Biology and Ecology of the Tsau//Khaeb National Park and Richtersveld: Evolution and ecological processes of the Southern Namib Desert and the Succulent Karoo.

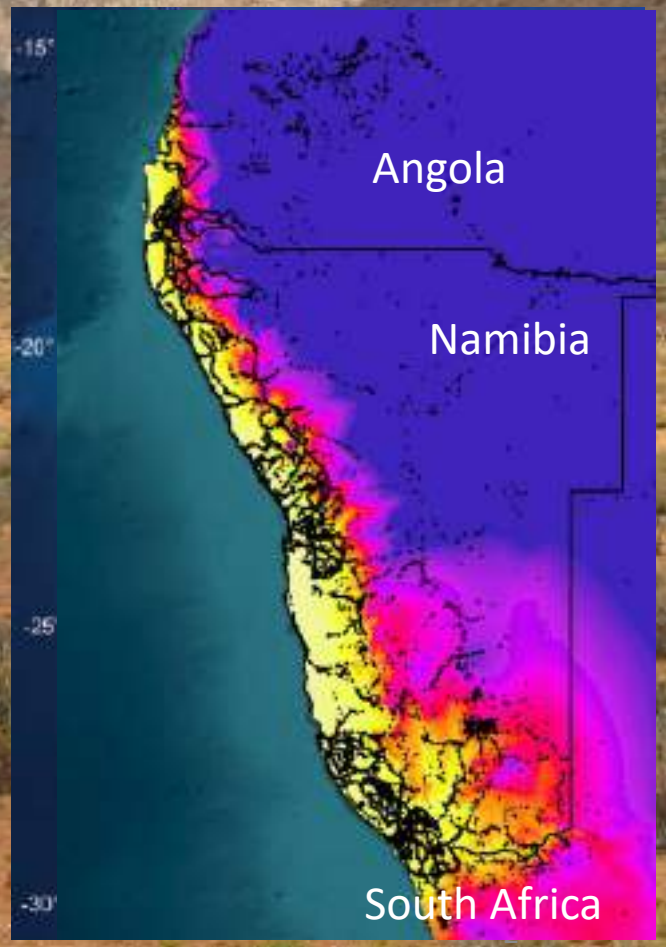
Norbert Jürgens, Prof Emeritus University of Hamburg, …

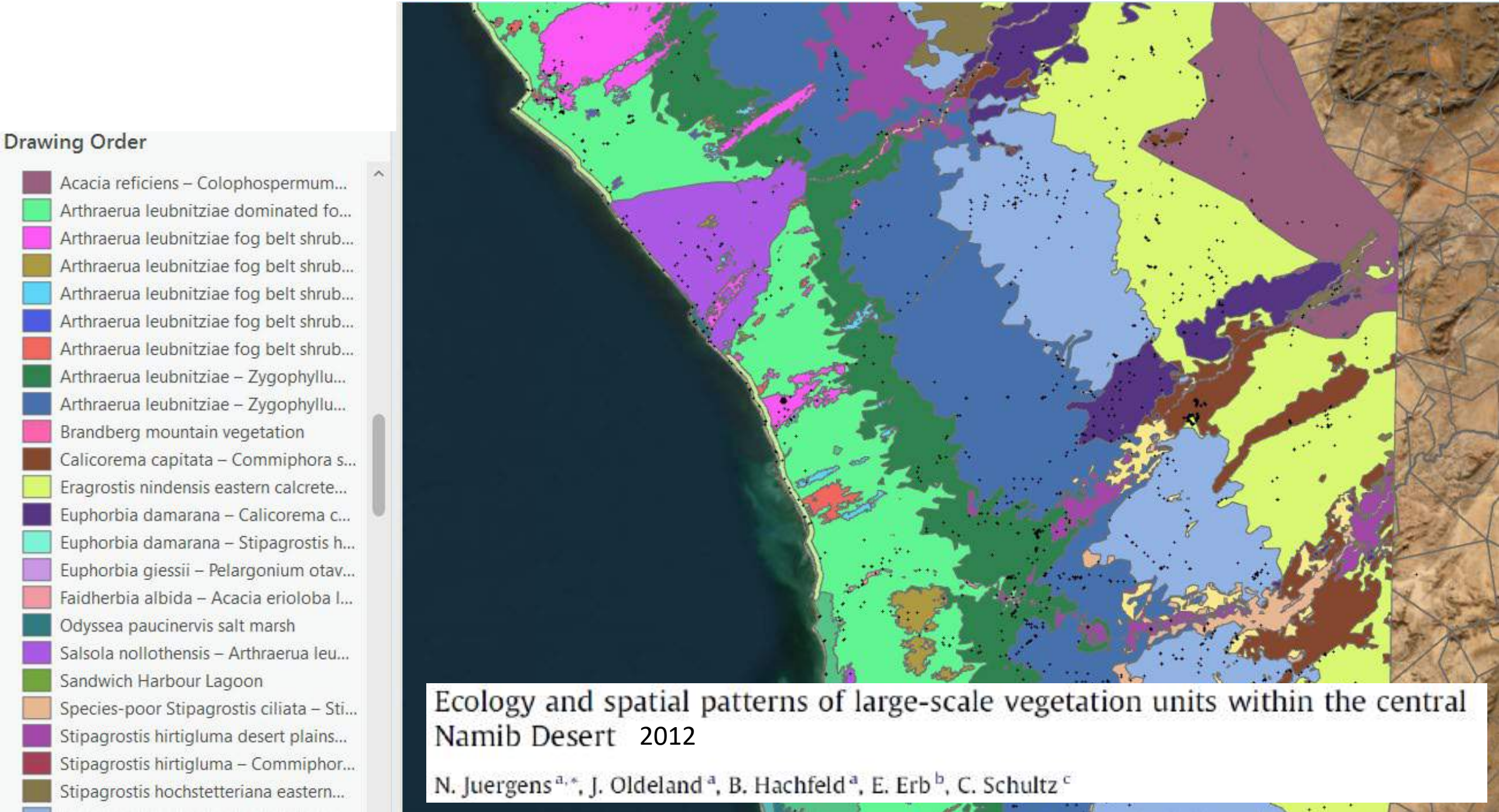
Windhoek, 17.09.2026

Background of the presenter:
Prof emeritus Universität Hamburg: Evolution and biodiversity of plants

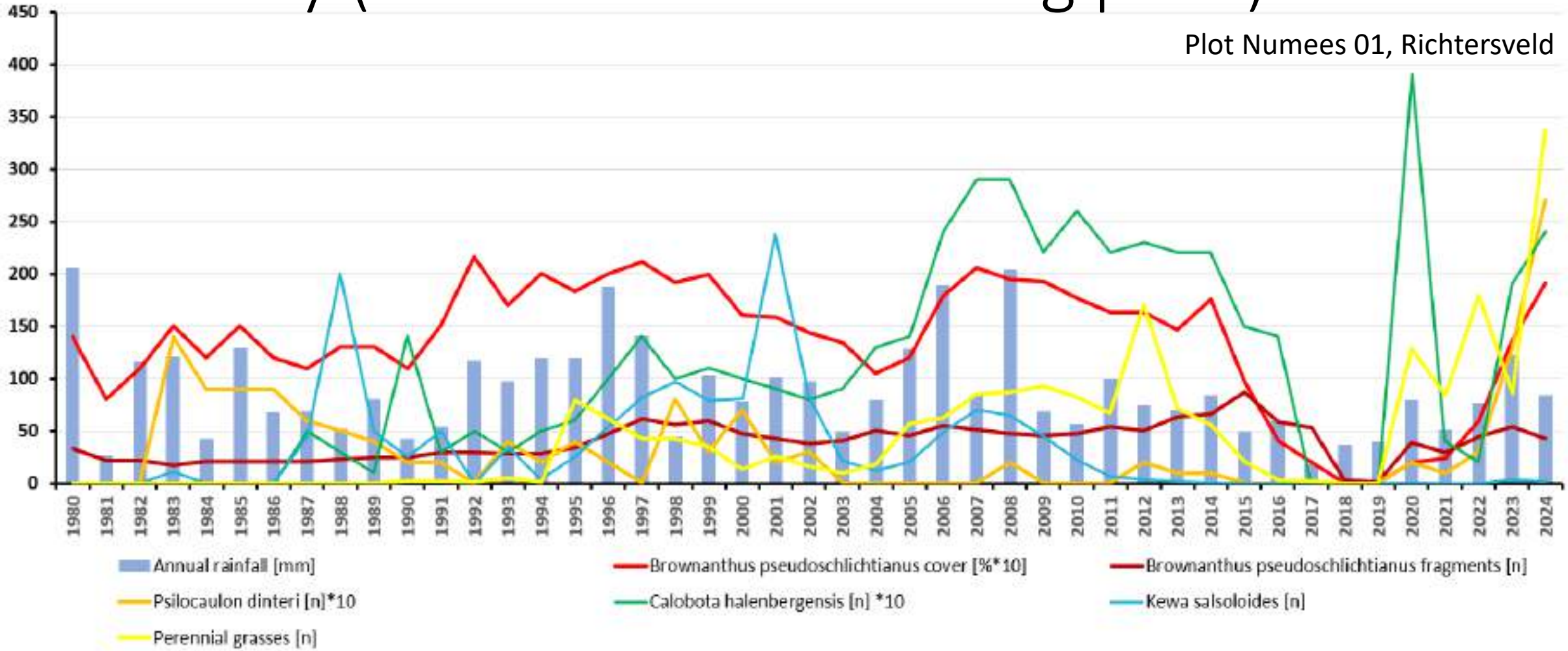
Since February 1980 research focus on
Ecology and vegetation of the entire Namib Desert
in Angola, Namibia und South Africa.

_Mapping
_Monitoring




Drawing Order
Acacia reficiens – Colophospermum...
Arthraerua leubnitziae dominated fo...
Arthraerua leubnitziae fog belt shrub...
Arthraerua leubnitziae fog belt shrub...
Arthraerua leubnitziae fog belt shrub...
Arthraerua leubnitziae fog belt shrub...
Arthraerua leubnitziae fog belt shrub...
Arthraerua leubnitziae – Zygophyllu...
Arthraerua leubnitziae – Zygophyllu...
Brandberg mountain vegetation
Calicorema capitata – Commiphora s...
Eragrostis nindensis eastern calcrete...
Euphorbia damarana – Calicorema c...
Euphorbia damarana – Stipagrostis h...
Euphorbia giessii – Pelargonium otav...
Faidherbia albida – Acacia erioloba l...
Odyssea paucinervis salt marsh
Salsola nollothensis – Arthraerua leu...
Sandwich Harbour Lagoon
Species-poor Stipagrostis ciliata – Sti...
Stipagrostis hirtigluma desert plains...
Stipagrostis hirtigluma – Commiphor...
Stipagrostis hochstetteriana eastern...
Ecology and spatial patterns of large-scale vegetation units within the central Namib Desert 2012
N. Juergens [a,*], J. Oldeland [a], B. Hachfeld [a], E. Erb [b], C. Schultz [c]

Monitoring: 47 years. Resilience, drought and recovery (one of > 50 monitoring plots)



Blue columns = rain in mm/year

red line = cover of scorpionstail dwarf shrubs in % surface area

Coordinator of large cooperative research projects: Acacia (DFG), Biota Africa, The Future Okavango, SASSCAL (BMBF). For example:

BIOTA Africa

Capacity Building in Biodiversity Research Projects in Cooperation with various African countries - Funded by the German BMBF in 2000 – 2009

	In Germany	In African Countries
Post Docs	52	16
PhDs	117	97
Masters	146	159
Paraecologists	5	100

Initial statement

- Political decisions regarding new developments in Namibia are taken by Namibian politicians and stakeholders.
- As a scientist I see my role in providing robust data which will help to (a) avoid unnecessary damage relevant for society and environment and (b) to compensate for unavoidable damages to sustain conservation in a biodiversity hotspot region.
- At present, numerous projects related to the mining of mineral resources and the production of regenerative energy are planned or established in the Tsau//Khaeb NP and in the Richtersveld. This presentation may serve as an eye-opener and may help to consider important environmental risks in all future planning.
- The presentation shall mainly improve the awareness of the globally outstanding values of the biodiversity which you posses in your Southern Namib landscapes, being both, a resource and a responsibility. It shows several observations, new to science.

Content

1 Introduction to the Namib Desert, the Southern Namib, the Succulent Karoo and the Gariep Centre(s) of endemism, using the environmental history and biogeographical patterns as guiding principles.

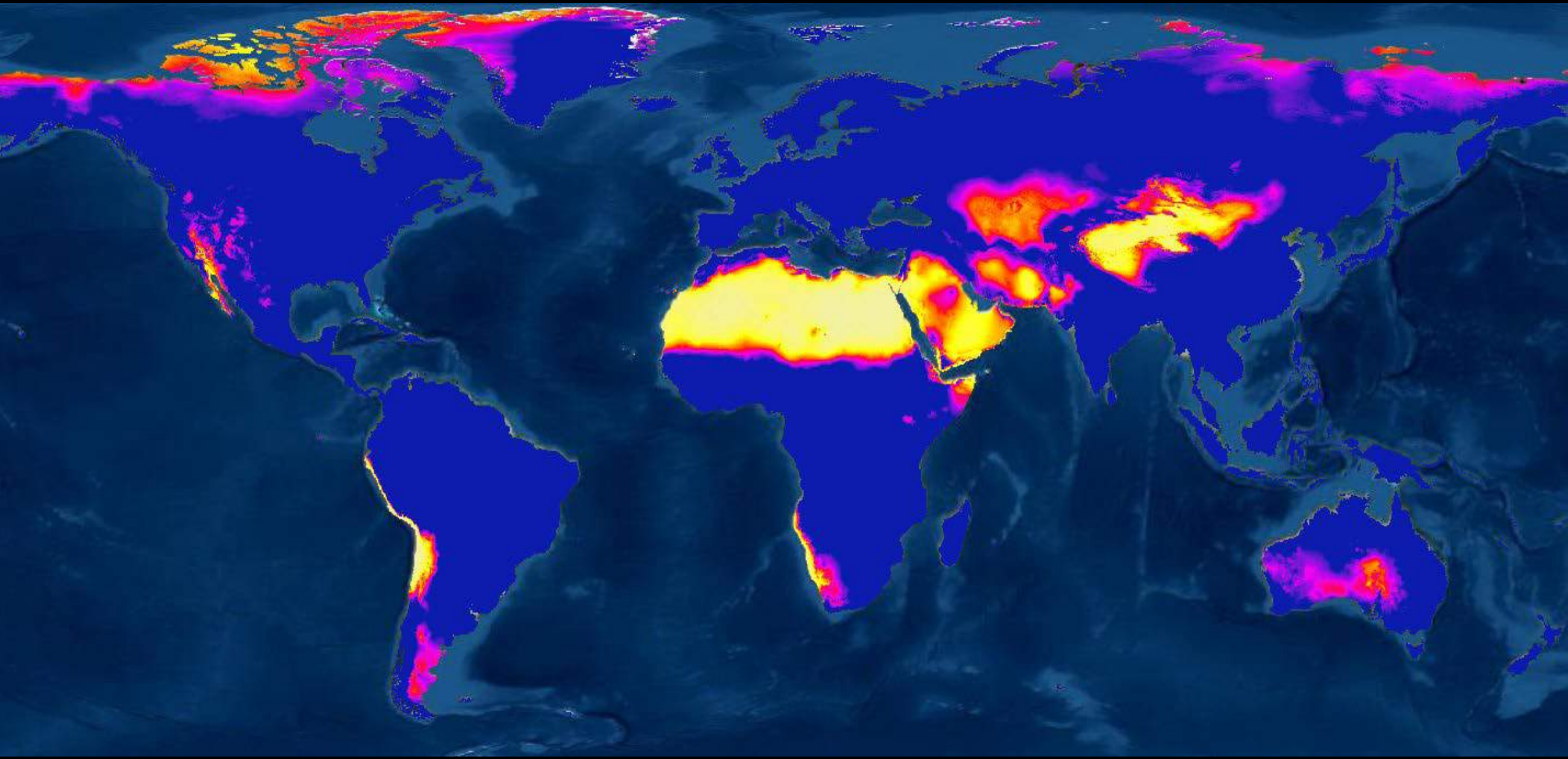
2 Introduction to the biodiversity of the Southern Namib and the Succulent Karoo using the evolution of key adaptations to the extreme environments as guiding principle.

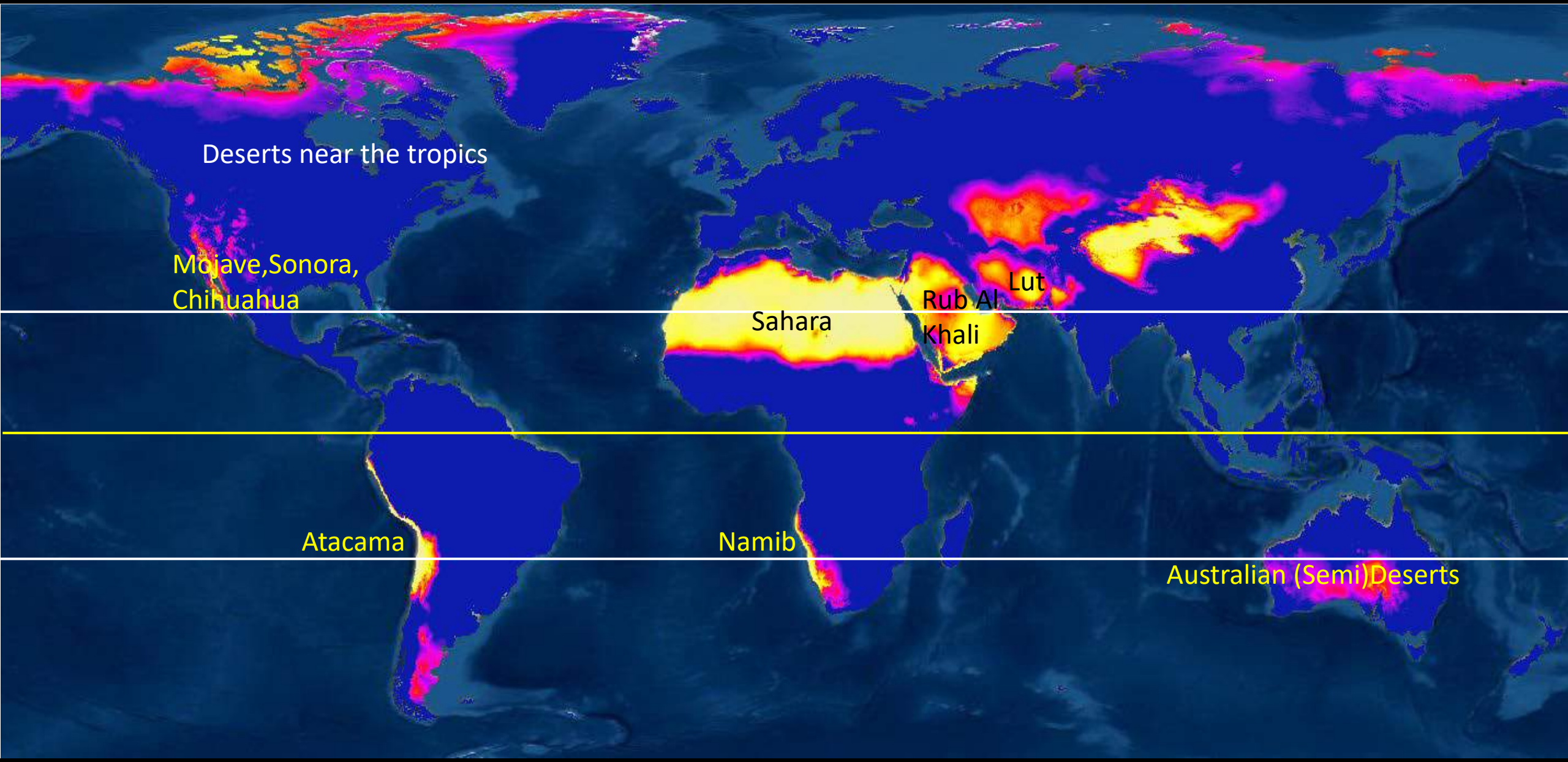
3 Functional ecology based on outstanding ecosystem engineers and their role in landscapes.

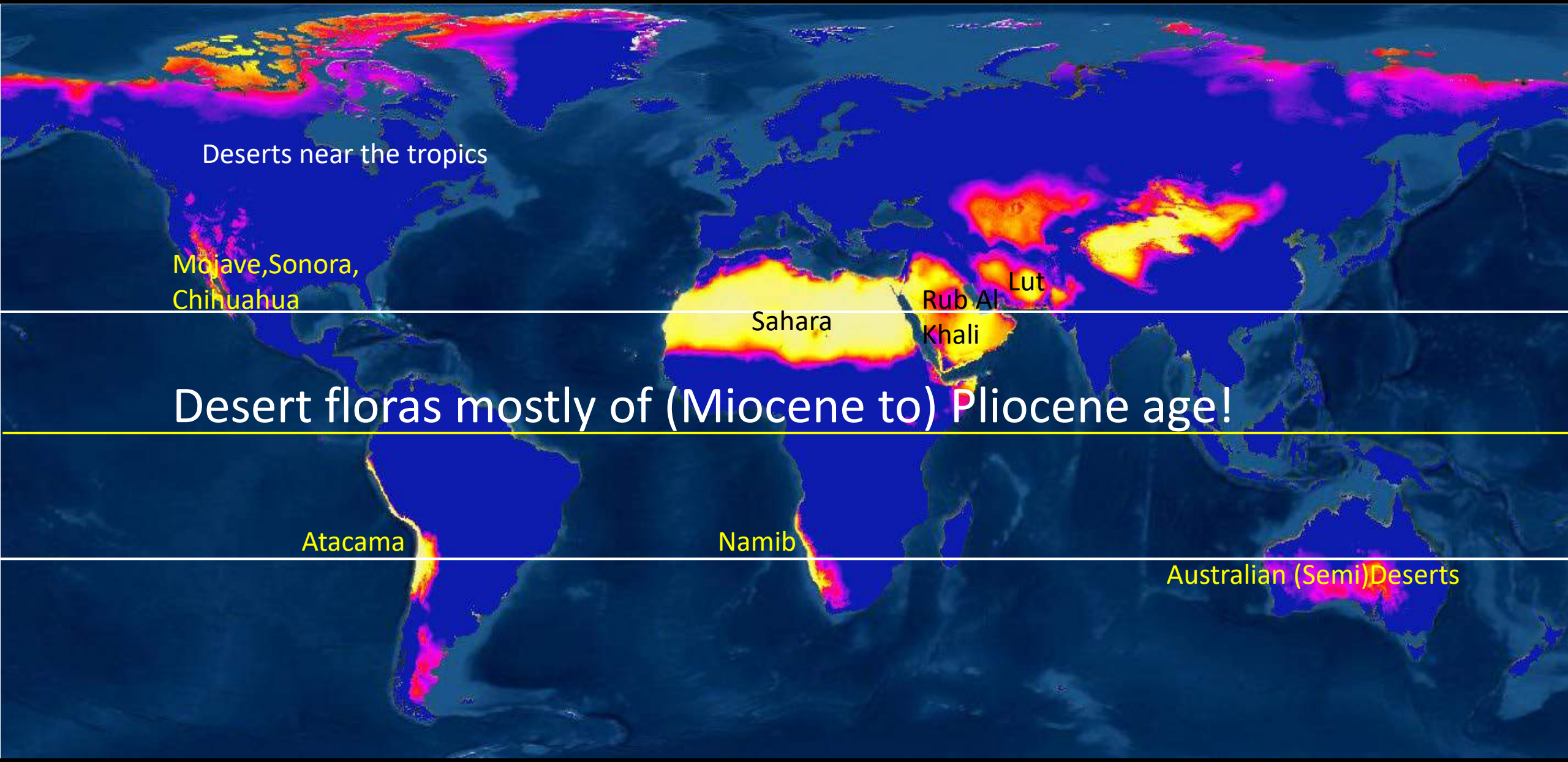
4 A perfect storm: Degradation and Namib Desert expansion in the Richtersveld.

5 Lessons learned from the Richtersveld: Enduring stability and potentially dangerous ecosystem processes in the Tsau//Khaeb. First broad recommendations for conservation and development, considering recent development plans.

1 Introduction to the Namib Desert, the Southern Namib, the Succulent Karoo and the Gariep Centre(s) of endemism, using the environmental history and biogeographical patterns as guiding principles.




Deserts near the tropics
Mojave,Sonora,
Chihuahua
Sahara
Rub Al
Khali
Lut
Atacama
Namib
Australian (Semi)Deserts


Deserts near the tropics
Mojave,Sonora,
Chihuahua
Sahara
Rub Al
Khali
Lut
Desert floras mostly of (Miocene to) Pliocene age!
Atacama
Namib
Australian (Semi)Deserts

Paläo-Endemiten in ariden Refugien

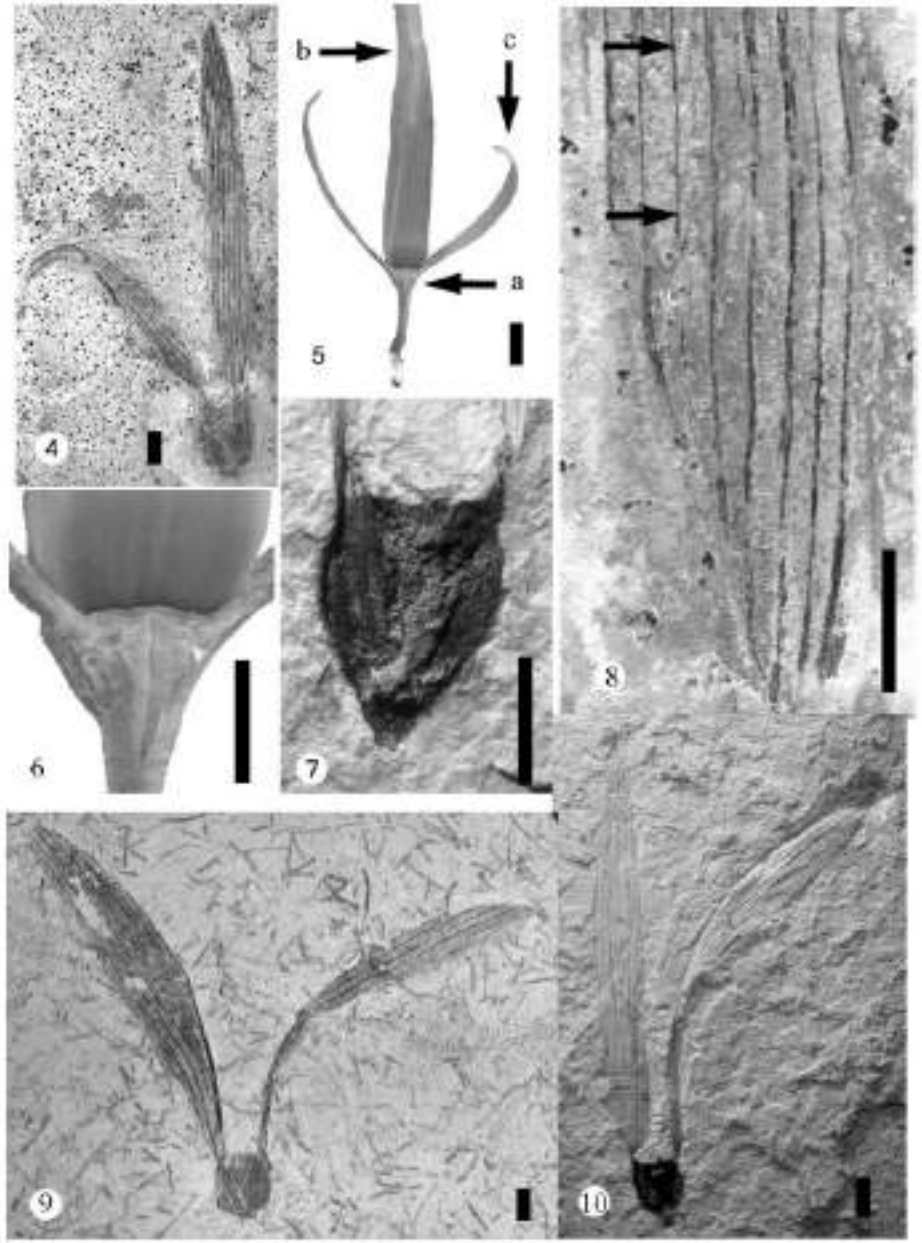


Welwitschia mirabilis ssp mirabilis, SW-Angola

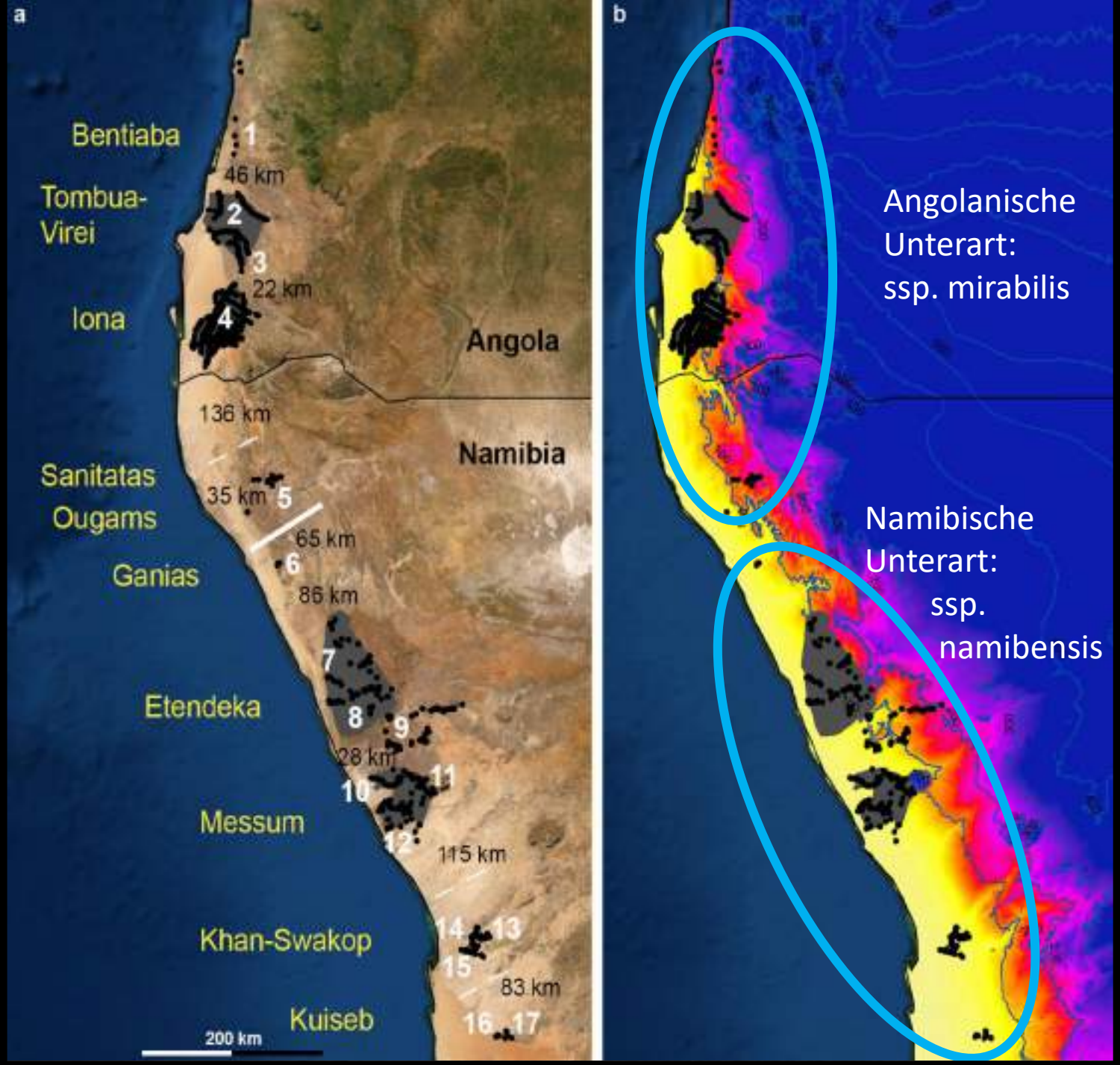

Welwitschia mirabilis
ssp namibensis
Brandberg West

Relatives of Welwitschia occurred on many continents during Apt (Upper Cretaceous)

Fossils from NE Brazil 112 My old show striking similarity to modern Welwitschia (Dilcher et al. 2005).

