



Assessment of abundance, distribution and threats on *Prunus africana* in Rwanda,

Case study: Nyungwe and Gishwati-Mukura National Parks.

Final Report

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ABSTRACT

Prunus africana has a wide distribution in Afromontane regions of Africa. It is a canopy tree of 30–40 m in height. Nowadays, *P. africana* is declining from its natural range in some countries due to different threats and it is listed as Vulnerable by International Union for Conservation of Nature. In Rwanda, diverse scientist's studies on biodiversity have suggested the occurrence of *Prunus africana* in some of the National parks .However, there was lack of information on distribution, abundance, and threats on this species. The goal of the study was to provide baseline information about population status, spatial distribution and threats of *P.africana* in NNP and GMNP. Random sampling method was used based on disturbed areas. For each site, 4 belts transect of 50m width and 340m length was established perpendicular to the altitudinal gradient. Moreover, the interval between belts transects were 100m. In each site, sixty four (64) plots of 25x 25m were carved out with aid of a compass and 20 m was the distance from one plot to another. Diameter Breast Height was measured at 4.5 feet above the ground, Global positioning system (GPS) was used to provide coordinates where the plots and transects were designed and where *Prunus africana* species encountered. 50 questionnaires were used in each site, 30 questionnaires were distributed to the farmers adjacent to study sites, 10 to traditional healers and remain 10 questionnaires to rangers. Microsoft office excel was used for data entry, processing, and analysis. A total of 52 trees of *P.africana* have been recorded; 50trees recorded in Nyungwe and 2 trees of *P. africana* found in Gishwati - Mukura National Park. The diameter class size distribution showed the high number of large trees which indicates unstable and intermittent population structure of *P. africana* in NNP and GMNP. Agriculture and timber are the main threats to this species in NNP and GMNP. There is need of in-situ and ex- situ conservation strategies.

Key words: Distribution, GMNP, NNP, *Prunus africana*, threats, Vulnerable.

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ACRONYMS AND ABBREVIATIONS

ACNR	Association pour la Conservation de la Nature au Rwanda
CITES	Convention on International Trade in Endangered Species of wild
DBH	Diameter Breast Height
	fauna and flora
GMNP	Gishwati-Mukura National Park
IUCN	International Union for Conservation of Nature
KBNP	Kahuzi-Biega National Park
NBSAP	National Biodiversity Strategy and Action Plan
NNP	Nyungwe National Park
RDB	Rwanda Development Board
UGZ1	Unité de Gestion Zone 1
WCS	Wildlife Conservation Society

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1. Introduction

The African cherry, *Prunus africana*, is an evergreen tree, with a stem diameter of 1.5 meter; dark-brown bark (Nsawir and Ingram, 2007; Betti, 2008). *Prunus africana* is a medicinal tree (Betti, 2008; Orwa *et al.*, 2009; Bii *et al.*, 2010) , distributed in montane and Afromontane forest habitats of West, East, and Southern Africa (White, 1983; Stewart, 2003a; Stewart, 2009).

This species faced the unsustainable harvesting as mostly challenge in some countries where it distributed; (Cunningham, 2005) reported that over the last 40 years *P. africana* bark harvest has shifted from subsistence use to large-scale commercial use for international trade. This species is used by pharmaceutical companies to manufacture a drug used in treating prostate problems common in men over 50 ages (Stewart, 2003a). Furthermore the high strength and durability of *P. africana* timber makes it a useful tree throughout its natural range. Nowadays, *P. africana* is declining from its natural range in some countries due to different threats and it is listed as Vulnerable by International Union for Conservation of Nature (IUCN 2016).

P. africana had been listed also as an endangered species in Appendix II of the Convention of International Trade in Endangered Species of wild fauna and flora (CITES) (Dawson *et al.*, 2001; Stewart, 2003b).

In Rwanda, diverse scientist's studies on biodiversity have suggested the occurrence of *Prunus africana* in some of the National parks. However, there was lack of information on distribution, abundance, and threats on this species. *P. africana* is protected by the law governing biodiversity in Rwanda, Ministerial order n°007/2008 of 15/08/2008 establishes the list of protected animal and plant species; in its article 4, *P. africana* is classified on the list of plant species which need protection.

National Biodiversity Strategy and Action Plan (NBSAP) has been developed based on national needs and priorities for biodiversity conservation, in response to threats that are facing biological resources at country level. This strategy listed 5 objectives and 19 targets that aim to stop biodiversity loss and increase the economic benefits associated with the biological resources utilization and ecosystems services. For its Target 10, NBSAP suggested that by 2020, the extinction of threatened species is prevented and their conservation status improved particularly for those identified as Alliance for zero extinction. NBSAP also expected target 10, to be implemented through conducting inventory of threatened species especially those in danger of extinction and propose specific measures for their conservation, Identify Alliance for Zero Extinction (AZE) sites and evaluate their degradation status and also Ex-situ conservation of EN or CR species .

The goal of the project was to provide baseline information about population status, spatial distribution and threats of *P.africana* in Rwanda.

Therefore this information can be contribute in implementation of NBSAP; target 10, and help government's plans in the management of protected areas and sustainable utilization of natural resources by influencing policy decision making process. Addition to that, information can be used in formulating Conservation Strategy of the *Prunus africana* to be applicable into these protected areas (Nyungwe and Gishwati-Mukura National Park)

2. Materials and Methods

2.1. Study sites

2.1.1. Nyungwe National park

Nyungwe National park is located on the edge of Lake Kivu in south west of Rwanda, and is adjacent to the national park of Kibira in Burundi. Nyungwe is one of the largest blocks of montane rainforest remaining in Africa with a surface area of 1000 km². It contains rainforest, bamboo, grassland, swamps and bogs, at altitude of 2° 28' 43" S, 29° 12' 00" E, 2465m. Nyungwe national

park holds 1068 plant species 13 primate species, 275 bird species, 85 mammal species, 32 amphibian and 38 reptile species. The number of endemic species found here is greater than in any other forest in the Albertine Rift Mountains that has been surveyed.

2.1.2. Gishwati-Mukura national park

The Gishwati-Mukura National Park is located in western part of Rwanda. The Law °45/2015 of 15/10/2015 establishing the Gishwati-Mukura National Park was signed and gazetted on 01 February 2016. This National Park is composed of the Gishwati Forest with an area of 1,439.72 Hectares and Mukura Forest with a total surface of 1,987.74 hectares, the total surface area of 3,427.46 hectares. Gishwati-Mukura Park is known for a wide range of flora and fauna, including primates, chimpanzees and mammals among others. It also boasts of about 60 species of trees, including indigenous hardwoods and bamboo.

2.2. Study methodology

Survey done in 2 sites (*Nyungwe, Gishwati-Mukura national parks*) and each site was surveyed 2 times. Random sampling was used based on disturbance gradient, assuming higher disturbance near forest edges. For each site, 4 belt transect each measuring 50m width and 340m length was established and *P. africana* was targeted. Moreover, the interval between belt transects was 100m whereas 20 m was the distance from one plot to another. 16 plots of 25x25m was provided from each belt transect. A total of 4 belt transects and 64 plots were designed for each site.

Abundance of *P. africana* was determined by recording the number of trees in plots of 25m x 25m within the belt transects. Global positioning system (GPS) was used to provide coordinate where the plots and transects were designed and acquire spatial references for all the species encountered (for mapping distributon of *P. africana*). In addition to that Diameter was measured at breast height (DBH) using diameter tape. The measurements were made at 4.5 feet above the ground in order to give an average diameter estimate .In each

designed plots, direct observation procedures was applied in order to evaluate the process event or situation of physical outcomes.

