Off-roading

Translating science into a user-friendly format for more effective dissemination of information and implementation of responsible off-roading in protected areas

Presented at the Savanna Science Network Meeting, 2025

Woollon, H.L.[1] & Nortjé, G.P[2]

[1]*andBeyond Ngala Private Game Reserve, Timbavati, 1380, South Africa*

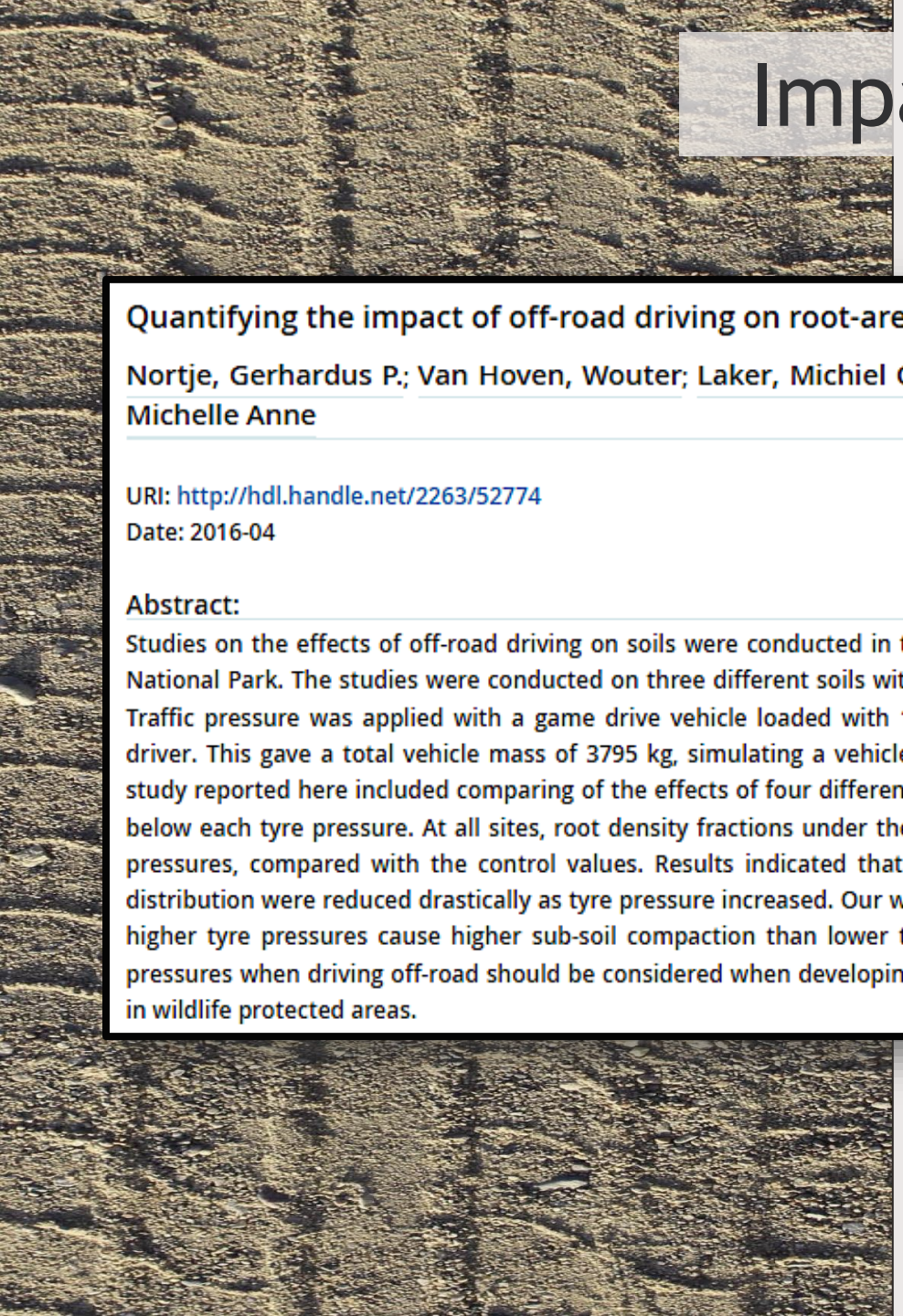
[2]*Environmental Sciences Department, University of South Africa, Johannesburg, South Africa*

heather.woollon@andBeyond.com; nortjgp@unisa.ac.za


Game drives are the bread and butter of the ecotourism industry in the savannas of Africa

Detrimental effects on ecosystems

Impact on Vegetation



Quantifying the impact of off-road driving on root-area distribution in soils

Nortje, Gerhardus P.; Van Hoven, Wouter; Laker, Michiel Christiaan; Jordaan, J.C. (Joyce); Louw, Michelle Anne

URI: http://hdl.handle.net/2263/52774
Date: 2016-04

Abstract:

