

The distribution of the underground rat population of a south Yorkshire drift mine

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INTRODUCTION

Observations on the biology of rodents in coal mines are few. Elton (1936) described twelve specimens of house mice (*Mus musculus*) from 1800 ft. in a coal mine in Ayrshire, and Ritchie (1914) recorded the presence of mice and *Rattus norvegicus* living in a Midlothian mine at a depth of 750 ft.

Whilst studying infestations of *R. norvegicus* in drift mines certain observations were recorded on the distribution and movements of rats underground in relation to the presence of men.

THE HABITAT

One or more tunnels, the drifts, 4–8 ft. high and 10–14 ft. wide, connect the underground workings with the surface. Their lengths vary from 30 to 2000 yards and their construction from solid rock to debris supported by steel arches and concrete slabs. The floor in the largest mines may be concrete but more usually is a natural one, in many cases wet. The surface openings of drift mines may be amongst the pit head buildings although in some cases they are amongst woodland and agricultural land.

The underground workings are similar to the drift except that for the most part the walls are formed of 'pack', a honeycomb structure made of the shattered rock and debris removed with the getting of coal.

In the drift mine studied the men were distributed underground in the following manner: coal face, 65%; loading and transfer points, 20%; travelling on roadways, 15%.

At loading and transfer points where the tubs change direction or where coal is transferred to another conveyor belt it is usual to find three or four men who spend their working time at that point. Electrical installations are usually situated at such places set in large recesses in the rock where there is space for several men to sit and eat their food.

The travelling men whose duty it is to clear up spilled coal and keep the drifts and roadways tidy usually join one or other of the groups for meal breaks. Thus the largest manpower groupings are at the coal faces with smaller groups scattered throughout the pit. The distance apart of these small units depends upon the extent of the workings. The coal face workers usually retreat 10 or 20 yards from the face for meals.

Fig. 1 shows the distribution of men and rats in a medium-sized drift mine in

south Yorkshire. It will be seen that group A is nearest the mine entrances and group F the most distant. The number of men working in each of the six groups per 24 hr. is as follows:

Group A	Loading point	27 men
B	Coal face	21
C	Coal face	18
D	Travelling men	12
E	Coal face	51
F	Coal face	36

(The rat colonies are similarly referred to as colony A, B, etc., according to the group of men with which they are associated.)

The temperature in drift mines is fairly constant, being higher than surface temperatures in winter and lower in summer, coupled with a fairly high humidity. Most parts of a mine are in darkness.

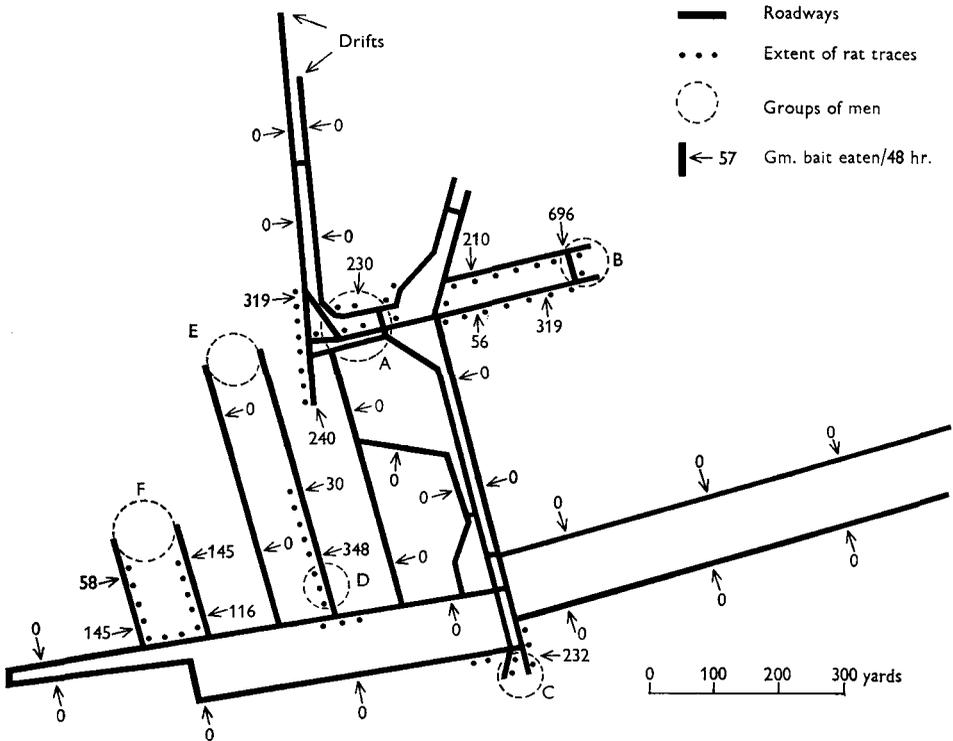


Fig. 1. Underground distribution of rats and men.

