THE ECOLOGY AND CONTROL OF FERAL CATS

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HABITAT UTILISATION BY FERAL CATS IN PORTSMOUTH DOCKYARD

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Introduction

In recent years it has become increasingly apparent that feral or free-living cats *(Felis catus)* are much more numerous than was once realised. In view of the threat of rabies entering Britain attention has been focussed on these animals and their status and the nuisance that they can cause has been much discussed.

The present study of the cats in Portsmouth dockyard, part of Her Majesty's Naval Base in Hampshire, was conducted from October 1975 to July 1979. These cats may be described as feral since they are not domiciled with man. Although they are by no means completely independent no constraints are placed on their breeding and very few are tame enough to be handled. They are officially considered to be pests and, until the start of this study, were trapped and destroyed by the dockyard Pest Control Officers.

THE HABITAT

The physical component

Portsmouth dockyard is situated on the west side of Portsea Island, in Hampshire, southern England. The city of Portsmouth covers the whole of Portsea Island and also extends northwards on to the mainland. The first record of a walled dockyard there was in 1212, but since this time the dockyard has been much enlarged and altered. It is divided into three areas, on a historical basis, Area 1 being the first to be developed, and Area 3 the last *(Figure 1).*

The main existing walls were built in 1711 and 1864 and stand three to five metres high. They form an effective barrier to the outside world in those regions of the dockyard which are not bounded by the waters of Portsmouth Harbour. There are six gates leading into the dockyard, two of which (marked A and D in *Figure 1)* are open for at least pedestrian access at all times. The remaining four are only open for limited periods each day.

The dockyard measures, at its widest points, 1.6 km east-west, and 1.3 km north-south, but is irregular in shape and includes large basins and docks, resulting in a land area of about 85 hectares.

Most of the dockyard is covered by buildings, any open areas generally being used as open-air stores or for construction work. The buildings range in size from one which covers nearly two hectares down to those which cover only a few square metres. They range in height from single storey buildings to large construction shops or multi-storey office buildings. They are all numbered, both on a metal plate on the wall of each building and on the maps. This fact, together with the north-south, east-west orientation of most of the buildings, makes the location of positions in the dockyard very easy. The buildings are used for a wide variety of purposes, including ship

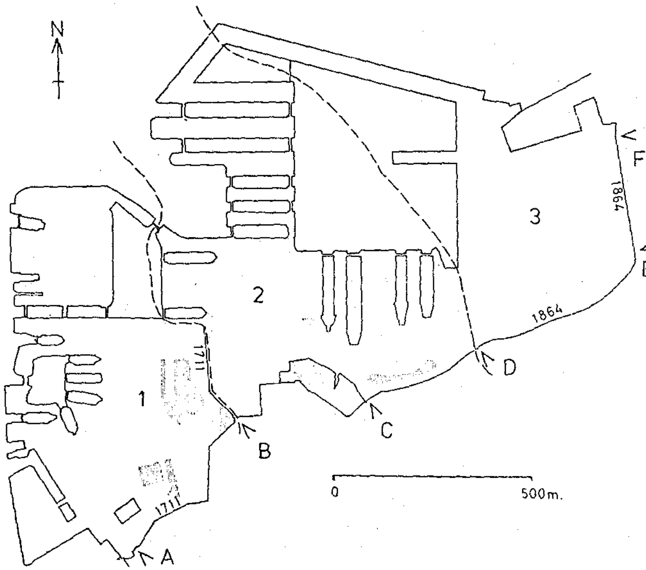


FIGURE 1
Map of Portsmouth dockyard, showing the division into three areas, the dates of the walls, the gates (A - F) and the main areas of vegetation (stippled).

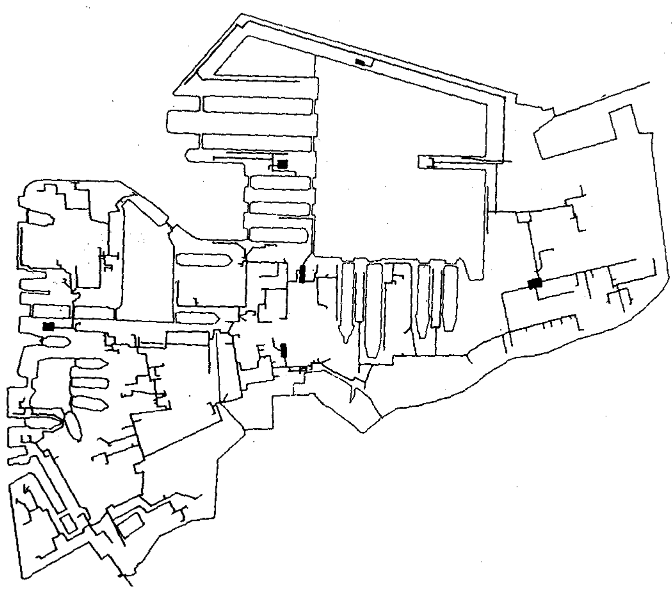


FIGURE 2
A simplified map of the steam pipe system, to indicate the areas covered.

shops, welding shops, stores, offices, canteens, fleet amenity centres, boiler houses, a church, a few residential houses, and the museum buildings of H.M.S. Victory. The buildings vary in the degree to which they are secure from entry, some storage sheds having open sides or permanently open doorways. Other buildings have large doorways which are open for all or part of the working day, or have holes in the walls, broken windows, or tunnels through which cables pass. All these provide access for animals of cat size or less.

As well as the walled buildings, there are a number of compounds fenced with wire netting. These are either storage areas or house large transformers. The netting is two to three metres high but is not always secure as there are often holes at the bottom or gaps under the gates.

