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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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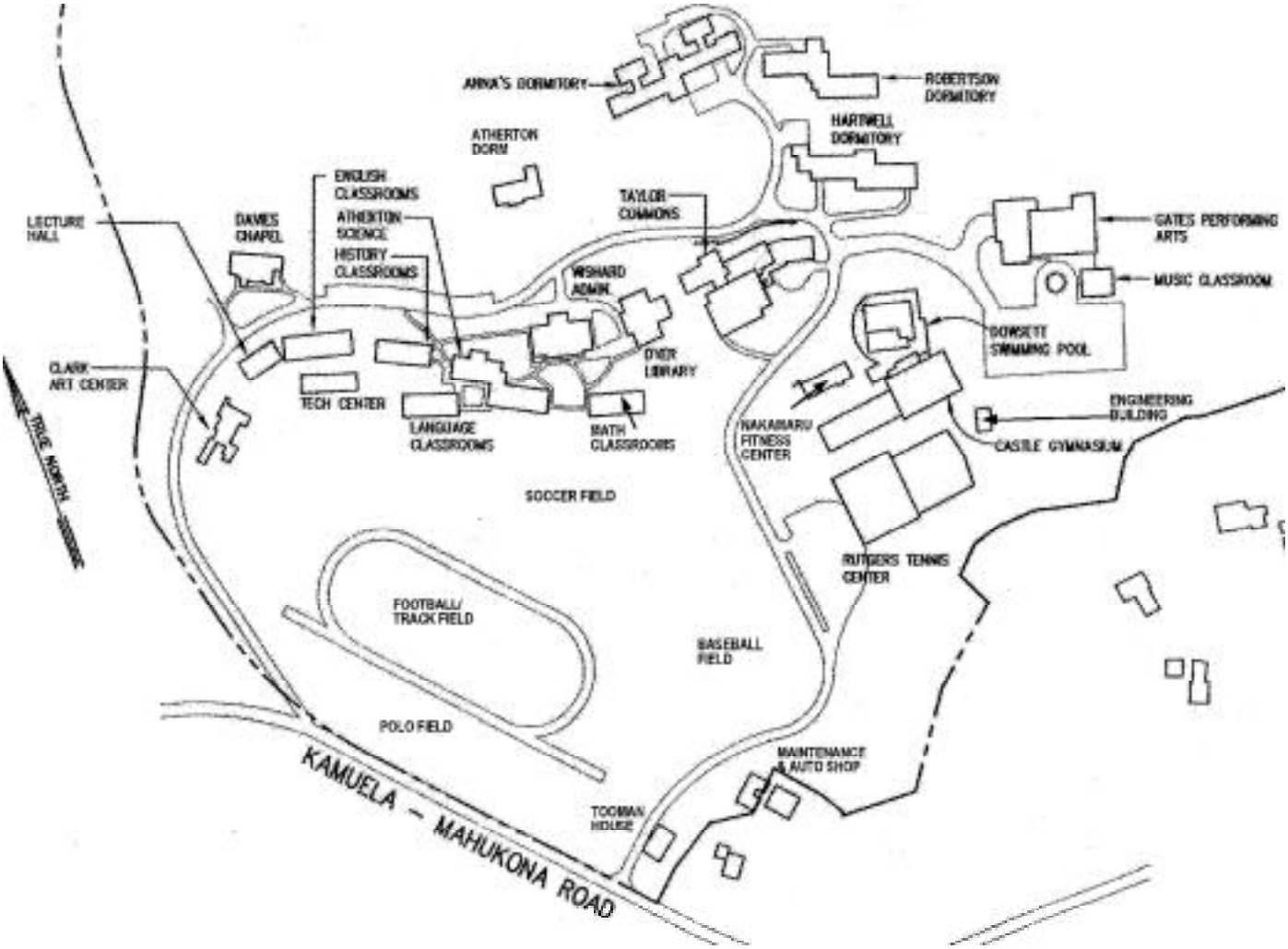
83rd ANNUAL MEETING OF THE PACIFIC DIVISION, AAAS

PROGRAM WITH ABSTRACTS

TABLE OF CONTENTS

MAP
of
HAWAII PREPARATORY ACADEMY
(*courtesy of Hawaii Preparatory Academy)*



ANNUAL MEETING OF THE PACIFIC DIVISION, AAAS AND ITS AFFILIATED SOCIETIES AND SECTIONS AT HAWAII PREPARATORY ACADEMY, WAIMEA, HAWAI`I
June 12 - 16, 2002

GENERAL INFORMATION

SECTIONS SPONSORING SESSIONS AT THE ANNUAL MEETING

The following sections are sponsoring sessions at the 83rd Annual Meeting of the AAAS, Pacific Division:

Agriculture and Horticultural Science
Anthropology and Archaeology
Atmospheric and Oceanographic Sciences
Biological Sciences
Earth Sciences
Ecology and Environmental Sciences
Education
Health Sciences
Psychology
Social, Economic and Political Sciences

HAWAII PREPARATORY ACADEMY

The Hawaii Preparatory Academy is located in Kamuela (also called Waimea, not to be confused with towns of the same name on the islands of Kauai and Oahu) on the island of Hawai`i. Hawai`i, at 4,038 square miles, is the largest of the eight islands that comprise the state of Hawai`i. It was formed by the convergence of lava flows from four volcanoes, Mauna Kea (the tallest at 13,796 feet above sea level), Mauna Loa, Kohala (the oldest) and Kilauea (the active one). The west, or leeward side of the island, is dry (about 73 inches per year rainfall in Kailua Kona) compared to the east, or windward side of the island (150 inches per year at Hilo, the second most populous city in the state and also the capitol of the island of Hawai`i).

The geography of Hawai`i varies considerably. There are lush tropical rain forests and arid deserts, white sand beaches and snow-capped mountain peaks. Islanders grow sugar cane, the famous Kona coffee and cattle. Waimea is the location of the Parker Ranch, once the largest privately owned cattle ranch in the world.

The Hawaii Preparatory Academy, founded in 1949, is a coeducational college-preparatory boarding school with grades K-12 situated on two campuses. We will be meeting on the upper campus, which houses grades 9-12. It is about 38 miles north of the Kona airport, a pleasant drive through volcanic lava flows which are peppered with messages written in arrangements of white rock. The Academy sits at about the 2,000 foot level and close to a boundary between the drier leeward side and wetter windward side of the island.

HAWAIIAN ISLAND CULTURE, HISTORY and CONTEMPORARY SOCIETY

The following educational materials on Hawaiian culture, history, and society were developed by author Noe Noe Wong-Wilson and commissioned by The Kohala Center. The Kohala Center is pleased to permit the use of these materials for educational purposes by the American Association for the Advancement of Science, Pacific Division.

The Kumulipo

O ke au i kahuli wela ka honua	At the time when the earth became hot
O ke au i kahuli lole ka lani	At the time with the heavens turned about
O ke au i kuka`iaka ka la	At the time when the sun was darkened
E ho`omalamalama i ka malama	To cause the moon to shine
O ke au o Makali`i ka po	The time of the rise of the Pleiades
O ka walewale ho`okumu honua ia	The slime this was the source of the earth
O ke kumu lipo, i lipo ai	The source of the darkness that made darkness
O ke kumu o ka Po, i Po ai	The source of the night that made night
O ka lipolipo, o ka lipolipo	The intense darkness, the deep darkness
O ka lipo o ka la, o ka lipo o ka po	Darkness of the sun, darkness of the night
Po wale ho`i	Nothing but night
Hanau ka po	The night gave birth

Modified from "The Kumulipo, A Hawaiian Creation Chant" by Martha Warren Beckwith, University of Chicago, 1951

"Locally, it is considered vitally important that science-research programs, staff and facilities recognize key cultural values: land, family, respect for traditional beliefs and the contributions of pre-contact Hawaiian society. Contemporary socially-responsible progress - economic, political, educational, technological, scientific - is a primary concept guiding all local support for prospective projects in the Islands.

"The Kumulipo, one of Hawai`i's most important creation chants, is an oral history, a recounting of the creation myth detailing the beginning of all life for Hawaiians that was committed to memory and passed from generation to generation. Attributed to Keaulumoku in 1700, the entire chant was translated by Queen Lili`uokalani during her imprisonment at I`olani Palace in 1895.

"In its entirety, the more than 2,000 lines of the Kumulipo speak of the relationship between the Hawaiian people and their environment: the gods, the sky, the land, the sea, and all the creatures within. The Kumulipo remains an important resource for Hawaiian language scholars who continue to study and retranslate the information contained within its poetry.

"The Kumulipo serves as a wellspring of information about the profound relationship between Hawaiians and nature and their environment. Our ancestors possessed a deep understanding of each creature and the relationships between them. For each creature born of the land, another was born of the sea and their traits and characteristics were reflective of each other. This was part of the symmetry of all nature.

"From the Kumulipo comes the beginning of time, the cycle of days, months, seasons and years. Born were the gods and the stories of their relationships with each other and their supernatural feats. Born was man, the younger sibling of the kalo, or taro plant, which provides us with sustenance, the main staple of the Hawaiian diet, poi.

"Our people have lived and thrived on these islands perhaps since 300 A.D. Voyaging canoes from islands in the South Pacific continued until approximately 1300 A.D. Great temples were built in honor of the Hawaiian gods, and ruling chiefs fought for control over land and resources. A unique political and land management system called ahupua`a was developed during the time of Kamehameha I. The ahupua`a, or land section was often pie-shaped, and extended from the mountain summit to the ocean. Each ahupua`a was a self-sufficient unit, providing sustenance for its residents and goods for trade and annual tribute to the ruling chief.

"Hawaiians did not own land. The concept of individual land tenure was introduced in 1845 in a major land transfer called the Mähele. Instead, Hawaiians understood that the land belonged to the akua, the gods. The chief or ali`i was respon-

sible for the care of the land and the people. He appointed a series of lesser chiefs to manage the daily activities. The commoners, maka`äinana, were responsible for planting and harvesting, fishing, and gathering of wild foods, birds, feathers and the making of kapa, bark cloth, rope and other tools necessary for daily life and to provide support for their ali`i and their gods.

“In January 1779, Captain James Cook and the ship *Resolution* landed in Kealakekua Bay, South Kona. His propitious arrival during the time of the Makahiki, the annual harvest and celebration, bode well for Cook who was welcomed as the god, Lono.

“After a brief stay, Cook and his ship departed only to return when it was dismasted in a storm. This time Cook's demands for supplies and his disastrous attempt to retrieve one of his rowboats resulted in his death in a skirmish on the beach at Kealakekua Bay. The technology brought by Cook's expedition – guns, nails, liquor and tobacco, for example – was coveted by the native people. Unfortunately, Cook's expedition and subsequent shore visits by whalers, traders and beachcombers also introduced deadly diseases previously unknown to the islands. The people were struck by sexually transmitted diseases, measles, typhoid, smallpox, typhus, flu, and the bubonic plague. In a little more than 100 years the population of Hawai`i was decimated from an estimated high of 1,000,000 to fewer than 40,000 people by 1896.

“In 1792, Kamehameha I became ruler over Hawai`i Island. At Kawaihae, Pu`ukohola heiau stands in tribute to his feat. After uniting Hawai`i Island, Kamehameha launched successful war campaigns against the chiefs of Maui and O`ahu and negotiated a truce with the chief of Kaua`i to unite all the islands under his rule. Kamehameha’s victories were ensured by his possession of the war god, Küka`ilimoku and an arsenal of the first guns used in Hawaiian battles.

“After a peaceful and united reign, Kamehameha I died in 1819 in Kona. His death was followed by the overthrow of the `Aikapu, a system of social order that had governed the lives of the people since the beginning of time. In addition, the old religion was overturned and many heiau or temples were desecrated or destroyed under the direction of Ka`ahumanu, the Kuhina Nui or Prime Minister, and favorite wife of Kamehameha. Within four months of these tumultuous events, the first American missionaries arrived on the ship Thaddeus, bringing Christianity to the islands.

“The years immediately following Kamehameha's death saw profound change to the social order, governance and customs of the people. Within a few years, Western influence was evident in all areas of life for the Hawaiian people. Although still governed by a succession of monarchs who descended from Kamehameha's lineage, the ali`i suffered from exposure to foreign diseases and each succumbed in a few short years. In 1887, King Kaläkaua, under force, signed away his rights as monarch in a document called the ‘Bayonet Constitution’. His sister, Queen Lili`uokalani, upon attaining the throne after Kaläkaua's death became victim to an illegal overthrow of her government in 1893. A group of second-generation missionary families, businessmen with interests in sugar plantations, were seeking alliance with the United States government for profitable purposes. Backed by armed Marines from a U.S. Naval warship stationed in Honolulu Harbor, they imprisoned the Queen in her palace. Lili`uokalani prevented a war when she asked her personal guards to refrain from opening fire on the advancing marines.

“In 1900, despite opposition from the deposed monarch and a petition signed by a majority of Native Hawaiians stating their total opposition, Hawai`i was annexed by the United States Congress.

"Presently, Native Hawaiians are a minority group in their own land. With a per capita income far below the rest of the population, Native Hawaiians also suffer from extremely high incidence rates of diabetes, heart disease, cancer and other lethal diseases.

“Although former President Bill Clinton signed a formal apology issued by Congress in 1993 for the United States’ role in the illegal overthrow of our Queen and her government, Native Hawaiians are still not recognized as ‘Native Americans’ by the United States Congress. And,

Federal programs for the improvement of Native Hawaiian health and education are under siege in the U.S. courts by individuals and groups who do not believe that our ailing population deserves special support.

"Self-determination is a topic of discussion within many Native Hawaiian households today. How can we become responsible for our own destiny, and for the future of our children, our ocean, our sky and our land? How can we ensure that the Hawai`i of our youth remains intact for our grandchildren and their grandchildren to come? Will they experience the hypnotic fragrance of the maile vine in our lush rainforests? Will they hear the call of the `Apapane bird or witness the magnificent flight of the `Io hawk as it soars high in the sky? Will they view the sun's rays striking the unblemished summits of our highest peaks of Mauna Kea and Mauna Loa as each new day dawns? Will they swim and surf in an ocean untainted by man's spoils and disregard for nature?

"We Hawaiians come from these islands. They cannot be replaced, just as we cannot be replaced. If there is no Hawai`i, then we will cease to exist. Our mountains and our ocean govern our daily lives. It provides the cycle of life, the water that nourishes the land and the people. These things were not a mystery to our ancestors. The clues to their vast knowledge about our world and the cycles of life are kept within the poetry of chants like the Kumulipo. We are rediscovering and reaffirming through scientific investigation what they knew long ago.

"The lesson that we must learn is to listen and remember the wisdom of our ancestors as we travel the new pathway to knowledge through modern science. It is our responsibility to care for our `äina or land and our environment so that it will continue to sustain and nurture us. When Native Hawaiians, the host people and culture, survive and flourish, so will all of those who choose to make these beautiful islands their home.

"Our grandchildren must be able to experience the beauty and nature of these islands of Hawai`i as they have existed for millennia. They must know the creatures and plants of the ocean, the land and the sky. They must remember the language, culture and history of our Hawaiian people. This responsibility belongs to all of us."

REGISTRATION

Registration Headquarters will be in the lobby of Taylor Commons. Hours for registration are:
Tuesday, 3:00 - 5:00 p.m.
Wednesday, 8:00 a.m. - 10:30 a.m. and
2:00 p.m. - 5:30 p.m.
Thursday, 8:00 a.m. - 5:00 p.m.
Friday, 7:00 a.m. - 9:00 a.m.
Saturday, 8:00 a.m. - 2:30 p.m.

About the field trips: Advance registration was required for the field trips. However, space may still be available on some of the excursions. If you are interested in one or more trips, inquire at the Registration Desk if space is still available.

At least one member of a family group requesting reservations for a field trip *must* be registered for the meetings.

The fees for registrations are Professional, $65; Teachers K-14, $50; Students, $40; Retired and Emeritus, $40; Participating Spouse, $40; One-day, $45.

ACCOMMODATIONS, FOOD SERVICE and TELEPHONE NUMBERS

Residence Halls. Housing at HPA is in residence halls and a residence house. The four night package includes all meals, including the Wednesday Welcome Buffet, the Thursday Beach Barbeque and the Saturday Divisional Lual. Off-campus motel and hotel rooms are available at significantly higher rates. The HPA rooms are clean and house one or two persons (up to four with small children), but they are dormitory style, with no private bath facilities. Bathroom facilities on each floor are shared. Rooms are not air-conditioned, but evenings are usually cool enough for comfort. Check-in time is 3 p.m. on Wednesday, 12 June 2002; Check-out by 8:30 a.m. on Sunday, 16 June 2002.

Food Service. For those staying on campus, dining facilities are located in the Taylor Com-

mons. Meals are served cafeteria style. Because meals are included in the accommodations package, HPA makes allowances for meals associated with special events, such as the Saturday evening Luau dinner and the Thursday evening barbeque. For those who opt to stay at a motel or hotel off campus but would like to take their meals on campus, a meal card can be purchased separately. Drop-in meals are available: breakfast, $3; lunch, $6; dinner (Wednesday and Friday), $9. Dinner drop-ins are not available on Thursday or Saturday due to the nature of those meals. Those not holding HPA meal cards must purchase meal tickets in advance for the barbeque on Thursday evening ($20) and the Luau on Saturday ($25). For those wishing to take their meals in town, a list of near-by restaurants will be included in your registration packet, which will be distributed upon check-in.

Telephone Numbers. EMERGENCY: In an emergency, one of the following phone numbers should be used. The caller needs to indicate that the person being sought is part of the AAAS Pacific Division conference. *Security:* (2:00 p.m. – 6:00 a.m.) 808-881-4006. *Special Programs Office:* (8:00 a.m. – 4:00 p.m.) 808-881-4087.

MESSAGES: To leave a message for a meeting participant, call 808-881-4360. This number connects directly to voice-mail, which will be monitored throughout the meeting. *Do not leave emergency messages at this number!* Use one of the above numbers for emergency messages.

TRANSPORTATION

The Hawaii Preparatory Academy is located on the Big Island of Hawai`i, the largest of the eight islands that make up the state of Hawai`i. The main airport on the Big Island is located in Kona. United, American, Aloha, and JAL Airlines provide direct or non-stop flights into the Kona International Airport from San Francisco, Los Angeles, Chicago, Washington DC, and Tokyo. Aloha and Hawaiian Airlines provide inter-island service from the Honolulu International Airport, which is located on the island of Oahu. Aloha and Hawaiian Air also offer several flights daily to Kona and Hilo from Maui and Kauai.

HPA is located 38 miles north of the Kona International Airport on Highway 19, about a 45 minute drive. Hilo International Airport is about 65 miles distant, also using Highway 19. Rental cars are available at both Kona and Hilo airports. Taxis service Waimea at the cost of $75 each way for 1 to 4 people. Shuttles are available for a sliding fee, starting at $60 for one up to $76 for five.

MEETING ROOMS

Meeting rooms are equipped with a 35mm slide projector and an overhead projector. Poster boards measure 4' X 4' (1.2 X 1.2 m). Speakers requiring other specialized equipment must have made their requests on the e-mail abstract submission form. Specialized equipment will be provided if available. Computers and computer-projection equipment rental incur additional costs, which are the responsibility of the speaker, and subject to equipment availability.

A Speaker's Preview Room, with projection equipment, will be open during the meeting.

Slides should be arranged and numbered in the order in which they are to be shown. Spot the slides on the back, bottom, left-hand corner to facilitate their correct arrangement for projection. When turned upside down for placement in the projector, the spot on the back will be in the upper right-hand corner. If you bring your own carousel, tag it with your name.

SPECIAL EVENTS

Wednesday Evening Traditional Hawaiian Welcome. Co-sponsored by The Kohala Center, the 83rd annual meeting of the Pacific Division will officially open with a traditional Hawaiian Welcome. The events are designed to introduce meeting attendees to the importance of understanding Hawaiian culture for all major endeavours involving the Islands. Please understand that the religious aspects are not designed to proselytize or convert. Rather, attendees are asked to participate only as a form of respect for the presenters – much the same as one might when vis-

iting, observing or participating in holy events in any of the world's main religions.

