

Predation on avian wildlife by domesticated and feral cats

Author: Tom Veldhuis (s3425436)

25-05-2020

Course: Animal ecology research

Faculty of Science and Engineering

Supervisor: Dr. ir. R.H.G. Klaassen

Abstract

Felis catus, the domestic cat, has become one of the most invasive species on the planet, with many of them becoming feral and living independent from humans. Through the help of humans, they have reached location inaccessible to them through normal means, driving multiple species to extinction in the process. With the European union's directive to protect avian wildlife, cats need to be considered as a potential threat to these birds, as they are one of the most abundant predators in Europe. Many studies on the predation impacts of cats were unable to prove the significant effect they have on bird populations and only a few proving there is a strong effect when cat densities are high, leading the public to believe there is no threat and causing a lack of management of cat predation. Often these studies used unsuitable methods and failed to take into account the many factors influencing predation rates. Many of these studies took place in the United States, further complicating the application of any results to the European situation. Here, having analysed the methods used to measure predation by cats to I recommend using extensive field observation and population monitoring to properly asses the impact of domestic and feral cats on the protected avian wildlife in Europe.

Contents:

Introduction: Page 3

Studies on cat predation rates and their methods: Page 4

Effects on bird population: Page 6

Public views on research and management: Page 7

Discussion and conclusion: Page 9

References: Page 10

Introduction:

When thinking about the world's most effective killers and the leading cause of the extinction of multiple species, a soft cat enjoying its owners attention is not usually the first thing that springs to mind. The occasional dead mouse or bird left near the house as a 'present' might even be seen as cute, or as a token of affection. This species, *Felis catus*, was domesticated by humans approximately ten thousand years ago as a means to control the pests attracted by the rise of agriculture (Driscoll *et al.* 2009). In the following millennia, domesticated cats have accompanied the human race in the colonisation of the world, becoming one of the most invasive species on the planet.

Currently, an estimated 25% of European households keep one or more cats as their pet, meaning over 100 million domesticated individuals (The European pet food industry 2018). Some of the cats become feral, living independently from humans, making it very difficult to measure their numbers. This large and growing amount of cats preying on (potentially protected) wildlife is a concern for conservationists and general bird enthusiasts who see the bird species they protect or simply enjoy observing being preyed on by cats. Not only is this issue relevant to the particular organisations and individuals, but a case could also be made that the members of the European union are obligated to look into matter by the EU Birds directive. The EU Birds directive prohibits any deliberate destruction, disturbance, transportation or sale of any wild birds and their nests to ensure the maintaining or growth of bird populations (Publications Office of the European Union). Complying with the European union's focus on the preservation of bird species and habitats, domesticated and feral cats should thus be thoroughly investigated as a potential threat to these species.

In island ecosystems, predation by domestic and feral cats is known to have strongly contributed to the extinction of 11 species of birds and the endangerment of many more (Medina *et al.* 2011). Although the impact of predation by cats is not as well documented or apparent on the mainland as it is on islands, this is a clear example of the potential danger cats pose. Due to limited compelling evidence, and in some cases evidence suggesting causes of high bird mortality other than cats (e.g. Peach *et al.* 2008), the actual effects of cats on bird populations remain unclear. Some of these studies have been carried out either in the United Kingdom or outside of Europe altogether, possibly making their results less applicable to the situation in mainland Europe. Despite this the general results of any such studies are useful in formulating expectations of predation effects in Europe and will therefore also taken into account here. The estimated extent of cat predation varies greatly between studies, leading to a lack of clarity on the actual effect of cat predation. Here, I analyse the results and methods of these studies in an attempt to find out why the true impact of cat predation on mainland birds remains unclear, and propose further studies required to decisively prove or disprove the danger cats pose to bird populations in mainland ecosystems. To properly address the presented issue, I have formulated the following questions:

1. How has the predation on birds been studied thus far and how do methods differ?
2. How has the actual impact of predation by cats on bird species and populations been studied and what do these studies suggest?
3. How can these study designs be combined and/or improved in order to result in compelling evidence proving or disproving the negative effect of cats on bird species and populations?
4. How might the public opinion of feral cats complicate research and potential measures taken to manage them?

