1.0. QUALIFICATION SPECIFICATION

SECTION A

QUALIFICATION DEVELOPER	Botswana International University of Science and Technology (BIUST)		
TITLE	Bachelor of Science (Hons) Ecology and Evolutionary Biology	**NCQF LEVEL**	8
FIELD	Natural, Mathematical and Life Sciences	**SUB-FIELD**	Ecology and Evolutionary Biology

New qualification	✓	Review of existing qualification					
SUB-FRAMEWORK	General Education		TVET		Higher Education	✓	
QUALIFICATION TYPE	Certificate		Diploma		Bachelor		
	Bachelor Honours	✓	Master		Doctorate		
CREDIT VALUE: 648							

1.1. RATIONALE AND PURPOSE OF THE QUALIFICATION

Botswana is known for its high biodiversity, which is one of the important economic drivers for the country. Sustainable use of the country's biodiversity will rely on a strong human capacity on biodiversity management and ecosystem functioning. Ecology and evolutionary biology are one of the most relevant educational disciplines to advance knowledge on biodiversity issues and ecosystem management. The livelihoods of rural communities of Botswana are inextricably tied to availability of natural resources, therefore not only does capacity in sustainable biodiversity management benefit the eco-tourism sector but it ensures continuity of the livelihoods and welfare of rural communities as well. Knowledge and skills in ecology and evolutionary biology therefore are potentially one of the influential factors towards achieving a knowledge-based economy. However, there are currently major gaps in human capacity in the **Ecology and biodiversity sectors**. The need for filling these gaps is evident in various governmental level documents (National Development Plan, NDP11; National Biodiversity Strategy and Action Plan, NBSAP; the Fifth National Report to the Convention of Biological Diversity) and in Botswana being party to global commitments (Nagoya Protocol on Access and Benefit Sharing; UN Convention of Combating Desertification; RAMSAR convention on Wetlands of International Importance; Stockholm convention on persistent pollutants; United Nations Sustainable Development Framework (UNSDF); World Bank

programme Wealth Accounting and Valuation of Ecosystem Services, WAVES, Convention of Biological Diversity, CBD).

The degree in Evolutionary Biology and Ecology (Hons) will address the skills and knowledge gap presently experienced by the country. This qualification will be largely human-centered and applied within the local arid zone context, while maintaining global relevance and international appeal. The need for Bachelor qualification in Evolutionary Biology and Ecology (Hons) within Botswana is evident in the following areas:
1. The wellbeing of a country's population is resting on its natural resources and its human derived capital. The monetary system of national accounts reflect a limited fraction of the value added of natural capital. Nonetheless, *two major sectors in Botswana are fully dependent on biodiversity conservation and ecosystem management/function/services under global change through factors generated within and from outside of Botswana: the tourism industry and the agricultural sector*. The tourism industry is the second largest industry in Botswana, and potentially the most sustainable industry. Although contributing only 3% to Botswana's GDP, the agriculture sector is a growing sector, while crops and livestock are the livelihood for many. The influence of irrigation, and run-offs of fertilizers and pesticides into rivers not only affects the health of ecosystems and people, but agricultural productivity itself, through direct/indirect effects on ecosystem services. The importance of local research on biodiversity and ecosystems and mitigating the threats imposed on it, is critical for informed and rapid governmental and intergovernmental level decisions meant to alleviate the impact of environmental changes.
2. *Conserving Botswana's biodiversity and ecosystems is mandated by various documents on governmental level* (National Development Plan, NDP11; National Biodiversity Strategy and Action Plan, NBSAP) *and on global level* (Botswana ratified the Nagoya Protocol on Access and Benefit Sharing; Botswana is under the obligation of the UN Convention of Combating Desertification, the RAMSAR convention on Wetlands of International Importance, and the Stockholm convention on persistent pollutants to protects its natural resources).
3. *Students entering the job market*. The role of human capital in the supply and delivery of ecosystem services is increasingly recognised as a socio-economic system, where the welfare of humans and the health of the ecosystems are co-dependent. The sectors most likely to absorb students with a degree in Science and Technology in Botswana are those specializing in biodiversity and ecosystem-related sciences as set out in the degree programmes proposed in this document. Although other sectors/industries are currently growing in Botswana, the current reality is a shortage of industries to absorb students in technical degrees, while there is a shortage of qualified expertise in biodiversity and

environmental conservation, especially those with qualifications that allow them to contribute towards innovative solutions to global threats impacting Botswana's natural resources.

