



# Aldabra's Sisal Eradication

SIF Research & Conservation Symposium

Eradication by Aldabra team, presented by Nancy Bunbury





# What is sisal?

## Sisal *Agave sisalana*

- Native to Mexico
- Cultivated in hemp fibre production
- Invasive alien species in Seychelles & WIO
- Large – leaves 1.5m long
- Produces mono-dominant impenetrable stands
- Sharp, spiky, serrated leaves
- Toxic sap causes burning and irritation
- Outcompetes native flora, decreases biodiversity
- Reproduction - sexual (bulbils) & asexual (stolons)



# History of sisal on Aldabra: 1956-2013

1956: Sisal noted as present on **Picard** (*Beamish*)

1971: Sisal noted as important cultivated species on Aldabra (4 sites)

1976/77: Most sisal cleared on **Picard/Polymnie/Ile Michel** - manually

1986: Sisal partly cleared on Malabar

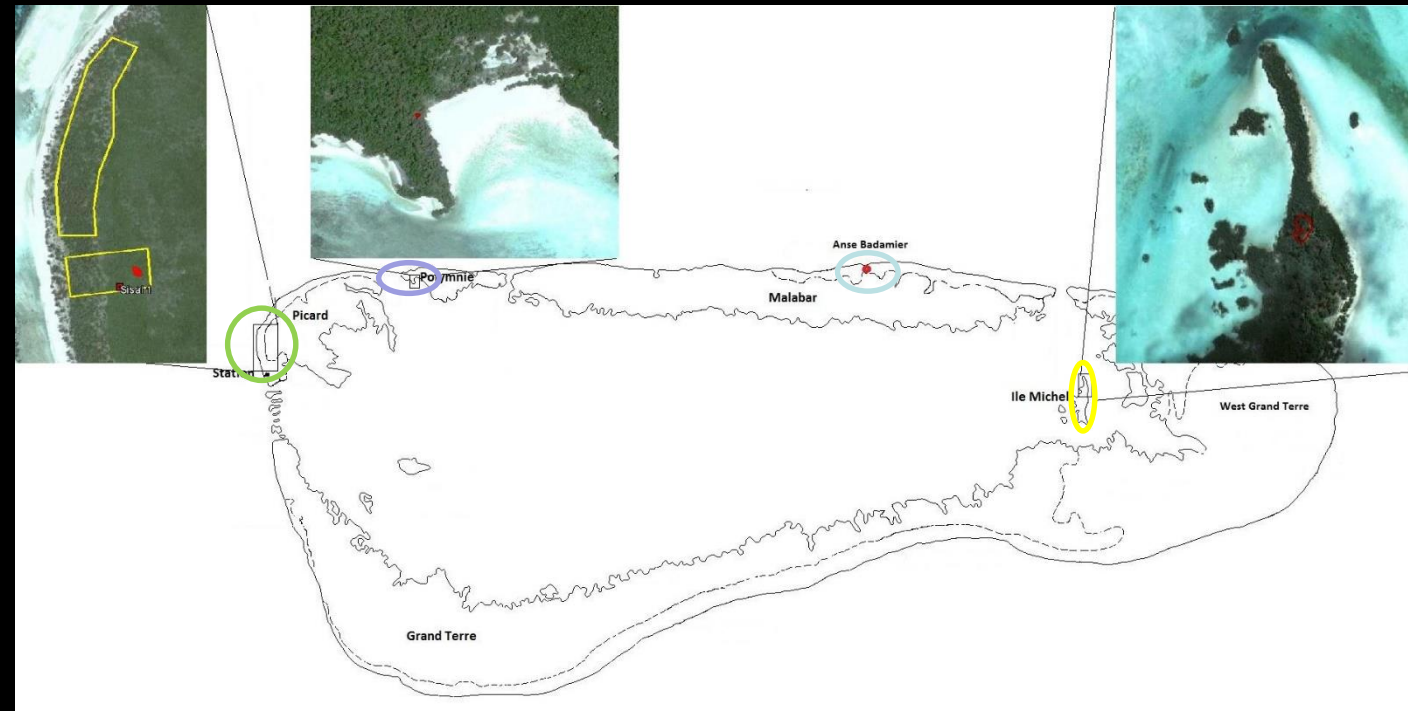
2005: Sisal cleared on Malabar ✓

2005: Discovery/clearing of **Picard** sisal

2010: Rediscovery/clearing - **Picard**

2012: Discovery/(partial) clearing - Polymnie

2013: New patch discovered on **Picard**, 70 m further inland





## Herbicide vs Manual removal?

### Manual method:

- Time-consuming and difficult, risky for staff
- Manual method tried repeatedly – not all sisal removed as roots often remained

