Supporting Information

Wildlife Consumption Surveys

Semi-structured interviews were conducted annually in 641 households from 2007-2011 throughout both Makira and Masoala. These communities were chosen to represent the region's geographic and cultural diversity. Villages were grouped by previously established travelling or trade routes and then randomly cluster-sampled. Households within selected villages were identified for surveys using systematic random sampling techniques and were recruited over a period of several years starting in 2004.

With regard to wildlife consumption, interview questions attempted to quantify annual rates of consumption of each mammal species of concern (Golden et al. 2013 for methods). In our subsequent analysis of consumption, only the common tenrec, *Tenrec ecaudatus*, and the bush pig, *Potamochoerus larvatus*, were considered legally hunted game species. Because snares and traps are illegal means of harvesting in Madagascar, *P. larvatus* harvest was only legal in 11% of cases (unpublished data). Hunting of the hedgehog tenrec, *Setifer setosus*, also was conducted illegally because a government-issued permit is required for legal harvest (Rakotoarivelo et al. 2011). We estimated that at least half of tenrec hunting occurred at night, when they are active, and thus half of the hunting of the common tenrec, *Tenrec ecaudatus*, was illegal (Rakotoarivelo et al. 2011). Hunting of all bats in this study area was also illegal because the use of nets and hunting after dark are illegal (Rakotoarivelo et al. 2011). All lemurs are illegal to harvest throughout Madagascar, whether inside or outside of a protected area (Rakotoarivelo et al. 2011).

During semi-structured interviews, we asked the head of household to quantify household characteristics and the dynamics of wildlife harvest in the study area. Annual household cash income was measured by adding the value of products sold, wages earned and items bartered but did not include the subsistence harvest or consumption of other provisioning services (e.g. crops, tubers, honey, wood for construction, etc.). We also obtained estimates of the total number of individual animals of each of the 23 locally-occurring mammal species that were consumed by the household during the previous year (Golden 2009, Golden et al. 2013). Total harvest for each village was then determined by summing the harvest of each wildlife species for all surveyed households and extrapolating to the total number of households within sampled villages. A range of total biomass harvested for each species was calculated by multiplying the extrapolated total annual harvests of each species by the midpoint of the range of adult body mass (Garbutt 2007). Use of adult biomass may have produced a slight overestimation of total biomass harvested as not all individuals were adults.

Although much of the reported wildlife harvest is illegal, we are confident that the prices and reports are accurate because of our long-term presence in these communities, with assistants living in and visiting sites throughout the year. We used a conversion rate of 2,000 ariary per dollar to convert local prices to US dollars. Though currency exchange rates fluctuate widely, the price of wildlife in local Malagasy currency remained stable during the study (unpublished data).

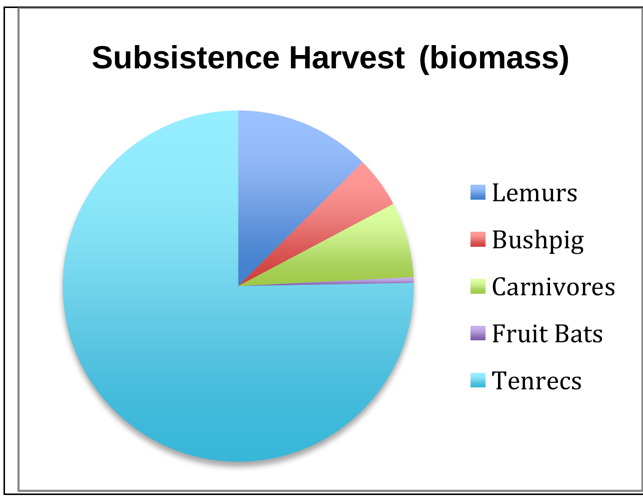
Assumptions and limitations of the analysis

