Development of a digital habitat suitability analysis for black rhinos

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Research Project

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Black rhinoceros (*Diceros bicornis*)

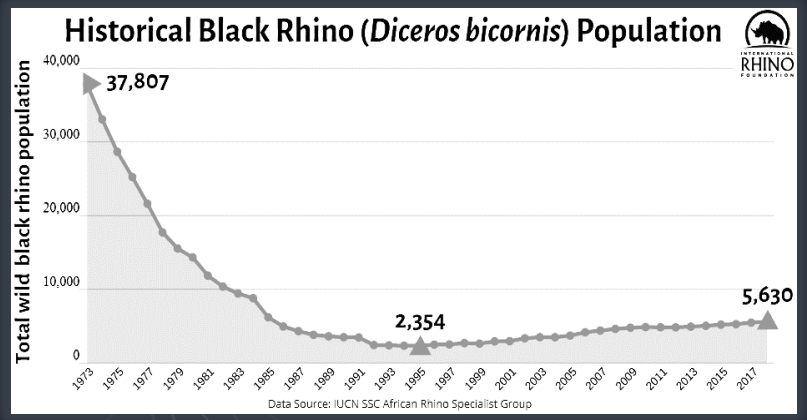


Figure 1: Black rhino population

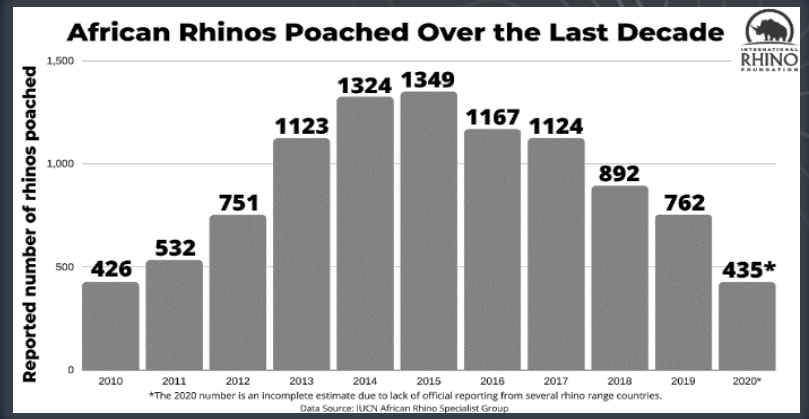


Figure 2: Poaching numbers (2010-2020)

- Listed as ´**critically endangered**´ by the IUCN (2020)
- **5,500 individuals** left throughout Africa
- Intensive hunting and poaching caused an **extreme decimation** in the last century
- Today: **poaching; habitat loss** and **fragmentation of populations** remain the major threats
- **Namibia** offers the most important ranges and hosts the largest meta-population of black rhinos

Namibia‘s Black Rhino Custodianship Programme

- Due to the growing human population and the increase of settlements in rural areas, **usable habitat for black rhinos becomes less** and remains in Non-Governmental Organization and private areas
- To establish viable subpopulations in these areas, Namibia’s conservation authorities initiated a **breeding programme** in 1993
  - **Decentralisation** of the main population from the Etosha National Park
  - **Relocation** to private farmland and communal conservancies

Figure 3: Namibia‘s black rhino translocation

Namibia's Black Rhino Custodianship Programme

Advantages:

- Many viable populations throughout the country (above-average growth rates)
- Locals become rhino custodians and provide basic care
- **Lower risk** of extinction from potential threats
- Potential use as a **resource** for income (safari tourism)
- Increased **acceptance** within local communities

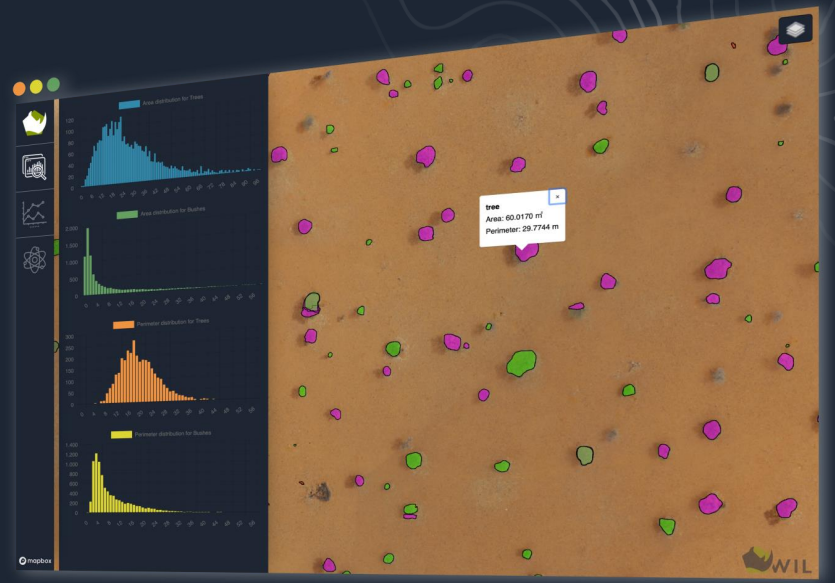
Problems:

