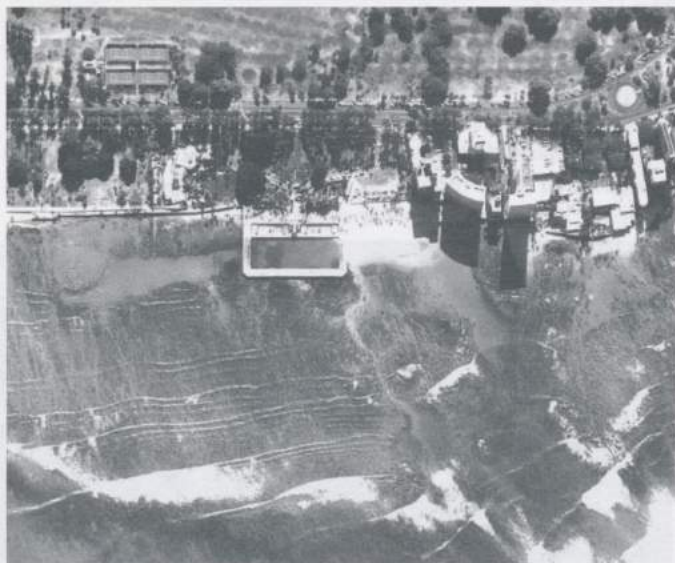


INVASIVE ALGAE IN WAIKIKI

by Jennifer E. Smith^{1,2}, Cynthia L. Hunter², Eric J. Conklin^{2,3} and Celia M. Smith²

Human Alteration of Waikiki

The reefs off world-famous Waikiki Beach have undergone substantial change over the last century. Prior to developments in the 1930's, the Waikiki and Honolulu areas were largely productive wetlands; many may remember ducks and water lilies at the end of the trolley lines in Kapi'olani Park or the precarious rides across the McCully trestle. With increased human population and urbanization, these wetlands were filled-in and paved, streams were lined with concrete, and the Ala Wai canal was built to channel water from the mountains to the ocean, forever altering the flow of nutrient rich waters onto reefs of this ahupua'a.



Waikiki Reef and the War Memorial Natatorium

Silent Changes on the Reef at Waikiki

In the early 1950's, a Navy fuel barge from Guam—heavily fouled with a number of non-indigenous species—arrived at Pearl Harbor. Among these bottom-foulers was the red alga *Acanthophora spicifera* which has now become one of the most common intertidal species of algae on the reef flats at Waikiki. In the 1970's, a researcher based at the University of Hawai'i was exploring possible development of seaweed aquaculture for the carrageenan and agar industry around the tropical Pacific. The red alga, *Gracilaria salicornia*, was brought from Hilo harbor to two locations on O'ahu: Waikiki and Kane'ohe Bay. This species was established in a relatively small area near Hilo and may have arrived a century earlier via ballast for navigation; the exact date and mechanism of its arrival remain unknown. It is also unclear just how quickly this species spread over the next

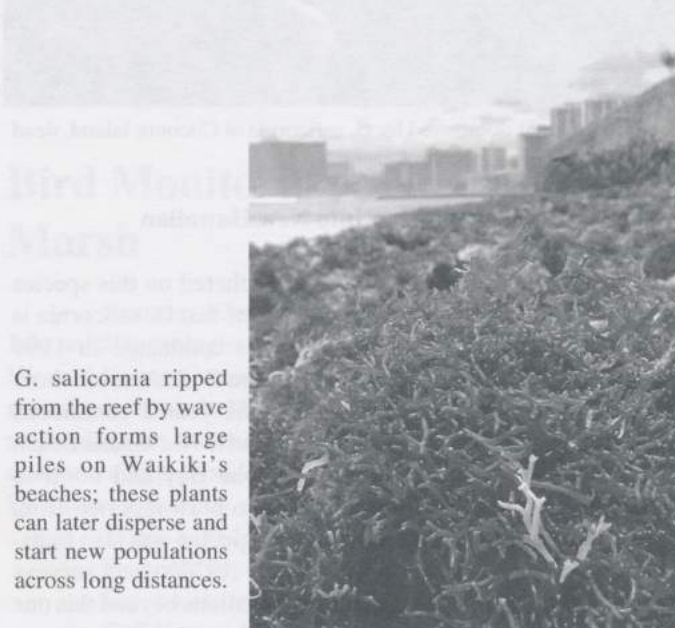
few decades or how it became the ecologically dominant species it is today on certain reefs in Hawai'i.