Apart from these permanent and prominent features of the habitat there are others which may remain in one place for less than a day or for many months. Piles of wood, metal, propellers, aerial boxes, rudders, crates, cable drums and many other materials, sometimes covered by tarpaulins, are to be seen around the dockyard and are usually relatively permanent although there is a turnover in the individual parts which make up each pile. Gangways are abundant in all areas near the water's edge and may be left in the same place, unused, for several months. Large skips and smaller bins are also common, especially near ships, and although they are emptied frequently they are returned to approximately the same place. The ships themselves, although not strictly part of the habitat, may have an important influence on the area where they are berthed. However ships which are refitted in dry docks may remain for over a year and as a result become an integral part of the dockyard habitat.

Cars and other vehicles form the most transient feature of the dockyard but are important since they are present in such large numbers. Almost the whole dockyard is surfaced with tarmac or concrete so there is vehicle access between any buildings which are sufficiently separated. There is also a network of kerbed roads which has been extended over recent years.

The less obvious features of the dockyard are those below the ground. Most of the dockyard uses steam for basic heating and there is a network of steam and condensate mains, spreading from several boiler houses (Figure 2). Both steam pipes and large electrical cables are laid in trenches which are roofed over either with thick steel plates or with concrete slabs. There is usually a space, where pipes or cables enter or ascend the side of a building, which is large enough to allow cat-sized animals access into the tunnel and sometimes into the building as well. Some pipes and cables are laid in large tunnels, high enough for a man to walk down, which are reached by steps or a ladder. The steam pipes are an important physical factor since, in spite of their insulation, they release quite large amounts of heat and sometimes steam. The high temperature of the steam-pipe covers becomes obvious after rain when they show up as dry strips.

A further important difference between the dockyard habitat and a natural environment is the level of illumination at night. Most of the dockyard is lit with yellow street-lamps to the standard of a normal urban street. Although there are some darker areas, there are also some very brightly-lit areas, especially around ships in refit. It should be noted that the dockyard forms a very changeable habitat in comparison with most natural environments. During the period of this study there were a number of changes in the buildings and there were several recently-built construction shops when the work commenced. Buildings are continually being pulled down and new structures erected during the dockyard's programme of redevelopment.

The biological component

The dockyard is essentially an urban habitat. Apart from a few cultivated areas the dockyard initially appears devoid of non-human life. Closer examination, however, reveals a relatively wide diversity of urban, wasteland and salt-tolerant species. The plant life of the dockyard mainly occurs as small clumps or single plants. Excepting the cultivated areas and two overgrown sites in the north-east of the dockyard *(Figure I),* the vegetation seldom covers areas of more than a few square metres. However, a surprising number of species were identified. Of the 54 species, the commonest were annual meadow grass *(Poa annua)* and Oxford ragwort *(Senecio squalidus).* The latter is a large plant and is the most abundant herb measured in terms of biomass.

Of the insect life in the dockyard, the most abundant large species are the cockroaches *(Blatta orientalis* and *Periplaneta americana)* and house crickets *(Acheta domesticus).* These are imported species which seek out warmth and are therefore confined to buildings and steam pipes. The dockyard authorities consider them to be pests. Although none of these species is seen frequently the crickets can often be heard stridulating from the steam pipes. Blowflies *(Calliphora vomitoria)* are also observed in the dockyard. No attempt was made to identify the smaller invertebrate species.

The bird life consists mainly of black-headed gulls *(Larus ridibundus),* feral pigeons *(Columba livia)* and sparrows *(Passer domesticus),* which roost in many areas of the dockyard. These birds forage in the dockyard and also in the city and surrounding area. Other birds which are seen in the dockyard are starlings *(Sturnus vulgaris)* herring gulls *(Larus argentatus)* and woodpigeons *(Columba palumbus).* Blackbirds (*Turdus merula)* are seen around the garden areas. One kestrel (*Falco tinnunculus)* and one common tern *(Sterna hirudino)* were observed flying over the dockyard.

The mammalian life, apart from the cats and people, consists of mice *(Mus musculus)* and rats *(Rattus norvegicus* and possibly *Rattus rattus).* These are important pests, and their populations are controlled by the Pest Control Officers, using Warfarin. The size of the populations is difficult to assess. Mice venturing into the open were observed on only two occasions, and dead young rats (measuring about 25 cm nose to tail) were observed twice. However, some dockyard workers reported that they had frequently seen rodents in the dockyard although they appeared to be less common than they had been in the past.

Dogs *(Canis familiaris)* were also observed in the dockyard, usually accompanied by their owners. One stray was known to have entered the dockyard but was quickly caught and removed by the authorities. There were only a few owned dogs which belonged to the residents or to ships which were confined to inland waters. (Ships' pets were generally forbidden, due to concern over rabies.)

Man is obviously an important factor in the habitat. Approximately ten thousand people work in Portsmouth dockyard and of these about a quarter are office staff. Many of the remainder spend most of their time working in the open. The main clocking-on time is 7.30 a.m., although some staff start to arrive at 6.30. They start to leave at 4.00 p.m., and leave half-hourly until 6.00 or 6.30 p.m. In the period between 6.30 p.m. and 6.30 a.m., the dockyard is very quiet, the only people present being those involved in maintenance and security and a few night-shift workers and naval personnel. Saturday mornings are as busy as weekdays, but the afternoons and Sundays are quiet, although there is more activity than during weekday evenings.

Use of cover

Cats are seldom seen crossing open areas or resting in exposed places and the observed ranges of cats suggest that cover is an important factor in their distribution. The dockyard was found to support a population of about 300 cats which utilise all the varied forms of cover that are available.

