COLLEGE OF SCIENCE AND TECHNOLOGY
BIOLOGY DEPARTMENT
OPTIONS: BOTANY/ZOOLOGY AND CONSERVATION
ACADEMIC YEAR 2016/2017

INTERNSHIP REPORT CARRIED OUT IN BIOCOOP Rwanda from 19th June 2017 to 19th July

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Done at Kitabi On: July 18th, 2017

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Declaration:

We, [*our names*] declare that this internship report is solemnly our original work conducted in BIOCOOP from 19th June to 19 July, 2017. It has not been submitted to any other institution or any university as an internship report.

Date:……../……/ 2017

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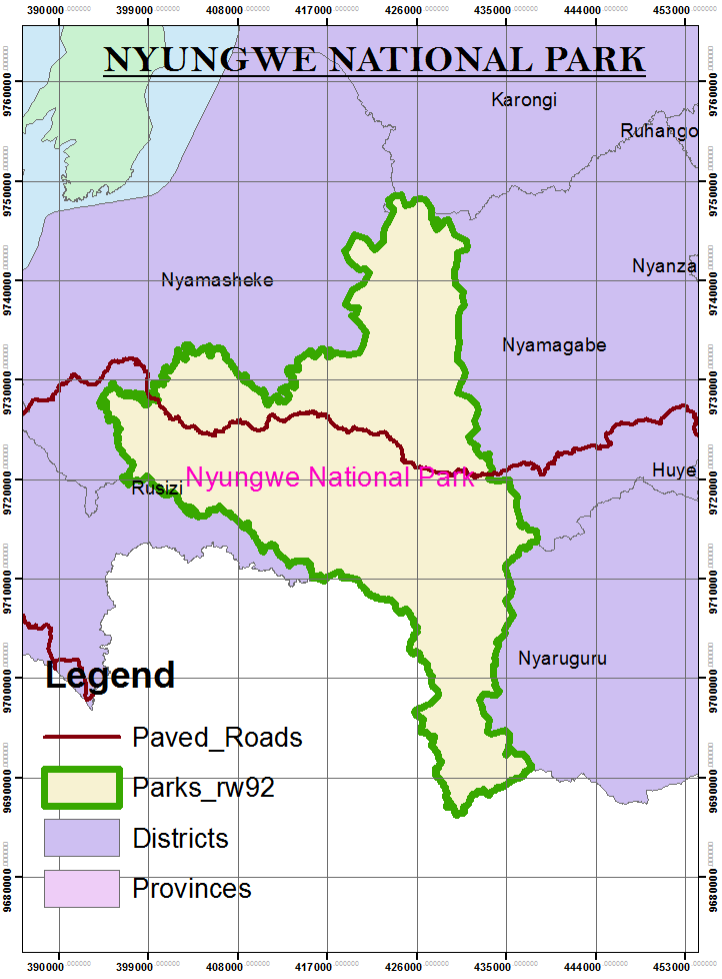
CHAPTER 1: INTRODUCTION

1.1. Background and literature review



Nyungwe National Park is a forest located in southwestern Rwanda at (2°15' – 2°55' S, 29°00'– 29°30' E), (1,600 – 2,950 m ASL) of altitude, with an average minimum temperature of 10.9° C and an average maximum temperature of 19.6° C. The mean annual rainfall is 1,744 mm (Plumptre ,2002; Ferdinand ,2007). This forest contains an abundance of plants and animal species. Dowsett, 1990 cited in (Plumptre ,2002) illustrated that more than 260 species of trees and shrubs have been found in Nyungwe with 24 species believed to be endemic to Albertine Lift. This park also contains 260 bird species of which 25 are endemic to Albertine Lift, 13 species of primates, including chimpanzees, Owl-faced guenons and Angolan black and white colobus monkeys (Plumptre ,2002). However, these creatures are being disturbed by other exotic species introduced within their ecological habitats.

The exotic species are those introduced willingly or accidentally in a new environment. They compete with the indigenous species for resources which may result in a total displacement of the indigenous from their native habitats. The introduction of exotic species particularly *Eucalyptus* and *Pines* planted in buffer zones or near natural forests are threatening them (REMA ,2007). Studies illustrated that exotic plant species change the microbial community structure and function in the soil (Brunswick ,2002).

Vitousek 1990 cited in (Brunswick ,2002) published that the displacement of native plant species by exotics is an increasingly common event. Therefore, In one of the problems occurring in natural forest is that the exotic plant species may become invasive due to scarce of resources and enemy release hypothesis (*which states that plant species, on introduction to an exotic region, experience a decrease in regulation by herbivores and other natural enemies, resulting in a rapid increase in distribution and abundance*) (Keane et al. ,2002). In addition, exotics in late stages of invasion eliminate native species and replace their functional roles (Zavaleta et al. ,2001). Exotic Eucalyptus which is useless to the native fauna is highly interfering with Nyungwe forest integrity (Pritam ,2014). Therefore, REMA recommended that there might be the management of exotic species (their harvest, sylviculture, elimination) in Nyungwe National Park (Pab, 2007).

