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Diets of Owls and Feral Cats in Hawaii

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Abstract: The feral house cat (*Felis catus*), Hawaiian Short-eared Owl or Pueo (*Asio flammeus sandwichensis*), and Common Barn Owl (*Tyto alba*) are important predators of birds and introduced rodents in Hawai'i. Cat scats from the island of Hawai'i ($n = 87$), Pueo pellets from Hawai'i, Kaua'i, and Kaho'olawe ($n = 36$), and Barn Owl pellets from Hawai'i, O'ahu and Kaho'olawe ($n = 301$) were examined to determine the incidence of rodent, bird and insect remains in the diets of these predators. Rodents were the main prey of cats, Pueo, and Barn Owls, but the incidence of bird remains in diets of all three predator species was high relative to studies conducted elsewhere in the world.

Introduction

Predation of native birds by introduced mammals and birds has been postulated as a leading cause of the accelerated decline and extirpation of endemic Hawaiian bird species and as a major factor limiting present populations of endangered forest birds (Atkinson 1977, Berger 1981, Scott et al. 1986). Three species of introduced rodents, the black or roof rat (*Rattus rattus*), Polynesian rat (*R. exulans*), and Norway rat (*R. norvegicus*), and the introduced Indian mongoose (*Hespestes auropunctatus*) and feral house cat (*Felis catus*), have all been documented as important predators on native Hawaiian birds (Baldwin 1945, Johnson 1945, King and Gould 1967, Atkinson 1977, van Riper 1980, Berger 1981, Pletschet and Kelly 1990, Banko 1992, Amarasekare 1994). However, few studies have documented the food habits of these introduced mammals in Hawaii, particularly in upland forests.

Native birds in Hawaii are also preyed upon by three species of raptors, the Hawaiian Short-eared Owl or Pueo (*Asio flammeus sandwichensis*), the introduced Common Barn Owl (*Tyto alba*), and the Hawaiian Hawk or I'o (*Buteo solitarius*). The Pueo is an endemic subspecies of the Short-eared Owl, which is found on every continent except Australia and occurs on many small islands throughout the world. The earliest fossil remains of Pueo are from post-Polynesian times, and Pueo may not have become established in Hawaii until after the Polynesians introduced the Polynesian rat and created more open habitat (Olson and James 1982). Barn Owls were first introduced to the islands during 1958-1963 to help control rodent populations in sugarcane fields (Tomich 1962, Au and Swedberg 1966). The two owl species are present on all of the main islands, and are regularly sighted on Kaho'olawe and many offshore islets. Very little is known about the diets or nesting biology of these predators on Hawai'i.

In the course of our studies on factors limiting populations of Palila (*Loxioides bailleui*) and other native forest birds, we obtained information on diets of feral house cats, Pueo, and Barn Owls on Hawai'i, with particular reference to the incidence of bird remains in scats and pellets. Additional owl pellets from Kaho'olawe and O'ahu were provided to us by other researchers.

Methods

We determined predator diets from analysis of 87 cat scats, 36 Pueo pellets, and 301 Barn Owl pellets. All cat scats were collected in dry mamane (*Sophora chrysophylla*) - naio (*Myoporum sandwichensis*) forests on the western and eastern slopes of Mauna Kea above 2000 m elevation. Pueo pellets were collected in dry forests on Mauna Kea ($n = 13$), from Kaumana Gulch on Kaho'olawe ($n = 21$), and from the Alakai Swamp on Kaua'i ($n = 2$). Barn Owl pellets were collected at roosts and nests at Hakalau Forest National Wildlife Refuge on Hawai'i ($n = 207$), near the Pu'u La'au cabin on Mauna Kea ($n = 73$), on O'ahu ($n = 19$), at Ahupu Beach on Kaho'olawe ($n = 1$), and in Hawai'i National Park on Hawai'i ($n = 1$). Accumulations of Barn Owl pellets were found below roosting sites, whereas single Pueo pellets were found below tall trees or on open ground (Mauna Kea), or on cliff faces on Kaho'olawe. On Kaua'i, Pueo pellets were found in an open bog near the remains of a recent Pacific Golden-Plover kill.