The preferred resting places for cats are: inside netted compounds, where they are safe from human intrusion; on top of or inside steam pipe tunnels, or on the steam pipes which run along the sides of buildings, where they are warm and can easily conceal themselves from people; and on or under gangways, which are of such a shape that a resting cat is not easily visible to passers-by. Cats will also rest among anything that provides a relatively warm substratum and where they are not too obviously visible. Apart from all the stores and dockyard materials which provide cover for cats, there are also an extraordinary number of boxes, usually filled with bedding of some sort, and provided with doorways, which are put out by the dockyard workers for the cats to use.

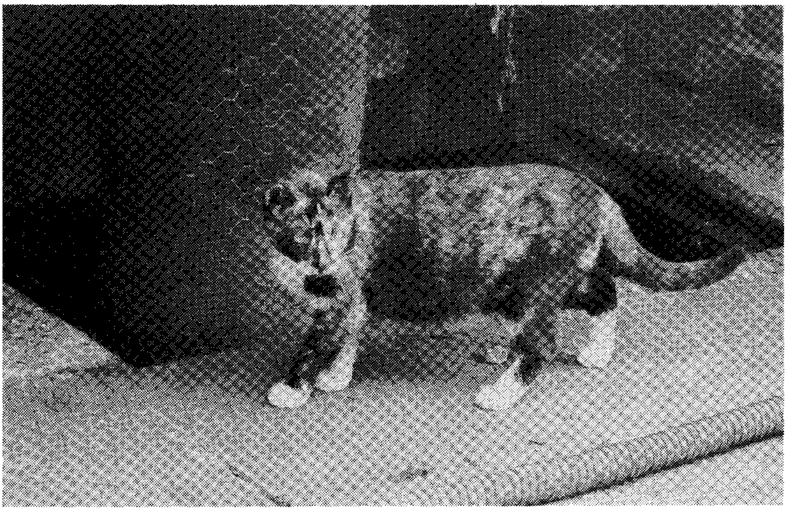
Parked cars are not only used for concealment by resting cats, but are also used by cats which are proceeding between resting places, in preference to walking in the open. It is also possible that cats travel between areas in the steam pipe or cable tunnels.

Buildings obviously provide useful cover from the elements, if not from people, and it seems likely that cats spend some time inside buildings if they can. Sometimes cats are encouraged to live inside a building, and become "pets", but usually one cat is considered sufficient, and most cats are unpopular indoors, mainly because of smells. Workers generally make their buildings cat-proof if they can, and some people also discourage cats outside by putting metal plates or bricks over steam pipe holes, or by pouring disinfectant on the ground.

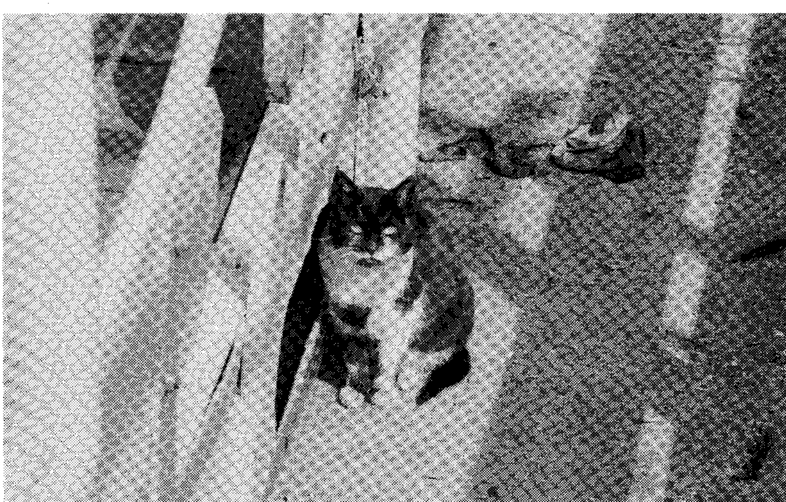
USE OF FOOD

Observational data

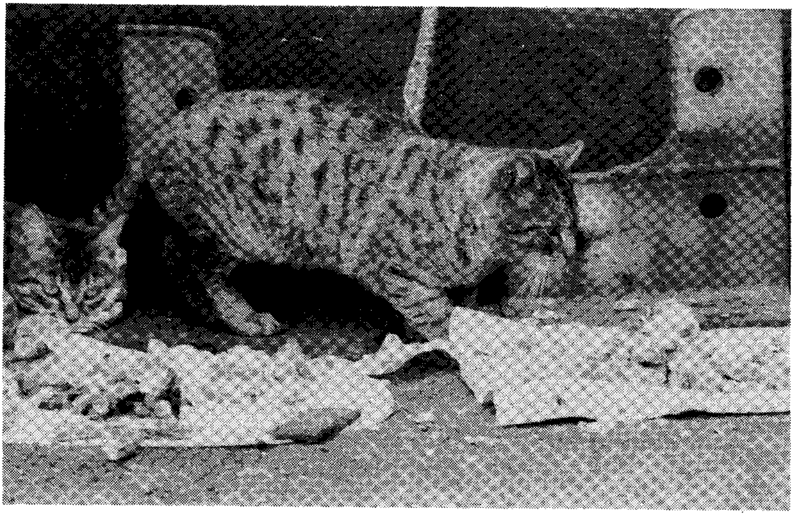
As is the case with cover, there are both accidental and deliberate sources of food for cats. Observations of feeding cats and food availability suggests that the food put out for cats by dockyard workers and, to a lesser extent, naval personnel is the most important source. Feeding of cats varies in extent from people who casually throw food down, to people who feed cats every day, including weekends and bank holidays, usually at a particular site (Figure 3). In the latter case, the cats soon learn where and when they are fed and gather at the appropriate place and time. Some cats utilise a number of different feeding sites and several groups are fed by more than one person. The food supplied may be tinned or dried cat food (some