The welcome will begin at 5:15 p.m. outside Taylor Commons with a reception, followed by an Oli (chant) and hula presentation by Kumu Hula Pili Pang, and his speaking about Hawaiian culture, people, land, etc. At about 6:30 p.m. there will be welcomes from various individuals and groups, followed at about 6:45 p.m. by a Pule (prayer) by a local kahu.

Wednesday Evening Dinner Buffet. Immediately following the Welcome, at about 6:45 p.m., will be a finger-food dinner buffet in Taylor Commons. A variety of foods, such as Korean chicken wings, spring rolls, won tons, fresh fruit and vegetables will be served in an informal atmosphere to allow participants to become acquainted and enjoy a beautiful Hawaiian evening. Cost: $9 for those not staying at HPA. Tickets will be available at the Registration Desk Wednesday afternoon and at the door that evening. Beer and wine will be available at a slight additional charge.

Thursday Evening Beach Barbeque. Dinner Thursday will be an Hawaiian barbeque at Hapuna Beach, about a 20 minute drive from HPA. Participants can either drive or ride in a 52–passenger school bus which has been chartered for the evening. The school buses will pick up and return passengers in the parking area above Taylor Commons. Cost is $20 for persons not staying at HPA. Tickets must be purchased in advance and are available at the Registration Desk until noon on Thursday.

Business Meeting of the Council of the Pacific Division. The Council of the AAAS Pacific Division will hold its annual breakfast and business meeting at 7:00 a.m. on Saturday, 15 June in the lobby of the Gates Performing Arts Center. The Council will elect officers, discuss programs for the 2003 annual meeting, and transact such other business as required by the Division's By-Laws.

Student Awards and Presidential Address. Starting at 5:30 p.m. in the Gates Performing Arts Center. The Division will announce the names of the student winners of the Division's Laurence M. Klauber, Geraldine K. Lindsay, J. Thomas Dutro, Rita W. Peterson, Presidents', Best Poster, and AAAS-Robert I. Larus Awards. Following the awards, Dr. Nina G. Jablonski (Anthropology, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118) will deliver the Presidential Address.

Saturday Evening Divisional Luau and Closing Ceremony. Following the announcement of the student awards and the Presidential Address will be the Divisional Luau and Closing Ceremony for the meeting. A reception will begin at Taylor Commons about 6:45 p.m., followed by the luau at 7:15 p.m. Traditional luau foods will be served, with entertainment by local performers. Cost is $25 for those not staying at HPA. Tickets must be purchased in advance and are available on a space-available basis at the Registration Desk until noon on Saturday. Beer and wine will be available at a slight additional charge.

STUDENT AWARDS FOR EXCELLENCE

The AAAS: Pacific Division offers each affiliated society and section participating in the annual meeting an opportunity to recognize outstanding student participants through the presentation of certificates of merit and cash prizes of $175 for first place and $100 for second place. Several societies supplement these awards with their own cash prizes.

In 2002, seven Division-wide awards may be given: **Laurence M. Klauber Award for Excellence** (unrestricted); **Geraldine K. Lindsay Award for Excellence in the Natural Sciences; J. Thomas Dutro, Jr. Award for Excellence in the Geosciences; Rita W. Peterson Award for Excellence in Science Education; Presidents' Award for Excellence** (unrestricted); **Best Poster Award** (for poster presentations only but otherwise unrestricted); and the **AAAS-Robert I. Larus Travel Award**, which provides for travel and other expenses for the awardee to present their paper as a poster at the 2003 annual meeting of

AAAS in Denver, CO. Awards are given to those students whose presentations are judged the most significant in the advancement or understanding of science.

Eligible students must: (1) register for the meeting, (2) be the principal research investigator on the project, and (3) present the paper or poster. Student presentations, oral and poster, are judged on their abstracts, content, style of delivery or presentation, and audio-visual aids and/or handouts (if used). The evaluation forms (oral and poster) are posted on the meeting page of the Division's web site. Students who register for the meetings and present papers will be the Division's guests at the Divisional Luau following the awards presentations and Presidential address on Saturday evening. Students not already holding an HPA meal card can pick up their tickets at the Registration Desk before 12:00 p.m. on Saturday.

PUBLIC LECTURES

Members of the general public are invited to attend these special lectures at no cost.

Thursday, 13 June

PLENARY LECTURE SERIES
Gates Performing Arts Center

0800 *Welcome and Introductions*

0810 *Growth and Destruction of the Island of Hawai`i.* Donald A. Swanson, U.S. Geological Survey, Hawaiian Volcano Observatory, Hawai`i National Park, HI 96718.

0840 *Contemporary Submarine Volcanic Processes: Loihi Submarine Volcano, Hawai`i.* Alexander Malahoff, Department of Oceanography, University of Hawai`i at Manoa, 1000 Pope Road, MSB 319, Honolulu, HI 96822.

0910 *The Hawaiian Starlight: Stargazing from Mauna Kea.* Jean-Charles Cuillandre, Canada France Hawaiian Telescope.

SPECIAL NOONTIME LECTURE
Gerry Clark Art Center

1215 *Our knowledge of native Hawaiian ecosystems is mushrooming!* Don E. Hemmes, Biology Department, University of Hawai'i, Hilo, HI 96720.

Saturday, 15 June

SYMPOSIUM: *Vog--Volcanic Fog*
Gates Performing Arts Center

1330 *Introduction*

1340 *Epidemiologic Studies of the Effects of Vog.* Elizabeth Tam, University of Hawai`i at Manoa, Honolulu, HI 96822.

1410 *Vog Genesis and Effects on Hawai`i Volcanoes National Park Air Quality.* A. Jeff Sutton* and Tamar Elias, U.S. Geological Survey, Hawaiian Volcano Observatory, PO Box 51, Hawai`i National Park, HI 96718.

1500 *Vog: An On-going Investigation of Its Possible Acute Health Effects.* Jon-Pierre Michaud, Department of Chemistry and Natural Sciences, University of Hawai`i at Hilo, 200 W. Kawili Street, Hilo, HI 96720.

1530 *Volcanic Air Pollution on Horticultural Crops.* B.A. Kratky* and C.L. Chia, University of Hawai`i CTAHR, TPSS Department, Beaumont Agriculture Research Center, 461 W. Lanikaula St., Hilo, HI 96720.

FIELD TRIPS

Field trips are open for advance registration to all preregistrants and their families. Space is limited for all trips, so preregistration is recommended. Occasionally, cancellations occur. If you are interested in one or more of these excursions listed below, check at the Registration Desk on availability of space.

52-passenger school buses will be used for transportation. Buses will depart from and return to the parking lot above Taylor Commons.

Field trip participants will prepare their own sack lunches prior to leaving. Materials to prepare the lunches will be available at Taylor Commons 45 minutes prior to each scheduled departure time. Be sure to show up early to pack your lunch!

WEDNESDAY

Rain Forest, Wednesday, 12 June. Led by Don Hemmes (Department of Biology, University of Hawai`i at Hilo). Departs HPA at 10:00 a.m., returning at 4:30 p.m.

Fee: $45, including transportation and self-prepared sack lunch.

We will drive south from HPA to the Saddle Road (Route 200) and then proceed east along it, first stopping to see the endemic mamane-naio, a dry forest near the Saddle Road. This is the home of the endemic and endangered palila (one of the honeycreepers). We will then proceed east to view several kipukas (islands of old rain forest) surrounded by more recent lava flows. Participants will eat sack lunches in one of the kipukas. The kipukas are spectacular examples of the endemic plants of the Hawaiian rainforest. After lunch, we will proceed east to view another kipuka and then go to see Akaka Falls with its spectacular setting that features bamboo and other exotic introductions. We will then turn north along the Hamakua Coast through Honokaa with a stop at Tex's Drive-in for an opportunity to have a world-famous malasada and coffee before proceeding north back to HPA. There are no strenuous hikes, thus tennis shoes and shorts are adequate. Participants should have a rain jacket as rain falls on at least some rain forest sites almost every day.

FRIDAY

Volcano, Friday, 14 June. Led by Donald A. Swanson (US Geological Survey, Hawaiian Volcano Observatory, Hawai`i National Park, HI 96718). Departs HPA at 7:30 a.m., returning late evening if lava flows are visible. Otherwise, returning mid-evening.

Fee: $45, including transportation and self-prepared sack lunch. Those staying at HPA will be given a $9 credit for dinner.

The volcano tour will proceed south on Highway 19 along the Hamakua Coast to Hilo and then on Highway 11 to the Jaggar Museum and USGS Hawaiian Volcano Observatory for a 1–1.5 hour tour of the facility. Following will be a tour around the Kilauea Caldera from Crater Rim Drive. The Thurston Lava Tube and Kilauea Iki Crater will be visited. The tour will then proceed south along the Chain of Craters Road to view various young volcanic features in Hawai`i National Park. In the latter part of the day participants will drive to the east side of the East Rift Zone in hopes of viewing lava flowing into the sea. The view of the flows at night is awe-inspiring but NO LAVA HAS BEEN VISIBLE SINCE LATE APRIL. The tour will return north to Waimea along Highways 11 and 19 and should arrive in Waimea by 10:30 p.m or about 8:00 p.m. if there is no lava viewing. Make-your-own sack lunches will be prepared by participants in the HPA dining room prior to leaving. Dinner will be at your own expense. Those staying in the HPA dorms will be given a $9 credit toward dinner.

Mariculture and Cold, Deep Water Research, Friday, 14 June. Led by Sara Peck (Sea Grant Program), Bill Woermer (West Hawai`i Explorations Academy) and Ann Bailey (Common Heritage Corporation). Departs HPA at 8:00 a.m., returning at 4:30 p.m.

Fee: $45, including transportation and make-your-own sack lunch.

This field trip proceeds south from Waimea along the Queen Kaahumanu Highway toward Kailua-Kona. The first stop will be at the Natural Energy Laboratory at Keahole Point. Sara Peck will discuss mariculture and the work of the Natural Laboratory. Additionally, there will be other presentations followed by tours of one or two commercial mariculture facilities. Bill Woerner will show marine research at his innovative Charter School (West Hawai`i Explorations Academy). Ann Bailey will demonstrate the use of cold, deep water in an innovative agriculture program, a goal of which is to experiment with making the root zone of a number of cool temperate crops cool enough to grow in a warm tropical environment.

Dry Forest Ecology and Reforestation Projects, Friday, 14 June. Departs HPA at 8:00 a.m., returning at 4:30 p.m.

Fee: $45, including transportation and make-your-own sack lunch.

This field trip travels the Saddle Road up the slope of Mauna Kea. We will learn of the history

of early ungulate releases (cattle, sheep and goats) and ranching and herding and their impact Mauna Kea. Fire ecology and recent fire history will also be discussed. We will look for the endemic and endangered palila (honeycreepers). At the Ahumoa Road junction we will identify the Naio (*Myoporum sandwichense*: Myoporaceae) and mamane (*Sophora chrysophylla*: Fabaceace), the dominant trees of the subalpine dry forest, and discuss trends in native plant regeneration and impacts of alien grasses and other weeds. Moving on to the Puu Laau Cabin, we will discuss the history of forest reserve, forestry, and early ungulate control programs. We will walk to a cinder pit in order to compare pasture and forest reserve habitats and the likely results when cattle are removed. We then move to a sandalwood enclosure to discuss the history of sandalwood trade and the former composition of dry forests. Ecology and land use of the inter-volcano regin will be discussed, with views of Hualalai, Mauna Loa, Kohala, and Kone, Maui. An overview of the Palila Project will be given, with discussion of bird, insect, vegetation and predator studies. Moving on, we will proceed to Dog-leg, then go to the tree line and, if participants wish, visit a silversword enclosure.

Kaloko-Honokohau Historical Park, Friday, 14 June. Led by Paul Haberstroh (Marine Biology, University of Hawai`i at Hilo). Departs HPA at 8:00 a.m., returning at 4:30 p.m.

Fee: $45, including transportation and make-your-own sack lunch.

The Kaloko-Honokohau Historical Park is designated a National Historical Park and managed by the National Park Service. It is a small part of the arid west coast of the Big Island. The site is characterized by numerous small anchialine ponds that do not connect directly to the sea yet receive sea water during high tides and fresh water from downslope run-off from rains in the hills. The ponds are inhabited by endemic species of invertebrates, especially crustaceans, and are "homes" to many species of water fowl and fish. Historically, the ponds were used by native Hawaiians to grow fish by letting in young fish from the sea and growing them in the ponds until harvested. There are numerous petroglyphs in the vicinity of the ponds which can be easily viewed. Issues relevant to the ponds are cultural, dealing with use of the ponds and the area as a living site for Hawaiians, as well as scientific, dealing with the restoration of the ponds and on-going studies of seepage of pollutants into the ponds. The area is also a favorite for bird watchers. The trip will leave HPA at 8:00 a.m., traveling south from Waimea along the Queen Kaahumanu Highway to the Kona Boat Harbor (Honokohau Harbor). The Kaloko-Honokohau National Historical Park is adjacent to the harbor.

SUNDAY

Volcano, Sunday, 16 June. Led by Donald A. Swanson (US Geological Survey, Hawaiian Volcano Observatory, Hawai`i National Park, HI 96718). Departs HPA at 7:30 a.m., returning by 4:30 p.m.

Fee: $45, including transportation and make-your-own sack lunch.

This field trip is similar to the Friday Volcano trip except that we will not stay into the evening and return by 4:30 p.m. Participants must have made arrangements for Sunday evening lodging or flights prior to leaving on the field trip. HPA is able to store luggage but currently is completely booked by another group arriving Sunday.

EVERY EVENING

Astronomical Observatory.

Fee: none

Telescopes for viewing the night sky and interpreters will be available at the Astronomical Observatory at the 9,300 foot level of Mauna Kea. This is a self-guided field trip. Participants leave mid-evening (8:00 p.m. or so) and drive to the Observatory following directions supplied at the AAASPD Registration desk. Van rides may be available at a nominal cost. Otherwise, there is no charge for this event. If you are interested in riding in a van, inquire at the registration desk about their availability. Available every evening, Wednesday through Saturday. Dress warmly!

GENERAL SESSIONS

Wednesday, 12 June

TRADITIONAL HAWAIIAN WELCOME

Outside of Taylor Commons
5:15 p.m.

This event is co-sponsored by the Kohala Center and officially opens the 83rd Annual Meeting of the Pacific Division. The events are designed to introduce meeting attendees to the importance of understanding Hawaiian culture for all major endeavours involving the Islands. The welcome will include a reception, an Oli (chant) and hula presentation by Kumu Hula Pili Pang, welcomes from various individuals and groups, and a Pule (prayer) by a local kahu. Beer and wine will be available at a minimal cost.

WELCOME DINNER BUFFET

Taylor Commons
6:45 p.m.

An informal finger-food dinner buffet offering a variety of foods, such as Korean chicken wings, spring rolls, won tons, fresh fruit and vegetables. Take this time to get acquainted or reacquainted with colleagues. Beer and wine will be available at a slight additional cost.

Cost is $9 for those not staying at HPA. Tickets may be purchased at the Registration Desk and at the door on a space-available basis.

Thursday, 13 June

PLENARY LECTURE SERIES

Gates Performing Arts Center
8:00 a.m. – 9:40 a.m.

This series of half hour talks highlights science on the Big Island of Hawai`i. It is open to the public at no charge.

0800 *Welcome and Introductions*

0810 *Growth and Destruction of the Island of Hawai`i.* Donald A. Swanson, U.S. Geological Survey, Hawaiian Volcano Observatory, Hawai`i National Park, HI 96718.

0840 *Contemporary Submarine Volcanic Processes: Loihi Submarine Volcano, Hawai`i.* Alexander Malahoff, Department of Oceanography, University of Hawai`i at Manoa, 1000 Pope Road, MSB 319, Honolulu, HI 96822.

0910 *The Hawaiian Starlight: Stargazing from Mauna Kea.* Jean-Charles Cuillandre, Canada France Hawaiian Telescope.

NOON LECTURE

Gerry Clark Arts Center
12:15 p.m.

This talk is open to the public at no charge.

Our knowledge of native Hawaiian ecosystems is mushrooming! Don E. Hemmes**,** Biology Department, University of Hawai'i, Hilo, HI 97620.

BEACH BARBEQUE

Hapuna Beach
5:30 p.m.

Drive yourself or ride in a 52-passenger school bus which has been chartered for the evening to Hapuna Beach, about 20 minutes from HPA. *The school buses will pick up passengers at 5:00 p.m.* in the parking lot above Taylor Commons. (Passengers will also be returned to this parking lot.)

Cost is $20 for persons not staying at HPA. Tickets must be purchased in advance and are available at the Registration Desk until noon on Thursday.

Saturday, 15 June

COUNCIL OF THE PACIFIC DIVISION
Business Meeting
Lobby of Gates Performing Arts Center
7:00 a.m.

The Council of the AAAS Pacific Division will hold its annual business meeting and breakfast at 7:00 a.m. on Saturday, 15 June. The Council will elect officers, discuss programs for the 2003 annual meeting, and transact such other business as required by the Division's By-Laws.

VOLCANIC FOG
Gates Performing Arts Center
1:30 p.m. – 4:30 p.m.

This symposium is open to the public at no charge.

1330 *Introduction*

1340 *Epidemiologic Studies of the Effects of Vog.* Elizabeth Tam, University of Hawai`i at Manoa, Honolulu, HI 96822.

1410 *Vog Genesis and Effects on Hawai`i Volcanoes National Park Air Quality.* A. Jeff Sutton* and Tamar Elias, U.S. Geological Survey, Hawaiian Volcano Observatory, PO Box 51, Hawai`i National Park, HI 96718.

1500 *Vog: An On-going Investigation of Its Possible Acute Health Effects.* Jon-Pierre Michaud, Department of Chemistry and Natural Sciences, University of Hawai`i at Hilo, 200 W. Kawili Street, Hilo, HI 96720.

1530 *Volcanic Air Pollution on Horticultural Crops.* B.A. Kratky* and C.L. Chia, University of Hawai`i CTAHR, TPSS Department, Beaumont Agriculture Research Center, 461 W. Lanikaula St., Hilo, HI 96720.

STUDENT AWARDS AND PRESIDENTIAL ADDRESS
Gates Performing Arts Center
5:30 p.m.

The Division will announce the names of the student winners of the Division's Laurence M. Klauber, Geraldine K. Lindsay, J. Thomas Dutro, Presidents', Best Poster, and AAAS-Robert I. Larus Awards, starting at 5:30 p.m. in the Gates Performing Arts Center**.** Following the awards, Dr. Nina G. Jablonski (Anthropology, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118) will deliver the Presidential Address.

DIVISIONAL LUAU AND CLOSING CEREMONY
Taylor Commons
7:15 p.m.

Immediately following the announcement of the student awards and the Presidential Address will be the Divisional Luau and Closing Ceremony for the meeting. Traditional luau foods will be served, with entertainment by local entertainers.

Cost is $25 for those not staying at HPA. Tickets must be purchased in advance and are available on a space-available basis at the Registration Desk until noon on Saturday. Beer and wine will be available for a slight additional cost.

TECHNICAL SESSIONS

1100 (time italicized and underlined) indicates a student presentation in competition for Awards of Excellence.
* indicates the speaker from among several authors listed.

I. SYMPOSIA

Thursday, 13 June

ISLAND BIOGEOGRAPHY, WITH A PACIFIC FLAVOR

Castle Lecture Hall
Thursday
10:00 a.m. – 5:00 p.m.

Program Organizer: *Nina G. Jablonski,* Department of Anthropology, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118.

Sponsored by: Pacific Division Section on Anthropology and Archaeology.

Natural historians from Darwin onward have noted that the floras and faunas of islands are distinctive, sometimes dramatically so. Islands have been said to be microcosms of evolution, in which the workings of the process — isolation, the production of variation, natural selection, and adaptation — are laid bare. In this symposium, scientists who have studied both the process of biotic evolution on islands and the biogeography of island biotas, will come together to present and discuss some of their latest research. Presentations will include those devoted to how the islands of the Pacific have been colonized by different kinds of organisms and what has happened to various lineages of animals and plants after the original colonization events. The biogeography of Hawai`i itself will also be highlighted. The scientists participating in the symposium represent many fields, including systematic botany and zoology, molecular biology, and oceanography. There is no better place to learn about island biogeography than Hawai`i!

