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Invasive Kahili Ginger and Forest Bird Density in Volcanoes National Park, Hawai'i

By Nathaniel W. Carroll, School of Forestry and Environmental Studies, Yale University, New Haven, CT 06511

Nathaniel Carroll is a June 2002 recipient of a Hawaii Audubon Society Research Grant. This article is a report of his study results.

Abstract

This study looks at the effect of Kahili ginger (*Hedychium gardnerianum*) on the density of three species of forest bird: the Japanese White-eye (*Zosterops japonicus*), the O'mao (*Myadestes obscurus*), and the 'Apapane (*Himatione sanguinea*). For six weeks during June and July of 2002, the density of bird species was recorded in ginger invaded and ginger removed forest plots in Hawai'i Volcanoes National Park. Japanese White-eye density was found to be significantly higher in ginger plots. 'Apapane density was found to follow the percentage of 'Ohi'a (*Metrosideros polymorpha*) tree flowers in bloom, regardless of ginger invasion, and Oma'o density was found to not correlate with ginger invasion. The correlation between ginger eradication and decreased White-eye density points to the multiple benefits that strategic invasive species management actions might hold.

Introduction

Invasive alien species (IAS) encroachment is one of the greatest threats to Hawai'i's native ecosystems (Wilcove 1998). More than 90% of Hawai'i's native species are threatened by invasive species (Staples and Crowie 2001, Elmqvist 2000). Accordingly, IAS are also an urgent challenge facing the Hawaiian Islands' natural resource managers (Loope *et al.* 2001). As an expanding human population and its peripatetic ways increases the rate of IAS introduction and creates eco-tones of biotic invasion, we must examine the capacity for these degrees of disturbed habitat to support native biodiversity.

The process of plant and animal invasion is as complex and variable as the characteristics of the invading organism and host ecosystem. Determining the impacts of IAS and their underlying mechanisms is critical to effective management of native lands and to the preservation of endemic wildlife. While much research has been conducted on the role of predators and diseases in the decline of Hawaiian birds, more information is needed on how invasive plants contribute to the problem (Loope *et al.* 2001, Vitousek *et al.* 1997).

This study aims to understand the impacts of invasive plants on avian communities, specifically to detect the change in bird density and the life history characteristics that are affected by the invasion of an ornamental ginger (Kahili ginger, Zingiberaceae: *Hedychium gardnerianum*). With this information we may better gauge the capacity of native Hawaiian forest invaded by Kahili ginger to sustain endemic Hawaiian bird life and the impacts of ginger removal, as well as perhaps gain insight into the complex of inter-specific interactions.

It is hypothesized that Kahili ginger invasion will reduce avian density for birds that feed in the understory, while other species less dependent on native fruiting plants in the shrub layer

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Cattle Egret on Majuro Atoll

by Nancy Vander Velde Majuro, Marshall Islands nancyv@ntamar.net

On Sunday, February 15, 2004, a single Cattle Egret (*Bubulcus ibis*) was observed in a fenced grassy area of downtown Majuro Atoll, Marshall Islands. It was accompanying a young pig and a chicken, all of which appeared to be seeking food in the grass. This Cattle Egret was in basically non-breeding plumage, with a yellow bill and greenish-black legs. It did have, however, a slight rusty colored area on the top of its head. It was observed almost daily at least until early March. At first it was usually with the other animals but sometimes alone. However, at the end of February, the pig was eaten, leaving the Cattle Egret to forage on its own.

As the common name implies, the Cattle Egret tends to be found around cattle (Grewal 1995). The attraction is not the cows themselves but the insects hiding in the fields that try to scurry out of the way of the larger animals – as well as any insects attracted to the mammals. The Cattle Egret will also associate with other livestock, such as pigs, horses and water buffaloes, as well as elephants, camels and game animals (Wetmore 1965, Maclean 1985). Only pigs are to be found in the Marshall Islands so it is no surprise to find the Cattle Egret near one.

The original range of the Cattle Egret was probably Africa, or perhaps Africa and Eurasia. It is now figured to inhabit virtually every continent, aside from Antarctica (www.zoo.org, nis.gsmfc.org). On its own accord it appears to have spread across the Atlantic to South America, and then up into North America (Wetmore 1965). It arrived in Florida in 1952 and Texas 1955, and was expected to continue to expand its range (Peterson 1961). True to this prediction, in 1964 it was observed in California and is now established there (Small 1974).