### Herbicide application

- Reaches roots
- Application can be done locally (single plant), limiting herbicide exposure of surrounding plant community
- Rapid breakdown time in environment (in sunlight)



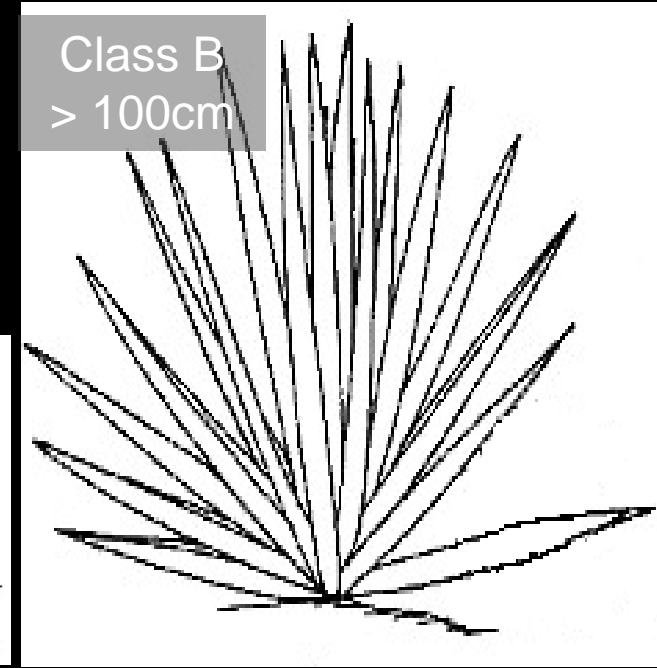
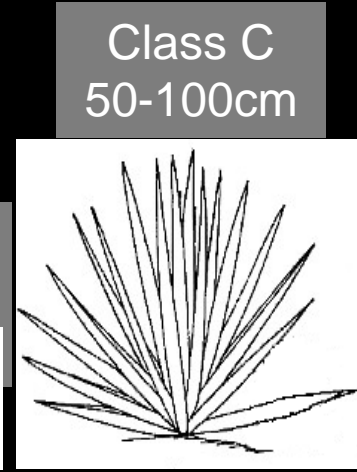
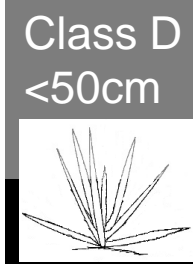
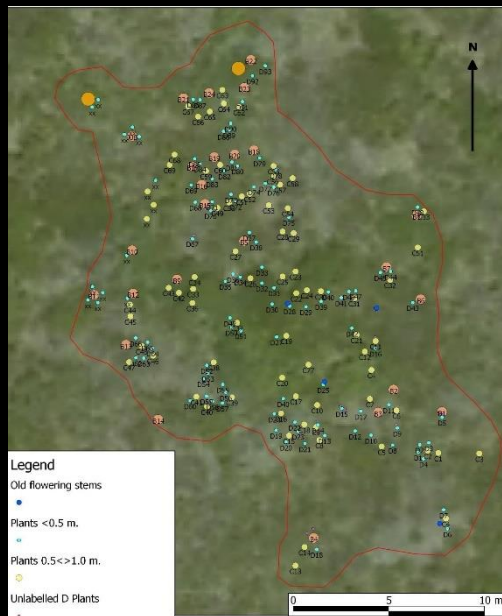
## Herbicide application trials 2013

**Objective: Determine the overall most effective and practical method for eradicating sisal from Aldabra with minimal non-target effects**

