Oryzomys palustris. By James L. Wolfe

Oryzomys palustris (Harlan, 1837)

Marsh Rice Rat

Mus palustris Harlan, 1837:385. Type locality "Fast Land" near Salem, Salem Co., New Jersey.

Arvicola oryzivora Bachman, 1854:214. Type locality St. Johns Parish, South Carolina.

Oryzomys palustris Baird, 1858:459. First use of name combination.

CONTEXT AND CONTENT. Order Rodentia, Family Muridae, Subfamily Cricetinae. Hall (1960, 1981) suggested that *Oryzomys palustris* and *O. couesi* were conspecific. However, Benson and Gehlbach (1979) presented evidence that the two forms were distinguishable in southern Texas. This account considers *O. palustris* as distinct from *O. couesi* but recognizes the need for further research to elucidate the status of these taxa. Six subspecies are recognized (Hall, 1981; Hall and Kelson, 1959).

O. p. coloratus Bangs, 1898:189. Type locality Cape Sable, Monroe Co., Florida.

O. p. natator Chapman, 1893:44. Type locality Gainesville, Alachua Co., Florida.

O. p. palustris (Harlan, 1837), see above (*oryzivora* Bachman a synonym).

O. p. planirostris Hamilton, 1955:83. Type locality Pine Island, Lee Co., Florida.

O. p. sanibeli Hamilton, 1955:85. Type locality Sanibel Island, Lee Co., Florida.

O. p. texensis Allen, 1894:177. Type locality Rockport, Aransas Co., Texas.

DIAGNOSIS. *Oryzomys palustris* differs from *O. couesi* in being smaller and grayer. The structure of its X chromosome is also different (Benson and Gehlbach, 1979). *Oryzomys argentatus* of the lower Florida Keys is silver-gray as opposed to brownish-gray, and has a narrower skull with slender nasal bones (Spitzer and Lazell, 1978). *Oryzomys palustris* superficially resembles *Rattus* spp. of similar size but is more nearly bicolor, and is readily distinguishable by having two rows of upper molar cusps rather than three. The skulls of large *Peromyscus* spp. are similar, but the upper molar cusps are distinctly alternate whereas those of *O. palustris* are nearly opposite. *Peromyscus* skulls also lack the prominent supraorbital ridges and extended (beyond the last molars) hard palate.

GENERAL CHARACTERS. The marsh rice rat is a medium-sized generalized rat (Fig. 1). Adult weights range from about 45 to 80 g. Dorsal coloration varies from gray to grayish brown. Some subspecies from Florida have been reported as tawny, reddish, or ochraceous (Goldman, 1918). The underparts, including the tail and feet, are much lighter. The underfur is dense, soft and water repellent. The ears are small and well haired.

The ranges for external measurements (mm) are: total length, 226 to 305; tail, 108 to 156; and hindfoot, 28 to 37 (Hall and Kelson, 1959). Average measurements (total, tail, and hindfoot, in mm) reported from various geographic areas are: Virginia, 252, 121, 30; Florida, 227, 143, 34 (Hamilton and Whitaker, 1979); Louisiana, 237, 117, 28 (Lowery, 1974); and Texas, 266, 136, 33 (Benson and Gehlbach, 1979).

The skull of *Oryzomys palustris* (Fig. 2) was described by Park et al. (1974) as being fairly large with a flattened dorsal region. The supraorbital ridges are everted and projecting. The zygomatic arches are widely spread, and the anterior palatine foramina are long, reaching back to the first molars. The frontal bones taper to a narrow point posteriorly in the median line between the parietal bones. The interparietals are small and their anterior border forms a straight line while the posterior border has a slight median angle. Lowery (1974) provided the following average cranial measurements (ranges in parentheses) in mm, of 89 adults: greatest length, 28.8 (26.2 to 32.8); cranial breadth, 12.8 (11.8 to 13.5); zygomatic breadth, 14.9 (13.5 to 16.7); interorbital breadth, 4.9 (4.4 to 5.5); length of nasals, 11.4 (9.5 to 13.7); length of diastema, 7.4 (6.4 to 8.6); palatilar length, 11.3 (8.9 to 13.6); postpalatal length, 10.2 (8.8 to 11.8). The inner re-entrant angles of the lower molars reach less than half-way across moderately worn teeth (Hall, 1981).