Studies on cat predation rates and their methods:

The first step in quantifying any potential threats by domestic and feral cats to avian wildlife is to establish the actual amount of cats in an area and the degree in which they prey on birds.

Fortunately, the number of owned cats is properly tracked by both governments and the European pet food industry (The European pet food industry 2018). The number of feral cats in Europe is understandably much more difficult to measure and Any estimations regarding their numbers would most likely be very inaccurate. Many studies vary in their estimations of bird mortality caused by cats, making it difficult to accurately analyse the actual threat cats pose (Churcher and Lawton 1987, Baker *et al.* 2005, Woods *et al.* 2003, Thomas *et al.* 2012, and Kays and DeWan 2004)

The next problem that arises when measuring predation is estimating the number of prey animals consumed by each cat. Currently, three main methods are used to estimate predation rates. The first and most frequently used method to quantify predation rates counts the amount of prey brought home by domesticated cats. Multiple studies have used this method in order to quantify predation (Churcher and Lawton 1987, Baker *et al.* 2005, Woods *et al.* 2003, Thomas *et al.* 2012, and Kays and DeWan 2004). Woods *et al.* (2003) measured an average predation of 4.1 birds per cat over the course of five summer months, and used this data to estimate an average predation of 27 million birds in the whole of Britain during those same months. Kays and DeWan (2004) suggest an average predation of 1.2 birds per cat over the same period, while Churcher and Lawton (1987) suggests an average predation of 3.8 birds per cat throughout the whole year. Thomas *et al.* (2012) reported a staggering mean annual predation rate of 18.3 prey per cat. Although these estimates are in the same order of magnitude, there clearly is a lot of variation in reported predation rates, making it difficult to establish a generalized value for cat predation. All studies reported higher predation rates during the warmer months of the year. This method relies on the cooperation of cat owners in collecting any prey they find and is not without flaws. Krauze-Grys *et al.* (2012) found that this method is biased against smaller prey, which adds to the uncertainty of predation rate estimates. Additionally, as this method relies on volunteers to collect data, participant selection may be biased, potentially skewing results.

The second method to quantify predation rates uses analyses of the stomach content of cats The analysis of stomach contents has been used multiple times in specific regions in the United States (Parmalee, 1953, Jackson, 1951, Errington, 1936). These studies were not focussed on predation on birds and are not very recent, but do demonstrate the possibilities and potential issues with this method. Errington (1936) warns that specimens must be acquired inside the areas where the birds live. This approach was used by Krauze-Grys *et al.* (2012), who reports that the method is biased towards more palatable prey. Furthermore, this method can only be used to study the predation by feral cats, as owned cats can for obvious reasons not be dissected.

A third method to quantify predation rates is the constant monitoring of specific cats as they go about their daily business and recording any observed predation. This approach was followed by Kays & DeWan (2004). This method requires a lot of field work and it might prove difficult to perform, but is not as susceptible to biases as the other methods. In this study also number of prey returned to the house were quantified, which yielded lower predation rates than the direct observational method. A trade-off to the observation method is that manual tracking of individuals can be difficult in areas with high vegetation. It is also possible to use monitoring of individuals to look at predation from the perspective of the prey. By equipping chicks with radio transmitters, a study on the impact of predation on chicks of farmland birds in the Netherlands showed that out of 662 chicks, only two were killed by cats (Teunissen *et al.* 2005). Unfortunately, the density of cats in the study areas was not reported, making it difficult to infer much from this result, although it does show that certain

areas/circumstances predation rates could be notably low. The decreased predation by cats could simply be the result of a lower cat density in these areas but it was also reported that many transmitters were not recovered, possibly due to cats taking their prey home. Further studies in these areas could show if farmland birds are less affected by the presence of cats.

