Are cats on rubbish dumps a problem?

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ABSTRACT

The study examines feral cats on rubbish dumps at four locations, two in NSW and two in the ACT Estimations of the following took place at selected dumps: total cat population; population density; population recovery after culling and population turnover. The epidemiology of the cats was examined in respect to: *Toxoplasma gondii* and *Sarcocystis* spp.; Feline Immunodeficiency virus (FIV), Feline Leukemia Virus (FeLV); and Upper Respiratory Tract Viral Disease. General condition, rectal temperature, and eye infection status were examined in relation to FIV positive cats.

Demographic parameters were investigated by trapping, collaring and spotlighting. Euthanasia was used to investigate population recovery. Cage traps and soft catch leg hold traps were used to capture the cats. A capture, mark, recapture system was developed which allowed populations to be estimated using the Lincoln / Peterson Index. The density and total population estimations from all sites were lower than previous studies would predict. This may be due to predators, particular factors in dump habitat, or population structure. Euthanasia of all trapped cats at one rubbish dump established that the population took approximately six months to recover to 70 percent of its original size. Cat population turnover was related to births, deaths, immigration and emigration.

A majority of the cats were suffering from some form of disease. There were indications of a high prevalence of Upper Respiratory Tract Viral Disease, gingivitis and FIV infection. No FeLV was found. FIV infection was more prevalent in adult males than in other classes, and made these cats more susceptible to other infections. FIV was associated with chronic, rather than potentially fatal disease. Though a majority of cats suffered indications of chronic disease, this did not appear to hinder them in any way nor restrict their reproduction.

It was concluded that cats on rubbish dumps are a problem because they influence the surrounding populations of feral cats and because they are reservoirs of disease for wildlife, livestock and humans, but particularly for domestic cats. However, the problem is limited. Management of dump sites and regular control every six months of cat populations will reduce this problem to a negligible level. Such control operations need to be considered in the context of integrated control of other pests, particularly exotic rodents such as *Rattus rattus* and *Mus domesticus.*

INTRODUCTION

The report presented here is a summary of an II month thesis conducted at the Department of Forestry (School of Resource and Environmental Management) at the Australian National University and the South Gundaroo Veterinary Clinic for an honours degree.

Why are feral cats on rubbish dumps a potential problem?

The potential problems that feral cats living on rubbish dumps pose can be divided into two aspects

1) Demography

i) Rubbish dumps may act as havens and breeding reservoirs for feral cats. They may create a constant supply of feral cats for surrounding areas.

ii) Large numbers of feral cats may have an impact on native fauna populations.

2) Epidemiology

i) Cats harbour a wide range of diseases communicable to other animals. However, the focus of this study was the spread of certain diseases as follows:

a) Human beings: toxoplasmosis and other parasitic infections;

b) Livestock: toxoplasmosis and sarcocystosis;

c) Native wildlife: toxoplasmosis and other parasitic infections;

d) Domestic cats: toxoplasmosis, sarcocystosis, general parasitic infections, Upper Respiratory Tract Viral Disease, Feline Immunodeficiency Virus and Feline Leukemia.

In summary , information was sought on whether feral cats living on rubbish dumps alter the surrounding populations of feral cats and whether cats on rubbish dumps act as a reservoir of disease that may affect other animals.

OBJECTIVES

Primarily the study aimed to answer the question' Are cats on rubbish dumps a problem ?' The objectives outlined below consider the demographical and epidemiological aspects of this question.

Demography

The demographic objectives of this study were to increase knowledge of the dynamics of:

1) Cat populations and cat density: how many cats live on rubbish dumps?
2) Cat population recovery: after the original population is removed?
3) The turnover of cats within the rubbish dump populations.

Epidemiology

The epidemiological objectives of this study aim to increase the level of knowledge concerning the role of parasites and disease in feral cat populations living on rubbish dumps. The epidemiological objectives of this study are the assessment of the prevalence of the following in the rubbish dump cat populations:

1. toxoplasmosis and sarcocystosis;
2. internal and external parasites;
3. Feline AIDS and Leukemia;
4. Upper Respiratory Tract Viral Disease.

