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ABUNDANCE AND FOOD-SEARCHING INTENSITY OF WOOD MICE (*APODEMUS SYLVATICUS*) IN FRAGMENTED FORESTS

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ABSTRACT.—Abundance, food-searching intensity, physiological status, and population attributes of wood mice (*Apodemus sylvaticus*) were studied in forest islands of central Spain. Seventeen isolated woodlots (*Quercus rotundifolia*) ranging from 0.1 to 280 ha were studied. The results show high densities of mice and high rates of predation on acorns in the smaller forests.

Impact of forest destruction on wildlife is one of the main subjects of investigation in wildlife conservation (Soulé, 1986; Verner et al., 1986). Animal communities are usually affected by reduction and fragmentation of forests because of habitat modifications, greater activity of predators, and extinctions (Gilpin 1987; Wilcove et al., 1986). In spite of the contribution of small mammals to ecosystems (Golley et al., 1975), little work has been devoted to the experimental study of their role in this process of forest destruction (Bennet, 1987).

Stamps et al. (1987) considered which forest patches may be bounded by a "hard edge," an impenetrable physical or psychological barrier that some small mammals never cross to enter surrounding habitats (Wegner and Merriam, 1979; Yahner, 1983). Under these conditions, populations of forest vertebrates face increasing local extinction rates not compensated by a parallel increase in immigration rates as patch-size of forest decreases (Mac Arthur and Wilson, 1967). Geuse et al. (1985) observed local extinctions of the bank vole (*Clethrionomys glareolus*) in small forests. Forest patches also may be bounded by "soft edges," boundaries permeable to emigrating individuals of some species. Wood mice (*Apodemus sylvaticus*), for instance, cross open fields to reach islands of wooded habitat (Kikkawa, 1964) in which they can reach high densities during winter (Geuse et al., 1985). Because mice eat a broad range of resources (mainly seeds, but also fruit and invertebrates—Hansson, 1985; Obrtel and Holisova, 1983) in the ground, shrubs, and trees (Montgomery, 1980), high rates of predation on seeds could strongly affect the regeneration patterns of many plant species (Hansson, 1974; Reichman, 1979). As wood mice mainly occupy forest edges (Hoffmeyer and Hansson, 1974) and edge: size ratio of forests increases as forest size decreases, abundance and impact on forest food resources of mice should be higher in smaller woodlots.

Herein, we describe patterns of abundance and food-searching intensity of wood mice wintering in different sized woodlots of central Spain. As abundance may be a misleading indicator of habitat quality (Van Horne, 1983), we also studied some physiological (weight, reproductive status) and population (sex ratio) attributes of mice to test the effect of forest reduction on their populations.

STUDY AREA

The study was conducted during winter 1988–1989 in a flat area with an average elevation of 800 m and dominated by extensive fields of grain crops (mainly barley and wheat). Remnants of the original forest are interspersed among these fields. These patches consist of holm oaks (*Quercus rotundifolia*) mixed with a smaller proportion of Lusitanian oaks (*Q. faginea*) and Sabina junipers (*Juniperus thurifera*), accompanied by shrubs from the genera *Cistus*, *Thymus*, *Lavandula*, and *Genista*. Holm oaks exhibit interyear differences in acorn production (Ceballos and Ruiz, 1979). The 1988 crop was low and no acorns were observed in or under trees during winter.

We studied rodents in 17 isolated woodlots ranging from 0.1 to 280 ha (assessed from aerial photographs). Earlier trapping and the study of owl (*Strix aluco*) pellets showed that wood mice, common voles (*Microtus arvalis*), and garden dormice (*Eliomys quercinus*) occupy these forests. Common voles were scarce in these forests and occupied sectors were easily noted from runways through grass. Garden dormice hibernate

