

“Conservation of Biodiversity in French Polynesia”, UC Berkeley, Tetiaroa, 18 Jan. 2023

Conservation of (terrestrial !) biodiversity in French Polynesia: from research to management... and education



with a focus on Tetiaroa atoll (Society Is.)

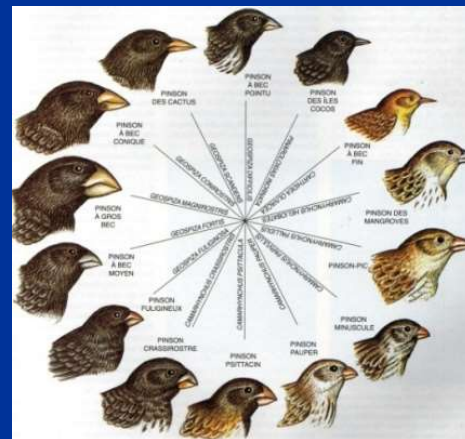
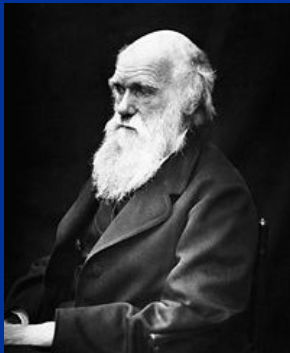


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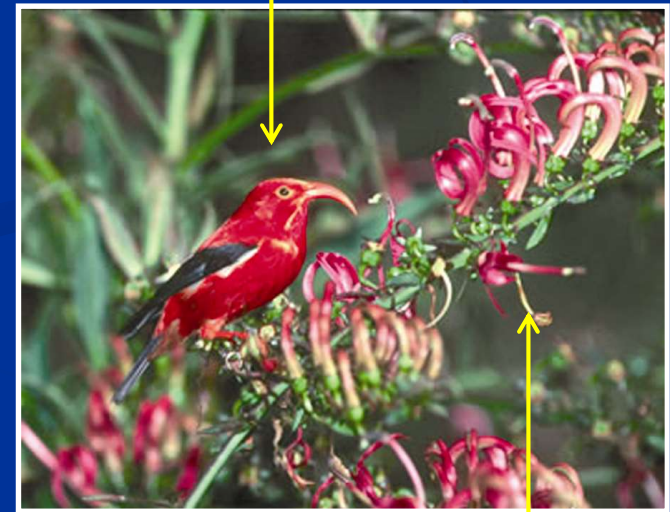
Island biota is unique...

- **Relatively high species richness** (ca. 20% of all species on less than 7% of the world area)
- **Very high endemism** (89% flowering plants in Hawaii, 80% in New Caledonia, 72% in French Polynesia...)
- **Spectacular adaptative radiations** (e.g. Galápagos finches, Hawaiian honeycreepers & lobeliads)



60 endemic honeycreepers in the endemic subfamily Drepanidinae

'Tiwi Vestiaria coccinea

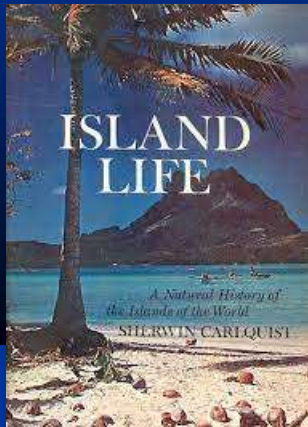


Trematolobelia sp.

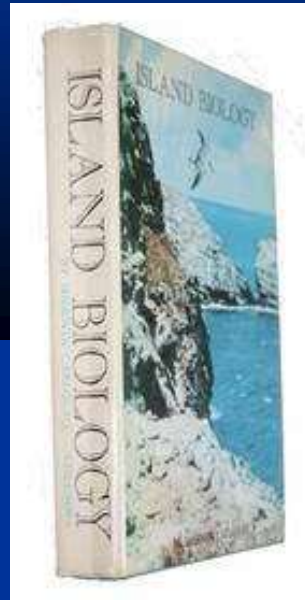
126 endemic lobeliads within 6 endemic genera (Campanulaceae, Lobelioidae)

The « island syndrome »

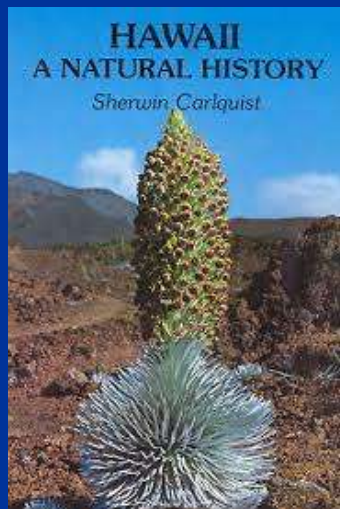
(2021)



(1965)



(1974)



(1980)



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Global Ecology and Conservation

journal homepage: www.elsevier.com/locate/gecco

Check for updates

Scientists' warning – The outstanding biodiversity of islands is in peril

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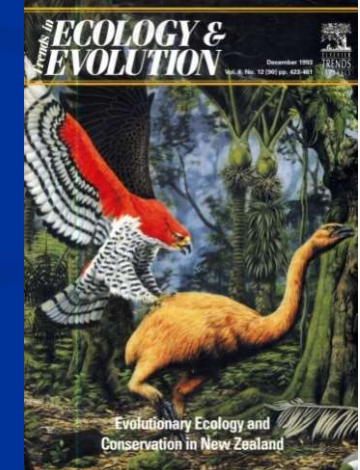
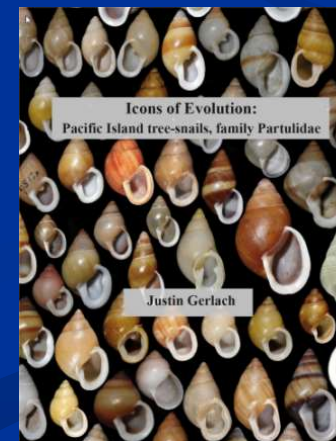
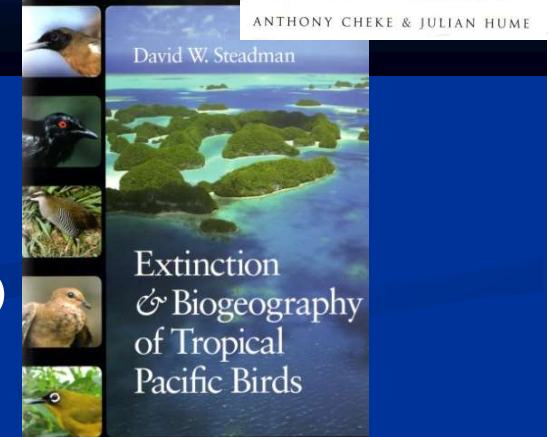
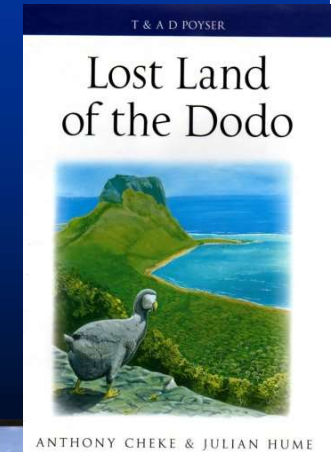
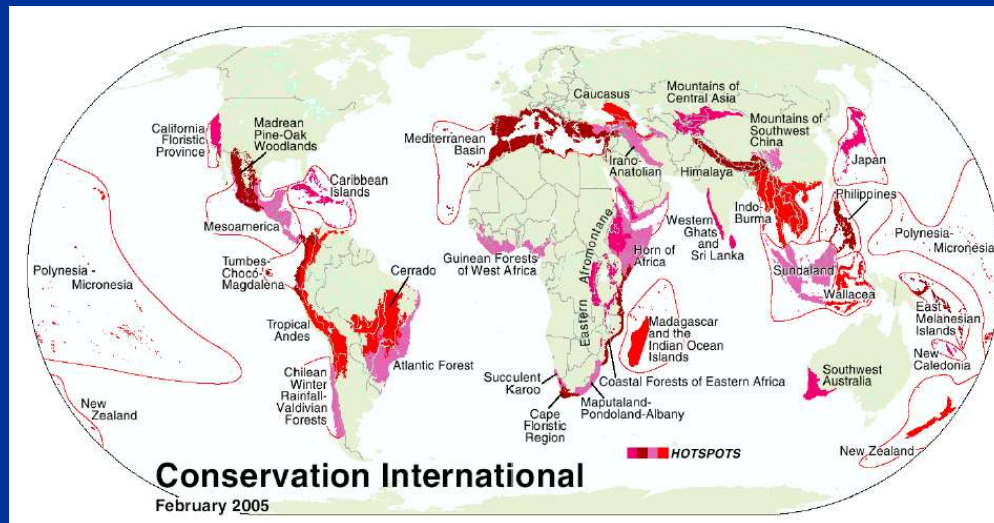
	island	continent	
low species richness			community level
disharmonic biota			
high endemcity			
few interactions			
demographic release			species level
ecological release			
flightlessness			
dwarfism			
gigantism			
secondary woodiness			
loss of defenses			
tameness			
slow reproduction			
loss of dispersal ability			

Fig. 3. Some typical characteristics of island species and communities that make them different from continental ones.

(in memory of Sherwin CARLQUIST, 1930-2021†)

...but highly vulnerable

- **Massive past extinction events** (75% of all extinct species, >90% of all extinct birds and reptiles)
- **Current endangered biota** (>90% of all the threatened birds)
- **10 of the 36 recognized “Biodiversity Hotspots”** (areas with high endemism and high level of threat)