We used the size, appearance, and consistency to determine the source of scats and pellets. Cat scats were smaller than pellets and had tapered ends with fewer bones distributed through them. Pueo pellets were smaller than Barn Owl pellets and had a uniformly cylindrical shape. They fit Mikkola's (1983) description as "elongated, roughly cylindrical, dark gray and formed from a tightly-massed conglomeration of fur or feathers with a central core of mammal and bird bones." Barn Owl pellets were larger than Pueo pellets and cat scats, oblong, and slightly compressed in one aspect of their diameter (Tomich 1971).

We teased dry scats or pellets apart using forceps and probes and identified material with the aid of a dissecting microscope. Bones and other identifiable material, including identifiable feathers, aluminum or colored plastic bird bands, insect remains, plant material, and trash were separated from the mass of hair and feather quills. We sorted and counted skulls, lower and upper mandibles, long bones of legs or wings, scapulae, and other large bones to determine the number of prey in each scat or pellet. Rodent skulls were identified from a key developed by Conant (1972). Measurements of bones taken from specimens at the Bernice P. Bishop Museum and a reference collection of bones we developed were used to identify remains to species. A local field guide (Pratt et al. 1987) and a volume on vertebrate anatomy (Romer 1962) also aided in identifying remains.

We determined percentages of scats or pellets that contained mammal, bird, or insect material, and the number of prey items per scat or pellet. Reported values are means ± one standard error unless otherwise stated.

Results

Introduced rodents, including the house mouse (*Mus musculus*) and the three species of rats, comprised the majority of the diet for

Table 1. Number (and %) of feral house cat scats and owl pellets containing remains of rodents, birds and insects.

Species	n	Rodents	Birds	Insects
House cat	87	76 (87.4)	59 (67.8)	15 (17.2)
Pueo	36	32 (88.9)	13 (36.1)	11 (30.6)
Barn Owl	301	300 (99.7)	45 (15.0)	4 (1.3)

Table 2. Mean (±SE) number of prey per feral cat, Pueo, and Barn Owl scat or pellet.

Species	n	Mice	Rats	Birds
Feral cat	87	0.79 (0.09)	0.16 (0.04)	0.79 (0.09)
Pueo	36	2.05 (0.31)	0.36 (0.10)	0.44 (0.10)
Barn Owl	301	2.08 (0.11)	0.67 (0.04)	0.15 (0.02)

feral cats, Pueo, and Barn Owls (Tables 1 and 2). Eight-seven percent of cat scats contained remains of small mammals, and mammal remains were found in 89% of Pueo pellets and 100% of Barn Owl pellets (Table 1). Three Barn Owl pellets each contained remains of eight different mice; one Pueo pellet contained the remains of seven mice.

Although black rats and house mice were the most commonly consumed rodents at middle and upper elevations, remains of Polynesian and Norway rats also were found in owl pellets collected in forests above 1500 m elevation. Remains of nine different Polynesian rats were found in Barn Owl pellets collected from two roosts in the Hakalau Forest National Wildlife Refuge at elevations of 1650 and 1770 m. We found the skull of a Norway rat in a Barn Owl pellet collected near the Pu'u La'au cabin at 2428 m elevation, and we captured a Norway rat in a trap at 3018 m in mamane-naio forest on the eastern slope of Mauna Kea. The previous extreme elevation of record for the Norway rat was 1903 m at Halepiula on Mauna Kea (Tomich 1969).

Bird remains were common for all three species of predator (Table 3). Occurrence of bird remains in owl pellets was 36% for Pueo and 15% for Barn Owls. Mean number of birds per pellet was 0.44 ± 0.10 for Pueo and 0.15±0.02 for Barn Owls. Sixty-eight percent of cat scats contained bird remains, and in 30 scats collected near Pu'u La'au, we found aluminum and colored plastic bands from five different banded birds (3 Common 'Amakihi, 1 'I'iwi, and 1 'Elepaio).