If interactive processes are responsible for native species decline, then removal of exotic species should result in a direct increase in the richness and relative abundance of native species (Didham et al. ,2005). **Eradication** (*poisoning and mechanical harvesting*) as a removal of every individual and propagule of an exotic species so that only reintroduction could allow its return, is the favored approach in removing exotic species. However, this method might not accomplish the desired level of recovery of native ecosystems; therefore, there should be both: (1) ***pre-eradication assessment***, to tailor removal to avoid unwanted ecological effects; and (2) ***post-removal assessment*** of eradication effects, on both the target organism and the invaded ecosystem (Zavaleta et al. ,2001).

Thus, Biodiversity Conservation Cooperative (BIOCOOP) as an organization which aims at linking biodiversity conservation with human welfare has taken initiative in implementing these methods in conducting a biodiversity survey in Nyungwe buffer zone and remove exotic plant species from Nyungwe entire forest to ensure the total ecosystem recovery.

It is in this context BIOCOOP preferred to involve young people in environmental friendly activities including University students who came for internship to put in practice what they learnt in class. BIOCOOP usually receives students from KCCEM (Kitabi College of Conservation and Environmental Management) and from University of Rwanda, particularly the students who study conservation related courses.

After getting information about this organization, we decided to request an internship there anticipating more skills on practical field activities.

Our internship in BIOCOOP lasted for a period of 4 weeks from 19th June to 19th July. The internship is set for 4th year bachelor program at University of Rwanda. In BIOCOOP, our emphasis was based on **plant exotic species removal in Nyungwe National Park and Biodiversity survey in Nyungwe Buffer zone**.

Buffer zones are regarded as "*areas peripheral to specific protected areas, where restriction on resource use and special development measures are undertaken in order to enhance the conservation value of the protected area*". Buffer zones have been suggested as a particularly suitable practice for climate change mitigation, as they may facilitate the shifting of populations from reserves to adjacent lands according to the climatic needs of species (IUCN ,2015). Buffer zones have a two-fold purpose; to reinforce reserves by, e.g., increasing the size of area considered, and to eliminate or reduce negative influence on the reserves from their surroundings. Reserve species may find supplemental habitat in buffer zones, but buffer zones may also be core area for other species, and become core area for new species if habitat or climate changes (Thorell and Gotmark ,2005).

1.2. Institutional analysis

1.2.1. Historical background of BIOCOOP

BIOCOOP (Biodiversity Conservation Cooperative) is a Community Based Organization whose members are aimed in :Biodiversity conservation, Hygiene and sanitation, and Environmental management and protection for sustainable development (Efforts 1994). This institution was founded by **Ange Imanishimwe**, in 2012; its main goal is to eradicate extreme poverty in local people around Nyungwe National Park (NNP) by involving them in different money making projects. This reduces illegal activities in the forest, and it is a reliable result for welfare of fauna and flora in NNP.

BIOCOOP emphasizes on community awareness and provides trainings to local community in farming techniques and workshops to educate them on biodiversity conservation.

BIOCOOP is divided into four departments: First is **Capacity building**. It aims at building the capacity of youth around NNP in ICT, biodiversity conservation, wildlife management, natural resources management, ecotourism, environmental management, water, hygiene, sanitation, climate change mitigation, agriculture, entrepreneurship, project management, civic leadership, and business development.

Second is a department of **community health and social welfare**. This department is oriented in water, hygiene, sanitation, nutrition, and social work. They implement the projects based on public health and human nutrition as a result of eradicating malnutrition in local communities through education.

Third is a department **of agriculture and livestock promotion**. It aims at reducing the soil acidity in Nyamagabe and Nyaruguru districts by making organic fertilizers easily accessible to everyone. They integrate farming and human nutrition as the strategy of eradicating extreme poverty and malnutrition in the country.

The lastly is a **department of biodiversity conservation, environmental management, and ecotourism promotion** which integrates biodiversity conservation projects and sustainable development of the people around NNP.

BIOCOOP works with different institutions including: Ministry of youth and ICT, UNDP, WFP, SFH Rwanda, Good Neighbors Rwanda, RDB, Government of Rwanda, UNDP, SFH RWANDA, UR, and KCCEM.

1.2.2. Aims

a. Increasing the livelihoods of community and put them at the good standards of physical and financial capacity through teaching them on improved agricultural techniques
b. Promote community based ecotourism (CBET) around Nyungwe National Park
c. Unemployment alleviation in youth and women by green job creation and entrepreneurship development.
d. Enhance youth involvement in the implementation of our country priority programs.
e. Promote integrated biodiversity conservation and sustainable development
f. Integrate Biodiversity Conservation and Health for the sustainable social welfare
g. Tree planting for carbon sequestration to take mitigation measures to climate change
h. Enhance evergreen agriculture and green infrastructure in Rwanda
i. Encourage hygiene and sanitation in rural areas of Rwanda
j. Promote wildlife conservation and protection in and around protected areas of Rwanda
k. Promote conservation education at secondary schools and at high education institutes (universities and colleges)
l. Promote research in biological sciences

m. Strengthen civic leadership and entrepreneurship
n. Connect youth to scholarship and training opportunities

1.2.3. Vision

- Contribute to the development of Rwanda to the level of middle income countries using our resources and skills.

