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Maximising the value of visual data in South African National Parks

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Introduction

Technological advancements are reshaping how biodiversity data are collected and analysed (Kays, McShea & Wikelski 2020). Alongside the evolution of more accessible and efficient visual and communication technologies, technological advancements have become indispensable in modern conservation efforts (Berger-Tal & Lahoz-Monfort 2018). For example, photographs, videos, and audio can be manually or automatically recorded to provide biodiversity occurrence data (Kays et al. 2020). These born-digital data are a valuable resource for conservation research and monitoring. They are generated at a rapid rate and higher resolution than traditional physical collections of specimens, and they can be collected through citizen science platforms, such as iNaturalist (Kays et al. 2020).

During the coronavirus disease 2019 (COVID-19) pandemic, the value of using technology for monitoring became evident when wildlife monitoring continued in the absence of conservation staff on the ground (Primack, Bates & Duarte 2021). For example, acoustic monitoring of shark and fish movement and behaviour was possible off Australia's coast (Huveneers et al. 2021), and camera traps enabled the monitoring of wildlife movements. In addition, illegal activities could continuously be monitored using camera traps, such as Panthera's PoacherCam, which can process images of humans using built-in artificial intelligence and transmit these photographs to relevant authorities (Blount et al. 2021).

Observations derived from drones, fixed point cameras, and aerial and satellite remote sensors can also be used to understand and safeguard the natural world. Protected areas have increasingly adopted drones for various applications, such as monitoring invasive plant species (Bowness 2023) and assisting in anti-poaching efforts (Nuwer 2017). Furthermore, fixed-point photographs have been used to study temporal changes in vegetation in Camdeboo National Park, Graaff-Reinet, in the Eastern Cape Province, South Africa, in response to rainfall and herbivory by indigenous ungulates (Masubelele et al. 2013).

In South Africa, conservation organisations use multiple technologies for monitoring and research to inform conservation decision-making. This article explores the use of camera traps and baited remote underwater video (BRUV) stations, focusing on how South African National Parks (SANParks) can maximise the use of visual data to assist in conservation efforts. The insights included in the article emanated from a project funded by the JRS Biodiversity Foundation to improve the management of visual data at SANParks. This project included hosting two best practice workshops (Appendix 1) at SANParks' Cape Research Centre, Tokai, Cape Town, South Africa and developing standard operating procedures for camera trap and BRUV data management.

The use of camera traps in conservation

Camera trapping is a highly useful wildlife monitoring technique that uses non-intrusive motion and thermal remote sensing devices that capture georeferenced photographic evidence of species at a particular time and location, showcasing species presence, behaviour, patterns, and visual traits. Photographs from camera traps enable the identification of individual animals and estimation of population sizes using robust methods, such as capture-mark-recapture modelling (Wearn & Glover-Kapfer 2017). They play an important role in studying elusive and uncommon species (Whitworth et al. 2016), estimating species occupancy and population density (O'Connell & Bailey 2011), and exploring species–habitat relationships and preferences (Rovero et al. 2013). Such information is useful for identifying areas in need of conservation interventions (Cordier et al. 2022). Camera traps can be deployed in the field for extended periods of several weeks to months to monitor medium- to large-sized terrestrial mammals across vast spatial and temporal scales (Kays et al. 2020), and they have recently been shown to be effective in studying small mammals and canopy-associated animals (Bowler et al. 2016).

Examples of the use of camera traps to assist in conservation efforts in South Africa

In South Africa, camera traps are used by national and provincial conservation authorities, non-government organisations (NGOs), private nature reserves and private individuals as a research tool to monitor wildlife in South Africa. National and provincial conservation authorities collaborate with NGOs, such as Panthera, the Cape Leopard Trust (CLT), Endangered Wildlife Trust (EWT), and Snapshot Safari (Pardo et al. 2021), in addition to conducting their own camera trap monitoring. The Snapshot Safari camera trap network is one of the largest globally. It monitors population trends of southern and east African mammals in many private reserves and national parks in South Africa (Pardo et al. 2021). Panthera and Wildlife ACT monitor leopards in provincial reserves in KwaZulu-Natal (KZN) Province (Hudson 2018), and the CLT monitors leopard distribution, density, and population trends in CapeNature reserves (CapeNature 2022) and private properties in the Western Cape Province. Cape Leopard Trust staff also gather baseline data on other mammal species in the same areas (CLT 2023). Panthera monitors leopard occurrence, distribution, individuals and population density (i.e. leopards/100 km^2), using spatially explicit capture-recapture techniques to model and evaluate population trends in private reserves in South Africa, such as the uMkhuze Game Reserve, and Tembe Elephant Park both in KZN, and Pilanesberg National Park and Game Reserve in Northwest Province. The results and data from these surveys are also passed on to the South African National Biodiversity Institute (SANBI) for further independent analysis (G. Mann [Panthera] pers. comm., 22 November 2023).

