

MANAGED POLLINATORS IN COMMERCIAL AGRICULTURE

The case of South Africa

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Pollination in SA

- 3 biodiversity hotspots! (Cape: ~9,000 plant species, 70% endemism)
- Pollination of native plants ~83% of Fynbos plants are insect pollinated; large specialisation in Succulent Karoo – monkey beetles
- SA authors contributed ~4% of the world total of 5432 papers published in pollination biology over 2004-2009. But relatively few families, new plant-pollinator interactions discovered regularly.
- It is estimated that honeybees are pollinators for approximately 60% of flowering plants in South Africa



Pollinators of South African Crops



Honeybees are very important pollinators: Of the > 1,000 known species of bees in southern Africa, one is the honeybee, *Apis mellifera*. Two sub-species have been recognized: *A. m. scutellata* (occurring in the warmer rainfall areas) and *A. m. capensis* (occurring in the winter rainfall areas). These indigenous honeybees are the most important pollinators of many South African crops because they can be managed by humans on the scale needed to supply the commercial pollination service for our large-scale crops. Honeybees frequently visit different flowers of the same species and are highly mobile, which enables them to visit many plants in a large area. Honeybees are under threat from:

- Pests and diseases (such as varroa mite and American foulbrood);
- Pesticides (including pyrethroids);
- Being over-worked during essential long distances within short time frames to provide the pollination services;
- A scarcity of large, monofloral flowers with nectar energy and pollen quantity.

Pollination is the process by which pollen (male) is transferred from the ripe anther to the receptive stigma in a flower of the same species, thereby enabling fertilisation of the ovary (female) and the production of fruit and seeds (the reproduction of the plant). Only 10% of flowering plants are pollinated without animal assistance (i.e. self-pollinated, wind-pollinated, or water-pollinated). More commonly, the process of pollination requires a **pollinator** (most often an insect, but sometimes birds, bats, or rodents).

Think about what role you can play in helping our honeybees. We can all play a role in providing forage for honeybees by planting bee-friendly plants and encouraging our friends, family and government to do the same.

Oilseed (sunflower and canola)

Where: Limpopo, Western Cape, Free State, North West, and Mpumalanga Highlands.
Pollinators: honeybees, non-Apis bees and other insects. SA is the world's 10th largest producer of sunflower seed for oil. Both sunflower and canola seeds are used by biologists to capture incoming honeybees and to breed bees.

Deciduous fruit (apples, pears, peaches, plums, apricots, cherries)

Where: mostly Western and Eastern Cape, also Free State, Mpumalanga, and Gauteng.
Pollinators: honeybees (commercial), non-Apis bees and other insects.
Apples can be resistant if there is insufficient pollination, making adequate pollination very important for export quality. Citrusbeetle that represents about 12% of SA's agricultural export earnings.

Rambos seed

Where: Eastern region of the Western Cape.
Pollinators: cotton weaver, insecticide and capsaicin bees, possibly honeybees.
Over 8,000 tonnes of rambos is produced per annum, of which ~40% is exported to the market. Pollination is needed for seed production (the rambos from the stems and leaves).

Euphorbia cut flowers (gerbera, iris, gladiolus etc.)

Where: Cape Floristic Region (most Gladiolus in the Free State) and Port Elizabeth.
Pollinators: bees, bees, butterflies, bees, and flies. 100 producers, half self-seeds and cut flowers, generating a turnover of 500 million per annum. Cut flowers and flowers are essential for the cut seed cut, requiring a pollinator or greater than average.

Squashes (pumpkin, marrow, butternut, bitterball)

Where: Western and Northern Cape, Limpopo.
Pollinators: honeybees (commercial), non-Apis bees and other insects.
Earl's flower has to be visited many times for complete pollination. Incomplete pollination results in small and misshapen fruits.