Studies on the effects of off-road driving on soils were conducted in the Makuleke Contractual Park of the Kruger National Park. The studies were conducted on three different soils with different textures and soil compactibilities. Traffic pressure was applied with a game drive vehicle loaded with 10 sand bags, each weighing 70 kg, plus the driver. This gave a total vehicle mass of 3795 kg, simulating a vehicle fully laden with tourists. The results of the study reported here included comparing of the effects of four different tyre pressures on the root area distribution below each tyre pressure. At all sites, root density fractions under the tracks were reduced significantly at all tyre pressures, compared with the control values. Results indicated that root penetration percentage and root area distribution were reduced drastically as tyre pressure increased. Our work reaffirms previous research showing that higher tyre pressures cause higher sub-soil compaction than lower tyre pressures. Thus, driving with lower tyre pressures when driving off-road should be considered when developing management strategies for off-road driving in wildlife protected areas.

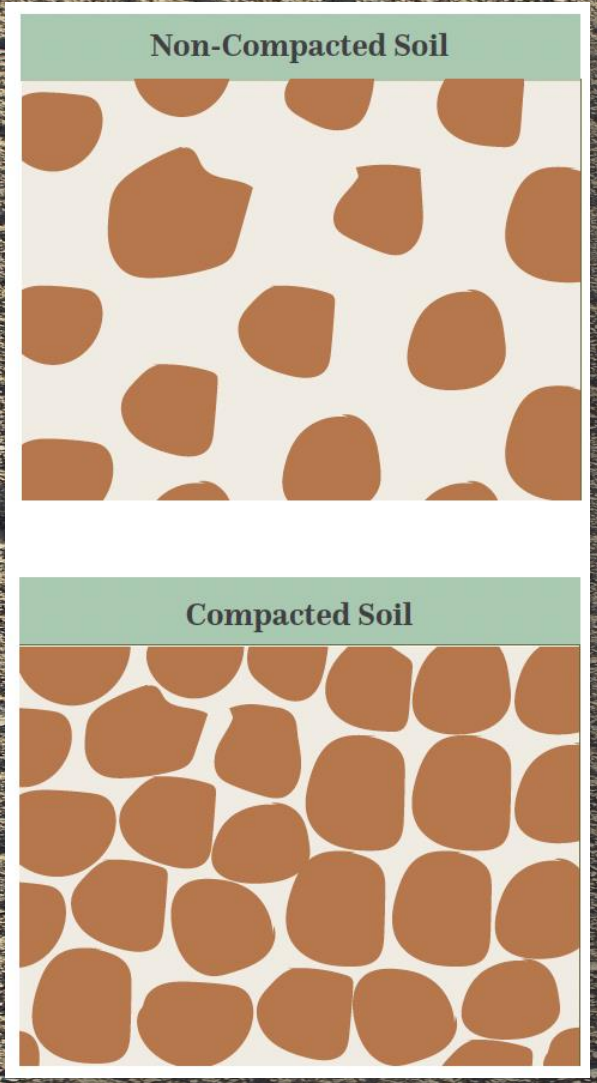
At all tyre pressures & all sites:

- ↓ root density fractions

As tyre pressure ↑:

- ↓ root penetration %
- ↓ root area distribution

Impact on Soils



Factors affecting the impact of off-road driving on soils in an area in the Kruger National Park, South Africa