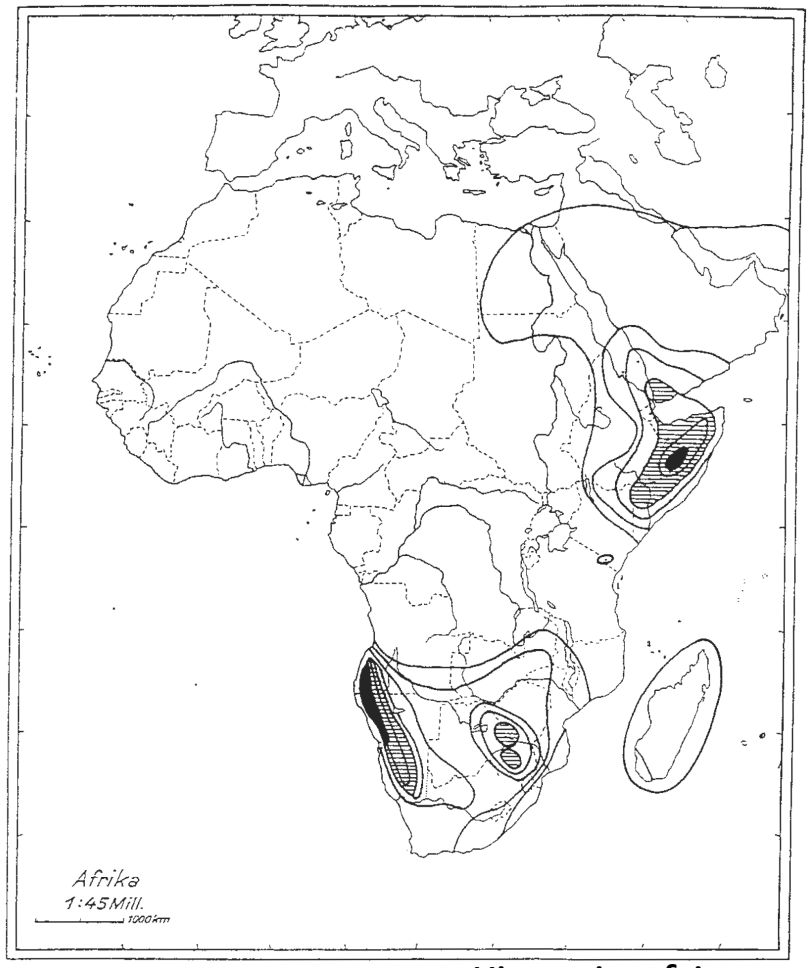


Figs. 4–10. Young plants in cotyledonary stage of *Welwitschiella austroamericana* sp. nov., Crato Formation, Araripe Basin, Brazil. 4, 8, GP/3E-7529. 4, 9, 10. Whole plant. 4. Cotyledons with prominent subparallel venation. 5. Seedling of *Welwitschia mirabilis*; a: hypocotyl axis; b: first growth of paired leaves; c: cotyledons still attached. 6. Enlargement of Fig. 5 showing a split in the epicotyl axis between the clasping leaf bases of the cotyledons. 7. Epicotyl axis showing the two clasping cotyledon leaf bases. GP/3E-7530b. 8. Enlargement of right cotyledon shown in Fig. 4 showing venation and rare gland chevrons (arrows). 9. Cotyledons spreading out from an axis. The cotyledons narrow and their bases clasp the axis. SMB 16437. 10. Counterpart shown in Fig. 7; cotyledons narrow at base and spread out from the axis. GP/3E-7530a. Scale bar for Figs. 4, 5, 7, 9, 10 = 5 mm; Fig. 6 = 2.5 mm; Fig. 8 = 3 mm.



Welwitschia: Phylogeography of a living fossil, diversified within a desert refuge. **Jürgens, N.**; I Oncken, J Oldeland, F Gunter, B Rudolph, 2021 *Scientific reports* 11 (1), 1-14

Paläo-Endemiten in ariden Refugien (Jürgens 1997)



Kissenia africana
(Loasaceae)

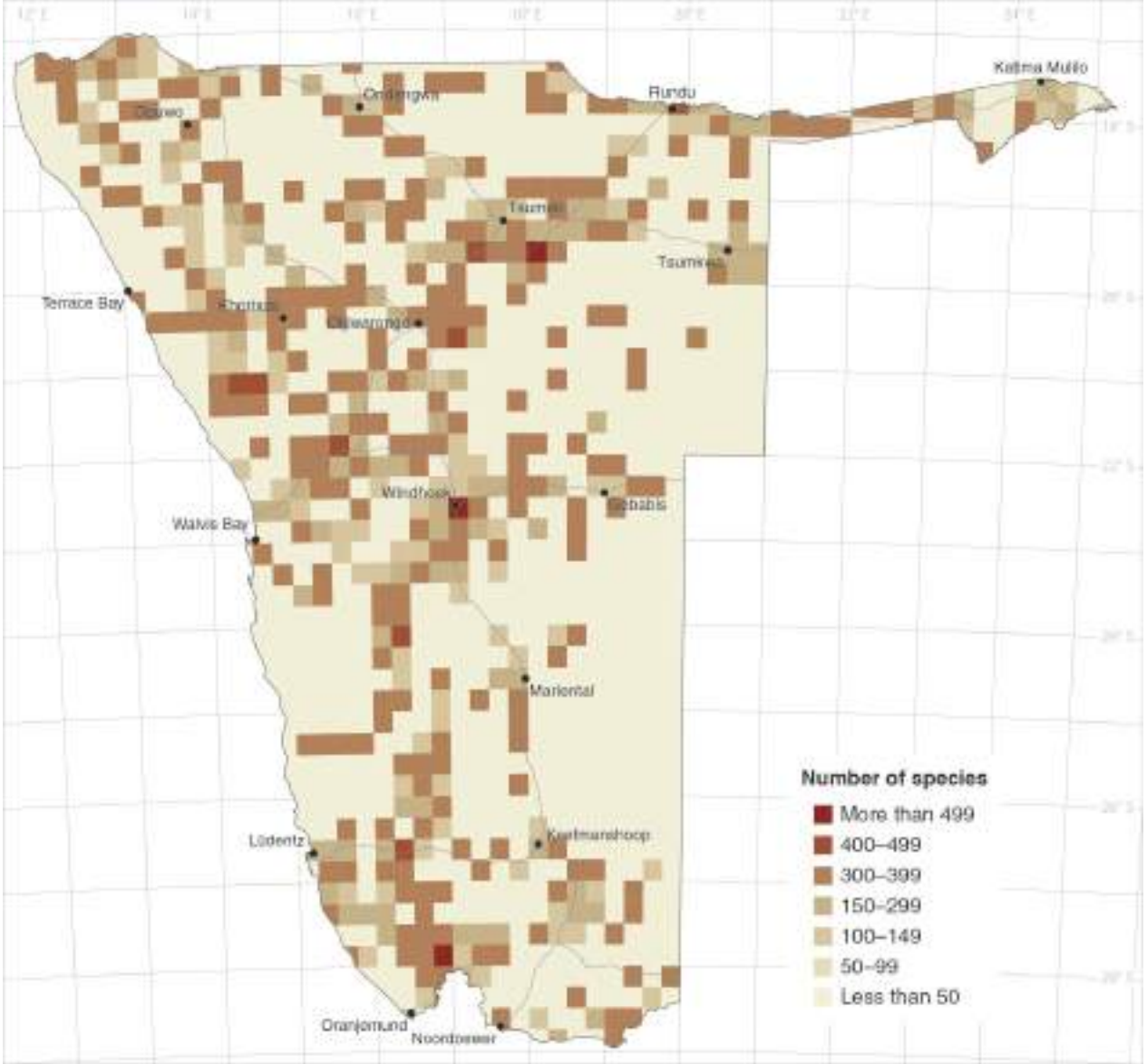
Wellstedia dinteri
(Boraginaceae)

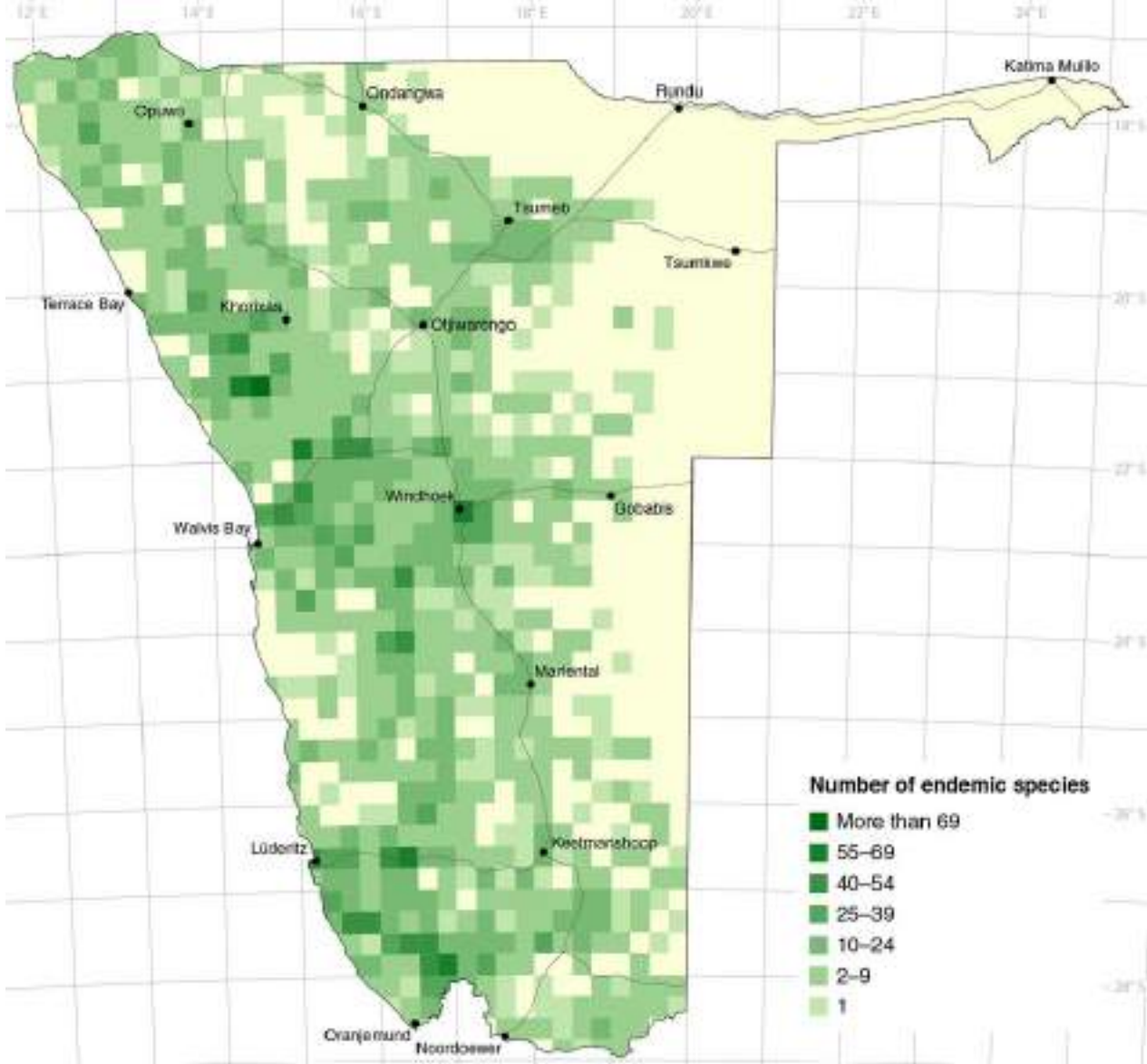




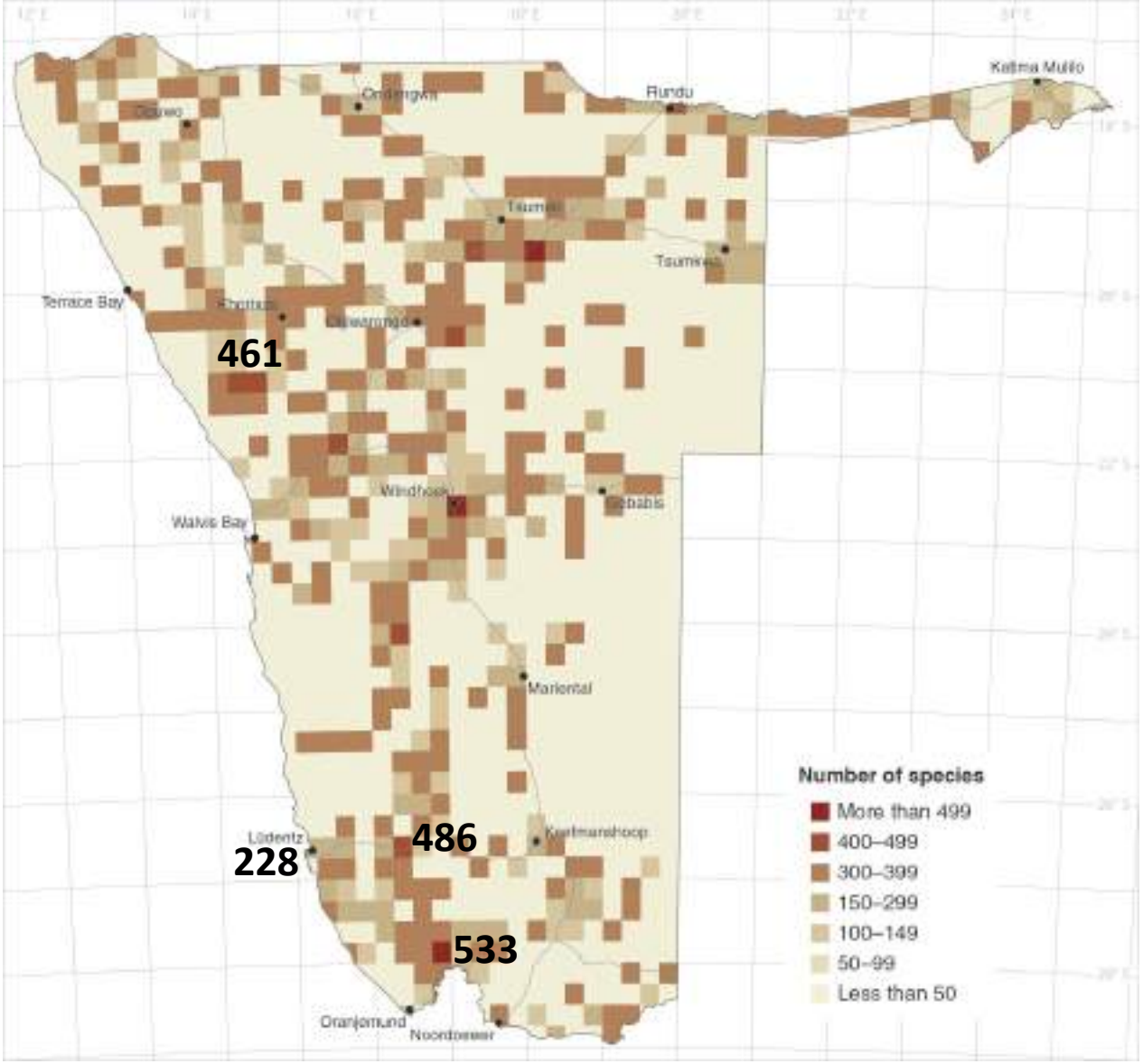
Sesamothamnus benguellensis
(Pedaliaceae)

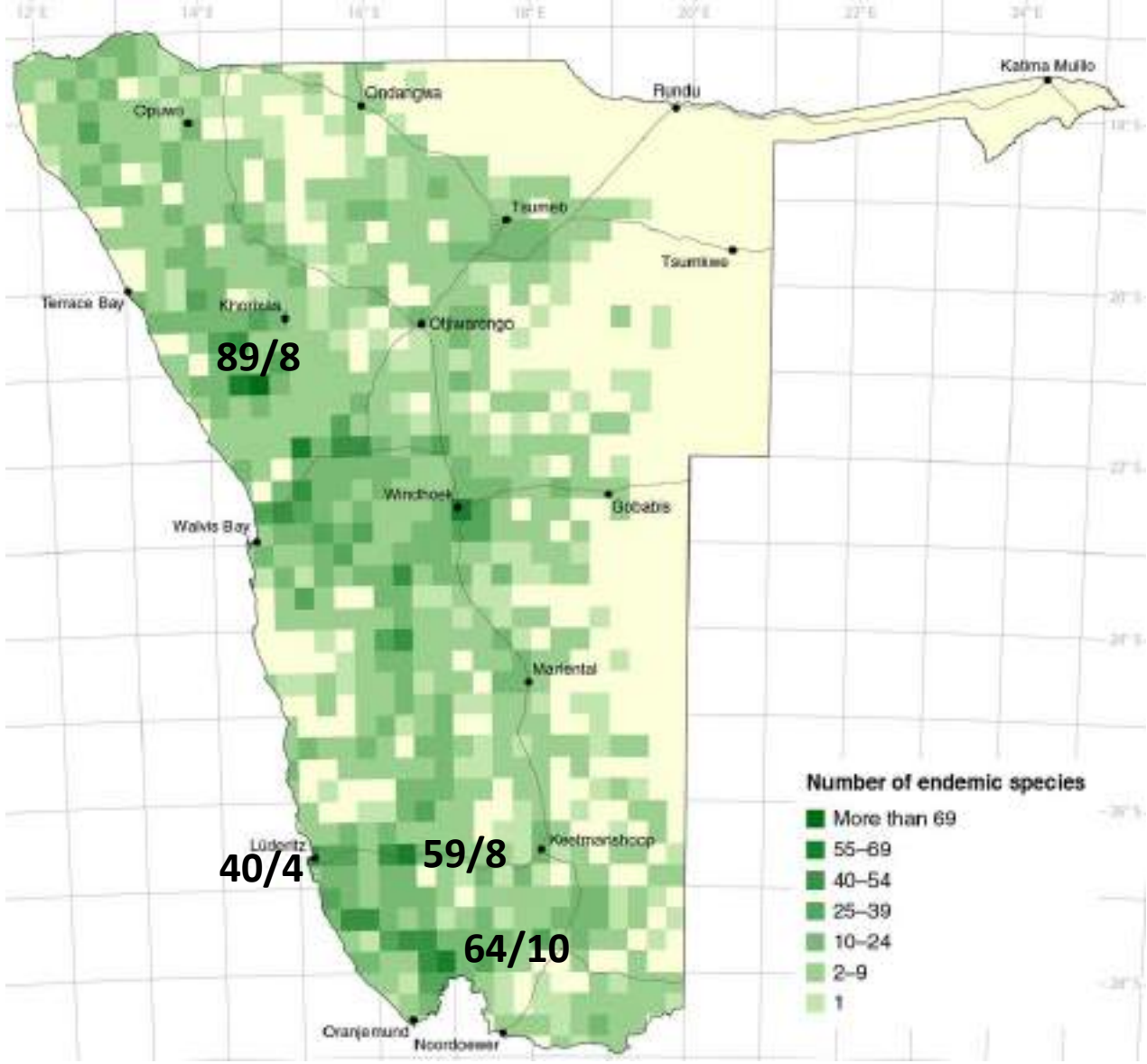






Source: Atlas of Namibia, based on Craven & Forster:
Patterns of plant diversity and endemism in Namibia, Bothalia 36: 175-189

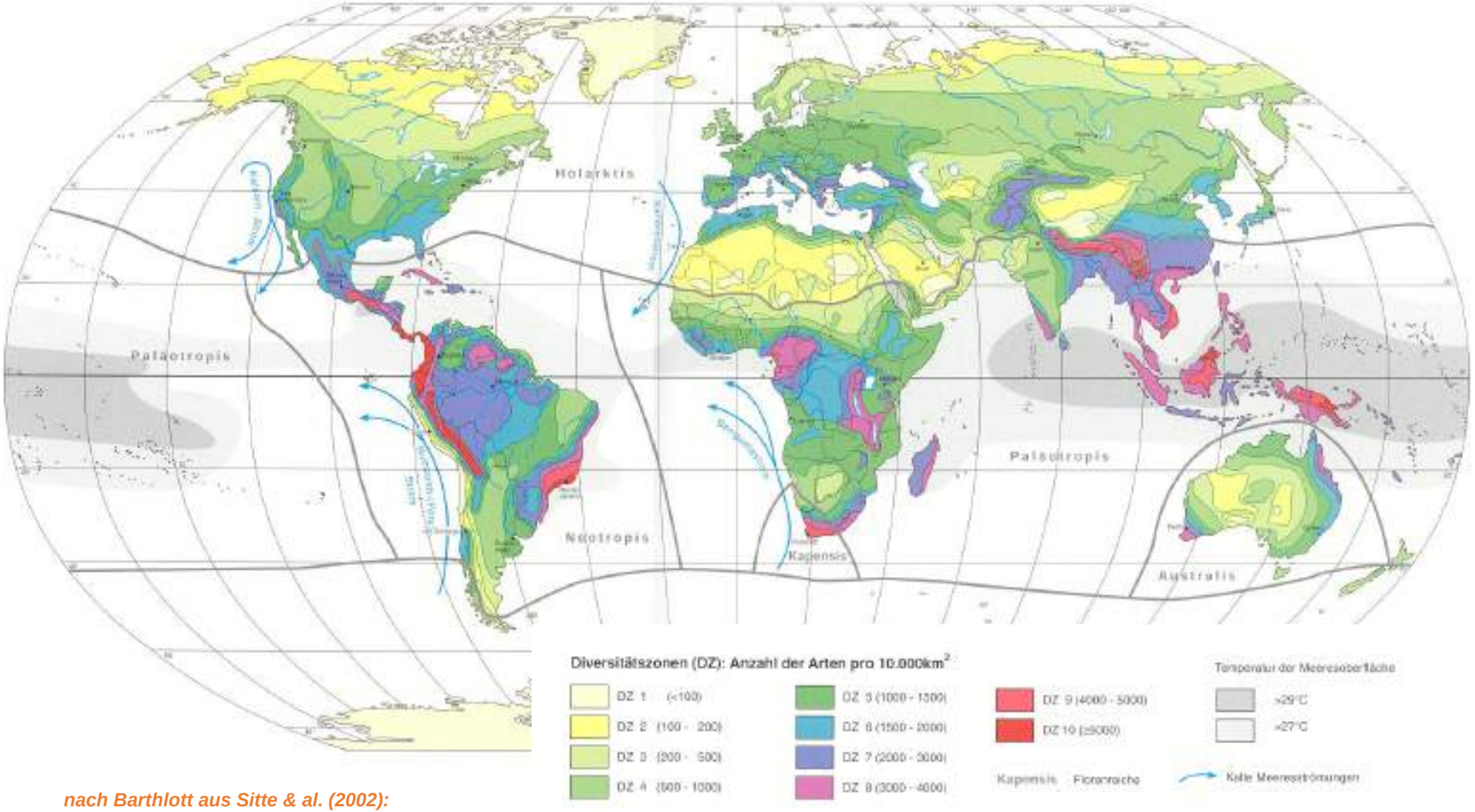




Source: Atlas of Namibia, based on Craven & Forster:
Patterns of plant diversity and endemism in Namibia, Bothalia 36: 175-189 (2006).

Very high level of biodiversity, compared to all other drylands.

Higher plant species numbers on 10.000 km²



nach Barthlott aus Sitte & al. (2002): Lehrbuch der Botanik

Cape Floral Kingdom

Winter rain
> 250mm/y



Fynbos

Leucospermum conocarpodendron (Cape Peninsula)

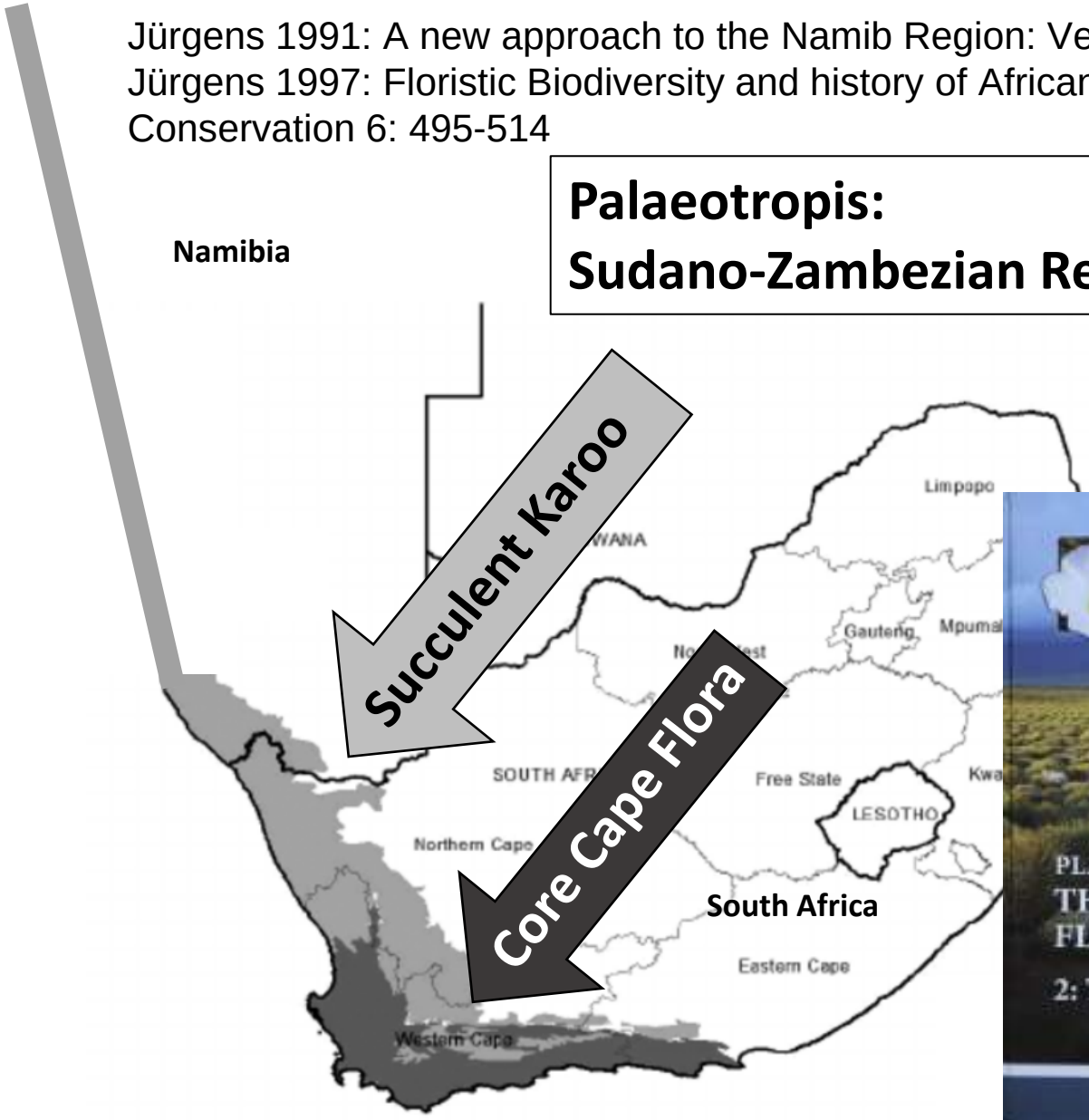


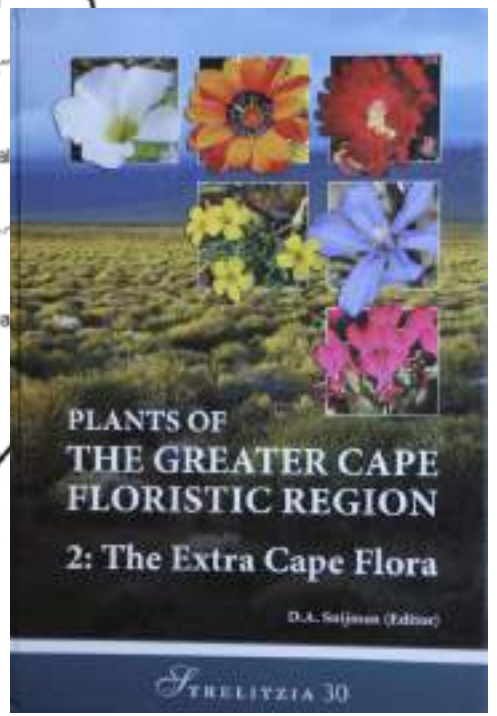
Erica regia (Cape Peninsula)

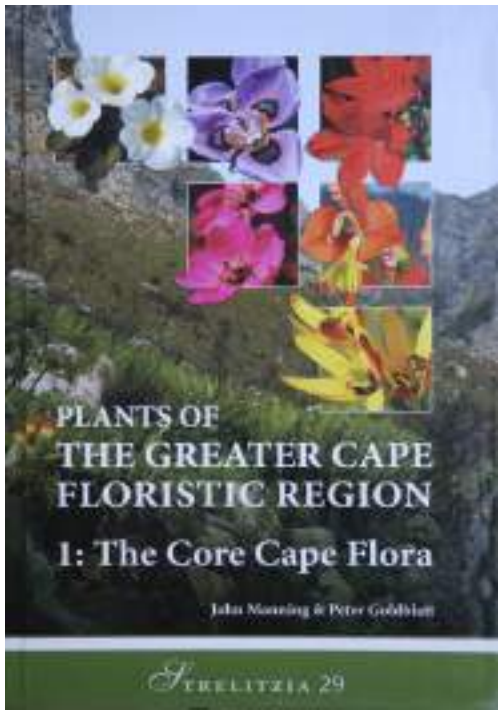
Kapflora → Greater Cape Flora

Jürgens 1991: A new approach to the Namib Region: Vegetatio 97:21-38,
Jürgens 1997: Floristic Biodiversity and history of African arid regions: Biodiversity & Conservation 6: 495-514

Palaeotropis:
Sudano-Zambezian Region









Winter rains
< 250 mm/y

Part of the Greater Cape Flora

Succulent Karoo



Examples for leaf succulent Aizoaceae



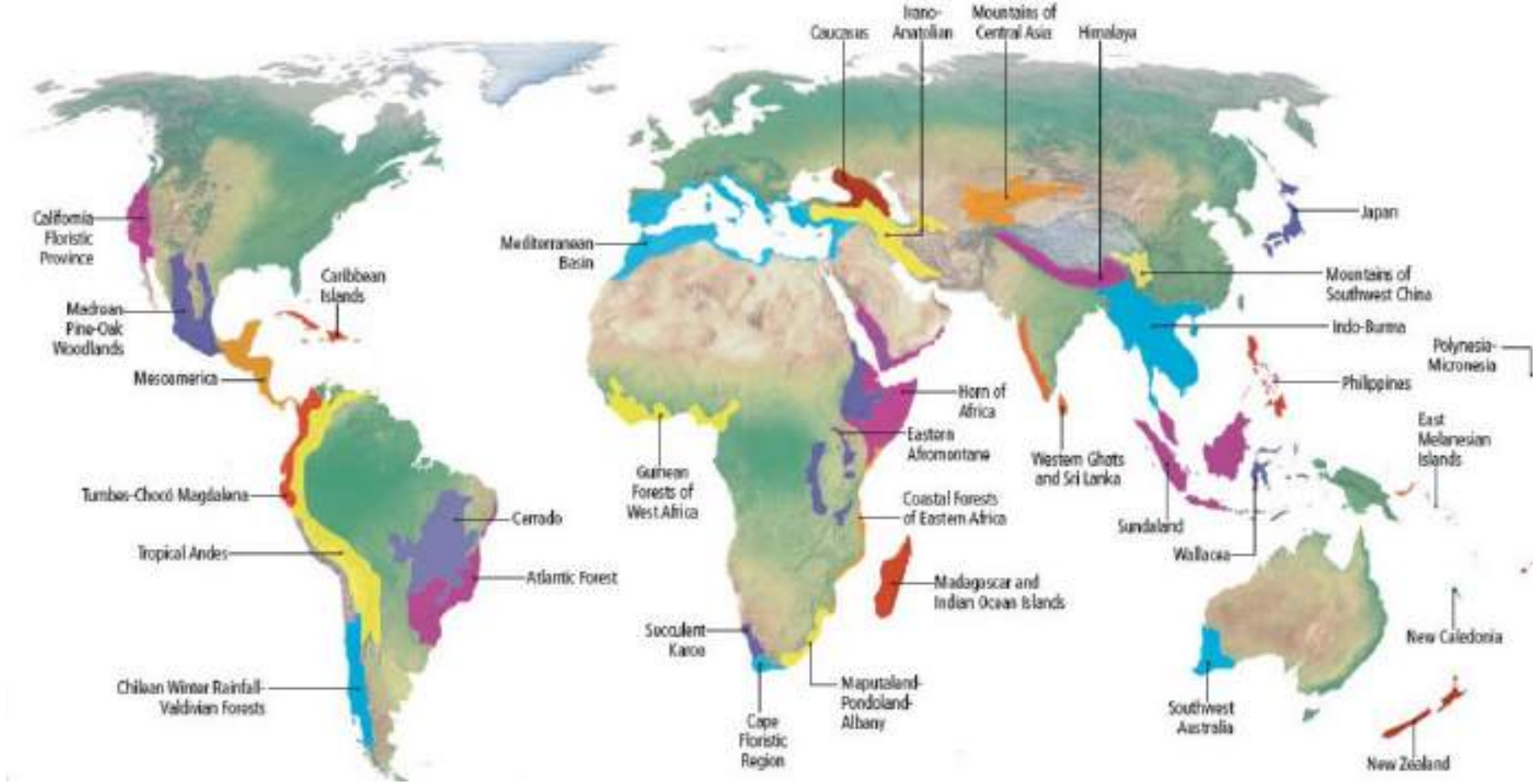


Succulent Karoo

- More than 5000 plant species on 100.000 km²
- Of these, 2000 species (40 %) are endemic
- More than 800 plant species endangered
- 4-5 Mio years old
- Winter rainfall climate

Global Biodiversity Hotspots
Mittermeier et al. 1998 Cons.Biol. 12: 516-520

Hotspot: As many as 44% of all species of vascular plants and 35% of all species in four vertebrate groups are confined to 25 hotspots comprising only 1.4% of the land surface of the Earth.



