How good are novel ecosystems?

Invasions, extinctions, interactions, plant successions and conservation strategies in some Polynesian Islands

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A new paradigm in ecology

« Emerging » ecosystems?

Novel ecosystems: theoretical and management aspects of the new ecological world order

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Restore degraded native habitats or accept inevitable changes... and do nothing?

The New York Times
The Opinion Pages
Mother Nature’s Melting Pot

Conservation Magazine • Vol. 13 No. 2 • April-June 2010

RAGAMUFFIN EARTH
A small group of ecologists is looking beyond the pristine to study the scruffy, fertilized and unbunded. Emma Marris learns to appreciate ‘novel ecosystems’
A rapidly changing world

➢ No more pristine ecosystems on Earth?
(22% « wild », 37% « anthromes », Ellis et al. 2010, Global Ecol. & Biog.)

➢ Local and global anthropogenic changes

(Mt Orohena, Tahiti (2241 m))

(Henri Jay)

(Wasp Vespula vulgaris)

(Evolution of Life on Pacific Islands and Reefs, East-West Center, Honolulu, 28 May 2011)

(Pouteau et al. 2010)
How new is novel? Historical changes in Polynesia

- « *Transported landscape* » (Kirch 1984)
- Impacts documented by archaeological and paleo-ecological data

Marae in *Inocarpus fagifer* forest

Evolution of Life on Pacific Islands and Reefs, East-West Center, Honolulu, 28 May 2011

Pacific rat *Rattus exulans*
Moorea (Society Is.)

- 310 native vs 767 alien plants (182 naturalized)
- A matrix (« mosaic ») of alien and native (nearly pristine) habitats

Quickbird satellite image (Near IR)

Vegetation dominated by:
- Hibiscus biliceus
- Falcataria moluccana
- Leucocoea leucocephala
- Neomaclea forsteri
- Casuarina equisetfolia
- Pinus caribea
- Inocarpus tagiifer
- Diococystis linearis
- Metrosideros colensoi
- Aeluropus moluccana
- Typha domingensis

Other land cover types:
- Cloud forest
- Ridge shrubland
- Cloud
- Anthropogenic area

(Pouteau, Meyer & Taputuarai, unpub. data)
Novel biotic communities: the «Good»

- Species replacement, functional redundancy and ecological substitutes
- Ecosystems services and resilience
- Alien species: «curse or nurse»?

Pollination by introduced Honey bees *Apis mellifera* on islands

*Gorse Ulex europaeus* in New Zealand

*Zosterops lateralis* Extinction of the Hawaiian avifauna resulted in a change of pollinators for the ibie, Freycinetia arborea

*OIKOS* 41: 195–199. Copenhagen 1983

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The « Evil »

- Alien invasive plants as ecosystems « transformers » (Richardson et al. 2000)

- Change of the « fundamental rules of existence » (Vitousek 1990)

Evolution of Life on Pacific Islands and Reefs, East-West Center, Honolulu, 28 May 2011
Extinctions and cascading effect

- Extinction of ca. 2,000 bird species in the tropical Pacific Islands since human occupation (Olson & James 1982, Steadman 2006)

- Keystone species critical for ecosystem functioning (e.g. feeding guilds)

"Are large seeds still being dispersed in the Tropical Pacific?" (McConkey & Drake 2002)
Loss of frugivores in Southeastern Polynesia

- 28 studied islands (Australs, Cook, Marquesas, Pitcairn, Society, Tuamotu)
- 70 rare or threatened endemic taxa (12 genera) with large fleshy fruits > 1 cm diam.

![Graph showing islands with bird extinction vs. islands with no bird extinction](graph.png)

(Meyer & Thibault unpub. data)

- Ochrosia (Apocynaceae)
- Hernandia (Hernandiaceae)
- Psychotria (Rubiaceae)
- Ixora (Rubiaceae)
- Planchonella (Sapotaceae)
- Nesoluma (Sapotaceae)
- Pritchardia (Arecaceae)
- Cyrtandra (Gesneriaceae)
- Santalum (Santalaceae)
Changes in plant succession & forest dynamics

Limited native plant regeneration in novel, exotic-dominated forests on Hawai‘i

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Study of forest structure, composition and dynamics in a network of 20x20 m permanent plots in secondary & primary forests on Moorea (Meyer et al. unpub. data, 2005-on going)
Mutualism breakdown

- Seed dispersal network: native & alien plants and frugivorous native & exotic birds

Endemic fruit dove *Ptilinopus purpuratus*

Tarenna sambucina (native Rubiaceae)  
*Miconia calvescens* (Melastomataceae)

![Bar chart showing the number of seeds consumed by the Fruit Dove on Moorea.](chart_image)

Erica Spotswood (UC Berkeley)
Discussion: theory...

- The impossible « pristine dream » of conservationists (Simberloff et al. 2011, Science 332)
- The « Human well-being » diktat (Millenium Ecosystem Assessment 2005)
- The predominance of Functional & Global Ecology (CBD 1998-on going)

« We expect that the focus of conservation efforts will shift from issues of biodiversity to assuring that ecosystems provide adequate services (such as clean air and water) for humans » (Walker & Bellingham 2011)
...and practice

- Values of species (rare vs common, keystone vs umbrella, flagship...) and associated habitats

- The need for an interdisciplinary dialogue: habitats and species of ethno/socio-cultural importance in the Pacific Islands - the « ethnobiiodiversity » concept - (Thaman 1999, McClatchey et al. 2008)
Conclusions

➢ « Management must recognize the change is inevitable » (CBD 1998, COP4 meeting, SBSTTA 5 Recommendation V/10)

➢ « Novel strategies » that integrate both the preservation of « Historical » ecosystems, and the management of « Novel/Modern » ecosystems (see e.g. Hobbs et al. 2009, TREE)

➢ Islands as natural laboratories for evolution, models for ecology & biogeography…and « listening posts » for local & global changes

Tamanu plateau, Tahiti
Jacques FLORENCE (IRD, MNHN, Paris)

"Novel" relationships

Vicki, Warren, Nancy & Carol (Smithsonian NMNH, Washington)

Lloyd Loope (USGS-BRD, Maui)

Robin Pouteau, Ravahere Taputuarai, Marie Fourdrigniez, Julie Fraisse (« Moorea Biocode Plant TaxTeam »)

Priscille Tea Frogier (Head of the Research Dept, Tahiti, Gvt of French Polynesia) for continuous moral & funding support

Evolution of Life on Pacific Islands and Reefs, East-West Center, Honolulu, 28 May 2011

Mahalo nui loa!

“Traditional ” relationship

“Novel” relationships