The Effect of Cats and Dogs on Bird Distribution

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ABSTRACT

Cats and dogs are very common pets in Greece and especially cats, are commonly allowed to roam freely and even become feral. This was thought to have detrimental effects on wildlife, especially birds. I evaluated whether cats and dogs affect the distribution of birds in the north-eastern provinces of Athens. Different areas were sampled and analysed to determine if areas with different densities of dogs and cats have different densities of birds. Dogs, showed to not impact any bird species apart from Blackbirds which were surprisingly positively correlated with dogs. On the other hand, cats seem to impact Sardinian warblers and blackbirds negatively. Areas with more cats seemed to have a lower number of these two avian species. These findings support that cats can impact wild bird populations and that owners need to be responsible, while it shows no evidence to support that dogs can do the same. However, in this study there were not enough samples to statistically analyze the impact of these two animals on all bird species, while there were also no samples from different natural habitats other than dry Mediterranean bushland with few trees such as pine trees, olive trees and deciduous trees found in gardens.

Introduction

Cats

Cats (*Felis catus*) are widely found in Greece with their population estimating around 600,000 (Statista, 2020). Apart from common pets, they are also invasive predators, and they prey upon a variety of animals including mammals, birds, amphibians, reptiles, fish, and invertebrates (Trouwborst et al., 2020). In the US alone, a study estimated that there are around 1.2-4 billion birds, and 6.3-22.3 billion mammals killed by cats annually (Loss et al., 2013). In another study in Italy, 145 cats brought home 2042 vertebrates from at least 207 different species (Mori et al., 2019) and in the UK, 696 cats were recorded to have brought 2809 dead birds to their household from 44 different species over the course of 5 months (Woods et al., 2003) Only a small fraction of the preys caught by cats (less than 25%) is brought home (Trouwborst et al., 2020), which means that the total preys of cats is considerably higher than the number of prey items they bring home. In Australia, the mortality of birds by cats has been found to be around 377 million birds per year, of which 71% are killed by feral cats in human-unaffected habitats (Woinarski et al., 2017). The way they impact wildlife, however, is not limited to predation and includes fear effects (Loss & Marra, 2017), disease transmission (Trouwborst et al., 2020), and competition (Merson et al., 2018). Cats have been found to be imposing fear effects on birds, causing them to migrate to different habitats and change their feeding patterns (Beckerman et al., 2007). These effects can lead to the parents, investing less energy on reproduction and thus have a dramatic impact on the species abundance of up to 95% (Beckerman et al., 2007). All the effects above inevitably mean that species could be in danger of extinction. Cats have taken part in 63 global species extinctions of which 40 were birds, 21 were mammals and 2 were reptiles, which accounts for 26% of all known extinctions that have taken place in recent years (Doherty et al., 2016).

Dogs

Similar to cats, dogs also pose the same problems. If left to roam freely, they can directly kill wildlife, impose fear-effects on animal, and transmit diseases (Young et al., 2011). A study in Argentina showed that dogs have preyed upon or at least chased 60 different bird species and a similar number of mammalian species (Zamora-Nasca et al., 2021). Another study on a Spanish coast, showed that dogs flushed plovers twice more often than humans out of their nest, due to the perception of dogs as predators (Gómez-Serrano, 2020). This increases the plover's stress levels and decreases their energy levels and in turn their fecundity. A third study showed that forest areas where dogs are found have a 35% decreased diversity of birds and 41% decreased abundance of birds (Banks & Bryant, 2007).

This study focuses on the way cats and dogs affect the abundance of different avian species. It was initially thought that due to the above effects of these two species, areas with higher densities of cats and dogs would have a lower number of most birds. On the other hand, it was also debated whether dogs would have a smaller effect than cats since they can be more easily controlled by fences and leashes, not allowing them to roam freely. Lastly, it was predicted that perhaps areas with a high dog density would have a lower cat density, due to the fear effects dogs might pose on the cats, as they are larger predators.

Methods

Area and timeline

The survey took place in the wider area of Athens, Greece (fig 1) and more precisely in the north-eastern provinces (fig 2). Data collection started on the 26th of April 2022 and finished on the 25th of August 2022 (table 1).

Table 1: Date and type of habitat of each sample.

