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The Biology and Control of Field Rats

by

Mr. Jesus P. Sumagil

Seniors Plant Pest Control Officer, Bureau of Plant Inudstry
and Staff Member, Rodent Research Center, UPCA

Present identification of the medium-sized, white-bellied common ricefield rat (Rattus rattus unbriventer subsp. nov.) is a tentative one[2] and obviously needs final clarification. This foremost agricultural pest species comprises more than 99 percent of all rat form collected in infested lowland ricefields and roughly 85 percent of animals examined in varying upland conditions, the remainder being generally represented, in the order of their imporatnce, by the medium-sized, dark-bellied common house rat (R. rattus minidanensis mearns) and the small Polynesian or bush rat (Rattus exulans Peale). The common house rat shows strong dependence on man and represents 95 and 65 percent of all rats collected inside, of, and on adjacent areas to, human dwellings. The ricefield and bush rats demonstrate some sommensal habits which are esssentially logistic and appear to have some inter-relationship with the house rat.

Separate works find biological imbalance (Rabor, 1954), the abundance of land snails (de Jesus, 1960), and other disturbed sets of natural conditions (Villadolid, 154 and Nemenzo, 1962) as important causative mechanisms to explain the initial but widespread rat eruptions in Cotabato province in 1953. Intensive study on biology of the common ricefield rat further indicates reproductive cyclism (Sumangil, et al, 1963) as a realistic explanation to the species violent seasonal abundance, which results in severe and widespread infestations and the destruction of rice, corn, and other field crops before harvest.

BIOLOGY

The three species generally follow a continuous but irregular breeding pattern where the environment tends to the uniform, with three (3) to four (4) litters of 6 to 9 young each delivered during the whole year. Distinct seasonal climate strongly influences the ricefield rats to reproduce largely during the apex of the rainy season. During this brief period of 6 to 7 months roughly, the same number of rats are delivered and weaned per mature female, indicating a seasonal reproductivity of 24 rats coming from 4 deliveries of 6.44 weaned rats per litter. This explains the violent fluctuation in number of the animals during the height of the regular planting season. Ricefield rats, however, also reproduce even in distinct dry season condition in the presence of irrigated rice crops, but the principal breeding period

remains to be the wet months when more than 70 percent (Sumangil, unpublished) of the offsprings are delivered in the same unimodal breeding pattern.

Ricefield rats undergo a 21-day gestation period with embryonic counts ranging from 3 to 18 per litter. About 8 young are born to a brood at parturition, and following a similar 21-day lactation period, the litter is weaned. The youngsters then undergo an irregular juvenile phase with sexual maturity attained in one to 6 months after delivery. The first three litter sets normally show exceptional sexual precociousness, and this tends to enable the animal population to breed 4 times during the shortened breeding period. Laboratory rats live to 3 or 4 years but hardly reach one year under normal field conditions.

Compared with others, ricefield rats reveal peculiar habitat preference for water-logged ricefields. Being excellent burrowers, they create complex and oftentimes intricate dike burrows primarily for breeding purposes. Unfortunately, the rise and excessive increase in number of ricefield rat populations during latter half of the rainy season coincides with the booting and maturing development of rice crops and the greening of corn, or the period when the plants are most attractive and selected as choice food by rats. Rice plantations offer adequate cover to the animals, particularly from avian predators, and animal movements and establishment into this food-rich habitat vigorously complements breeding chances in rat communities.

Population surveys in 1953 to 1956 in many localities of Cotabato, Davao, and Mindanao Occidental have commonly exhibited densities reaching 2,500 to 3,800 rats per hectare. The carrying capacity of standing grains is known to be high even after harvest and this most probably retards the occurrence of "en masse" rat migrations to distant places. Rats in suitable habitats are not far or wide-ranging in their local movements. Most small rat communities feel secure in 30-foot paddies, although group foragings may reach 200 meters or more when food availability in a harborage is inadequate. Ricefield rats are known to travel as far as 20 kilometers (de Jesus et al, 1959) as a result of forcible movement and migration. Any such movement is non-directional.

CONTROL

Thirteen provinces (Laguna, Mindoro, Occidental, Iloilo, Zamboanga del Sur, Zamboanga del Norte, Cotabato, South Cotabato, Davao del Norte, Nueva Ecija, Tariac, Pampanga and Bulacan) are described as "seriously" infested areas, while twelve others (Pangasinan, Camarines Sur, Albay, West Samar, East Samar, Loyie del Norte, Lanao del Norte, Lanao del Sur, Misamis Oriental,

Agusan, and Surigao del Norte), are termed as "moderately" infested. A total of 290 municipalities and 2,937 barrios covering about 600,000 to 900,000 hectares, are affected.

