Scavenging birds and ecosystem services

Experience from Germany

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Abstract: Scavengers play an important role in ecosystems. Their obvious service for public health is well known at least in developing countries: In terms of ecosystem services they remove rotten meat and bones and in doing so prevent serious diseases in people and livestock. Vulture decline and its negative effect on economy, public health and culture has well been studied in the case of India. One major effect was that rabies spread as carrion was no longer consumed by birds but by mammals. So there is good evidence on the importance of vultures as scavengers. However, vultures are mainly extinct in industrial countries like Germany or China after prosecution and lack of food. Extinction of vultures occurred at least 200 years ago. Rabies was a major risk to public health in Germany until the disease was eradicated by vaccinating foxes. Without competition by vultures and without rabies causing death among foxes, their population increased tremendously and foxes are now regarded as a threat for ground breeding birds. Whereas Germany interferes in the carrion food web again by vaccinating foxes and causing more negative effect, India sees to eradicate the reasons for vulture decline such as banning the use of Diclophenac in animal husbandry.In the NECROS project of BTU Cottbus (Germany) the fragmented remaining food web based on carcasses is studied. Road kills of game, mainly roe deer and wild boar, are deposited in a nature reserve to carry out field experiments. Carcasses are monitored by automatic cameras. One of the main research aims is to find out what happens to the carrion food web with only some vertebrate scavengers around and no vultures at all. Results show that compared to complete ecosystems with large predators and vultures, the rudimentary food web based on carrion in Germany cannot provide the desirable ecosystem services.

Keywords: ecosystem services; scavenging birds; carcasses; vultures

1. Introduction

1.1. Ecosystem service

Ecosystem services are natural processes that benefit humans. The United Nations Millennium Ecosystem Assessment distinguishes four principal types of ecosystem services (WHELAN et al. 2008):

- Provisioning services, such as production of fiber, clean water, and food;
- Regulating services, obtained through ecosystem processes that regulate climate, water, and human disease;
- Cultural services, such as spiritual enrichment, cognitive development, reflection, recreation, and aesthetics;
- Supporting services, which include all other ecosystem processes, such as soil formation, nutrient cycling, provisioning of habitat, and production of biomass and atmospheric oxygen.

Birds play many roles in ecosystem, such as predators, pollinators, scavengers, seed dispersers, seed predators and ecosystem engineers (WHELAN et al. 2008). Birds take part in all the four kinds of ecosystem service.

1.2. Scavengers in ecosystem service

There are numerous sources of mortality which cause nonpredatory death: death due to old age, malnutrition, disease, parasites, accidents, exposure, and catastrophic events; collisions with human-built structures, collisions with automobiles, poisoning, and pollution (WHELAN et al. 2008). If sufficient scavengers exist, nonpredatory carcasses will be consumed. But if large obligatory scavengers are absent, carcasses will not be consumed as quick as possible with bacteria dominating the process of decomposition.

Among vertebrate scavengers, vultures are essentially obligate scavengers which are significant spiritually, economically and environmentally. They have historically played a very important role in environmental health, by disposing of animal and human remains (PAIN et al. 2003, GREEN et al. 2004, MARKANDYA et al. 2008). Compared to other scavengers, vultures have high mobility, the flight maximize rapid carrion detection. They can finish the carcasses effectively and efficiently (WHELAN et al. 2008).

In India and elsewhere vultures have important role in culture and religious significance (PAIN et al. 2003). For thousands of years and in different parts of world, hu-

mans have laid out their dead for consumption by scavengers. By consuming the dead person, birds literally take the soul of the deceased to heaven.

1.3. Vulture declines in India

Vultures help to dispose cattle carcasses in areas where beef eating is forbidden (RODRIGUEZ & BEARD 2005). The acidic condition in the stomach of Gyps Vultures can kill many pathogenic bacteria, such as anthrax, and reduce the risk of disease spread (PAIN et al. 2003). They also help the Parsees to remove human corpses from traditional sites of "laying to rest" (RODRIGUEZ & BEARD 2005), which are called "towers of silence" (PAIN et al. 2003).

However, there was a sudden and drastic decline of vulture population in India. The use of the drug diclofenac in livestock was the cause of that decline (GREEN et al. 2004, SWAN et al. 2006). Livestock was the main diet of vultures in India (RODRIGUEZ & BEARD 2005). Diclofenac is a common drug against pain and inflammation (KRAWCZYNSKI & WAGNER 2008). Although healthy for mammals, it or its metabolistic remains are poisonous for vultures (GREEN et al. 2004, SWAN et al. 2006).