Melons and watermelons

Where: Western and Northern Cape, Limpopo.
Pollinators: honeybees (commercial), and other bees and insects.
It is increasingly important to use SA's largest red watermelon, producing 100,000 tonnes in the month of December in the Free State, to be in demand in commercial trade.

Nuts (macadamia, cashew, almonds, pistachio)

Where: Mpumalanga, Limpopo, Western and Northern Cape, and subtropical coastal areas of Southern Natal and Eastern Cape.
Pollinators: honeybees (commercial), other bees, wasps, flies, ants, and beetles.
Nut trees are long-lived and often only start bearing in their 5th year. Cross-pollination is usually necessary, and commercial production is increasingly fraught with.

Berries (raspberry, blackberry, Marionberry, drachberry)

Where: Southern and Western Cape, Free State, and Gauteng.
Pollinators: honeybees (commercial), non-Apis bees and other insects.
Most raspberries are self-fermenting, with insufficient cross-pollination resulting in irregular fruits. In raspberries and blackberries an increased fruit yield of a number of kilograms, berry weight and firmness depend on the number of stigmas receiving pollen.

Citrus (orange, lemons, lime orange, tangerine, mandarin, satsuma)

Where: Eastern and Western Cape, Mpumalanga, Limpopo.
Pollinators: honeybees and other insects.
Pollination requirements vary across cultivars, with growers often trying to prevent pollination in some cultivars to limit the number of seedlings in the fruit. The citrus industry in SA is worth ~\$2 billion, with > half of the produce exported.

Subtropical fruit (mango, litchi, avocado, guava, papaya)

Where: Mpumalanga, Limpopo, subtropical coastal areas of Southern Natal and the Eastern Cape.
Pollinators: honeybees (commercial), other bees, wasps, flies, and possibly roaches.
Nearly half of the annual avocado produce of 30 000 t is exported. Honeybees, ants and flies have been found to be important for mango pollination.

Lucerne seed

Where: Overblom district of the Western Cape.
Pollinators: (wild) bees and carpenter bees. Seventeen of the Overblom district produces ~90% of the lucerne seed in SA. Bees (like the honey bee) from Germany, but Italian bees and carpenter bees are better pollinators than honeybees.

Vegetable seed (cumin, pumpkin, carrot, cauliflower, broccoli, Brussels sprouts, cabbage etc.)

Where: Edenburg (Western and Eastern Cape) and Northern Cape.
Pollinators: honeybees (commercial) and other insects.
Vegetable seeds are usually produced separately in the vegetable seed SA, particularly the Edenburg area, plays a major role in the global seed production market. Calliphoridae flies and leafhoppers contribute to certain pollination.



Photographs of the pollinators have kindly been supplied by Sarah Stone, Jonathan Dicks, John Christoffel, Luanne Christoffel and Justus-Peter Piesse.

This poster was created by the pollinator and honeybee project team at the South African National Biodiversity Institute, as part of the GEF/UNEP/SA National Pollinator Project.



Did you know:
"You can thank a pollinator for one out of three bites of food you eat!" 60% of global food production volume comes from crops that do not depend on animal pollination (e.g. wheat, maize, and rice)—use so-called 'major' foods; 35% from crops that do not depend on pollinators, and 5% are unevaluated. But also remember: meat comes from animals that eat plants—some of which require pollination by pollinators!

Know your veg!
Pollination requirements of vegetables can be categorised according to what part of the plant is eaten:

- If the 'vegetable' is a 'fruit' then pollination is required both for the production of the vegetable AND for seed production, e.g. tomatoes, peppers, and pumpkins.
- If the 'vegetable' is in the form of leaves or shoots (e.g. lettuce, cabbage, and bok choy) or a 'storage root' (e.g. carrots and beetroots) then pollination is not required or desired for the production of the vegetable ONLY for seed production.
- If the 'vegetable' is a 'storage stem' then pollination is not required for EITHER the production of the vegetable or seed because seed is not required for propagation, e.g. potatoes and Jerusalem artichokes.

iSpot
Contribute to pollinator research through iSpot! Not all flower visitors are pollinators, and not all pollinators of species that they visit. Some are simply nectar thieves! Careful identification and observation need to be undertaken to know whether or not a flower visitor is in fact a pollinator. There could be highly important pollinators of our crops that we need to know more about and protect. Anyone can make a contribution to the field by making careful, detailed observations supported by photographs. Use www.ipsot.org.za to find your observations.

