COULD FORENSIC TRACERS HELP SAVE OUR WILD CYCADS?

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Figure 1. Twenty–four *Encephalartos lehmannii* plants confiscated from poachers. This species is listed as Near Threatened in the IUCN Red List.

THE CURRENT EXTINCTION CRISIS

Cycads are the most threatened group of plants on Earth, with 62% classified as threatened in the 2010 IUCN global assessment. South Africa is a cycad diversity hotspot with 37 species in the genus *Encephalartos*, yet 78% are threatened with extinction. The greatest threat to our cycads is illegal harvesting from the wild (see Figure 1). Three species are already extinct in the wild, four are close to extinction and another seven have fewer than 100 individuals remaining. The rate of loss has placed the existence of wild cycads on a knife's edge.

CYCAD FORENSICS: A SOLUTION TO THE CRISIS?

One of the greatest challenges to regulating this illicit trade is providing proof of wild origin once cycads are removed from the wild. A collaborative study between the South African National Biodiversity Institute and the University of Cape Town is developing a solution to this problem by using stable isotopes to distinguish between wild and cultivated cycads. Stable isotopes have been used in numerous forensic studies, such as determining the origin of drugs and ivory, and are now being applied to cycads.

So how do stable isotopes work?

Stable isotopes of an element have the same atomic number, but differ in atomic mass. They are called "stable" as they do not radioactively decay, and so can act as a permanent tracer. Importantly, geographic locations differ in their composition of stable isotopes, leading to a distinct chemical signature that can be identified in the tissue of a plant from that growing location. This allows us to identify growing localities and potentially link formerly wild cycads back to their populations. Practically, we sample the oldest section of the stem (possibly representing wild tissue) and leaves (grown in the current location) of a suspicious cycad and compare these stable isotope signatures with those of the wild population (see Figure 2). Radiocarbon dating is also used to determine when a cycad was removed from the wild.

Stable isotopes are advantageous forensic tracers because they cannot be removed from the plant. Thus a plant carries its history with it and can be examined *in situ*, without the need to have marked the plant beforehand in the wild. This history can be compared with a reference database of plants from the wild to determine the likelihood of a wild origin, or compared with specific locations to test the veracity of claims of origin. This technique is currently being tested in specific investigation case studies.

BOX 1: LEGAL FACTS ABOUT CYCADS

- Cycads are listed as Threatened or Protected Species (TOPS) in terms of the National Environmental Management: Biodiversity Act (NEMBA) of 2004, therefore permits are required for possession and translocation of all indigenous cycads or cycad material. (Note these are not the only restricted activities requiring permits for cycads.)
- Harvesting of wild cycads without a permit has been illegal since the 1970s.
- As from May 2012, it is prohibited to harvest, trade, sell, buy, donate, import, export, convey or receive any wild indigenous cycad (even plants that have possession permits).
- Possession of wild origin cycads is also prohibited, unless they form part of legally obtained parental stock where permits were issued prior to May 2012.
- CITES permits are required for all imports and exports of cycads and cycad material. (South Africa has been a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since 1975. Cycads are listed in Appendix I, meaning that commercial trade is not allowed. However, artificially propagated specimens are exempt from this ban. CITES has defined strict criteria for deciding when a specimen is "artificially propagated".)
- Artificially propagated cycads with a stem diameter of more than 15 cm (or for dwarf species more than 7 cm) may not be exported from South Africa.
- Penalties for contraventions of any of the above laws (e.g. collection, possession and trading in illegal cycads) are up to 10 years in prison, or a R10 million fine, or both.
- If you suspect: The responsible action is to report any suspicious cycads or activities to the Department of Environmental Affairs' Environmental Crimes Hotline on 0800 205 005

Other advances in cycad forensics

Another new technology is the use of microdots, which are invisible to the naked eye. Microdots are similar to microchips in that they have a unique reference tag, but instead of being inserted into the stem, hundreds are sprayed onto the outside of the stem. DNA fingerprinting of wild populations has also been done for some species, thus there is a unique DNA reference for these wild plants that can never be altered. The use of stable isotopes in combination with these other forensic technologies now provides the Green Scorpions with a comprehensive suite of methods for identifying cycads removed from the wild. These forensic methods may be the break-through needed for saving our critically threatened cycads from an extinction crisis.

