

NEWS AND VIEWS

PERSPECTIVE

Bushmeat and bycatch: the sum of the parts

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In many developing countries, the killing of wild animals for commercial purposes (the bushmeat trade) is a significant factor in the reduction of biodiversity, and probably represents a major threat to the survival of many more populations than we know. This includes marine species such as cetaceans, sea turtles and sirenians ('marine bushmeat'), which are often neglected in the discussion of this issue. Estimating the impact of the bushmeat trade anywhere is problematic because even the most thorough visual surveys of meat markets cannot easily translate an observed quantity of butchered products into the number of animals killed. In this issue of *Molecular Ecology*, Baker *et al.* provide a powerful new tool for such assessments: molecular identification of commercially available products from a depleted population of minke whales in South Korea is combined with genotyping and novel capture–recapture methods to estimate not only the number of individuals taken, but also the persistence of the resulting products in the marketplace.

As human populations continue to increase and the ability of traditional agriculture and fisheries to maintain an adequate food supply is overwhelmed, people in developing nations are progressively turning to wild sources of meat for sustenance, with often devastating impacts on local wildlife (Milner-Gulland *et al.* 2003). For most areas, there is no reliable estimate of the scale of this problem. This is partly due to a lack of observer effort in much of the dauntingly large range of places where the bushmeat trade occurs. In countries where surveys are conducted, assessment of the impact on populations has been hampered by an inability to determine the number of animals killed: not all outlets can be monitored, and it is impossible to count animals after butchering.

This is where the Baker *et al.* study offers hope. Previously, these authors had used molecular techniques to determine the species identity and origin of cetacean products found in Japanese and South Korean marine markets (Baker *et al.* 1996). Results included species not taken in whaling operations, or not legally exportable under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (in one notable case, meat from a rare blue-fin whale hybrid killed by Icelandic whalers was identified in Japan; Cipriano & Palumbi 1999).

In their latest study, Baker *et al.* focus on minke whales in the Sea of Japan (known to Koreans as the East Sea). They obtained 289 samples of minke whale meat from South Korean markets over a 5-year period, and used a combination of mitochondrial haplotype, sex and microsatellite-based genotyping to determine that the products originated from 205 individuals. They then used a capture–recapture technique to estimate that 827 minke whales (CV, 0.20) had passed through the markets between 1999 and 2003 – a number that is considerably larger than the 458 reported by South Korea to the International Whaling Commission (IWC) for the same period. Furthermore, the authors' estimate itself may be too small: they model various sources of potential bias in their data, and conclude that all but one would negatively skew the resulting estimate.

Importantly, the study goes one step further than simply estimating removals. The authors note that the availability of products from an individual animal diminishes with time as the butchered parts are sold, in a manner analogous to the decay of radio-isotopes. Again using the capture–mark–recapture model, they estimate that the 'half-life' of minke whale products in their South Korean market surveys was about 1.8 months. This information is critical, because it can be used to determine the effective frequency with which markets should be monitored to give the most accurate survey results (Fa *et al.* 2004).

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Fig. 1 Many cetacean species continue to be killed for food, despite nominal protection in many countries: Melon-Headed Whales ready to be sold for meat at a market in West Africa. Photo credit: Koen Van Waerebeek.

The study's findings are of considerable significance for Sea of Japan minke whales. Known in IWC parlance as 'J stock', this population has long been the subject of concern. Genetically distinct, J stock whales were hunted until the IWC passed a moratorium on commercial whaling in 1986, but have since been subject to high mortality from entanglement in fishing gear. Nominally, this is labelled 'by-catch', although in both Japan and South Korea it is legal to kill and sell whales caught in nets as long as the event is officially reported. This regulatory permissiveness is thought to have created a huge problem: given that fishermen can reportedly make up to \$100 000 from the sale of a single minke whale—many times their average annual income—there is a powerful incentive to undertake what might be termed 'directed entanglement'. Indeed, some view this as a modern resumption of traditional net whaling, which in Japan dates back to at least the 16th century. In addition, genetic analysis suggests that some portion of J stock disperses to the southern and eastern coasts of Japan; there, the whales face additional risk from Japanese 'scientific whaling', which kills 50 minke whales a year in this region. The finding that the officially reported catches greatly underestimate the true mortality in South Korea underscores the need for urgent action to conserve this population. At the current high levels of take, the outlook for J-stock minke whales is bleak indeed.

Not only have Japan and South Korea done nothing to address this specific problem, but Japan has consistently refused to include market monitoring in any whaling management programme. Movement towards a resumption of commercial whaling is currently stalled in part through disagreement over the IWC's 'Revised Management Scheme' (RMS), which constitutes the set of controls and inspection procedures that would accompany any lifting of the moratorium (Clapham *et al.* 2007). Although both Japan and Norway have established DNA registries to archive reference material from legally killed whales, both

have resisted independent international oversight of these databases, and have taken the position that market monitoring is outside the IWC's jurisdiction. Yet the Baker *et al.* study provides further evidence that the by-catch issue is too large to be ignored, and that management of whaling and the RMS must incorporate this source of mortality. Market monitoring may be the only way to assess the full toll of by-catch, poaching and legal whaling.

The focus of the current paper on a marine species is significant. In some developing nations, there are indications that hunting for wild terrestrial mammals increases following declines in local fisheries (Brashares *et al.* 2004). However, often overlooked is the fact that such terrestrial hunting is either preceded or coincident with increased exploitation of marine wildlife. With the introduction of virtually indestructible nylon fishing nets in the 1960s, incidental catches of cetaceans, sea turtles and other marine fauna rose exponentially worldwide; while initially discarded by fishermen in some nations, these animals were subsequently sold as by-catch, then ultimately became the targets of directed hunting as fish landings plummeted. Market surveys conducted in several South American and West African coastal nations found that the sale and consumption of cetacean and sea turtle products is common (Van Waerebeek *et al.* 1997, 2000; Fretey 2001). Indeed, the main anthropogenic threat to six sea turtle species, three sirenians and an undetermined number of cetaceans may well be the bushmeat trade. Yet these species often slip between the cracks because of disagreement regarding whether they fall under the jurisdiction of either fisheries or wildlife managers.

As Milner-Gulland *et al.* (2003) note, extensive sampling of markets is urgently required to assess the scope of the bushmeat problem. Baker *et al.*'s study is a critical development in this regard, since their genetic and analytical techniques can be applied to products collected anywhere. They offer scientists and managers a means to determine how many animals are killed in this trade, and thus to begin to assess its impact.

Such knowledge cannot come soon enough for most affected populations—including minke whales in the Sea of Japan. It is time for the conservation community to recognize the concept of marine bushmeat, and to urgently implement research aimed at assessing the scope of this problem.

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