1.2.4. Mission

- Build a Nation, Environ-Socio - Economically stable through our skills and our Resources.

CHAPTER 2: DESCRIPTION OF THE INTERNSHIP

2.1. Problem statement

Due to the ability of exotic plant species in an ecosystem, they compete with the indigenous and may totally displace them from their native location ; The major problem of the exotic species is that they regenerate very fast in an ecosystem (Lorenz and Lorenz 2014; Rwanda 2011). In Nyungwe National Park, there is a big problem of exotic plant species along the sides of the tarmac road mainly caused by anthropogenic activities (Association, 2015). Local communities around NNP have little knowledge about biodiversity conservation; which is causing gradually the spread of harmful species in Nyungwe forest.

2.2. Internship objectives

2.2.1. General objectives

Acquiring skills from different techniques and materials utilized in surveying biodiversity and assessing the impact of removing exotic and invasive plant species in Nyungwe National Park.

2.2.2. Specific objectives

- To assess the negative impact of exotic and invasive species in Nyungwe national forest.
- Assessing how biodiversity conservation is linked directly to local community's livelihood
- Identification of plant species and techniques they use in removing exotic plant species

- Assessing the relationships between animals and plants
- Linking biodiversity conservation with job creation
- To put in practice what we had theoretically
- To know how the exotic plant species can be removed from natural habitat without harming indigenous species
- To know animal species rare in other areas of Rwanda
- Access to Nyungwe National Park as a good field for conservationists
- Cross cultural exchange

2.2.3. Methodology and materials

2.2.3.1. Methodology

- Counting the number of exotic and invasive plant species removed
- Visiting the field for nature observation and survey
- Sampling methods by line transect techniques.
- Applying ***cutting down, girdling and hand-pulling*** techniques to remove exotic and invasive plant species

2.2.3.2. Materials

Table 1: Materials

1	***Boots***	For cover and protection from rain, mud
2	***Note Books***	Used to keep collected data
3	***Pens***	To jot down some comments and recording the number of species
4	***Rain coats***	For cover from the rain
5	***Machetes and axes***	For cutting down exotic plant species and clearing while tracing the transect line
6	***Gloves***	For hands protection
7	***GPS***	For allocating the coordinates along the transect
8	***Digital Camera***	For taking pictures
9	***Hip-Chain***	For measuring the total length of transect and to locate the plots.
10	***Compass***	For illustration of the direction in 90 degrees.
11	***Decameter***	For measuring the DBH and tracing the plot.
12	***Range finder***	For measuring the distance in which an object is found.
13	***Tangent height gold***	For measuring the height of the tree

Chapter 3: INTERNSHIP ACTIVITIES

3.1. Week one: Nature Walk in Nyungwe Buffer zone

First week: Familiarization week

During the familiarization week, we made a nature work by traveling different trails including: **Mabende, Mushabarara** and **Mwumba** trails**.** We hiked different trails and identified different plant and animal species. The exotic species found there were **Eucalyptus, Acacia, cupresus** and **Pine tree**. As most of them had been removed; wew managed to identify some remaining plant species in those trails. **(Table 8)** represents the indigenous species we collected in the trails of Nyungwe buffer zone in Kitabi sector.

Specificity in each trail:

- **Mushabarara:** Beehive hang-up
  Signs of wild bush pigs
- **Mabende :** High diversity of pinus
  People use that place for praying
- **Mwumba**: Tea plantation is abundant
  Tea factory

ACTIVITIES IN THE TRAILS

- **Identification of species along the trails and to know their importance (Table …).**
- **Evaluation of community activities around the buffer zone**
- **Identifying challenges of the ecosystems**
- **Evaluating the role of buffer zone**

III.3.1. Identification of species along the trails and to know their importance

Species identified have been arranged in a table summarizing all observed species in the whole month and they are found in (**table 15**). All these species are indigenous and have proved a survivorship signs after exotic plant species had been removed from them.