...therefore honeybees...

- Our farms are too big and only need pollination for brief periods in a very intense manner. Most farms not able to obtain adequate pollination ES from the surrounding natural vegetation.
- SA's commercial agriculture is almost solely reliant on an indigenous, commercialised honeybee species
- The sustainability of pollination ES in SA requires an understanding of how managed honeybees utilise resources across landscapes (regional scale ES: forage and swarm trapping)



Honeybees in SA (Allsopp)



- Two sub-species: *Apis mellifera capensis* and *A.m. scutellata*
- Both good pollinators, especially if handled correctly
- Wild & managed populations same ← because indigenous

Trapping + absconding!

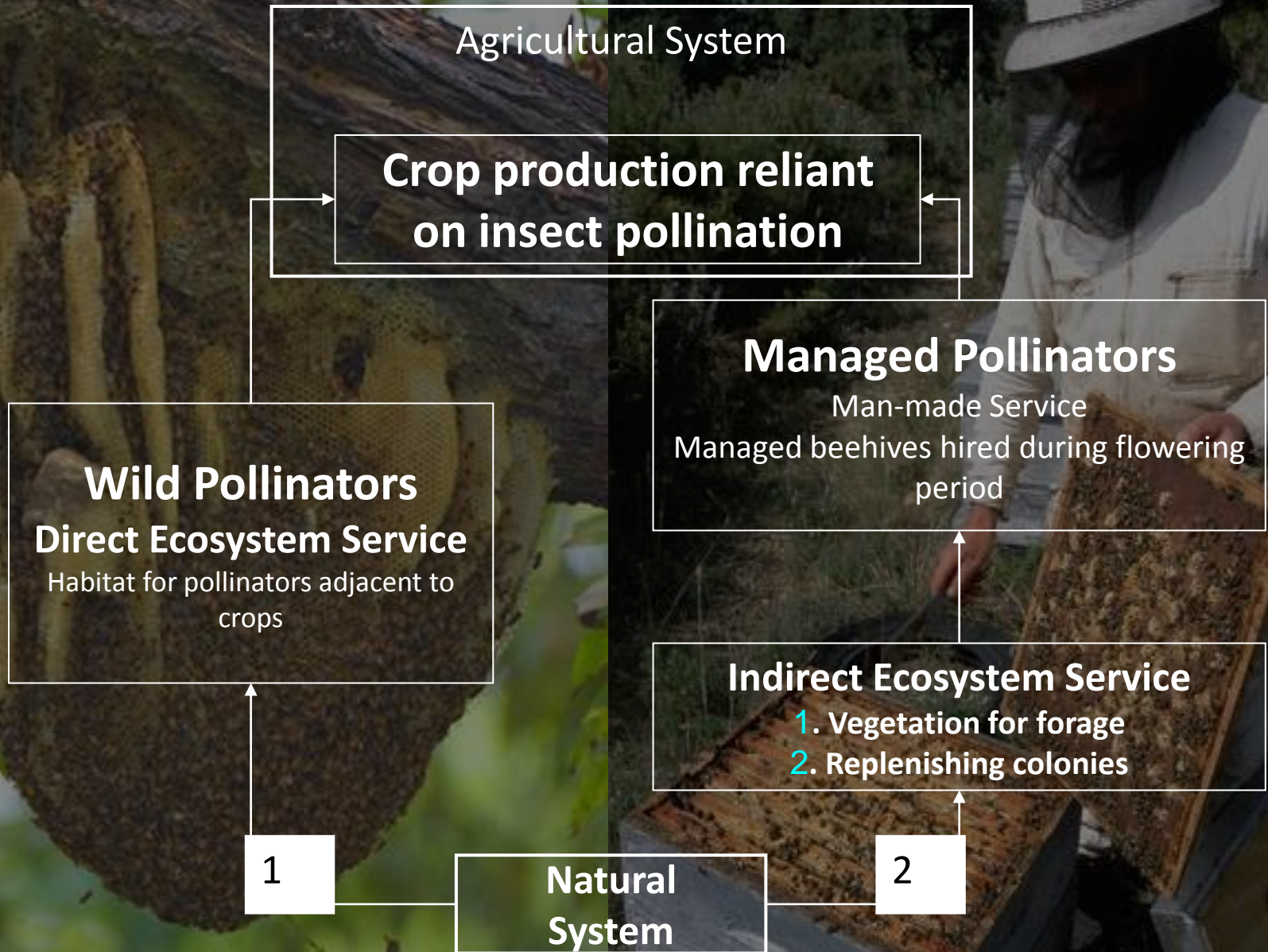
- Limited honey production – we import. Marginal bee country
- Beekeeping is a highly managed & migratory system (~2,000km following honey flows!)