It is estimated that if, under ideal conditions, present rat populations in Cotabato alone are left undisturbed for two successive years the resulting plague would equal, if not exceed, the same hectares of standing rice and corn crops totally destroyed in 1953. The estimate of damage to rice crops before harvest in 1958 is P48,000,000. Computation is based on an average damage of 5 cavans per hectare and involving 600,000 hectares infestation at a cost of P16.00 per cavan. Very little information is known on the extent of rat damage in sugar cane and coconut plantations and of stored cereal crops. Any estimate on them would be tremendous in value.

Philippine rat control is anchored on Act No. 3942 or Rat Extermination Law, approved November 26, 1952, which commits all able-bodied male inhabitants in infested municipalities between the age of 16 and 60 to render gratuitous service in the extermination of rats. Through this law organized national or local rat control is formed and maintained and thus minimizes employment of individualized rat control. Act No. 3942 is further complemented by Presidential Proclamation 179 of August 11, 1955, which declares the "period from September 1 to 30, 1955, and every September thereafter as Anti-Rat Campaign Month." It is mobilizing order staged annually during the peak of the rat breed-season and which authorizes and directs the employment of thorough and active rat control in all affected barrios, towns, cities, and provinces. This makes all rat control efforts the prime and joint responsibility of the government and the public the former supplying the technology and chemicals required and the latter supplies the manpower and other materials needed in control projects. The amount of P1,000,000 is appropriated each year by the national government for rat control, and the Bureau of Plant Industry of the Department of Agriculture and Materials Resources programs and manages the entire national operation Philippine rat control systems and procedures are numerous and as varied. Their successful field implementations, however, hangs sensitively on many factors, the more important being (1) the proper and timely application of control programs and (2) the extent and degree of control, organization and community participation.

CHEMICAL CONTROL

All forms of poisoning works are known to result only in temporary relief. Notwithstanding, the use of poisons remains to be the main approach to local rat eradication. Properly baited, poisoning offers instant relief and is comparatively more economical

to use and easier to employ. Most acute raticides have serious limitations (Sumangil, 1966b). Sodium flour acetate, zinc phosphide, arsenious oxide and thalium sulphate have their respective limitations and have caused the restrictionof their usage, particularly where public safety and the protection of wildlife and domestic animals are concerned. Relative acceptance of poisons by rats and the building up of "tolerance" and bait-shyness after intake of sublethal doses among exposed populations have further limited the employment ofacute poisons. Realistic applications of chronic or slow-acting poisons, particularly in the use of Warfarin, Diphacin, Tomorin and their relatives have not only reduced hazards of poisoning but have increased overall control effectivity through the removal of tolerant and bait-shy populations.

Philippine large-scale rat control programs make full use of the massive type of operations (Sumagil, 1966a). This is a study of organized community effort in rat control. When employed simultaneously in either barrio or town-sized basis on a 4-to-5 day planned integrated rat control operation, results range from 86 to 94 percent rat fatality, depending upon the degree of plant dessication in the infested areas. The massive type of rat control offers immediate and widespread relief. It functions on the principle that, if 100 farmers were aligned 10 meters apart, a kilometer-long moving swath of previously trained pest control workers undertaking selective poisoning can, in a period of three to four hours, cover the whole area of a barrio or locality of infestation in a series of movement.

Maximum effectivity in rat control is seriously influenced by the timing of control program implementations. The results of September or rainy season poisoning campaign have been much less desirable than what have been expected and these are largely due to critical control problems related to rain and the availability of acceptable baits in the presence of preferred natural foods. These have reduced poisoning efficiency to a low range of 40 to 83 percent rat kill. Maximum relief through poisoning is obtained only thru organized control programs during the dry season months. Rainy season control works offer very little or no relief at all, considering that the base populations are able to recover their number through reproduction. Dry season or summer rat control work results in longer-lasting relief (see Fig. 3), and the surviving populations are able to recover their pre-control number only after the termination of their regular breeding period. Summer massive rat control operations find easy acceptance in view of the following limiting factors: (1) ready availability of needed bait and poison bait acceptance is increased on account of lack of natural foods in the field:

(2) manpower development is easier during dry season months (3) mobility and penetration into infestation areas is insured and (4) concentrated work on rat control work is enhanced due to reduced activity in other agricultural endeavors.

