Species composition, distribution, relative abundance, and threats of medium and large mammals in Arjo Diga Forest, Western Ethiopia

Girma Tefera[1] and Tariku Gutema[1]

[1]Jimma University College of Agriculture and Veterinary Medicine

September 20, 2022

Abstract

Mammals play a role in environmental engineering. Outside of protected areas, Ethiopia's mammalian supply is rapidly dwindling, and there is a scarcity of data on mammalian diversity and ecology. As a result, from June 2020 to February 2021, a study was conducted in Arjo Diga Forest to determine the species composition, distribution, relative abundance, and threats of large and medium wild mammals. Using transect lines, survey techniques were used to record mammals from four habitat types, Eighty people participated in a questionnaire survey to identify the current threatening factors. A total of 763 individuals were compiled belonging to 19 mammalian species, 6 orders, and 12 families. Papio Anubis (30.3 %) was the most abundant in the research region, followed by Chlorocebus mitts (22%), while Panthera pardus and Panthera Leo were the least, contributing 0.79 % and 0.39 % of the total observation, respectively. There is, however, a significantly varied among habitats ($\chi 2 = 246.4$; DF = 18; $P < 0.05$). Among observed mammals, (n = 433, 56.75%) individuals were recorded in dry season, while (n = 330, 43.25%) individuals were recorded in wet season and abundance of mammals species not significantly between seasons ($\chi 2 = 12.12$; DF = 18; $P > 0.05$). The diversity of species varies depending on the stratified habitat types. The Shannon–Wiener Index values, on the other hand, do not differ much between habitat types. The research area's species diversity was H' = 2.296, with the highest Simpson Index of diversity (1-D) being (0.8406). Agricultural land expansion, illegal logging, overgrazing, quarry operations, and illegal hunting are all threats to the species that inhabit the study area. A quick national park is required to rescue these species

Species composition, distribution, relative abundance, and threats of medium and large mammals in Arjo Diga Forest, Western Ethiopia

Girma Gizachew, Tariku Mekonnen

Department of Natural Resource Management, Colleague of Agriculture and Veterinary Medicine, Jimma University, P.O. Box 307, Jimma, Ethiopia.

Corresponding author: kennaa20047@gmail.com

Tel: +25191755006

Abstract

Μαμμαλς πλαψ α ρολε ιν ενιρονμενταλ ενγινεερινγ. Ουτσιδε οφ προτεστεδ αρεας, Ετηιοπια'ς μαμμαλιαν συππλψ ις ραπιδλψ δωινδλινγ, ανδ τηερε ις α σσαρσιτψ οφ δατα ον μαμμαλιαν διερσιτψ ανδ εσολογψ. Ας α ρεσυλτ, φρομ Θυνε 2020 το Φεβρυαρψ 2021, α στυδψ ωας γονδυστεδ ιν Αρθο Διγα Φορεστ το δετερμινε τηε σπεσιες γομποσιτιον, διστριβυτιον, ρελατιε αβυνδανσε, ανδ τηρεατς οφ λαργε ανδ μεδιυμ ωιλδ μαμμαλς. Υσινγ τρανσεστ λινες, συρεψ τεχηνιχυες ωερε υσεδ το ρεχορδ μαμμαλς φρομ φουρ ηαβιτατ τψπες, ειγητψ πεοπλε παρτιχιπατεδ ιν α χυεστιονναιρε συρεψ το ιδεντιφψ τηε χυρρεντ τηρεατενινγ φαχτορς. Α τοταλ οφ 763 ινδιδυαλς ωερε γομπιλεδ,

βελονγινγ το 19 μαμμαλιαν σπεσιες, 6 ορδερς, ανδ 12 φαμιλιες. Παπιο Ανυβις (30.3 %) ωας τηε μοστ αβυνδαντ ιν τηε ρεσεαρση ρεγιον, φολλοωεδ βψ ἠλοροσεβυς μιττς (22%), ωηιλε Παντηερα παρδυς ανδ Παντηερα Λεο ωερε τηε λεαστ, ϲοντριβυτινγ 0.79 % ανδ 0.39 % οφ τηε τοταλ οβσερατιονς, ρεσπεϲτιελψ. Τηερε ις, ηοωεερ, α σιγνιφισαντλψ αριεδ αμονγ ηαβιτατς (χ2 = 246.4· ΔΦ = 18· Π < 0.05). Αμονγ τηε οβσερεδ μαμμαλς, (ν = 433, 56.75%) ινδιδυαλς ωερε ρεϲορδεδ ιν τηε δρψ σεασον, ωηιλε (ν = 330, 43.25%) ινδιδυαλς ωερε ρεϲορδεδ ιν ωετ σεασον ανδ τηε αβυνδανϲε οφ μαμμαλς σπεσιες ωας νοτ σιγνιφισαντλψ βετωεεν σεασονς (χ2 = 12.12· ΔΦ = 18· Π >0.05). Τηε διερσιτψ οφ σπεσιες αριες δεπενδινγ ον τηε στρατιφιεδ ηαβιτατ τψπες. Τηε Σηαννον–Ωιενερ Ινδεξ αλυες, ον τηε οτηερ ηανδ, δο νοτ διφφερ μυϲη βετωεεν ηαβιτατ τψπες. Τηε ρεσεαρση αρεα΄ς σπεσιες διερσιτψ ωας H′ = 2.296, ωιτη τηε ηιγηεστ Σιμπσον Ινδεξ οφ διερσιτψ (1-Δ) βειινγ (0.8406). Αγριϲυλτυραλ λανδ εξπανσιον, ιλλεγαλ λογγινγ, οεργραζινγ, χυαρρψ οπερατιονς, ανδ ιλλεγαλ ηυντινγ αρε αλλ τηρεατς το τηε σπεσιες τηατ ινηαβιτ τηε στυδψ αρεα. Α χυιϲκ νατιοναλ παρκ ις ρεχυιρεδ το ρεσϲυε τηεσε σπεσιες.

Κεψ ωορδς: Αρθο Διγα, Διστριβυτιον, Διερσιτψ, Μαμμαλς, Ρελατιε αβυνδανϲε

1. Ιντροδυϲτιον

Μαμμαλς αρε τηε μοστ νυμερους ανδ προφιταβλε ανιμαλ τεαμ ον τηε πλανετ, ωιτη ρουγηλψ 5,416 σπεσιες ιν εξιστενϲε (Ρεαλε *ετ αλ* ., 2014·Γελετα & Βεκελε, 2016). Μορε τηαν 1150, 360, 320 σπεσιες οφ μαμμαλς ϲαν βε σεεν ιν Αφριϲα (Νεωβολδ *ετ αλ* ., 2015), εαστερν Αφριϲα (Γιρμα *ετ αλ* ., 2012·Διριβα *ετ αλ* ., 2020), ανδ Ετηιοπια (Τεφερα, 2011· Αμαρε, 2015· Λαρενϲηενκο & Βεκελε, 2017) ρεσπεϲτιελψ. Φιφτψ φιε οφ Ετηιοπια΄ς 320 μαμμαλιαν σπεσιες αρε ενδεμις, ωιτη 14 ορδερς ανδ 39 φαμιλιες (Ραβιρα *ετ αλ* ., 2015· Λαρενϲηενκο ανδ Βεκελε, 2017). Ιν αδδιτιον, σπεσιες οφ μαμμαλς αϲτ ας αν υμβρελλα φορ τερρεστριαλ εϲοσψστεμς ας τηεψ μακε α ϲοντριβυτιον το τηε ϲονσερατιον εφφορτς οφ διφφερεντ σπεσιες (Βενε *ετ αλ* ., 2013· Υδψ *ετ αλ* ., 2021) ανδ μαινταιν αν εϲοσψστεμ βαλανϲε. Μεδιυμ ανδ γιαντ μαμμαλ σπεσιες πλαψ α ιταλ ρολε ιν μανψ οφ τηε ωορλδ΄ς εϲοσψστεμς, ωηιλη ινϲλυδε γραζινγ, γραζινγ ανδ σεεδ δισπερσαλ (Γεβρεσενβετ *ετ αλ* ., 2018· Ρεεδερ *ετ αλ* ., 2019· ΙΥΝ, 2021). Φυρτηερμορε, τηεψ προιδε ιμπορταντ περσονάλ βενεφιτς συϲη ας φοοδ, εντερταινμεντ, ανδ προφιτς (Ωολφ ανδ Ριππλε, 2018· Πενθορ*ετ αλ* ., 2021). Ιν ϲοντραστ, σπεσιες οφ μαμμαλς ηαε ενδεδ υπ ενδανγερεδ ωορλδωιδε ανδ ρεγιοναλλψ δυε το αντηροπογενις αϲτιιτιες (Ριππλε *ετ αλ* ., 2014· Γιρμα & Ωορκυ, 2020). Λοσς οφ Ηαβιτατ αρε μαθορ τηρεατς το μαμμαλς (Κασσο & Βεκελε, 2017· Ωαλε *ετ αλ* .,2017· Χυφα ανδ Βεκελε, 2019· Ασεφα *ετ αλ* ., 2020).

Ετηιοπια ις ονε αμονγ τηε 25 ριϲηεστ βιοδιερσιτψ ϲουντριες ωιτηιν τηε ωορλδ ανδ ηοστς τωο οφ τηε 34 μοστ φαμους πλαϲες ωιτηιν τηε ωορλδ. Οερ 60% οφ μαμμαλ σπεσιες αρε μεδιυμ ανδ ενορμους (Νεγερι *ετ αλ* ., 2015). Τεμπερατυρε ϲηανγε ανδ ϲλιματε αρε τηε φορεμοστ ιμπορταντ πρεδιϲτιονς οφ τηε ρανγε οφ μαμμαλ σπεσιες ωιτηιν τηε ωορλδ (Τεφερα, 2011· Αμαρε, 2015· Βελετε & Μελεσε, 2016). Ηοωεερ, τηε ποπυλατιον οφ λαργε ανδ μεδιυμ μαμμαλς ηας δεϲλινεδ σιγνιφισαντλψ ωιτηιν τηε ϲουντρψ ινϲλυδινγ προτεϲτεδ αρεας (Ραβιρα *ετ αλ* ., 2015). Ιτ ις δυε το τηε βοομ οφ ηυμαν ποπυλατιον, ηαβιτατ λοσς, φραγμεντατιον, συσϲεπτιβλε μαναγεμεντ οφ τηε ινϲλυδεδ αρεας, ανδ δεφορεστατιον (Γεβρεσενβετ*ετ αλ* ., 2018· Γιρμα & Ωορκυ, 2020· Λεμμα & Τεκαλιγν, 2020).