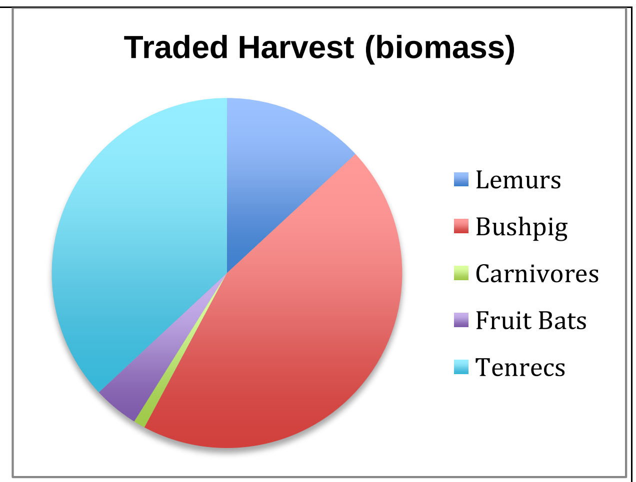
A) Imputing value from demand

The statistical model for estimating the demand for bushmeat is based on several assumptions. First, we assume that willingness to pay for bushmeat in market transactions is indicative of the value of all bushmeat that is consumed: both what is and is not traded. Economic theory suggests that if a) the transactions costs are low, b) the market is competitive (i.e., many independent hunters) and c) there are many consumers, then the market-clearing price is "efficient"; i.e., the marginal cost to the producer is equal to the marginal benefits to the consumer. Under these conditions, surplus value (profit and consumer surplus) is maximized and the allocation of bushmeat is said to be "Pareto optimal". The marginal cost to the producer is inclusive of both the cost of hunting as well as the opportunity cost of foregoing consumption. Therefore, the market demand curve represents the value of the harvest.

However, the bushmeat market is atypical for economic analysis in that it does not often "clear": quantity harvested is greater than the quantity demanded. This is partly attributable to stochastic environmental effects that make the harvest quantity less predictable to hunters, who have to pre-determine rates of effort, and may end up with surpluses. In addition, the supplier's are often malnourished and living in extreme poverty; their primary objective is usually subsistence and not trade. When the hunters choose to consume rather than sell their harvest, it suggests that they derive greater benefit from the harvest than the market price, and therefore the market demand curve is an underestimate of true value.

A second important assumption that we make about demand is that the primary purpose of bushmeat is the utility derived from consumptive nutrition, and therefore we can aggregate bushmeat from different species into a single indicator of biomass. The figure below shows that there are differences in the composition of meat by taxa between subsistence harvests and bushmeat trade. Tenrecs comprise the largest portion of meat that is hunted for consumption, while bushpig is the most commonly traded meat. However, there is little evidence to suggest that tenrecs are valued differently than bush pigs when standardized by weight. The observed market price of bushpig (0.97 USD/kg) is in between the observed market prices of the two species of tenrecs (3.92-6.72 USD/kg for *S. Setosus*, 0.24-0.48/kg USD for *T. ecaudatus*). While bushpig constitute a smaller portion of the total subsistence wildlife than traded wildlife, the majority of bushpig is hunted for subsistence like the other taxa. The main difference between the pie charts is simply that many more tenrecs are caught than sold. We suggest that this pattern should be attributed not to differences in the benefit of the animal-source food, rather to differences in the transaction costs: bushpig is easier to sell in the marketplace because it can be easily subdivided and sold.





B) Instrumental Variables

If the explanatory variable (price) is truly independent of the response variable (quantity demanded), then a simple ordinary least squares regression would suffice for estimating wildlife demand with equation 1. However, these variables are unlikely to be truly independent. In market transactions, prices are thought to be determined by both supply and demand. This can cause simultaneity bias and confound statistical inference (Wooldridge 2002). To overcome simultaneity bias we used a generalized two-stage least squares (G2SLS) method (Wooldridge 2002, Bonds et al. 2012).