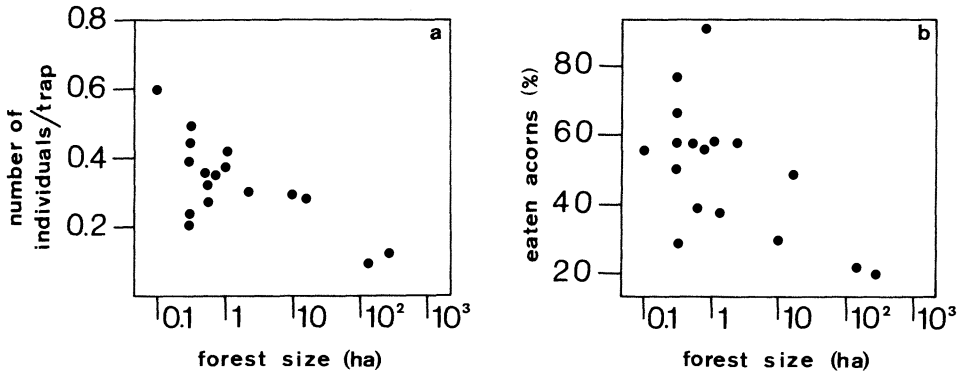


FIG. 1.—Relationship between (a) abundance of wood mice (individuals/trap) and forest size and (b) between the mean percent of acorns preyed upon and forest size.

throughout the winter. The wood mouse, thus, is the most ubiquitous, abundant, and active wintering rodent in these forests.

METHODS

One-half acorns (*Q. rotundifolia*) were used to assess food-searching intensity by mice. This approach was useful as acorn remnants showed teeth marks after being used by mice. Further, fecal pellets near acorns were used to identify acorn predators (always wood mice). Groups of three one-half acorns were placed during the night in all forest sites, from six groups in forests under 2 ha to 49 groups in forests >200 ha, according to a logarithmic scale of forest size. They were situated in transects starting in the border and traced across the core of forests. Separation between consecutive stations varied according to forest size: about 10–15 m in small forests and 20–30 m in forests >10 ha. Of the three one-half acorns in each group, one was pinned with a nail on the ground, over a root of the selected tree; one also was pinned on the bare bark of the trunk, ca. 1.5 m above ground; and one was bound with a wire to a branch (ca. 1 cm diameter) 3–4 m above the base of the tree. The distance above the base for acorns on branches was measured as the theoretical lineal path followed by a mouse searching for food from the ground. Two experiments were performed during January and February in which 1,287 one-half acorns (429 trees) were placed for mice during a night. Percentages of one-half acorns eaten by mice were used to evaluate the intensity of seed predation during January, February, and the whole period (mean predation rate).

Six to 49 trap stations were placed in each woodlot during the 1st days of March, after the foraging tests. Each station was provided with two snap-traps to prevent saturation (Smith et al., 1975). Trap stations were located close to trees used in foraging tests. Captures during 2 consecutive nights were used to obtain an abundance index (number individuals caught/trap) in each forest. Additional trap stations (five series with 15 trap stations each) also were used to estimate abundance in surrounding corn fields. For all mice captured, weight, sex, and reproductive status (testes development in males and pregnancy in females) were recorded. Data transformations and statistical analyses were made according to Zar (1984).

RESULTS

Abundance of mice was greater in forests than in surrounding fields (0.014 mice/trap, 132 traps, in cornfields and 0.179 mice/trap, 876 traps, in forests). Abundance diminished as forest size increased (log-transformed forest size and arcsine-transformed abundance, $r = -0.73$, $P < 0.001$; Fig. 1). Acorn use also decreased as forest size increased (log-transformed forest size and arcsine-transformed percent acorn use, $r = -0.59$, $P < 0.05$; Fig. 1). Acorn use also was correlated positively with abundance (acorn use and abundance, both arcsine-transformed, $r = 0.54$, $P < 0.05$). Percent acorn use in January and February was correlated positively (arcsine-transformed values, $r = 0.78$, $P < 0.001$), which seems to indicate a constant pattern of spatial distribution of predation rate in forests of different size throughout winter. Intensity of acorn use by mice increased in all substrata as forest size decreased. Mice preyed more intensively on acorns on

TABLE 1.—Half acorns eaten by wood mice according to forest size and substrate.

Substrate	Forest size						χ^2
	<10 ha		10–100 ha		>100 ha		
	n	% eaten	n	% eaten	n	% eaten	
Ground	156	81.4	99	60.6	174	42.5	20.44***
Trunks	156	62.2	99	43.4	174	15.5	46.62***
Branches	156	29.5	99	17.2	174	4.6	30.65***
χ^2	32.27***		23.45***		62.51***		

*** $P < 0.001$.

the ground than on trunks; acorns on branches were used least. These patterns of foraging were similar in forests of different sizes (Table 1).

