

OVERCOMING DATA DEFICIENCY IN ENDANGERED SPECIES: PILOTING AN INTEGRATED STRATEGY FOR MONITORING AND CONSERVING THE PEL'S FLYING SQUIRREL (*Anomalurus pelii*) IN GHANA



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EXECUTIVE SUMMARY

The Pel's Flying Squirrel (*Anomalurus pelii*) is the largest of all scaly-tailed squirrels. They are confined to a relatively small region in West Africa, ranging from Ghana to eastern Liberia. This species was recently classified as Least Concern by IUCN. However, in Ghana the species population continue to suffer severe threats from hunting and the bushmeat trade. In addition, the species' habitats are constantly threatened by both legal and illegal logging. This project sought to address knowledge gaps of the field ecology of *Anomalurus pelii* and engage forest communities to create an awareness about the plight of the species. The study was conducted in the Suhuma forest region in the southwestern part of Ghana. The study employed surveys, key informant interviews and transect surveys to collect data. A Multicriteria Decision Making (MCDM) modelling technique (combing spatial data parameters including vegetation, tree height and closeness to water from field surveys) was used to produce habitat suitability map for *Anomalurus pelii* in the Suhuma forest reserve. Hunters reported hunting 10-50 individuals of *Anomalurus pelii* in a month although the species population is declining compared to 10 years. Surveys also confirmed the presence of the Derby's Scaly-tailed Squirrel (*Anomalurus derbianus*), Dwarf Scaly-tailed Flying Squirrel (*Anomalurus pusillus*) and Beecroft's Scaly-tailed Squirrel (*Anomalurus beecrofti*) in the Suhuma forest region. Traders were also observed selling volumes of bushmeat including *Anomalurus pelii*. We identified a thriving bushmeat market for other threatened species including White-thighed Colobus (*Colobus vellerosus*), Lowe's Monkey (*Cercopithecus lowei*), Patas monkey (*Erythrocebus patas*), White-bellied pangolin (*Phataginus tricuspis*), Black-bellied pangolin (*Phataginus tetradactyla*), and Grey parrot (*Psittacus erithacus*). Apart from its use as a food source, Pel's Flying Squirrel fluffy tail was kept as a trophy. The materials in the gut of the species were believed to cure hypertension. The hunting and especially the trade of bushmeat in the study area also poses a threat to public health in terms of the spread of zoonotic diseases due to the unhygienic conditions trade is organized. This project educated 1000 schoolchildren and their teachers for the first time in Ghana about the plight of *A. pelii*. In addition to sustaining education programs and restoration of the species degraded habitats, there is a need for an immediate assessment of the perceptions of bushmeat actors about the risk of hunting, trade, and zoonotic diseases in the Suhuma area to enhance education and law enforcement.

BACKGROUND

The Pel's Flying Squirrel (*Anomalurus pelii*), the largest of the scaly-tailed squirrels, is confined to a relatively small region in West Africa, ranging from Ghana to eastern Liberia. This species has recently been classified as Least Concern (Gerrie 2021) from Data Deficient, which was the species status during the time of this study (e.g. see Hutterer and Decher 2009).

In Ghana, *Anomalurus pelii* is typically found in protected areas in the high forest zone in the southwest, where it plays a significant role in the distribution of a heavily harvested timber species locally known as Kyenkyen (*Antiaris toxicaria*) (FAO 2007). In this region, the species faces severe threats to its survival, with hunting and deforestation likely contributing to its apparent disappearance. For instance, based on accounts of hunters, the species is the most hunted wildlife species in the Suhuma forest reserve (Ofori and Attuquayefio 2010). However, this forest is among the priority habitats for species conservation in the West Africa subregion.

According to a Global Forest Watch regional assessment, Ghana has the highest rate of primary forest loss in West Africa (Global Forest Watch 2019). This is a warning that *Anomalurus pelii* is on the verge of disappearing in Ghana, as the species abundance is strongly influenced by the local availability of dense primary forest (Schunke and Rainer Hutterer 2005). There is little incentive for policymakers and managers to commit resources to the species due to the absence of a proper assessment of its field ecology. Against this background, this project aims to provide baseline data on the species occurrence, population trends, and habitat preference. In addition, for the first time promote awareness about the species conservation needs in Ghana. The long-term plan is to engage traditional authorities, the Ghana Forestry Commission, timber companies, and non-governmental organizations to support an action plan for the conservation of *Anomalurus pelii* in Ghana.