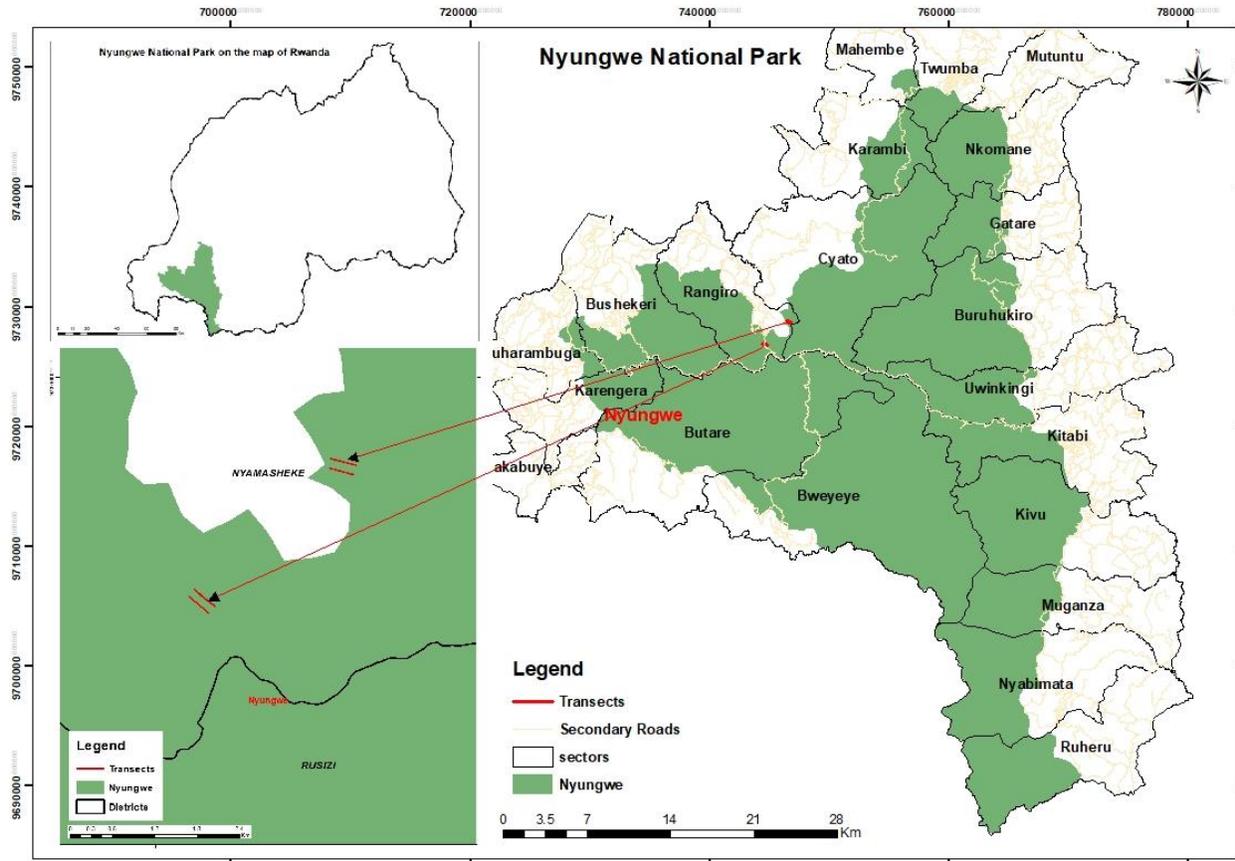


Figure 1: Map showing study area and sampled transects in Nyungwe National Park (Source: ACNR)

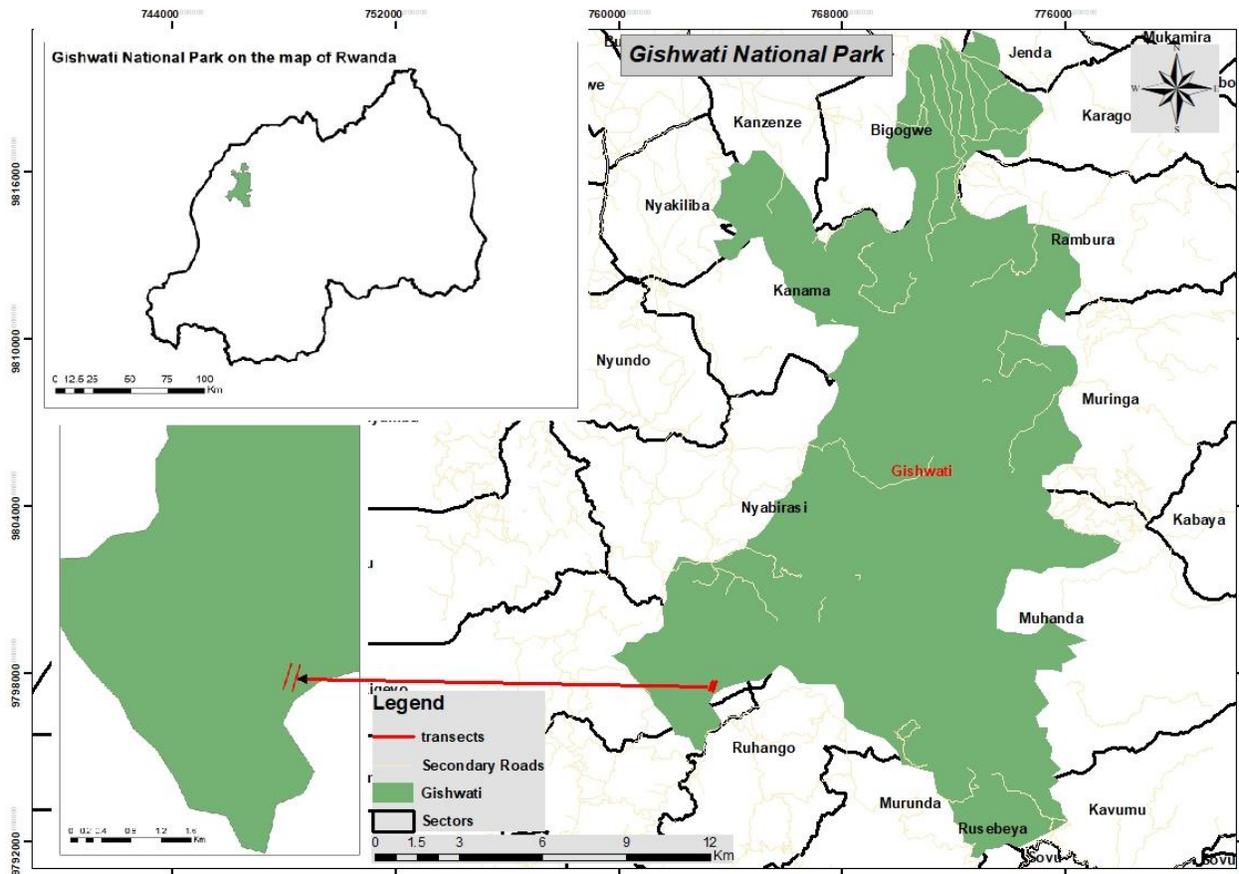


Figure 2: Map showing the study area and sampled transects in Gishwati
 (Source: ACNR)