- Many farmers and wildlife sanctuaries do not have enough funds to continuously monitor and **protect them against poaching**
- Due to growing black rhino populations on the farms, most areas are **reaching their carrying capacity**
- Area assessment for introduction is a **complicated procedure** and translocations are very **expensive**

Urgent need to find new suitable areas in order to enable the continuation of this successful breeding programme

Addressing the problem

Development of a software that helps to identify new suitable areas for black rhinos



Ecosystem Observation

Satellite, drone, and wildlife camera data enable a continuous and holistic surveillance of an ecosystem

Ecosystem Analysis

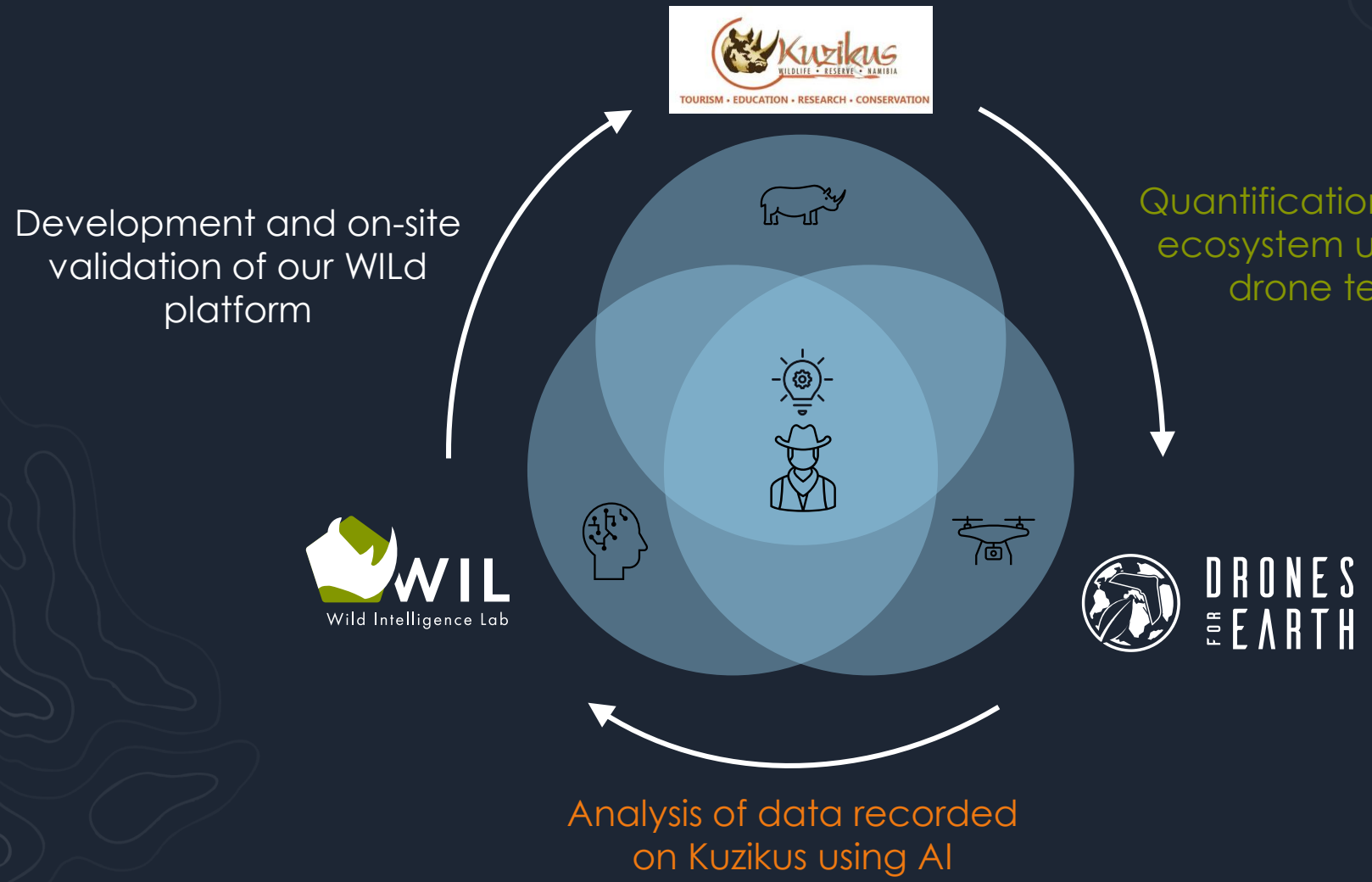
Automated analysis of ecosystem data to calculate a detailed, digital ecosystem database