In this current project, we report on an exploratory study that examined: (a) the habitat suitability and distribution of *Anomalurus pelii* in the Suhuma forest reserve; and (b) population trends of the species based on surveys with hunters and traders. The project also (3) our education programs in school. In the succeeding sections, Pel's Flying Squirrel is used interchangeably with *Anomalurus pelii*.

STUDY AREA DESCRIPTION

This project was conducted in the Suhuma forest reserve (hereafter Suhuma), and neighboring communities located in southwestern Ghana. The forest reserve is located in the Western North region of Ghana and covers an area of 359 sq km. A relatively large area of the reserve has been logged, with the remaining forest stand still subjected to active logging. Trees in the reserve have a discontinuous canopy usually reaching an average height of 43m and 50- 60m. Suhuma is a moist semi-deciduous forest with an undulating topography with steep slopes (Hawthorne and Abu-Juam 1995). It is part of the Upper Guinea rainforest, a biodiversity hotspot. The forest records annual rainfall in the range of 1200-1800 mm. Two rainfall peaks are characterized in the forest with the rainfall pattern falling between May and June, and September and October. The dry season is recorded from November to March (Swaine and Hall 1983).

RESEARCH METHODS

The study employed surveys and key informant interviews to gather data on the species occurrence in Suhuma and its utilization patterns. Purposive snowball sampling techniques were used to interview key informants that comprised hunters with over 10 years of hunting experience in the area. Interviews were conducted face-to-face using a semi-structured questionnaire. The study also used these techniques to interview bushmeat vendors. The community chief of Sefwi Aferee (Nana Kwaku Mintah II) served as the first contact person and was very instrumental in helping to build the respondents list for the study. Communities within the forest area that were engaged comprised Adiembra, Asiekrom, Asamoakrom, Bedii, and Sefwi Aferee. Market surveys mainly focused on Sefwi Dwenase, a municipal town in the Western North region with the biggest market center and thriving bushmeat market. The surveys and interviews were to gather information on all aspects of the species' ecology, collection, and uses. These activities were conducted within 20 days over three months.

Transect surveys and trapping were employed to document the occurrence of *Anomalurus pelii* in Suhuma. Surveys used entries from the five (5) fringe communities listed above. The survey team comprised of recruited community members and volunteers to search potential and suitable habitats for the species. Data was captured on foraging activities of the species, inspection of tree holes and estimation of tree diameter and height, suitability of habitat (proximity to waterbodies), and records of human activities. Surveys were conducted parallel to questionnaire surveys and interviews.

Data obtained from key informant interviews (hunters), opinion leaders, community members, and bushmeat vendors were organized and analyzed in Microsoft Excel. Data (vegetation cover, tree height, and closeness to water etc.) from transect surveys was analyzed with raster data layers in ArcGIS software to develop a habitat suitability map for *Anomalurus pelii* in Suhuma.



Figure 1. Project team members conduct a face-face interview with two hunters.

RESEARCH OUTPUTS

Habitat Suitability Analysis for *Anomalurus pelii*

The multicriteria Decision Making (MCDM) modeling produced a map of five (5) suitability classes (**Figure 3**): very high suitability, high suitability, medium suitability, low suitability, and very low suitability. Very high suitability is the area that meets all the favorable conditions in the criteria and very low suitability refers to areas that least meet the conditions. As one moves from the very high suitability to very low suitability area, the favorable conditions in all the criteria drop and this influences the species population and distribution. The very high suitability area is found in the interior of the forest reserve and represents 11.10% of the total forest cover. This means that a small portion of the forest reserve meets the original habitat conditions of Pel's flying squirrel. The rest of the suitability areas represent areas that have been transformed or highly degraded and they are mostly found at the edges of the forest reserve. Human activities such as illegal logging, wildfire, and hunting among others reduce the quality of the forest reserve. This is primarily due to the management regime of the forest reserve which classifies it as a production forest reserve.



