculata*  
(Orchidaceae)



*Acanthephippium*  
(Orchidaceae)



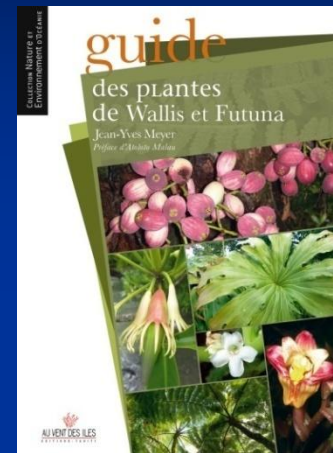
*Micromelum minutum*  
(Rutaceae)



*Medinilla*  
(Melastomataceae)



*Dipteris conjugatum*  
(Dipteridaceae)



(Meyer, 2017)



# Genetic diversity of Polynesian plants

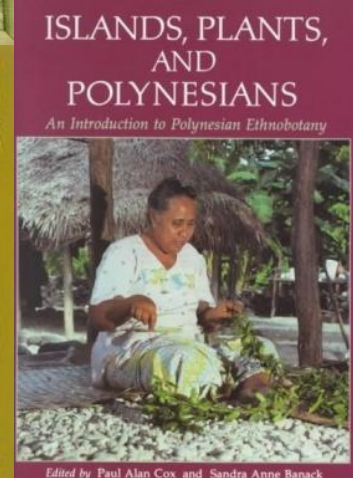
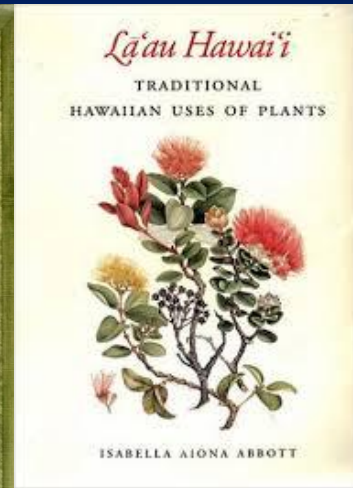
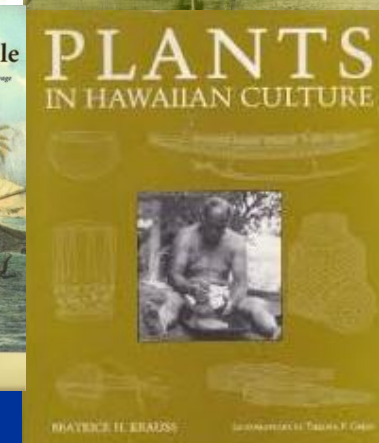
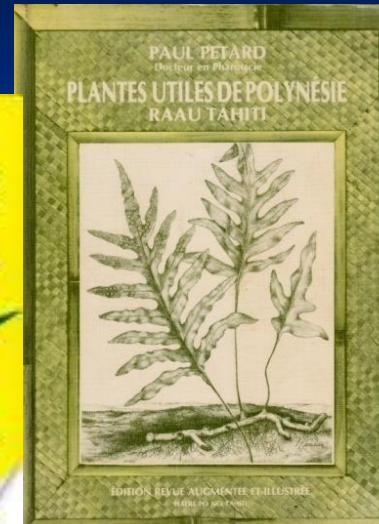
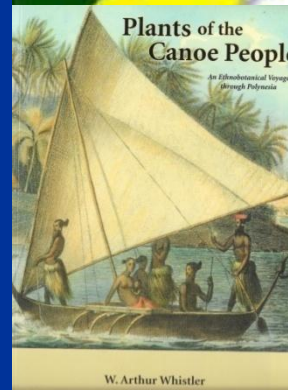
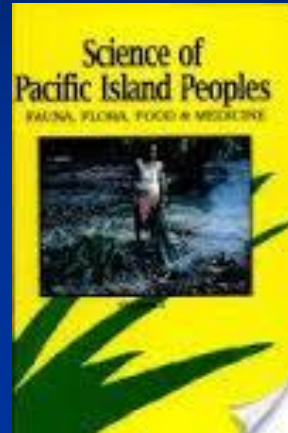
- > 430 named cultivated varieties/cultivars/cultigens of plants introduced and cultivated by Polynesians in the Society and the Marquesas Is. (after Cuzent 1860, Henry 1928, Brown 1931, 1935):

