



Efficacy of Fish-flavored Diphacinone Bait Blocks for Controlling Small Indian Mongoose (*Herpestes Auropunctatus*) Populations In Hawai'i

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Introduction

The small Indian mongoose (*Herpestes auropunctatus*) was originally introduced to the Hawaiian Islands in 1883 in an effort to control rats in sugar cane fields. This adaptable predator has flourished since its introduction, and now occupies a variety of habitats on O'ahu, Moloka'i, Maui and Hawai'i Island (Baldwin et al. 1952). While mongooses do indeed prey on rats and other rodents, their diet is extremely varied and also includes birds, bird eggs and nestlings, introduced skinks and geckos, a variety of arthropods, fruit, and even garbage (Baldwin et al. 1952, Kami 1971, Tomich 1986). Birds on oceanic islands that were originally predator-free are especially vulnerable to predation by introduced mammals because their nests are often easily accessible and they have little prior experience with predators and often show little fear of them. Mongooses are considered a threat to eight Hawaiian species of ground-nesting birds listed as endangered under the federal Endangered Species Act (Stone et al. 1994). Nene (*Branta sandvicensis*; Stone et al. 1994) and several species of waterbirds, including the Hawaiian Duck or Koloa (*Anas wyvilliana*), the Hawaiian Coot or 'Alae ke'oke'o (*Fulica alai*), the Hawaiian Moorhen or 'Alae 'Ula (*Gallinula chloropus sandvicensis*), and the Hawaiian Stilt or Ae'o (*Himantopus mexicanus knudseni*) (U.S. Fish and Wildlife Service 1999).

Because mongooses pose such a serious threat to many native Hawaiian birds, there have been several conservation efforts aimed at reducing mongoose populations, primarily through trapping and the use of poisoned bait (Stone 1985,

Stone and Keith 1987). In the mid 1980s the U.S. Department of Agriculture-National Wildlife Research Center conducted research necessary to register diphacinone, an anticoagulant toxicant, with the Environmental Protection Agency for use in controlling mongoose populations to protect endangered Hawaiian birds (Keith et al. 1989). An experimental use permit was issued by the EPA in 1988 to conduct field tests of diphacinone in hamburger bait at Hawai'i Volcanoes National Park on Hawai'i Island and at James Campbell National Wildlife Refuge on O'ahu. Based on the success of those tests, a special local need registration was issued for diphacinone in 1991 under the Federal Insecticide, Fungicide, and Rodenticide Act. Hamburger-diphacinone bait was successfully used from 1992-1994 to control mongooses in the Kipuka Nene area of Hawai'i Volcanoes National Park in order to protect nesting Nene (Stone et al. 1994), but logistical problems associated with formulation and storage of fresh hamburger bait made this method impractical, and the registration was discontinued (R. Sugihara, pers. comm.). Mongooses have also been effectively controlled in Hawai'i by removal trapping. From 1993-1995 the Wildlife Services branch of the U.S. Department of Agriculture used live-traps to remove mongooses from several wetland areas on O'ahu and Hawai'i where they were a threat to nesting waterbirds (Hays 1999).

Diphacinone is also often used to control rats (*Rattus spp.*), and one highly effective method of diphacinone application is in peanut-butter and molasses-flavored bait blocks manufactured for that purpose by the J.T. Eaton Corpora-

tion. In January 1998, a fish-flavored variety of Eaton's bait blocks was registered in Hawai'i for control of rodents and mongooses for conservation purposes. The following study reports on the efficacy of J. T. Eaton 0.005% diphacinone bait blocks with fish flavorizer in reducing mongoose populations at two locations on O'ahu where they posed a threat to nesting waterbirds or seabirds.

Study Areas

This study was replicated in two areas, each consisting of a treatment site (mongoose removal) and a control site (no mongoose removal). In the first area, Hamakua Marsh Wildlife Sanctuary (Hamakua) was used as a treatment site and Kawainui Marsh was used as a control site. In the second area, the Ka'ena Point access road (Ka'ena) was the treatment site and Dillingham Airfield served as the control site. Each pair of treatment and control sites were chosen for their spatial proximity and habitat similarity. Hamakua Marsh Wildlife Sanctuary is located along Hamakua Canal (Kawainui Stream), Kailua, O'ahu. The 22 acre parcel was donated to the non-profit conservation organization Ducks Unlimited, Inc. by Kane'ohe Ranch, Ltd., and subsequently donated to the Department of Land and Natural Resources in 1995 for management as a wetland wildlife sanctuary. The area is currently undergoing restoration intended to open approximately 20 acres of wetlands for waterbird habitat. Kawainui Marsh is located on State land approximately two kilometers from Hamakua Marsh. The portion of Kawainui Marsh used for this study is

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leased for pasture, and is adjacent to Castle Hospital and the Pohakapu subdivision. A total of at least 16 waterbird species are known to use Hamakua and Kawainui marshes, including four federally listed endangered bird species: the Hawaiian Stilt, the Hawaiian Coot, the Hawaiian Duck, and the Hawaiian Moorhen. Common plant species found at both sites include koa haole (*Leucaena leucocephala*), christmasberry (*Schinus terebinthifolius*), mangrove (*Rhizophora sp.*), marsh fleabane (*Pluchea sp.*), *Bacopa monnieri*, *Paspalum sp.*, and pickleweed (*Batis maritima*).

Ka'ena Point is located in the northwestern corner of O'ahu, and the tip of the point is managed by the Hawai'i State Natural Area Reserve System. The reserve supports one of the finest native coastal ecosystems remaining in Hawai'i, and is home to a growing breeding colony of Wedge-tailed Shearwaters (*Puffinus pacificus*) between February and November and to several pairs of Laysan Albatross (*Diomedea immutabilis*) from No-

vember to August. These seabirds nest on or below ground, making predation by mammals, including mongooses, a potentially serious threat. The study site at Ka'ena was along the access road leading to the reserve, where the vegetation is more disturbed, including kiawe (*Prosopis pallida*), naio (*Myoporum sandwicense*), 'a'ali'i (*Dodonaea viscosa*), golden crown-beard (*Verbesina encelioides*), marsh fleabane (*Pluchea sp.*), ma'o (*Abutilon grandifolium*), milkweed (*Asclepias sp.*), and swollen fingergrass (*Chloris barbata*). Dillingham Airfield is located about 4 km east of the Ka'ena Point access road. The habitat at Dillingham is similar to that along the Ka'ena access road, but also includes guinea grass (*Panicum maximum*), castor bean (*Ricinus communis*), ironwood (*Casuarina sp.*), and ivy gourd (*Coccinea grandis*).