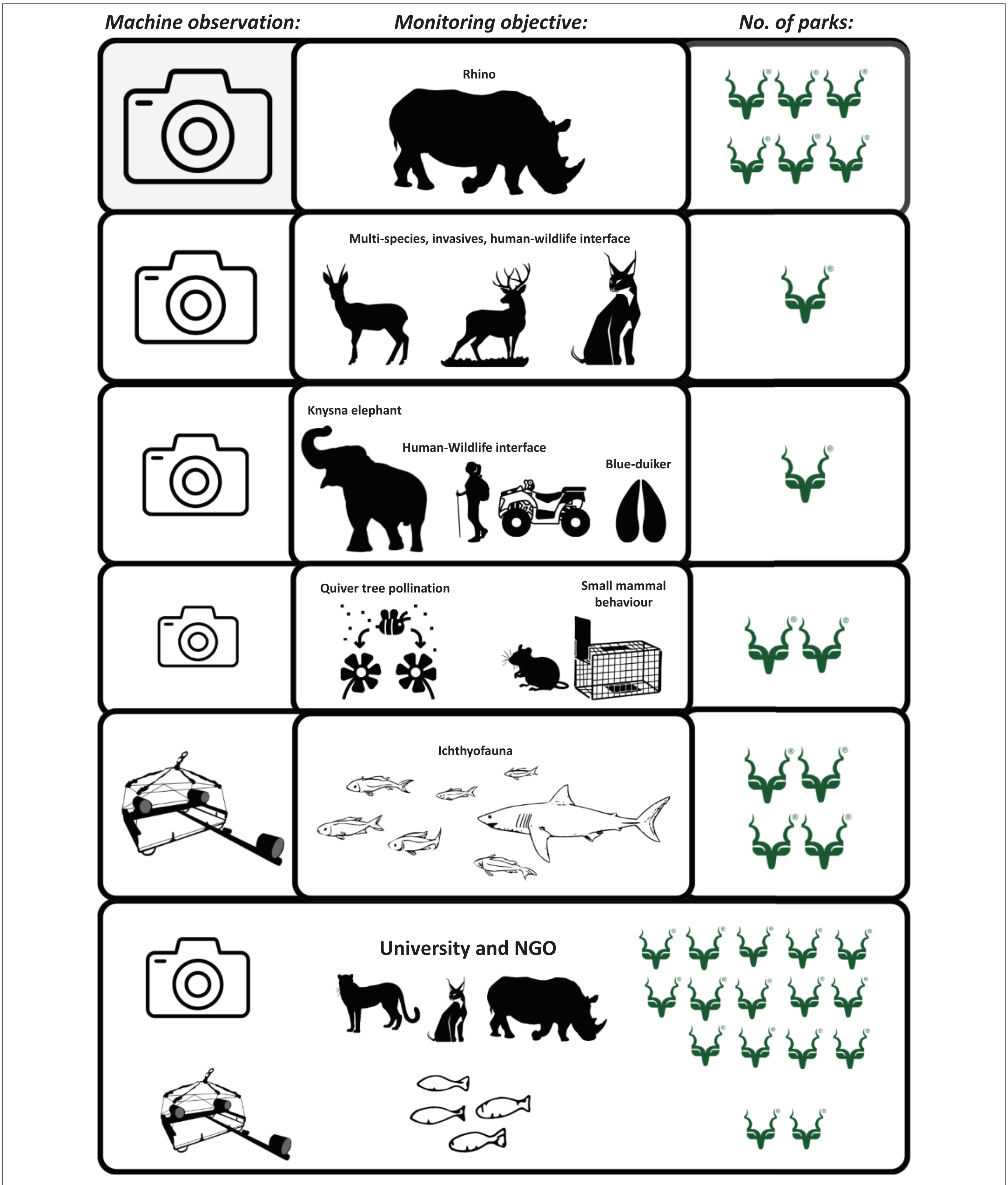
CapeNature collaborates with additional organisations to conduct monitoring assisted by the use of camera traps: EWT monitors riverine rabbits using spatial distribution models, and SANBI conducts research on Cape mountain zebra (CapeNature 2022). In addition, the Wilderness Foundation deploys camera traps on private properties and conservation-worthy land in potential ecological corridor areas. Images from these cameras provide very useful insights for landowners on the wildlife present on their properties, leading to enhanced and collective conservation efforts (R. Brand [Wilderness Foundation Africa] pers. comm., 22 November 2023).

