

Understanding the linkage between human food insecurity and lemur population decl...

[Environment](#), [Animals](#)



Introduction

Lemurs are the most imperiled group of mammals on the planet. Despite various conservation efforts, the lemur populations are still struggling to find stability in the tropics of Madagascar. Out of the 103 known lemur species and subspecies, approximately 94% of them face some level of threat.

Therefore, it has become necessary to expand our knowledge of the threats affecting lemurs. Extensive research has been done to prove that deforestation is a strong indicator of lemur population declines because of habitat loss, but minimal research has been directed towards other potential causes. By hyper focusing on deforestation, there is higher risk of ignoring other potential elements. After Madagascar broke off and separated from mainland Africa, isolated evolution took place over the span of millions of years. This created high levels of biodiversity and endemism unmatched by any other country. Maintaining these levels of biological diversity is essential for the sustainability and resilience of entire ecosystems. Lemurs, for example, have important ecological roles of preserving forests through seed dispersal. If they were to go extinct, it would likely trigger extinction cascades of species located throughout Madagascar. Furthermore, these unique species are not found anywhere else on earth, so prevention and restoration actions must be adapted to best fit Madagascar. Unfortunately, loss of biodiversity is not Madagascar's only challenge at the moment.

Poverty may be the foundation that leads to all other subsequent issues.

Madagascar is one of the poorest countries in the world with more than 90% of the population living on less than two U. S. dollars per day. The population

is growing, and this inevitably means more individuals to feed. People are becoming desperate and switching to unsustainable practices of obtaining food for the short-term benefit of human health at the long-term cost of the environment. In addition, there has been less support from the government since the military coup that occurred in 2009. This political instability led to lack of regulation and funding for environmental initiatives, but the newly elected administration is expected to inspire positive change.

Fish Stocks

Because Madagascar is the fourth largest island in the world, there is also a huge abundance of coastline allowing easy access to marine resources. A majority of Malagasy have found livelihoods in the fishing industry. Not only do people depend on marine resources for food security, the oceanic features have even shaped the distribution of the human population. Most of the country's fishers live on the west coast where coral reef and mangrove ecosystems are located, and consequently this region experiences the highest fishing pressures. As a developing country, small scale fisheries are a significant part of subsistence and income, but catches are usually not recorded by national reporting systems. This is a result of both the vessels not reporting catches when unloading at a landing site and the government lacking adequate finances or scientific capacity to perform stock assessments. Therefore, most catch data are incomplete when reported to the Food and Agriculture Organization.

Adding to the discrepancy, catch statistics fail to account for illegal, unreported, and unregulated (IUU) catches as well. Researchers attempted

to reconstruct the flawed data based on expert and local knowledge along with other forms of literature. From these sources, educated assumptions were made for each of the fisheries sectors. They determined that over the 1950-2008 period, the reconstruction adds more than 200% to already reported data. Although reporting improved in recent years, under estimates still have substantial impacts. The reconstructed catch-time series portrays a leveling off of catches and even decline for certain taxa over the last two decades, which could be due to improvement of bycatch handling or overfishing draining the available stock. These results clearly demonstrate errors in past reports that could account for low fish supply. However, it is difficult to quantify the accuracy of these assumptions. Although this reconstruction project was useful for highlighting the significant quantity of missing catch reports, there is still some limitation due to lack of concrete data. Researchers had to estimate the total number of catches based on local knowledge and existing studies. This method can undoubtedly skew the results. A substantial amount of the numbers were calculated according to assumed stability of other years. However, this is not always the case because the numbers could fluctuate during the period of twenty years. Therefore, research that analyzes fishing report patterns of past years may not be entirely accurate, especially with the involvement of illegal activity. Illegal fishers have even more of a reason to try to hide their exact numbers in fear of getting caught. It is difficult to think of an alternate strategy for uncovering missing data, and without an improved monitoring and enforcement system, Madagascar will continue to suffer from the actions of illegal fishing.