Figure 2. A typical tree habitat (with a hole) for the Pel's Flying Squirrel (*Anomalurus pelii*) in Suhuma was recorded during surveys.

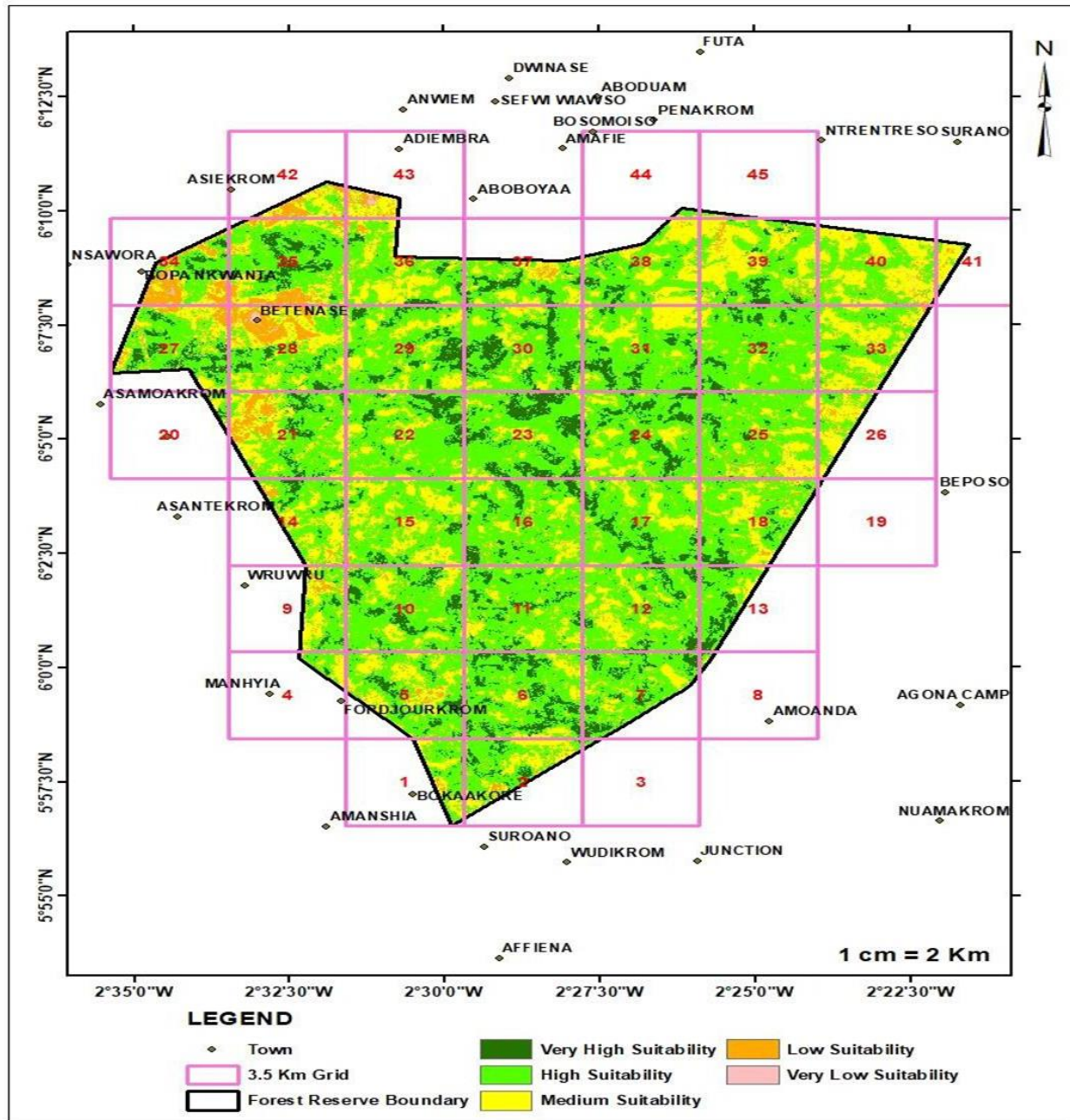


Figure 3. Habitat suitability map for Pel's Flying Squirrel in Suhuma.