Chair: Nina G. Jablonski

1000 *Introductory Remarks,* Nina Jablonski

1010 *Keynote Address: Evolution in Action: New Animals and Plants on Hawai`i's Newest Volcanoes.* Hampton L. Carson, Department of Cell and Molecular Biology, School of Medicine, University of Hawai`i at Manoa, Honolulu, HI 96822.

1100 *Spiders on the Storm: Adaptive Radiation on Pacific Archipelagos.* Rosemary G. Gillespie, Insect Biology, 201 Wellman Hall, University of California, Berkeley, CA 94720-3112.

1135 *Hawaiian Silverswords and Guadalupe Island Deinandras: Independent Pacific Radiations of the California Tarweeds (Compositae: Madiinae).* Bruce G. Baldwin, Jepson Herbarium and Department of Integrative Biology, 1001 Valley Life Sciences Building #2465, University of California, Berkeley, CA 94720-2465.

LUNCH

1330 *Contrasting Patterns of Diversification in Hawai`i's Flightless Landbirds.* Beth Slikas*, Helen F. James, S. Olson, E. Paxinos, M. Sorenson, A. Cooper, and Robert Fleischer, Department of Systematic Biology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20008-0551.

1405 *A Paleontologist's View of Island Biogeography.* Helen F. James, Department of Systematic Biology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560.

1440 *Evolution and Consequences of Food Specialization in a Hawaiian Honeycreeper.* Paul C. Banko*[1], and Martin L. Cipollini[2]. [1]USGS Pacific Island Ecosystems Research Center, Kilauea Field Station, P.O. Box 44,

Hawai`i National Park, HI 96718; [2]Department of Biology, Berry College, P.O. Box 430, Mount Berry, GA 30149.

BREAK

1530 *Impacts of Introduced Disease on Native Hawaiian Avifauna: Genetic Studies of Host-Parasite Coevolution.* Susan Jarvi*[1,2], Carter Atkinson[2], Robert Fleischer[3], Margaret Farias[1], Kiara Banks[1], Cheryl Tarr[3], and Lori Eggert[3]. [1]Biology Department, University of Hawai`i at Hilo, 200 W. Kawili St, Hilo HI 96720; [2]Pacific Islands Ecosystems Research Center, USGS-Biological Resources Division, Hawai`i Volcanoes National Park, HI 96718; [3]Museum of Natural History, Smithsonian Institution, Washington DC 20008-0551.

1605 *Globalization and Invasions of Oceania by the Red Imported Fire Ant.* Ellen Vangelder* and Lloyd Loope, USGS-BRD, Haleakala Field Station, P.O. Box 369, Makawao, HI 96768.

1640 *Concluding Remarks and General Discussion*

POSTER

Taylor Commons
Thursday, 13 June
1:30 p.m. – 5:00 p.m.

(1) *Colonization of the Insular Pacific by Herbivorous Insects: The Role of Host Shifts and Dispersal.* George Roderick, Environmental Science, Policy and Management, Division of Insect Biology, 201 Wellman Hall, University of California, Berkeley, CA 94720-3112.

e-LEARNING IN SCIENCE: WIDE RANGE OF ACTIVITIES K-16

Gerry Clark Art Center
Thursday
10:00 a.m. – 12:00 p.m.

Program Organizer: *Kathleen M. Fisher*, Center for Research in Mathematics and Science Education and Department of Biology, San Diego State University, San Diego, CA 92120.

Sponsored by Pacific Division Section on Education.

e-Learning can be broadly defined as the process of teaching and learning across the Internet. It is the fastest growing domain in education today, with a multi-billion dollar investment that is expected to increase by more than ten billion dollars in the next five years. Initial instructional efforts involved simple transfer of traditional course materials to the Internet. More creative methods are now being explored. This symposium presents a snapshot of some of the approaches being developed, including

- use of real-time scientific data transmitted over the Internet to engage both grade K-8 and college students in collecting data, comparing data, and generating and testing hypotheses
- a doable and affordable method for teaching large enrollment general education science classes, and
- a model for teaching a highly interactive, collaborative science classes globally.

Chair: Kathleen M. Fisher

1000 *Metacognition and Gender Differences in an Elementary School Science Tutorial.* Brockenbrough Allen, Department of Educational Technology, San Diego State University, San Diego, CA 92120.

1030 *Linking K-6 Science Learning with Near-Real-Time Data.* Donna Ross, Howard Coven, Kevin Cummins, Ruben Pacheco, Christine Prowd, Eric Fisher, Nancy Taylor, and Walter C. Oechel, San Diego State University, San Diego, CA 92120.

1100 *Bringing Field Stations and Global Change Technology into Large Classes to Enhance College Ecology Education.* Kathy Williams, Department of Biology, San Diego State University, San Diego, CA 92120.

1130 *A Blended Model for College Science Teaching on the Internet: As Affordable and Time-Convenient but More Interactive than Lectures.* Kathleen M. Fisher, Department of Biology, San Diego State University, San Diego, CA 92120.

RECENT ADVANCES IN VOLCANOLOGY IN HAWAI`I

Gerry Clark Art Center
Thursday
1:30 p.m. – 4:00 p.m.

Program Organizer: *Donald A. Swanson*, United States Geological Survey, Hawaiian Volcano Observatory, PO Box 51, Hawai`i National Park, HI 96718.
Sponsored by the Pacific Division Section on Earth Sciences.

Chair: Donald A. Swanson

1330 *Revision of Haleakala's Volcanic History.* David R. Sherrod, U.S. Geological Survey, Hawaiian Volcano Observatory, PO Box 51, Hawai`i National Park, HI 96718.

1350 *The Hawai`i Scientific Drilling Project: A Probe into the History, Structure, and Dynamics of an Ocean Island Volcano.* Donald M. Thomas*[1], D.J. DePaolo[2], and E.M. Stolper[3]. [1]Center for the Study of Active Volcanoes, [2]University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720; University of California, Berkeley, CA 94720; [3]California Institute of Technology, MS170-25, Pasadena, CA 91125.

1410 *Real-Time Thermal Monitoring of Kilauea Volcano from Space and the Ground.* Andrew J.L. Harris, HIGP/SOEST, University of Hawai`i, 2525 Correa Road, Honolulu, HI 96822.

1430 *Lava Flow Advances.* Jim Kauahikaua, U.S. Geological Survey, Hawaiian Volcano Observatory, PO Box 51, Hawai`i National Park, HI 96718.

BREAK

1510 *Imaging Kilauea Volcano's Magmatic System with Borehole Tilt- and Strainmeter Measurements.* Peter F. Cervelli* and Asta Miklius, U.S. Geological Survey, Hawaiian Volcano Observatory, Hawai`i National Park, HI 96718.

1530 *Explosive Eruptions at Kilauea.* Donald A. Swanson*[1], Richard S. Fiske[2] and Timothy R. Rose[2]. [1]U.S. Geological Survey, Hawaiian Volcano Observatory, Hawai`i National Park, HI 96718; [2]Department of Mineral Sciences, Smithsonian Institution, Washington DC 20560.

ATMOSPHERIC CARBON DIOXIDE: ITS MEASUREMENT AND REMEDIATION

Library
Thursday
1:15 p.m. – 5:00 p.m.

Program Organizer: *Roger G. Christianson*, Department of Biology, Southern Oregon University, Ashland, OR 97520.
Sponsored by the Pacific Division Sections on Atmospheric and Oceanographic Sciences, Biological Sciences, and Ecology and Environmental Sciences.

Atmospheric carbon dioxide measurements have shown a steady increase over the last half century. At the Mauna Loa Observatory in Hawai`i this increase has been about 12.5%. Increases of carbon dioxide and other heat-trapping gases have raised concerns that warming on a global scale might occur, causing significant climate shifts, disruptions to agriculture, and rising ocean levels due to melting ice caps. Indeed, the past 10 years have been the warmest in recent history. In this symposium we will look at global climate change as it relates to changing carbon dioxide levels. We will also consider existing and developing technology of carbon dioxide reduction and public policy as it relates to carbon dioxide reduction.

Chair: Henry Oman

1315 Introductions

1320 *Global Climate Change: Circum-Pacific and Global Net Ecosystem CO2 Fluxes.* Walter C. Oechel*, Hyojung Kwon, Rommel Zulueta, Steve Hastings, and Joe Verfaille Jr, Global Change Research Group, San Diego State University, San Diego, CA 92182.

1400 *Carbon Dioxide in the Oceans: Building the Long-Term Record.* John E. Dore* Daniel W. Sadler and David M. Karl, De-

partment of Oceanography, University of Hawai`i at Manoa, Honolulu, HI 96822.

1440 *Reducing Carbon Dioxide Emissions--False vs Valid Technology.* Henry Oman, Consulting Engineer, 19221 Normandy Park Drive SW, Seattle, WA 98166.

BREAK

1540 *Production of High Value Products and Mineral Carbon from Smoke Stack Gases Using Photobioreactor Grown Microalgae.* M. Olaizola*[1], E. Mazzone[1], J. Thistlethwaite[1], T. Nakamura[2] and Stephen M. Masutani[3]. [1]Aquasearch, Inc., Kailua-Kona, Hawai`i; [2]Physical Sciences Inc., Andover, Massachusetts; [3]University of Hawai`i at Manoa, Honolulu, HI 96822.

1620 *CO_2 Ocean Sequestration.* Stephen M. Masutani, University of Hawai`i, Hawai`i Natural Energy Institute, 2540 Dole Street, Holmes Hall 246, Honolulu, HI 96822.

Saturday, 15 June

CONSERVATION OF NATURE AND KNOWLEDGE ABOUT NATURE IN HAWAI`I

Gerry Clark Art Center
Saturday
8:30 a.m. – 12:00 p.m.

Program Organizer: *Sam Gon,* The Nature Conservancy of Hawai`i

Sponsored by the Pacific Division Sections on Anthropology and Archaeology, Biological Sciences, Ecology and Environmental Sciences, Education and Social, Economic and Political Sciences.

Conservation challenges in Hawai`i are a microcosm of those facing the global biosphere. A history of change in an isolated and vulnerable setting have lead to great losses of biodiversity, but much has been retained, leaving hope for the future. Certain ecosystems (such as lowland dry and mesic forest) have been all but lost, taking many endemic species with them into extinction, while others, more remote, or less suitable for human use, have held many of their original elements of biological diversity. Following an initial history of habitat loss and disturbance from direct human land use, starting with the impact of indigenous Hawaiians and accelerating in the 200+ years since Western contact, the current challenges to Hawaiian ecosystems and species are more subtle, and more intractable—the effects of introduced plants and animals on a preexisiting set of native natural communities. Their direct and indirect effects occur at a small enough scale, and in an isolated system that is accessible to scientific inquiry, rich enough to involve the full gamut of complex ecological processes, and yet highly instructive to larger global problems. Global warming, for example, is reducing the size of high-elevation refugia for native Hawaiian forest birds from introduced avian diseases.

The richness of evolutionary and ecological lessons from Hawai`i are the exemplars of the modern biological curriculum. Research on Hawaiian species and ecosystems continue to provide insight on the process of evolution and speciation, and on adaptations of species to a wide spectrum of environments—from coast to alpine, and from desert to arguably the wettest spot on Earth. In addition to the knowledge accumulated in scientific literature is traditional indigenous knowledge; a source that is receiving growing recognition as a complementary body of information of value to the pursuit of understanding of the natural world.

This symposium will include speakers reviewing current research on native species and ecosystems in Hawai`i, on the efforts being made in environmental education, and on the connections between the rich natural history of Hawai`i and the correspondingly rich Hawaiian culture that developed here.

Chair: Sam Gon

0830 Introduction

0835 *Conservation Challenges on the Island of Hawai`i.* James D. Jacobi, U.S. Geological Survey, Pacific Island Ecosystem Research Center, Hawai`i Volcanoes National Park, HI 96718.

0905 *Tracking the Status of Hawai`i's Native Species and Ecosystems for Conservation.* Shannon McElvaney, Hawai`i Natural Heritage Program, Center for Conservation Research and Training, University of Hawai`i, 3050 Maile Way, Gilmore 409, Honolulu, HI 96822.

0935 *Traditional Hawaiian Knowledge and Epistemology in the Natural World.* Iokepa K. Nae`ole, The Nature Conservancy of Hawai`i, PO Box 1716, Makawao, HI 96768.

BREAK

1020 *Landscape-scale Conservation in Hawai`i: New Challenges and Partnerships.* Mark L. White, The Nature Conservancy of Hawai`i, PO Box 1716, Makawao, HI 96790.

1050 *Addressing the Complexities of Alien Species Prevention and Control in Hawai`i: Biology, Politics and Economics.* Steve Lohse, Coordinator, The Coordinating Group on Alien Pest Species.

1120 Discussion

PEOPLING OF THE PACIFIC

Castle Lecture Hall
Saturday
10:20 a.m. – 5:00 p.m.

Program Organizer: *Nina G. Jablonski*, Department of Anthropology, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118.

Sponsored by the Pacific Division Sections on Anthropology and Archaeology, and Biological Sciences.

The islands of the Pacific were the last frontiers to be explored and colonized by humans. Almost everything about this process—especially the nature of the peoples and the technologies used in getting to remote places and staying there—has invited great public and scientific interest. We are now at a unique point in our intellectual quest to understand the process of the peopling of the Pacific, because we have available to us many new and different kinds of data. To the traditional battery of archeological and skeletal evidence, we now have molecular and linguistic evidences that bear on the nature and timing of this lengthy and complex colonization process. We also know much more about how early “natives” behaved, and how they contributed to sometimes dramatic changes in island ecosystems in short spans of time. In this symposium, a wide variety of scientists, from the fields of archaeology, physical anthropology and molecular genetics, will be brought together to present new evidence on the colonization and utilization of Pacific island environments by humans. For anyone interested in human evolution and human history, this will be a session not to be missed!

Chair: Nina G. Jablonski

1020 Introductory Remarks: Nina G. Jablonski

1030 *Keynote Address: Human Dispersal in the Pacific and Population Structure.* Rebecca Cann, University of Hawai`i at Manoa, Honolulu, HI 96822.

1120 *Keynote Address: Lapita and the Initial Expansion of the Oceanic-Speaking Peoples.* Patrick V. Kirch, Archaeological Research Facility and P.A. Hearst Museum of Anthropology, University of California, Berkeley, CA 94720.

LUNCH

1330 *Population Origins, Gene Flow, Drug Metabolism, and Malaria in the Pacific.* J. Koji Lum*, Akira Kaneko, Nobuyuki Takahashi and Takatoshi Kobayakawa, Department of International Affairs and Tropical Medicine, Tokyo Women's Medical University, 8-1 Kawada-cho, Shinjuku-ku, Tokyo 162-8666, Japan.

1405 *Nuclear Micronesian Word for 'Dog': An Ethnolinguistic Puzzle.* Kenneth L. Rehg, Department of Linguistics, University of Hawai`i at Manoa, 1890 East-West Road, Honolulu, Hawai`i 96822.

1440 *Easter Island Prehistory: A Story of Success or Failure?* Terry L. Hunt, Department of Anthropology, 2424 Maile Way, Saunders Hall 346, University of Hawai`i at Manoa, Honolulu, HI 96822.

BREAK

1530 *Traditional Samoan Use of the Tutuila Island Landscape.* David J. Addison, American Samoa Power Authority, PO Box 2545, Pago Pago, AS 96799, USA.

1605 *Ancient Hawai`i's Northwestern Frontier: Nihoa, Necker (Mokumnamana?) and French Frigates Shoal (Mokupapapa?).* Ben Finney, University of Hawai`i at Manoa, Honolulu, HI 96822.

1640 *Concluding Remarks and Discussion*

POSTER
Taylor Commons
Thursday, 13 June
1:30 p.m. – 5:00 p.m.

(2) *Ancient Quarries of Tutuila.* Riley A. Arthur, South Pacific Academy, PO Box 3178, Pago Pago, AS 96799, USA.

Vog - VOLCANIC FOG

Gates Performing Arts Center
Saturday
1:30 p.m. – 4:30 p.m.

Program Organizer: *William B.N. Berry*, Department of Earth and Planetary Sciences, 307 McCone Hall, University of California, Berkeley, CA 94720-4767.

Program Sponsored by the Pacific Division Sections on Agriculture and Horticultural Science, Atmospheric and Oceanographic Sciences, Earth Sciences, Health Sciences, and Social, Economic and Political Sciences..

Chair:William B.N Berry

1330 Introduction

1340 *Epidemiologic Studies of the Effects of Vog.* Elizabeth Tam, University of Hawai`i at Manoa.

1410 *Vog Genesis and Effects on Hawai`i Volcanoes National Park Air Quality.* A. Jeff Sutton* and Tamar Elias, U.S. Geological Survey, Hawaiian Volcano Observatory, PO Box 51, Hawai`i National Park, HI 96718.

1440 *Vog: An On-going Investigation of Its Possible Acute Health Effects.* Jon-Pierre Michaud, Department of Chemistry and Natural Sciences, University of Hawai`i at Hilo, 200 W. Kawili Street, Hilo, HI 96720.

BREAK

1530 *Volcanic Air Pollution on Horticultural Crops.* B.A. Kratky* and C.L. Chia, University of Hawai`i CTAHR, TPSS Department, Beaumont Agriculture Research Center, 461 W. Lanikaula St., Hilo, HI 96720.

1550 Discussion

II. CONTRIBUTED PAPERS

1100 (time italicized and underlined) indicates a student presentation in competition for Awards of Excellence.
* indicates the speaker from among several authors listed.

AGRICULTURE AND HORTICULURAL, BIOLOGICAL, AND EARTH SCIENCES
Joint Session

Cosponsored by: **Agriculture and Horticulural Sciences:** Section Chair: *William F. Campbell*, Department of Plants, Soils and Biometeorology, Utah State University, Logan, UT 84322-4820; **Biological Sciences:** Section Chair: *Anne Michelle Wood*, Department of Biology, University of Oregon, Eugene, OR 97403; **Earth Sciences:** Section Chair: *J. Thomas Dutro, Jr.*, U.S. Geological Survey (E-308), National Museum of Natural History, Washington, DC 20560-0137.

Gerry Clark Arts Center
Saturday, June 15
1:30 p.m. – 4:50 p.m.

Chair: A. Michelle Wood, University of Oregon

1330 *Characterization of the Nuclear-encoded Genes that Regulate the Translation of the Chloroplast-encoded psbA mRNA of Chlamydomonas reinhardtii.* L. Flores*[1], L. Arce[2], R. Hawk[3] and A. Cohen[1]. [1]Department of Biological Science, California State University, Fullerton, 800 N. State College, Fullerton, CA 92834-6850; [2]Department of Molecular Biology and Biochemistry, University of California, Irvine, 3205 McGaw Hall, Irvine, CA 92697-3900; [3]Department of Pharmaceutical Sciences, School of Pharmacy, University of Southern California, 1985 Zonal Ave. PSC 716, Los Angeles, CA 90089-9121.

1350 *Investigations of Capricious Gene Expression in Drosophila Wing Development.* Michelle Itano* and Lois Abbott, University of Colorado, Molecular, Cellular, and Developmental Biology Department, UCB 347, Boulder, CO 80309.

1410 *The Effect of Colored Mulches on Development of Basil, Lettuce, and Radish Grown in a Greenhouse Environment.* Jesse Liwai* and William S. Sakai, University of Hawai`i, Hilo, HI 96720.

1430 *Karyomorphology and Genome Analysis of Four Cultivars of Tulipa.* Tasneem F. Khaleel, Department of Biological and Physical Sciences, Montana State University-Billings, 1500 N. 30th Street, Billings, MT 59101.

BREAK

1510 *Biomonitoring of Toxic Heavy Metals: The gastropod Biomphalaria glabrata, a Laboratory Model.* S.N. Thompson, Analytical Chemistry Instrumentation Facility and Department of Entomology, University of California, Riverside, CA 92521.