Κνοωλεδγε ον νεαρβψ φαυνα ις ιντεγραλ φορ φυτυρε ϲονσερατιον τεϲηνιϲυες ανδ γραντς φυνδαμενταλ φαϲτς φορ γρεατερ ϲομπλεξ εϲολογιϲαλ ανδ βιογεογραπηιϲαλ στυδιες, ανδ ωηιϲη ις τηε φιρστ στεπ φορ ϲονσερατιον αϲτιον (Βοτεληο *ετ αλ* ., 2012·Φορνιτανο *ετ αλ* ., 2015). Ρεσεαρϲη ον τηε διερσιτψ οφ μαμμαλς, τηειρ ηαβιτατ, ανδ αβυνδανϲε ηας προιδεδ φαϲτς αβουτ ηυμαν ρεπυτατιον φορ γοοδ ϲονσερατιον μεασυρες (Ραβιρα *ετ αλ* ., 2015· Ψοσεφ, 2015). Ηενϲε, τηε λαϲκ οφ συρεψ μαψ αδδιτιοναλλψ πρεϲλυδε τηε πρεπαρατιον οφ αν αππροπριατε αδμινιστρατιον δεσιγν ιν τηε προτεϲτεδ αρεας (Φορνιτανο *ετ αλ* ., 2015). Μορεοερ, ιν Ετηιοπια μοστ στυδιες ον μαμμαλ σπεσιες ωερε ϲονφινεδ το προτεϲτεδ αρεας (Ωαλε, 2017· Φετενε *ετ αλ* ., 2019) βυτ τηε διερσιτψ ανδ διστριβυτιον στατυς οφ μαμμαλς ουτσιδε προτεϲτεδ αρεας ις νοτ ωελλ κνοων (Γεβρεσενβετ *ετ αλ* ., 2018). Ηοωεερ, τηε δετερμινε αβουτ μαμμαλς ιν πυβλις λοϲατιονς ις ιμπορταντ εχυαλλψ (Υδψ *ετ αλ* ., 2021), εεν εξτρα σο δυε το τηε φαϲτ οφ τηειρ λαργε διμενσιον αντηροπογενις πρεσσυρες (Γιρμα *ετ αλ* ., 2012· Βυργιν *ετ αλ* ., 2018· Λεγεσε*ετ αλ* ., 2019· Ωορκυ & Γιρμα, 2020).

Τηε πρεσεντ στυδψ ωας ϲαρριεδ ουτ ιν τηε Αρθο-Διγα Φορεστ οφ Ωεστερν Ετηιοπια ανδ ωηιϲη ωας δεμαρϲατεδ ιν 2014 φορ μαινστρεαμινγ τηε ινϲεντιε φορ βιοδιερσιτψ ϲονσερατιον. Τηε στυδψ αρεα σιτε ις παρτ οφ α λαργε

φορεστ ανδ ιτ φαλλς ωιτηιν τηε Εαστερν Αφρομοντανε βιοδιερσιτψ ηοτ σποτ αρεα. Ιτ ις αλσο ιν τηε ωατερσηεδ οφ Δηιδηεσσα Ριερ, ωηιςη ις ονε οφ τηε μαιν τριβυταριες οφ τηε Βλυε Νιλε Ριερ, γιινγ ιτ ρεγιοναλ ανδ ιντερνατιοναλ ιμπορτανςε φορ βιοδιερσιτψ ανδ ηψδρολογψ. Ηοωεερ, τηε ωιδερ τερραιν αρουνδ τηε φορεστ εχοσψστεμ ηας εξαχερβατεδ τηε δετεριορατιον οφ νατυραλ ρεσουρχες, ανδ ωιλδλιφε ις φαχινγ μαθορ χηαλλενγες ας α ρεσυλτ οφ μανμαδε αχτιιτιες, ωηιςη χουλδ λεαδ το χομπλετε δεγραδατιον (Γολε, 2017). Υνδερστανδινγ τηε διστριβυτιον οφ προμινεντ βιολογιχαλ χομπονεντς συχη ας μαμμαλ΄ς σπεχιες ανδ αντηροπογενις τηρεατς ιν τηε αρεα ις εσσεντιαλ φορ εμεργενςψ μαναγεμεντ πραχτιχες. Ιν αδδιτιον, νο βιολογιχαλ ρεσεαρχη ηας βεεν χονδυχτεδ σο φαρ ιν τηε αρεα. Τηερεφορε, το χοντριβυτε τοωαρδς χλοσινγ τηεσε γαπς ανδ το συππλψ τηε πριμαρψ εσσεντιαλ χυαντιτατιε βιτς οφ κνοωλεδγε, τηε πρεσεντ στυδψ ωιλλ φοχυς ον μαμμαλιαν διερσιτψ ανδ τηρεατς οφ μεδιυμ ανδ λαργε μαμμαλς ιν Αρθο Διγα Φορεστ, Ωεστερν Ετηιοπια.

2. ΜΑΤΕΡΙΑΛΣ ΑΝΔ ΜΕΤΗΟΔΣ

Τηε στυδψ αρεα

Τηις στυδψ οχχυρρεδ ιν Ορομια Νατιοναλ Ρεγιοναλ Στατε΄ς νεωλψ εσταβλισηεδ Αρθο Διγα Φορεστ, Εαστ Ωολλεγα Ζονε. Ιν 2014, τηε ΥΝΔΠ, τηε Φεδεραλ Γοερνμεντ, ανδ ρεγιοναλ γοερνμεντς δεελοπεδ α χονσερατιον προγραμ ιν τηις αρεα. Τηε σιζε οφ τηε φορεστ ις 1268.6 ηεχταρες, ωιτη αν ελεατιον ρανγε οφ 1200 το 2220 μετερς αβοε σεα λεελ. Ιτ ις ρουγηλψ 346 κιλομετερς ωεστ οφ Αδδις Αβαβα ανδ 15 κιλομετερς ωεστ οφ Νεκεμτε τοων. Ιτ λιες βετωεεν τηε λονγιτυδες οφ 8°56′00’N ανδ 9°10′00’N, ανδ 36°15′30’E ανδ 36°26′30’E. (Φιγ. 1). Τηε αρεα΄ς τεμποραλ ραινφαλλ παττερν ινδιχατες α σινγλε πεαχ αρουνδ Θυλψ ανδ Αυγυστ, ωιτη νο δισχερνιβλε διφφερενχε βετωεεν τηε λεσσερ ανδ μαιν ραιν σεασονς, ας ις χομμον ιν σεεραλ παρτς οφ Ετηιοπια. Τηε αρεα΄ς αεραγε αννυαλ ραινφαλλ ρανγες φρομ 800μμ το 2110μμ, ωιτη α μονομιαλ ραινφαλλ διστριβυτιον μαρχεδ βψ ηιγη αμουντς οφ ραινφαλλ οερ α λενγτηψ περιοδ οφ τιμε δυρινγ τηε συμμερ. Μαψ τηρουγη Οχτοβερ ις τηε ραινψ σεασον, ωιτη τηε ηιγηεστ αεραγε μοντηλψ ραινφαλλ ιν Θυλψ, Θυνε, ανδ Αυγυστ (ΝΜΑ, 2017). Τηε λοωεστ τεμπερατυρες ρανγεδ φρομ 12 το 18 δεγρεες ℮λσιυς δυρινγ ωετ, ωηιλε τηε μαξιμυμ τεμπερατυρες ρανγεδ φρομ25 το 35 δεγρεες ℮λσιυς δυρινγ τηε δρψ σεασον.

Μετηοδολογψ

Στυδψ Περιοδ

Τηε στυδψ ωας χονδυχτεδ φρομ Θυνε 2020 το Φεβρυαρψ 2021, ιν τωο σεασονς, δρψ (Δεχεμβερ το Φεβρυαρψ 2020/2021) ανδ ωετ σεασον (Θυνε το Αυγυστ, 2021). Δυρινγ τηε πρελιμιναρψ στυδψ, τηε αχχεσσιβιλιτψ, τοπογραπηψ, ινφραστρυχτυρε, μαμμαλιαν οχχυπανχψ οφ τηε στυδψ αρεα, ανδ ηαβιτατ στρατιφιχατιον βασεδ ον λανδ χοερ φεατυρες (Δενσε φορεστ, σηρυβς, χυλτιατεδ λανδ, ανδ γρασς λανδ ηαβιτατ τψπες) ωερε χολλεχτεδ.