- *Musa × paradisiaca* (banana)= 75 Marquesas, 34 Tahiti
- *Cocos nucifera* (coconut)= 50 Marquesas, 16 Tahiti
- *Colocasia esculenta* (taro)= 30 Marquesas, 29 Tahiti
- *Artocarpus incisa* (breadfruit)= 40 Tahiti
- *Piper methysticum* (kava)= 21 Marquesas, 14 Society
- *Musa troglodytarum* (fe'i)= 18 Tahiti, 3 Marquesas
- *Saccharum officinale* (sugarcane)= 14 Marquesas, 7 Society
- *Cordyline fruticosa* (ti)= 13 Tahiti, 6 Marquesas
- *Ipomoea batatas* (sweet potatoe)= 6 Tahiti, 5 Marquesas
- *Ananas comosus* (pineapple) = 6 Marquesas



# Uses of Pacific Island Plants

- medicine
- general construction
- body ornamentation (tattoos)
- fuelwood
- ceremony and ritual
- toolmaking
- food
- boat or canoe making
- dyes or pigments
- magic and sorcery
- fishing equipment
- cordage and fibre
- games or toys
- perfumes and scented coconut oil
- fertiliser and mulching
- woodcarving
- weapons or traps
- food wrapping, domesticated and wild animal feed, handicrafts, cooking equipment, clothing, fish poisons, adhesives or caulking, and musical instruments
- subjects of legends, mythology, songs, riddles, and proverbs...





# Coastal and atoll plants: the « cool hotspots »



- 75 different purpose/use categories for 140 common Pacific Island coastal plants almost all of which are found on atolls
- Frequency of usage for the 140 plants was 1024, an average of 7.3 purpose/use categories per plant (up to 125 for the coconut!)
- 17 species have 20 or more reported uses

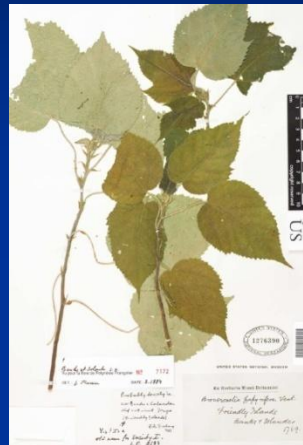
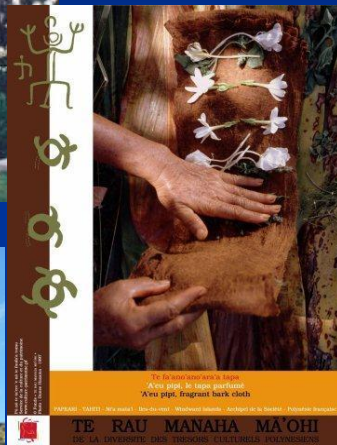
(Thaman 1992, *Atoll Research Bulletin*)



*Broussonetia papyrifera* (Moraceae) : mûrier à papier, paper mulberry, « aute » (Society), « ute » (Marquesas), « wauke » (Hawai'i), « mahute » (Rapa Nui)



Tahiti (1993)



Type specimen (Banks & Solander, 1769)