Hunter Surveys

Ten (10) hunters from three (3) forest communities (Bedii, Aferee, and Amafie) who have been hunting for more than 10 years were interviewed. Although we interviewed these few hunters, they gave general information about the hunting of the species and covered other hunters that we may have missed in the survey.

All the hunters confirmed the presence of *Anomalurus pelii* in Suhuma. After showing a photo guide to the hunters they confirmed these species to be occurring in the forest: Lord Derby's Scaly-tailed Squirrel (*Anomalurus derbianus*) and Dwarf Scaly-tailed Flying Squirrel (*Anomalurus pusillus*). *Anomalurus derbianus*'s geographic range extends to Ghana while *Anomalurus*

pusillus's range does not extend to Ghana but Liberia. However, IUCN further reaffirms that it is not known if *Anomalurus pusillus* ranges more widely in West Africa than is currently known (Cassola 2016).

The Pel's Flying Squirrel was reported to be found in riverine and hilly areas of Suhuma forest with tall and isolated trees without lianas. Trees preferred by the species include Kyenkyen (*Antiaris toxicaria*), Esia (*Petersianthus macrocarpus*), Esa (*Celtis mildbreadii/Celtis zenkeri*), Ofram (*Terminalia superba*), Emire (*Terminalia ivorensis*), Wawa (*Triplochiton scleroxylon*) and the invasive Ogyama (*Musanga cercropoides*). The hunters reported that during the dry season (November to March), the species frequent riverine areas with tall trees, as these areas provide fresh leaves and succulent tree bark for consumption. The hunters indicated that the peak season for hunting the Pel's Flying Squirrel was the dry season, specifically in February and March when fresh shoots/leaves are sprouting out of the species' preferred trees.

When asked how many species they hunt in a month, the hunters reported that they could hunt 10-50 individuals of *Anomalurus pelii* in a month. Also, when asked about the current population trend of the species, all hunters reported that it was declining. This decline was attributed to the logging activities and hunting pressure in the forest. According to hunters with 30 years of hunting experience, Pel's Flying Squirrel was not abundant in Suhuma until timber logging began extensively in the forest around 20 years ago. The massive logging cleared the forest and allowed for the growth of the invasive *Musanga cercropoides*, which is a preferred food source for the species. Despite their higher abundance at that time, the species was not heavily targeted for hunting until around 10 years ago.

When asked about the uses of the species, hunters reported that the species was mainly hunted for food and trade. The hunters either smoked the carcass or sold the fresh carcasses within their community for local consumption or sold it by the roadside. Some hunters also smoked and stored the meat for bushmeat merchants who came weekly to buy it for sale in nearby towns including Sefwi Bekwai, Sefwi Wiawso/Dwenase, and Juaboso. Local restaurant operators (popularly known as chop bars) and community members in places like Aboanidua, Amafie, and Ahwiaa also purchased the species from hunters. The price of a whole carcass at the time of the survey ranged from ₵25 (£3) to ₵50 (£6), depending on its size and the hunter's relationship with the buyer. Seasonal hunters who engage in bushmeat trade make an average of ₵450 (£54.2) per month, while full-time hunters make ₵1,000 (£120.3) per month from hunting. Some hunters involved their wives and/or children in selling the meat. In addition to its use as a food source, some hunters mentioned that the species' fluffy tail was kept as a trophy. Its gut materials were also used as a medicine concoction due to the herbs it feeds on. The gut materials were either sieved or cooked and consumed as a cure for hypertension.

The most common method reportedly used to hunt Pel's Flying Squirrel was a gun. However, a few hunters resorted to felling down and/or burning the host tree of the species to capture it. Typically, hunting is carried out by a single individual who uses a gun, bullets, cutlass, and a sack to load the carcass. Full-time hunters often lodge in the forest alone (with a gun, bullets, snares for other species, food items, and cooking utensils) for mostly six (6) days to hunt. They often return on Tuesday (market day) when bushmeat vendors come to their homes to buy for retailing.