4. *Increased biological invasions coincident with climate change.* Changes in climate has caused increased invasions of pest species, with severe impacts on crop production and food security, integrity of biological diversity and human health. These biological invasions directly or indirectly affects the provision of ecosystem services and socioeconomic wellbeing of the native population. Training in this component will help the country have technical capacity on how to identify invasive species, routes to invasion, and how to cope with invasive species. This is in alignment with the United Nations (UN) sustainable development goals (1) '*no poverty'*, (2) '*end hunger, achieve food security and improved nutrition and promote sustainable agriculture'* and (13) '*combat climate change and its impacts'*.

As the consequences of global change increases, threats to Botswana's biodiversity will also increase. In conservation biology, the need for rapid action in response to such threats are critical. Failure to take action may cause irreversible damage/loss of biodiversity and associated ecosystem services. Human interventions to monitor and preserve biodiversity also requires habitat/site-specific, baseline data. Except for some *ad hoc* faunal and floral checklists, however, the biodiversity of Botswana, and Africa at large, and its habitat requirements, remain grossly understudied and poorly understood. The degree in Evolutionary Biology and Ecology will train future scientists to deal with issues related to biodiversity. Botswana has unique natural environments (the Okavango Delta, expansive pan systems, vast Kalahari system to name a few) which attract global attention from scientists, students, and tourists alike. The proposed qualification will improve Botswana's human capital in biodiversity management and hence improve the country's image of wildlife protection and innovative ways to deal with ecosystems and threats to ecosystems and the services they provide. The following additional points further demonstrate the need for the proposed qualification.

Compliance with HRDC guidelines

Local communities: The degree will strengthen community based natural resource management, increase sustainability of biological diversity and the services they provide and also contribute to a reduction in human-wildlife conflict.

Botswana institutions: The degree will provide capacity to strengthen Botswana's biodiversity institutions, especially natural history scientific repositories, which provides the basis for biodiversity related research

and sustainable development (species-level research, environmental impact studies, land change, etc.), and as repository for voucher specimens for future reference by local and international scientists.

Future knowledge-based economy: Globally, biotechnologists work synergistically with ecologists. Biodiversity knowledge forms the foundation for mainstreaming natural products and indigenous knowledge into environmental policy and management. Students emerging from the degree will have a breadth of knowledge that will be crucial for future bioprospecting and biotech research. Furthermore, knowledge on invasion species ecology and mitigation would help the country protect from such losses associated with the species, and thus contributing to a knowledge economy.

Unique opportunity for internationalization:

The degree in Evolutionary Biology and Ecology offers unparalleled opportunities for internationalization. As such, the degree structure is strategically designed to foster internationalisation, international-local collaboration, and local hands-on training. Botswana's natural resources offer valuable, and highly attractive, research and training opportunities. They are, however, grossly underutilised for this purpose.

1.2. Purpose of the Qualification

The purpose of this qualification is to produce graduates who can:

1.2.1. Apply highly specialized knowledge of Ecology and Evolutionary Biology science to develop solutions for complex and unpredictable environmental and ecological problems.

1.2.2. Implement Botswana's domestic sustainable development goal of 'Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

1.2.3. Conduct applied research to promote inventory of Botswana biodiversity and facilitate the identification bioproducts of medical and economical importance.

1.2.4. Analyse and model local and global biodiversity threats to facilitate development of mitigation measures

1.2.5. Will be eligible to qualify for higher education and training in Ecology and Evolutionary Biology or related field and hence this qualification will support the life-long learning principle.

2.0. ENTRY REQUIREMENTS (including access and inclusion)

The minimum requirement into the programme is Certificate IV, NCQF Level 4 (BGCSE or equivalent).