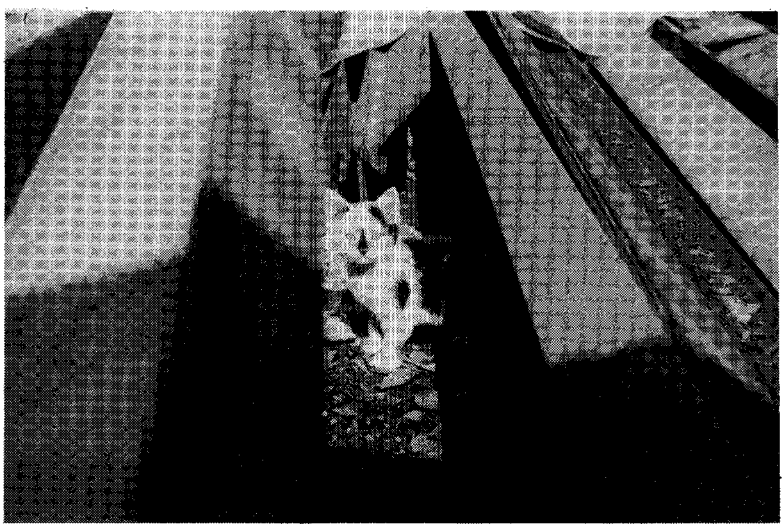
Cat by steam pipe hole-Portsmouth Dockyard



Cat by gangway-Portsmouth Dockyard



Tom and female feeding on scraps-Portsmouth Dockyard



Kitten using dockyard materials for cover-Portsmouth Dockyard

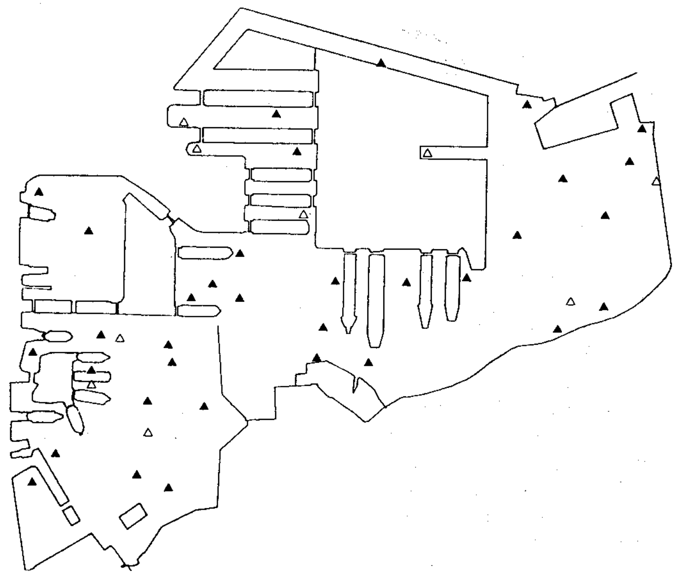


FIGURE 3

The locations of feeding sites, where cats were fed by dockyard workers at least once every weekday. (▲ = sites in use in 1978. Δ = sites no longer in use in 1978).

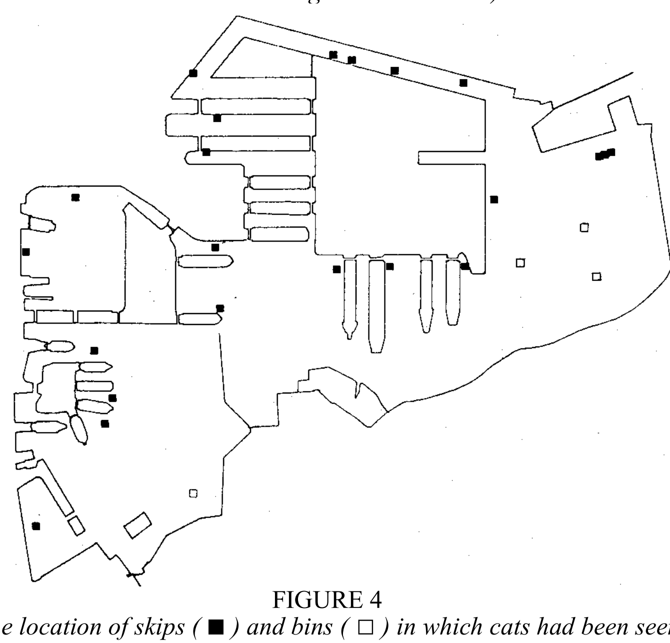


FIGURE 4

The location of skips (■) and bins (□) in which cats had been seen foraging. Note that the sullage ground, in the north-east of the dockyard, is represented by three skips. There were usually six or more skips at this site.

people spending as much as fifteen pounds a week on this), with water or milk, or cooked or raw scraps. Sometimes large mounds of cooked chicken, sausages or roast beef may be seen, which appear suitable for human consumption.

Another form of food supplied by humans is fresh fish, since it is common to see people fishing from the jetties at weekends or lunch-times. Cats have learnt that an ample supply of small fish may be obtained on these occasions, and will sit around fishermen waiting for the catch to be reeled in.

The second most important source of food appears to be that obtained by foraging in the skips or bins. These contain a variety of rubbish, those in areas close to ships often containing large quantities of discarded food. Skips are taken to the sullage ground in the north-east corner of the dockyard to be emptied, and the waste is compressed and removed to the city dump. The cats in this area therefore benefit from a constant supply of refuse in which to forage. There are two sizes of skip, both having at least one side sloping outwards to the lower lip of the opening. In the taller skips, this lip is about 1.5 metres off the ground, but, despite this, cats will jump up on to it from a sitting position. Cats also forage in the smaller cylindrical wheeled bins. The locations of skips and bins in which cats have been seen foraging are shown in *Figure 4*.