Materials and Methods

One trap line was established at each of the four study sites. Each trap line had ten stations at 100 meter intervals, with

two Tomahawk Model #201 (5 x 5 x 16 inches, single door) live traps per station. Traps were baited with dry cat food. The traps were set for four nights and checked each morning, for a total of 80 trap-nights (20 traps per line at four nights each). All animals captured were measured for weight and length (nose to tip of tail), fitted with aluminum identification tags on both ears, and sexed. At Hamakua, 10 animals representative of the population (five males and five females of different weights) were also fitted with Wildlife Materials Inc. model SOM-2380A radio transmitter collars. Radio-collared animals were tracked using a Wildlife Materials Inc. model TRX 1000S receiver with a three element antenna. Trapping began on 25 August 1998 at Hamakua and Kawainui, and on 8 December 1998 at Ka'ena and Dillingham. All animals were released after tagging.

After four nights of trapping all traps were closed at each site. At Hamakua and Ka'ena, a bait station consisting of a two-foot length of 4 inch diameter ABS pipe

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'ELEPAIO

ISSN 0013-6069

Managing Editor: Linda Shapin

Scientific Editor

Ronald Walker, 235-1681 (H)

Distribution: Susan Miller

Layout Editor: Mitchell Lee Groth

The 'Elepaio is printed on recycled paper
and published nine times per year:

February, March, April, May, June/July,
August/September, October, November,
and December/January

was set out at each of the 10 stations. The pipe sections were secured to the ground by first drilling holes at each end of the pipe, then pounding a three foot length of #4 rebar into the ground, leaving six to eight inches above the pipe. The remaining rebar above the pipe made it difficult to lift or displace the pipe, and the position of the rebar inside the pipe, running vertically from top to bottom, essentially

cut the diameter of the pipe in half, making access to the bait blocks more difficult for larger animals such as cats or dogs. Each station contained eight two-ounce blocks of Eaton's fish-flavored bait with 0.005% diphacinone (the maximum amount allowed per station as designated by the product label). No baiting was done at Kawainui or Dillingham, so they could serve as control (no treatment) sites. Bait stations were monitored for three weeks at

Hamakua and for four weeks at Ka'ena, daily the first week, and every two to four days thereafter, to determine consumption rates, refilling as necessary. Radio-collared animals were tracked to determine bait efficacy, length of time until death, and to assess the potential hazards of secondary poisoning of non-target animals through scavenging of carcasses.

After baiting, the bait stations at Hamakua and Ka'ena were emptied and live traps were reset at all four sites for an

	Hamakua (Treatment 1)	Kawainui (Control 1)	Kaena (Treatment 2)	Dillingham (Control 2)
Before Bait	38	16	49	26
After Bait	1	13	7	17

Table 1. Numbers of mongoose trapped in 80 trap-nights at treatment and control sites before and after baiting with diphacinone blocks.

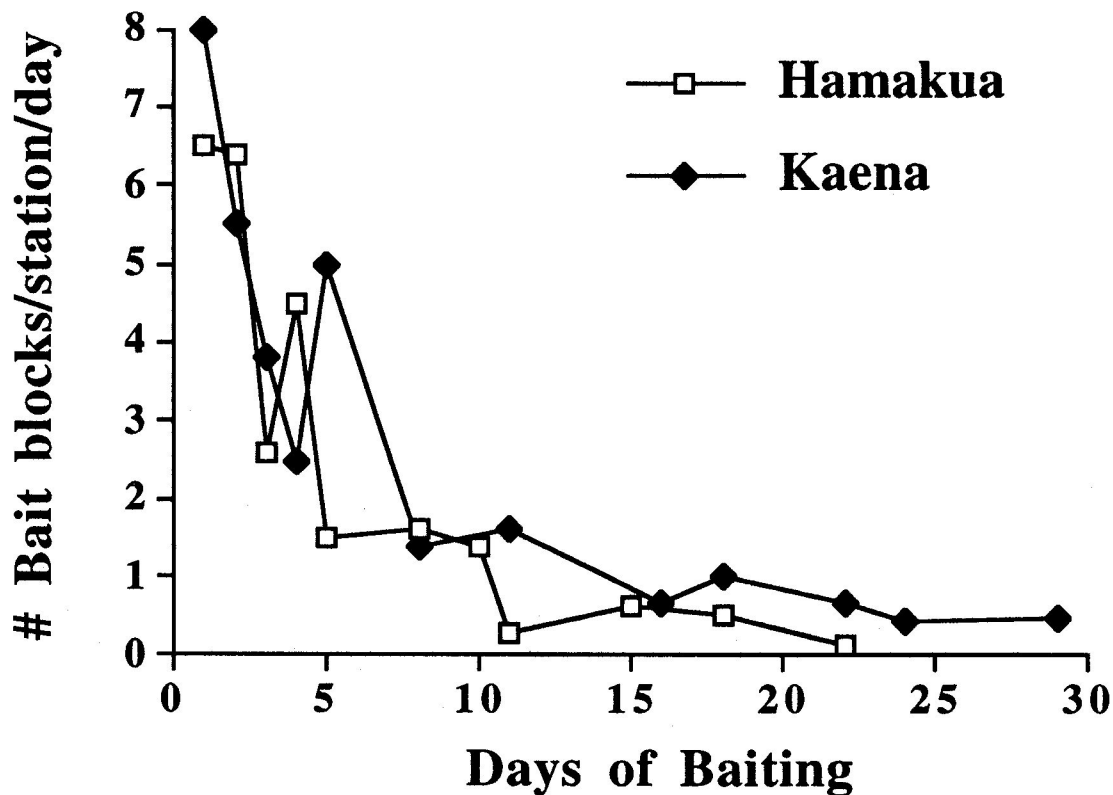


Figure 1. Daily take of diphacinone bait blocks at Hamakua Marsh and Ka'ena Point. Day zero was 30 August 2000 at Hamakua and 19 December 2000 at Ka'ena.

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additional four nights (80 trap-nights). At Dillingham two traps were missing after the first night of the second round of trapping. These traps were replaced, but this resulted in a total of only 78 trap-nights. Captures per trap-night and recapture rates of previously ear-tagged animals were compared between treatment and control sites to determine what effect, if any, the diphacinone baiting had on the mongoose populations.