The use of camera traps to assist conservation efforts in South African National Parks

Camera traps have been deployed in 11 national parks (NPs; Figure 1, Table 1) by scientists, regional ecologists and biotechnicians. In the Garden Route National Park (GRNP) in the Western Cape Province, camera traps have been used to monitor the Knysna elephant and elusive and vulnerable species, such as blue duiker, and to investigate the human–wildlife interface. Camera traps are used to monitor rhino populations in some national parks and to investigate the pollination of Quiver trees in Augrabies Falls NP, Northern Cape Province. In Table Mountain NP, 88 cameras are systematically placed in a grid array to investigate species diversity, relative abundances, and human–wildlife interactions and monitor the presence of invasive mammal species (Table 1). In parks where camera traps are used to monitor target species, such as rhinos, bycatch photographs are often neglected and not analysed because of lack of capacity. Therefore, additional useful information is waiting to be extracted from these photographs. Camera traps are also used by park operations for management purposes. For example, in Mokala NP, camera traps are used to monitor animals that may need management interventions, and in Bontebok NP in the Western Cape Province, there are prospects of deploying camera traps to monitor zebra. Many of the cameras used by the Scientific Services division of SANParks have been funded externally. For example, 40 camera traps in Addo Elephant NP (AENP) have been funded by the International Union for Conservation of Nature-Save Our Species (IUCN-SOS) programme (Bissett et al. 2022), the Peace Parks Foundation funded camera traps for a white rhino project in Marakele NP in Limpopo Province, and the Department of Forestry, Fisheries, and the Environment (DFFE) has funded 88 camera traps in Table Mountain National Park (TMNP), Western Cape Province. Camera traps are stationed in the field continuously for weeks to months, generating large volumes of data. Several camera trap projects have been conducted in parks by researchers from the CLT, Snapshot Safari, South African Environmental Observation Network (SAEON) and universities (Figure 1, Table 1). Some examples of camera trap projects include investigating the impact of fence removal on medium- to large-sized mammals in Addo Elephant NP, leopard populations in Agulhas NP (Western Cape Province), species diversity and ecological dynamics of southern African mammals and herbivore density and distribution patterns in the Kruger NP.

The use of baited remote underwater video stations in conservation

In marine environments, BRUV stations are used to study marine life. A BRUV station comprises a baited camera system suspended in the water column by a weighted metal frame designed to attract fish and other marine organisms into the field of view (Langlois et al. 2020). Two types of BRUV stations exist: mono-BRUV stations have a single camera, and stereo-BRUV stations have two cameras mounted to a horizontal plane. These underwater video systems are a non-destructive yet highly efficient and repeatable means of recording the occurrence of species, relative abundances (MaxN), and fish sizes, and characterising habitat types and water conditions



Note: The diagram progresses according to the scale of camera trap or baited remote underwater video deployments, from the highest to the lowest number across the parks.
NGO, Non-Government Organisation.

FIGURE 1: Illustration depicting the range of machine observation and monitoring objectives across multiple parks where projects are implemented.

(Langlois et al. 2020). They are also useful for monitoring temporal changes in marine ecosystems and assessing the effectiveness of conservation measures (Espinoza et al. 2014). For example, it is expected that fish sizes will be larger in marine protected areas where fishing is prohibited.

The use of baited remote underwater video stations to assist in conservation efforts in South Africa

The Kogelberg Small Scale Fishery Improvement Project (2014) in CapeNature reserves in the Western Cape Province

TABLE 1: Examples of camera trap and baited remote underwater video (BRUV) data collection conducted by Scientific Services of SANParks.