Extinction crisis on islands

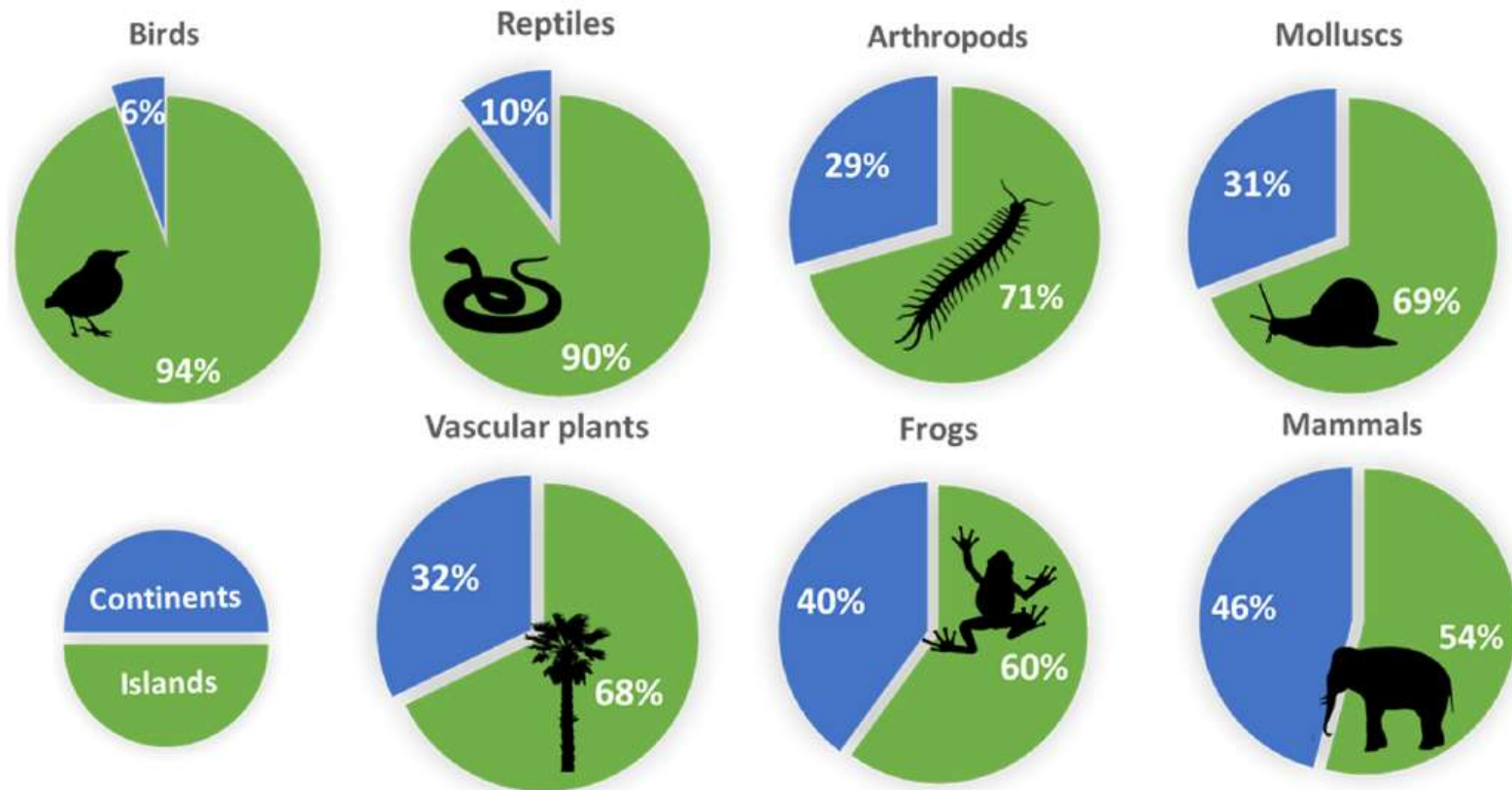
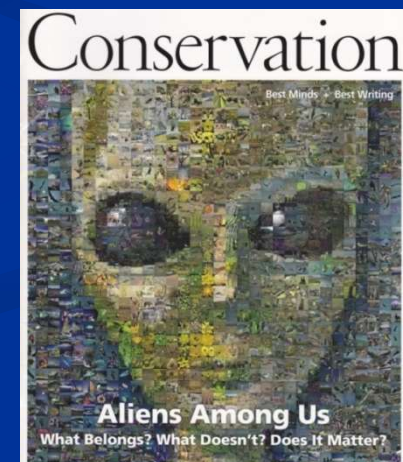
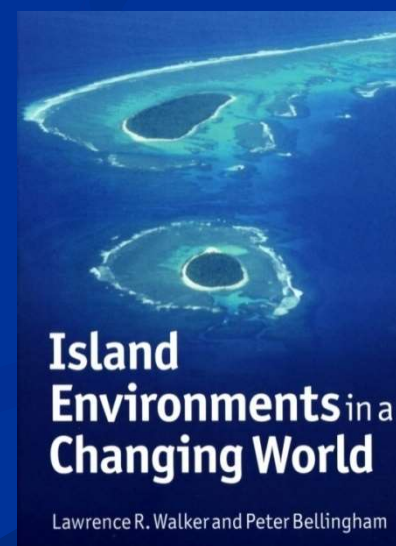
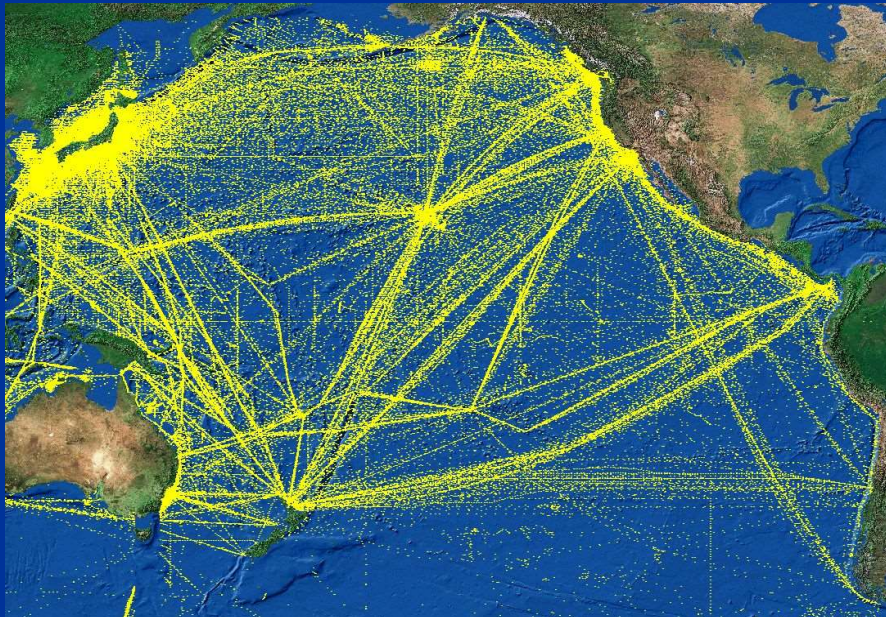


Fig. 4. Number of terrestrial species of major taxa that have gone extinct globally, or become extinct in the wild, along with percentages of insular extinctions relative to the total amount of known post-description extinct species.

Source: IUCN, 2017.

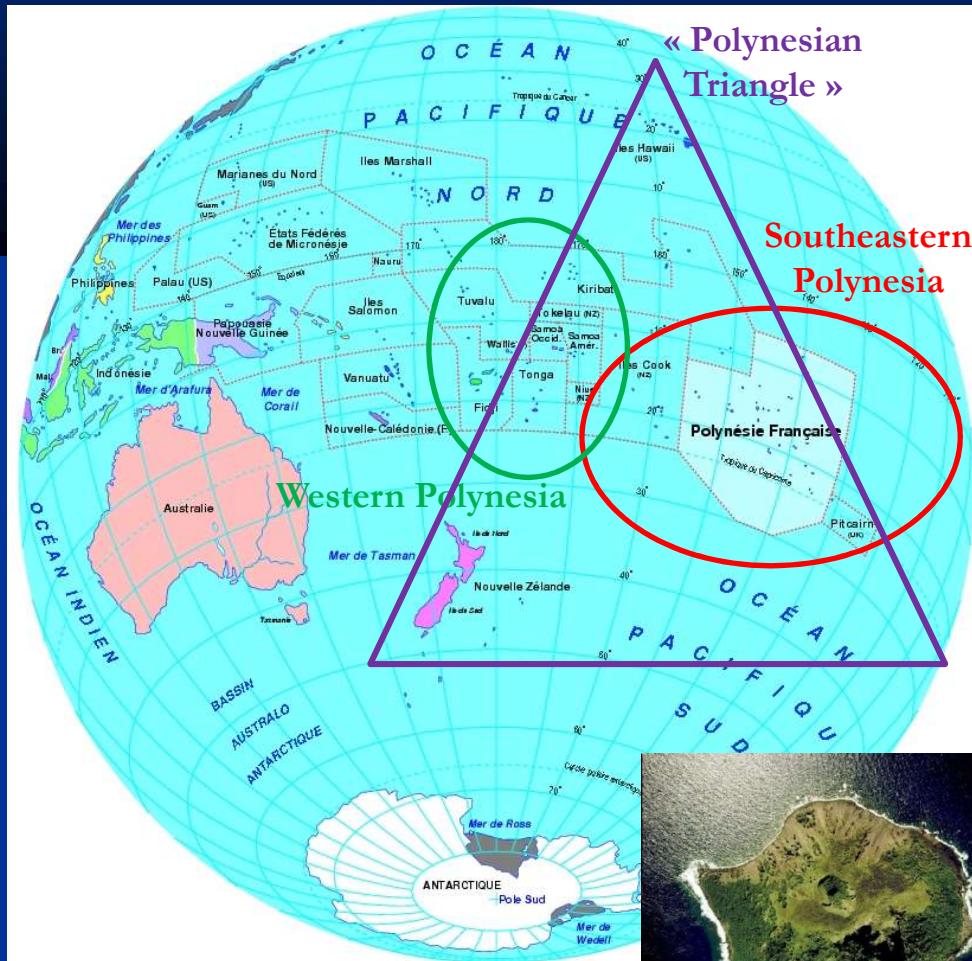
The Anthropocene

- Globalization & “Biotic Mixing”
- Global Change(s)
- Extinction crisis



French Polynesia: a case study

Ecosystem diversity



- 120+ oceanic islands, 3,520 km², 30,000 yrs to 60 MY (atolls)
- Tropical to subtropical climate
- 34 high volcanic islands (e.g. Tahiti, Mo'orea) to almost atolls (e.g. Bora Bora, Mai'ao) and « composite » islands (e.g. Rimatarara, Rurutu)
- 84 atolls (76 in the Tuamotu) including 6 uplifted atolls (e.g. Makatea, Niau, Ana'a)

Me'etia (Society)



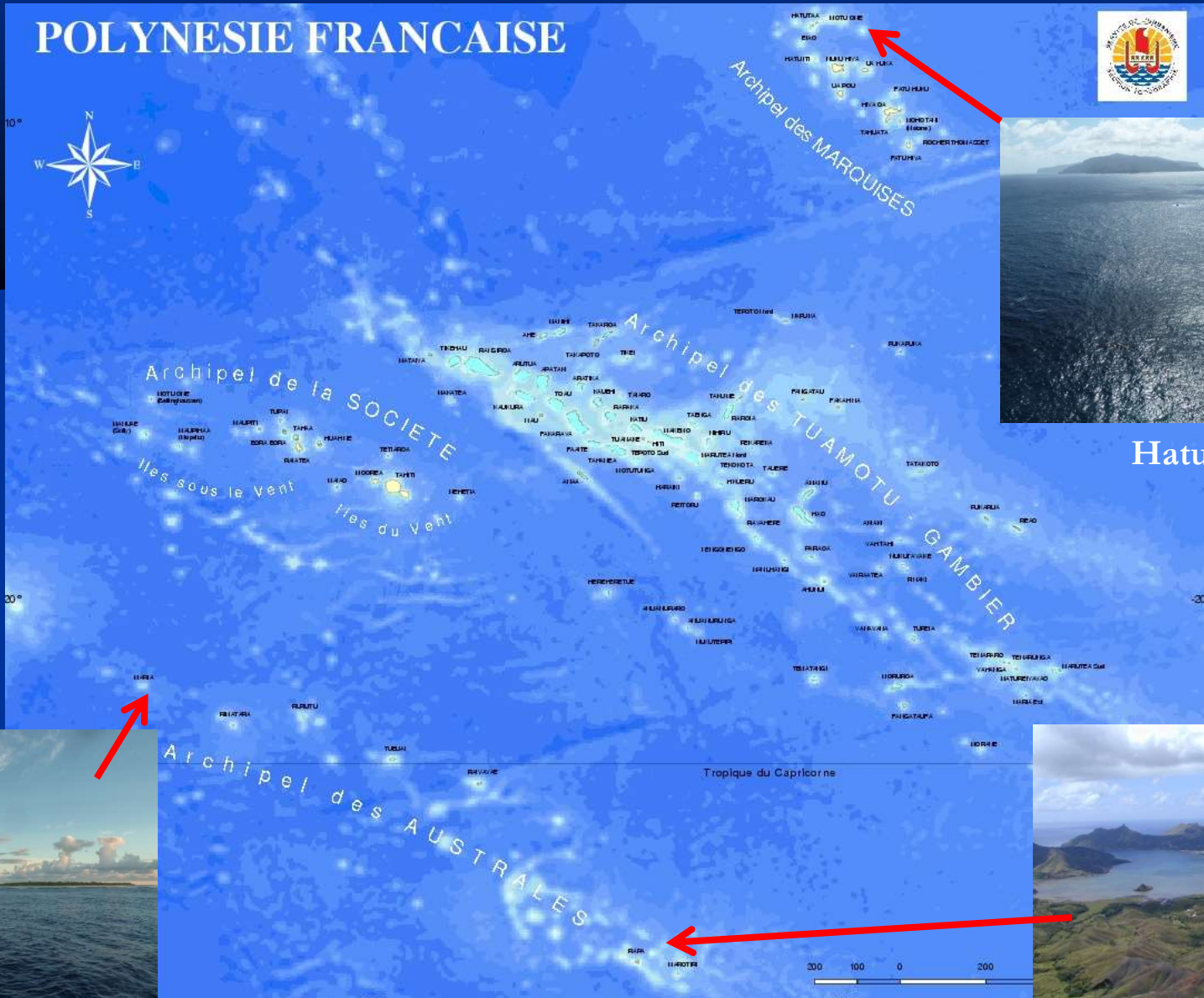
Ua Pou (Marquesas)



Makatea (Tuamotu)

Isolation & pluri-insularity

POLYNESIE FRANCAISE



Hatutaa & Eiao

Maria atoll



Rapa



Habitat diversity & vegetation types

- Coastal/littoral vegetation & forests
- Para/supra-littoral forests
- Semi-Dry forests
- Mesic forests
- Lowland and valley wet/rainforests
- High elevation/montane rainforests (« cloud forests »)
- Sub-alpine vegetation (« summit shrublands »)
- Wetland vegetation (from sea-level to mountains)



Niau (Tuamotu)



Te Pari, Tahiti Iti
(Society)



Mt Orohena (2,241 m),
Tahiti Nui (Society)



Roto Rahi & Roto Iti lakes, Maiao (Society)



Pariati valley & slopes, Rapa (Austral)



Gulch below Mt Aorai (ca. 1,700 m)