METHODOLOGY

Location

Four rubbish dumps were chosen as study sites, two in rural settings and two in the ACT on the outskirts of Canberra. The two rural study sites were Gundaroo Rubbish Dump (north east of the ACT in the Shire of Gunning, NSW) and Mac's Reef Road Rubbish Dump, (north east of the ACT in the Shire of Yarralumla, NSW). The two urban sites were Mugga Lane Rubbish Dump and Belconnen Rubbish Dump both in the ACT Belconnen Rubbish Dump is in North Canberra and Mugga Lane Rubbish Dump is in East Canberra.

Methods

A regime of trapping, spotlighting, collaring and euthanasia was implemented.

Trapping: cats were trapped by either cage traps or soft catch leg hold traps. Bait consisted of a combination of fresh fish, cat food and fresh cat nip.

Spotlighting: spotlighting at the smaller rural dumps was performed on foot following a set path around the dump. To cover the larger city dumps spotlighting was conducted from a four wheel drive vehicle.

Collaring: upon the completion of the physical examination, cats intended for release were individually fitted with a colour coded collar and chest harness. Reflective aluminium discs were riveted to a wool collar. Each collar had a unique combination of reflective discs, which were identifiable when illuminated by a spotlight. A harness was incorporated in the design to ensure that the cats were unable to remove the collars.

Euthanasia: once the trapped Mugga Lane Dump cats had been anaesthetised and examined, they were put down by an injection of Valabarb euthanasia solution (Sodium pentobarbitone 300 mg/ml).

Demographic methodology

Spotlighting, trapping, collaring and euthanasia of cats were performed selectively at each dump to estimate different aspects of the demography outlined in the objectives.

Gundaroo Rubbish Dump: this site was used for trials of the collar design and trapping methodology.

Mac's Reef Road Rubbish Dump: cats at this site were collared and the population estimated by applying spotlighting counts to the Lincoln/Peterson Index.

Mugga Lane Rubbish Dump: cats trapped were euthanased and the time taken for the population to recover was measured. The population was estimated by ample spotlighting counts.

Belconnen Rubbish Dump: trapped cats were collared and the population estimated by applying spotlighting counts to the Lincoln/Peterson Index. The numbers of collared and uncollared cats in the population was monitored over a six month period to assess the population turnover.

Epidemiological methodology

Parasite analysis: cat faeces were tested for the presence of parasite eggs or oocysts by means of routine faecal flotation in a saturated solution of either sodium nitrate or sodium chloride.

Blood tests for FIV and FeLV: a packaged test kit produced by CITE Combo of the IDEXX Corporation was used to test the anticoagulated whole blood samples for the presence of the Feline AIDS (FIV) and Leukemia viruses: in FIV infected cats, Upper Respiratory Tract Viral Disease, elevated rectal temperature, eye infection and the general condition of the cats were analysed to examine any possible relationship between a greater prevalence of disease and FIV infection (see below for methods of physical examination).

Physical examination and indices of Upper Respiratory Tract Viral Disease: the incidence of throat, eye and nose infection gives an indication of the possible prevalence of upper respiratory disease and a measure of the general health of the cat populations:

a. Throat: the throat of each cat was examined by gently pulling out the tongue of the animal and checking the pharynx for any redness or inflammation.

b. Eyes: the eyes and eye lids and membrane were checked for any visible disorders. Discharge from the eyes was recorded if present. Discharge from the eyes gives an indication of the possible presence of Upper Respiratory

Tract Viral Disease.

c. Nose: discharge from the nose was recorded if present. Discharge from the nose gives an indication of the possible presence of Upper Respiratory Tract Viral Disease.
d. Gums: the presence or absence of gingivitis was recorded, but the severity of infection was not categorised.

Reproductive capacity: in males the scrotum was felt for the presence of the testicles. If the testicles were present the cat was recorded as complete and, if they were absent, as incomplete. In females if a mid ventral or lateral scar was present the cat was presumed to have been spayed and it was recorded as incomplete. If a scar was not visible the reproductive capacity of the cat was presumed to be complete.

Rectal temperature: rectal temperature was taken with a thermometer as soon as possible after capture. Cat rectal temperature was recorded in two categories to estimate the proportion of the population suffering from elevated rectal temperatures. The categories were as follows:

a. ≤39.0o C: below or equal to this temperature, cats were presumed as not febrile.
b. ≥39.lo C: above or equal to this temperature cats were presumed as febrile.