Results

The first round of trapping at Hamakua Marsh yielded 38 total captures of 29 different mongooses over 80 trap-nights, or 0.475 captures per trap-night. 13 of the animals were males (average weight = 669 g; average length = 58.2 cm) and 16 were females (average weight = 363 g; average length = 50.4 cm). At Kawainui Marsh there were 16 total captures of 14 different mongooses over 80 trap-nights, or 0.20 per trap-night, including nine males (average weight = 595 g; average length = 58.4 cm) and five females (average weight = 393 g; average length = 50.8 cm).

At Ka'ena Point, the first round of trapping resulted in 49 total captures of 27 different mongooses over 80 trap-nights, or 0.61 per trap-night, all of which were females (average weight = 441 g, average length = 54.6 cm). At Dillingham there were 26 total captures of 21 different mongooses over 80 trap-nights, or 0.33 per trap-night, including 11 males (average weight = 809 g, average length = 59.3 cm), and 10 females (average weight = 585 g, average length = 57.1 cm).

A total of 341 bait blocks were taken over the three-week baiting period at Hamakua, and 451 bait blocks were taken at Ka'ena Point over 4 weeks. At both sites the number of blocks consumed per day was high at first, but declined rapidly, and remained low after about 10 days (Figure 1). Mongooses were not the only animals to affect the bait supply. Rat droppings were sometimes present inside the stations, and stations were also often occupied by African snails (as many as 13 in one station) and a variety of arthropod species.

The second round of trapping at Hamakua Marsh, after baiting, yielded only one capture in 80 trap-nights, or 0.013 captures per trap-night. No ear-

tagged animals were recaptured from the first round of trapping. During the second round of trapping at the control site in Kawainui, there were a total of 13 captures in 80 trap-nights, or 0.16 per trap-night. The 13 animals at Kawainui included four untagged animals and nine ear-tagged animals recaptured from the first round of trapping.

Similar results were obtained in the second replicate; After baiting at Ka'ena there were 7 total captures over 80 trap-nights, or 0.088 per trap-night, none of which were recaptures from the first round of trapping. During the second round of trapping at the control site in Dillingham there were 17 total captures of 15 different mongooses, or 0.22 per trap-night, 8 of which were recaptures from the first round and 7 were new.

At both treatment sites many fewer mongooses were caught after baiting than were caught before baiting, while the number of mongooses caught at each control site remained similar during the same time periods (Table 1). The decrease in catch rate after baiting was 91% at both treatment sites combined. There was a significant difference in catch rate between the treatment and control sites in the first and second rounds of trapping (Table 1; Hamakua-Kawainui Chi-square = 18.2, df = 1, $p < 0.001$; Ka'ena-Dillingham Chi-square = 9.68, df = 1, $p = 0.002$). Furthermore, the proportion of mongooses from the first round of trapping that were recaptured in the second round of trapping was relatively high at both control sites (56% at Kawainui, 38% at Dillingham), but no ear-tagged animals were recaptured at either treatment site.

Of the ten radio-collared animals, seven were recovered and confirmed dead, two were tracked to a large pile of scrap metal and old boat engines where there was a strong odor of decay, but could not be recovered, and one collar apparently malfunctioned and was not included in analyses. The locations of the seven recovered collars were as follows: three were dug out of underground burrows, three were under large piles of scrap metal and wood, and one was recovered in the middle of an open field. The latter animal was tracked to a large brush pile the previous day where a strong smell of decay was detected, but the carcass could not be located. It is likely that the carcass was subsequently dragged

out into the open by another animal. The absence of any tracks or distinguishing marks and the advanced degree of decomposition of the carcass when found make identification of the scavenger difficult, but the location of the carcass under a large brush pile suggests that only another small animal, such as a mongoose or rat, could have had access to it.

Discussion

Results of this study indicate that poisoning mongooses with Eaton's fish-flavored 0.005% diphacinone bait blocks is an effective means of population control. The catch rate of mongoose declined 91% after baiting at both treatment sites combined, while the catch rate at two control sites declined only 27% during the same period, indicating the decline was due to the baiting treatment and not to regional declines in mongoose populations. Mortality of mongooses during baiting appeared to be very high; 100% of the radio-collared animals were confirmed dead, and no previously ear-tagged animals were recaptured after baiting at either treatment site. The eight untagged animals captured at the treatment sites in the second round of trapping may not have visited the bait stations, may have immigrated from other areas, or may have survived the poison. Similar results were obtained by Stone et al. (1994) in a study examining efficacy of diphacinone in hamburger bait for controlling mongooses in Nene breeding habitat at Hawai'i Volcanoes National park; capture rates were much lower in treatment areas after baiting, and all animals captured after baiting were new animals that probably immigrated to the study area.

Radio-collaring demonstrated that there is little risk of secondary poisoning to non-target mammals from scavenging of mongoose carcasses. All but one animal was found dead either underground or under thick cover where it was not accessible to domestic or feral animals such as dogs or cats. The one carcass recovered in the open was likely was dragged there by a small scavenger, such as another mongoose or a rat, after it was mostly decomposed and consisted of skeleton and hide, and would be unlikely to cause harm to other animals.

There does, however, appear to be a risk of small quantities of bait being

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removed from the stations where they could be accessible to non-target animals. On several occasions pieces of bait blocks were found lying in the open. The amount of bait was small in each case, but demonstrates the need to design stations that allow access to mongooses, yet more effectively retain bait. Stations must also be sturdy and secured to the ground or an immovable object so they cannot be lifted, shaken, broken, or chewed open by large animals such as dogs or pigs.

Although the results of this study demonstrate that fish-flavored diphacinone bait is effective at reducing mongoose populations, the study areas were relatively small and the duration of the study was short. Hamakua Marsh in particular is a small wild land area surrounded by extensive urban and suburban sprawl, which may act as a buffer against mongoose immigration. The very low capture rate after baiting at Hamakua (only a single animal) may not be typical of larger areas where mongooses are found over a broad region. Further study is needed to assess the long-term efficacy

of this method in larger areas with continuous mongoose populations.

Based on computer modeling of mongoose population dynamics, Hays (2000) concluded that the optimal time for mongoose removal is during the three or four months prior to the nesting season of the protected bird species. Timing of mongoose reproduction likely varies among areas depending on climate, but Hays (1999) found that at one site dispersal of young females was highest in September, which could explain why so many females were captured in early December at Ka'ena Point during this study.