Apart from the food that is present due to man's activities, all the non-human fauna (except dogs) is potential food for cats. However, although cats were often seen eating cat food or foraging in skips, there was little observational evidence of the natural food supply being utilised.

In view of the large population of insects in the dockyard, it might be expected that the cats would prey on them. However, although cats were observed stalking or pouncing on insects, and one cat was found holding a cricket (*Acheta domesticus*) down with his paw, there was only one occasion on which a cat was observed to eat an insect (a blue-bottle, *Calliphora vomitoria*). In view of the fact that cats were also observed pouncing repeatedly on scraps of paper blowing in the wind, it seems likely that their attention to insects should be classified as play rather than as serious hunting.

Dead birds and piles of feathers were found relatively frequently in the dockyard. Of 14 dead birds which were noted during patrols, eight were feral pigeons, three were blackbirds, and the remaining three were a sparrow, a black-headed gull, and a starling. The sparrow was being played with by a juvenile cat. It was not usually possible to tell whether the birds had actually been killed by cats, but the fact that all of them were at sites where cats rested suggests that this was so. All except the sparrow and the gull were damaged, in most cases evidently from feeding by cats, although some may just have rotted. Often the head or breast meat was missing.

Several people reported that they had seen cats stalk and kill gulls. I never observed any actual kills although several unsuccessful stalks were seen. On one occasion I saw two cats pouncing on a young pigeon which was unable to fly. Despite three attacks, the pigeon walked away and the cats apparently lost interest in it.

Although the rodent population in the dockyard was reported to be relatively high, mice and rats were rarely seen. However, of two dead rats observed, both were in the same area, and one was in the possession of a cat and her three kittens. This was not eaten, as it was found again a few days later, rotting.

The other mammal available as food in the dockyard is the cat itself. Although there is no evidence that adult cats were eaten, six out of 30 dead kittens found were partly eaten. One of these was removed from an adult female which was eating it, and was judged to be at least a week old. Although it is possible that other animals (such as rats) were sometimes responsible for the damage to dead kittens, this finding suggests that cats were the most likely culprits.

The cause of death of the kittens found was usually unknown, although there is some reported evidence that kittens may be killed by adult cats. It seems unlikely that the kittens were actually killed for food. Inexperienced mothers are sometimes recorded as eating their kittens after eating the after-birth, and this may account for one of the half-eaten kittens. For the older kittens, it seems more likely that they had died and been chewed after death. The sites of damage were not always consistent with normal feeding patterns. For example, one kitten was found with the legs and tail missing, and the head chewed to a pulp.

Cats were seen eating grass on several occasions, and in one case the cat had walked some distance from her usual area, directly to a relatively large (about 0.5 m^2) patch of grass, and started eating there. Only once was a cat observed to vomit after eating grass, but evidence that this had occurred was found on two other occasions. Most of the fluids utilised by cats were milk or water provided by people. However, they were also seen drinking from puddles, or from leaking water supply lines to berthed ships.

Stomach contents and faeces

Some investigation of stomach contents and faeces was undertaken in an attempt to ascertain how much naturally-occurring food in the dockyard was eaten by cats.

The stomachs of 14 cats which were found dead were examined, either by me or by a veterinary surgeon, Mr. T. Gruffyd-Jones, during *post mortem* examination. They were from seven kittens, five juveniles (6-12 months old), and two adults. Four stomachs were completely empty. One contained blood due to injuries sustained at the time of death, and another was empty except for four large nematode worms (probably *Toxocara cati),* and a little hair. The eight stomachs which contained food all contained soft, amorphous food which could have been either cat food or scraps, with the exception of that of a three-week-old kitten, which was full of milk. One stomach examined by the veterinary surgeon also contained bones which were thought to be those of a rodent. Of six stomachs which were not completely empty, three contained grass fragments up to 3.5 cm long, or seed husks. Four contained cat hair, in one case large amounts forming hair-balls. The results are summarised in *Table 1.*

Samples of faeces were collected from most of the areas where groups of cats lived. A total of 23 samples from 20 areas, with an average weight of approximately 60 g (total weight of 1400 g) were analysed. The dry faeces were soaked in water for 24 hours, and then sieved through a deck of soil sieves with a jet of fast-running water. The contents of the sieves were then examined for identifiable remains. The occurrence of the types of remains found is given in *Table 2.*

Table 1

Contents of 14 stomachs examined

Contents of stomach	*No. of stomachs*
Empty of food	6
Soft food	7
Milk	1
Bones	1
Nematode worms	2
Hair	4*
Grass	3*
Plastic bay (corner)	1

* out of six stomachs examined which were not completely empty.

Of the four samples in which large numbers of fish vertebrae were found, two came from areas where cats had been seen obtaining fresh fish from fishermen, and three of these samples also contained otoliths. No attempt was made to identify the species of fish eaten, since these were known to be provided by people, and were not natural prey.

The non-fish bones observed (in 21 samples) were, in most cases, too fragmented to be identifiable, but in five samples vertebrae were found, which were identified as being from birds. These vertebrae were all large, and would have come from species the size of a gull or chicken. It seems likely that much of the bone was from birds, being light cream in colour and delicate in structure. However, some larger fragments of darker bone were also found. It is possible that these came from cooked food fed to the cats or obtained from skips. These would typically be large bones from joints of meat, but some chicken bones or even whole chicken carcasses may sometimes have been available.

In support of the evidence from the bones that birds were being eaten, fragments of feathers were found in six samples. Unfortunately the feathers were downy or fragments of covert feathers in most cases, and identification by the node shape of the downy barbules (Day 1966) was only possible in one sample. These were identifiable as Columbiform, and therefore probably came from a feral pigeon.

