Forest Hall Estate

Garden Route Natural Science Research Facility

The Garden Route Natural Science Research Facility developed from the *Baartman/Biko Environmental Initiative* at Forest Hall Estate started in 2005 and spearheaded by Albert Ackhurst, a local botanist/conservation scientist and the previous ownership of this exquisite property. The present ownership has continued with the project and allowed for the growth of this vision, to now seriously engage and accommodate University student facilitation and the compilation of an extensive Natural Science library and forest rehabilitation programme.

Outlined below is an extensive Re-aforestation effort compiled and initiated by Albert Ackhurst some 10 years ago as part of a broader biodiversity conservation and Agroforestry programme with a conclusive growth period substantiating theory and practical lessons learnt in forest rejuvenation and Fynbos succession.

As of 01 March 2014 all prior reference to the Sara Baartman Private Nature Reserve and or the Baartman / Biko environmental initiative will now be known as the

'Garden Route Natural Science Research Facility'.

The Non Profit Organisation 'The Green Ticket' is now leading the scientific data interrogation and capture of all related sciences within the realm of Botany, Zoology, Marine Biology and the continued expansion of the re-aforestation and agroforestry programme.

Life Skills in SA (www.lifeskillsinsa.com) will be supervising all Alma Mater's interest and facilitating the Project Leaders (Masters & PHDs) and student's with board, lodging and their general well being whilst on the property, including extra curriculum activities off the property.

All projects associated with Natural Sciences on the property Forest Hall Estate will include the property adjacent known as Buitenverwachting.

Associations with other like minded organisations from the Bitou region are in conference and updates regarding such will be publicised as and when they come into effect.

The Garden Route Natural Science Research Facility is headquartered within the Sara Baartman Private Nature Reserve at Forest Hall, a colonial manor house constructed in 1864 from Outeniqua Yellowwood and unbaked clay brick located on 179 hectares bordering the Tsitsikamma National Park.

Forest Hall Facilities
The Forest Hall Manor House, grounds, nursery and various out buildings provide logistical support for the research facility and is located at (33°59'22.06"S-23°29'34.80"E).

Contact: Bruce Kietzmann
bruce@thegreenticket.org
info@lifeskillsinsa.com
+27(0) 822 55 1951

Accelerated Re-aforestation (ARP) of the Sara Baartman Private Nature Reserve

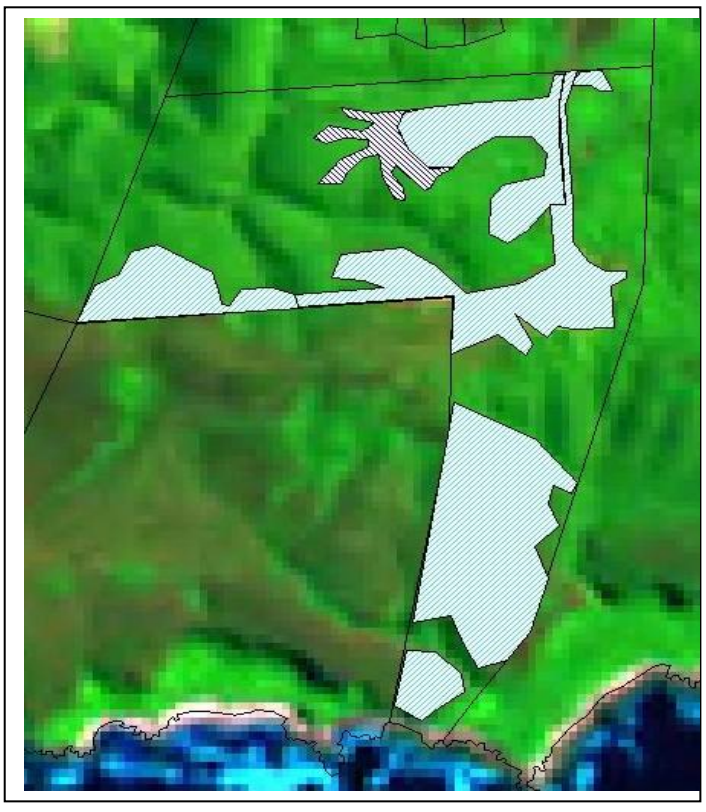
By: Albert Ackhurst
BSc Hons Botany, BCom Hons, Advanced Wilderness Management –CEAD

1. Introduction

Sara Baartman Private Nature Reserve lies in a natural forested area of the southern coastal platform, directly to the west of the Tsitsikama National park and adjacent to the south-coast, east of Keurboomstrand and Buitenverwachting. The dominant vegetation type according to some leading authors is:

- Afro-montane forest (Low & Rebelo),
- Knysna forest (Acocks),
- Indigenous forest patches (Landcover 1999 study – CNC Metadata)
- Knysna Afromontane Forest (Broad habitat Units – Expert Vegetation map by Lombard & Wolf, 2004).

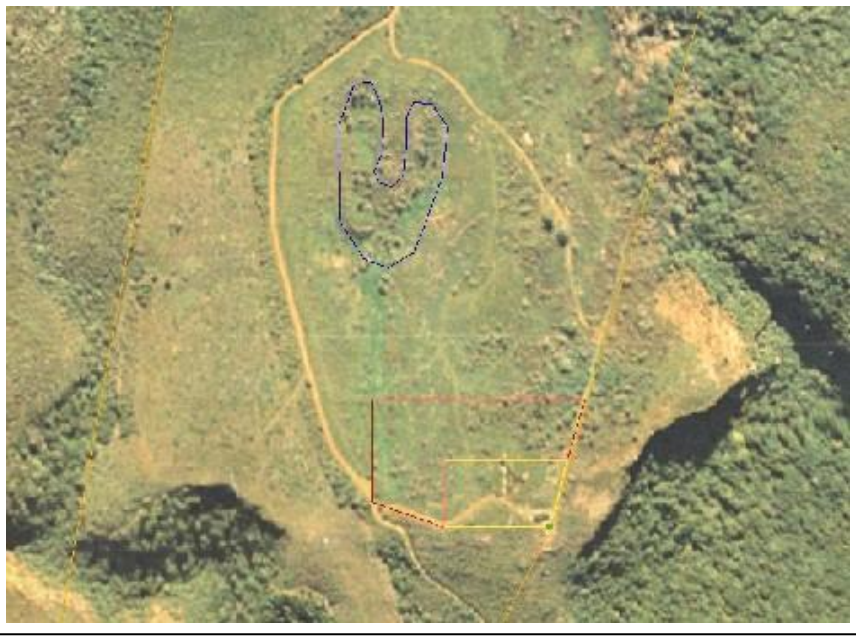
The upper reaches of the Reserve are relatively intact and consist mainly of medium to high evergreen forest of varying maturity in the 100 to 300m-altitude line. There is however a relatively large homestead development and adjacent pastures within the boundaries and a few invasive alien intrusions are also evidence of historic land-use impacts.



The middle to lower reaches of the coastal platform has been extensively impacted over (at least) the last 150+ years, firstly by deforestation and then by agricultural practices especially the burning and grazing practice for livestock. This is also evident on the lower western reaches of the Tsitsikama National Park, De Vasselot section and the adjacent SANParks managed land (Buitenverwachten).

A thin stretch adjacent to the ocean in front of an old cliff-break pattern is littoral coastal forest/scrub forest with even large Outeniqua yellowwoods within meters of the beach. This is a very important forest type and its linkages and corridors to the upper plateau forest are critical to maintain. One of its most important linkages is on the Reserve and it has been severely degraded over the years.

Therefore the first **experimental** phase of the project was concerned with the rapid re-aforestation of sections of the impacted middle to lower coastal platform.



The lower reaches of The Reserve
(Phase 1 - **Target area in red** – approx 1.1 hectares)

2. Target Area Ground Investigation

An assessment of the target area commencing in January 2005 has so far established that the area is significantly transformed and its vegetative nature can only be ascribed to recent succession in the absence of forest, which naturally will include fynbos, herbaceous, succulent and woody elements. According to the studies and authors mentioned in the introduction, it should be Afro-montane forest with **Very-high** vegetation sensitivity. Although natural coastal fynbos patches do occur along the south coast associated with forest, the Phase 1 target area is arguably not one of them as demonstrated by the following:

a) The primary succession is dominated by senescent woody ericoid species but the fynbos diversity is relatively low especially since there are also numerous herbaceous and succulent species interspersed, even some South Coast Renosterveld species. In fact the current status of the succession is currently intermediate between senescent fynbos and thicket/ pioneer forest mosaics with *Chrysanthemoides monilifera* (Bitou) dominating. This is however a very slow process (additionally retarded by historic human impacts) and constantly runs the risk of being set back again by rampant fires.

b) A perfect example of this process (as a control area) is the adjacent impacted landscape (Buitenverwachten) managed by SANPARKS. Very similar to the lower aspects of The Reserve, it has been left for more than 15 years and its current succession is moving into 3 to 5 meter high thicket and scrub forest.

c) Remnants of the original forest/thicket species still occur throughout the area e.g. Cape beech (*Rapanea melanophleos*), Candlewood (*Pterocelastrus tricuspidatus*), Keurboom (*Virgillia oroboides*), Wild Pomegranate (*Burchellia Bubalina*), Monkey Plum (*Diospyros dichrophylla*), Bitou (*Chrysanthemoides monolifera*), Cape Sumach (*Osyris compressa*), Campher bush (*Tarchonanthus camphoratus*), cross-berry (*Grewia occidentalis*) and a some Rhus species to mention a few. These are especially evident on the edge of cut-lines or fencing-lines where “bossiekappers” were not employed.