Diphacinone bait blocks are an improvement over the previous method of diphacinone application using hamburger as bait because bait blocks are cheaper (\$2.00 per pound), readily available, do not decay and are easily stored, no bait mixing is necessary, and blocks are relatively easy to deploy in the field. Although we did not calculate the total cost of mongoose control using Eaton's bait blocks, it is clearly less expensive than either live trapping or hamburger baiting as calculated by Stone et al. (1994). Baiting with diphacinone blocks also requires

less labor than trapping because stations do not have to be checked as often, whereas traps must be checked at least every two days to be effective and for humanitarian reasons (Stone et al. 1994). Diphacinone baiting using Eaton's fish-flavored blocks thus appears to be an effective and practical method of mongoose control that can be implemented when a trapping program is not possible due to time or budget constraints.

Acknowledgments

We thank R. Sugihara, Wildlife Specialist at the USDA National Wildlife Research Center, Hawai'i Field Station, for valuable suggestions on the design of the study and on the manuscript. P. Baguistan and G. Weigand provided field assistance with tagging and radio collaring of mongooses. The manuscript was improved by comments from Warren Hays, Chuck Stone, and an anonymous reviewer. This paper is dedicated to Pedro Baguistan. Pedro passed away while performing his duties at Kaohikaipu State Seabird Sanctuary shortly after this research was conducted.

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Field Trips for 2000

All trips with an * are still in the process of being planned. Details will be provided as the scheduled dates get closer. A donation of \$2.00 per participant on all field trips is appreciated.

August 20 Native Forest Bird Captive Propagation Unit at Honolulu Zoo. See and hear 'amakihi, 'apapane, and 'i'iwi up close, along with an aging but charming Laysan finch. Two trips, 9:30am and 1:30pm, each limited to 10 people. Both trips are currently full, but call the HAS office to be put on cancellation list - 528-1432.

September 4 Keauhou on the Big Island We will tour Keauhou Bird Conservation Center ("KBCC") in Volcano - Birds to be seen include 'Elepaio, Puaiohi, Palila, Maui Parrotbill, Hawai'i Creeper, Crested Honeycreeper, Nene, and live videos of 'Alala. We will then head mauka (up the mountain) in 4 wheel drives to see more birds - possibly 'Apapane, 'Amakihi, 'Oma'ono, 'Elepaio, 'I'iwi, 'Akiapola'au, 'Akepa and Honeycreeper, along with many unusual non-native species and gamebirds in the wild. This is about a 5 hour round-trip journey. The cost of the 4-wheel drive vehicle and gasoline will be split by participants, who are also responsible for their own flight reservations, airfares, meals, and hotel accommodations. As September 4th is Labor Day (flights in and out of Hilo need to be booked early), and considering the time involved in taking the 4-wheel drive journey (we may not make it back to Hilo in time for the last flight out), participants may want to arrange to spend the night of the 4th in Hilo or Volcano. Plenty of hotels and bed-and-breakfasts are available, but book early. Participants should layer clothing, bringing a warm sweater or coat, rain gear, and hiking shoes. Binoculars, camera, snacks and water are also necessities. Call the HAS office before August 14th to reserve your place - 528-1432.

October 28 James Campbell National Wildlife Refuge See Hawai'i's endangered waterbirds and other migratory waterfowl at one of O'ahu's few remaining wetlands. Birds seen in past years include Hawaiian stilt, Hawaiian moorhen, Hawaiian coot, Hawaiian duck, Northern Pintail, Northern Shoveler, Lesser Scaup, Wandering Tattler, Ruddy Turnstone, Sanderling, Red Knot, Semipalmated Plover, and Bristle-thighed Curlew. Bring water, snacks, binoculars, spotting scope if you have one, and sunscreen. To register for this trip, please call Mary Gaber at 247-0104.

November 25th 'Ewa Plains Sinkholes to look for fossils of extinct Hawaiian birds with Dr. Alan Ziegler, who will lead us on a short walk from the Barber's Point Deep Draft Harbor to the sinkholes, sharing information about the geology along the way. Carpool at 8am on the Punchbowl side of the State Library at King Street or meet at the Harbor on Malakole Road at 9am. Bring hat, sunscreen, water, and, if you like, a picnic lunch to eat at Barber's Point Beach Park. To register for this trip, please call Mary Gaber at 247-0104.

December -*Christmas Bird Count - Details will be available in November's issue.

Nominating Committee Seeks Candidates for Board of Directors

At the Board Meeting of July 10, 2000, a Nominating Committee of Tonnie Casey, Ron Walker, and Liz Kumabe was formed. The committee is looking for Society members who are willing to serve on the Board* of Directors. The bylaws call for fifteen directors to serve two-year terms; five of the fifteen directors are elected by the membership to officer positions. Normally eight directors are elected in even years and seven elected in odd years. This varies, however, as a result of resignations and Board members being appointed to fill unexpired officer terms.

The following positions are now open for nominations: President, Treasurer, and seven directors. Incumbents continu-

ing to serve until December 2001 are First Vice President Liz Kumabe, Second Vice President Dan Sailer, Recording Secretary Tonnie Casey. Incumbents whose terms will end this December and are up for reelection are Marlee Breese, Trae Menard, and Mary Gaber.

The HAS Board is a dynamic group of committed individuals whose energy and expertise involve many aspects of environmental protection in Hawai'i from fund raising to education, and from birding to habitat cleanup.

All members of the Board are expected to attend two-hour monthly meetings and a Leaders Retreat in January. Directors are also expected to be active on one of the Society's two standing

committees: Conservation and Education. Persons interested in serving on the Board are encouraged to attend a Board meeting; the next one is listed in the Calendar section on the back page.

If you want to be a candidate, please submit a letter of interest and brief resume of your background and activities (in and/or outside of HAS) to the attention of the Nominating Committee at the Society's address by November 10, 2000. For an information sheet giving more specific information regarding responsibilities of officers and directors, please call the office at 528-1432. Nominating Committee members may be contacted as follows: Tonnie Casey, 808-936-6539, Ron Walker, 235-1681, and Liz Kumabe, 956-2860.