DISTRIBUTION. Marginal records for *O. palustris* were given in Hall (1981). The northernmost records are from southeastern Pennsylvania and southern New Jersey. From there the range extends southward to the tip of Florida (excluding the Keys) and westward to eastern Texas. The southern limit in Texas is near Corpus Christi. The northern boundary of its range seems somewhat unstable. There are records from southern Kentucky, southern Illinois, southwestern Missouri and southeastern Oklahoma (Fig. 3).

FOSSIL RECORD. Fossils of *O. palustris* have been reported from fifteen localities in Florida (Webb, 1974) and one in Georgia (Ray, 1967). The geologic range is early Rancholabrean (Sangamonian) to Recent. An extinct subspecies, *O. p. fossilis*, is known from the Kansan glacial and Sangamonian interglacial periods of Texas (Dalquest, 1962, 1965) and the Illinoian and Sangamonian of Kansas (Hibbard, 1955, 1963). Richards (1979) summarized recent remains from caves and archaeological sites in Iowa, Illinois, Indiana, Ohio, West Virginia, and Pennsylvania which are north of the present range.

FORM. Eight pairs of mammae are present in females, 4 pectoral and 4 inguinal (Svihla, 1931). The male accessory glands consist of five types (Arata, 1964). Paired preputial glands are large, and lie on each side of the glans penis. The vesicular glands are well developed, lobate and recurved. Compact ampullary glands are adjacent to the vasa deferentia. Four pairs of prostates are present (anterior, dorsal, two ventral). Small bulbo-urethral glands are also present.

The shaft of the baculum is 3.5 to 4 mm long with a ventral keel. It has a terminal three-pronged cartilaginous process. Overall length is 7 mm. The base is expanded to a width of 2.2 to 2.4 mm (Burt, 1960; Hamilton, 1946b). Lowery (1974) reported a basilar width of 0.87 mm and an overall length of 5.1 mm.

A detailed description of dental morphology is presented by Park (1974). The dental formula is i 1/1, c 0/0, p 0/0, m 3/3, total 16. There are four toes on the forefoot and five on the hindfoot. A comparative study of the musculature of four cricetine genera (Rinker, 1954) included *O. palustris*.

FUNCTION. Little is known of the physiology of *O. palustris*. Sharp (1967) found that assimilation efficiencies of various natural foods ranged from 88 to 95%. Animals lost weight on diets of *Spartina*, fiddler crabs (*Uca*), or sunflower seeds. Combinations of these items or mealworms seemed to provide an adequate diet. Negus et al. (1961) found that animals in the field frequently lost
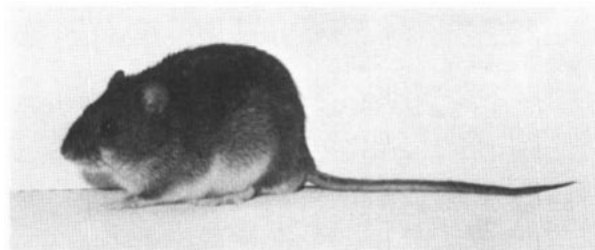