d) Although it may appear as if Keurboom (*Virgillia oroboides*) is dominating in patches one has to recognise the species as an early pioneer in places where forest was denuded by fire or other disturbance. This is particularly evident in a pronounced band on the lower coastal platform that’s intruding in a fire-fan-front into the naturally restoring forest. The problem with the keurbooms further down is that they are growing in very poor soils (due to loss of topsoil and erosion of the forest humus layer in the exposed areas) making them perform less than amicable as pioneers that can lead to secondary broad-leafed

succession. This was observed by studying their undergrowth succession – most keurbooms have a weak or exposed canopy and there is not sufficient humus rich soil to nurse broad-leafed species to maturity. In scattered patches where the soil is humus rich and the canopy is more protective, broad-leaved species are already beyond sapling phase above 500mm. This is rare however, in the target area.

e) The damage/transformation over an extended period (>150 years) is such that the target area became incessantly exposed to wind, rain, salt-spray and sun. Without its forest canopy the generally thin nutrient layer of the forest was easily lost to erosive activity and probably landed-up downhill in the coastal thicket/forest area. Bare leached, sandy soils remained (especially in the drier spots and between now-exposed-rocky-outcrops). Forest species (including it's pioneers) have a very hard time to establish themselves in these conditions (In many cases only in a stunted form) hence the fact that succulents and woody fynbos species invaded and are now evident in the area.

3. Pioneers for Target area

When an area is laid bare by natural or human disturbance, the plant type that is most competitive is the one that can establish itself quickly, or is already there. The plant must then grow rapidly and produce lots of widely distributed seeds that will reach sites of future disturbance. The plant types typifying this character profile are called pioneers. **The primary pioneer used on the Reserve is keurbooms** but a small controlled experiment has also been launched to test *Acacia karoo* in denuded soils in which keurbooms are not favoured.

Lesson learned from East Coast dune forests

A proven chief pioneer on the coastal dunes at Richards Bay for instance, is the coastal Sweet Thorn, *Acacia karroo*. It can cope with the extreme conditions prevailing on bare dunes and sandy patches. Seed is produced in profusion and is very long-lived in the soil seed-bank. The probability is high for Sweet Thorn to be in the right place at the right time when an area is laid bare. Sweet thorn is also known to be hardy and persistent and a nitrogen fixer, even in difficult growth conditions as in poor soils or drought stricken areas.

Once it germinates, the Sweet Thorn grows fast because of its light-efficient design. A complete single layer of leaves in a tree canopy cannot use all the available sunlight and the plant leaves get light saturated. The Sweet Thorn's response is to have a multi-layer canopy, composed of a deep bed of small leaves that may be in several overlapping layers to catch and use light. The small leaves do not cast long and dark shadows, so the top leaflets do not rob the lower ones of light. The result is that Sweet Thorns have large areas of leaf-factories for turning sunlight into plant material.

Until the secondary species reach dominance, the forest under the Acacia karroo is changing, dynamic, vibrant and diverse. There is sufficient light penetration for a variety of sub-canopy shrubs, grasses and flowers. Caterpillars, birds, bees, butterflies, monkeys and many others pollinate flowers and distribute fruits.

Bartmann-Biko Environmental Initiative accelerated re-aforestation Project

Considering the available literature and discussions with various experts in propagation and re-aforestation a list of regional forest trees were established and from it a shortlist of species that will be used in the rapid or accelerated re-aforestation project at The Reserve. This list is not exhaustive and the species were selected on the basis of their value as, pioneers, fast growers, ease of propagation and species that grow favourably under minimum tending conditions. Furthermore the species represent differing canopy heights in order to establish a well-distributed sub-canopy.

The Shortlist of forest trees:

Species	Common name	M	mm/year	Notes
Acacia karoo	Sweet thorn	20	1000	Pioneer, nitrogen fixer
Podocarpus falcatus	Outeniqua yellowwood	46	600 - 900	Fast easy growing high canopy
Celtis africana	White stinkwood	40	2000	Very fast easy growing high canopy
Virgilia oroboides	Keurboom	12	2000	Pioneer, short lived, Water hungry,
Rhus chirindensis	Red currant	20	1000	Fast, mature wide canopy
Rapanea melanophleoeos	Cape beech	20	600	Pioneer on forest margin
Nuxia floribunda	Forest elder / Vlier	20	800	Prefer roadsides & open places
Buddleja salviifolia	Sagewood	8	700	Stabiliser prevents drying of streams.
Halleria lucida	Tree fuchsia	30	1000	Grown from seed, flower after 2 years

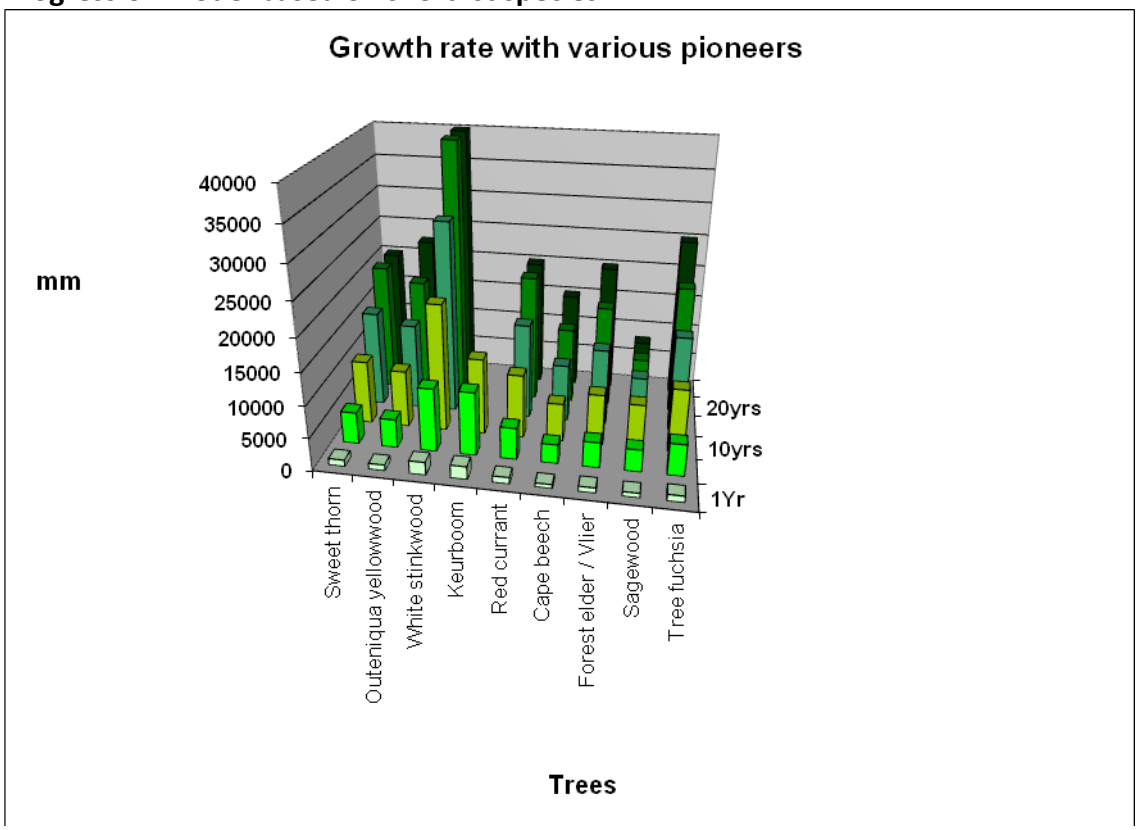
M = height and **mm/year** = growth rate per year

Therefore the following pioneers are suggested for the target area:

a) *Acacia Karoo* – as most likely pioneer to proliferate in bad soils and bare patches (Only as a test quadrant for comparisons with other pioneers)
b) *Vigilia oroboides* – primary existing pioneer
c) *Rapanea melanophleos* – sec. pioneer buffering on new forest margin
d) *Nuxia floribunda* – sec. Pioneer adjacent to roads (masking)

An in-house progression model was developed in-house and was used to model various species in various associations.

