NDF Case Study: 

Dioon Edule

Compiled by: Andrew P. Vovides
Curator: Jardín Botánico Fco. J. Clavijero
What are cycads?

- Primitive living seed plants classified with the gymnosperms with fossil history going back to the Permian
- About 300 species known worldwide with 50 in Mexico giving it 2nd place worldwide for cycad diversity
- *Dioon edule* is endemic to Mexico and there are estimated over 10,000 plants in the wild
- Major threats are habitat loss and illegal harvesting of leaf crowns (decapitation) for the domestic market
- They are much appreciated as ornamentals
Distribution of *Dioon edule*

- Along the Gulf of Mexico seaboard
- In tropical dry forests on rocky soils
- Also in steep canyons
- Climate with prolonged dry season with summer rains
A) Graph shows a reverse “j” structure with high seedling mortality

B) Spatial distribution with preference on shallow soils

Genetic diversity of *Dioon edule* is high throughout its range and is correlated with latitude.

- Highest diversity is found in the south.

- Seeds are a reservoir of genetic diversity.


Octavio-Aguilar *et al.* (In press) *Plant Biol.*
Major threats:

- Global habitat destruction:
- Land use change for agricultural expansion
- Deforestation
- Use of herbicides for land clearing
- Illegal national commercial collecting
- Decapitation of *D. edule*
THE JARDIN BOTANICO FCO. J. CLAVIJERO
& The National Cycad Collection

• For education, outreach and extension
• For research and ex situ conservation
• For propagation and assessment to sustainable management nurseries (UMAS)
Cultivation and germination trials on cycads enabled us to produce an adequate technology easily transferable.

*D. edule* presents over 90% germination.
Monte Oscuro Nursery, Veracruz

*(Dioon edule)*

**Based on ecological studies and germination trials:**

- Farmers who own cycad habitat were given talks and invited to take part in a sustainable management project.
- Hands-on basic horticultural training was given.
- First sustainable management nursery established in 1990.
- Many drop-outs during early years.

(Vovides 1990 *Amer. J. Bot.* 77: 1532-1543)
AT MONTE OSCURO

- Ca 80 ha of relatively well-preserved tropical dry forest is harvested
- Seeds (500 - 10,000) are harvested from a population of ca 3,000 plants
- Harvesting done in autumn but not every year
- Female cone monitoring is done to ensure ripe seed since the female cone cycle for *D. edule* is two years
- A seed scale is removed and the seed cut lengthwise to examine embryo
- Cone harvested if embryo length is ¾ of the seed length or more
- If less cone is left for a further period to ripen
The teaching process

- Basic nursery practice by using available materials
- Combining farmers’ traditional knowledge
- Improving and adapting technical practices to their needs
- The publication of a practical manual

Farmers participate in reintroduction projects

- In Sept. 1997 300 2, 4, and 7 yrs old seedlings of *D. edule* were introduced into habitat
- Yearly monitoring took place to register growth and deaths
- Mortality has not been greater than 20% for all classes
- Two year old plants can safely be reintroduced
1. Reintroduced *D. edule* plants in 1997 - No significant change in stem dia, (approx 4 cm) max no. leaves 3, no appreciable stem growth detected in 2005 (ca 4 cm)

2. Plants in nursery - aprox. 12 cm stem dia, max leaf no. 15 (2005)

3. Male plants began to cone at 15 years after germination in nursery

4. Female plants cone after 17 years (2007) (Unpubl. Data)
BUT IS IT WORTHWHILE REINTRODUCING SEEDLINGS OF *D. EDULE*?

- Demographic studies and elasticity matrix modelling (Lefkovich) indicate that the most important life-cycle stage for maintaining the population is the adult stage.

- Habitat conservation and especially adult plants (avoid decapitation) is more efficient for population growth and conservation than introducing seedlings.

- It is better to reintroduce few nursery produced reproductive plants than many seedlings.