FIGURE 1. Photograph of *Oryzomys palustris palustris* from Mississippi, by R. J. Esher.
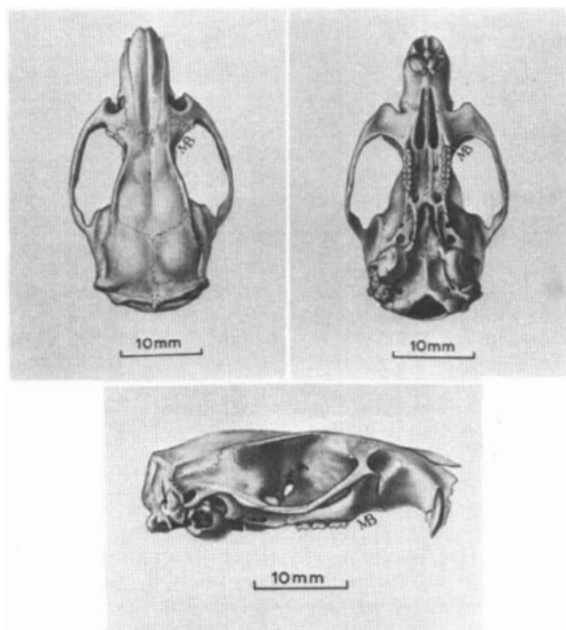
FIGURE 2. Cranium of *Oryzomys palustris natator*. Reprinted from Park et al. (1974).
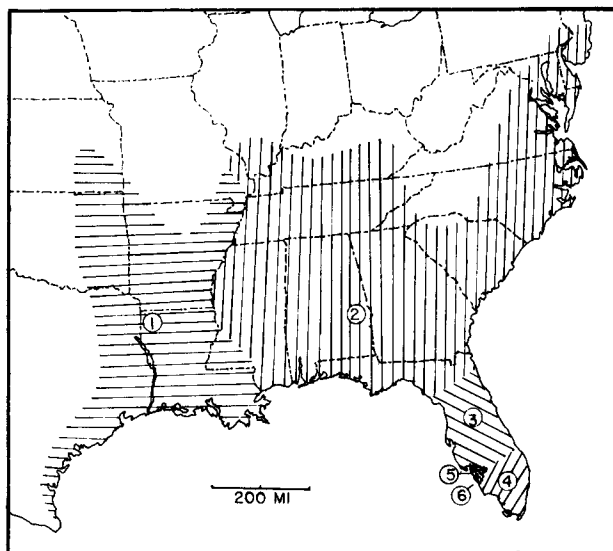

FIGURE 3. Geographic distribution of *Oryzomys palustris*. Subspecies are: 1, *O. p. texensis*; 2, *O. p. palustris*; 3, *O. p. natator*; 4, *O. p. coloratus*; 5, *O. p. planirostris*; 6, *O. p. sanibeli*.

weight during winter. A 200% increase in adrenal weight was associated with an emaciated physical condition of individuals and a declining population.

ONTOGENY AND REPRODUCTION. The gestation period was reported as 25 days by Svihla (1931) and 21 to 28 days by Park and Nowosielski-Slepowron (1972).

Hamilton (1946a) summarized early reports on litter size, which were for the most part based on few litters. More recent reports of average litter sizes include 5 (4 to 6) by Conaway (1954) and 3.6 by Park and Nowosielski-Slepowron (1972). Negus et al. (1961) reported an average of 4.8 based on embryo counts and 5.9 based on counts of corpora lutea. The latter reference reported much variation related to phase of population growth.

Breeding may occur throughout the year, with perhaps an intrinsic bimodal seasonal cycle (Park and Nowosielski-Slepowron, 1972) which is highly influenced by population and environmental variables (Negus et al., 1961). Goldman (1918) suggested that breeding occurred throughout the year and noted that many young were produced in April and May. Negus et al. (1961) reported a January to March breeding "surge" during a period of population growth, and a generally low reproductive rate during hot summer months. Worth (1950a) and Svihla (1931) observed no winter breeding in their colonies, but Conaway (1954) found reproduction in November, December, and January.