Progression model based on shortlist species



4. Undergrowth and small shrubs

The inherent nature of the under storey (currently dominated by ericoid woody shrubs and a proliferation of shoulder high bitou) is such that it hardly justifies a vegetation type. It is rather a mix of herbaceous, succulent and fynbos plants with scattered shrubs or thicket elements. The following list derived from a preliminary (and ongoing) vegetation assessment may clarify:

Type	Species	Common name	Sex		Distribution	Site
Fynbos	Berzelia intermedia	Knoppiesbos		PC	Sparse	Upper
Fynbos	Brunia nodiflora?			PC	Sparse	Upper
Fynbos	Erica canaliculata	Erica / heath	Bi	PC	Dense	All
Fynbos	Leucadendron sp. ?			PC	Dense	All
Fynbos	Leucadendron eucalyptifolium	Sunshine conebush	fem		Dense	Upper
Fynbos	Woody ericoid	passerina obtusifolia?		PC	Very dense	All
Fynbos	Erica densifolia	Sticky erica (Ackh)			Scattered	All
Fynbos	Elytropappus rhinocerotis	Renosterbos			Scattered	Upper
Fynbos	Hyobanche sanguinea	Red broomrape / katnaels			Sparse	Upper
Shrublet/Fynbos	Agathosma sp.	Buchu		PC	Scattered	Upper
Shrublet/Fynbos	Phylica sp.	imberbis?		PC	Dense	Lower
Fynbos-like	Struthiola sp. (macowanii?)	Hirsuta? Tuberculosa?		PC	Scattered	Upper
Herb	Babiana sambucina	Bobejaantjie			Sparse	Lower
Herb	Cyanotis nodiflora	Commelina			Sparse	Lower
Herb	Peucedanum gummiferum	Carrot family			Scattered/loc	Upper
Herb	Herschelianthe hians	Bloumoederkappie orchid			Localized	lower-West

Herb	Commelina africana	Wandering jew			Scattered	All
Herb	Trifolium burchellianum	Wild clover		PC	Scattered	Upper
Herb	Helichrysum teretifolium	Everlasting			Scattered	Lower
Herb	Helichrysum sp.	squamosum?		PC	Dense	
Herb	Lobelia decipiens	Butterfly lobelia			Scattered	Upper
Herb	Lobelia tomentosa	or coronopifolia? Wild lobelia			Scattered	All
Herb	Pelargonium dipetalum	Knolmalva		PC	Sparse	Midd-east
Herb	Pelargonium alchemiloides	Geranium		PC	Scattered	All
Herb	Satyrium	(membranaceum?)			Dense	Lower
Herb	Agapanthus praecox subsp. Minimus	Blue lily			scattered	Lower cliffs
Herb	Anapalina sp.	nervosa / caffra? (Iridacea)		PC	Sparse	Upper
Herb	Tritoniopsis caffra	Outeniqua snakeflower			sparse	Lower
Creeper	Asparagus africanus	Haakdoring / Katdoring			Dense	Upper
Restio	Calopsis gracilis	Restio	fem	PC	Sparse	Upper
Restio	Elegia neesii	Restio	fem	PC	Sparse	All
Shrub	Passerina rigida	Dune string		PC	Dense	Lower
Shrub	Metalasia sp?	Blombos (dull pink)		PC	Dense	All
Shrub	Carissa bispinosa	numnum			Sparse	Lower
Shrub	Osyris compressa	Cape sumach			Sparse	Lower
Shrub	Burchellia bubalina	Wild Pomegranate			Sparse	Upper
Shrub	Chrysanthemoines monolifera	Bitou	Bi		Dense	All
Shrub	Psoralea affinis	Bloukeurboom		PC	Scattered	Upper
Shrub/tree	Tarchonanthus camphoratus	Camphor bush		PC	Scattered	All
Shrub/tree	Pterocelastrus tricuspidatus	Candlewood			Scattered	Upper
Shrub/tree	Apodytes dimidiata	White pear			Scattered	Upper
Succulent	Crassula pyrimidalis	Rygbossie			Scattered	Lower
Succulent	Eriocephalus paniculatus	Wild rosemary			Scattered	Lower
Succulent	Cotyledon orbiculata var. orbiculata	Bergbessie			Scattered	lower
Succulent	Mesemb: Lamphrantus?	Vygie		PC	Scattered	All
Succulent	Crassula rupestris	Bergkraaltjies		PC	Scattered	Lower
Succulent	Bulbine natalensis?			PC	Localized	lower-West

This plant list is not exhaustive and was aimed at establishing whether very sensitive vegetation occurs in the experimental area.
There are also a few localized invaders (*Acacia Cyclops*) although they are in the process of being identified and eradicated.

5. Sara Baartman Private Nature Reserve Reserve ARP

Forest conservation has various facets.

a) The maintenance of components which requires the conservation of the large mammals and birds which disperse seeds and maintain gap processes which allow succession within the forests.
b) Since 2005 a more controlled conservation presence of people and zero hunting practises has seen the emergence again of Chacma Baboon, vervet monkey and bush buck (antelope) which has definitely assisted with seed dispersal and sapling growth of pioneer, sub climax and climax species of trees. Old hunting

practises surely influenced the regression of these forest species through mismanagement of the entire biosphere.

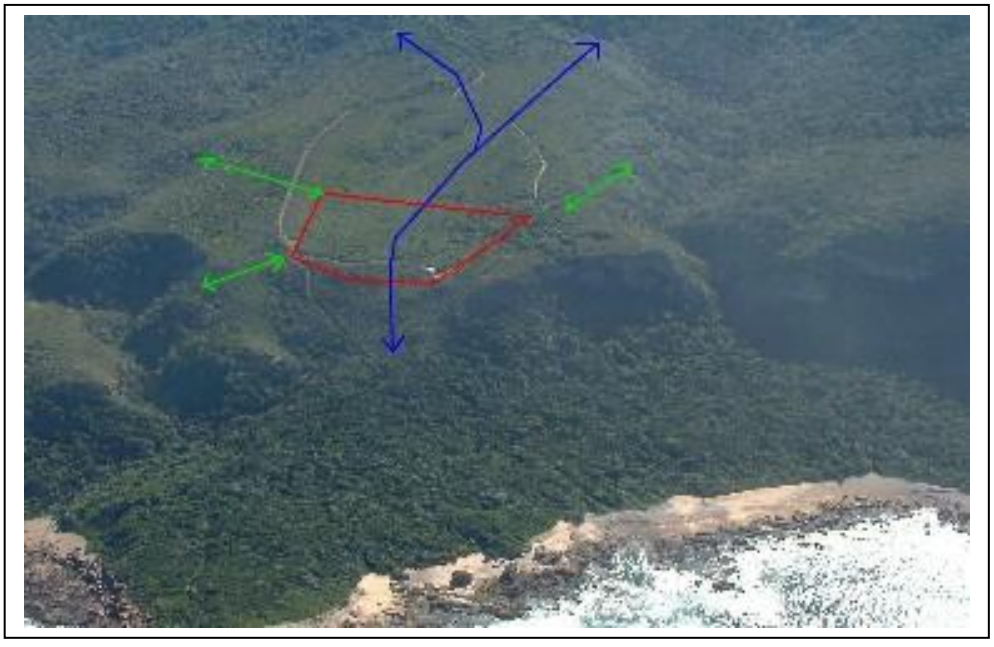
c) Maintenance of fire breaks and foot trails is an ongoing priority as the outbreak of fire will certainly retard forest species and rejuvenate fynbos encroachment.
d) Cleared fynbos thicket has been placed in situ to aid humus and broad leaf species growth.
e) Maintenance of critical processes e.g. the maintenance of gene flow, which requires allowing seed dispensers and pollinators to move along the corridors between forest patches that are not fragmented.
f) Maintenance of forest dynamics like mortality and recruitment rates, growth rates, forest grain and even species level considerations.
g) Since May of 2011, 42 Bee hives have been introduced in the fynbos quadrants to assist as pollinators.

List of associated biodiversity

Species	Common name	Notes on associated Biodiversity
Acacia karoo	Sweet thorn	Club tail charaxes, hairtails, topaz spotted blue, other spotted butterflies, honey bees
Podocarpus falcatus	Outeniqua yellowwood	Bats, bushpigs. Knysna louries, Rameron pigeons.
Celtis africana	White stinkwood	Bushbuck, vervet monkeys, baboons, bulbuls, mousebirds, barbets, parrots, louries, doves, rameron pigeons. African snout, blue spotted charaxes butterflies
Virgilia oroboides	Keurboom	Goat moth (keur moth)
Rhus chirindensis	Red currant	Bushbuck, red duiker, vervet monkeys. Knysna louries, pied barbets, Cape white eyes,
Rapanea melanophloeos	Cape beech	Baboons, vervet monkeys, bushpigs. Crested guineafowl, Rameron pigeons, Knysna louries, barbets.
Nuxia floribunda	Forest elder / Vlier	Bushbuck, klipspringer, red duiker, grey duiker
Buddleja salviifolia	Sagewood	Bushbuck, grey duiker. African leopard butterflies, honey bees and various other insects
Halleria lucida	Tree fuchsia	Bushbuck, grey duiker. Sunbirds, Rameron pigeons, Knysna louries, bulbuls, robins, white eyes. Honeybees

The interrelations, associations and interactions between species are also worthy of consideration (intra-specific activity). For instance, bushbuck may be found associated with baboons or monkeys due to the fruit that they drop from the canopy. Vervet monkeys are also sometimes associated with baboons and they may compete with blue monkeys in the forest edge. In terms of corridors or linkages it is therefore important to observe that both buck and primates will need to be able to traverse the same stretches in the canopy and on the forest floor. In this way they will also be important seed vectors between forest patches assisting in gene flow, especially through areas, which are currently inaccessible to them (except baboons) due to the transformed landscape. They will also bring the balance of species into the project area by seed in droppings. Further, a troop of vervet monkeys foraging on the forest floor may spread out in a broad front (often more than 100 meters wide) and move at a very slow pace (e.g. 20 min / 50m – Estes RD, 1992) processing the forest floor.