Gerhardus Petrus Nortjé [1], Wouter van Hoven, Michiel C Laker

Affiliations + expand

PMID: 23079698 PMCID: PMC3497957 DOI: 10.1007/s00267-012-9954-y

Abstract

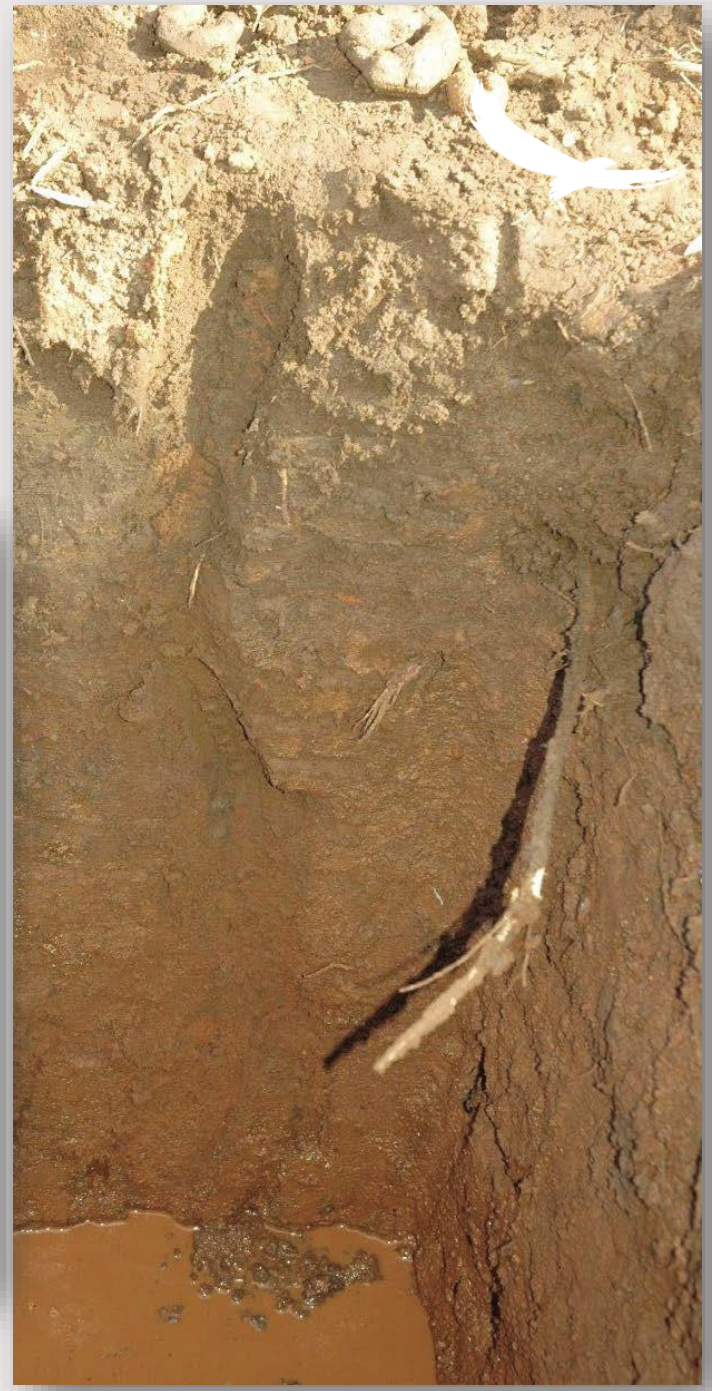
Studies on the effects of off-road driving on soils were conducted in the Makuleke Contractual Park of the Kruger National Park. The studies were conducted on three different soils with different textures and soil compactibilities. Traffic pressure was applied with a game drive vehicle loaded with 11 sand bags, each weighing 70 kg. This gave a total vehicle mass of 3,795 kg, simulating a vehicle fully laden with tourists. The study included: (i) comparing of the effects of four different tyre pressures; (ii) comparing the effects of 1-3 vehicle passes over the same tyre tracks; (iii) comparison of traffic effects under dry and wet soil moisture conditions, on soil compaction, respectively. After each pass penetration resistances were measured (a) on the tyre tracks, (b) between the tyre tracks and (c) at different distances outside the tyre tracks. As expected, vehicular traffic caused soil compaction below the wheel tracks. Lower tyre pressures caused less compaction than higher tyre pressures. Fewer vehicle passes also caused less compaction than more passes on the same tracks, but most compaction occurred during the first pass. Thus, driving on the same tracks more than once is less damaging than driving once on different tracks. Controlled traffic should be considered when developing management strategies for off-road driving in wildlife protected areas.

All tyre pressures & all sites:

- Penetrometer resistances affected
- Wet or dry
- Up to 90% compaction after first pass
- ↑ tyre pressure = deeper compaction

Sub-soil compaction and crust formation:

- ↓ water infiltration and availability
- ↓ vegetation cover
- ↓ soil and vegetation resilience
- ↓ root penetration



Impact on Invertebrates

- Ghost crabs (Family Ocypodidae)
- ↑ traffic = ↓ population density
- 20 cm depth = 10 - 30% mortality
- Single vehicle = 0.75% intertidal population mortality

Vehicles *versus* conservation of invertebrates on sandy beaches: mortalities inflicted by off-road vehicles on ghost crabs

Thomas A. Schlacher, Luke Thompson, Sam Price

First published: 15 June 2007 | https://doi.org/10.1111/j.1439-0485.2007.00156.x | Citations: 91

✉ Thomas A. Schlacher, Faculty of Science, Health & Education, University of the Sunshine Coast, Maroochydore DC, QLD-4558, Australia.
E-mail: tschlach@usc.edu.au

Impact on Predators

DOI: 10.4098/j.at.0001-7051.074.2008 • Corpus ID: 13406832

The impact of tourists on lion Panthera leo behaviour, stress and energetics

M. Hayward, Gina J. Hayward • Published in ACTA THERIOLOGICA 1 September 2009 • Biology, Environmental Science

TLDR Investigating the impact of tourist presence and absence on the reintroduced lion Panthera leo Linnaeus, 1758 population in Addo Elephant National Park, South Africa found that lions incur stress and an energetic cost from being observed by tourists, which may increase their susceptibility to disease by reducing their immunity.

What do tourists think about off-roading?