1530 *Seasonal Effects of Water Quality in the Yellowstone River Basin on Root Growth and Mitotic Index in Allium cepa L.* Tasneem F. Khaleel, Johnna Hedman*, Laura Madden, and Amber Osborne, Department of Biological and Physical Sciences, Montana State University-Billings, 1500 N. 30th Street, Billings, MT 59101.

1550 *Fossil Sharks of the Rocky Mountains: Ctanacanthus and other Chondrichthyan Spines and Denticles.* Wayne M. Itano*[1], Karen J. Houck[2], and Martin G. Lockley[2]. [1]1995 Dartmouth Ave., Boulder, CO 80305; [2]Department of Geography, Geology, and Environmental Science, University of Colorado, Denver, CO 80217.

1610 *Forcing Shoot Growth from Rhizomes of Dendrobium Orchids for Off-Season Cut-flower Production.* William S. Sakai*, Leonard Gines, and Jason C. Eberly, University of Hawai`i, Hilo, HI 96720, and Hawaiian Tropicals Direct, Kapoho, HI.

1630 *To Change or Not To Change Plant Genetics: Can We Find a Compromise?* Carl Torkko, 2105 SW 173rd Place, Seattle, WA 98166.

POSTER SESSION

Taylor Commons
Thursday, 13 June
1:30 p.m. – 5:00 p.m.

(3) *Reproductive Inhibition by Methyl Farnesoate in the Tadpole Shrimp Triops longicaudatus.* William K. Nelson*, Jennifer Rose and Brian Tsukimura, Department of Biology, California State University, Fresno, CA 93740-3963.

(4) *Examination of the Gut Contents of Big Island Reef Fish for the Presence of Toxigenic Dinoflagellates.* Jesselynne Krief* and Michael L. Parsons, Marine Science Department, University of Hawai`i, Hilo, HI 96720.

(5) *Ciguatera in Hawai`i: Distribution of Toxigenic Dinoflagellates, Ciguateric Fish and Related Abiotic and Biotic Factors.* Darla J. White* and Michael L. Parsons, Marine Science Department, University of Hawai`i, Hilo, HI 96720.

(6) *Nutritional Composition of Edible Hawaiian Macroalgae from Wild Populations.* Sara M. McCutcheon, Marine Science Department, University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720.

(7) *High Incidence of Rare Dopamine Receptor D4 (DRD4) Alleles in Children Diagnosed with Attention Deficit Hyperactivity Disorder (ADHD).* D. L. Grady*, Y. -C. Ding, H. -C. Chi, M. Smith, E. Wang, S. Schuck, P. Flodman, M. A. Spence, J. M. Swanson and R. K. Moyzis, Department of Biological Chemistry and Child Development Center, College of Medicine, University of California, Irvine, CA 92697.

(8) *Aggressive Behavior in Triplet Combinations of Unisexual and Bisexual Gecko Species.* Deborah C. Ishii-Thoene*, Roanne LeBrun and Susan G. Brown, Social Sciences Division, University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720-4091.

(9) *Variables Affecting Egg Mass Laying and Snail Emergence in Endemic Hawaiian Snails.* Karen Crowell*, Patricia Keene and Susan G. Brown, Social Sciences Division, University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720-4091.

(10) *Association of a Low-Phycourobilin Containing Phycoerythrin with Upwelling-Influenced Waters in the Gulf of California.* A. Michelle Wood*[1], Scott Pegau[2], Helmut Maske[3], Chuck Trees[4], Jim Mueller[4] and W.K.W. Li[5]. [1]Ecology and Evolution, University of Oregon, Eugene, OR 97403; [2]COAS, Oregon State University, Corvallis, OR; [3]CICESE/Ecologia, Ensenada, B.C., Mexico; [4]CHORS, San Diego State University, San Diego, CA 97331; [5]Bedford Institute of Oceanography, Dartmouth, N.S., B2Y4A2 Canada.

(11) *Spinosad as an Organophosphate Alternative for Areawide Fruit Fly Control in Hawai`i.* Roger I. Vargas*, Neil W. Miller and Ronald J. Prokopy, USDA-ARS.

(21) *Whole Genome Comparison: Visual Analysis of Pattern Hunter Nucleotide Homology Data.* Lawrence J. Miller* and Ming Li, Department of Computer Science, University of California, Santa Barbara, California 93106.

(22) *Arabidopsis Protease Activity Increases as a Result of Exposure to Ultraviolet Radiation.* April Agee* and Lois Rodrigo, Department of Biological Science, California State University, Fullerton. 800 N. State College Blvd., Fullerton, CA 92831.

ECOLOGY AND ENVIRONMENTAL SCIENCES, INDUSTRIAL SCIENCE AND TECHNOLOGY, AND SOCIAL, ECONOMIC AND POLITICAL SCIENCE

Joint Session

Cosponsored by the Pacific Division Sections on **Ecology and Environmental Sciences:** Section Chair: *Michael Parker*, Dept. of Biology, Southern Oregon University, Ashland, OR 97520, **Industrial Science and Technology:** Section Chair: *Henry Oman* , 19221 Normandy Park Drive SW, Seattle, WA 98166, and **Social, Economic and Political Sciences: Section Chair:** *Mark Aldrich*, Dept. Economics, Smith College, Northampton, MA 01063.

Library
Thursday, 13 June
10:00 a.m. – 12:20 p.m..

Chair: Michael Parker, Southern Oregon University.

1000 *Effects of Ozone on Marine Toad Behavior, Water Balance, and Immune Function: Implications for Amphibian Declines?* Michael R. Dohm* and William J. Mautz, Department of Biology, University of Hawai`i, Hilo, HI 96720.

1020 *Effects of Ozone on Water Conservation Behavior in the Coqui Tree Frog, Eleutherodactylus coqui.* Raymond McGuire*, Loney J. Salas, Michael R. Dohm, and and William J. Mautz, University of Hawai`i, Hilo, HI 96720.

1040 *Respiratory Pattern Changes in a Tropical Tree Frog (Eleutherodactylus coqui) Exposedt to Ozone.* Loney J. Salas*, Raymond McGuire, Michael R. Dohm and William J. Mautz, Department of Biology, University of Hawai`i, Hilo, HI 96720.

1100 *Algal Turf Composition at Two Sites on the Island of Hawai`i.* Brooke Stuercke, Marine Science Department, University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720.

1120 *Seasonal Variation in Benthic Community Structure of the Bighorn River.* Stanley M. Wiatr*, Benjamin S. Martin and Bryan J. Knaub, Department of Biological and Physical Sciences, Montana State University-Billings, 1500 North 30th St., Billings, MT 59101.

1140 *Carrier Effect of Natural Zeolite and Its Applications.* Nai-Qian Feng*, and Gai-Fei Peng, Department of Civil Engineering, Tsinghua University, Beijing 100084, China and Faculty of Civil Engineering and architecture, Northern Jiaotong University, Beijing 100044, China.

1200 *Cultural Contributions to Destination Competitive Advantage.* Marcia Sakai*[1] and Sonia Juvik[2], [1]Department of Tourism and Economics, University of Hawai`i, Hilo, HI 96720; [2]Department of Geography, University of Hawai`i, Hilo, HI 96720.

POSTER SESSION

Taylor Commons
Thursday, 13 June
1:30 p.m – 5:00 p.m.

(16) *Evaluating Geographic Information Systems (GIS) as a Tool for Mariculture Site Selection Utilizing the Example of Pearl Oyster Farms in Hawai`i.* Lisa M. Wedding, Marine Science Department, University of Hawai`i at Hilo, 200 West Kawili St., Hilo, HI 96720.

(17) *GIS Applicability to Agroecosystems Research: A Case Study Mapping the Insect Community of a Hawaiian Banana Patch.* Christian A. Rygh, Department of Geography and Environmental Studies, University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720.

(18) *The Cold Tolerance of Two Species of Hawaiian Drosophila from the Big Island of Hawai`i.* Angela Reza*, Michael R. Dohm, Sheryl Moore, Cedric Muir, William J. Mautz and Donald Price, Department of Biology, University of Hawai`i, Hilo, HI 96720.

(19) Assessment of Potential Inbreeding Depression in the Nene (Branta sandvicensis or Hawaiian Goose). Anne Valliet*, R. Trimble, B. Flesher, Cedric Muir, Donald Price, Department of Biology, University of Hawai`i at Hilo, 200 West Kawili, Hilo, HI 96720.

*(20) A GIS Exploration of Anthropogenic Factors to Elucidate the Distribution of Green Sea Turtle Fibropapillomatosis around the Island of Hawai`i.* Lisa K. Canale, Ecology, Evolution and Conservation Biology, University of Hawai`i at Hilo, 200 West Kawili Street, Hilo, HI 96720.

EDUCATION

Sponsored by: **Education Section:** Section Chair: *Kathleen M. Fisher*, Center for Mathematics & Science Education, San Diego State University, San Diego, CA 92120

Library
Saturday, 15 June
9:00 a.m. – 12:00 p.m.

Chair: Kathleen M. Fisher

0900 *Use of Collaborative Problem Solving in the Field to Predict "Future" Effects of Past Events.* Garry F. Hayes, Geology Department, Modesto Junior College, 435 College Ave., Modesto, CA 95350.

0920 *Developing Life Skills through First Hand Experience: ESTP.* Judy Suing, Anna Frankel, Michael Goodblatt, Kathalyn Tung, Bonnie Wang and William B.N. Berry*, Environmental Sciences Teaching Program, Division of Undergraduate and Interdisciplinary Studies, University of California, Berkeley, CA 94720.

0940 *Undergraduates Increasing Awareness of Environmental Science in the Lives of Underserved Students.* Cynthia S. McCormick, Alison N. Toy, Jeffrey J. Hoyos, Adele Thornbury, and William B.N. Berry*, Environmental Sciences Teaching Program, Division of Undergraduate and Interdisciplinary Studies, University of California, Berkeley, CA 94720.

BREAK

1020 *Successful Techniques for Teaching Online Science Courses.* Ivy Merriot, Abaetern Academy Virtual School, 1627 West Main, #376, Bozeman, MT 59715.

1040 *The Rise and Fall of Science Education.* Carl Torkko, 2105 SW 173rd Place, Seattle, WA 98166.

1100 *Roundtable Discussion of Hands-On Learning,* led by William B.N. Berry, Department of Earth and Planetary Science, University of California, Berkeley, CA 94720. All teachers and others interested in hands-on learning, including project-based learning, at all levels are invited to participate in this roundtable discussion.

POSTER SESSION
Taylor Commons
Thursday, 13 June
1:30 p.m. – 5:00 p.m.

(12) A Conservation Biologist in the K-12 Classroom: Terrestrial Field Ecology for the 6th Grade. Candace J. Lutzow-Felling, Botany Department and Ecology, Evolution, and Conservation Biology Program, 3190 Maile Way, Room 101, University of Hawai`i, Honolulu, HI 96822.

HEALTH SCIENCES AND PSYCHOLOGY
Joint Session

Cosponsored by: **Health Sciences:** Section Chair: *Carl Maida*, UCLA Div. General Internal Medicine & Health Services Research, Department of Medicine, School of Medicine, Center for Health Sciences, 10833 Le Conte Avenue, Los Angeles, CA 90095; **Psychology:** Section Chair: *J. Ken Nishita*, California State University, Monterey Bay, 100 Campus Center, Seaside, CA 93955.

Castle Lecture Hall
Saturday, 15 June
8:00 a.m. – 10:00 a.m.

Section Chair: Angela R. Christianson

0800 *The Role of Vocational Identity in Satisfaction with Life.* Vladimir Skorikov*, Tamia McKeague and Tadashi Serikawa, University of Hawai`i at Hilo, 200 West Kawili St., Hilo, HI 96720.

0820 *Aging and Decision-Making Competence.* Melissa L. Finucane, Kaiser Permanente Center for Health Research Hawai`i, 501 Alakawa St., Honolulu, HI 96817 and Decision Research Science Institute, 1201 Oak St., Eugene, OR 97401.

0840 *Extra-corporeal Model-building: Mankind's Step Up from Genetic, then Neural, Model-building.* Danielle Mihram[1] and G. Arthur Mihram*[2]. [1]Center for Excellence in Teaching, LVL-301B, University of Southern California, Los Angeles, CA 90089-0182; [2]PO Box 1188, Princeton, NJ 08542-1188.

0900 *Dementia as a Form of Language Disorder: Nosological Clarification.* Fred C.C. Peng, Neurological Institute, Veterans General Hospital, 201 Shih-Pai Rd. Sec 2, Taipei, Taiwan 11217.

0920 *Cleaning the Pipe: Critical Issues with Data Integrity, Analysis and Interpretation in High Throughput Screening Experiments.* Edward J. Moler* and Filippo Randazzo, 4560 Horton Street, Mail Stop 4.3, Emeryville, CA 94608.

0940 *Evidence That Smith-McCort Dysplasia in the Chamorro Population Results from a Founder Mutation in a Gene on the Long Arm of Chromosome 18.* Nadia Ehtesham[1], Rita M. Cantor[2,3], Lily M. King[1], Kent Reinker[5], Berkley R. Powell[6], David L. Rimoin[1,2,3,4], and Daniel H. Cohn*[1,2,3]. [1]Medical Genetics-Birth Defects Center, Ahnanson Department of Pediatrics, Cedars-Sinai Research Institute, Los Angeles, CA 90048; [2]Departments of Human Genetics, [3]Medicine, and [4]Pediatrics, UCLA School of Medicine, Los Angeles, CA; [5]University of Texas Health Sciences Center, San Antonio, TX; [6]Children's Hospital Central California, Madera and Department of Pediatrics, UCSF School of Medicine, Fresno, CA.

POSTER SESSION

Taylor Commons
Thursday, 13 June
1:30 p.m. – 5:00 p.m.

(13) *Mauna Kea Commuters Down-Regulate Exhaled Nitric Oxide during the Work Week.* C.M. Beall*[1], D.E. Brown[2], P. Mills, H. Porter, V. Contos and K.P. Strohl. [1]Anthropology, Case Western Reserve University, Cleveland, OH 44106; [2]Anthropology, University of Hawai`i, Hilo, HI 96720; Medicine, Case Western Reserve University, Cleveland, OH 44106.

(14) *Desirable Body Weight Image and Vigorous Exercise: Gender and African-American/White Differences.* Ryan Lee*, Stephen Morewitz, Shervin Shamtoub, Joyce Tse, Katrine Muhl and Samantha Mullins, California College of Podiatric Medicine, 100 Corporate Place, Ste C., Vallejo, CA 94590.

(15) *An Empirical Test of Different Models of Adolescent Mental Health.* Tamia McKeague*, Tadashi Serikawa, Donna Maemori, Deborah Hamamoto and Vladimir Skorikov, University of Hawai`i at Hilo, 200 West Kawili Street, Hilo, HI 96720.

III. POSTER PAPER SESSION

(52) (number italicized and underlined) indicates a student presentation in competition for Awards of Excellence.
* indicates the speaker from among several authors listed.

Taylor Commons
Thursday, 13 June
1:30 p.m. – 5:00 p.m.

ISLAND BIOGEOGRAPHY, WITH A PACIFIC FLAVOR

(1) *Colonization of the Insular Pacific by Herbivorous Insects: The Role of Host Shifts and Dispersal.* George Roderick, Environmental Science, Policy and Management, Division of Insect Biology, 201 Wellman Hall, University of California, Berkeley, CA 94720-3112.

PEOPLING OF THE PACIFIC

(2) *Ancient Quarries of Tutuila.* Riley A. Arthur, South Pacific Academy, PO Box 3178, Pago Pago, AS 96799, USA.

AGRICULTURE AND HORTICULTURAL, BIOLOGICAL, AND EARTH SCIENCES

(3) *Reproductive Inhibition by Methyl Farnesoate in the Tadpole Shrimp Triops longicaudatus.* William K. Nelson*, Jennifer Rose and Brian Tsukimura, Department of Biology, California State University, Fresno, CA 93740-3963.

(4) *Examination of the Gut Contents of Big Island Reef Fish for the Presence of Toxigenic Dinoflagellates.* Jesselynne Krief* and Michael L. Parsons, Marine Science Department, University of Hawai`i, Hilo, HI 96720.

(5) *Ciguatera in Hawai`i: Distribution of Toxigenic Dinoflagellates, Ciguateric Fish and Related Abiotic and Biotic Factors.* Darla J. White* and Michael L. Parsons, Marine Science Department, University of Hawai`i, Hilo, HI 96720.

(6) *Nutritional Composition of Edible Hawaiian Macroalgae from Wild Populations.* Sara M. McCutcheon, Marine Science Department, University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720.

(7) *High Incidence of Rare Dopamine Receptor D4 (DRD4) Alleles in Children Diagnosed with Attention Deficit Hyperactivity Disorder (ADHD).* D. L. Grady*, Y. -C. Ding, H. -C. Chi, M. Smith, E. Wang, S. Schuck, P. Flodman, M. A. Spence, J. M. Swanson and R. K. Moyzis, Department of Biological Chemistry and Child Development Center, College of Medicine, University of California, Irvine, CA 92697.

(8) *Aggressive Behavior in Triplet Combinations of Unisexual and Bisexual Gecko Species.* Deborah C. Ishii-Thoene*, Roanne LeBrun and Susan G. Brown, Social Sciences Division, University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720-4091.

(9) *Variables Affecting Egg Mass Laying and Snail Emergence in Endemic Hawaiian Snails.* Karen Crowell*, Patricia Keene and Susan G. Brown, Social Sciences Division, University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720-4091.

(10) *Association of a Low-Phycourobilin Containing Phycoerythrin with Upwelling-Influenced Waters in the Gulf of California.* A. Michelle Wood*[1], Scott Pegau[2], Helmut Maske[3], Chuck Trees[4], Jim Mueller[4] and W.K.W. Li[5]. [1]Ecology and Evolution, University of Oregon, Eugene, OR 97403; [2]COAS, Oregon State University, Corvallis, OR; [3]CICESE/Ecologia, Ensenada, B.C., Mexico; [4]CHORS, San Diego State University, San Diego, CA 97331; [5]Bedford Institute of Oceanography, Dartmouth, N.S. B2Y4A2, Canada.

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(21) *Whole Genome Comparison: Visual Analysis of Pattern Hunter Nucleotide Homology Data.* Lawrence J. Miller* and Ming Li**,** Department of Computer Science, University of California, Santa Barbara, California 93106.

(22) *Arabidopsis Protease Activity Increases as a Result of Exposure to Ultraviolet Radiation.* April Agee* and Lois Rodrigo, Department of Biological Science, California State University, Fullerton. 800 N. State College Blvd., Fullerton, CA 92831.

EDUCATION

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HEALTH SCIENCES AND PSYCHOLOGY

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(14) *Desirable Body Weight Image and Vigorous Exercise: Gender and African-American/White Differences.* Ryan Lee*, Stephen Morewitz, Shervin Shamtoub, Joyce Tse, Katrine Muhl and Samantha Mullins, California College of Podiatric Medicine, 100 Corporate Place, Ste C., Vallejo, CA 94590.

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ECOLOGY AND ENVIRONMENTAL SCIENCES

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(17) *GIS Applicability to Agroecosystems Research: A Case Study Mapping the Insect Community of a Hawaiian Banana Patch.* Christian A. Rygh, Department of Geography and Environmental Studies, University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720.

(18) *The Cold Tolerance of Two Species of Hawaiian Drosophila from the Big Island of Hawai`i.* Angela Reza*, Michael R. Dohm, Sheryl Moore, Cedric Muir, William J. Mautz and Donald Price, Department of Biology, University of Hawai`i, Hilo, HI 96720.

(19) *Assessment of Potential Inbreeding Depression in the Nene (Branta sandvicensis or Hawaiian Goose).* Anne Valliet*, R. Trimble, B. Flesher, Cedric Muir, Donald Price, Department of Biology, University of Hawai`i at Hilo, 200 West Kawili, Hilo, HI 96720.