Extensive surveys were conducted on Waikiki's shallow reef flats in the late 1960's and 70's; our group resurveyed these same areas in 2002. Results of these comparisons indicate that bio-diversity (number of species) on these reefs has decreased since the arrival of *G. salicornia*. Today, this alien alga occupies over 30% of the reef in front of the Natatorium and can be as high as 100 percent in many areas.

The shallow Waikiki reef flat was once home to over 60 species of macroalgae with up to 7 kg of wet weight biomass per m² at the wave washed reef crest. The maximum number of macroalgal species recorded in the same area in 2002 was 29 with *G. salicornia* making up over 10 kg wet weight biomass per m². The areas with peak biomass are no longer at the reef crest but the inner quieter water areas near shore. After large south swells much of this biomass becomes dislodged and ends up forming extensive piles on the beach. Algal material cast ashore will rot in the sun and create a foul odor that may detract tourists and beach goers from partaking in reef related activities.

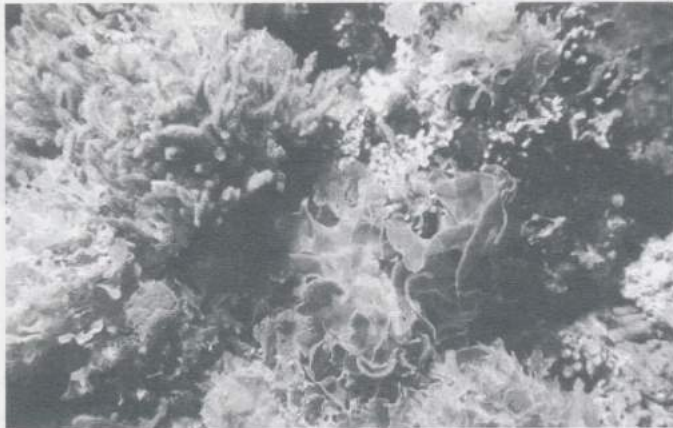


Gracilaria salicornia



G. salicornia ripped from the reef by wave action forms large piles on Waikiki's beaches; these plants can later disperse and start new populations across long distances.

In Kane'ohē Bay, the situation is similar. *Gracilaria salicornia* is now present at 11 of 15 sites surveyed and covers from 1-50% of the bottom at these sites. Species diversity in Kane'ohē Bay is also much higher at sites where *G. salicornia* is not present. Much of the lagoon and shallow reef areas surrounding Coconut Island at the University of Hawai'i's Institute of Marine Biology are infested with *G. salicornia*. These results indicate that once this invasive species enters a reef environment, it is capable of monopolizing resources and outcompeting Hawai'i's native reef species. Unfortunately in some cases this translates into reef corals being overgrown and eventually killed by this alga, leading to possible irreversible, long-term damage to these fragile reef ecosystems.



A diverse algal assemblage in northern Kane'ohē Bay.



An environment dominated by *G. salicornia* at Coconut Island, dead coral can be seen in the background.

Aliens Are Still Dispersing Into New Hawaiian Coastal Areas

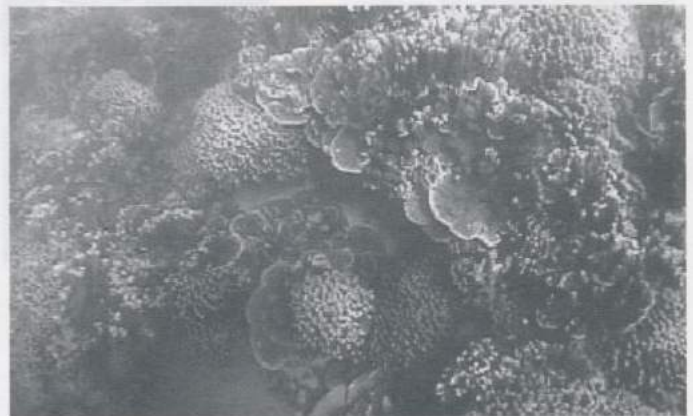
Distributional data are still being gathered on this species and the most current information suggests that *G. salicornia* is still on the move in Hawai'i. Surveys conducted in 1999 identified populations in a few locations on O'ahu's south shore as well as in Kane'ohē Bay, while this year a continuous population was found from Diamond Head to Ala Moana Beach Park, Hawai'i Kai, throughout Kane'ohē Bay and north to Kualoa Beach Park. Sightings have also been reported from Pearl Harbor and Ke'ehi Lagoon. This species was also transported to Puko'o on Moloka'i in the 1970's and surveys conducted in 1999 did not find any populations beyond this one location. However, recent reports suggest that it is now a