Corridors, linkages & migration routes



Key:
Phase 1 re-aforestation
Potential linkages in east-west corridor (Phase x)
North-south corridor (Phase y)

The moist passage (periodic watercourse) to the west of the north-south corridor is ideally suited for rehabilitation in a further phase and to link the higher coastal platform forest with the lower coastal forest/thicket belt. Sagewood (*Buddleja salvifolia*) may also be helpful in that corridor to assist with water flow and stabilise the edges of the watercourse (Venter, F & J, 2002).

6. Process Schedule

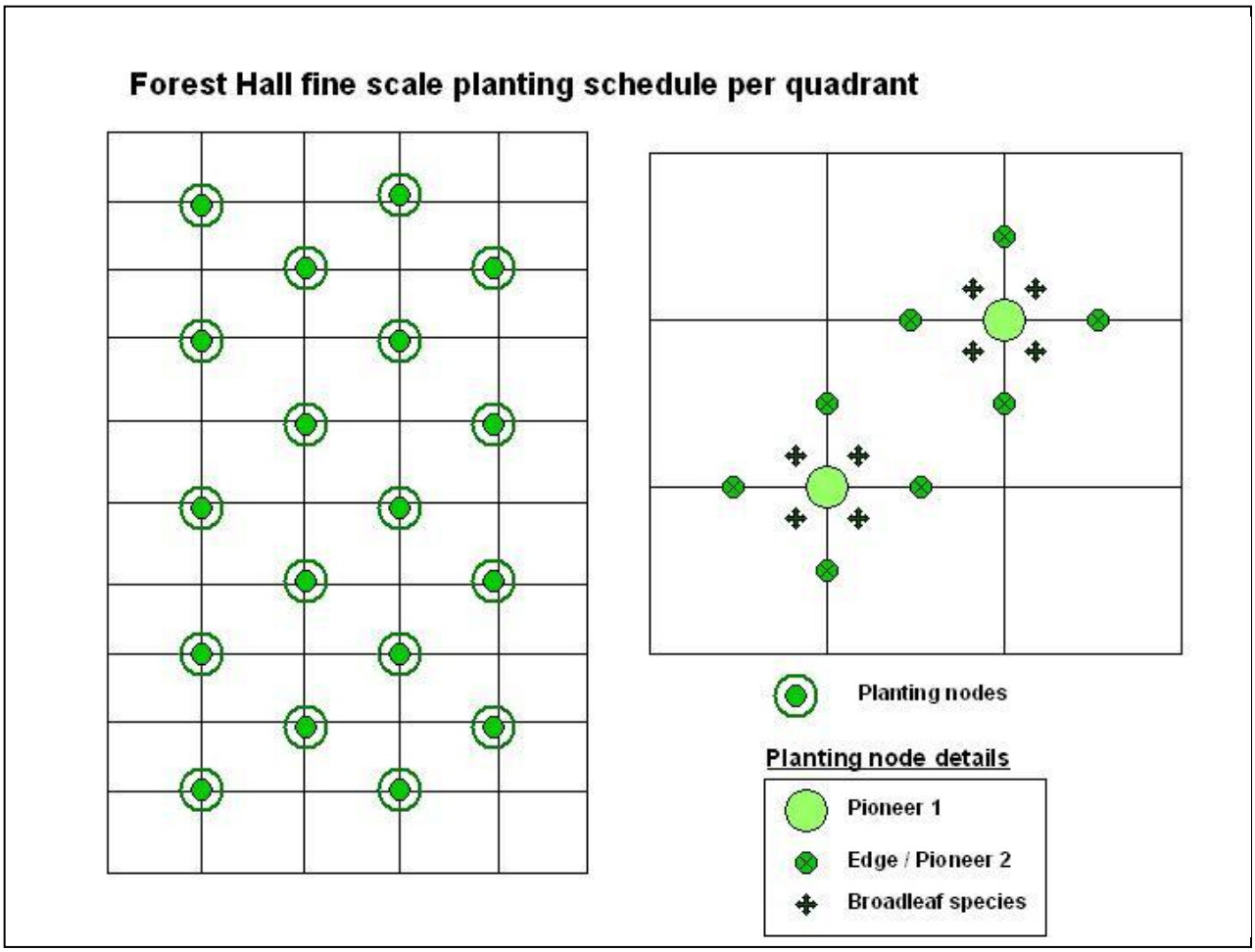
	Activity	Time frame
♪	Establish GIS system and associated software and hardware, latest software introduced 2014	15 Jan 05
♪	Establish GIS project (initial forest restoration project)	15 Jan 05 continued 2008 - 2014
♪	Assess current vegetation and biodiversity processes	yearly
♪	Assess vegetation required for restoration	Started 31 Jan 05
♪	Build 1st progression model (pioneers and first succession)	Initiated 25 Jan 05
♪	Do inventory of current nursery and plants required	Initiated 31 Jan 05 continued through to 2014
♪	Identify lots and plot on GIS	31 Jan 05 – Jan 2010
♪	Plan procurement and propagation of resources (people, plants, tools, etc) expansion of the project Dec 2013	28 Feb 05
♪	Build 2nd progression model (Ecological model)	28 Feb 05 – March 2010
♪	Finalise project plan (incl. Cost and sustainability)	yearly
♪	Procure Forest restoration team and responsibilities / started	Mar 05
♪	Establish forest resource centre (Plants, water, tools, equip, additives, etc.)	Mar 05
♪	Clear remaining alien/invader species	Mar 05 continued through to 2013
♪	Establish planting sites/plots and prepare substrate	Mar 05
♪	Establish initial experimental plots of phase 1	April 05
♪	Monitor and record plant viability and progress	Started 30 April 05 assessed again June 2013
	Establishment of the learning facility in association with the research programme	2013 - 2014
♪	Establish laboratories and source scientific equipment / microscopes and YSI probes for testing soil PH levels and carbon content	March 2014
♪	Establish seed bank for forest nursery	ongoing
♪	Collect, process, clean and store seeds	Continuous
♪	Develop seed inventory	Continuous
♪	Do seed trials under varying conditions (keep records)	July 05 onwards
♪	Propagate 1st batch before growth season (waning moon) experimental	July 05
	Propagate 2nd batch during growth season (waxing moon)	Aug 05
	Collect and propagate seeds with regular intervals	Ongoing
♪	Keep inventory of propagation schedules	July onwards
	Establish plots on phase 2	June 05 / **Aug 05**

	Stabilise Phase 1 and 2 growth platforms before growth season (Aug) / During growth season	July 05 / **Sept 05**
	Monitor and adjust new growth patterns and bio-diversity	July 2013 onwards

7. Process detail plot 1 – Phase A

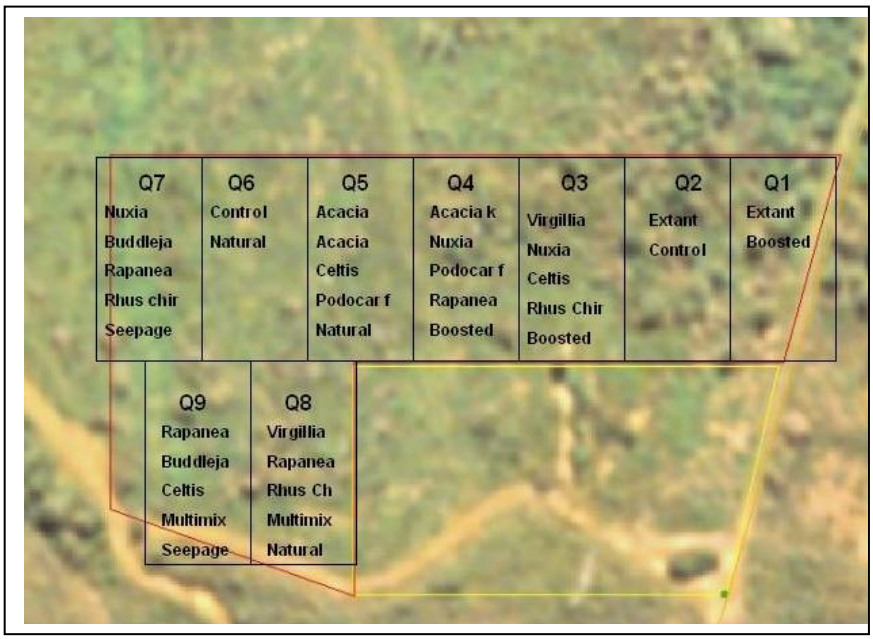
Quadrants have been established for plot 1 - Phase A (Q1 to Q9). Each quadrant is approximately 25m x 25m. Each quadrant contains up to 20 nodes or planting sites arranged in a way that maximises distribution and reduces see-through visibility. The grid is angular but the nodes can be shifted randomly as long as an average of 3 to 4 meters separate adjacent nodes. For the particular study quadrants in phase one will be 25 x 25 meters and will contain up to 20 nodes per quadrant. Basically the one half of the quadrant will be planted and the other half (25 x 25m) will act as a control.

Example of a typical quadrant illustrating nodes and planting details



Depending on extant pioneers and the aspect of the sun in the northern sky, plants will also be arranged to maximise growth and protection for saplings.

Distribution of pioneers, broad leaf species and control areas per quadrant (Q1 to Q9)
Below is actually just an example; the actual plantings were modelled with a comparative tool developed by Albert Ackhurst.



