described Elfin Woods Warbler and other bird records from the West Indies. Carib. J. Sci. 13:231–235.

GRADWHOL, J. AND R. GREENBERG. 1982. The effect of a single species of predator on the arthropods of aerial leaf litter. Ecology 63:581–583.

JAMES, F. C. AND H. H. SHUGART, JR. 1970. A quantitative method of habitat description. Audubon Field Notes 24:727–736.

KEPLER, C. B. AND K. PARKES. 1972. A new species of warbler (Parulidae) from Puerto Rico. Auk 89:1–18.

MUNN, C. A. AND J. TERBORGH. 1979. Multi-species territoriality in Neotropical foraging flocks. Condor 81:338–347.

PEREZ-RIVERA, R. AND L. A. MALDONADO. 1977. Lista de Cotejo de las aves de Cayey y algunos comentarios sobre estas. Revista Cayey 9(19):129–136.

ROSENBERG, K. V. 1990. Dead-leaf foraging specialization in tropical forest birds: measuring resource availability and use. Stud. Avian Biol. 13:360–368.

SKUTCH, A. F. 1967. Life histories of Central American highland birds. Publication No. 7, Nuttall Ornithol. Club, Cambridge, Massachusetts.

STILES, F. G. AND A. F. SKUTCH. 1989. Guide to the birds of Costa Rica. Cornell Univ. Press, Ithaca, New York.

U.S. FISH AND WILDLIFE SERVICE. 1989. Notice of Review 50 CFR Part 17. USFWS Division of Endangered Species and Habitat Conservation, Washington, D.C.

WETMORE, A. 1927. The birds of Porto Rico and the Virgin Islands. Sci. Surv. of Porto Rico Virgin Islands, Vol. IX, Part 4. New York Acad. Sci., New York.

WILEY, J. W. 1985. Bird conservation in the United States Caribbean. Pp. 107–159 *in* Bird conservation, Vol. 2 (S. A. Temple, ed.). Univ. Wisconsin Press, Madison, Wisconsin.

WILLIS, E. O. 1972. Local distribution of mixed species flocks in Puerto Rico. Wilson Bull. 85:75–77.

BRYAN ARROYO-VAZQUEZ, *Dept. Biological Sciences, Univ. of Arkansas, Fayetteville, Arkansas 72701* (Present address: *U.S. Fish and Wildlife Service, 611 East 6th Street, Room 449, Austin, Texas 78701*). *Received 30 April 1991, accepted 12 Nov. 1991.*

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Vulnerability and mortality of young Australian Magpies on roads.—The process of development from hatching to the adult varies in the time required for each stage, the amount of learning required to master the necessary skills, and the type of learning or skill required. Nevertheless, the young of all birds must learn to cope with a variety of hazards once they leave the relative safety of the nest. Often the early aspects of learning that take place before or after fledging are ignored, although Bateson (Proc. 19th Int. Ornithol. Congr. 1116–1126, 1988) and others have extensively studied imprinting. The period following departure from the nest is particularly traumatic because young birds must learn to forage by themselves, to recognize appropriate foraging and roosting habitats, and to avoid predators and other dangers. One problem for many species in the modern world is to avoid vehicles on roads, particularly those birds that scavenge on animals hit by cars. This problem is increasing as more roads are built and as dirt roads are paved.

Study area and methods.—This study was conducted along primary and secondary roads in the South Island, New Zealand from 4 November to 8 December 1990. We travelled a

TABLE 1
AUSTRALIAN MAGPIE COUNTS ALONG 1803 KM OF MAJOR PAVED ROADS ON SOUTH ISLAND, NEW ZEALAND

	Dead on road	Live on road	Within 25 m of road	26–50 m from road	51–75 m from road
One young	53	44	44	21	3
One adult	0	23	41	42	45
One adult and one young	0	9	22	27	18
Two adults and one young	0	1	1	3	4
One adult and two young	0	2	6	11	21
One adult and three young	0	0	2	5	3
Total sightings		79	116	89	94
Total young		58	79	88	76
Total adults		36	73	91	95

variety of roads east of the mountains from Kaikoura to Dunedin, recording Australian Magpies (*Gymnorhina tibicen*) as a function of age and their location relative to the road. Data were recorded in 5 km stretches, and we did not include towns or cities in our censuses. We noted the presence of all magpies, the size and age composition of groups, and their location in five categories: dead on road, alive on road, within 25 m of the road, between 28–50 m of the road, and 51–75 m from the road. We did not record birds more than 75 m from the road. We also noted the presence of other dead animals on the road for comparison.