Σαμπλινγ Δεσιγν ανδ Σαμπλινγ Τεχηνιχυες

Τηε διερσιτψ ανδ τηρεατς οφ μεδιυμ ανδ λαργε μαμμαλς ιν Αρθο Διγα Φορεστ ανδ ιτς ενιρονς ωερε στυδιεδ υσινγ σψστεματις ωιλδλιφε συρεψ τεχηνιχυες (Νορτον-Γριφφιτης, 1978). Μαμμαλιαν διερσιτψ ωας μεασυρεδ υσινγ στρατιφιεδ σαμπλε αππροαχηες ιν α αριετψ οφ ηαβιτατς, ινχλυδινγ δενσε φορεστ, σηρυβς, γρασσλανδ, ανδ χροπλανδ βασεδ ον τηε εγετατιον στρυχτυρε ανδ τοπογραπηψ οφ τηε λανδσχαπες (Γιρμα *ετ αλ* ., 2012· Μαμο *ετ αλ* ., 2012). Ιν τηε χασε οφ στρατιφιεδ ηαβιτατ τψπες, τρανσεχτ λινες ωερε ινσερτεδ ατ ρανδομ ανδ προπορτιοναλ το τηε ηαβιτατ τψπε΄ς αρεα (ἄρμαν & Συκυμαρ, 1995). Τρανσεχτ λινε μετηοδ ωας υσεδ το εστιματε τηε αβυνδανχε ανδ δενσιτψ. Τηε αδθαχεντ τρανσεχτς ωερε ατ λεαστ 1 το 2κμ απαρτ ανδ αλλ τρανσεχτ λινες ωερε ρουγηλψ παραλλελ το εαχη οτηερ ανδ τηειρ ενδς ωερε νοτ λεσς τηαν 1κμ φαρ φρομ τηε ηαβιτατ εδγε (Ρεγασσα & Ψιργα, 2013) ανδ τηε τρανσεχτ λενγτη ωας μεασυρεδ ανδ λοχατεδ ιν τηε στυδψ αρεα ωιτη τηε ηελπ οφ ΓΠΣ λοχατιον. Τηε σαμπλε τρανσεχτ ωας χοερεδ 25% (15.84 κμ^2) οφ τηε στυδψ αρεα (63.35 κμ^2). Α τοταλ οφ 32 λινε τρανσεχτς ωερε εσταβλισηεδ αχροσς τηε φουρ μαθορ ηαβιτατ τψπες. Τηε νυμβερ οφ τρανσεχτς αριεδ αμονγ ηαβιτατς δεπενδινγ ον τηε αρεα χοερ οφ εαχη ηαβιτατ: 12 ιν τηε δενσε φορεστ, 15 ιν σηρυβς, 3 ιν χροπ λανδ, ανδ 2 ιν γρασσλανδ ηαβιτατ. Τηε σιζε οφ εερψ τρανσεχτ λινε ωας ονχε 5 κμ ανδ α χονσταντ σιγητινγ διστανχε οφ 100 μ ον εαχη ασπεχτ οφ τρανσεχτ ωας υσεδ ιν τηε ηαβιτατ. Ιν αδδιτιον το τηε διρεχτ οβσερατιον οφ στραψ ανιμαλς, οβλιχυε προοφ ωας υσεδ το τηε ηαβιτς συρεψ· ιτ ις ονε οφ τηε εξχελλεντ μετηοδς φορ εστιματινγ τηε αβυνδανχε οφ εξχεεδινγλψ μασσιε ανδ χονσπιχυους μαμμαλς (Κρεβς, 2006). Τηερεφορε, χομβινινγ τηε διυρναλ

λινεσ-τρανσεςτ ωιτη οβλιχυε συρεψς (ινςλυδινγ σπαρκλινγ τραςκς, φεςες, ηαιρ, ηορνς, βυρροως, ανδ διγγινγ) ςαν βεαυτιφψ τηε δετεςταβιλιτψ φορ μανψ μαμμαλ σπεςιες, ςοντριβυτινγ το μαξιμιζε τηε σπεςιες λιστσ(Λαρσεν, 2016). Αδδιτιοναλλψ, το ςολλεςτ δατα ον τηε ςυρρεντ τηρεατενινγ αριαβλες, σεμι-στρυςτυρεδ οπεν ανδ ςλοσεδ-ενδεδ χυεστιονναιρες, ιντεριεως, ανδ διρεςτ ανδ ινδιρεςτ οβσερατιονς ωερε υσεδ. Τηε Αρθο Διγα φορεστ ωας φραςτυρεδ ιν ειγητ οφ τηε Διγα διστριςτ΄ς 24 Κεβελες. Α τοταλ οφ 80 πεοπλε (10 πεοπλε περ σαμπλε σιτε) παρτιςιπατεδ ιν αν ιντεριεω χυεστιονναιρε συρεψ ανδ α γρουπ δισχυσσιον το ιδεντιφψ πρεσεντ προβλεμς ανδ ςονσερατιον ςονςερνς, ας ωελλ ας ποσσιβλε φυτυρε σολυτιονς.

Δατα ὃλλεςτιον

Δατα ωας οβταινεδ τηρουγηουτ τηε δρψ σεασον ανδ τηε ωετ σεασον. Μαμμαλ συρεψς ωερε ςονδυςτεδ τωιςε δαιλψ (6:00 το 10:00 μορνινγ, ανδ 15:00 το 18:00 αφτερνοον, ωηεν μοστ σπεςιες αρε αςτιε) (Ωολδεγεοργις ανδ Ωυβε, 2012· Βελετε & Μελεσε, 2016). Ιν αδδιτιον, δυρινγ τηε ινεστιγατιον περιοδ, εαςη τρανσεςτ λινε ωας σςαννεδ ειγητ τιμες. Α ρεσεαρςηερ ανδ φουρ τραινεδ δατα ςολλεςτορς ςονδυςτεδ τηε τρανσεςτ ισιτς. Το αοιδ διστυρβανςε οφ μαμμαλιαν σπεςιες, τηε ινφορματιον ςολλεςτορς ωαλκεδ σιλεντλψ αλονγ εαςη τρανσεςτ ωιτη τηε ωινδ ατ α γεντλε σπεεδ (Νορτον-Γριφφιτης, 1978). Δατα ωερε γατηερεδ τηρουγη διρεςτ ανδ ινδιρεςτ μετηοδς. Τηε ινδιρεςτ μετηοδς ινςλυδε φεςαλ δροππινγς, φεεδ μαρκς, τραςκς, βυρροως, τερριτοριαλ μαρκινγς, βαςκβονε σουνδ, ανδ διφφερεντ ειδενςε (Κινγδον, 2015· Ραβιρα *ετ αλ* ., 2015). Το αοιδ ρεςουντινγ οφ τηε σαμε σιγν δυρινγ συβσεχυεντ μοντηλψ σαμπλινγ περιοδς, ονλψ τηε ςουντεδ σιγνς βψ δατα ςολλεςτορς ανδ τηε ρεσεαρςηερ ωερε μαρκεδ ατ α πλαςε. Το ρεδυςε βιας, δατα ςολλεςτορς μοεδ αλονγ τηε τρανσεςτς.Ωηεν τηε ανιμαλς αρε σιγητεδ, δατε, τιμε, πλαςε τψπε, ανιμαλ ναμε, ινδιιδυαλ νυμβερ φορ εαςη σπεςιες, ανδ ΓΠΣ λοςατιον ωερε ρεςορδεδ (Γιρμα *ετ αλ* ., 2012· Ραβιρα *ετ αλ* ., 2015· Διριβα *ετ αλ* ., 2020). Ανιμαλς ωερε ςουντεδ υσινγ νακεδ εψες ανδ ωιτη τηε συππορτ οφ βινοςυλαρς. Α φιελδ γυιδε βοοκ ωας υσεδ το ιδεντιφψ σπεςιες οφ μαμμαλς ωηενεερ νεεδεδ (Κινγδονγ, 2015). Φορ εαςη τρανσεςτ, δατα φρομ φουρ δυπλιςατε συρεψς φορ εαςη σεασον ωερε ςομπιλεδ ανδ αναλψζεδ (Διριβα *ετ αλ* ., 2020· Γιρμα & Ωορκυ, 2020). Τηρουγηουτ τηε δατα ςολλεςτιον, ΄Ο΄ΙΔ 19 πρεεντιον μετηοδς συςη ας σοςιαλ ισολατιον ανδ οραλ μασκς ωερε υσεδ.

Δατα αναλψσις

Βασεδ ον διρεςτ ανδ ινδιρεςτ σιγναλ τρανσαςτιον συρεψ ρεςορδς, τηε πρεσενςε / αβσενςε δατα ματριξ ωας γενε-ρατεδ ανδ αναλψζεδ ωιτηιν τηε στυδψ αρεας ανδ σεασονς. Ινδιιδυαλ-βασεδ ραρεφαςτιον μετηοδ ωας αςςυστομεδ το χυαντιφψ τηε ριςηνεσς οφ σπεςιες ανδ αβυνδανςε βψ ηαβιτατ τψπε ανδ σεασον (Λεγεσε *ετ αλ* ., 2019· Χυφα & Βεκελε, 2019· Γεβο*ετ αλ* ., 2021). Σιμιλαριτιες ωιτηιν τηε φορματιον οφ σπεςιες βετωεεν ηαβιτατς ωερε πρεσεντεδ υσινγ τηε εν διαγραμ. Τηε συμμεδ αβυνδανςε οφ τηε νυμβερ οφ ενςουντερς οφ εαςη σπεςιες ρεςορδεδ αλονγ εαςη τρανσεςτ φορ εαςη ηαβιτατ τψπε ιν εαςη σεασον ωας υσεδ ας τηε ινπυτ φορ τηε ινδιιδυαλ-βασεδ ριςηνεσς ςομπυτατιον. ἤι-σχυαρε ($\chi 2$) test, at 0.05 level of significance was used to evaluate differences in the abundance of mammal species between habitats and the typical seasonal difference in the abundance of medium and large-sized mammal species in the study area. Although, to get an idea of whole species richness in the habitats, Jackknife II species richness was calculated using PAST model 2.04 software (Hammer *et al* ., 2001). The richness of the species, diversity, and similarity of the species of mammals in the study area were analyzed using Shannon – Weaver diversity Index: H '= -[?] PilnPi, where H ' is Shannon's indicator of diversity, Pi is the population of a particular species in the sample, and ln = natural logarithm of Simpson index rule: D = 1- [?]Pi2 was used (Shannon & Weaver, 1949). The Simpson variance index is as follows (1 - D) using the formula: J = H ' / H ' max, where H ' is the indicator of variability and H ' max = ln (S); S = number of species in each habitat; ln = natural logarithm was computerized to obtain balance and dominance among mammal species (Krebs, 2006).