- Tourist expectations vs. land practices
- Believe off-roading negatively impacts environment
- Yet prefer off-roading

Tourists' perceptions of off-road driving in the Makuleke Contractual Region of Kruger National Park

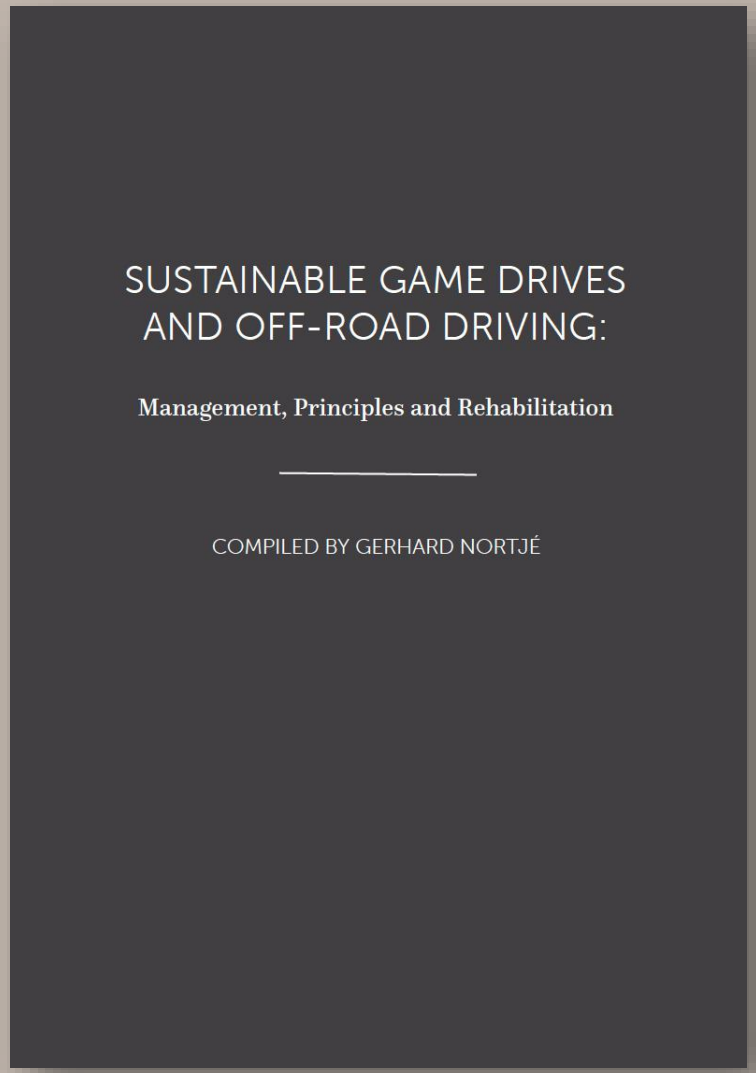
November 2017 · African Journal of Hospitality Tourism and Leisure 6(4)

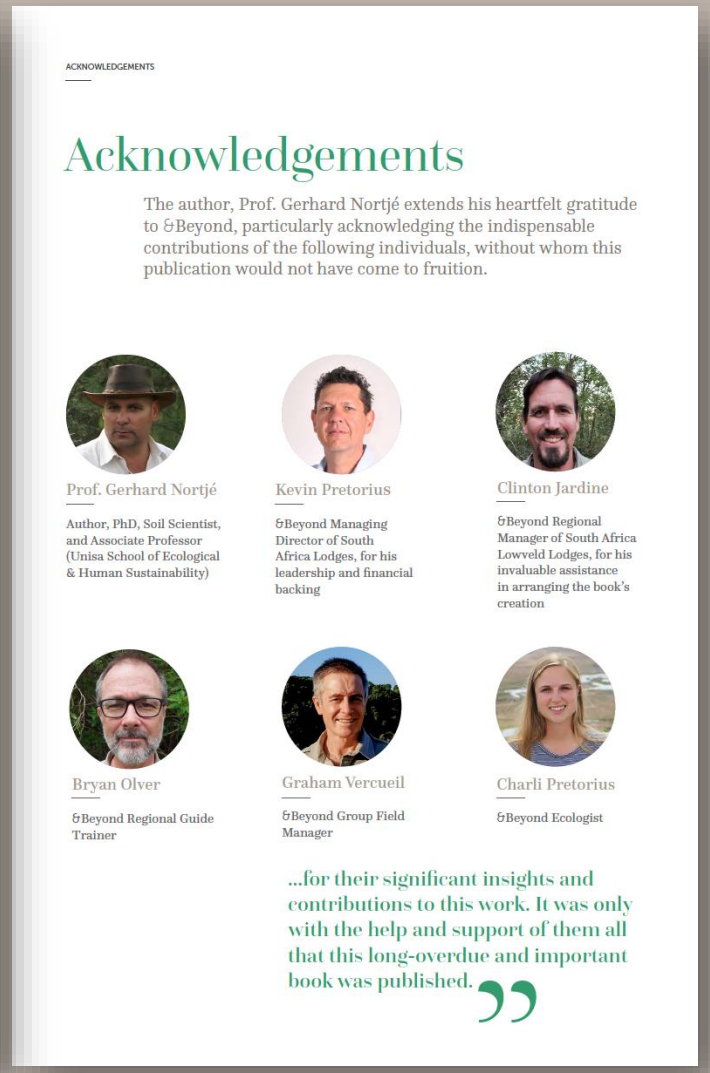
Authors:

Gerhardus Petrus Nortjé
University of South Africa

Kevin Mearns
University of South Africa

Sustainable game drives and off-road driving: Management, Principles and Rehabilitation





ACKNOWLEDGEMENTS

Acknowledgements

The author, Prof. Gerhard Nortjé extends his heartfelt gratitude to &Beyond, particularly acknowledging the indispensable contributions of the following individuals, without whom this publication would not have come to fruition.