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Program Meeting Speaker Changed, Date Rescheduled for April: on Wednesday, April 21st, Sheldon Plentovich will speak on on Seabird Biology

There was a schedule conflict at Chaminade concerning our Program meeting on April 19th, and our previously scheduled speaker, Nick Kalodimas, was unavailable on April 21st. In June, we will return to our usual third Monday of every other month schedule.

Sheldon Plentovich, a graduate student in zoology at the University of Hawai'i, will speak on sea bird biology, her research on the effect of invasive ants on nesting sea birds on the offshore islands of Southeast O'ahu, efforts to restore Hawai'i's offshore islands and how she gets local elementary school kids involved in her research and restoration efforts. She worked with the US Fish and Wildlife Service with endangered sea birds before starting her PhD studies at University of Hawai'i.

Program meetings are held at Henry Hall Room 109 on the Chaminade University campus, 3140 Wai'alae Avenue, Kaimuki. Meetings are from 7:30 to 9:30pm. Refreshments are served, and HAS publications, T-shirts, and maps are available for purchase.

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850 Richards Street, Suite 505
Honolulu, HI 96813
Tel: (808) 528-1432 Fax: (808) 537-5294
E-mail: hiaudsoc@pixi.com
Website: www.hawaiiaudubon.com

Pacific Fisheries Coalition (PFC)
(a project of Hawaii Audubon Society)
Tel: (808) 529-0430 Fax: (808) 537-5294
Website: www.pacfish.org

The Natural and Cultural History of Kailua Ahupua'a and Kawai Nui Marsh

sponsored by Kawai Nui Heritage Foundation, 'Ahahui Malama I ka Lokahi and Kailua Hawaiian Civic Club

Educational tours of Kailua Ahupua'a and Kawai Nui Marsh are designed to inform residents, visitors, educators and members of community organizations about Hawaiian archaeological, historic and ecological sites at the marsh. Field study trips for elementary through college age student groups or other Hawaiian cultural groups are also available.

Saturday May 15	**Chants and Traditional Stories of Kawai Nui Sacred Places**
Saturday Sept. 4	**Cultural and Natural History of Kawai Nui Marsh**
Saturday Oct. 2	**Geology of the Kailua Ahupua'a**
Saturday Oct. 29	**Kawai Nui Ho'olaulea and Makahiki**
Saturday Nov. 6	**Archaeology and Historic Sites of Kawai Nui Marsh**
Saturday Dec 4	**Birds of Kawai Nui Marsh (Kawai Nui, Hamakua, and Kaelepulu)**

Groups meet at Ulupo Heiau next to the Windward Kailua YMCA at 8:30am and will walk and car pool to the various sites, returning to Windward YMCA by 1:00 pm. Donations of $5.00 for non-members and $3.00 for members are gratefully accepted. Money suppors cultural and ecological restoration work at the Marsh. Groups limited to 25 persons. Dates of tours may be subject to change depending on weather or other circumstances. Check updates at website: http://www.ahahui.net/

What to bring: Backpack or fanny-pack, walking shoes, water bottle, mosquito repellent, sunscreen, rainwear, hat or cap, sunglasses. Optional: camera, binoculars, snacks.

Please call Chuck "Doc" Burrows to register at: 595-3922 or email: <ahahui@hawaii.rr.com>

Field Trips for 2004

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 per participant on all field trips is appreciated. Field Trip information is also available on the HAS office answering machine (528-1432) and on our website, <www.hawaiiaudubon.com>

Saturdays, April 3rd and 17th, both 7:30am Shorebird Farewell at Paiko Lagoon. A chance to bid our shorebirds (Pacific Golden Plover, Ruddy Turnstone, Sanderling, etc.) goodbye, as they will be leaving for Alaska shortly. Wear old tennis shoes or reefwalkers, and bring sunscreen, water, and lunch. We will meet at Paiko Lagoon. Call Alice to register, 538-3255.

Sunday, May 16th, 10:30am Ka'ena Point hike. See Laysan Albatross chicks and other seabirds, lots of wild beauty, and Native coastal plants. Wear shoes appropropriate for hiking and bring binoculars, sunscreen, lots of water, and lunch. We will meet at the parking lot at the end of the road on the Mokuleia side. Remember not to leave anything valuable in your car or trunk. Call the HAS office to register – 528-1432.

