

# Chapter 1

## Introduction

### 1.1 Problem Description

Wildlife conservation is a global project that seeks to preserve wildlife across all ecosystems. One of the more important ecosystems is the wetland ecosystem. Wetlands are areas where the land is covered with water such as marshes, sedges, river deltas, edges of lakes or oceans, etc. Wetlands benefit society in many ways. These include flood control, storm buffering and water quality improvement. These wetlands are invaluable to society and their surrounding communities.

Unfortunately, the importance of wetlands has only recently been realised. According to the Department of Environmental Affairs, South Africa has lost or experienced severe degradation of 35-60% of its wetlands due to bad agricultural practices. There have been recent programs for wetland rehabilitation. Most notably, the Working for Wetlands, initiated in 2003. Working for Wetlands was initiated by the Water Research Commission, in partnership with the Department of Environmental Affairs, and aims to rehabilitate and protect wetlands in South Africa.

Destruction or degradation of an ecosystem leads to a decrease in species populations and/or a decrease in biodiversity. According to the WWF's 2018 living planet report, it's stated that there's been a 60% decrease in global population biodiversity of mammals, fish, birds, reptiles and amphibians. These views are supported by the Living Planet Index. There has been a notable increase in effort to preserve and recover global biodiversity. The Aichi Biodiversity targets being the most notable. The Aichi Convention on Biological Diversity presented a strategic plan in 2011 to improve global biodiversity. This plan is made up of 5 goals and 20 targets. The Living Planet Index measures the progress of Aichi strategic goal C, "To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity".

Biodiversity is invaluable to our ecosystems and society at large. With loss of biodiversity comes reduced ecosystem resilience (ref biodiversity\_report.pdf). It's thus imperative to keep track of an ecosystem's biodiversity and species population dynamics to understand the ecosystems health. The easiest species to track are birds. A citizen scientist initiative, called the Coordinated Waterbird Counts (CWAC), was initiated in 1992 by the Animal Demographic Unit (ADU), to keep track of bird counts in wetlands around South Africa. The CWAC dataset has bird counts of over 200 different bird species from approximately 400 different wetland locations in South Africa. Some of these counts go back as far as the 1970s.

## 1.2 Background to Research

The South Africa Biodiversity Data pipeline for wetlands and waterbirds (BIRDIE), is a project that aims to use the citizen-science based freshwater bird monitoring datasets to aid wetland conservation and management decisions. The BIRDIE project is being conducted by the South African National Biodiversity Institute (SANBI), in association with FitzPatrick Institute for African Ornithology (FIAO, UCT), the Centre for Statistics in Ecology, Environment and Conservation (SEEC at the University of Cape Town, UCT), Seascope Belgium and the Royal Belgian Institute of Natural Sciences (RBINS). The end goal is to provide automated statistical computing processes on the raw data and effective visualisations hosted on a web app.

The CWAC dataset is well managed and maintains standard protocols for the counters to ensure reliable counts. The census data captured is also presented to international biodiversity contributors such as The African-Eurasian Migratory Waterbird Agreement (AEWA) and the Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar).

CWAC counts usually take place biannually. Once in summer, traditionally during January and February, and once in winter, traditionally during July. The manner of counting is standardised to increase reliability of the counts and the ability to compare counts across different wetland sites. Counters are encouraged to adhere to these methods as closely as possible. Variables such as number of counters, routes followed, time of day, tide, viewing technique, viewing aids, personnel and counting technique are all kept constant for each wetland. Due to varying terrains and environments, each wetland may require slightly different counting techniques, but these techniques remain constant once established.

The CWAC dataset provides an important insight into wetland health across South Africa. Unfortunately, the data is raw and difficult to analyse by non-experts. Analysing the count data and identifying patterns in species abundance, biodiversity and population dynamics over the years is an important step in identifying wetland health and to measure if wetland rehabilitation programs have been working.

## 1.3 Aim and Objectives

The CWAC dataset is currently not being used in any decision process regarding wetland health and conservation. The aim of this study is to change that by analysing the CWAC data and providing relevant bioindicators to track bird species population dynamics and biodiversity. State space time series models will be used to model the population dynamics and Shannon and Simpson indices will be used to form biodiversity indicators. Wetland conservation decision makers will be able to utilise these indices and models to measure the wetland health in terms of its bird species. Furthermore, it can be used as a tool by AEWA, Ramsar and even the common bird enthusiast, to monitor the waterbird species in South Africa. The Barberspan wetland is used as pilot study, but if successful, this analysis can be used on all wetland sites represented in the CWAC dataset.

The following are the objectives that, if followed, will lead to successful completion of the aim:

1. Perform exploratory data analysis on the CWAC dataset for the Barberspan region.
2. Research and develop best state space time series model for bird population dynamics in Barberspan.
3. Formulate relevant biodiversity indicators using the output of the state space model.
4. Visualise both the state space models and biodiversity indicators such that it can be used by non-experts in understanding the state of the Barberspan wetland in the context of bird species abundance and biodiversity.

## References

<https://www.environment.gov.za/projectsprogrammes/workingfowetlands> (ref this article)

ref WWF living planet report 2018

<https://www.cbd.int/sp/targets/> (ref this site)

Stoett P, Davies J, Armenteras D, Hills J, McRae L, Zastavniouk C, Bailey R, Butler C, Dankelman I, Garcia K, Godfrey L, Kirilenko A, Lemke P, Liggett D, Mudd G, Seager J, Wright CY, Zickgraf C (2019) *Chapter 6 - Biodiversity*. In: Global

Environment Outlook (GEO-6): Healthy Planet, Healthy People. United Nations Environment Programme, Cambridge, UK.