While not being a unique method, a useful tool to be considered for the estimation of predation rates is the use of models and/or the synthesis of separate studies to estimate and predict predation. This method does not generate new data and is therefore very different from the other methods, but it does allow for a more general overview of the predation of cats. Loss *et al.* (2012) synthesised multiple studies on predation by cats to estimate an annual mortality caused by cats of 1.3-4 billion in the United States. They also found that most mortality from predation is caused by feral cats rather than owned cats. This finding makes estimates of predation rates based on prey returned home by domestic cats less relevant when estimating total predation rates as feral cats do not have a home to bring their prey to. Therefore, studies that base predation rates on the number of prey brought home would underestimate the number of birds predated. This particular study was conducted (mostly) in the United States, but should be applicable to Europe as well. Because this study provides an estimation of predation on a national scale, it is less useful when considering impacts on a particular population on area. However, the knowledge on the impact difference between feral and domestic cats is invaluable when considering study designs and potential measures against predation.

With all these different methods, it hardly comes as a surprise that the estimated rates of predation vary between studies. Additionally, studies were conducted in different areas, at different times of year and were not always aimed specifically estimating bird predation rates, for example as they included mammals and reptiles. To properly establish the mortality cats pose on birds, methods need to be combined and focussed on the effects on birds specifically. The findings of Loss *et al.* (2012), that most predation on birds is caused by feral cats, is particularly important as it means that the use predation rates based on the number of prey brought home by domestic cats would result in underestimates of bird predation rates. This, combined with bias of this method found by Krauze-Gryś *et al.* (2012) greatly reduces the usability of this method. The same study by Loss *et al.* (2012) also indicates that the analysis of stomach contents of feral cats is more useful when estimating predation and should thus be used as a general means of estimating predation rates instead of the currently preferred 'prey brought home' methods. The most effective method of measuring cat predation on birds in a specific area would be to combine the analysis of stomach contents and field observation by researchers and/or volunteers as performed by Kays & DeWan (2004). Additionally, a method not used in any of these studies, the use of camera traps, could be useful in estimating feral cat populations (O'Connell *et al.* 2010)

Effects on bird populations

Although knowledge on the number of birds killed by cats is crucial in understanding the threat cats might pose, this information loses much of its impact without detailed knowledge on the (local) bird populations. Knowledge on the internal mechanisms governing mortality and birth rates in individual populations are necessary to find the effects of cat predation on these populations. Such mechanisms might cause interference in any data simply measuring population growth and decline. To confidently make claims regarding the role of cats as a threat to bird populations both the predation by cats and the impact of this predation need to be considered together. Studies focusing on the actual effect of predation by cats are less common than studies simply describing the amount of predation, making it

more difficult to make a strong case regarding the effect of cats. In this paragraph I will discuss some of the studies that have focussed on effects of cat predation on bird populations.

Thomas *et al.* (2012) compared the effects the estimated rate of predation would have on the urban bird populations they studied. Their data showed that in around 39% of occasions the amount of birds killed by domestic cats was greater than the actual proportion of adults in the bird population. This indicates that these population would decline without migration from other populations. The study also showed that higher housing densities and higher cat densities were negatively correlated with the average annual predation per cat.

Van Heezik *et al.* (2009) combined the method of counting returned prey and data from several other studies to create a mathematical model predicting the impact of cat populations on the bird populations in the area. Similar to Thomas *et al.* (2012) they concluded that urban populations were sinks relying on other populations to maintain stable numbers.

Domestic and feral cats might also negatively influence populations sizes by indirect means. Indirect effects are usually not included in analyses of the effect cats have on bird populations. The presence of predators have so-called 'fear effects' on prey populations, causing their prey to alter their behaviour, potentially reducing their lifespan and fecundity. For example, it was shown that urban blackbirds reduced food provisioning rates to their young after being confronted with taxidermy mounts of domestic cats, decreasing the fitness of their young (Bonnington *et al.* 2013). In a study in Denmark, the presence of cats led to an increased speed of reproductive decline in barn swallows as they aged, resulting in decreased offspring over the course of their lives (Balbotín and Møller, 2015). This study suggested that the presence of domestic cats caused sublethal effects, indicating that estimates of predation rates by cats alone are insufficient to estimate the effect they have on bird populations.