Despite a shortage of data on mice inhabiting large forests, we suggest no differences in number of females:number of males among mouse populations (32:50, 14:25, and 4:8 in <10, 10–100, and >100 ha woodlots; $\chi^2 = 0.46$, $P > 0.05$), proportion of sexually active males (37/50, 14/25, and 6/8 sexual active/sexual inactive males in the three forest size intervals; $\chi^2 = 0.84$, $P > 0.05$), and proportion of pregnant females (0/37, 0/14, and 0/4 active/inactive females). Females (19.7 ± 3.3 g, 21.1 ± 3.6 g, and 20.4 ± 3.4 g in small, medium, and large forests, respectively; analysis of variance, $F = 1.02$, $P > 0.05$) and males (23.1 ± 3.4 g, 23.2 ± 2.7 g, and 21.3 ± 3.5 g; analysis of variance, $F = 1.20$, $P > 0.05$) inhabiting forests of different sizes showed similar weight-distribution patterns.

DISCUSSION

From these results, we suggest crowding of wintering mice in smaller forests where they are more abundant than in large forests and surrounding cornfields. This pattern of winter distribution of mouse abundance in these agricultural areas can be related to winter-nesting and feeding requirements of the species. In agricultural areas of central Spain, wood mice occupy open fields during summer, but concentrate during winter in the most highly vegetated, unploughed plots, probably because such areas provide better winter-nesting places than intensively cultivated corn fields (Montgomery and Gurnell, 1985). Nevertheless, the surrounding fields provide the species with a supply of weeds, its main food resource. The weed density in fields is higher than that obtained on the forest floor (Roberts, 1981; Tellería et al., 1988).

Suitability of small forests as wintering habitat for wood mice also must be tested by analyzing traits other than abundance patterns (Van Horne, 1983). Differences in sex ratios could illustrate any kind of intrasexual competition (e.g., young males usually are excluded by dominant males under population stress—Dobson, 1982; Gurnell, 1978); differences in weight and reproductive status could demonstrate differences in physiological conditions at the end of winter (the winter sexual activity was related to adequacy of environmental conditions—Clarke, 1985; Hansson, 1984). However, no clear difference was observed among populations, indicating that mice from small forests seem to be similar to those inhabiting the large ones. Thus, in spite of crowding, mice inhabiting small forests seem to occupy an adequate habitat in which they can efficiently survive during winter.

The increase in use of experimental acorns, and the parallel increase of food-searching intensity (e.g., increasing use of bare trunks and branches) as forest size decreases suggest negative consequences of mouse distribution during winter in forest islands. Mice can become significant seed eaters in European forests (Drozd, 1966), many of which have interyear fluctuations in the seed crops. Nielsen (1977) and Jensen (1982) showed that in a year of major seed production a large number of beech (*Fagus sylvatica*) nuts or acorns survive predation, hence have the potential of germinating into new individual plants. In contrast, between years of major seed crops, they showed that rodents alone consumed large percentages of the seeds produced. Synchronization of seed production thus has the advantage of maximizing the probability of seeds escaping

predation (Janzen 1971). This effect may be reduced in small forests (Boucher, 1981; Nilsson and Wästljung, 1987; Wästljung, 1989), especially if, as we show, there is a sharp increase in the abundance of some seed predator. This fact should contribute to a floristic change of these forest remnants and a decrease in their regeneration capability. Therefore, seed depletion may have a negative effect on other vertebrates that feed on seeds or fruit during autumn and winter (e.g., many wintering birds in the Mediterranean Region—Herrera, 1984; Jordano, 1987; Telleria, 1988).

According to Main (1987), retention of forest habitats that existed more widely before fragmentation and the provision of habitat for plant species, and migratory and sedentary animals, are the main role of forest remnants in agricultural landscapes. This role probably cannot be fulfilled in small forests because of the disturbing effects resulting from fragmentation. However, little work has been devoted to study of the causal origin of these negative trends (e.g., role of the different groups of species and their interactions). From our results, we suggest the need of more work about the role of small mammals in determining the structure and dynamics of forest remnants.