(20) *A GIS Exploration of Anthropogenic Factors to Elucidate the Distribution of Green Sea Turtle Fibropapillomatosis around the Island of Hawai`i.* Lisa K. Canale, Ecology, Evolution and Conservation Biology, University of Hawai`i at Hilo, 200 West Kawili Street, Hilo, HI 96720.

ABSTRACTS

Traditional Samoan use of the Tutuila Island Landscape. **DAVID J. ADDISON** (American Samoa Power Authority, PO Box 2545, Pago Pago, AS 96799, USA).

This paper discusses aspects of the traditional Samoan use of the island of Tutuila and draws on data from recent archaeological studies conducted there. The island is a steep volcanic island partially surrounded by a fringing coral reef. It is one of the smaller islands in the Samoan Archipelago. Current evidence suggests human use beginning around 3500 years ago. Samoa has long been proposed as an area from which other parts of Polynesia were settled. Basalt adzes from Tutuila have been found on widely dispersed islands in the Pacific. Recent archaeological projects have produced data suggesting that basalt quarries are much more common on Tutuila than previously documented. Additionally, they suggest extensive use of inland locations for habitation and agriculture around 1000 years ago. These recent findings are discussed.

Arabidopsis Protease Activity Increases as a Result of Exposure to Ultraviolet Radiation. **APRIL AGEE and LOIS RODRIGO** (Department of Biological Science, California State University, Fullerton. 800 N. State College Blvd., Fullerton, CA 92831).

Depletion of the atmospheric ozone layer has led to increasing amounts of physiologically damaging UV-B radiation reaching the Earth's surface. Mechanisms of UV damage and adaptations that protect living systems from such damage are important topics for current research. Plants respond to UV-related stresses by increasing DNA repair, producing UV-absorbing flavonoid pigments, and producing free radical scavenging compounds. It is known that proteins absorb UV, and they are likely targets for UV damage, along with DNA and lipids. The focus of this project is to determine the effects of UV-B radiation on the breakdown of proteins in Arabidopsis. In these experiments, plants exposed to UV-B radiation were found to have depleted levels of crude cellular protein, and increased cellular protease activity in purified extracts. It is likely that this increased protease activity is due, at least in part, to the enzymatic activity of the 20S proteasome.

Ancient Quarries of Tutuila. **RILEY A. ARTHUR** (South Pacific Academy, PO Box 3178, Pago Pago, AS 96799, USA).

Prior to the arrival of Europeans in the Pacific, indigenous tool technology relied heavily on stone, especially basalt. High-quality basalt for tool production is not a ubiquitous resource on Pacific islands and some islands completely lack it. Conversely, several basalt tool quarries have been previously documented on the Samoan island of Tutuila. Adzes geochemically provenienced to Tutuila Island have been found on a variety of widely spaced islands in the Pacific. The research presented here examines the possibility of a wider distribution and frequency of basalt tool manufacturing areas on Tutuila Island than previously documented. Forty-two streambeds were examined for evidence of stone tool manufacturing. The majority of these showed some evidence indicating tool production. Two watersheds in the research area were explored for quarries. Although no quarries have yet been found, there is strong evidence to suggest that they exist. This research is ongoing; the next step will be to examine ridge tops surrounding watersheds drained by streams that show evidence of tool production. There I expect to find quarries.

Hawaiian Silverswords and Guadalupe Island Deinandras: Independent Pacific Radiations of the California Tarweeds (Compositaeœ Madiinae). **BRUCE G. BALDWIN** (Jepson Herbarium and Department of Integrative Biology, 1001 Valley Life Sciences Building #2465, University of California, Berkeley, CA 94720-2465).

Multiple lines of phylogenetic evidence indicate that two major lineages of the California tarweeds gave rise to insular endemic lineages in the Pacific: the Hawaiian silversword alliance (*Argyroxiphium*, *Dubautia*, *Wilkesia*) and the shrubby tarweeds (*Deinandra*) of Guadalupe Island, Mexico. Both oceanic-island groups are woody lineages that arose after considerable radiation of the California tarweeds, a grade of mostly annual herbs based in the summer-dry California Floristic Province. Biosystematic and field studies on the Guadalupe Island deinandras have revealed that taxa of the group are fully interfertile and that natural hybridization occurs in areas of sympatry, as is well documented for the Hawaiian silversword alliance (Carr 1985; Carr and Kyhos 1986), wherein hybrids range from partially to fully fertile. Molecular phylogenetic investigations provide evidence that hybridization in the Hawaiian setting has had a lasting impact on the genetic constitution of some lineages in the silversword alliance, although divergent (rather than reticulate) evolution appears to have been widespread. Self-incompatibility æa rare condition among oce-

anic island plantsæis widespread in the silversword alliance (Carr et al. 1986) and universal within the Guadalupe Island deinandras, which may represent two exceptions to Baker's Rule (i.e., that colonizing taxa are generally capable of selfing). Evidence of minimal interisland dispersal, major ecological shifts associated with diversification, and unusually rapid diversification illustrate that the silversword alliance strictly conforms to expectations for an adaptive radiation. The Guadalupe Island deinandras, although of low diversity compared to the silversword alliance, also show evidence of considerable ecological change associated with recent diversification.

Evolution and Consequences of Food Specialization in a Hawaiian Honeycreeper. **[1]PAUL C. BANKO and [2]MARTIN L. CIPOLLINI** ([1]USGS @ Pacific Island Ecosystems Research Center, Kilauea Field Station, P.O. Box 44, Hawai`i National Park, HI 96718; [2]Department of Biology, Berry College, P.O. Box 430, Mount Berry, GA 30149).

The palila (*Loxioides bailleui*) is one of the last seed-specialist Hawaiian honeycreepers largely due to the prevalence of mamane (*Sophora chrysophylla*), the tree species that provides nearly all their nutritional requirements. Mamane promoted specialization by palila because its seeds are available year-round, where trees are distributed along a substantial gradient of elevation, and they are nutritionally valuable, although palila must work hard to open the pods and they ingest potentially toxic alkaloids. Competition for seeds of the few widely-distributed tree species available in the islands likely drove ecological and morphological diversification among the honeycreepers. The difficulty that young birds have in opening pods and preference for seeds of particular trees (presumably in response to varying levels of alkaloids) indicates that mamane promoted the phenotypic differentiation of palila. Ecological speciation occurred as palila became reproductively isolated, as demonstrated by the overriding influence of seed availability on timing of breeding, length of breeding season, and number of pairs that nest. This specialized seed-eater is particularly vulnerable to habitat destruction wrought by introduced browsers, which relish mamane foliage. Even so, alternative foods, especially in the form of insect prey that are easily obtained even by birds having a heavy, thick bill, also may be critical to the persistence of palila populations. Historically, palila were known to consume large quantities of caterpillars found on mamane, but alien parasitic wasps and flies and predatory ants and wasps now threaten palila insect prey to such a degree that they may greatly affect palila abundance and distribution.

Mauna Kea Commuters Down-regulate Exhaled Nitric Oxide during the Work Week. **C.M. BEALL, D.E. BROWN, P. MILLS, H. PORTER, V. CONTOS and K.P. STROHL** (Anthropology, Case Western Reserve University, Cleveland, OH 44106, Anthropology, U. of Hawai`i, Hilo, HI 96720, Medicine, Case Western Reserve University, Cleveland, OH 44106).

Nitric oxide (NO) in the lungs may help offset hypoxia by influencing blood flow and oxygen delivery. However, studies of healthy lowlanders exposed to minutes, hours or days of hypoxia report less NO synthesis, as measured by lower concentrations in exhaled breath. The present study was designed to measure the effects of repeated exposure to high-altitude hypoxia on exhaled NO. A sample of 11 men who were non-smokers traveled daily Monday through Thursday from Hilo, Hawai`i at sea level to the summit of Mauna Kea, worked a full day at 4200m and then returned to Hilo. On Monday, exhaled NO decreased from a morning pre-exposure average of 5.3 ppb to a post-hypoxia evening average of 4.6 ppb. On Thursday, exhaled NO decreased from a morning pre-exposure average of 4.1 ppb to a post-hypoxia evening average of 2.6 ppb. The sea level NO exhalation values significantly changed over time (using log-transformed NO values, repeated measures ANOVA, $F=7.6$, $p<0.001$; Bonferroni pairwise comparisons: Monday pre-exposure significantly higher than Thursday post-exposure, $p<0.01$; Monday post-exposure and Thursday pre-exposure significantly higher than Thursday post-exposure, $p<0.05$). Neither immediate relief of hypoxia upon evening descent nor overnight relief of hypoxia restored NO although three days at sea level did. The commuters' Monday morning pre-exposure exhaled NO did not differ from that of a sample of sea-level residents. Prolonged discontinuous hypoxia can cause a prolonged decrease in exhaled NO.

Human Dispersal in the Pacific and Population Structure. **REBECCA CANN** (University of Hawai`i at Manoa, Honolulu, HI 96822).

Colonization of Remote Oceania by humans marked a cultural transition akin to recent human experiences with space travel, according to some Pacific specialists. Is this metaphor correct? Genetic markers classically used to examine neutral population polymorphisms, as well as those linked to different behavioral strategies, such as the dopamine receptor D4 @ 7R allele, provide an increasingly broad view of the process of population expansion into Oceania. While the homeland of Austronesian-speaking colonists who eventually populated the far corners of the Polynesian triangle is still contested, increasing evidence of cultural and biological interactions between Near and Remote Oceanic populations has accumulated. The many high-density, stratified societies that evolved in just a few thousand years along a common resource axis (a horticulturally-transformed lowland coastal ecosystem combined with an intimate knowledge of the ocean) maintain levels of genetic diversity that imply sustained two-way interactions for most of the period of expansion. Nuclear genetic loci, contrasted

with paternal and maternal genetic systems, show that influxes of alleles due to secondary contact (in some places, linked to the kava trade network) can be differentiated from initial founding lineages. In general, diversity increases in a cline from the most eastern to the most western islands, as predicted by navigation ease and shared linguistic elements. Exceptions to the general pattern (Hawai`i, Rapa Nui) suggest that epidemiologists working with historical documents will provide further insights into the process of population replacement.

*A GIS Exploration of Anthropogenic Factors to Elucidate the Distribution of Green Sea Turtle Fibropapillomatosis around the Island of Hawai`i.* **LISA K. CANALE** (Ecology, Evolution and Conservation Biology, University of Hawai`i at Hilo, 200 West Kawili Street, Hilo, HI 96720).

In 1999 Landsberg, Balazs, Steidinger, Baden, Work, and Russell were the first to consider the long-term effects of biotoxins in aquatic animals in their paper, "Potential Role of Natural Tumor Promoters in Marine Turtle Fibropapillomatosis." The authors found an association between the distribution of Fibropapillomatosis (FP) in the Hawaiian Islands and the distributions of toxic benthic dinoflagellates (*Prorocentrum* spp.) known to produce okadaic acid, a tumor promoting chemical. The sites study on the west side of the Island of Hawai`i showed low levels of FP and low levels of *Prorocentrum* spp. per substrate species as compared to the study sites on the other four main islands. There were no study sites on the east side of the Island of Hawai`i however, this area has moderate to high level of FP tumor severity. In this study Geographic Information Systems technology was employed to explore three non-point source pollution mechanisms, water quality and coastal currents on the Island of Hawai`i to explain the difference in FP levels on the east and west side of the Island of Hawai`i. A west side-east side comparison of these factors lends general support to theory of bioaccumulation of toxin causative agents in the etiology of FP.

*Evolution in Action: New Animals and Plants on Hawai`i's Newest Volcanoes.* **HAMPTON L. CARSON** (Department of Cell and Molecular Biology, School of Medicine, University of Hawai`i at Manoa, Honolulu, HI 96822).

The volcanoes of the high Hawaiian Islands have been formed in succession as the Pacific Plate has moved slowly northwestward over a fixed "hot spot" of molten lava arising from the earth's mantle. As each younger island or volcano has cooled, most colonists come from the adjacent older island or volcano. The extreme geographical isolation of the archipelago as a whole (prior to human arrival) renders long-distance dispersal from the continents improbable, as it appears to have always been. Northwest of Kauai, the older islands have been naturally reduced in size and height, so that Kauai (age about 5 million years), represents a practical starting point for the tracing of lineages down the island chain. This sort of study is made easier by the strong tendency for most of the ancient lineages of terrestrial plants, snails and arthropods to show high degrees of single-island endemism of species. The origin of the "Big Island" of Hawai`i took place less than 0.5 million years ago and provides a superb venue study of recent genetic changes in populations. Tracing the origin of its species can often be supported by precise systematic and genetic data by comparing populations of putative ancestors with populations of the corresponding neospecies on the Big Island. A few *Drosophila* cases will be briefly discussed, including one dealing with certain groups of populations of the Big Island species, *Drosophila silvestris*. The data document the neoevolution of a unique polygenic character in males.

Imaging Kilauea Volcano's Magmatic System with Borehole Tilt- and Strainmeter Measurements. **PETER F. CERVELLI and ASTA MIKLIUS** (U.S. Geological Survey, Hawaiian Volcano Observatory, Hawai`i National Park, HI 96718).

An array of borehole strainmeters and tiltmeters monitor Kilauea volcano's summit caldera, its east rift zone, and the active vent, Pu`u `O`o. Over the last several years, four events stand out prominently in the tilt and strain records. These four highly self-similar events are characterized by a period of slow summit deflation, lasting about 24 hours, followed by very rapid inflation, lasting only a few tens of minutes. After inflation ceases, the summit then deflates asymptotically toward its pre-event level. Intense harmonic tremor precedes the rapid inflation by a few minutes; tremor then stops just before the inflation begins, only to resume again as the inflation reaches its peak. We interpret the initial deflation as arising from an interruption in magma supply to the shallow summit chamber. When the interruption ends, rapid inflation ensues, driven by the excess pressure of the accumulated magma below the locus of interruption. The asymptotic return to the pre-interruption level reflects the gradual re-equilibration of the magma system. This interpretation requires a two-tiered summit magma system: the shallow chamber below the caldera and a deeper reservoir, which long-term GPS and leveling measurements suggest lies south of the summit caldera. If our interpretation is correct, we can make several inferences about the connection from the summit magma system to Pu`u `O`o. These inferences include estimates of the effective conduit radius, the long term flux rate, and a lower limit on the depth of the conduit where it leaves the summit magma system.

Variables Affecting Egg Mass Laying and Snail Emergence in Endemic Hawaiian Snails. **KAREN CROWELL, PATRICIA KEENE and SUSAN G. BROWN** (Social Sciences Division, University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720-4091).

This research examined the factors related to egg mass laying and snail emergence in two endemic Hawaiian snails, *Succinea thaanumi* and *Succinea cepulla*. Data on egg mass laying, snail emergence, whether calcium was visible in the egg mass, and microhabitat fluctuations within the reserve were obtained. Embryos laid with visible calcium emerged sooner than embryos laid without visible calcium. The gel surrounding the embryos protected them from dehydration. When drought occurred, the gel contracted and embryos were found glued to the backs of leaves without visible gel. As rains resumed, the gel expanded and snails emerged. Egg mass laying was negatively correlated to weekly fluctuations in temperature, humidity and rainfall. Snail emergence was negatively related to fluctuations in rainfall and positively related to the number of masses laid 28 days previously. A snail's decision to lay a mass depends more on fluctuations in microhabitat variables rather than absolute temperature, humidity or rainfall. Additionally snails must decide whether to lay eggs with visible calcium deposits.

Effects of Ozone on Marine Toad Behavior, Water Balance, and Immune Function: Implications for Amphibian Declines? **MICHAEL R. DOHM and WILLIAM J. MAUTZ** (Deptartment of Biology, University of Hawai`i, Hilo, HI 96720).

Amphibian populations are disappearing from even relatively prisitine areas in the United States and the rest of the world at an increasingly alarming rate. Although many mechanisms have been proposed, explanations for the losses remain elusive. We are investigating the effects of ozone exposure on the behavior, immune function, and physiology of amphibians. Ozone is a common urban air pollutant, and in wildlife habitats adjacent to urban sources, ozone levels often exceed the U.S. federal standard. Ozone causes metabolic, immunological, and respiratory tract inflammatory responses in mammals, but ozone's effects on other vertebrate groups are not known. Amphibians may be particularly sensitive to ozone because their skin is a gas exchange organ. Thus, unlike mammals, a significant portion of the respiratory exchange surface of amphibians may receive direct exposure to airborne pollutants. In the toad, *Bufo marinus*, we found that water balance, thermal preferences, and immune function were all adversely affected one day after a 4-hr exposure to 0.8 ppm ozone at 22ºC. Compared to toads exposed to air, toads exposed to ozone had greater evaporative water loss and selected lower body temperatures in a thermal gradient. Ozone also impaired toad pulmonary immune function. In a phagocytosis assay, pulmonary macrophages from ozone-exposed toads consumed fewer microsphere test particles. We have replicated some of these findings in another amphibian species, which suggests that our results may add to the growing list of potential explanations for regional and global declines of amphibian populations.

Carbon Dioxide in the Oceans: Building the Long-Term Record. **JOHN E. DORE, DANIEL W. SADLER and DAVID M. KARL** (Department of Oceanography, University of Hawai`i at Manoa, Honolulu, HI 96822).

The world's oceans play a central role in regulating the concentration of carbon dioxide (CO_2) in the atmosphere. Because this key radiatively active gas is accumulating in the atmosphere as a result of the combustion of fossil fuels, much attention to the mechanisms controlling CO_2 exchange between the atmospheric and oceanic reservoirs has recently been generated. Despite the importance of the oceanic reservoir in the global cycle cycle of carbon, time-series measurements of oceanic inorganic carbon parameters were not implemented until the 1980's, and to date only a few locations globally have been sampled regularly over time. In the central North Pacific Ocean, the largest contiguous biome on Earth, a long-term oceanic CO_2 data record has been accumulating since 1988, thanks to the efforts of the Hawai`i Ocean Time-series (HOT) program scientists and staff. These data demonstrate not only a clear increasing trend of ocean CO_2 in response to the atmospheric accumulation, but also significant seasonal and interannual variability, the causes of which we are only beginning to understand.

Evidence that Smith-McCort Dysplasia in the Chamorro Population Results from a Founder Mutation in a Gene on the Long Arm of Chromosome 18. **NADIA EHTESHAM[1], RITA M. CANTOR[2,3], LILY M. KING[1], KENT REINKER[5], BERKLEY R. POWELL[6], DAVID L. RIMOIN[1,2,3,4], and DANIEL H. COHN[1,2,3]** ([1]Medical Genetics-Birth Defects Center, Ahmanson Department of Pediatrics, Cedars-Sinai Research Institute, Los Angeles, CA 90048; [2]Departments of Human Genetics, [3]Medicine, and [4]Pediatrics, UCLA School of Medicine, Los Angeles, CA; [5]University of Texas Health Sciences Center, San Antonio, TX; [6]Children's Hospital Central California, Madera and Department of Pediatrics, UCSF School of Medicine, Fresno, CA).

Smith-McCort dysplasia is a rare autosomal recessive osteochondrodysplasia characterized by short limbs and a short-trunk with a barrel-shaped chest. The radiographic phenotype includes platyspondyly, generalized abnormalities of the epiphyses and metaphyses, and a distinctive lacey appearance of the iliac crest. We performed a genome-wide scan in a consanguinous family from Guam and found evidence for linkage to a region on the long arm of chromo-

some 18. Analysis of a second smaller family was also consistent with linkage to this region, producing a maximum combined 2-point LOD score of 3.04 at a recombination fraction of zero for the marker at locus D18S450. A 10.7 cM region containing the disease gene was defined by recombination events in two affected individuals in the larger family. Furthermore all affected children in the larger family were homozygous for a subset of marker loci within this region, defining a 1.5 cM interval likely to contain the defective gene. Since both parents in family 1 and the mother in family 2 are of Chamorro descent, the data suggest the possibility that the Chamorro population has multiple Smith-McCort dysplasia carriers with the mutant founder chromosome.

Carrier Effect of Natural Zeolite and Its Applications. **NAI-QIAN FENG and GAI-FEI PENG** (Department of Civil Engineering, Tsinghua University, Beijing 100084, China).