Date	Samples taken	Type of habitat
26/04/2022	2	semi-natural
27/04/2022	1	semi-natural
28/05/2022	1	semi-natural
29/05/2022	1	semi-natural
01/06/2022	1	semi-natural
12/06/2022	1	semi-natural
13/06/2022	2	semi-natural
14/06/2022	2	semi-natural
15/06/2022	1	urban
16/06/2022	1	semi-natural
17/06/2022	2	semi-natural
18/06/2022	1	semi-natural
19/06/2022	1	semi-natural
20/06/2022	1	semi-natural
27/06/2022	1	semi-natural
28/06/2022	1	urban
29/06/2022	1	semi-natural
30/06/2022	1	natural
01/07/2022	3	natural

Date	Samples taken	Type of habitat
02/07/2022	2	natural and urban
03/07/2022	2	semi-natural
04/07/2022	1	semi-natural
05/07/2022	1	semi-natural
06/07/2022	1	semi-natural
07/07/2022	1	semi-natural
13/07/2022	1	semi-natural
14/07/2022	3	semi-natural
22/07/2022	1	urban
23/07/2022	1	urban
24/07/2022	1	semi-natural
25/07/2022	1	urban
26/07/2022	2	semi-natural
27/07/2022	3	urban
28/07/2022	1	semi-natural
29/07/2022	1	semi-natural
30/07/2022	2	semi-natural
31/07/2022	2	natural and urban
01/08/2022	1	natural
02/08/2022	1	natural
03/08/2022	2	semi-natural
04/08/2022	1	urban
17/08/2022	1	natural
18/08/2022	2	semi-natural
22/08/2022	1	semi-natural
23/08/2022	4	2 semi-natural, 2 naturals
24/08/2022	2	semi-natural, natural
25/08/2022	2	semi-natural

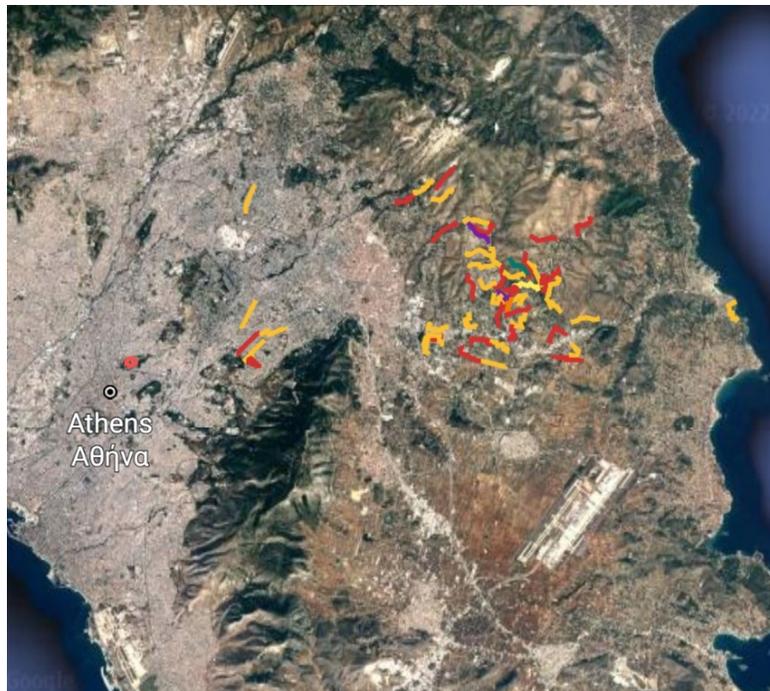*Figure 1: Athens, Greece (Google Earth, 2022)*

Figure 2: Data collection lines followed in red, yellow and purple (Google Earth, 2022)

Planning and Sampling

The habitats were separated in 3 groups:
- Natural habitats which primarily comprised of dry bushlands with few pine trees.
- Semi-natural habitats which had small densities of buildings and gardens.
- Urban habitats which were densely built but had gardens as well.