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LITERATURE CITED

- BENNET, A. F. 1987. Conservation of mammals within a fragmented forest environment: the contributions of insular biogeography and autecology. Pp. 41–52, *in* Nature conservation: the role of remnants of native vegetation (D. A. Saunders, G. W. Arnold, A. A. Burbidge, and J. M. Hopking, eds.). Surrey Beatty, Norton, Australia, 410 pp.
- BOUCHER, D. H. 1981. Seed predation by mammals and forest dominance by *Quercus oleoides*, a tropical lowland oak. *Oecologia* (Berlin), 49:409–414.
- CEBALLOS, L., AND J. RUIZ. 1979. Árboles y arbustos de la España Peninsular. Escuela Técnica Superior de Ingenieros de Montes, Madrid, Spain, 512 pp.
- CLARKE, J. R. 1985. The reproductive biology of the bank vole (*Clethrionomys glareolus*) and the wood mouse (*Apodemus sylvaticus*). Pp. 33–59, *in* The ecology of woodland rodents bank voles and wood mice (S. R. Flowerdew, J. Gurnell, and J. M. W. Gipps, eds.). Symposia of the Zoological Society of London, 55:1–418.
- DOBSON, F. S. 1982. Competition for males and predominant juvenile male dispersal in mammals. *Animal Behaviour*, 11:363–384.
- DROZDZ, A. 1966. Food habits and food supply of rodents in the beech forest. *Acta Theriologica*, 11: 363–384.
- GEUSE, P., V. BAUCHAU, AND E. LE BOULENGÉ. 1985. Distribution and population dynamics of bank voles and wood mice in a patchy woodland habitat in central Belgium. *Acta Zoologica Fennica*, 173:65–68.
- GILPIN, M. E. 1987. Spatial structure and population vulnerability. Pp. 125–139, *in* Viable populations for conservation (M. E. Soulé, ed.). Cambridge University Press, Cambridge, United Kingdom, 189 pp.
- GOLLEY, F. B., K. PETRUSEWICZ, AND L. RYSZKOWSKI. 1975. Small mammals: their productivity and population dynamics. Cambridge University Press, Cambridge, United Kingdom, 451 pp.
- GURNELL, J. 1978. Seasonal changes in numbers and male behavioural interaction in a population of wood mice, *Apodemus sylvaticus*. *The Journal of Animal Ecology*, 47:741–755.
- HANSSON, L. 1974. Small mammal productivity and consumption in spruce forest and reforestation in South Sweden. *Oikos*, 25:153–156.
- . 1984. Winter reproduction of small mammals in relation to food conditions and population dynamics. Pp. 225–234, *in* Winter ecology of small mammals (J. F. Merritt, ed.). Special Publication of the Carnegie Museum of Natural History, 10: 1–380.
- . 1985. The food of bank voles, wood mice and yellow-necked mice. Pp. 141–168, *in* The ecology of woodland rodents bank voles and wood mice (S. R. Flowerdew, J. Gurnell, and J. M. W. Gipps, eds.). Symposia of the Zoological Society of London, 55:1–418.
- HERRERA, C. M. 1984. A study of avian frugivores, bird-dispersed plants and their interaction in Mediterranean shrubland. *Ecological Monographs*, 54: 1–23.
- HOFFMEYER, I., AND L. HANSSON. 1974. Variability in number and distribution of *Apodemus flavicollis* (Melch.) and *A. sylvaticus* (L.) in South Sweden. *Zeitschrift für Säugetierkunde*, 39:15–23.
- JANZEN, D. H. 1971. Seed predation by animals. *Annual Review of Ecology and Systematics*, 2:465–492.
- JENSEN, T. S. 1982. Seed production and outbreaks of non-cyclic rodent populations in deciduous forests. *Oecologia* (Berlin), 54:184–192.
- JORDANO, P. 1987. Avian fruit removal: effects of