Insect remains were found in cat scats and Pueo pellets, but were rare in Barn Owl pellets. Seventeen percent of cat scats contained insect remains, whereas 31% of Pueo pellets contained insects. Caterpillars were the main type of insect found in cat scats. All of the Pueo pellets containing insects (mostly grasshoppers) were collected from Kaho'olawe, where rodents and birds may occur at lower densities. Only 4 of 301 (1.3%) Barn Owl pellets contained insects.

Barn Owl and Pueo pellets found on Kaho'olawe contained remains of only two rodent species: the Polynesian rat and house mouse. Tomich (1969) found black rats on Kaho'olawe, but it has not been found there during recent surveys (B. Eilerts, pers. comm.).

Discussion

Ebenhard (1988) concluded that the feral cat was the most dangerous predator ever introduced to islands by man, and cited 38 known or probable cases where cats have seriously affected the abundance of prey populations. Cats have caused the extinction of several bird species from offshore islands of New Zealand, and have since been eradicated from at least eight islands at great expense to the New Zealand government (Veitch 1985). Cats on islands are versatile in their food habits, depending on available prey. On islands where rabbits and rats are present, rabbits are the main prey item and rats are rarely taken (Jones 1977, Fitzgerald 1988). On Howland and Jarvis Islands in the tropical Pacific, seabirds are the most important prey item (Kirkpatrick and Rauzon 1986). In most other studies of feral cat diets on islands, including our study, rodents comprised the majority of the cats' diet (Marshall 1961, Miller and Mullette 1985, Konecny 1987).

The high incidence of bird remains in cat scats that we examined (68% of 87 scats), and our discovery of bands from five different birds in only 30 scats collected near Pu'u La'au, points to the important role of feral cats as predators of Hawaiian forest birds. Van Riper (1978) examined stomachs of nine feral cats captured near Pu'u La'au and found remains of 11 birds in 6 of the stomachs. Twelve percent of 45 cat scats examined by

Table 3. Numbers of prey by species identified in feral cat, Pueo, and Barn Owl scats and pellets.

Species	Scientific Name	Cat	Pueo	Barn Owl
'Apapane	*Himatione sanguinea*		1	1
Common 'Amakihi	*Hemignathus virens*	5	2	3
'Elepaio	*Chasiempis sandwichensis*	1		
'I'iwi	*Vestiaria coccinea*	1	5	
'Oma'o	*Myadestes obscurus*			2
Eurasian Skylark	*Alauda arvensis*	1		5
House Finch	*Carpodacus mexicanus*			1
Japanese White-eye	*Zosterops japonicus*		2	
Lesser Golden-Plover	*Ploralis fulva*		1	
Nutmeg Mannakin	*Lonchura punctulata*			1
Red-billed Leiothrix	*Leiothrix lutea*	1		1
Wild Turkey	*Meleagris gallopavo*	1		
Other Passerines		11	2	5
Other Galliformes		12	1	
Other Birds		25	7	20
Egg Remains		1		

Amarasekare (1994) contained bird remains. Pletschet and Kelly (1990) attributed 5% of Palila nest mortality to egg depredation and 35% to nestling depredation by feral cats and black rats, but they were unable to determine the individual contribution of each predator species. Several nest failures of Palila in 1993 were attributed to predation by feral cats (T. Pratt, pers. comm.).

We found remains of insects, mostly caterpillars, in 17% of the cat scats we examined. Amarasekare (1994) examined scats from the same area and found that 46% of scats contained insect remains. On Raoul Island in New Zealand, insects were found in 58% of cat stomachs, although in terms of biomass consumed, cats preyed almost entirely on Polynesian rats and birds (Fitzgerald et al. 1991). The high incidence of insect remains in diets of cats from islands suggests that cats intentionally feed on insect material rather than consume insects incidental to preying or scavenging on larger prey.

