

**WORLD HEALTH
ORGANIZATION**

Regional Office
for the Eastern Mediterranean



**ORGANISATION MONDIALE
DE LA SANTÉ**

Bureau régional
pour la Méditerranée orientale

**SEMINAR ON PUBLIC HEALTH AND
ECONOMIC ASPECTS OF RODENT CONTROL**

Alexandria, 2 - 8 December 1974

EM/SEM.PH.EC.ASP.ROD.CTL/5

11 October 1974

ENGLISH ONLY

**RODENTS OF HEALTH AND ECONOMIC IMPORTANCE
IN WHO'S EASTERN MEDITERRANEAN REGION**

by

Mr D.C. Drummond*
WHO Consultant

* Ministry of Agriculture
Fisheries and Food
Pest Infestation Laboratory
Hook Rise South
Tolworth
Surrey, Surrey
UNITED KINGDOM

EMRO/74/1472

TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION	1-2
II. IMPORTANT RODENT PEST SPECIES	2-8
III. OTHER RODENT SPECIES OF LESSER IMPORTANCE	9
Annex I	
Annex II	

I. INTRODUCTION

There can be little doubt that, ever since man began to grow crops and store them, rodents have profited by taking a share of the harvest and have also made matters worse by spreading disease. And it is not surprising that in an area that has seen the dawn of civilization, there are to be found some glimpses of man's earliest encounters with these animals. From Mohenjodaro (Pakistan) and Bampur (Iran) come fragments of pottery traps dating from the 3rd millenium B.C. On a Sumerian clay tablet from Nippur (Iraq - c. 1700 B.C.) a farmer advises his son that, after the sprout has broken through the ground, a prayer should be said to Ninkilim, goddess of field mice and vermin, lest they harm the growing grain. An Egyptian papyrus of the New Kingdom (1567-1085 B.C.) warns that mice are numerous in the fields, whilst another recommends fat of cat as a mouse repellent.

Since these early times the depredations of rats, mice and other rodents and the struggles of man to prevent them have in no way diminished. Indeed in recent decades, with the increasing desire of all countries throughout the world to raise living standards, including standards of health, often in the face of rapidly rising human populations, the problem has become more acute. This situation is just as keenly felt in the countries of the Eastern Mediterranean Region as elsewhere and the present Seminar bears witness to the desire and the need in this Region to share knowledge and experience to find some practical solutions.

Satisfactory solutions can only be expected after determining the nature and extent of the problem and as a first step in this direction the present paper briefly considers some of the more important rodent pests and their biology.

II. IMPORTANT RODENT PEST SPECIES

1. General

The most important rodent pests of the Region all belong to one family (Muridae) out of a total of about 20 families in the order Rodentia. Nevertheless they are of fairly mixed faunal origins (Table 1) and by no means all exist throughout the Region. On the other hand, acting as unifying influences are the climate and the nature of the terrain producing within the Region's boundaries the greater part of the world's largest arid zone, stretching from the Sahara to Sind. Because of the uniform conditions in this area over a very long period, a rather unique fauna specially adapted to arid conditions has arisen and the area is sometimes referred to by zoogeographers as the Saharo - Sindian Region (Bodenheimer, 1935; Ranck, 1968). Amongst the specialized desert rodents may be mentioned particularly the jerboas (Dipodidae), gerbils (Gerbillus spp.) and jirds (Meriones spp.). To withstand the direct heat during the day they remain at an appropriate depth in their underground burrows and further to conserve moisture, they are able to eliminate very concentrated urine and faeces. The desert rodents with which we shall be mainly concerned are the jirds and to a lesser extent the Indian gerbil (Tatera indica). The other important rodents in the Region are mainly either cosmopolitan and more or less confined to urban environments or are localized in fertile areas, particularly those of the valleys of the Indus, Nile, Tigris and Euphrates.

In the following sections each important rodent species and its geographical and habitat distribution is given, together with that part of its known ecology and behaviour which seems most appropriate to understanding how to control its deleterious effects on human health and economics. Some of the more common inter-relationships between rodent ecology, behaviour and control are shown schematically in Figure 1.