Rachel E. Golden Kroner1045 × 477Bildersuche
Biodiversity Hotspots, as defined by Conservation International http://www.conservation

Numerous endemic Geophytes



Oxalis sonderiana



Pelargonium sibthorpiifolium



Lachenalia nutans



Photo: P van Wyk



Amaryllis paradisicola
Richtersveld, auch in Flottbek

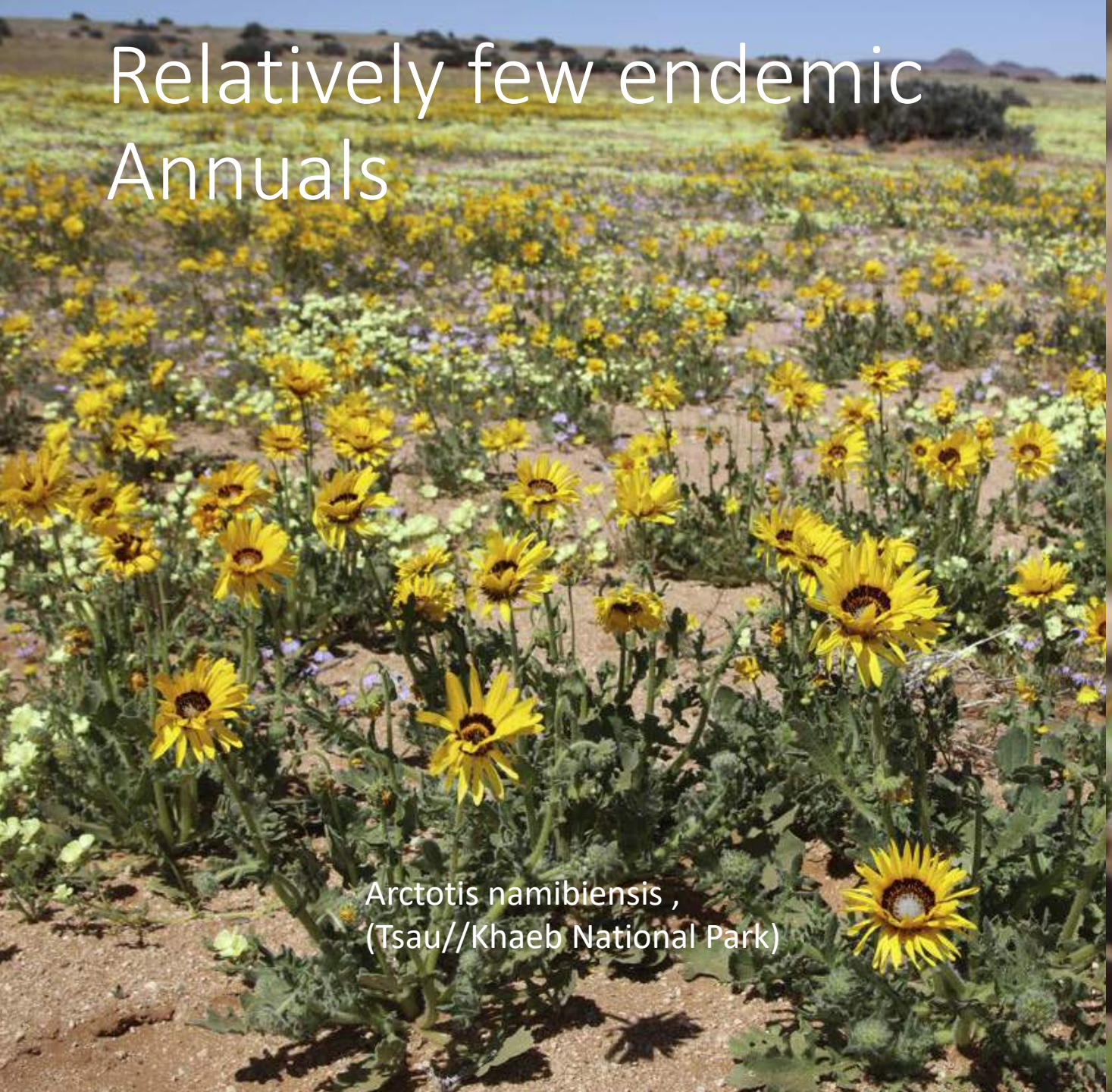
… sometimes dominant role in the vegetation…



Grielum humifusum (Neuradaceae)

Lapeirousia barklyi (Iridaceae) (Tsau//Khaeb National Park)

Relatively few endemic Annuals



Arctotis namibiensis ,
(Tsau//Khaeb National Park)

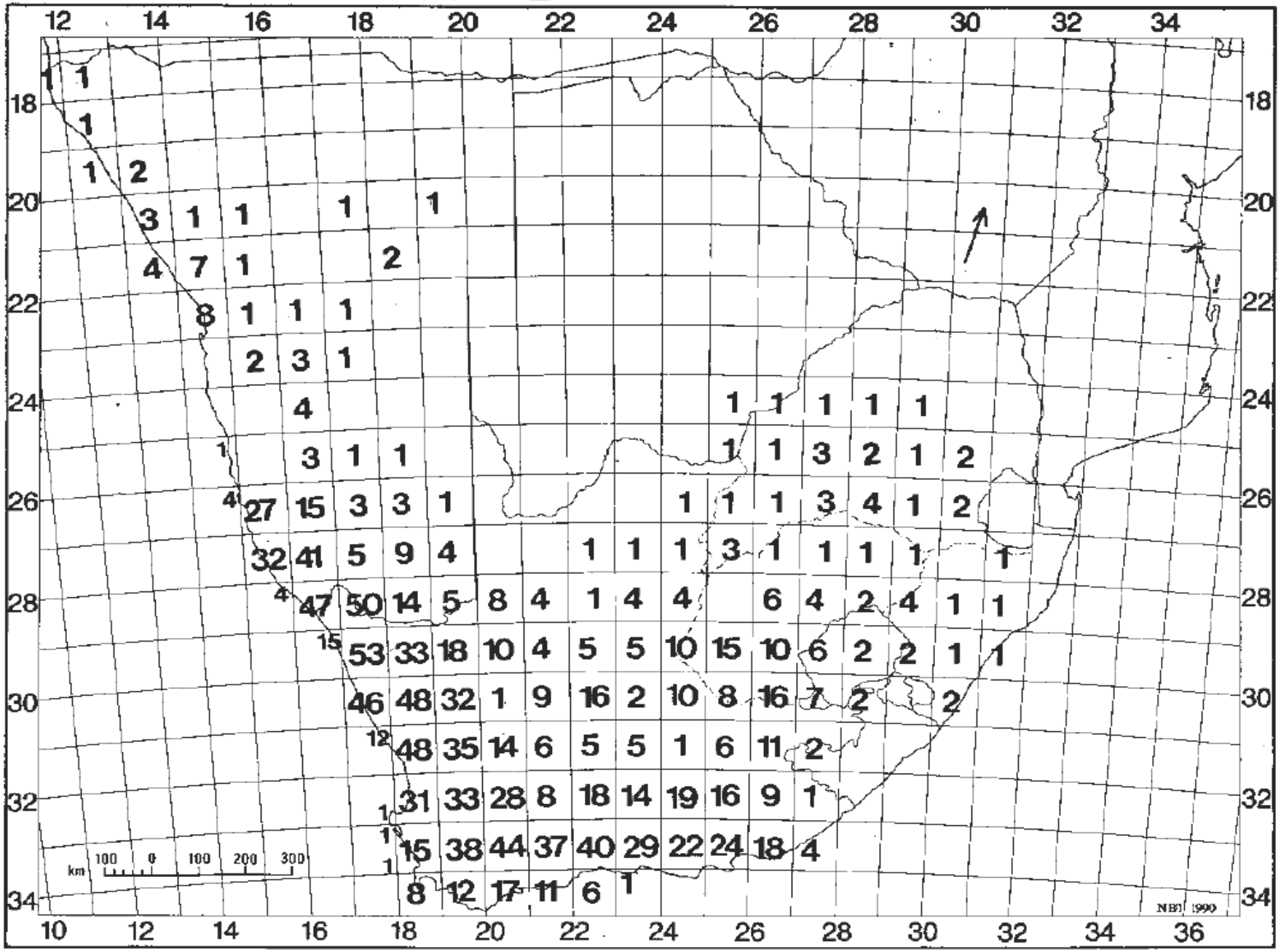


Berkheyopsis (Hirpicium) echinus, (Tsau//Khaeb National Park)

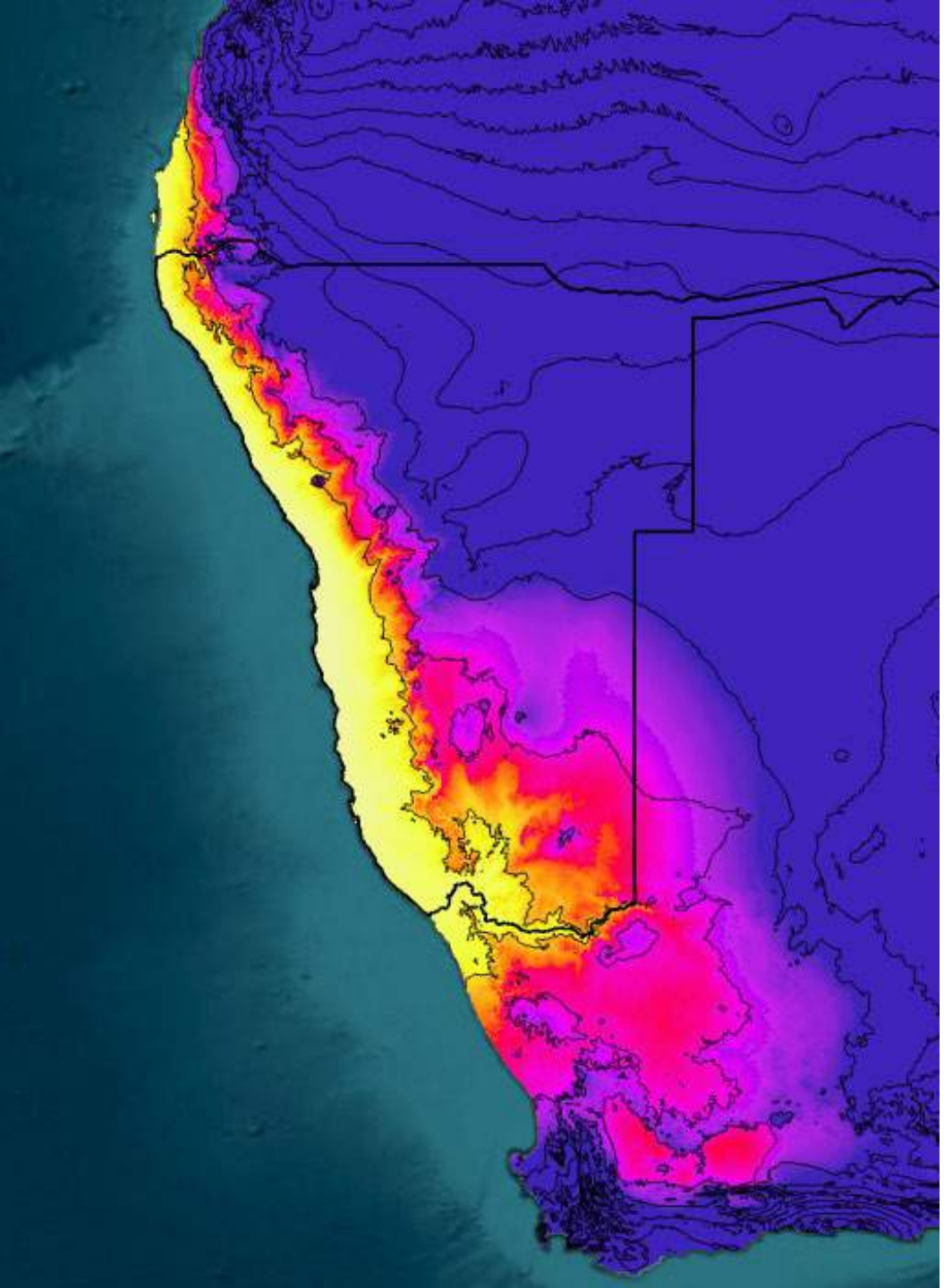


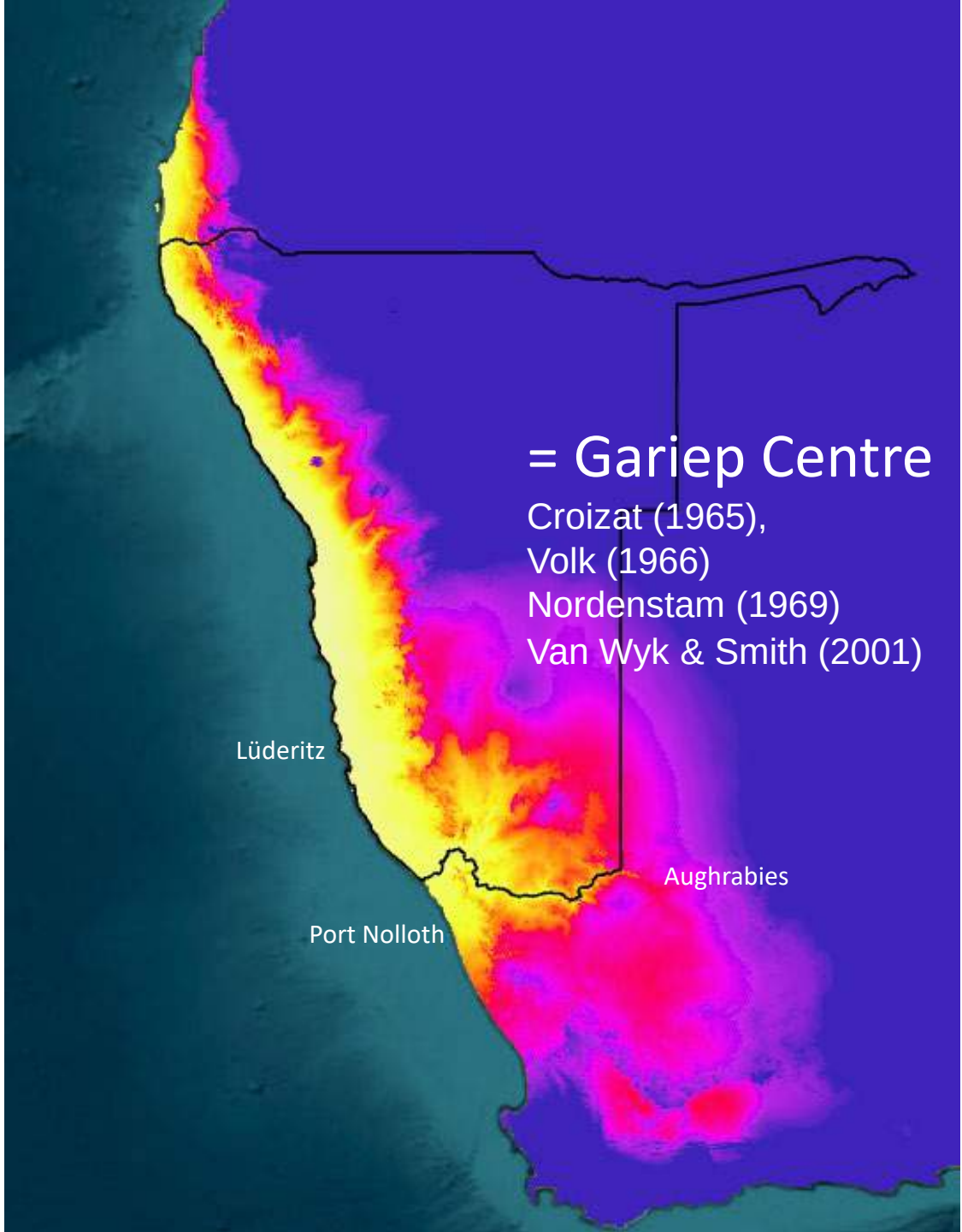
Living stones
Midday flowers
Aizoaceae
Vygies

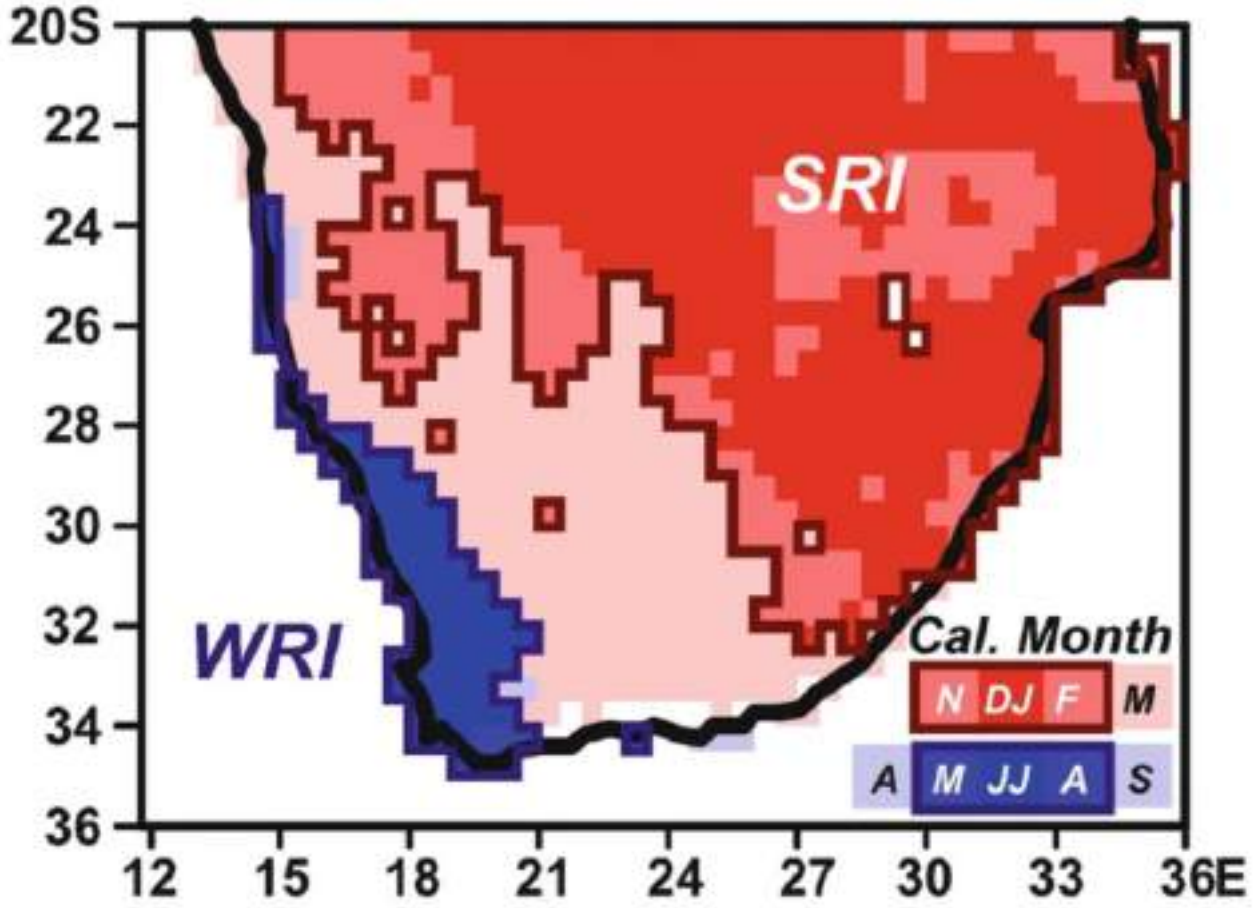
Titanopsis schwantesii
at Aus.
Photo: Piet Swiegers



Peak of genera of **Aizoaceae** in the Gariep Centre: Jürgens, 1991 Vegetatio




= Gariep Centre
Croizat (1965),
Volk (1966)
Nordenstam (1969)
Van Wyk & Smith (2001)
Lüderitz
Aughrabies
Port Nolloth



Spatial distribution of southern Africa's wettest month of the year (calendar month: red, summer: November to March; blue winter: April to September). Lines and colors delineate the area used to calculate summer and winter rainfall averages and indices (SRI and WRI)



Mathieu Rouault, Bastien Dieppois, Nele Tim, Birgit Hünicke & Eduardo Zorita: Southern Africa Climate Over the Recent Decades: Description, Variability and Trend. Ecological Studies, vol 248. Springer, Cham. https://doi.org/10.1007/978-3-031-10948-5_6

Hartmann, H.E.K.: Aizoaceae. Illustrated Handbook of Succulent Plants. Springer 2017.

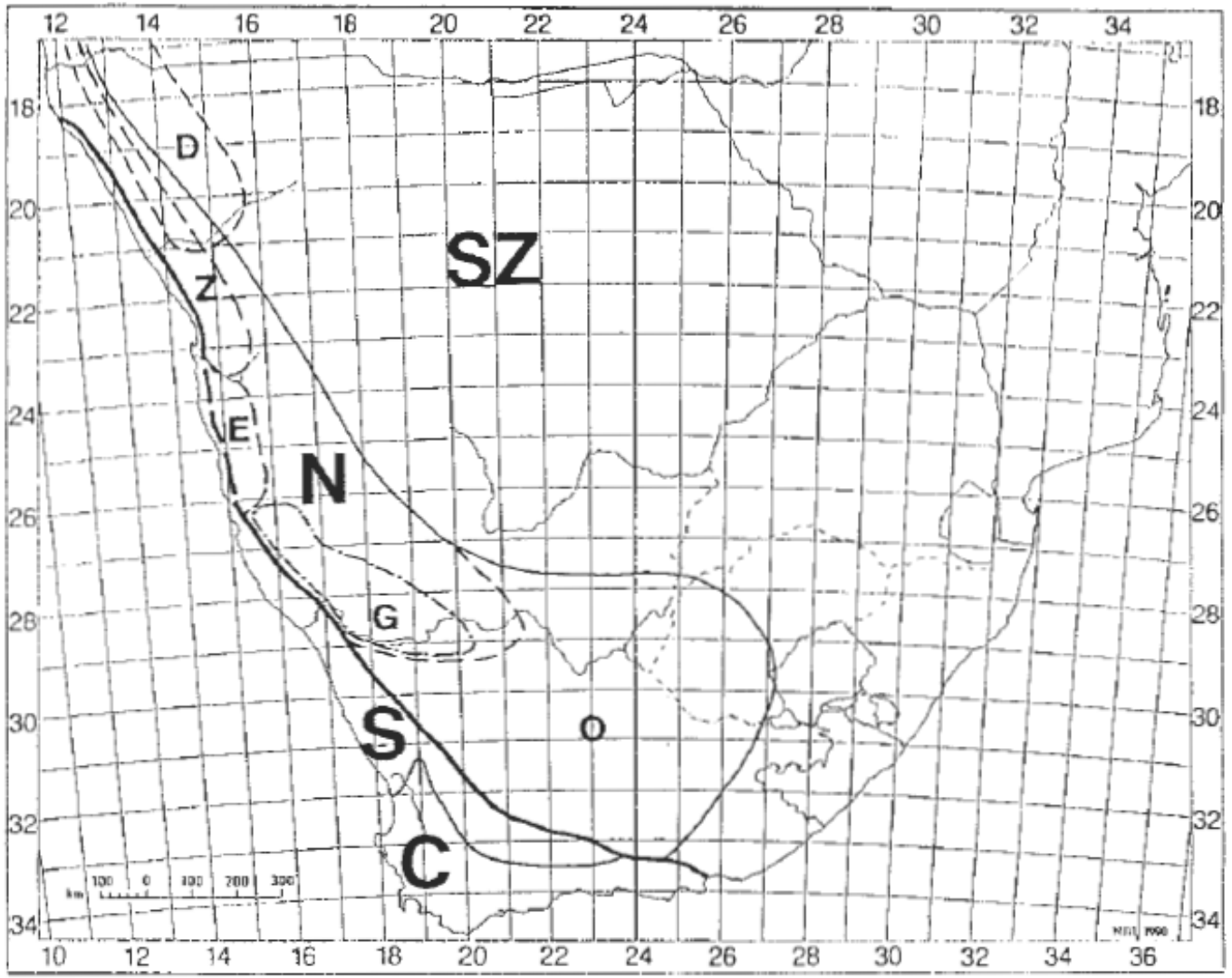


Figure 5. Phytogeographical subdivision of the arid regions of Southern Africa (from Jürgens, 1991, modified). C and S = Greater Cape Flora, N and SZ = Palaeotropical Flora; C = Cape Floristic Region, S = Succulent Karoo region, N = Nama Karoo Region, SZ = Sudano-Zambezian Region. O = Upper Karoo, G = East Gariep Centre, E = Namib Dunefield, Z = Central and Northern Namib Desert, D = Kaokoland-Damaraland Centre.

Jürgens 1991

SZ Sudano-Zambezian Region

N Nama Karoo Region

G East-Gariep Centre

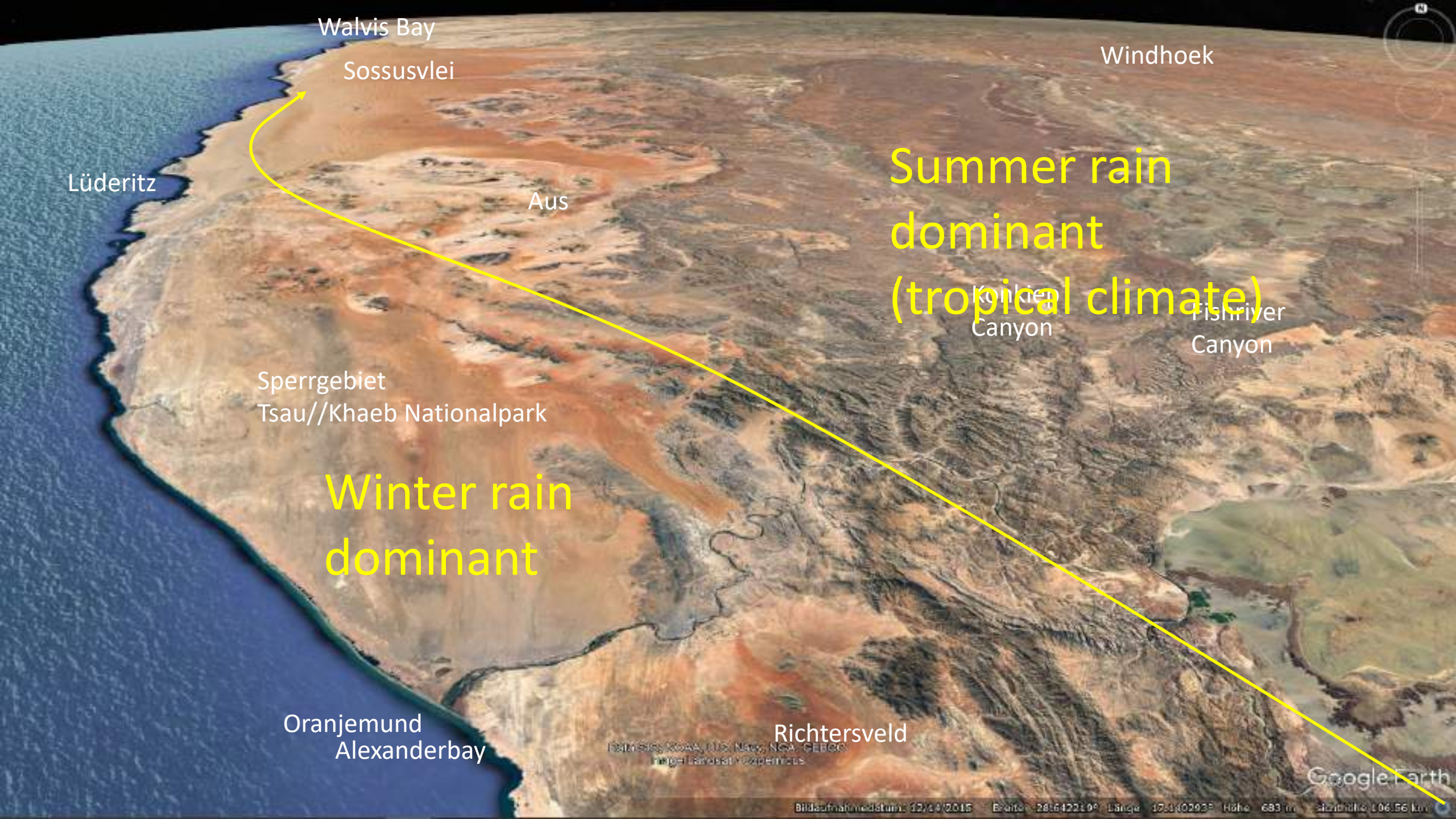
S Succulent Karoo Region

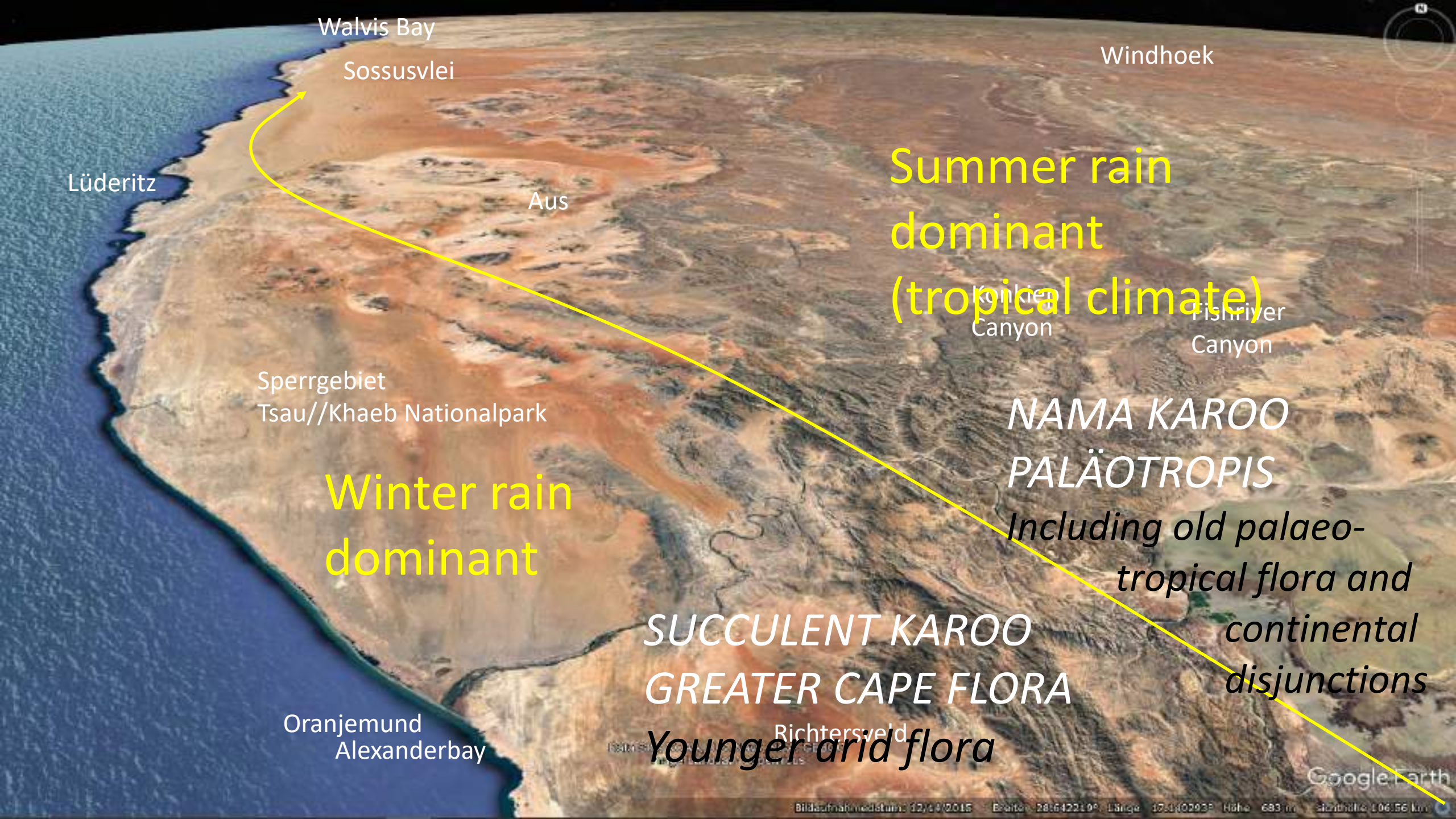
C Core Cape Region

S plus **C** = Greater Cape Region


Walvis Bay
Windhoek
Sossusvlei
Map of the “Gariep”Centres of endemism, including parts of the Tsau//Khaeb and the Richtersveld.
Namib-NaukluftNational Park
Lüderitz
Aus
Fish
Konkiep
Tsau//Khaeb National Park
Sperrgebiet
Rosh Pinah
Oranjemund
Alexanderbay
Richtersveld
Google Earth