General condition: the general condition of the cat was scored subjectively on the basis of external physical observations only. Coat gloss and condition, weight and fat deposits present were used to assess the general condition score for each cat. The condition of the cat was recorded on a scale of one to five as follows:

1. emaciated;
2. poor condition;
3. average condition;
4. good condition;
5. excellent condition.

RESULTS

Where it was necessary to compare results in the demographic study for significant differences, the Mann-Whitney U Test was applied (Runyon and Haber 1984). A P value of < 0.05 was considered to be significant.

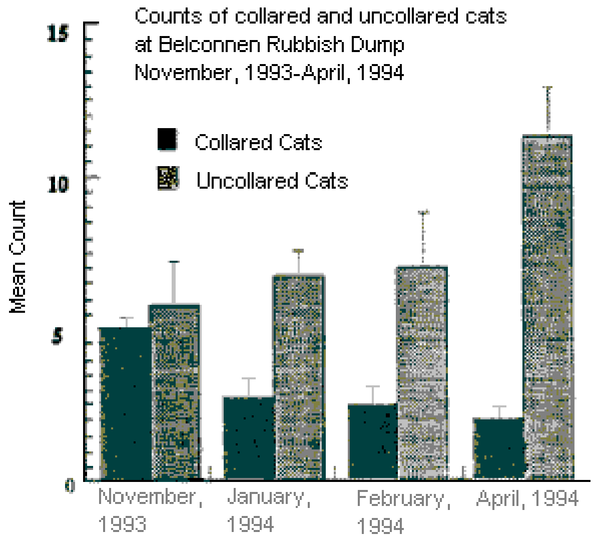
Cat populations and density at rubbish dumps

(i)	Mac's Reef Road:	Population of 22 cats		
		Density (22 cats 125 ha)	=	90 cats km^{-2}
(ii)	Mugga Lane:	Population of 24 cats		
		Density (24 cats 1140 ha)	=	19 km^{-2}
(iii)	Belconnen:	Population of 36 cats		
		Density of(35 cats /95 ha)	=	38 cats km^{-2}

Cat population recovery time: Mugga Lane Rubbish Dump

Consider Figure 1. There is a significant difference between the November, 1993 population estimate and the January, 1994, February, 1994 and April, 1994 results. This indicates a significant increase in the numbers of cats and shows the recovery of the population after the cull. As can be seen from Figure 1, following the removal of cats in November 1993, the count of cats at this site was greatly reduced. In November 1993, the count of cats was 15 percent of what it had been in September 1993. However. in January 1994. it had reached 50 percent of the September count. This rose to 60 percent in February 1994, and to 70 percent at the beginning of April 1994.

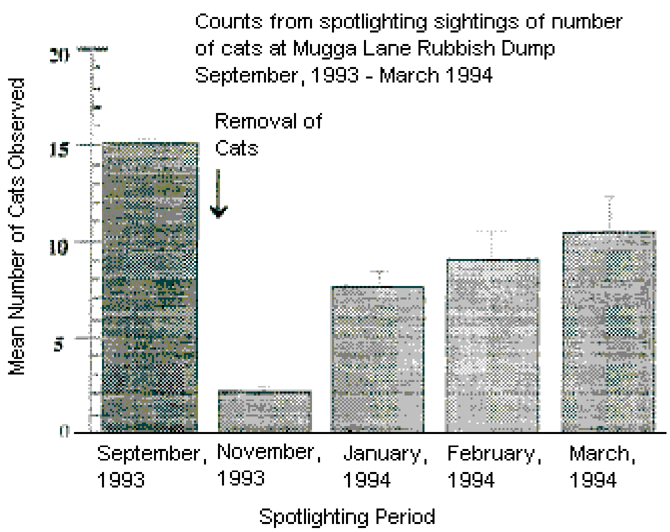
Figure 1



Population turnover: Belconnen Rubbish Dump

The variation in the counts of collared (black) and uncollared cats (stippled) at Belconnen Rubbish Dump is illustrated in Figure 2. Each bar of the graph represents counts of either collared or uncollared cats for the four nights in each spotlighting period. There was a significant drop in the count of collared cats between the November, 1993 and the January, 1994 spotlighting periods. This is also the case between the November, 1994 and April, 1994 spotlighting periods. There is a drop in collared cats that is not quite significant between the November, 1993 and February, 1994 spotlighting periods. Despite this slight inconsistency the trend shown is a fall in the number of collared cats over time. Increases in the number of uncollared cats between the January, 1994 and April, 1994 spotlighting periods did not quite reach significance and all other differences between periods were not significant. Although the increases in the number of uncollared cats were not significant, a trend of increasing numbers of these cats is observable.