Shark Finning Finally Regulated

by Linda Paul, Executive Director of Western Pacific Regional Fisheries Coalition

The Hawaii Audubon Society's mission statement, "to foster community values that result in protection and restoration of native ecosystems and conservation of natural resources through education, science and advocacy in Hawaii and the Pacific" includes the marine ecosystems that sustain both sea birds and shore birds. Protection includes mitigating the many types of human actions that threaten the integrity of marine ecosystems. Sharks play an important role in these ecosystems. They are an apex predator in the marine food chain and their feeding habits ensure that fish assemblages remain healthy and in balance. When large numbers of sharks are removed, the whole ecosystem is thrown out of balance and other fish populations may be affected. Shark populations rebuild very slowly once they are over fished. Unlike other fish species, sharks take several years to reach sexual maturity and only give birth to a small litter of young after a 9-12 month gestation period. These characteristics make sharks more vulnerable to over fishing than most fish.

Shark finning is also an extremely wasteful practice: no more than 5% of the shark is utilized. The waste involved offends all of us, but most particularly native Hawaiians and other indigenous peoples of the Pacific. Once the dorsal, pectoral, and tail fins are sliced off, the stunned shark, usually still alive, is thrown overboard to sink to the bottom and die. About 100,000 sharks, mostly oceanic blues, are taken each year by the Hawai'i-based longline fishery alone. Eighty percent are alive when brought along side

the boat. Recent observer data indicates that more than 90% of the sharks taken as bycatch are finned and the rest of the shark is discarded. Logbook data indicates 67% were finned in 1999. The number of sharks caught live as bycatch that are finned has increased every year since 1993. Globally, fins from every species of shark that swims are being taken, including the whale shark, the basking shark, and the great white shark, which were proposed for listing on Appendix II of the Convention on Trade in Endangered Species (CITES) this year as species that may be threatened by the shark fin trade. An estimated 50 million sharks are caught world-wide each year, some for food, but most for fins.

The United Nations Food & Agricultural Organization (FAO) International Plan of Action for Conservation and Management of Sharks (IPOA-SHARKS) calls for countries to develop by the year 2001 national plans of action to ensure that direct and indirect shark catches are sustainable. The aim of the FAO initiative, which the U.S. government helped draft, includes the full use of dead sharks, the minimization of waste and discards from shark catches, the minimization of unutilized incidental catches of sharks, the improvement of biological and trade data collection, and the implementation of harvesting strategies consistent with the principles of biological sustainability and rational long-term use. The U.S. Secretary of Commerce has taken major steps to implement the FAO initiative, including prohibiting finning in the Atlantic, Gulf and Caribbean U.S. EEZ unless the entire shark is utilized. The National Ma-

rine Fisheries Service has stated that the full utilization policy will apply to all U.S. waters in the future.

This past February international shark experts gathered in Honolulu at Shark Conference 2000, which was hosted by the Hawaii Audubon Society. They talked about the negative impact that shark finning is having on shark populations around the globe and stressed that when finning is occurring, management is impossible because needed data is not collected on sharks that are finned and discarded. They urged countries to implement the UN/FAO IPOA-SHARKS full use policy. In March the American Fisheries Society, the oldest and largest professional society representing fisheries scientists, published its policy statement on shark management, calling on regulatory agencies to "mandate full utilization of shark carcasses and prohibit the wasteful practice of finning."

On June 22 Governor Cayetano signed into law a bill that prohibits the landing of shark fins in the State of Hawai'i unless they are still attached to a shark. On June 7 the U.S. House of Representatives passed H.R.3535, the Shark Finning Prohibition Act, which prohibits removing any of the fins of a shark, including the tail, and discarding the carcass of the shark at sea. On June 29 Senators Kerry and Hollings introduced similar legislation in the U.S. Senate. The achievement of a ban on shark finning has been a goal of the Western Pacific Fisheries Coalition project of the Hawaii Audubon Society for the past two years. After much hard work that goal is finally being achieved. Congratulations to all those who gave it their time and support.

Aloha Larry!

HAS Treasurer Col. Larry Kimmel recently retired from 20+ years of military service and left Hawai'i to drive cross-country at the end of June. He will arrive in North Carolina sometime in August to start his new life as a civilian. Larry made sure to renew his membership for the next two years before he left, as he hopes to return to Hawai'i someday. The Society bids him a fond Aloha and thanks him for his service on our Board of Directors.

August 21 Program Meeting on Seabirds

Beth Flint, Wildlife Biologist for the U.S. Fish and Wildlife Service will give a presentation entitled, "Conservation and Status of Seabirds in Hawai'i and the Tropical Pacific." Did you know that some seabirds spend years out at sea before returning to land to find a mate and raise young? Beth Flint has spent most of her career researching seabird ecology. She recently coordinated the Second International Conference on the Biology and Conservation of Albatrosses and Other Petrels held in Honolulu in May 2000. Program meetings are now held in Room 109, the Audio-Visual room on the first floor of Henry Hall on the Chaminade University Campus. Meetings are from 7:30 to 9:30pm. Refreshments are served, and HAS publications and T-shirts will be available for purchase.

Judge Orders Fish and Wildlife Service to Protect Imperiled O'ahu Forest Bird's Critical Habitat

In a ruling from the bench June 26, 2000, Judge Helen Gillmor of the federal district court in Honolulu ordered the Secretary of the Interior and the Director of the United States Fish and Wildlife Service ("Service") to designate critical habitat for the O'ahu 'elepaio (a native forest bird) by October 31, 2001, rejecting the federal defendants' request to delay designation until October 2004. The court's ruling brings to a successful close a lawsuit brought by Earthjustice Legal Defense Fund on behalf of the Conservation Council for Hawai'i (CCH) to secure protection for this critically imperiled bird under the federal Endangered Species Act.

"We're pleased that the court recognized the need to hold the Service's feet to the fire on this one," said Earthjustice attorney David Henkin. "We don't have many native forest birds left on O'ahu, and we need to protect the 'elepaio's critical habitat if we want to have a fighting chance to save this one."

Sightings of the O'ahu 'elepaio — once abundant in forested areas throughout O'ahu -- have plummeted in recent years, with only an estimated 1,500 birds remaining, and the bird now occupies only about 4 percent of its original, his-

toric range. Habitat destruction currently poses one of the primary threats to the 'elepaio's survival and recovery. For example, the H-3 freeway (completed in 1997) cut through Halawa Valley, home to one of only seven remaining populations of the bird. Ordnance-induced fires and related military activities at Makua Military Reservation and Schofield Barracks threaten a large part of the bird's remaining habitat in the eastern Wai'anae Mountains. Suburban and golf course development also displaces habitat the O'ahu 'elepaio needs.

