

The Raccoon dog – A condemned species without a trial?

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Abstract

Since the introduction of the raccoon dog (*Nyctereutes procyonoides*) in former Soviet Union in late 1920ies they have colonized more than 1.4 million square kilometers in Europe. Invasive species may pose a major threat to native wildlife and even humans, although the term invasive mostly refers to the species ability to quickly adapt to new environments. This review focusing on the impact of raccoon dogs on Swedish ecosystems, in case of a future establishment of raccoon dog in the country. I found that the raccoon dog's threat to other carnivore species, such as the fox and the badger, is small as long as the food supply is sufficient. Predation by raccoon dog upon ground-nesting birds and amphibians could cause problem to small populations in isolated areas, but overall the raccoon dog does not threaten this species to extinction. Raccoon dog as a vector species for diseases, particularly rabies seems to be the biggest concern if they establish in Sweden as it threatens not only wildlife but also humans.

Introduction

The problems with invasive species, including the raccoon dog, conquer new areas and threatening the native flora and fauna are a major concern throughout the world today (DAISIE 2008). Populations of raccoon dogs exist throughout Europe from Russia down to Germany and Hungary. It was brought to Europe as a game species and has kept spreading ever since. There are some countries that have not yet been colonized, including countries in the westernmost Europe and Sweden, Norway and the British Isles. As the raccoon dog is abundant in Finland and Denmark, it constantly threatens to invade Sweden, which in some way are the last outpost for raccoon dog to spread over the entire Scandinavia. For this reason, much money and effort is put into the work to prevent the raccoon dog from entering Sweden. The Swedish Environmental Protection Agency, SEPA, is responsible for monitoring invasive species and in 2008 they started the Swedish Raccoon dog project, the goal of which is to kill existing individuals, and prevent the establishment of raccoon dog in Sweden, and if both this fails, at least monitor and try to control further spread southward. The project extends over four years and the financial resources amounts 10 million SEK (Dahl *et al.* 2009). The question is however, is whether the efforts are well spend in relation to the



The raccoon dog (*Nyctereutes procyonoides*). Photo: JC Schou. Biopix.dk, with permission

potential threat that the raccoon dog poses to Swedish people and wildlife?

The raccoon dog as an invasive species

There are a few attributes that makes the raccoon dog especially successful in conquering new areas. The reproductive potential of the raccoon dog is one of the highest among canids (Bekoff *m.fl.* 1981). It's ability to hibernate during harsh winters and omnivorous preference for food makes it a survivor in various habitats (Kauhala 1994). Also the relative high genetic diversity among European raccoon dogs contributes to its success (Pitra *et al.* 2010).

Reproductive potential

The raccoon dogs have extraordinary high reproductive potential, with litter sizes of nine pups on average. This figure could be compared to red foxes and other carnivores of the same size with an average litter size of 4-6 pups (Bekoff *et al.* 1981). The largest litter sizes are found among females of 3-5 years of age (Helle & Kauhala 1995). The pups reach sexual maturity within 10 months and move up to 40 kilometers in search for new territories.

Hibernation

The climate in northern Europe is too cold for the raccoon dog to forage all year around. Instead, when the ambient temperature is below -10°C , the snow depth exceeds 35 centimeters and day length is shortened, the raccoon dog is mostly found inside some kind of den or shelter. It is not fully resolved whether the raccoon dog's behavior during winter is hibernation by strict definition. Indeed, the body temperature of the animal is decreasing during winter, but not enough to call it hibernation in comparison to, for instance, bears. The hibernation cause the raccoon dog to compete with badgers or foxes over dens. However, it seems that the competition among them is not that serious because they share different parts of the dens and in addition the hibernation of the badger is more firm than the raccoon dog. The risk of infection spread however, is higher if different individuals share the same dens.

Food preference

Raccoon dogs are omnivorous meaning that they eat both flesh and vegetables, pretty much depending on what they could find. Anything between small rodents, snails, amphibians, fish, carcasses, fruit and grain are good enough for them. This means that the raccoon dog is likely to find food in most kind of habitat throughout Europe. Studies of the competition over food among medium sized carnivores in Finland showed that the raccoon dog has preferences for vegetative diet, and thus the competition among carnivores was shown to be small. A study performed in Japan however, gives a different picture. The native raccoon dog and two invasive species were found to have considerable overlap in their diet, indicative of some geographical difference in food overlap among medium sized carnivores. Overall it seems like competition over food is limited as long as there are enough food in the area. Also the raccoon dogs predation on waterfowl is moderate. In Finland the raccoon dog is estimated to consume 1.2-3.5 percent of the female eiders in Finland's southernmost archipelago (Kauhala & Auniola 2001). Damage caused by red fox and pine marten is considered a bigger threat against waterfowls because these predators kill more adult birds than the raccoon dog. Invasive species are considered to have double the impact on pray population because usually the pray have adapted their reproduction strategy so that it is fitted to predation by native predators.

Genetics

The genetic studies that has been carried out indicates that the raccoon dog has higher genetic diversity than would be expected considering its history of spread throughout Europe in the past 70-80 years (global $F_{st}=0,139$). Today there are six known subspecies of *Nyctereutes procyonoides* along its native and introduced areas in Asia and Europe respectively.

Comparative genetic studies in Europe and Amursk area however, are indicative of a new subspecies developing in Europe. The argument for this assumption is that, although the genetic diversity is high among European raccoon dogs, they considerably diverge from their Asian relatives.

Diseases

The raccoon dog are an important vector for many diseases like rabies, tapeworm, mange and trichina (Kauhala m.fl. 2007). The most serious threat to Sweden is the rabies virus since Sweden is one of few countries in Europe that are considered rabies free. Both Finland and Denmark has had rabies outbreaks, as late as in the 1980'ies in Finland. The red fox is the main vector for rabies in Europe, but since the introduction of the raccoon dog the importance of the fox has decreased. None of the vector species alone is thought to be numerous enough to spread the rabies fast and effectively, but together the carnivores could reach the critical population densities needed. The raccoon dog also seems to have an important role of trichina spread in Europe today, and this role is thought to increase in the future (Di Cerbo *et al.* 2008). When examining raccoon dogs for trichina in Finland, scientists discovered that they had the highest infection intensity among carnivores. They were also the only carnivore where they found all four species of *Trichina* nematodes present.

Uncertainty

There are some uncertainties about the role of the raccoon dog as vector species for disease spread in Europe. In addition there is a suspicion that a new genetic subspecies is developing in Europe, but too few individuals have been sampled to confirm this. Finally, the impact of climate changes on distribution limits for the raccoon dog in the world, and with special reference to northern Scandinavia, should be investigated.

Recommendations

To elucidate the uncertainties mentioned above, more research needs to be performed on the genetic composition of European raccoon dogs. Changes in distribution limits should also be monitored to detect changes over time in relation to the global warming. Moreover, research is needed to investigate the consequences of raccoon dog's on the well-being of wildlife and humans in areas where it is introduced. Methods should be developed to isolate the ecological effects of raccoon dogs from other medium-sized carnivores in Europe. It is also recommended to streamline the cooperation within Europe and internationally, so that knowledge could be shared between countries with the intention to prevent further spread of the raccoon dog and other invasive species.

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