Conference Climate Change & Biodiversity Loss, 7-11 July 2008, La Réunion

Impacts of Global Change on Montane Island Ecosystems: Developping Listening Posts in the European Overseas Territories & Countries

Jean-Yves MEYER[1], Philippe FELDMANN[2] & Dominique STRASBERG[3]

[1] Délégation à la Recherche, Gouvernement de Polynésie française
[2] Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), France
[3] Université de La Réunion

BIO-ECOLOGICAL EFFECTS of GLOBAL WARMING

IPPC (2007) scenario:
🌡 +2.4-6.4°C in 2100 ⇒ +0.4°C/10 years

- **Changes in growing season lenght**
- **Earlier flowering of plants, earlier emergence of insects, earlier migration and egg-laying in birds**
- **Breakdown in symbiotic relationships**
- **Changes in abundance and local extinctions**
- **Latitudinal and altitudinal shifts in species range**

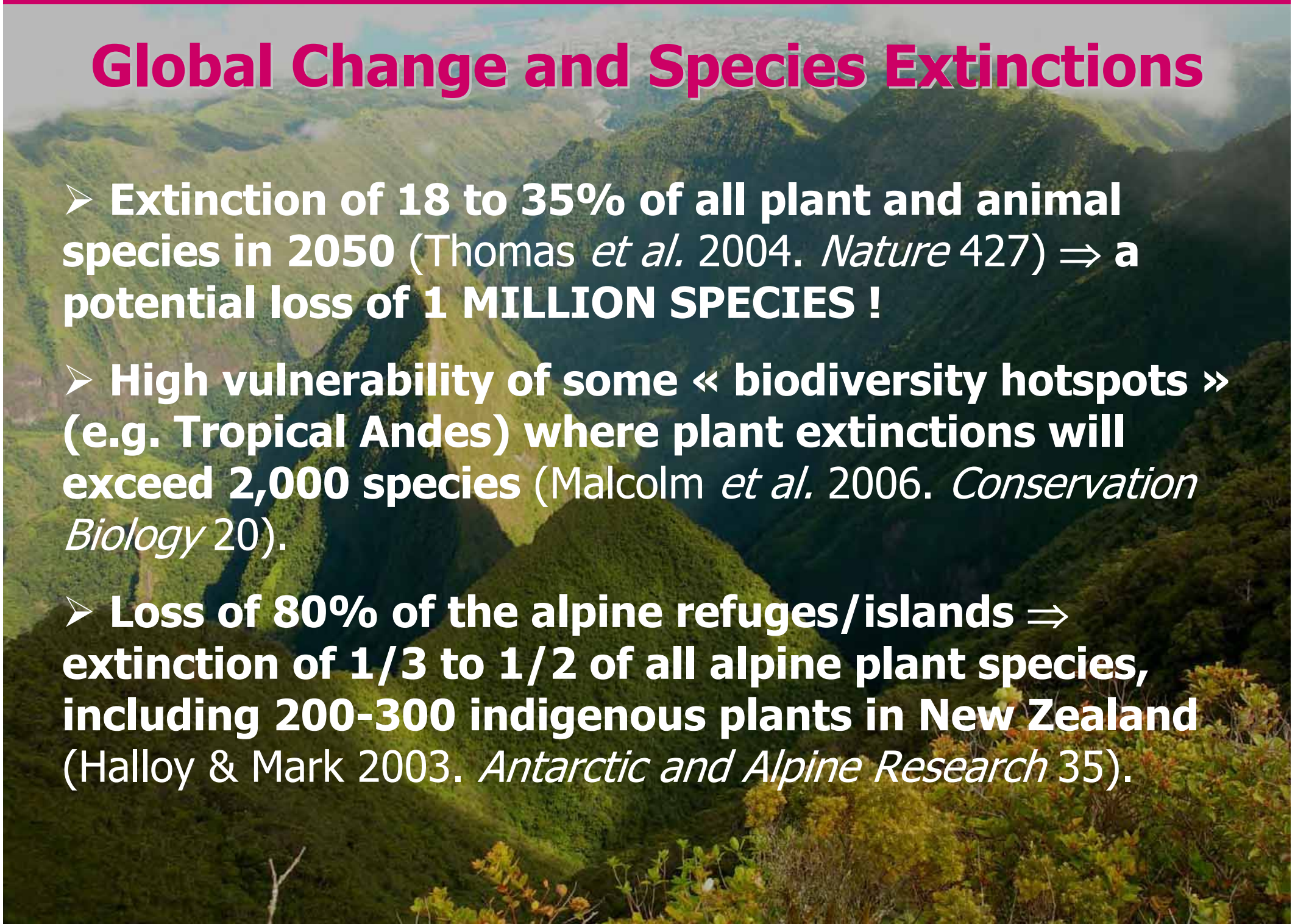
Organisms may move or adapt (« the winners ») or become locally extinct (« the losers ») !