common component of the reef flat community on much of Moloka'i's south shore. *Gracilaria salicornia* has even been given a common name on Moloka'i: gorilla ogo.

How Do Alien Species Out Compete Native Species?

Competitive attributes of this species include the ability to form large three dimensional mats and to reproduce by fragmentation. Pieces of tissue as small as 0.5 mm can re-grow into individual plants. Research conducted by Nate Nishimura, Kamehameha Schools/Bishop Estate, while a graduate student in Botany in the late 1990's revealed that the entire Waikiki population was nearly a single genetic entity, a clone. Literally millions of fragments are generated naturally after any kind of storm or swell event and are carried away to populate other areas. Another factor contributing to the success of *G. salicornia* is the fact that grazing fishes don't like to eat it. Experiments designed to determine which limu species fishes like to eat found that *G. salicornia*, while eaten, was less preferred than many of its native competitors. This could assist *G. salicornia* in expanding into new habitats, as the fishes literally eat up the competition and leave *G. salicornia* behind to grow unchecked.

This species grows upward and laterally to form thick mats that can smother and overgrow other reef species. These phenomena are particularly concerning when the other species at hand are reef building corals. While the loss of native species and native diversity to aliens is clearly bad from a number of perspectives, losing coral cover is something that can take hundreds to thousands of years to regain. Living corals construct the landscape and habitats found within coral reefs and when in a single year these organisms get overrun by fleshy algae, it is unclear if the corals will ever come back.



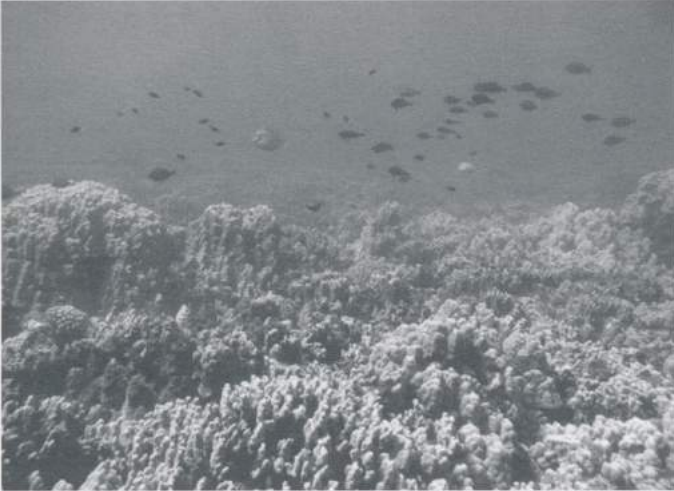
Coral gardens of Kane'ohē Bay



Kane'ohē corals being overgrown by *G. salicornia*.

Other Changes to the Reef Ecosystem

When entire reefs become dominated by a single species of algae the entire landscape and associated processes can be altered. For example, in dense mats of *Gracilaria salicornia*, sediment becomes trapped preventing adequate flushing and water clarity can become drastically reduced. It has also been demonstrated that entire fish communities may change after a reef has become invaded by *G. salicornia*. Because many herbivorous fish do not prefer to eat this alien species they will move to other reef locations in search of more palatable food sources.



Healthy reef on Maui with abundant fish populations and high coral cover.



Sediment trapped in alien algal mats can reduce visibility significantly.

All is Not Lost

Despite its rapid spread, this species still has a limited distribution on Hawaiian reefs and control should still be possible. The time has come for researchers and resource managers to develop a comprehensive multidisciplinary approach to address marine invasive species issues and to follow these programs through to implementation. Given the competitive advantages that *Gracilaria salicornia* appears to possess, it is going to be important to develop other management strategies that include transplanting natives back into areas cleared of alien

species. The effort to replenish reefs with native species recognized as ho'ō kahua hou.