As a main rock mineral of natural zeolite, zeolite is a family of frame-structured alumino-silicate hydrates. This paper presents several research results in China on carrier effect of zeolite, including both an ion-exchange function and ion-absorption function, that can be utilized for manufacturing new products of building materials. These products have been successfully applied to overcome some difficulties in construction engineering practice in China. Natural zeolite powder (NZP) can be prepared to form Ag^+ carrier, to further produce anti-bacteria ceramics, papers and plastics. In concrete, NZP can replace partial cement and inhibit harmful expansion caused by alkali-aggregate reaction. Low-alkali zeolite cement can also be manufactured by using the ion-exchange function of NZP. Gas- or water-carrier formed from the ion-absorption of NZP can be utilized to manufacture cellular concrete or a moisture-conditioning material, and minimize cracking caused by self-shrinkage in high performance concrete, respectively. NZP can also absorb superplasticizer and act as a carrier, which can control slump loss of fresh concrete when added in concrete.

*Ancient Hawai`i's Northwestern Frontier: Nihoa, Necker (Mokumanamana?) and French Frigates Shoal (Mokupapapa?).* **BEN FINNEY** (University of Hawai`i at Manoa, Honolulu, HI 96822).

Nihoa and Necker (Mokumanamana?) are the first two islands of the chain of ten small volcanic islands and atolls that make up the Northwest Hawaiian Islands and extend almost 2000 km beyond the main, inhabited islands of the Hawaiian chain. Nihoa lies some 240 km from Ni`ihau and Kaua`i, the last of the permanently inhabited Hawaiian islands, and Necker lies another 290 km to the northwest. These two small volcanic fragments are among the dozen or so "mystery islands" of Polynesia—so-called because they show signs of previous Polynesian occupation but were uninhabited at the time of European contact. Rather than treat Nihoa and Necker as isolates, we follow a regional approach such as recently applied by Weisler to Mangareva, Pitcairn and Henderson in Southeastern Polynesia and Di Piazza and Pearthree to Kirimati (Christmas) and Tabueran (Fanning) in the Line Islands. Legends, chants and more recent oral testimony about voyaging suggest that Nihoa, Necker and the adjacent atoll of French Frigates Shoal (Mokupapapa?) were formerly linked together with Ni`ihau-Kaua`i in an interaction sphere in which canoes, people, agricultural products, fish, turtles, highly valued feathers and other goods circulated. A concerted research program in archaeology, oral traditions, voyaging and other approaches is required to investigate systematically how Hawaiians once extended their reach to the northwest.

Aging and Decision-Making Competence. **MELISSA L. FINUCANE** (Kaiser Permanente Center for Health Research Hawai`i, 501 Alakawa St, Honolulu HI 96817 and Decision Research Science Institute, 1201 Oak St, Eugene OR 97401).

Older adults need to maintain strong decision-making competence as they age. However, age-related physical and psychological changes may impact older adults' judgment and decision processes. In this paper, research is reported on older versus younger adults' performance on two aspects of competence: comprehension and consistency across separate versus joint evaluation contexts. Results of two studies showed that increasing age relates to greater comprehension errors and inconsistent preferences, even when covariates (education, income, gender, self-perceived skill and health, decision style, attitude toward delegation) are held constant. The results will be discussed within the "compiled cognition" and the "expertise development" approaches to cognitive aging.

A Blended Model for College Science Teaching on the Internet: As Affordable and Time-Convenient but More Interactive than Lectures. **KATHLEEN M. FISHER** (Department of Biology, San Diego State University, San Diego, CA 92120).

Lecture teaching is the most frequently-used instructional method in universities, presumably due to its remarkable ease and efficiency. It is assumed that any educated person can lecture with no special training and little preparation, and that lecture content can be changed with ease in successive presentations. This paper describes a similarly affordable method for teaching large enrollment, university-level, science courses on the Internet. The model was initially developed and tested in a pilot study involving about 6,000 students, 18,000 credit units, and five instructors in the humanities and social sciences, and then was assessed in

a general education evolution course with about 50 students. In the pilot study, (a) preparation time by faculty was not much greater than is currently invested in lecture courses, (b) management of the course was not too difficult or time-consuming for the teaching staff or the institution, and (c) updating instructional material was relatively easy. Data from these studies will be presented. The instructional methods aims to promote each student's construction of his or her own knowledge and deep understanding of the material being taught. It involves significantly more student active learning than a lecture course. There are five primary components in the instructional model: instructor-generated knowledge webs; shared knowledge objects; self-testing; learner collaboration, and peer communication. These components will be described and demonstrated.

Characterization of the Nuclear-encoded Genes that Regulate the Translation of the Chloroplast-encoded psbA mRNA of Chlamydomonas reinhardtii. **L. FLORES[1] L. ARCE[2] R. HAWK[3] and A. COHEN[1]** ([1]Department of Biological Science, California State University, Fullerton, 800 N. State College, Fullerton, CA 92834-6850, [2]Department of Molecular Biology and Biochemistry, University of California, Irvine, 3205 McGaw Hall, Irvine, CA 92697-3900, [3]Department of Pharmaceutical Sciences, School of Pharmacy, University of Southern California**,** 1985 Zonal Ave. PSC 716, Los Angeles, CA 90089-9121).

In the unicellular green alga *Chlamydomonas reinhardtii*, a set of nuclear-encoded proteins (RB38, RB47 and RB60) that bind to the 5'-untranslated region of the chloroplast *psbA* mRNA has been identified as translational activators (Danon and Mayfield, 1991, EMBO: 10:3993). In order to investigate the primary signals that regulate the expression of the nuclear genes that encode for the *psbA* mRNA binding proteins, wild type and y-1 strains of *Chlamydomonas reinhardtii* were used. Wild type cells contain a mature chloroplast in light- and dark-grown cells, whereas y-1 cells contain an etioplast in dark-grown cells. RNA blots showed that RB47 mRNA accumulated equally in light- and dark-grown wild type and y-1 cells, whereas RB38 and RB60 mRNA accumulated in a light-dependent manner in both cell types. Thus, the genes that encode for the RB38 and RB60 proteins appear to be induced by light at the transcriptional level, while the gene that encodes RB47 is constitutively expressed. Immunoblot analysis of crude soluble protein samples isolated from light- and dark-grown wild type and y-1 cells showed that the RB38 and RB60 proteins accumulated in a constitutive manner. Similarly, the nuclear-encoded OEE1 protein, which was previously shown to be light regulated (Malnoî et al, 1988, J. Cell Biol. 106: 609), accumulates in both wt and y-1 light- and dark-grown cells. Additional immunoblot analyses of protein accumulation over a 24-hour period and evaluation of polysomal RNA accumulation should provide a more comprehensive picture of the primary expression characteristics of the *psbA* RB38, RB47 and RB60 genes.

Spiders on the Storm: Adaptive Radiation on Pacific Archipelagos. **ROSEMARY G. GILLESPIE** (Insect Biology, 201 Wellman Hall, University of California, Berkeley, CA 94720-3112).

Adaptive radiation involves the diversification of species to exploit different ecological roles, with related adaptations. It is associated with the occupation of new environments that are sufficiently isolated as to allow colonists to diversify by filling multiple ecological roles. How is the diversification achieved? I have been studying spiders in the genus *Tetragnatha* in order to elucidate commonalities underlying patterns of adaptive radiation. In this talk I will first compare three archipelagoes of differing isolation across the Pacific and show that the genus has diversified within each, although the lineages are unrelated to each other. Second, I compare different lineages within the Hawaiian Islands, where the diversification is the most prolific, to determine how species differentiation is occurring within the archipelago. I show that one clade, the spiny-leg clade, has progressed down the island chain, with species on any one island most closely related to others on the same island. Moreover, the same set of ecological forms has evolved repeatedly, filling the ecological space in a similar manner and allowing multiple species to co-occur. However, another clade of spiders, a web-building clade, is ecologically conservative, and has differentiated between geographic areas only, with a single representative of the clade at any one site. The general conclusion is that adaptive radiation has occurred in multiple lineages of *Tetragnatha* in the Pacific, and has done so independently, with multiple mechanisms underlying diversification.

High Incidence of Rare Dopamine Receptor D4 (DRD4) Alleles in Children Diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). **D. L. GRADY, Y. -C. DING, H. -C. CHI, M. SMITH, E. WANG, S. SCHUCK, P. FLODMAN, M. A. SPENCE, J. M. SWANSON, and R. K. MOYZIS** (Department of Biological Chemistry and Child Development Center, College of Medicine, University of California, Irvine, California, 92697).

Associations have been reported of the 7-repeat (7R) allele of the human dopamine receptor D4 (DRD4) gene with both the personality trait of novelty seeking and attention deficit/hyperactivity disorder (ADHD). The increased frequency of the 7R-allele in ADHD probands is consistent with the common variant-common disorder (CVCD) hypothesis, which proposes that the high frequency of many complex genetic disorders is related to common DNA variants. Recently, based on the unusual DNA sequence organization and strong linkage disequilibrium surrounding the

DRD4 7R-allele, we proposed that this allele originated as a rare mutational event, that nevertheless increased to high frequency in human populations by positive selection (Ding et. al., Proc. Natl. Acad. Sci. USA 99, 309-314, 2002). We have now determined, by DNA resequencing of 250 DRD4 alleles obtained from 132 ADHD probands, that most ADHD 7R-alleles are of the conserved haplotype found in our previous 600 allele worldwide DNA sample. Interestingly, however, over 10 percent of the ADHD probands had novel haplotypes, not previously found in our worldwide allele sample. The probability that this high incidence of novel alleles occurred by chance in our ADHD sample is less that 0.001. Most of these novel haplotypes were 7R-allele derived. These results suggest that genetic heterogeneity is also contributing to the association of the DRD4 locus with ADHD, as is routinely found for "single-gene" genetic disorders.

Real-Time Thermal Monitoring of Kilauea Volcano from Space and the Ground. **ANDREW J.L. HARRIS** (HIGP/SOEST, University of Hawai`i, 2525 Correa Road, Honolulu, HI 96822).

In 1997 we began to develop a means of gaining timely thermal data for Kilauea. To achieve this, we used data from the GOES satellites. These data are ideal because they are sensitive to eruption-related hot spots and are available every 15 minutes. To make hot spot information available in a timely fashion, we developed an automated system that processes the data, searching for hot spots, on reception. Results are placed on http://goes.higp.hawaii.edu/ as soon as they are available and are updated 4 times an hour. In addition, an automated email notice is distributed should interesting thermal events be detected. During 2000 we began work on a second, ground-based system. This involved placing three thermal sensors, in protective cases, on the rim of Pu`u `O`o. These were installed during November 2000 and continue to operate. Data are telemetered to the Hawaiian Volcano Observatory every 3 seconds and are immediately available on a dedicated PC. Data are also used to update web-based graphs every 15 minutes. These data are capable of timing the onset, development and decay of activity. Successful testing of these tools on Kilauea has led to an expansion of the GOES system to include the entire eastern section of the Pacific rim. In addition, a second thermal system based on the Kilauea design will be installed on Stromboli during May 2002. In the meantime five portable versions of the design have been used for temporary deployments in Africa, Central America, and South America.

Use of Collaborative Problem Solving in the Field to Predict "Future" Effects of Past Events. **GARRY F. HAYES** (Geology Department, Modesto Junior College, 435 College Ave., Modesto, CA 95350).

Many sites in the field provide vivid examples of the negative effects of human intervention in natural systems adjacent to areas not yet affected. Such sites allow students to utilize collaborative problem solving techniques to predict the effects of the intervention, and to receive immediate validation of their predictions by observing the changes that have already taken place. Gower Gulch near Zabriskie Point in Death Valley National Park is one place where this technique is demonstrated. At the beginning of the exercise, students work in small groups to predict the effect of diverting storm runoff from a major (170 square miles) desert drainage basin into a smaller (2 square miles) gully with the intended purpose of preventing flood damage at the Furnace Creek Resort complex. Students report and discuss their predictions about the diversion, including changes in the new and old channels, in flow of groundwater, and patterns of deposition on the alluvial fan, along with unintended changes at the resort itself. The channel was actually diverted a short distance upstream in 1941, and many of the effects of the diversion are visible within a short walk from Zabriskie Point. Students can immediately assess the accuracy of their predictions. This technique can be adapted to a wide variety of environmental and geological situations such as mass wasting in urban areas, sand depletion and beach drift near coastal developments, introduction of non-native species, and mine development in sensitive ecosystems.

Our Knowledge of Native Hawaiian Ecosystems is Mushrooming! **DON E. HEMMES** (Biology Department, University of Hawai`i, Hilo, HI 96720).

The Hawaiian Islands are widely recognized as living evolutionary laboratories. Because of the differing ages of the various islands and the many biomes and ecological niches within the archipelago, Hawai`i is still a fascinating place for naturalists and evolutionary biologists to study. Hawai`i's fascinating forest birds, the honeycreepers, are prime examples of radiation of species into the various ecological niches from a few common founders. The explosion of *Drosophila* and other insect genera into 100's of species and incredible adaptive shifts such as the development of predatory caterpillars highlight the evolution of insects in isolation in Hawai`i. The radiation of endemic tree snails, the Achatinellidae, on isolated mountain ridges in Hawai`i is well known. And we cannot forget the vascular plants, the silversword alliance, the lobeliads, native mints, violets, and other groups that have involved into many unique species. The story continues. We can now add the Agaricales, the fleshy mushrooms of Hawai`i, as being special and unique with an endemicism of native rain forest species approaching ninety percent.

Easter Island Prehistory: A Story of Success or Failure? **TERRY L. HUNT** (Department of Anthropology, 2424 Maile Way, Saunders Hall 346, University of Hawai`i, Honolulu, HI 96822).

The archaeology of Easter Island (Rapa Nui) reveals a remarkable story. People of a small, isolated Polynesian society carved and transported more than a thousand colossal statues (moai) to all corners of the island. In art, architecture, and material culture, the ancient Rapa Nui invested more per capita than any other society in Polynesia, perhaps in the world. The same people saw the island's forest disappear and suffered increasing competition as resources dwindled on this already marginal island. Some authors have suggested that irrational escalating of one-upmanship in statue manufacture/transport depleted resources and led the ancient society into its decline and fall. In this presentation, I propose a dramatic alternative: these investments in cultural elaboration brought Easter Island society relative success, indeed persisting longer than it could have otherwise. I outline the available and necessary lines of evidence which may lend support this alternative view of Rapa Nui's prehistory.

Aggressive Behavior in Triplet Combinations of Unisexual and Bisexual Gecko Species. **DEBORAH C. ISHII-THOENE, ROANNE LEBRUN and SUSAN G. BROWN** (Social Sciences Division, University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720-4091).

Lepidodactylus lugubris, a species of unisexual gecko, are usually intolerant of the close proximity of other individuals. In contrast, *Hemidactylus frenatus*, a bisexual species, are often found in close proximity to each other. Optimal spacing between *L. lugubris* is maintained through aggressive interactions. Research has examined the aggressive behavior of the unisexual with that of the physically larger bisexual species, but the results have been contradictory. In this study, we videotaped the aggressive behavior between various triplets of the two species. We found that unisexuals displayed more aggressive behavior than the bisexuals. The unisexuals were more likely to aggressively approach the bisexuals than the opposite. The bisexuals usually did not respond to the unisexuals' aggressive displays. Because the *H. frenatus* rarely respond to the *L. lugubris* displays, an optimal distance is seldom reached between individuals. This most likely stresses the unisexuals and might account for the decreased number of eggs laid by unisexuals when they are housed with bisexual geckos.

Investigations of Capricious Gene Expression in Drosophila Wing Development. **MICHELLE ITANO and LOIS ABBOTT** (University of Colorado, Molecular, Cellular, and Developmental Biology Department, UCB 347, Boulder, Colorado 80309).

Previous work using a reporter gene suggests that *capricious* (*caps*) has a role in *Drosophila* wing development. Use of the LacZ reporter gene present in *caps* mutants indicates that *caps* may have a function in wing development because of the presence of a consistent staining pattern in the wing discs, precursors to adult wings. An *in situ* hybridization is a procedure in which a probe made of *caps* cDNA is hybridized to the wing discs. This indicates which cells are expressing *caps*. *Caps* expression was observed in the wing discs, supporting the hypothesis that *caps* has a function in wing development. Another procedure for testing this hypothesis is clonal analysis. This procedure consists of creating small patches of cells mutant for *caps* in the wing discs. The phenotypic effect of these mutant cells will be used to indicate the role *caps* has in wing development.

Fossil Sharks of the Rocky Mountains: Ctenacanthus and other Chondrichthyan Spines and Denticles. **WAYNE M. ITANO[1], KAREN J. HOUCK[2], and MARTIN G. LOCKLEY[2]** ([1]1995 Dartmouth Ave., Boulder, CO 80305; [2]Dept. of Geography, Geology, and Environmental Science, University of Colorado, Denver, 80217).

Chondrichthyan spines and dermal denticles are reported from the Middle Pennsylvanian Minturn Formation, Eagle County, Colorado. The most common element is a dorsal finspine referred to *Ctenacanthus buttersi* St. John and Worthen. The holotype and only previously figured specimen of *C. buttersi*, from the Pennsylvanian of Illinois, consists of the proximal half of a dorsal finspine. The Colorado specimens allow us to reconstruct the appearance of nearly the entire finspine. The finspine of *C. buttersi* shows an unusual combination of features, since the surface ornament, consisting of numerous, finely denticulated longitudinal ribs, is typical of ctenacanthiform sharks, while the posterior face is convex, a feature normally associated with another group of sharks, the hybodonts. Less common remains from the Minturn Formation include a dorsal finspine referred to *Acondylacanthus nuperus* St. John and Worthen, another dorsal finspine close to *"Ctenacanthus" furicarinatus* Newberry, a spine fragment probably referrable to *Physonemus* sp., and two large-noded dorsal finspines probably referrable to two different species of *Bythiacanthus*. Dermal denticles are referred to *Petrodus patelliformis* M'Coy. All of these finds represent extensions of the known geographic ranges to the southern Rocky Mountain region of these taxa, most of which were originally described from the mid-continent of North America. *Ctenacanthus buttersi* finspines and some large cladodont teeth, referred to *"Cladodus" occidentalis* Leidy, may belong to the same species. This conjecture is based mainly on the relative abundances of chondrichthyan teeth found at the same locality.

*Conservation Challenges on the Island Of Hawai`i.* **JAMES D. JACOBI** (U.S. Geological Survey, Pacific Island Ecosystem Research Center, Hawai`i Volcanoes National Park, HI 96718).

The extremely unique biota of the Hawaiian Islands is dramatically juxtaposed with changes that have occurred in these native ecosystems following the arrival of humans in this isolated archipelago starting nearly 2,000 years ago. Since then, many thousands of species of plants and animals have been either purposely or accidentally introduced into Hawai`i, with the majority of them coming in within the past 150 years. Today, less than 50% of the landscape found on the eight major islands is still dominated by native plant communities, and a large number of the native plants and animals are extremely rare, or, in some cases, extinct. Currently, natural resource conservation efforts in Hawai`i are focused on several types of issues: 1) preventing, reducing, or eliminating the impacts of alien species; 2) restoration of degraded native plant and animal populations and their habitats; and 3) increasing public awareness and support of the uniqueness of the Hawaiian ecosystems and the value in conserving these important resources. Examples of how these critical challenges are being addressed on the island of Hawai`i are described.

A Paleontologist's View of Island Biogeography. **HELEN F. JAMES** (Department of Systematic Biology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560).

Island biogeographers believe that the simplicity and clarity of island ecosystems will lead them to insights into evolutionary and ecological processes. On islands compared with continents, it can be easier to identify and thoroughly sample clades, map distributions, define barriers to gene flow, and trace the history of landscape change.