Newborn weigh between 3 and 4 g; mean weights of 3.2 (Svihla, 1931) and 3.7 g (Hamilton, 1946a) were reported. Neonates have a sparse covering of fine hairs, some dorsal pigmentation, and well-developed mystacial vibrissae (Hamilton, 1946a; Park and Nowosielski-Slepowron, 1972; Svihla, 1931). The pinna unfolds soon after birth, but the external auditory meatus remains closed until about day 8. Toes with claws are well formed and high-pitched vocalizations are emitted on day 1 (Hamilton, 1946a; Park and Nowosielski-Slepowron, 1972). The young are capable of reasonably coordinated crawling at two days of age (Hamilton, 1946a). On days 3 and 4 other facial vibrissae erupt and on day 5 pigmentation increases along the fusion line of the eyelid (Park and Nowosielski-Slepowron, 1972). On days 6 and 7 the mammae become obvious in females, the incisors become visible, and locomotory activity increases. Between days 8 and 11 the eyes open, solid food is taken and the pelage becomes sleek and shiny (Hamilton, 1946a). Weaning has been reported at age 11 days (Svihla, 1931), 11 to 13 days (Hamilton, 1946a), and 20 days (Park and Nowosielski-Slepowron, 1974; Worth, 1950a).

Regressions of weight and/or length against age have been presented by Hamilton (1946a), Negus et al. (1961), and Park and Nowosielski-Slepowron (1972, 1975a). Considerable variation in growth rates both within and between studies is apparent. Some of the discrepancies may well be due to subspecific differences.

Also, the work of Park and Nowosielski-Slepowron (1972) was carried out on a highly inbred laboratory colony derived from *O. p. natator*. Weights reported for 10 days of age range from 8 to 17 g; 20 days, 18 to 27 g; 40 days, 27 to 40 g; 60 days, 40 to 60 g; and 120 days, 50 to 80 g (Hamilton, 1946a; Negus et al., 1961; Park and Nowosielski-Slepowron, 1972, 1975a).

Both sexes appear to reach puberty at 50 to 60 days of age (Conaway, 1954; Svihla, 1931), although Negus et al. (1961) found perforate vaginae in wild females (*O. p. texensis*) at 40 to 45 days.

Duration of the estrous cycle is 7.72 ± 0.19 days with a range of 6 to 9 days (Conaway, 1954). There is a post-partum estrus (Svihla, 1931). Details of the ovarian cycle are given by Conaway (1954) and Negus et al. (1961).

ECOLOGY. *Oryzomys palustris* is semi-aquatic (Esher et al., 1978; Hamilton, 1946a; Svihla, 1931), and is found in greatest numbers in wetlands, including Atlantic and Gulf coastal marshes. The species is found in other habitats as well, especially hydric hammocks, swamps, and freshwater marshes and meadows (Goertz and Long, 1973; Goldman, 1918; Hamilton, 1946a; Hamilton and Whitaker, 1979; Kale, 1965; Layne, 1974; Lowery, 1974; Negus et al., 1961; Sharp, 1967; Svihla, 1931). Coleman (1948) reported a population in South Carolina at 3,000 ft along a mountain stream. Animals occasionally taken in upland and xeric habitats are probably transients.

The sex ratio at weaning is approximately 1:1 (Park and Nowosielski-Slepowron, 1972). Joule and Jameson (1972) reported that sex ratios did not change because of experimental treatment, but did not report the unperturbed ratios. Birkenholz (1963) found 23 males and 16 females in a sample from central Florida.

The only comprehensive, long-term ecological study of *Oryzomys palustris* is that of Negus et al. (1961). The population studied (Breton Island, Louisiana) occupied a sedge-shrub community on coastal dunes, which the authors noted was probably not representative of typical habitat. Densities ranged from 3.3 to 0.1 per ha (7.2 to 0.2 per acre). There was no obvious seasonal pattern of density fluctuations, although two drastic winter declines were recorded. In a Texas coastal prairie, Joule and Jameson (1972) captured 44 individuals on a 10.8 ha study area. Densities of over 50 per ha were reported in the Florida everglades by Smith and Vrieze (1979). Negus et al. (1961) considered weather and perhaps nutrition to be major influences on the population dynamics of this species. Seasonal rainfall had a pronounced effect on densities in hammocks and prairies of the Florida everglades (Smith and Vrieze, 1979).