Human Food Insecurity

The USDA defines food security as equal access to nutritious food at all times (2017). Incomplete catch data leads to serious over estimation of resource availability, which can be problematic for a country of people that rely heavily on seafood as a source of protein in their everyday diet. Exploitation of the ocean greatly impacts food security, and it does not help that Madagascar still experiences the effects of political turmoil and economic downturn. As a result, local authorities do not have enough power to effectively control fisheries. This allows foreign fleets to illegally fish without retribution or any benefit for the national economy. In addition, tensions between commercial shrimp fleets and local fishers have escalated in recent years, suggesting more resource competition and fishing effort. There is not sufficient attention directed towards small-scale fisheries which represent a significant contribution to domestic food security in Madagascar. There needs to be a more integrated fisheries management system for the future where sustainable small-scale fisheries are given precedence over export-oriented commercial or foreign access fisheries. This is becoming even more relevant now that catches of small-scale fishers are predicted to drastically decline within 10-20 years as inferred from simple interpolation of trends. With accurate catch statistics, the government can develop better legislation to promote sustainable maritime endeavors. Most studies of fish stock related food insecurity fail to mention how the local people are responding to this crisis. It is evident that fishers adopt increasingly destructive practices of fishing, but unclear how other people are reacting, especially those that live on the east coast where fishing is less prevalent. Are they forced to turn to

alternate sources of protein in hopes of maintaining healthy levels of nutrition?

Lemur hunting

Hunting bushmeat is a common activity that occurs during times of low food security. It is a tactic used by developing countries to compensate for diminishing amounts of domestic protein, such as livestock or fish. The Malagasy people also turn to forest resources for subsistence in times of desperation. The research associated with wildlife hunting has recently expanded to improve understanding of this practice from both conservation and socio-economic perspectives. Although lemur hunting is prohibited, there is growing evidence that hunters operate illegally inside national parks. Researchers used structured interviews and direct observations to obtain information about the species hunted, the frequency of hunting, trapping methods, and income generation. Data were collected on both the consumer and producer sides of the bushmeat industry to determine that bushmeat accounted for 10% of the total meat consumed. However, this percentage is probably much higher in reality because of people not telling the truth to avoid getting in trouble for illegal hunting or disrespecting tradition. Taboos, known as fady, tend to limit the consumption of some wildlife that is deemed culturally significant, but the degree of this long-term protection is decreasing according to local monitoring data.

Other studies look at the harvest sustainability of hunting wildlife. According to research conducted by Christopher Golden, hunting of lemur species is most likely unsustainable based off of the maximum harvest rate quantified

from life history information (2009). Lemurs are more prone to the effects of hunting because they are primates, which means they do not reproduce as often and generally have only one offspring at a time. Hunting of protected species is widespread as demonstrated by the high prevalence of households consuming bushmeat. These results could give insight into how to best plan the addition of protected areas in Madagascar by switching the focus from fragmentation and deforestation to commercial and subsistence hunting because they are major threats to wildlife persistence. None of the above is possible though without the endorsement of the local people. Once the Malagasy people become invested through economic incentive, conservation efforts are more likely to be successful. For example, sanctions must be communicated and implemented if illegal hunting is to be reduced.

Eco-tourism is another promising approach that encourages conservation while at the same time alleviates poverty because the local people will realize the value of protecting rare species. Studies that depend on word of mouth as the main source of data are not always completely reliable, especially when the activity of interest is illegal or socially unacceptable. However, new forms of interviewing have decreased this experimental error. Researchers have adopted a specialized method for investigating sensitive behaviors, known as the randomized response technique or RRT. By not asking individually identifying information and guaranteeing confidentiality, researchers embolden respondents to reveal participation on sensitive behavior. Interviews using RRT compared to direct questions proved to have significantly higher estimates of bushmeat consumption in communities

surrounding a protected area. These results further add to evidence that hunting of protected species exists at numbers higher than expected, and more informed action needs to be taken to save the depleted biodiversity of Madagascar. Informed action is possible because RRT improves the research by reducing both non-response bias and social-desirability bias, ultimately removing the downward skew on estimates of illegal hunting in order to overcome limitations of past studies.

Despite new interviewing techniques, there still remains the concern of having a completely random sample of the population. Extending the sample size could increase statistical accuracy because previous studies focus on specific regions of Madagascar, which might not be characterized the same as other regions.

Lemur Conservation

Conservation efforts to protect lemur populations emphasize the implementation of nature reserves. These projects are restricted by lack of context on human-animal interactions in the forests of Madagascar. It is challenging to identify priority areas for new reserves without understanding the effects of cultural disturbance on lemur distribution and abundance. Researchers use geographical information systems (GIS) to evaluate a rapid fauna survey and habitat modeling. Statistical procedures were applied to natural and cultural environmental variables at 64 stratified survey sites to distinguish areas at low risk of disturbance. Lemur diversity was most strongly affected by habitat clearing and human disturbance, which included harvesting, stock grazing, and hunting, within 8 km of villages. The study

indicates that protected areas should be surrounded by buffer zones of up to 4-8km in width to minimize human impact. The article points out that some species of lemurs are more tolerant to disturbance than others but does not go into detail to explain why. This study needs to be updated since it occurred over 20 years ago and does not incorporate assessment of new nature reserves.