WILD RESEARCH

Softwareplatform

Processing of the collected data for the development of nature conservation strategies and work planning

Automated Ecosystem Quantification Lifecycle



Step 1: Aerial imaging

Drones and satellites:

- Data capture on **landscape level**
- Mapping of **whole ecosystems**
- Accessibility to **remote terrain**
- More **cost-efficient** and **safer** than traditional methods such as helicopters, airplanes, vehicles, on foot, etc.
- Assembly of additional hyperspectral and multispectral **sensors**

Step 2: Training artificial intelligence

- **Identification of habitat components such as v**egetation, water points, topography, other animal species, human infrastructure, etc.
  - Through georeferenced **annotations** on aerial images (drawing polygons around individuals trees, bushes, animals, etc.)

Figure 4: Exemplary aerial image of the Kalahari landscape

Step 2: Training artificial intelligence

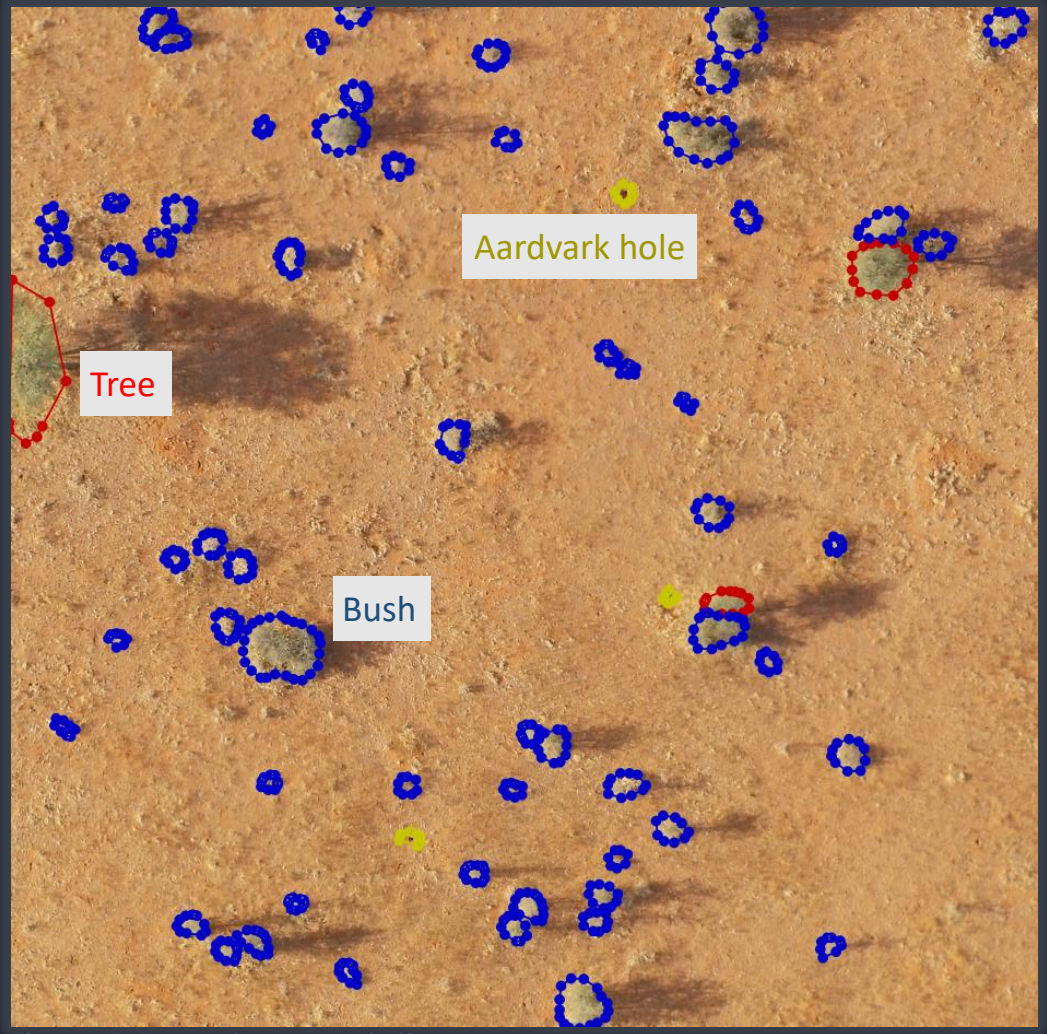


Figure 5: Exemplary annotation

Step 3: Analysis of habitat components

- Application of different analysis methods to **automatically** assess local habitat components (*trained algorithms*)