2. Rattus norvegicus: (Norway rat)

The Norway rat is the largest of the important rodent pests of the Region and adults weighing over 400g are not uncommon. The tail is relatively thick, pale beneath and usually shorter than the combined length of head and body. Compared with the roof rat, the nose is blunt and the eyes and ears are relatively small. Most specimens have a brown back and pale belly, but very dark forms and albinos occasionally appear.

Although occurring throughout the Region, it remains more or less confined to urban environments on the coast and only in a few places such as Teheran (Wichmand, 1969) and several towns in Israel (Gratz, 1973) has it managed to penetrate inland. It should be noted, however, that Gratz reports that its spread in Israel, where it is replacing the roof rat, is of fairly recent occurrence and is apparently still taking place.

Despite the fact that it is a good climber, the Norway rat tends to live in burrows which it digs in the ground. Where food supplies are good it generally breeds throughout the year, adult females having litters of about 8 roughly 4 or 5 times a year. Thus very large populations are able to build up rapidly in such places as food stores, refuse tips, sewers and in fact any urban area with poor hygiene and sanitation.

The Norway rat is very much a creature of habit, tending to keep to the same pathways in travelling from burrow to food and to water and often taking some time to accept changes in its environment which may be necessary during control procedures.

3. Rattus rattus: (Roof rat)

The roof rat rarely attains a weight greater than 250g. It has a slender tail, usually longer than the combined length of its head and body, and its relatively large ears are more or less translucent. Although intermediates are sometimes found, it generally occurs in 3 more or less distinct colour forms which apparently interbreed freely when they occur together; the rattus form has a dark grey back and belly; the alexandrinus form has a brown back and dark grey belly; the frugivorus form has a brown back and white belly. There is some indication that the colour forms may be of adaptive significance since the darker forms seem to occur more frequently in urban situations and frugivorus in more rural environments.

The distribution of the roof rat in the Eastern Mediterranean is very similar to that of the Norway rat except that it occurs somewhat more commonly in inland areas and has colonized some cultivated areas away from buildings, particularly, apparently, those growing citrus fruits or dates.

The roof rat, as its name implies, tends in urban environments to live in roof spaces and travel along overhead runs and even when living out-of-doors it seems to prefer not to burrow but to make use of suitable debris, and shrubs and trees as nesting sites. Its reproductive potential and behaviour is similar to that of the Norway rat.

4. Mus musculus: (House mouse)

The house mouse is rather similar in appearance to the roof rat, but it is of a much smaller size with adults rarely weighing more than 20g or exceeding 200 mm in length. Although mainly important as an urban pest throughout the Region, it is fairly widespread in other habitats including many arid areas.

The reproductive potential and behaviour of the house mouse is similar to that of the 2 species of rat just mentioned, enabling it rapidly to develop very large populations where suitable conditions of food supply and harbourage are available.

Its small size, its tendency when feeding to take a bite here and nibble there and its often very confined home range are amongst the house mouse's chief characteristics which make it a very difficult animal to control successfully.

5. Mastomys (or braomys) natalensis: (multimammate rat)

The multimammate rat is a very small greyish brown rat generally weighing no more than about 80g and having a tail about the same length as that of its head and body combined. The number of nipples is variable but there are usually about 10 pairs, giving rise to the name "multimammate".

It is widespread throughout Africa south of the Sahara and in the Eastern Mediterranean Region is of importance in the Sudan and Ethiopia. It lives in buildings, farms and villages as well as inhabiting cultivated ground and adjoining scrubland.

Mastomys breeds in underground nests throughout the year, but shows a marked preference for the end of the rains and the early part of the dry season, giving rise to considerable seasonal variation in numbers. With its great reproductive potential indicated by its average litter size of about 11.5, it can respond very rapidly to favourable conditions and quickly produce very large populations. Such favourable conditions often seem to arise in years in which rains have been prolonged (Taylor,).

6. Arvicanthis niloticus: (Nile rat or harsh-furred rat)

The Nile rat is intermediate in size between the roof and multimammate rat and has coarse brown speckled fur. The tail is relatively hairy and generally shorter than the length of head and body combined. This rat is found throughout much of Africa and in the East Mediterranean Region occurs in Sudan, Ethiopia, Egypt and Southern Arabia. It seems to be particularly common on cultivated land. Unlike the other rodents so far dealt with it rarely enters buildings and tends to be diurnal rather than nocturnal.