"Designating critical habitat will force federal agencies like the Army and the Department of Transportation to take a hard look at activities they fund, approve, and carry out — such as military training and new highway construction — to make sure that they won't destroy habitat that the O'ahu 'elepaio needs for recovery," explained Earthjustice attorney David Henkin. "It's a powerful tool to help us get a handle on Hawai'i's extinction crisis."

"Critical habitat" consists of those areas that must be managed to permit an imperiled species to recover to a level where it is safe, for the foreseeable future, from the danger of extinction. Criti-

cal habitat designation generally has little impact on private land owners since it is directed solely at actions carried out, funded or approved by federal agencies. Nonetheless, designating critical habitat confers significant benefits on Hawai'i's listed species by protecting them from federal agency actions that can adversely modify or destroy the habitat on which these species depend for their survival and recovery. Also, designating critical habitat performs an important educational role, informing the public as well as state and local governments about areas essential to the conservation of Hawai'i's native species.

Conservation Council for Hawai'i, the Hawai'i affiliate of the National Wildlife Federation, is a non-profit citizens' organization with over 300 members on O'ahu, approximately 550 members elsewhere in Hawai'i, and several hundred members in other parts of the United States. CCH seeks to promote environmental health and education in general, and the conservation and management of Hawai'i's natural resources in particular, including imperiled Hawaiian forest birds like the O'ahu 'elepaio.

Source: News release from Earthjustice Legal Defense Fund dated 06/26/00
Contact: David Henkin, (808) 599-2436 (Earthjustice)

A Visit to the Chevron Refinery's Stilt Ponds

by Mary Gaber,
Field Trip Coordinator

On June 23, twelve HAS members made the first guided tour of the ponds at the Chevron Refinery since Chevron announced the opening of guided tours of the ponds to the public. When we arrived, we found a big yellow school bus waiting for us. Accompanied by Larry Rhodes from Chevron and Gordon Smith from U.S. Fish and Wildlife Service, we boarded the bus and wended our way slowly through the maze of blue conveyor belts and silver tanks to the first of two ponds on the premises. There we saw

about 30 Hawaiian Stilts, or Ae'ō (*Himantopus mexicanus knudseni*), including some juveniles which had hatched there, and also spotted some nests. Several Hawaiian Coots, or 'alae ke'oke'ō (*Fulica alai*) and ducks were there also.

Most of the stilts were wading and feeding in the shallow waters, but some flew across the pond to where we were parked and plopped down on the warm asphalt. We were asked not to alight from the bus, but we had a clear view of all of them. Gordon explained that the only "managing" done on the ponds was trapping, mostly mongooses; keeping people from getting too close to the birds; and

clearing weeds after the nesting season. No living creatures have been introduced into the ponds. Gordon explained that the stilts' food consists mainly of the larval forms of several insect species. We saw a lot of dragonflies hovering about, no doubt one of the food sources for the birds.

The second pond we visited has been named Rowland's Pond. There we saw 20 more stilts. Each pond is about 5 acres in size. In the fall and winter months, migratory birds often visit the ponds on their return from far north, but the stilts are year-round residents.

Talks Begin on Northwestern Hawaiian Islands Initiative

On June 27, 2000, representatives from the Departments of Commerce and the Interior met with officials from the State of Hawai'i and the Western Pacific Regional Fishery Management Council and agreed to a joint public process to explore ways to ensure the comprehensive protection of the coral reef ecosystems of the Northwestern Hawaiian Islands. This was the first meeting of these groups in response to a May 26 directive from President Clinton to protect "our tropical rainforests of the water."

Furthering the Administration's efforts to protect coral reefs through the Coral Reef Task Force and other activities, President Clinton asked the two Secretaries - in cooperation with the State of Hawai'i and in consultation with the Fishery Management Council - to make recommendations to him within 90 days to ensure strong and lasting protection of the extensive coral reef resources of Northwestern Hawaiian Islands as well

as to provide for sustainable use of their resources.

All parties agreed to hold a series of open meetings to seek the public's vision for the future use and protection of the area. A number of meetings to gather public input were planned on several Hawaiian islands in the last part of July, and one meeting will occur in Washington D.C. in late July.

In directing the Secretaries to protect the coral reefs of the Northwestern Hawaiian Islands, President Clinton cited their importance to Hawai'i, the Pacific Region, and the nation. The islands contain nearly 70 percent of all coral reefs within the waters of the United States, and are home to many endangered and threatened species (including the green sea turtle and Hawaiian monk seal), as well as other protected species.

The extraordinary value and unique characteristics of these islands and coral reefs have long been recognized. The

area is home to the Hawaiian Islands National Wildlife Refuge established by President Teddy Roosevelt in 1909, Midway Atoll National Wildlife Refuge, and a State Wildlife Sanctuary on Kure Atoll. The Western Pacific Fishery Management Council is developing a Coral Reef Ecosystem Fishery Management Plan for the area, and the State is also developing additional protective measures through the development of a Fishery Management Area.

Subsequent to the public process, the two Secretaries will make recommendations to the President on a new coordinated management regime to increase protection of the coral reef ecosystems and to provide for sustainable use of these resources.

source: USFWS News Release dated 6/28/00

contact: Barbara Maxfield, USFWS, 808-541-2749 or 808-342-5600

Fish and Wildlife Service Funds Four Projects on Private Lands to Benefit Native Species

Four private landowners will receive a total of more than \$200,000 for projects that will conserve threatened and endangered or other rare plants and animals in Hawai'i under a U.S. Fish and Wildlife Service grant program. The Private Landowner Incentive Program was designed to encourage private entities to take an active role in conserving species that are either already listed under the Endangered Species Act or may be listed in the future.

"With so many listed species here in Hawai'i, it's not difficult to find potential projects," said Paul Henson, field supervisor for the Service's Pacific Islands office. "What I find extraordinary is the number of private landowners here who are more than willing to work with us in an effort to save Hawai'i's native species. We are very pleased to provide at least some of these landowners with financial incentives to continue the outstanding efforts they are undertaking."

The projects to be funded will benefit native Hawaiian plants, tree snails, forest birds, and insects located on five different islands. All of the landowners are contributing additional funding to the

projects.