The critical feature of an IV is that it is correlated with the endogenous explanatory variable (i.e., $P_{i,t}$), but is not independently correlated with the dependent variable (i.e., $Q_{i,t}$) in the demand function (Bonds et al. 2012). We consider $S_{i,t}$ to be a good IV because it reflects the distance-weighted total supply of wildlife from the perspective of a given household, but the influence of purchases of any given household on this indicator is negligible. While $S_{i,t}$ or $M_{i,t}$ are the most plausible instruments available, if they are independently correlated with demand – e.g., because of geographically-determined preferences for wildlife – they would not qualify as IVs. Based on contextual information and preliminary analysis, there is no indication that these IVs are correlated with demand.

For the instrumental variables to be valid they must be both "relevant" and "excludable" (Wooldridge, 2002; Bonds, 2012). Relevance requires that they are correlated with the price index. Excludability requires that they are not independently correlated with demand. The first assumption is tested in the first-stage regression. Table 2A indicates that both the park dummy variable and the regional supply variable are statistically significantly correlated with the prices faced by each household. The second assumption of excludability is stronger because it is not fully testable. Our analysis assumed that the main difference between the two parks is the density of wildlife populations. However, it is possible that there are differences in the demand for bushmeat due to ethnic differences or from the differential history of conservation. To ensure the robustness of our results, we ran a variation of the analysis that excluded the park dummy variable. The table below (column a) shows the results of an analysis that uses only the distance-weighted wildlife consumption variable as an IV.

First-Stage Regression Dependent Variable: ln(Price) for household *i* in year *t*		
Independent Variable	**Parameter Estimates a.**	**b.**
Park Dummy, λ_1	-- -----	**-0.38*** (0.13)**
ln(Regional Supply), λ_2	**-0.40*** (0.07)**	**-0.47*** (0.08)**
Constant, λ_0	**8.37*** (0.43)**	**8.91*** (0.46)**
Standard errors are presented in parentheses below their corresponding parameters estimates; *n* = 232. ***Significant at the 1% level;		

Second-Stage Regression Dependent Variable: ln(Quantity) in kilograms of wildlife		
Independent Variable	**Parameter Estimates a.**	**b.**
Imputed Price, β_1	**-1.33*** (0.22)**	**-1.12*** (0.17)**
Constant, β_0	**10.26*** (1.31)**	**8.98*** (1.02)**
R^2	0.33	0.33
Standard errors are presented in parentheses below their corresponding parameters estimates; *n* = 232. ***Significant at the 1% level.		

Notice that the results are nearly identical for the first- and second-stage regressions, whether or not the park dummy is used as an IV. Also note that for both estimations, the distance-weighted wildlife variable is negatively correlated with the price: i.e., price falls where consumption rises. This is a strong indication that the regional consumption variable represents changes in the supply of wildlife. If variation in the regional consumption of bushmeat were due to demand factors, then the coefficient would be positive instead of negative.

Traditional ecosystem service valuations

Harvest area was calculated as a circle surrounding a community center, with a mean radius of 4.4 km, determined by hunter reports of either distance or time travelled to actively hunt or passively trap lemurs (see Golden 2009 for details). We used geographic information systems (ArcGIS v. 9.3) to obtain the total forested area within the maximum radius, hereafter called the "harvest area"

(Fig. 1). We did not include other habitat types besides forest since the majority of mammal species included in the analysis (i.e., lemurs, carnivore species, etc.) are heavily forest-dependent (Irwin et al. 2010). Combining these estimates of harvest area with recorded harvest rates provided a dollar value of production per hectare which is a common unit of comparison in ecosystem service analyses (e.g., Kremen et al. 2000). When the harvest areas of adjacent communities overlapped, the area was not double counted, but, instead, the combined value of wildlife biomass of communities with overlapping areas was calculated and then adjusted based on the size of the harvest area shared by adjacent communities. We extrapolated only to community harvest areas and not to the entire area of the Makira as the majority of central Makira is unhunted because of lack of settlements and traveling paths.

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