Monitoring plant health in sentinel sites: botanic gardens and arboreta in South Africa

Mesfin Gossa

FABI, University of Pretoria

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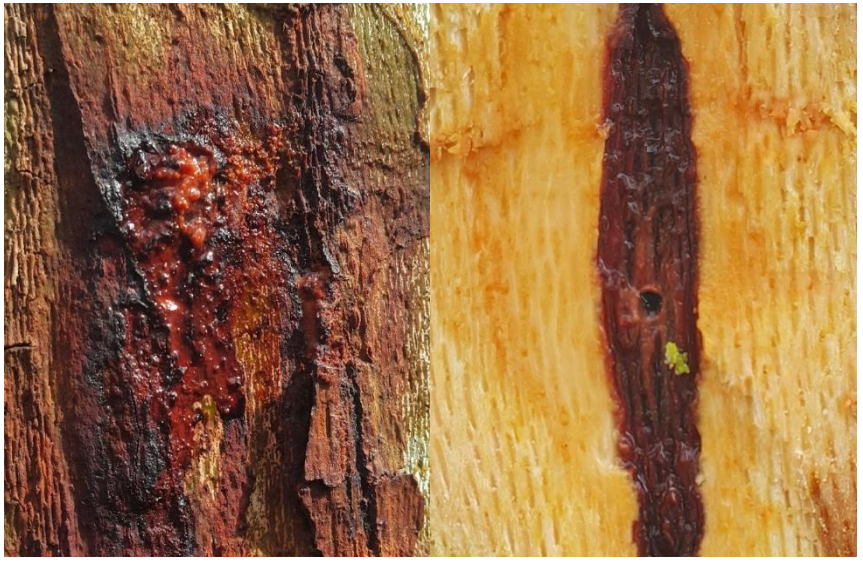
Many exotic plant pests and pathogens are unknown to science or unknown to cause serious damage prior to their establishment in a new environment

Dutch elm disease

Laurel wilt disease

Emerald ash borer

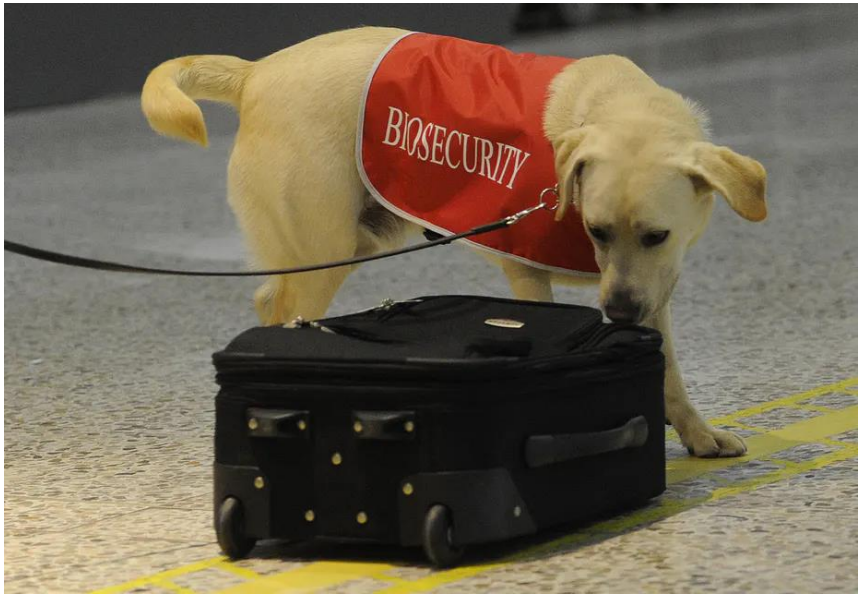


Polyphagous shot hole borer

Early warning systems and biosecurity measures required

- Prevention of entry – first and best line of defense
- Early detection – second line of defense
- Eradication
- Containment
- Control/management interventions

Surveillance and monitoring of pests and pathogens at various locations is important



What are the target locations for surveillance/monitoring?