« The Losers »

- Geographically localised, restricted to small isolated habitats
- Genetically impoverished species
- Specialised species with narrow habitat requirements
- Poor dispersers
- Peripheral or disjunctive populations
- Montane and alpine species:« Nowhere to Go! »

= the « Island Syndrome » !

Global Change and Species Extinctions



- **Extinction of 18 to 35% of all plant and animal species in 2050** (Thomas *et al.* 2004. *Nature* 427) ⇒ **a potential loss of 1 MILLION SPECIES !**
- **High vulnerability of some « biodiversity hotspots » (e.g. Tropical Andes) where plant extinctions will exceed 2,000 species** (Malcolm *et al.* 2006. *Conservation Biology* 20).
- **Loss of 80% of the alpine refuges/islands ⇒ extinction of 1/3 to 1/2 of all alpine plant species, including 200-300 indigenous plants in New Zealand** (Halloy & Mark 2003. *Antarctic and Alpine Research* 35).

Impacts on Island Terrestrial Ecosystems

- **Rising sea levels ⇒ Loss of low-lying COASTAL vegetation & LITTORAL FORESTS (25-80% of coastal WETLANDS in the US)**
- **Less rainfall for the Leeward side of islands ⇒ drought, bushfires ⇒ loss of DRY FORESTS**
- **Sea-level temperature increases incidence and intensity of hurricanes/cyclonic events ⇒ drastic changes in RAINFORESTS canopy structure ⇒ favor the spread of invasives**

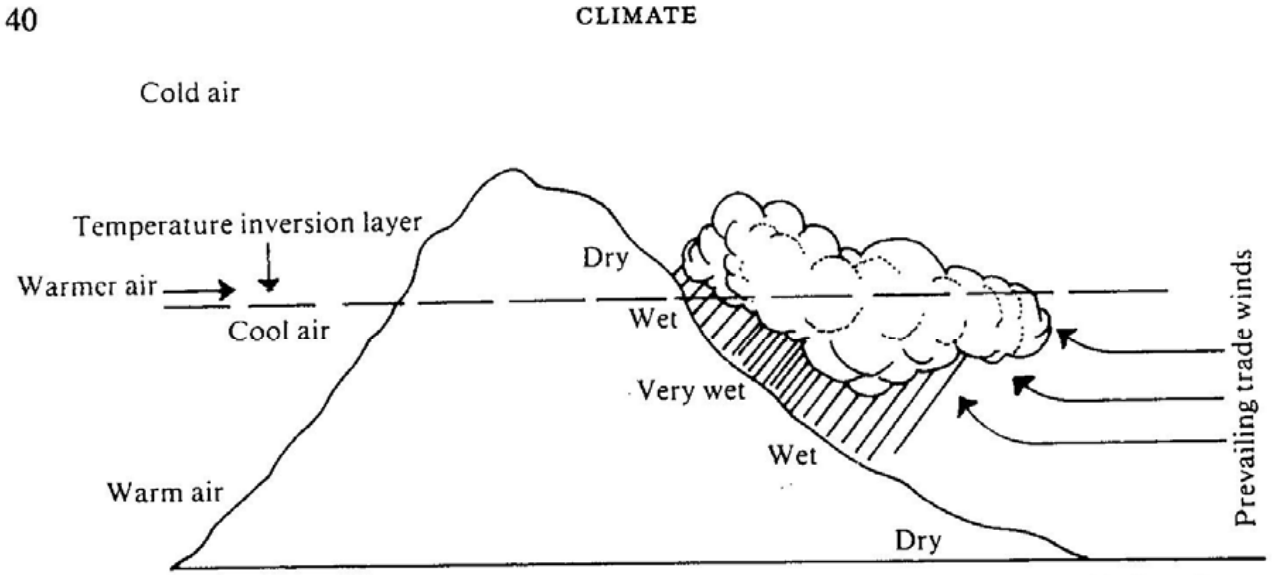
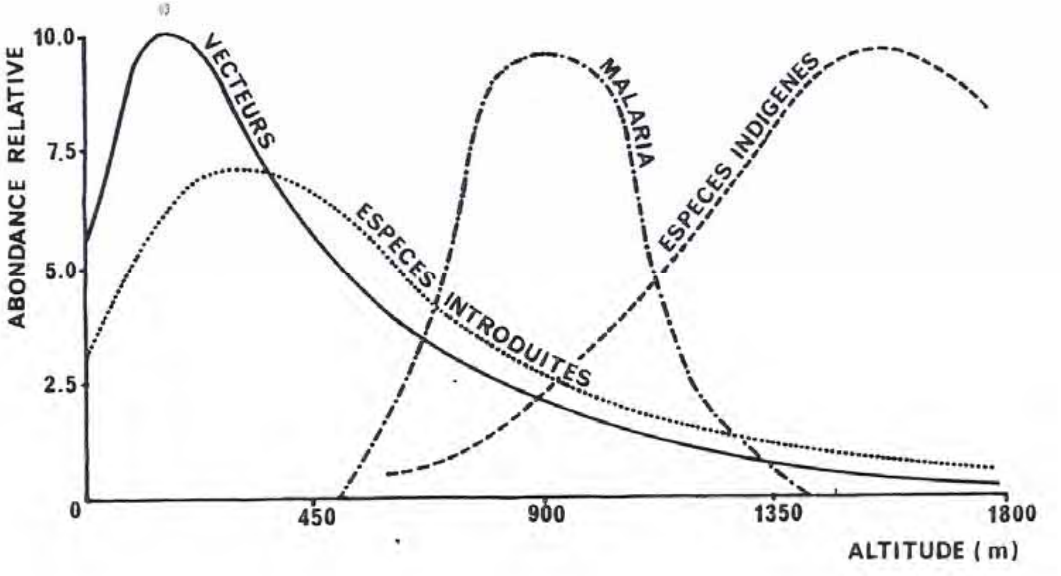