Beckerman *et al.* (2007) showed that these sub-lethal fear effects caused by the presence of predators could, when reducing bird fecundity by even the smallest amount, greatly reduce bird populations in urban environments. Even when only 1% of bird mortality was caused by direct predation the model predicted drastic effects on bird populations, potentially decreasing population sizes by up to 95%. This study also remarks that cat populations do not follow the usual predator-prey models as domestic cats are not dependent on birds or other prey animals as a food source. This allows the number of cats to greatly exceed the carrying capacity of their environment, making the potential impact they have on an ecosystem greater than any naturally occurring predator. The lack of including effects such as these in the assessment of the potential threat posed by cats could very well explain why many studies have not been able to decisively prove a negative effect on populations caused by cats. Should these fear effects actually affect bird populations to the extent suggested by this study, the actual threat posed by cats as a predator by, even when predation rates are low, would be much larger than initially thought.

These studies on the effect cat populations show that cats can, especially in urban environments, have serious effects on bird populations. Even when predation rates are low, the mere presence of a cat can change the behaviour of their potential prey, significantly reducing the population size. This information should now be used to establish general methods to estimate these effects in specific areas. The study by Thomas *et al.* (2012) as well as the studies on the predation rates of domestic cats described earlier suggested that predation rates and the subsequent effects on bird populations are strongly dependant on seasonal conditions, predator density, predator age and terrain. Most studies fail to take all of these factors into account when making their estimations which might allow regional

effects on predation to remain unnoticed. Due to these differ factors, it might not be suitable to combine data from studies very different areas (e.g. Van Heezik *et al.* 2009) to model the impact of cat predation, as the circumstances from one study might not apply to another Rural areas and nature reserves should be analysed separately from urban regions, where most research has thus far been conducted, with datasets being collected to describe specific areas to asses the threat to avian wildlife for each location.

Public views on research and management

An important factor to be considered when dealing with cats, both feral and domestic, is the public opinion on these animals. As cats are one of the most popular pet species in Europe (The European Pet Food Industry 2018), methods involving the killing of feral cats might not be received well by the general public. Additionally, management strategies highly depend on the cooperation of cat owners. A study in the United Kingdom designed to gauge the general opinion of cat owners on cat hunting behaviour and the need for management of cats showed that there is a broad spectrum of viewpoints regarding this topic (Crowley *et al.* 2018). The interviews they conducted showed six main perspectives on predation by cats, displayed in figure 1.

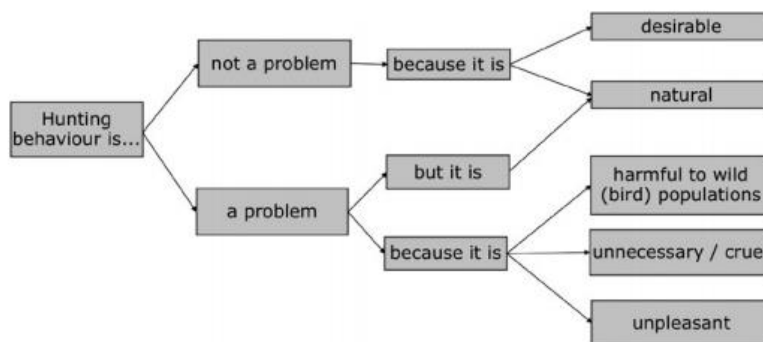


Figure 1: Flowchart depicting the main perspectives of cat owners in the UK. Adapted from Crowley, Cecchetti and McDonald, 2018.

The interviews also revealed that cat owners generally view cats to be less of a threat to wildlife than non-owners do, with cat owners who were concerned about this topic being unable to find compelling evidence to convince themselves of the threat posed by their pet. Many cat owners believed their cats did not hunt enough to cause a problem to local wildlife.

In this study participants were also asked about their sense of responsibility regarding the management of their cat(s) and cats in general, as depicted in figure 2.