DISTRIBUTION AND MOVEMENTS OF RATS

Rat footprints

Methods

Very fine stone dust, used in fire suppression in the pits, proved excellent material for tracing rat footprints. When used in the drifts it is difficult, when footprints overlap, to determine the direction of movement by this method but some measure of the frequency of use of the drift can be obtained.

The difficulty of finding droppings and smears in the workings is compensated by the ease with which footprints and tail marks are found in the fine coal dust which exists throughout most of a mine.

Test baiting

In order to determine the limits of an infestation it is standard practice to test bait prior to carrying out poison treatments. Usually the work is done in sections over a period of a few weeks but on the occasions from which the present data were collected the entire mine was baited. A surplus of bait was provided at all points.

Rat entry

Results

Although some rats must be taken underground in materials the majority almost certainly walk down the drift and it seems that the greatest movement takes place at night when human activity in the drifts is at a minimum and rats are more active. Nevertheless at the mine studied, rats were commonly seen foraging amongst the surface buildings in daytime.

First-hand accounts from mine managers and officials of how, when leaving the mine at night, they have seen rats moving down the drift, their eyes reflecting the light from the miner's spot lamp, are too numerous to ignore altogether.

During a test period of 4 months from October to January dust tracing in the drifts of the study mine revealed rat footprints on almost every night during a 4-week period (10 October–14 November), often going in both directions. The drift entrances were 30 yards from colliery buildings which were rat infested. Traces ceased on 14 November and had not been seen by 5 December when poison treatments were carried out. Various devices to determine whether these were surface rats going down or vice versa had to be abandoned because of the passage of tubs and men down the drift.

Underground it is seen that rat footprints are common in the immediate neighbourhood of the areas where men work and eat their food and extend some distance away from this place in one or more directions. In the small mine where distances between the groups are short it is fairly common to find footprints between the groups but rarely do they form a regular run, more often they are isolated tracks. In a large mine where distances are greater and may be half a mile or more between groups rat traces are rarely found in the inter-group roadways.

Colony A. This was situated at the bottom of the drifts where considerable human activity centred around the despatch of coal to the surface. The area was predominantly wet and had little illumination other than that from miners' lamps.

Rat activity extended approximately 80 yards in two directions from the edge of the circle of human activity and high takes of 319 and 240 g. were recorded at the limit of the range.

Colony B. Slightly smaller in manpower than group A this unit had a rat population which extended its movements two hundred yards from the group down both approach roadways and along a linking trunk road. There did not appear to be any movements linking the rats of this colony with those of colony A.

In addition to the men in group B one man permanently, and others occasionally, worked and had meal breaks at the road junction nearest to the point showing a take of 56 g. It was not possible to determine whether there was a subsidiary rat colony living near this point because of the high general level of activity in the roadways.

Colony C. From the last traces of rat colony B it is 490 yards to the colony at group C. This colony was small and no traces were found more than 50 yards from the men.

Colony D. The twelve men at D are those who travel along the roadways in the vicinity during work but congregate either at D or at a face for meals. There was a small number of rats in close proximity whose range extended 120 yards towards group E and 40 yards along the main roadway.

Colony E. The largest face in the mine in terms of men was distinguished by the fact that it had no rats at the time of investigation although there is no reason to suppose that any factor other than time was responsible for this state of affairs. It was not possible to postpone poisoning to allow colonization of the area to occur.

Colony F. A large rat colony whose range extended down both approach roads and linked up along the main road in much the same manner as at group B was present at this, the second largest group of men. At the junction nearest the point from which 116 g. of bait was taken one man, occasionally joined by another two, had his eating place.

Additional evidence for the rat-man relationship

An interesting piece of information was collected from a drift mine in south Yorkshire during 1954.

During the first 5 months of 1954 reports were received of extensive rat activity in two districts of the mine, East 7 and East 8, which were working full time. At the end of May both districts ceased work on reaching the boundary and East 6 was started as a replacement district. Prior to this time it had neither men nor rats. All workmen were transferred to East 6 and East 7 and 8 were abandoned except for two or three men engaged on salvage work. Within a week reports were received of a considerable infestation in East 6 district. Test baiting revealed that takes in East 6 were heavy whilst they were small in East 7 and 8.