3. Results Species composition and richness

A total of 19 mammalian species belonging to six orders and 12 families were identified in the study area (Table 1). Among the six orders identified, Order Carnivora was the first most abundant order in terms of the number of families (five families) and species (seven species), respectively. While, the order Rodentia and Tubuldenta were represented each by a single species. At the family level, Cercopithecidae and Felidae were the dominant families and were represented each by three species, while seven families were represented

each by a single species (Table 1).

Species distribution

At the habitat level, mammal species richness and assemblage were varied among the four habitat types, in increasing order of shrubs < crop land < grass land < forest (Figure 2). Twelve species (63.2%) had all habitat types in common (habitat generalists), while *Panthera pardus* and *Panthera leo* were found only in forests, and *Lepus habessinicus* was found only in grasslands (habitat specialists)(Figure 2).

Species relative abundance

A total of 763 species with evidence of mammalian species were recorded in the study area. The number of records varied among orders and families. The abundant order by the number of records from the study area was order Primates which include 480, followed by order Carnivora including 111. The least abundant order was Tubulidentata, which composes only nine records. The most abundant family by the number of records was Cercopithecidae (425), whereas the least was Felidae, comprising only three records. Based on the frequency of records,*Papio Anubis* (30.3%) became the most abundant in the study area, followed by *Chlorocebus aethiops* (22 %). Based on IUCN Red List categories, the vulnerable species such as *Panthera pardus* and*Panthera Leo* each contributed 0.79% and 0.39%, respectively.

The results of the present study showed that of the 763 total observations, 38% (N = 290) was recorded in dense forest, 17.56% (N = 134) in shrubs, 20.45% (N = 156) in crop land and 23.98% (N = 183) in grass land habitats. The number of records of mammalian species was not varied significantly among habitats by kruskal -Wallis tests (KWχ2 = 4.37; P > 0.05). Average amount of species richness and related quantities (frequency of records) computed by the rarefaction curve among the four stratified habitat types and seasons is represented by Figure 3 below. At species-specific level, *Papio Anubis* was the most abundant species in forest habitat (35.9%, n = 83) and grassland (25.97%, n = 60) followed by *Chlorocebus aethiops*(44.6%, n = 75) in forset and in grass land habitat (19.05 %, n = 32), respectively. *Papio Anubis* (23.37%, n = 54) was also the most abundant in crop land followed by Crocuta Crocuta (63.83%, n = 30) while, in shrubs habitat the most abundant was *Chlorocebus aethiops* (25%, n = 42) followed by *Papio Anubis* (14.7%, n = 34). *Panthera pardus, Panthera Leo,* and *Lepus habissincus*were only recorded in forest and grassland habitats, respectively. Mammalian species frequency of records among the four habitat types is described in Figure 4 below.

The number of species records of mammals was higher in the dry season (n = 433, 56.75%) than in the rainy season (n = 330, 43.25%). The abundance of mammalian species was not significantly between seasons (χ2 = 12.12; DF = 18; P >0.05). Two species (*Papio Anubis* and *Chlorocebus aethiops*) were relatively the most abundant in both seasons (Figure 5). These two species contributed 56.06% and 49.42% of the total records of the wet and dry season survey, respectively. The remaining mammalian records contributed between 0.17and 0.27% in the wet season and 0.14 and 0.37% during the dry season survey. Frequency of records across habitat types was significantly different (χ2 = 246.4; DF = 18; P < 0.05) between seasons.

Species diversity and similarity index

The Shannon diversity of mammal species was higher in the grassland (H = 2.198) and in dense forest (H=2.165), respectively, than in other habitats. However, there was no significant difference in Shannon – Wiener Index values between the four habitat types. The higher and lower evenness of the mammalian species was recorded in grassland (E = 0.5628) and natural forest (E = 0.4843). The dominance of mammalian species was recorded from the highest to the lowest in the crop land (D = 0.1881) and grassland (D = 0.1655), respectively. Shannon differing qualities, records and dominance of mammalian species were similar during the dry and wet seasons. The overall species richness of Arjo Diga forest was 19 and Shannon–Wiener Index value (H) was 2.296 and Simpson's index of diversity showed the highestspecies diversity (0.8406) in the study area. Among the four habitats, more closeness of mammalian species was watched between shrubs and crop land (0.55) and the least similarity observed between grassland vs. dense forest (0.48)(Figure 6).

The main threats to mammals in the study area

Human activities have threatened mammals and their habitats in the study area. During the present study period, according to those who responded (27.5%), there was the extension of farmed land, which are the major threats observed in the area. Whereas, (7.5%) of the respondents felt that expansion of settlement were another threat (Figure 7). During the transect walk, evidence of illegal logging for fuel wood, construction materials, grazing by livestock, encroachment, extensive agricultural expansion, and charcoal production from both plantations and natural forests were observed. People in and around the study area seemed to have unrestricted access to cut trees of their interest because it is a source of revenue generation for the poor. Trampling and grazing by livestock were commonly observed during the survey period.

4. DISCUSSION

Species taxonomic composition

The orders and families of mammalian species recorded within the shown study were higher than within the study conducted on medium and large-sized well-evolved creatures in several territories. On the occasion, Legese *et al* ., (2019) recognized five orders and seven families within the Wabe timberland, Ethiopia. Too, Girma and Worku (2020) distinguished five orders and nine families within the Nensebo Timberland, Southern Ethiopia; Lemma and Tekalign (2020) recorded four orders and five families within the Humbo Community-Based Timberland Range, Southern Ethiopia; here in Arjo Diga forest 6 orders and 12 families were recorded. On the contrary, Gebo *et al* ., (2021) identified six orders and 13 families from the Faragosa-Fura landscape, Gamo Zone, Southern Ethiopia; Qufa and Bekele (2019) identified seven orders and 11 families from the Lebu natural conservation forest, Southwest Showa Ethiopia which is higher in families and order respectively than the present study. The minimal number of orders or families in the present study area might be attributed to the limited survey period, variation in the size of the area, severe habitat loss, and fragmentation by various anthropogenic activities.

The Carnivora were the most abundant order recorded in terms of the number of families and species, respectively. The result is consistent with the different studies elsewhere in Ethiopia (Rabira *et al* ., 2015; Bakala & Mekonen, 2020; Girma & Worku, 2020; Lemma & Tekalign, 2020). Order primate was the second most abundant in terms of the number of families (two families) and species (four species). Similarly, several studies have also reported a higher relative abundance of Primates than other orders from different parts of Ethiopia (Rabira*et al* ., 2015; Belete & Melese, 2016; Bakala & Mekonen, 2020; Worku & Girma, 2020). This is could be due to the high reproductive successes, their more adaptive nature to different habitats, diversified foraging behavior, and high tolerance level of primates to human disturbances (Negeri *et al* ., 2015; Lemma & Tekalign, 2020). Moreover, Order Artiodactyla has the second abundant order recorded. This is in agreement with the study in the Nensebo forest in Southern Ethiopia where Artiodactyla was the most abundant order containing more species (Girma & Worku, 2020; Lemma & Tekalign, 2020). Orders like Rodentia and Tubulidentata have been recorded as much less as the wide variety of individuals. This is in keeping with different research in various parts of Ethiopia (Rabira *et al* ., 2015; Getachew & Mesele, 2018; Fetene *et al* ., 2019; Girma & Worku, 2020; Worku & Girma, 2020).

Species richness

The types of mammals recorded in the current study were higher than those of mammals with medium and large mammals in different areas. For example, according to Geleta and Bekele (2016) reported that 15 species of mammals were recorded in the Wacha reserved forest, Western Ethiopia, with direct and circumstantial evidence. Moreover, Woldegeorgis and Wube (2012) and Abdu *et al* ., (2020) recorded 14 mammals species from the Yayu forest in southwestern Ethiopia and consequently the Birbir Protected Forest, Western Ethiopia respectively. However, small (12) mammals have recorded inside the Mengaza network woodland, Gojjam, Ethiopia (Getachew & Mesele, 2018). In contrast, the total number of medium and large-sized mammalian species (19) recorded during the present study was relatively low compared to areas of different protection levels across the country and elsewhere. For instance, 28 species of medium and large mammals were recorded from Dhati wolel National Park (Rabira *et al.,* 2015), 23 species from Baroye Control Hunting area (Dereje *et al.,* 2015) and Borena Saint National Park (Alemu, 2010), 20 species from

Alatish national park (Girma & Afework, 2008) and 22 species from Fragmented Ruminant Forest around Asela town (Kasso & Bekele, 2017) and 21 species from the Faragosa-Fura landscape, Gamo Zone, Southern Ethiopia (Gebo *et al* ., 2021).

Similarly, research performed in distinctive countries revealed that the medium and large-sized mammals recorded had been higher than the end results bought from the present study. Some of the studies amongst others include, Melo *et al* ., (2015) recorded 33 mammals species in Brazil; Botelho *et al* ., (2012) recorded 27 species of medium to large-sized mammals in the Humaitá wooded area protected, inside the south West of Amazonia; Campos *et al* .,(2013) observed 23 mammals' species in Brazil and Oliveira an Hannibal, (2017) recorded 22 species of deciduous wooded area, with leafy bushes in Brazil.These differences may be due to climate change, variation in mammal's group composition, variation in vegetation structure, human impact due to deforestation, agricultural expansion, coal production, and the increase in domestic livestock and other environmental factors. The current study area, however, was not given due attention to biodiversity conservation and landscape restoration within the beyond decade.

In addition, as shown in the paragraph above, the wide variety of mammals recorded all through the cutting-edge determine about it used to be additionally in contrast with a few different research performed in Ethiopia and elsewhere. Therefore that, the relative abundance of food resources, coverage of green vegetation, and the presence of water (Dhidhessa River) may also be key factors in controlling their abundance and richness of biodiversity in the current lookup area. Recent research has shown that endangered species round the world such as Panthera Leo and Panthera pardus were recorded in the area, indicating the area has practicable for biodiversity conservation.