Owls are the best-documented predators. Rice rats appear as major food items in the diet of barn owls (*Tyto alba*) in Texas (Svihla, 1931), Maryland (Harris, 1953), Virginia (Blem and Pagels, 1973; Jackson et al., 1976) and Louisiana (Jemison and Chabreck, 1962). Jemison and Chabreck (1962) reported 97.5% of 1,008 vertebrate remains from pellets to be rice rats. Lesser numbers have been reported from the pellets' of marsh hawks (*Circus*

cyaneus) in Maryland (Harris, 1953) and Mississippi (Jackson et al., 1972). Svihla (1931) mentioned cottonmouths (*Agkistrodon piscivorous*) as predators, and Lowery (1974) stated that rice rats were heavily preyed upon by hawks, owls, and water snakes. Harris (1953) found rice rat remains in the stomachs and scats of raccoons (*Procyon lotor*) and red foxes (*Vulpes vulpes*). Hamilton and Whitaker (1979) added barred owls (*Strix varia*), mink (*Mustela vison*), weasels (*Mustela* spp.), and skunks (*Mephitis mephitis*) to the list.

Negus et al. (1961) found the average home range of 23 males to be 0.37 ha (0.81 acres) and 12 females to be 0.23 ha (0.51 acres). These estimates were based on an average of four captures. The inclusive boundary-zone method was used. Birkenholz (1963) used similar methodology in Florida and found the average home range of males to be 0.25 ha (0.56 acres) and that of females to be 0.33 ha (0.72 acres). Average range length was reported as 74.7 m (245 ft) in a Maryland study (Harris, 1953). Pournelle (1950) reported range lengths of 67.7 m (222 ft) and 82.3 m (270 ft) in northern Florida.

Oryzomys palustris coexists with several other small mammals which are possible competitors. In northern parts of its range, *Microtus pennsylvanicus* is a common associate. Although some resources are shared, a competitive relationship has not been demonstrated (Harris, 1953). *Sigmodon hispidus* is the most common associate in southern parts of the range. Birkenholz (1963) found that water levels in a Florida wet prairie marsh habitat influenced the relative abundance of the two species. In Texas, the removal of cotton rats from experimental plots did not affect rice rats, but when rice rats and *Reithrodontomys fulvescens* were removed, changes in sex ratios and weights of cotton rats were reported (Joule and Jameson, 1972).

Sharp (1967) summarized the literature on food habits and suggested that *O. palustris* is predominantly carnivorous. However, other authors contend that the food consists mainly of seeds and succulent plant parts (Hamilton and Whitaker, 1979; Lowery, 1974; Svihla, 1931). Negus et al. (1961) reported considerable seasonal variation; vegetation and seeds constituted up to 85% of the diet at times, and arthropods up to 75% in other samples. Overall, their work indicated that about equal amounts of plant and animal foods were eaten. Little specific information is available on plant foods eaten. *Spartina alterniflora*, *S. glabra*, *Salicornia europea*, *Tripsacum* sp., and *Elymus* sp. were listed as *Oryzomys* foods by Hamilton (1946a) and Hamilton and Whitaker (1979). Negus et al. (1961) reported that the fungus *Endogone* was consumed in some quantity at certain times of the year. Animal foods are varied, but insects, fiddler crabs (*Uca*), and snails are common items in the diet (Hamilton and Whitaker, 1979; Lowery, 1974). Among other animal foods listed were fishes, clams, and the carcasses of muskrats, deermice, and sparrows. Goodpaster and Hoffmeister (1952) stated that baby turtles (*Graptemys* and *Chrysemys* were major food items in freshwater marshes bordering Reelfoot Lake in Tennessee. Kale (1965) showed that rice rats were the chief predators on eggs and young of long-billed marsh wrens (*Telmatodytes palustris*), accounting for as much as 84% of all predation on this species during certain years. Parasitological evidence from a marsh population near Cedar Key, Florida, indicated that 48 of 91 rice rats sampled were infected by a species of trematode which could have been contracted only by eating killifishes of the genus *Fundulus* (Kinsella and Heard, 1974). One hundred percent of the sample was infected by microphallid trematodes for which blue (*Callinectes sapidus*) and fiddler (*Uca* spp.) crabs are intermediate hosts (Kinsella, pers. comm.).

