Potential Distribution and Conservation of Endangered Bird *Anthus sokokensis* in Ruvu-south Coastal Forest Reserve, Tanzania

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Abstract— *Ruvu-South Coastal Forest Reserve forms one of the most important coastal forests in Eastern Africa coastal belt. It provides important ecological habitat for most endemic and endangered fauna and flora species including endangered Sokoke pipit bird (Anthussokokensis). The study evaluated the potential distribution and conservation of globally endangered Sokoke pipit bird in Ruvu Coastal Forest Reserve in Tanzania. Specifically the project assessed the current population size, distribution, and habitat conditions of Sokoke pipit bird in the study area. Using National Forest Inventory protocol, a total of 9 tagged line transects were established 900m from each other and sample plots of 50m x 30m were laid at every 400m along tagged transects. In each sample plot, information about forest floor conditions, forest gaps and signs for forest disturbances were assessed.Study recorded a total of 201 disturbance events along all 13 transects. Tree cutting events were observed at highest frequency rate with 71 incidences compared to others; followed by fire damage incidences. Also the study recorded 28 Sokoke pipit birds distributed in 5 sample plots among all 39 plots surveyed.The mean density ofS.pipit bird found is0.02 birds/ha, with a projected overall bird population estimated at 611 individuals in the entire forest. The study recommends further studies to other parts of the forest reserve so as to identify other fundamental niche, endangered and endemic species. Also to enhance of forest management by local authority and raise conservation awareness to address human-mediated forest destruction.*

Keywords— Sokoke pipit, distribution, population,Ruvu south coastal forest.

I. INTRODUCTION

Coastal forests are the most important habitats for biodiversity because they host at least half of all terrestrial plant and animal species. Studies show that these forests face the greatest threat from human exploitation, destruction and ecosystem degradation and modification. It is estimated that coastal forests are degraded at an estimated loss rate of c. 10% every decade particularly in areas without formal protection(Otieno et al., 2014).

Forest-dependent birds are among the most affected by ecosystem conversion, destruction and subsequent habitat loss. They respond to such disruptions with changes in their spatial distribution. A study of their distribution represents an appropriate indicator for monitoring the forest habitat and its suitability for other fauna and flora species. Coastal forests are found in eastern Africa on the coastal plain between the mangrove and montane forests, below an altitude of 500-700m (Burgess et al., 1998). Tabor et al., (2010) estimated that the coastal forests had the least remnants of former habitats of any of the 25 hotspots of global biodiversity recognized at that time. There was a high risk of species becoming extinct if there was a significant further loss of habitat.

Ruvu-South Coastal Forest Reserve forms one of the most important coastal forests in Eastern Africa coastal belt. The reserve habitat is comprised of closed canopy dry, scrub and riverine Zanzibar-inhambane forest mosaics vegetation(Gwegime et al., 2013). The reserve provides important ecological habitat for most endemic and endangered fauna and flora species including endangered Sokoke pipit *(Anthussokokensis)* bird.

The Sokoke Pipit is endemic bird to coastal forests in Tanzania and Kenya. According to Otieno et al., (2014), the bird is a forest-floor insectivore of the East African Coastal forests generally restricted to near-closed canopy woodland habitat dominated by Brachystegia tree species (Leguminoceae). It feeds on arthropods on the ground or in the lower understory, in parts of the woodland with deep floor litter cover.Observation by (Gwegime et al., 2013) indicated that the bird prefers the thicker areas of the understory, with mostof the time spent less than 2 m above ground when not feeding, quickly flushing to upper branches when threatened before returning to forage on the forest floor.

The bird's particular attributes qualify it as an indicator species for monitoring disturbance trends in the lower understory of the Brachystegia forests. A report by IUCN (2017) Red List of Threatened Species calls for immediate conservation action and mentions that the main threat to the species is the degradation and reduction of its habitat, especially the removal of Brachystegia trees. Various studies such as Bull et al., (2006); Burgess et al., (1998) and Oyugi et al., (2008) indicated that Ruvu Coastal Forest Reserve, as other sites of the endangered bird, is suffering from continued forest damage resulting from a breakdown of traditional systems of conservation, encroachment, selective logging, pole-cutting, intensive charcoal burning and cutting. IUCN, (2017) estimated that while there are about 5,500 individuals remaining in the Arabuko-Sokoke Coastal Forest in Kenya, the Sokoke Pipit population in Ruvu Coastal Forest Reserve in Tanzanian is unknown.