# Herbicide application trials: Methods

November 2013: Plants divided into 3 size groups

Herbicide: Tordon 101



*Whole plant:*  
0.5%, 1% or 2%  
sprayed onto leaves

Or

*Neat to cut:*  
5%, 20% or 50%  
straight to cut in stem



Plant health scored monthly  
&  
Surrounding area checked



# Herbicide application trials: Results

SPRAY

NEAT TO CUT

BEFORE



6 MONTHS  
LATER



0.5%



2%



5%



20%

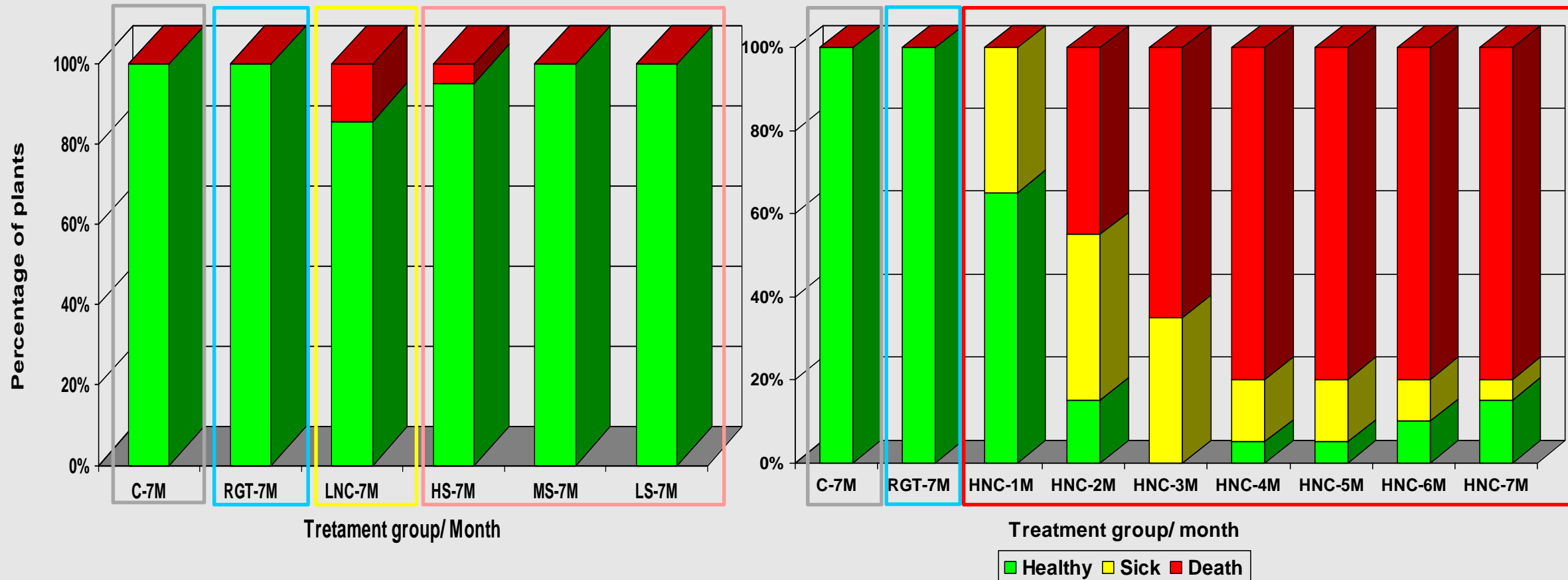


50%



# Herbicide application trials: Results

Status of treated plants 7 months after: No treatment (Control: C), Removal of growth tip (RGT), High/medium/low con<sup>n</sup> spray (HS/MS/LS), Low concentration (5%) neat to cut (LNC) and High concentration (50%) neat to cut (HNC)





# Herbicide application trials: Publication

## Trial of herbicide control methods for sisal *Agave sisalana* in the arid island environment of Aldabra Atoll, Seychelles

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### SUMMARY

Sisal *Agave sisalana* is an invasive alien plant species of concern at the UNESCO World Heritage Site of Aldabra Atoll in the Seychelles. Physical control efforts since the 1970s to remove sisal from Aldabra have only been partially successful because the roots cannot be completely removed, resulting in continuous control efforts. We conducted a seven month herbicide trial, using different herbicide concentrations with two application methods, to determine the most effective and feasible control method for sisal. We also checked effects on surrounding native plants. The highest treatment mortality was from 50% herbicide concentration applied directly to the cut growth tip, which resulted in 80% sisal mortality after four months. Fewer treated plants died at lower herbicide concentrations and more small plants died than large plants. No sisal plant died that was foliar sprayed, only cut, or in the control group. There were no visible negative effects of any treatment on the surrounding native flora. The results indicate that chemical control of sisal is effective at high herbicide concentration applied directly to the cut growth tip. A full-scale eradication of sisal from Aldabra has been started based on the trial results.