7. Nesokia indica: (short-tailed bandicoot rat)

Nesokia is similar in size to Arvicanthis but very different in appearance, with soft light-brown fur, small ears and a more or less naked tail distinctly shorter than the combined length of head and body. It is particularly common on cultivated land in Northern India and in Pakistan and its distribution spreads westwards to encompass Iran, Iraq, Syria, Israel, Jordan, Northern Saudi Arabia and Northern Egypt.

It spends most of its life underground where it makes extensive burrows, throwing up small mounds of earth as it goes, a habit which has given rise to the name of mole rat. Its burrows are often abundant along irrigation channels and, except when females have young, each burrow is generally occupied by only one rat.

8. Tatera indica: (Indian gerbil)

The Indian gerbil is a large greyish brown rather rat-like gerbil. It is generally larger than the roof rat and easily distinguished from it by its relatively large hind feet and its long hairy, black-tufted tail.

It is distributed throughout India and Pakistan and westward through Iran, Iraq, Syria and Northern Arabia. It is apparently not so well adapted to desert conditions as other gerbils and is frequently found in agricultural areas and human settlements, where it may readily enter houses.

The Indian gerbil is usually found in colonies occupying large burrow systems or living in fodder stacks or stone walls. The average litter size is about 5 to 6 and breeding occurs throughout the year but with peaks, at any rate in the Indian Desert, in February, August and November. The August peak is the highest and apparently associated with rains (Jain, 1970).

9. *Meriones spp: (jirds)

The genus Meriones comprises about 15 species and is dealt with collectively here because the species are not easy to separate and their taxonomy still seems subject to much revision. The jirds are rather similar in appearance to the Indian gerbil but generally smaller and unlike the jirds T. indica has a tail black above and below and pale at the sides.

One or more species are generally present in the more arid parts and not infrequently in cultivated areas more or less throughout the Region. Some species (M. crassus and M. lybicus) are very widespread, while the distribution of others such as M. shawi, M. persicus and M. hurrianae are more restricted and centre on N. Africa, Iran and Pakistan respectively.

Jirds live in colonies in burrows, sometimes close to human habitation and M. persicus for example in S.E. Iran is said to enter houses readily. Like T. indica, jirds probably breed throughout the year when conditions are suitable but it is likely that their breeding peaks are associated with rains (see Prakash, 1960 for M. Hurrianae in the Indian Desert) and in some years very large numbers of individuals may be produced (see Bernard, 1969 for M. shawi in Tunisia).

10. Microtus socialis: (social vole)

For the purposes of this review M. guenther and M. philistinus are regarded as conspecific with M. socialis (see Harrison, 1972). The social vole is a small brown rodent not much larger than a mouse but with a blunt nose, small ears and a short hairy tail.

It occurs throughout Turkey, Lebanon, Israel and the Northern parts of Syria, Iraq and Iran. It generally favours grasslands where it lives in colonies.

Breeding is confined to the spring and summer months but its breeding potential is such that its populations can increase tenfold within 6 months and in some years enormous numbers build up and spill over on to neighbouring cultivated lands (Bodenheimer, 1949).