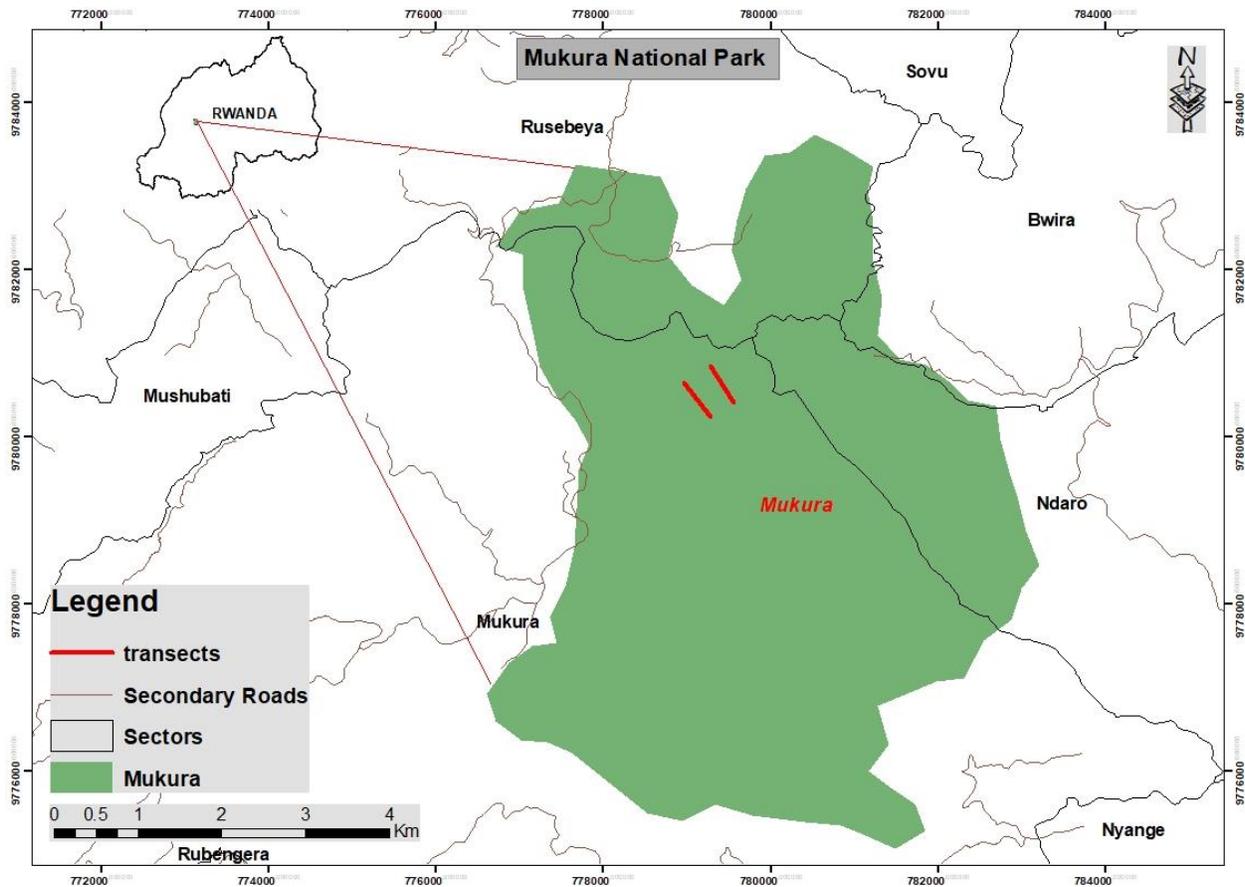


Figure 3: Map showing the study area and sampled transects in Mukura

(Source: ACNR)

In order to achieve research goal, information on threats of *Prunus africana* was collected by using questionnaires and interviews with concerned people from Rangiro, Kigeyo and Mukura sectors. A semi-structured questionnaire was used to generate realistic and accurate data. The questionnaire was composed of semi-closed and open questions designed for both males and females of different age (35-90) adjacent to study sites including; rangers, traditional healers, and farmers. 50 questionnaires were used in each site, 30 questionnaires were distributed to the farmers adjacent to study sites, 10 to traditional healers and remain 10 questionnaires to rangers. Open questions were used to allowing the respondents the liberty to answer on their own words which was easy provided great qualification in their responses (Cohen et al., 2000). The closed questions were grammatical questions in which the

respondent had different options to choose. The information obtained from respondents can contribute to revealing the real situation of *Prunus africana* and in Nyungwe and Gishwati-Mukura National Park.

2.3. Data analysis

Microsoft office excel was used for data entry, processing, and analysis. In addition to that, a compass was used to indicate direction of the transect at study area, and GIS10.2.2. Was used to make a map of the distribution of *P.africana*

Prinus africana abundance was expressed in terms of number of individuals observed in belt transects. The size of the belt transect were converted to hectare (10, 000m² =1 ha). Density was calculated as the number of trees per hectare in each of the belt transect. Age classes were determined from DBH such that seedlings were < 1.5cm no DBH, saplings were < 10cm in DBH while Mature trees were >10cm in DBH.

3. Results

A total of 52 trees of *P.africana* have been recorded; 50trees recorded in Nyungwe and 2 trees of *P. africana* found in Gishwati - Mukura National Park. The high number of respondents who knew this species was in the 50-90 age range. The high percentage of respondents reported agriculture and timber as the main threats to *Prunus africana*.

3.1. Abundance, density, DBH of *P.africana* in NNP

The highest abundance of *P. africana* was recorded in Transect 3 (T3) with 37 individuals, and T2 there was absence of *P.africana*. A total of 50 individuals were recorded in the 16 out of 64 plots sampled with in the 4 transects. The high density was in T3 with 37trees/ha.

Table 1: Abundance, density and DBH of *P. africana* per transect in Nyungwe National Park.

Site	Transect	Abundance	Density individual /ha	DBH Mean (Cm)
Nyungwe	T1	12	12	57.03
	T2	-	-	-
	T3	37	37	124.5189
	T4	1	1	N/A

Note: - stand for absent of P. africana and N/A stands for DBH mean none applicable because was 1 individual in T4).

3.2. Abundance, density, DBH of *P.africana* in GMNP

Gishwati-Mukura National Park, there was equal abundance and density in T1 and T3 where as T2 and T4 there was absence of *Prunus africana* .

Table 2: Abundance, density and DBH of *Prunus africana* per transect in Gishwati-Mukura National Park

Site	Transect	Abundance	Density Individual/ha	DBH (cm)
Gishwati-Mukura	T1	1	1	182.9
	T2	-	-	-
	T3	1	1	227.4
	T4	-	-	-

3.3. DBH size classes of *Prunus africana* in NNP and GMNP

Population structure of *P. africana* in NNP was represented in almost all DBH size classes; the results indicate higher number of large trees at 101-200cm. There was inadequate of *Prunus africana* in large trees and also absence in small size trees at <50cm, GMNP.

Diameter classes distribution of *P.africana* in Nyungwe and Gishwati-Mukura National Parks.