### BACKGROUND

Invasive alien species are one of the top four drivers of biodiversity loss (Sanderson & Moulton 1998, Mooney *et al.* 2005). Invasive alien plants are a particular threat to native island plant communities and their control is widely used in habitat restoration (Caujapé-Castells *et al.* 2010). The main control techniques are chemical and physical, although bio-control methods are also used for major pests (Flory & Clay 2009). Early detection and response is the most cost- and labour-effective, and also the most successful way to address invasive alien plants problems (Clout & Williams 2009). In insular ecosystems there can be additional constraints, such as high sensitivity of endemic habitats, the necessity to reduce disturbance wherever possible and difficulty of site access.

An invasive alien plant that has spread to non-native areas around the world is sisal *Agave sisalana* (Agavaceae) (ISSG 2014). Sisal is a large succulent perennial plant which is native to Mexico and has been introduced into tropical and sub-tropical areas as an ornamental and cultivated plant, notably in Brazil, Tanzania, Madagascar and Kenya for fibre production (Nobel 1988, Jacobson 2005). Sisal produces monospecific stands which exclude native flora, contribute to habitat homogenisation, and reduce biodiversity and food sources for native wildlife (Badano & Pugnaire 2004). The species is a sexually sterile clone, probably of hybrid origin, and produces no seed. Reproduction occurs via bulbils (young plantlets that root where they fall, following development on a 5–6 m tall inflorescence), and via sprouting of new plants from elongated underground stolons (Nobel 1994, Weber 2003, Gentry 2004).

Sisal has long been considered an alien plant of concern at the UNESCO World Heritage Site of Aldabra Atoll (9°24'S, 46°20'E; 34 × 14.5 km; Figure 1) in the Seychelles; a large raised coral atoll consisting of a rim of four main islands (Figure 1) with a total land area of approximately 152.5 km<sup>2</sup>.

Aldabra has been strictly protected since 1976, was inscribed on the UNESCO World Heritage list in 1982 and has been managed since 1979 by the Seychelles Islands Foundation. Aldabra's mean annual rainfall is approximately 975 mm, which is unevenly distributed throughout the year, with most rain falling during the wet season from January to April with the remainder of the year being dry or very dry (Seychelles Islands Foundation, unpublished data).

Sisal was identified on Aldabra as a target species for control as early as 1971 (Stoddart 1971) and between 1972 and 1976 large patches (800 m<sup>2</sup> and larger) were manually removed from several locations. Clearing of patches near the settlement area on Picard alone accumulated at least 2100 man hours in 1974 (Seychelles Islands Foundation, unpublished data). In the mid-1970s, coordinated control efforts on Aldabra to remove sisal patches started by uprooting plants, followed by removal and/or burning. This type of control was successful in residential and frequently visited areas (e.g. the area around Picard settlement; Figure 1). The hard porous limestone substrate of Aldabra, however, enables plants to root deeply in the rock, making it difficult to remove them completely. This resulted in re-sprouting of sisal around the atoll after initial removal and thus in continuous control efforts. These efforts, over many years, led to Aldabra's current limited distribution of sisal at only three locations; Picard, Ile Michel and Anse Polymnie (Figure 1, Table 1).