A more recent study recommends continued monitoring and accumulating survey data at finer scales and across broader habitat gradients. There is always potential for experimental error during fauna and habitat survey methods, especially when working with nocturnal species that are difficult to detect.

Synthesis

When evaluating the research on wildlife hunting, the motives seem to be overlooked in most studies. It is interesting to note that most people prefer eating domestic animals and fish as sources of protein instead of bushmeat. In fact, “ few respondents preferred wild meat (8+/- 3%) but most had eaten it at least once in their lifetime (78 +/- 7%)”. So why are people eating bushmeat if they do not like it? The answer depends on whether price or taste plays a bigger role in protein choice. However, there are many factors that affect the price of meat sold at markets. A comparison between low fish stocks and lemur hunting could reveal an indirect relationship linking the two fields of protein accumulation. It has already been discovered that underreported catches have increased resource competition and fishing effort beyond sustainable yields due to inaccurate predictions of fish stocks.

Much of the subsistence sector is absent from the official statistics, and signs of decline have already been observed in many stocks adding to the unavoidable food insecurity of Madagascar. Reaching a plateau in terms of total catches can be problematic when the population continues to grow at a rapid rate. There are less fish available, so prices are raised to balance the supply and demand, but people cannot afford to pay these elevated prices. Therefore, they turn to other forms of protein that are more affordable and accessible in order to prevent malnutrition.

Findings support the hypothesis that more food insecure areas reported higher rates of wild meat consumption. This is especially convenient when humans live near wild habitats. Patterns of wild meat consumption in Madagascar vary over large spatial scales and across different ethnic groups. "Data were collected on the consumption of wild and domestic meat only, not that of fish and non-meat proteins". Inclusion of fish data could be essential to finding a better correlation between food insecurity and lemur conservation. Over 64% of respondents admitted they ate lemurs due to insufficient food resources. These models of meat consumption do not include all influencing factors. Does this pattern persist when adding fish as a variable to the study? Fish supply could be inversely related to the hunting of lemurs. Understanding the extent of this relationship could provide new insights and solutions that reduce threats to lemur populations.

Literature Gaps

In a study that incorporates a wider range of factors that influence wild meat consumption, results showed that poverty, poor health, and child

malnutrition were the leading predictors of lemur trapping. These three factors are all associated with food insecurity. This study actually does include extraction of marine products into their analysis, but once again interviews are not the most reliable method for data collection. This qualitative method has more potential for bias and a less randomized sample. Interviews are more appropriate for small sample sizes, and consequently, do not reflect the overall response of a larger population. In addition, the researchers combined variables of alternative animal foods into one confounding group that depicts mild association with the decision to trap lemurs. The authors fail to address the connection between fish supply and human food security. Therefore, it may be advantageous to collect data using a quantitative method and to narrow the focus of protein source to only fish stocks for a more in-depth analysis. As previously mentioned, fish supply is directly related to human food security, so it is logical to start with the root of the cause. However, there is minimal empirical evidence to support this assumption at larger geographic scales in Madagascar.

Based on a parallel study in Ghana, it may be more effective to look at spatial and temporal trends in correlations of fish stock and wildlife declines. This research examined the protein limitation hypothesis by comparing annual rates of population decline for 41 species in six nature reserves with supply of fish in the region from 1970-1998. Their findings supported the hypothesis because annual biomass of terrestrial mammals from 1970-1998 were closely linked to annual per capita fish supply. In contrast, fish supply and wildlife declines were unaffected by other explanatory variables used as

controls in the experiment. To further prove their prediction, the researchers conducted an observational study to determine that annual counts of hunters spotted by wildlife rangers in five nature reserves in Ghana were negatively related to per capita fish supply from 1976 to 1992. They also tested for evidence of harvest pressure transfer from aquatic to terrestrial resources by looking at sales and price data from local markets. The results suggested that bushmeat sales were greatly influenced by fish availability and price. These quantitative methods provide a more objective outlook on the data and can be easily replicated to assess lemurs in Madagascar because there is less chance for ambiguity of interpretations. If a similar relationship does exist, then it would be imperative to shift management policies to sustainable fishing in order to conserve endemic lemur species. Thus, the purpose of this study was to identify a stronger connection between low fish supply and lemur population declines in Madagascar.