The study of native Hawaiian birds has all these advantages, plus one more of special value. The islands have an abundant fossil record of birds, presenting the chance to apply data with real time depth to the study of processes that, after all, take place over long stretches of time. Many of the extraordinary species of birds in the fossil record became extinct after humans arrived in the islands (perhaps 1500 years ago). Fossil-based estimates of the numbers of native land bird species present in pre-human times indicate that the archipelago had attained high species richness, despite its isolation from continental source areas. A phylogeographic study of the adaptive radiation of Hawaiian honeycreepers, incorporating fossil and recent distributions, reinforces the importance of rare inter-island dispersal events in generating this diversity. That inter-island colonization is infrequent is supported by long-term fossil records of avifaunal change, which reveal a surprising stability in the avifaunas of individual islands over time. Study of the extinction record indicates that geographically widespread species are likely to suffer extinction as well as geographically restricted ones, contradicting the idea that specialized species with restricted distributions are the most vulnerable to extinction.

Impacts of Introduced Disease on Native Hawaiian Avifauna: Genetic Studies of Host-parasite Coevolution. **SUSAN JARVI[1,2], CARTER ATKINSON[2], ROBERFLEISCHER[3], MARGARET FARIAS[1], KIARA BANKS[1], CHERYL TARR[3], and LORI EGGERT[3]** ([1]Biology Department, University of Hawai`i at Hilo, 200 W. Kawili St, Hilo HI 96720, [2]Pacific Islands Ecosystems Research Center, USGS-Biological Resources Division, Hawai`i Volcanoes National Park, HI 96718, [3]Museum of Natural History, Smithsonian Institution, Washington DC 20008-0551).

Studies of human malaria provide evidence that the selective pressure of infectious disease can profoundly modify the genetic make-up of hosts and that selection by the host may, similarly, modify parasite populations. The relatively recent introduction of malaria (*Plasmodium relictum*) and its mosquito vector to the Hawaiian archipelago has influenced population structure and size and has limited habitat availability for many species of honeycreepers. In fact, the current elevational and geographic distribution of honeycreepers appears directly correlated with relative susceptibility or resistance to this disease. Our laboratory studies provide a comparative analyses of genetic variability of a more susceptible species (e.g. i`iwi) with a more resistant species (e.g. amakihi), as defined by malaria challenge experiments. Current genetic results are based on analyses of mtDNA, *Mhc* genes and genome-wide analyses of hosts by AFLP and microsatellites. Similarly, we are evaluating diversity and pathogenicity of the parasite. We have found that amakihi appear more genetically diverse than i'iwi based on mtDNA and *Mhc* RFLP analyses, and that selection is intense at *Mhc* antigen-binding regions in honeycreepers as compared with other passerines. No variation was found among mtDNA sequences from 11 i`iwi from three islands, as compared with high variability found in amakihi. This suggests that i`iwi may have experienced a population bottleneck. We have found at least 8 distinct malaria variants based on 18S rRNA genes and up to 40 variants based on genes encoding a cell-surface molecule (TRAP). Multiple infections have been documented in all individuals evaluated to date.

Lava Flow Advances. **JIM KAUAHIKAUA** (U.S. Geological Survey**,** Hawaiian Volcano Observatory, P.O. Box 51, Hawai`i National Park, HI 96718).

Hawaiian lava flows have received a great deal of study in the last two decades; the results have had interesting ramifications beyond Hawai`i. We have discovered that

many pahoehoe flows inflate as long as they are supplied with lava, similar to the way a balloon inflates as air is blown into it. Inflated Hawaiian flows are rarely more than a few kilometers in horizontal dimension. The inflation mechanism may help to explain the emplacement of some of the largest lava flows on Earth and other planets; these flows attain dimensions of hundreds of kilometers. Lava flowing within a tube is capable of melting and/or eroding the underlying solid rock at a rate of 10 cm/day. This measurement settles a long-lived controversy and offers a plausible explanation for a wide range of puzzlements. This includes how metals are scavenged by komatiite lava flows, some of the largest and hottest lava flows in Earth's history. Komatiite streams simply melt the metal-rich sediments they flow over.

`A`a flows have been studied as well. All volcanology students have been taught that a pahoehoe flow can change into an `a`a flow but that the reverse is never observed. However, we have observed the apparent reverse transition several times. If we refrain from identifying a liquid as either pahoehoe or `a`a, and reserve those terms for the solidified products only, then liquid lava can solidify as either pahoehoe or `a`a depending on the local circumstances.

Karyomorphology and Genome Analysis of Four Cultivars of Tulipa. **TASNEEM F. KHALEEL** (Department of Biological and Physical Sciences, Montana State University-Billings, 1500 N. 30th Street, Billings, Montana 59101).

Chromosome morphology, karyotype and genome analysis of four cultivars of *Tulipa* is presented. These are Apeldoorn's Elite (flowers red with yellow edge), Brigitta (yellow with red blush), Candela (solid yellow) and Hollandia (shiny red). Cultivated tulips are divided into 15 divisions based on the flowering time, bulb and flower characteristics. Three of the cultivars (Apeldoorn 's Elite, Brigitta, and Hollandia) are mid-season flowering tulips and Candela is early flowering. Brigitta and Hollandia belong to Division #3 Triumph. Apeldoorn 's Elite belongs to Division #4 Darwin Hybrids and Candela to #8 Fosteriana. Triumph tulips are the result of hybridization between Single Early Group and Later Flowering Tulips. Darwin Hybrids are obtained from crossing Darwin tulips and varieties of *Tulipa fosteriana*. The basic chromosome number is n=12 in all four cultivars. Candela and Hollandia are diploid and Brigitta and Apeldoorn's Eite are triploid. Candela and Hollandia (2n=24) show similar karyotypes composed of 11 pairs of acrocentric (arm ratio between 1:4-1:6) and one pair of submetacentric (arm ratio 1:2) chromosomes. In Brigitta (2n=36), 33 chromosomes are acrocentric and three are submetacentric. In Apeldoorn's Elite (2n=36), 34 chromosomes are acrocentric (ten triplets and two pairs) and one pair is submetacentric. The genus *Tulipa* may provide a useful system with which to examine further the mechanism of karyotype evolution.

Seasonal Effects of Water Quality in the Yellowstone River Basin on Root Growth and Mitotic Index in Allium cepa L. **TASNEEM F. KHALEEL, JOHNNA HEDMAN, LAURA MADDEN and AMBER OSBORNE** (Department of Biological and Physical Sciences, Montana State University-Billings, 1500 N. 30th Street, Billings, Montana 59101).

This study determines the seasonal effects of Yellowstone River water quality on root growth and mitosis in *Allium cepa* L. Land use in the Yellowstone River Basin is largely agricultural. Agricultural practices change water composition during each crop maintenance phase. We chose to study the effects of water composition during the beginning and end of the active growing season, and compared it to inactive season. We determined a correlation between the chemicals present in water and root growth morphology and mitotic index. This study focused on water samples from three sites: the Yellowstone River at Corwin Springs (located upstream from any large agricultural or industrialized areas to obtain likely indications of natural seasonal fluctuations in water composition), Sidney (at the base of the Yellowstone watershed, located downstream from a great deal of agricultural land) and the Soda Butte River at Silvergate, Montana which flows through a heavily mineralized and historically mined area that does not support agriculture. Bulbs of *Allium cepa* were grown in tubes filled with water samples from each site and distilled water for five days. On the sixth day, root data was recorded and root tips were fixed in 1:3 acetic alcohol. Mitotic index was calculated from each sample site and the controls by scanning 2000 cells. Statistical analysis was done to determine the significance of the morphological and the cytological abnormalities. Results suggest a relationship between water quality, cell cycle events and root morphology. Mitotic abnormalities such as c-mitosis, anaphase bridges, and stickiness were observed.

Lapita and the Initial Expansion of the Oceanic-Speaking Peoples. **PATRICK V. KIRCH** (Archaeological Research Facility and P. A. Hearst Museum of Anthropology, University of California, Berkeley, CA 94720).

The Austronesian-speaking peoples are dispersed from Madagascar to Easter Island, reflecting one the world's major diasporas. One major subgroup of the Austronesians, the Oceanic language group, includes the vast majority of peoples within the Pacific Island region, including most of island Melanesia (with the exception of New Guinea), Polynesia, and central-east Micronesia. Utilizing independent lines of evidence from archaeology, historical linguistics, and biological anthropology, a strong argument can be advanced that the initial expansion of Proto-Oceanic speakers corresponds with a major archaeological phenomenon—the Lapita Cultural Complex. Archaeological sites bearing Lapita pottery are distributed from the Bismarck Archipel-

ago in the west, to New Caledonia in the south, and as far east as Tonga and Samoa. In time, these sites date from ca. 3500 to 2800 years before present (B.P.). In this paper I review the lines of evidence for correlating the Lapita Cultural Complex with the Proto-Oceanic group of Austronesians. The nature of early Lapita/Oceanic culture is reviewed, including aspects of subsistence economy, settlement pattern, trade and exchange relations, and social organization. The sequence of geographic expansion of the Lapita/Oceanic culture is considered, as are the implications for initial cultural diversification in Remote Oceania.

Examination of the Gut Contents of Big Island Reef Fish for the Presence of Toxigenic Dinoflagellates. **JESSELYNNE KRIEF and MICHAEL L. PARSONS** (Marine Science Department, University of Hawai`i, Hilo, HI 96720).

Toxins responsible for causing ciguatera fish poisoning (CFP) are produced by several different species of epiphytic dinoflagellates, many of which are present and growing on macrophytes in Hawaiian coastal waters. While it is inferred that the direct mechanism enabling these toxins to enter the food web is through the ingestion of macrophytes (and the epiphytic dinoflagellates) by herbivorous fish, little data have been collected to study this trophic transfer. Samples of several species of reef fish were collected from various sites around the Big Island of Hawai`i to examine the gut contents of the fish to determine if and to what extent toxigenic dinoflagellates were present, demonstrating the mechanism of toxin transfer. The samples consisted predominantly of *Ctenochaetus strigosus* (Kole), an herbivorous reef fish often implicated in CFP, and therefore hypothesized to contain significant numbers of toxigenic dinoflagellates in their gut contents. Kole gut contents were stained with diethanol and examined under an epifluorescent microscope, which facilitated the identification and enumeration of dinoflagellates. The numbers of toxigenic dinoflagellates enumerated were classified by fish size and location and then analyzed statistically. Potentially toxic dinoflagellates from the genera *Prorocentrum*, *Ostreopsis*, and *Gambierdiscus* were present in the gut contents of many Kole, independent of location. This finding is significant as cases of Big Island CFP reported to the Department of Health are mostly caused by fish caught in West Hawai`i, implying that West Hawai`i fish are more likely to contain ciguatera toxins. The results of this study, however, demonstrate that the vector for ciguatera toxin accumulation may be present for all of the coastal waters of the Big Island.

Volcanic Air Pollution on Horticultural Crops. **B.A. KRATKY and C.L. CHIA** (University of Hawai`i CTAHR, TPSS Dept., Beaumont Agricultural Research Center, 461 W. Lanikaula St., Hilo, HI 96720).

Volcanic air pollution damage to tomatoes may result when foliage is burned by moist air with high sulfur content or from rainfall in a voggy location which deposits pollutants onto plants and interferes with pollen viability.

Periodically, there has been an obvious sulfurous odor at the UH CTAHR Volcano Agricultural Experiment Station on Wright Road which is located less than 10 km from The Volcanoes National Park. The high sulfur content of the air combines with dew, fog or high moisture in the air to form sulfuric acid which causes contact injury of plants and is expressed as foliage burning. Even vegetables growing in plastic-covered rainshelters and greenhouses do not escape injury. For example, greenhouse-grown lettuce (a short-term crop) suffered permanent injury, whereas greenhouse-grown tomatoes (a long-term crop) suffered severe leaf burning, but they recovered and produced a very good crop. There have been incidences where a sulfurous event occurred during midday when plant surfaces were dry and no damage resulted.

During 1969-1973, atmospheric haze “volcanic smog” (now known as vog) in the Kona area about 75 km from Kileaua Volcano coincided with an eruption period. Rainwater collected during this period was acidic (pH 4.0 to 4.4) and it contained measurable quantities of chloride and sulfate ions plus 27 detectable (but unidentified) organic compounds the ppb range. Similar organic compounds in Oahu rainwater measured in the ppt range or a thousandfold less than in the Kona district.

A mysterious tomato disease occurred in the Kona area at this time. Symptoms included blossom drop, poor fruit set, hollow and almost seedless fruits and a less luxuriant appearance plus yields and quality were severely reduced. A plastic-covered rainshelter was placed over an experimental tomato plot in the Kainaliu area during an extended vog episode in 1972. These plants produced 6 kg of salable tomatoes per plant, whereas unprotected plants growing in the open field produced no salable yield.

Pollutants from vog in the acidic rainwater contributed to poor pollen germination which did not improve when this rainwater was made less acidic in a laboratory test. Poor pollen germination can cause almost seedless fruits which also lack the gelatin-like placenta which normally surrounds the seeds and this causes the locules of the fruit to become hollow.

Leaching of nutrients from plants can contribute to a less luxuriant appearance and smaller fruit size. More calcium, magnesium and potassium leached from tomato leaves immersed in Kona rainwater than from leaves immersed in distilled water. Presumably, the acidic nature of the rainwater caused it to become a better extractant of nutrients from the foliage.

We concluded that open-field-grown tomatoes were injured because the contents of the vog were dissolved in Kona rainwater and deposited on the plants. The plastic-covered rainshelter intercepted the rainfall, and thus, protected the plants from these pollutants. Therefore, growing plants in plastic-covered rainshelters or greenhouses was a

practical solution for growing tomatoes during this vog episode.

Damage to fruit crops is not as well documented. Avocado growers in Kona attribute yield decline after 1984 to poor weather conditions including drought, acid rain and vog. Vog particulates have been suggested to have a negative impact on coffee crops grown in Kona. Vog also has been implicated in reducing rainfall in South Kona and this has been blamed for poor macadamia harvests.

The Effect of Colored Mulches on Development of Basil, Lettuce, and Radish Grown in a Greenhouse Environment. **JESSE LIWAI and WILLIAM S. SAKAI** (University of Hawai`i, Hilo, HI 96720).

Mulches are commonly used in the production of vegetable crops. Benefits include, but are not limited to, the conservation of water and weed control. In the past, the most common artificial mulch color was black. Colored mulches were hypothesized to retain the benefits of black mulch, but to also affect the growth of the crop plant in desirable ways. This study compares the growth of basil, lettuce, and radish from seed for thirty days using flats with colored mulches of black, blue, orange, red, and white or no mulch in a greenhouse environment. Mulches were made by spray-painting gravel until completely covered. This experiment appears suitable for use as a laboratory in an introductory horticulture class.

Desirable Body Weight Image and Vigorous Exercise: Gender and African-American/White Differences. **RYAN LEE, STEPHEN MOREWITZ, SHERVIN SHAMTOUB, JOYCE TSE, KATRINE MUHL and SAMANTHA MULLINS** (California College of Podiatric Medicine, 100 Corporate Place, Ste. C, Vallejo, CA 94590).

Body image is an predictor of physical activity (Gordon-Larsen, 2001). For example, Gordon-Larsen (2001) found that obese adolescents had a larger ideal body size image and lower levels of physical activity, and higher inactivity than non-obese adolescents. Using data from the 1998 Health Interview Survey (N=30,534 adults), this study evaluates possible gender and African-American-White differences in desirable body weight image and participation in vigorous exercise. The Survey obtained self-report data on a variety of health issues, including desirable body weight, frequency of vigorous exercise, and lower extremity pain. Correlational analysis was performed to test the null hypothesis that there are no gender and African-American/White differences in desirable body weight and vigorous activity. Partial correlations were performed to control for possible intervening variables, such as ankle pain, arthritis impairment, weight impairment, and family income. The null hypothesis was rejected. There was a low positive correlation between body image and vigorous exercise among White females. Those White females who felt that they are 5-9% or more above their desirable weight were more likely to engage in vigorous exercise ($r=+.124$, $p<.000$, $N=14,323$). In contrast, there was a negligible positive correlation between desirable weight and exercise among White males and no association between desirable body weight and exercise among African-American females and males. These differences remained significant after controlling for possible predictor variables. This investigation found gender and racial/ethnic differences in desirable body weight image and participation in vigorous exercise.

Addressing the Complexities of Alien Species Prevention and Control in Hawai`i: Biology, Politics and Economics. **STEVE LOHSE** (Coordinator, CGAPS, The Coordinating Group on Alien Pest Species).

Good alien pest management (biosecurity) = good biology + good politics + good economics. These three elements are jointly necessary AND sufficient for good management. Biology is the necessary substance of good management. We cannot “manage” what we do not understand. Understanding arrives in many forms by several approaches, both authoritative and empirical. In fact, good politics demands that it do so in Hawai`i. Politics is the necessary process of good management. We cannot “manage” if we cannot make or implement good public decisions. The decision process can be very difficult, especially when it involves “paying dues.” In fact, good economics demands that we do just that in Hawai`i. Economics is the necessary engine that moves good management. We cannot “manage” what we will not “pay” for. Unfortunately, biosecurity is a pure public good, like national security, neither exclusive nor rival. Pure public goods reward us in the short term for NOT paying sufficient maintenance to sustain them, for externalizing their true costs, i.e., free-riding on the environment. Biosecurity = adequate environmental understanding + healthy environmental decision-making processes + internalized environmental costs. To the extent that we achieve these three conditions, we will have sustainable alien species prevention and control.

Population Origins, Gene Flow, Drug Metabolism, and Malaria in the Pacific. **J. KOJI LUM, AKIRA KANEKO, NOBUYUKI TAKAHASHI, and TAKATOSHI KOBAYAKAWA** (Department of International Affairs and Tropical Medicine, Tokyo Women's Medical University, 8-1 Kawada-cho, Shinjuku-ku, Tokyo 162-8666, Japan).

Origins and post-settlement interactions influence an island population’s genetic diversity, genetic capacity to respond to the environment, and the establishment of pathogens. Archaeological and linguistic evidence suggests that the Pacific islands were settled in two stages. The settlementending into the Northern Solomons began approximately 40-60,000 years before present. In contrast, Remote Oceania (Eastern Melanesia, Polynesia, and Micronesia)

was settled within the last 3,500 years. Genetic and morphological analyses of Polynesian and Micronesian populations support a common origin of both in Island Southeast Asia, consistent with archaeological and linguistic patterns. Although Remote Oceanic Melanesia is archaeologically and linguistically linked to Polynesia and Micronesia, its populations are biologically distinct, more closely resembling Melanesians from Near Oceania in many ways. Specifically, although Vanuatu was settled approximately the same time as Fiji, Tonga, and Samoa presumably by related groups of people making similar pottery and speaking related languages, its populations have much higher levels of genetic diversity and metabolize many commonly prescribed drugs at significantly slower rates. These data are consistent with significant levels of post-settlement gene flow from Near Oceania into Vanuatu. High levels of linguistic diversity within Vanuatu, often including multiple languages on each island may result from multiple migrations to many islands from farther West in Melanesia rather than in situ language evolution. St of Near Oceania, the region of New Guinea and surrounding areas of Melanesia exuch putative, large scale population movements may be responsible for the establishment of malaria in Vanuatu, but not farther into Melanesia, Polynesia, or Micronesia.

A Conservation Biologist in the K-12 Classroom: Terrestrial Field Ecology for the 6th Grade. **CANDACE J. LUTZOW-FELLING** (Botany Department and Ecology, Evolution, and Conservation Biology Program, 3190 Maile Way, Room 101, University of Hawai`i, Honolulu, HI 96822).

Scientists are increasingly being encouraged to collaborate with K-12 teachers in an effort to improve science teaching and learning. How can we share our research and passion for science at the K-12 level without talking over the student's heads or sounding condescending? The National Science Foundation's Graduate Teaching Fellows in K-12 Education program (GK-12 Program) is a nationwide experimental initiative designed to explore solutions to this question. This project examines the development, implementation, and impact of a field ecology curriculum created through a peer partnership between a 6th grade teacher and myself, a GK-12 fellow. The curriculum devised is designed to develop student skills in scientific inquiry, to introduce students to the biotic and abiotic diversity of Hawaiian ecosystems, and to nurture a joy in conducting scientific investigation and an appreciation for the uniqueness of Hawai`i's ecosystems. Students enjoyed the hands-on, field-based aspects of the program and learned to recognize and appreciate the biotic diversity of the Hawaiian Islands. The teacher, who had no prior training in science teaching, improved her content knowledge in science and gained confidence in teaching the field ecology course independently. Specific elements of success for this project, and other potential scientist-teacher partnerships, are a long-term relationship between the scientist and teacher that is built on mutual trust, the scientist's willingness to evaluate the foundational basis of his/her research, the desire to meet the teacher's needs rather than to present a ready-made curriculum, and administrative support from the school.