Eye lenses were found in 12 samples. Unfortunately it was not possible, on the basis of structure, to determine the group of animals from which these originated. This may have been possible using immunological assay methods. It would appear that they came from either birds or fish, but both groups may have been represented, since lenses were found in samples which contained fish remains, birds remains, or both.

Insect remains were found in four samples, and consisted of fragments of chitin, a leg and two elytra.

The faeces provided no evidence to indicate that mammals had been eaten, although it is possible that some of the bone fragments were mammalian in origin. It was not possible to detect any hair other than cat hair, which was present in very large quantities, and sometimes accounted for a large part of the volume of the faeces. All the samples contained hair, and in most cases this was matted together to form hair-balls. The amount

Table 2

The occurrence of identifiable remains in 23 samples of faeces, collected from group areas

Group	*Bone fragments*	*Bird vertebrae*	*Feather fragments*	*Eye lenses (no.)*	*Fish vertebrae (no.)*	*Fish otoliths (no.)*	*Grass**	*Cat hair (index**)*	*Insect*	*Other*	*Weight of remains****	*Sample weight (g)*
A	+	-	-	-	8	1	(+)	0	-	-	+	c.45
A	-	-	-	-	-	-	0.03	0	-	-	-	45
B	+	-	-	1	-	2	+ +	3	-	-	+	c.25
B	+	-	-	1	-	-	0.37	4	-	-	0.01	44
C	+	-	-	-	-	-	+	1	+	-	+	c.25
C	+	+	-	3	-	-	0.23	3	-	-	1.29	71
D	+	+	+	-	2	-	0.51	3	-	maize	2.12	61
E	+	-	-	2	1	-	0.04	2	-	-	0.37	83
F	+	-	-	1	1	-	(+)	0	-	-	+	c.30
G	+	-	+	-	-	-	0.08	3	-	-	1.85	58
I	+	+	+	2	2	-	+	4	-	paper	0.98	72
M	+	+	-	-	-	-	0.50	4	-	-	1.89	65
N	+	-	-	3	-	-	0.09	0	+	plastic	0.29	42
0	+	-	-	8	-	5	0.11	2	-	claws	0.02	100
P	+	-	+	1	10	1	0.08	2	-	-	0.11	90
R	+	-	+	1	6	2	0.02	4	-	****	0.32	43
S	+	-	-	1	1	-	-	1	-	-	0.08	101
T	+	-	+	-	-	-	+	1	-	-	0.17	40
V	-	-	-	-	-	-	+	4	+	-	-	90
W	+	+	-	1	7	-	+	2	-	rubber	0.23	54
Z	+	-	-	-	1	-	0.04	3	+	-	0.41	65
1-94	+	-	-	-	1	-	+ +	4	-	-	0.04	82
2 -104	+	-	-	2	-	1	0.61	3	-	-	0.67	67
Occur.	21	5	6	13	11	6	22	19	4	6		1398
% occ.	91	22	26	57	48	26	96	83	17	26		

+ and - indicate presence or absence.

* Dry weight (g) is given where available. (+) = very little, + = some, + + = lots.

** See text for index. Presence is of hair-balls.

*** Weight of bone, lenses and otoliths.

**** This sample contained a rubber band, portion of plastic bag and maize.

Table 3

A comparison of densities of cats *(Felis catus)* in different environments

Location	*Habitat type*		*Approx. No. /Km²*	*Source*
Portsmouth Dockyard	Urban	Total (average)	> 300	Present study
		Adult (average)	> 200	
Sacramento Valley (U.S.A.)	Rural		12	Hubbs (1951)
Orongorongo Valley (New Zealand)	Rural	Average	1	Fitzgerald & Karl (1979)
		Maximum	3	
Devon farm	Rural		6	Macdonald & Apps (1978)
Marion Island	Sub-antarctic	Coastal regions	14	van Aarde (1978)
		Interior regions	5	
Macquarie Island	Sub-antarctic		4-7	Jones (1977)
Monach Islands (Outer Hebrides)	Rural, uninhabited		6	Corbett (pers. comm.)
Kerguelen Island (Indian Ocean)	Rural		2-3	Derenne (1976)

of hair present was difficult to quantify, and the presence of hair-balls was therefore scored on a four-point index scale.

The grass which was found in the faeces was almost completely unaffected by its passage through the cat's digestive system, green blades up to 17 cm long being found, and also flowerheads. The latter were usually from *Poa annua,* which suggests that the cats were eating the most readily available grass. Grass in the faeces was frequently found to be bound up with hair-balls or fragments of bone, and it appeared possible that grass helped to clear these from the gut. There was some indication of a positive correlation between the amount of hair and the amount of grass and solid remains in the samples.

Density and distribution

Individual cats were identified by coat pattern, and observations over three years revealed that the total population fluctuated around 300 (252 - 351), and that of the adults around 190 (164 - 203). This gives an average density of over two cats per hectare, which is very high in comparison with rural cats *(Table 3).* The population was found to be surprisingly stable.

On a large scale, the cats were distributed relatively evenly throughout the dockyard, there being no significant difference between the observed distribution in nine major areas and that expected, assuming uniform density. However, the deviation from expected was slightly greater for females than for males. Females outnumbered males in all areas except one.

On a smaller scale, the distribution of female cats was markedly aggregated. Social groups of females and their offspring shared ranges and core areas, and areas between the group core areas were seldom used except by mature toms (Dards 1978). The distribution of the group ranges is shown in *Figure 5,* and a comparison with *Figures 3* and *4* reveals a relationship with the distribution of feeding sites. Toms' ranges were ten times the size of those of females and overlapped freely.