Prof. Gerhard Nortjé

Author, PhD, Soil Scientist, and Associate Professor (Unisa School of Ecological & Human Sustainability)

Kevin Pretorius

&Beyond Managing Director of South Africa Lodges, for his leadership and financial backing

Clinton Jardine

&Beyond Regional Manager of South Africa Lowveld Lodges, for his invaluable assistance in arranging the book's creation

Bryan Olver

&Beyond Regional Guide Trainer

Graham Vercueil

&Beyond Group Field Manager

Charli Pretorius

&Beyond Ecologist

...for their significant insights and contributions to this work. It was only with the help and support of them all that this long-overdue and important book was published.

&BEYOND

Leaving our World a Better Place

UNISA university of south africa

Significance Formula

$$S = ([f + in + se + ex + ss] \times [dc + cr + cp + si + st] \times P)$$

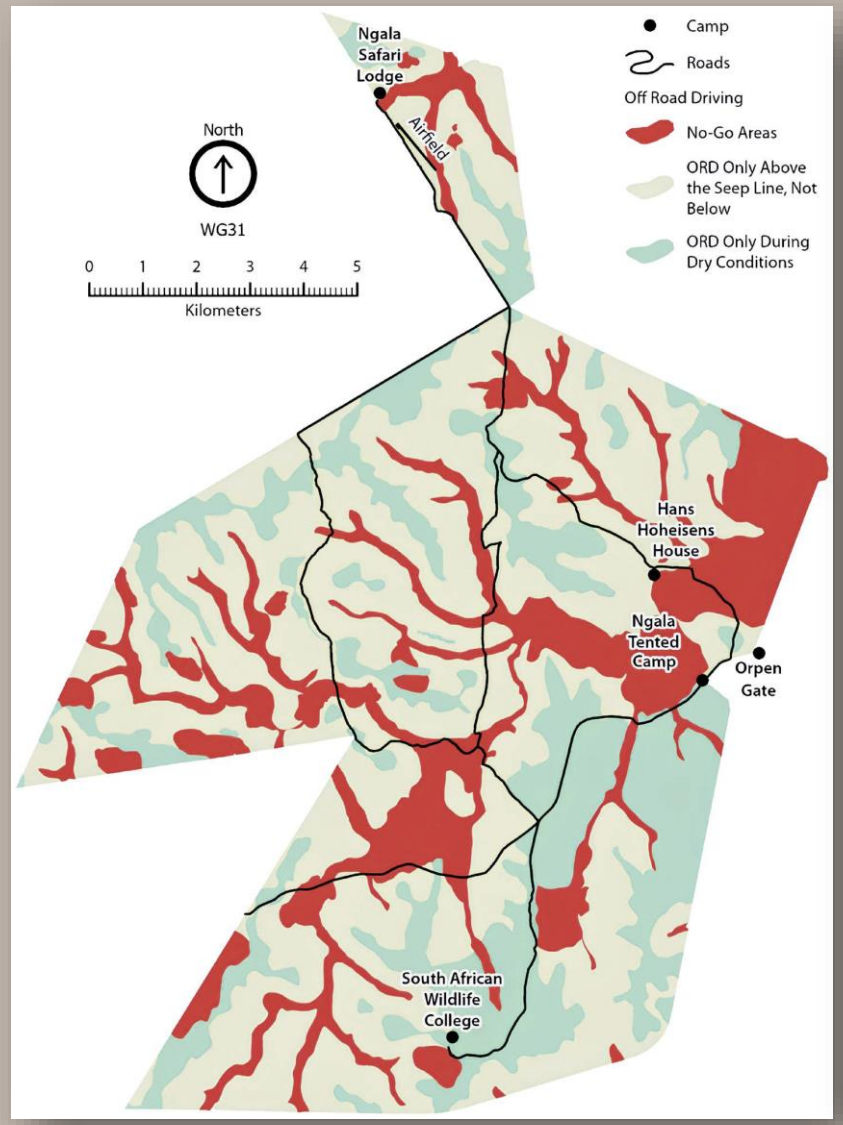
- No dedicated legislation
- Environmental risk factors → higher value = higher impact-causing
- Allows comparison of impact
- Directs management efforts