We found that introduced rodents, particularly the house mouse and black rat, were the major prey of Pueo and comprised essentially the entire diet of Barn Owls. Mikkola (1983) reviewed several European studies and reported that >95% of the diet of Short-eared Owls was composed of small mammals. Numerous other studies have found that voles, mice, and shrews are the main prey items of Short-eared Owls (Maser et al. 1970, Clark 1975, Hughes 1982, Colvin and Spaulding 1983, Taylor 1984). Gubanyi et al. (1992) found that 17 species of small mammals comprised 99.3% of prey items of Barn Owls in Nebraska. Studies of Barn Owl diets in Oregon (Taylor 1984) and Spain (Perez et al. 1989) similarly found that small mammals made up >95% of the Barn Owls' diet.

The incidence of bird remains in pellets of both Pueo and Barn Owls that we examined was higher than in most continental studies. Thirty-six percent of Pueo pellets we examined contained bird remains, compared with only 0.3 to 15% in seven studies from North America and Spain (Maser et al. 1970; Clark 1972; Buckelew and Lindsay 1976; Hughes 1982; Colvin and Spaulding 1983; Taylor 1984; Perez et al. 1989). However, Glue (1977) found that birds were the primary prey of Short-eared owls at five winter sites in Europe, and noted that owls will switch to alternate prey if voles are scarce. Similarly, Smith and Hanebrink (1982) found that 51% of the diet of Short-eared Owls in Arkansas comprised birds, which they attributed to the high occurrence of migrant birds in the area.

The relatively high incidence of bird remains in Barn Owl pellets in our study (15%) is surprising considering the low occurrence of birds in Barn Owl pellets elsewhere. Taylor (1984) examined 48 pellets from Oregon and found no evidence of predation on birds. Perez et al. (1989) found bird remains in only 12 of 446 (2.7%) pellets in Spain, and Gubanyi et al. (1992) found that only 0.7% of 10,140 prey items in Barn Owl pellets from Nebraska were birds. The relatively low density of small mammals on Mauna Kea (Amarasekare 1994), where most of our pellets were collected, probably accounts for the higher rate of predation on birds by Pueo and Barn Owls.

We found no difference in the mean number of mice per pellet between Pueo and Barn Owls, but Barn Owl pellets contained a higher number of rats and the incidence of bird remains was higher in Pueo pellets. Taylor (1984) noted the high degree of dietary overlap between Short-eared Owls and Barn Owls and thought that differences in time of day spent hunting allowed the two species to coexist. In our study area, Pueo hunted during daylight as well as at night, whereas Barn Owls were strictly nocturnal. Differences in diets may therefore be attributed to prey availability, since bird prey are relatively more available during daylight hours and rats are more active at night.

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Effects of Rat Predation on Bonin Petrel *(Pterodroma hypoleuca)* Reproductive Successs at Midway Atoll

by Nanette Seto[1]

Island avifauna are quite vulnerable to predation by introduced mammals such as cats, rats, or mongooses. These predators were not present on most oceanic islands before human contact. As a result, insular birds, as opposed to those of continents, have lost behavioral adaptations that would have allowed them to coexist with these mammals (Moors et al., 1992). Seabirds, small procellariforms and terns especially, have been observed to be particularly vulnerable because of their small size, low annual productivity, lack of effective anti-predator behavior, and their habit of leaving nests unattended while making long-range feeding flights (Moors and Atkinson, 1984).

As introduced predators to oceanic islands, rats, in particular, have a strong impact on island avifaunas. On Kure Atoll, at the westernmost end of the Northwestern Hawaiian Island chain, the introduced polynesian rat (*Rattus exulans*) has been observed to attack and kill adults and chicks of the Laysan Albatross (*Diomedia immutabilis*), as well as the eggs of Bonin Petrels (*Pterdroma hypoleuca*) and Sooty Terns (*Sterna fuscuta*) (Kepler, 1967). Among the different introduced mammalian predators, ship or black rats (*Rattus rattus*) have been most frequently identified in connection with bird declines and rat-induced catastrophes on islands (Atkinson, 1985). For example, the Galapagos race of the Dark-rumped Petrel (*Pterodroma phaeophygia*), was recorded in 1970 to have very low breeding success on the island of Santa Cruz due mainly to nest predation by R. rattus (Harris, 1970). In addition, only two years after its introduction, R. rattus dramatically reduced the number of landbirds on Lord Howe Island, off the coast of Australia. Ultimately five species, over one-third of the island total, became extinct as a result of this invasion (Moors et al., 1992).