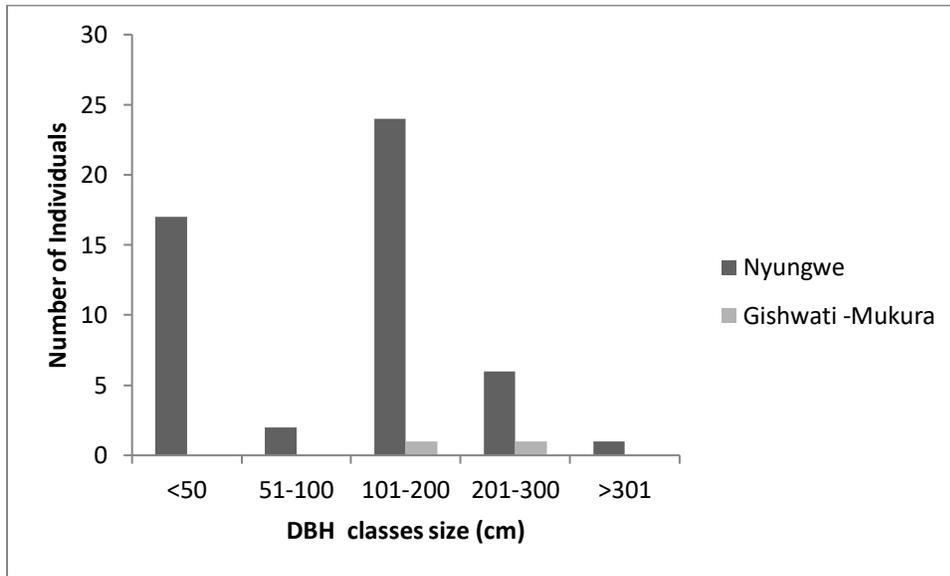


Figure 4: DBH size classes in NNP and GMNP

3.4. Age classes of *P.africana* in NNP and GMNP

Figure 5 results on age classes of *P.africana* in Nyungwe and Gishwati-Mukura National Parks . The results indicate presence of higher number of mature trees in NNP and very low number of seedlings (almost cleared for fodder, photo 2B took in January 2019) this result the J-shaped. Results also showed Absence of seedlings and saplings and few mature trees in GMNP.

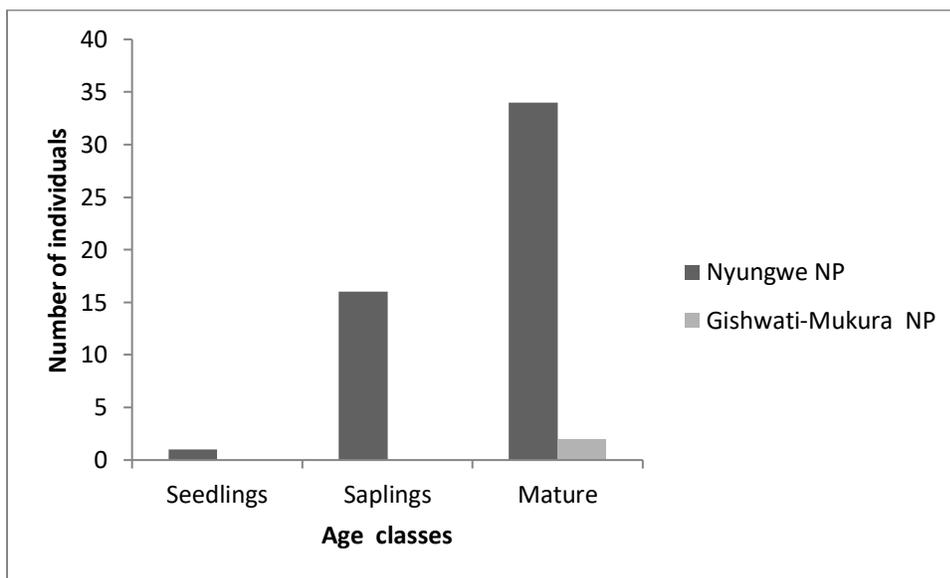


Figure 5: Age classes of *Prunus africana* in NNP and GMNP

3.5. Distribution of *P.africana* in NNP

Using spatial data of *P.africana* recorded in NNP, GIS showed a higher density of *P.africana* found towards the Northern part of the NNP near at the edge of this Park. Lower density also found in Northern part towards interior of the NNP .

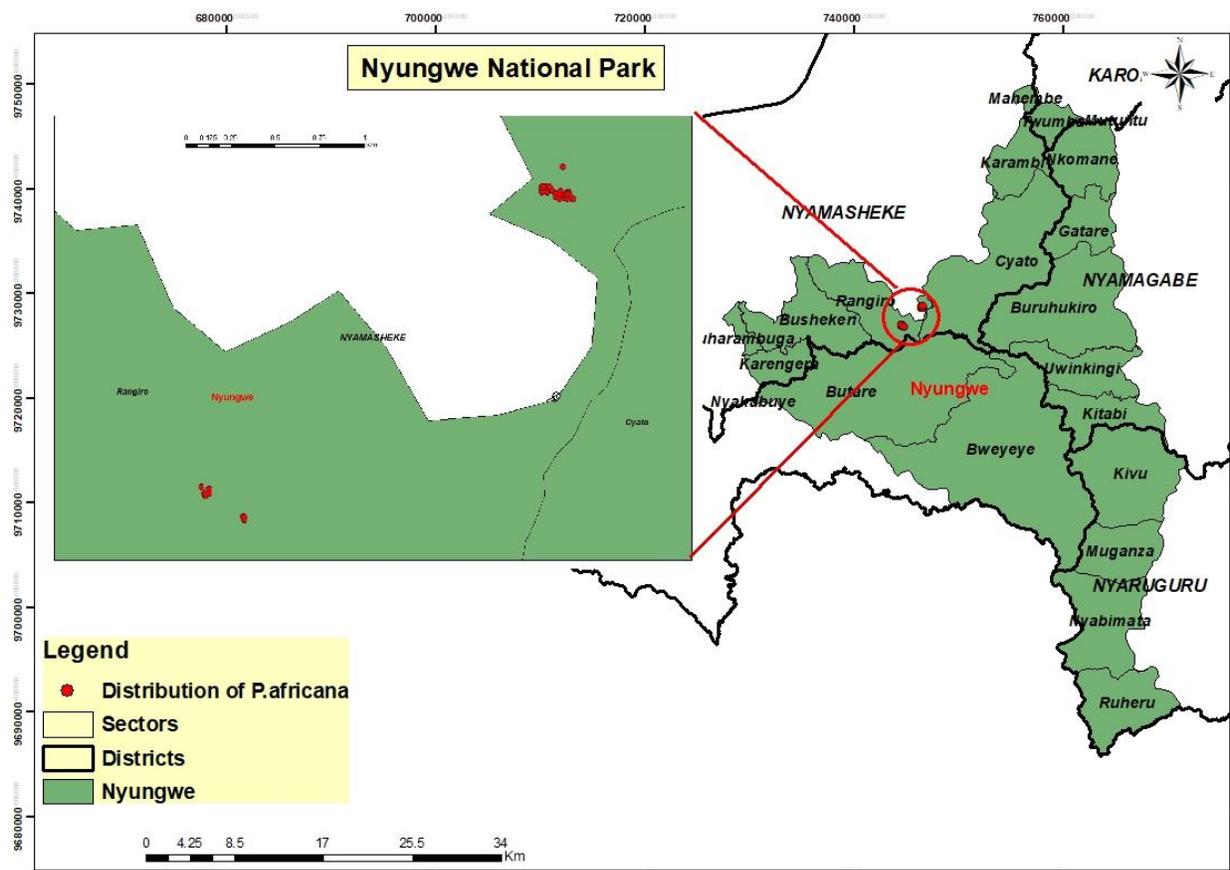


Figure 6: Map showing distribution of *P. africana* in Nyungwe National Park (Source : ACNR)

3.6. Distribution of *P.africana* in GMNP

Using spatial data of *P.africana* recorded in Gishwati-Mukura National Park, GIS showed in general lowest density of *P.africana* in this park, density found towards the southwestern part of former Gishwati forest reserve around at the edge, another individual found northern part of former Mukura forest reserve.