Management Challenges

Currently, several state, federal and nongovernmental agencies including the University of Hawai'i, the Hawai'i Department of Land and Natural Resources, the Waikiki Aquarium, the Hawai'i Coral Reef Initiative, National Oceanic and Atmospheric Administration, Fish and Wildlife Service, the Nature Conservancy and Reef Check, are working together to develop mitigation strategies. However, without a rapid response from state and federal governmental officials a long-term solution is likely to take several years. Terrestrial invasive species counterparts such as *Miconia* or the Coqui Frog have received much attention and funding but to many people the marine invasive species are "out-of-site, out-of-mind". For those of us who spend much of our time underwater the problems are clearly visible. The challenge lies in educating people who do not see or hear these problems (it's hard to ignore the Coqui frog if it's in your backyard). As conservation biologists we cannot simply give up and allow these species to continue spreading. Hawai'i's coral reefs are invaluable resources and make up over 70 percent of all coral reefs under US jurisdiction. Preserving these unique ecosystems for future generations should be a priority for both state and federal management agencies.



Algae graduate students really get into their work. Ph D candidate Ryan Okano appears to be drowning in *Gracilaria salicornia*; this is just a fraction of the algae removed on Aug. 24th.

What You Can Do

On Saturday, August 24th, 2002, the first multi-agency and community-based effort was launched to begin cleaning up the 25+ year accumulation of *Gracilaria salicornia* at Waikiki. In just under six hours, a group of 73 volunteers, researchers, students, and resource managers managed to remove approximately 5,500 pounds (=2,500 kg or 2.75 tons!!) of alien algae from the reef in front of the Waikiki Aquarium. A local green-waste recycling company hauled away the biomass for use as compost.



Volunteers formed a brigade to ferry bags of aliens from the divers into shore for disposal. Over 70 volunteers donated efforts on this Saturday morning.

Despite this initial success, much remains to be done. The UH divers reported that the total effort (nearly 1,000 pounds per hour) represents perhaps just 5% of the alien algae in the immediate area. While this may seem an impossible task, we must remember that these alien algae have a 25 year head start on clean up efforts. Work will continue and we are actively seeking volunteers to help. This effort will continue as long as support is available and/or until the problem is resolved. Contact Dr. Cindy Hunter, Waikiki Aquarium [hunter@waquarium.org], Reef Check [reefcheck@islanddivershawaii.com], or The Nature Conservancy [eco@tnc.org] for more information.

George C. Munro Environmental Law Award

Hawaii Audubon Society annually sponsors a monetary award, named in honor of past president George C. Munro, to the top student in the Environmental Law course at William S. Richardson School of Law at the University of Hawai'i. Congratulations to Kathryn L. Opedal who is this year's award recipient.



Give Hawai'i's native birds a future.

**Make a donation to Hawaii Audubon Society
850 Richards St., Ste. 505 Honolulu, HI 96813**

808-528-1432 hiaudsoc@pixi.com



It takes many hands to clean an ahupua'a.

For More Information See:

http://muse.jhu.edu/journals/pacific_science/v056/56.3smith.pdf

<http://www.botany.hawaii.edu/ReefAlgae/default.htm>

<http://www.botany.hawaii.edu/GradStud/smith/websites/ALIEN-HOME.htm>

¹University of Hawai'i at Manoa, Department of Botany 3190 Maile Way, Honolulu HI, 96822

²University of Hawai'i at Manoa, Waikiki Aquarium, 2777 Kalakaua Ave., Honolulu HI, 96815

³University of Hawai'i at Manoa, Dept. of Zoology, 2538 McCarthy Hall, Honolulu HI, 96822

It's Annual Mailing Time Again!!

We Need Your Help

**Saturday, November 23rd,
10 a.m. to 4 p.m.
at the HAS office**

Can you spare a couple of hours to stuff and seal envelopes so that you and your fellow members can receive 2002 HAS ballots, local membership renewals, and the President's annual report/appeal?? Come for the whole time or just a few hours.