The following parasites have been reported from *Oryzomys palustris*:

Mites and Ticks:

Bdelonyssus bacoti	Morlan (1952), Worth (1950b)
B. sp.	Morlan (1952)
Gigantolaelaps cricetidarum	Morlan (1952), Worth (1950b)
Haemolaelaps glasgowi	Morlan (1952), Worth (1950b)
Laelaps sp.	Morlan (1952), Worth (1950b)
Eutrombicula multisetosa	Worth (1950b)
E. batatas	Worth (1950b)
Trombicula splendens	Morlan (1952), Worth (1950b)
Listrophorous sp.	Morlan (1952), Worth (1950b)
Demacentor variabilis	Morlan (1952), Worth (1950b)

Lice:

Hoplopleura hirstuta	Morlan (1952), Worth (1950b)
H. quadridentata	Worth (1950b)
Polyplax spinulosa	Morlan (1952)
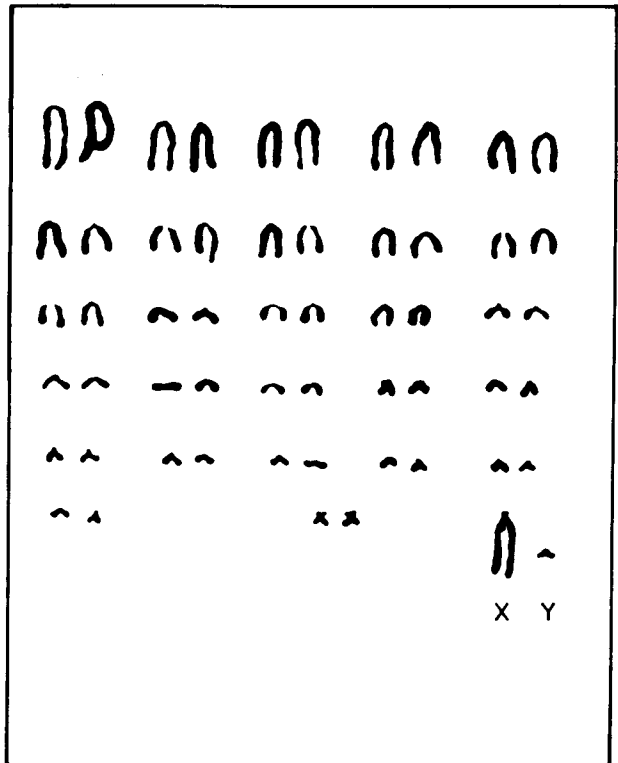
FIGURE 4. Karyotype of *Oryzomys palustris*. Reprinted from Benson and Gehlbach (1979).

Flea:	
Polygenis gwyni	Layne (1971), Worth (1950b)
Nematodes:	
Mastorphis muris	Doran (1955), Kinsella (1974a)
Pterygodermatites ondatrae	Doran (1955), Kinsella (1974a)
Angiostrongylus schmidti	Kinsella (1971)
Physaloptera hispida	Kinsella (1974a)
Litomosoides scotti	Forrester and Kinsella (1973)
Hassalstrongylus forresteri	Durette-Desset (1974)
H. lichtenfelsi	Durette-Desset (1974)
Digeneans:	
Zonorchis komareki	Lumsden and Zischke (1961)
Catatropis johnsoni	Bush and Kinsella (1972)
Stictodora cursitans	Kinsella and Heard (1974)
Lyperosomum intermedium	Denton and Kinsella (1972)
Microphallus basodactylophallus.	Kinsella (1974a), Overstreet (1978)
Gynaecotyla adunca	Kinsella (1974a)
Probolocoryphe glandulosa	Kinsella (1974a)
Maritrema sp.	Kinsella (1974a)
Pentastomid:	
Porocephalus crotali	Forrester et al. (1970), Kinsella (1974b)
Coccidians:	
Isospora hammondi	Barnard et al. (1971a)
Eimeria palustria	Barnard et al. (1971a)
Eimeria kinsellai	Barnard et al. (1971b)

Rice rats are known to have a bacterial peridontal disease which has been the subject of considerable research in the area of dental medicine (Dick et al., 1968).