Figure 4. Carcasses of Pel's Flying Squirrel recorded during interviews with hunters. A: suspected smoked Flying Squirrel; B: Fresh carcass of a Flying Squirrel.

Market Assessment

The market surveys were conducted in the Sefwi Wiawso and Dwenase municipality, the capital of the Western North region. The primary market of this municipality is the Dwenase market which operates on Tuesdays. Traders from eight (8) surrounding districts, as well as individuals from other regions of Ghana, including Ashanti, Bono, Oti, and Greater Accra, frequent the market. With the growth of the region's economy and the demand for market space, a new market has emerged from the main market. The new market is situated at the new Metro Mass Bus station on Nzuonzua road and begins as early as 6:00 am and ends at 6:30 pm. During the survey, the two market centers and a trader of fetish materials were surveyed.

Pel's Flying Squirrel was encountered during market observations. One trader claimed to have sold Beecroft's Scaly-tailed Squirrel (*Anomalurus beecrofti*) in the past. While some traders could not specify, others stated that they could sell more than 15 Pel's Flying Squirrels every week. Except for one trader, all of them reported a significant decline in the population of Pel's

Flying Squirrel. Traders had 10 and over 20 years of experience in the bushmeat trade.

Observations at the Nzuonzua Bushmeat Market

During the survey at 8:15 am, 10 bushmeat vendors were present, all stationed along the dusty road leading to Nzuonzua. Six of them agreed to speak to the survey team. The team observed various species of wildlife, including the Pel's Flying Squirrel, kept in sacks, pans, on tables, and the ground. The processed bushmeat was either smoked or partially smoked and frozen, while fresh and unprocessed carcasses were also present. New consignments of bushmeat were brought to traders in sacks by mostly women who did not respond to the survey team's interrogations. The market women paid them, and they left the scene. Traders handled bushmeat with their bare hands, for both processed and unprocessed carcasses. They were observed eating and drinking without properly washing their hands with soap; most of the time they rubbed their hands on their apparel before proceeding to eat or drink, even for those who were nursing mothers. Occasionally, they fanned off flies with a piece of rug. Some partially processed carcasses were dissected in the market to remove gut materials and intestines, which were either kept in a container or discarded directly into a nearby bush.

Buyers often lifted any carcass they wished to buy (without any handwashing/sanitizing protocol) just to know its weight to the price offered. Before the research team left the scene, about 73 individuals of bushmeat were counted, aside from sacks of carcasses that were not opened for observation and content counting. Some other species identified included the Maxwell's duiker (*Philantomba maxwellii*), Giant African rat (*Cricetomys gambianus*), Greater cane rat or Grasscutter (*Thryonomys swinderianus*), African civet (*Civettictis civetta*), and unidentified primates and mongoose. The survey also identified some specific species, including Black and White Colobus (*Colobus guereza*), Lowe monkey (*Cercopithecus lowei*), Patas monkey (*Erythrocebus patas*), White-bellied pangolin (*Phataginus tricuspis*), Black-bellied pangolin (*Phataginus tetradactyla*), and African grey parrot (*Psittacus erithacus*).





Figure 5. Wildlife observed at the Nzuonzua bushmeat market in Sefwi Wiawso municipality. A: bushmeat packed in a sack; B: bushmeat including the Pel's Flying Squirrel displayed for sale on a table; C: Smoked bushmeat of assorted species.



Figure 6. Pangolins observed on the bushmeat market at Nzuonzua.

Observation at the Main Dwenase Market

This location was highly populated, but vendors were arranged into market sheds based on their trade items. The traders who sold fish, meat, and bushmeat were situated in proximity to a large, refrigerated storage unit within the marketplace. Specifically, there were five bushmeat traders present in the area, each offering significant quantities of well-smoked bushmeat displayed on tables. Adjacent to one of the traders was a popular bushmeat restaurant. Notably, there was no evidence of Pel's Flying Squirrel in this section of the market. All the observed species (based on the present heads and skulls) were either primates or antelopes, and all the bushmeat available for sale in this market was sourced from the Bono and northern regions of Ghana (Savannah zone), according to the traders.