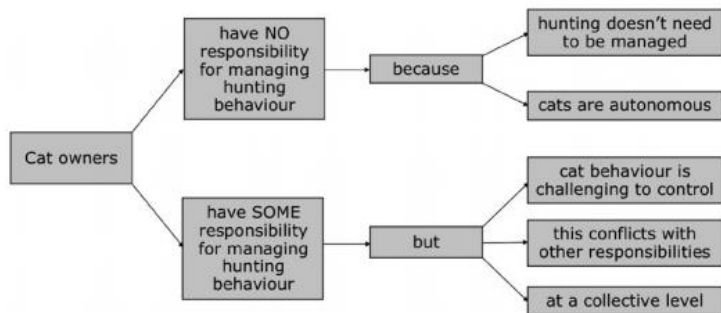


Figure 2: Flowchart depicting main perspectives of cat owner responsibility. Adapted from Crowley, Cecchetti and McDonald, 2018.

Here we encounter a situation similar to the views on the threat of predation by cats, where owners who thought their cats did not hunt a lot did not feel like it was their responsibility to manage the behaviour of their cats. This shows how important it is for the public to be properly informed on the threats that their cats can pose to wildlife, with clear evidence (such as presented in the studies discussed earlier) to make them aware of the necessity of cat predation management.

Thomas *et al.* (2012) also provided information on the public opinion on specific management options. They found that the most acceptable options were using anti-predation collars, mandatory sterilisation and mandatory registration of owned cats. Remarkably, only 15.7% of participants found the instatement of a curfew to be an acceptable solution. This low approval rate is most likely caused by the view that this would impair the cat's freedom and thus quality of life. Participants were asked to assume that predation by cats was harmful to bird populations. They also found that 51% of interviewees considered cats to have only low impacts on bird populations, with 16% believing them to have no impact at all.

Aside from issues in management of owned cats, the management of feral cats is quite controversial. Currently, the most commonly used method to manage cats in the United States is the use of Trap-Neuter-Return or TNR. In this method feral cats are, as the name suggested, caught, neutered or spayed and then returned to nature. The aim of this method is to reduce the total population of feral cats while causing minimal harm to the individual animal. Despite it being a publicly accepted and widely used method, it is criticized by members of the scientific community (Loss and Marra 2017, Longcore *et al.* 2009, Lepzyk *et al.* 2010), stating that the method is not supported by scientific evidence when it comes to proving the effectiveness in reducing federal cat populations. An alternate method, lethal control of feral cats has been met with severe opposition by Opposition was also directed towards the researchers involved, even while unaffiliated with the movement supporting lethal cat control (Marra and Santella 2016). Such strong responses to the lethal control of animals has also been observed in Europe, with an extreme case being protests against the culling of deer populations in the Oostvaardersplassen nature reserve in the Netherlands. The news of the planned culling resulted in public protests by animal welfare organisations and concerned citizens, resulting in large-scale protests and threat being made against those responsible for making and enforcing the culling policy. With cats being seen as considerably more 'cuddly' and as pets, such culling actions against feral cats could potentially lead to similar, if not more severe responses from the general public.

The common issue to be found here is the failure of the scientific community to properly educate the public on the facts and studies on the effects of cats on wildlife. Scientific evidence is not presented in such a way that interested parties can easily understand the risk these cats pose. The Royal Society for

the Protection of Birds even states on their official website that there is no scientific evidence that cat predation can cause bird population declines (Royal Society for the Protection of Birds). Because of this, the public is unaware of the threat to wildlife posed by cats, unaware of the need for cat owners to help manage the behaviour of their pets and unaware of what methods are necessary in preventing the predation of avian wildlife by feral and domesticated cats (Thomas *et al.* 2012, Crowley, Cecchetti and McDonald, 2018).