Species diversity

- **Arthropods > 3000 native species** incl. 1570 endemics (1406 endemic insects*)
- **Plants > 900 native taxa** incl. 570 endemics, 62% endemism
- **Land molluscs > 525 native taxa**, 95% endemism
- **Freshwater fishes = 37 native species** incl. 15 endemics
- **Land birds = 36 native land birds** incl. 27 endemic species
- **Reptiles = 9 native geckos & skinks**



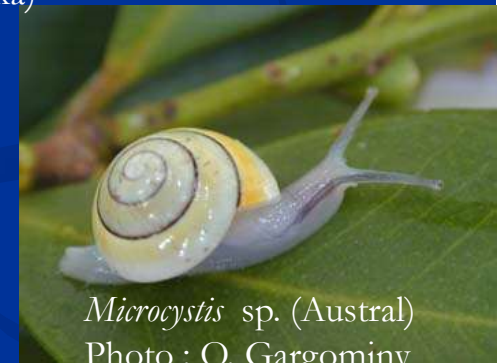
Rhyngogonus planatus (Ua Huka)



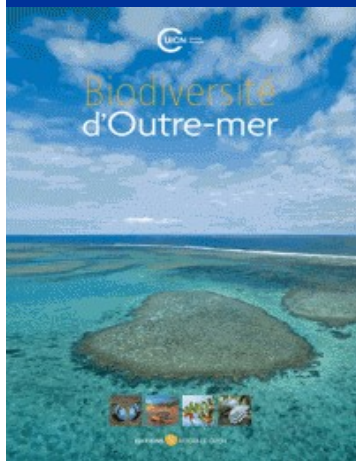
Nacaduba tabitiensis (Tahiti)



Lentipes rubrofasciatus
(Marquesas) Photo : P. Keith



Microcystis sp. (Austral)
Photo : O. Gargominy



Sclerotheca (Apetabia) raiateensis (Raiatea)



Ducula galeata (Nuku Hiva)



Vini kuhlii (Rimatara)

Endemism (Angiosperms)

Archipelago/Island (area)	Native flowering plants	Endemic flowering plants (%)	Endemic species density (per sq. km)
New Caledonia (19,060 km ²)	3,063	2,448 (80%)	0.128
Fiji (18,270 km ²)	1,302	799 (61%)	0.050
Hawaii (16,880 km ²)	966	859 (89%)	0.051
La Réunion (2,512 km ²)	797	309 (39%)	0.123
French Polynesia (3,520 km²)	659	478 (72%)	0.136

Speciation & evolutive radiation

Archipelago	<i>Cyrtandra</i> (Gesneriaceae)	<i>Psychotria</i> (Rubiaceae)
Hawai'i	60	11
Fiji	37	76
French Polynesia	28	27+



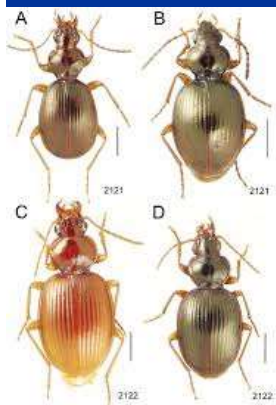
Cyrtandra



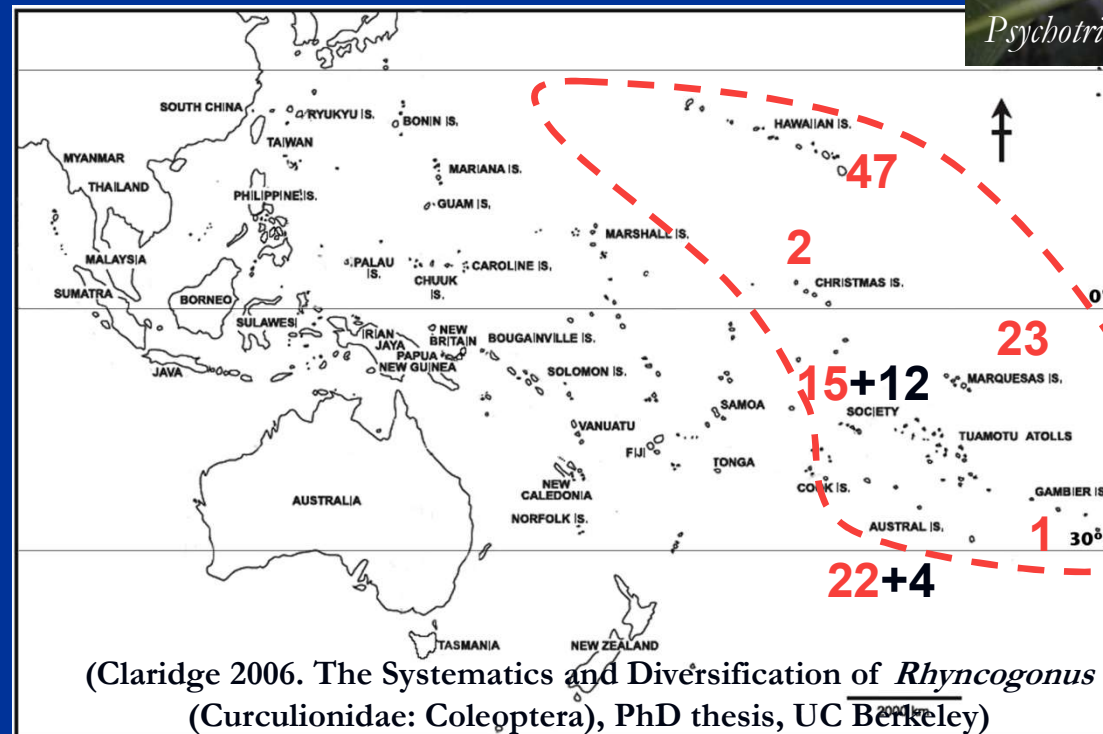
Psychotria



Rhyncogonus adamsonii (Hiva Oa)



Mecyclothorax spp.
(101 species)



(Raiatea, 2006)

Main threats to biodiversity

- Population growth (x2 in the past 30 yrs)
- Urbanization pressure
- Deforestation & fragmentation + Pollutions + Overexploitation + Introduction of alien species + Climate change

The Earth's Evil Destroyer
of Biodiversity:

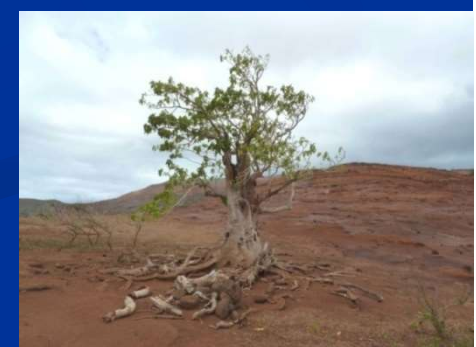
Habitat Destruction

Invasive Species

Pollution

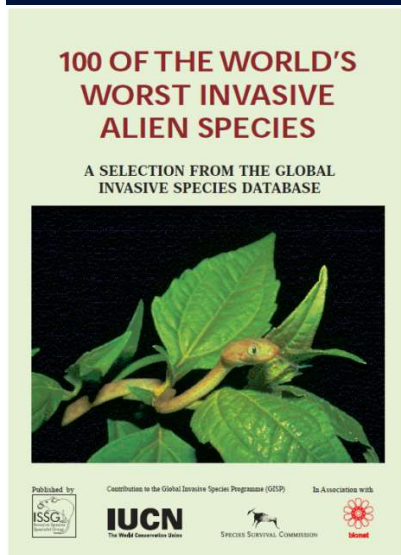
Population

Overharvesting



Invasive alien species

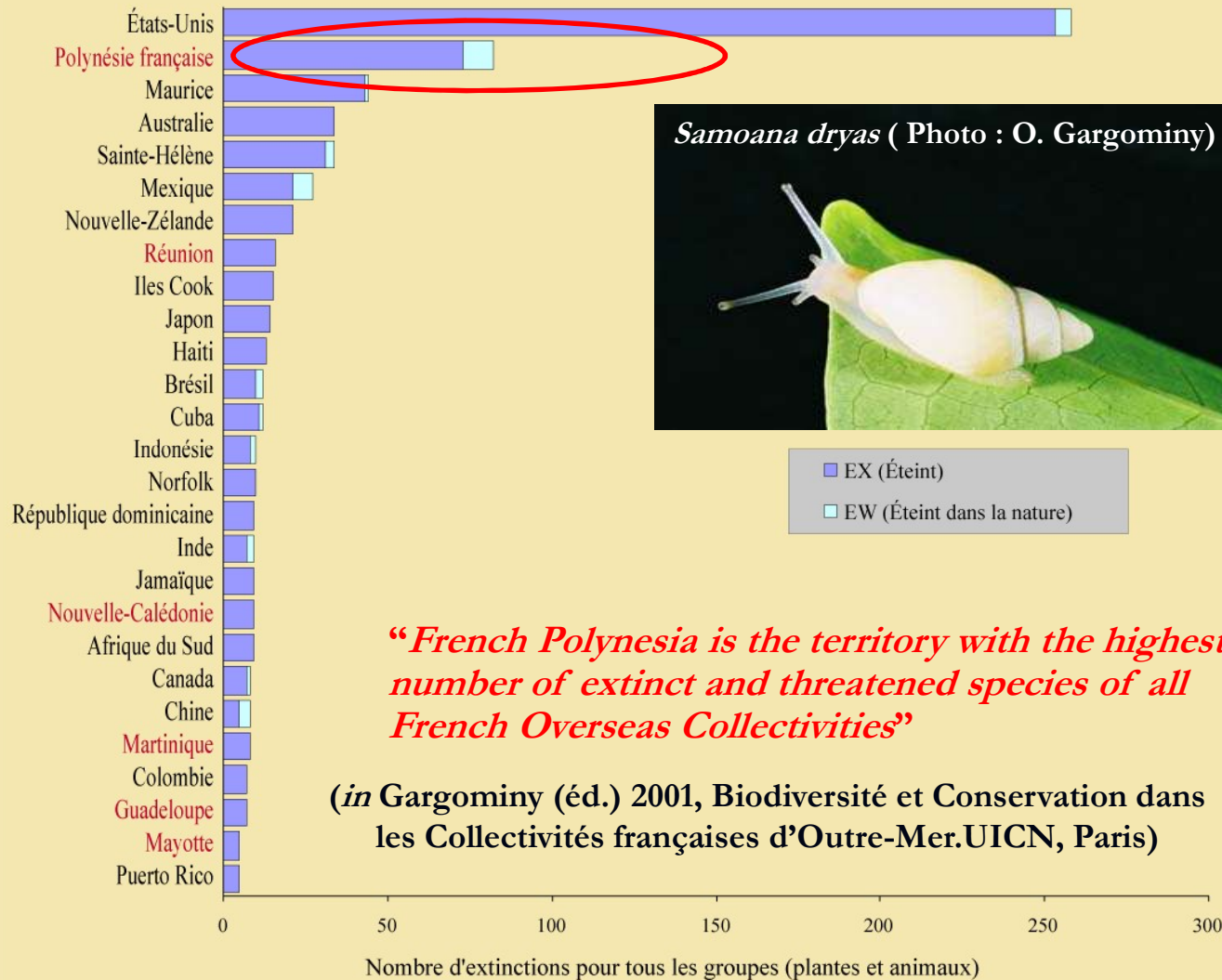
- Increasing transportation of goods and people
- Huge ecological, socio-economical and human health impacts !