<u>Borders</u>

- Involves inspecting goods arriving in a country for signs and symptoms of pests
- Valuable in identifying pests that are moving around the world, pathways and the frequency of movement

<u>Post-border areas</u>

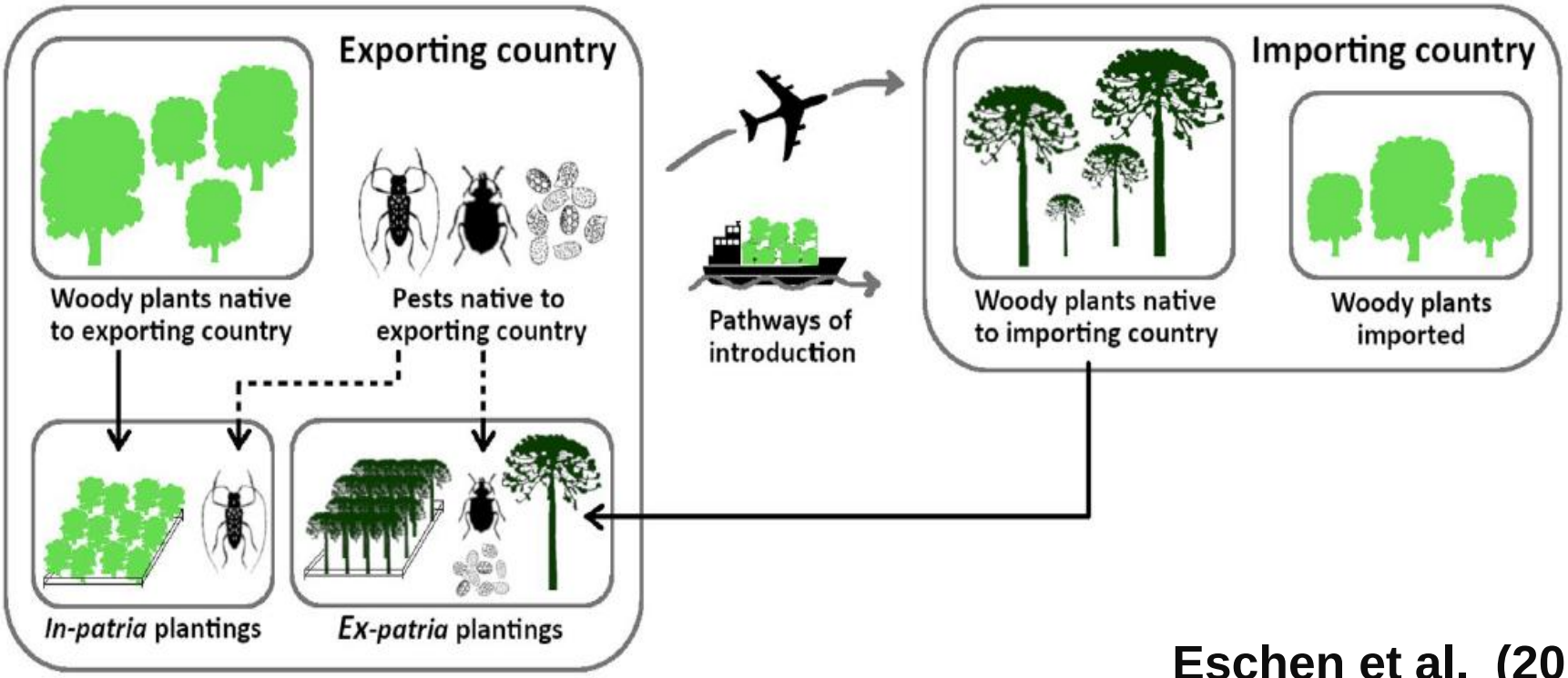
- Targeted surveillance at high risk areas (seaports, airports, import warehouses, containers and pallet depots, **botanic gardens)**
- Can be done using traps, **sentinel plants** and 'blitz' surveys

Plantations, farms, natural forests and <u>urban forests</u>

- Carried to assess forest health and to detect outbreaks of endemic or new pests
- surveillance methods include walk-through, drive- through, aerial (helicopters, drones) and remote sensing