Yet, carcasses of cattle are still transported to areas on the edge of towns and villages. As there is no longer domination of vultures at carcasses, feral dogs, foxes and rats get access to food otherwise consumed by vultures. This leads to growing populations of scavenging mammals which are in contrast to vultures carrying and spreading rabies. The risk for people and livestock of being infected with rabies has dramatically heightened. Some areas are now increasingly dangerous to visit (RODRIGUEZ & BEARD 2005). Declines of vulture populations have an ecological impact and present risks to health, social systems and local economies (PAIN et al. 2003). In most industrial countries such as Germany or China, vultures are extinct. Extinction happened in Central Europe at least 200 years ago (BAUER et al. 2005) and decline was not rapidly like in the case of India but took place slowly by hunting, poisoning and lack of food. Ecosystem services carried out by vultures have been lost long ago.

In NECROS project of Brandenburg Technical University, the fragmented remains of the food web based on carcasses are studied. What will happen to carcasses of large animals under such conditions? How long will it take to decompose carcasses under different conditions? Can other scavengers provide the same ecosystem service as vultures?

2. Methods

Study site is part of one of the largest former military training sites in Brandenburg, Germany. The area selected offers some advantages not found elsewhere: Most of the area is closed to the public due to contamination by ammunition, so disturbances by passersby are expected to be few; large vertebrate scavengers such as Wild Boar (Sus scrofa), Wolf (Canis lupus), White Tailed Eagle (Haliaeetus albicilla), Red Kite (Milvus milvus), Ravens (Corvus corax) and others are known to be present. Experiments were performed in all seasons from November 2008 till October 2011. We experimentally laid out road kills of game, mainly Roe Deer (Capreolus capreolus) and Wild Boar (Sus scrofa) as most common game species. Carcasses are monitored by three automatic cameras with two of them taking pictures and one taking videos. SD cards are changed every second day.

3. Results

We found several influences having impact on the decomposition and consumption of carcasses:

- Season: In summer, carcasses are mainly consumed by arthropods and bacteria. Only Red Fox (Vulpes vulpes) is regularly eating from rotting carcasses, while in winter consumption is done mainly by vertebrates. Wild Boar (Sus scrofa), Wolf (Canis lupus), Pine Marten (Martes martes), Domestic Cat (Felis catus) and Raccoon Dog (Nyctereutes procyonoides) used carcasses only in winter, especially after snowfall. In winter there are large flocks of Raven (Corvus corax) at the carcass, in summer only the resident couple.
- Condition of carcass: It makes a significant difference if the road kill shows open wounds or if the animal died of inside injuries. With no open wounds even White Tailed Eagle (Haliaeetus albicilla) with its strong beak has difficulties in opening a carcass, and trying to open it is time consuming. In combination with the season, the carcass starts rotting fast in summer and will not be used by most vertebrates. We have evidence for just one case when Ravens Corvus corax) were able to open the softer skin of a Wild Boar's (Sus scrofa) belly and feed on the intestines.
- Age of scavenger: While adult Red Foxes (Vulpes vulpes) will eat of any carcass, the puppies are mainly feeding on the large insects near and on the carcasses.
- Feeding strategy: Ravens (Corvus corax) do not actually feed at the carcass. They fill their craw with meat, hide it away and come back for more meat. As we often find more than 20 Ravens (Corvus corax) at the same carcass, consumption rate can be accelerated much by Ravens (Corvus corax).

- Competition: Interspecific and intraspecific competition is more complicated than expected. Although adult White Tailed Eagles (Haliaeetus albicilla) dominate young ones at the carcasses, in groups of Raven (Corvus corax) there will be one to mob any eagle by pulling their feathers on the wings or tail. This strategy fails when used on Buzzards (Buteo buteo) as the Buzzard (Buteo buteo) will strike back and single Ravens get mobbed themselves by Red Kites (Milvus milvus) stealing the Raven's meat stored in a hideaway. Competition between vertebrates and bacteria is also remarkable; it seems to follow "first come, first served".