YOU WILL BE REWARDED with lunch and other refreshments, good company, and endless gratitude!

Please call Linda Shapin at the HAS office a 528-1432 (or email at hiaudsoc@pixi.com) and let her know when you can come by on that day.

HAS Annual Awards Dinner

Tuesday, October 22, 2002, 6:00 – 9:30pm
UH Manoa at Hawai'i Imin Conference Center
Garden Level, Makana Room

\$25.00 per person

Please join us for Hawaii Audubon Society's Annual Awards Dinner when outstanding volunteers, corporate leaders and public servants will be recognized for their contributions in protecting Hawai'i's native wildlife and habitats. This promises to be a memorable and festive affair, with a buffet dinner (last year's was wonderful!) catered by Hale 'Aina Award winner Kaka'ako Kitchen. A special slide presentation is planned:

The Life and Times of Kolea (Pacific Golden Plover) by Dr. Phil Bruner

Kolea are the most common migratory shorebird wintering in Hawai'i. Their breeding range is in western Alaska and the Russian far east. Long term studies in both Hawai'i and Alaska have revealed much about their lives in these two very different parts of the world.

Supported in part by Hawaii Audubon Society's Kolea Research Fund, current research on the Pacific Golden Plover has revealed new information about the habits and migration of these remarkable birds. Many questions have prompted these investigations. Why do they migrate? How do they prepare for this incredible journey? Why are they territorial? Why do they exhibit low mate fidelity? How do they go about selecting a site to nest? How long do they live? The answers to these and other questions may help us better understand and appreciate this remarkable bird.

The presentation will be illustrated with slides from both the Hawai'i and Alaska study sites.

Please RSVP (528-1432)
before Friday, October 11th to reserve your place!
As this is a catered dinner,
no one without reservations can be admitted.

'ELEPAIO

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Scientific Editor:

Ronald Walker, 235-1681 (H)

Distribution: Susan Miller

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University of Hawai'i
Windward Community College

Birding for Beginners

October 16 - November 2, 2002
Wednesdays, classroom 7:00-8:30 pm and
Saturdays, field trip 8:00 a.m.-12 noon
Course fee: \$60

Discover Hawai'i's birds and the joy of bird watching in this fun and interactive class designed for beginners as well as experienced birdwatchers. Three class sessions will cover an overview of the world of birds (why birds fascinate us so) as well as a summary of Hawai'i's native and migratory birds. The course will also include the basics of bird watching (how to identify birds by sight and sound) and tips on purchase of equipment, guides and how to plan your next birding adventure.

Three field sessions will be conducted at different sites (TBA) to see where Hawai'i's birds live, to learn the basics of bird behavior through first-hand observation, and to help aspiring birdwatchers develop their field observation and identification skills. Find out why so many people are fascinated with birds – you too can get hooked for life!

Limited to 20 participants. Requires own transportation to field sites. Limited enrollment, pre-registration is required.

In-person registration at Continuing Education in Hale Kuhina, Room 102 or use your VISA or MasterCard to register by phone. Call Continuing Education at 235-7433 or 235-7400 or visit the website for more information: <http://ocet.wcc.hawaii.edu>

Special arrangements for the disabled may be made if requested in advance.

Field Trips for 2002

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.

October 12 (Saturday) James Campbell National Wildlife Refuge to see Hawai'i's endangered waterbirds and other migratory waterfowl at one of O'ahu's few remaining wetlands. This is a good place for unusual sightings! Past years have featured the Red Knot, Semi-palmated Plover, Common Pochard, Black-tailed Godwit, and a Peregrine Falcon. Bring water, snacks, binoculars, spotting scope if you have one, and sunscreen. This is a non-strenuous field trip, very little walking is involved. We will meet at 9am. Number of participants is limited to 15. Call the HAS office to register – 528-1432.

November 16 (adults) and 30 (children welcome!) Our annual trip to the 'Ewa Plains sinkholes to look for fossils of extinct Hawaiian birds with Dr. Alan Ziegler. Two trips will take place this year, one for participants over 12 years of age, and one for children (accompanied by adults). Bring hat, sunscreen, water, and, if you like, a picnic lunch to eat at Barber's Point Beach Park. To register, please call Alice at 538-3255.