A move towards sentinel plant research

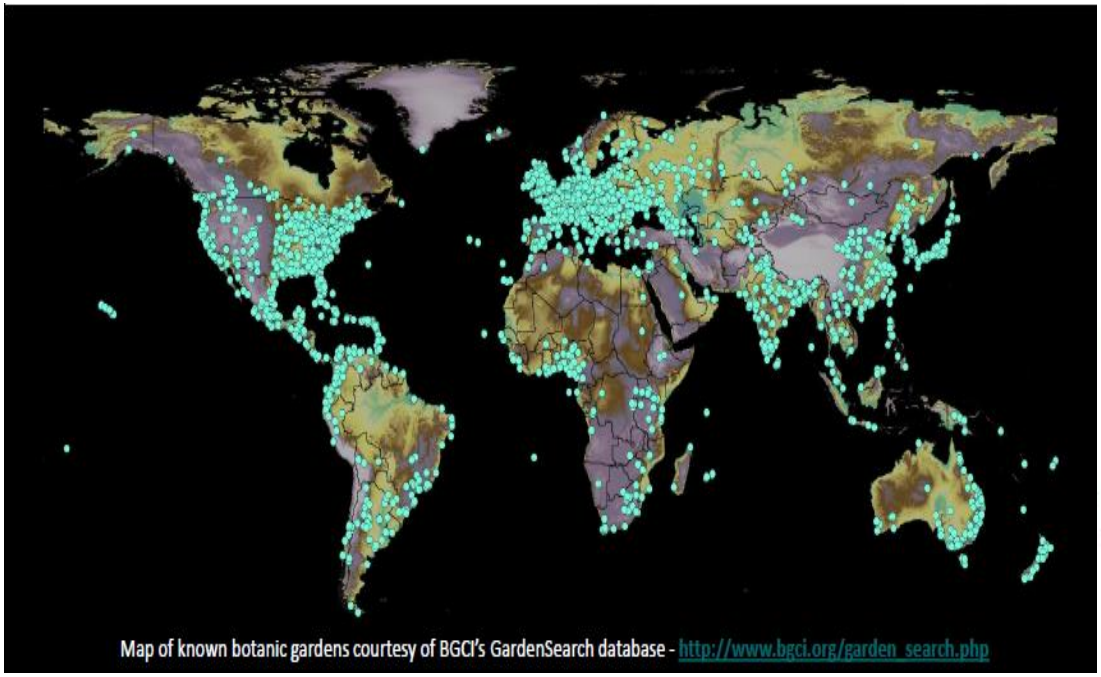
- serves as an **early warning system** by identify new and emerging pest and pathogen risks before they arrive in a new environment
- **Sentinel plants:** plants present in the vicinity of high-risk sites that are regularly inspected
- **Sentinel plantings**: are located in the country of origin of pests