Recognition of Prior Learning (RPL) and Credit Accumulation and Transfer (CAT) will be considered for entry and access for applicants who do not meet the minimum requirement. RPL and CAT shall apply as per the individual ETP policies in line with the BQA RPL policy. These considerations will be done following guidelines of the ETP which are aligned with BQA/National policies.

3.0. QUALIFICATION SPECIFICATION	SECTION B
GRADUATE PROFILE (LEARNING OUTCOMES)	**ASSESSMENT CRITERIA**
3.1. Competently use highly specialized knowledge of Ecology and Evolutionary Biology in solving ecological problems.	3.1.1. Design appropriate methods for collecting biological samples, sample preparation and analysis of data with due concern for bias and safety considerations while solving ecological problems. 3.1.2. Execute laboratory activities commonly carried out in the laboratory including, but not limited to, DNA isolation, PCR, electrophoresis, centrifugation, solution preparation, the culture of biological organisms and instrumental analysis. 3.1.3. Execute appropriate field methods for recording quantitative and qualitative biological and environmental data for solving ecological problems. 3.1.4. Analyze ecological data to deduce scientific evidence and draw valid arguments and conclusions to address ecological and biodiversity issues. 3.1.5. Retrieve and synthesize ecological information from different sources to generate solutions to local, regional and international ecological problems.
3.2. Apply highly specialized knowledge in ecology and evolutionary biology when articulating issues in biodiversity conservation and environmental protection forums.	3.2.1. Perform hypothetico-deductive reasoning towards finding solution to climate and human-induced disturbances to both terrestrial and aquatic ecosystems

	3.2.2. Apply ecological concepts in explaining scenarios and observations during ecological capacity building seminars, workshops, training activities, etc. 3.2.3. Apply ecological concepts, such as biological monitoring, to advice conservation managers and other stakeholders when performing biodiversity conservation and environmental protection tasks.
3.3. Demonstrate high level awareness of bioethics and safety diligence when working with biological specimens	3.3.1. Handle biological specimens in an ethically and culturally sensitive manner and within the legislative framework while undertaking experiments in ecology and evolutionary biology. 3.3.2. Apply ethical practices and safety measures when handling, using, and modifying biological systems. 3.3.3. Demonstrate ethical and cultural sensitivity when disseminating scientific findings
3.4. Demonstrate considerable responsibility and accountability for own work output and of others within a field of Ecology and Evolutionary biology	3.4.1. Develop effective and realistic programmes for undertaking research projects in ecology and evolutionary biology 3.4.2. Manage time effectively when undertaking science projects in ecology and evolutionary biology

	3.4.3. Contribute to scientific assignments as a member of a team or group in scientific project or investigations.
3.5. Communicate specialized ecological information effectively to a wide diversity of audience in solving ecological and environmental problems.	5.5.1. Communicate research findings effectively in oral and in written form, using diverse platforms including online platforms. 5.5.2. Use appropriate referencing conventions in written communications, avoiding plagiarism and respecting intellectual property.
3.6. Apply highly specialized knowledge to propose generate new knowledge in the field of ecology and evolutionary biology field	3.6.1. Undertake scientific experiments or other types of research investigation to produce new and impactful knowledge in ecology and evolutionary biology 3.6.2. Competently undertake analyses and discussions of new findings in the context of published scientific literature
3.7. Use specialized basic and applied entrepreneurial and business skills in developing and manage business projects within the field of ecology and evolutionary biology	3.7.1. Undertake market research to identify a market gap for wildlife resources. 3.7.2. Devise a business plan for wildlife resource-based business. 3.7.3. Analyze value chain for wildlife products and services. 3.7.4. Develop marketable products and services from ecological resources 3.7.5. Evaluate natural resources in monitory terms.