Another example of how *R. rattus* has caused local extinctions or reductions in seabird populations in some insular systems is found on Midway Atoll, Northwestern Hawaiian Islands. *R. rattus* was accidentally introduced to Midway Atoll in 1943 (Fisher and Baldwin, 1946). These rats are thought to have been a primary factor in the extinction of translocated populations of Laysan Rails (*Porzana palmeri*) and Laysan Finches (*Telespiza cantans*), which occurred by 1945 (Fisher and Baldwin, 1946). *R. rattus* is also responsible for drastic declines of petrel and shearwater populations on both Sand and Eastern Islands of the Atoll (Woodby, 1988). A small breeding population of Bulwer's Petrels (*Bulweria bulwerii*) was last recorded in 1945 (Fisher and Baldwin, 1945). Wedge-tailed Shearwater (*Puffinus pacificus*) and Christmas Shearwater (*Puffinus nativitatis*) populations have also decreased (Woodby, 1988) since the rat introduction.

The impact of rat predation on Bonin Petrels at Midway Atoll has been significant. Bonin Petrels had a large population at Midway Atoll before the arrival of *R. rattus*. Their numbers have dramatically declined from 500,000 individuals (Hadden, 1941) to as low as 5,000 nesting pairs (Ludwig et al.,1979) since rat introduction. Evidence of rat predation on Bonin Petrels has been observed and is believed to be the major cause of their decline (Woodby, 1988). Bonin Petrels have been exterminated as successful breeders on Eastern Island where the rat population is quite dense and no control efforts are currently conducted by the Navy. Rat predation on Bonin Petrel eggs was observed on Sand Island and has greatly affected their hatching success (Grant et al.,1983). A better understanding of the interactions of the two species (predator and prey) will aid in formulating specific management actions for the conservation of the Bonin Petrel.

In January 1993, I began my first year of a two-year study examining the effects of rat predation on Bonin Petrel reproductive success. The purposes of my study were to develop a method of studying these burrow nesting birds, determine the period of vulnerability to predation during the petrel breeding season, and to determine the effectiveness of rodenticide in reducing the rat population and thus increasing the petrels' reproductive success. This article reports the results of my first year's work.

Bonin Petrels excavate nesting burrows in sandy ground. The burrow tunnels can be as long as three meters and may extend below the surface as much as one meter. The burrows usually have one or more turns before ending

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in a nesting chamber. The petrels first arrive at their breeding grounds in August and spend all fall courting and excavating burrows. Egg laying occurs in January and chicks hatch in March. My study included six study areas on Sand Island. Three of these areas were treated with the rodenticide, Vengeance, while the remaining three control areas were not. I monitored a total of 131 nests in these study areas to measure reproductive success and observe incidences of rat predation.

A fiberoptic scope provided by the U.S. Fish and Wildlife Service was initially used to examine burrow contents but proved to be too delicate an instrument for this function. I then used a closed circuit miniature camera system, with infrared sensors linked to a small monitor for viewing. The camera body was protected with a ziplock bag and duct tape. A rubber hose encased the wire from the camera leading to the monitor. Motorcycle brake cables, one on either side and one on top, were taped to the camera body. This provided turning capability as the camera was inserted into the burrow from the entrance. This camera and monitor set-up proved to be sufficient to examine burrow contents. However, the camera body was 3.25 in. by 2.5 in. and rectangular in shape. Thus, it could not fit into every burrow. Some petrel burrows were very narrow in shape and contained roots that blocked passage.

The nests were monitored every other day after egg laying until the chick fledged. A chick was assumed to have fledged when it left the burrow. Causes of nest failure included rat predation, nest abandonment, and burrow destruction. Burrow destruction was caused by albatrosses, erosion, or humans. Direct evidence of eggs taken by rats was found in five nests. These include broken egg shell remains. If a burrow was found empty with no signs of egg, I concluded the egg was removed by a rat. No chicks were observed missing.