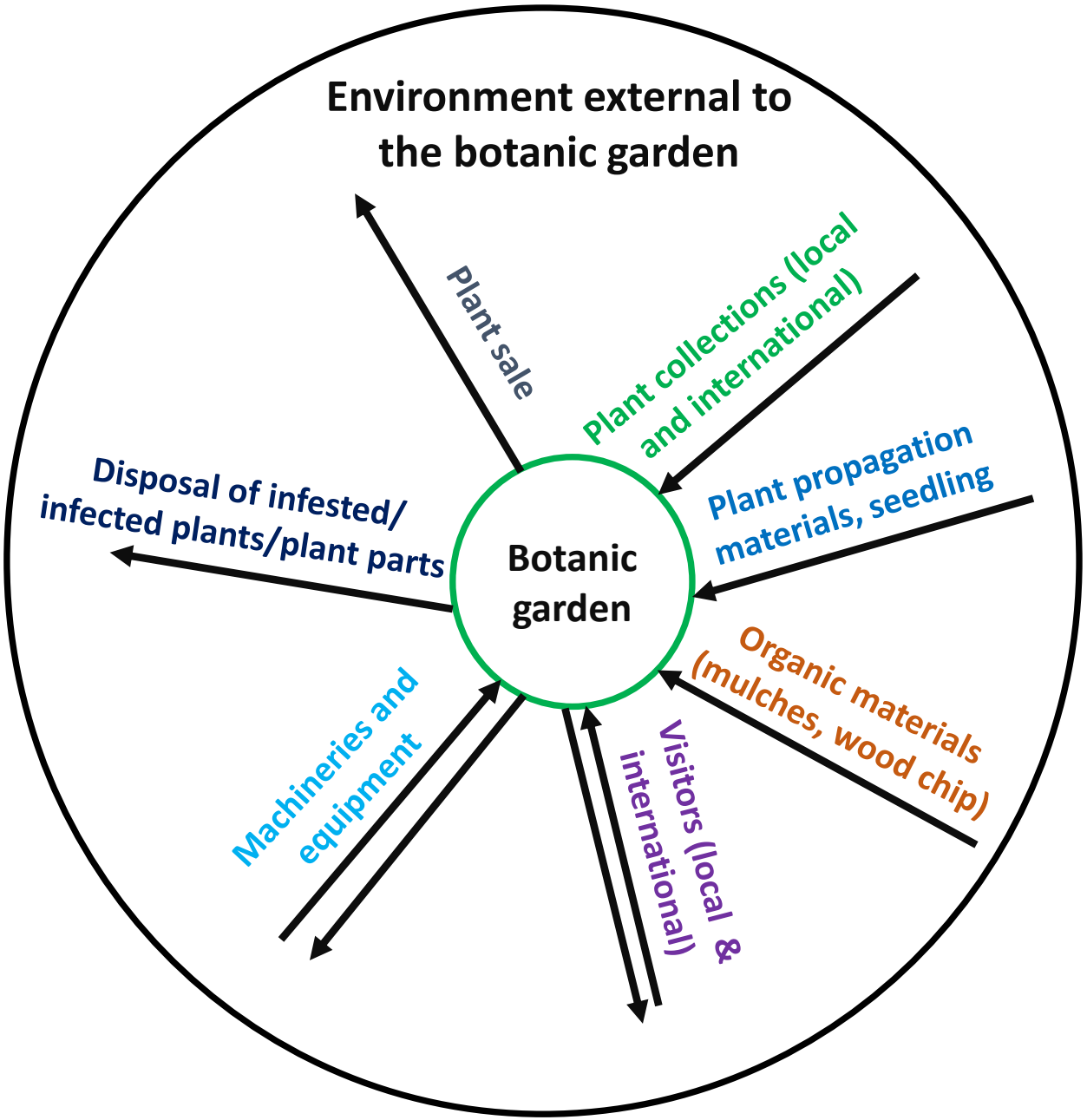
Eschen et al. (2019)

The value of botanic gardens for sentinel research

- Present a very unique opportunity for sentinel plant research/biosecurity research
- Over 3,000 botanic gardens widely distributed across the world
- House an estimated 30-40% of known plant species
- Located close to high risk areas and natural ecosystems
- South Africa is privileged to have many botanic gardens



Regular garden activities that lead to biosecurity risks



- Hence, botanic gardens provide a very unique opportunity for sentinel plant research or biosecurity studies

SANBI funded postdoc project

- Initiated in 2016 under the framework of IPSN
- Focuses on monitoring plant health in botanic gardens and arboreta
- First term: Mid 2016 to end 2018 - Trudy Paap
- Second term: 2019 and 2020 - Mesfin Gossa

International Plant Sentinel Network

Project aim

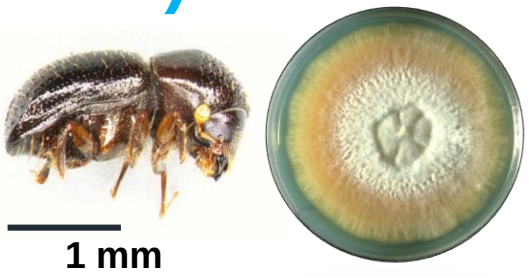
Improving surveillance and identification of new and emerging pest and pathogen risks by using botanical gardens and arboreta in South Africa as sentinel sites

Key tasks

- Interacting with botanical garden staff to build capacity to detect and manage tree pests and pathogens
- Providing a status report on pests and pathogens in the gardens
- Assisting with consolidating quarantine lists of pests and pathogens

Outputs of the first term (2016-2018)

- Polyphagous Shot Hole Borer (PSHB) was detected
- Plant pathogens were identified



Ganoderma

G. austral
G. destructans
G. ingmaticum
G. gibbosum
G. resinaceum

Phytophthora

P. amnicola
P. asparagi
P. capensis
P. cinnamomi
P. chlamydospora
P. lacustris
P. multivora
P. tropicalis

Armillaria roo rot

A. mellia
A. gallica

- Scale insects on cycads and aloes – *Aulacaspis yesumatsui*, *Aspidiotus capensis*, *Duplachionaspis* sp.