National park (NP) or Marine Protected Area (MPA)	No. of Camera Traps/BRUV stations	Monitoring objectives
Addo Elephant NP	136	Black rhino (*Diceros bicornis*)
Augrabies Falls NP	-	Pollination of Quiver trees (*Aloidendrum dichototum*)
Garden Route NP	45	Knysna elephant (*Loxodonta africana*)
	-	Human-Wildlife Interface
	8–12	Blue duiker (*Philantomba monticola*)
Golden Gate Highlands NP	2	Small mammals at Sherman traps
Karoo NP	22	Black rhino (*Diceros bicornis*)
Kruger NP	8	Herbivore use in the Nkhulu exclosure
	-	Rhinoceros
Marakele NP	4	Southern white rhino (*Ceratotherium simumsimum*)
	8	Black rhino (*Diceros bicornis*)
Mokala NP	5–10	Black rhino (*Diceros bicornis*)
Mountain Zebra NP	15	Black rhino (*Diceros bicornis*)
Table Mountain NP	88	Species diversity, detection maps, relative abundance, occupancy modelling potential, human-wildlife interactions
West Coast NP	18	Effect of caracal (*Caracal caracal*) presence on occupancy of small antelope
Langebaan Lagoon MPA, Robben Island MPA and Table Mountain MPA	5 mono- and 6 stereo- BRUV stations	Determining the abundance and diversity of marine ichthyofauna in three different protection zones in the MPAs
Tsitsikamma MPA and Garden Route NP	6 mono- and 12 stereo- BRUV stations	Determining the impact of coastal fishing on close inshore fish communities (including sharks and rays)

in South Africa used BRUV stations for multi-species surveys of line fish and West Coast rock lobster in the Betty's Bay Marine Protected Area (MPA) along the southern coast of the province (CapeNature 2020). Moreover, CapeNature, in partnership with the Dyer Island Conservation Trust, deploys BRUV stations to investigate species diversity and monitor the relative abundance of fish species in the waters surrounding Dyer Island, Gansbaai, Western Cape Province (CapeNature Report 2022:29). This project is of national importance and forms a priority monitoring site for the National BRUV Working Group led by the South African Institute for Aquatic Biodiversity (SAIAB). CapeNature also deploys BRUV stations in the Stillbaai, Goukamma, Robberg and De Hoop MPAs along the southern coast of the Western Cape Province (CapeNature 2022:29). Their assessments of fish diversity and abundance both inside and outside MPAs inform management decisions and actions, mainly through the monitoring of reef fish species assemblages, abundances, and distributions using BRUV stations (CapeNature 2022:29).

The SAEON oversees long-term monitoring projects, such as the Benthic Ecosystem Long-Term Ecological Research stations, using BRUV stations and jump cameras to monitor benthic ecosystem changes over extended periods in Algoa Bay, Agulhas ecoregion in South Africa (T. Parker-Nance [SAEON] pers. comm., 17 October 2023). Similarly, the South African DFFE uses BRUV stations in fishing hotspots and MPAs to determine species compositions, abundances, and the size frequencies of reef-associated line fish (DFFE 2023). Ezemvelo KZN Wildlife leads the expansion planning of MPAs across the province, working closely in collaboration with national initiatives. In addition, they lead the African Coelacanth Ecosystem Programme Surrogacy and Spatial Solutions projects in South Africa, Mozambique, Tanzania, Kenya, the Comoros, the Seychelles and Madagascar. They have deployed BRUV stations within and outside MPAs to monitor changes in the diversity of fish species over time and to study patterns in and relationships between fish assemblages (Harris 2018).

The use of baited remote underwater video systems in South African National Parks

In SANParks' MPAs, BRUV stations are used to investigate the effectiveness of MPA zonation and the effects of coastal fishing. Marine biologists at the Cape Research Centre have deployed mono-BRUV stations since 2018 and stereo-BRUV stations since 2022 in different zones of MPAs: the no take, controlled, and sanctuary zones. Information derived from the analysed BRUV data is used to assess the effectiveness of the West Coast, Robben Island and Table Mountain National Park MPAs in the Western Cape Province. Stereo-BRUV stations are preferred by SANParks researchers because they can be used to measure fish sizes, and the size frequency distribution of fish populations is often a better indicator of MPA effectiveness than relative abundance alone. In Garden Route NP, mono-BRUV stations were initially deployed for monitoring purposes from 2014 to 2017, and later stereo-BRUV stations were deployed from 2018 to 2021. These BRUV stations were deployed in marine and estuarine ecosystems to investigate the impact of the Tsitsikamma MPA's (Eastern Cape Province) re-zonation on coastal fishing and local fishing communities. Furthermore, a trial study in the Knysna Estuary (Western Cape Province) investigated fish-habitat associations in the marine bay regions of the estuary, and monitoring of fish-habitat associations in the Swartvlei Estuary (Western Cape Province) between open and closed phases of the river mouth. A once-off study also used BRUV stations to investigate the estuarine fish community in the Touws River Estuary, Western Cape Province. The SAEON and SAIAB also have long-term monitoring projects with sites in the Tsitsikamma MPA, monitoring sub-tidal reef fish in the Garden Route region.

Baited remote underwater video surveys are sea and weather-dependent and have occurred annually in the GRNP and bi-annually in the Cape Region. On average, sampling is conducted for 2–3 days, and the number of deployments varies between 6 and 18 per survey. This generates large amounts of 1-h BRUV data.