III.3.1.1. ANIMAL SPECIES IDENTIFIED

Figure 1: *Cercopithecus l'hoesti*

Figure 2: Butterfly (*Pyrisitia nise*)

Table 2: By the help of dungs, records of different animal species were also found in this trail

Record	**PHISICAL APPEARANCE**	**VEGETATION SARROUNDING**	**DISTURBENCE**	**General observation**	**TIME**
White and black colobus monkey	Old	*Ericae spp. (nyiragishihe)*	No disturbance	Dungs are located in hidden areas	9h:32’
Umuhari	Flesh	*Pinus elioti*	Disturbance	Trapped by humans	9:50’
Urutoni	Flesh	Umuhobobo	No disturbance	Dungs not located in hidden areas	10:20’

By the help of ***hearing sounds and observation***, we recorded different bird species:

1. *Papyrus canary*
2. *African penduline tit*
3. *Lesser masked weaver*
4. *White throated swallow*
5. *Cabanis' greenbul*

III.3.2. Evaluation of community activities around the buffer zone

- **Agricultural activities:**

  Tea (*Camellia sinensis*)

  Wheat (*Triticum aestrivum*)

  Peas *(Pisum sativum)*

  Beans *(Phaseolus vulgaris)*

  Potatoes *(Ipomoea batatas).*
- **Beehives hang-up** (honey production)
- **Farming**
- **Commercial activities**

Figure 3 Tea Plantation in Mwumba

Figure 4: Beehive in Mushabarara trail

III.3.3. Identifying challenges of the ecosystems

- Illegal cutting down of trees
- Hunting
- Wild animals destroying local people's crops
- Fire from honey harvesters
- Illegal charcoal making

III.3.4. Evaluating the role of buffer zone

Conservational role:

- Slow water runoff and enhance infiltration
- Protect from wind
- Increase biological control of pests
- Protect from flood waters
- Buffer zone inhibits illegal activities that would harm the park
- Protection of endemic species from going extinct
- Restore connectivity
- Increase access to resources
- Shade stream to maintain temperature

Economic role:

- Conflict reduction between local community and animals from the park
- Produce marketable products
- Reduce energy consumption
- Increase property values
- Provide alternative energy sources
- Provide ecosystem services
- Local people collect grasses for their cattle from buffer zone
- Different activities of local people take place only in the buffer zone.

  For insteance : ***Beehives hang-up***

Social importance:

- Traditional medicine for local people are found in the buffer zone
- Promote nature-based recreation
- Jobs for local people from companies responsible for managing the buffer zone.
  Eg: New Forest Company (**NFC**).

3.2. Week two: Revisiting the area where exotic species were removed

In this week, we visited the areas along (Mushabarara and Sigira trails) where BIOCOOP had removed the exotic plant species which were hindering the growth of indigenous species in Nyungwe National Park. We were guided by Mr Ange Imanishimwe, CEO and founder of BIOCOOP and Irene IDUHUZUKURI, our supervisor. We realized that the indigenous had already established in those areas and many other species including animals were enjoying the food and habitat from the rest of the tree cuttings that had been left there as fertilizers. Among the removed we encountered included: ***Acacia melanoxylon, Eucalyptus spp, and Cupresus spp.*** Only ***cupresus*** and ***pinus*** did not regenerate but others did.

3.2.1. Reasons of exotic plant species removal from Nyungwe National Park

BIOCOOP is removing them due different reasons: to securing the integrity of the indigenous forest of Nyungwe (to protect the indigenous Species because they are food for wildlife animals), they compete with indigenous plant species and may become invasive which may disturb the whole ecosystem, protection of endemic species from going extinct and finally, by securing the indigenous species will sustain research and tourism**.**

Figure 5: Mr Ange explaining methods they used

Figure 6: Arising shoot of eucalyptus

3.2.2. Purpose of the visit

The purpose of the visit was to examine: (i) The success of the exotics removed or regenerated, (ii) The unrecognized species and we removed them, (iii) The ecosystem restoration success of the indigenous species, and (iv) the importance of the remaining cut part of the plant (igitsinsi).

Figure 7: Black ants on chopped down exotic species

Figure 8: Debris that turn into fertilizers

3.2.3. Techniques of removing exotic plant species

The removal of exotic plant species needed some techniques. These included (i) Cutting plant and removing the outer coat of the remaining cut part of the plant, (ii) Uprooting where it was possible, (iii) Drying by removing the outer coat of the plant without cutting it, and (iv) revisiting the site after three months to evaluate the success (monitoring). Each method was utilized depending on the area and where they would be reliable and applicable.

NB: The removed trees are taken to ranger posts and secondary schools to be used as firewood; and the remained in the forest are used by other living organisms as fertilizers, food, and epiphytes support.

Table 3: Techniques used in removing Exotic plant species

Cutting down	Process used where the trees don't harm the forest by falling down
Girdling Techniques	Process used where falling trees could harm the forest; includes the removal of bark around the tree
Hand-Pulling Technique	Process applied for young developing trees of any exotic species

Images illustrating one of the techniques and the outcome

Figure 9: *Cutting and removing the outer coat of the plant*

Figure 10: *Ecosystem restoration*

After removing exotic plant species in Nyungwe National Park (NNP), light and resources of indigenous trees species increased then plants eaten by animals grew faster to give food for wild animals such as insects (bees and ants), birds and monkeys. Along MWUMBA site, we also identified some insects such as red ants, termites and black-ants. Signs of antelopes were apparent through their dungs.