Life cycle and elasticity values in 3 populations
EARLY MARKETING

1994-95: 25,000 Pesos (Garden shop & congress) + 200 USD (export to USA)

Export of 500 plants to Europe (1998-99) not successful
Education for marketing

• Creation of CYCAMEX 1998
• Web page 2006
• Sales point: Botanic Garden shop 1994
• Official plant labels 2000
• Meeting with producers in Chiapas to connect with CYACMEX 2006
• Invitation of local authorities
It is hoped to link nurseries to national and international markets.
Market and sales

- **Successes:**
  - Conservation through propagation accepted by farmers
  - Other communities are following example

- **Failures:**
  - Cycads relatively unknown in Mexico
  - Sporadic and inconsistent sales
  - Competition by poachers
  - Lack of marketing experience
  - Lack of coordination between producers and authorities

- **Challenges:**
  - Improve cultivation
  - Market exploration
Growing interest in cycads among landscape architects

It is becoming fashionable to use native plants

- Residential estates
- Hotels
- Municipal landscaping
CHALLENGES: Cultivation improvement

Experiments at the Botanic Garden

ENDOMYCORRHIZA

- *Dioon edule* has mycorrhizal symbiosis with *Glomus* sp.
- Better growth of *D. edule* seedlings after inoculation with *Glomus*
- Mycorrhizal and root pruning experiments in process at the Botanic Garden with *D. edule*

Vovides (1991) *Brenesia* 35: 97-103
**VISIBLE DIFFERENCES IN GROWTH**

**ANOV A of FW differences between treatments and controls after one year (n = 15)**  
\[ P = 0.019 \text{ (significant)} \]

<table>
<thead>
<tr>
<th>Origen de las variaciones</th>
<th>Suma de cuadrados</th>
<th>Grados de libertad</th>
<th>Promedio de los cuadrados</th>
<th>F</th>
<th>Probabilidad</th>
<th>Valor crítico para F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entre grupos</td>
<td>153.536</td>
<td>1</td>
<td>153.536</td>
<td>6.243</td>
<td>0.019**</td>
<td>4.196</td>
</tr>
<tr>
<td>Dentro de los grupos</td>
<td>688.599</td>
<td>28</td>
<td>24.593</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>842.134</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The importance of solidarity
(“If you sink, we sink with you”)

- Training must be kept simple, and by example
- Much repetition is necessary
- Continuous assessment essential
- Local idiosyncrasies must be considered
- Assessor identification and solidarity with the farmers is also essential

RECOMMENDATIONS

- Marketing assessment is crucial during the early stages
- More long-term funding is required
- A multidisciplinary team required in; conservation biology, horticulture, anthropology, sociology and marketing expertise
- Start off with small medium-term pilot project rather than to inject mega-scale funding on a short-term basis.
- The species/habitat to be managed should be on the farmers’ collective or individual private property and must be an integral part of the management system
- Close coordination between producers and authorities should be encouraged, possibly a marketing officer’s duties.
- Projects involving sustainable management of threatened species should be encouraged nationally and internationally, especially within buffer zones of biosphere reserves.
ACKNOWLEDGEMENTS

RESEARCHERS:
Jorge González-Astorga (genetics); Pablo Ocatvio-Aguilar (demography); Miguel Angel Pérez-Farrera (research collaborator, UNICACH, Chiapas)

BOTANIC GARDEN STAFF:
Carlos Iglesias, Victor Luna, Antonio Vázquez, Julian Peréz, Jesús Domínguez, Daniel Hernández, Javier Hernández, Genaro Justo and Joel López

MONTE OSCURO PRODUCERS:
Concepción Díaz Villa, Miguel Rodriguez Cruz and Elpidio González Jiménez

CYCAMEX:
Juan Carlos Andrade and Ivan Trejo

FUNDING AGENCIES:
CONACyT: Grant Nos 29379N; 34077N; D112-904133; N9106-0063; 837P-N9507; PCCBBNA-021192

CONACyT-SEMARNAT 2002-C01-0183.

CONABIO: Grant No. B-140.

FMCN: Grant No. B2-00-013.

GTZ-Germany and GTZ-ProTrade: Grant No. PN93.2208.2-06.205.

THANKS, GRACIAS!