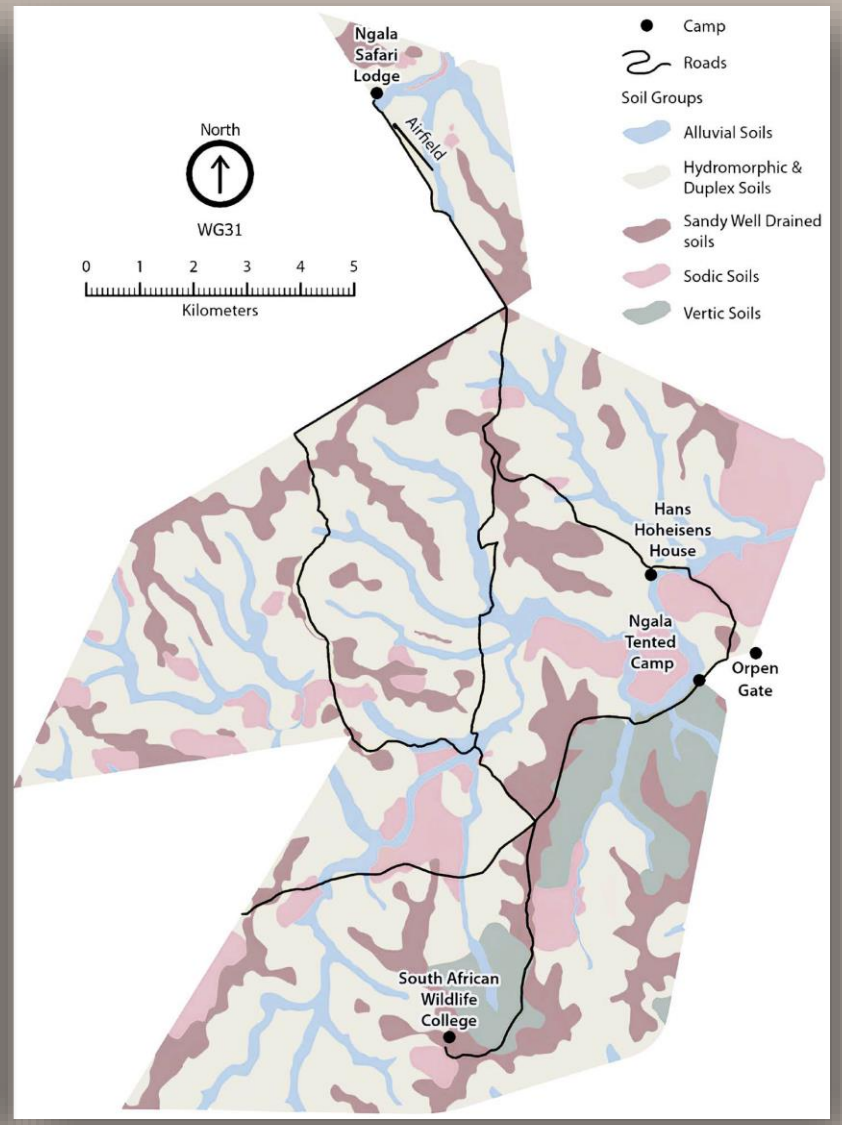
Where :

S = significance of impact value
f = frequency and duration of the off-road driving impact
in = intensity (concentration and quantity) of the off-road driving impact on the environment
se = severity of the off-road driving impact on the environment
ex = extent of the off-road driving impact
ss = site sensitivity (soil form/type, vegetation type, and position in landscape)
dc = degree of compliance with concessions' guidelines
cr = conformance rating to requirements for off-road driving/agreement of compliance
cp = covered in concessions' policy
si = severity of impact on interested and affected parties (environment, e.g. animals, soil, and plants) related to site sensitivity and resilience
st = presence of strategy to solve issue
P = probability of occurrence of impact

Monitoring & Management

- Soil & vegetation surveys
- Design/redesign road networks
- Seasonal restrictions
- Avoid sensitive areas
- Lower tyre pressures





Monitoring & Management

- Road user's code of conduct and SOPs
- Training
- Marketing, tourism and guide education
- Alternative recreation activities

&BEYOND

Off-road Driving (ORD) Standard Operating Procedures
for
AndBeyond Ngala Private Game Reserve