Prior to the evacuation of men to East 6 that area was not in the range of the rats of East 7 and 8 and it would seem that they either followed the workmen in search of food or the almost abrupt curtailment of scraps forced them to range further in search of food until they eventually contacted their former source.

Further evidence of discrete rat colonies is presented by poisoning records. It is normal practice to poison one or two areas of rat activity at a time and when this is combined with test baiting of other colonies at the same time there is no measurable effect on their consumption of bait such as would be expected if there was a constant interplay between colonies.

Available food

It seems certain that, in the absence of horses, rats must depend almost entirely upon the scraps thrown away by the men. Apart from scraps thrown down during a meal it is common for miners to throw away all uneaten food at the end of the shift and on one occasion the equivalent of two large white loaves plus the filling of the sandwiches was found.

Nevertheless, food cannot always be abundant, for numerous reports exist of food being eaten from the pockets of jackets laid on the pack or machinery and rats have been seen to approach and take scraps thrown down less than 6 ft. from the feet of sitting men.

Considerable speculation has existed concerning the part played by human faeces and tub grease as items of diet but there is no evidence that either of these is eaten. Evidence is also lacking to support the eating of fungi by rats. Several species of insects and spiders are usually present but it is not known how far these go to supplement the diet.

Miscellaneous observations

Of the rats examined by the writer all were in good physical condition but were not fat (Elton, 1936). Pregnant females have been caught underground during December and January, but insufficient data are available to suggest that winter breeding in mines is at a higher level than that of surface populations.

Nests have never been found presumably because nesting takes place in the pack which is never disturbed. Nesting material is no doubt scarce and considerable damage has been done to clothing put down whilst men are working, not always, it would appear, in the search for food. One group of men watched a rat drag a scarf from a jacket pocket into a hole in the pack.

Material damage to installations is slight. The only serious case recorded by the writer was that of a power failure. On investigation the charred body of a rat was found by a heavily armoured power cable which had been gnawed through. Such an occurrence in a dust-filled mine section could result in an explosion with disastrous consequences. Doors and wooden structures are commonly gnawed but rarely does danger or inconvenience result.

DISCUSSION

It has been shown elsewhere (Twigg, 1961) that there is a close correlation between the presence or absence of rats and the size of a mine in terms of manpower. Other features have also been shown to increase the chance of infestation and it seems clear that the extent and amount of pit head buildings also assists in the establishment of a surface rat colony.

The stages in the colonization of the underground regions are not known, but by whatever processes this is accomplished the rats form colonies underground in close association with the groups of men and in the mine studied there appeared to be no contact between colonies.

It is interesting that the largest group of men in the pit, group E, had no rats. It is possible that the distance of face E from the main road linking groups C and F

had something to do with this, the rats having instead contacted the small group D and become established there. One can only surmise, reasonably enough it seems, that without any control measures being applied the colony at D would eventually contact group E.

Despite evidence of considerable food spillage one feels that Elton (1936) best summarized the food situation when he said 'life is probably not very luxuriant, since even the absence of enemies must tend to encourage increase of the population up to the limits of subsistence'.

The process of colonization *de novo* probably began in the mine studied when rats contacted the men of group A but whether colonization and contact with other groups of men was effected by other rats at more or less the same time or by the population pressure at A eventually forcing some animals to forage further afield for food, is not known.

In the existence of discrete colonies the rats in a coal mine must resemble those in sewers (Bentley, 1955). The difficulties to poisoning sewer populations are absent in coal mines where extermination is a relatively easy task, due in no small degree to the shortage of food. For this reason poison campaigns in mines have usually taken place during the 2 weeks annual holiday when bait acceptance is good. The rat populations are usually very high in the region of underground stables and more attractive baits are often necessary to draw rats away from their normal diet of horse feed.

Finally it should be pointed out that it is highly improbable that the conditions described in this account will be found at the present time anywhere in coal mines of the British Isles, for a determined campaign of control and inspection has resulted in the reduction of coal mine rat populations in all areas.

SUMMARY

Test baiting has shown that rats underground are distributed in a series of discrete colonies, each one in close association with a group of men. Interplay between colonies is rare in large mines although evident in small ones. In the absence of stables the rats must depend almost entirely on miners' food scraps.

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