Figure 7. Trade winds are forced upward by mountain masses. When they penetrate cold air at the upper limit of a temperature inversion layer (air warmer than near ground level), they condense into rainfall on the windward side of an island.

Biological Invasions on Islands

- **Increase of mouse *Mus musculus* populations in the subantarctic Marion Island ⇒ predation on soil invertebrates** (Smith & Steenkamp 1990. Oecologia 85).

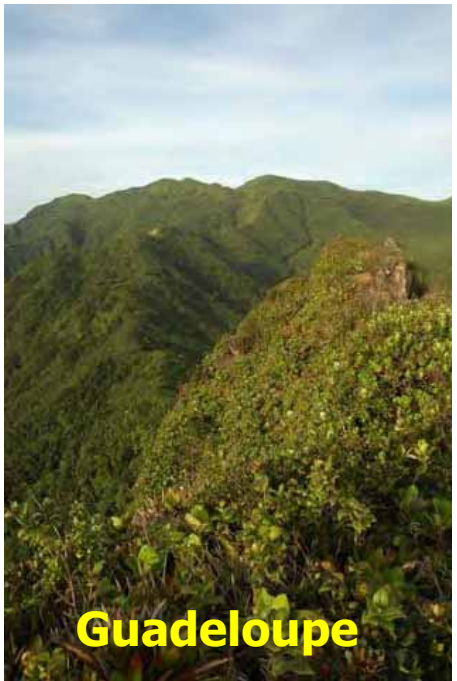
- **Potential spread of alien mosquitoes *Culex quinquefasciatus*, vector of the avian malaria, to higher elevations in Hawaii ⇒ decline of the Hawaiian honeycreepers?** (Loope 1995 *in* Vitousek, Loope & Adsersen (eds), *Islands. Biological Diversity and Ecosystem Function*).