Approximate Cost of total trees needed for Plot 1 - Phase A
Planting Schedule as of 2005 / 2007

Species		Total Nr	Stock	Source	Kg	Cost	Est cost
Acacia karoo	Soetdoring	20	0		4	10.05	R 201
Acacia karoo	Soetdoring	10	0		20	38.5	R 385
Apodytes dimidiata	White pear	10	10		?	0	R 0
Buddleja salviifolia	Sagewood	20	20		?	0	R 0
Celtis africana	White stinkwood	85	0		4	12.55	R 1,067
Cunonia capensis	Red alder?	10	10		?	0	R 0
Curtisia dentata	Assegaai	10	10		?	0	R 0
Halleria Lucida	Tree fuchia	26	20		10	22.6	R 588
Nuxia floribunda	Forest alder	90	40		10	25.3	R 2,277
Olea capensis	Black ironwood	10	10		?	0	R 0
Olinia ventosa	Hard pear	5	5		?	0	R 0
Podocarpus falcatus	Outeniqua Y-wood	80	0		4	12.55	R 1,004
Podocarpus latifolius	Common Yellowwood	880	880			0	R 0
Pterocelastrus tricuspidatus	Candlewood	10	10		?	0	R 0
Rapanea melanoploeos	Cape beech	110	10		10	22.6	R 2,486
Rhus chirindensis	Red currant	30	0		20	47.15	R 1,415
Rhus chirindensis	Red currant	38	0		4	12.55	R 477
Virgillia oroboides	Keurboom	30	30		?	0	R 0
Totals		**1474**	**1055**	**0**			
							R 9,899

Plot 1 - Phase A actual planting and plotting

Phase A were planted in 25m x 25m quadrants from Quadrant 1 through to Quadrant 9, each with a unique combination of different tree species at different tree heights. Most quadrants were planted with 20 nodes within the 625m^2 Area (more or less evenly distributed bar big bushes or impenetrable scrub where necessary). Quadrants 1 and 2 were planted with individual trees to establish primary succession. Quadrant 3 has 11 nodes with 5 to 9 trees per node. From Quadrant 4 to Quadrant 9 a node consisted out of 5 trees. Furthermore, each individual tree from Quadrant 3 to 9 in this phase virtually has a specific address as per co-ordinates indicated.

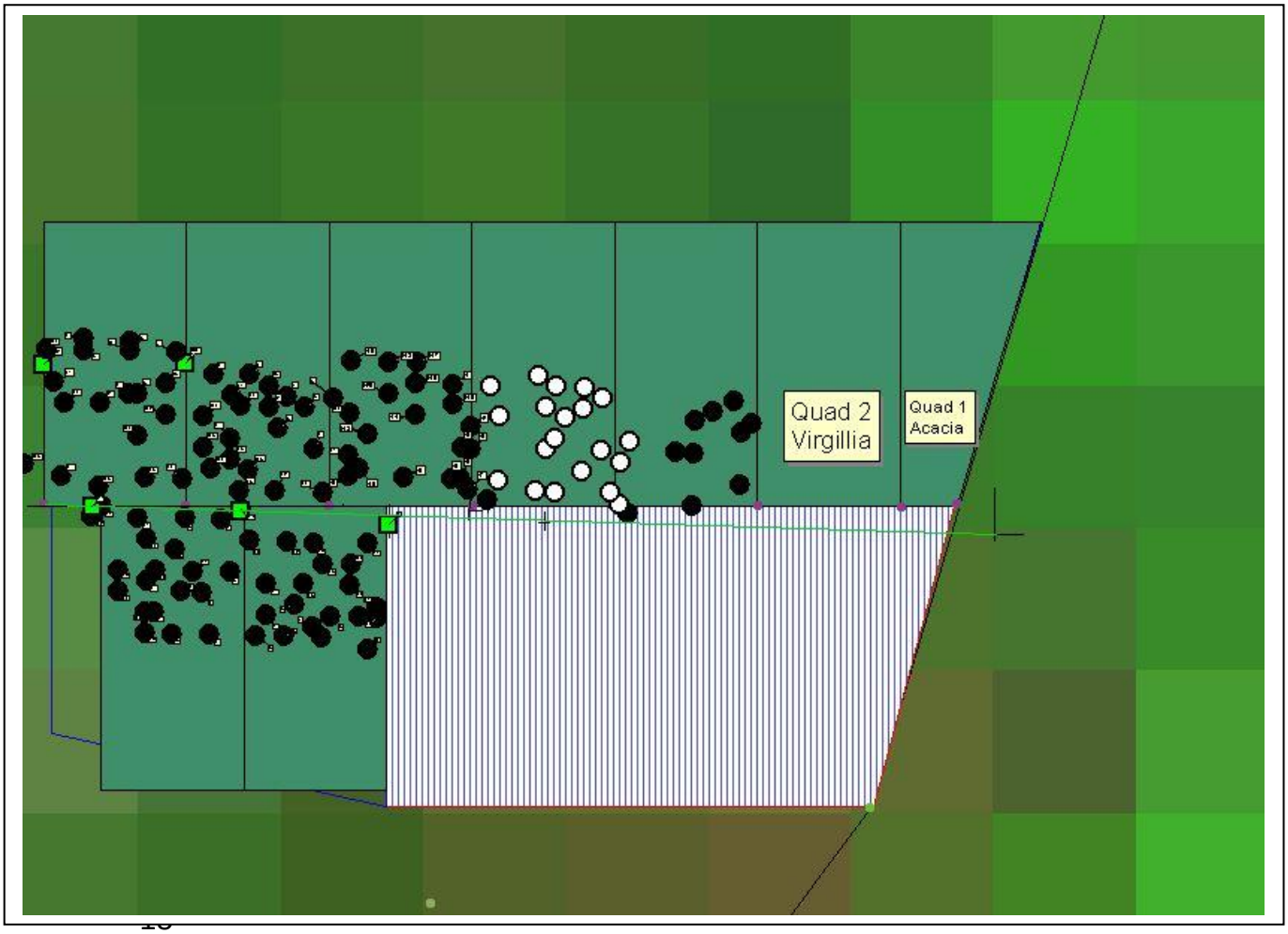
The first two quadrants were planted with primary pioneers to establish comparison of succession on soils denuded of nutrients

Quadrant 1

SPECIES	Nr planted	Av hgt cm
Acacia karoo	7	90
Acacia karoo	21	30
A	0	0
A	0	0
A	0	0
A	0	0
A	0	0
A	0	0

Quadrant 2

SPECIES	Nr planted	Av hgt cm
Virgilia oroboides	9	90
Virgilia oroboides	15	30
A	0	0
A	0	0
A	0	0
A	0	0
A	0	0
A	0	0

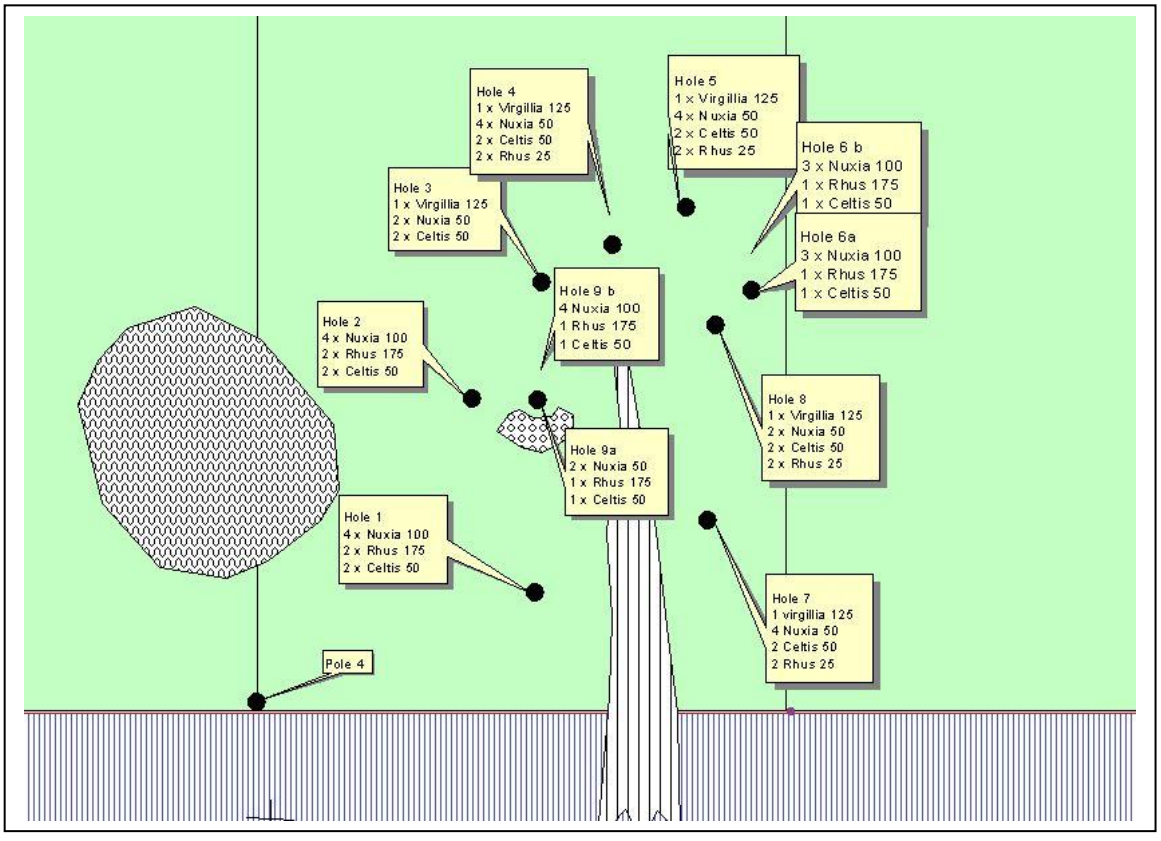


Quadrant 3

The issue here is to test Virgillia (5) with Nuxia (20) as pioneers and Nuxia on its own (16) as companion to larger broadleafed species