Figure 2



Epidemiological results

Where it was necessary to compare results in the epidemiological study for significant differences, the Fisher's Exact Test was applied to a 2 x 2 contingency table. The exception to the use of the Fisher's Exact Test was the consideration of general condition of the cats. In this case the results were compared using the Mann-Whitney U Test. In all cases a p value of < 0.05 was considered to be significant.

Parasite analysis

All the parasites in the Table 1 present a potential risk of infection to domestic cats. Particular note should be paid to the presence of *Spirometra erinacei*, *Toxocara cati*. *Ancylostoma tubaeformae* and *Toxoplasma gondii*, as all these parasites have been recorded as infecting humans. Attention is also drawn to the absence of *Sarcocystis spp.* and the incidence of *T. gondii.* The prevalence of these species is important in assessing the risk of parasitic infection to wildlife and livestock.

Table I.

Prevalence and identifications of parasite species

Faecal analysis	**Number of cats identified with parasite species**	**Percentage prevalence**
where n = sample size = 53		
Helminth species:		
* *Spirometra erinacei*	20	38
* *Ancylostoma tubaeformae*	26	49
Protozoan species:		
**Toxoplasma gondii*	3	6
Sarcocystis spp.	0	0

*Species known to be infectious to human beings.

Blood test results: Feline Immunodeficiency Virus (FIV) and Feline Leukemia Virus (FeLV)

The cats positive for FIV are shown in Table 2. Note that no juveniles and only one sub adult cat tested positive for antibodies to FIV. The results indicated that FIV was almost completely restricted to the adult cat population.

None of the cats surveyed in the study was positive for the presence of the FeL V antigen. Thus this virus is unimportant in the epidemiology of these feral dump cats, and its complete absence is, in itself, worthy of note.

FIV infection in relation to other health indices

General condition: there was a significant difference in the general condition score between FIV positive and FIV negative cats. This infers that cats with FIV have poorer general condition.

Rectal temperature: consideration of FIV positive cats and those that .were not positive showed that the number of FIV positive cats in the elevated temperature category was significant. From this one can state that FIV cats have higher rectal temperatures than the other cats examined.

Eye infection: there was no significant difference in eye infections between all FIV positive cats and all FIV negative cats. However, further analysis showed that when only male adult cats were considered, there was a significant difference in the prevalence of eye infection between FIV positive and FIV negative categories. The results suggest that FIV positive adult males were more prone to eye infection than FIV negative adult males.

Table 2

Prevalence of FIV infection in age/sex classes

Age/Sex class	Sample size	Percentage FIV positive
Adult females	29	17
Adult males	31	45
Sub adult females	3	0
Sub adult males	6	17
Juvenile males	5	0
Juvenile males	9	

Indices of Upper Respiratory Tract Viral Disease

The study found that over half the cats examined were suffering from throat infections and that over one fifth of the cats were suffering from eye infections (see Table 3). This indicates that there may be a high prevalence of Upper Respiratory Tract Viral Disease in the dump cats. The study also found that 64 percent of all cats suffered from gingivitis infections.

Table 3

Prevalence of gingivitis and indices of Upper Respiratory Tract Viral Disease

Population category	Sample size	Gingivitis	Eye condition	Throat condition
	n =	% infected	% infected	% infected
Adults	60	72	17	50
Sub adults	9	78	33	67
Juveniles	14	21	43	64
TOTAL	83	64	23	54

Reproductive capacity

Physical examination to ascertain the reproductive capacity (number of desexed cats) in the population found that only one of the 97 cats trapped was neutered. The neutered cat was an adult male trapped at Belconnen Rubbish Dump.