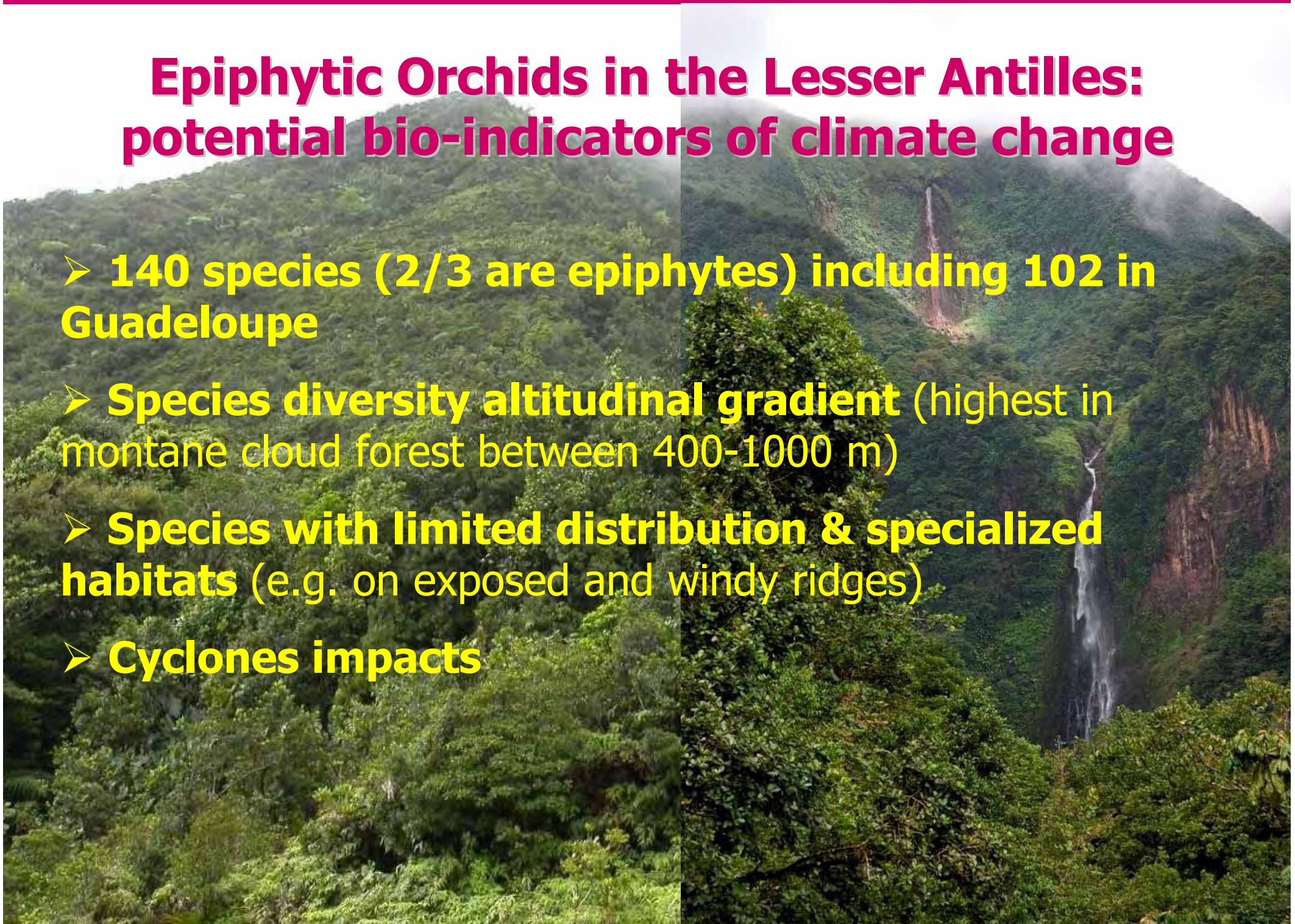
(Van Riper *et al.* 1986 *in* Barbault 1992)

Tropical Montane Cloud Forests, Subalpine & Alpine Ecosystems

- **One of the most species rich terrestrial ecosystem (« *the hottest hotspots* »,** Myers 2000, *Nature* 403: 853-858)
- **Watershed and biodiversity reservoirs**
- **Socio-economic importance (e.g. tourism)**
- **« *Unique and vulnerable systems* »** (IPCC 2007). Vegetation zones might shift upward by 300-800 m in 2100 !