The status of visual data collection in National Parks in South Africa

Although SANParks has made strides in visual data collection and has plans for improved data management, in the past, visual data management lacked standardisation across all parks, leading to data being dispersed, inconsistently formatted, and difficult to access. Challenges such as limited storage capacity for large volumes of data, insufficient staff capacity for data processing, and incomplete metadata further hinder effective data management. As a result, scientists often find themselves managing administrative tasks that delay their ability to analyse data for decision-making. While SANParks faces these hurdles, it also has opportunities to enhance its data infrastructure and capacity by learning from other organisations with dedicated data management teams and advanced storage solutions. Addressing these gaps could significantly improve the efficiency of SANParks' data management processes.

The vision for South African National Parks visual data

Improving visual data management at SANParks requires standardisation in camera trapping and BRUV survey methods, sampling designs, and data management procedures. This is essential to extracting the most value from the data and includes following the FAIR data principles: to be Findable, Accessible, Interoperable, and Reusable (Wilkinson et al. 2016).

Maximising the value of visual data in SANParks is crucial for effective conservation efforts. This requires following best practices in how to collect and manage data. The use of standardised data processing procedures can ensure consistency and reliability in datasets and makes it easier to integrate SANParks' data with global datasets. Quality-control can be assured using tools to verify and check the accuracy of data and open-source software, such as R (R Core Team 2024) can be used for repeatable data analysis. To make SANParks data more accessible and get the most use out of it, metadata and data need to be uploaded to global repositories. This will enable further use of SANParks visual data by researchers worldwide. Another way to maximise the use of SANParks visual data is by making SANParks bycatch video and photograph data available to other researchers.

To enable better use of SANParks visual data, investment is needed in modern data infrastructure, including better internet connectivity and tools to quickly back up and store large volumes of photographs and videos. Additional data technicians would also be useful to ensure timely data processing and storage.

Best practice for managing camera trap data

Managing camera trap data effectively maximises its value in biodiversity research and conservation efforts. Best practices include establishing a systematic data management system that organises images, metadata, and associated information in a standardised format. This system should include data collection, storage, and analysis protocols to ensure consistency and reproducibility. Appropriate metadata standards and annotation tools, such as TrapTagger, can facilitate data interpretation and sharing among researchers. Other fundamental best practice recommendations include ensuring that datasets conform to standardised metadata fields and attributes, such as using standardised coordinate and date formats, as well as regularly checking and servicing cameras in the field. In addition, regular data quality checks, backups, and documentation of processing steps are essential to maintain data integrity and reliability, and increase dataset longevity (Figure 2).

Best practice for managing baited remote underwater video data

Standardised procedures are also needed to manage BRUV data and extract its maximum value efficiently. This entails following best practices during fieldwork, securely transferring and backing up footage to storage systems, and organising it into standardised folders with consistent naming conventions. Subsequently, data processing should be conducted using robust tools, such as EventMeasure, followed by quality assurance checks with tools such as CheckEM, and standardised, repeatable statistical analysis in platforms such as R. Once scientific or internal reports on the data have been generated, the data and associated metadata should be archived in global repositories, such as the Ocean Biodiversity Information System (2024) and GlobalArchive (2024), to enable data sharing and synthesis across localities (Figure 2). Importantly, findings from these data also need to be shared with local fishing communities at stakeholder engagement events.

To maintain the vision of maximising the value of SANParks' visual data, SANParks must stay aligned with global best practices and use available resources to ensure SANParks' data management follows international standards. By doing so, data handling and processes in SANParks will be streamlined and ensure that SANParks can effectively manage the ever-growing volumes of data that play a crucial role in conservation efforts. Best practice data governance and stewardship will enable SANParks to know what datasets are available, where they reside, who is authorised to use them, and how to maximise SANParks' data value.