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and understory will remain unaffected or possibly be augmented. With specific information on species affected and by what mechanisms, we may better manage Hawaiian forests for bird diversity and forecast the impact of Kahili ginger on the avifaunas of other Pacific islands.

Study Species

Kahili Ginger:

Many invasive plants tend to favor disturbed sites, but occasionally an alien species thrives in pristine habitat (Elton 1958). These species present an important challenge for the preservation of native flora and fauna. Some plant families such as Zingiberaceae have proven to be effective invaders of Hawaiian native forest (Smith 1985). The ability of non-native, shade-tolerant plants to invade undisturbed forest makes them a particularly significant factor in initial disturbance of intact forest. Kahili ginger forms monospecific (composed of a single species) understory stands in native forests. Its native range is the lower slopes of the Himalayas, India, but it was introduced to almost all the Hawaiian Islands by horticulturalists as an ornamental plant. Ginger was first recorded in the park in the early 1900s, but kept in check (along with native understory plants) by feral pigs. In the early 1970's feral pigs were fenced out of the park and ginger was able to grow unchecked (Zimmer 2002). Its potential range of invasion in Hawai'i is great, including essentially all wet habitats below 1,700 m a.s.l. (Smith 1985). Kahili ginger can invade both disturbed and undisturbed areas in Hawai'i and is able to establish and thrive in sites with 100% canopy cover, and forms vast, dense colonies, possibly suppressing recruitment of native trees and causing displacement of native shrubs (Warschauer 2002). The ginger propagates by stolons (underground branches that produce new plants), through seeds dispersed by frugivorous birds, and by human plantings. Complete eradication of Kahili ginger stands is difficult and usually requires a combination of mechanical removal and an herbicide called Escort® (DuPont™) sprayed on root stumps.

Forest Birds:

This study focuses on three forest birds common to the Kilauea summit area: the Japanese White-eye (*Zosterops japonicus*), the O'ma'o (*Myadestes obscurus*), and the 'Apapane (*Himatione sanguinea*) and other bird species, such as 'I'iwi (*Vestiaria coccinea*) and 'Amakihi (*Hemignathus virens virens*) were recorded during surveys, but were not observed in sufficient numbers to calculate accurate density estimates. The White-eye forages at all heights in the forest but particularly in the subcanopy, eating insects, fruit, and nectar. The Oma'o, while frequenting the canopy of forest, often forages in the understory for fruits, berries, seeds, and insects. The 'Apapane forages almost exclusively in the forest canopy for nectar and insects.

Research on avian habitat selection has shown that vegetative composition and structure is a good predictor of the diversity and distribution of bird species (MacArthur and MacArthur 1961). Researchers have gained insight into the nature of the correlation between habitat structure and species distribution by studying life history traits and foraging patterns (Robinson and Holmes 1982, Cody 1981). Lloyd *et al.* (1998) found the invasion of mesquite in Arizona grassland to increase the abundance of some bird species while depressing abundances of others based on life history characteristics such as feeding habits and nesting preference. The current ranges of most Hawaiian forest birds appear closely tied to the distribution of forests dominated by native tree species. It is unclear whether this association is due to feeding specialization on native plants, or if other factors, such as disease or predators, restrict native birds from disturbed habitats (Jacobi and Atkinson 1995.

The abundance and composition of birds may react differently to plant invasion depending on the bird species' feeding habits (guilds) (Lloyd *et al.* 1998). Some guilds may be negatively affected (i.e., decreased density) while others may respond positively (increased density) or not at all. This assumes that density is positively correlated with habitat quality, which is best determined with demographic data (Van Horne 1983) but not in the scope of this pilot study. Successful guilds are often able to utilize the new vegetation as a resource, and, in some cases, even aid the invasion by dispersing seeds (Vitousek and Walker 1989). Thus, alterations in forest plant composition can have varying degrees of impact on local bird populations, with some bird species coping with plant invasion more easily than others. Understanding the habitat requirements of both resistant and vulnerable bird species will aid in preserve design, restoration efforts, compatible land use, and corridor design; all are critical elements in adapting environmental management to the problem of invasive alien species (Glover 1999).