(Photo : H. Jourdan)

Species extinctions

Les 26 pays avec plus de 5 espèces éteintes depuis 1500



Samoana dryas (Photo : O. Gargominy)

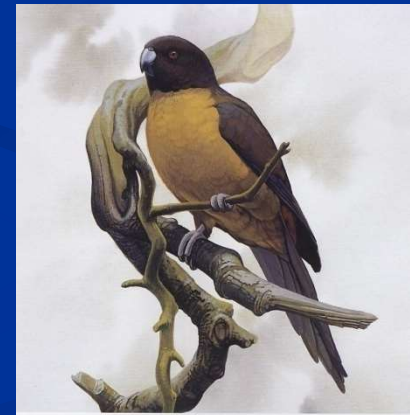
■ EX (Éteint)
■ EW (Éteint dans la nature)

“French Polynesia is the territory with the highest number of extinct and threatened species of all French Overseas Collectivities”

(in Gargominy (éd.) 2001, Biodiversité et Conservation dans les Collectivités françaises d’Outre-Mer. UICN, Paris)



Sesbania coccinea subsp. atollensis var. parkinsonii
(Sydney Parkinson, 1773)



1777
Raiatea Parakeet
(*Cyanoramphus ulietanus*)
Cyanoramphus ulietanus

Contemporary extinction or decline of monarchs (flycatchers) *Pomarea* spp. in Eastern Polynesia

Rarotonga

P. dimidiata ★

Tahiti

P. nigra ★

P. fluxa † 1977

P. nukuhivae † 1930s

P. iphis ☆

P. mira † 1985

MARQUESAS

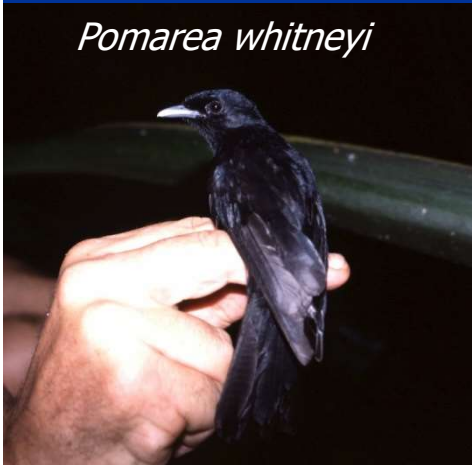
P. mendozae † 1975

P. motanensis ★

P. mendozae † 1922

P. whitneyi ★

- † Extinct
- ★ Critical
- ★ Endangered
- ☆ Vulnerable



(Thibault & Meyer 2001)

The impacts of the Carnivorous snail *Euglandina rosea*



Achatina fulica
1967



Microcystis saintjohni (Tubuai)



Euglandina rosea
1975



Partula otabeitana (Tahiti)



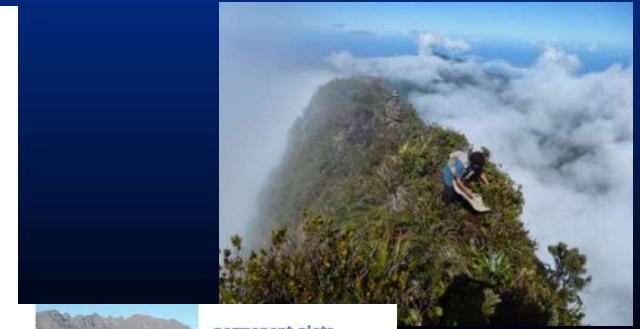
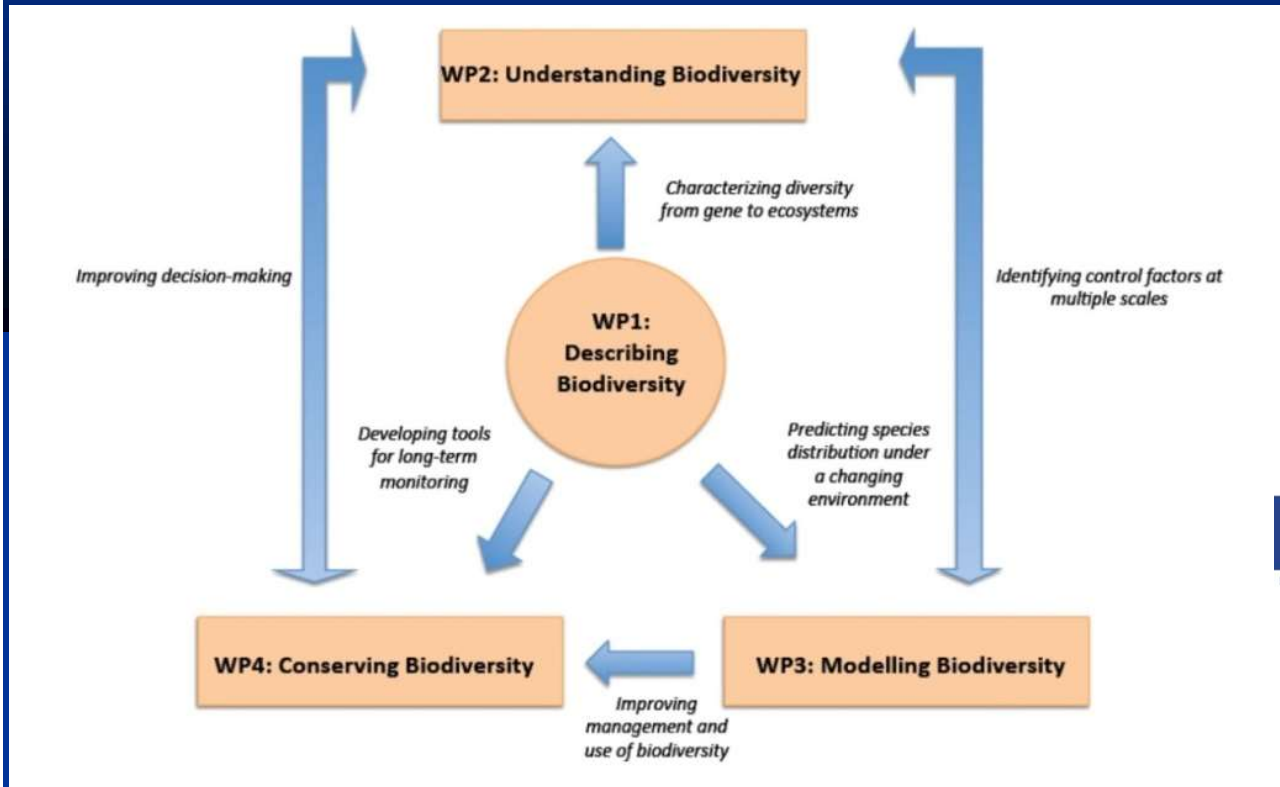
Partula taeniata (Moorea)



Samoana ganymedes (Tahuata)

- Extinction of 56 of the 61 endemic *Partula* species in the Society Islands

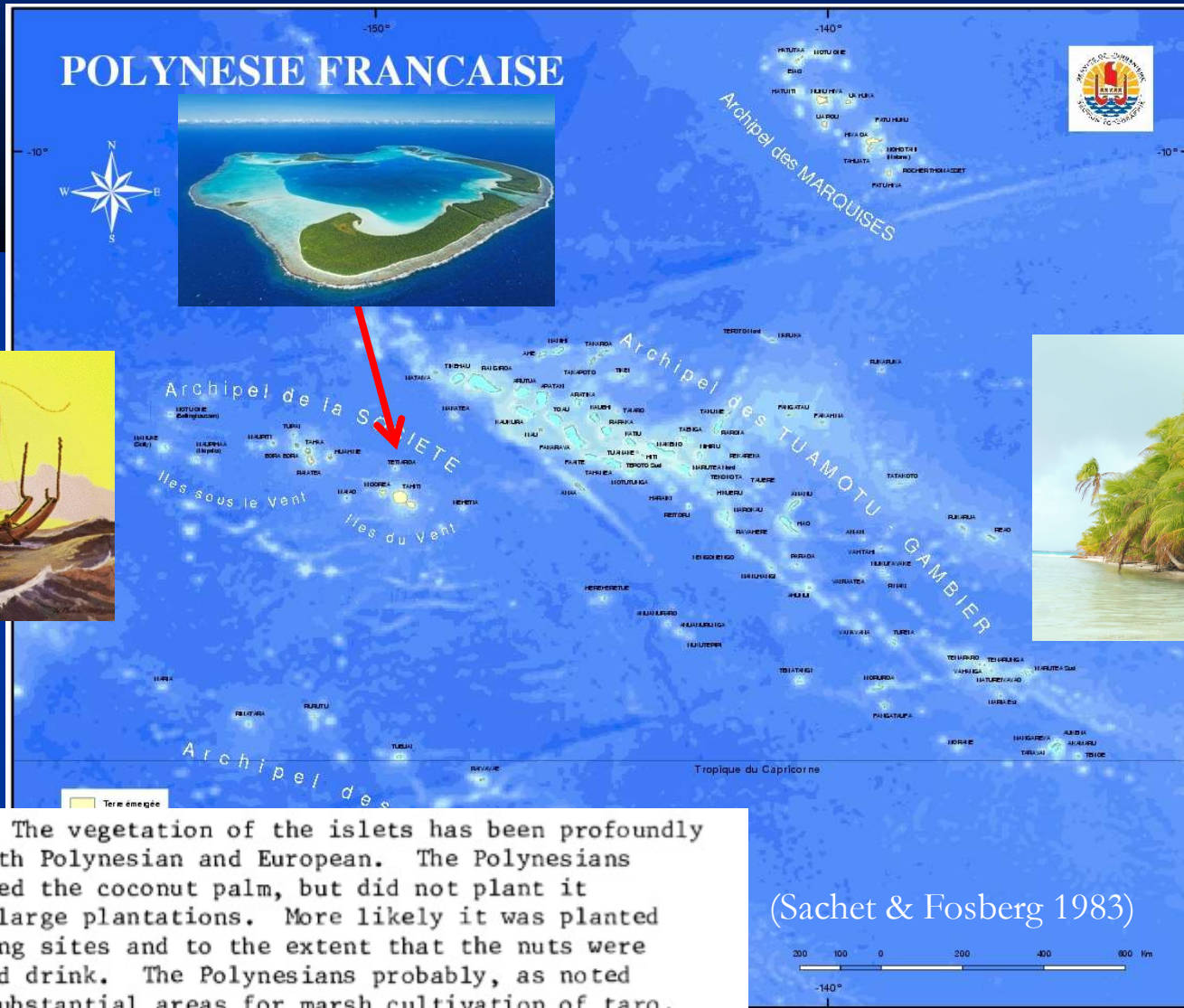
From research to management



Montane vegetation
as listening posts for climate change



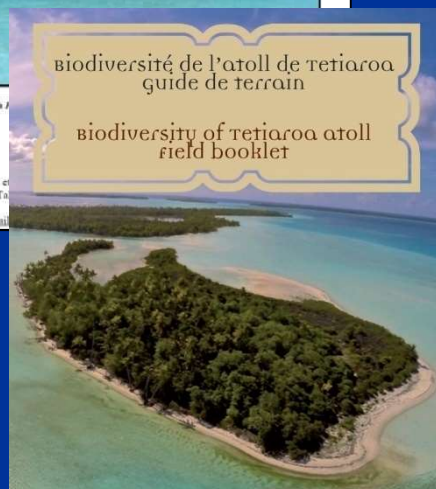
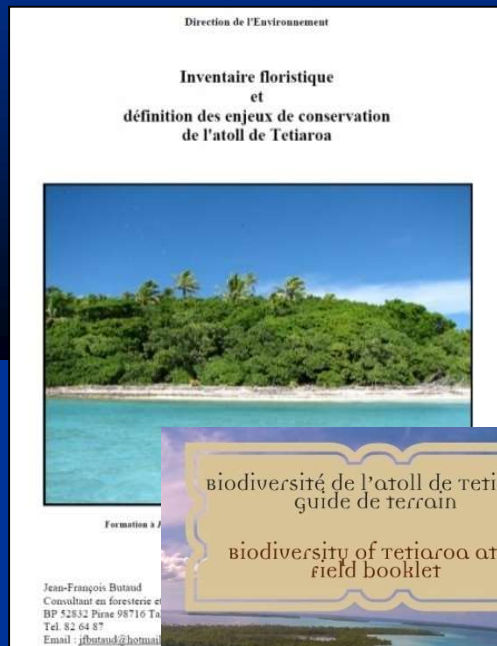
Tetiaroa as a (socio-ecological) model system



Vegetation: The vegetation of the islets has been profoundly altered by man, both Polynesian and European. The Polynesians certainly introduced the coconut palm, but did not plant it generally to form large plantations. More likely it was planted only around dwelling sites and to the extent that the nuts were needed for food and drink. The Polynesians probably, as noted above, excavated substantial areas for marsh cultivation of taro.