4.0. QUALIFICATION STRUCTURE SECTION C			
	Title	**Level**	**Credits**
FUNDAMENTAL COMPONENT Subjects / Units / Modules /Courses	General Chemistry	5	12
	Introduction to Computing	5	12
	Pre-Calculus	5	12
	Introductory Physics I	5	12
	Technical Writing and Academic Literacy I	5	6
	General Chemistry	5	12
	Introduction to Statistics	6	12
	Calculus	6	12
	Introductory Physics II	6	12
	Technical Writing and Academic Literacy II	6	6
	Principles of Biology I	5	12
	Principles of Biology II	6	12
	Total credits		**132**
CORE COMPONENT Subjects / Units / Modules /Courses	Cell Biology	7	12
	Zoology	7	12
	General Biochemistry	7	12
	Principles of Ecology	7	12
	Genetics	7	12
	Communication in Biological Sciences	7	12
	Behavioural Ecology	7	12
	Entrepreneurship: Concepts and Principles	7	12
	Molecular Biology	7	12
	Environmental Microbiology	7	12
	Population and Evolutionary Genetics	7	12
	Plant Systematics	7	12
	Developmental Biology	7	12

	Evolutionary Biology	7	12
	Parasitology & Disease Ecology	7	12
	Population and Community Ecology	7	12
	Industrial placement	7	24
	Ecology Field Course	7	12
	Starting and Sustaining a Business	7	12
	Research Methods	7	12
	Remote Sensing	7	12
	Global Change Biology	7	12
	Undergraduate Research Project	7	24
	Bio-Statistics	8	12
	Field survey techniques	8	12
	Conservation and Biodiversity	8	12
	Invasion Biology	8	12
	Macro-Ecology	8	12
	Natural Resource Management	8	12
	Evolutionary development	8	12
	Biosystematics and Phylogenetics	8	12
	Honours Research Project I	8	30
	Honours Research Project II	8	30
ELECTIVE COMPONENT Subjects / Units / Modules /Courses	Comparative Animal Physiology	7	12
	Plant Physiology	7	12
	Environmental Impact Assessment	7	12
	Aquatic systems	7	12
	Vertebrate Ecology	7	12
	Bioethics	7	12
	Bioinformatics	7	12
	Terrestrial biomes of Botswana	8	12
	Evolutionary development	8	12
	Integrated Pest Management	8	12
	Climate Modelling	8	12

4.1. Rules of combinations, Credit distribution (where applicable):

Fundamental level 5 = 66

Fundamental level 6= 66

Core level 7 = 324

Core level 8 = : 180 credits

Electives level 7 = 24 credits (students choose any 2 from the available electives)

Electives level 8 = 24 credits (students choose any 2 from the available electives**)**

Total = 648 credits

5.0. ASSESSMENT AND MODERATION ARRANGEMENTS

Assessment

Assessment for this qualification will be constituted by the following:

Formative assessment = 60%

Summative assessment = 40%

Assessment should be undertaken by suitably qualified persons in ecology and evolutionary biology or related

Moderation

There will be provision for internal and external moderation as a quality assurance. Moderation must be done by suitably qualified persons in the area of ecology and evolutionary biology or related fields.

6.0. RECOGNITION OF PRIOR LEARNING (if applicable)

Candidates may submit evidence of prior learning and current competence and/or undergo appropriate forms of RPL assessment for the award of credits towards the qualification in accordance with applicable RPL policies and relevant national-level policy and legislative framework

7.0. PROGRESSION PATHWAYS (LEARNING AND EMPLOYMENT)

Learning Pathways

7.1. Vertical articulation (NCQF Level 9):

- Master of Science in Ecology and Evolutionary Biology
- Master of Philosophy in Ecology and Evolutionary Biology

7.2. Horizontal articulation (NCQF Level 8):

- Post Graduate Diploma in Ecology and Evolutionary Biology

7.3. Employment progression pathways:

a) Ecologist
b) Environmental consultant
c) Entomologist
d) Landscape manager
e) Conservation officer
f) Environmental Impact Assessor

8.0. QUALIFICATION AWARD AND CERTIFICATION

8.1. Qualification Award

A candidate must earn a minimum of 648 credits and fulfil the rules of combination stated in this document.