The overall objective of this study was to evaluatethe population, potential distribution and conservation of globally endangered bird in Ruvu Coastal Forest Reserve in Tanzania. Specifically the project assessed the current population size, distribution, and habitat conditions of Sokoke pipit bird in Ruvu south coastal forest reserve. Although there have been various studies on the Ruvu forest reserve biodiversity in generaland one on forest disturbanceno study has been carried to evaluate current population size of Sokoke pipit bird in the study area.

Gwegime et al., (2013)examined overall biodiversity richness of Ruvu coastal forest thereserve but did not specifically examine population size, location for fundamental niche and distribution of Sokoke pipit bird. Therefore, the study intended to fill this gap by establishing current population of the endangered bird in the study area, update local database and raise conservation and habitat protection awareness. Furthermore, the results of the project will inform immediate, middle and long term Forest Reserves conservation objectives, priorities and decisions in Tanzania.

II.   MATERIALS AND METHODS

Study area

The study was conducted at Ruvu-South Coastal Forest Reserve located in Kisarawe district, Coastal region, eastern Tanzania. The forest reserve is 30,633hain size and lies at 6º 53'S to 7º 03'S and 3846'E to 3902'E, 120 - 260m elevation above sea level(Tanzania Forest Services, 2018). Ruvu-South Forest climate is influenced by tropical East African oceanic temperatures that are slightly modified by the altitude. It receives an average annual rainfall of about 967mm per year and short rains usually less than 50 mm falls between June and October(Burgess et al., 1998). During dry seasons the South Ruvu forest reserve has been facing fire incidences caused by charcoal makers and animal hunters where by about 250ha burnt annually.
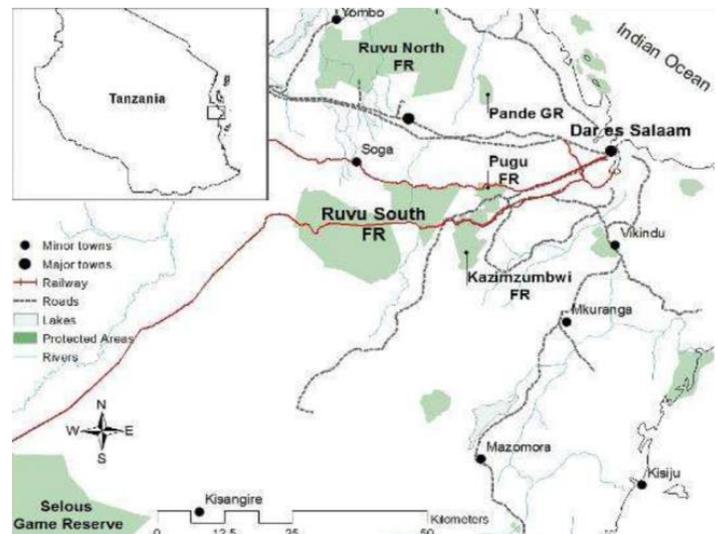

Fig.1: Location of Ruvu Coastal Forest Reserve, *(Modified from: (Gwegime et al., 2013)*

Sampling strategy

The survey work was carried out over 48 days between March and May, 2018 within single block in the Brachystegia woodland.To assess ecological habitat conditions, bird distribution and population size, the survey team adopted survey protocol based on National Forest Inventory protocol (2009). Total of 9 tagged line transects were established 900m from each other and sample plots of 50m x 30m were laid at every 400m along tagged transects. Plots were oriented from west to east and co-ordinates of each plot were recorded using GPS device with x20 resolution