(Sachet & Fosberg 1983)

Vascular flora of atolls in French Polynesia

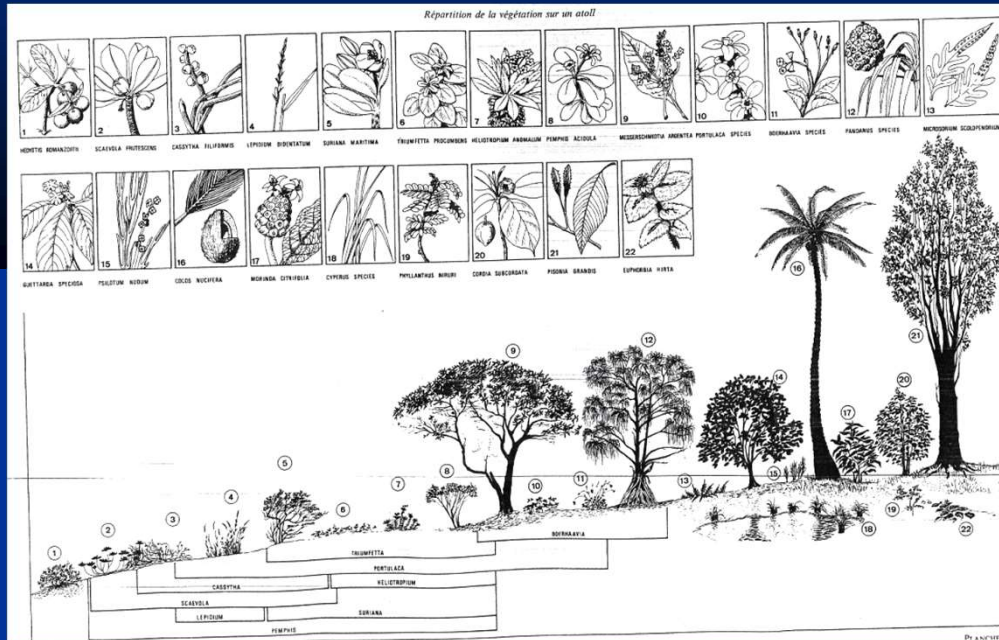


Atoll	Area (km ²)	Native plants	Alien plants	Source
Toau (Tuamotu)	12	33(+)	74	Taputuarai & Niva, 2015
Tupai (Society)	11	40(-)	95	Butaud, Taputuarai <i>et al.</i> , 2011; Meyer, 2021
Raraka (Tuamotu)	7	30(+)	105	Taputuarai & Niva, 2015
Tetiaroa (Society)	5	39(-)	180(+)	Butaud, 2006, 2013; Meyer 2014-on going
Taiaro (Tuamotu)	4	25	21	Niva & Taputuarai, 2013
Moruroa (Tuamotu)	3	29	55	Meyer, 2007
Morane (Gambier)	2.2	21	1	Meyer, 2020
Maria (Australs)	1.5	24	10	Meyer, 2013

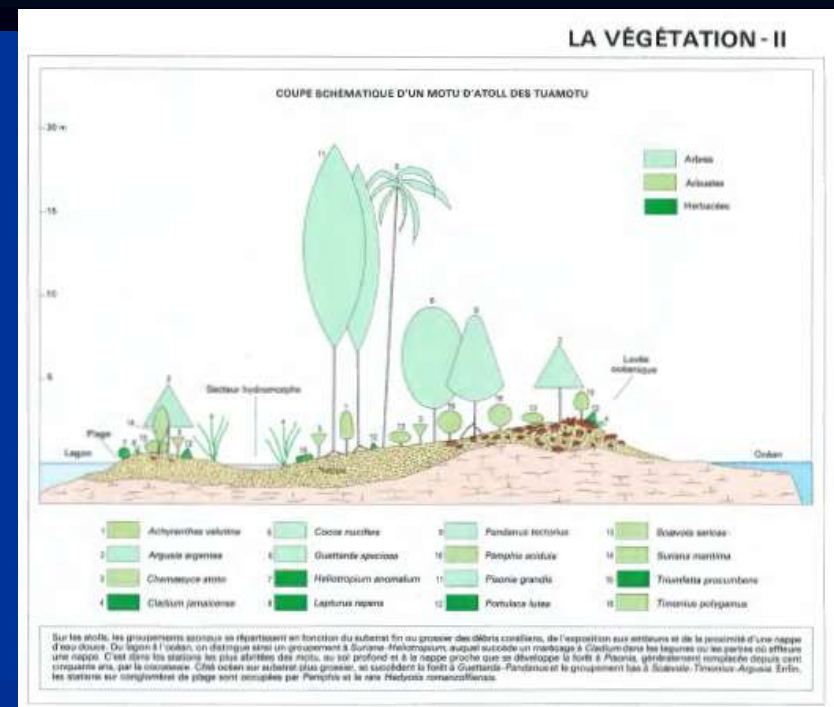


(Morane, 2019)

Botany, plant ecology and phyto-sociology

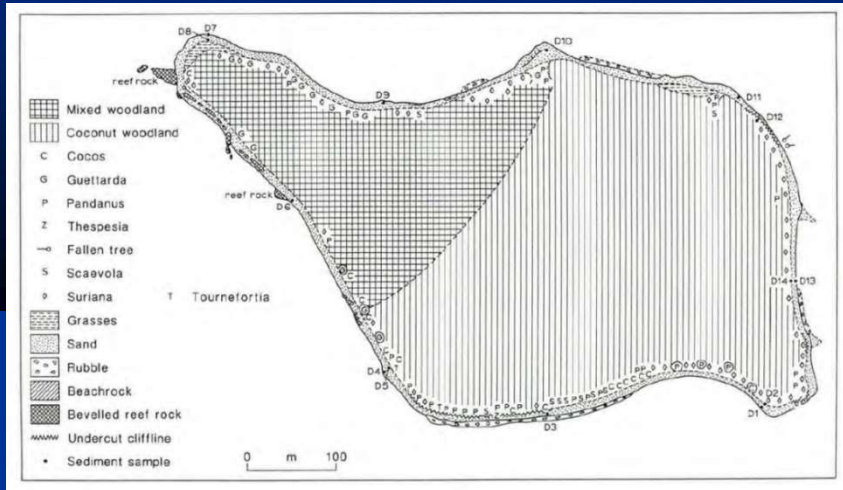


(in Cayet, O. 1973. Le Monde Vivant des Atolls. Polynésie française)



(in Florence 1993. La végétation de quelques îles. Atlas de la Polynésie française)

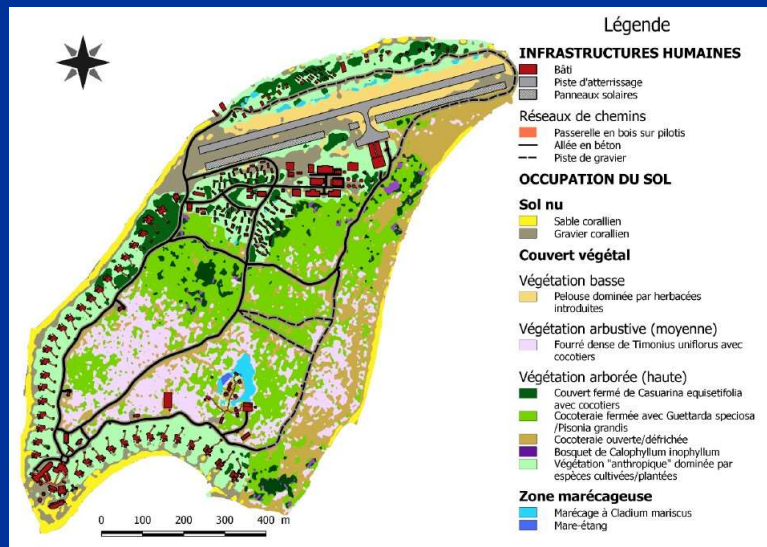
GIS & Vegetation map



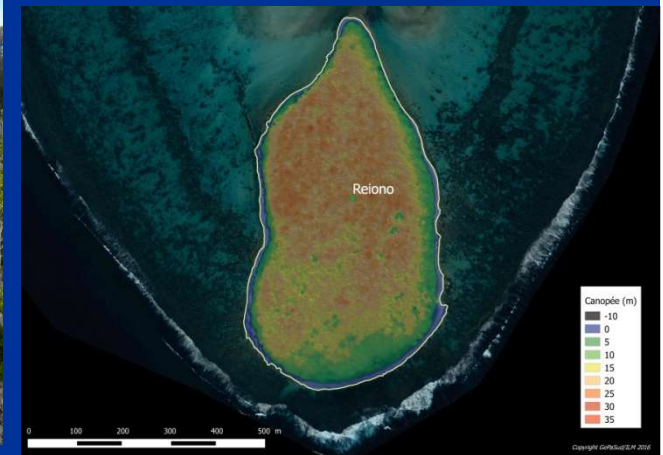
(Stoddart, unpub. data)



(Google Earth©)



(Jost, 2016)

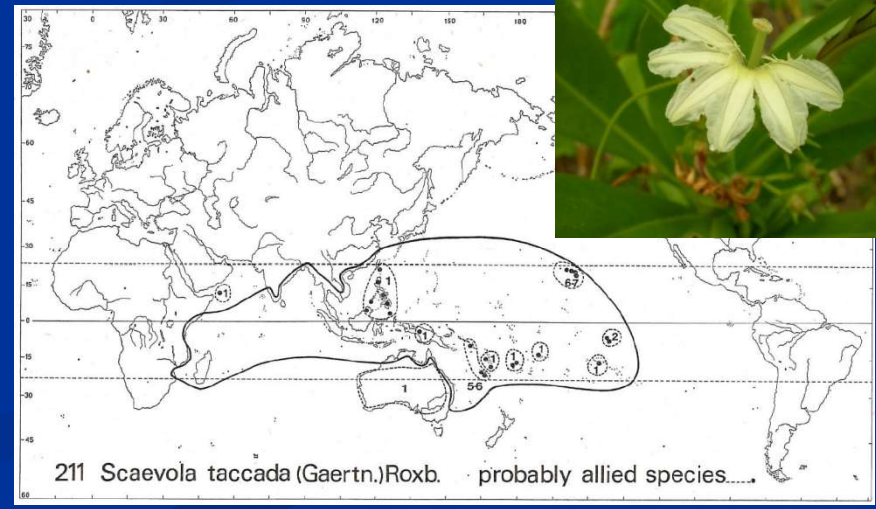
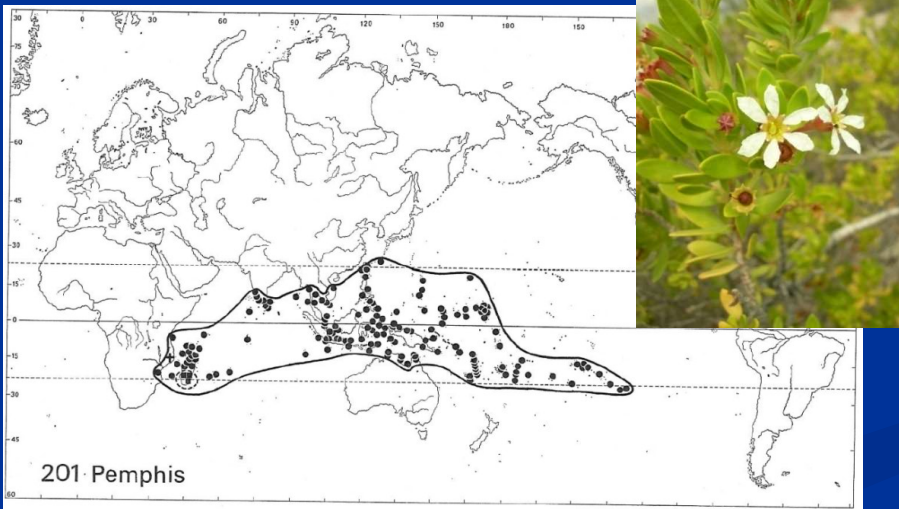
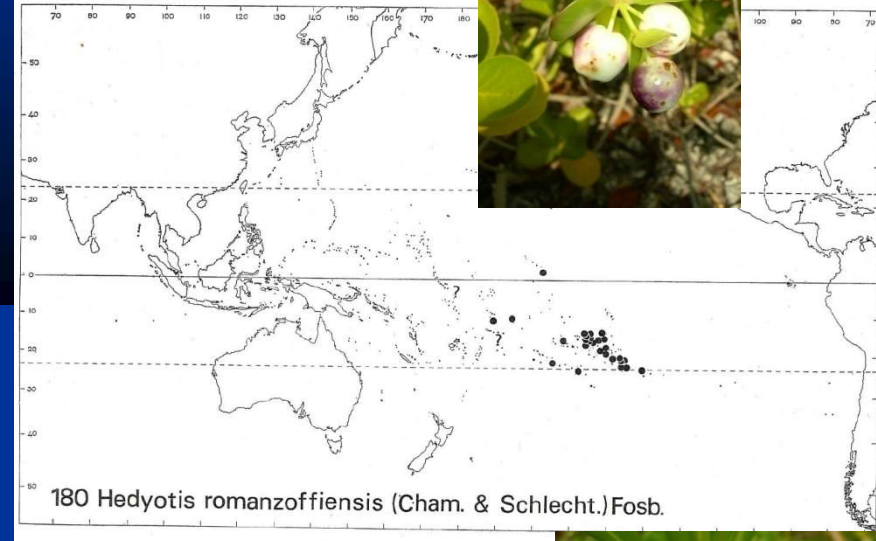
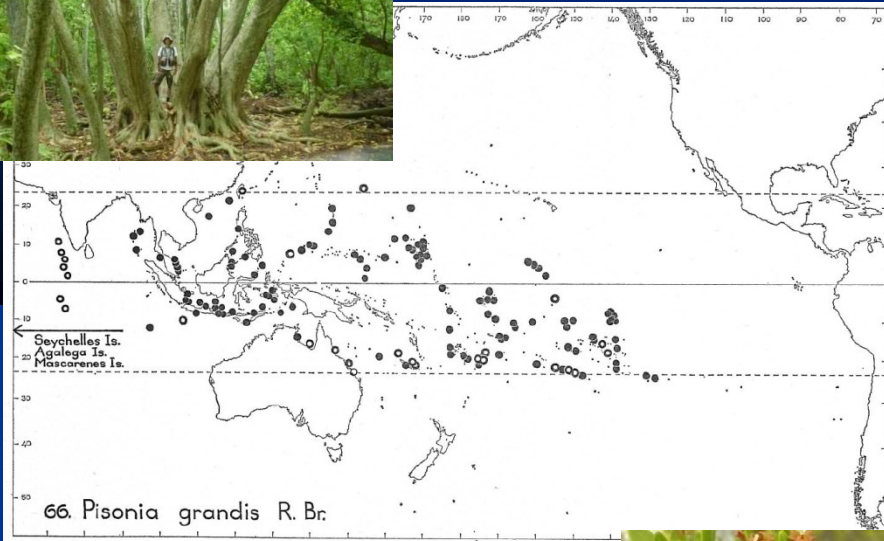
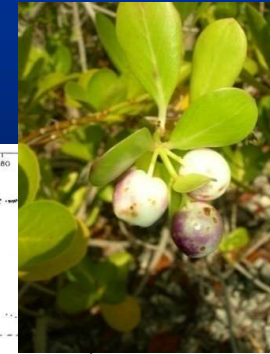