- Estimation of **vegetation densities** *(distances between individual trees and bushes)*
- Estimation of **vegetation heterogeneity** (*species composition*)
- Estimation of **plant health** and **biomass** (*NDVI*)

Figure 6: Exemplary vegetation density analysis

Step 4: Data intersection

- **Integration** of black rhino habitat use data from the Kalahari ecosystem

→ Creation of reference-database (*Kuzikus Wildlife Reserve*)

- **Overlapping** and **allocation** of multiple data layers

→ Creation of habitat-use-criteria-catalogue

Black rhino home ranges/ key areas

Vegetation heterogeneity

Vegetation density

Vegetation types

Drone/satellite imagery

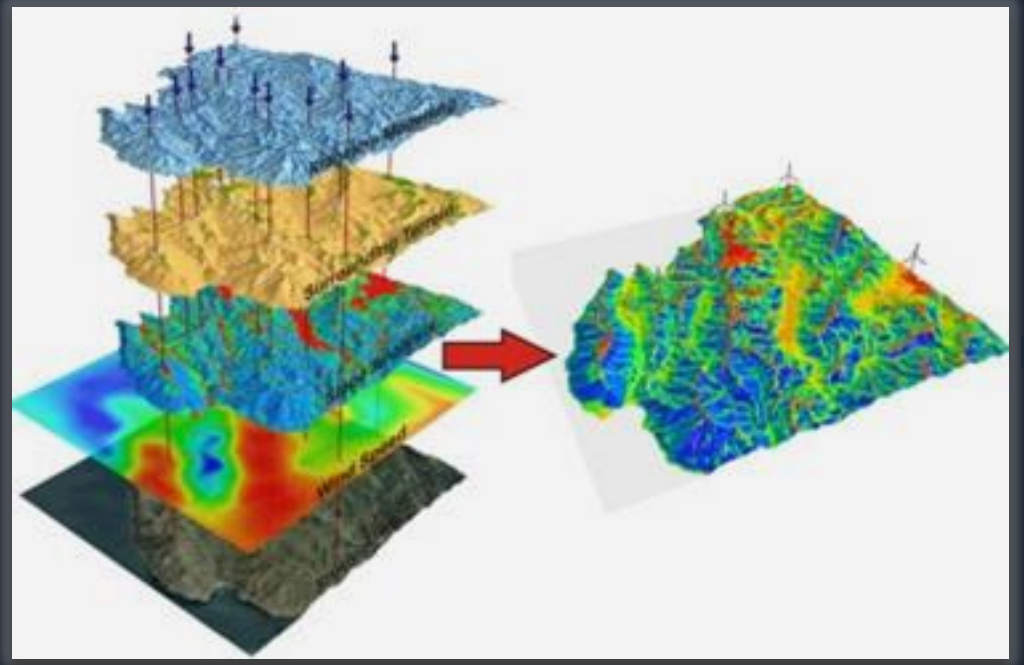


Figure 7: Exemplary data intersection

Identifying the decisive habitat components and decoding key factors of black rhino habitat use

Step 5: Translating the catalogue of habitat use criteria into WIL's GIS-based application

BLACK RHINO HABITAT USE CATALOGUE

Farm Size
- Total area available

Habitat
- Topography
- Vegetation density
- Vegetation heterogeneity

Water
- Number and distribution of water points
- Number and distribution of mud wallows