To examine the magpie's avoidance of roads with fast-moving traffic, we conducted a separate series of censuses on paved highways and on adjoining dirt roads that were perpendicular to the highways. Thus the habitat was similar. Each census was of 5 km of a dirt road, and the adjoining 5 km of paved highway. These data are not included in our overall census data.

Results.—We observed 603 live magpies and 53 dead magpies along 1803 km of roads. All dead magpies were young. In the same distance we also saw the following dead animals: Four Marsh Harriers (*Circus approximans*), eight South Island Pied Oystercatchers (*Haematopus ostralegus*), three Mallards (*Anas platyrhynchos*), 273 Brush-tailed possum (*Trichosurus vulpecula*), 99 European rabbits (*Oryctolagus cuniculus*), eight hedgehogs (*Erinaceus europaeus*), and five ferrets (*Mustela furo*). For all the other species of birds, both adult and young were found dead on the road. Although both young and adult magpies were found in all locations relative to the road, more young than adults were closer to the road (Table 1). Over 85% of the solitary young were within 18 m of the road, whereas only 53% of the solitary adults were there ($\chi^2 = 34.9$, df = 1, $P < 0.001$). Further, parents with young were even less likely to be within 18 m of the road (32%, N = 43) than within 18–54 m (68%, N = 92). Thus, although solitary adults feed within 18 m of the road, they generally keep farther away when they have young ($\chi^2 = 5.2$, df = 1, $P < 0.05$).

For 10 censuses (each 5 km), there were significantly more magpies along side roads than along paved highways (Table 2, $\chi^2 = 121.8$, df = 1, $P < 0.001$).

Discussion.—We found that all of the dead magpies found on the roads were young. There are two possible reasons for this finding: (1) young have more difficulty finding natural foods

TABLE 2

COMPARISON OF AUSTRALIAN MAGPIE COUNTS ON MAJOR PAVED HIGHWAYS WITH COUNTS ON DIRT ROADS RUNNING PERPENDICULAR TO THEM

	Dirt roads	Major paved roads
One young	22	6
One adult	32	9
One adult and one young	26	10
One adult and two young	13	3
One adult and three young	7	
Two adults and one young	12	1
Two adults and two young	1	
Two young	5	
Two adults	2	
Total	120	29
Total young	119	23
Total adults	108	24

and so rely on dead carcasses on the road more often than do adults, and (2) they are less able to perceive and avoid an oncoming vehicle. In almost all studies where age differences have been examined (see Burger, Proc. 19th Int. Ornithol. Congr. 1127–1140, 1988), young have more difficulty finding or capturing food. Thus it is not surprising that young magpies might be so handicapped. We found significantly more young magpies feeding on the road than adults, suggesting that they use the available food on the road more than do the adults. Only young were killed by vehicles. Whenever we could, we noted the distance between our oncoming car and the magpies when they flushed. Whenever both were present, adults always flushed before young. Thus it seems likely that young magpies are killed on the highways both because they forage there more often and because they wait longer to flush from oncoming vehicles.

Not surprisingly more magpies were near (within 54 m) secondary roads than near paved highways. As the habitats were similar, this difference shows either avoidance of paved roads or that unwary magpies near highways were already killed, reducing the "paved road" population.

Dhindsa et al. (Environ. Conserv. 15:303–310, 1988) suggested that in India granivorous birds are attracted to roads, and that insectivorous and other birds are repelled by them. They attributed this to the grain spilled on roads in India. However, in New Zealand, magpies on the highways and secondary roads were primarily eating road-killed animals and were often killed while flying from this food source.

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JOANNA BURGER, *Dept. of Biological Sciences, Rutgers Univ., Piscataway, New Jersey 08855;* AND MICHAEL GOCHFELD, *Environmental and Community Medicine, UMDNJ-Robert Wood Johnson Medical School, Piscataway, New Jersey 08854.* *Received 9 Sept. 1991, accepted 18 Nov. 1991.*