Each vegetation sample plot was positioned 5m to 50 m inside the forest boundary in order to avoid disturbance and edge effect alongthe forest boundary. Team surveyed a total of 39 plots in the west-southern part of the reserve extending to north east. Selection of this block area was based on

Hansen dataset (2017), which indicated undisturbed brachystegia forest woodland in the selected area. A total 1404 ha equivalent to 5 percent of the total area were surveyed during this study.Location and position of the vegetation plots are indicated in the following figure.
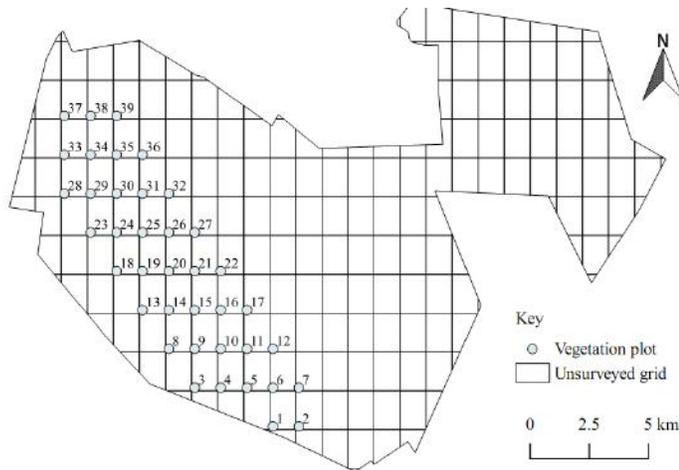

Fig.2: Location of Vegetation Sample Plots

In each sample plot, information about forest floor conditions, forest gaps and signs for forest disturbances were assessed. Brachystegia woodland and forest cover were assessed andrecorded in each plot. These are the forest trees providing important niche associated with endangered *A.sokokensis*. Also bird census were done through travelling along permanent established line transects each day for two to three hours every day from 7: 00 am. This isthe recommended time in which bird vocalization are at the peak for most birds, thus ensureshigh visibility and detectability. Territory Mapping was also done in order to produce a detailed map of the distribution so as to link bird distribution with habitats.

III.   RESULTS AND DISCUSSION

During this study, the assessment of ecological habitat conditions as well as current distribution of critically endangered Sokoke pipit(*Anthussokokensis*) birdand its population were studied. This section presents results on ecological habitat conditions as well as population of the Sokoke pipit bird.

Ecological Habitat Conditions

Habitat conditions were assessed based on the level of forest disturbances indicated by the number of incidences of anthropogenic activities such as tree cutting, fire damage, charcoal making, clearings, roads/paths and cultivation.Survey team recorded a total of 201 disturbance events in total along all 13 transects.The most disturbed area being the southern site of the forest. Tree cutting events were

observed at highest frequency rate recording 71 events than others followed by fire damage incidence. We recorded both old cut and fresh cut trees and this number excluded naturally dead and fallen down trees. The result indicates continual deforestation of forest trees due to anthropogenic pressure and it is directed on remaining good forest.
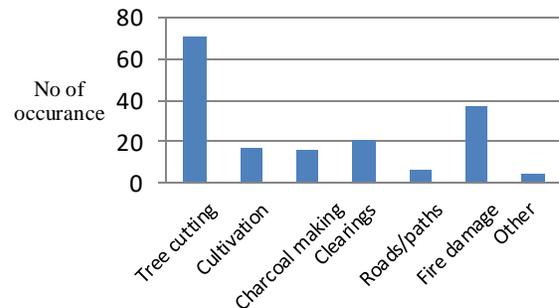

Fig.3: Type of forest disturbance

As indicated in Fig 3 above, fire damage was observed to be the second most frequent forest disturbance type to be observed. Plots 6, 10, 11, 12 and 17 were affected mostly by fire incidences.

Fig 4: Live Charcoal kiln in Ruvu forest

There was evidence that fire spread were associated with charcoal burning as the team noted various remains and live charcoal kilns as indicated in Fig 4.