Figure 11: Image of antelopes' dungs (*Alcephinea antelope*)

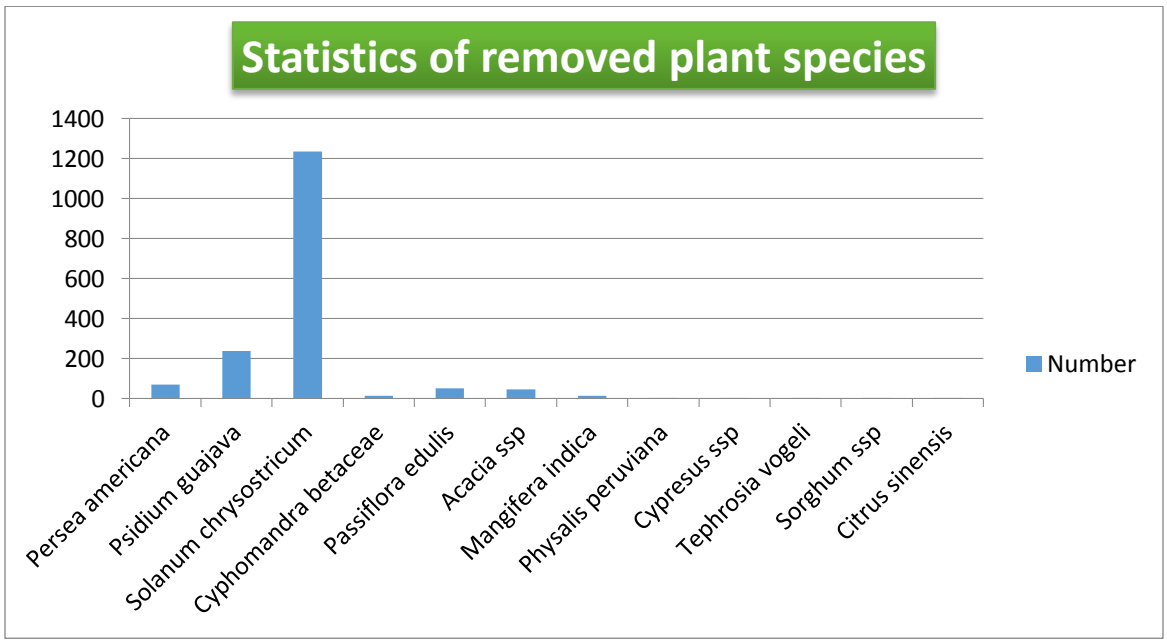
3.3. Week three: Removing exotic plant species in Nyungwe forest

This was a week in which we removed exotic and invasive plant species in Nyungwe National Park from Kitabi to Karamba. We encountered two silver monkeys who were moving near the tarmac road at KUWASENKOKO. We also met with Blue necked sunbird, three blue-great turacos, one antelope one Gambian rat and the dead snake overrun by a vehicle on tarmac road.

Figure 12: Plant species removal in action

Table 4: Number of plant species removed

No	Species Name	Number
1	*Persea americana*	71
2	*Psidium guajava*	238
3	*Solanum chrysostricum*	1237
4	*Cyphomandra betaceae*	15
5	*Passiflora edulis*	51
6	*Acacia ssp*	47
7	*Mangifera indica*	14
8	*Physalis peruviana*	2
9	*Cupresus ssp*	3
10	*Tephrosia vogeli*	1
11	*Sorghum ssp*	1
12	*Citrus sinensis*	1
	Total	**1681**



3.4. Week Four: Practical field activity involving Biodiversity survey carried out in Nyungwe Buffer zone

We worked on a **biodiversity survey in Nyungwe Buffer zone** located in Nyamagabe district, Kitabi sector, and Kagano cell; dealing with transects and plots by identifying plant and animal species within the same range and recording human signs along the transect.

Transect line number 2 (in which we worked) had 2.5 km long, along which we designed 5 plots separated by 500m each. It traversed the Nyungwe buffer zone, whose direction was from West to East.

- We were exposed to a number of different tools and how they are used on the field which included: **GPS, Camera, heap-chain, compass, Tangent height gold, decameter, range finder** and **Machetes**.

Plot identifications:

- **Circle of 9.77** radius used to count **DBH** for higher plant species referring to circumference measured at 1.30m of the plant and divide it by 3.14.
- **Smaller circle of 3.99** radius applied for shrubs and herbs and on trees with less than 10 cm of diameter.

Figure 13: Line transect tracing

Animal species recorded

- Ikimata
- Squirrel
- Cameleon

Plant species identified:

Table 5: Herbs:

