How to re-conciliate conservation and valorization of island endemic plants?

The case of orchids in Indo-Pacific tropical islands

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Introduction: The « Grand Challenge »

- Conflict of interests between stakeholders: exploitation / valuation (« monetarization ») vs conservation/legal protection of biodiversity

- Orchids as « flag-ship species »… and bio-indicators / early warning systems in conservation (« pit canaries »)!

*Jumellea (syn. Angraecum) fragrans* (« faham », La Réunion)  
*Angraecum sesquipedale* (Madagascar)
Main threats to biodiversity

- Habitat destruction
- Overexploitation
- Pollutions
- Invasive alien species
- Climate change

"10ème CIPAM & Cos", Tahiti, Punaauia, 19 nov. 2018
Forest loss & habitat fragmentation

Rivière St-Denis (La Réunion)
Photo: D. Strasberg

Tahiti (Society Is., French Polynesia)
Makatea (Tuamotu)
Eiao (Marquesas)

(Strasberg et al. 2015, Biodiv. & Conserv.)
Highly threatened endemic flora

- From 47 Red Listed species (www.iucnredlist.org)...to 302!
- 165 legally protected species (Code de l’Environnement)

<table>
<thead>
<tr>
<th>Archipelago</th>
<th>EX</th>
<th>CR</th>
<th>EN</th>
<th>VU</th>
<th>Threatened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marquesas</td>
<td>1</td>
<td>55</td>
<td>53</td>
<td>23</td>
<td>132</td>
</tr>
<tr>
<td>Society</td>
<td>1</td>
<td>36</td>
<td>55</td>
<td>19</td>
<td>111</td>
</tr>
<tr>
<td>Austral</td>
<td>2</td>
<td>24</td>
<td>28</td>
<td>11</td>
<td>65</td>
</tr>
<tr>
<td>Gambier</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Tuamotu</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>French Polynesia</td>
<td>6</td>
<td>118</td>
<td>134</td>
<td>50</td>
<td>302*</td>
</tr>
</tbody>
</table>

*Some species are endemic to more than one archipelago

(UICN, MNHN, DIREN 2015)

Ochrosia tahitensis (CR)

Erythrina tahitensis (CR)

Liparis clypeolum (VU)
Orchids at a glance

- **Largest flowering plant family** (>25,000-35,000 species, >870-1000 genera)
- **Mainly tropical and subtropical** (75% are epiphytic)
- **Artificially (and massively) propagated** for the ornamental trade
- **Used as a medicine for millennia** (China, Japan, India…)
- **Over-collected/harvested in the wild**
- **Many threatened endemic species**
- **All taxa are included in the CITES Appendices I and II: international trade is strictly controlled and monitored**

Orchids as medicinal plants?

Medicinal Orchids: An Overview

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The uses and misuses of orchids in medicine

C.J. Bulpitt

Conclusions

It is surprising that despite the large number of alkaloids in orchid tissue, no medicinal use for them has been proven. By proven, I mean 'shown to be efficacious' as determined in a double-blind randomized trial. Until such experiments determine the benefits and risks of consuming orchid products as medicine, we must conclude that these beautiful plants have no place in medicine. For flavouring, however, both vanilla...
Over-exploitation of orchids

- 299 (24%) of the 1,240 orchid species known in China are used and collected as medicinal plants (Yan Zhi-jian 2004)
- The most expensive herbal medicine in the world is a preparation ("feng dou") made in China from the orchid *Dendrobium moliniforme* (syn. *D. candidum*)
- *D. officinale* (syn. *D. cattenatum*, “shi hu”) and *Gastrodia elata* ("tran ma"), both artificially cultivated, are considered CR and VU respectively
- 40 species are collected in the wild in Turkey to make “salep”, a type of flour used for food and beverages (and ice cream!). 1000 plants are needed to make 1 kg of the flour (Ôzhatay *et al*. 1997)
### Orchids in some tropical Indo-Pacific islands

<table>
<thead>
<tr>
<th>Island/Archipelago</th>
<th>Number of taxa</th>
<th>Endemic taxa</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guadeloupe</td>
<td>103</td>
<td>3</td>
<td>Feldman 2012</td>
</tr>
<tr>
<td>Martinique</td>
<td>80</td>
<td>-</td>
<td>Feldman 2012</td>
</tr>
<tr>
<td>La Réunion</td>
<td>228</td>
<td>64</td>
<td>Szelengowitz &amp; Tamon 2013</td>
</tr>
<tr>
<td><strong>PACIFIC ISLANDS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Caledonia</td>
<td>205</td>
<td>99</td>
<td>Jaffré <em>et al.</em> 2004</td>
</tr>
<tr>
<td>Samoa</td>
<td>101</td>
<td>15</td>
<td>Cribb &amp; Whistler 1996</td>
</tr>
<tr>
<td>Tonga</td>
<td>43</td>
<td>1</td>
<td>Cribb &amp; Whistler 2011</td>
</tr>
<tr>
<td>Wallis et Futuna</td>
<td>39</td>
<td>0</td>
<td>Morat et Veillon 1985, Meyer 2016</td>
</tr>
<tr>
<td>Society</td>
<td>30</td>
<td>13</td>
<td>Meyer <em>et al.</em> 2006, Margonska 2012</td>
</tr>
<tr>
<td>Cook</td>
<td>13</td>
<td>1</td>
<td>Cribb &amp; Whistler 2011</td>
</tr>
<tr>
<td>Hawaii</td>
<td>3</td>
<td>1</td>
<td>Wagner <em>et al.</em> 1990</td>
</tr>
</tbody>
</table>
Orchids as medicinal plants in Polynesia