Figure 7. Smoked bushmeat of various species observed on the main Dwenase market.

Observation at the Dwenase Fetish Market

In the heart of Dwenase town, along the road to Sefwi Asafo/Juabeso, a 77-year-old man operated a fetish market. At the time of observation, he had over 300 pieces of wildlife specimens, organized in various forms for sale. In a calabash, he had different sun-dried snakeheads, including those of the cobra (*Naja spp.*), Gaboon viper (*Bitis gabonica*), the royal python (*Python regius*), and rock python (*Python sebae*). Other items included tortoise shells, snake skins, bird feathers (including eagle, owl, and sparrow), porcupine spines, dried chameleons, scorpions, horns and skins of wild ungulates, and pieces of bones, teeth, hoofs of several wildlife species, as well as the skulls of crocodiles, including the slender-snouted (*Mecistops cataphractus*) and dwarf crocodile (*Osteolaemus tetraspis*). Only a fur from the tail of Pel's Flying Squirrel was observed.



Figure 8. Specimens observed at the Dwenase Fetish Market including Left: tail fur of the Pel's Flying Squirrel. Right: Skulls and horns of unidentified mammal species.

Characteristics of the Bushmeat Trade

Based on the survey, it was found that the bushmeat traders selling Pel's Flying Squirrel sourced their supply from hunters and retailers located in fringe communities around the Suhuma, Sui, and Krokosua Hills forest reserves, including Aboboyaa, Bedii, Aferee, Amafie, Sikaneasem, Wansampo, among others. Traders reported that their buyers were mostly from nearby communities within the Sefwi Wiawso municipality, although bushmeat merchants from the Bono region of Ghana also came to buy the Pel's Flying Squirrel for retail. As the Tuesday market in Sefwi Wiawso only occurs once a week, traders explored nearby markets, including Sefwi Juaboso (Wednesdays), Nsawora (Thursdays), Asawinso (Thursdays), and Bekwai (Wednesdays), to sell their products. Some traders also sold Pel's Flying Squirrel carcasses from their homes, primarily to community members. On average, the bushmeat traders invested about ₵800 (£96.3) into their business and earned a monthly profit ranging from ₵500 (£60.2)- ₵850 (£102.3). For traders, bushmeat was a source of livelihood. None of the traders indicated that they sold parts of the Pel's Flying Squirrel for purposes other than human consumption, and the entire carcass was typically sold for an average of ₵51 (£6.2), depending on size, quantity, and the customer's relationship with the trader. The traders also reported that they knew on average eight (8) other traders in their communities. Women were predominantly involved in the bushmeat trade. Occasionally, children of hunters and traders were also involved in processing and selling carcasses.

Conservation of Pel's Flying Squirrel

Perceptions of hunters

The major benefits mentioned by hunters from Suhuma apart from bushmeat were non- timber forest products, including herbs, raffia, and fuelwood. The proceeds from the hunting expeditions and harvesting of non-timber forest products were mainly used by hunters for household expenses, paying their children's school fees, and buying gun bullets. The forest is therefore a livelihood support system for most local people in the region.

The threat associated with the conservation of Pel's Flying Squirrel can be broadly attributed to the lack of national and local conservation by-laws protecting these species. People living within the surroundings of Suhuma rely heavily on bushmeat as a livelihood which poses a great threat to the survival of the species. There was no adherence to the closed hunting season (observed between August 1 to December 1 every year) which is a national law regulated by the Wildlife Division of the Forestry Commission to sustain wildlife population.

None of the hunters interviewed were able to mention any ecological importance or traditional knowledge associated with the species apart from its use for food, medicine, and bushmeat trade. All except one hunter indicated that they would stay away from Pel's Flying Squirrel if there was even a small chance of getting very sick from handling or eating the species. None of the hunters interviewed had a license for hunting, although three (3) of them had a license for possessing small arms. Most hunters indicated an interest in seeing the species protected, feeling that this was necessary to give the species a chance to survive and prevent extinction. The few hunters who disagreed or were indifferent felt that protecting the species would mean a total ban on hunting or consuming it.