Fig.5: Fire demage in Ruvu south forest

Fig.6: Distribution of S.pipit bird in Ruvu Forest Reserve

Personal communication with Kipangeni village leader, one of the villages surrounding Ruvu coastal forest indicated that charcoal making and pole extraction is a one of the major source of income to many families in the village. Other disturbance events observed which accounted for about 8 incidences (4 percent) included disturbance due to grazing, encroachment as well as footpath.

From these observations, it is indicative that ecological habitat for fauna and flora species in Ruvu coastal forest reserve is continuing to deteriorate at moderate rate. The findings are similar to observations by (IUCN, 2017; Oyugi et al., 2008; Tabor et al., 2010)who reported on continuing forest degradation due to anthropogenic activities and inadequate capacity to manage the forest reserve in terms of funds, tools and personnel compared to big threat towards illegal harvesting.

Brachystegia woodland and vegetation cover which supports Sokoke pipit are observed to be affected by these human activities as well. The heavy pressure on remaining good forest is contributed by population pressure due toincrease in population of the adjacent communities and the surrounding areas like Kibaha andDar es Salaam,uncontrolled issuing of permits for charcoal production, timber harvesting, and failure of authorities to enforce forest laws.

Anthussokokensis population and distribution

This was the second objective for this study. Survey for the endangered species was conducted to determinecurrent population size of the bird and identify bird's fundamental niche and richness.Survey indicated a total of 28 Sokoke pipit birds distributed in 5 sample plots among all 39 plots surveyed.
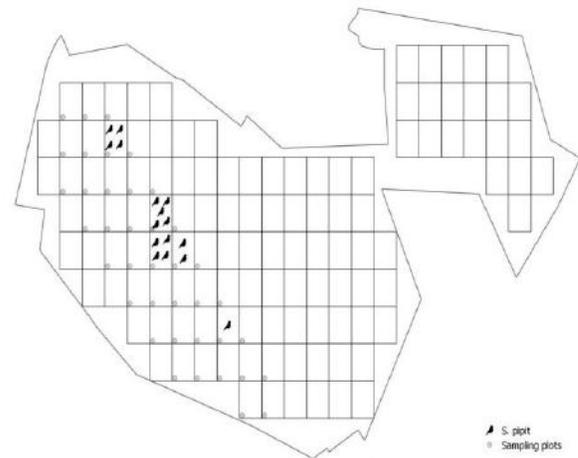
As indicated in figure 6, fundamental habitat for the bird are found in the midst part of the forest where it contains undisturbed brachystegia forest cover and adequate litter depth. In sample plot number 26, team recorded highest number of Sokoke bird individuals in sample plots number 20 and 26 with 8 and 10 individuals respectively.Across all plots surveyed, the mean density ofS.pipit bird is0.02 birds/ha, with a projected overall bird population estimated at 611 individuals in the entire forest. The density was observed to be higher in the relatively less disturbed Brachystegia forest zone than the disturbed ones in the northern part.

IV. CONCLUSION

Ruvu south forest reserve provides still hosts the endangered Sokoke pipit bird. Favored habitat includes open understorey with deep litter cover, often but not always with dense vegetation.Its density and estimated population is higher in Brachystegia woodland located at the central parts of the reserve compared to the southern parts. This is presumably because of higher disturbance rates in the southern parts.

Due to continuing rate of degradation, the estimated population size and density of the endangered bird might be lower than it was in the previous. This observation suggests an increasing pressure on the species resulted from increased loss and degradation of its habitat. The study found treeloss due to deforestation and fire damageare the main cause of the habitat degradation. Reduced deforestation in the southern parts and along forest boundaries are the immediate steps recommended for sustainable conservation of endangered bird and forest biodiversity.

Enhancingforest management by local authority and raising conservation awareness to the surrounding communities will help in addressing human-mediated forest destruction particularly along Brachystegia woodland area. It is expected that this will feasibly boost Sokoke Pipit population and

densities and also benefit the conservation of biodiversity in general in the study area. Survey to other parts of the forest which were not covered during this study is also recommended in order to establish a more representation bird population in Ruvu south coastal forest.

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