Walvis Bay
Sossusvlei
Windhoek
Lüderitz
Aus
Konkiep
Canyon
Fishriver
Canyon
Sperrgebiet
Tsau//Khaeb Nationalpark
Oranjemund
Alexanderbay
Richtersveld
Google Earth


Walvis Bay
Sossusvlei
Windhoek
Lüderitz
Aus
Summer rain
dominant
(tropical climate)
Kuiseb
Canyon
Fishriver
Canyon
Sperrgebiet
Tsau//Khaeb Nationalpark
Winter rain
dominant
Oranjemund
Alexanderbay
Richtersveld
Google Earth

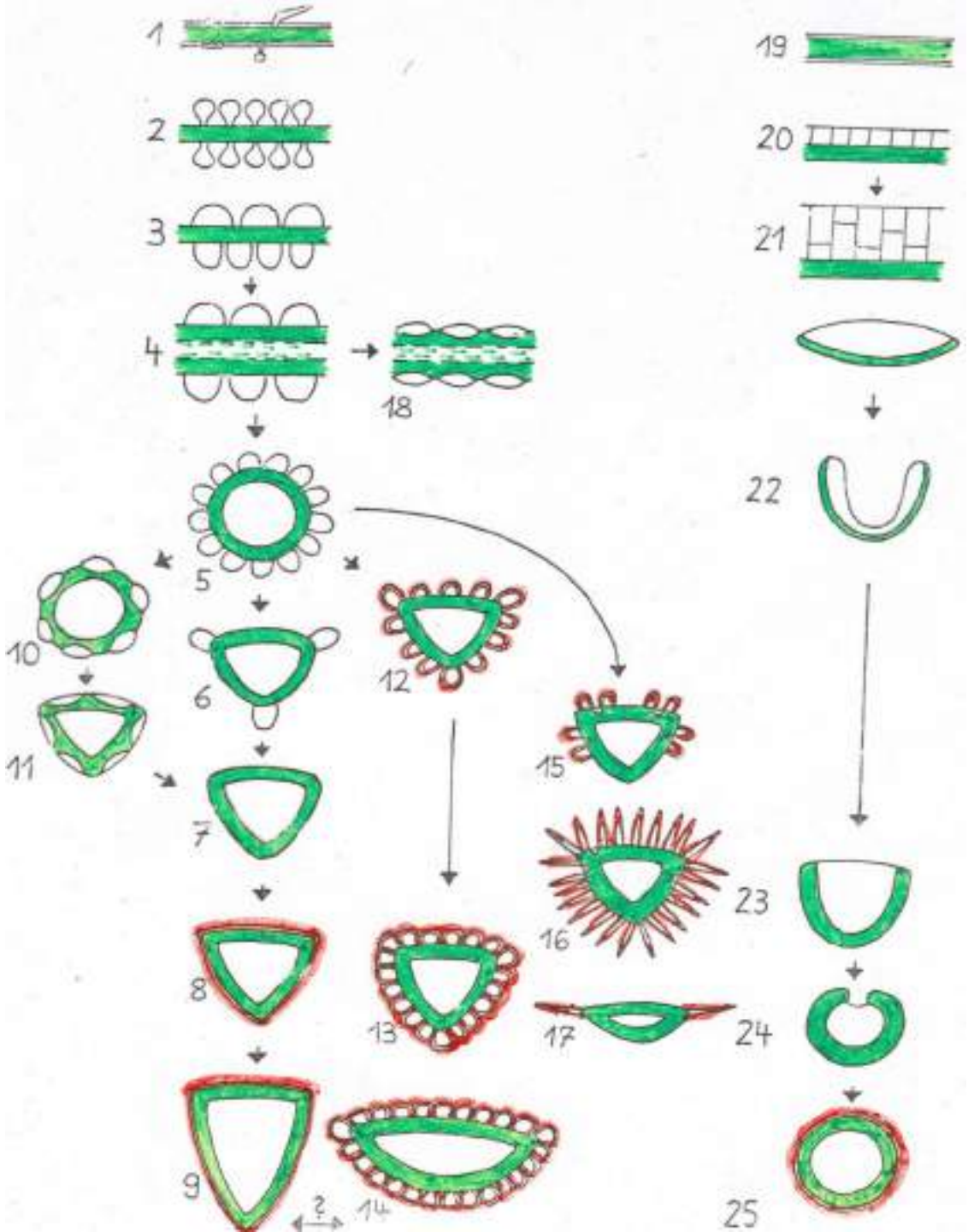

Walvis Bay
Sossusvlei
Windhoek
Lüderitz
Aus
Summer rain dominant (tropical climate)
Konkiep Canyon
Fishriver Canyon
Sperrgebiet
Tsau//Khaeb Nationalpark
NAMA KAROO
PALÄOTROPIS
Including old palaeo-tropical flora and continental disjunctions
Winter rain dominant
SUCCULENT KAROO
GREATER CAPE FLORA
Younger arid flora
Oranjemund
Alexanderbay
Richtersveld
Google Earth

2 Introduction to the biodiversity of the Southern Namib and the Succulent Karoo using the evolution of key adaptations to the extreme environments as guiding principle.

Succulent Karoo Region (Jürgens 1991)

Extremely long period of **uninterrupted** aridity in the Southern Namib →Evolution of unique key adaptations→High biodiversity in extreme environments. Unique features are:

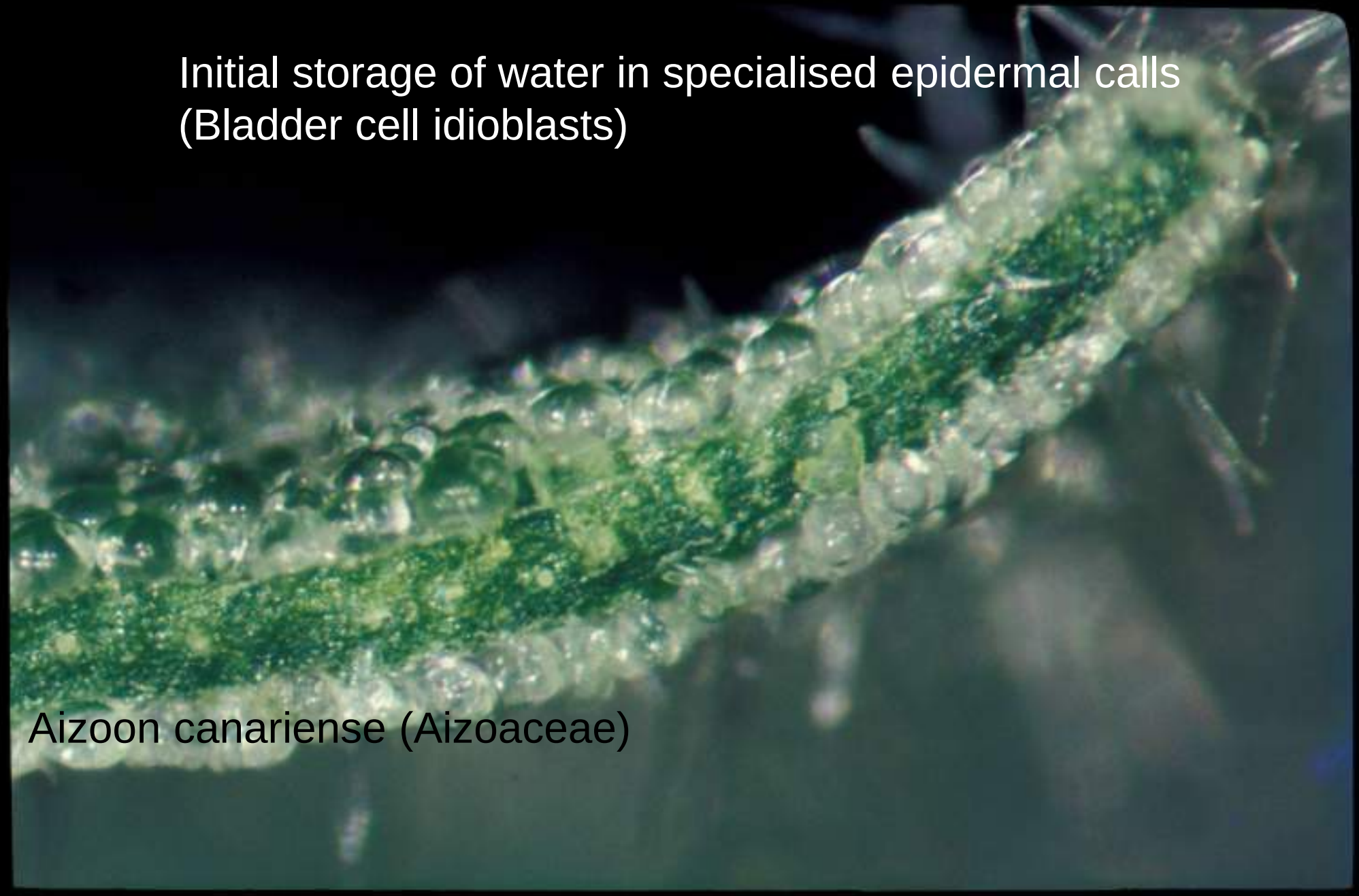
1. Succulence: Evolution of water storage in plant bodies
2. Evolution in adaptation to quartz stone pavements
3. Adaptations to sand blasting (subterraneous life forms)
4. Adaptations to sand blasting (“psammophorous plants”)
5. Adaptations to fog and high air humidity, in spite of low rainfall
6. Evolution of ecosystem engineers causing soil formation.



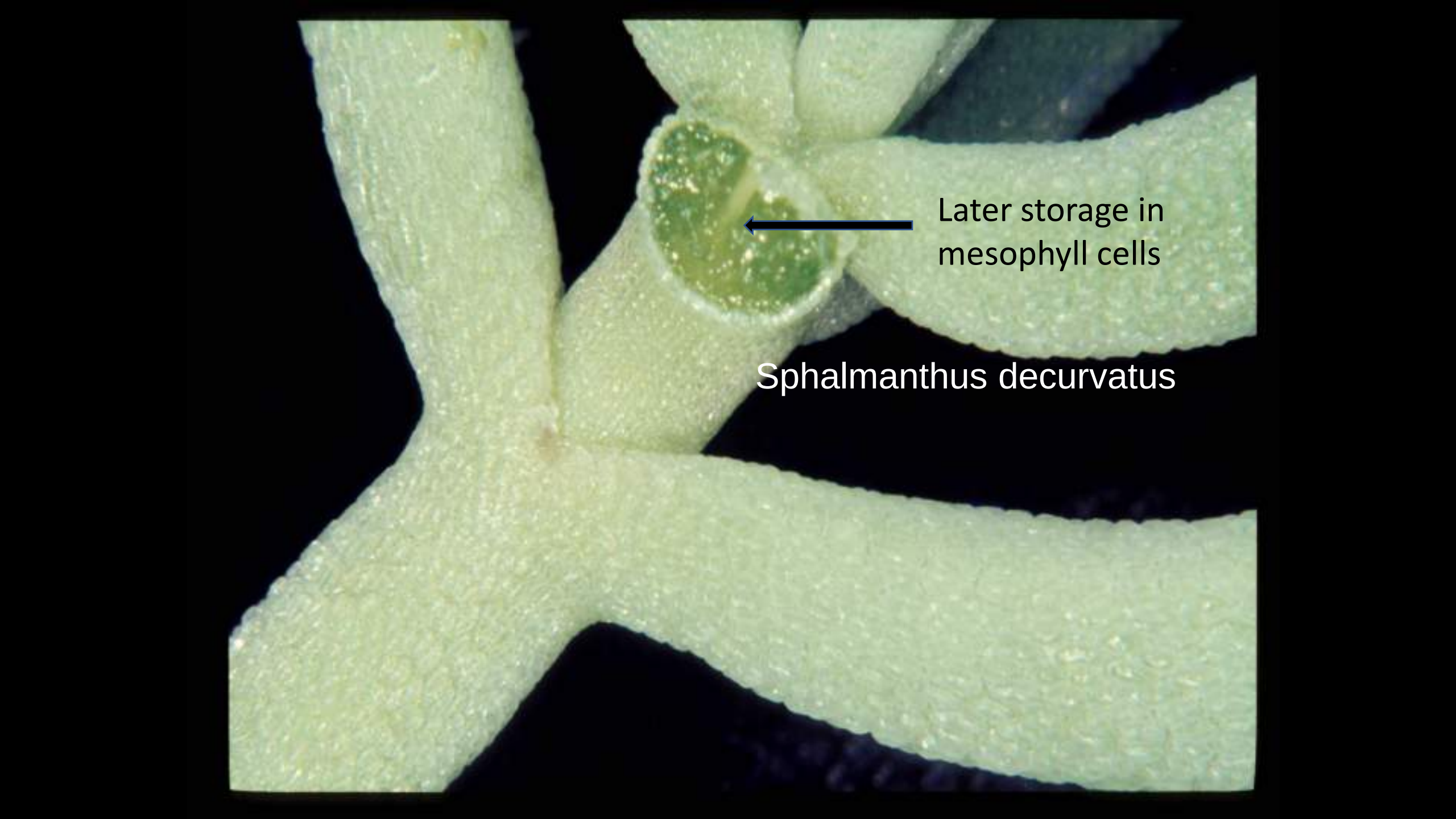
1 Evolution of water-storing = succulent leaves (Jürgens 1986)

Convergent evolution in several leaf succulent Plant families, always starting with water storage at the periphery, leaf epidermis or single cells, later adding water storage in the deeper tissues.

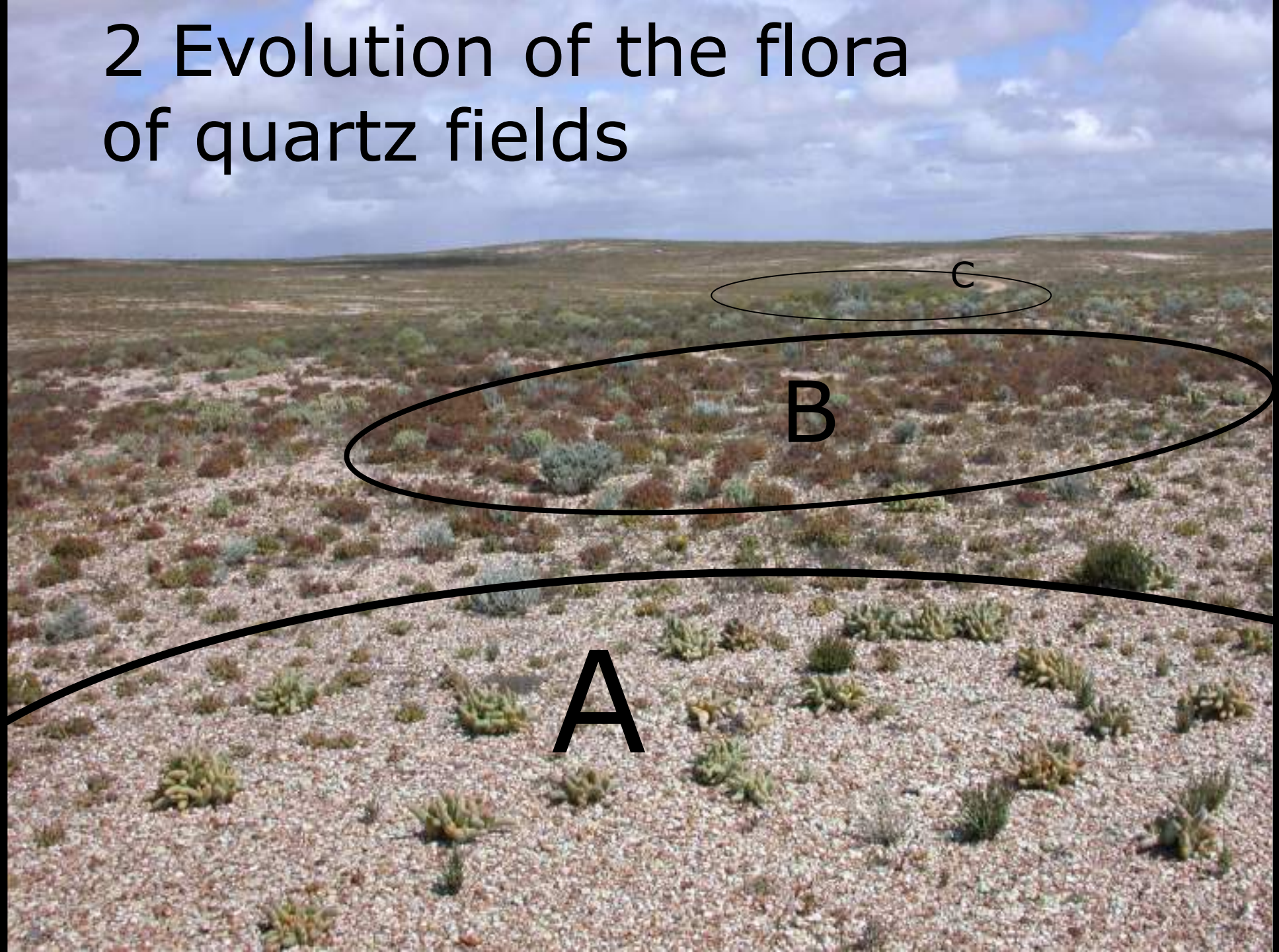
Initial storage of water in specialised epidermal calls (Bladder cell idioblasts)



Aizoon canariense (Aizoaceae)


Later storage in
mesophyll cells
Sphalmanthus decurvatus

2 Evolution of the flora of quartz fields

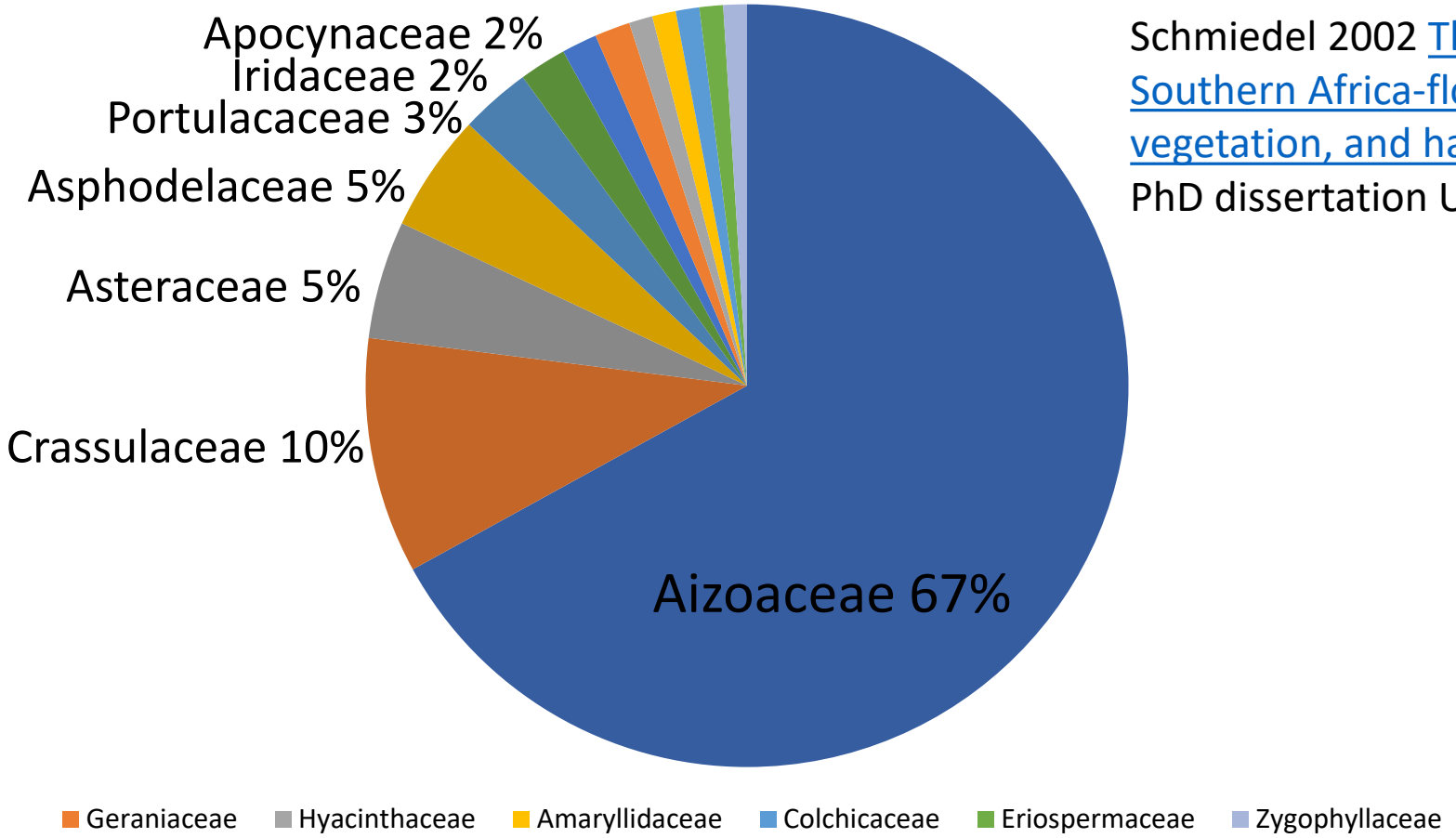




Dactylopsis digitata
= Mesembryanthemum digitatum


Argyroderma delaetii

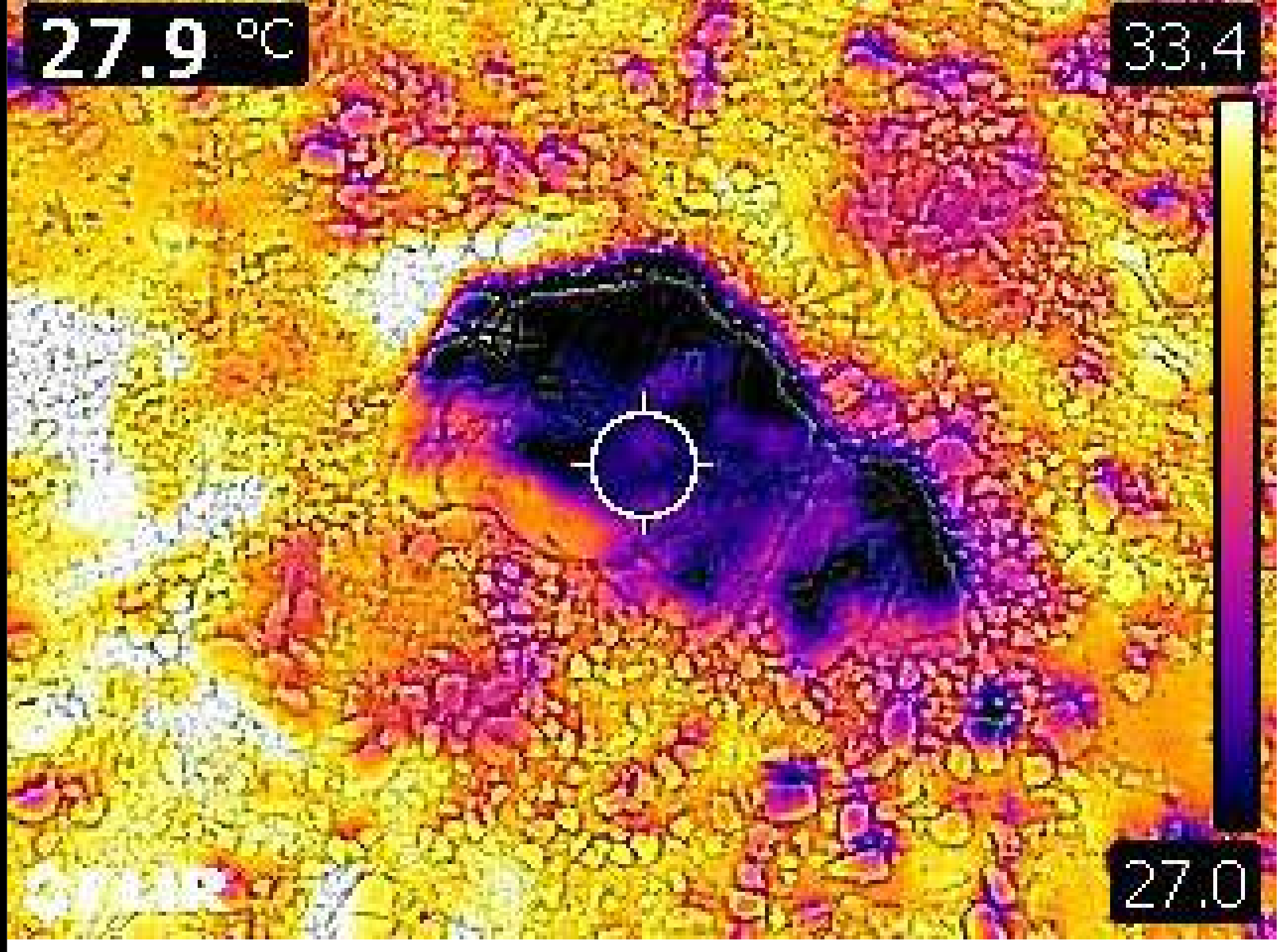
Quartz field flora



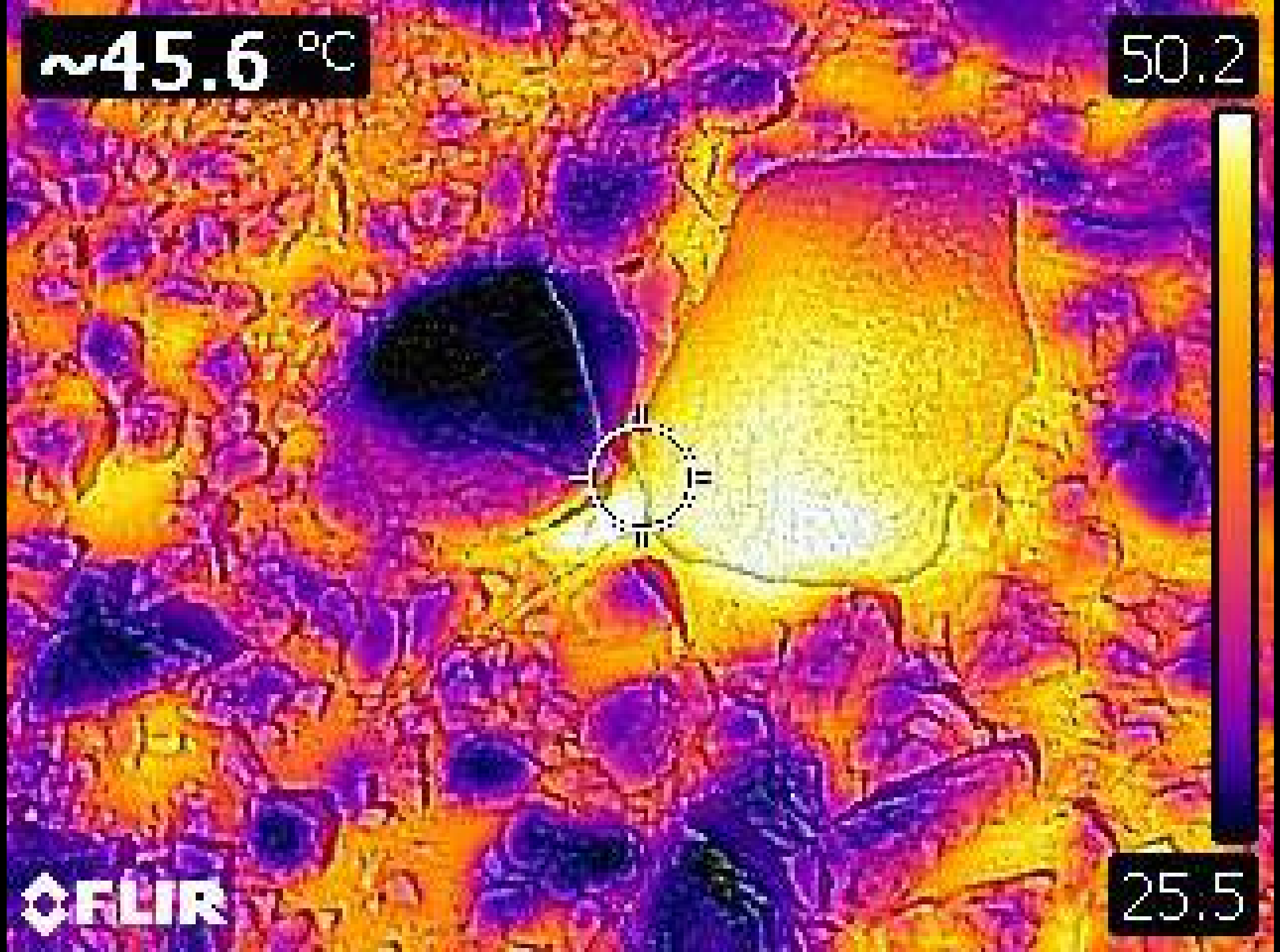
Schmiedel 2002 The Quartz Fields of Southern Africa-flora, phytogeography, vegetation, and habitat ecology
PhD dissertation Universität zu Köln