SPECIES	Nr planted	Av hgt cm	Position
Virgilia oroboides	5	125	Holes 3,4,5,7,8
Nuxia floribunda	20	50	Holes 3,4,5,7,8
Rhus chirindensis	10	25	Holes 4,5,7,8,
Celtis africana	10	50	Holes 3,4,5,7,8
A	0	0	Write notes here
Nuxia floribunda	16	100	Holes 1,2,6a,6b,9a,9b
Rhus chirindensis	8	175	Holes 1,2,6a,6b,9a,9b
Celtis africana	8	50	Holes 1,2,6a,6b,9a,9b

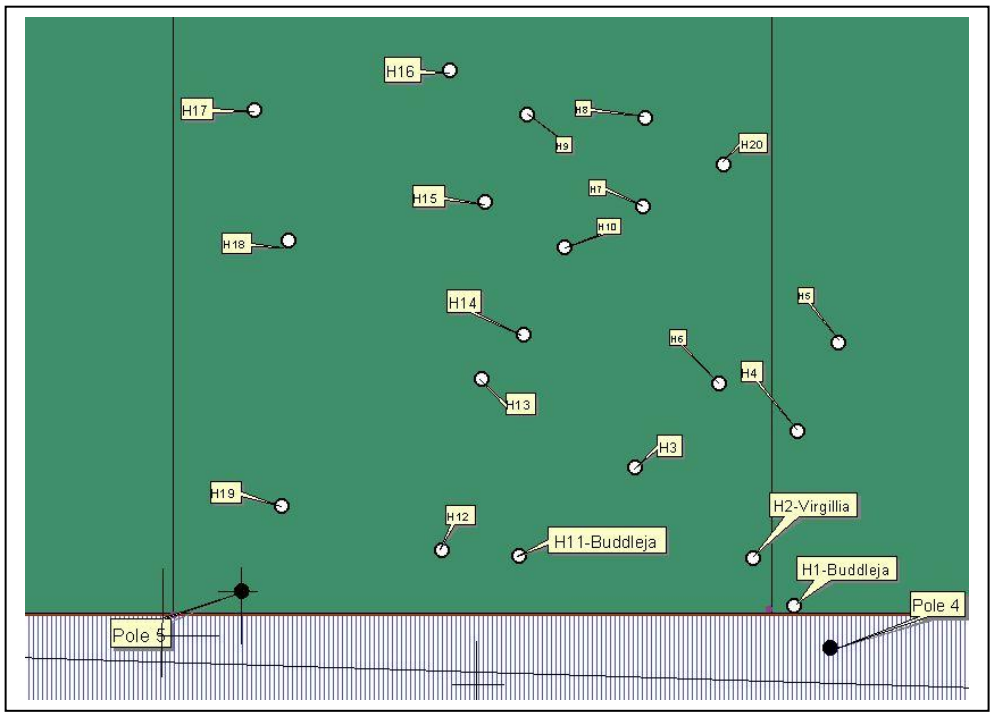
H1	E	23	29	519
H1	S	33	59	940
H2	E	23	29	517
H2	S	33	59	935
H3	E	23	29	519
H3	S	33	59	932
H4	E	23	29	521
H4	S	33	59	931
H5	E	23	29	523
H5	S	33	59	930
H6	E	23	29	525
H6	S	33	59	932
H7	E	23	29	524
H7	S	33	59	938
H8	E	23	29	524
H8	S	33	59	933
H9	E	23	29	519
H9	S	33	59	935
091P4	E	23	29	511
091P4	S	33	59	943



Quadrant 4

The issue here is to test Virgillia (9) and Buddleja (9) with Rapanea (18) as joint pioneers

SPECIES	Nr planted	Av hgt cm	Position
Virgilia oroboides	10	125	In Holes 2,4,6,8,10,12,14,16,18,20
Rapanea melanophleoeos	20	125	In Holes 1 - 20
Podocarpus falcatus	20	50	In Holes 1 - 20
Celtis africana	20	50	In Holes 1 -20
Buddleja salviifolia	10	125	In Holes 1,3,5,7,9,11,13,15,17,19
Rhus chirindensis	20	25	In Holes 1 - 20
A	0	0	Write notes here
A	0	0	Write notes here



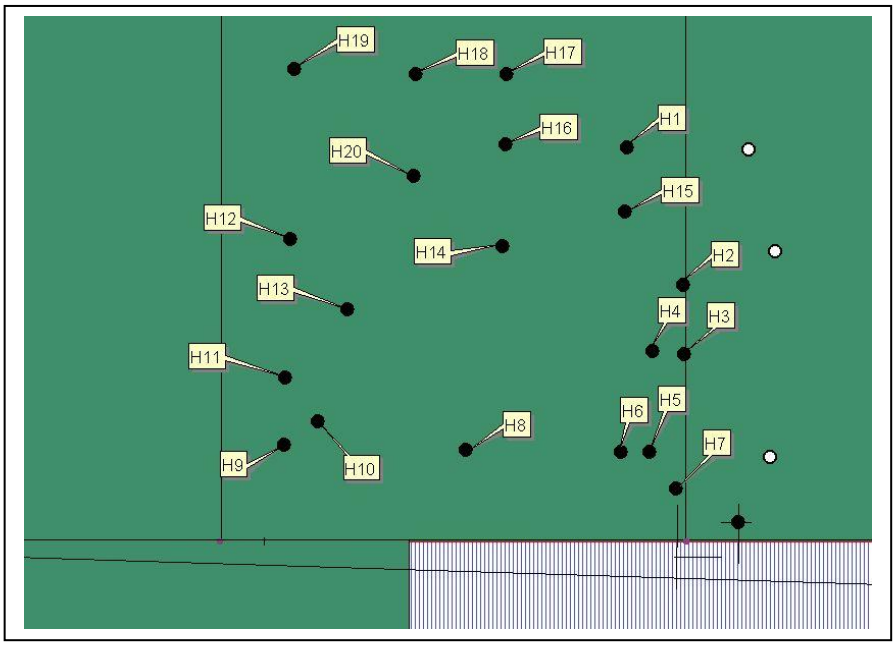
GPS Placements

092H1	E	23	29	511
	S	33	59	940
092H2	E	23	29	510
	S	33	59	939
092H3	E	23	29	507
	S	33	59	937
092H4	E	23	29	511
	S	33	59	936
092H5	E	23	29	512
	S	33	59	934
092H6	E	23	29	509
	S	33	59	935
092H7	E	23	29	507
	S	33	59	931
092H8	E	23	29	507
	S	33	59	929
092H9	E	23	29	504
	S	33	59	929
092H10	E	23	29	505
	S	33	59	932
092H11	E	23	29	504
	S	33	59	939
092H12	E	23	29	502
	S	33	59	939
092H13	E	23	29	503
	S	33	59	935
092H14	E	23	29	504
	S	33	59	934
092H15	E	23	29	503
	S	33	59	931
092H16	E	23	29	502
	S	33	59	928
092H17	E	23	29	497
	S	33	59	929
092H18	E	23	29	498
	S	33	59	932
092H19	E	23	29	498
	S	33	59	938
092H20	E	23	29	509
	S	33	59	930

Quadrant 5

The issue is to test and compare this quadrant with no imported pioneers but with extant bitou, Campher, Osyris and Diospyros dichrophylla

SPECIES	Nr planted	Av hgt cm
Rhus chirindensis	20	125
Celtis africana	20	50
Podocarpus falcatus	20	50
Podocarpus latifolius	40	125
A	0	0
A	0	0
A	0	0
A	0	0