In these habitats, different lines of 1200 meters were designated, and then sampled. On those lines, all cats and dogs were recorded while walking. Dogs were separated into house dogs, dogs on walk, stray dogs, and total dogs. Cats were separated in cats that were seen inside properties, cats that were seen outside properties, and total cats. Sampling was performed by me and the help of a volunteer. Every 200m we would stop and record all birds around us but also cats and dogs for 3 minutes, until the end of the 1200m, so there were 6 stops at 100m, 300m, 500m, 700m, 900m, and 1100m. When done, we would walk all the way back without stopping and only recording dogs, cats, and birds of prey. All birds on a maximum distance of 100m from the path were recorded, except for birds of prey which were recorded at a maximum distance of 200m from the path. Each path was sampled once or twice, once in the morning starting on sunrise, and once starting an hour and 30 minutes before sunset. These times were determined because cats and most birds show the highest activity at around dawn and dusk (Goszczyński et al., 2009; Trnka et al., 2006; Robbins, 1981). While walking, the only birds that we recorded were birds of prey. All the rest were solely recorded at those 3-minute periods. House Martins, Swallows, Swifts and Crows were not recorded as I thought the location where they are found does not represent the location where they land (and thus predated upon) as they fly for long distances over long period of times. The bird species/categories that were recorded in high enough numbers worth of analyzing (sampled in more than 10 areas) were:

- House sparrows (*Passer domesticus)*
- Sardinian warblers (*Sylvia melanocephala)*
- Great tits (*Parus major)*
- European goldfinches (*Carduelis carduelis)*
- Blackbirds (*Turdus merula)*
- Parakeets (*Psittacula krameri* and *Myiopsitta monachus*)
- Chukar Partridges (*Alectoris chukar)*
- Doves (*Streptopelia decaocto, Columba livia)*
- Eurasian Magpies (*Pica Pica)*
- Birds of Prey (Mostly *Falco tinnunculus* and *Buteo buteo)*
- Eurasian Jay (*Garrulus glandarius)*

Apart from these categories I made a more general category called 'songbirds' where I placed all the songbirds that either had small populations to be analyzed alone, or small birds, the precise species of which could not be identified. At the end, building density of each line was determined by counting the number of buildings in contact with the path that was surveyed.

Data Analysis

I run linear regression models in RStudio using cat or dog numbers as the explanatory variable and a different bird species each time as the response variable. Number of buildings was also used as an explanatory variable in relation to bird numbers to examine whether differences are observed due to higher building numbers (thus higher habitat destruction) and not due to cat and dog effects.

Results

Table 2: The correlation between each bird species/group to cats, dogs and building density, using all samples from all habitats. Positive and negative correlations had p-values<0.01. Weak correlations had 0.01<p-value<0.05.

Bird species/group	Correlation to cats	Correlation to dogs	Correlation to buildings
House sparrow	Positive	Positive	Positive
Sardinian warbler	Negative	Weak negative	negative
Great tit	none	none	none
European goldfinch	none	none	None
Blackbird	Weak negative	positive	none
Parakeets	none	none	Weak positive
Chukar partridge	none	none	none
Doves	positive	positive	positive
Eurasian Magpie	Weak negative	none	negative
Birds of prey	Weak negative	negative	negative
Eurasian Jay	none	none	none