(Stoll, GePaSud, UPF/ILM 2016)

Habitat types & plant formations



Phytogeography



Common native species in atolls

Scaevola taccada var. *taccada* & var. *tuamotensis* (syn.
Scaevola sericea, Goodeniaceae)
SOC = « naupata », HAW = « naupaka »



Heliotropium arboreum (Boraginaceae, syn. *H. foertherianum*,
Tournefortia argentea), SOC = « tāhinu », TUAM =
« tōhinu », « geogeo », « piupiu », MANG = « to'unu »,
COOK = « tau'unu' »

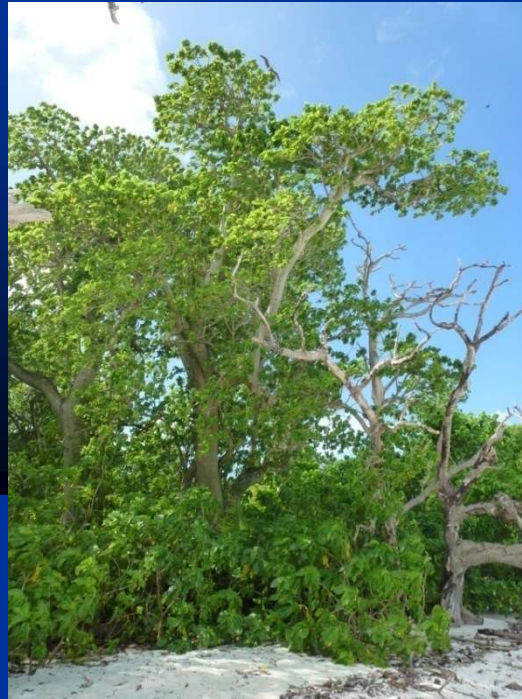
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Suriana maritima (Surianaceae) SOC = « 'o'uru » ;
TUAM = « kokuru », « kuku », « 'u'u », COOK =
« kuru », MANG = « giegie » ?, TONG = « ngingie » ?



Pemphis acidula (Lythraceae) SOC = « 'ā'ie », COOK = « ngangie », TUAM = « mikimiki », « gagie »,
« giegie », MANG = « ngangie », TONG = « ngingie », 'UVEA = « giegie »

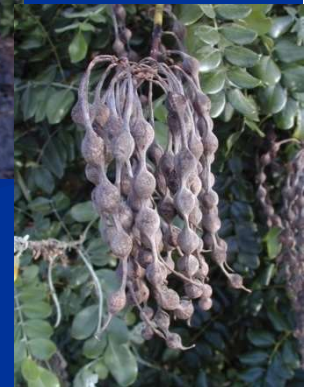
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Sophora tomentosa (Fabaceae), SOC = « pofatu 'ao'ao », TUAM = « pofatukao », AUST = « pohuta'ata », « pohuturata », COOK = « po'utukava »



Pisonia grandis (Nyctaginaceae), SOC = « pu'atea », MARQ = « pukatea », TUAM = « ngatae », « puka » (also forest)



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Hernandia nymphaeifolia (syn. *H. peltata*,
Hernandiaceae), SOC = « ti'anina »,
« tōnina », « tūnina », MANG =
« pukamaga », 'UVEA = « puko »,
FUTUNA = « puka »



Guettarda speciosa (Rubiaceae) SOC =
« tāfano », TUAM = « kahāia », MANG =
« ano », MARQ = « hano », « fano »

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Cordia subcordata,
(Boraginaceae), SOC,
MARQ = « tou », MRQ =
« kou », HAW = « kou »,
SAM = « tauanave »,
TONG = « taukanave »,
'UVEA = « kanava »

Thespesia populnea,
(Malvaceae), SOC =
« miro », « 'āmae »,
« rau 'ava » (feuilles),
MARQ « mi'o », HAW
= « milo », SAM =
« milo », 'UVEA =
« milo », FIJI =
« mulomulo »



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(*Lepidium bidentatum*,
Brassicaceae) SOC = « nau »,
« horahora », MANG =
« naunau », COOK =
« naunau », HAW =
« ‘anaunau »

Laportea ruderalis (Urticaceae), SOC = «
'iriā'eo » (ortie ?), TUAM = « ogaoga »



Polynesian introductions



Gardenia taitensis (SOC = « tiare tahiti »)



Tacca leontopetaloides (SOC, MARQ = « pia »)



Ficus tinctoria (SOC = « mati »)

Native species... probably introduced by Polynesian in the atoll of Tetiaroa



Barringtonia asiatica (Lecythidaceae), SOC = « hotu », « hutu »

Calophyllum inophyllum
(Calophyllaceae), SOC =
« tamanu », « 'ati » (fruits :
« pōro 'ati »), HAW =
« kamani »



« Cryptic species »: native or introduced by Polynesians?



Sida fallax (Malvaceae),
HAW = « 'ilima », TUAM
= « kurima »



Pipturus argenteus var. *tuamotuense* (Urticaceae), SOC = « rō'ā »



Colubrina asiatica var. *asiatica*
(Rhamnaceae), SOC, COOK = « tutu »,
SAM = « fisoa »



Nervilia aragoana (Orchidaceae),
COOK = « rautahi »

Atolls as « Cool Spots »

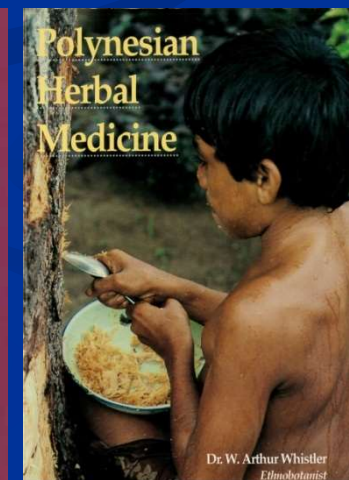
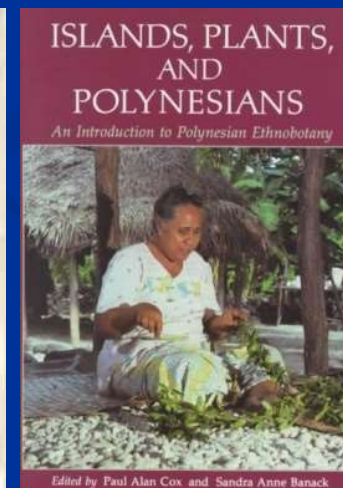
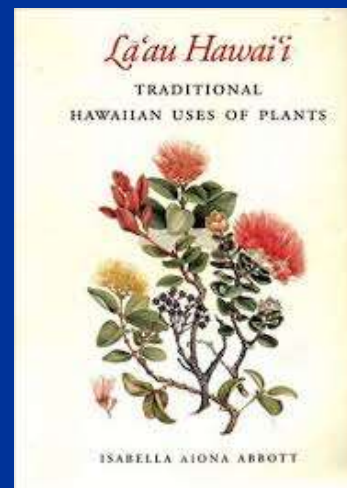
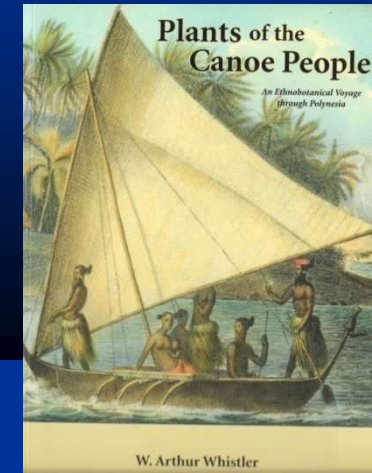
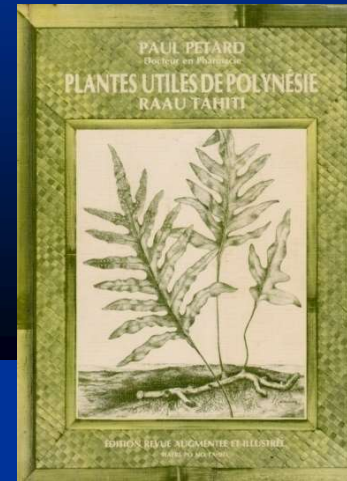
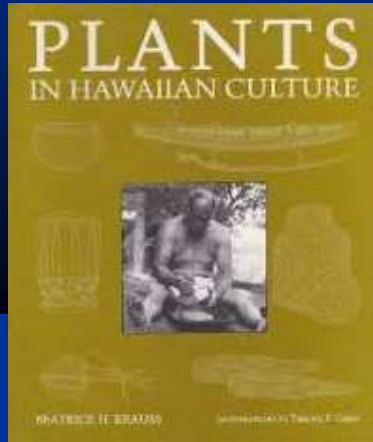


- 75 different purpose/use categories for 140 common Pacific Island coastal plant species, almost all of which are found on atolls
- An average of 7.3 purpose/use categories per plant
- 17 species have 20 or more reported uses

(Thaman 1992, *Atoll Research Bulletin* 361)

Ethnobotany and « TEK »

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



(In memory of **W. Arthur WHISTLER**,
1944-2020†)

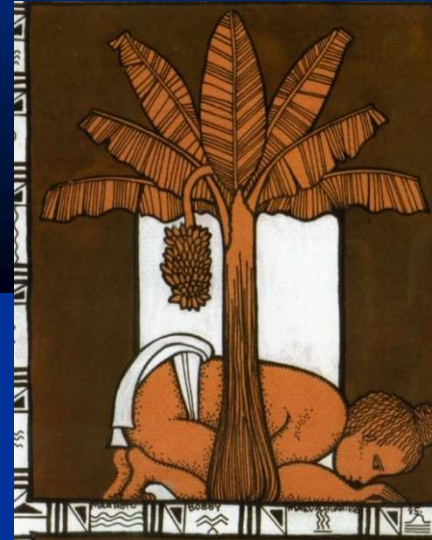
« Ethnobiodiversity »



(Heiva i Tahiti, 2013)



(Kiritimati, 2012)



(Alofi, 2008)



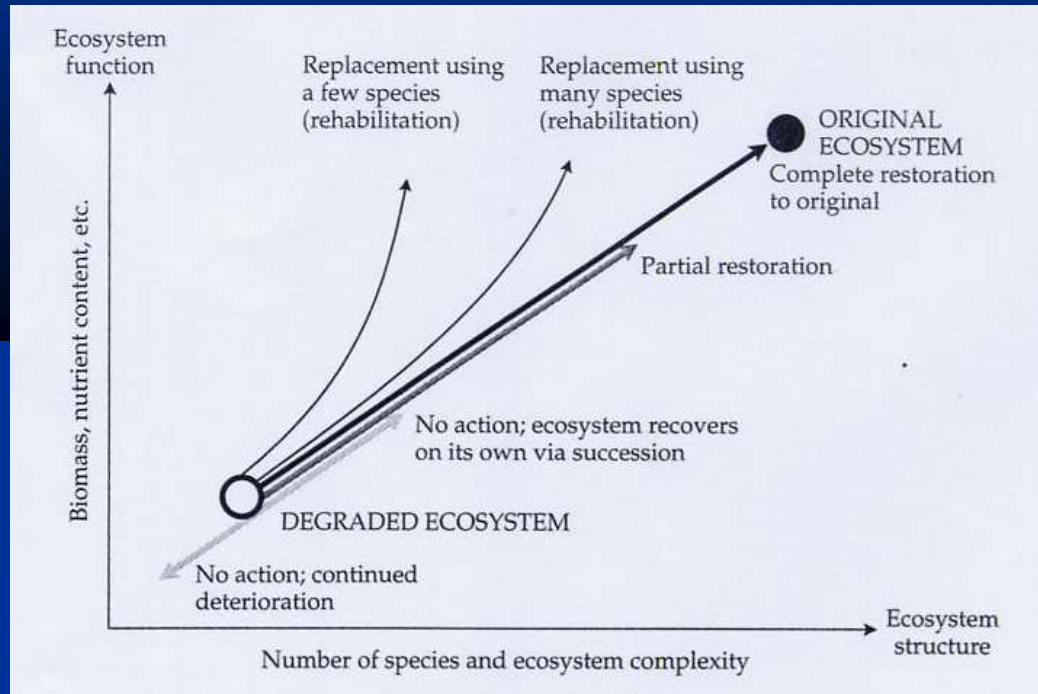
(Hiva Oa, 2012)