- 87% of colonies in W. Cape used for commercial pollination (~60k units)

- SA honeybees not experiencing same dramatic declines as Europe and N. America, but signs of stress in SA honeybees (over-worked, insufficient forage, pollution, diseases, *Capensis* issue, vandalism, etc).



TWO ECOSYSTEM SERVICES STREAMS



But how to manage these resources?



Nectar – energy
Pollen – protein

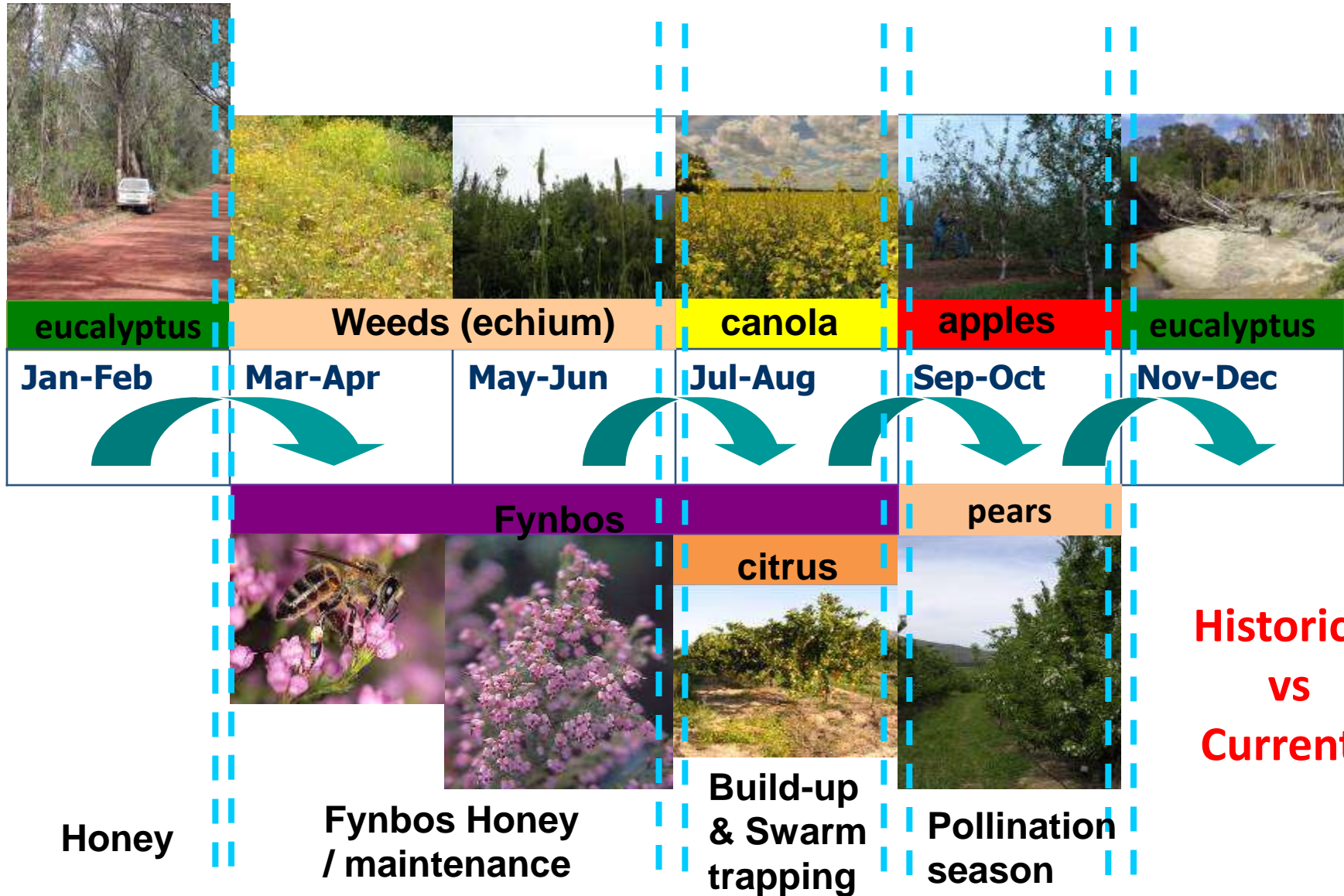
“How much do we have and how much do we really need?”