Security
- Game fence
- Public roads
- Distance to settlements in and outside the farm
- Surroundings

Disturbance
- Roads
- Domestic livestock / human infrastructure

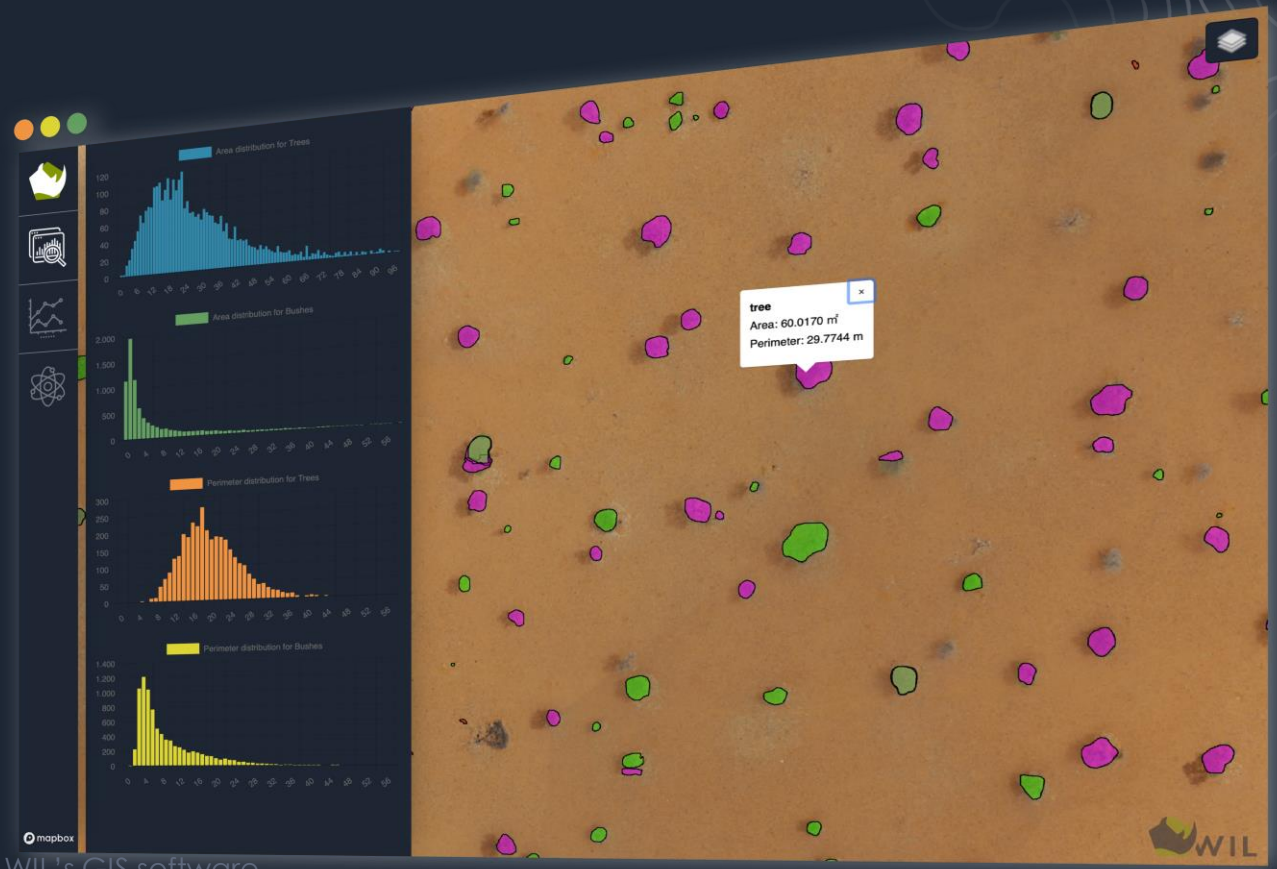
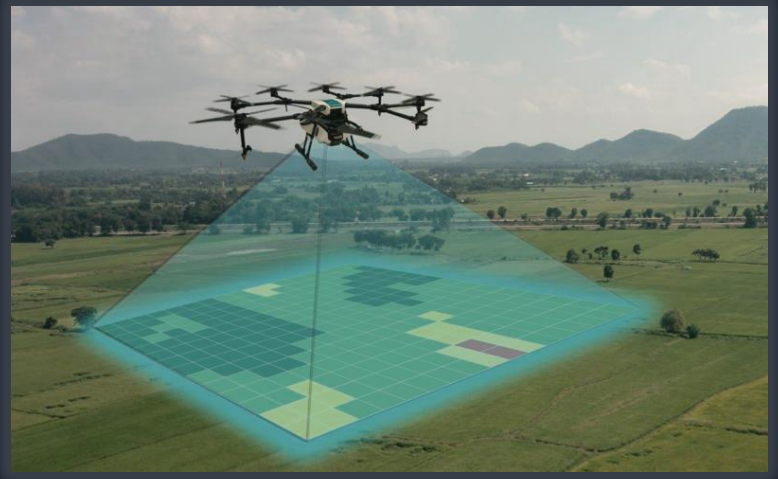