Conclusions

It is apparent, from the high density of cats present, that Portsmouth dockyard is a very favourable environment for these animals. Cover is abundant, providing shelter from both people and the elements. For the latter aspect the steam pipes, which provide warmth, are especially important. Food also appears to be abundant. So much cat food is available at some sites that food may remain uneaten for relatively long periods. The veterinary surgeon, after conducting *post mortem* examinations on several animals, commented that they were in surprisingly good condition, with large fat deposits.

From observational evidence, it seems that handouts (in the form of cat food or scraps) and refuse are the most important sources of food for the cats. Most groups utilise both these sources, although handouts probably contribute most to the diet overall.

Faecal analysis results show that the natural food supply is being utilised to only a limited extent. It is known that many well-fed housecats still hunt, kill, and frequently eat their natural prey (George 1974, 1978). They may be motivated by a strong drive to hunt, or be seeking variation in the diet. The degree of predation on birds shown by the dockyard cats is probably

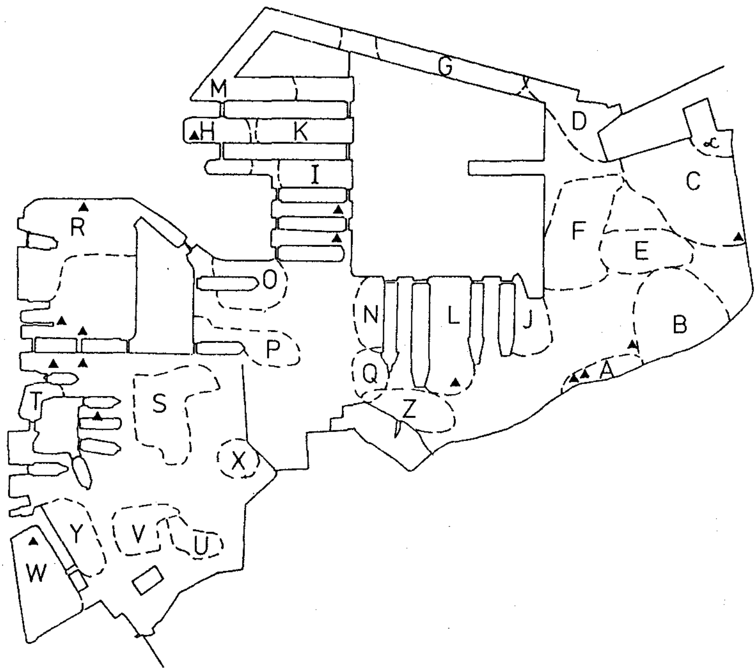


FIGURE 5

The locations of the group ranges, based on the home ranges of the females. The core areas of solitary females which were seen more than ten times are also shown (▲)

comparable with that of these housecats, and does not indicate that the artificial food supply is inadequate. In fact, it appears that there is so much food available that cats can afford to ignore the less palatable items. For example, they were observed to leave dead fish uneaten on many occasions, and the fishermen who fed them reported that the cats preferred live fish to dead ones. The evidence that few insects are eaten also supports the suggestion that alternative food supplies are plentiful. McMurry and Sperry (1941) found that in an urban area of their study, insects, mainly Orthoptera, could form 25 per cent of the diet of free-ranging cats. Thus the dockyard cats are not exploiting a suitable, and apparently abundant, food supply.

The lack of rodent remains in the faeces of dockyard cats is surprising, in view of the common incidence of bird remains. Fitzgerald and Karl (1979), in their review of the food habits of free-ranging cats, noted that these animals are generally predators of small mammals, and that birds are a less important item in the diet. The exception is the situation in which rodents are scarce, and ground-nesting birds plentiful, as is found on some subantarctic islands. In view of the uneaten dead rats which were observed in the dockyard, it is possible that the cats find mice and rats less palatable than birds. Alternatively, rodents may be less common in the dockyard than the authorities believe.

It is possible that the cats would eat more hunted prey if the handouts were reduced, although some cats are probably poor hunters. The effect of the cats on the rodent population is not known, and it may be that many more individuals are killed than are eaten.

Although there appears to be an abundant supply of food in the dockyard, it is possible that water may sometimes be in short supply. It appears that the major source of fluids for the dockyard cats is that provided by people, mainly in the form of milk. Other sources of water may not be available during extremes of temperature. Puddles dry up in hot weather, although leaking water will still be available. In very cold weather all water supplies may freeze.

Grass must also be considered to be an important part of the diet. The interweaving of grass with hair, and to a lesser extent bone, in the faeces, suggests that grass may be eaten in order to help clear the gut. This may well be a more important result of eating grass than the better-known emetic effect. It should be noted that both these effects have an important function, since impacted hair in the stomach can make an animal seriously ill. The quantities of cat hair found in the dockyard faeces were enormous in comparison with those found in rural areas (Corbett, pers. comm.), probably due to the large amounts of time that the cats spent washing in this dirty environment.

In general, the apparent abundance of food in the dockyard is important, since it appears that this is an example of a population which is not ultimately limited by food. In view of this, it is interesting to speculate on the reasons for the observed stability of the population, in spite of a relatively high turnover in numbers. There is some indication that social factors may be inhibiting reproduction in some cases. However, much further work is needed on this subject before a firm conclusion can be drawn. However, if it is indeed the case that the population is self-regulating, it makes the problem of population management by people a difficult one. It is possible that the carrying capacity of the habitat in terms of food would have to be drastically reduced in order to have any effect on the number of cats. Cover may be a more important aspect of the habitat, but equally difficult to control. It is suggested that the problem of control in the dockyard should be directed more towards minimising the nuisance effect of the cats than towards reducing the numbers of cats themselves.