Capacity raising within the gardens

KwaZulu-Natal NBG

Kirstenbosch NBG

Pretoria NBG

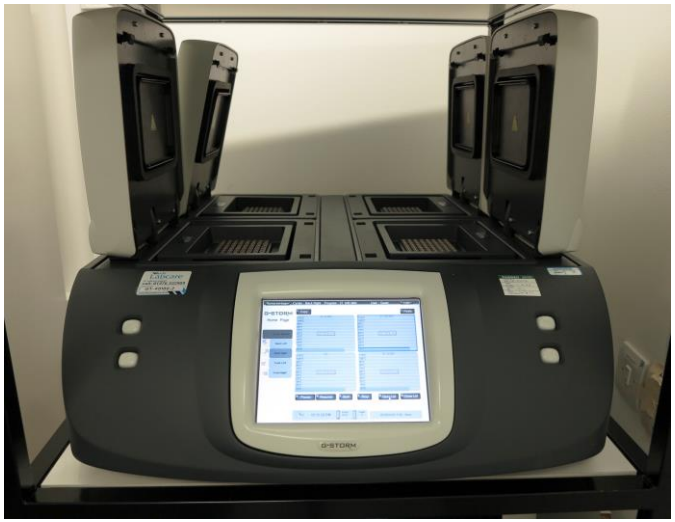
Topics covered

- Importance of sentinel plants
- Alien invasive pests and pathogens
- The importance of biosecurity
- Best practices in garden maintenance such as pruning
- Insecticide application

>120 delegates attended the workshops

Progress during the second term (2019-2020)

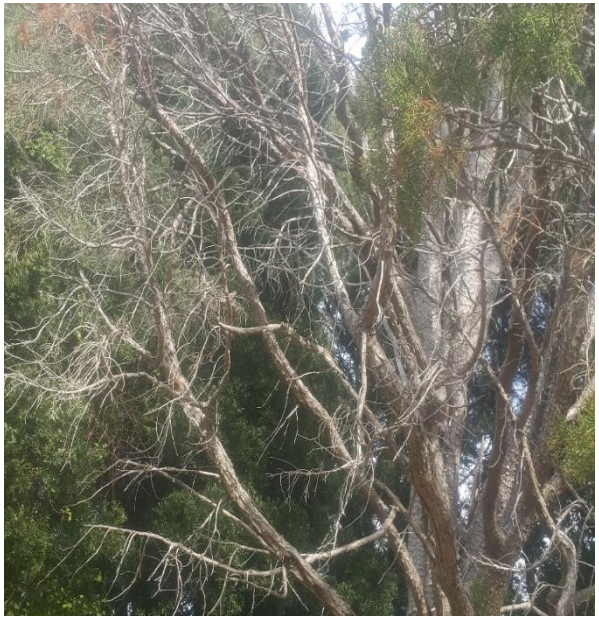
- Assessed tree health in 10 botanic gardens



- Problem targeted and random sampling
- Insect samples were identified using morphological and molecular methods

Two cryptic aphid species (*Cinara cupressi* and *C. tujafilina*)

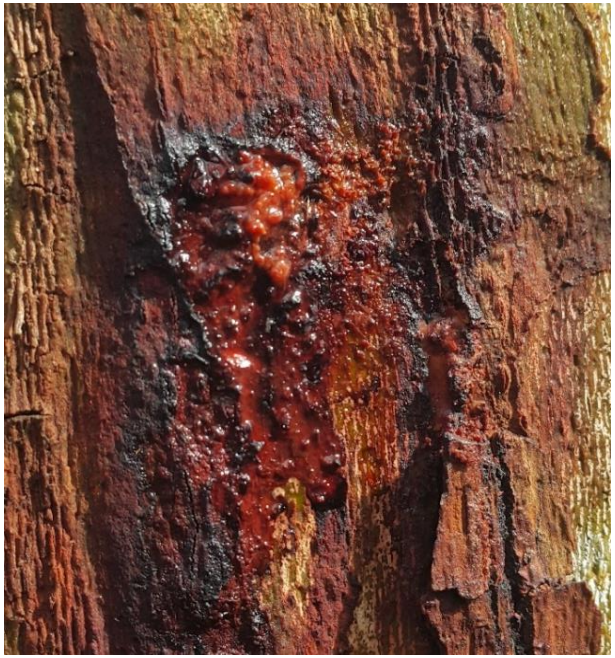
- Found on *Widdringtonia nodiflora* and *W. wachilli* trees in Kirstenbosch NBG
- *Cinara cupressi* is Native to N/America and *C. tujafilina* to Asia
- Have broader host range in Cupressaceae
- Infested trees were declining with brown needles and branch dieback