Cats

When examining the results based on the small 200m areas in relation to total cats, House sparrows (Linear regression, $F_{1,412} = 14.876$, $p<0.001$, $r^2 = 0.0348$) and Doves (Linear regression, $F_{1,412} = 46.548$, $p<0.0001$, $r^2 = 0.102$) showed a positive correlation, while Sardinian warblers showed a negative correlation (Linear regression, $F_{1,334} = 10.728$, $p<0.01$, $r^2 = 0.0311$, fig 3). In addition, Blackbirds (Linear regression, $F_{1,412} = 4.0022$, $p<0.05$, $r^2 = 0.00962$, fig 4), Birds of prey (Linear regression, $F_{1,412} = 5.2107$, $p<0.05$, $r^2 = 0.0125$) and Magpies (Linear regression, $F_{1,412} = 6.1121$, $p<0.05$, $r^2 = 0.0146$) all showed a weak negative correlation. Sardinian warblers have negative correlation with cats but also houses. In semi-natural areas though, they show a negative correlation with cats but not with houses. Also, Blackbirds showed a weak negative correlation with cats and no correlation with building density in all habitats. House sparrows, doves and Birds of prey show a much stronger correlation with buildings than with cats in all habitats. The rest avian species/groups of species showed no correlation to cats. Lastly, cats are positively correlated with building density.
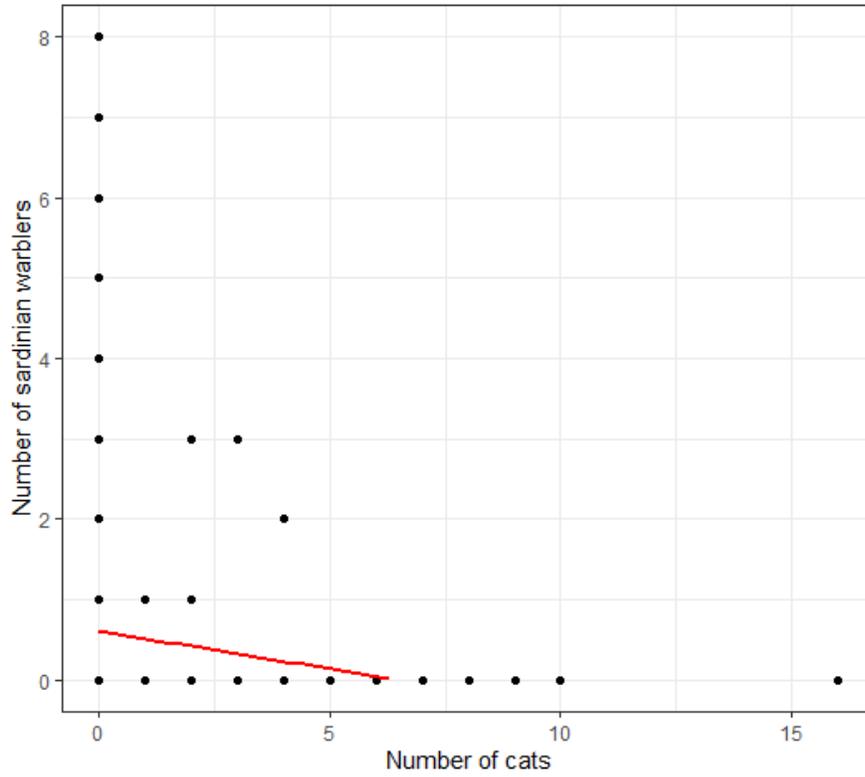
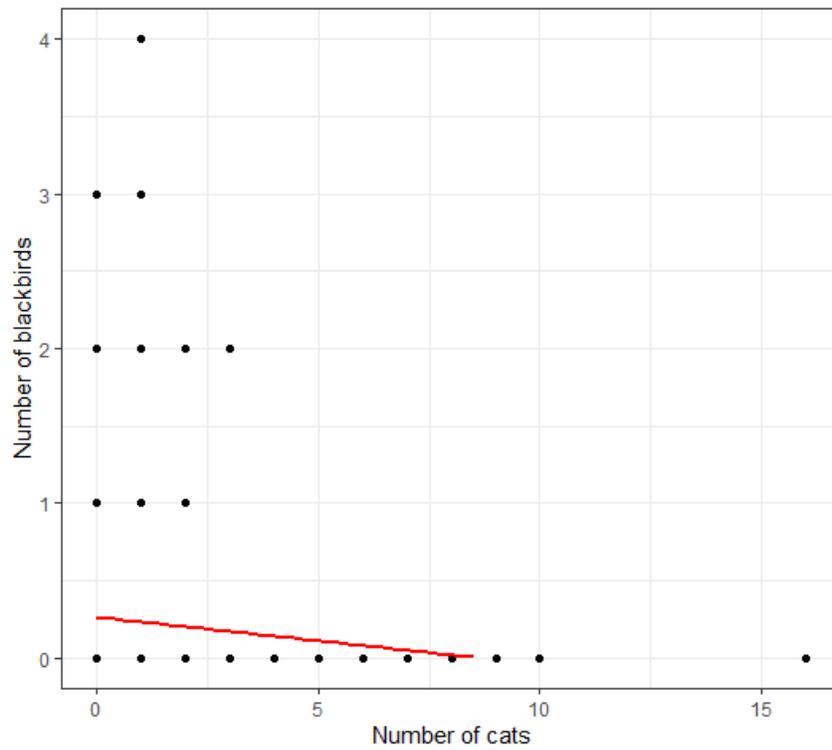*Figure 3: Sardinian warbler numbers in relation to cat numbers in 200m areas.*

Figure 4: Number of blackbirds in relation to number of cats in 200m areas.