Species relative abundance

Papio Anubis and *Cercopithecus aethiops* were the most recorded and *Panthera Leo* , *Panthera pardus, Leptailurus serval, Civettictis civetta, Canis adustuss* , and *Orycteropus afer* were the least recorded mammal species in the study area. The low abundance (frequency of records) of carnivores might be associated with their nocturnal behavior. As described by Wolf and Ripple (2018), Gebresenbet *et al* ., (2018), Lemma and Tekalign (2020), and Worku and Girma (2020), most carnivore species are solitary, nocturnal and crepuscular so that their presence could not be easily documented. Similarly, Alves *et al* ., (2014) and Abdu *et al* ., (2020) identified that the low frequency of commentary for carnivores could be due to their nocturnal habits, with the avoidance of their visualization as they are shy, and the inaccessibility of the night survey in the study area. The present study contradicts the hypothesized trend of a higher frequency of records during the wet season than the dry season because of resource availability. For example, the variety of archive species of mammals recorded during the dry season exceeds the record recorded during the rainy season. In addition, many species of Arjo Diga forest such as *Phacochoerus Africanus, Potamochaerus larvatus, Sylvicapra, grimmia, Canis, adustus, Lepus habissincus, Heliosciurus gambianus, Hitrix cristata, Colobus guerza* and *Civettictis civetta* recorded records in a lower frequency of records during the wet season as compared with the dry period. In contrast, *Mellivora capensis* and *Canis adustus* were recorded in the highest frequency in the wet weather compared to the dry season. This is is often in keeping with the work of Kasso and Bekele (2017) and Gebo*et al* ., (2021) in the dense jungle of Assela, Ethiopia, and within the countries of Faragosa Fura, Gamo Zone, and Southern Ethiopia respectively. However, disagrees with the work of Worku and Girma (2020) and Bakala & Mekonen (2020) in the Geremba forest of Southern Ethiopia and Adaba Community Forest, West Arsi Zone, Southeast Ethiopia respectively where more mammalian species were observed during the wet period than the dry season. The possible explanation for this could be the growth of herbaceous and ground vegetation providing thick cover for the mammalian species, which makes the sighting of them difficult (Girma*et al* ., 2012; Qufa & Bekele, 2019; Diriba *et al* ., 2020; Girma & Worku, 2020). Furthermore, earlier research in different parts of Ethiopia found out that mammalian species diversity is frequently excessive in areas where there are sufficient food sources and volume of habitat and to be had water sources (Yimer and Yirga, 2013). However, the much less range of mammalian species in plantation habitats all through both seasons became in all likelihood related to the presence of a greater anthropogenic effects than the herbal forest. The herbal woodland is notably ways from human settlement so that human effect was minimal.

Therefore, with the findings of the prevailing study, the viable causes for this will be ant bites and human disturbances happening extra throughout the wet season than inside the dry season, especially inside the woodland region. Similarly, human activities, along with agricultural activities, tended to be excessive at some point of the rainy season; this contributed to the discount of mammals' vision. Furthermore, heavy rainfall at some point of the wet season, which certainly complements the regeneration and increase of herbaceous flora and groundwater, might also offer for the animals, making them tough to spot. According to Girma *et al* ., (2011), the excessive rain during the wet season can be attributed to terrible viewing of animals due to flora outgrowth which is just like this look at.

Species distribution

The results of the present study showed that of the 763 total records, the frequency of records was higher in the forest (38%) followed by grassland. The result agrees with other studies (Rabira *et al* ., 2015; Geleta and Bekele, 2016; Abdu *et al* ., 2020). All species recorded in the forest, shrubs, crop land, and grass land (except*Panthera Leo, Colobus guereza* , and *Panthera pardus*) habitats are subsets of the species recorded in the grassland habitat. On the other hand, *Lepus habissincus* was recorded only in grass land areas and *Civettictis civetta* and *Canis adustus* were not recorded in crop land and shrubs, respectively. Given the relatively small length of the grassland habitat in comparison to the wooded area, these effects are incredible and inconsistent with the hooked courting of species; which means that habitats with a large location tend to have a better wide variety of species than animals with smaller habitats (Bakala & Mekonen, 2020; Diriba *et al* ., 2020; Udy *et a* l., 2021; Worku & Girma, 2020). In particular, the presence of a large variety of order Artiodactyla (herbivore species) found in the grassy area, due to the high quality of habitat, may also attract a large number of organized Carnivora species and resulting in an accelerated range have led to an increase in diversity (Diriba *et al* ., 2020; Fetene *et al* ., 2019; Girma & Worku, 2020; Gebo *et al* ., 2021). Moreover, separate living areas ought to take delivery of the same interest. Extra researches that specialize in animal-hunting relationships are wanted to devise for effective control of the Arjo Diga forest ecosystem.

Papio Anubis and Cercopithecus aethiops were the maximum considerable species, both within the herbal wooded area habitat in the present study location. similarly, (Girma *et al* ., 2012; Gebo *et al* ., 2021) confirmed that the maximum abundant species had been Papio Anubis and Cercopithecus mittis in and around Wondo Genet woodland Patch, Southern Ethiopia, and inside the Faragosa-Fura landscape, Gamo quarter, Southern Ethiopia respectively. The possible cause for the abundance of P. Anubis inside the gift examined might be the result of its potential to adapt to a large range of ecological niches and feeding conduct with a ramification of meal items and due to excessive reproductive fulfillment or due to less sensitivity to anthropogenic impact (Mullu and Solomon, 2016). Moreover, this species may use the natural forest to escape the onslaught of local people to prevent their plants from invading wildlife. However, Panthera pardus and Panthera Leo are the most extensively disbursed cats in the world, where food and cover are to be had (Burgin *et al* ., 2018; Wolf & Ripple, 2018). However, they are vulnerable and at risk of nearby extinction (Tefera, 2011; Ripple *et al* ., 2014; Lavrenchenko & Bekele, 2017; IUCN, 2021). The presence of those conservation-established species demonstrates that the study landscape is a capacity vicinity for wildlife conservation. Furthermore, in the gift observe location, they had been limited to forest habitats and sparsely vegetated herbal wooded areas more suitable for the detection of mammals. This is probably because of the struggle with the local community because of predation by domestic animals (Tefera, 2011). Moreover, this might make contributions to the rareness of these species.

Diversity index of landscape

Species index of diversity confirmed that there is a variant in species range among the habitats. As an example, grassland and dense forest have the highest species range (H' = 2.198; H= 2.165), respectively, whilst the least species variety becomes recorded from the plants' land (H' = 2.037). The species index of the diversity of the examined location confirmed better species richness (H = 2.296; 1-D = 0.8406) than to the observe conducted by Qufa and Bekele (2019) inside the Lebu natural included wooded area, Ethiopia (H = 2.119; 1-D = 0.8167) and less than look at conducted through Gebo et al., (2021) in the Faragosa-Fura landscape, Gamo Zone, Southern Ethiopia (H=2.56; 1-D=0.8968). In addition, research performed by Kasso

and Bekele (2017) confirmed that the variant in the range and abundance of mammal species among unique habitats is associated with the quality of the habitat, preference of the species, availability of food assets, dense forest cover, and water is probably contributed to better species richness. Our finding is inconsistent with the study carried out by way of (Geleta and Bekele, 2016; Gebo *et al* ., 2021), in which they obtained a better species range in the grassland and herbal wooded area. Those variations might be due to human stress on the Arjo Diga conservation forest earlier than it became protected.

The main threats of mammals

The present study shows that the forest ecosystem has exacerbated the deterioration of natural resources, and wildlife is facing major challenges as a result of manmade activities, which could lead to complete degeradation. The findings agree with (Geleta and Bekele, 2016; Legese *et al* ., 2019). In addition to habitat loss, anthropogenic activities can modify a habitat in ways that change species interactions, distribution, and diversity (Kasso and Bekele, 2014). Due to the low punitive system in the studied area, the practice of anthropogenic activities appeared to be unrestrained. Deforestation in the study area appeared to be exacerbated by a lack of tolerance among local and zonal forest workers (Girma Gizachew, 2021). Violations between forest wardens and loggers might not be enough to stop the situation unless their operations are governed by law. The proximity of Nekemte town to the forest, on the other hand, may have exacerbated forest devastation for fuel wood and construction materials. Charcoal production was used as the best revenue generation for poor people who are incapable of producing timber. If deforestation continues, the current flora and wildlife of the research region may go extinct. Despite this, poor communication and a lack of active engagement had resulted in misunderstandings between decision makers, resulting in selective fire fuel collecting being allowed (Girma Gizachew, 2021). As a result, conservation issues have remained unresolved for over a decade. Therefore, the challenges of wildlife conservation necessitate tolerance to overcome the constraints that conservation efforts face.

5. Conclusion and Recomendation

The study surveyed medium and big-sized mammalian fauna of Arjo Diga forest that is one of the recently established biodiversity conservation area in western Ethiopia. The modern examined the vicinity of our results can also make contributions to a higher expertise the quantity of medium and large mammalian species, together with endangered species which includes Panthera Leo and Panthera pardus were recorded in place, indicating the location has attainable for biodiversity conservation. moreover, Papio Anubis and Cercopithecus aethiops had been the maximum recorded While, Panthera Leo, Panthera pardus Leptailurus serval, Civettictis Civetta, Canis adustus, and Orycteropus afer were the least recorded within the study region across the habitat types and seasons. This is the first ecological record of the abundance, species range, and distribution of the mammals inside have a look region, which would serve as precious baseline data for the federal and nearby governments must legalize as a wildlife refuge location to conserve mammals of the area. On the other hand, due to a lack of commitment and a weak penal system, agricultural encroachment and illegal logging appear to be unregulated. People who have encroached on the forest's defined areas are still causing problems that must be addressed if the forest is to be recovered. Therefore, to reduce the influence of anthropogenic activities on the study area's wildlife, joint conservation practices with the local community must be initiated to conserve and enhance the welfare of mammals that arise in the area. In so doing, a lengthy-term comprehensive evaluation of mammals desires to be documented and the provision of know-how-based conservation and management tasks have to receive in place.