The hunters indicated that they would comply with any hunting and trade regulations governing the species if they were aware of them. Finally, the hunters proposed several alternative livelihood interventions (Table 1) in addition to increased education, restrictions on hunting and trade, and logging restrictions, including afforestation in the species' habitat, as key measures to halt the decline of the species.

Table 1. Alternative livelihood interventions suggested by hunters.

Alternative livelihood intervention	Reason for choice of intervention
Beekeeping	-Profitable -It requires minimal physical strength, therefore suitable for me given my age
Any livelihood that fetches money	The financial returns are what matters
Fish farming	-It requires minimal physical strength and is suitable for me given my age. -Profitable
Grasscutter keeping	-Profitable -Requires minimal physical strength would be suitable for me given my age
Raw materials for my side business	I don't have my own materials for my business, so I want to buy my own to maximize profits
Snail farming	-Profitable

Perception of traders

All the traders interviewed did not have any permits for trading in bushmeat. Only three of the traders were aware of the government's annual closed hunting season. None of them could mention any other ecological significance of the species. However, they all agreed on protecting the species based on the following reasons:

- “I want to continue to stay in business”.
- “To ensure the long-term survival of the species”.
- “I don't want my business to collapse”.
- “So that people will get meat to consume, and I also benefit from trading”.

The main use of the income from the bushmeat trade, according to the traders, was used to fund their children's education and their family's upkeep. All the traders interviewed expressed an interest in alternative livelihood support in exchange for halting the trade of the species.

Some of the livelihoods mentioned included soap making, support to start their own business including restaurants, cosmetics sale, and pastries. The traders cited the potential profitability of these businesses as the reason for their interest, as there is a daily demand for their products.

OUTREACH ACTIVITIES

Five (5) educational campaigns were organized in five (5) communities; Adiembra, Asiekrom, Asamoakrom, Bedii, and Sefwi Aferee. Approximately 1000 schoolchildren and teachers were engaged. The educational campaign focused on the conservation ecology of Pel's Flying Squirrel and its plight in their communities. The ecological importance of the species was explained, including its role as an indicator species for seed dispersal and forest regeneration and its significance in the ecological food chain. Threats (both direct and indirect) to the species were

also explained, and emergency conservation action needed for the species' long-term survival was emphasized.



Figure 9. Group picture after an education session with pupils and teachers at Bosomoiso Junior High School



Figure 10. Pupils taking notes at a conservation education session with a cluster of schools at a community center.

CONCLUSION AND RECOMMENDATION

In general, there is a lack of awareness about the conservation needs of Pel's Flying Squirrel among bushmeat actors in the Suhuma forest area in the Western North region of Ghana. The actors also seem to only value the species for the economic benefit that they derive from its utilization. There is an urgent need for interventions towards changing the behavior of local people towards the species. Thus, future research should focus on understanding the perceptions of bushmeat actors on aspects of hunting and utilization of the species; this is to help develop targeted education programs for the various actors. Conservation of the Pel's Flying Squirrel requires an integrated approach that includes law enforcement, promotion of alternative livelihoods, education, and research. These measures will protect the species and livelihoods of local forest communities. Furthermore, the 11.10% of the forest reserve that serves as the most suitable area of the species should be protected from further forest degradation or deforestation. The rest of the suitable areas should be restored through enrichment planting and following the harvesting schedule to ensure compartments that are not due for exploitation are closed for natural regeneration. This will increase the habitat suitability area of Pel's flying squirrel. The hunting and especially trade of bushmeat in the study area also poses threat to public health in terms of the spread of zoonotic diseases due to the unhygienic conditions trade is organized. Future activities should also focus on sensitizing actors about the dangers of zoonoses threat. In fact, some hunters stated that the only reason that will stop them from hunting is if they detect the species can make them sick. In addition to sensitization, this aspect can be studied to frame appropriate conservation messages for education programs.

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