The largest project provides \$90,130 to The Nature Conservancy of Hawai'i to protect 27 species from feral pigs in Hono'uli'uli Preserve on O'ahu. A 70-acre area in central Kalua'a Gulch will be fenced to protect existing species such as the endangered O'ahu 'Elepaio and to provide a protected site where critically endangered plants may be reintroduced.

On the island of Hawai'i, the North Kona Dry Forest Working Group - a multi-member partnership coordinated by the Hawai'i Forest Industry Association - will receive \$72,000 to continue its efforts to re-establish viable populations of nine endangered dry forest plants, some of which are on the brink of extinction, as well as provide habitat for the endangered Blackburn's sphinx moth. The 70-acre Ka'upulehu Dry Forest is located on land owned by Kamehameha Schools and leased to the PIA Kona Limited Partnership. The funding will provide for fence repair and construction, weed control, and propagation and outplanting of the nine endangered plants.

The Nature Conservancy will also receive funding for its Kapunakea Pre-

serve on Maui within the West Maui Mountains. The \$30,000 project is designed to remove feral pigs and alien plants from existing fenced areas that protect at least 22 species of rare plants, four native forest birds, and four species of rare Hawaiian tree snails.

The Lana'i Company, Inc., will construct a fence around approximately 10 acres on the summit area of Lana'ihale to protect native plants and tree snails from the threats of feral ungulates, especially axis deer. The \$27,500 project also will include removing alien plants that outcompete their native counterparts.

"Our Hawaiian projects fared very well in competition for these limited funds," explained Henson. "Almost 70 percent of the funding available in six western states came to Hawai'i. We congratulate these landowners on their desire to save Hawai'i's unique treasures and look forward to increasing our joint efforts in the future."

source: USFWS News Release dated 7/10/00

contact: Barbara Maxfield—808-541-2749 or Craig Rowland—808-541-3441

Field Trip Report, Pelagic Trip, June 17, 2000

by Larry Kimmel

On June 17, seventeen birders departed Ko Olina Harbor at 10:00 AM on a 41 foot sail boat in search of pelagic birds to the South and west of Oahu. We sailed out about 7.5 miles and then returned to port at 3:00 PM. The following birds were identified:

Seen at sea:

Brown Booby	14 observed
Wedge tailed Shearwaters	well over 300 observed
White Terns	28 observed
Brown Noddy	well over 100 observed
Sooty Terns	approximately 80 observed
Greater Frigatebird	1 observed
Red footed Booby	4 observed
Christmas Shearwaters	2 observed
Bulwer's Petrel	1 observed

Seen on shore/at the harbor:

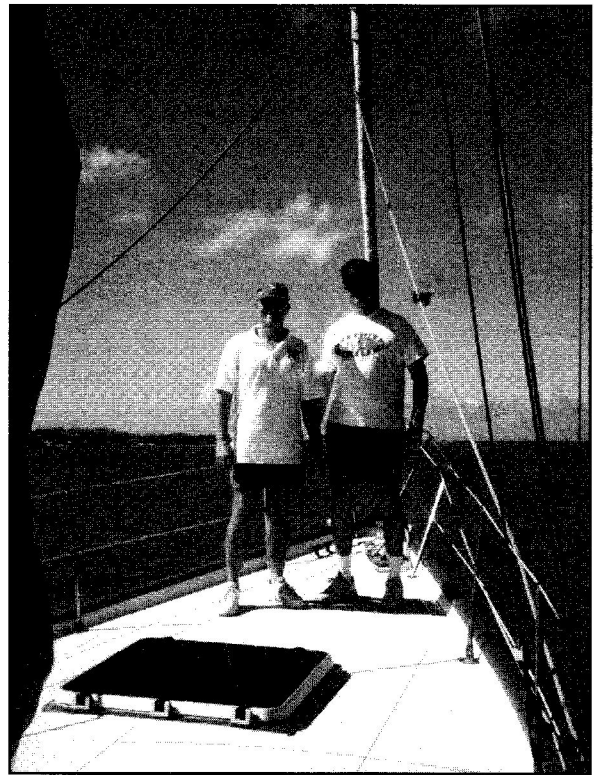
Ruddy turnstone	1 observed
Least sandpiper	probably observed, no photo confirmation

(Observers—Paul Hlava, editor of New Mexico Audubon, and Larry Kimmel, HAS)

The group of birders had a very enjoyable day being hosted aboard the "La Force Contraire" captained by Mr. Breck Jeffery and Diane Jeffery of Ko Olina/JICPAC. The group was made up of some long term birders, and some novices. They all had a wonderful trip, and many returned with new life birds. Participants were: Larry Kimmel, John Kimmel, Mary Kimmel, Marge Hlava, Paul Hlava, Marisa Leandro, Michelle Mazeres, Jenny Porter, Karen Veriato, Berna Mings, Kurt Pohlman, Renate Gassmann-Duvall, Fern Duvall, Harvey King. The weather was delightful, with light trades 10-15 knots, clear skies, seas of 2-3 feet, and temperatures of approximately 80 degrees.

The majority of the birds were seen at two "feeding frenzies" where it appears that large fish had driven smaller fish to the surface, and the birds were feasting on them. The Wedge-tailed Shearwaters were rafting on the water in large numbers, and were the most numerous species noted, especially in the area 1-3 miles from shore. Beyond the four mile mark from shore, the birds seemed to be much more scarce and fewer were counted.

At the end of the trip, the captain was thanked for sharing his boat with the Hawaii Audubon Society. Several birders recommended that a winter trip would be in order to assess the change in species of birds to be observed. It was an enjoyable trip for all.



Col. Larry Kimmel (L) and our Captain, Breck Jeffery (R) aboard "La Force Contraire"

Two Research Grants and the Rose Schuster Taylor Scholarship Awarded by the Society

by Dr. Phil Bruner, Chair, Grants and Scholarship Committee

Hawaii Audubon Society is pleased to announce the awarding of two grants and a full tuition scholarship. Whitney Nekoba of Kurtistown on the Big Island was awarded \$500.00 to support her research on Habitat Selection for Nest Cups in the Genus *Pluvialis* at Nome, Alaska. She will look at the question of whether or not plover in the genus *Pluvialis* randomly or selectively choose

the location of their nest cups. Amber Whittle also received \$500.00 from Hawaii Audubon Society to look at larval supply and recruitment within and outside of a Marine Life Conservation District on O'ahu. This work is part of her doctoral dissertation at the University of Hawai'i. We wish both of these researchers well and eagerly await a report of their findings in a future issue of 'Elepaio.