December 15 – January 5 Annual Christmas Bird Count – more information in the November issue.

Tucson Birding and Bat Watching

by Arlene Buchholz

Tucson and the surrounding Sonoran desert are a great area for birdwatching and observing wildlife. We went to Tucson and Green Valley south of Tucson in early August – the monsoon season. Thunderstorms formed over the mountains surrounding Tucson and several inches of rain fell. The clouds kept the temperature in the low 90s and increased the humidity for several days. Often the temperature is above 100 in August. The rain brings out large Sonoran toads similar to *Bufo marinus* of Hawai'i. Smaller spadefoot toads also wait until the rains to quickly lay eggs in temporary pools.

We saw many resident and migratory birds including the cactus wren, curve billed thrasher, pyrrhuloxia, northern cardinal, inca dove, mourning dove, white-winged dove, turkey vulture, red tailed hawk, vermilion flycatcher, great horned owl, verdin, house finch, black-tailed gnatcatcher, hooded oriole, gambel's quail, lesser goldfinch and many hummingbirds. The Tucson Audubon Society has a great store and library in Tucson near the University of Arizona where you can pick up a copy of their newsletter the Vermillion Flycatcher, find out about their fieldtrips and find perfect gifts for birdwatchers. The staff is very friendly and has a wealth of information on binoculars, bird watching areas locally and internationally and the sightseeing in the Tucson area.

The Arizona Sonoran Desert Museum west of Tucson has an excellent collection of Sonoran wildlife in natural appearing enclosures and classes on desert animals and plants. We went to a class on the Bats of Arizona by a conservation biologist at the museum. She showed slides of the 28 species of bats that are found in Arizona from the small western pipistrelle bats with a wingspan of 8.6 inches to western mastiff bats with a 22.8 inch wing span. The majority of the bats feed on insects and 2 species, the endangered lesser long-nosed bat and the threatened Mexican long-tongued bat feed on the nectar and fruits of saguaro cactus and the agave. At dusk we went out on the museum grounds to the riparian exhibit of the coatimundi, river otters and beavers with ponds, cottonwood trees and palms. The small pipistrelle bats were the first bats that came down from their daytime resting areas in the surrounding mountains. They have very rapid silent wing beats and flew in circles and figure 8 patterns over the water. The museum has handheld bat detectors that translate the high frequency echolocation of bats into beeps that can be heard by the human ear. The beeps speed up as the bat finds insects and moves in to capture them. Larger myotis bats came out after the pipistrelles. The bats will fly down over streams and ponds to drink water as they feed.

Candidates Needed for '02 Election

Members are encouraged to submit nominations

Do you attend Field Trips and Program Meetings? Are you interested in protecting Hawai'i's native species and their fragile environment? Why not become a member of our Board?

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 Board meetings every other month and a one-weekend 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.

The Society bylaws (Article VII, Section 4) provide that members may nominate candidates by submitting their names in writing, along with their written consent to be nominated, to the Elections Committee at the HAS office address by November 10, 2002.

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, 2002. Nominating Committee members may be contacted as follows: Linda Paul at linpaul@aol.com, John Harrison at jth@hawaii.edu and Liz Kumabe at hiaudsoc@pixi.com.

The Natural and Cultural History of the Kailua Ahupua'a and Kawai Nui Marsh 2002

Sponsored by the Kawai Nui Heritage Foundation and 'Ahahui Malama I ka Lokahi

Dates of Remaining 2002 Tours:

Saturday Oct. 5 - Geology of the Kailua Ahupua'a

Saturday Nov. 2- Archaeological & Historic sites of Kawai Nui Marsh

Saturday Dec. 7- Birds of the Marsh

The purpose of these tours is to inform residents, educators and members of various community organizations about Hawaiian archaeological, historic and ecological sites of the marsh.

The tour groups will meet at Ulupo Heiau next to the Windward Kailua YMCA on Kailua Road at 8:30 am and walk as well as car pool to the sites as time permits. Return trip should be back at the Kailua YMCA by 1:00 pm. A donation fee of \$5.00 for non-members and \$3.00 for members will be accepted for the tour. Group size will be limited to 15-20 persons.