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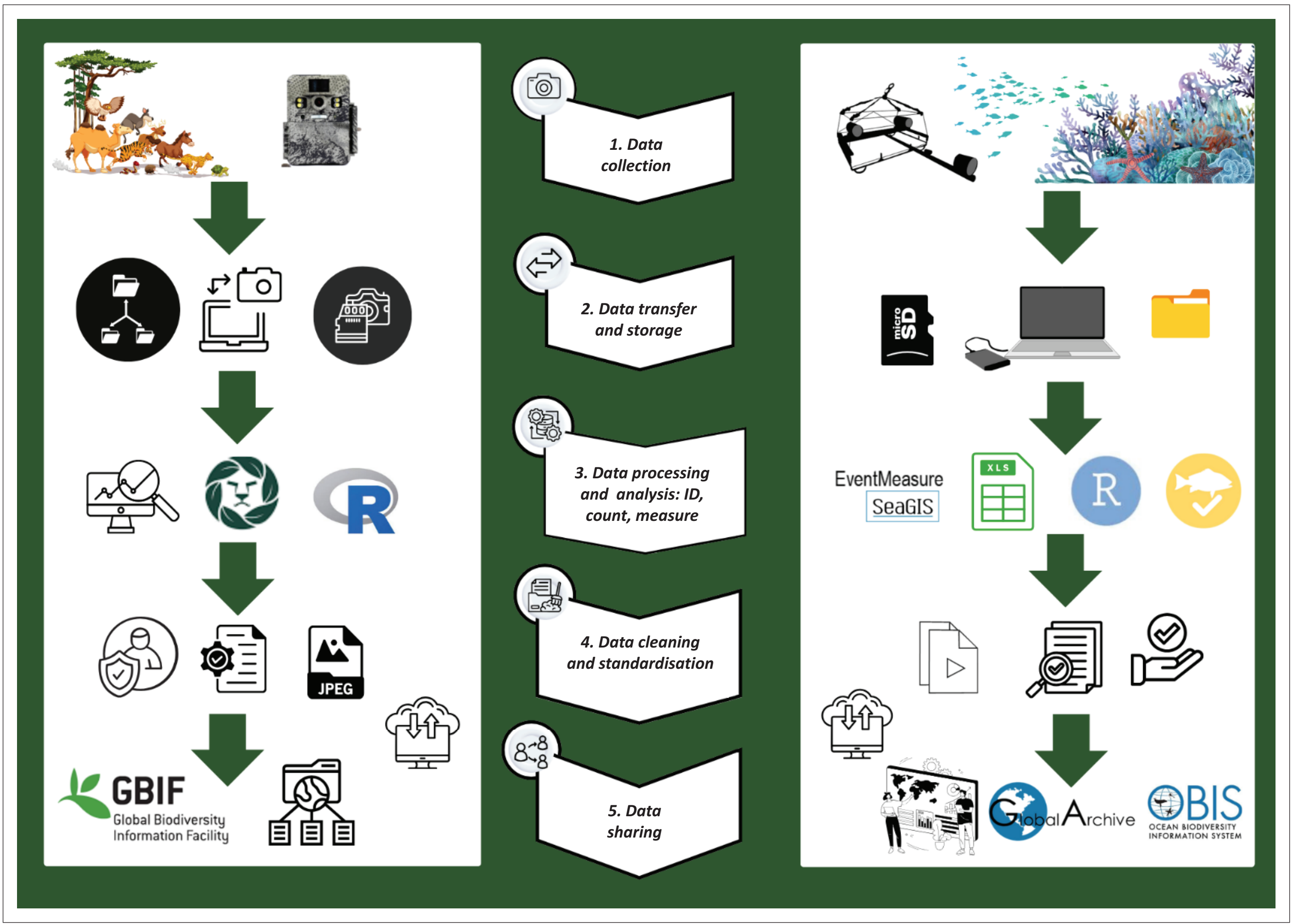

Note: Field-collected data are transferred from SD cards to a computer and organised into standard folders. Annotation tools and software are employed for processing and annotation, followed by analysis using open-source programs such as R. Data undergoes cleaning and quality control and standardisation. Upon completion, reports and publications are generated. The standardised data, along with metadata and reports, are uploaded to the SANParks cloud platform and reports and (meta)data are shared with stakeholders (park management, collaborators, scientific community, etc.) and uploaded to open global repositories.

FIGURE 2: The envisioned workflow for managing visual data in South African National Parks.

the most out of SANParks' visual data. The JRS Biodiversity Foundation is thanked for funding this work.

Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

D.A.S. and D.S. conceptualised the article. D.A.S. wrote the article and D.S. reviewed and edited the article.

Ethical considerations

This article followed all ethical standards for research without direct contact with human or animal subjects.

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Data availability

Data sharing is not applicable to this article, as no new data were created or analysed in this study.

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Appendices start on the next page →

Appendix 1

TABLE 1-A1: Best Practice BRUV workshop agenda.