The impact of ORD

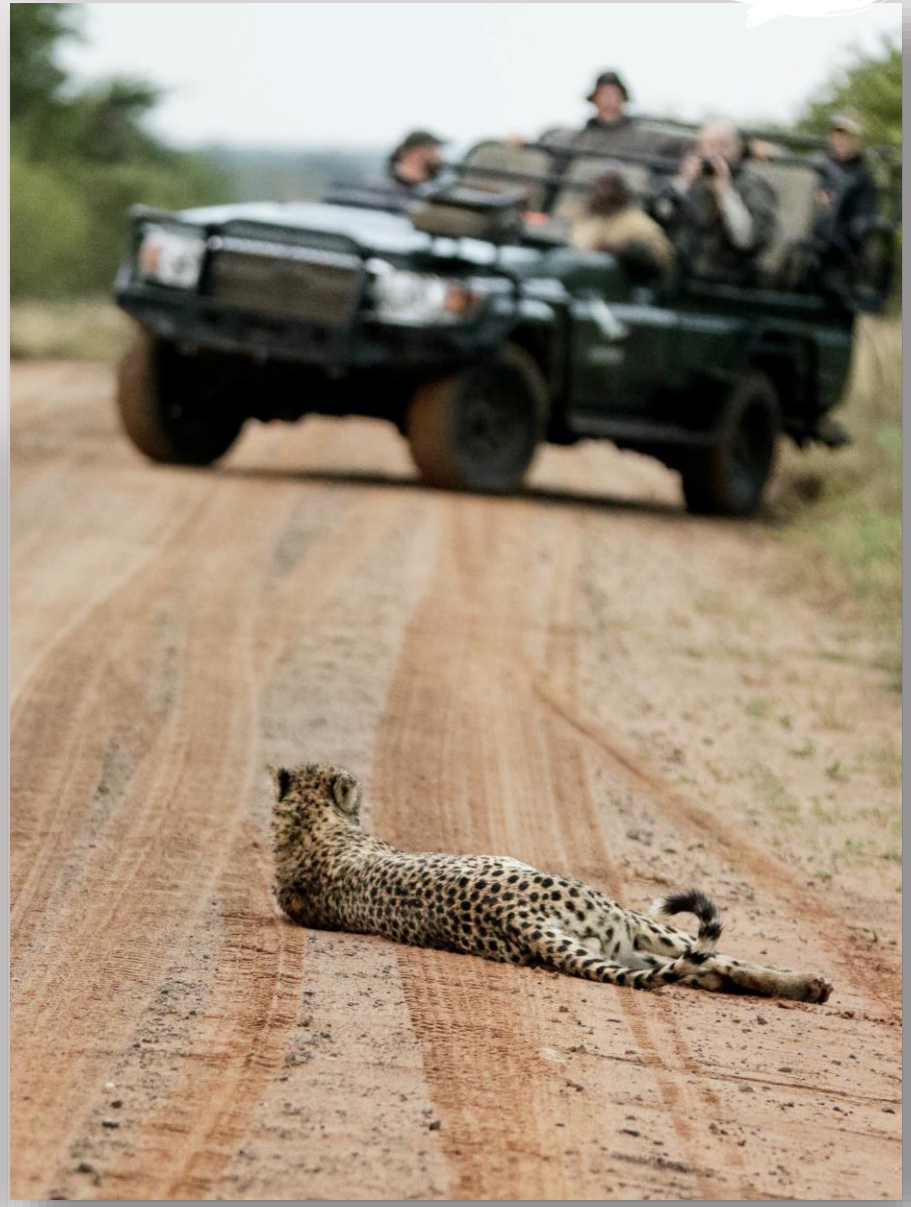
Refer to booklet "*Sustainable Game Drives and Off-road Driving: Management, Principles and Rehabilitation*" compiled by Gerhard Nortje at
https://acrobat.adobe.com/id/urn:aaid:sc:EU:774fa1f0-4761-48c9-b00e-e145e889f1c7

As guides and custodians of the land we operate on, it is our responsibility to ensure we cause the least damage possible to the very environment we aim to conserve. Off-road driving (ORD) has been shown by scientific research to be unsustainable in terms of, especially, ecological sustainability;

SUSTAINABLE GAME DRIVES
AND OFF-ROAD DRIVING:

