Pesticides and the decline of Guam's native birds

SIR—Diamond[1] recently reviewed the factors which might be responsible for the decline of Guam's native birds. Although Diamond's commentary was based on a report by Jenkins[2] that included several hypotheses (pesticides, introduced predators and disease), Diamond suggested that pesticides were the most likely cause.

The pesticide hypothesis evolved from two reports. In 1946, Baker[3] stated the organochlorine pesticide DDT was used extensively on the island during and after the Second World War. In 1977, Drahos[4] reported concentrations of DDE, a metabolite of DDT, of less than 0.4 p.p.m. in the carcass lipid (about 0.03 p.p.m. whole carcass wet weight) or swiftlets (*Aerodramus vanikorensis bartschi*) and concentrations of DDT and DDE of less than 0.10 p.p.m. (believed to be on a dry weight basis) in swiflet guano.

Diamond[1] and others[2,4] considered these data indicative of potential harmful effects of DDT, a conclusion not supported by critical evaluation of Drahos' data or concentrations of DDT and DDE ($\leq$0.2 p.p.m. dry weight) detected in swiftlet guano I collected in 1981. The carcass residues reported by Drahos[4] indicate that swiftlets were exposed to DDT or DDE, but concentrations are a fraction of those associated with mortality ($>$ 600 p.p.m. in carcass lipid)[5] or reproductive failure (78 p.p.m. whole carcass wet weight)[6] in birds. Residues in the guano are difficult to interpret because relationships between concentrations of organochlorines in bird faeces and those in their carcasses have not been determined. These relationships have been determined for bats, however, and residues in swiftlet guano are similar to those in guano of bats (*Myotis grisescens*) whose carcasses contained only a fraction of lethal levels[7].

Soil and avian prey I collected in 1981 were essentially free of organochlorine pesticides; only a sample of skinks (*Carlia fusca*) contained a detectable concentration (DDE at 0.04 p.p.m. wet weight, 0.13 p.p.m. dry weight). Residues in shrews (*Suncus murinus*) trapped in 1981 did not exceed 0.30 p.p.m. wet weight. These levels are also less than those known to adversely affect birds or small animals.

In addition, it is unlikely that present use of pesticides by civilians or the military on Guam is responsible for the decline. Agricultural lands comprise less than 1% of the island's total area and more than 84% of the pesticide used is organophosphates or carbamates[8], chemicals that do not persist in the environment[9]. Of the four pesticides used the most (malathion $>$ diazinon $>$ naled $>$ carbaryl), only diazinon has been implicated in wildlife mortality elsewhere[9]. Malathion is also the pesticide used in the greatest quantity by the military, and with few exceptions, use has been restricted to housing areas. Although spray operations by the military may have temporarily decreased insect abundance, such decreases cannot explain the continuing decline of the island's avifauna.

It is unfortunate that Diamond[1] and others[2,4] incorrectly equated pesticide use or residues on the island with harmful effects. Although the use of some pesticides can be hazardous to birds, and effects associated with the use of DDT still persist today[9,10], there are no data supporting the hypothesis that pesticides are responsible for the continuing decline of Guam's native avifauna.

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SIR—In his *News and Views* piece on the "Possible effect of unrestricted pesticide use on tropical birds"[1], Diamond used Guam's avifauna as an example based on Jenkins' report *The Native Forest Birds of Guam*[2]. Jenkins suggested that pesticide usage may be responsible for the drastic decline of Guam's birds. However, due to publication time lag, Jenkins' monograph is only current through 1979. Research since that time suggests that although pesticides were extensively used on Guam, they do not appear to be responsible for the general decline of the avifauna (C. Grue, personal communication). However, pesticides may have impacted certain species in the past, such as the insectivorous Vanikoro swiftlet and sheath-tailed bat.

My research has focused on the possible roles of introduced avian diseases and predators. Between 1982 and 1984, a variety of birds were sampled in collaboration with the USFWS National Wildlife Health Laboratory for parasites, bacteria and viruses and two sentinel experiments were conducted. To date, no infectious organisms have been isolated that could account for the current extinctions and range reductions.

Feral dogs, cats and rats are a problem on all major islands in the Marianas. The only predator unique to Guam is the brown tree snake, *Boiga irregularis*. The snake is the major cause of the decline of the forest avifauna. This species was introduced to Guam in 1946, and its range expansion corresponds to the avian range contraction. Predation intensity on bird-baited traps is extremely high, and alternative prey items have also declined. Supporting data are currently being prepared for publication.

Thus, although Guam may not be the best example for the dangers of unrestricted pesticide usage, it certainly should serve as a warning of the potential disastrous effects of introducing exotics to island ecosystems.

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Electrostatics revindicated . . . classically . . .

SIR — Berezin[1] has considered the minimum energy configuration of N point charges placed inside or on a circle. This problem has a well defined continuum limit, namely the distribution of charge over a metallic disk. The solution, given in Jeans' textbook[2], has a finite charge density all over the disk rising to infinity at the edge. Consistency with this limit *demands* that for increasing N, charges (in the minimum energy state) leave the edge and occupy the interior. The use of a $1/r$ rather than an $\ln r$ potential implies that the circle is really a disk embedded in three-dimensional space and there is thus no contribution with the usual notion that charges reside on the surface of a conductor. These arguments imply that in the case of a sphere, there will be no minimum energy solution with charges in the interior, as is already clear from Earnshaw's theorem[2].

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. . . by conducting ellipsoid

SIR — A very old problem in electrostatics is to find the distribution of charge on a conducting ellipsoid which will be taken to be an ellipsoid of revolution. The charge density is of course confined to the surface and is everywhere finite. If we let the length of the axis of rotation go to zero we get a highly idealized two-dimensional object, a two-dimensional (infinitely thin) conducting disk. If the radius of this disk is R, the charge density is well known to be proportional to $(R^2 - r^2)^{-1/2}$. This density