Tuesday 17 October 2023				
Start	**End**	**Min**	**Session Name**	**Speaker**
Session 1: Opening				
08h30	08h35	5	Welcoming	Nkabeng Mzileni
08h35	08h45	10	Introduction- Setting the scene, workshop overview and expectations	Daniëlle Seymour
08h45	09h00	15	Presentation on the status of SANParks BRUV projects, data storage, analysis, challenges, and way forward	Daniëlle Seymour
Session 2: Best Practice BRUV Field techniques and procedure				
09h00	09h10	10	BRUVS in the field (Cape Parks)	Sisanda Mayekiso
09h10	09h25	15	Best practice: BRUVS in the field	Shirley Parker-Nance
09h25	09h40	15	Discussion (reflect on similarities and differences with field methods: where are the gaps, where can we improve)	All
Tea Break				
Session 3: BRUV Data Quality Control and Management				
10h00	10h15	15	CheckEM tool	Brooke Gibbons
10h15	10h30	15	Checking and validating EMObs incl. manual review methods	Anthony Bernard
10H30	10H45	15	Discussion: Reflection on validating EMObs and achieving suitable precision with fish IDs and Counts	All
10h45	11h00	15	An overview of GlobalArchive service for archiving and sharing stereo-BRUV annotations	Tim Langlois (UWA)
11h00	11h15	15	Discussion: Use of GlobalArchive repository in our organizations	All
Session 4: Best Practice BRUV Data Management				
11h15	11h25	10	SANParks BRUV data curation, storage, and management (Garden Route)	Kyle Smith
11h25	11h35	10	SAEON BRUV data curation, storage, and management	Tim Parker-Nance
11h35	11h45	10	SAIAB BRUV data curation, storage, and management	Elodie Heyns-Veale
11h45	11h50	5	Reflection: SANParks BRUV data curation, storage, and management—similarities and gaps (Cape Parks)	Sisanda Mayekiso
11h50	12h05	15	Discussion (reflect on data management as discussed in the session: where are the gaps, where can we improve)	All
Lunch				
Session 5: BRUV Data processing and analysis				
12h45	12h55	10	SANParks BRUV data processing and analysis (Cape Parks)	Alison Kock
12h55	13h05	10	SANParks BRUV data processing and analysis (Garden Route)	Kyle Smith
13h05	13h15	10	SAIAB BRUV data processing and analysis	Anthony Bernard
13h15	13h25	10	SAEON BRUV data processing and analysis	Shirley Parker-Nance
13h25	13h40	15	Discussion (reflect on data processing and analysis: where are the gaps, where can we improve)	All
Tea Break				
Session 6: Wrap Up				
13h50	14h05	15	Reflection of the day and closing Q and A	All
14h05	14h15	15	Closing comments, way forward	Daniëlle Seymour
SANParks staff SOPs and reflection session				

Workshop insights

The Cape Research Centre hosted a workshop on baited remote underwater video (BRUV) stations with experts from prestigious institutions aiming to foster collaboration and knowledge sharing in BRUV research. Best practices in BRUV deployment and data management were discussed, emphasising the importance of standardised methods to ensure data consistency and reliability. Participants explored tools such as CheckEM and repositories such as GlobalArchive for efficient data management and validation. Key insights included the need for modern data infrastructure, specialised data teams, and leveraging open-source software for data analysis. Ensuring alignment with global ocean best practices and effective data management for robust reporting were highlighted as crucial for conservation efforts. Overall, the workshop demonstrated the promising future of BRUVs in South Africa for conservation and long-term monitoring initiatives.

TABLE 2-A1: Best practice BRUV workshop participants.

Name:	Organisation:
Angus van Wyk	South African Institute for Aquatic Biodiversity
Anthony Bernard	South African Institute for Aquatic Biodiversity
Anne Treasure	South African Environmental Observation Network
Aseeqah Davids	South African Institute for Aquatic Biodiversity
Brooke Gibbons	University of Western Australia
Claire Parenzee	South African National Parks
Cloverley Lawrence	South African National Parks
Daniëlle Seymour	South African National Parks
Dian Spear	South African National Parks
Elodie Heyns-Veale	South African Institute for Aquatic Biodiversity
Grant Van Der Heever	Department of Forestry, Fisheries and the Environment
JJ Forgus	South African Environmental Observation Network
Judith Botha	South African National Parks
Keith Spencer	CapeNature
Kylen Brown	South African National Parks
Kyle Smith	South African National Parks
Laurenne Snyders	Department of Forestry, Fisheries and the Environment
Nkabeng Mzileni	South African National Parks
Roxanne Juby	South African Institute for Aquatic Biodiversity
Rushdi Ariefdien	South African National Parks
Shaun Deyzel	South African Environmental Observation Network
Shirley Parker-Nance	South African Environmental Observation Network
Sisanda Mayekiso	South African National Parks
Tim Parker-Nance	South African Environmental Observation Network
Tim Langlois	University of Western Australia

TABLE 3-A1: Best practice camera trap workshop agenda.