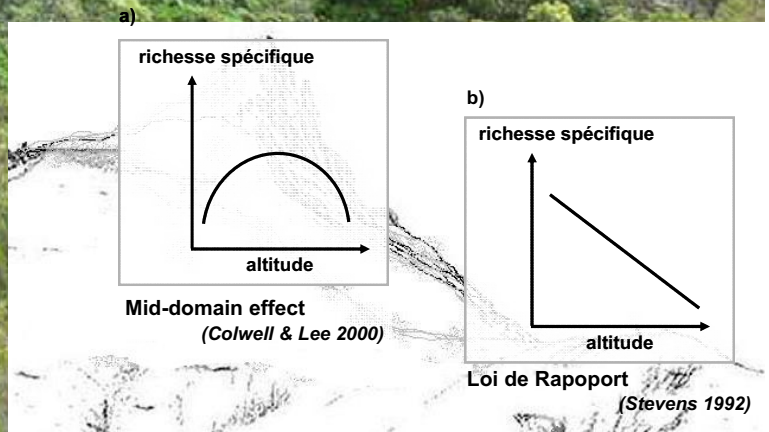
Epiphytic Orchids in the Lesser Antilles: potential bio-indicators of climate change



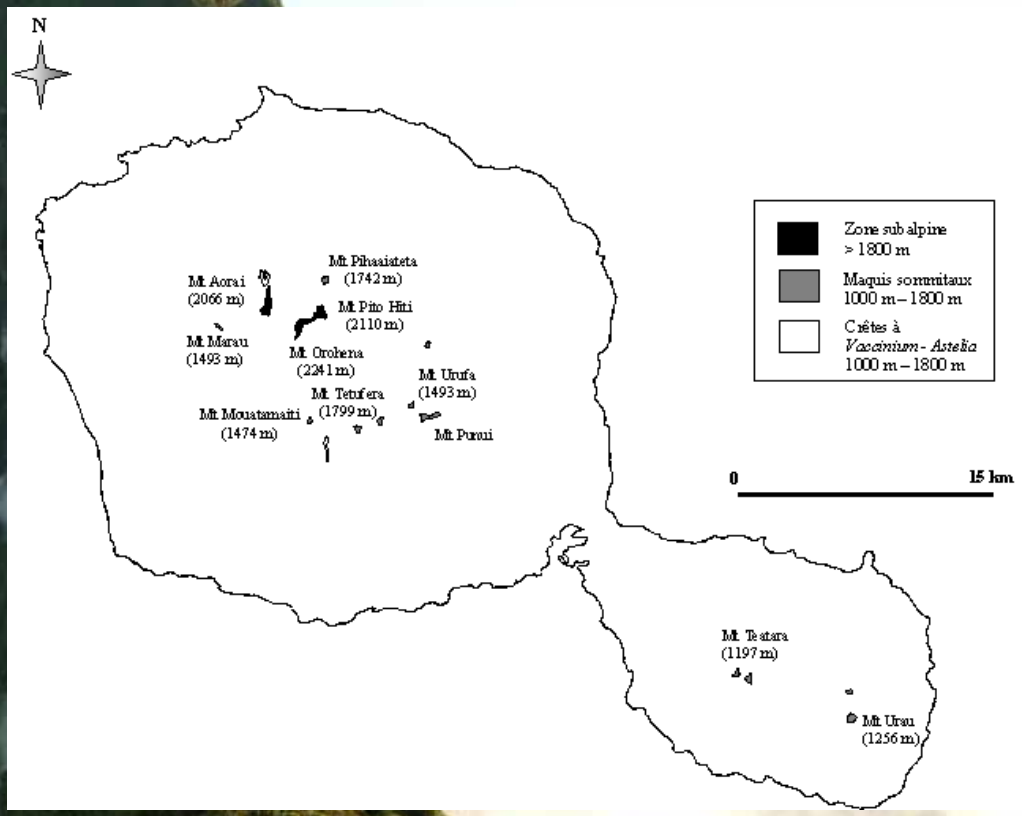
- **140 species (2/3 are epiphytes) including 102 in Guadeloupe**
- **Species diversity altitudinal gradient** (highest in montane cloud forest between 400-1000 m)
- **Species with limited distribution & specialized habitats** (e.g. on exposed and windy ridges)
- **Cyclones impacts**

Bryophytes in Western Indian Ocean Islands (Comores, Madagascar, La Réunion)