I attempted to measure the effect of the rodenticide on the rat population in the three study areas. Live trapping was conducted during the entire petrel breeding season from mid-January through mid-June in each study area to obtain an index of abundance of the rat population. When rats were captured, each was marked with two monel ear tags and released, so as not to interfere with the petrel reproductive success study. The trapping rate was very low in five of the six study areas. In these five areas, only one rat was captured during the entire period. In the remaining area, however, 32 rats were captured, of which 16 were recaptured at least once.

An indirect measure of the effect of the rodenticide on the rat population is found in the measure of the overall reproductive success of the petrels in each study area. The overall reproductive success for treatment areas in comparison to control areas was higher, except for one. Therefore, it appears that the rodenticide reduced the rat population which in turn increased the petrels' reproductive success. Preliminary results show evidence that the reproductive success of the Bonin Petrels is indeed affected by rat predation. Out of 131 nests monitored, 45 nests appear to have failed due to rat predation. These failures all occurred during the egg stage of the breeding season. There were no observations of rat predation on chicks. Thus, rat predation appeared to have the most impact during the egg stage of the petrels' breeding cycle.

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[1]949-A Hala Drive
Honolulu, HI 96817

Candidates Needed

Sherilyn Garrett will chair the Nominating Committee for the 1994 elections. Other committee members are John Harrison and Kendall McCreary.

Members are invited to submit nominations for president, second vice president, recording secretary, and five directors. All are two year terms.

Nominations should be sent to the Nominating Committee, Hawaii Audubon Society, 1088 Bishop Street, Suite 808, Honolulu, HI 96813 by 31 August. For more information call Sherilyn Garrett, 924-8037 (H) or 921-6535 (W).

Research Grants and Scholarship Given

by Phil Bruner

The Hawaii Audubon Society has awarded research grants in the amount of $500 each to David Hopper and Karen Lombard. Hopper is investigating the interisland variation in the pollination system and population viability of the endemic legume *Sesbania tomentosa*. This area of biology is vital to the conservation of our native plants. Lombard's project seeks to produce a population viability analysis to help define the recovery needs of the endangered and endemic Hawaiian monk seal.

Lance Tanino, a zoology major at the University of Hawaii-Manoa, has been awarded the $1,460 Rose Schuster Taylor Scholarship. We wish him success as he prepares for a career in wildlife biology and ornithology.

Nine 'Alala Chicks Hatch—With Help from Their Nonfeathered Friends

Top: Hungry unfeathered 'Alala chicks waiting to be fed. Photo © U. S. Fish and Wildlife Service.

Left: Puppet preparing to feed two feathered 'Alala chicks which are being kept warm by artificial light. Photo © U. S. Fish and Wildlife Service.

by Lynne Matusow

The critically endangered 'Alala (Hawaiian Crow) has taken another step toward recovery with nine chicks hatching this spring. The 'Alala is one of the most endangered birds in the world, with fewer than 17 birds thought to exist in the wild on the Big Island of Hawai'i.

This year's excitement began on 3 May, when the first of six eggs gathered from wild nests hatched in a temporary incubation facility operated by the Peregrine Fund on the Big Island. Although one chick later died, the remaining five are healthy. The Peregrine Fund will rear the chicks and return at least some of them to the wild later this year.

On Maui, personnel at the State's Olinda Endangered Species Propagation Facility have successfully incubated and hatched four of five eggs laid by Wa'alani, a captive 'Alala, the most chicks in one season since 1981. At press time, Wa'alani had laid two eggs in her third clutch.

Peter Shannon, director of the facility, said, "we removed the first two clutches of eggs to incubate and hatch artificially." Another young female, Ho'oku, laid her first eggs ever, but they were infertile or had bad embryos. Shannon has hopes that she will breed successfully next year.

In 1993, when the known population of 'Alala in the wild numbered 12 birds, intensive recovery efforts based on recommendations from the National Academy of Sciences and the 'Alala Recovery Team of which Hawaii Audubon Society President Reginald David is a member, began when seven young were hatched and reared in a temporary facility on the Big Island. Five of the young were returned to the wild last year and two were sent to Olinda.