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POINTS RAISED IN DISCUSSION

Mrs. de Clifford (*Cats Protection League)* asked about the general state of health of the cats in **Mr. Rees'** colony and was told that veterinary surgeons from Liverpool University, who had performed the neutering operations, considered the cats to be in very good health. Asked at what size colonies stopped increasing in numbers and remained static **Mr. Rees** said it would probably depend on the food and shelter available and would vary between colonies. Most colonies were subjected to removal by man so there was little opportunity to examine other regulating factors. However, there did appear to be a balance between births and losses due to mortality and/or emigration.

Dr. Panaman *(St. Andrews University)* asked whether the approximate number of feral cats in Great Britain was known and **Mr. Tabor** replied that he currently estimated this to be 1½ millions. He would continue to gather information to improve the definition of that number.

Asked about the validity of the linear graph *(Figure 1* in his paper) relating the home range to cat density, **Mr. Tabor** pointed out that it was based on work carried out independently by three different groups, Macdonald and Apps on farm cats, Dards on dockyard cats and himself, and it was interesting that when these data were plotted in this way they lay on a straight line.

In reply to a question about cross-suckling **Mr. Tabor** said a number of cat-breeders had noticed co-operation between cats of the same genetic stock helping with cross-suckling. **Dr. Macdonald** had recorded on film a sequence where semi-feral farm cats helped each other when kittens were born and then cross-suckled. **Mr. Tabor** went on to say he had observed similar acts when the mothers were not from the same genetic stock but had been put together while young kittens and no doubt believed they were of the same family unit. The things which bound a family unit together were socially cohesive displays of rubbing and similar association, i.e. cross-suckling occurred because of a tight family social grouping and not necessarily because of genetic linking. Close social behaviour did improve the survival rate of a particular group of animals, whether or not they were closely linked genetically.

Mr. Davy *(MAFF)* asked whether, during the weaning period when the adult females were away catching prey to bring home, the tom cat helped in any way. Communal kitten minding would obviate the likelihood of strange toms entering, also predators such as the fox and badger. **Dr. Macdonald** replied that he was fairly certain the tom did not help, although it was seen on two occasions dragging back large prey and leaving it half hidden where the mothers subsequently discovered it, but there was nothing to suggest it was brought back specifically for them. Biologists had been taught that carnivores were social because they hunted collaboratively, but subsequently it was noticed that badgers, and to some extent foxes although living together did not hunt collaboratively. Information relating to collaborative rearing might be the start of an answer as to why this was so.

Dr. Panaman asked whether it would be useful to distinguish between the various kinds of amicable interactions–shoulder rub, head rub, etc.

Dr. Macdonald replied that the data were available but had not been analysed yet and there might, or might not, be significant differences.

Mrs. de Clifford asked whether measurements had been taken to discover which of the females had the most milk. **Dr. Macdonald** replied that a mother cat produced most milk the closer to the time she had her kittens. It was difficult to quantify because kittens were born on different days, were different sizes and the mothers in a different stage of milk cycle.

Dr. Panaman asked whether inbreeding could affect the population in Portsmouth Dockyard. **Dr. Dards** said that although all the groups were related family units, the female kittens that were born stayed in the group but the male kittens left as soon as they were sexually mature and went to other areas in the dockyard. A lot of mixing took place and although immigration from the outside was very low there was not so much inbreeding as there was in other small isolated groups.

In reply to **Miss Hammond's** question regarding mortality **Dr. Dards** said all the kittens seemed to contract cat 'flu to some extent and the mortality was high. She pointed out that the actual number of kittens born was lower than normal; given that there were about 100 female cats in the dockyard the average number of kittens born was only four per female per year.

Dr. Dards was asked how long the dockyard had been isolated. She replied that the main walls were built in 1711 and 1864. The coat colour genetics were very different from the remainder of the South of England and the gene frequencies supported the suggestion that the cat population in the dockyard had been effectively isolated since the walls were built. **The Chairman, Dr. Jackson**, asked what was the relationship of the various coat colours, as there appeared to be large numbers of black and white cats. **Dr. Dards** replied that the frequency of the non-agouti (that is, black) allele was about the same as it was in the rest of the country. The differences between dockyard cats and those in the rest of the South of England were to be found in the other colours. For example, there were not many orange cats and there were rather more mackerel tabbies and less blotched tabbies than would have been expected. There were also more whitespotted cats, especially among the darker-coloured animals, although this was not so in young cats. This suggested that something was selecting against dark-coloured adults without white spotting, and it appeared that these were the animals most likely to be hit on the roads when the dockyard workers left at night.

In reply to **Miss Hammond's** question about the possibility of neutering the cats **Dr. Dards** said she thought the dockyard was an exceptional case, apart from its size, because there was a large number of family groups within a fairly small area, the groups lived close together and the females could easily wander into other areas. In addition there would be the traumatic effect of removal and return after neutering.

Mr. Davy asked for more information about the grass which was found in the intestines. **Dr. Dards** explained that the grass binds up with the hair balls and bone fragments and helped to clear the gut and the Chairman said that, as a veterinary surgeon he would like to point out that cats ate grass as a form of medicine; it was freely available roughage and some cats required more grass than others–it was certainly not eaten as a food.

Mr. Sealey-Clark (*Cat Action Trust*) asked whether any signs of stress had been seen in the cats living at such a high density level and **Dr. Dards** replied that she had never actually observed any stress signs. The cats seemed to live amicably within the groups and although there was some indication that there was inhibition of breeding it was not very clear-cut. **Mr. Sealey Clark** went on to ask when were the main peaks of activity in the dockyard and **Dr. Dards** said the cats were not very active but were more active during the day than at night with peaks at dawn and dusk, even when these did not coincide with human activity, and again during feeding time.