The difficulties of physical control led us to investigate the potential for chemical control, which has been successfully used in many eradication programs elsewhere (Soria *et al.* 2002, Wotherspoon & Wotherspoon 2002). Herbicide trials on *A. sisalana* and *A. americana* (century plant) in Australia showed several herbicide-carrier-application combinations to have positive results (>90% above-ground plant mortality; Foley & Bolton 1990, Bickerton 2006). On Aldabra, herbicide should reach the difficult to remove roots of the sisal plants, preventing re-sprouting and ultimately leading to potential eradication of this invasive plant from the atoll. An important consideration for chemical control on Aldabra, however, is that

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## Results of trials published in *Conservation Evidence*

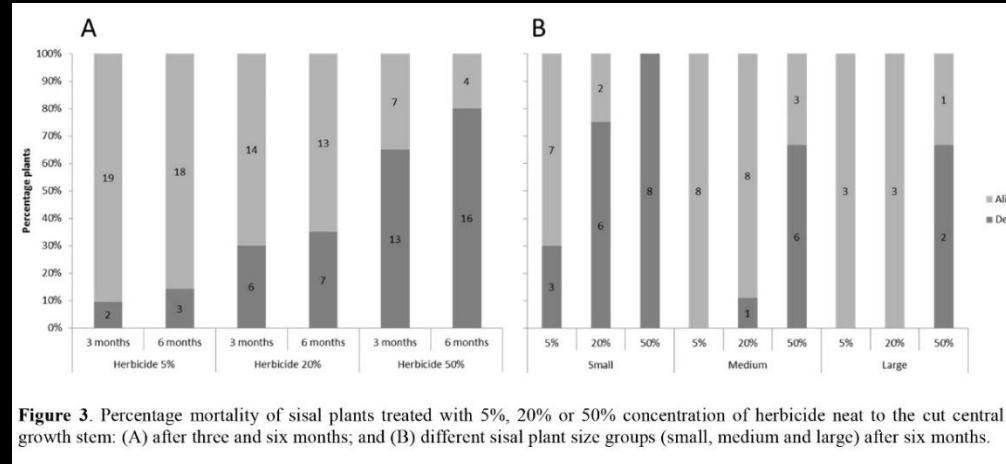
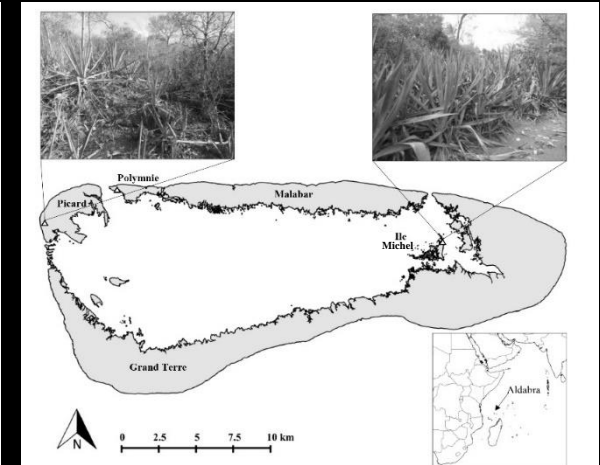


Figure 3. Percentage mortality of sisal plants treated with 5%, 20% or 50% concentration of herbicide neat to the cut central growth stem: (A) after three and six months; and (B) different sisal plant size groups (small, medium and large) after six months.



Based on results of herbicide trials:

- Larger cut - creates bigger contact area
- Apply 30% herbicide concentration (lower usage)



# Sisal eradication: 2014

## Final method:

- Herbicide 30% neat to cut
- All individual plants treated
- Multiple treatments required



## 3 patches to clear:

- Picard (Jun & Sep 2014)
- Polymnie (Feb & Jul 2014)
- Ile Michel (Mar, Jul & Oct 2014)





## Picard



Before (June 2014)



After (Sept 2014)



## Ile Michel



Before (Jul 2014)

During eradication

After (Oct 2014)



## Ile Michel



Before (March 2014)



After (Oct 2014)



# Sisal eradication monitoring: 2015–2018

3 years of monitoring:

- No re-growth at Picard and Polymnie
- Regrowth at Ile Michel after first wet season
- No signs of sisal regrowth at Ile Michel for > 2 years
- Last monitoring trip December 2018 found no regrowth
- January 2019...



## Sisal eradicated from Aldabra!





# Thank you

**Very special thanks to Martijn van Dinther, Ronny Gabriel, Marvin Roseline, Catherina Onezia, Sheril de Commarmond, Samuel Basset, Rowana Walton, Janske van de Crommenacker & Heather Richards**







# Ile Michel



August 2015 check (no regrowth)



Dec 2018 check

