CHAPTER 8 – GENERAL CONCLUSIONS AND RECOMMENDATIONS

8.1. General Conclusions

The recognition of the occurrence, importance and effects of contaminants on food chains and ecosystems has led to the development of biomonitoring programmes that use indicator species to estimate the levels in other parts of the ecosystem. There has been an international trend to incorporate birds in biomonitoring programmes. Birds form an integral part of the ecosystem and are publicly very visible. There has also been a move to use biomarkers that are non-invasive, so that even threatened species may be used in biomonitoring. The province of Gauteng is a major concern regarding pollution, as there has been an increase in formal and informal urbanization, industrialization and mining activities. It is thus important to continuously develop new methods including the use of birds as a non-invasive technique in biomonitoring programmes. To achieve this, this project had two aims:

First Aim:

The first aim of the study was to see whether the bioaccumulation of metals in weaver feathers could be used for metal biomonitoring in Gauteng. To achieve this, the metal levels in the feathers from different sites during two time periods were determined, as well the level of physiological stress in the birds, using biomarkers. The levels of stress correlated well with the levels of metals in the feathers. Sites with higher metal levels had higher levels of organism stress. Thus the study showed that the feathers can indeed be used in biomonitoring.

Second Aim:

The second aim of the project was to develop EcoQOs for weavers in Gauteng. Data from both museum specimens and field samples were used to achieve this. There was an increase over time in the levels of most metals in the feathers. Using this data the Current, Reference and Target Levels for the various metals were determined. The

metals could also be classified according to the metal levels and the relationship between the Current and Target Levels. This can be a useful tool in the management of metal pollution.

8.2. Recommendations

Although the two aims of the project were met, there are several recommendations to better future projects and for further studies.

- Haematological biomarkers should be used in conjunction with other biomarkers during multivariate analysis to show trends rather than specific values. Normal values should also be determined for the test organism.

- Not all the biomarkers gave an ideal response. These biomarkers should be developed further for use in birds. Other biomarkers also need to be investigated for their use in birds. Some biomarkers need to be adapted for birds, for example using the ratio between oxidised and reduced glutathione instead of just the reduced glutathione content. Biomarkers that have previously been used in birds should be used in conjunction with these biomarkers.

- Laboratory studies on birds are also needed to test whether there are clear dose-response relationships between the various biomarkers and the various metals. The values for the various toxicological endpoints used in toxicity tests (for example LD_{50}) should be determined for the various species. The specific mechanism and effects of the metals on the birds should be determined in the laboratory.

- A thorough study of the metal levels in the environment should also be done. This could include water, sediment and air samples. The levels of organic pollutants should also be assessed, as these may have an impact on the biomarker response in the birds.

- When using museum specimens, the exact preservation method of the specimens should be known. The chemicals used for the preservation should also be tested to see what their exact metal content is, as this may influence the results.

- The EcoQOs should also be compared to data from other areas, to see whether they are realistic or not. They should also be compared to other guidelines regarding metal content in the environment.

- The reason why certain metals are showing an increase over time should also be investigated. The main sources of pollution should be identified. The history of pollution should be researched, to see what levels of metals, industries have previously released into the environment.

- Integrated planning between projects is also needed. Birds only form a part of the ecosystem. Important aspects, such as the geology of the area, should also be investigated. Interdisciplinary approaches are thus important to fully understand what is happening in the specific ecosystem. The interrelationships between birds and other species also need to be investigated.