hours observing which species visited manduvi trees, and whether they removed fruit. This part of the study revealed that by far the bird that most frequently visited manduvi trees and removed fruit was the toco toucan (*Ramphastos toco*). Toco toucans made up 64% of all visitors to the trees, and committed 86% of the fruit removal. These toucans therefore have the most opportunity to spread manduvi seeds away from their mother tree.

The importance of seed dispersal to the macaw's ecology was assessed by finding the location of manduvi seedlings around current nest sites. The distance from each seedling to the nearest adult tree was measured, indicating that most seedlings were located near adult trees. More than 50% of all adult trees, however, were greater than 30 m from each other. Pizo and his colleagues concluded that manduvi seeds are most likely to grow into suitably large trees only if they are dispersed away from other trees. Additionally, Pizo's team found that there is typically 30 m between trees that have been colonised by the macaws, indicating the birds' preference for a bit of isolation from their neighbors.

To determine which species were entering hyacinth macaw nests and eating eggs, Pizo and his assistants monitored over 300 nests for five years. Blame for any harm done to the nest was assigned based on actual observation of the act, feathers or other signs left behind, or by the occupation of the nest by another animal.

In addition to the usual suspects of jays, opossums, and coatis, toco toucans emerged as an unexpected predator. Overall, 23% of the eggs that were monitored were destroyed by predators. Among the destroyed eggs, toucans were responsible for half.

The authors conclude that any efforts to conserve the hyacinth macaw must address its ambiguous relationship to the toucan. In the short term, toucans are a major source of mortality, while in the long term they promote the creation of new habitat. The fate of the macaw is therefore intricately tied to the toco toucan. Based on their experience, Pizo and his colleagues encourage other researchers and managers to be aware of the consequences of such complicated interactions.

Further reading:

The hyacinth macaw:
http://en.wikipedia.org/wiki/Hyacinth_macaw
Parrots:
http://en.wikipedia.org/wiki/Psittacidae
The IUCN Red List:
http://www.iucnredlist.org/details/142575
The Pantanal:
http://en.wikipedia.org/wiki/Pantanal

Summarised from:

Pizo, M.A., C.I. Donatti, N.M.R. Guedes and M. Galetti. 2008. Conservation puzzle: Endangered hyacinth macaw depends on its nest predator for reproduction. *Biological Conservation* 141: 792.

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Bushmeat Biometrics

Biologists Take a Critical Look at How Bushmeat Hunting Should be Assessed

Nathan Brouwer

Wild game is a major food source for many people in the tropics. Rural population growth and an increasing urban demand for meat have made hunting a major threat to biodiversity. Most researchers investigating this problem assume that the impact hunters have on wildlife is somehow proportional to the amount of time and effort they exert in hunting. But how do you calculate their effort? According to Janna Rist and her colleagues from London's Zoological Society and the Imperial College of London, different researchers employ a myriad of methods. In order to gauge hunting effort and derive impacts on wildlife, different calculations may integrate days spent hunting, distance traveled while hunting, or distance traveled to a hunting location.

With so much variation in how, where, and what is hunted, Rist and her colleagues question whether there is a consistent relationship between the time hunters spend in the field and the number of animals harvested. After evaluating numerous studies, they found that the significance of these potential sources of variation has not been assessed. From the literature, the authors identified nine assumptions

that commonly occur in the bushmeat literature. They then formulated these into hypotheses, that they tested with data from an intensive 15-month study of hunting in West Africa (Table 1).

The study was based in Midyobo Anvom, a remote jungle village in Equatorial Guinea. Most hunters work from camps located up to 13 km from the village; the rest hunt within a day's hike from home. Wire leg snares and neck traps of various sizes are located in trap groups around the camp; a few hunters also used guns. Hunters leave the camp each week to sell game to traders from the regional capitol of Bata.

Rist or her assistants observed 225 hunting trips, recording every detail. They timed the durations of all aspects of the hunt, including travel to hunting camps, active hunting, and resting. They also recorded the time it took to remove animals from traps or retrieve animals that hunters had shot. Different types of traps catch different animals, so the number and proportion of each trap type was noted. The identity of every animal killed, whether it was useable for food or not, was also recorded.

Of the nine assumptions, Rist and her colleagues rejected four of them outright (Hypotheses 1, 4, 7, 8). Many researchers assume that the amount of time spent actively hunting is proportional to the total time spent away on a hunting trip (Hypothesis 1). The number of days or hours spent out hunting can therefore be used to calculate the impact of the hunters. Rist's data, however, indicates that the time spent actively hunting varied with the distance of the camp from the village. Similarly, it is often assumed that the time spent checking traps is always the same for all hunters (Hypothesis 2). In the field, Rist found that hunters based in the village spent 10% less time checking their traps because they spent more time travelling from home to their hunting sites than hunters based from camps. Another common assumption is that hunters always use the same number of traps, and the same portion of trap types (Hypothesis 7). In fact, Rist's data indicates that hunters use different mixes of traps at different locations in the forest. Finally, researchers often assumed that traps are not species-specific (Hypothesis 9). Rist, however, found that leg and neck traps target different species.

Only two common assumptions were found to be true in this study (Hypotheses 3 and 5). As many researchers assume, the handling of prey does not take up much of a hunter's time. It is therefore not necessary to account for handling time when calculating hunting effort. It is also assumed that the number of traps set by hunters does not vary between hunting sites. Rist's data supports this, making it acceptable to estimate hunting effort from the number of trap groups set without knowing the exact number of traps. The remaining three hypotheses had equivocal evidence (Hypotheses 2, 6, and 9).

Through their literature review and their detailed study of this African hunting system, Rist and colleagues have been able to systematically identify sources of bias in bush meat studies. Information on the activities of hunters is relatively easy to collect and is therefore a popular tool for assessing the impact of bushmeat hunting. Rist's detailed fieldwork will help future researchers collect data that accurately translates into impacts on prey populations.

Table 1: Hypotheses tested by Rist *et al.* (2008: 2092)

	Common assumptions / hypotheses in bushmeat literature	**Conclusion**
1	The time spent checking traps is a consistent proportion of the total time spent on a hunting trip	Rejected
2	Hunts all last the same amount of time	Mixed support
3	The time spent removing animals from traps, or retrieving them after they have been shot, does not represent a significant amount of time	Accepted
4	Hunters spent the same portion of their time checking traps on every hunt	Rejected
5	The number of traps set in a group does not vary between location	Accepted
6	The length of a hunt or the time spent checking traps depends on the number of traps in a trap group	Mixed support
7	Hunters always use the same number of each type of trap	Rejected
8	All species are caught equally by all trap types	Rejected
9	Few animals go to waste	Mixed support

Trap groups are a set of traps set by a hunter in the same area of the forest

Summarised from:

Rist, J., M. Rowcliffe, G. Cowlishaw and E.J. Milner-Gulland. 2008. Evaluating measures of hunting effort in a bushmeat system. *Biological Conservation* 141: 2086-2099.

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