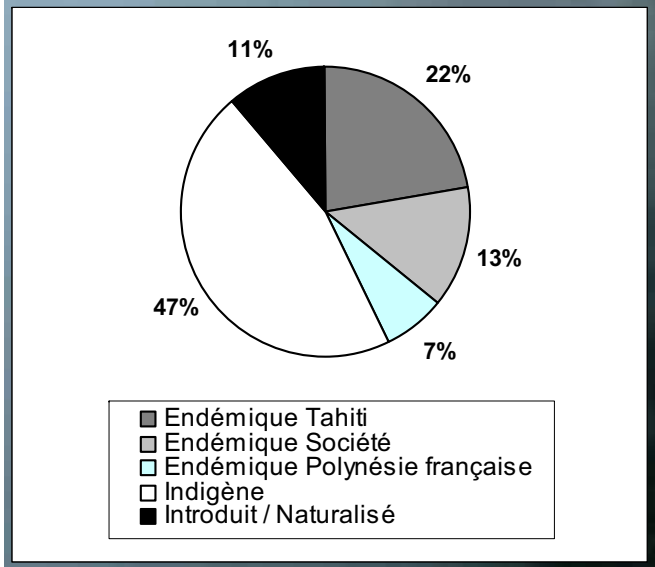
- 2/3 of the ca. 18000 species in the Tropics
- 404 species in La Réunion (72 endemics), 192 species in Comoros (37 endemics), 731 species in Madagascar (231 endemics)
- Diversity altitudinal gradient
- Large *vs* Small distribution ranges
- Generalist *vs* Specialized species



Subalpine flora of Tahiti



A very small and disjunct area (3 summits above 1,800 m for a total area of 125 ha = 0.12% of the island)