Nbr	***Species names***	***Species code***	***Family***
1	*Crasoccephalum vitellinum*	CV	Asteraceae
2	*Virectoria major*	VM	Rubiaceae
3	*Panicum heterostacyum*	PH	Poaceae
4	*Killinga stenophyla*	KS	Cyperaceae
5	*Bothriocline ugandensis*	BU	Asteraceae
6	*Polygala rwenzoriensis*	PR	Polygalaceae
7	*Katschya aeschynomensis*	KA	
8	*Senecio mariettae*	SM	Asteraceae
9	*Gynura scandens*	GS	Asteraceae
10	*Rumex beguaerti*	RB	Polygonaceae
11	*Bothriocline nyungwensis*	BN	Asteraceae
12	*Spermacoce princiae*	SP	Rubiaceae
13	*Cyperus latifolius*	CL	Cyeraceae
14	*Rubus steudneri*	RS	Rosaceae
15	*Triumfetta cordifolia*	TC	Malvaceae
16	*Lindernia nummularifolia*	LN	Scrophulariacea
17	*Bothriocline glomelota*	BU	Asteraceae
18	*Eleagion fluitans*	EF	
19	*Cyathula cylindrica*	CC	Amaranthaceae
20	*Pteridium aquirinum*	PA	
21	*Achyranthus aspera*	AA	Amaranthaceae

Table 6: Shrubs and trees with less than 10 cm of the diameter

Nbr	*Species names*	*Species code*	*Family*	*Number*
	Eucalyptus maiden	EM	Myrtaceae	3
	Macaranga kilimandjarica	MK	Euphorbiaceae	1
	Eucalyptus grandis	EG	Myrtaceae	4

Table 7: Trees

		Tree position		
No	**Species name**	**D ref (cm)**	**H Bole [m]**	**H Tot [m]**
1	*Pinus patula*	33	15.1	20.21
2	*Pinus patula*	51	17.8	23.9
3	*Pinus patula*	42.9	17.2	21.3
4	*Pinus patula*	33.7	15.7	17.6
5	*Pinus patula*	33.7	22.1	24.7
6	*Pinus patula*	53.5	25.2	28.9
7	*Pinus patula*	30.8	22.8	26.1
8	*Pinus patula*	32.1	22.2	26.2
9	*Pinus patula*	30.8	22.7	25.3
10	*Pinus patula*	38.5	26.2	28.4

Animal species identified

Figure 14: *The molted skin of a snake*

Figure 15: Chameleon

Chapter 4: RESULTS, RECOMMENDATION AND CONCLUSION

4.1. Results

Table 8: Identified indigenous plant species in Nyungwe Buffer Zone

No	kinyarwanda Name	Scientific name	Family	Function
1	Umwungo	*Polyscias fulva*	Araliaceae	Medicinal, Timber and/or Firewood etc
2	Umushwati	*Carapa grandiflora*	Moraceae	Food for wild animals
3	Ibishihe	*Arthropteris orientalis*	Polypodiaceae	Food for wild animals
4	Umwufe	*Myrianthus holstii*	Moraceae	Fruits are edible for humans, and all types of chimps
5	Idoma	*Helichrysum helvolum*	Asteraceae	Medicinal
6	Igicumucumu	*Leonitis nepetifolia*	Lamiaceae	Food for rabbits , Medicinal
7	Igifuraninda	*Crassocephalum montuosum*	Asteraceae	Eaten by rabbits
8	Igikuryi	*Verectoria major*	Gesneriaceae	Bees food
9	Igishayote	*Sechium edule*	Cucurbitaceae	Edible fruit
10	Igishihe	*Arithropteris orientalis*	Tectariaceae	Mixed with ibarizo to make briquette
11	Igitamatama	*Bothriocline ugandensis*	Asteraceae	Bees' food
12	Igitenetene	*Kalanchoe crenata*	Crassulaceae	Medicinal
13	Igitovu	*Acanthus pubescens*	Acanthaceae	Medicinal
14	Ikidashya			Medicinal
15	Ikinetenete	*Alchornia hirtella*	Euphorbiaceae	Medicinal
16	Ikinobonobo	*Psychotria spp.*	Rubiaceae	Eaten by black and white colobus monkeys
17	Ikinyabushishi	*Erica spp.*	Ericaceae	Medicinal
18	Ikirumbi	*Panicum adenophorum*	Poaceae	Used in handcraft, Food for animals except pigs
19	Imbatabata, mbatama	*Plantago palmate*	Anacardaceae	Sign of disturbance
20	Umurengarutare	*Pseudosabicea arborea ssp*	Rubiaceae	Used as traditional mattresses