Site Description

Hawaii Volcanoes National Park is located on the southeast side of the island of Hawai'i, and includes portions of the Mauna Loa and Kilauea volcanoes. The altitudinal range of the park is from sea level to 4,170 m, although much of the wet forest and the research station are at approximately 1,500 m. The weather is dominated by northeast trade winds and the windward slope mid-slope receives a mean annual rainfall of 381cm. Five major ecological zones have been identified within the park, from rainforest to desert scrub.

The wet montane forest at the summit of Kilauea Volcano is dominated by 'Ohi'a (*Metrosideros polymorpha*), the most widespread canopy tree in Hawai'i, and contains sites of Kahili ginger invasion and areas of complete ginger eradication. A total of four plots were included in this study: two plots, Ginger 1 and Ginger 2, contained greater than 90% ginger invasion and are 35 ha and 25 ha, respectively. Two other plots, No Ginger 1 (36 ha) and No Ginger 2 (42 ha), were placed in forest from which ginger was removed. The understory of these plots was composed of native vegetation, primarily: Hapu'u (*Cibotium glaucum*), 'Ohelo (*Vaccinium calycinum*), Pilo (*Coprosma* spp.), Kolea (*Myrsine lessertiana*) and Uluhe (*Dicranopteris linearis*). The four sites share topographic, vegetative and climatic characteristics. All plots are placed in closed canopy 'Ohi'a forest growing on 1790 volcanic substrate (Wolf and Morris 1996), between 1300 m to 1400 m with a general west facing aspect.

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Methods

Fieldwork was conducted during June and July of 2002. Twelve sampling stations were placed in each of the four plots. All 48 stations were sampled once a week for six weeks, totaling 288 station observations.

The Variable Circular Plot (VCP) method (Buckland *et al.* 2001, Reynolds *et al.* 1980) was used to estimate bird density at each station. This distance sampling method takes into account the distance between the observed bird and the observer at a fixed point in the center of the plot. From these distance data, estimated by the observer, a detection function is calculated using Distance 4.0© software that assesses the probability of detecting a bird at a given distance (Thomas *et al.* 2002). Accurate estimates of forest bird density can be derived from the function model (Camp 2002, Nelson and Fancy 1999, Fancy 1997).

Counts took place between sunrise and noon, the period of highest bird activity. Counts consisted of standing in the center of a station for eight minutes recording all birds seen or heard and their estimated distance from the observer. Eight minutes is considered to be an appropriate length of time in the closed canopy forest of Hawai'i after which birds are more likely to be counted twice (Reynolds 1980). In addition, at each station condition baseline data was collected on: percent cloud cover, rain intensity (0-4), wind (0-5), and gust (0-5).

To select sampling stations within plots, a random starting point was chosen from along the borders of each plot (Buckland *et al.* 2001) by numbering the perimeter and rolling a dice. From each starting point, transects were drawn systematically to fill plots entirely. Along each transect, sampling stations were placed every 150 meters, to ensure sampling independence. Based on past experience, 'Oma'o were expected to have the largest detection distance of roughly 70 meters and any larger estimates would likely be truncated in analysis (Woodward 2002). 'Oma'o estimated detection radius (EDR) in this study was determined to be 55.43 meters. 'Apapane EDR was 18.8 m and Japanese White-eye was 17.95 m. All stations were at least 75 meters from the edge of a plot.

At each station, vegetation data were collected according to protocols described by Ralph *et al.* 1993 and BBIRD (http://pica.wru.umt.edu/BBIRD/). The data were collected within a circular plot of radius 12.6 meters measured around the observation point. Measurements included: tree data (canopy height, canopy density, 'Ohi'a DBH, Ilex DBH, and snag DBH), Understory data (tree fern (Hapu'u) abundance, ginger percentage, and native and non-native shrub abundance), and bloom and fruit data (percent 'Ohi'a bloom, ginger bloom abundance, and fruit abundance). Latitude and longitude were also recorded for each station with a Magellan GPS receiver.

SAS® and MINITAB® statistical softwares were used to run one-way analysis of variance tests with Tukey's comparison of means, t-tests, and power analyses.

Results

Birds: Density per station and plot was calculated and compared for the three species of bird: Japanese White-eye, 'Oma'o, and 'Apapane. A comparison of density per station among plots shows a distinctly higher density of Japanese white-eye in Ginger-invaded forest than Ginger-removed forest (Figure 2). A one-way Analysis of Variance (ANOVA) with Tukey's comparison of means confirms a significantly higher density of Japanese white-eye in Ginger plots ($F(3,44) = 10.09$, $p < 0.0001$).