Acknowledgements

We would like to thank the East Wollega Zone and the Diga Woreda Environment Authority for releasing the Arjo Diga forest baseline survey data, as well as Mr. Ashetu Kejela, the GIS/GPS expertise, for his help during the survey. Special thanks to the responders for taking the time to complete the survey and providing the needed responses. The associate editors and reviewers' comments and suggestions considerably improved the work.

Authors' contributions

The study data collection was conceptualized and designed by Girma Gizachew and Tariku Mekonnen. Girma Gizachew did the fieldwork, analyzed it, wrote the manuscript, and revised it all. Tariku Mekonnen edited the manuscript and amended the primary document's final version before submitting it for evaluation. The authors participated in the manuscript's writing and approved the final version.

Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are included in the article and the documents attached in the file upload.

Girma Gizachew ORCID ID: 0000-0003-3445-7415

References

Abdu, I., Jira, G., & Tut, G. (2020). *Diversity and Relative Abundance of Medium and Large Mammals in Birbir Protected Forest , Western Ethiopia* .

Ahumada, J. A., Silva, C. E., Gajapersad, K., Hallam, C., Hurtado, J., Martin, E., ... Sheil, D. (2011). Community structure and diversity of tropical forest mammals: Data from a global camera trap network. Philosophical Transactions of the Royal Society.

Alemu, M. C. (2010). *Mammalian Diversity in Borena-Sayint National Park, South Wollo, Ethiopia* . 1–74.

Alves, G. B., Marcal Junior, O., & Brites, V. L. de C. (2014). Medium and large-sized mammals of a fragment of cerrado in the triangulo mineiro region, southeastern Brazil. *Bioscience Journal* ,*30* (3), 863–873.

Amare, A. (2015). Wildlife Resources of Ethiopia: Opportunities, Challenges and Future Directions: From Ecotourism Perspective: A Review Paper. *Natural Resources* , *06* (06), 405–422.

Asefa, M., Cao, M., He, Y., Mekonnen, E., Song, X., & Yang, J. (2020). Ethiopian vegetation types, climate and topography. *Plant Diversity* , *42* (4), 302–311.

Bakala, F., & Mekonen, G. (2020). Species diversity and relative abundance of medium and large-sized wild mammalian species: A study from adaba community forest, West Arsi Zone, Southeast Ethiopia. African Journal of Ecology, 59(2), 38–43.

Belete, T., & Melese, M. (2016). Assessment of large mammals potential in Tululujia Wildlife Reserve, Southwestern Ethiopia.*International Journal of Agricultural and Life Sciences* ,*October* . https://doi.org/10.22573/spg.ijals.016.s12200070

Bene, J. K., Bitty, E. A., Bohoussou, K. H., Abedi-, M., Gamys, J., & Soribah, P. A. J. (2013). Current Conservation Status of Large Mammals in Sime Darby Oil Palm Concession in Liberia. *Global Journal of Biology, Agriculture & Health Sciences* , *2* (3), 93–102.

Botelho, A. L. M., Calouro, A. M., Borges, L. H. M., & Chaves, W. A. (2012). Large and medium-sized mammals of the Humaita Forest Reserve, southwestern Amazonia, state of Acre, Brazil. *Check List* ,*8* (6), 1190–1195. https://doi.org/10.15560/8.6.1190

Burgin, C. J., Colella, J. P., Kahn, P. L., & Upham, N. S. (2018). How many species of mammals are there? *Journal of Mammalogy* ,*99* (1), 1–14. https://doi.org/10.1093/jmammal/gyx147

Campos, F. S., Lage, A. R. B., & Ribeiro, P. H. P. (2013). Diversity of medium and large sized mammals in a Cerrado fragment of central Brazil.*Journal of Threatened Taxa* , *5* (15), 4994–5001. https://doi.org/10.11609/jott.o3342.4994-5001

Dagnachew Mullu and Melese Solomon. (2016). Feeding Ecology of Olive Baboon (Papio anubis) in Arba Minch Forest, Arba Minch, Ethiopia.*Am J Primatol* , *January* , 1–5.

Diriba, G., Tamene, S., & Mengesha, Girma, A. A. (2020).*Diversity of medium and large mammals in the Loka Abaya .June* , 9896–9905. https://doi.org/10.1002/ece3.6649

Fetene, A., Yeshitela, K., & Gebremariam, E. (2019). The effects of anthropogenic landscape change on the abundance and habitat use of terrestrial large mammals of Nech Sar National Park. *Environmental Systems Research* , *8* (1). https://doi.org/10.1186/s40068-019-0147-z

Fornitano, L., Angeli, T., Costa, R. T., Olifiers, N., & Bianchi, R. de C. (2015). Medium to large-sized mammals of the augusto ruschi biological reserve, Sao Paulo state, Brazil. *Oecologia Australis* ,*19* (1), 232–243. https://doi.org/10.4257/oeco.2015.1901.15

Gebo, B., Takele, S., & Shibru, S. (2021). Impacts of habitats and seasons on mammalian diversity and distribution in the Faragosa-Fura landscape, Gamo Zone, Southern Ethiopia. *Geology, Ecology, and Landscapes* , *00* (00), 1–12.

Gebrecherkos Woldegeorgis and Tilaye Wube. (2012). *A Survey on Mammals of The Yayu Forest In Southwest Ethiopia . 35* (2), 135–138.

Gebresenbet, F., Baraki, B., Yirga, G., Sillero-Zubiri, C., & Bauer, H. (2018). A culture of tolerance: Coexisting with large carnivores in the Kafa Highlands, Ethiopia. *Oryx* , *52* (4), 751–760. https://doi.org/10.1017/S0030605316001356

Geleta Mosissa & Bekele Afework. (2016). Survey of Medium and Large-sized Mammals in Wacha Protected Forest , Western Ethiopia.*Scholarly Journal of Agricultural Science* , *6* (3), 71–79.

Getachew, A., & Mesele, Y. (2018). Species composition and relative abundance of medium and large mammals in Mengaza communal forest, East Gojjam, Ethiopia. *Journal of Ecology and The Natural Environment* ,*10* (2), 34–40. https://doi.org/10.5897/jene2017.0667

Girma Gizachew. Local Community Perceptions and Attitudes towards Biodiversity Conservation: In the Case of Arjo Diga Forest Ecosystem, Western Ethiopia. International Journal of Natural Resource Ecology and Management. Vol. 6, No. 4, 2021, pp. 176-185.

Girma Mengesha and Afework Bekele (2008). Diversity, distribution and habitat association of large mammals of Alatish, North Gonder, Ethiopia. Acta Zoologica Sinca 54: 20 29.

Girma, Z., & Worku, Z. (2020). Large Mammal Diversity in Nensebo Forest, Southern Ethiopia. *International Journal of Zoology* ,*2020* (December). https://doi.org/10.1155/2020/8819019

Gole, T. W. (2017). *Mainstreaming Incentives for Biodiversity Conservation in CRGE Report To undertake a biodiversity score card Submitted to UNDP Country Office* (Issue December).

Greenwood, J.J.D. and Robinson, R. A. 2006. (2006). General Census Methods. pages 87–185, In: Sutherland, W.J. (Editor)nd.Ecological Census Techniques: A Handbook. 2 edition. Cambridge University Press, London. In *Journal of Materials Processing Technology* (Vol. 1, Issue 1).

Hammer , Harper D.A.T. and Ryan, P.D. (2001). PAST: Paleontological Staistics Software Package for Education and Data Analysis. Palaeontologia Electronica, 4(1): 1-9.Happold.

Haugaasen, T., & Peres, C. A. (2005). Mammal assemblage structure in Amazonian flooded and unflooded forests. *Journal of Tropical Ecology* , *21* (2), 133–145. https://doi.org/10.1017/S026646740400207X

IUCN. (2021). The IUCN red list of threatened species. Version 2020-3.12 January 2021. https://www.iucnred list.org

Kasso, M., & Bekele, A. (2014). Threats to Mammals on Fragmented Habitats around Asella Town, Central Ethiopia. *International Journal of Biodiversity* , *2014* , 1–7.

Kasso, M., & Bekele, A. (2017). Diversity , Abundance and Distribution of Mammals in Fragmented Remnant Forests around Asella Town, Ethiopia.*MAYFEB Journal of Biology* , *1* (January), 1–12.

Kingdon, J. (2015). *Kingdon field guide to African mammalian species-bloomsbury natural history (2nd ed.).*

Krebs, C. J. (2006). Ecological census techniques: a handbook, by W. J. Sutherland (Book Review). *Trends in Ecology & Evolution ,125417* (1), 81–82.

Lavrenchenko, L. A., & Bekele, A. (2017). *Diversity and conservation of Ethiopian mammals: What have we learned in 30 years?April 2018* .

Lavrenchenko, L. A., & Bekele, A. (2017). Ethiopian Journal of.*Ethiop. J. Biol. Sci.* , *16* (April 2018), 1–20.

Legese, K., Bekele, A., & Kiros, S. (2019). A Survey of large and medium-sized mammals in Wabe forest fragments, Gurage zone, Ethiopia.*International International Journal of Avian & Wildlife Biology* ,*4* (2), 32–38. https://doi.org/10.15406/ijawb.2019.04.00149

Lemma, A., & Tekalign, W. (2020). Abundance, species diversity, and distribution of diurnal mammals in humbo community-based forest area, Southern Ethiopia. *International Journal of Zoology* , *2020* . https://doi.org/10.1155/2020/5761697

M.Norton-Griffiths. (1978). Norton-Griffith MN. (1978). Counting Animals (2nd edition). African Wildlife Foundation, Nairobi, Kenya, pp.1-25. In*Journal of Chemical Information and Modeling* (Vol. 53, Issue 9).

Melo, É. R. D. A., Gadelha, J. R., Da Silva, M. D. N. D., Da Silva, A. P., & Pontes, A. R. M. (2015). Diversity, abundance and the impact of hunting on large mammals in two contrasting forest sites in northern amazon. *Wildlife Biology* , *21* (5), 234–245.