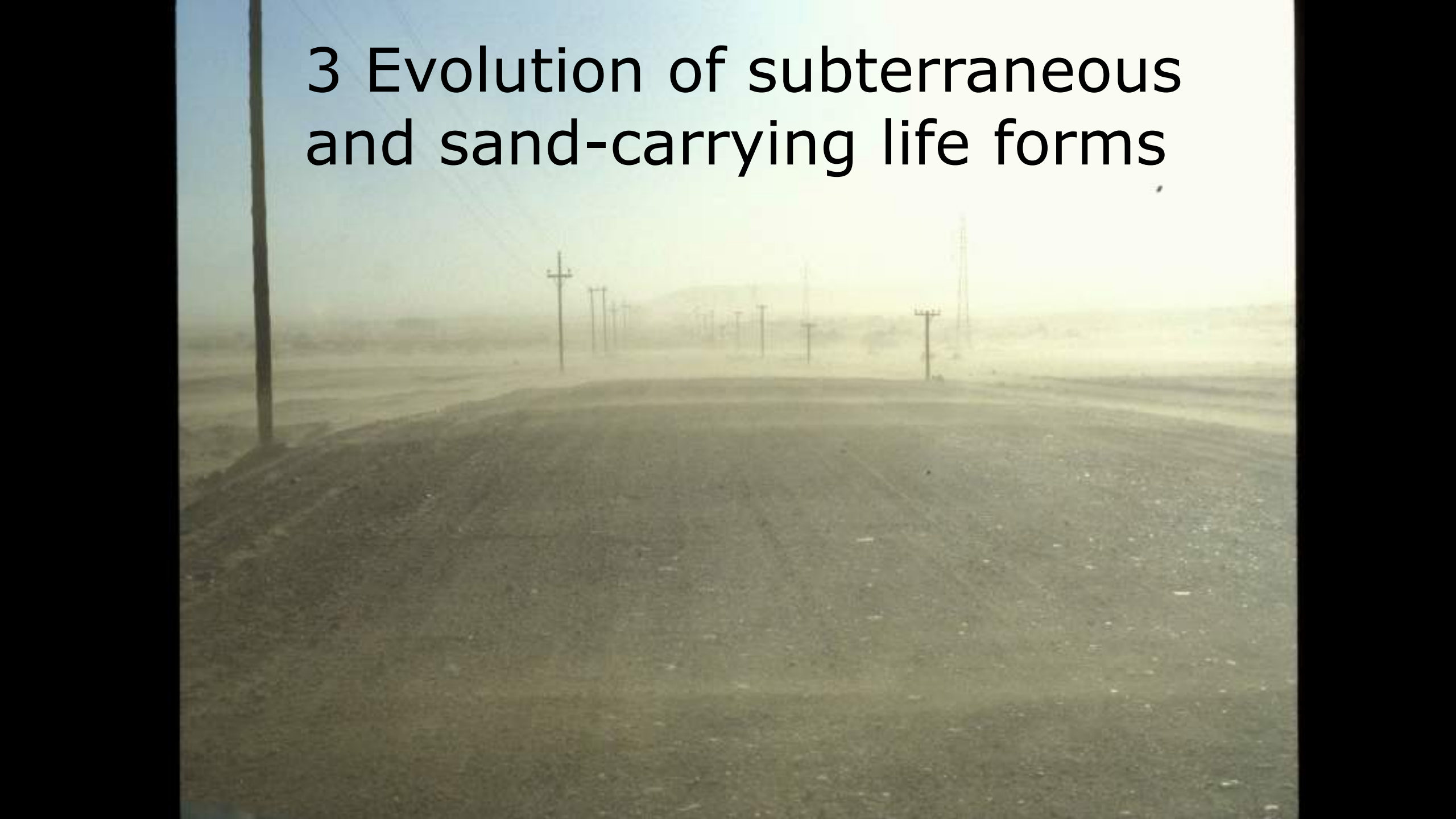
Habitat ecology of southern African quartz fields: studies on the thermal properties near the ground.
Schmiedel, Jürgens ***Plant Ecology*** 170 (2), 153-166 (2004)



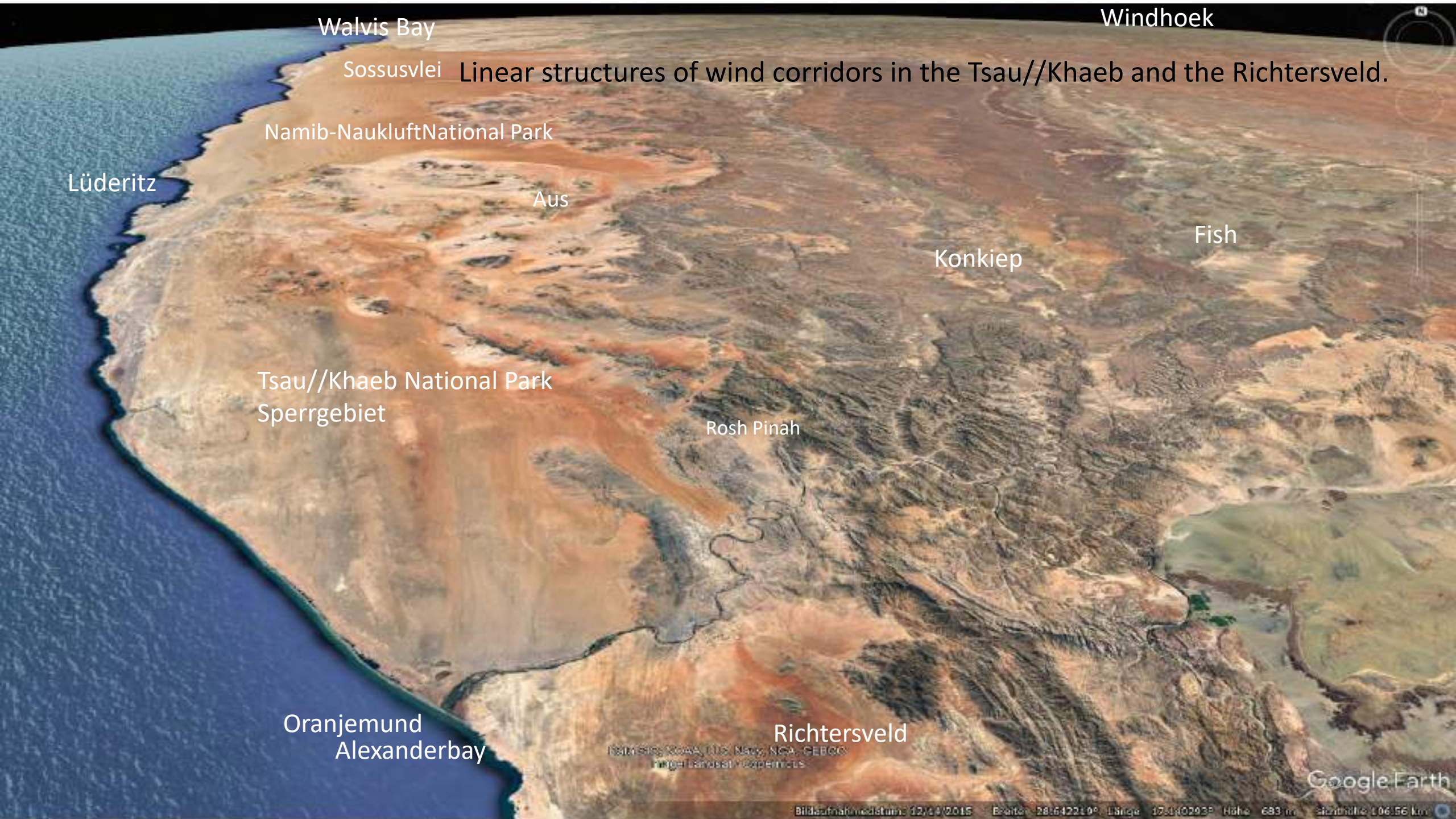

27.9 °C
33.4
27.0

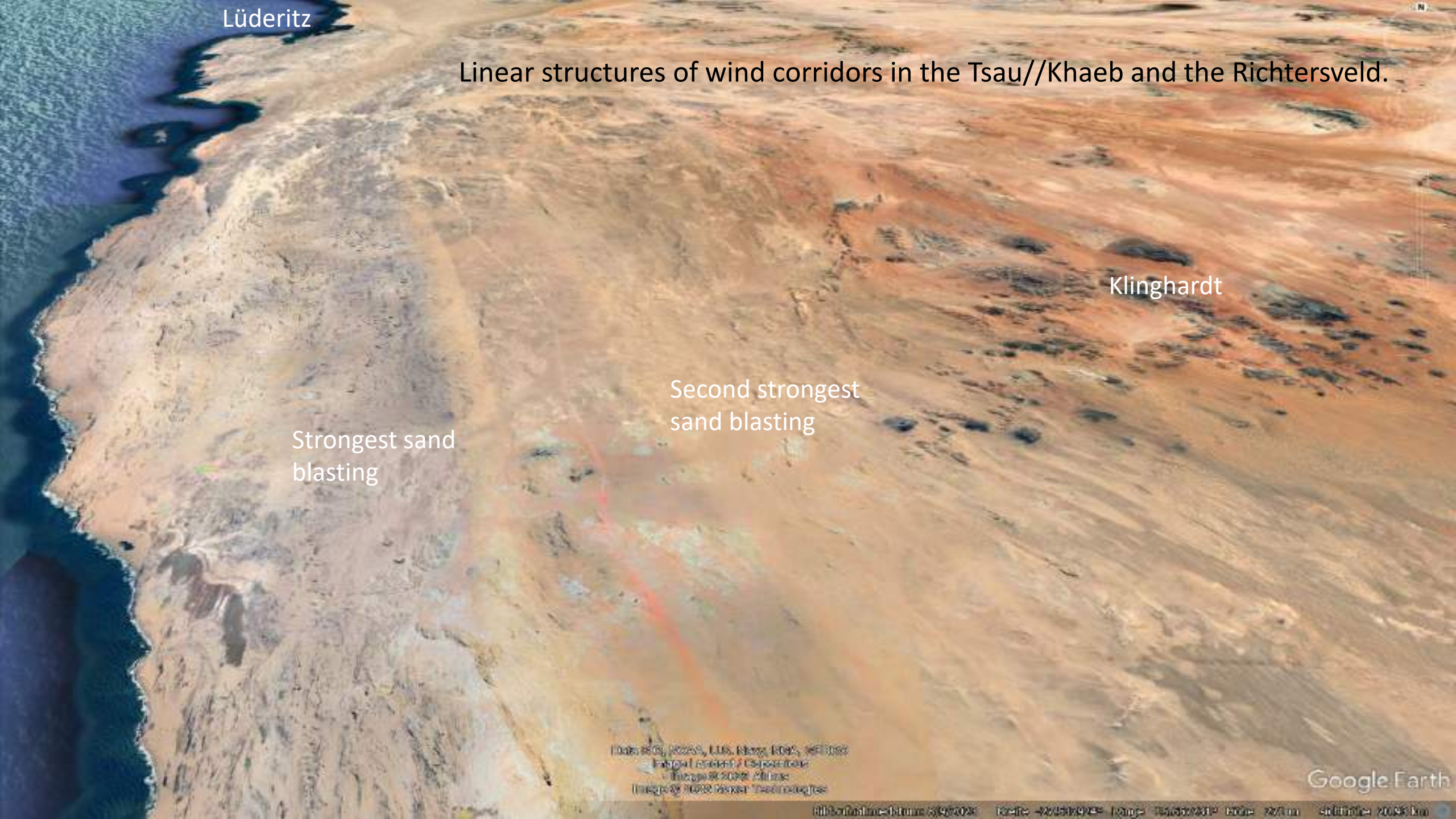



~45.6 °C
50.2
25.5
FLIR



3 Evolution of subterraneous and sand-carrying life forms


Walvis Bay
Windhoek
Sossusvlei
Linear structures of wind corridors in the Tsau//Khaeb and the Richtersveld.
Namib-NaukluftNational Park
Lüderitz
Aus
Fish
Konkiep
Tsau//Khaeb National Park
Sperrgebiet
Rosh Pinah
Oranjemund
Alexanderbay
Richtersveld
Google Earth


Lüderitz
Linear structures of wind corridors in the Tsau//Khaeb and the Richtersveld.
Klinghardt
Second strongest
sand blasting
Strongest sand
blasting
Google Earth


Sand blasted dolomite near Grillental



Sand blasted dolomite near Grillental



Euphorbia tuberculata sunken into the soil surface during the dry season

3 Evolution of subterraneous life forms



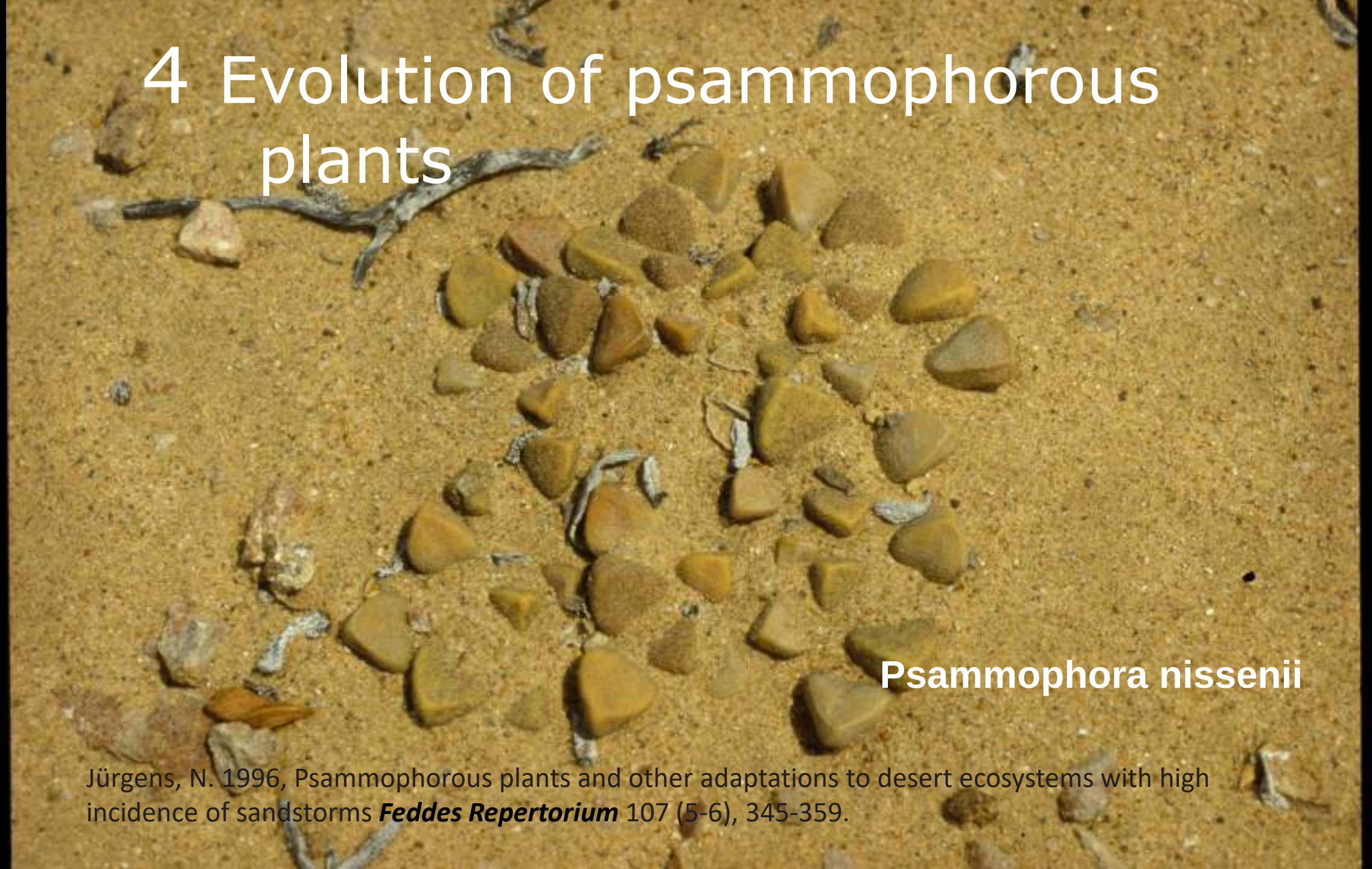
Euphorbia tuberculata


Re-appearing during of Euphorbia tuberculata the next winter rain season
Euphorbia tuberculata


Fenestraria rhopalophylla


Fenestraria rhopalophylla

4 Evolution of psammophorous plants

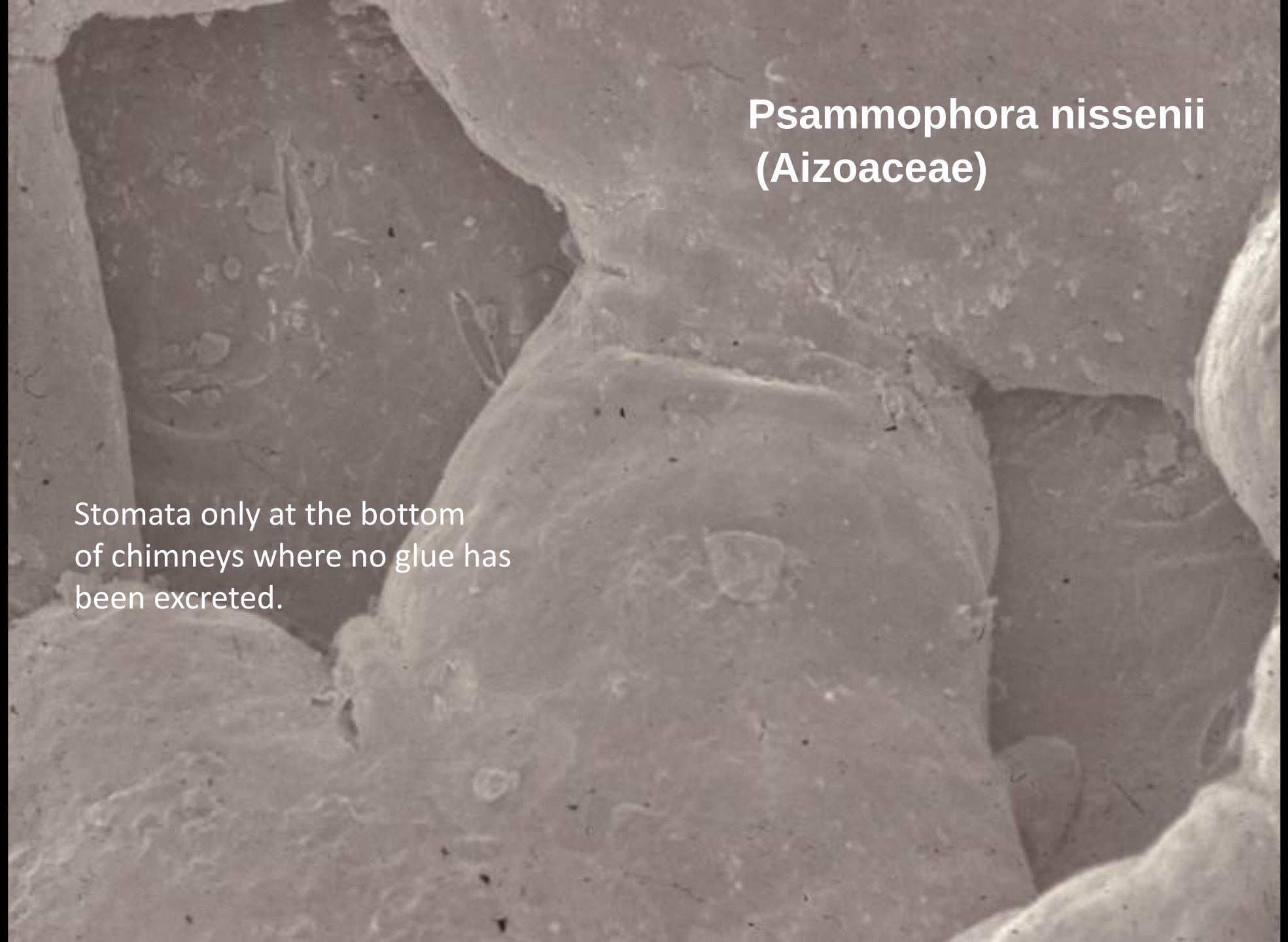


Psammophora nissenii

Jürgens, N. 1996, Psammophorous plants and other adaptations to desert ecosystems with high incidence of sandstorms ***Feddes Repertorium*** 107 (5-6), 345-359.


Liquid glue on young leaves cultivated in the greenhouse
Psammophora nissenii

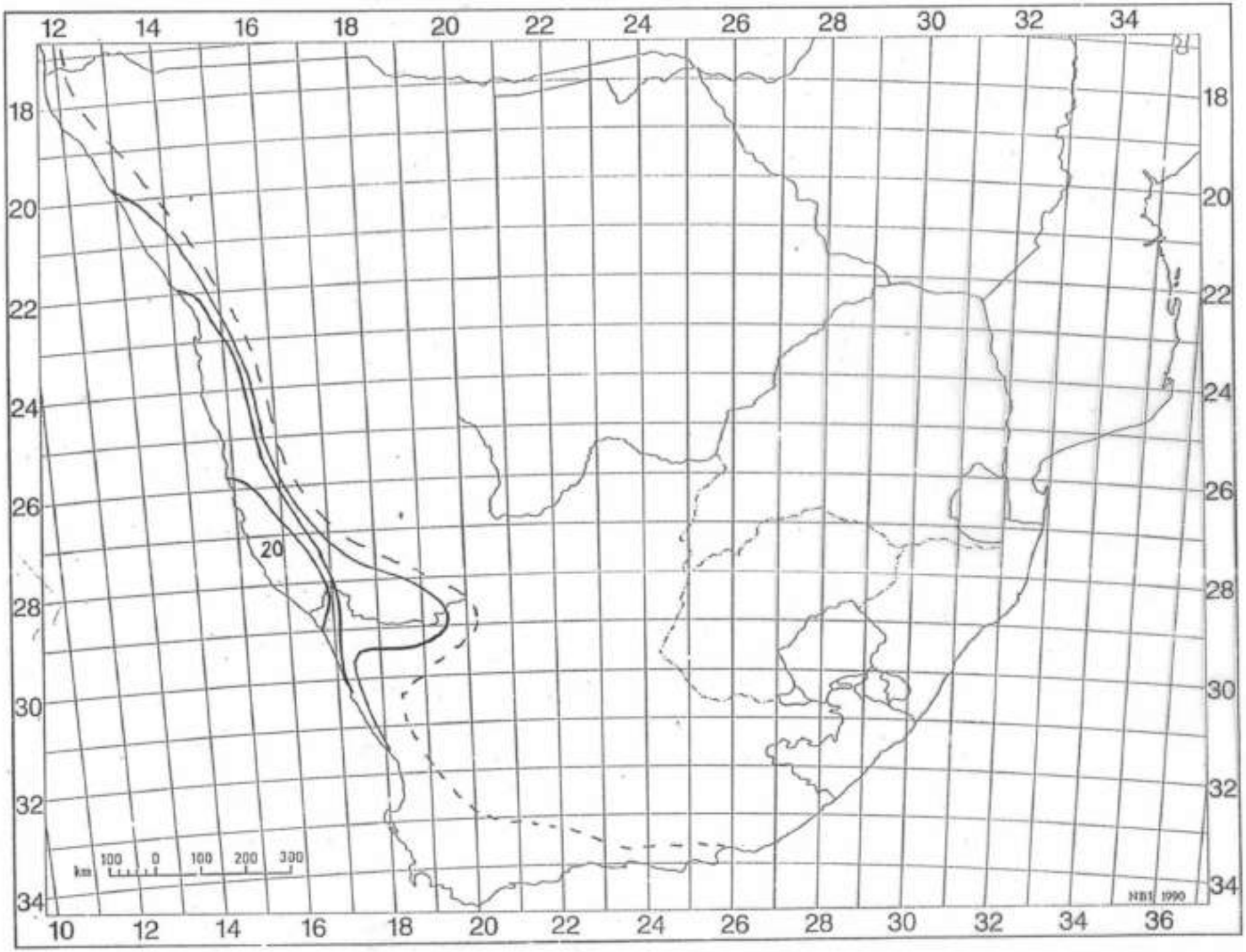

Cemented glue on young leaves cultivated in the greenhouse
Psammophora nissenii


Psammophora nissenii
(Aizoaceae)
Stomata only at the bottom
of chimneys where no glue has
been excreted.

Numerous examples. Here:
Chlorophytum viscosum







Number of psammophorous Plant species per quarter degree square.

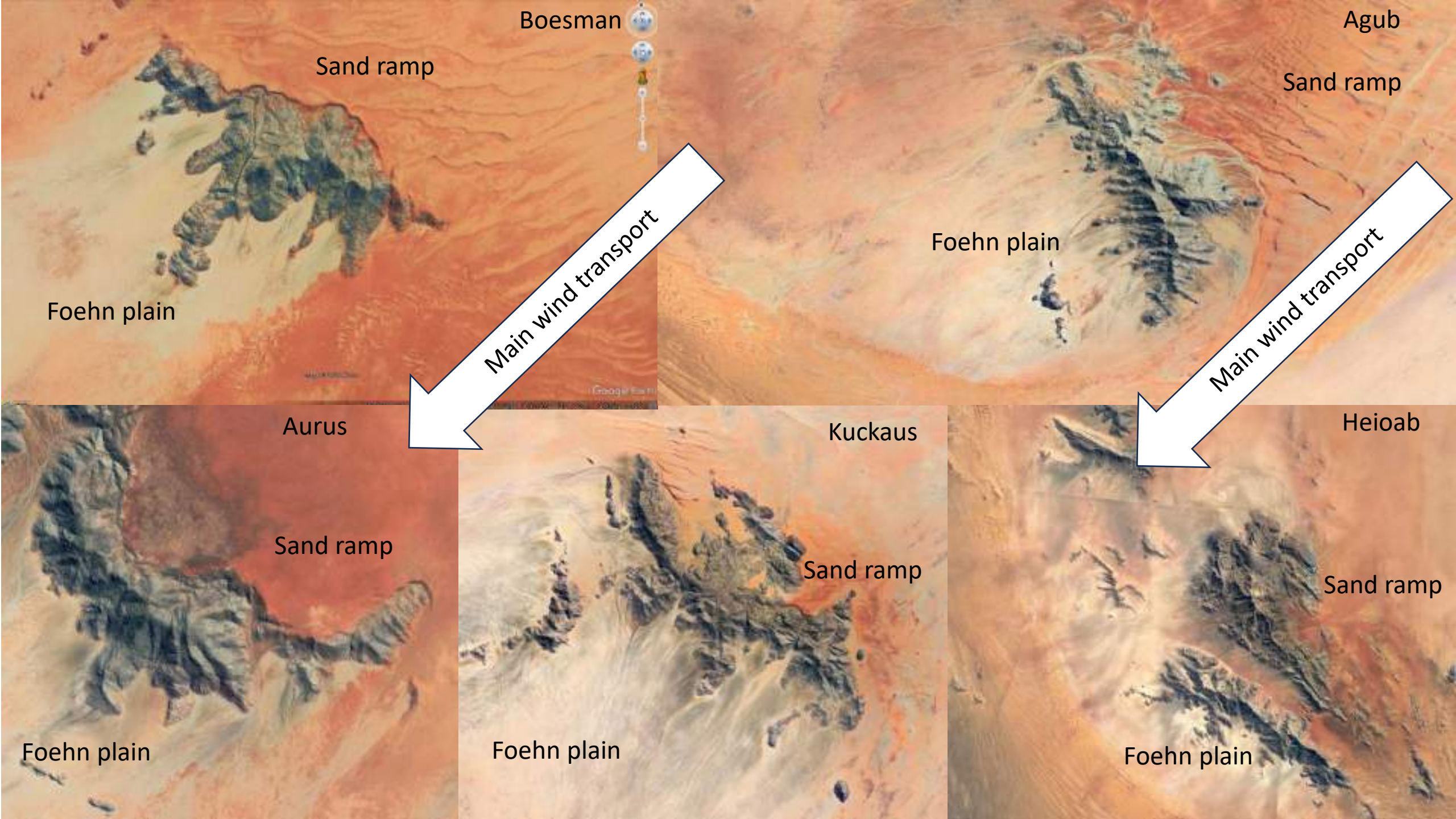
Psammophorous plants and other adaptations to desert ecosystems with high incidence of sandstorms
Jürgens N *Feddes Repertorium* 107 (5-6), 345-359. 1996

Surviving a dune burial








Boesman
Sand ramp
Foehn plain
Main wind transport
Agub
Sand ramp
Foehn plain
Main wind transport
Aurus
Sand ramp
Foehn plain
Kuckaus
Sand ramp
Foehn plain
Heioab
Sand ramp
Foehn plain



Foehn plain



Synaptophyllum juttae



5 Evolution of Fog Plants and Lichen Fields

(the latter a globally unique feature of the Namib).





Stipagrostis sabulicola

Ramalina capensis lichen field on Lüderitz peninsula





Teloschistes capensis lichen field near Alexander Bay

3 Functional ecology based on outstanding ecosystem engineers and their role in landscapes.













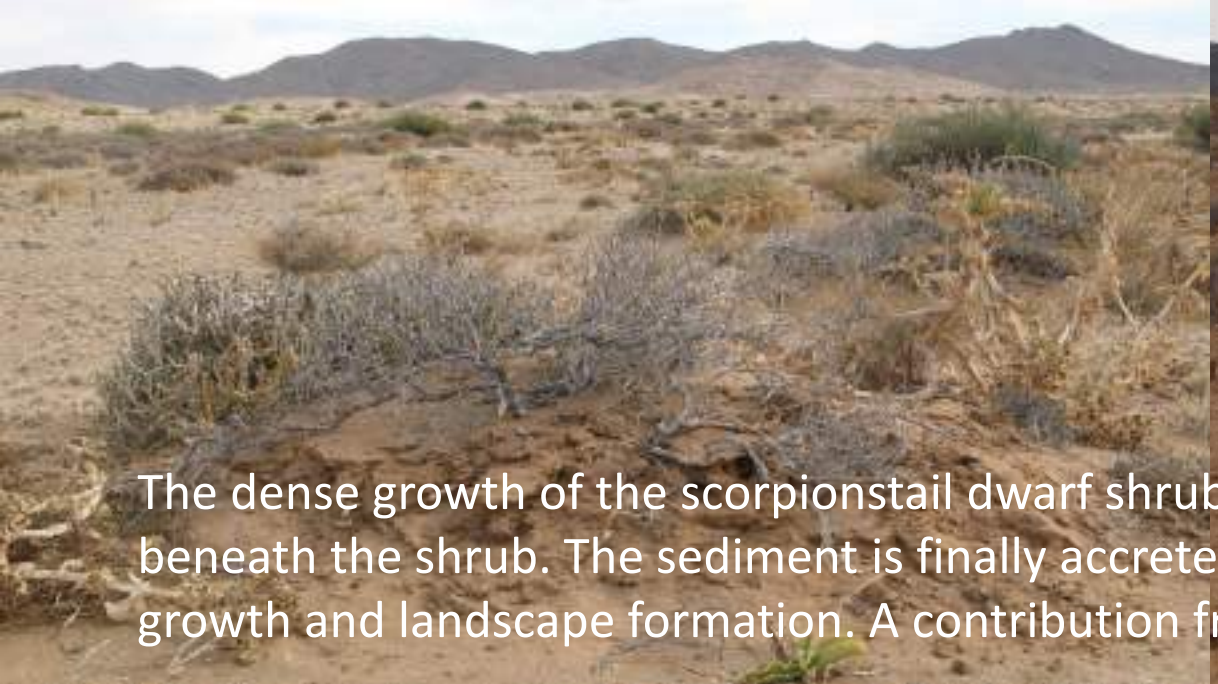
Evolution of soil-forming ecosystem engineers: Brownanthus pseudoschlichtianus („Scorpionstail“)



Jürgens, N., Burke, A., van Wyk, P., Gröngröft, A., Oldeland, J. A perfect storm: unprecedented expansion of the Namib Desert and cascading desertification processes in the northernmost Succulent Karoo: *Journal of Arid Environments* 2025.









The dense growth of the scorpionstail dwarf shrubs cause sedimentation of aeolian dust (silt) and sand beneath the shrub. The sediment is finally accreted to the soil. By this process, scorpionstail adds to soil growth and landscape formation. A contribution from “desert margin loess”!