III. OTHER RODENT SPECIES OF LESSER IMPORTANCE

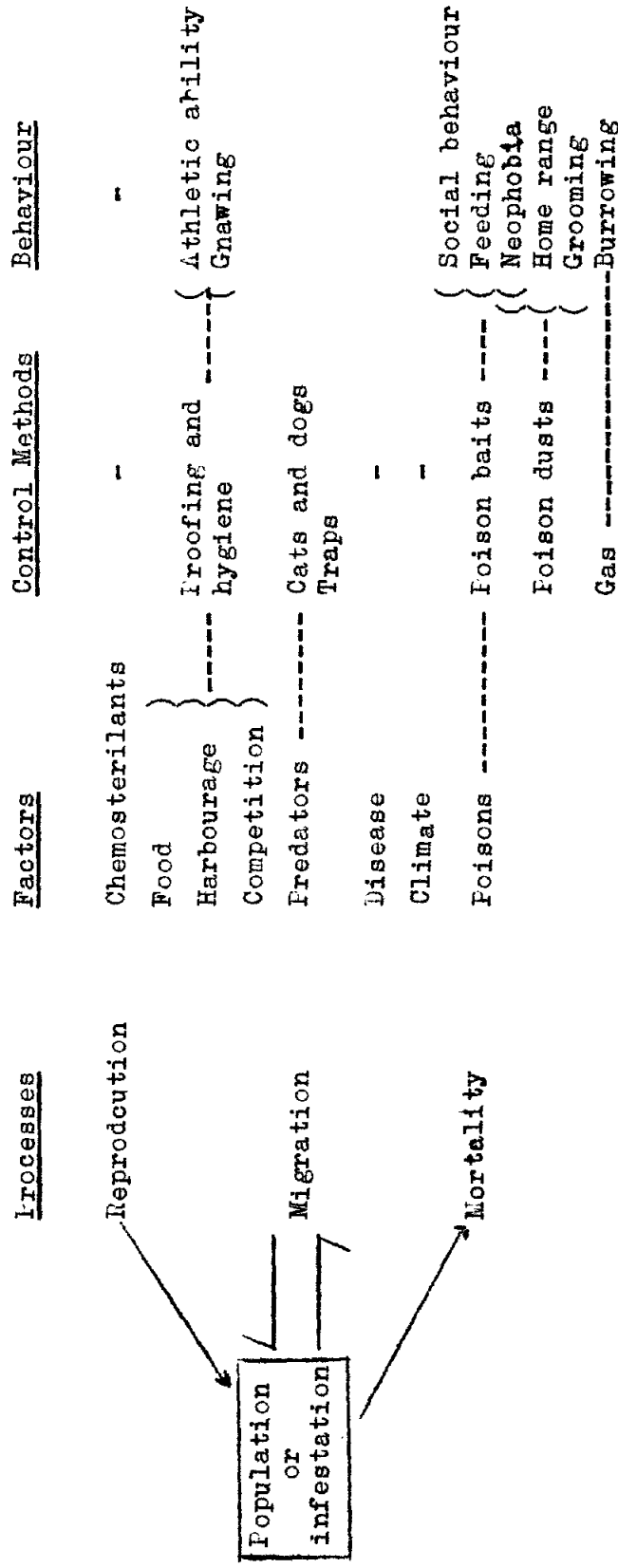
Throughout the remaining sessions of the Seminar we shall largely be concerned with those rodents already described, particularly with the diseases they spread, the economic damage they do and how these can be prevented. There are, however, a number of other species in the Region that may become of local importance and deserve at least a brief mention. They include Rhombomys opimus (great gerbil) a reservoir of leishmaniasis in Iran, Hystrix indica (Indian crested porcupine), a widespread marauder of vegetable gardens, Citellus fulvus (large-toothed souslik) a damager of cereals in northern Iran, Glis glis, Cricetulus migratorius, Arvicola terrestris, Golunda ellioti, Bandicota bengalensis and Acomys cahirinus.

TABLE 1RODENTS OF PARTICULAR ECONOMIC AND PUBLIC HEALTH IMPORTANCE
IN WHO EAST MEDITERRANEAN REGION

<u>Family</u>	<u>Sub-family</u>	<u>Species</u>	<u>Faunal group</u>
Muridae	Murinae	<u>Rattus norvegicus</u>	Cosmopolitan
"	"	<u>R. rattus</u>	"
"	"	<u>Mus musculus</u>	"
"	"	<u>Mastomys natalensis</u>	Ethiopian
"	"	<u>Arvicanthis niloticus</u>	"
"	"	<u>Nesokia indica</u>	Oriental
"	Gerbillinae	<u>Tatera indica</u>	"
"	"	<u>Meriones</u> spp	Palearctic
"	Microtinae	<u>Microtus socialis</u>	"

A SCHEMATIC REPRESENTATION OF THE RELATIONSHIPS BETWEEN
RODENT ECOLOGY, BEHAVIOUR AND CONTROL

The often complicated and variable interactions between the factors and the processes they control are omitted for the sake of simplicity.