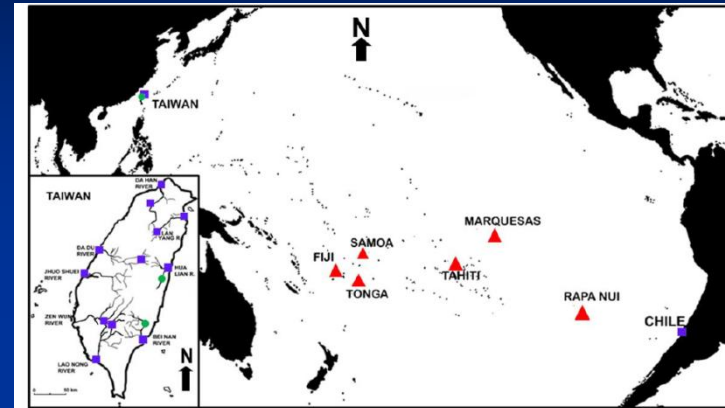


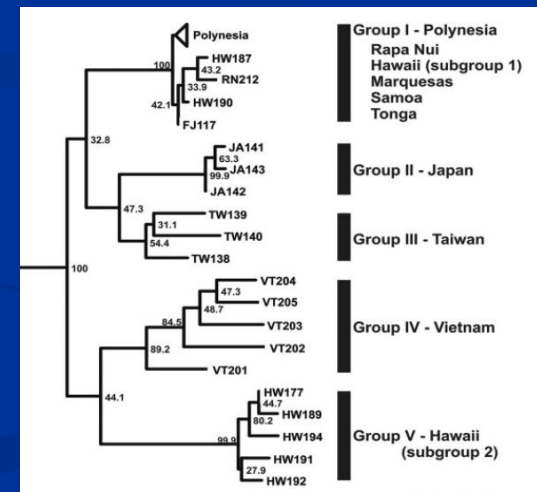
Figure 1 Map of the Pacific and Taiwan showing *Broussonetia papyrifera* sampling locations. Codes (▲, ■) indicate different genotypes as discussed in the text and also shown in Figure 2.



(Rapa Nui)



(Taiwan, 2012)

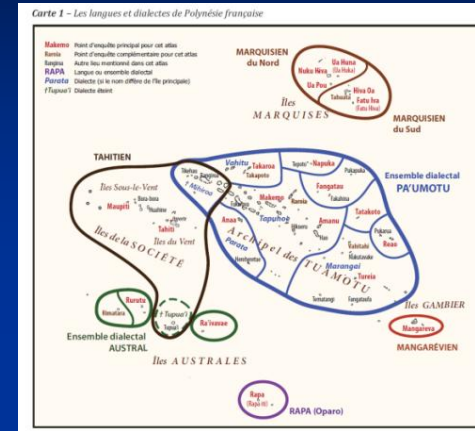
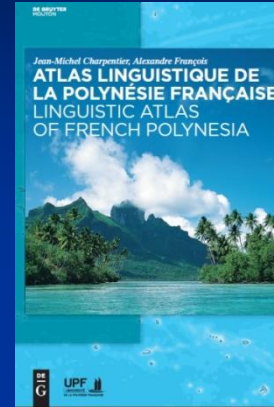


(Seelenfreund *et al.* 2011, Gonzalez-Lorca *et al.* 2005, New Zealand J. Botany;)



# Ethnobotany & linguistics: when plants « change names »

***Calophyllum inophyllum*** : « fetau » (Niue, Samoa) « feta’u » (Tonga, Futuna), « fatau » (Vanuatu), « tilo » (Futuna), dilo (Fiji)



***Calophyllum neo-ebudicum*** : « tamanu » (Alofi, Futuna, Samoa, Tonga, Niue, Vanuatu), « ndamanu » (Fiji)



Calophyllum inophyllum (arbre)	'ati	Calophyllum inophyllum (tree)
		1. tamanu 2. tamanu
		3. tamanu 4. tamanu
		5. tamanu
		6. 'ati 7. 'ati
		8. 'ati 9. tamanu
		10. moroati 11. 'ati
		12. tamanu ~ 'afi 13. 'ati
		14. tamanu 15. 'ati
		16. 'ati
		17. tiairi 18. 'ati
		19. tamanu 20.