FORENSIC TRACERS AND LEGAL IMPLICATIONS

Advances in forensic tracers are helping to determine when and where a cycad originated from. This will not only improve detection of the illegal cycad trade, but will also ensure better management of the legal trade with cultivated plants. Proof of origin will facilitate compliance with the CITES regulations. Stable isotopes can assist in identifying suspect cycads during export and ensure that parent plants used to propagate exported seeds/seedlings are legal.

As from 2012, it is illegal to trade with any cycad that came from the wild. This includes wild cycads permitted prior to May 2012 (see Box 1), which a person can still legally possess, but is unable to trade, sell, buy, donate, import, export, convey or receive. Box 2 provides guidelines for identifying cycads that may have originated from the wild. If you suspect a cycad originated from the wild, do not purchase it and inform environmental officers in your region.

Cycads are part of our national and global heritage. The illegal trade is threatening the survival of this 300 million-year-old lineage, and is depriving South Africans

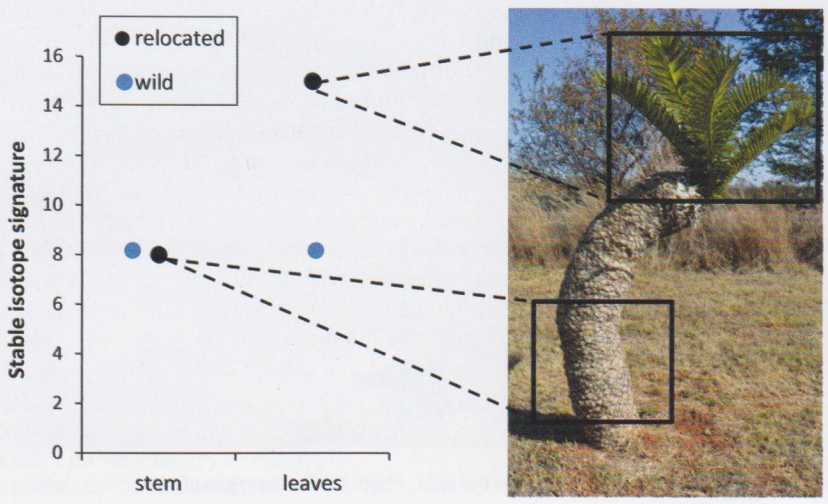

Figure 2. Sampling of the stem and leaves from a relocated and wild plant can show that the stable isotope signature in a relocated plant is consistent with a wild origin, whereby the stable isotope signature in the old tissue sampled from the base of the stem in the relocated plant matches the stable isotope signature in the wild plant, while the signature in the new tissue sampled from the leaves is completely different.

BOX 2: HOW DO I KNOW THAT I AM NOT BUYING A WILD CYCAD?

- A cycad may be of wild origin if it has one or more of the following features:
- micro-chip in the stem (the plant would need to be scanned to determine whether the
- micro-chip identifies the plant as a legal garden cycad or a wild cycad)
- stem with strange deformities
- over hanging stem shaped like a crescent
- variations in the diameter of the stem (indicating varying growth rates)
- long stems with small leaf bases (indicating slow growth)
- compact, generally smaller leaf bases at the lower parts of the stem (indicating harsher wild conditions) and bigger leaf bases further up the stem (indicating milder garden conditions)
- multiple side branches from the main stem
- burn marks on the stem from veld fires
- stem sanded with wire brush or sand paper to remove burnt leaf bases
- cut marks on the stem made from a panga when removing the cycad from the wild
- deep holes in the base of the stem where poachers have tried to remove the micro-chip
- absence of leaves
- patches of leaf bases completely removed by porcupine or traditional healers in the wild (very unlikely in a nursery)
- numerous old leaves still attached to the stem or recently removed (this is the dress of the cycad, which is usually cut off in garden specimens).
- no permit or the permit is not for the correct size and threatened status of the species

and foreign tourists alike from seeing these iconic plants in the wild where they belong (Figure 3). While advances in forensic sciences may help to limit this trade, ultimately the survival of these iconic plants will depend on individuals choosing not to purchase wild-harvested cycads.

READING

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Figure 3. Mature *Encephalartos friderici-guilielmi* (Near Threatened) in the wild. Photo by De Wet Bösenberg.