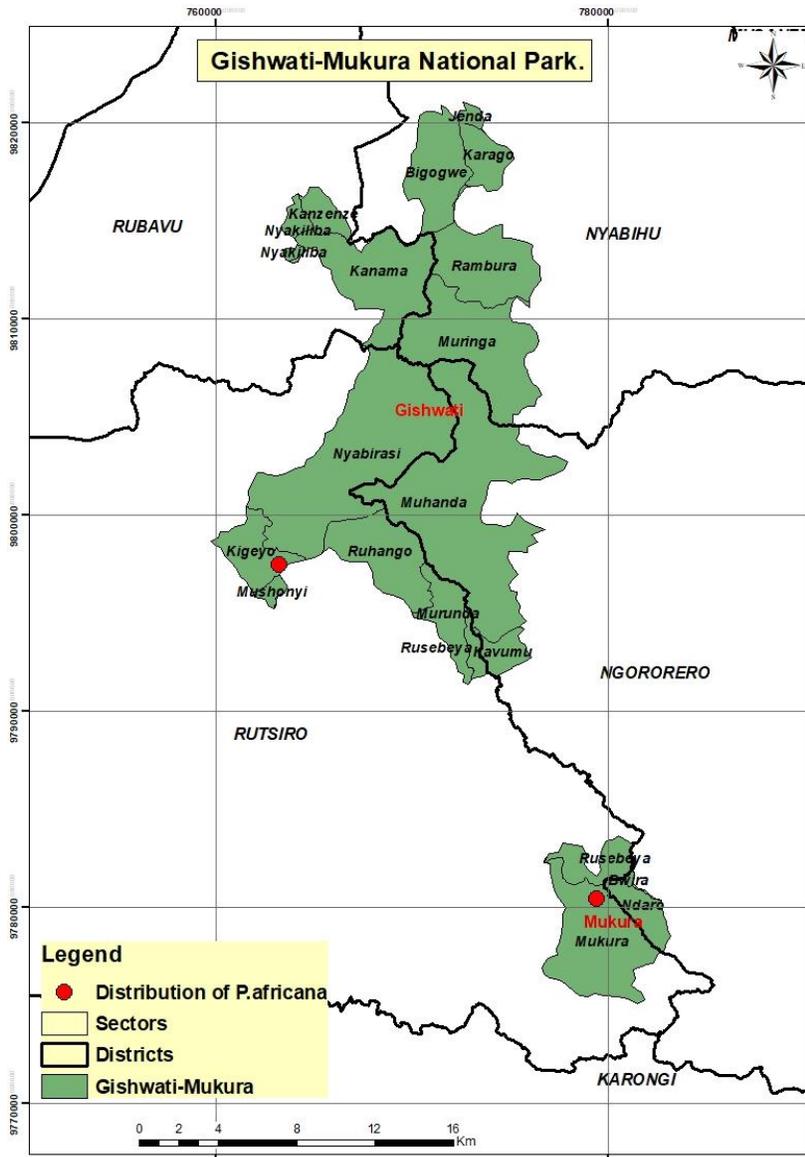


Figure 7: Map showing distribution of *P.africana* in Gishwati-Mukura National Park

(Source: ACNR)

3.7. Threats to *Prunus africana*

3.7.1. Threats to *Prunus africana* in NNP

3.7.1.1. People engage in plant collection in different periods, NNP

Respondents (72%) accepted that in the past were involved in collection of plants for multipurpose use such as food, medicines, timber and firewood, 26% said that never been engaged in this activity, few of them 2% accepted that currently collecting plants in Nyungwe National Park.

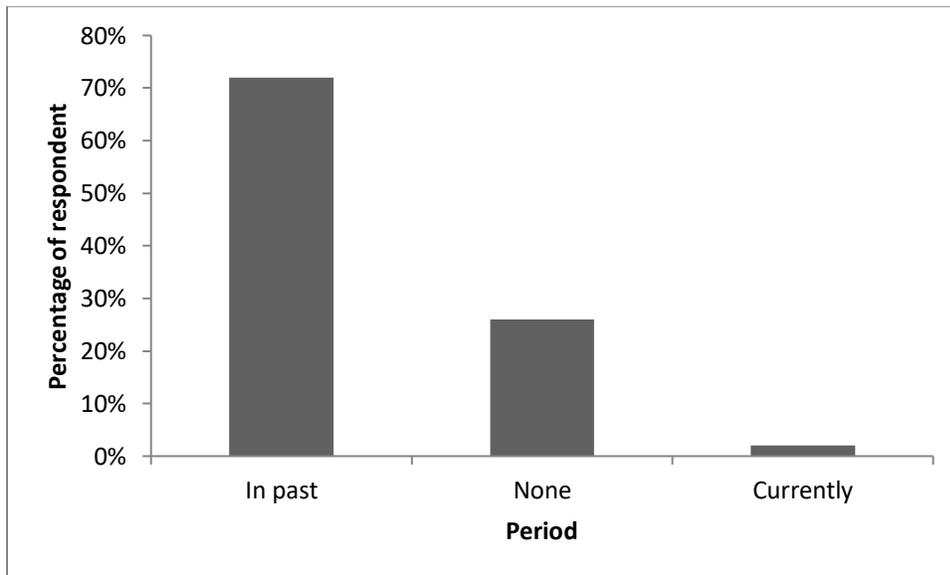


Figure 8. Percentage of people engage in collection of plants, NNP

3.7. 1.2. People collected *Prunus africana*

People live adjacent to Nyungwe National park reported that they harvested *Prunus africana* ,40% reported that they used timber from *P.africana*,30% said firewood ,20% showed that they used *Prunus africana* as medicine to treat domestic animals and people , 10% used *Prunus africana* in other ways including used its branches of this species for supporting crops to grow.

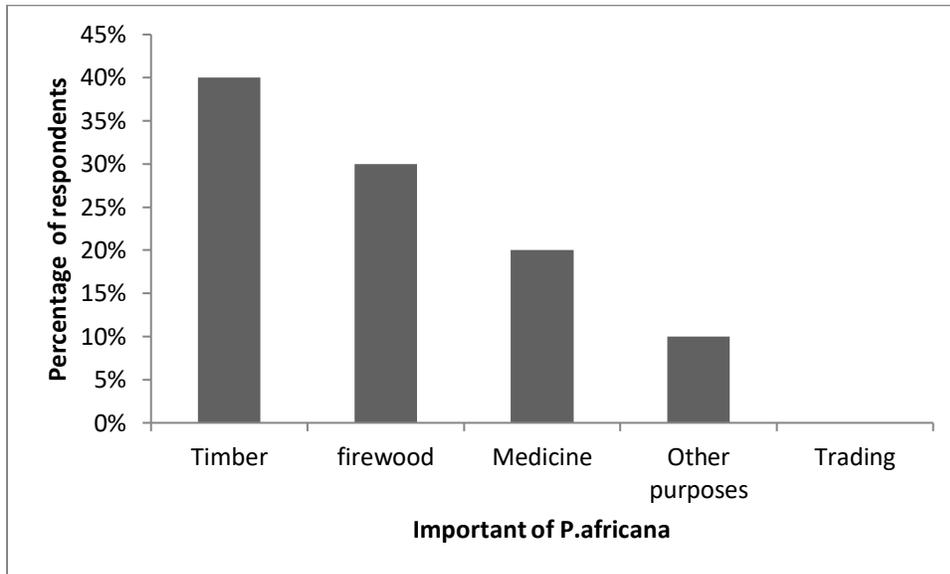


Figure 9: People used *Prunus africana*

3.7.1.3. People perception on *P.africana* population in three decades (1988-2018)

Respondents' (50%) have no idea on *P.africana* population, 32% reported that population of *P.africana* decreased, 10% said that it's similar and few of them 8% replied that population of this species increased.