BIBLIOGRAPHIE

EM/SEM.PH.EC.ASP.ROD.CTL./5

- Anon. (1957) Fire threat in rats. Pest Control 25 (8) 44.
- Avidov, Z, Ben-haim, N. (1950) Observations on pests of subtropical fruit trees in Israel. Ktavim, 1 55-69.
- Bahmanyar, M. (1966) Ecological studies on sylvan rodent reservoirs of plague in Iran. WHO/Vector Control/66.217 Seminar on Rodents and Rodent Ectoparasites Geneva 29-34.
- Bahmanyar, M. (1971) Human plague episode in the district of Khawlan, Yemen. American Journal of Tropical Medicine and Hygiene 20 123-128.
- Barnett, S.A. (1951) Damage to wheat by enclosed populations of Rattus norvegicus. Journal of Hygiene (Cambridge) 49 (1) 22-25.
- Benenson, A.S. (ed.) (1970) Control of communicable diseases in man. American Public Health Association New York 11th ed. 316 pp.
- Bentley, E.W. (1968) The control of rodents in Pakistan. FAO PL: CP/23/RP 16 pp.
- Bernard, J. (1969) Les mammifères de Tunisie et des régions voisines. Bulletins de la Faculté d'Agronomie Tunis Nos 24-25 Aout et Decembre 1969 41-172.
- Bodenheimer, F.S. (1935) Animal life in Palestine: an introduction to the problems of animal ecology and zoogeography. Jerusalem, Mayer.
- Bodenheimer, F.S. (1949) Problems of vole populations in the Middle East. Report on the population dynamics of the Levant vole (Microtus guentheri D. et A.). Research Council of Israel, Jerusalem North Holland Publishing Co. Amsterdam, 77 pp.
- Davis, G.E. and Hoogstraal, H. (1954) The relapsing fevers: a survey of the tick-borne spirochaetes of Egypt. Journal of the Egyptian Public Health Association 29 (5) 139-143.
- Drummond, D.C. (1974) An outline of the current status of large scale urban rat control in England and Wales. In press: Zeitschrift für angewandte Zoologie.
- Farhang-Azad, A. (1970) The flea fauna of Iran IX Distribution and hosts. Bulletin de la Société de Pathologie Exotique 63 107-126.
- Farhang-Azad, A. (1971) Report on the 1970 survey of small-mammal-borne diseases in Iran. Iran-WHO International Epidemiological Research Centre, Institute of Public Health Research, University of Teheran 59 pp.
- FAO Grain Storage Newsletter & Abstracts (1963) Sudan: field rats, 5 (3) 9-10.
- FAO Grain Storage Newsletter & Abstracts (1964) Sudan: Control of field rats, 6 (3) 6.
- For. Div. Sudan (1949/50) Report 22-32.
- Garg, S.S.L., Singh, J. and Prakash, V. (1966) Losses of wheat in threshing yards due to birds and rodents. Bulletin of Grain Technology 4 94-96.

- Gratz, N.G. (1957) A rodent ectoparasite and murine typhus survey in Haifa port. Bulletin of the Research Council of Israel 6E (3) 178-181.
- Gratz, N.G. (1973) Urban rodent-borne disease and rodent distribution in Israel and neighbouring countries. Israel Journal of Medical Science 9 (8) 969-979.
- Harrison, D.L. (1972) The mammals of Arabia: Vol. III Lagomorpha, Rodentia. London: Ernest Benn 670 pp.
- Hoeden, J. van der, (1953) Leptospirosis among goats in Israel. Journal of Comparative Pathology 63 101-111.
- Hoeden, J. van der, and Halevy, C. (1953) Leptospirosis in cattle in Israel. Journal of Comparative Pathology 63 93-100.
- Hoogstraal, H. (1968) Tick-borne human disease in the Eastern Mediterranean. WHO/VBC/68.57 Seminar on the ecology, biology, and control of ticks and mites of public health importance. Geneva 17-21.
- Ibrahim, M.M. (1972) Damage and control of the field or the Nile rat, Arvicanthis niloticus Desm. Proceedings of the First Scientific Symposium of Rodents and their Control in Egypt Assiut University 27-39.
- Jain, A.P. (1970) Body weights, sex ratio, age structure and some aspects of reproduction in the Indian gerbil, Tatera indica indica Harwicke, in the Rajasthan Desert, India. Mammalia 34 415-432.
- Judenko, E. (1967) The loss of yield in a crop of sweet corn (Zea mays L.) following the complete destruction of some plants at an early stage by brown rats (Rattus norvegicus Berk). PANS A 13 412-414.
- Kassab, A., Badran, A.A.F., and Kamel, A.H. (1961). Warfarin bait in the control of the field rat: "Arvicanthus niloticus Desmarest" in Egyptian shounas. U.A.R. Min. Agric. Plant Prot. Dept., Cairo, 10 pp.
- Kent, N.L. (1958) Mice in the stackyard. An estimate of rodent damage to stacked grain. Scottish Agriculture 37 18-22.
- Khan, A.M. and Gilani, S. (1963) Scrub typhus in Sialkot district (West Pakistan). Pakistan Journal of Health 13 (2) 88-95.
- Krishnamurthy, K., Uniyal V., Singh, J. and Pingale, S.V. (1967) Studies on rodents and their control - Part 1. Studies on rat population and losses of food grains. Bulletin of Grain Technology 5 (3) 147-153.
- Matossian, R.M., Garabedian, G.A., and Malakian, A.H. (1962). Status of typhus in Lebanon. American Journal of Tropical Medicine and Hygiene 11 104-107.
- Oktar, I. and Ilker, I. (1965) Preliminary studies on the morphology, distribution, life history, type of damage and control measures of lemon rat (Rattus rattus frugivorus Rafin 1814. Rodentia-Muridae) in Aegean region/ Türkiye Cumhuriyeti Tarım Bakanlığı 3-41 Teknik Bulten No. 2 41 pp.