Dogs

When run with total dogs, Blackbirds (Linear regression, $F_{1,412}=10.272$, p<0.01, $r^2=0.0243$; figure 5) and Doves (Linear regression, $F_{1,412}=7.9215$, p<0.01, $r^2=0.0189$) showed a positive correlation, while birds of prey (Linear regression, $F_{1,412}=10.466$, p<0.01, $r^2=0.0248$) and Sardinian warblers (Linear regression, $F_{1,334}=6.6265$, p<0.05, $r^2=0.0195$) showed a negative and weak negative correlation respectively. For House sparrows (Linear regression, $F_{1,412}=6.4398$, p<0.05, $r^2=0.0154$) there was a weak positive correlation. For all the species mentioned above, except for the Blackbird, the correlation they show with building density is stronger than the one they show with dogs. The rest avian species/groups of species showed no correlation. Lastly, dogs also show a strong positive correlation with building density.
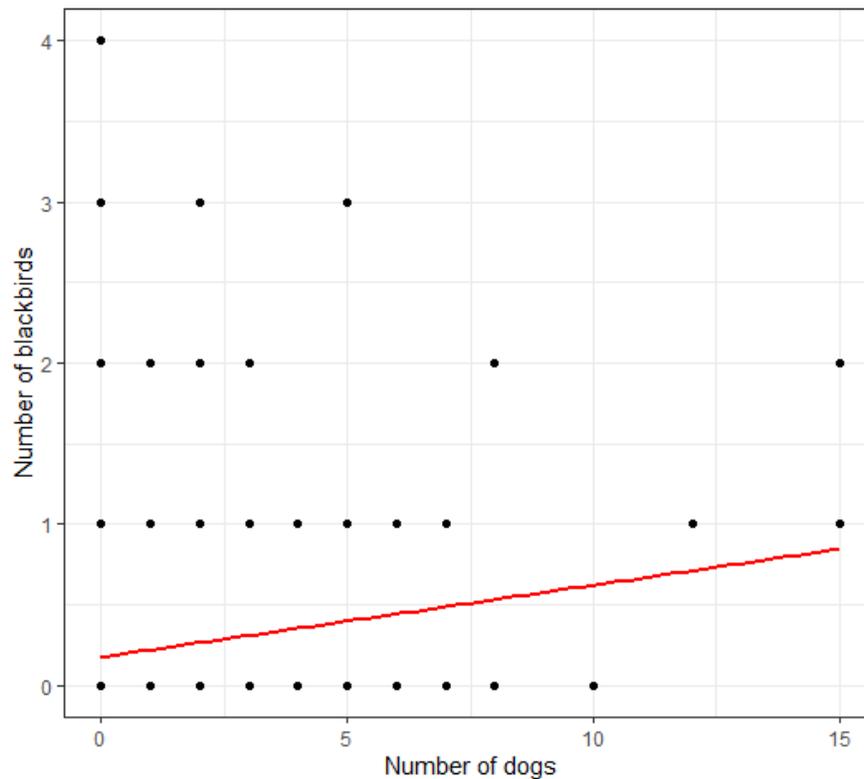

Figure 5: Number of blackbirds in relation to number of dogs in 200m areas.

Discussion

What the Results Mean

For many species, the correlation with cats and dogs is likely to be unrepresentative of the cat and dog effect. Areas with more buildings were found to have significantly more cats and dogs, which means that these two animals are proxies for building density. Thus, avian species that have a strong correlation with dogs or cats but an even stronger one with building density, are probably mostly affected by building density, which mostly represents habitat destruction but also presence of humans. Not all species are negatively affected by that, as we saw that house sparrows and doves are mostly found in densely built areas.

When looking at the effect of cats, there are two species that are possibly affected by them: Blackbirds, and Sardinian warblers. For Blackbirds, there is weak negative correlation with cats and no correlation with buildings in all habitats, meaning the effect is probably due to the cats. Concerning the Sardinian warbler, even though when using all samples, it has a strong negative correlation with both cats and building density, when only analysing semi-natural habitats, which are the majority of the samples, there is still strong negative correlation with cats, but no correlation with buildings, showing that in rural areas, cats are likely affecting the distribution of Sardinian warblers, decreasing their abundance at cat infested areas.