« 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)



(‘Uvea, 2007)

Ecological restoration



BEST 2.0+ Projet P-25

Période de convention : 01/08/2021 - 28/02/2023 (19 mois)

Budget alloué : 59 997,21€

"Préserver, restaurer & valoriser la végétation indigène du littoral en Polynésie française"

Préparé par Lisa Di Salvia, Chargée de Projet



Biotic interactions

Anous solidus



Anoplolepis gracilipes



Aedes polynesiensis



Pisonia grandis



Pandanus tectorius

Birgus latro



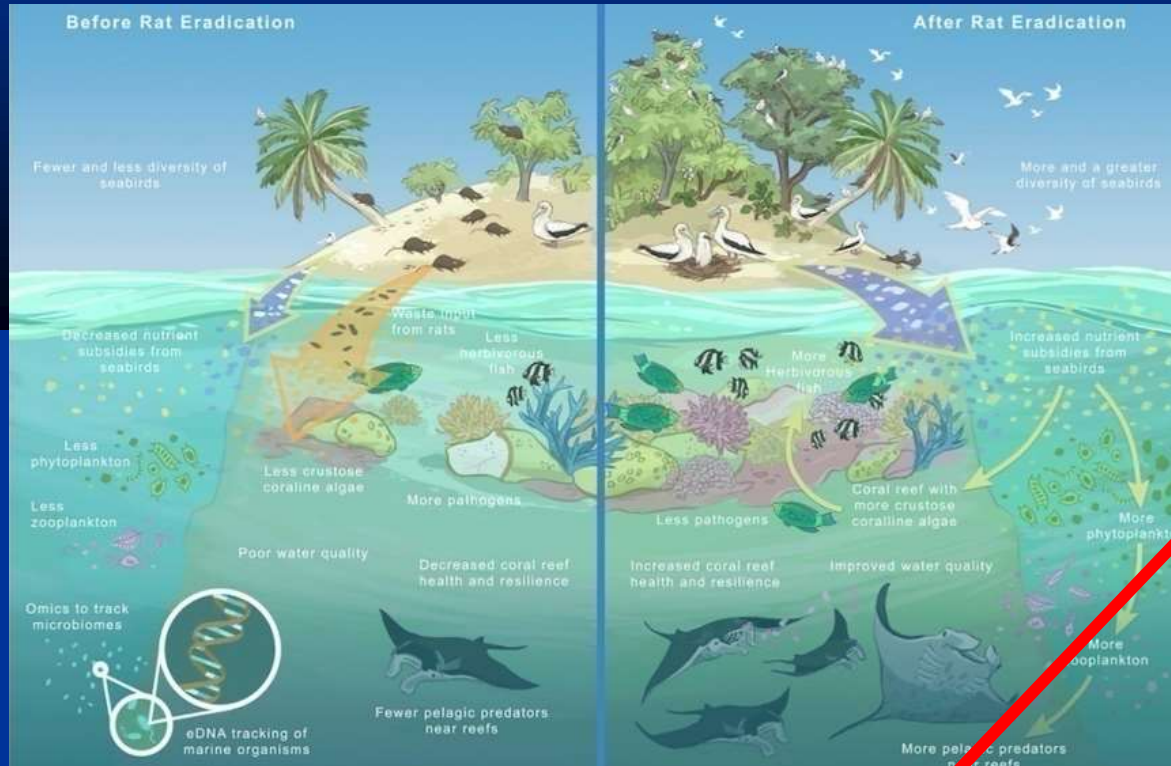
Rattus exulans



Cocos nucifera



Ecosystem trajectories: *where do we go now?*



(VEGA-THURBER *et al.*)



Pisonia grandis forest



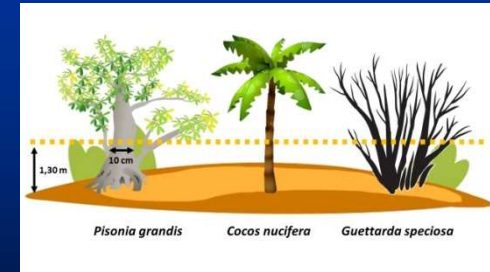
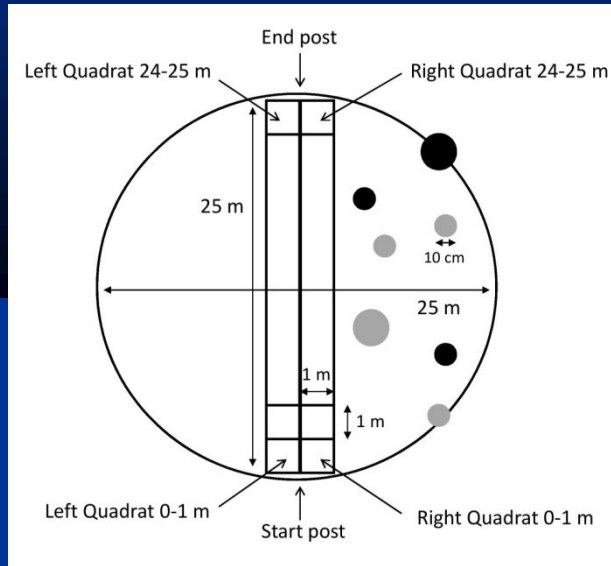
Rat-free Motu 'A'ie (Tetiaroa)



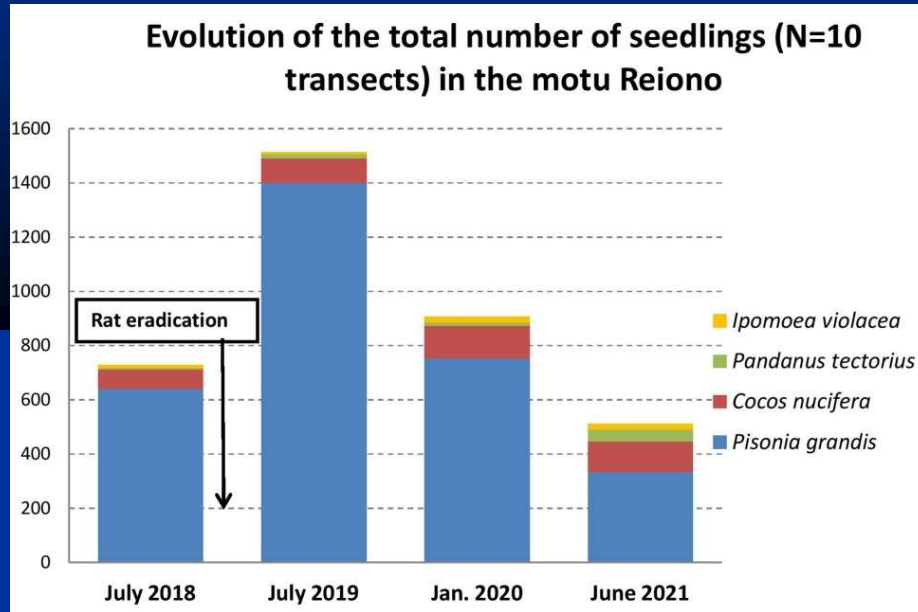
Rat-free atoll of Morane
(Tuamotu-Gambier)



Protocol



Preliminary results



(2018)

(2021)



Pisonia grandis



Pandanus tectorius

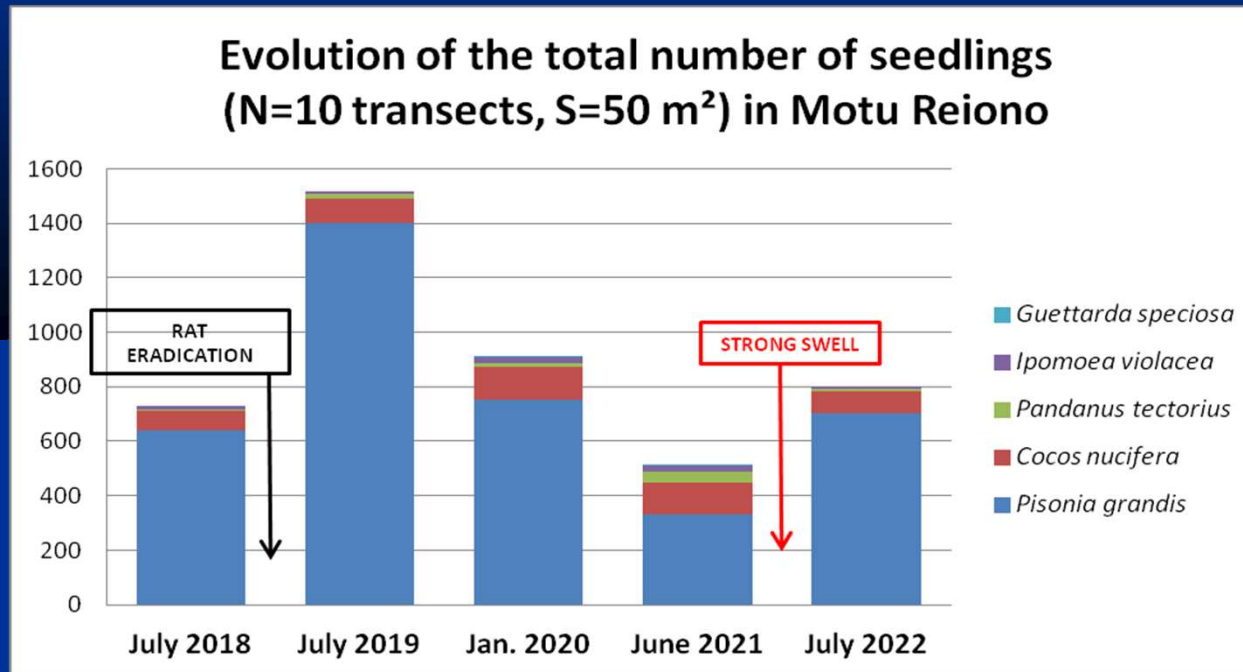


Ipomoea violacea



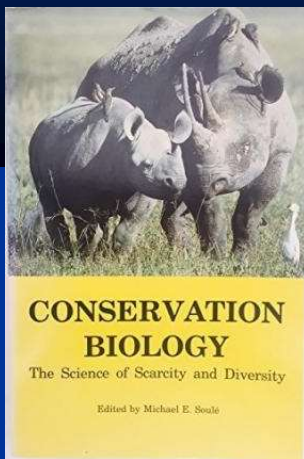
Cocos nucifera

Effects of natural disturbances!