21	Indondori	*Impatiense burtonii*	Balsaminaceae	Edible
22	Indondori	*Impatiense kagamensis*	Balsaminaceae	edible
23	Indondori	*Impatiens ssp.*	Balsaminaceae	Edible
24	Inkeri	*Rubus spp.*	Rosaceae	Edible, Medicinal
25	Intaratara	*Cyperus distans*	Cyperaceae	Handcraft for baskets
26	Intomvu	*Lobelia gibberoa*	Campanulaceae	Used by bees but honey taste bitter, purgative, umwirongi
27	Intono (umuvuno)	*Olea hochstetteri*	Oleaceae	Food for wild animals
28	Irebe	*Nymphaea spp.*	Nymphaeceae	heal diarrhea, wound
29	Ishinge	*Aristida adoensis*	Poaceae	Icyarire, gusakara, Kwenga, ifumba, inkuyo
30	Isogo	*Solanum nigrum*	Solanaceae	Medicinal, edible
31	Mbatama/ imbatabata	*Plantago palmata*	Plantaginaceae	Signs of disturbance
32	Mbogagifu			Edible
33	Mugabudasumirwa	*Carduus leptocanthus*	Asteraceae	Skin medicine, Bayikubita inka yanze konsa
34	Nyirabuti	*Conyza welwitschii*	Asteraceae	Medicinal. Bees' food
35	Nyiragaheha			Medicinal
36	Rugugura		Poaceae	Food for animals
37	Rwagara	*Isodon ramosissums*	Lamiaceae	Acidic honey
38	Setaria	*Setaria spp.*	Poaceae	Consumed by cows
39	Ubugomboro/ indarama	*Basella alba*	Basellaceae	Heal snake bites and is used as vegetables
40	Uruvunanka			Baruphundikiza inkono y'amateke
41	Umubirizi	*Vernonia amygdarina*	Urticaceae	Medicinal
42	Umufumba	*Rumex usambarensis*	Polygonaceae	Edible
43	Umugeti	*Hagenia abyssinica*	Rosaceae	Food for primates (gorilla, monkeys)
44	Umugote	*Sygyzium guineense*	Myrtaceae	Medicinal, food for chimps
45	Umuhahi			Medicinal
46	Umuhanda	*Casearia runssorica*	Salicaceae	Purgative

47	Umuhanga	*Maesa lanceolata*	Primulaceae	Medicinal, Food for wild animals
48	Umuhanurankuba	*Embelia ubeniana*	Primulaceae	Given to pregnant women
49	Umuhati	*Dracaena afromontana*	Asparagaceace	Eaten by goats
50	Umuhehaheha			From which bees make insinda (bees' life cycle)
51	Umuhokoro	*Phytolacca dodecandra*	Phytolaccaceae	Medicinal
52	Umuhulizi	*Podocarpus latifolius*	Podocarpaceae	Used for timber
53	Umuhurura	*Ipomea wighitii*	Convoluvulaceae	Used in Rwandan culture during the naming of cows
54	Umukamba	*Clematis sinensis*	Dryopteridaceae	Medicinal
55	Umukaragata	*Embelia schimperi*	Primulaceae	Their leaves are edible
56	Umukeri	*Rubus spp.*	Rosaceae	Edible
57	Umukipfu, urubogo, umutepfu	*Sericostachys scandens*	Amaranthaceae	Food for elephants
58	Umukiryi	*Virectaria major*	Rubiaceae	Medicinal
59	Umukubayoka	*Cassia floribunda*	Fabaceae	Medicinal
60	Umukumbuguru	*Clerodendron buchholzii*	Verbenaceae	Food for monkeys
61	Umumenamabuye	*Pavetta ternifolia*	Rubiaceae	Food of chimps
62	Umunaba	*Triompheta annua*	Malyaceae	Handcraft
63	Umunayu	*Brillantaisia cicatricose*	Acanthaceae	Bees' food
64	Umunazi	*Dasylepis racemosa*	Achariaceae	Medicinal
65	Umunazi	*Parinari excelsa*	Chrysobalanaceae	Food for chimps, Medicine
66	Umunekeneke	*Lobelia petiolata*	Campanulaceae	Medicinal
67	Umunkamba	*Clematis sinensis*	Ranunculaceae	Medicine for skin infection and kids' brain pain
68	Umurara	*Macaranga kilimandjarica*	Euphorbiaceae	Abundant in NNP
69	Umurengarutare	*Pseudosabicea arborea spp.*	Rubiaceae	Cultural use
70	Umurishafumberi	*Phyllanthus fraternus*	Euphorbiaceae	Eaten by antelopes
71	Umusamanzuki	*Hypericum revoltum*	Hypericaceae	
72	Umusarenda	*Triumfetta cordifolia*	Malvaceae	Used in handcrafts for baskets
73	Umusekera	*Macaranga neomilbreadiana*	Euphorbiaceae	Monkeys' food

74	Umusekera	*Macaranga kilimandjarica*	Euphorbiaceae	Monkey's food
75	Umushababarara	*Canthium oligocarpum*	Rubiaceae	Monkeys' food
76	Umushabishabi	*Asparagus spp.*	Asparagaceae	Monkey's food, Medicinal
77	Umushishi	*Symphonia globilifera*	Clusiaceae	Medicinal, Home for birds (Rwenzori turaco)
78	Umushishiro	*Zehneria scabra*	Cucurbitaceaea	Medicinal (Amahumane)
79	Icandage			Leaves flour heal the wound
80	Umushyoshyo	*Polygala ruwenzoriensis*	Polygalaceae	Bees' food
81	Capsini			Medicinal
82	Umutavunika	*Bothriocline nyungwensis*	Asteraceae	Medicinal
83	Umuvumu	*Ficus thonningii*	Moraceae	Infrastructure, cultural function
84	Umuvunanka, Rurira	*Lactuca inermis*	Asteraceae	Medicinal
85	Umuyogera	*Crotalaria spp.*	Fabaceae	Purgative
86	Umwanya	*Neoboutonia macrocalyx*	Euphorbiaceae	Cultural use
87	Umutaki	*Ocotea milchelsonii*	Lauraceae	Medicinal
88	Urukooko	*Setaria longeseta*	Poaceae	Food for goats
89	Urutintibo	*Alchornea hilterra*	Euphorbiaceae	Food for monkeys, Eaten by antelopes, Highly abundant in NNp
90	Ubusuna	*Cyperus articulatus*	Cyperaceae	Handcrafts