DISCUSSION

Population estimation and density

The estimates of cat population and density found in this study from all three sites are lower than might have been predicted from the previous studies of cats living on garbage refuse. Cats living on rubbish dumps have clumped food resources in the form of garbage and would be predicted to be in the highest density classification of Liberg and Sandell (1988). For example, studies associated with clumped food resources such as Izawa et al. (1982) found feral cats at population densities of 2,350 krn^{-2}, while Natoli (1985) found densities of cats between 1000 and 2000 krn-2 in Rome. Haspel and Calhoon (1989) found densities of 488 cats km^{-2} in the streets of Brooklyn and Dards (1981) studied feral cats feeding on garbage skips and food handouts in Portsmouth Dockyards and found a high density of cats namely, 200 km^{-2} .

The only site in this study to approach this highest density level was at Mac's Reef Road where density was 90 cats per krn^{-2}. which is at the lower end of the high density classification. The two urban sites were classified in the medium density class of between 5 and 50 cats krn^{-2} (Liberg and Sandell 1988).

This study and that of Page et al. (1992) at Avonmouth Docks in England indicated that foxes were common in the study locations. It is possible that fox predation on the cat population in these areas is restricting the number of cats. It may be plausible to hypothesise that foxes are the limiting factor for these cat populations.

A second plausible reason for the smaller than expected population of cats in this study relates to group size formation. Liberg (1980) noted that the combined range of a group of female cats does not overlap with that of any other group of females. Dards (1978) also found evidence for this in Portsmouth Docklands. Izawa et al. (1982) found that cats living on dumped fish wastes in Japan formed feeding groups. The combination of numbers of cats in separate feeding groups may be responsible for the high population numbers recorded in these above studies.

If cats at each rubbish dump in the present study had formed a single feeding group around one central rubbish face or feeding site the maximum population size for those singular groups may be the limiting factor of those cat populations.

Population recovery and population turnover

Population recovery: consideration of the growth of these counts would suggest that a period of approximately 6-8 months is needed for the count to recover to its original pre-euthanasia level. Thus, one can say with some confidence that following euthanasia at a dump site such as Mugga Lane, the population of cats will be restored to 70 percent of its original level in approximately six months. Spotlighting at Mugga Lane four to five months after the cats were put down indicated a distinct presence of juvenile cats. However, spotlighting results indicated that the population recovery was a result of both natural population increase and immigration to the dump.

Population turnover: in consideration of Figure 2 it appears a significant proportion of the original collared cats seen in November, 1993 either left the site or died over the period between November, 1993 and April, 1994. The apparent high turnover rate seen in the cat population at Belconnen Dump may be explained in three ways: (1) high death rates may occur and the losses so sustained may be replaced by high immigration; (2) high rates of emigration may occur accompanied by high rates of immigration; (3) the possible existence of a central population of cats that actually live on the rubbish dump and a large surrounding population that utilise the dump as a part of their home range. The central cat population may reach a ceiling so that new additions to that population must leave the central area of the dump and establish a range outside of the rubbish face area. These cats may disperse from the central area of the dump to the periphery or emigrate entirely from the dump area. This seems the most plausible explanation. A study by Liberg (1980) supports the notion of dispersal of sub adult males from a rubbish site, as he found that juvenile males dispersed from their birth places when establishing themselves as adults.

Reproductive capacity

A interesting finding of this study was that only one of the cats that inhabited the rubbish dumps was desexed. Is this the case because owners of desexed cats care more for their pets and are less likely to abandon or lose them, or because entire cats are more likely to become feral than desexed cats ?

DISCUSSION OF THE EPIDEMIOLOGICAL STUDY

Discussion of parasite analysis

Toxoplasmosis had an overall of 6 percent. A low finding of *T. gondii* oocycts is not surprising as juvenile cats normally only excrete oocyts for short periods and it is rare for adult cats to excrete oocyts (Dubey and Beatie 1988). Studies conducted in Baltimore, USA suggested that FIV infection and associated immuno-suppression may be a factor in active Toxoplasma infection in cats (Witt et al. 1989). With this in mind, while the prevalence of *T. gondii* found in this study was low, it does not negate the possibility that toxoplasmosis infection could be more prevalent than was detected. It is therefore concluded that, although the prevalence of *T. gondii* was low, there is still some risk of *Toxoplasma* infection to livestock, wildlife and humans.

The study revealed no *Sarcocystis* spp. in the cat faecal samples tested. Although the parasite analysis was not completely conclusive, this result suggests that there is a negligible to non-existent risk of rubbish dump cats being responsible for the transmission of *Sarcocystis* spp. to livestock.