- fruit variation, crop size and insect damage. *Ecology*, 68:1711–1723.
- KIKKAWA, J. 1964. Movement, activity and distribution of small rodents *Clethrionomys glareolus* and *Apodemus sylvaticus* in woodland. *The Journal of Animal Ecology*, 33:259–299.
- MAC ARTHUR, R. H., AND E. O. WILSON. 1967. *The theory of island biogeography*. Princeton University Press, Princeton, New Jersey, 203 pp.
- MAIN, A. R. 1987. Management of remnants of native vegetation—a review of the problems and the development of an approach with reference to the wheatbelt of western Australia. Pp. 1–13, in *Nature conservation: the role of remnants of native vegetation* (D. A. Saunders, G. W. Arnold, A. A. Burbidge, and J. M. Hopkins, eds.). Surrey Beatty, Norton, Australia, 410 pp.
- MONTGOMERY, W. I. 1980. The use of arboreal runways by the woodland rodents *Apodemus sylvaticus* (L.), *A. flavicollis* (Melchior) and *Clethrionomys glareolus* (Schoener). *Mammal Review*, 10: 189–195.
- MONTGOMERY, W. I., AND J. GURNELL. 1985. The behaviour of *Apodemus*. Pp. 89–115, in *The ecology of woodland rodents bank voles and wood mice* (S. R. Flowerdew, J. Gurnell, and J. M. W. Gipps, eds.). *Symposia of the Zoological Society of London*, 55:1–418.
- NIELSEN, B. O. 1977. Beech seeds as an ecosystem component. *Oikos*, 29:268–274.
- NILSSON, S. G., AND U. WÄSTLJUNG. 1987. Seed predation and cross-pollination in mast-seedling beech *Fagus sylvatica* patches. *Ecology*, 68:260–265.
- OBRTEL, R., AND V. HOLISOVA. 1983. Winter and spring diets of three coexisting *Apodemus* spp. *Folia Zoologica*, 32:291–302.
- REICHMAN, O. J. 1979. Desert granivore foraging and its impact on seed densities and distribution. *Ecology*, 60:1085–1092.
- ROBERTS, H. A. 1981. Seed banks in soils. *Advances in Applied Biology*, 6:1–55.
- SMITH, M. H., R. H. GARDNER, J. GENTRY, D. W. KAUFMAN, AND M. H. O'FARRELL. 1975. Density estimators of small mammal populations. Pp. 25–53, in *Small mammals: their productivity and population dynamics* (F. B. Golley, K. Petruszewicz, and L. Ryszkowski, eds.). Cambridge University Press, Cambridge, United Kingdom, 451 pp.
- SOULÉ, M. E. (ED.). 1986. *Conservation biology. The science of scarcity and diversity*. Sinauer Associates, Inc., Sunderland, Massachusetts, 584 pp.
- STAMPS, J. A., M. BUECHNER, AND V. V. KRISHMAN. 1987. The effects of edge permeability and habitat geometry on emigration from patches of habitat. *The American Naturalist*, 129:533–552.
- TELLERÍA, J. L. (ED.). 1988. Invernada de aves en la Península Ibérica. *Monografías de la Sociedad Española de Ornitología*, 1:1–208.
- TELLERÍA, J. L., T. SANTOS, G. ALVAREZ, AND C. SÁEZ-ROYUELA. 1988. Avifauna de los campos de cereales del interior de España. Pp. 172–319, in *Avifauna de los medios urbano y agrícola* (F. Bernis, ed.). *Monografías de la Sociedad Española de Ornitología*, 2:1–319.
- VAN HORNE, B. 1983. Density as a misleading indicator of habitat quality. *The Journal of Wildlife Management*, 47:893–901.
- VERNER, J., M. L. MORRISON, AND C. J. RALPH (EDS.). 1986. *Wildlife 2000. Modeling habitat relationships of terrestrial vertebrates*. University of Wisconsin Press, Madison, 470 pp.
- WÄSTLJUNG, U. 1989. Effects of crop size and stand size on seed removal by vertebrates in hazel *Corylus avellana*. *Oikos*, 54:178–184.
- WEGNER, J. F., AND G. MERRIAM. 1979. Movements by birds and small mammals between a wood and adjoining farmland habitats. *The Journal of Applied Ecology*, 16:337–394.
- WILCOVE, D. S., C. H. MCLELLAN, AND A. P. DOBSON. 1986. Habitat fragmentation in temperate zone. Pp. 237–256, in *Conservation biology. The science of scarcity and diversity* (M. E. Soulé, ed.). Sinauer Associates Inc., Sunderland, Massachusetts, 584 pp.
- YAHNER, R. H. 1983. Population dynamics of small mammals in farmstead shelterbelts. *Journal of Mammalogy*, 64:380–386.
- ZAR, J. H. 1984. *Biostatistical analysis*. Prentice Hall, Englewood Cliffs, New Jersey, 717 pp.

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