BEHAVIOR. Hamilton (1946a) and Svihla (1931) mentioned the predisposition of rice rates to swim and dive. Esher et al. (1978) further documented this behavior in a laboratory study, which demonstrated that the tendency for rice rats to enter water and swim was about 20 times that of cotton rats (*Sigmodon hispidus*). Rice rats frequently swam under water for distances greater than 10 m, and swam significantly faster than cotton rats. Svihla (1931) described rice rats as "very cleanly," and Ham-

ilton (1946) had never before seen a small mammal "so solicitous of its toilet." Both describe self-grooming in some detail. The importance of this behavior may be in maintaining the water-repellent quality of the pelage (Esher et al., 1978).

Oryzomys palustris is known to be primarily nocturnal from trapping studies and from comparisons of its relative frequency in hawk and owl diets (see ECOLOGY). Worth (1950a) reported that caged animals were active only at night. Kilduff and Dube (1979) clearly demonstrated a nocturnal pattern in the laboratory and suggested temporal separation as a possible factor in segregating the niches of *Oryzomys palustris* and *Sigmodon hispidus*.

Grapefruit-sized nests of woven grasses and sedges are usually placed on high ground under debris, at the bases of shrubs, or at the end of shallow burrows (Goodpaster and Hoffmeister, 1952; Hamilton, 1946a; Negus et al., 1961). They also may be attached to marsh vegetation in areas that are flooded at high tide (Audubon and Bachman, 1854; Sharp, 1967; pers. observ.). Nests of long-billed marsh wrens (*Telmatodytes palustris*) are appropriated and modified on occasion (Kale, 1965; Sharp, 1967). Rice rats have been reported to nest inside the houses of *Neofiber alleni* (Birkenholz, 1963; Harper, 1920) and *Ondatra zibethicus* (Harris, 1953; Rhoads, 1902; Stone, 1898).

Lanier et al. (1974) conducted food-hoarding experiments on ten species of muroid rodents, including *Oryzomys palustris*. Rice rats failed to show appreciable hoarding. However, Goodpaster and Hoffmeister (1952) observed rice rats returning to their nests with food.

Worth (1950a) reported much agonistic behavior upon placing a female in a cage of a male. High-pitched squeaks were associated with this behavior. Svihla (1931) also reported such vocalizations during fights, and by young in the nest. Christensen (1980) found a higher rate of agonistic interaction between matched pairs of rice rats than between matched pairs of cotton rats. When rice rats were matched against cotton rats, interaction rate was lower than in either intraspecific pairing. He suggested that the role of interspecific social behavior in resource partitioning between these two species was a minor one.

The motor patterns of copulatory behavior are similar to those of laboratory rats, but less exaggerated. There is a pronounced Coolidge effect (ability of a new female to elicit copulation from a previously satiated male), and there is vigorous pursuit of the female by the male during the post-ejaculatory interval (Dewsbury, 1970). Antagonism toward the male by females with newborn litters was reported by Svihla (1931).

GENETICS. The diploid chromosome number is 56; the fundamental number is 60. The X and Y chromosomes are acrocentrics (Benson and Gehlbach, 1979). The karyotype is illustrated in Fig. 4.

Mutants have been reported with fused and supernumerary molar teeth in a laboratory colony kept at Harvard (Griffiths and Shaw, 1961) and a "pale-pelage" mutant in a colony at Dundee, Scotland (Nowosielski-Slepowron, 1972; Park and Nowosielski-Slepowron, 1975b).

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