8.2. Certification

Candidates who meet the above will be offered a certificate. Candidates who do not meet the minimum requirements will be offered a transcript to indicate their achievements.

9.0. REGIONAL AND INTERNATIONAL COMPARABILITY

Bachelor of Science Honours in Wildlife management, University of Pretoria (South Africa)

This qualification was compared with BSc Hons in Wildlife management offered by University of Pretoria because it is a very similar qualification in the southern Africa region despite bearing different name. Like BSc Hons in Ecology and Evolutionary Biology, the core modules of the BSc Hons in Wildlife Management equips graduates with knowledge and skills in ecology research and management of wildlife resources. The BSc Hons in Wildlife Management qualification however has two exit levels two exit levels constituting two discrete qualifications, its first exit level is at NCQF level 7 (BSc degree in ecology) and its final exit level is at NCQF level level 8 (Honours degree in Wildlife management). While the learning programme of BSc Hons in Wildlife Management is comprised by two discrete qualifications, the South Africa's BSc Hons in Wildlife Management was the regionally closest qualification to BSc Hons in Ecology and Evolutionary Biology since there are no similar qualifications in the region with a continuous learning programme from NQF level from level 6 to 8. The other difference between these two qualifications is that the minimum credits required for BSc Honours in Wildlife Management is 565 whereas for BSc Hons in Ecology and

Evolutionary Biology the minimum number of credits required is 648. This difference, of 83 credits, between the two qualifications corresponds to the differences in durations of the two programmes, BSc Hons in Ecology and Evolutionary Biology will take 5 years to complete whereas BSc Honours in Wildlife Management at University of Pretoria takes four years to complete. The difference in duration arises from the fact that BSc Hons in Ecology and Evolutionary Biology offers some fundamental modules at NCQF level 5 and 6 to prepare graduates of BGCSE (level 4) for a level 7 programme. BSc Hons in Wildlife Management offers a few programmed orientation fundamental modules contributing only 12 credits to the total qualification credits. Despite the differences in duration and exit points, the two qualifications are very similar in terms of graduate profiles. The graduates of the two qualifications are instilled with skills in ecological research techniques, effective communication skills and ecosystem management skills. Graduates of BSc Hons in Ecology and Evolutionary Biology will have additional skills entrepreneurship since the qualification offers core modules that target to develop the skills. In terms of career paths, the graduates of both programmes will have similar career paths but that those from BSc Hons in Ecology and Evolutionary Biology will be better equipped with skills to start-up their own business within the ecology and evolutionary biology discipline.

Bachelor of Science (Hons) in Ecology and Conservation Biology, Monash University (Australia).
In terms of international comparability, the Australian BSc Hons Ecology in Ecology and Conservation Biology is one of the closest qualifications to BSc Hons in Ecology and Evolutionary. The two qualifications are similar in terms of the core modules although the Australian programme does not have fundamental courses and hence does not have level 5 and 6 modules. The other difference is that BSc Hons in Ecology and Evolutionary has modules that builds entrepreneurial skills as part of the core modules whereas such courses are not offered by the Australian degree programme. In general, the degree programmes are similar in that they equip learners with the key principles of the discipline, underpinning the exploration of the broad range of fascinating and practically important biological questions that can be addressed by the study of biodiversity. Similar to the proposed degree, the Australian EEB programme equips learners with intellectual, practical and communication skills to gain employment in diverse situations. Graduates of the Australian EEB are expected to be able to undertake research activities for universities and organisations such as the Commonwealth Scientific Industrial and Research Organisation (CSIRO), or to continue onto more specialised postgraduate studies. In BSc Hons in Ecology and Evolutionary degree, graduates are expected to undertake research in similar scenarios i.e., in government and non-governmental organizations. They may also gain employment in developing conservation policy for government

environment agencies, in environmental consultancy, work for non-government organisations active in wildlife and habitat management or helping mining and engineering companies to limit their environmental footprint; skills which are relevant for Botswana's wildlife conservation.

10.0. REVIEW PERIOD

This qualification will be reviewed after 5 years or as and when the need arises.