In general we gained:

- Inspiration of linking biodiversity conservation and job creation
- New plant and animal species names and their importance
- Knowledge about the importance of the buffer zone in conservation
- Knowledge about the impact of exotic species on indigenous species
- Techniques of removing exotic species
- Experiences in team work

- Knowledge about the outcome after removing exotic species (ecosystem restoration)
- Practical field experience of removing exotic species
- Observational skills of how exotic species disturb the ecosystem
- Realization of human influence in spreading exotic species
- To see how local community getting involved in conservation
- We gained skills in identifying animal behaviors
- Plant species from which bees forage nectar
- Hands on actual tools used in biodiversity survey
- Practical knowledge about biodiversity survey techniques

4.2. Recommendation

- Though the park protection is in place, some individuals are still entering the park illegally; therefore, there needs to be an improvement in law enforcement, sensitization, education and job creation projects in cooperatives etc.
- Though the sign posts remind the passengers not to throw non-biodegradable materials and edible fruits in the park, still those objects are there; therefore, park managers need collaboration with transportation agencies travelling in NNP.
- Some exotic species that are not listed among the ones to be removed such as: ***Desmodium intortum***, ***Pennicetum ssp***. *and* ***Synodon dactylon***, should also be added to the list of removal.
- Though there are rules and regulations concerning drivers warning them on how they have to behave in the road, some animals are losing life being hit by vehicles; therefore, reinforcement of the law for hit animals by a vehicle is needed.

Figure 16: Plastic materials thrown in the park

Figure 17: Animal hit by a vehicle

4.3. Conclusion

Finally, by the desire to protect and maintain the integrity of species in Nyungwe forest, BIOCOOP is doing an amazing work in biodiversity conservation and sustainable development for local people around the park. They have slightly reduced a number of poachers in the park through educational and job based creating programs they provide for local communities in Nyamagabe. And the work being conducted by BIOCOOP of removing exotic plant species from Nyungwe is proving an effective work of keeping Nyungwe forest with indigenous species only in some few years ahead. Indigenous trees are now recovering and recapturing their native habitats. However, this job still needs daily monitoring processes for effectiveness of a total removal of exotic species from Nyungwe forest.

Reference:

Andrew J. Plumptre, Etl. 2002. “Biodiversity Surveys of the Nyungwe Forest Reserve.” *Researchgate.Net* (19): 96.

Association, Hope. 2015. “Rwanda Wildlife Policy.” (March).

Brunswick. 2002. “EXOTIC PLANT SPECIES ALTER THE MICROBIAL COMMUNITY STRUCTURE AND FUNCTION IN THE SOIL.” 83(11): 3152–66.

Didham, Raphael K et al. 2005. “Are Invasive Species the Drivers of Ecological Change ?” 20(9): 470–74.

Efforts, Conservation. 1994. “Nyungwe Forest.”

Ferdinand, Ngayabahiga. 2007. “Seed Survival of the Elephant-Dispersed Carapa Grandiflora (Meliaceae) Tree in Nyungwe National Park : Preliminary Observations.” : 91800.

IUCN. 2015. “Buffer Zones.”

Keane, Ryan M, Michael J Crawley, Ryan M Keane, and Michael J Crawley. 2002. “Exotic Plant Invasions and the Enemy Release Hypothesis.” 17(4): 164–70.

Lorenz, Marie Christine, and Marie Christine Lorenz. 2014. “Report on the Effectiveness of Exotic Plant Removal in Nyungwe National Park.”

Pab, Rema. 2007. “Nyungwe Park Buffer Zone and Road Issues : Joint Commission Field Mission Report Nyungwe Park Buffer Zone and Road Issues : March 2007.” (April).

Pritam, Baruah. 2014. “Trip Report : Nyungwe National Park , South Western Rwanda 1 St Sep to 4 Th Sep 2014 – By Pritam Baruah Logistics :” : 1–13.

REMA. 2007. “CHAPTER 6 : FOREST AND PROTECTED AREAS Current Status of Forestry Resources in Rwanda.” 1960(Ror 2004): 1–11.

Rwanda. 2011. “Rwanda Biodiversity Policy.” (September): 68.

Thorell, Maria, and Frank Gotmark. 2005. “Reinforcement Capacity of Potential Buffer Zones : Forest Structure and Conservation Values around Forest Reserves in Southern Sweden.” 212: 333–45.

Zavaleta, Erika S et al. 2001. “Viewing Invasive Species Removal in a Whole-Ecosystem Context.” 16(8): 454–59.