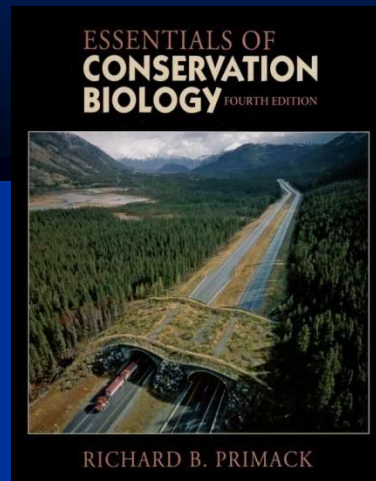


Conservation Biology

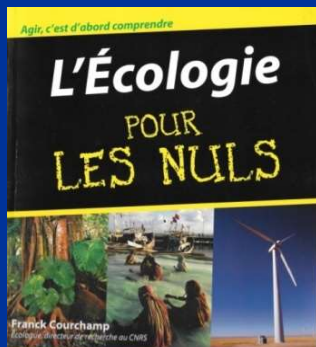
« *The Science of Scarcity and Diversity* »
(Soulé 1986)



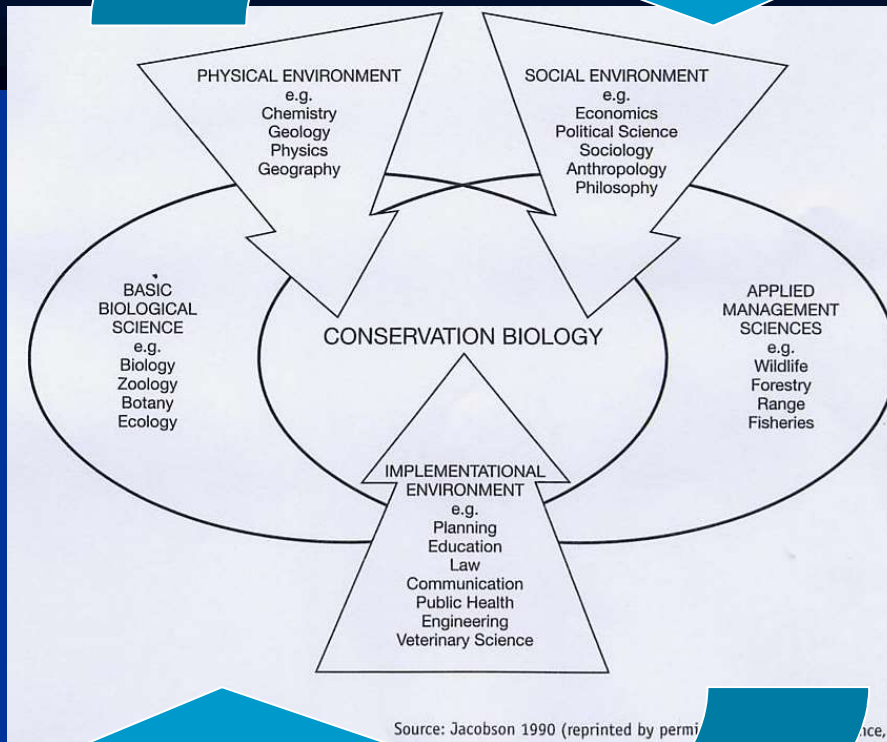
« *A crisis discipline* »
(Primack 2006)



« *A science of dilemmas and doubts* »
(Courchamp 2009)



New ideas, principles and approaches

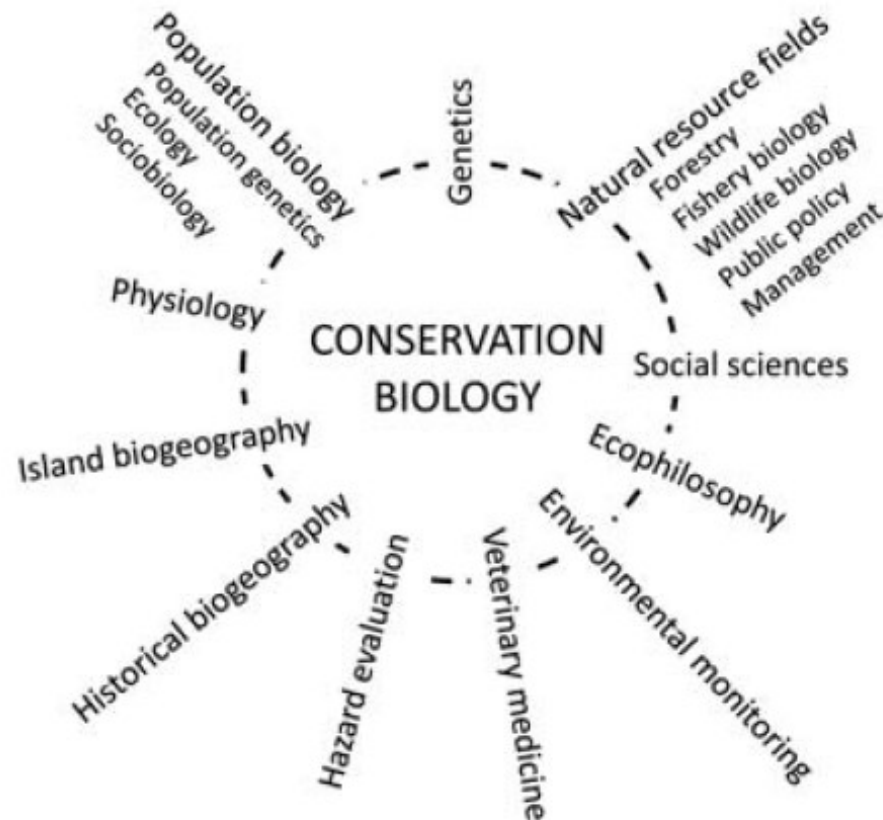


Field experiments and research needs

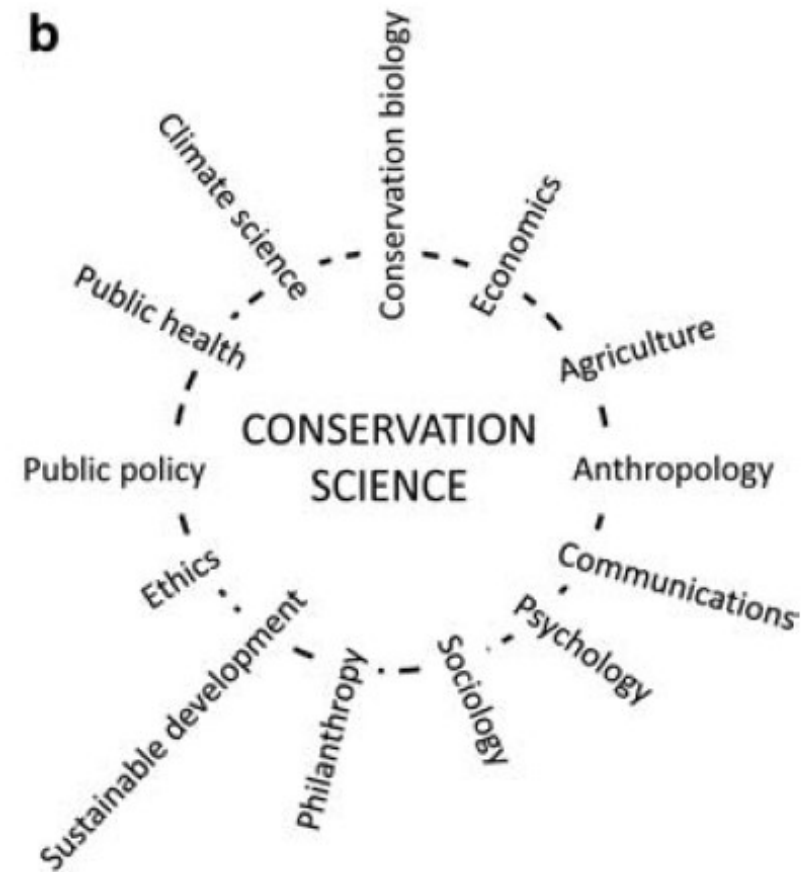
What Is Conservation Science?

PETER KAREIVA AND MICHELLE MARVIER

a

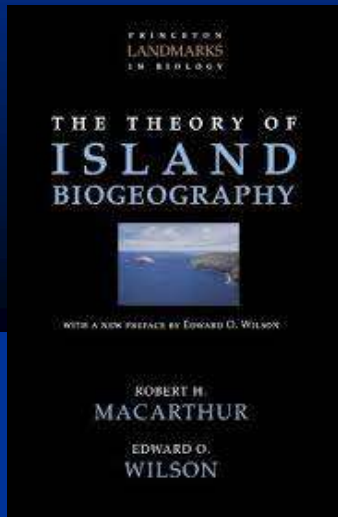


b

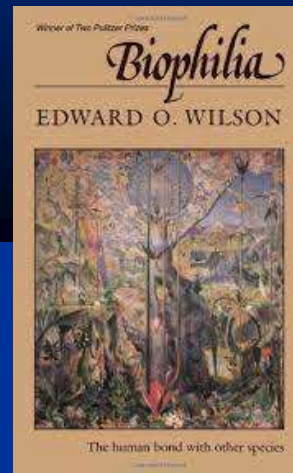


In memory of Edward O. WILSON (1929-2021†)

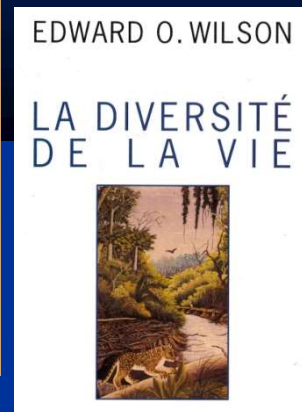
“The next century will, I believe, be the era of restoration in ecology” (Wilson 1992)



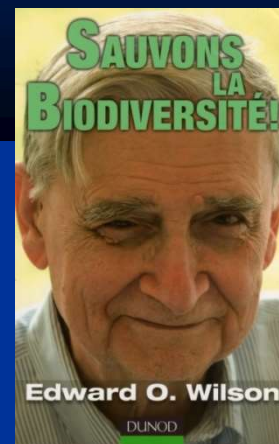
(1967)



(1984)



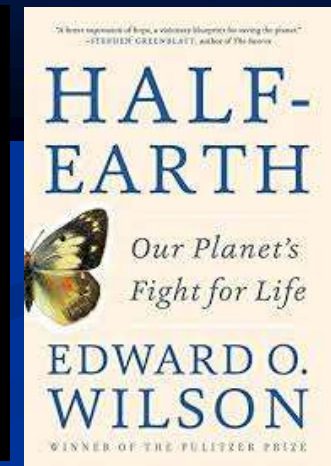
(1993)



(2002)



(2007)



(2016)



(1988)

“For a minority of conservation projects, some amount of restoration, meaning human intervention, is necessary. Each project is special unto itself. Each requires knowledge and love of the local environment shared by partnerships of scientists, activists, and political and economical leaders. To succeed, it needs every bit of their entrepreneurship, courage, and persistence” (Wilson 2016)

Mauruuru roa, merci beaucoup, thanks a lot for your (long) attention!



(Tetiaroa, 1993)



« Super Dupont »
(Gotlieb©)



(« One Team », 2023)

“It is my hope that the island will serve as an ecological model...”
(Marlon BRANDO)

Examples of ecosystem/habitat restoration and plant species/communities conservation

- ❑ Miconia biological control program in Tahiti, Raiatea, Nuku Hiva (2000-on going)
- ❑ Invasive plant control on Temehani Rahi plateau in Raiatea (2012-on going)
- ❑ Fencing dry-mesic forest and strawberry guava control in Rapa (2013-on going)
- ❑ Fencing, weeding and rat control on Maraetia plateau in Tahiti (2013-on going)



STRATÉGIE
NATIONALE POUR LA
BIODIVERSITÉ
ADHÉRER ET S'ENGAGER



BEST
VOLUNTARY SCHEME
FOR BIODIVERSITY AND
ECOSYSTEM SERVICES
IN TERRITORIES OF
EUROPEAN OVERSEAS



Nature protection legislation & regulation texts

- 1985. Department of Environment (« Délégation à l’Environnement »)
- 1996. First law « Délibération relative à la protection de la nature »
- 2003. First « Code de l’Environnement »
- 2006. First « French Polynesia Biodiversity Strategy »

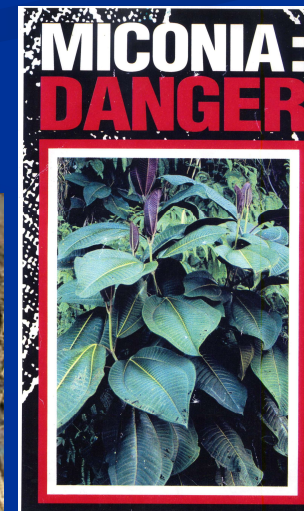


➤ Decree « Espèces protégées » : 164 vascular plants + 33 land birds + all tree snails (Partulids) + coconut crab

➤ Decree « Espèces menaçant la biodiversité » : 38 vascular plants + 4 land birds + 4 rodents + 1 reptile + 1 amphibian + 1 mollusc + 1 insect (little fire ant) + 1 flatworm



Platydemus manokwari



The importance of local NGO's

Nature protection groups (« Associations »)

- « Ia Ora Te Natura » (1973)
- Protection de la vallée de la Punaruu (1986)
- « Te Rau Atiati a Tau a Hiti Noa Tu » (1987)
- Société d'Ornithologie « Manu » (1990)
- Protection du patrimoine naturel et culturel de Raiatea « Tuihana » (2005)
- Fédération des Associations de Protection de l'Environnement « FAPE - Te Ora Naho » (2006)
- Tetiaroa Society (2013)