Indigenous natural veg
Weeds
Cultivated crops
Exotics / aliens

Preliminary results-Beekeeper Questionnaire Survey

	Category	EC	FS	GP	KZN	L	MP	NC	NW	WC
Census information	Total# of Beekeepers	12	5	36	17	37	6	5	6	71
	Total# of Hives	1780	210	1522	5448	1598	1977	5562	1361	16936
Forage use (Total per province)	Eucalyptus	6	3	9	2	3	4	3	8	12
	Crop plants	6	1	13	10	8	15	4	2	20
	Other Tree species	9	4	13	4	4	10	10	7	8
	Shrubs, succulents & herbs	5	0	3	1	1	2	2	1	14
	Weeds	1	6	4	0	0	3	2	1	3
	Veg. Type	12	2	2	3	3	3	3	2	13
Forage sites (Total per province)	Number of localities	21	3	55	21	5	17	7	15	98
Colony replenishment (%)	Swarm trapping	46.92	42	39.44	74.41	83.38	66.67	70	63.33	54.62
	Hive splitting	10.38	6	9.97	4.41	5	8.33	14	10	12.1
	New swarms	0	0	2.72	0.29	0.81	0	0	8.33	3.46
	Removal of problem colonies	35	52	22.86	15.29	0	8.83	16	18.33	14.41