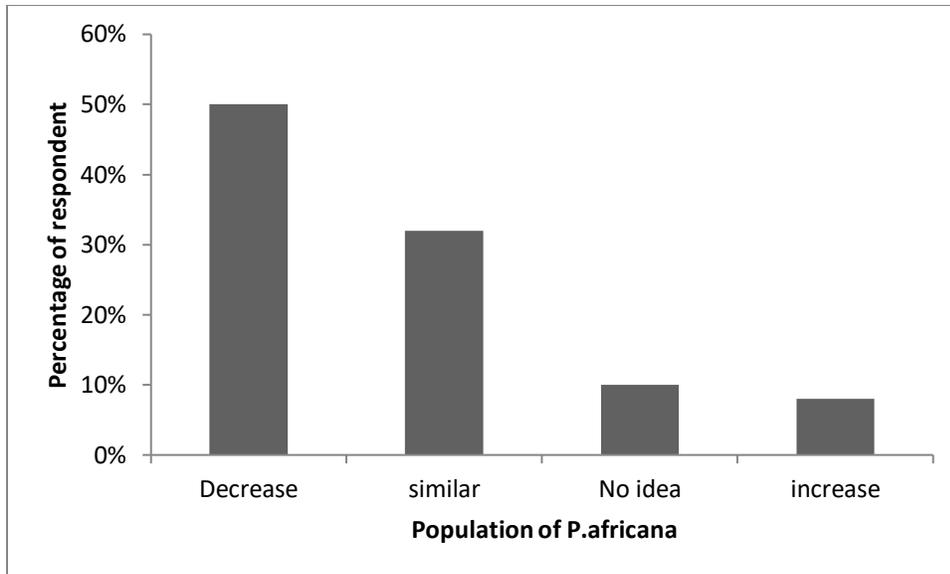


Figure 10: People perceptions on *P.africana* population

3.7.1.4. People perceptions on the main threats to *P.africana* ,NNP

Respondents (45.5 %) reported Agriculture as serious threats to *Prunus africana* due to clearing forests in order to expand the agriculture and use of *P.africana* branches for support crops to grow (for example beans) , 27.2% mentioned timber , 9% indicated that Wild honey collection also contribute to threatening this species , 9% considered harvest Medicine as threat to prunus africana , 4.5% assumed fodder for livestock and poor regeneration may also be threaten the survival of this species.

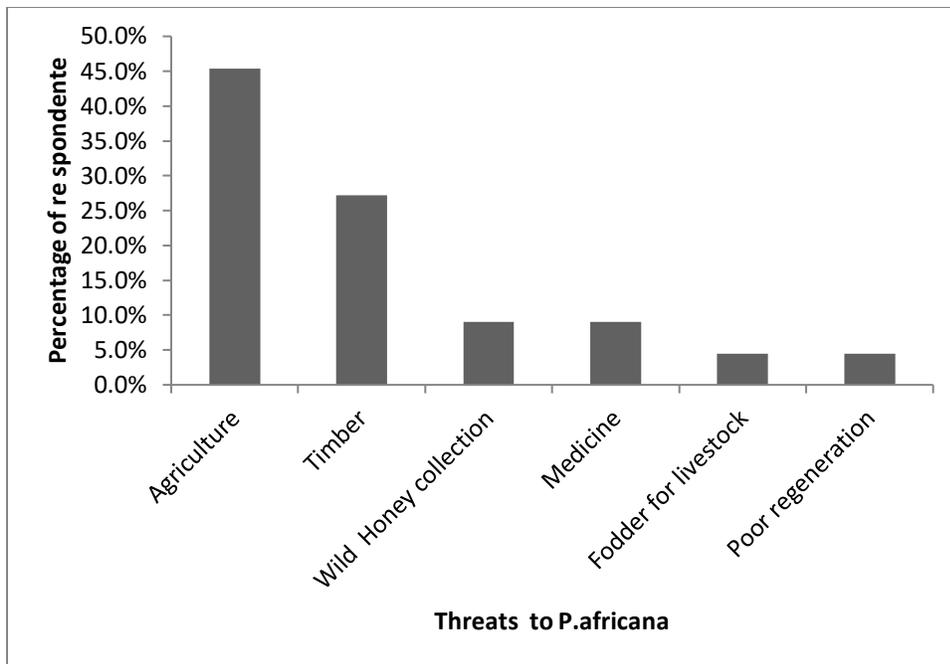


Figure 11: Threats to *Prunus africana* in NNP

3.7.2. Threats to *Prunus africana* in GMNP

3.7.2.1. People engage in plants collection from Gishwati-Mukura National park

Respondents (78%) reported that in the past they were involved in collection of plants, 16% said never engaged in this activity and 6% accepted that still engaging in collection of plants.

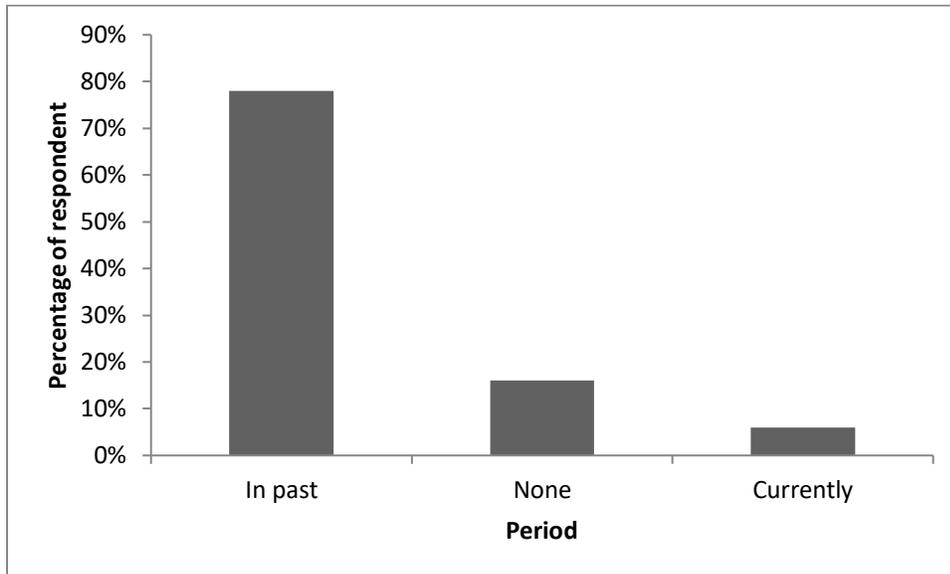


Figure 12: Percentage of people engage in plants collection GMNP

3.7.2.2. People collected *Prunus africana* in GMNP

Respondents (50%) reported that they used timber from *Prunus africana*, 27% said that harvested *Prunus africana* for medicine (leaves, roots and stems), 17% indicated that liked to use firewood, 7% respondents agreed that they used this species for other purposes while none reported that have been trading *Prunus africana*.