Discussion and conclusion

When comparing studies on cat predation on birds, the issue that stands out the most is how many of them show an incomplete picture. Studies estimating predation rates are often missing the necessary data on the prey populations to support claims of cat predation forming a threat to ecological diversity. In addition there is much uncertainty regarding the conditions influencing predation by cats and the accuracy of their methods. In many cases, studies discussing predation by cats are not exclusively focussed on the predation on birds, discussing the predation on vertebrates as a whole, making it more difficult to apply their findings to the impact on bird populations. Additionally, many of the studies focus on different ecological scales and different regions or use different methods to estimate predation rates. Added to this is the incomplete picture of the abundance of feral cats in Europe, making estimates even more difficult and uncertain. It is no surprise that, especially where estimates of predation by cats are concerned, both members of the public and the scientific community have had difficulties in finding decisive evidence on the threat domesticated and feral cats can pose to bird populations.

Fortunately, a few studies have specifically analysed whether, at least in urban environments, cat predation can exceed population birth rates, resulting in population declines. Despite the relatively low number of studies properly investigating the effects cats have on bird populations, I do believe this effect is real. These few studies do show direct and indirect population declines caused by cats, and even the studies unable to prove a population effect still estimated very high mortality rates caused by cats. These population declines, combined with the knowledge that cats have caused the extinction of species (albeit on island ecosystems) have convinced me that cats are capable of harming bird populations, and that management strategies are necessary to protect these populations. Outside of urban areas however, more quantitative data is needed regarding cat abundance, cat predation and population wide effects of predation by cats. Having established that cats are capable of causing bird populations to decline, I suggest the following course of action to acquire the data needed for more specific conclusions regarding the impact of domestic and feral cats: (1) Areas of interest should be chosen based on the diversity of bird species they contain and any possible declines in populations the area is facing. (2) The amount of cats in the area, both feral and domesticated, needs to be established accurately. The most practical way to achieve this is through camera traps for feral cats, and population surveys for owned cats. (3) Having compared the many ways of estimating predation by cats, I would recommend the use of camera traps and/or direct observation of cats and birds' nests, as these methods are least likely to be biased or inaccurate. (4) To measure the actual effect on the birds, populations will need to be monitored, measuring breeding pairs, fecundity and dispersal to and from other populations. This last measurement is needed to ensure the influx of individuals from other populations is hiding potential population declines.

The most important step is increasing the awareness of the issue of cat predation on birds. The fact that there *is* evidence supporting the threat of predation by cats needs to be presented clearly to the public and institutes concerned with bird welfare. Individuals and organisations concerned with animal welfare should be made aware of the annual mortality cats cause worldwide and that management is necessary. Only when cat owners are aware of their responsibility and possibilities in reducing predation rates and cat management policy is put into place can we reduce the effects these cats gave on the many species of birds they hunt. Hopefully one day, when cat predation is properly managed, we can stop worrying about the threat they pose to the feathered friends enjoying the bird feeder in our backyards, and simply enjoy their comforting presence as our pets.

References:

- Baker, P. J., Bentley, A. J., Ansell, R. J., & Harris, S. (2005). Impact of predation by domestic cats *Felis catus* in an urban area. *Mammal Review*, 35(3–4), 302–312. <https://doi.org/10.1111/j.1365-2907.2005.00071.x>
- Beckerman, A. P., Boots, M., & Gaston, K. J. (2007). Urban bird declines and the fear of cats. *Animal Conservation*, 10(3), 320–325. <https://doi.org/10.1111/j.1469-1795.2007.00115.x>
- Bonnington, C., Gaston, K. J., & Evans, K. L. (2013). Fearing the feline: Domestic cats reduce avian fecundity through trait-mediated indirect effects that increase nest predation by other species. *Journal of Applied Ecology*, 50(1), 15–24. <https://doi.org/10.1111/1365-2664.12025>
- Churcher, P. B., & Lawton, J. H. (1987). Predation by domestic cats in an English village. *Journal of Zoology*, 212(3), 439–455. <https://doi.org/10.1111/j.1469-7998.1987.tb02915.x>
- Crowley, S. L., Cecchetti, M., & McDonald, R. A. (2019). Hunting behaviour in domestic cats: an exploratory study of risk and responsibility among cat owners. *People and Nature*, 1(1), 18–30. <https://doi.org/10.1002/pan3.6>
- Driscoll, C., Clutton-Brock, J., Kitchener, A., & O'Brien, S. (2009). The Taming of the Cat. *Scientific American*, 300(6), 68-75. Retrieved May 8, 2020, from www.jstor.org/stable/26001382
- Jackson, W. (1951). Food Habits of Baltimore, Maryland, Cats in Relation to Rat Populations. *Journal of Mammalogy*, 32(4), 458-461. doi:10.2307/1375794
- Kays, R. W., & DeWan, A. A. (2004). Ecological impact of inside/outside house cats around a suburban nature preserve. *Animal Conservation*, 7(3), 273–283. <https://doi.org/10.1017/S1367943004001489>
- Krauze-Gryz, D., Gryz, J., & Goszczyński, J. (2012). Predation by domestic cats in rural areas of central Poland: An assessment based on two methods. *Journal of Zoology*, 288(4), 260–266. <https://doi.org/10.1111/j.1469-7998.2012.00950.x>