Colin McCormick of Kihei, Maui will begin his college career at the University of Hawai'i this fall. Colin has been cho-

sen by the Hawaii Audubon Society to receive the Rose Schuster Taylor Scholarship which is a one year full tuition scholarship. He has great potential and has demonstrated his interest in Hawai'i's native biota through numerous service projects, participation in Paradise Pursuits, and his course work at Maui High School.

We are confident that Colin will make many important contributions to Hawai'i's conservation needs in the years ahead. Congratulations to all the recipients.

Mosquito and Pig: A Cautionary Tale of Two Alien Species

from USGS Volcano Watch, May 21, 2000

Mosquitoes are not native to the Hawaiian Islands. Anyone driven away from an outdoor activity or rudely awakened by a biting mosquito would agree that the islands of old were indeed a paradise. That bit of paradise was lost in the early 1800s, when the southern house mosquito arrived, allegedly aboard the sailing ship Wellington. This mosquito has evolved in long and close association with humans. It utilizes any standing water but is particularly adapted to sewage-polluted water associated with people and livestock. By 1900, this mosquito was well established throughout the islands, wherever human activities created the stagnant water habitat necessary for its immature stages.

Most people realize that some mosquitoes transmit serious human disease, but few are aware of the many diseases mosquitoes transmit to domestic and wild animals. Fortunately, no known human diseases transmitted by this mosquito occur in Hawai'i. Unfortunately, two mosquito-transmitted bird diseases have become established.

The date of entry for avian pox and malaria remains a mystery, but the devastating impact of the two diseases on lowland populations of native birds has long been recognized. By 1900, some of the earliest naturalists had observed pox lesions on increasingly rare bird species. Avian malaria and pox, are no longer confined to lowlands, however; both diseases are now prevalent in mid-elevation forests.

How could the transmitting mosquito, so dependent on stagnant water around human settlements, become established

in the large remaining tracts of Hawaiian forest? This question was particularly baffling on the windward slope of Mauna Loa, where the porous nature of young volcanic soil prevents most standing water. Enter alien species number two, the feral pig, unwittingly paving the way for mosquitoes into the forest.

European domestic pigs were among the earliest introduced species to arrive in Hawai'i. Without predators or herbivore competitors, these animals adapted well to life in the wet forest and rapidly established large feral populations. The starchy core of native tree ferns is among the pigs' favorite foods. Foraging pigs greedily consume this starch, leaving behind cavities that quickly collect rainwater and fallen leaves. As the tree fern starch and leaves decompose, the water becomes rich with bacteria upon which larval mosquitoes feed. Chemicals from decomposing plant material are attractive to female mosquitoes, ensuring that eggs are laid in a suitable habitat. So, the activity of one alien species provided the habitat needed by another. The mosquito figuratively piggy-backed its way into the forest.

Many tree fern cavities are small, containing little more than a cup of water; some are larger and hold 3-4 liters (quarts). Even a small cavity can support development of hundreds of mosquito larvae. Consequently a typical acre of wet forest may produce thousands of mosquitoes that can spread the two bird diseases and have a profound effect on bird populations.

Every year between September and December, the Kilauea Field Station re-

ceives dead or dying birds from the Volcano area. Many are infected with avian malaria. Each year fewer 'i'iwi, the magnificent red honeycreeper, are seen in the mid-elevation forests, and vast tracts of wet forest are now largely devoid of bird life.

Can we control the diseases that threaten our native forest birds? In the few successful campaigns against mosquito-transmitted human disease (malaria on the mainland and in Europe, dengue in Hawai'i), elimination of the larval mosquito habitat was the winning factor. In the windward forests of Mauna Loa, reduction of feral pig numbers would reduce habitat for mosquitoes, ultimately disrupt disease transmission, and help enable forest-bird populations to rebound.

Mosquitoes would still be produced in agricultural and residential areas near forests, so we should practice mosquito control there as well. Everyone can do their part by eliminating standing water on their property. Cleaning a gutter or turning over a pail in the garden may one day be rewarded by a glimpse of an 'i'iwi in your own backyard.

Volcano Watch is a weekly feature of United States Geological Survey ("USGS") scientists. Readers can find additional information about the natural science research of the USGS at its website: <http://www.usgs.gov>

U.S. Geological Survey Hawaiian Volcano Observatory P.O. Box 51, Hawai'i National Park, HI 96718. Phone (808) 967-7328 FAX (808) 967-8890

Apply by October 1 for Research Grants in Hawaiian or Pacific Natural History

The Hawaii Audubon Society offers grants for research in Hawaiian or Pacific natural history. Awards are oriented toward small-scale projects and generally do not exceed \$500. Special considerations are given to those applicants studying dryland forests or aeolian systems in Hawai'i. Applicants are encouraged to

solicit grants from other organizations to fund research which cannot be funded entirely by the Society.

Grant recipients are expected to submit a 2-3 paragraph progress report, suitable for publication in the Society's journal 'Elepaio, within 6 months of the termination date specified for the project.

The recipients are also encouraged to draft a more detailed 2-3 page report which would be considered for publication in 'Elepaio.

Grants are reviewed semiannually. Deadline is October 1 for winter/spring grants. Call, write, fax or email the HAS office for application guidelines.



AUGUST/SEPTEMBER 2000

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Calendar of Events

Thursdays, August 3 and September 7

Education Committee monthly meeting, 7 p.m. at BaLe Sandwich Shop in Manoa Marketplace (near Safeway). For more information, call chairperson Wendy Johnson, 261-5957.

Mondays, August 14 and September 11

Conservation Committee monthly meeting at the HAS office at 5:45 p.m. For more information, call chairperson Dan Sailer, 455-2311.

Mondays, August 14 and September 11

HAS Board meeting, always open to all members, 6:30 to 8:30 p.m. at the HAS office.

Sunday, August 20

Field trip to Native Forest Bird Propagation Unit at Honolulu Zoo. See page 52 for details.

Monday, August 21

Program Meeting Beth Flint will do a presentation entitled, "Conservation and Status of Seabirds in Hawai'i and the Tropical Pacific." Details on page 53.

September 4

Field Trip to Keauhou on the Big Island - trip to see forest birds. See page 52 for details.

October 28

Field Trip to James Campbell National Wildlife Refuge. See page 52 for details.

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