Healthy “scorpionstail” succulent dwarf shrubland, Richtersveld National Park, Koeroegabvlakte




Google Earth


Image © 2026 Airbus
Google Earth
Bildaufnahmedatum: 3/24/2024 Breite -27.937505° Länge 16.186297° Höhe 351 m schräghöhe 929 m











Occurrence and formation of clast-free circular depressions in the southern Namib Desert, Tsau ǁKhaeb (Sperrgebiet) National Park, Namibia

Progress in Physical Geography
2024, Vol. 48(3) 275–297
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Sage

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Norbert Jürgens and Felicitas Gunter
Institute of Plant Science and Microbiology, University of Hamburg, Hamburg, Germany

Antje Burke
EnviroScience, Windhoek, Namibia



Microhodotermes viator Heuweltjie on Aurus Plateau



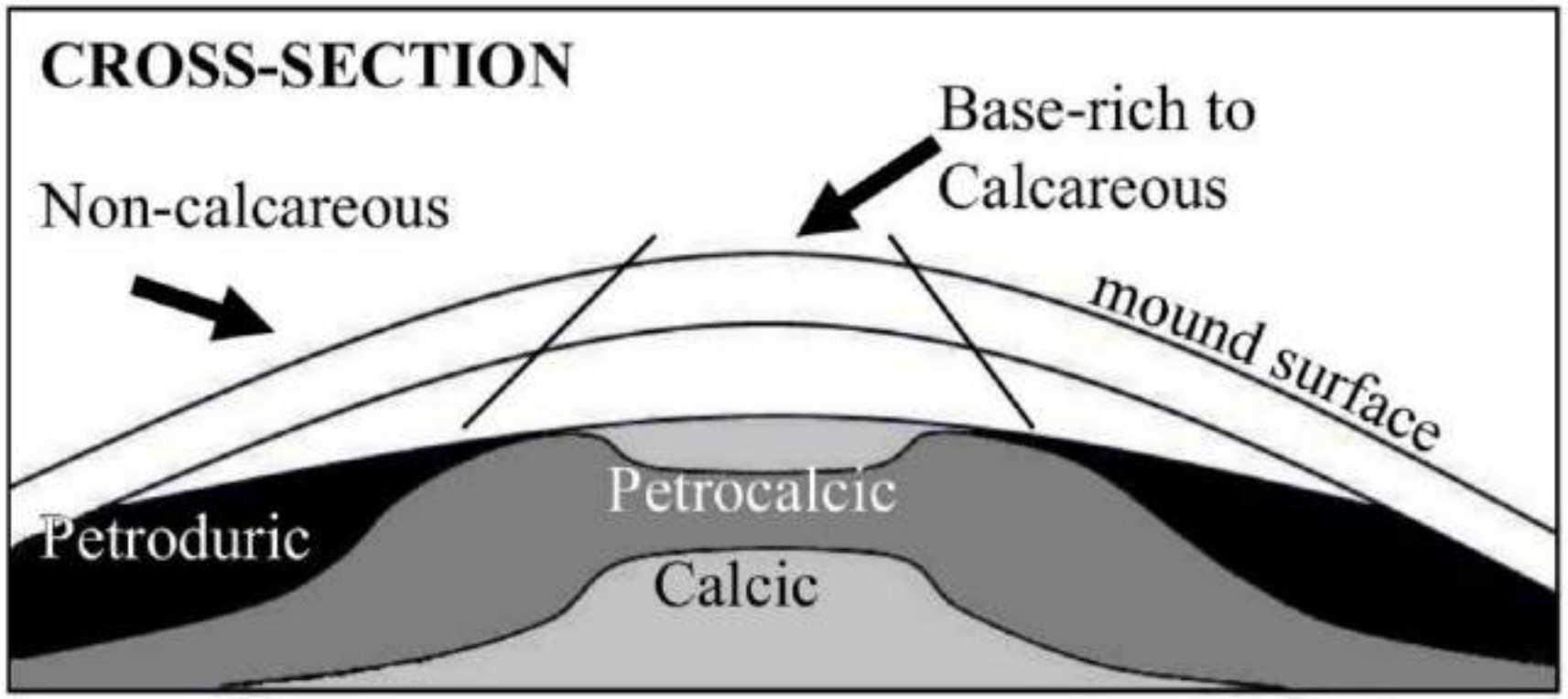
Heuweltjie-Covered Landscapes of Western South Africa – Interpretive Fieldtrip Guidebook: A new open-access resource

By Joseph R. McAuliffe, Desert Botanical Garden, Phoenix, Arizona USA and Catherine E. Clarke, Department of Soil Science, Stellenbosch University

Heuweltjie age: 34.000 years

Calcareous termite mounds in South Africa are ancient carbon reservoirs

M.L. Francis [c], L. Palcsu [b], M. Molnár [b], T. Kertész [b], C.E. Clarke [c], J.A. Miller [a], J. van Gend [a] Show more

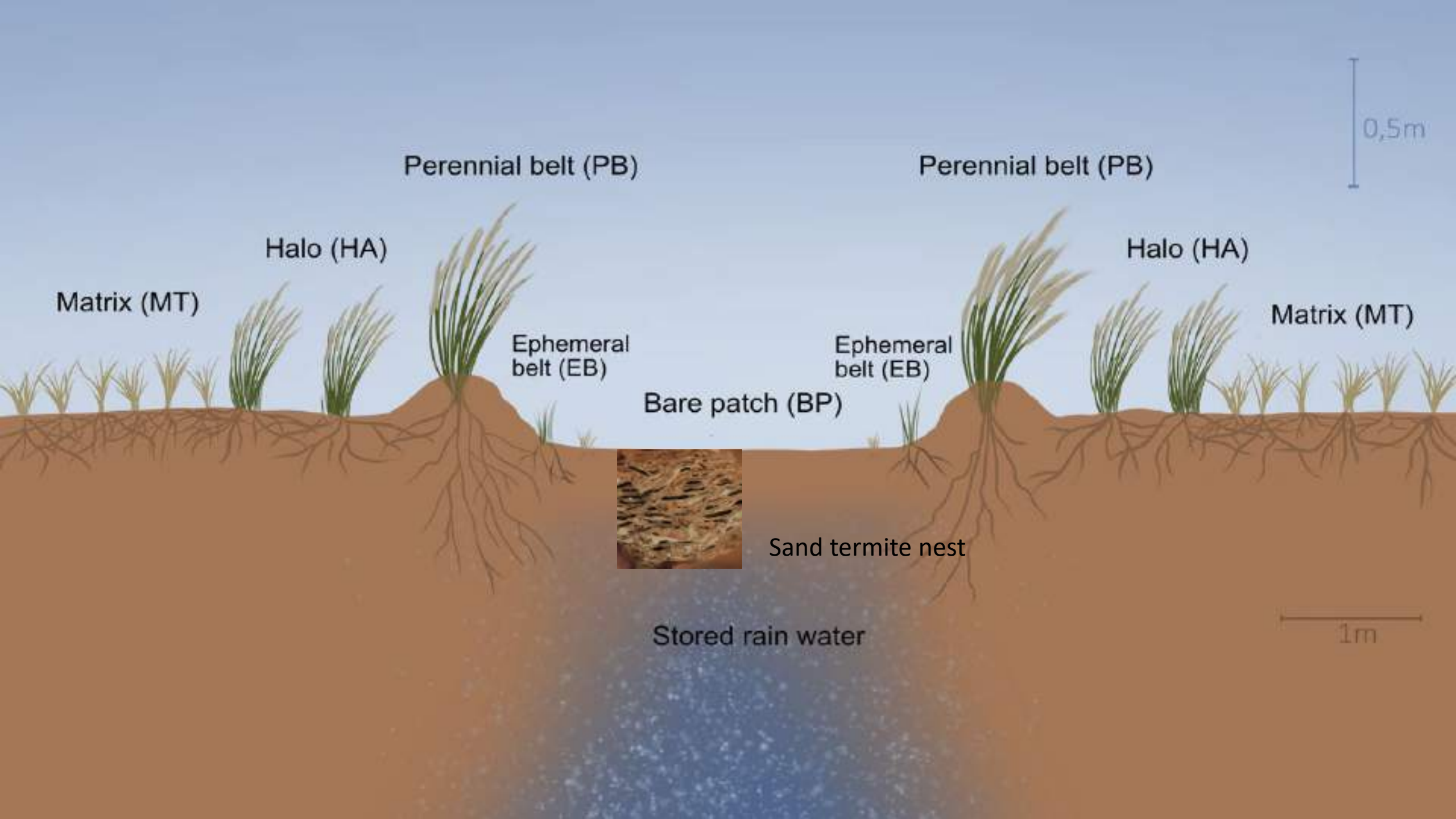


Estimated position of Microhodotermes viator nest

Heuweltjie-Covered Landscapes of Western South Africa – Interpretive Fieldtrip Guidebook: A new open-access resource

By Joseph R. McAuliffe, Desert Botanical Garden, Phoenix, Arizona USA and Catherine E. Clarke, Department of Soil Science, Stellenbosch University


Sandsheets
Fairy circles: Small whitish circles
Loamy soil
Heuweltjies: Large whitish circles
Google Earth


0,5m
Perennial belt (PB)
Perennial belt (PB)
Halo (HA)
Halo (HA)
Matrix (MT)
Matrix (MT)
Ephemeral belt (EB)
Ephemeral belt (EB)
Bare patch (BP)
Sand termite nest
Stored rain water
1m


Sand termite nest

4 A perfect storm: Degradation and Namib Desert expansion in the Richtersveld.

Risk of potentially dangerous ecosystem changes!

1. Climate models since 2007 project a strong decline and shrinking of Succulent Karoo
2. Recent centennial drought mobilised large amounts of sand and dust
3. Our recent publication identified a combination of both causal factors: anthropogenic desertification and climate change driven desert expansion.

Succulent Karoo plants do not survive higher temperatures

Potential vulnerability of Namaqualand plant diversity to anthropogenic climate change

G.F. Midgley[a,*], W. Thuiller[a,b]

Journal of Arid Environments 70 (2007) 615–628

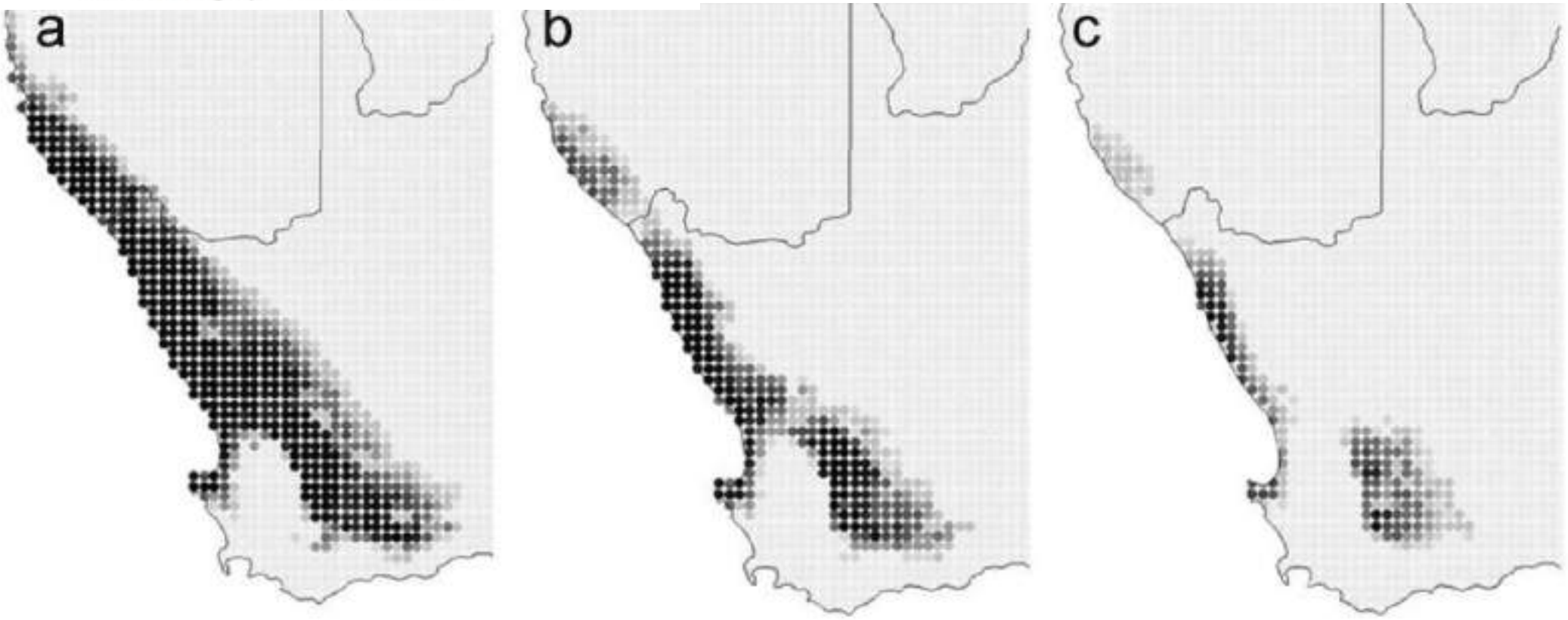


Fig. 1. Modelled habitat suitability for the Succulent Karoo Biome in southern Africa under current conditions (a), under future conditions by 2050 (b), and under future conditions by 2080 (c), according to the general circulation model HadCM3, using the BIOMOD approach of Thuiller (2004). Darker shading indicates high probability of occurrence.

Important component: Ecosystem properties and ecosystem processes:
Processes which potentially threaten natural environment, technical infrastructure and settlements

- Aeolian sand transport (ground truth monitoring)
- Aeolian dust transport monitoring (satellite monitoring)
- Topsoil salinity and toxic aeolian dust (satellite and ground truth)



NASA Worldview

Frequent foehn storms from easterly direction, especially during the winter months. Export of aeolian silt is well visible in satellite images.

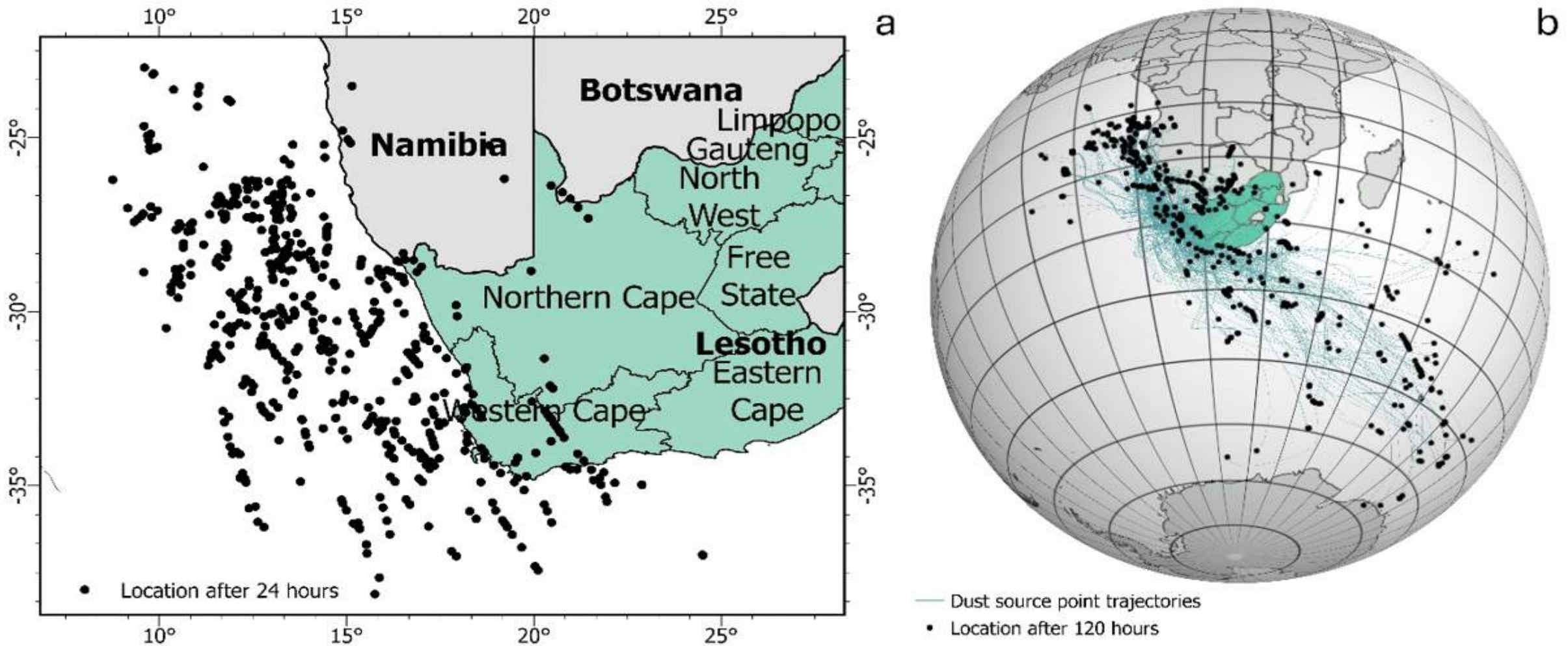
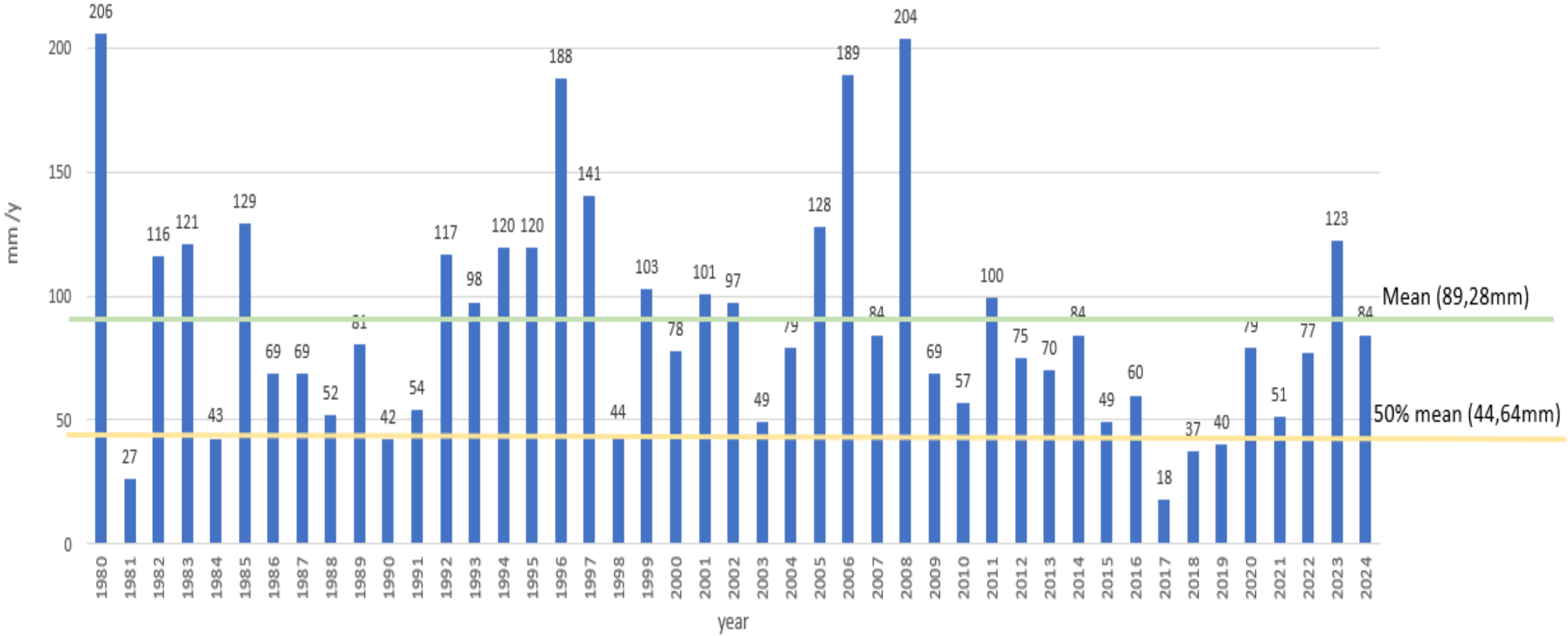


Figure 11. The location of the dust particle trajectories after 24 hours (a) and 120 hours (b) as calculated using the HYSPLIT model.

Source: Heleen C. Vos[1,2*] Johanna R. von Holdt[3] Helga van der Merwe[4,5] Igshaan Samuels[6, 7] Ute Schmiedel[8] Norbert Jürgens[8] Juliane Krenz[9] Mmoto L. Masubelele[10,11] Bavisha Koovarjee[3] Wolfgang Fister[9] Frank D. Eckardt[3] Clement Cupido[6] Nikolaus J. Kuhn[9] Susanne Fietz[1] 2025 Land cover, drought, and dust emission in arid Succulent Karoo shrublands. Aeolian Research 74 (2025) 101006

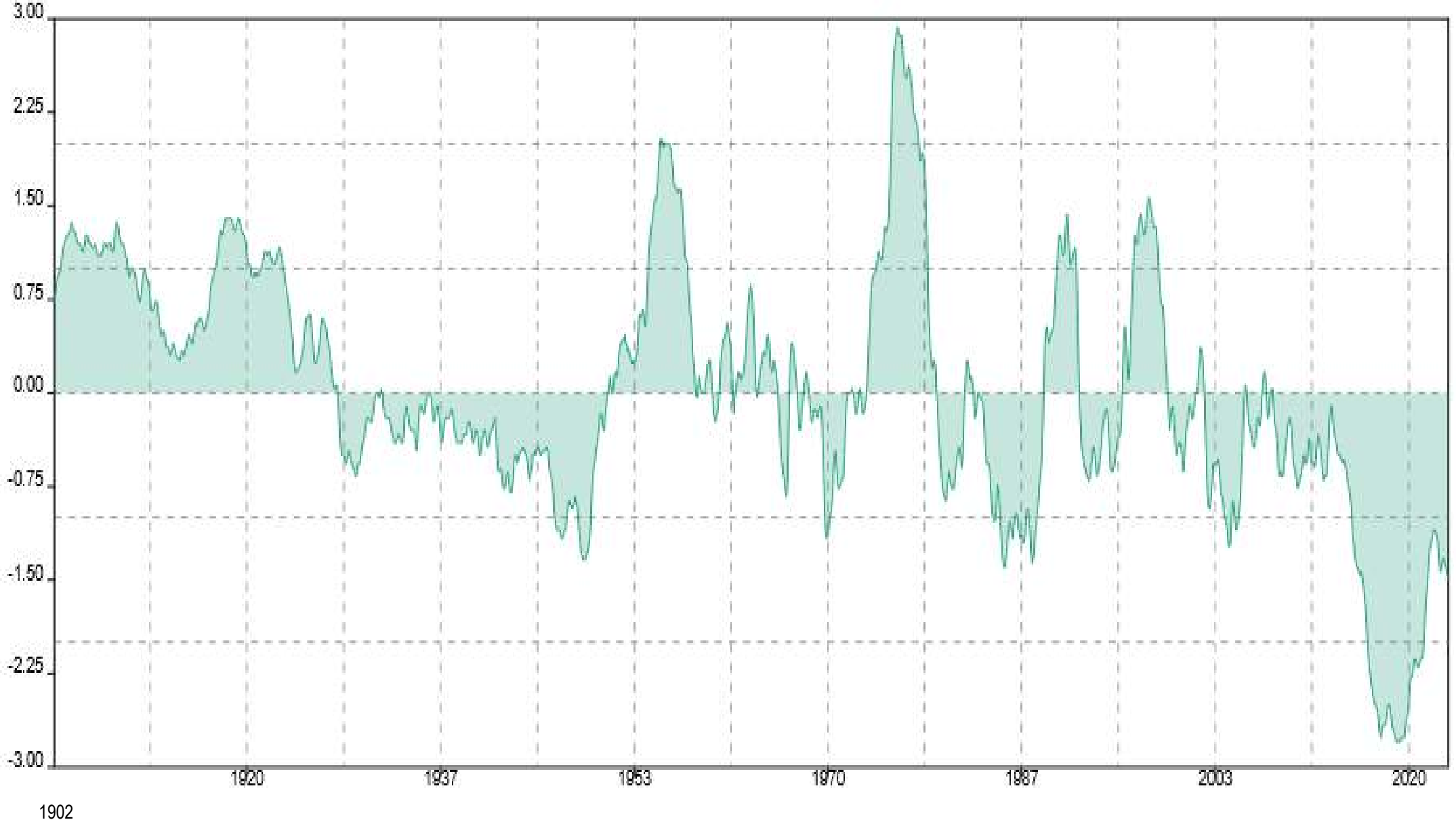
Centennial drought 2012-2022 (2015-2019)

10 years rain below average, 3y less than 50% of average.



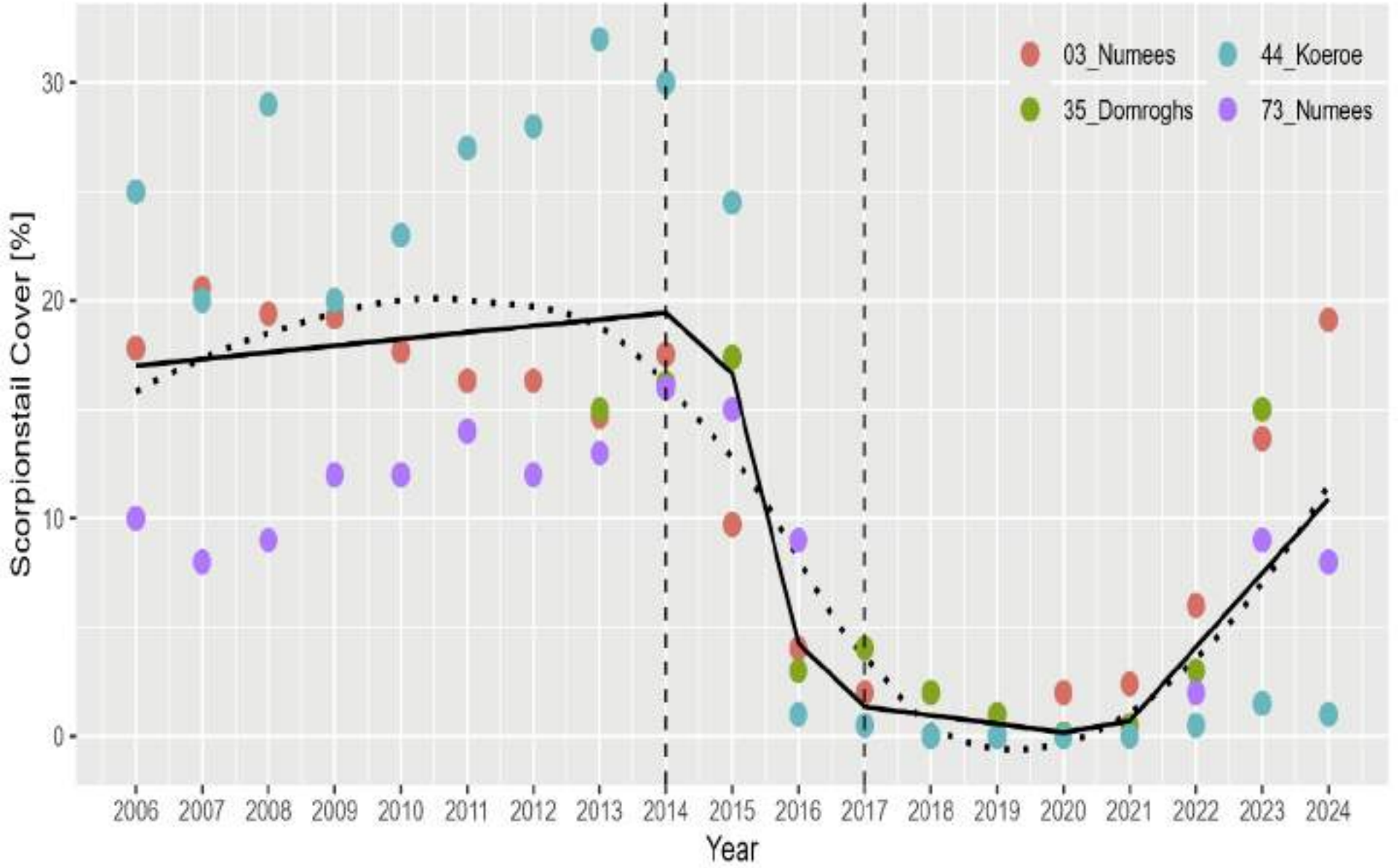
Rain at Numees, Richtersveld National Park

Drought lengths and intensities since 1902.

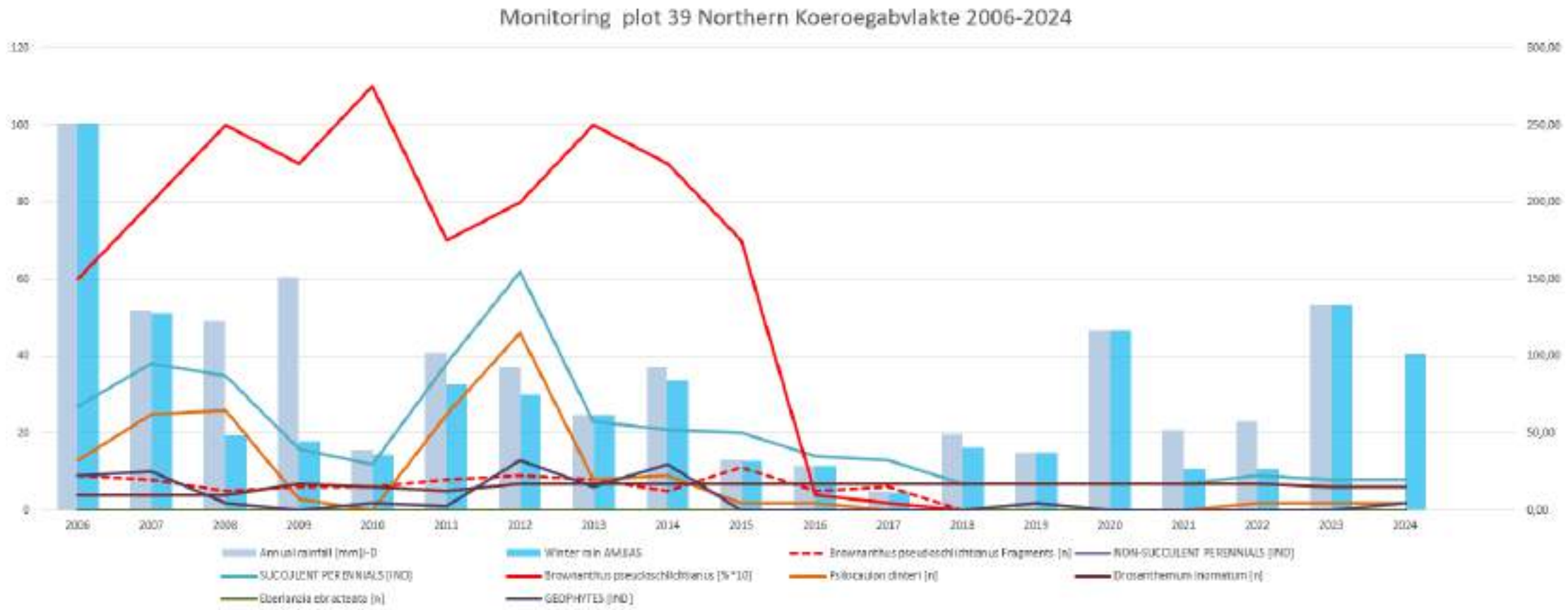


Modelled Precipitation / Evapotranspiration index (SPEI) calculated for Numees / Richtersveld NP

Response of scorpionshrub at those localities, where recovery took place after 2021.

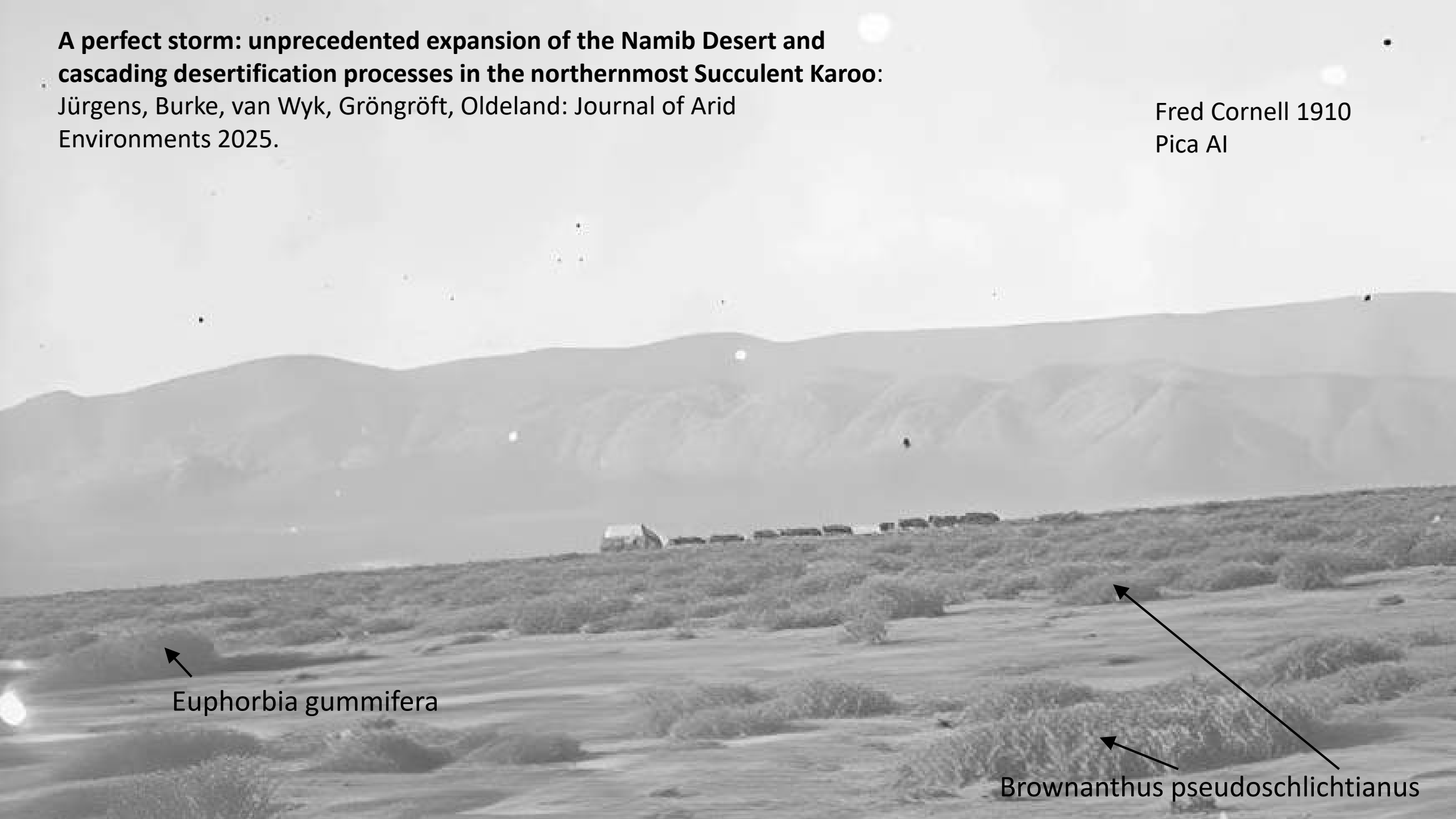


Collaps of scorpionshrub without recovery until 2024 in most study sites



A perfect storm: unprecedented expansion of the Namib Desert and cascading desertification processes in the northernmost Succulent Karoo: Jürgens, Burke, van Wyk, Gröngröft, Oldeland: Journal of Arid Environments 2025.