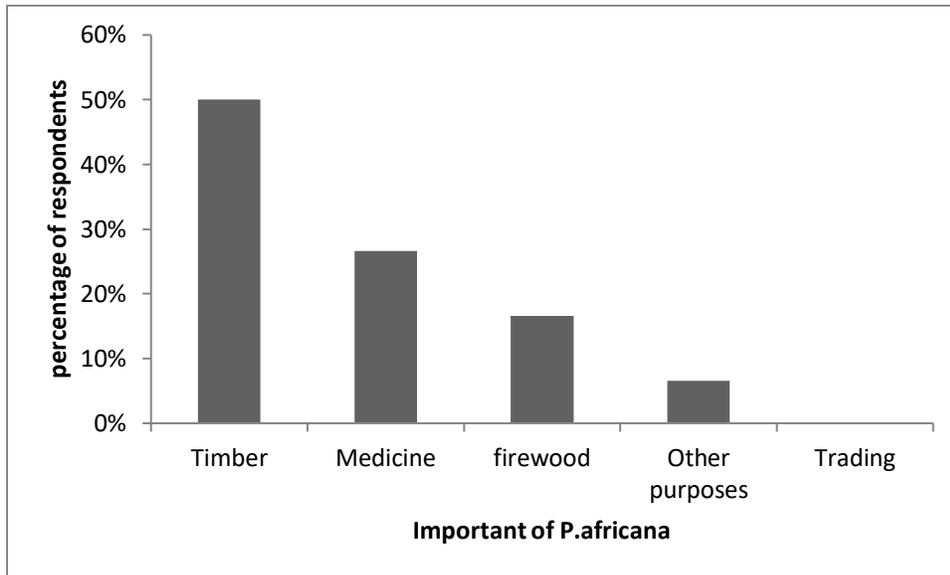


Figure 13: People used *Prunus africana* from GMNP

3.7.2.3. Perceived on population of *P.africana* in three decades (1988-2018)

Respondents (42%) affirmed that population of *P.africana* have been decreased in its nature in its nature range, 40% no idea, 18% assumed that population are similar since years ago until now, none agreed if it increased.

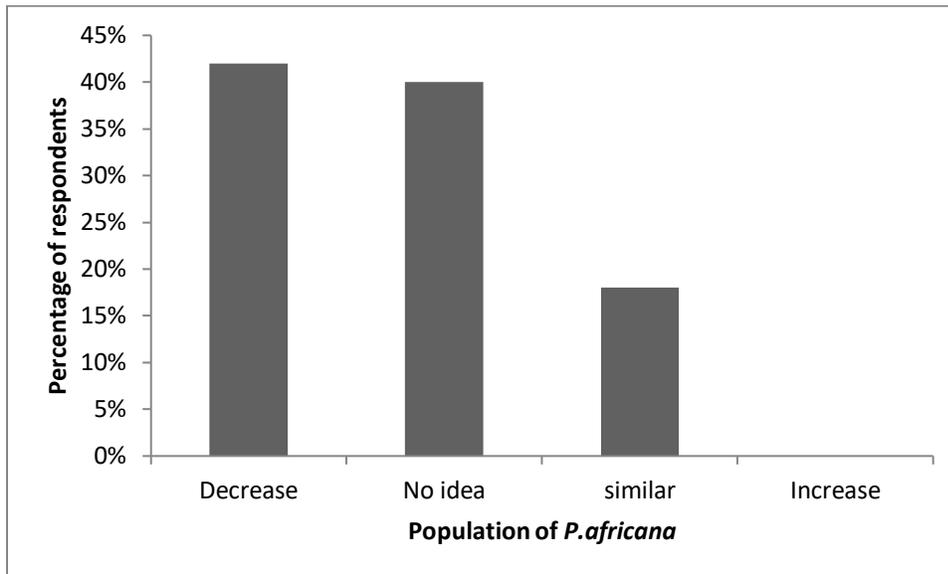


Figure 14: Perception of people on population of *P.africana* three decades

3.7.2.4. People perceptions on the main threats to *P.africana* in Gishwati-Mukura National Park

The main threats to *P.africana*, have been reported by people adjacent to Gishwati-Mukura National Park; 63% of respondents considered the Agriculture as high threat, 26% reported timber, 5% mentioned poor regeneration and 5% of respondents reported Medicine

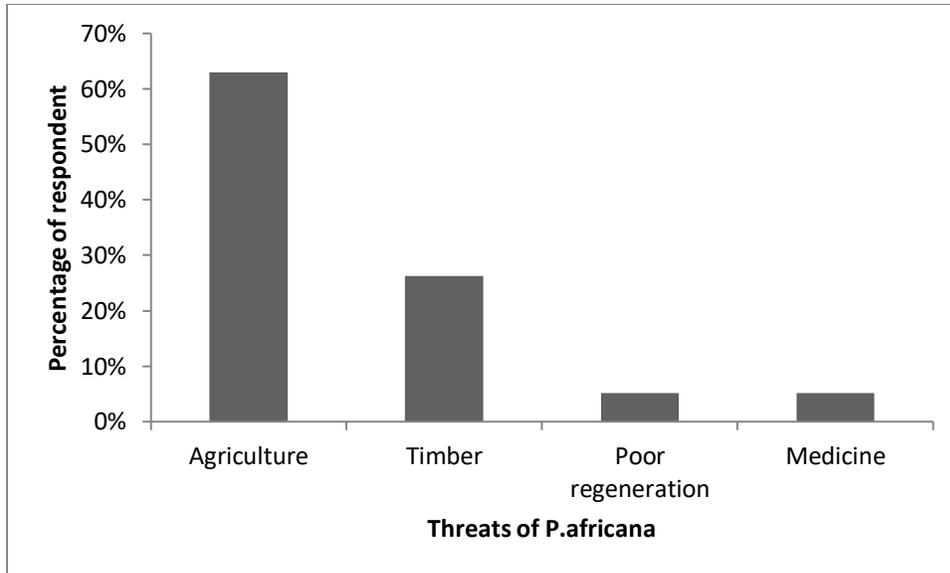


Figure 15: Threats to *Prunus africana* in GMNP

4. Discussion

This study determined the abundance, distribution and threats to *Prunus africana* in Nyungwe and Gishwati-Mukura National Parks. *P. africana* has a wide distribution in Afromontane areas where it provides multiple uses for people. Nowadays, *P. africana* is declining from its natural range in some countries due to different threats and it is listed as Vulnerable by International Union for Conservation of Nature (IUCN 2016). Previous study indicated that *Prunus africana* found in Nyungwe national Park, Virunga mountains, and Mukura (Betti ,2008).

The abundance and density of *P. africana* being higher in Transect 3, than in other transects in NNP. Probably because it has been planted by Unité de Gestion Zone 1(UGZ1) in1983 [the information reported by ranger from Wildlife conservation society (WCS)]. According the research conducted by african forest forum (2011), showed that there has been remarkable genetic degradation of germplasm particularly for the some dominant species, due to inbreeding. UGZ1 replanted dominant species and 253 indigenous tree (including *Prunus africana*) in order to improve forest plantation yield around Nyungwe buffer zone (AFF ,2011). The buffer zone around the Nyungwe forest has been planted with economically important species and is a source of building poles and firewood for local people (Ndayambaje 2002).The high number of indigenous species have been planted in <1985(years) around nyungwe buffer zone (AFF, 2011).This might have given opportunity to population of *Prunus africana* to increase in this area.