First record of PSHB in Tshwane Metropolitan Municipality

- Pretoria National Zoological Garden

	Tree species	Common name
1	*Acacia galpinii*	Monkey thorn
2	*Acer negundo*	Box elder
3	*Brachychiton discolor*	Pink flame tree
4	*Dombeya rotundifolia*	Wild pear
5	*Erythrina lysistemol*	Coral tree
6	*Erythrina* sp.	Coral tree
7	*Platanus* x *acerifolia*	London Plane
8	*Quercus kellogii*	Californian black oak
9	***Searsia lancea***	**Karee**
10	*Liquidambar styraciflua*	Liquid ambar



Two species of cycad stem borers

- Native to South Africa and Zimbabwe
- Bore deep in the stems of *Ecephalartos* cycads
- In nature, seem to damage weakened cycads only
- In gardens, most transplanted plants and plants subject to other stresses are vulnerable
- **The death rate of infested garden cycads is very high**

Phacecorynes sommeri

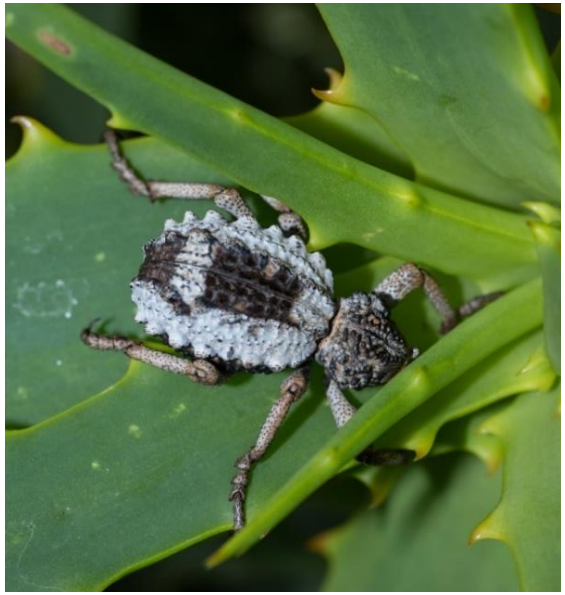
Phacecorynes variegatus

Aspidiotus capensis in Pretoria NBG

- Only known from South Africa and very little known about it
- Feeds on *Cycas* and *Ecephalartos* cycads – *E. senticosus & E. altensteinii*, both listed as **vulnerable** species facing a high risk of extinction in the wild.

Greater aloe snout beetle, *Brachycerus tauriculus*

- Native to Southern Africa
- Adult weevils nibble at the edges of aloe leaves
- The larvae feed in the crown, causing the crown leaf and upper part of the stem to rot



Lesser aloe snout beetle, *Rhadinomerus illictus*

- Native to Southern Africa
- Adult weevil feeds on the leaves causing circular scars
- The larvae feed in the crown causing the crown leaves and upper parts of the stem to rot

The white aloe scale, *Duplachionaspis* sp.

- Smothers the lower and upper leaf surface and deprives the plant of sunlight
- Natural enemies often keep the population in check
- Sometimes infestations can go out of hand

African citrus psyllid, *Trioza erytreae*

- Identified from *Clausena anisata* and *Zanthoxylum davyi* in Durban Botanic Garden
- A vector of the African form of Citrus Greening Disease (Huanglongbing)

Capacity raising within the gardens









Conclusions

- Pre-existing plant health issues and new pest and pathogen risks were identified in the various botanic gardens.
- Various capacity building activities were conducted to enhance the ability of garden staff in monitoring, detection and management of pests and pathogens.

Future work

- Packaging the outputs of the project and extending it to the garden staff and managers.
- Conduct further research to better understand and manage the identified plant health problems.

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CTHB

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