Fred Cornell 1910
Pica AI

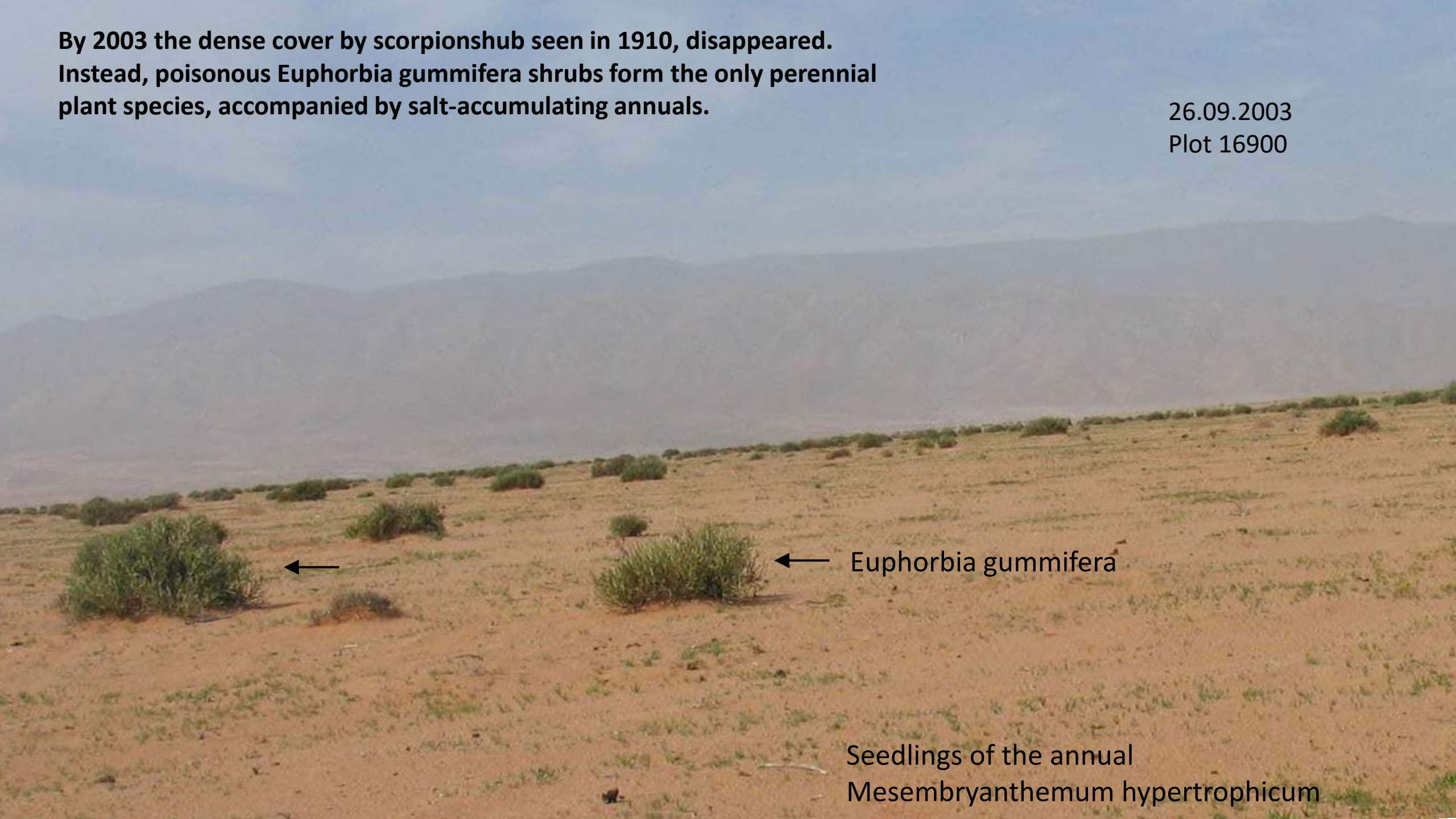


The position of the old oxen waggon trail is still well visible and allows to find the exact position of the photo from 1910.



By 2003 the dense cover by scorpionshub seen in 1910, disappeared. Instead, poisonous Euphorbia gummifera shrubs form the only perennial plant species, accompanied by salt-accumulating annuals.

26.09.2003
Plot 16900



By 2025, even the Euphorbia gummifera shrubs dies. The vegetation is now composed of salt-accumulating annuals and sparse desert grasses.



25.01.2025
2km north of Plot 16900

Export of topsoil loess / silt
Invasion of desert grasses

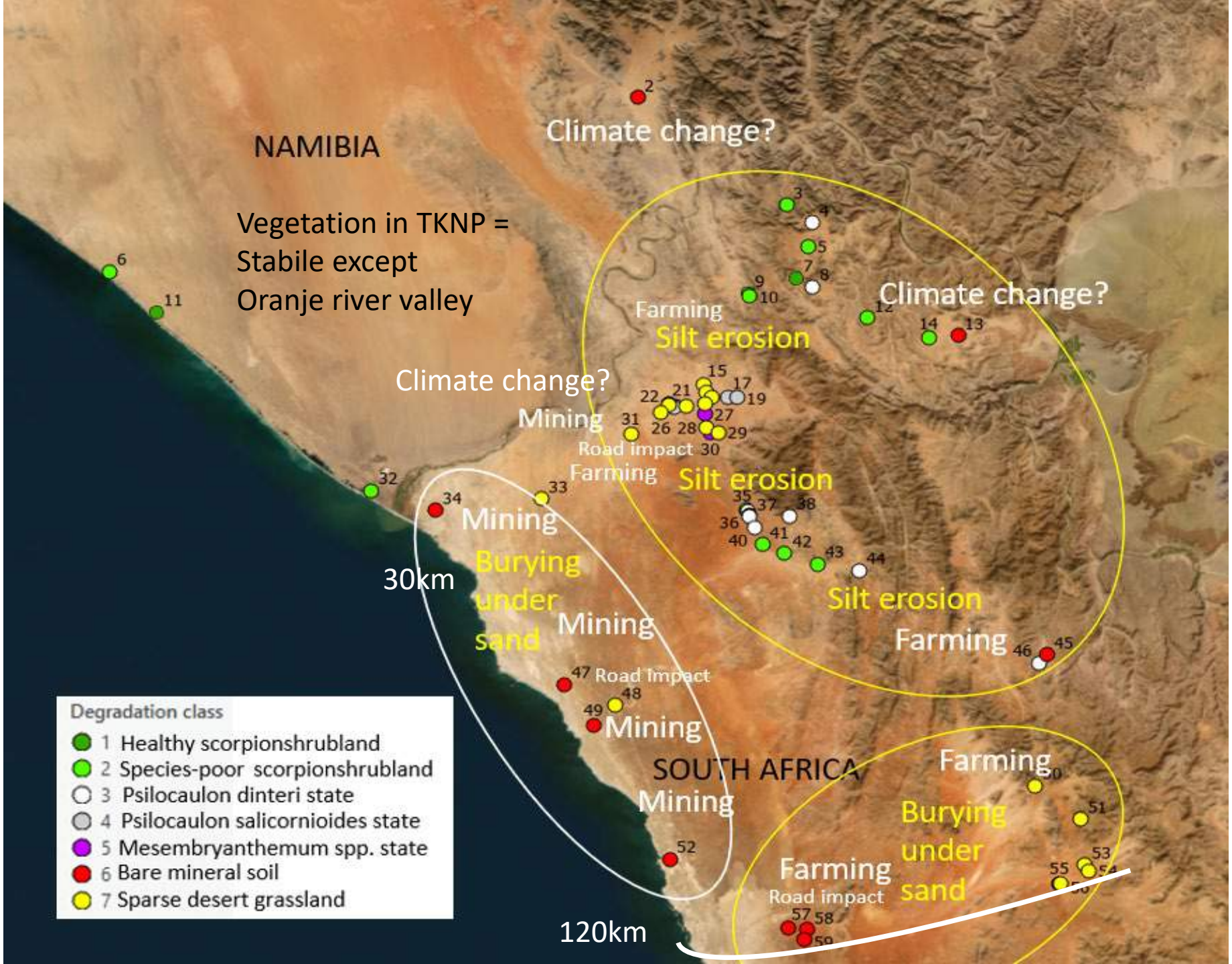




Schwund der Populationen von Aloidendron pillansii

Hoffman et al. SSRN Preprint 2025The long-term decline of a succulent tree, Aloidendron pillansii, in the hyper-arid Richtersveld region of southern Africa


1985
1985 – 2023 Vegetation change in SE
Richtersveld, Farm Grasvakte and neighbours
38985
Google Earth

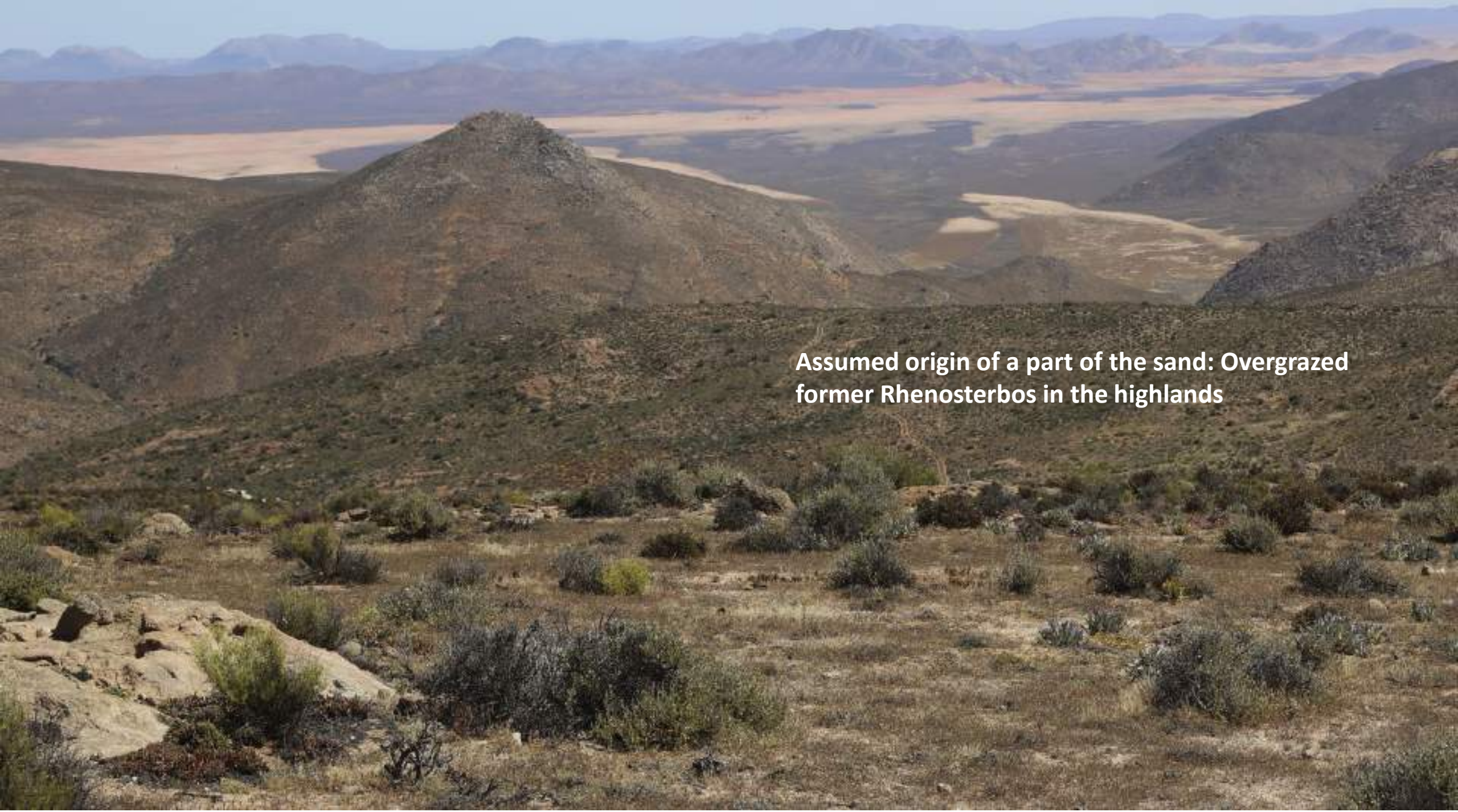

NAMIBIA
Vegetation in TKNP =
Stabile except
Oranje river valley
Climate change?
Climate change?
Farming
Silt erosion
Climate change?
Mining
Road impact
Farming
Silt erosion
Mining
30km
Burying
under
sand
Mining
Silt erosion
Farming
Road Impact
Mining
SOUTH AFRICA
Mining
Farming
Burying
under
sand
Farming
Road impact
120km
Degradation class
1 Healthy scorpionshrubland
2 Species-poor scorpionshrubland
3 Psilocaulon dinteri state
4 Psilocaulon salicornioides state
5 Mesembryanthemum spp. state
6 Bare mineral soil
7 Sparse desert grassland


2011
1985 – 2023 Vegetation change in SE
Richtersveld, Farm Grasvakte and neighbours
38985
Google Earth


2012
1985 – 2023 Vegetation change in SE
Richtersveld, Farm Grasvakte and neighbours
Google Earth


2023
1985 – 2023 Vegetation change in SE Richtersveld, Farm Grasvakte and neighbours
13344
38885
D2
1253962
1252
5869
13343
13342
26617
13341
13340
5861961
5853
1251
38985
38983
38886
146
38981
1818814
1250
147
1249
1819


Assumed origin of a part of the sand: Ploughed fields in the highlands


Assumed origin of a part of the sand: Overgrazed
former Rhenosterbos in the highlands


Vegetation sequence after burial under sand

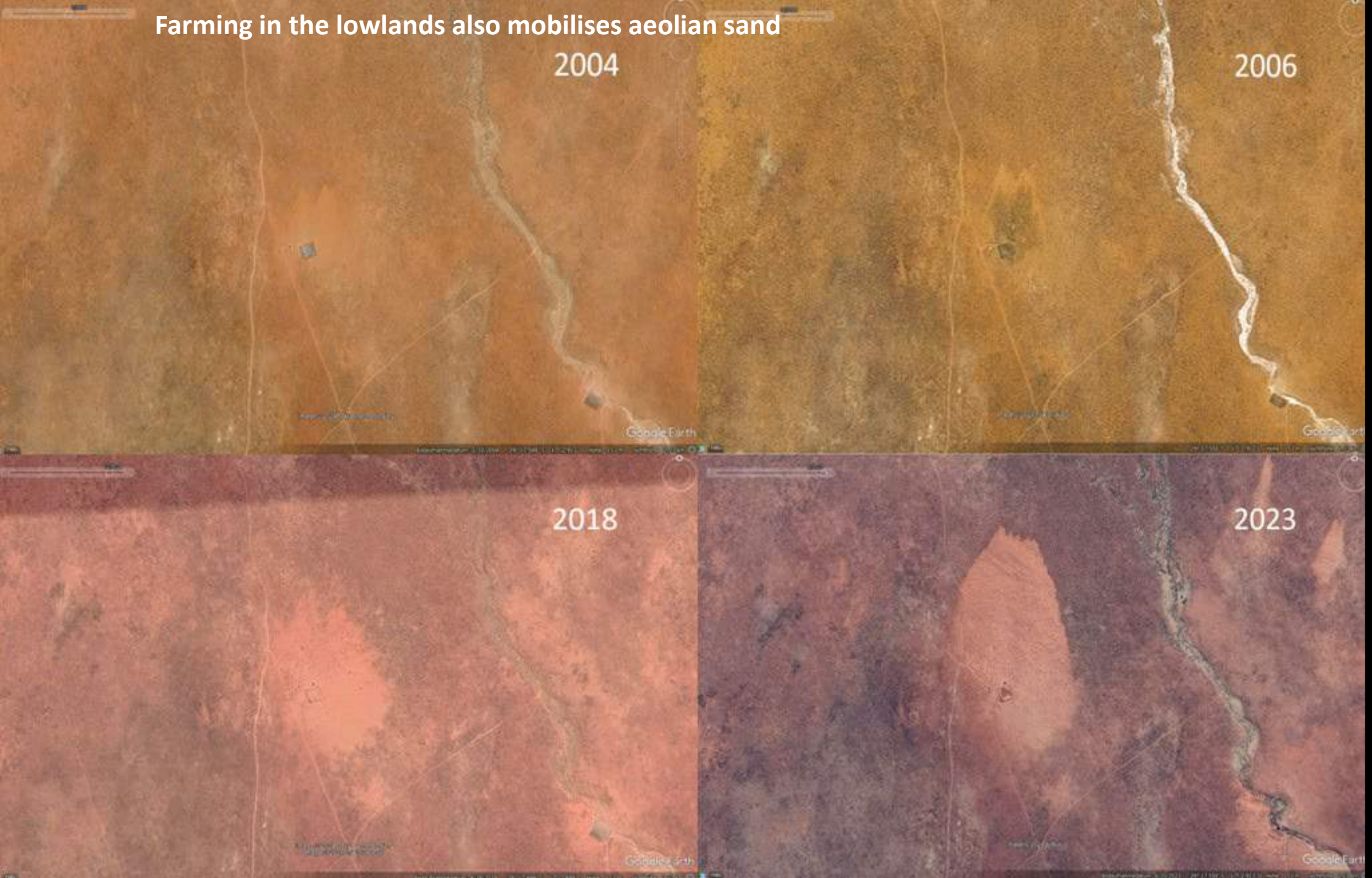

Vegetation sequence after burial under sand


Vegetation sequence after burial under sand


Vegetation sequence after burial under sand



Farming in the lowlands also mobilises aeolian sand







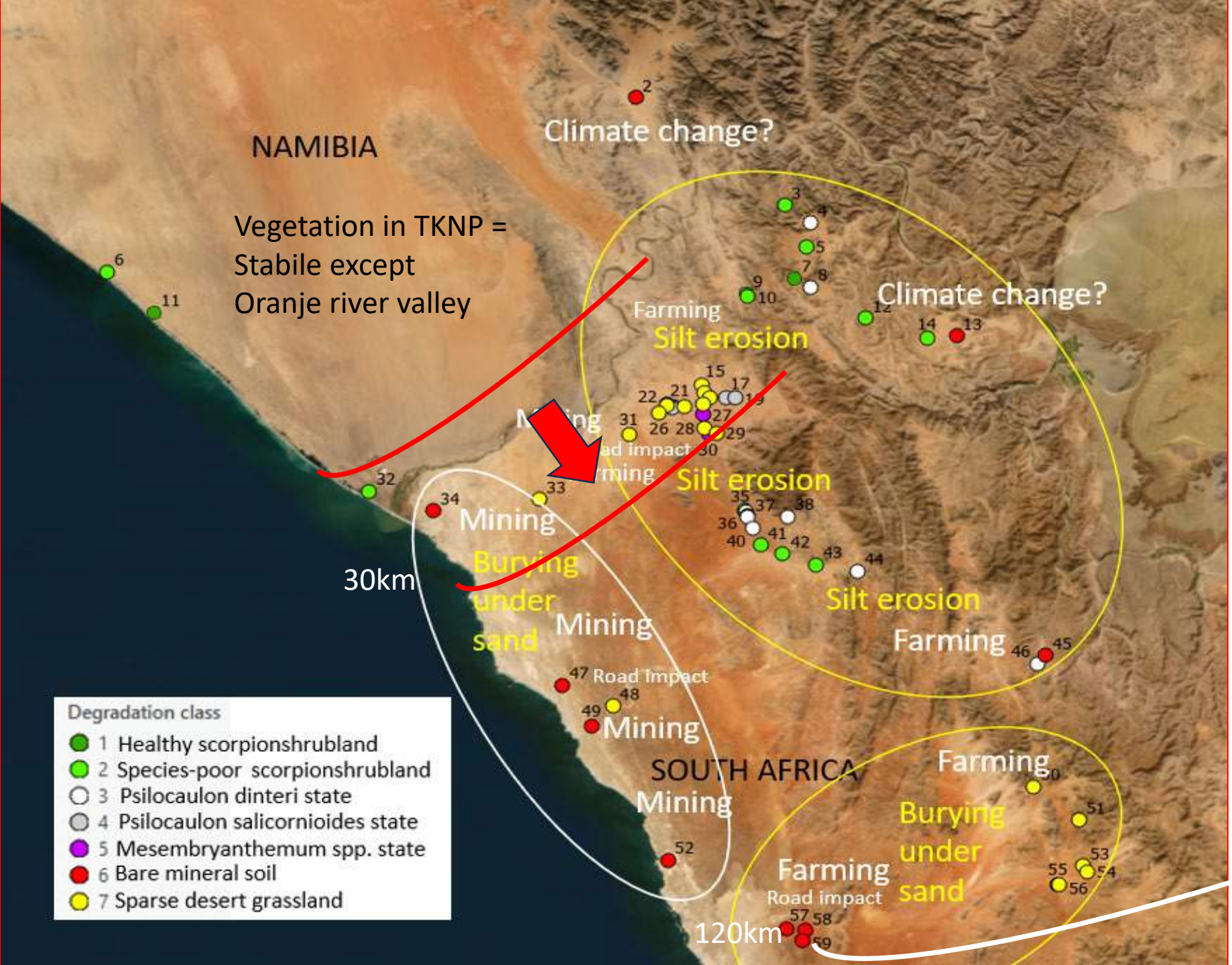




Open prospecting trenches in diamond mining areas do also mobilise aeolian sand.

Year	Length [m]	Area [m²]
2002	483	44005
2006	570	70612
2010	964	149048
2011	1045	168743
2013	1186	202157
2018	1625	309645
2020	1644	397558
2023	2221	495690


The famous Alexander Bay Lichen field is getting buried under aeolian sand coming from the adjacent mining area in southerly direction.



Southwards expansion of the Namib Desert as indicated by the invasion of sparse desert Grassland and migration of Namibian desert plants like Stipagrostis sabulicola. Desert expansion probably driven by increased temperatures and longer heatwaves (Hoffman et al. 2025)

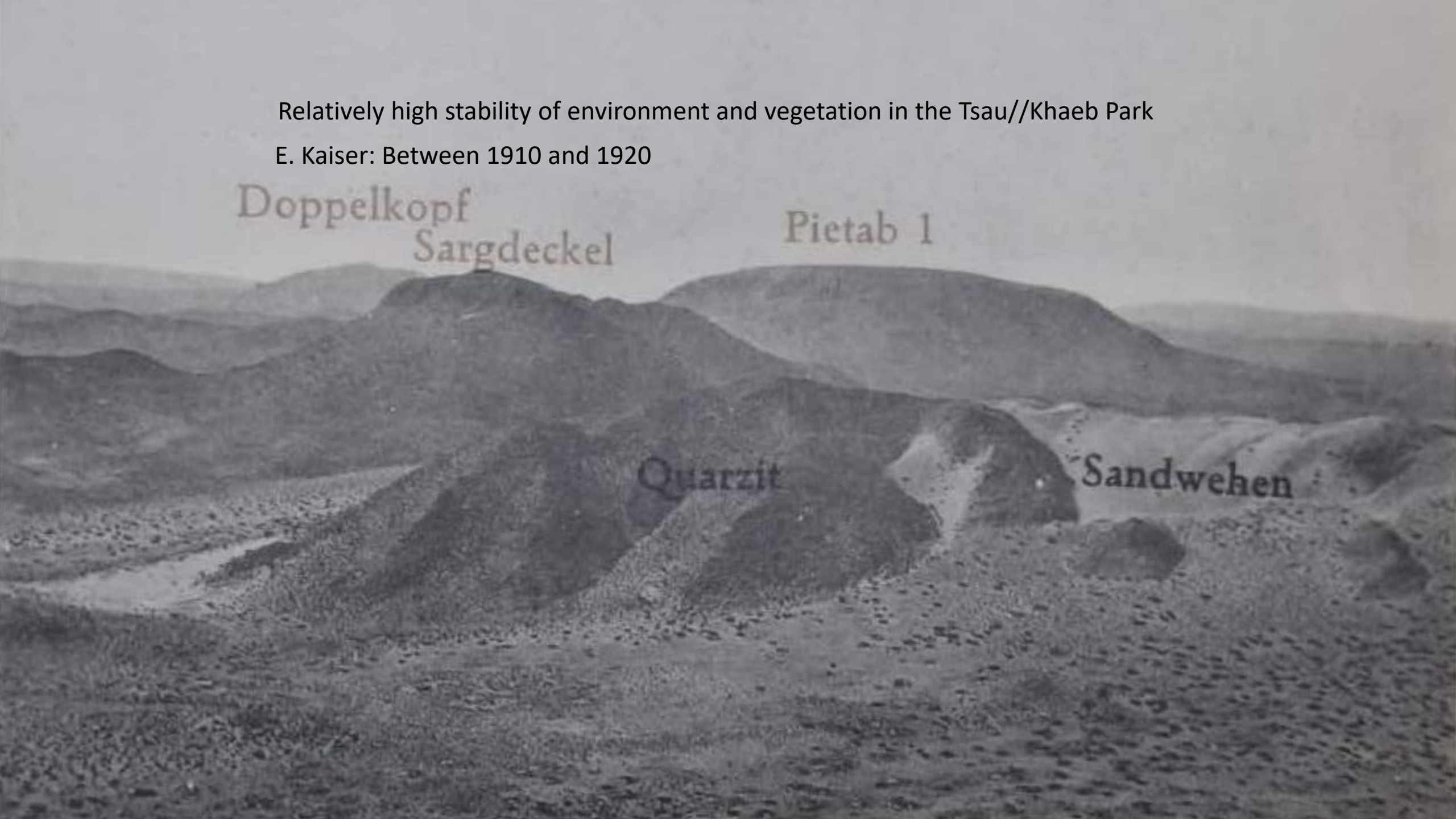
Relatively high stability of environment and vegetation in the Tsau//Khaeb Park

16.04.2026



Relatively high stability of environment and vegetation in the Tsau//Khaeb Park

E. Kaiser: Between 1910 and 1920





5 Lessons learned from the Richtersveld: Enduring stability, however, potentially dangerous ecosystem processes in the Tsau//Khaeb.

State of the art and some broad considerations for conservation and for development.

Uncharted southern TKNP: The upcoming and first comprehensive vegetation map of the entire TKNP will bring up many Surprises in terms of ecosystems so far not described for the TKNP.




Large amounts of sand are stored in the wind shadow inside and behind shrubs. Death of the shrubs, for example caused by a long drought, will release these sands and cause mass transport towards the north.

The Tsau//Khaeb/Sperrgebiet shares the same ecosystems with the Richtersveld. Therefore, in principle the same ecosystem properties cause the same vulnerabilities.

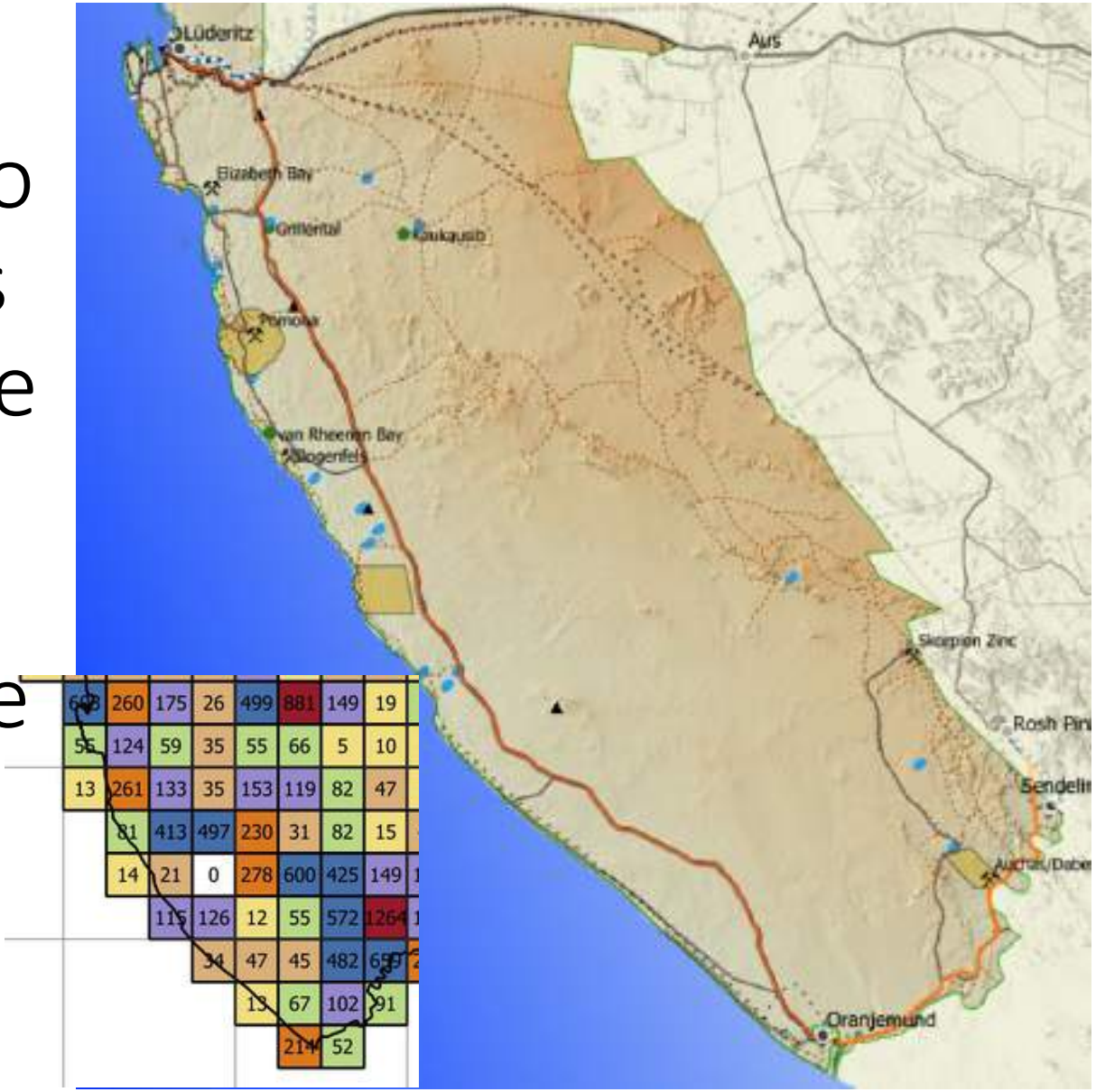
The presently observed stability of the ecosystems and the vegetation in the Tsau//Khaeb NP is therefore interpreted as being caused by the lack of human disturbance. The few gravel roads and powerlines in the TKNP show signs of beginning degradation.

Therefore, it will be crucial for both, the natural environment and the planned infrastructure, to first map the different ecosystems and their properties and their biodiversity and to then adapt infrastructures and developments to the specific risks.

Africa´s last wilderness. No fences, no roads, no stock, no lights, no humans. 260 x 100 km escaped the human transformation during the phase of human appropriation of all ecosystems.