4. Discussion

When looking at the results it becomes obvious that Ravens (Corvus corax) play a large role in carcass ecology. However, even large numbers of Ravens (Corvus corax) cannot contribute to the ecosystem services otherwise provided by vultures. Ravens (Corvus corax) can consume carcasses quickly until only bones and skin remains, which resembles the effectiveness of vultures. However, this needs some prerequisites:

- Number of Raven must be sufficiently high. As Ravens congregate in large flocks only in winter, they fail to provide vulture's ecosystem services year round.
- Carcasses must have open wounds so that Ravens can get access to the meat. Large predators such as Wolf (Canis lupus), Lynx (Lynx lynx) or Bear (Ursus arctos) leave their kills with open wounds. Game that dies of another cause like old age, disease or parasites does not have open wounds. So the presence of large predators is needed.

In Germany, there are only few areas that match these prerequisites. Such areas are Lusatia with Ravens (Corvus corax) and Wolfs (Canis lupus) or the Harz Mountains same as Black Forest and Ore Mountains with Ravens (Corvus corax) and Lynxes (Lynx lynx). And even there, large flocks of Raven will only be found in winter. So ecosystem services which are similar to those provided by vultures will be found only in small areas and even there only for few months.

Consequences of the loss of these services cover more than just lack of food for scavenging animals. It seems plausible, that following the decline of vulture populations in Central Europe, populations of scavenging mammals increased as happened in India some years ago. At least the threat of rabies was considerable until it could be eradicated by vaccination of foxes with drug prepared baits. However, with no rabies to kill the growing population of foxes, their numbers increased even more. Foxes are now a common sight even in city centers of large towns. In rural areas, foxes have become a serious threat to ground breeding birds such as lapwings.

References

[1] BAUER, H.-G., BEZZEL, E. & FIEDLER, W. (2005): Das Kompendium der Vögel Mitteleuropas. Band 1: Nonpasseriformes – Nichtsperlingsvögel. AULA: 1 – 808.

[2] GREEN, R.E., NEWTON, I., SHULTZ, S., CUNNINGHAM, A.A.,GILBERT,M.,PAIN, D.J., PRAKASH,V. (2004): Diclofenac-poisoning as a cause of vulture population declines across the Indian subcontinent. J. Appl. Ecol. 41, 793-800.

[3] KRAWCZYNSKI, R. & WAGNER, H.-G. (2008): Leben im Tod – Tierkadaver als Schlüsselelemente in Ökosystemen. – Naturschutz & Landschaftsplanung 40 (9): 261-264.

[4] PAIN, D.J., CUNNINGHAM, A.A., DONALD, P.F., DUCKWORTH, J.W.,HOUSTON,D.C.,KATZNER, T.,PARRYJONES, J., POOLE, C., PRAKASH, V., ROUND, P., TIMMINS, R. (2003): Causes and effects of temporospatial declines of Gyps-vultures.

[5] RODRIGUEZ, J.P., BEARD, T.D., AGARD, J.R.B., BENNETT,E., CORK, S., CUMMING, G.,DEANE, D., DOBSON, A.P., LODGE, D.M., MUTALE, M., NELSON, G.C., PETERSON, G.D., RIBEIRO,T., CARPENTER, S.R., PINGALI, P.L., BENNETT, M.E., ZUREK, M.B.(2005): Chapter 12:Interactions among ecosystem services. In Ecosystems and Human well-being: scenarios, volume 2 (2005).

[6] MARKANDYA, A., TAYLOR, T., LONGO, A., MURTY, M.N., MURTY, S., DHAVALA, K. (2008): Counting the cost of vulture decline-An appraisal of the human kealth and other benefits of vultures in India. (Available at http://www.scribd.com/doc/49834172/Counting-the-cost-of-vulture-decline%E2%80%94An-appraisal-of-the-human-health-and-other-benefits-of-vultures-in-India).

[7] SWAN, G. E., CUTHBERT, R., QUEVEDO, M., GREEN, R. E., PAIN, D. J., BARTELS, P., CUNNINGHAM, A. A., DUNCAN, N., MEHARG, A. A., OAKS, J. L., PARRY-JONES, J., SHULTZ, S., TAGGART, M. A., VERDOORN, G. & WOLTER, K. (2006): Toxicity of diclofenac to *Gyps* vultures. Biol. Letters 2006 2: 279 – 282.

[8] WHELAN, C.J., WENNY, D.G., MARQUIS, R.J.(2008): Ecosystem services provided by birds. (Available at http://onlinelibrary.wiley.com/doi/10.1196/annals.1439.003/abstract).