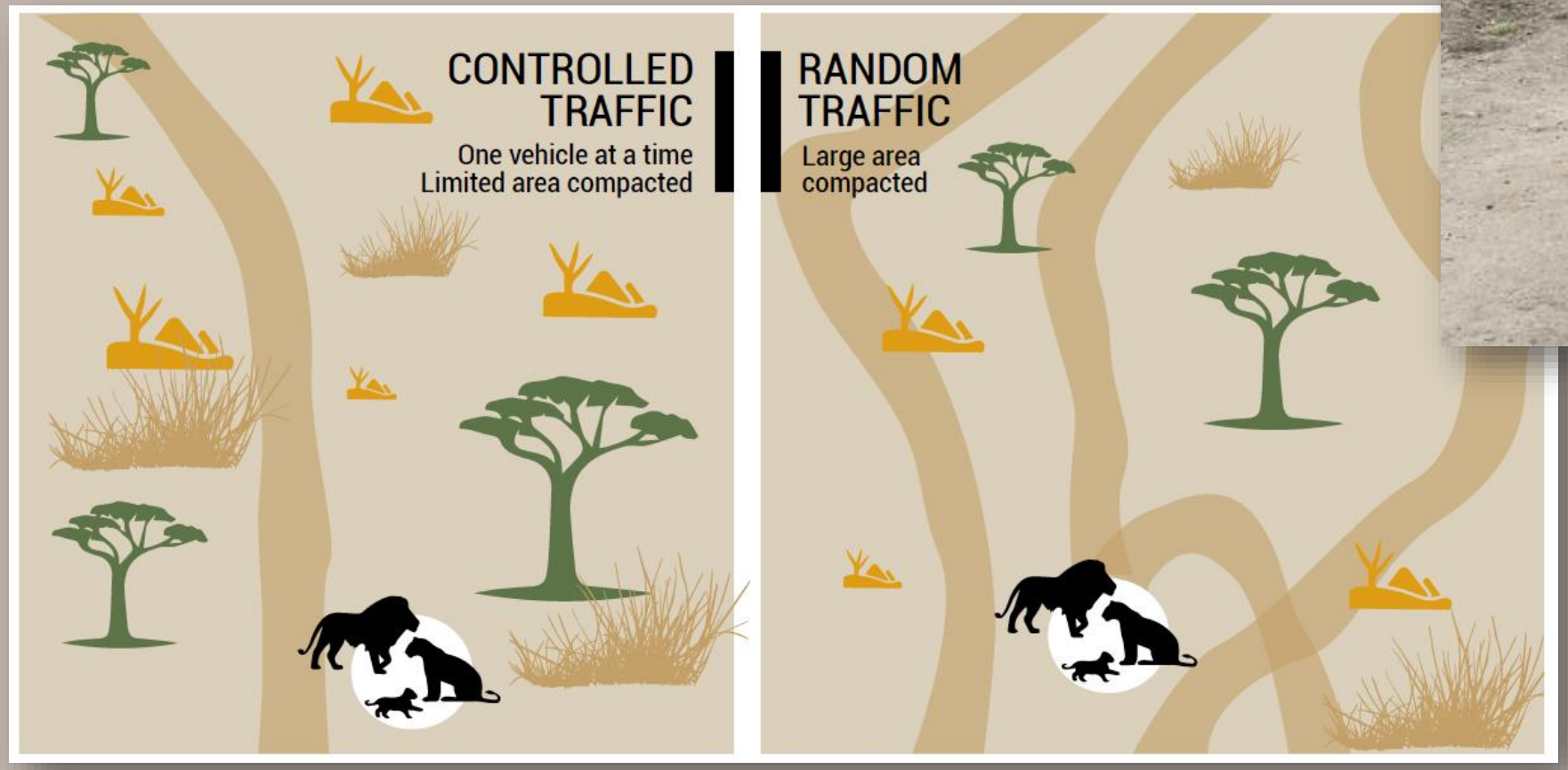
Management, Principles and Rehabilitation

COMPILED BY GERHARD NORTJÉ



Monitoring & Management

- Reduce bare soils
- Control vehicle traffic



Rehabilitation

- Brush packing, raking, gabions & reseeding
- Polyacrylamide (PAM): increased soil infiltration rates (100-206%) at USD$15/Ha
- **A combination**

Research Article

Quantifying the Effect of Soil Ameliorants on Soil Crusting by Means of Field Experiments in a Wildlife Protected Area, South Africa

Anélle Human,[1] **Gerhardus P. Nortjé**,[1] **and Michiel C. Laker**[2]

[1]*Department of Environmental Sciences, College of Agricultural and Environmental Sciences, University of South Africa, Roodepoort, South Africa*
[2]*University of Pretoria, Pretoria, South Africa*

Correspondence should be addressed to Gerhardus P. Nortjé; nortjgp@unisa.ac.za

Received 10 April 2023; Revised 15 November 2023; Accepted 18 February 2024; Published 29 February 2024

Academic Editor: Wafaa M. Abd El Rahim

Future Research

- Quantifying impact in a variety of environments
- Microbial communities
- Social studies - tourists & field staff
- Soil and vegetative rehabilitation techniques

Final Thoughts

- Hayward, MW. and Hayward G.J. 2009. The impact of tourists on lion Panthera leo behaviour, stress and energetics. *Acta Theriologica*, 54, pp 219–224.
- Human, A. Nortjé, G.P. and Laker, M.C. 2024. Quantifying the effect of soil ameliorants on soil crusting by means of field experiments in a wildlife protected area, South Africa. *Applied and Environmental Soil Science*, 2024.
- Nortje, G.P. 2014. Studies on the impacts of off-road driving and the influence of tourists' consciousness and attitudes on soil compaction and associated vegetation in the Makuleke Contractual Park, Kruger National Park. Unpublished PhD thesis.
- Nortjé, G.P. and Mearns, K. 2017. Tourists' perceptions of off-road driving in the Makuleke Contractual Region of Kruger National Park. *African Journal of Hospitality, Tourism and Leisure*, 6(4).
- Nortjé, G.P., Van Hoven, W. and Laker, M.C. 2012. Factors affecting the impact of off-road driving on soils in an area in the Kruger National Park, South Africa. *Environmental Management*, 50, pp.1164–1176.
- Schlacher T.A., Thompson, L. and Price, S. 2007. Vehicles versus conservation of invertebrates on sandy beaches: Mortalities inflicted by off-road vehicles on ghost crabs. *Marine Ecology*, 28(3), pp. 354–367.

Acknowledgements

&Beyond
Prof. Gerhard Nortjé
Charli Pretorius
Saskia Fleischack
Clinton Jardine
Dale Wepener
Kevin Pretorius
Berti Nolte & Ruth Matundu

Thank you!