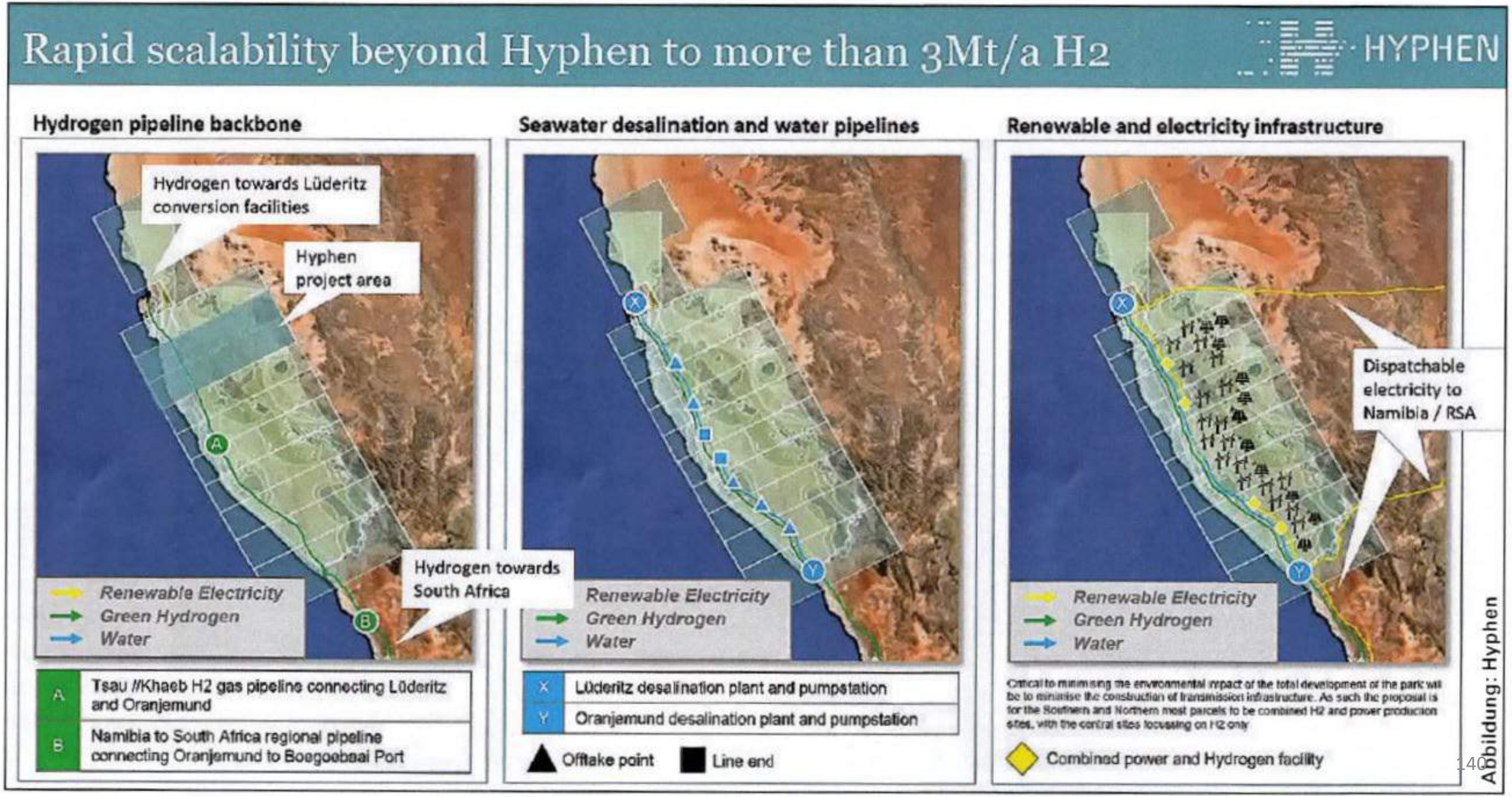


Due to the “Sperrgebiet” status since 1908, access to most of the hinterland was prohibited. Especially in the southern inland areas, devoid of any tracks, no scientific studies took place and vast areas are not or very poorly represented in scientific collections.



Sources: specimen/grid NBRI WIND
Roads & tracks: MEFT 2020: TKNP Mgmt Plan

Numerous development plans …



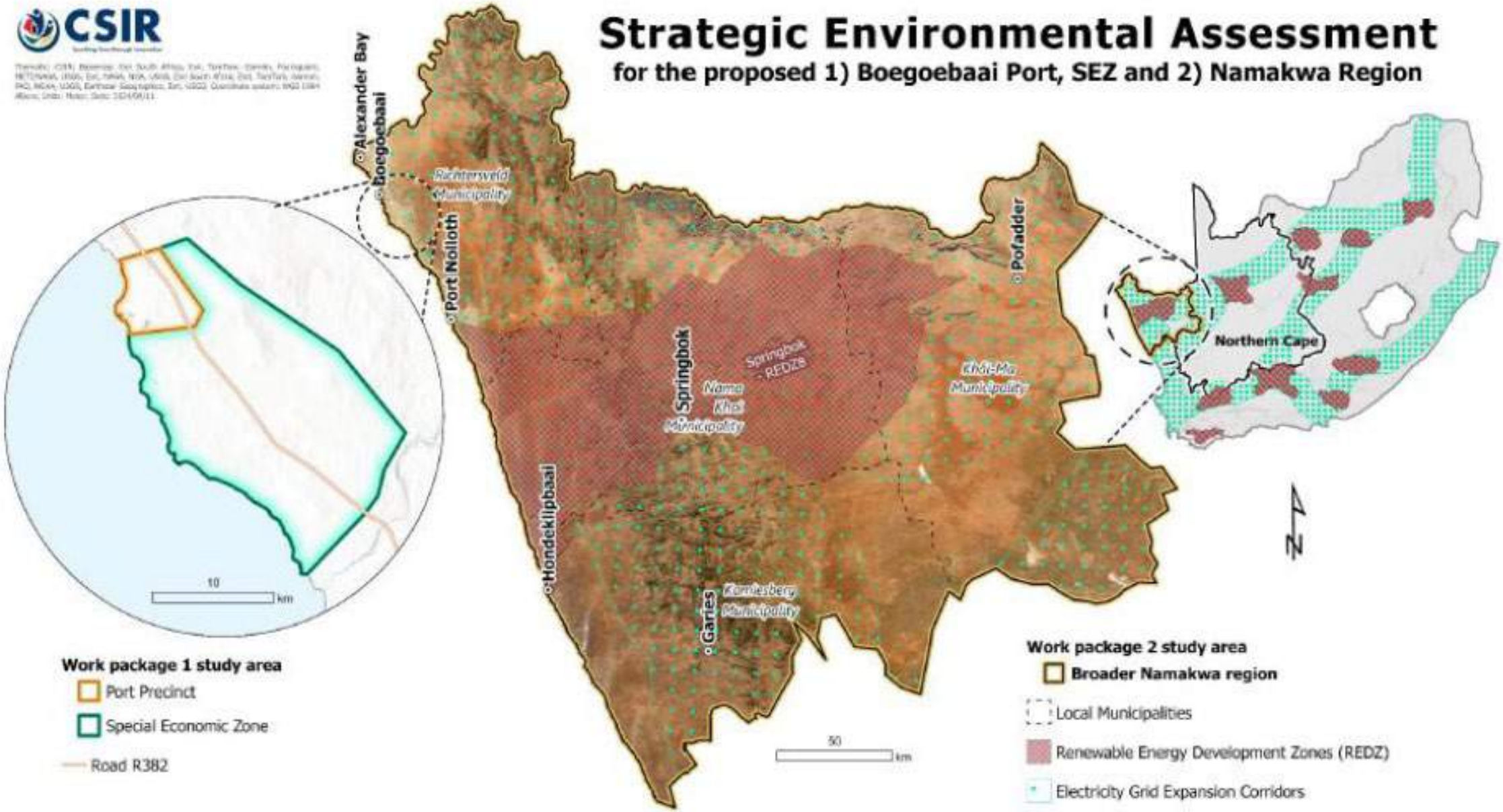


Figure 1-1: The spatial extent of the two SEA Work Packages (source: CSIR briefing note).

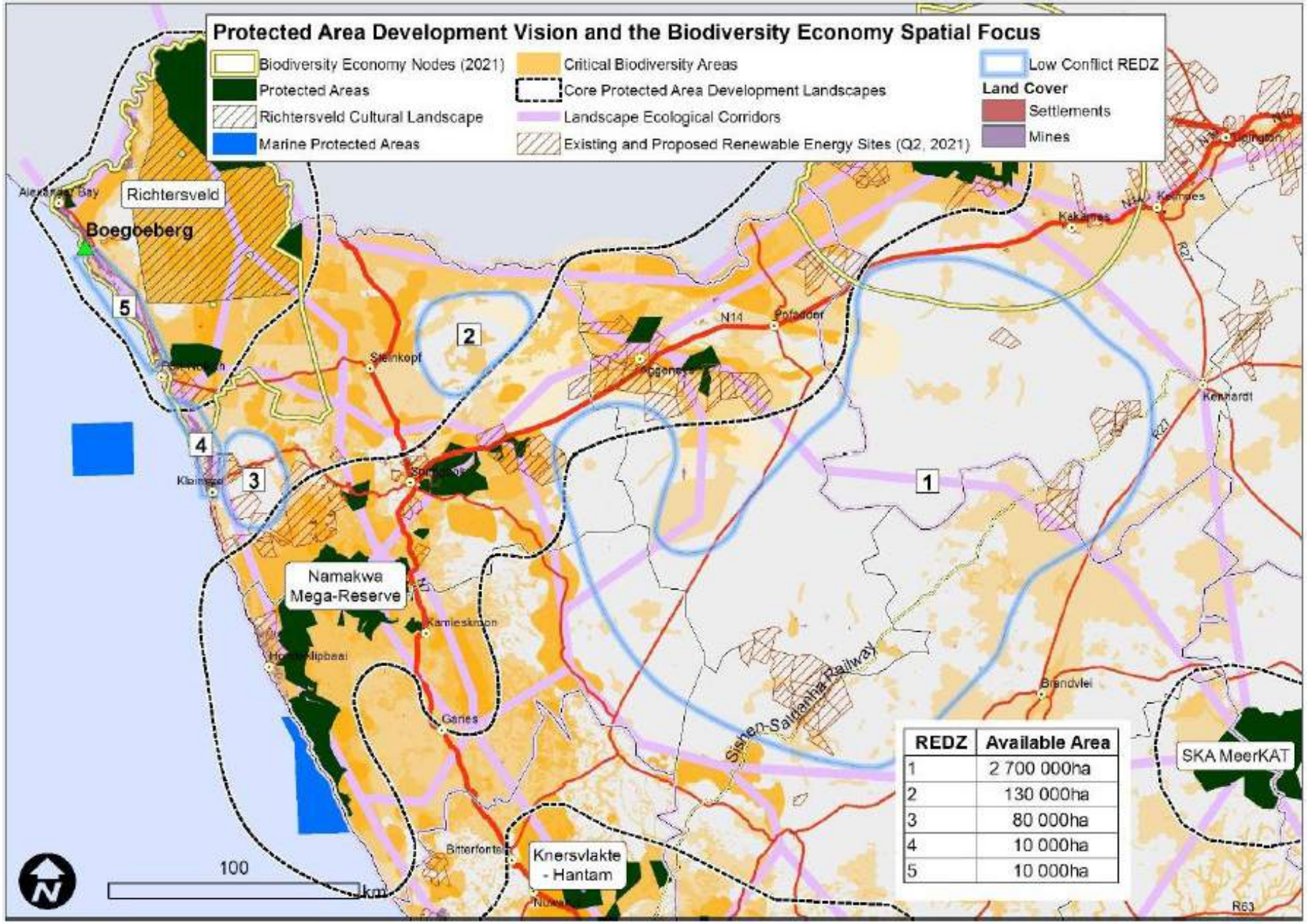


Figure 4-7: The three large areas able to accommodate especially PV production (1-3) to augment power from 2 large areas for WEF (4,5) on coastal mining scars. In a ratio of 60%PV:40%Wind for optimal operation. Note REDZ is

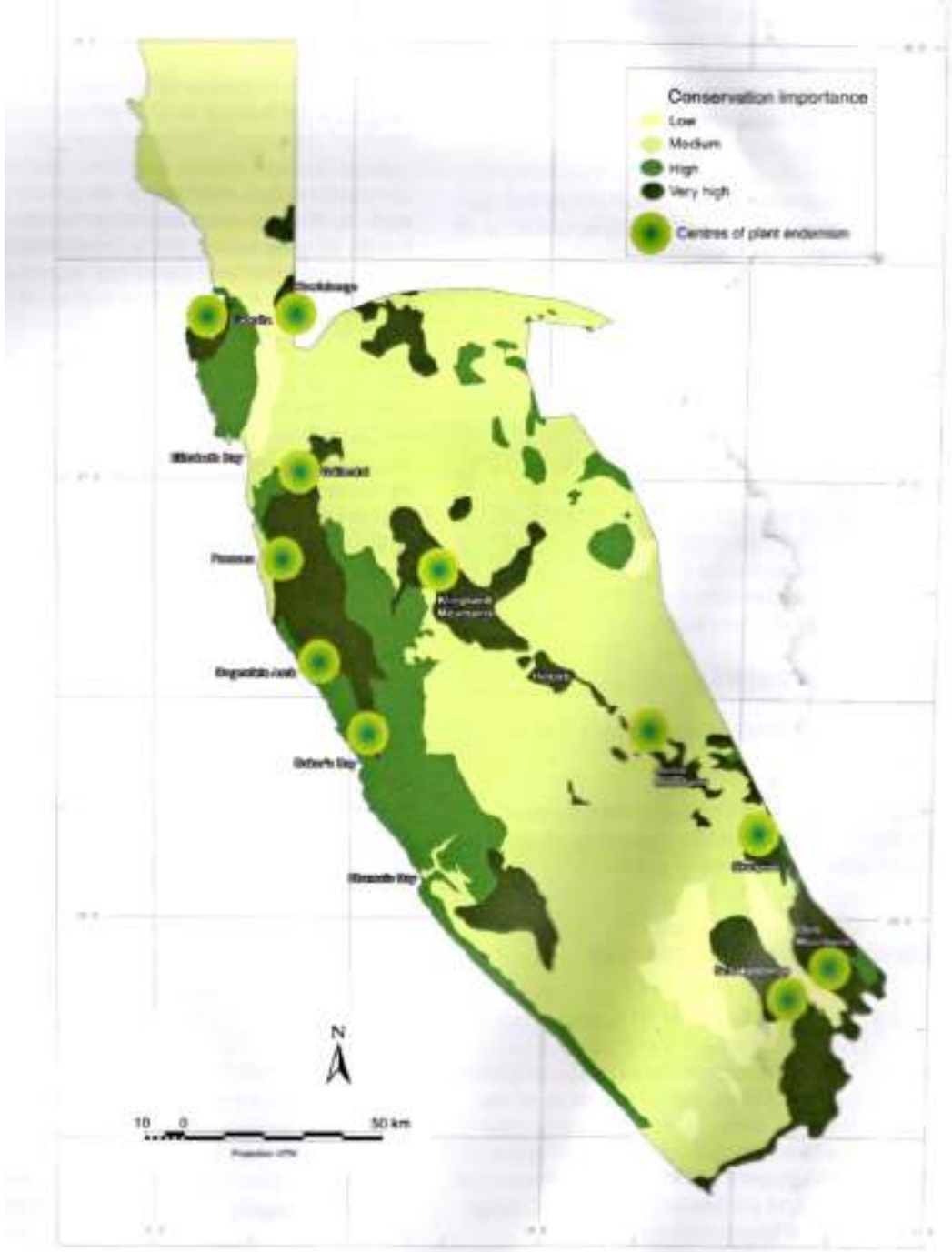


Figure 4: Centres of plant endemism and the conservation importance of vegetation types

Source: Burke 2006:
The Sperrgebiet
Managing its Biodiversity

Further data:
Burke (2020) und Burke & Loots 2020

Namibia >4000 plant species
>600 endemic species

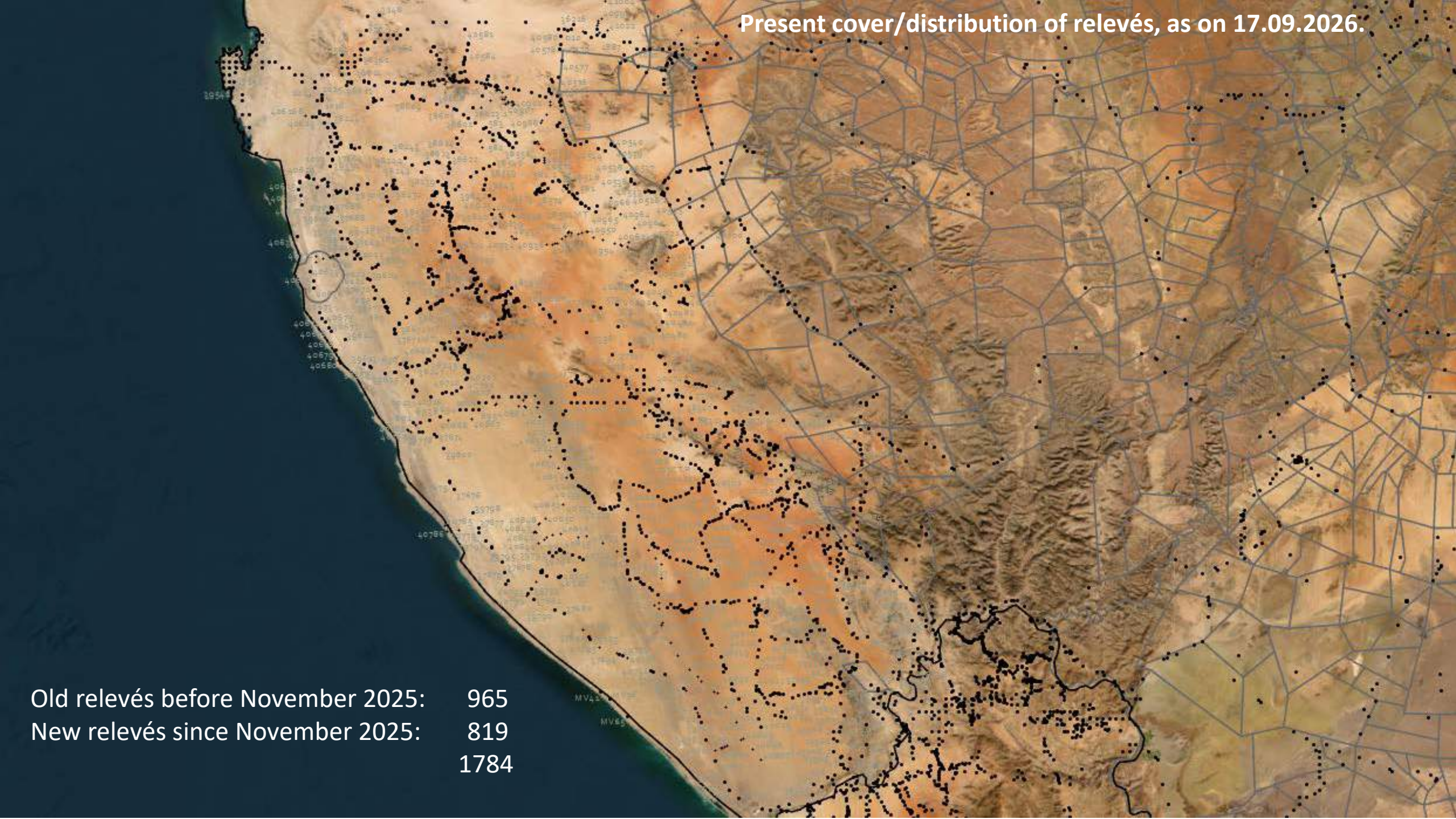
Endemic plant species
Tsau//Khaeb 31 (64)



Figure 4: Centres of plant endemism and the conservation importance of vegetation types

MANY ADDITIONS NECESSARY.

- Ressources for new settlements
- Aus = Biodiversity hotspot
- Threats from desertification
- Transboundary planning
- Consider predictable changes
- Cumulation of plans
- Compensation / “offset” where?


Present cover/distribution of relevés, as on 17.09.2026.
Old relevés before November 2025: 965
New relevés since November 2025: 819
1784

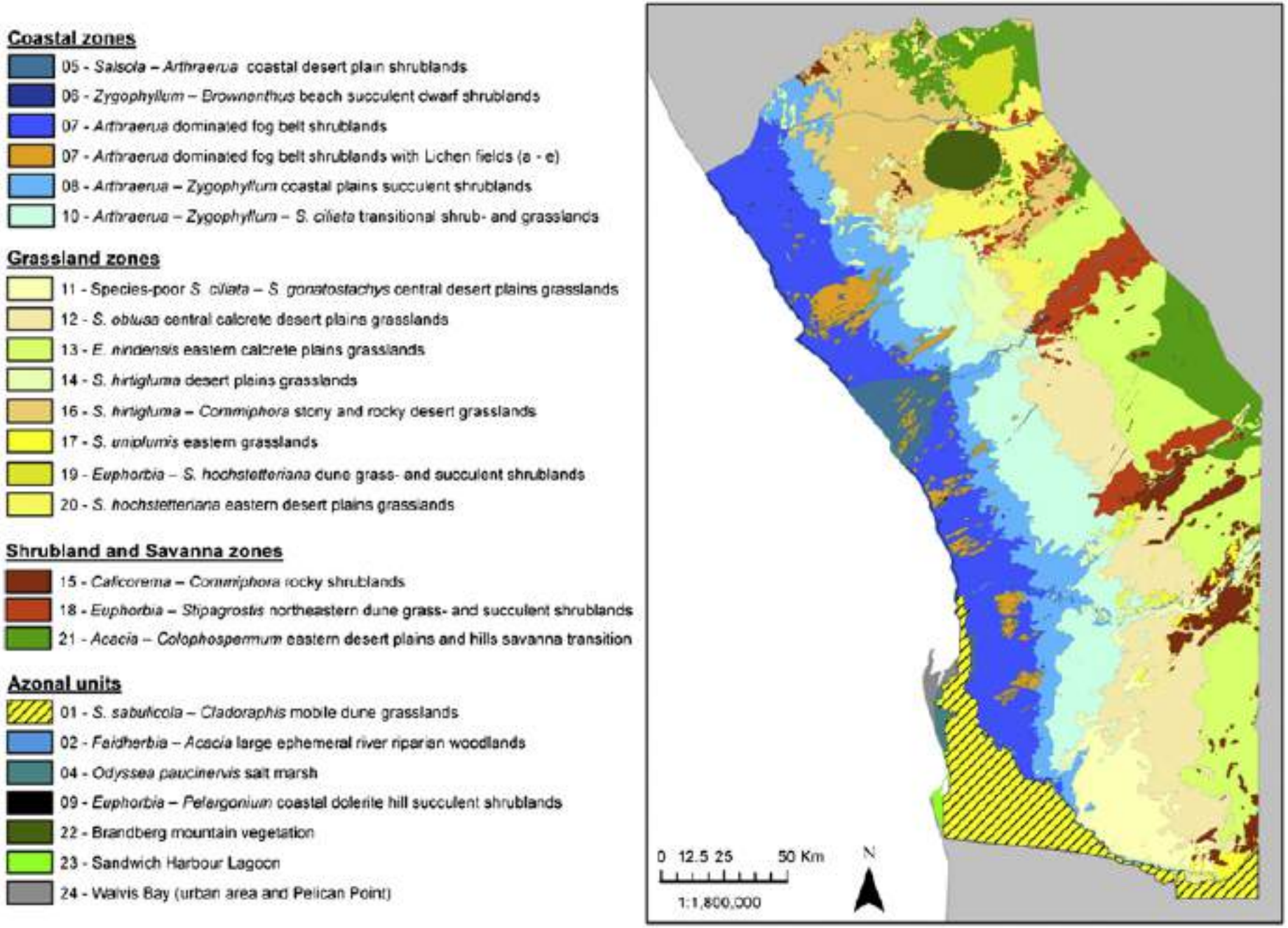


Fig. 7. New vegetation map of the Central Namib. In the labels, '*S.*' and '*E.*' code for '*Stipagrostis*' and '*Eragrostis*', respectively. A modified print version of this map and a KMZ are available at the BIOTA-AFRICA website: URL: http://www.biota-africa.org/downloads/cnvegmap.zip.

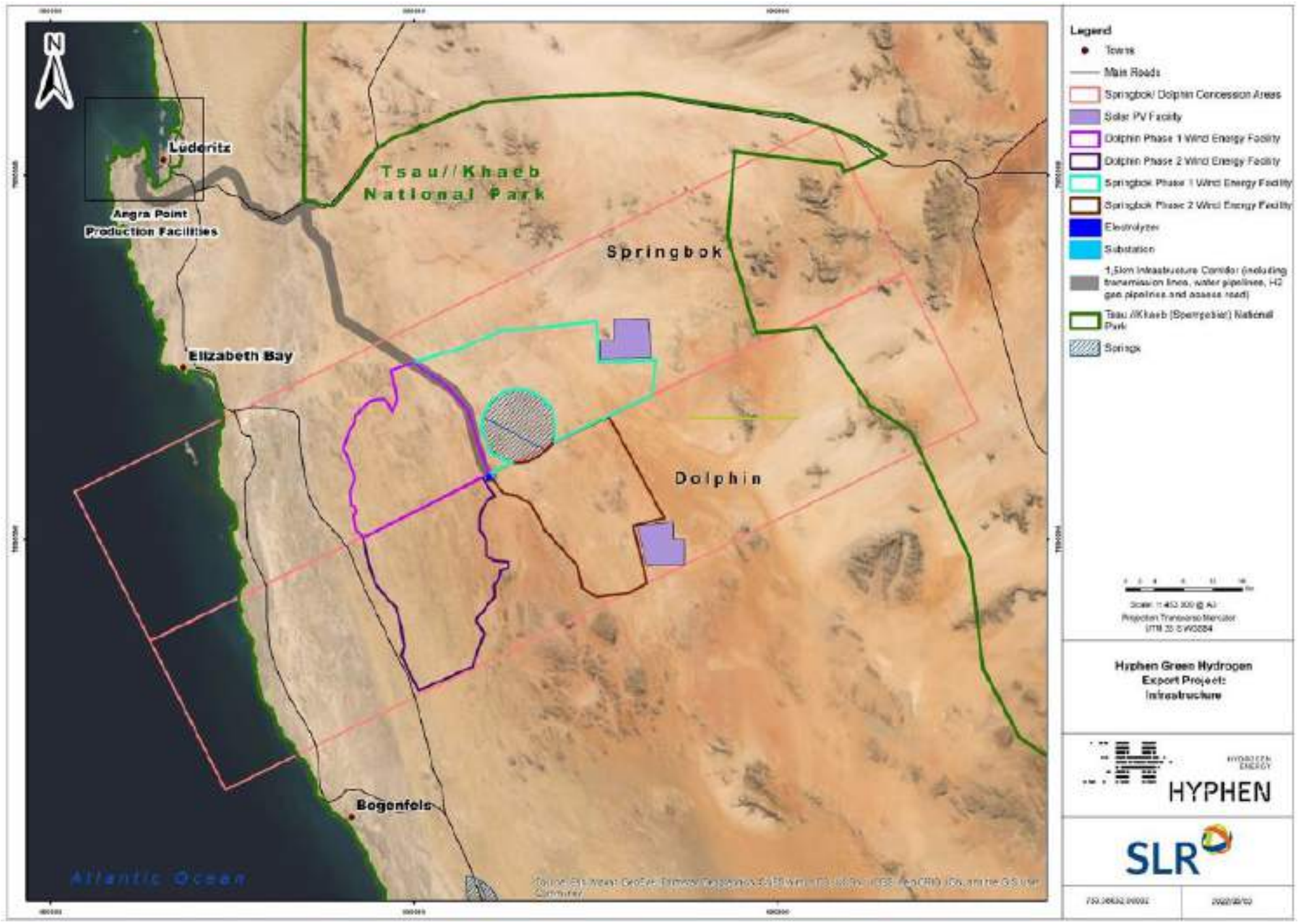
Needs, from a scientific angle of view

- The upcoming vegetation map is closely related to an ecosystem map. However, more important would be a map showing the vulnerability risks and the potential of harmful release of aeolian sand and dust. Soil data need to be included to better understand environmental risks.
- A focused monitoring of environmental variables and biodiversity should be initiated now. The monitoring approach should be able to capture important ecosystem processes. Maintenance of the few existing Automatic Weather Stations is overdue.

Thank you for your attention and for your support for good planning of both, development and conservation.

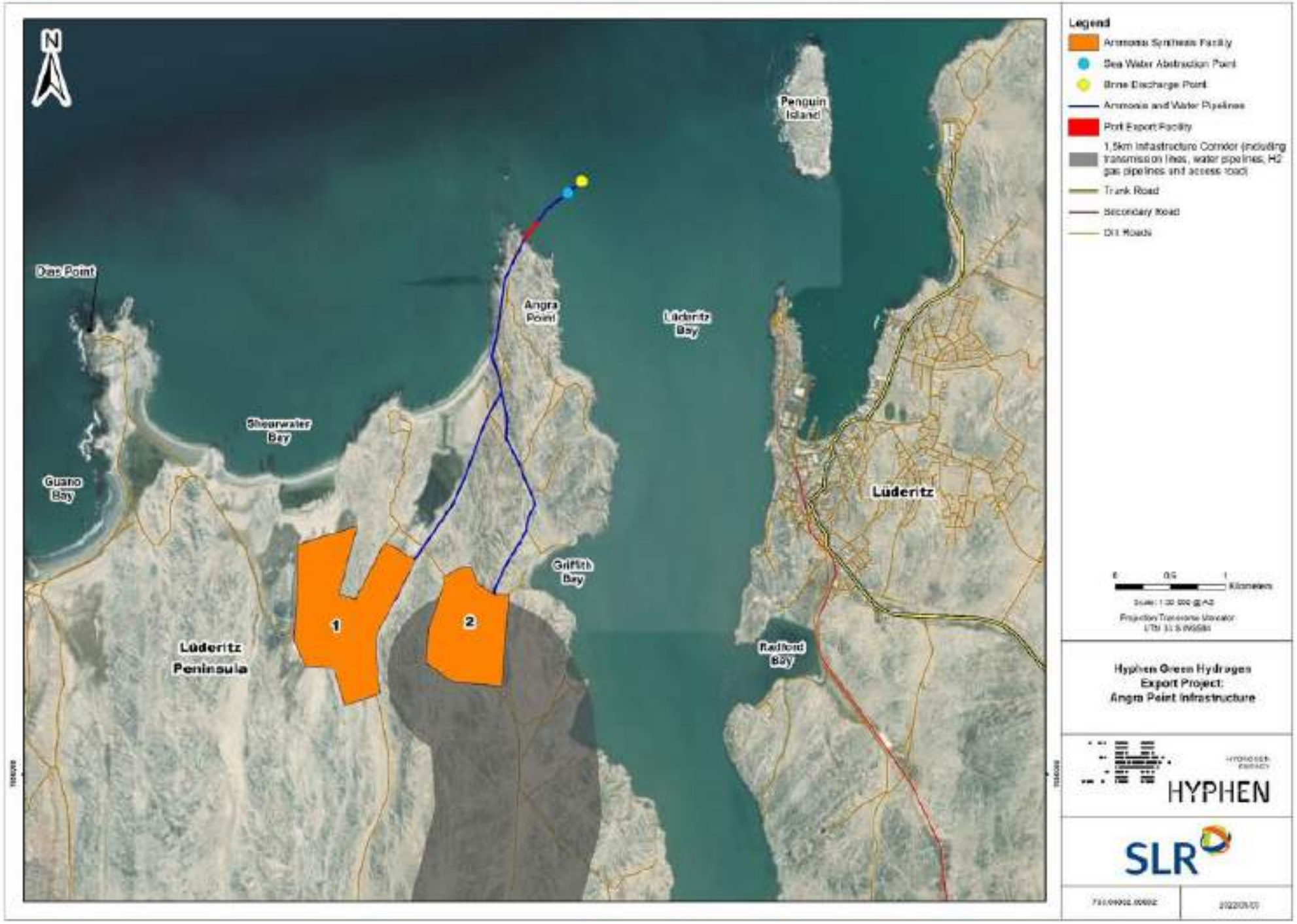


(Quelle: U.S. Department of Agriculture, Soil Conservation Service)



Geplante Infrastrukturen I

350000 to GH/y
7 GW energy
3 GW Electrolyzer
-700 Windgeneratoren
40 km² Solarfields



Geplante Infrastrukturen II

PLUS
15.000 Arbeiter
in der Bauphase

3.000 Jobs
Permanent

Viele weitere Projekte!