A one-way ANOVA with Tukey's comparison of means of Oma'o density among plots demonstrates a lower density of Oma'o in Ginger 1 than any other plot, including Ginger 2 ($F(3,44) = 7.62$, $p < 0.0002$) (Figure 3). 'Apapane density among plots revealed a different pattern, a significantly higher density of 'Apapane in Ginger 1 and No Ginger 2 than any other plot ($F(3,44) = 24.35$, $p=0.0001$), but not equal to each other (Figure 4).

***Vegetation*:** Abundance of native fruit plants as well as the quantity of fruit was calculated for each plot (Figure 5). No significant difference in the mean number of fruiting plants among plots was detected ($t(4) = 1.94$; $p = 0.12$, 95% CI = (-7.4, 41.8)). However, a significant difference in the mean number of fruit between treatment plots was documented ($t(5) = 3.61$; $p = 0.015$, 95% CI = (546, 3253)). Fruiting plants included: 'Ohelo, Olapa, Pilo, Kolea, Ilex, Manono and a few ginger (not quite fruiting yet).

No significant difference was found in canopy height and percent canopy cover among plots. Estimated basal area, calculated for the dominant tree species, 'Ohi'a, and the next most common tree species, *Ilex*, did not differ significantly among plots (ANOVA, Tukey: 'Ohi'a: $p = 0.064$ and *Ilex*: $p = 0.026$). Dead snag abundance and distribution of DBH also did not vary significantly among plots (ANOVA, Tukey: $p = 0.122$). 'Ohi'a bloom was surveyed twice during the study, at the start and the halfway point. The average percent of canopy in bloom shows higher number of flowers in bloom in the Ginger 1 and No Ginger 2 plots.

Discussion

These results suggest a relationship between ginger invasion and Japanese white-eye density, whereas the correlation is not as clear with Oma'o, and even unconnected to the 'Apapane.

Japanese white-eyes are an alien species that feed primarily on insects and nectar (Van Riper 2000). White-eyes were observed collecting nectar at ginger flowers (in peak bloom by the end of the study) several times during the study, though not often enough to influence density. If the significant increase in vegetative biomass caused by ginger invasion was accompanied by a rise in invertebrate abundance, and thus white-eye food source; this would provide a possible explanation for the observed pattern. For example, abundance of an alien insect (*Sophonia rufofoascia*) was found to be five to 19 times greater in nearby forest invaded by the non-native plant *Myrica faya* (Lenz and Taylor 2001). Invertebrates may be attracted to the flowers heads and rotting inflorescences found on mature ginger stalks, resulting in greater resource availability to white-eyes in ginger invaded forest.

The mechanisms behind of the pattern of 'Oma'o density, lower density in Ginger 1 than all others, is less clear than that for Japanese white-eye. A careful examination of the distribution of 'Oma'o density samples in plots Ginger 2 and No Ginger

1 shows that plot Ginger 2's three highest samples are in a corner surrounded nearly 270 degrees by plot No Ginger 1 (Figure 1). This edge effect where the ginger-removed plot is nearly surrounded the ginger invaded plot may erroneously inflate the density estimate of 'Oma'o in the enveloped corner – as passing birds would likely cut through the corner to reach other suitable habitat.

Surprisingly, there is greater fruit abundance, the primary component of the 'Oma'o's diet (Wakelee and Fancy 1999), in the ginger invaded plots (Figure 5). A possible explanation is interspecific competition between Oma'o and white-eyes, leaving a greater abundance of under-used resource in ginger-invaded plots. Ginger would serve as an indirect cause for lower 'Oma'o density with interspecific competition as a direct mechanism. While white-eyes are known to overlap in feeding strategies with native birds, they are not thought to do so with 'Oma'o (Mountainspring and Scott 1985). But conclusive, empirical evidence of such displacement competition is still lacking (Van Riper 2000). It may be that landscape characteristics such as topography and microclimate are influencing Oma'o density, or even recent disturbance, for example: ginger was eradicated from plot No Ginger 1 in 2000, whereas eradication in plot No Ginger 2 was conducted 15 years earlier in 1985. Ginger eradication is damaging to non-target understory vegetation, often leaving behind a barren habitat. Plot No Ginger 1 may not have had sufficient time to recover from the effects of invasion as well as eradication, explaining the much greater variability in 'Oma'o density in that plot (Figure 2).