Mengistu Wale, Abeje Kassie, Getachew Mulualem, Weldemariam Tesfahunegny, A. A. (2017). Wildlife Threats and Their Relative Severity of Eastern Ethiopia Protected Areas. *Ecology and Evolutionary Biology* , *2* (4), 59. https://doi.org/10.11648/j.eeb.20170204.12

Negeri, D., Gadisa, T., & Habtamu, T. (2015). The Diversity, Distribution and Relative Abundance of Medium and Large-sized Mammals in Baroye Controlled Hunting Area, Illubabor Zone, Southwest Ethiopia.*International Journal of Molecular Evolution and Biodiversity* .

Newbold, T., Hudson, L. N., Hill, S. L. L., Contu, S., Lysenko, I., Senior, R. A., Börger, L., Bennett, D. J., Choimes, A., Collen, B., Day, J., De Palma, A., Díaz, S., Echeverria-Londoño, S., Edgar, M. J., Feldman, A., Garon, M., Harrison, M. L. K., Alhusseini, T., ... Purvis, A. (2015). Global effects of land use on local terrestrial biodiversity. *Nature* , *520* (7545), 45–50.

NMA, 2021. National Meteorological Agency, Addis Ababa, Ethiopia

Norton-Griffiths, M. (1978). *Norton-Griffith MN. (1978). Counting Animals (2nd edition). African Wildlife Foundation, Nairobi, Kenya, pp.1-25.*

Ogutu, J. O., Bhola, N., Piepho, H. P., & Reid, R. (2006). Efficiency of strip- and line-transect surveys of African savanna mammals.*Journal of Zoology* , *269* (2), 149–160.

Penjor, U., Wangdi, S., Tandin, T., & Macdonald, D. W. (2021). Vulnerability of mammal communities to the combined impacts of anthropic land-use and climate change in the Himalayan conservation landscape of Bhutan. *Ecological Indicators* , *121* (October), 107085.

Qufa, C. A., & Bekele, A. (2019). A preliminary survey of medium and large-sized mammals from Lebu Natural Protected Forest, Southwest Showa, Ethiopia. *Ecology and Evolution* , *9* (21), 12322–12331. https://doi.org/10.1002/ece3.5733

Rabira, G., Tsegaye, G., & Tadesse, H. (2015). The diversity, abundance and habitat association of medium and large-sized mammals of Dati Wolel National Park, Western Ethiopia. *International Journal of Biodiversity and Conservation* , *7* (2), 112–118. https://doi.org/10.5897/ijbc2014.0808

Reale, R., Fonseca, R. C. B., & Uieda, W. (2014). Medium and large-sized mammals in a private reserve of natural Heritage in the municipality of Jaú, São Paulo, Brazil. *Check List* , *10* (5), 997–1004. https://doi.org/10.15560/10.5.997

Regassa, R., & Yirga, S. (2013). *Distribution , abundance and population status of B urchell ' s zebra (Equus quagga) in Yabello Wildlife . 5* (3), 40–49.

Ripple, W. J., Estes, J. A., Beschta, R. L., Wilmers, C. C., Ritchie, E. G., Hebblewhite, M., Berger, J., Elmhagen, B., Letnic, M., Nelson, M. P., Schmitz, O. J., Smith, D. W., Wallach, A. D., & Wirsing, A. J. (2014). Status and ecological effects of the world's largest carnivores.*Science* , *343* (6167).

Ripple, W. J., Newsome, T. M., Wolf, C., Dirzo, R., Everatt, K. T., Galetti, M., Hayward, M. W., Kerley, G. I. H., Levi, T., Lindsey, P. A., Macdonald, D. W., Malhi, Y., Painter, L. E., Sandom, C. J., Terborgh, J., & Van Valkenburgh, B. (2015). Collapse of the world's largest herbivores. *Science Advances* , *1* (4).

Roniel F. Oliveira, and W. H. (2017). Effects of Patch Attributes on the Richness of Medium- and Large-Sized Mammals in Fragmented Semi-Deciduous Forest. *Mastozoología Neotropical* , *24* (2), 401–408.

Shannon, C. E., & Weaver, W. (1949). *The mathematical theory of communication. Chicago, IL: University of Illinois Press.* (pp. 3–35).

Tefera, M. (2011). Wildlife in Ethiopia: Endemic Large Mammals. *World Journal of Zoology* , *6* (2), 108–116.

Trond H. Larsen. (2016). Core Standardized Methods for Rapid Biological Field Assessment. In *Conservation International* .

Udy, K., Fritsch, M., Meyer, K. M., Grass, I., Hanß, S., Hartig, F., Kneib, T., Kreft, H., Kukunda, C. B., Pe'er, G., Reininghaus, H., Tietjen, B., Tscharntke, T., van Waveren, C. S., & Wiegand, K. (2021). Environmental heterogeneity predicts global species richness patterns better than area. *Global Ecology and Biogeography* , *30* (4), 842–851.

Varman, K. S., & Sukumar, R. (1995). The line transect method for estimating densities of large mammals in a tropical deciduous forest: An evaluation of models and field experiments. *Journal of Biosciences* , *20* (2), 273–287.

Wolf, C., & Ripple, W. J. (2018). Rewilding the world 's large carnivores Subject Category : Subject Areas : Author for correspondence : *Royal Society Open Science* , *5* .

Yimer, D., & Yirga, S. (2013). Mammals of the Mazie National Park, Southern Nations, Nationalities and Peoples Regional State, Ethiopia.*SINET: Ethiopian Journal of Science* , *36* (1), 55–61.

Yosef, M. (2015). Attitudes and perceptions of the local people towards benefits and conflicts they get from conservation of the Bale Mountains National Park and Mountain Nyala (Tragelaphus buxtoni), Ethiopia.*International Journal of Biodiversity and Conservation* ,*7* (1), 28–40.

Zerihun Girma, Yosef Mamo, M. E. (2012). *Species composition ,distribution and relative abundance of large mammals in and around Woundo Genet forest patch,Southern Ethiopia* .

Zerihun Girma, A. B. and H. G. (2012). *Large mammals and Mountain Encroachment on Mount Kaka and Hunkolo Fragment,Southeast Ethiopia* .

Table. 1 List of mammalian species recorded in the Arjo Diga Forest, their scientific names, common names, local names

Order	Family	Species	Common name	Local name
Primate	Cercopithecidae	*Cercopithecus aethiops*	Gervet monkey	Qamalee
		Papio anubis	Anubis baboon	Jaldeesa
		Cercopethicus neglectus	DeBrazzes monkey	Chano
	Colobinae	*Colobus guerza*	Gureza	weenni

Artiodactyla	Suidae	*Phacochoerus africanus*	Warthog	Karkaroo
		Potamochaerus larvatus	Bush pig	Booyye
	Bovidae	*Tragelaphus scriptus*	Bush buck	Bosonu
		Sylvicapra grimmia	Bush Duiker	Quruphe
Carnivora	Felidae	*Panthera leo*	Lion	Leenca
		Panthera pardus	Leopard	Qerrensa
		Leptailurus serval	Serval cat	Iya
	Hynaenidae	*Crocuta Crocuta*	Spotted Hyena	Warabessa kololo
	Mustelidae	*Mellivora capensis*	Honey badger	Amaaqexa
	Viverridae	*Civettictis civetta*	African civet	Xirinyi
	Canidae	*Canis adustus*	Side striped Jackal	Sardiidoo
Lagomorpha	Leporidae	*Lepus habissincus*	Abyssinia Hare	Ileti
		Heliosciurus gambianus	Tree squirrel	Osole
Rodentia	Hystricidae	*Histrix cristata*	Crested porcupine	Dhade
Tubulidentata	Orycteropodidae	*Orycteropus afer*	Aardvark	Waldigessa

