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Editorial: Biodiversity informatics: building a lifeboat for high functionality data to decision pipeline

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Editorial on the Research Topic
Biodiversity informatics: building a lifeboat for high functionality data to decision pipeline

Biodiversity informatics is a multidisciplinary field that focuses on the use of computer technology to manage, explore, analyse, and interpret biological data (Soberon and Peterson, 2005; Guralnick and Hill, 2009). This field is designed to meet the worldwide requirements for biodiversity monitoring, addressing both the necessity for and the challenges associated with sharing data. Some of the key focus areas within biodiversity informatics include: 1) Taxonomy and genomics: the classification and naming of organisms, as well as the construction of phylogenetic trees to show evolutionary relationships. 2) Ecological modelling: the use of statistical and computational methods to understand the distribution and abundance of species across different habitats. 3) Data management and sharing: the development of databases and online platforms to store and share biodiversity data with fellow researchers and stakeholders. 4) Citizen science: engaging the public in collecting and sharing biodiversity data, using tools such as smartphone apps and online portals.

Data availability serves as the cornerstone of biodiversity science, fuelling research and discovery to inform evidence-based decisions for biodiversity conservation. However, resource limitations (financial, technological skills and infrastructure) severely hamper the establishment of inclusive information and communication technology (ICT) solutions and research and development of related approaches and tools. While the world is firmly cemented in a data age, we are drowning in data but thirsty for information and the synthesis of knowledge into understanding. The volume, diversity and speed at which new environmental and ecological data, in particular, are being generated is growing exponentially as biodiversity continues to decline worldwide (MacFadyen et al., 2022). Those able to successfully generate, collect, store and curate, share, analyse and

communicate the existence of clarified synthesised biodiversity data, will become central players in informing and influencing the debate around global biodiversity change.

The Biodiversity Informatics Symposium was held at the Stellenbosch Institute for Advanced Study (STIAS) from 28-30 November 2022. The symposium brought together 68 researchers, managers, and practitioners from across South Africa and abroad, with expertise in a wide range of fields including conservation, ecology, information science, information technology, mathematics and statistics. During the symposium, we discussed challenges, highlighted opportunities, and encouraged innovative solutions for biodiversity informatics in South Africa and beyond. Discussions were centred around six keynote addresses, 34 topical presentations and three facilitated panel discussions over three days. Emerging from this symposium, nine pivotal articles are featured here: Davis et al.; Cervantes et al.; Daly and Ranwashe; Kajee et al.; Sink et al.; Poole et al.; Parker-Allie et al.; de Beer et al.; and Spear et al.. These articles focus on enhancing data management through standardisation, embracing citizen science, and innovative tools, while also highlighting the critical roles of macroecological insights, the impact of alien species, and robust data infrastructure in conservation.

Emergent questions and solutions within the field of biodiversity informatics in South Africa include challenges like reluctance in data sharing, the vast amount of undigitized data, and the need for improved data management practices. Solutions proposed include changing perceptions about data sharing, employing Optical Character Recognition (OCR) for faster digitization, and advocating for standardised data formats and interoperability. These efforts aim to enhance the accessibility and utility of biodiversity data, fostering collaborative and informed conservation strategies. More specifically, biodiversity informatics in South Africa presents both challenges and promising solutions. One of the primary questions in this field revolves around data management and integration. How can data from various sources, including government agencies, research institutions, and citizen science initiatives, be effectively harmonised and centralised? Solutions involve the development of robust databases and data-sharing protocols, fostering collaboration among stakeholders, and utilising advanced technologies like machine learning for data analysis (Parker-Allie et al.).

Other challenges stem from elements contributing to the global biodiversity crisis, including: i) Invasive species, which pose a significant threat to biodiversity. How can biodiversity informatics aid in tracking and managing these invasions effectively? Solutions include the development of early warning systems using remote sensing and geographic information systems (GIS) to monitor changes in vegetation and habitat. Additionally, promoting public awareness and community involvement in invasive species management is essential. ii) Climate change is another key concern for biodiversity conservation. How can climate data be integrated with biodiversity information to predict ecological changes? Proposed solutions encompass interdisciplinary research, leveraging climate models, and working with policymakers to implement conservation measures that account for climate impacts. iii) Habitat fragmentation and urbanisation threaten South Africa's unique biodiversity. How can we address the challenge of fragmented habitats? Solutions include prioritising conservation in land-use planning, establishing wildlife corridors, and incentivising private landowners to participate in conservation efforts. iv) Engaging local communities in biodiversity informatics efforts is crucial. How can indigenous knowledge be incorporated, and communities be empowered to become stewards of their natural resources? Solutions involve community-based monitoring programs, culturally sensitive conservation initiatives, and integrating traditional ecological knowledge into biodiversity databases. iv) Capacity building and education are vital for the sustainability of biodiversity informatics in South Africa. How can we train a skilled workforce and promote data literacy? Solutions encompass the establishment of training programs, workshops, and educational initiatives at various levels, from school curricula to professional development opportunities. Implementing innovative solutions in these areas is essential for preserving the nation's rich biodiversity and contributing to global conservation efforts.

Looking forward, we anticipate significant growth in the field of biodiversity informatics both regionally and globally in the coming decades. This growth will be supported by well-established and documented data pipelines and analysis protocols that facilitate the following key developments: (1) Development of standards for data exchange and interoperability; (2) Improvement of data quality and completeness; (3) Enhancement of data integration and synthesis; (4) Development of tools for data analysis and modelling; (5) Improvement of access to data and information; (6) Development of methods for assessing and predicting biodiversity change; (7) Building capacity in biodiversity informatics; (8) Addressing ethical and legal issues related to data sharing and use. These developments are expected to empower researchers, policymakers, and conservationists with better tools and insights for effectively managing South Africa's rich biodiversity and addressing environmental challenges.

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Conflict of interest

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