'Apapane density does not seem to be directly affected by ginger invasion as would be expected for a wide-ranging canopy honeycreeper that feeds mainly on 'Ohi'a nectar. The significantly higher density of 'Apapane in Ginger 1 may result from local variation in Ohia bloom abundance, as Apapane density is known to be highly correlated with 'Ohi'a flowering (Fancy & Ralph 1997). Such a trend was supported by data collected on the percent of 'Ohi'a canopy in bloom (Figure 6).

Results support the hypothesis that species less dependent on native fruiting plants in the shrub layer and understory will remain unaffected or possibly be augmented ('Apapane and Japanese White-eye), but do not support the hypothesis that ginger invasion decreases density of understory-feeding birds ('Oma'o). The positive correlation between ginger invasion and increased density of alien Japanese White-eyes may impair the long-term capacity of native forest to sustain native Hawaiian birds through competition or continued habitat alteration. It may also be worth considering the possibility that white-eyes fill an ecological niche of extinct or rare bird species, although the line between filling an empty niche and pushing out other species is far from clear, such as the Hawaiian creeper (Mountainspring and Scott 1985), neither are side-effects of niche replacement by an alien species.

Management implications of this study stem from idea that the reinforcing interplay and mutual perpetuation often found among invasive species (Staples and Crowie 2001), may also, in certain circumstances, provide a means to influence non-target invading organisms. This underscores the importance for managers to consider the entire invasion front, not just species by species impacts. Which bird species are influenced by ginger invasion, and how, seem to depend on habit, diet, and possibly

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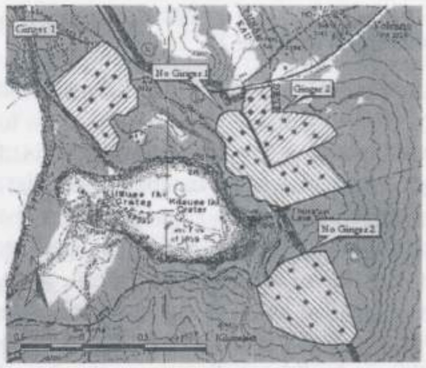

Figure 1. Study plots and point count stations in the Kilauea summit region.

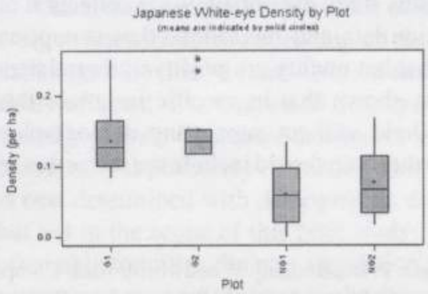

Figure 2. Japanese White-eye density by plot.

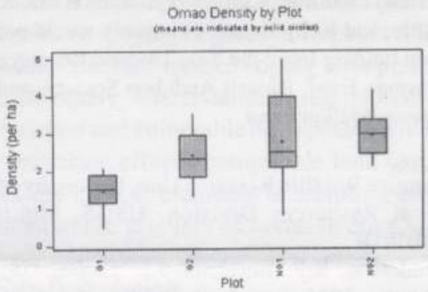

Figure 3. Oma'o density by plot.

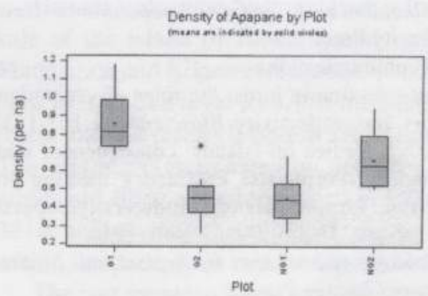

Figure 4. 'Apapane density by plot.