According to a study in Italy, Blackbirds were the most common bird species preyed upon by cats followed by the Blackcap which is closely related to the Sardinian warbler (Mori et al., 2019). Through our results we see that this predation rate is not negligible for the ecosystem as it seems that these two species are not found in cat infested areas. The impact is not limited to predation and extends to sublethal effects. A study in England that was done using Blackbirds, showed that cat presence imposes stress on parent birds which leads to them decreasing the amount of food they delivered to the chicks by a third (Bonnington et al., 2013). This had as a result for the chicks to grow slower by 40% (Bonnington et al., 2013).

Apart from direct predation and fear effects, cats can also compete with some bird species for food. Cats prey upon a large variety of vertebrates and invertebrates, many of which are main food sources for birds of prey. In Madagascar, fossa, a native predator is found to undergo competition against feral cats (Merson et al., 2018). Birds of prey are likely to be facing similar competition, even though through my data it is not clear whether birds of prey are influenced by cats as they are highly influenced by habitat destruction and in this study, cats are proxies for habitat destruction.

As it comes to dogs, the only species affected that is not affected by building density is the blackbird, which is positively correlated with dog numbers. The reason behind this trend is unknown. One possibility could be that dogs might deter cats, but our data does not show any such relationship between cats and dogs.

The cats that do the most harm, are the ones that get the chance to roam freely. This is supported by a study which showed that most wildlife killings are done by feral cats (Woinarski et al., 2017). In our study, cats that were not allowed to leave the house could not be spotted, so all cats that were seen are the ones that are allowed to roam and interact with wildlife.

Importance of Birds

Protecting birds benefits the whole ecosystem including humans. They not only pollinate plants, but also disperse their seeds, a crucial step for the survival of many plant species, some of which might be used by humans (Whelan et al., 2008). Moreover, they can act as pest controls, as a number of bird species feed on arthropods like crickets which can destroy crops (Whelan et al., 2008). Moreover, birds are the main natural control of weed grains, as they feed on them and limit their spread (Whelan et al., 2008). Some bird species like the woodpecker are also ecosystem engineers. Woodpeckers produce cavities in trees which are then used by other animals (Whelan et al., 2008). This shows that the protection of avian species, apart from being the ethically right thing to do, it is also something that can utterly help humans as well.

Owner's Responsibility

A study in the UK showed that most cat owners do not accept the fact that cats can be harmful to the ecosystem (McDonald et al., 2015). This is probably the main issue that needs to change in order for the owners to take measures and neutralize the effect that their cats have on wildlife. A study in Israel showed that a bit more than half of the cat owners of an area let their cats roam outside either for some time throughout the day or all the time (Finkler & Terkel, 2012). Another study in Australia showed that even though about half of the cat owners do not let their cats roam freely, the reason they do that is almost never affected by the fact that cats might disturb wildlife, and always had to

do with their pet's safety, which is another reason why cats should not be let to roam freely (Van Eeden et al., 2021). Cats on the street face many dangers such as cars, getting into fights with other cats, getting diseases or even poisoned (Trouwborst et al., 2020). Thus, it is not only in the best interest of birds for cats to not be roaming freely, but it is also in the best interest of the cats themselves. In the case that for any reason cats are left outside, there are still ways to minimize their impact. A study showed that the use of Catbibs (a colored cloth worn on the neck of the cat), prevented four-fifths of the cats from killing birds (Calver et al., 2007). The study also showed that most cats get used to the Catbib very easily.

Conclusion

The results on dogs show that they are not likely to be damaging avian populations significantly. On the other hand, this study showed that cats negatively affect Blackbirds and Sardinian warblers in Athens and most likely in many parts of the world.

Free-roaming cats and dogs, possibly affect the distribution of other species, which was not able to be specified in this study due to the small sample size. In addition, this study only covers a very small portion of habitats. Cats and dogs are present in most parts of the globe and interact with many more species than the ones mentioned in this study. A study of a bigger scale covering more parts of the world where cats and dogs are commonly found, could possibly identify more avian species that could face population declines and even extinction because of cats and perhaps by dogs. In order to protect wildlife from these pets, there needs to be a rise in awareness among the public and more specifically among pet owners. Studies like this show the ecological responsibility that comes with being a cat owner, but also a pet owner in general.

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