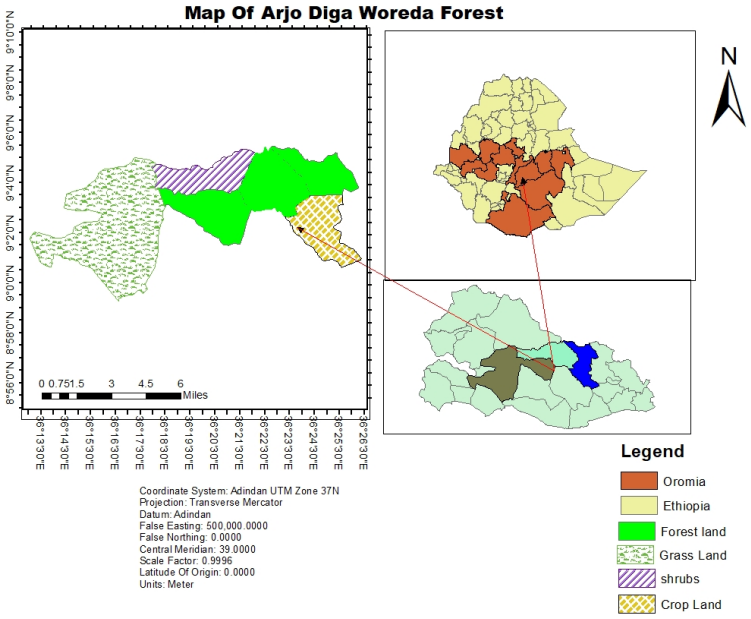


Figure.1.Map of the study area

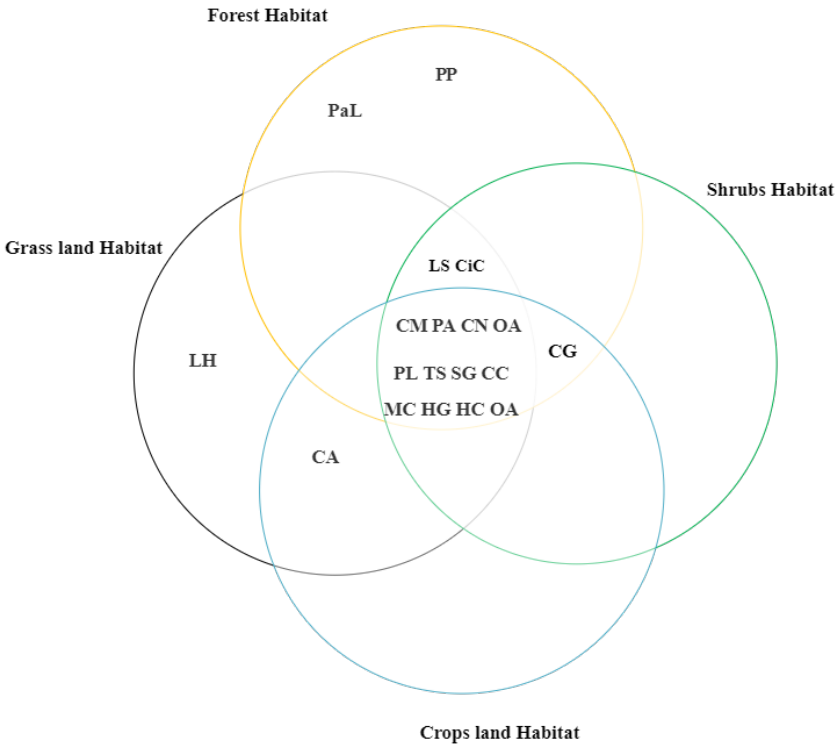


Figure 2. The Venn diagram showing assemblage of mammalian species in habitat types.Note: CM,Cercopithecus aethiops;PA,Papio anubis; CN,Cercopethicus neglectus;CG, Colobus guerza;PA, Phacochoerus africanus;PL,Potamochaerus larvatu;TS,Tragelaphus scriptus;SG,Sylvicapra grimmia; CC,Crocuta Crocuta; MC,Mellivora capensis;HG,Heliosciurus gambianus; HC, Histrix cristata; OA,Orycteropus afer; PaL, Panthera Leo; PP, Panthera pardus; LS, Leptailurus serval; CiC,Civettictis civetta; CA, Canis adustus and LH, Lepus habissincus.

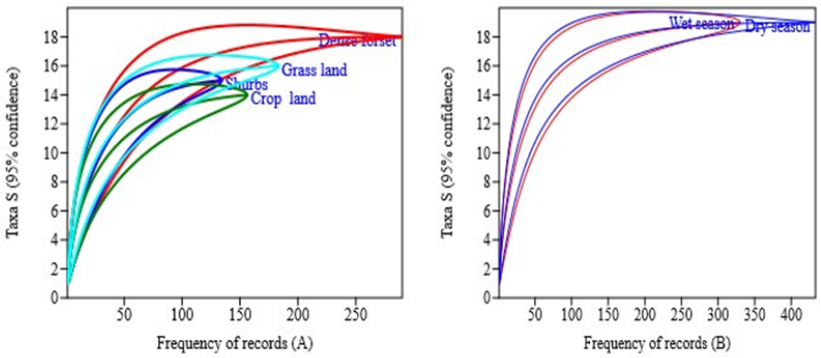
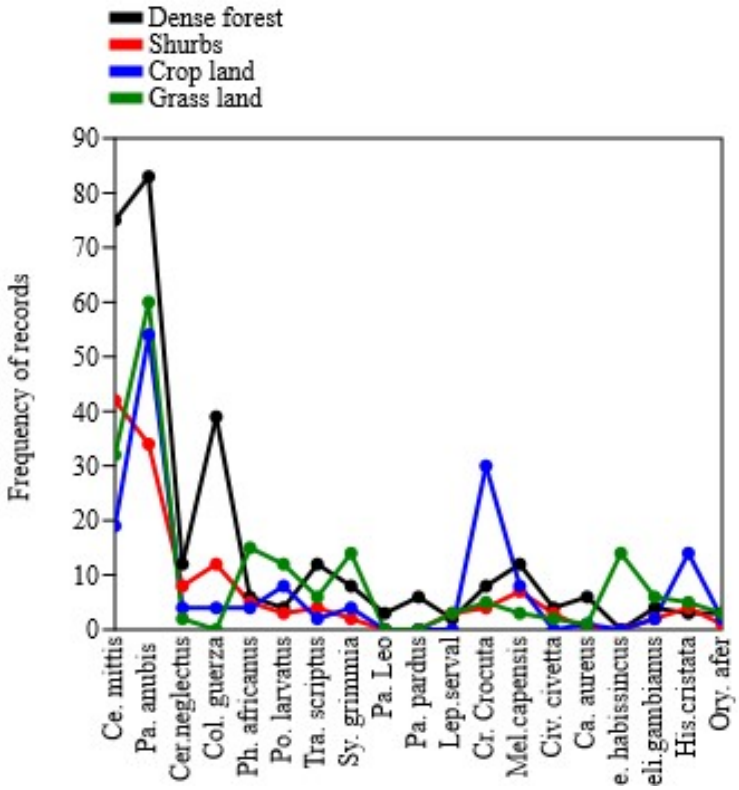


Figure 3. Mean number of species richness and frequency of records computed by rarefaction curve among the four stratified abitat types (A) and seasons (B).



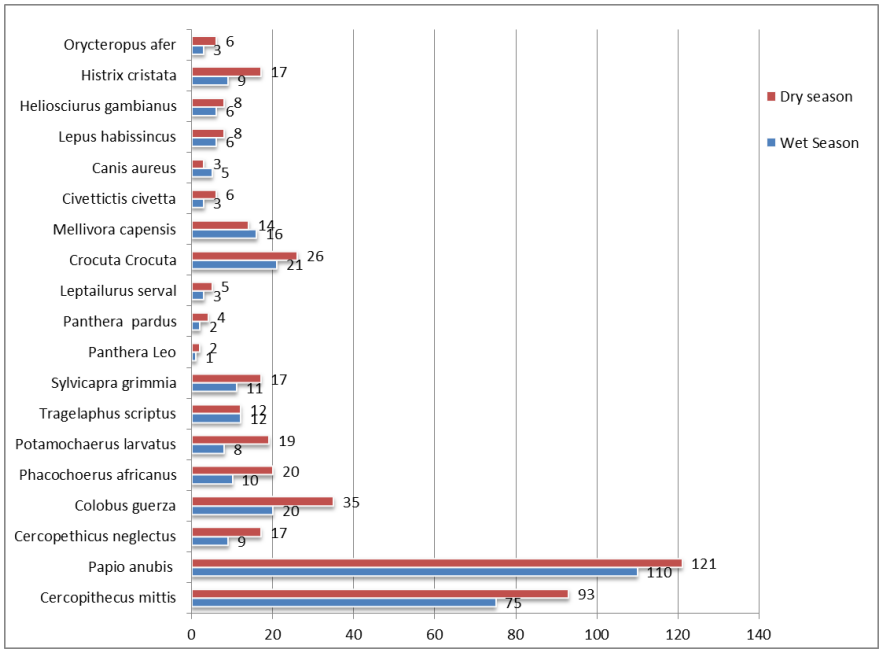


Figure 4. Mammalian species frequency of records among four habitat types

Figure 5. Mammalian species frequency of records in wet and dry seasons

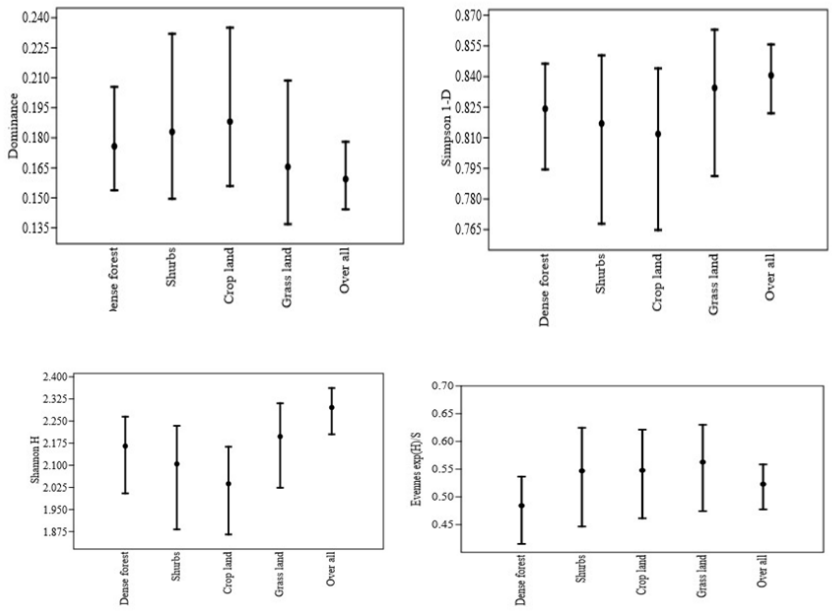


Figure 6. Error bars of mammalian species diversity indices across habitat types.

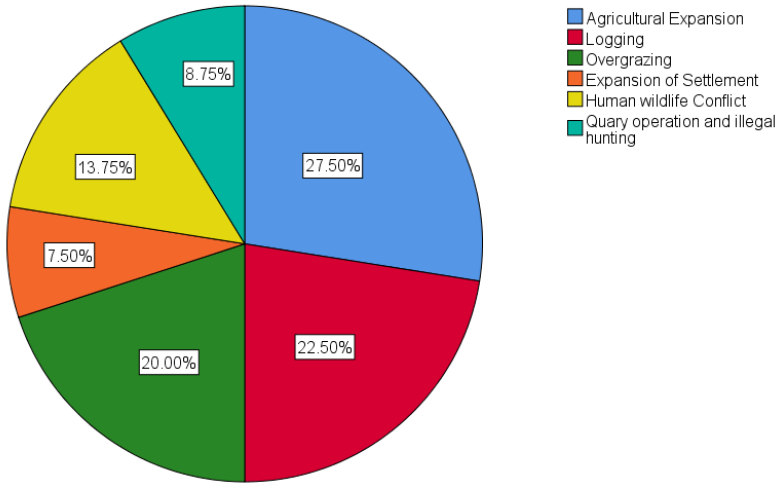


Figure 7. Main threats of mammals in the study area