The parasites *T. cali*, *A. lubaeformae* and *S. erinacei* have all been recorded as capable of parasitic infection in man (Mahood 1979). However, the incidence of these infections is low and it is my considered opinion that the risk to humans from dump cats is extremely slight.

Discussion of the blood tests for FIV and FeLV

FeLV was completely absent in the rubbish dump cat population. This result in the rubbish dump cat population is in agreement with the studies conducted by Wilkinson and Thompson (1987) in South East Queensland and studies conducted by Hardy (1980) cited in Wilkinson and Thompson (1987) in the USA. The results from the present studies and those listed above suggest that Feline Leukemia has a low prevalence within the cat populations.

The overall prevalence of FIV in cats in the study was 24 percent. These FIV positive cats were generally more subject to infection than others. It was found that these cats had higher rectal temperatures and poorer general condition than FIV negative cats.

Males were more heavily infected with FIV than females. This increase in male eye infection may be a reflection of the adverse immuno suppressant effects of this virus. Chronic conjunctivitis was found in 11 percent of cats positive for FIV by Yamamoto et al. (1989). Thus it would appear that eye infection is common among FIV positive cats.

The higher prevalence of FIV in the adult male population suggests biting as a predominant mode of transmission of the virus, as was suggested by Yamamoto et al. (1989). Adult male cats are more likely to be involved in fighting than other sections of the cat population and thus suffer a greater frequency of bite wounds.

The conclusion of the present study is that FIV infection in cats causes a generalised immune deficiency which leads to poorer general condition and to the establishment of various infections, although infection with FIV was associated with chronic disease rather than being a potentially fatal disease. FIV infection is likely to increase in the population with age and is more likely to have an increased prevalence in the adult male population. These conclusions are in general agreement with studies conducted by Grindem et al. (1989) in Wake County, North Carolina. Ishida et al. (1989) in Japan and Bennett et al. (1989) in Switzerland and the United Kingdom.

Discussion of the physical examination /indices of Upper Respiratory Tract Viral Disease

The indicators implied that upper respiratory viral disease was widespread in the examined cat population. This is in agreement with the study of Coman et al. (1981) which found feline Upper Respiratory Tract Viral Disease to be prevalent in feral cats in South Eastern Australia.

CONCLUSIONS

Conclusion for the demographic study

Cats on rubbish dumps are a problem in that they are a source of supply for other feral cat populations. This was strongly inferred from the high turnover rate at the Belconnen Rubbish Dump. Dumps are also a problem because they attract feral cats and allow them to multiply more than would be expected if they were living solely off live prey. This is inferred from the recovery of the populations following culling, an effect that must be due in part to immigration.

However, these problems are not as severe as one might expect. This is because the population and density of cats on the study sites was less than previous investigations might have predicted.

Conclusion for the epidemiological study

The seemingly contradictory overall conclusion reached by this study was that, despite high disease pressure, most cats appeared healthy and well nourished. The disease pressure in this study did not seem to prevent or restrict the cats from reproducing or hinder their lifestyle in any obvious way. The diseases in the population appeared to be of a chronic rather than an acute nature.

Rubbish dump cats are a reservoir of disease. This has the potential to affect other animals. How much it does so, however, is unknown.

Conclusions for management

Results of this study suggest that removal of cats from rubbish dumps would need to occur approximately once in every six months for effective reductions in cat populations. However , management to control feral cat populations may be more effective in the long term if control is exercised over the source of the problem rather than the problem itself. The provision of food and shelter are the factors that attract and sustain cat populations at rubbish dumps. If by overall management one could control these factors, feral cat numbers could be greatly reduced.

Overall conclusion: are cats on rubbish dumps a problem?

The answer to this question is yes, but to a limited degree. The issue is complex and possible solutions are also complicated. For example any control of cats would need to be tempered by the knowledge that rodent numbers may increase as a result. The managers of the Mac's Reef Road rubbish dump reported that at another rubbish dump under their control cats had been actively removed. The result of this action was an increase in the number of rodents at that site. Rodents can be serious predators of wildlife such as ground nesting birds (Atkinson 1985) and can also be vectors of disease (Innes 1990). Thus rubbish dump cat control may reduce cat problems but also cause other associated problems in the process.

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