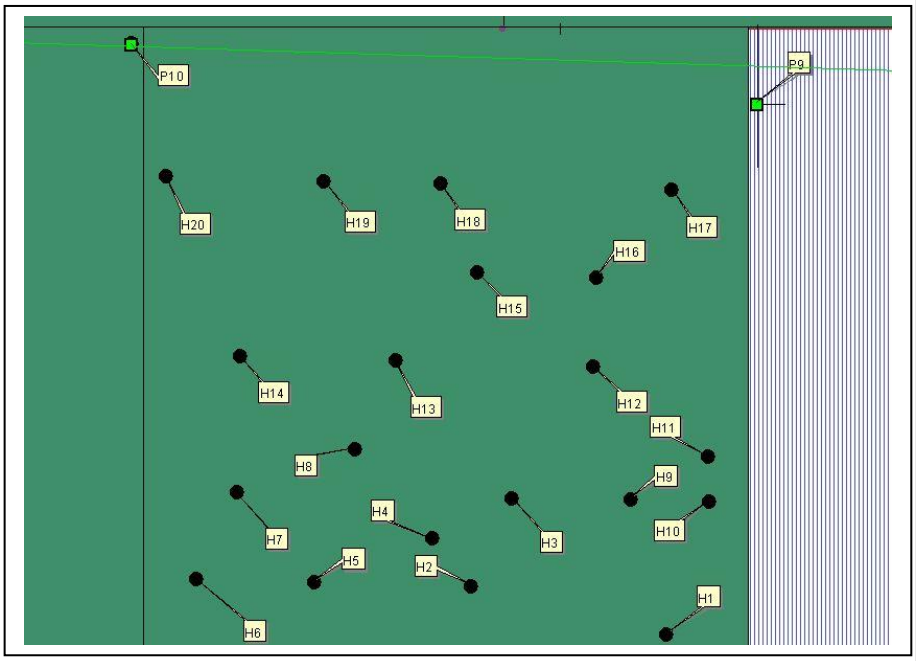
GPS Placements

093H1	E	23	29	493
	S	33	59	929
093H2	E	23	29	495
	S	33	59	933
093H3	E	23	29	495
	S	33	59	935
093H4	E	23	29	494
	S	33	59	935
093H5	E	23	29	494
	S	33	59	938
093H6	E	23	29	493
	S	33	59	938
093H7	E	23	29	495
	S	33	59	939
093H8	E	23	29	488
	S	33	59	938
093H9	E	23	29	482
	S	33	59	938
093H10	E	23	29	483
	S	33	59	937
093H11	E	23	29	482
	S	33	59	936
093H12	E	23	29	482
	S	33	59	932
093H13	E	23	29	484
	S	33	59	934
093H14	E	23	29	489
	S	33	59	932
093H15	E	23	29	493
	S	33	59	931
093H16	E	23	29	489
	S	33	59	929
093H17	E	23	29	489
	S	33	59	927
093H18	E	23	29	486
	S	33	59	927
093H19	E	23	29	482
	S	33	59	927
093H20	E	23	29	486
	S	33	59	930

Quadrant 6

The issue is to test Rapanea (2) and Nuxia (1) as joint pioneers with primary trees - both of which aparently grows slower than the primaries except real yellowwood

SPECIES	Nr planted	Av hgt cm
Rapanea melanophleoeos	20	125
Celtis africana	20	50
Podocarpus falcatus	20	50
Nuxia floribunda	20	100
Podocarpus latifolius	20	50
A	0	0
A	0	0
A	0	0

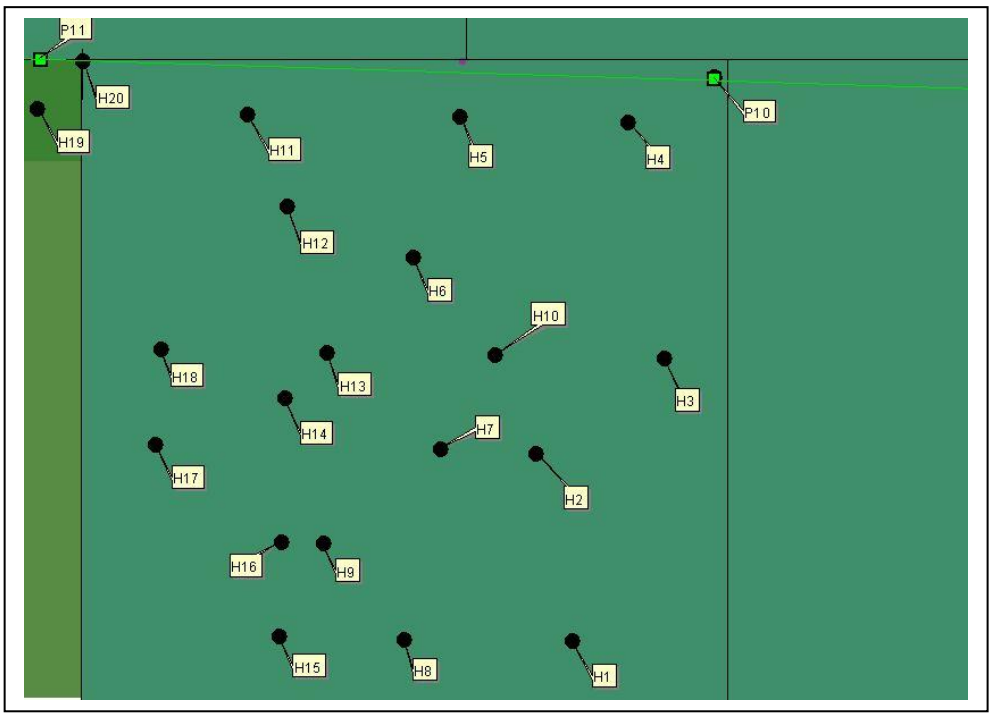


097H1	E	23	29	488
	S	33	59	952
097H2	E	23	29	483
	S	33	59	951
097H3	E	23	29	484
	S	33	59	949
097H4	E	23	29	482
	S	33	59	950
097H5	E	23	29	479
	S	33	59	951
097H6	E	23	29	476
	S	33	59	951
097H7	E	23	29	477
	S	33	59	949
097H8	E	23	29	480
	S	33	59	948
097H9	E	23	29	487
	S	33	59	949
097H10	E	23	29	489
	S	33	59	949
097H11	E	23	29	489
	S	33	59	948
097H12	E	23	29	486
	S	33	59	946
097H13	E	23	29	481
	S	33	59	946
097H14	E	23	29	477
	S	33	59	946
097H15	E	23	29	483
	S	33	59	944
097H16	E	23	29	486
	S	33	59	944
097H17	E	23	29	488
	S	33	59	942
097H18	E	23	29	482
	S	33	59	942
097H19	E	23	29	479
	S	33	59	942
097H20	E	23	29	475
	S	33	59	942

Quadrant 7

The issue is - Half plant sites exposed without much companion plants

SPECIES	Nr planted	Av hgt cm	Position
Podocarpus latifolius	20	40	H1 to H10
Podocarpus falcatus	25	35	H1 to H20
Rhus chirindensis	10	30	H1 to H10
Halleria lucida	10	30	H1 to H10
Buddleja salviifolia	10	75	H11 to H20
Pterocelastrus tricuspidatus	5	10	H11 to H14 & H20
Podocarpus latifolius	20	65	H15 to H19
A	0	0	Write notes here

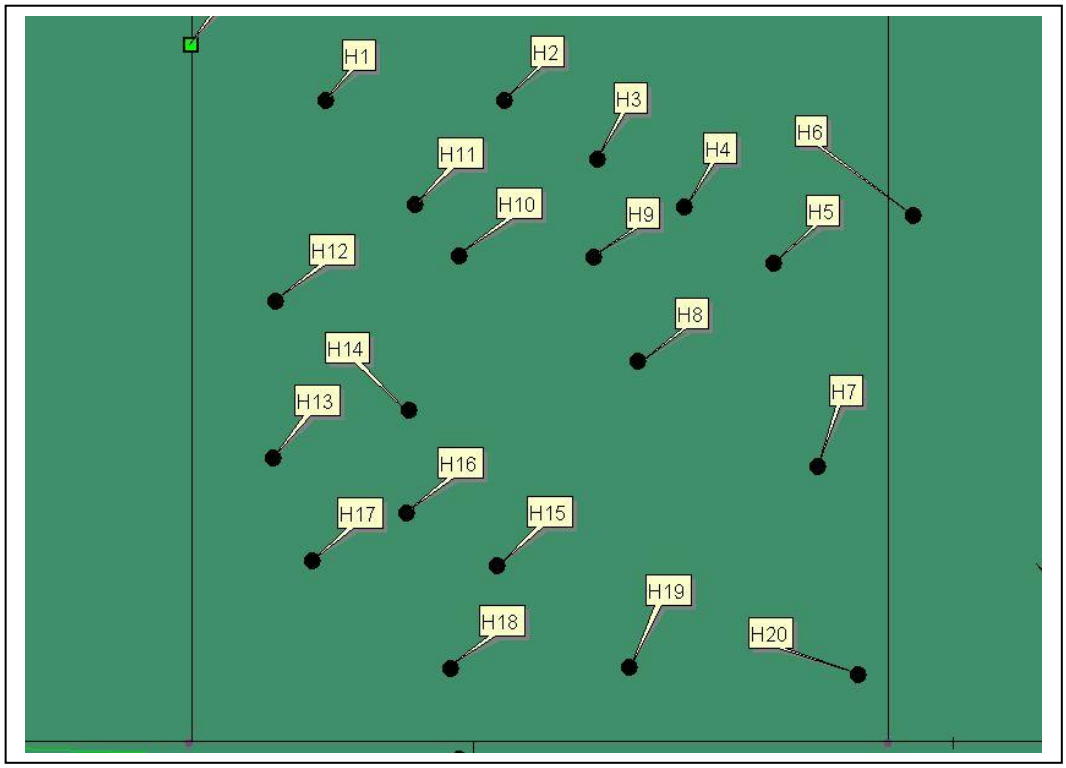


098H1	E	23	29	471
	S	33	59	951
098H2	E	23	29	470
	S	33	59	947
098H3	E	23	29	473
	S	33	59	945
098H4	E	23	29	472
	S	33	59	940
098H5	E	23	29	468
	S	33	59	940
098H6	E	23	29	467
	S	33	59	943
098H7	E	23	29	468
	S	33	59	947
098H8	E	23	29	467
	S	33	59	951
098H9	E	23	29	465
	S	33	59	949
098H10	E	23	29	469
	S	33	59	945
098H11	E	23	29	463
	S	33	59	940
098H12	E	23	29	464
	S	33	59	942
098H13	E	23	29	465
	S	33	59	945
098H14	E	23	29	464
	S	33	59	946
098H15	E	23	29	464
	S	33	59	951
098H16	E	23	29	464
	S	33	59	949
098H17	E	23	29	461
	S	33	59	947
098H18	E	23	29	461
	S	33	59	945
098H19	E	23	29	458
	S	33	59	940
098H20	E	23	29	459
	S	33	59	939
H11b	E	23	29	458
H11b	S	33	59	939