Marra, P.P., Santella C. (2016). *Cat wars: the devastating consequences of a cuddly killer*. Princeton, NJ: Princeton University Press.

Medina, F. M., Bonnaud, E., Vidal, E., Tershy, B. R., Zavaleta, E. S., Josh Donlan, C., Keitt, B. S., Le Corre, M., Horwath, S. V., & Nogales, M. (2011). A global review of the impacts of invasive cats on island endangered vertebrates. *Global Change Biology*, *17*(11), 3503–3510.

<https://doi.org/10.1111/j.1365-2486.2011.02464.x>

Camera Traps in Animal Ecology: Methods and Analyses (eds A.F. O'Connell, J.D. Nichols & K.U. Karanth), pp. 253–263. Springer Publishing, Tokyo, Japan.

Parmalee, P. (1953). Food Habits of the Feral House Cat in East-Central Texas. *The Journal of Wildlife Management*, *17*(3), 375–376. doi:10.2307/3797127

Paul L. Errington, Notes on Food Habits of Southern Wisconsin House Cats, *Journal of Mammalogy*, Volume 17, Issue 1, 14 February 1936, Pages 64–65, <https://doi.org/10.1093/jmammal/17.1.64-b>

Peach, W. J., Vincent, K. E., Fowler, J. A., & Grice, P. V. (2008). Reproductive success of house sparrows along an urban gradient. *Animal Conservation*, *11*(6), 493–503.

<https://doi.org/10.1111/j.1469-1795.2008.00209.x>

Publications Office of the European Union *The Birds Directive : 40 years conserving our shared natural heritage*. (n.d.). <https://doi.org/10.2779/87814>

Royal Society for the Protection of Birds. Are cats causing bird declines? Retrieved from:

<https://www.rspb.org.uk/birds-and-wildlife/advice/gardening-for-wildlife/animal-deterrents/cats-and-garden-birds/are-cats-causing-bird-declines/>

The European Pet Food Industry. (2018). European Facts & Figures 2018. *European Facts & Figures*, 1–10. http://www.fediac.org/images/FEDIAF_Facts_and_Figures_2018_ONLINE_final.pdf

Thomas, R. L., Fellowes, M. D. E., & Baker, P. J. (2012). Spatio-Temporal Variation in Predation by Urban Domestic Cats (*Felis catus*) and the Acceptability of Possible Management Actions in the UK. *PLoS ONE*, *7*(11), 20–23. <https://doi.org/10.1371/journal.pone.0049369>

van Heezik, Y., Smyth, A., Adams, A., & Gordon, J. (2010). Do domestic cats impose an unsustainable harvest on urban bird populations? *Biological Conservation*, *143*(1), 121–130.

<https://doi.org/https://doi.org/10.1016/j.biocon.2009.09.013>

Woods, M., McDonald, R. A., & Harris, S. (2003). Predation of wildlife by domestic cats *Felis catus* in Great Britain. *Mammal Review*, *33*(2), 174–188. <https://doi.org/10.1046/j.1365-2907.2003.00017.x>