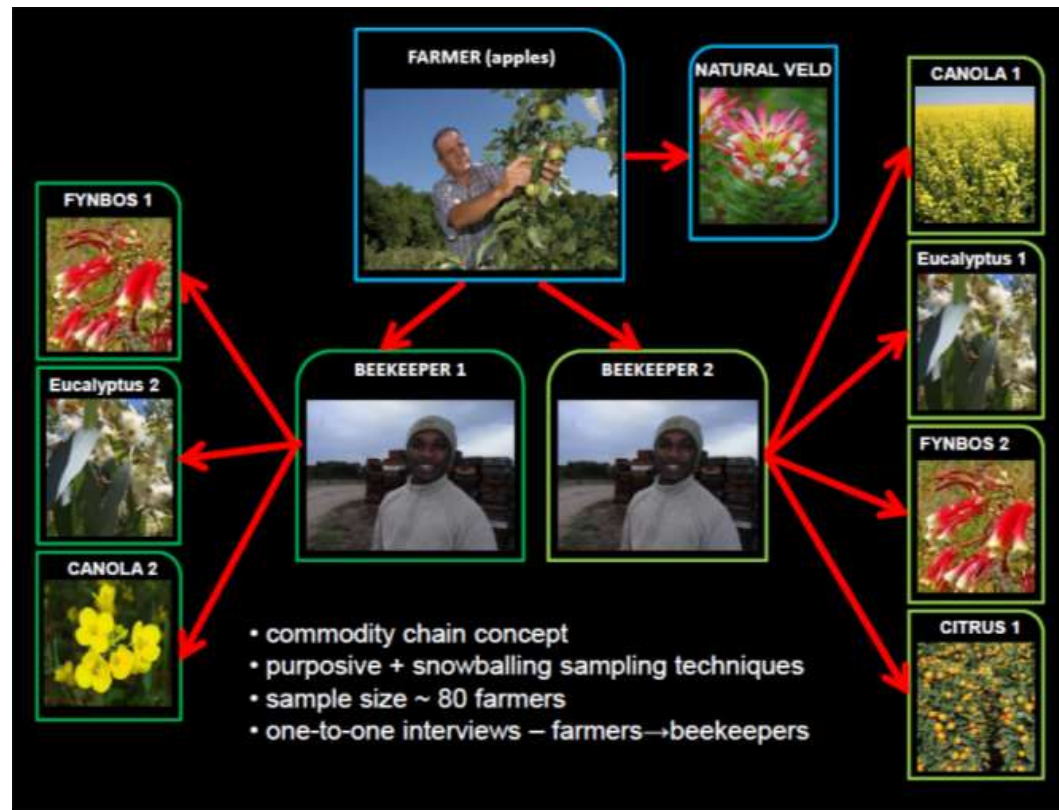
Forage provision to managed bees Western Cape



**Historical
vs
Current?**

Landscape requirements

- Model the links between the pollination services used by the WCape apple industry and the resources that support them
- Investigate correlations between the key resources and measures of biodiversity (e.g. threat status)
- What is the resilience / stability of current honeybee forage availability in sustaining managed hives?



Honeybee Forage Project

- Secured pollination services via strong forage knowledge base provide **solid policy advice**, with possible **alternate forage sources**
- Estimate number of beekeepers & colonies within South Africa (supply/demand)
- Dependence of managed honeybees on various forage resources – exotic/indigenous
- Provide national information on ES upon which managed bee industry depends
- Outline management practices that positively contribute to the provisioning of quality and sustainable forage
- National Forage Species List



Outputs

- “Beeplants of South Africa” book
- Capacity building materials: poster; DVD with film & associated activities; lectures
- Public awareness: plant a bee-friendly plant campaign (forage materials)
- Profiles of farmers and beekeepers
- Management consideration documents
- Impact Pathway:
 - Building understanding of honeybees as important crop pollinators (policy makers, educators, general public)
 - Protection of existing forage resources for honeybees: management of eucalypt, indigenous and crop forage; access to unusable forage (policy makers, forestry industry, private landowners, managers of public land)
 - Establishment of new small-scale forage resources for honeybees through exploring potential to grow forage on public and private land (managers of public land, forestry industry, landowners, urban greening programmes, general public)



More to be done?

- Further forage-related research:
 - Importance of Eucalyptus plantations in the forage cake (which cultivars, euc pests, etc)
 - How the forage cake slices might be impacted by climate change
 - How pesticide issues could impact forage resources
- Other honeybee-related research:
 - *Capensis* problem
 - Basic pollination research (hives/ha, bee dynamics within crops, strength of hives, etc)
- Better coordination: agriculture ↔ beekeepers ↔ forage owners
- National ‘home’ for beekeeping + high-level champions (top-down)
- Bottom-up: public awareness – buy local, plant bee-friendly plants

“What is good for managed pollinators will be good for the wild pollinators”



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