Quadrant 8

The issue is to compare Olea capensis and Curtisia as companions to Podocarpus latifolius

SPECIES	Nr planted	Av hgt cm	Position
Podocarpus latifolius	40	45	2 Per hole
Nuxia floribunda	20	55	1 Per hole
Rapanea melanophleoeos	20	85	1 Per hole
Curtisia dentata	10	80	Into holes 2,3,6,8,9,12,14,15,17,20
Olea capensis subsp. Macrocarpa	10	70	Into holes 1,4,5,7,10,11,13,16,18,19
A	0	0	Write notes here
A	0	0	Write notes here
A	0	0	Write notes here

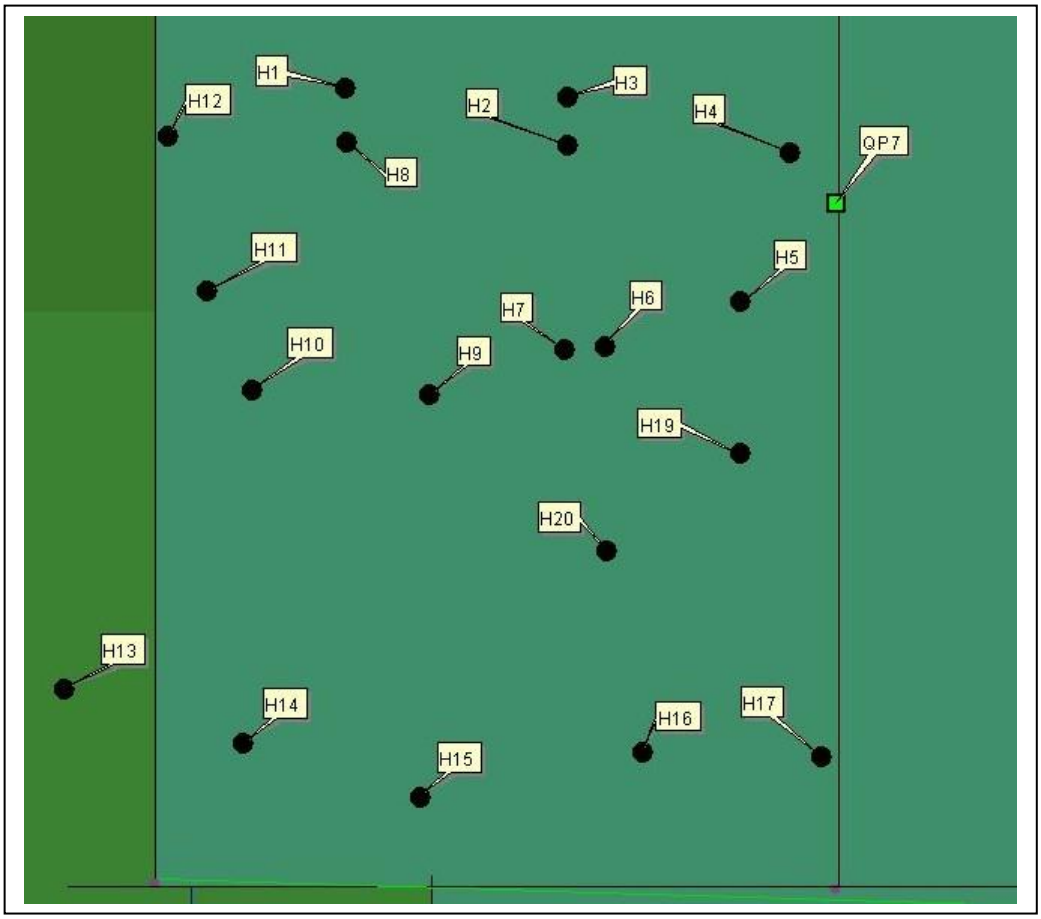


23	29	468	109H1
33	59	927	0
23	29	472	109H2
33	59	927	0
23	29	474	109H3
33	59	928	0
23	29	476	109H4
33	59	929	0
23	29	478	109H5
33	59	930	0
23	29	481	109H6
33	59	929	0
23	29	479	109H7
33	59	934	0
23	29	475	109H8
33	59	932	0
23	29	474	109H9
33	59	930	0
23	29	471	109H10
33	59	930	0
23	29	470	109H11
33	59	929	0
23	29	467	109H12
33	59	931	0
23	29	467	109H13
33	59	934	0
23	29	470	109H14
33	59	933	0
23	29	472	109H15
33	59	936	0
23	29	470	109H16
33	59	935	0
23	29	468	109H17
33	59	936	0
23	29	471	109H18
33	59	938	0
23	29	475	109H19
33	59	938	0

Quadrant 9

The issue is to test growth from small size with a number of primary species

SPECIES	Nr planted	Av hgt cm	Position
Podocarpus latifolius	40	50	2 Per hole
Rapanea melanophleoeos	20	25	1 Per hole
Podocarpus falcatus	10	55	Holes 1,2,11,12,13,15,17,18,19,20
Cunonia capensis	10	10	Holes 3,4,5,6,7,8,9,10,14,16
Celtis africana	6	55	Holes 2,3,5,10,12,16,
Olinia ventosa	5	15	Holes 6,7,11,17,?
Pterocelastrus tricuspidatus	5	20	Holes 1,4,9,13,14
Halleria lucida	4	40	Holes 8,15,19,20



110H1	E	23	29	454
	S	33	59	924
110H2	E	23	29	459
	S	33	59	925
110H3	E	23	29	459
	S	33	59	924
110H4	E	23	29	464
	S	33	59	925
110H5	E	23	29	463
	S	33	59	928
110H6	E	23	29	460
	S	33	59	929
110H7	E	23	29	459
	S	33	59	929
110H8	E	23	29	454
	S	33	59	925
110H9	E	23	29	456
	S	33	59	930
110H10	E	23	29	452
	S	33	59	930
110H11	E	23	29	451
	S	33	59	928
110H12	E	23	29	450
	S	33	59	925
110H13	E	23	29	448
	S	33	59	936
110H14	E	23	29	452
	S	33	59	937
110H15	E	23	29	456
	S	33	59	938
110H16	E	23	29	461
	S	33	59	937
110H17	E	23	29	465
	S	33	59	937
110H18	E	23	29	465
	S	33	59	932
110H19	E	23	29	463
	S	33	59	931
110H20	E	23	29	460
	S	33	59	933

Plot 1 - Phase B actual planting and plotting

Phase B will be approached differently than Phase A
Reasons:

a) Slope
b) Exposure
c) Ridge erosion – no substrate
d) Not comparisons
e) Etc….

Approx cost of trees as of 2005 - 2007

DESCRIPTION	SIZE	QTY	PRICE	DISC	UNIT TOT
Apodytes dimidiata - White Pear	10kg	sold out, sorry	R 27.90	5.00%	R 27.90
Buddleja saligna - False Olive	4kg	50	R 9.00	5.00%	R 477.50
Cassine peragua - Bastard	4kg	50	R 15.50	5.00%	R 786.50
Celtis africana - White Stinkwood	4kg	50	R 13.85	5.00%	R 708.00
Gymnosporia buxifolia = Maytenus	4kg	100	R 11.10	5.00%	R 1,155.00
Nuxia floribunda - Forest Elder	4kg	100	R 13.85	5.00%	R 1,416.00
Olea capensis ssp macrocarpa -	20kg	5	R 59.40	5.00%	R 304.40
Podocarpus falcatus - Outeniqua	4kg	50	R 13.85	5.00%	R 755.50
Rapanea melanophloeos -	10kg	50	R 24.90	5.00%	R 1,288.00
Rhamnus prinoides - Blinkbaar	10kg	sold out, sorry	R 24.90	5.00%	R 24.90
					R 6,890.90
					R 964.73
					R 7,855.63

Conservation economy potential

This economy is driven through conservation legislation, alien biomass utilisation, sustainable development parameters, grant funding and tourism. This body of knowledge have been researched and developed on **the Sara Baartman Private Nature Reserve** over the past 10 years.

Details of the process below:

Holistic Conservation Economy

A business based on the reclamation of historically destroyed critical biodiversity

Success is measured in ha's re-instated

The process is supported by local community capital and development potential (permanent professional jobs and livelihoods), and by utilising the gap-year (volunteer tourism) Phenomena that has already been trialled and tested at Forest Hall

This will lead to the development of local skills and capacity for the creation of an international learning centre