T4 was attributed to the disturbance in and at forest edge due to wild honey collection, agriculture and human settlement. The wild honey collectors frequently destroy *Prunus* trees at boundaries between forest and grassland areas (Cad 2013). Another perspective, *Prunus africana* fire wood is of high

quality (Gachie, 2002) and being a forest edge species, it is threatened by exploitation through selective logging for firewood and poles that may contribute to decreased number of individuals close to human settlements (Mligo *et al.*, 2009). Also, variation in habitat and effects of human disturbance are major contributing factors to difference in abundance and distribution of species (Sunderland & Tako, 1999). Other study also reported that forest clearing for subsistence farming, are considered as threat to *P.africana* in some african countries including Rwanda,(Betti, 2008).

T1 and T2 were attributed to the disturbances due to wildfire (this also reported by ranger from WCS) and *Sericostachys scandens*. Nyungwe forest had been experiencing wildfires for a period of time and large wildfires occurred in 1997 which destroyed over 10% of the forest (*Sericostachys scandens* workshop report ,2009).These resulted conditions for colonization by ferns including *Pteridium aquilinum* and inhibition of tree regeneration within the fire-affected forest areas (Mlotha 2008; Mulindahabi et al. 2011). Wildfires kill long-lived *P. africana* and other native afro-montane plants (Luke Jimu 2011). T1 and T2, there were some parts had high dominance of *Sericostachys scandens* and probably suppressed the regeneration of *P.africana*. In other ways, due to low percentage canopy cover while *P. africana* requires lighted areas to recruit from seedlings to saplings (Navarro-Cerrillo *et al.*, 2008; Geldenhugs, 1981). *Sericostachys* seedlings are capable of exploiting the full-sunlight conditions, suppressing other vegetation, affects the distribution and composition of vegetation in the Kahuzi-Biega National Park (KBNP) in DRC and other mountain forests in the Albertin Rift valley including Nyungwe National Park (Liengola,2008).

There was lowest abundance and density of *P.africana* in Gishwati-Mukura National Park. In this site, all transects was attributed to high incidence of

human activities such as Agriculture, settlement, mining and grazing. Forest clearing for subsistence farming, are considered as threat to *P.africana* in some African countries including Rwanda, (Betti, 2008). Thus some species might have been exploited also through grazing on the forest edge as have been reported as threats to *P.africana* by Mligo *et al.*, (2009). Another perspective, *Prunus africana* fire wood is of high quality (Gachie, 2002) and being a forest edge species, it is threatened by exploitation through selective logging for firewood and poles that may contribute to decreased number of individuals in a species close to human settlements (Mligo *et al.*, 2009).

The study showed on DBH class size, there was presence of high number of large trees in NNP and absence of small size trees in GMNP. The diameter class distribution with a high percentage of large trees indicates unstable and intermittent population structure of *P. africana* in the forest hence threatening their survival in the future (Cunningham, 2008; Abebe, 2008 ;). Age structure showed that the species was J-shaped whereby mature trees were abundant than sapling and seedlings in NNP and few mature trees without seedling and saplings in GMNP. This finding is supported by previous study by Hall *et al.*, (2000a, b) described this structure and it is indicative of a more or less unstable population structure (Mligo *et al.*, 2009). Very few mature trees means inadequate seeds production, a situation coupled with seedling mortality may endanger the survival of the species in the wild (David *et al.*, 2018).

The study indicated that, the high number of people has been involved in collection of plants for multi purposes such as food, medicine, firewood, timber in the past, and the few of them still collecting plants from Nyungwe and Gishwati-Mukura National Parks. Probably they collected the Valuable tree species such as *Prunus africana* tend to be overexploited, and the source of the needed products (Oldfield, *et al.*, 2012). The study showed specific high number of people harvested *Prunus africana* for timber .According the research

conducted by (Betti, 2008) in Malawi, found that harvesting for timber are considered as the major threats to *Prunus africana* .

The high percentage of respondents reported that *Prunus africana* decreased during the past three decades (1988-2018) due to mentioned threats. The study indicated that *Prunus africana* is facing various threats, mainly the agriculture and timber .The previous study (Betti, 2008); found that forest clearing for subsistence farming and timber cutting by pit sawyer, are considered as threat to *P.africana* in some Africa countries including Rwanda.

5. Conclusion and recommendation

This was the first study in Rwanda to provide *P. africana*'s abundance and distribution in Nyungwe and Gishwati-Mukura National Parks. The result shows that *P. africana* is highly concentrated along Northern area of NNP at the edge of this forest. GMNP in general study found that there is lower density of *Prunus africana* with only mature trees. The diameter breast height distribution showed the high number of large trees which indicates unstable and intermittent population structure of *P. africana* in NNP and GMNP. Agriculture and harvested *Prunus africana* for timber are main threats to this species in NNP and GMNP and also *Sericostachys scandens* in NNP. There is need for immediate conservation strategies such as Law enforcement especially ministerial order n°007/2008 of 15/08/2008), involve the local communities in conservation of these species through training on the role of conservation of the *Prunus africana*. Furthermore establishing of In-situ and ex- situ conservation strategies are also recommended .Protection of seedlings in NNP may be improved through minimize of human threats .Research is recommended on regeneration of *Prunus africana* in National Parks, and the impacts of *Sericostachys scandens* on regeneration of *Prunus africana*.

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APPENDICES

Appendix A



Photo 1: Diameter breast height measured, in Nyungwe National park,
(*photo credit: ACNR*)



Photo 2A : Took in first round survey , before the seeds and seedlings of *P.africana* cleared in T3 ,Nyungwe national park,2018 March (*photo credit* : ACNR)



Photo 2B: Took in second round survey ,seedlings of *P.africana* after cleared in T3 Nyungwe national park, January 2019 (*photo credit* : ACNR)



Photo 3: Stem of *P.africana* showing a scar caused by people ,collecting honey in the tree hollow,in Nyungwe National park, (Photo credit: ACNR)



Photo 4: Terminal bud of young *Prunus africana* destroyed by *Sericostachys scandens* in Nyungwe National park, (photo credit: ACNR)



Photo 5: The tree of *P.afircana* found in Gishwati- Mukura National park, its height has been affected by agricultural activities,(photo credit: ACNR)



Photo 6: Interview with ranger



Photo 6: Interview with traditional healer.



Photo 7: Interview with farmer

Appendix B

Questionnaire

Respondent's identification

Names.....

Age..... Sex: F M

Profession..... National Park.....

Telephone number.....

Date.....

Sector.....

Cell.....

Village.....

1. Have you ever engage in collection of plants for food, medicine, timber and firewood, from Nyungwe or Gishwati-Mukura National Parks?

- I. Currently
- II. In the past
- III. None

2. Do you know *Prunus africana* ? I) Yes ii) No

If yes, briefly explain what you know on *Prunus africana*

.....
.....

3. Where have you seen the *Prunus africana* ?

- a) In protected area
- b) Outside of protected area

4. Have you ever been collected this species? If so, for which Purpose?

- i. Timber
- ii. Medicine
- iii. Firewood
- iv. Trading
- v. Other purposes

5. Compare in three decades (1988-2018), what do you think on population of *Prunus africana*

- i) Increased
- ii) Similar
- iii) Decreased
- iv) No Idea

If decreased, what do you consider as the main cause of declining of this species?

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6. How can we improve the conservation of *Prunus africana*?

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Thank you for your contribution!!!!!!!!!!!!