Aerial dispersal of 1080-impregnated corn baits is resorted in where large isolated pockets of rat infestations are found. The system gives excellent results.

Physical or Mechanical Control

Rat traps and similar devices for field rat control have been relegated to house rat eradication where their employment is found more effective. In its place the "blanket system" (Townes and Morales, 1953) has become the established physical killing process applied on masses of field rats in natural cover. The system has since built up a reputation as a method lastly resorted to when other killing procedures including poisoning would have failed to gain desired results.

The blanket system, a Cotabato innovation requiring sizable man power to accomplish, has proliferated into many modifications, i.e. the use of nets, metal sheets, tarik or interwoven bamboo splits and of log rollers and even tractors, which greatly reduce its demand for manpower without diminishing the effectivity of the procedure. Night time blanketing works have been found to be particularly effective in decimating hard-to-kill experienced rodents in booting and maturing rice plantations. The blanket system has also become the Philippines' contribution to demography or the study of populations. As a method of estimating rat population densities through a modified 20-meter quadrat, it has the main advantage of being able to account immediately the animal densities in a very short period of time (Rosell and Sumangil, 1965).

The pit system, a local procedure which is best employed against severe infestations by ricefield rats on mandalas immediately following harvest, is worthy of mention among many other devices. This trenching work, measuring 5 feet wide and 5 feet deep, ringing newly harvested piled crops has been recorded to trap as many as 200 to over 1,000 swarming rats in one night as a result of food depletion in the field.

BIOLOGICAL CONTROL

Davis (1953) summarized the results obtained in many trials using the bacterium Salmonella enteritidies into populations of rats and concluded the tests as generally unsatisfactory for rat control, inasmuch as the pathogen has only "neglible effects under certain conditions and . . .such results vary according to local changes." Similarly, the spirochaete Lepteopive interna

morrhagie and the nematode Capillaria hepatica, although having high prevalence among populations tested, "have no relation to population changes." Dr. P. R. Aragon of the UP Institute of Hygiene, on examination of over 1,000 ricefield rats and 300 house rats in Butuan, Cotabato, in 1961 for the incidence of pathogenic organisms, found (on personal discussion) only the domestic or house rats to be carriers of some strain of Leptospira. No evidence of epidermic on account of high Leptospira prevalence has been observed or recorded in that locality.

For some reason there is some disagreement (Sumangil, 1963) in the immediate introduction of foreign vertebraic predators without initially securing safety of the animals by curbing excessive and uncontrolled hunting, as well as selecting a predator species with exceptional tolerance, fecundity, and food selectivity. Lessons can be learned from Hawaii, where a number of Arizona and Texas Barn owl (Tyto spp.) were introduced as predators. The State's Department of Agriculture (through letter) commented that it was "too soon" to know the population growth and predatory effects of the transplanted owls 4 years after their release. Sumangil (unpublished) lists 22 genera and 35 species of local vertebrate predators, the majority of which are partial rat eaters and their number and movements limited and restricted. The three primary predators (Grass owl, Tyto longimembris amauronota Cabanis; Black-winged kite, Elanus caerulus hypolencus Gould; and Leopard cat, Felis minuta Temminck) are most often too few and at times confined in distribution to significantly reduce rat populations, without the help of artifical killing procedures. Prevailing obervation points to external predation only as a mechanism regulating the natural size of rat populations, and not being able to totally deplete communities of rats in enlarge habitats.

Permanent reduction or natural eradication normally obtained in alteration or modification or habitat is generally effective in the control of house and cosmopolitan rats. This system, which embraces the principle of increasing animal competition by reducing or completely eliminating their food and shelter, does not fully fit into the more complex problems of field rat control where their basic necessities are adequate, easy to acquire, and sustained during a good part of the year. However, some agricultural practices like plant sanitation, reducing the size of paddy dikes to reduce or eliminate burrowing prevalence and non-intercropping of corn in rat-threatened rice plantations prevent the early penetration of rats, and thus provide a temporary margin of safety in protecting crops before harvest. Otherwise, biological control practices in the Philippines look forward to the possibilities of new subjects, i.e. strictly, to bring about a more successful control of rats.

SUMMARY

The necessity and demand for more effective and safe procedures and systems of rat control increase along with Philippine increased program for more cereals. Current knowledge and application of control procedures are adequate to a point, as when one compares local techniques and management processes with those of other countries.

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