Tuesday 21 November 2023				
Start	**End**	**Min**	**Session Name**	**Speaker**
Session 1: Opening				
08h30	08h35	5	Welcoming	Nkabeng Mzileni
08h35	08h45	10	Introduction-setting the scene and workshop overview	Daniëlle Seymour
08h45	09h00	15	Presentation on the status of SANParks camera trap projects, data storage, data analysis, challenges, and a proposed way forward	Daniëlle Seymour
Session 2: Best Practice Field techniques and procedure				
09H00	09H15	15	Best practice camera trapping in the field: SANParks	Deborah Winterton
09h15	09h30	15	Best practice camera trapping in the field: Cape Leopard Trust	Anita Wilkinson
09h30	09h45	15	Best practice camera trapping in the field: Panthera	Gareth Mann
09h45	10h00	15	Discussion (reflect on similarities and differences with field methods: where are the gaps, where can we improve)	All
Tea Break				
Session 3: Best Practice Data Management				
10h30	10h40	10	Camera Trapping with the Wilderness Foundation Africa	Reinhardt Brand
10h40	10h55	15	SANParks camera trap data storage, curation, and management	Daniëlle Seymour
10h55	11h10	15	Cape Leopard Trust camera trap data storage, curation, and management	Anita Wilkinson
11h10	11h25	15	Panthera camera trap data storage, curation, and management	Shannon Dubay
11h25	11h35	10	Reflection: SANParks data curation, storage, and management—similarities and gaps	Judith Botha
11h35	11h55	20	Discussion and lessons learnt (all to reflect on data management as discussed in session, where are the gaps, where can we improve)	All
Lunch				
Session 4: Data processing and analysis				
13h00	13h10	10	Cape Parks camera trap data processing and analysis	Deborah Winterton
13h10	13h20	10	Garden Route camera trap data processing and analysis	Lizette Moolman
13h20	13h30	10	Panthera camera trap data processing and analysis	Shannon Dubay and Gareth Mann
13h30	13h40	10	Cape Leopard Trust camera trap data processing and analysis	Katy Williams
13h40	14h00	20	Discussion and lessons learnt (all to reflect on data processing and analysis as discussed in session, where are the gaps, where can we improve)	All
Tea Break				
14h20	14h35	15	WildEye Conservation: TrapTagger	Nicholas Osner
14h35	15h00	25	Discussion: Resources, codes, and additional tools	All
Session 5: Wrap Up				
15h00	15h15	15	Reflection of the day and closing Q and A	All
15h15	15h20	5	Closing comments, way forward	Daniëlle Seymour
End				

Workshop insights

A workshop on best practices for camera trapping in conservation was held, featuring experts from various organisations. Discussions covered topics such as site selection, camera types, deployment procedures, and data management. The Cape Leopard Trust shared techniques for monitoring wildcats and collecting baseline data on mammal species in the Western Cape. Panthera discussed their global camera trapping surveys focusing on wildcat occurrences, population density, and individual monitoring. The Wilderness Foundation highlighted their use of camera traps to engage landowners and support conservation efforts. Participants discussed data management, emphasising standardisation of metadata, detailed data management plans, and the use of open-source software such as R for analysis. Key outcomes included the importance of adhering to fundamental procedures, well-managed metadata databases, and sufficient capacity for data management and storage. The workshop concluded with a site visit to Table Mountain National Park, providing firsthand experience of camera trapping in the park. Overall, the workshop emphasised the significance of creating platforms for engagement and capacity building in conservation, fostering meaningful interactions and potential collaborations among researchers.

TABLE 4-A1: Best practice camera trap workshop participants.

Name:	Organisation:
Anita Wilkinson	Cape Leopard Trust
Benjamin Gazeau	South African National Parks
Chandler Patel	South African National Parks
Daniëlle Seymour	South African National Parks
Deborah Winterton	South African National Parks
Dian Spear	South African National Parks
Ester van der Merwe	South African National Parks
Gareth Mann	Panthera
Judith Botha	South African National Parks
Katy Williams	Cape Leopard Trust
Kylen Brown	South African National Parks
Lizette Moolman	South African National Parks
Lethabo Gololo	South African National Parks
Melanie de Morney	South African National Parks
Nicholas Osner	WildEye Conservation
Reinhardt Brand	Wilderness Foundation Africa
Roxanne Erusan	South African National Parks
Shannon Dubay	Panthera