Figure 8: Exemplary catalogue of black rhino habitat use criteria and WIL's GIS software

Step 6: Expanding to other areas

- Scanning of potential locations for black rhinoceros introduction (farmland/communal areas) using drones and satellites
- Automatised quantification of aerial images



Step 7: Analysing habitat suitability with the software

Catalogue of habitat use criteria:

- **Spatial recording** and **automated delimitation** of local conditions
- Analysis and comparison of habitat parameters with those from the **reference area** (search for similar composition, distance and distribution of different habitat components)

→ **Ranking** various sections according to their suitability as a black rhino habitat (suitability score)

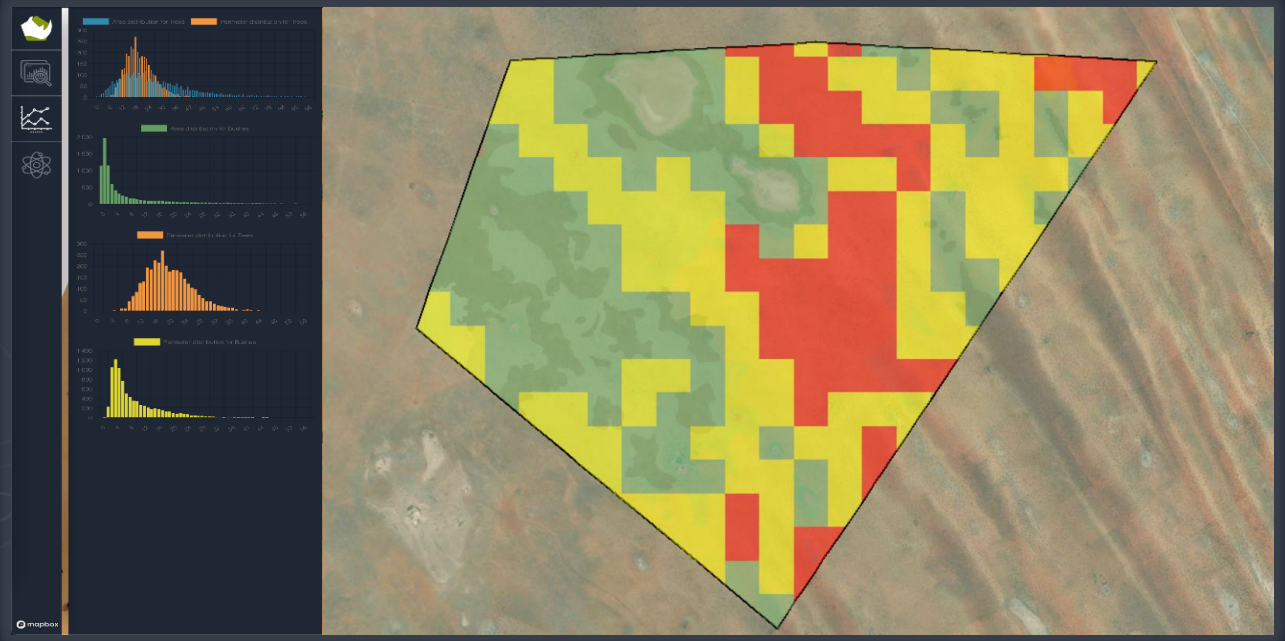


Figure 9: Exemplary habitat use analysis map

Step 7: Analysing habitat suitability with the software

- Can be used as an additional **area assessment method** for rhino management
- Provides a **detailed, spatial prediction** on the **landscape level**
- Indicates to what extent the **area is suitable** as a new location for the introduction of black rhinos
- Also applicable for the calculation of **carrying capacity** studies