Only three potential breeding pairs have been identified in the wild, all on private land in the Kona District of the Big Island. The five 'Alala reintroduced to the wild last year are too young to breed. An additional 12 birds, including three pairs, are in captivity at the State-managed facility on Maui.

The U. S. Fish and Wildlife Service contributed to this report—Ed.

'Elepaio to Appear Nine Times in 1995

by Lynne Matusow

At its July meeting, the Board of Directors voted to publish nine issues of the *Elepaio* in 1995. The printing schedule is December-January, February, March, April, May, June-July, August-September, October, and November. This decision was based on comments received from members who answered the questionnaire which appeared in the April *Elepaio*. Forty percent of the respondents favored six issues, 30% favored 12, and 15% favored 10.

Members also indicated that their main interest is scientific articles, followed closely by those dealing with conservation and the environment and legislation affecting same. Sixty three percent were opposed to splitting the *'Elepaio* into two publications while 37% favored the idea.

We thank those of you who took the time to answer the questionnaire.

Research Grants

The Hawaii Audubon Society makes grants for research in Hawaiian or Pacific natural history. Awards generally do not exceed $500 and are oriented toward small-scale projects within Hawaii. Special consideration will be given to those applicants studying dryland forests and aeolian systems on Hawai'i. The deadlines for receipt of grant applications are 1 April and 1 October.

For an application form send a self-addressed stamped envelope to Grants, Hawaii Audubon Society, 1088 Bishop Street, Suite 808, Honolulu, HI 96813. For more information, call Phil Bruner, (808) 293-3820 (W).

Hawaii Audubon Society

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The *'Elepaio* is printed on recycled paper.

T-shirts for Sale

The Hawaii Audubon Society has a stock of T-shirts designed to spread the Audubon message. Not only are they attractive personal apparel, but they make excellent presents as well.

T-shirts bearing the Society's 'Elepaio logo are available in ash (gray) with a black design. We also have a few in aqua, navy, white, and beige. In addition, the "hot" Kolea (Pacific Golden Plover) T-shirts are also available. This T-shirt is white with a three-color design of the Kolea and native hibiscus. Proceeds from the Kolea T-shirt go to help HAS fund research on shorebirds in Hawai'i and elsewhere in the Pacific region.

T-shirts are $12 each, plus $2.00 per shirt for postage. They are available in medium, large, and extra large adult sizes only. When ordering T-shirts, be sure to list size and first, second, and third choice of color. To order T-shirts send your check, payable to the Hawaii Audubon Society, to Yvonne Izu, 1957 Alai Place, Wahiawa, HI 96786. Don't forget to add $2.00 per shirt for postage. Insufficient postage will delay your order until the proper amount is remitted. T-shirts are not available at the HAS office.

HAS Dues for 1995

All amounts are in U.S. dollars.
Includes delivery of *'Elepaio*.

Regular Member	
Delivery to U.S. zip code addresses	
Via bulk mail	**$ 10.00**
(Not forwardable to new address)	
Via first class mail	**16.00**
(Hawaii residents: there is no significant time difference between bulk and first class mail to addresses within the state of Hawaii.)	
Junior Member (18 and under)	**5.00**
Contributing Member	**30.00**
Sustaining Member	**100.00**
Life Member (one-time payment)	**250.00**
(three annual payments)	**100.00, 100.00, 50.00**
Benefactor (one-time payment)	**500.00**
Patron (one-time payment)	**1,000.00**
Delivery to non-U.S. addresses:	
Mexico (airmail only)	**16.00**
Canada (airmail only)	**17.00**
All other countries (surface mail)	**18.00**
All other countries (airmail)	**28.00**
Introductory dues for National and Hawaii Societies:	**20.00**
(Includes delivery of *'Elepaio* and *Audubon Magazine* as bulk or 2nd class mail to U.S. zip codes. Renewal, $30 annually.)	