# Ethnobiodyersity



(Heiva i Tahiti, 2013)



(Kiritimati, 2012)



(Alofi, 2008)



(Hiva Oa, 2012)

- « The knowledge, uses, beliefs, resource-use systems and conservation practices, taxonomies and language that island societies have for their ecosystems, species, and genetic diversity » (Thaman 2008, *Micronesica*)

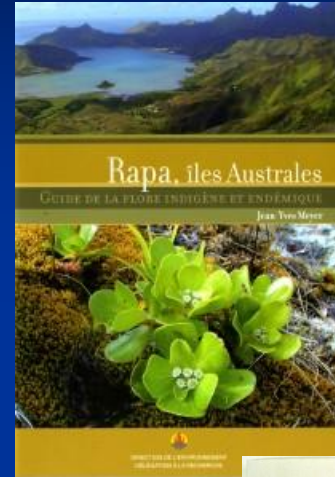


(‘Uvea, 2007)

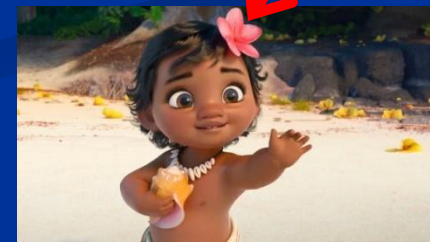
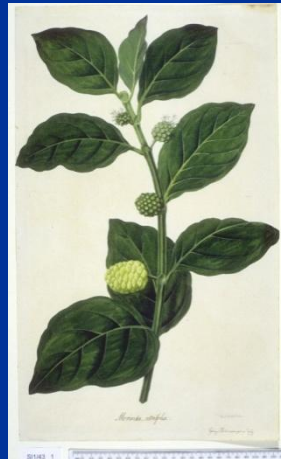
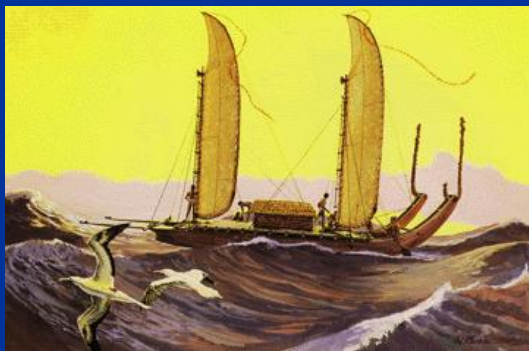


# Conclusions

- Floristic dissimilarities
  - Western vs. Eastern Polynesia
  - Archipelago and island endemic species
- Bio-cultural affinities
  - Common native species
  - Polynesian (and early European) introductions



(Mt Orohena summit at 2,241 m, Tahiti, French Polynesia)



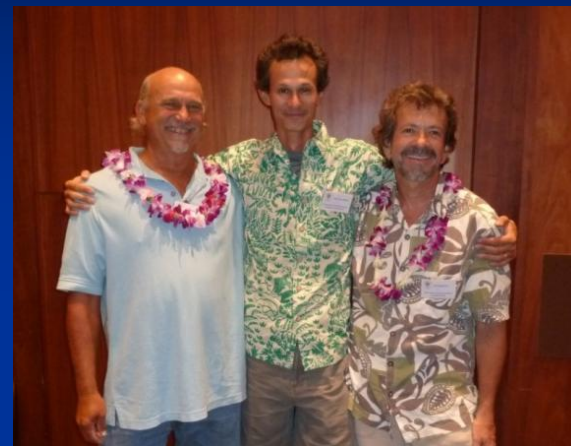
# Acknowledgements



(Tahiti, French Polynesia, 1999)



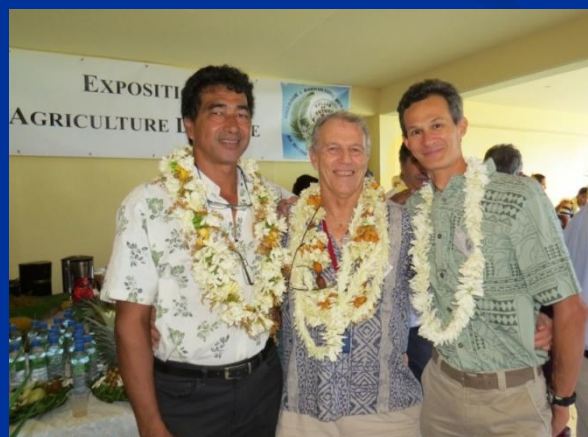
(Suva, Fiji, 2013)



(Honolulu, Hawai'i, 2011)



(Honiara, Solomon Is., 2012)



(Uvea, Wallis et Futuna, 2014)



(Atiu, Cook Islands, 2009)