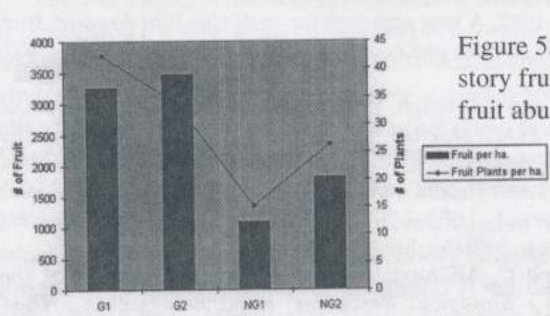

Figure 5. Understory fruit plant and fruit abundance

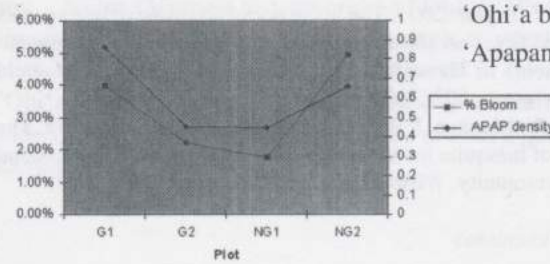

Figure 6. Percent 'Ohi'a bloom vs 'Apapane density

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the complex interplay among other bird species and available resources.

Long-term ecological research is needed on many aspects of this pilot study. Further investigation of the mechanisms underlying the White-eye/ginger relationship and clarification of the 'Oma'o/ginger relationship would be helpful for management decisions regarding the short-term impact of ginger eradication. Such studies should be expanded spatially and temporally to produce greater resolution of the mechanisms at work. In addition, the scope of this study did not allow for collection of survival and reproduction data, and thus follows the assumption that bird density and habitat quality are positively correlated. Van Horne (1983) has shown that in specific instances this assumption does not hold without supporting demographic data. Future studies on the topic should include the collection of demographic data.

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CATTLE EGRET ON MAJURO ATOLL **continued from pg. 17**

The Cattle Egret was introduced into Hawai'i from Florida in 1959 as a pest controller (Hawaii Audubon Society 1999). Pratt et al (1987) considers the Cattle Egret a common migrant to western Micronesia, presumably from Asia. It was reported from Palau as far back as 1932 when it was included in a Japanese hand list of birds (Baker 1951). It is now considered to be a common winter visitor from Palau to Pohnpei (Pratt et al 1987), although at least once, in 1978, a flock of about two dozen birds stayed the summer on Palau (Engbring 1988).

Previous to this recent sighting, the only reports for the Cattle Egret in the Marshall Islands were on Kwajalein Atoll by Schipper (1985). He observed one individual in breeding plumage on Roi-Namur in April 1980, and supposedly the same bird on May 10, which he photographed. On October 24, 1981, he reported a Cattle Egret on Kwajalein Island, which he speculated may have also been the same individual. Clapp (1990), however, felt it more likely to be another bird. Clapp also reports on Schipper's observation of a Cattle Egret at a rain pool in Roi-Namur, from March 1 to May 28, 1987.

Clapp felt that those reported on Kwajalein could have come from either Hawai'i or the western Pacific. The same conclusion can be made of the recent sighting from Majuro. But considering how this bird does spread so well on its own, it could have also come from some other area.

It is likely that the Cattle Egret could visit – or already has visited – other parts of Majuro Atoll as well as other atolls in the Marshalls. The white morph of the Pacific Reef Heron (*Egretta sacra*), appears similar enough that the two birds could easily be mistaken for each other by the casual observer. When local residents of the area asked about the name of the Cattle Egret, the Marshallese names for the Pacific Reef Heron ("kabaj" and "keke") were given. But the Cattle Egret has greenish black legs when not in breeding plumage and the Pacific Reef Heron's legs are yellowish. The Cattle Egret also has rusty coloring of its head, back and breast when breeding.

The two birds' behaviors are clearly different as well. The Pacific Reef Heron is almost always found along the beaches and hunts in shallow water for small fishes and marine invertebrates. The Cattle Egret is never along beaches but in grassy areas (Strange 1998). Identification is easy when the bird is in the company of a larger animal – such as a pig.

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Calendar of Events

Monday, May 17, Board Meeting:
Open to all members, 6:30 to 8:30 p.m. at the HAS office. Education and Conservation Committees meet at 5:45 p.m. before Board meetings.

Saturdays, April 3 and 17th, both 7:30am Field Trips:
Shorebird Farewell at Paiko Lagoon. See page 18.

Wednesday, April 21, Program Meeting:
Sheldon Plentovich on Seabirds. See page 18.

Sunday, May 16, Field Trip:
Ka'ena Point walk to see Laysan Albatross chicks. See page 18.

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