Manoa Trail Hike

by John and Donna de Haan

Eight eager hikers (including an enthusiastic vacationing Georgia birder) gathered on 12 June in perfect weather: cloud cover with sun peeping through periodically, a slight breeze and no prolonged gusts. Lance Tanino commented on these conditions being ideal for birding, and as we progressed, we were rewarded with sightings of two endemic bird species and native plants in bloom. The trail was muddy in spots (unfortunately heavily eroded in steep areas by trail bikes).

This trip was rescheduled from 13 March, when extreme wind conditions measuring 70-80 mph on our anemometer made for unsafe conditions on the trail and no birding possibilities. We walked the trail on 3 April, two-and-a-half weeks after the winds abated, and parts of it looked like a Mainland winter. Plants in exposed areas were totally stripped of foliage. There was still evidence of damage to the plants on this trip, in the form of uprooted trees and broken branches.

While on the cliffs, our Georgia birder spotted a bird flying into an 'ohi'a lush with lehua blossoms. Tanino identified it as a juvenile 'Apapane. Happily it stayed long enough for us to see some red blush on the feathers and hear its call as it flew off. At the junction of the Pu'u Ohi'a-Manoa Cliffs Trail we spotted several more 'Apapane and were treated to clear and distinctive calling. Many 'Amakihi were spotted and heard. In addition, we heard Japanese Bush Warblers and saw and heard Red-billed Leiothrix as we started the climb through the bamboo on Pu'u 'Ohi'a Trail. Shama Thrushes, Red-vented Bulbuls, and Red-whiskered Bulbuls were sighted and calling.

Many 'ohi'a were covered with blossoms and the koki'o-ke'oke'o was in full bloom. A couple of the party noticed a fine sample of kupaoa, an endemic silversword relative growing in a mossy tree base. It was the first sample we had ever seen on O'ahu. Many lobelia were seen, some with fat seeds hanging from them. We found two areas with vigorous maile vines crawling through other shrubs. The koa is still dying along the trail. It was sad to see one hugh koa without a leaf or phyllods, with only a few seed pods left.

Manoa Cliffs Trail is remarkable for the diversity of native plants, and fortunately there are labels on many of them.

Calendar of Events

First Monday of Every Month
Monthly meeting of the Conservation Committee, 6:30 p.m., at the Coffee Line, 1820 University Avenue (in the YWCA). To join or for more information call David Hill, 988-7460 (H).

Monday, August 8
Board meeting, 7:00 p. m., HAS office. Call Reggie David on Hawai'i, 329-9141 (W), for details.

Monday, August 15
General Membership Meeting, 7:30 p.m. Maura O'Connor of Moanalua Gardens will present a multi-media presentation using CD-ROM, video, etc. devoted to the Gardens' educational programs with an emphasis on the marine environment. **Please note the special location of this meeting...Manoa Innovations Center, 2800 Woodlawn Drive (mauka of Longs).** Refreshments will be served.

Sunday, August 21
Field trip to Kuli'ou'ou Trail. This hike features introduced plants and birds with the main objective to search for the O'ahu 'Elepaio. Meet at the State Library on Punchbowl Street at 7:30 a.m. Bring binoculars, raingear, insect repellant, and hiking shoes. For more information call Lance Tanino, weekday evenings, 247-5965 (H). Suggested donation: $2.00. Leader Tony McCafferty.

Friday, September 30
First Annual Hawaii Audubon Society Volunteer Awards Dinner, Waikiki Aquarium, 6:30 p.m. Price: $20 per person, $10 for seniors, students, and children. Full details will be in the September *'Elepaio*. For more information or to help with event planning call Nanea Parks, 593-1047 (H).

Publications Available

The Hawaii Audubon Society publishes books, checklists, and field cards relating to birds of Hawaii and the Pacific. For a complete price list send a self-addressed stamped envelope to Publications List, Hawaii Audubon Society, 1088 Bishop Street, Suite 808, Honolulu, HI 96813.

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Please allow four weeks for processing address changes. Because our records are kept in order by zip code, we need both old and new addresses.

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