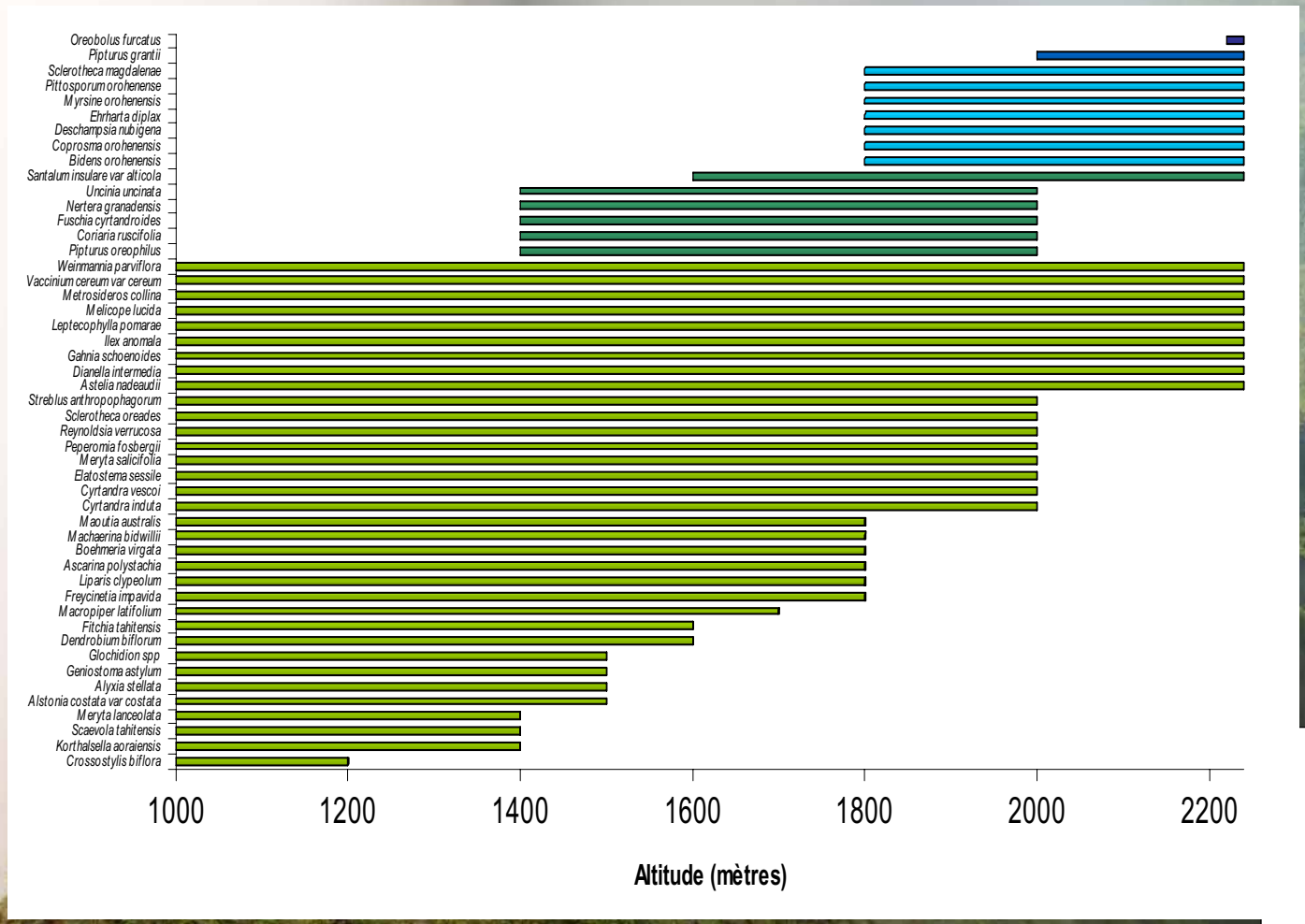


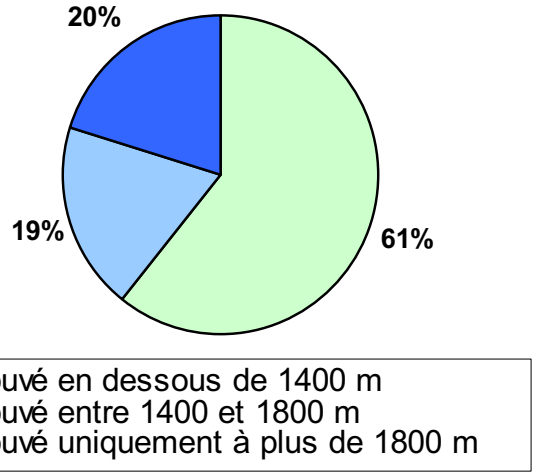
48 flowering plants (14 indigenous, 26 endemic, 8 introduced)

43 ferns (20 indigenous, 11 endemic, 2 introduced)

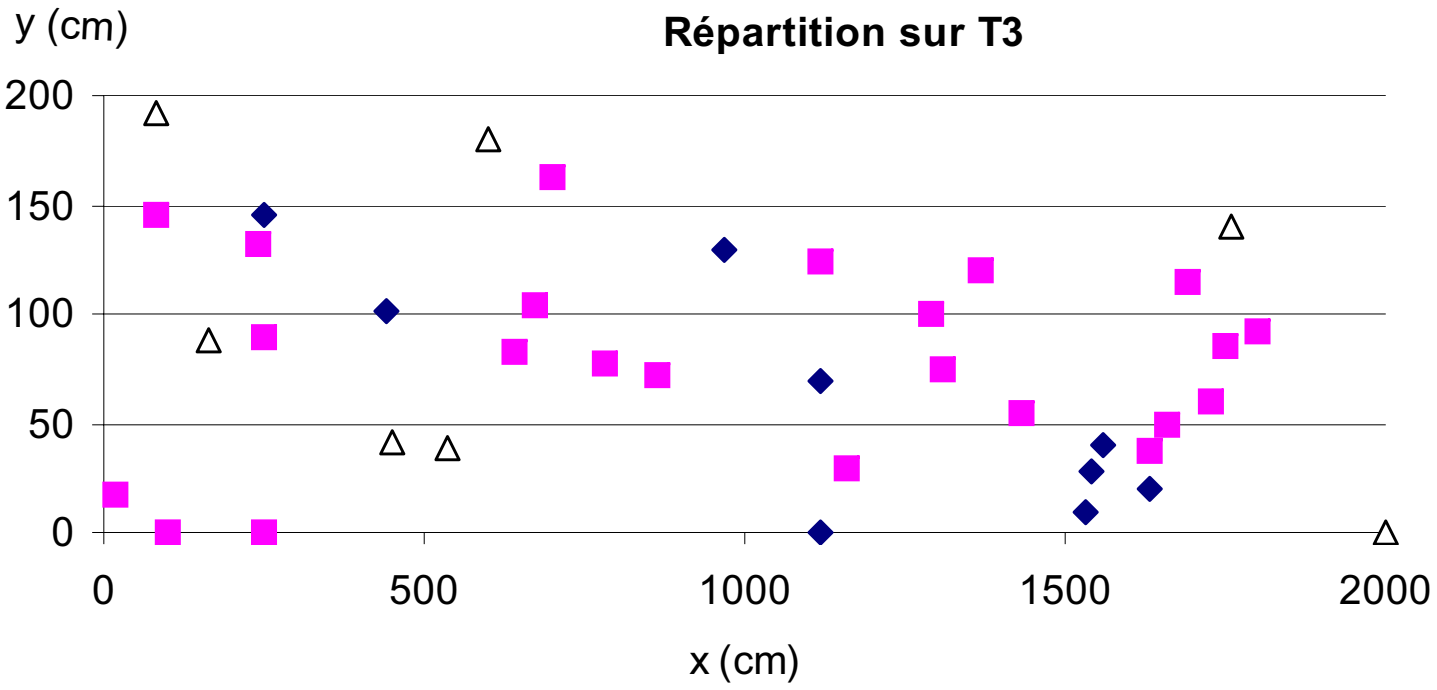
20 endemics species strictly restricted to Tahiti