Bring a backpack or fanny-pack, walking shoes, water bottle, snacks, mosquito repellent, sunscreen, rainwear, hat or cap, sunglasses, camera, binoculars, and notebook.

Call Chuck "Doc" Burrows for more information and to register for these educational tours at 595-3922 or email: cburrows@aloha.net

CHRISTMAS BIRD COUNT 2002-2003

We are starting to compile dates for the upcoming Christmas Bird Count. Below are the dates we have so far. Look for a more complete schedule in November's issue.

The Christmas Bird Count is a coast-to-coast annual bird census. Volunteers count every bird and bird species over one calendar day. Birds are indicators of the overall health of the environment. Christmas bird count data in any given area can provide valuable insight into the long-term health of bird populations and the environment.

Over 45,000 people from all 50 states, every Canadian province, the Caribbean, Central and South America and the Pacific Islands participate in more than 1,700 counts held during a two and a half week period!

Join our Christmas Bird Counts during the official count period from December 15, 2002 to January 5, 2003. If you want to do something good for birds and meet other "bird people," contact one of the coordinators to sign up. There is a \$5.00 charge per person to support compiling and publication of the nationwide results. Note: Special information is needed by the coordinator of the popular "Kulani Prison" count, so contact the Big Island Volcano coordinator by December 1 to ensure your spot.

<u>Island</u>	<u>Date</u>	<u>Coordinator</u>	<u>phone/email</u>
Kaua'i			
Waimea	TBA		
Kapa'a	TBA		
O'ahu			
Honolulu	12/21	Arlene Buchholz	988-9806 or snovakz@juno.com
Waipi'o	12/15	David Bremer	623-7613 or bremerd001@hawaii.rr.com
Maui			
Pu'u O Kaka'e (East Maui)	12/28	Lance Tanino	808-280-4195 or tanino1001@hawaii.rr.com
'Iao Valley (West Maui)	12/14	same as above	same as above
Moloka'i			
Kalaupapa	TBA		
Kualapu'u	TBA		
Hawai'i Island			
**Kulani Prison (Volcano)	TBA		
North Kona	TBA		

**Those interested in birding at Kulani Prison will need to submit their SSN and DOB by Dec 3. Contact one of the coordinators for more information (after dates and coordinators' names become available.)

Marine Policy Analyst Hired for HAS' Fisheries Project

Kim Moffie has joined the Hawaii Audubon Society's Pacific Fisheries Coalition project as its Marine Policy Analyst. Kim recently graduated with her J.D. from the William S. Richardson School of Law at UH, where she also earned an Environmental Law Certificate. She has an extensive background in the marine field, and will be working on the implementation of an inspection program to monitor aquarium species leaving the state and alien aquatic species that are being intentionally introduced into the state. Kim can be reached at (808) 529-0430 or kmoffie@aol.com.

Bird Monitoring at Pouhala Marsh

Saturday, October 5, 2002

Join wildlife biologist Sharon Reilly of Ducks Unlimited, Hawai'i Nature Center, and community members for a morning in Pouhala Marsh, a wetland that is currently being restored on the shores of Pearl Harbor. Sharon will teach the nuances of shorebird identification, the life history of Hawaiian shorebirds, and the natural history of the marsh.

Time: 8:00-10:30 am

Program Type: Adult

Fee: no charge

Call Hawaii Nature Center to register, 944-0110.

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Field Activities: Alice Roberts and Linda Shapin, 528-1432
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Programs: Arlene Buchholz
Publicity: vacant

Island Representatives
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Pacific Fisheries Coalition
Executive Director: Linda Paul, 262-6859

Marine Policy Analyst:
Kim Moffie, 529-0430

HAS Administrative Assistant:
Linda Shapin

Calendar of Events

Monday November 11

HAS 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.

Saturday, October 12

Field Trip to James Campbell National Wildlife Refuge.
See page 155.

Tuesday, October 22

HAS Annual Awards Dinner at Imin Conference Center.
See page 155.

Saturday, November 16

Field Trip (age 13 and up) to 'Ewa Plains Sinkholes to find bird fossils. *See page 155.*

Saturday, November 23

HAS Annual Mailout – volunteers needed. *See page 154.*

Saturday, November 30

'Ewa Plains Sinkholes to find bird fossils. (Children accompanied by adults) *See page 155.*

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