- Philip, C.B. (1968) A summary of mite-borne rickettsial pox. WHO/VBC/68.57 Seminar on the ecology, biology, and control of ticks and mites of public health importance, Geneva 55-56.
- Pollitzer, R. (1954) Plague. Geneva, WHO 698 pp.
- Prakash, I. (1960) Breeding of mammals in Rajasthan Desert, India. Journal of Mammalogy 41 386-389.
- Prakash, I. (1968) Ecotoxicology and control of Indian desert gerbil, Meriones hurrianae (Jerdon). V Food preference in the field during monsoon. Journal of the Bombay Natural History Society 65 (3) 581-589.
- Ranck, G.L. (1968) The rodents of Libya. Taxonomy, ecology and zoogeographical relationships. Bull. U.S. Nat. Mus. 275 Smithsonian Institute, Washington vii & 1-264.
- Robertson, R.G., Wisseman, C.L. and Traub, R. (1970) Tick-borne rickettsiae of the spotted fever group in West Pakistan. I Isolation of strains from ticks in different habitats. American Journal of Epidemiology 92 (6) 382-394.
- Spillett, J.J. (1966) Population studies of the lesser bandicoot rat in Calcutta. Indian Rodent Symposium Calcutta 84-92.
- Sterkhova, N.N. and Akhundov, M.G. (1959) The role of wild rodents in the epidemiology of Q fever. Zhurnal Mikrobiologii Epidemiologii i Immunobiologii 30 (9) 124-125.
- Tagizadeh, F. (1959) Liste des rongeurs de l'Iran, et leurs distribution. Entomologie et Phytopathologie Appliquées No. 18 41-47.
- Taylor, K.D. (1968) An outbreak of rats in agricultural areas of Kenya in 1962. East African Agricultural and Forestry Journal 34 66-67.
- Taylor, K.D. (1970) Assessment of losses due to rodents. Chapter in FAO Manual: Crop loss assessment methods 4 pp.
- Taylor, K.D. (1972) The rodent problem. Outlook on Agriculture 7 (2) 60-67.
- Taylor, R.M. (1957) A note on typhus in Egypt and the Sudan. American Journal of Tropical Medicine and Hygiene 6 863-870.
- Traub, R., Wisseman, C.L. & Ahmad, N. (1967) The occurrence of scrub typhus infection in unusual habitats in West Pakistan. Transactions of the Royal Society of Tropical Medicine and Hygiene 61 23-57.
- Wagle, P.V. (1927) Injurious field rats of Lower Sind and their extermination Part 1. Department of Agriculture Bombay Bulletin No. 138 1-30.
- Watson, J.S. (1951) The rat problem in Cyprus. A report of investigations made in carob-growing areas. HMSO: London. Colonial Office. Colonial Research Publications No. 9 66 pp.
- Wichmand, H. (1969) Rodent control in Iran. WHO Assignment Report EM/ES/125 EMRO 0157/R 18 pp & appendices.
- Wood, B.J. (1971) Investigations of rats in rice fields demonstrating an effective control method giving substantial yield increase. PANS 17 (2) 180-193.