“Among the thousand species recorded between Africa and Malaysia, about 400 were used in traditional pharmacopoeias, 60 are found in the Indonesian sector, including all 32 Polynesian species” (Roux 1999)

At least 5 native species are recorded as medicinal plants in French Polynesia (Brown 1931, Jacquet 1979)... but none are reported in the Samoa, Tonga, Wallis et Futuna?
Towards « Domestication » ?

- **Ex situ propagation** (tissue culture, germplasms, in vitro seed germination)…but not maintaining genetic diversity!

- Secondary (active) metabolites not always expressed under cultivation conditions!

- **In situ conservation** (translocation, reintroduction, “restoration-friendly cultivation”)…difficult because of their specific habitats, epiphytic habit and the complexity of mycorrhizal associations

- Certification (“Eco-labelling”) administrated by authorities?
Conclusions

- Orchids are at the front-line of the extinction crisis (Swartz & Dixon 2009. *Annals of Botany* 104)

- Exploitation/Valorization should concern only the LESS VULNERABLE taxa in order no to compromise the integrity of natural/wild populations

- An “ethical code of conduct” among all stakeholders (research scientists, natural resources managers, private companies, users…) is needed!
Future prospects for the use and valuation of the ethno-phyto-diversity

- Build on the MOST APPROPRIATE species and genotypes!
  - Polynesian or early European introductions
  - Native species
  - Common endemic species (low and mid-elevation)
  - “Endemic” Polynesian cultivars
Exclude THREATENED ENDEMIC species: do not create a new demand for rare plants!

Tableau 5 – Critères d’exclusion-sélection des espèces végétales

<table>
<thead>
<tr>
<th>Critères</th>
<th>Sélection</th>
<th>Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Originalité botanique</td>
<td>Plantes endémiques</td>
<td>Plantes naturalisées et largement répandues</td>
</tr>
<tr>
<td>Critères bio-écologiques</td>
<td>Espèces non vulnérables (indice IUCN)</td>
<td>Espèces vulnérables</td>
</tr>
<tr>
<td>Critères biogéographiques</td>
<td>Accessibilité</td>
<td>Espèces peu accessibles (peuplements dispersés, éclairés)</td>
</tr>
<tr>
<td>Usages locaux</td>
<td>Plantes médicinales locales</td>
<td>■ Plantes médicinales largement répandues dans le monde, bien étudiées et souvent exploitées. Pas de spécificité polynésienne</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Plantes alimentaires, épices et condiments banals</td>
</tr>
<tr>
<td>Critères chimiotaxonomiques</td>
<td>Le genre – niveau taxonomique le mieux corrélé à la distribution des métabolites secondaires</td>
<td>Espèces ou genres de faible intérêt pharmacobotanique</td>
</tr>
</tbody>
</table>

Source: contribution Moretti et Florence (voir CD-ROM).

(Fitchia spp. (CR, EN, VU) Oparanthus spp. (CR, EN)

Polyscias tahitensis (EN)

(Guézennec, Moretti, Simon, coord. 2006)
PROTECT natural resources and traditional knowledge ("TK")


- Loi de Pays n°2012-5 (2012): access of biological resources and benefit-sharing, incl. TK

- Loi nationale sur la Biodiversité (2016)
BUILD CAPACITY in “ethnosciences” by involving local communities and experts, and training local researchers in the fields of botany, taxonomy, genetic, plant chemistry, ethnobotany, ethnopharmacology, ethnology, anthropology, linguistics, sociology...

« Vascular Flora of the Marquesas »
(Ua Pou, 2004)

SCP « oral traditions »
(Maiao, 2007)

« Patrimoine biologique des Iles Marquises » (Hiva Oa, 2010)

« 10ème CIPAM & Cos », Tahiti, Punaauia, 19 nov. 2018
Mauruuru roa (to the orchidophiles!)

Bernard ROUX (Tahiti, 1996)

Philippe FELDMANN (Montpellier, 2009)

Walter TEAMOTUAITAU with Jacques FLORENCE (Tahiti, 2011)

Jean-Maurice TAMON (Plaine des Palmistes, La Réunion, 2013)