Plant species altitudinal ranges





Monitoring phenology on permanent plots



◆ *Styphelia pomarae* ■ *Vaccinium cereum* △ *Weinmannia parviflora*

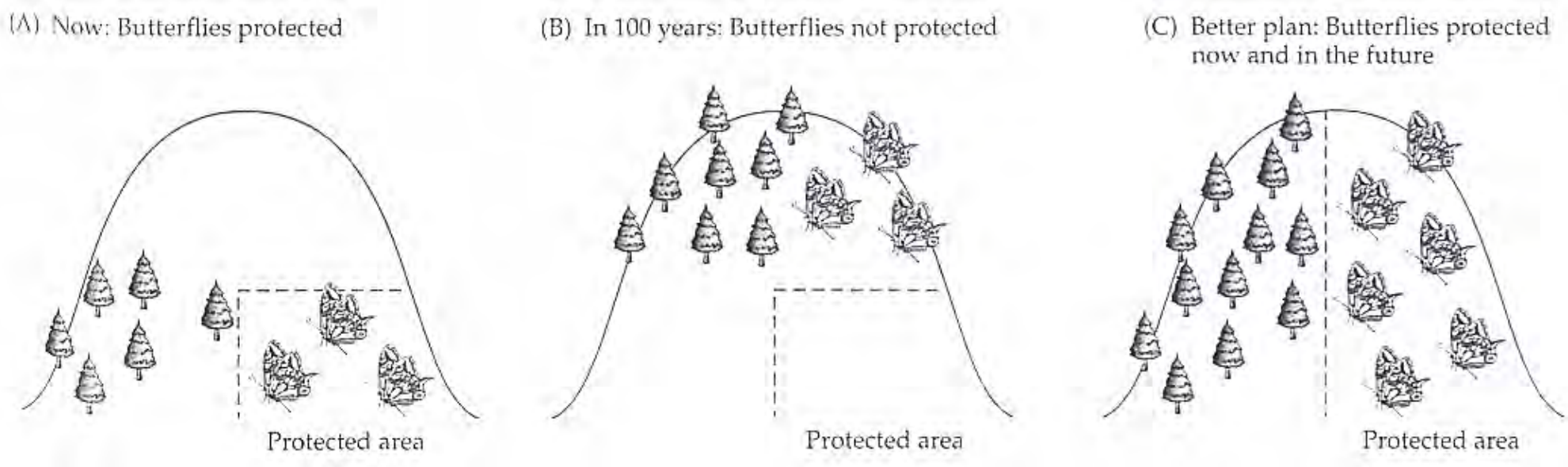
Towards an European Overseas Territories & Countries Collaborative Long-Term Research Program?

Developping a network of « listening posts » to assess and mitigate climate change impacts

- **Tropical and Subtropical Island Montane Ecosystems** (e.g. La Réunion >3000 m, Tahiti >2200 m, Guadeloupe >1300 m)
- **Common research protocol** (e.g. permanent plots, elevation gradient transects, global change indicator species or functional groups/guilds)
- **Long-term monitoring (> 10 years)**
- **Data access and sharing** (e.g. website)

Future Challenges

- **A radical restructuration of biological communities**
- **A mass extinction of alpine biota**
- **New conservation challenges** ⇒ creation of new protected areas (e.g. sites with large elevational gradients), transplantation of populations to new localities at higher elevations ?



In Primack 2006. *Essentials of Conservation Biology.*