*Contemporary Submarine Volcanic Processes: Loihi Submarine Volcano, Hawai`i.* **ALEXANDER MALAHOFF (**Department of Oceanography, University of Hawai`i at Manoa, 1000 Pope Road, MSB 319, Honolulu, HI 96822).

Loihi submarine volcano is a hot spot volcano located at a water depth of 990 meters, 34 kilometers south of the southern shoreline of the Island of Hawai`i. The edifice is approximately 34 kilometers long and 17 kilometers wide. It has been constructed through volcanism along a summit rift that terminates at the southern end at a water depth of 5,500 meters. This submarine environment is geodynamically active with a changing landscape dominated by mass wasting on the slopes and volcanism along the north and south rifts. Loihi marks an excellent site for repeat multibeam narrow-beam shipboard bathymetric surveys that would indicate changes in bathymetry with time. An excellent example of this methodology presented itself in the form of a SeaBeamôsurvey before and after a major seismic event, followed by a summit collapse of Loihi during the month of August 1996. Multibeam surveys of the summit of Loihi before and after the August 1996 earthquake sequence showed substantial changes in the summit of the volcano. The most intense period of earthquake activity ever recorded beneath Loihi took place between July 16 and August 10, 1996, with up to 140 earthquakes per day and magnitudes of up to 4.5. Visual observations of the Loihi summit using the submersible *Pisces V* after the earthquakes showed a fractured, faulted terrain covered by talus with the down-thrown component of the normal faults located towards the center of the summit and the complete disappearance of a 300-meter high summit cone which was replaced by a 300-meter deep, 1,000-meter-wide pit crater. The shipboard survey, which included the remapping of the Loihi edifice using a multibeam SeaBeam acoustic mapping system aboard the submersible mothership, R/V *Ka`imikai-o-Kanaloa*, showed in detail, the drastically changed terrain at the southern edge of the summit. The formation of the new pit crater, Pele’s Pit, exposed a 300-meter vertical section of the dike system that formerly supplied the heat for Pele's (hydrothermal) Vents that existed previously on the site. The pit crater formation resulted from a collapse of about 150×10^6 cubic meters, or about 380×10^6 tons of rock into the volcano. The now-exposed dike system was observed to be hydrothermally altered and there is sufficient heat remaining to generate new vigorous vent systems at the base of the dike system, on the floor of the newly-formed pit crater at a water depth of 1,300 meters, as well as along the rim of the crater at a depth of 1,000 meters. The collapse of the summit led to the formation of a westerly-directed hy-

drothermal plume emanating from Pele's Pit and a series of hydrothermal vents with temperatures up to 160°C and extensive bacterial mats. Since 1991, revisits to Pele's Pit using *Pisces V* showed a lowering of hydrothermal vent temperatures with 80ºC as the highest measured in 2001. Microbiological analyses of the bacterial mats using novel incubation techniques showed the presence of a diverse hydrothermal vent community. The collapse was probably generated by magma withdrawal into the hot spot magmatic plumbing. The fate of the withdrawn magma that gave rise to the collapse is not known.

CO_2 Ocean Sequestration. **STEPHEN M. MASUTANI** (University of Hawai`i, Hawai`i Natural Energy Institute, 2540 Dole Street, Holmes Hall 246, Honolulu, HI 96822).

The possibility of changes to global climate induced by increasing atmospheric concentrations of greenhouse gases has spurred development of CO_2 emissions control technologies. Removal of CO_2 from fossil fuel combustors and storage in the deep ocean is a concept that is being actively investigated by researchers in a number of countries as an interim measure to reduce the atmospheric CO_2 emissions burden. This course of action presumes a lack of personal and collective commitment to transition away from the established fossil energy infrastructure. It is predicted that greater than 80% of anthropogenic CO_2 emissions will eventually be absorbed by the ocean through the productive mixed layer where acidification can pose a threat to a host of organisms. The slow exchange between the atmosphere and the ocean, however, will result in continued build-up of CO_2 in the air until fossil fuels are nearly depleted. It has been proposed that CO_2 can be injected directly below the thermocline where it could be sequestered in the deep ocean for centuries. While the oceans have the capacity to absorb orders of magnitude more carbon than that contained in all known fossil fuel reserves, there is significant concern about the impact of direct sequestration on the deep ocean ecosystem. Research currently is focusing on evaluating the relative benefits and risks of ocean sequestration, but efforts to obtain field data on induced changes to sea water chemistry and impacts on biota have met significant opposition. This presentation provides background on the concept and summarizes ongoing research activities.

Undergraduates Increasing Awareness of Environmental Science in the Lives of Underserved Students. **CYNTHIA S. McCORMICK, ALISON N. TOY, JEFFREY J. HOYOS, ADELE THORNBURY and WILLIAM B. N. BERRY** (Environmental Sciences Teaching Program, Division of Undergraduate and Interdisciplinary Studies, University of California, Berkeley, CA 94720).

Undergraduates involved in U.C. Berkeley's Undergraduate Research Apprentice Program (URAP) are utilized in the Environmental Sciences Teaching Program (ESTP) to provide outreach to fourteen schools, influencing approximately three hundred middle and high school students. The program's main purpose is for these undergraduates to implement an in depth curriculum of environmental science including aspects of classical science disciplines, mathematics, and the value of peer interactions. Middle school students receive environmental science instruction emphasizing the impacts of human activities on the environment. Experiencing the natural world is pertinent to understanding the environment and conducive to good thinking (Orr 1990) therefore students are introduced to a variety of hands-on group activities including involvement in a wetland restoration project. High school students are exposed to advanced topics such as watershed, alternative energy, bioremediation, eutrophication, and resource management. For college bound students, a majority of these activities, preparatory to collegiate science, are conducted in a laboratory environment; and completion of the class will fulfill their physical science requirement for college. For students at continuation schools, with no college plans, curriculum is tailored to their own environmental interest. However, both middle and high school students, with this knowledge, will have the ability to form their own educated opinions and make effective decisions pertaining to environmental issues. Showing underserved students their vital connection to the natural environment, ESTP hopes to increase the community's scientific interest. In doing so, students become aware that age, gender, and ethnicity are not a determinant for attaining scientific success.

Nutritional Composition of Edible Hawaiian Macroalgae from Wild Populations. **SARA M. MCCUTCHEON** (Marine Science Department, University of Hawai`i at Hilo, 200 W. Kawili St. Hilo, HI 96720).

The nutritional composition of 16 species of edible Hawaiian macroalgae (*limu*) was determined using standard methods for analysis of ash, lipid, protein, carbohydrate, and selected minerals and vitamins . The species tested were traditionally eaten by Hawaiians in ancient and modern times. Macroalgae were collected from the islands of Hawai`i, O`ahu, and Maui. There was variation in nutritional composition among species and between sites. Most of the green (Chlorophyta) and brown (Phaeophyta) macroalgal species showed low levels of ash, while the reds (Rhodophyta) had higher values. All of the species contained low amounts of lipids. Protein contents ranged from 2.6-21.2% relative to dry weight. Members of the Rhodophyta were characterized by high carbohydrate contents (*Ahnfeltiopsis concinna* or *limu `aki`aki* 33.4%), while Phaeophyta species had the lowest values (*Dictyota acutiloba* or *limu alani* 5.9%). Some macroalgae contained measurable amounts of vitamin C, Beta carotene, B vitamins, and minerals (P, K, Mg, Ca, Fe, Cu, Zn, S, B, and Mn).

*Tracking the Status of Hawai`i's Native Species and Ecosystems for Conservation.* **SHANNON MCELVANEY** (Hawai`i Natural Heritage Program, Center for Conservation Research and Training, University of Hawai`i, 3050 Maile Way, Gilmore 409, Honolulu, HI 96822).

Over the last 17 years, the Hawai`i Natural Heritage Program (HINHP) has established itself as a vital source of information on the health and location of Hawai`i's rare biota and ecosystems. The Heritage Natural Diversity Database coupled with a Geographic Information System (GIS) creates Hawai`i's most comprehensive spatial database inventory of rare, endangered, and threatened plants, animals, and ecosystems. The database tracks such things as legal status, global and state rarity, location, condition, numbers, threats, management, observation date, source, and much more. HINHP is part of the NatureServe network of over 75 Heritage and Conservation Data Centers throughout the United States, Canada, Central and South America, and the Caribbean. In order to meet the changing needs of the conservation community, HINHP has expanded its role to include database modules and GIS layers that support the monitoring of ungulates and weeds, the tracking of genetic information for in situ and ex situ individuals, the collection, storage, and propagation of seeds and propagules, and the tracking of aquatic and marine species and threats. This presentation will discuss the ways in which these datasets serve and inform scientists, natural resource managers, land use planners, conservationists, and governmental, non-governmental, and private organizations, as well as the public.

Effects of Ozone on Water Conservation Behavior in the Coqui Tree Frog, Eleutherodactylus coqui. **RAYMOND MCGUIRE, LONEY J. SALAS, MICHAEL.R. DOHM, and WILLIAM.J. MAUTZ** (University of Hawai`i, Hilo, HI 96720).

Ozone is an important component of urban smog and known to be a major respiratory irritant and oxidizer of lipids in mammals, but little is known about ozone's effects on other vertebrates. In a previous study of amphibians, marine toads had significantly greater water loss during exposure to ozone compared to clean air. The behavior and life history of many anuran amphibians is strongly influenced by water balance. To determine if a greater water loss from ozone is a general phenomenon, we tested the coqui frog. Since amphibians are closely tied to water (reproduction, foraging and other activities) smog could be a factor to their decline. Coqui frogs are an ideal model for testing hypotheses of water loss and ozone exposure because they adopt distinct postures to reduce surface area when faced with dehydrating conditions. Frogs (N=120) were placed into a temperature-controlled cabinet and subjected to different levels of saturation (10%, 60%, or 95% relative humidity) and concentrations of ozone (0, 0.4, or .8 ppm) for three hours. Behavior was recorded at intervals throughout the exposure. Behavior scores ranged from 0 (water conservation posture) to 4 (active, alert, and moving). We found that humidity had a significant effect on the behavior of coqui frogs regardless of ozone concentration. Frogs were less active in ozone, but the difference was significant only for 60% RH. Thus, ozone had a small, but significant effect on frog behavior.

An Empirical Test of Different Models of Adolescent Mental Health. **TAMIA MCKEAGUE, TADASHI SERIKAWA, DONNA MAEMORI, DEBORAH HAMAMOTO, and VLADIMIR SKORIKOV** (University of Hawai`i at Hilo, 200 West Kawili Street, Hilo, HI 96720).

The goal of this study was to empirically compare different theoretical models of adolescent mental health: A single factor approach, externalizing vs. internalizing problems, over-controlled vs. under-controlled behavior, and a three-factor model incorporating problem behavior, distress, and well-being. The study was done on 300 students from a rural and urban high school in Hawai`i. The participants were volunteers who were granted the permission to participate by their parents. Data collection was conducted through a survey administered in the schools. Standard psychometric scales were used to measure various parameters of mental health including anxiety, depression, self-esteem, life satisfaction, delinquency, substance use, over-controlled behavior, and adjustment. Each of the measures has been shown to possess acceptable reliability and validity in previous research with adolescents. Data analyses were done with LISREL 8 using the structural equations modeling approach. We estimated the measurement models corresponding to different conceptualizations of mental health in terms of their statistical fit. Both a one and two-factor models showed poor fit (c^2=327, df=27 and c^2=141, df=26, respectively). However, a three-factor model showed good fit to the empirical data (c^2=29, df=23, p=0.17, RMSEA=0.03, GFI=0.98, AGFI=0.96). Furthermore, we found that with fewer variables there are many possible two-factor models that fit the data well but do not represent the entire spectrum of mental health symptoms. The results of this study provide evidence in support of a three-factor model of mental health. The major implication of this study is that theoretical models based on small number of variables may be incomplete.

Successful Techniques for Teaching Online Science Courses. **IVY MERRIOT** (Abaetern Academy Virtual School, 1627 West Main, #376, Bozeman, MT, 59715).

We will examine successful techniques for designing and delivering online science course content for grades 3 through college. This presentation is applicable for fully online courses or for courses which have only an onlne aspect for some assignments. Teaching methods used for online courses differ greatly from those used for in-house

courses. One can individualize the instruction to a great degree without sacrificing efficiency. Having a portion of an in-house course online enables students with various learning styles to flourish. Online assessments are especially useful in helping each student reinforce content knowledge without intimidation from peers.

These methods were first developed in cooperation with Dr. Dave Caditz at the National Teachers Enhancement Network at the Burns Telecommunication Center at Montana State University in Bozeman, MT. They have received the highest outside evaluation scores for online course delivery by Horizon Research.

Handouts and CDs with html coding for designing online courses will be available.

Vog: An On-going Investigation of Its Possible Acute Health Effects. **JON-PIERRE MICHAUD** (Departmet of Chemistry and Natural Sciences, University of Hawai`i at Hilo, 200 W Kawili Street, Hilo, HI 96720).

Vog exposure was estimated by collecting real-time air quality data for sulfur dioxide (SO_2) and sub-micron aerosol (PM_1) in Hilo. Simultaneous respiratory health data (lung function and symptoms) were collected in grade-school children in Hilo. Health status monitoring included several months of twice-daily PEFR, FEV_1, symptoms and maximal effort spirometry. Children were recruited based on a history of asthma or asthma-like symptoms, age (9–11), and location (Hilo). This epidemiological pilot-scale prospective panel study is a 'natural experiment' design that relies upon naturally 'controlled' changes in exposure to vog. During the thousands of hours when both air quality and health-related data were simultaneously collected, 'strong vog events' were elusive. We found that the 'asthmatic' population, selected for its sensitivity, did have a large range of variation in their respiratory health status measures, even when the air quality remained relatively clean with respect to our measured analytes. This high biological variation combined with the paucity of strong vog events, places intrinsic limits on data analysis and interpretation. We have not seen notable associations between air quality and either lung function or symptoms in this Hilo population in analyses to-date. We are presently collecting data in two 'healthy' populations nearer the volcano in hopes of less sensitive populations and greater ranges in vog exposure.

Extra-Corporeal Model-Building: Mankind's Step Up from Genetic, then Neural, Model-building. **DANIELLE MIHRAM[1] and G. ARTHUR MIHRAM[2]** ([1]Director, Center for Excellence in Teaching, University of Southern California, LVL-301B, Los Angeles, CA 90089–0182; [2]P.O. Box No. 1188, Princeton, NJ 08542–1188).

We note Neurologist J.Z. Young's conclusion [MODEL OF THE BRAIN] that the uniqueness of Mankind among the biological species is that, by means of tools and writing instruments, we construct models for survival outside the brain and outside the genetic system. One would need to correct Karl Popper's definitions of his "Three Worlds" to be instead: chemico-genetic; chemico-neural; and, extra-corporeal, or Man-made, this most recent model-building format being represented collectively by the contents of all libraries and museums (including marked cave walls) worldwide.

Striking, however, is the realisation that each of these three model-building formats represents a dynamics which is "conducted" by a single and quite biological process: in reality, a six-stage process (possessing three corrective feedback loops) which is shown to be the process by which the survival of all Life on Earth to date has been assured. The Scientific Method, by which truth(s) about Nature are established in our quest for the very explanation for any naturally occurring phenomenon, is therefore a heretofore unwitting mimicry of the biological process for ensuring survival. It behooves scientists therefore to require ethical conduct among fellow scientists.

For further information, one should examine SCIENCE 191: 790, 1976; AMERICAN SCIENTIST 67: 394, 1979; the full-length paper, PROC, JNT MTG, AAAS and SGSR: 464-473, 1974; plus, AN EPISTLE TO DR. BENJAMIN FRANKLIN, New York: Exposition-University Press, 1975(1974).

Whole Genome Comparison: Visual Analysis of Pattern Hunter Nucleotide Homology Data. **LAWRENCE J. MILLER and MING LI** (Department of Computer Science, University of California, Santa Barbara, California 93106).

As the body of genomic nucleotide sequence data increases, diverse approaches to the interpretation and analysis of large-scale data sets becomes crucial to our ability to understand genomics. We present a piece of computer software entitled "The Interactive Genomic Data Visualization Utility" that may be useful to the scientific community for the study of whole genome level comparisons.

This program is designed to present the results of homologous nucleotide alignment data generated by the PatternHunter program (please visit http://monod.uwaterloo.ca/papers/expanded.php3?paper=2002002) in a manner that will facilitate the visual interpretation, analysis, and manipulation of whole genome sized data sets. PatternHunter has revolutionized whole genome study by bringing powerful homology search capabilities to the desktop. This complimentary visualization utility provides the means for a powerful visual analysis of data that would otherwise be incomprehensible to a human being to the desktop as well.

We implemented this program using the Java programming language, Java's Swing graphical user interface, and its many rich graphical features. Color, geometry, alignment attributes (such as length, alignment score, and

orientation), and association with established genomic annotations are all used to aid a human user to find and isolate interesting subsets of alignments quickly and easily.

Examples taken from comparison between the recently published rice genome and the Arabidopsis genome will be presented.

This work was supported by NSF ITR grant 0085801.

Cleaning the Pipe: Critical Issues with Data Integrity, Analysis, and Interpretation in High Throughput Screening Experiments. **EDWARD J. MOLER** and **FILIPPO RANDAZZO** (4560 Horton Street, mail stop 4.3, Emeryville, CA 94608).

Modern pharmaceutical development models are built upon a series of high-throughput screening experiments followed by validation assays organized in a “pipe-line” from target discovery to drug discovery, drug development and pre-clinical testing, and clinical trials. Functional genomics screens, including cDNA and oligonucleotide arrays, are core platforms that are being increasingly employed at all stages of discovery, development, and testing. The high-throughput screening experiments are typically carried out by specialized teams who develop expertise in specific platforms, while the results are used by a large audience of biologists, chemists, pharmacologists, clinicians, and even members of the business and legal departments, e.g. for evaluating licensing opportunities. Because of the complexities inherent in these technologies, including the necessary combination of genomic analysis, statistics, computational sciences, and biochemistry, there are many opportunities for errors in executing the experiments, reducing and summarizing the data, annotating the results, and interpreting the meaning of the results. I will address the challenges and pitfalls of 1) ensuring data integrity through rigorous statistical analyses and quality control criteria, 2) annotating functional genomic screening results, and 3) educating scientists, who are not experts in the details of a specific platform, to properly interpret the experimental results.

Traditional Hawaiian Knowledge and Epistemology in the Natural World. **IOKEPA K. NAE`OLE** (The Nature Conservancy of Hawai`i, P.O. Box 1716, Makawao, HI 96768).

Anthropologist Bronislaw Malinowski wrote: “There are no peoples however primitive without religion and magic. Nor are there, it must be added at once, any savage races lacking either in the scientific attitude or in science, though this lack has been frequently attributed to them. In every primitive community, studied by trustworthy and competent observers, there have been found two clearly distinguishable domains, the Sacred and the Profane; in other words, the domain of Magic and Religion and that of Science.” (Malinowski 1948) Scientific? Perhaps. Savage? That is open to one's own interpretation. Nonetheless, one group of people that would certainly meet Malinowsi's criteria of the "Scientific Savage" would be the ancient Polynesians and their offbranch, the Hawaiians. From their migrations out of Asia in sailing canoes with a well–developed navigational ability, to their settlement of the Polynesian triangle and their imaginative and inventive use of the natural resources available to them, the list of their accomplishments are many. All of which were done using the very basics of scientific method—observation and experimentation—still inherent characteristics of Hawaiian culture. Nana ka maka, pa`a ka waha (the eyes look and the mouth remains silent) is a learning value still practiced in Hawai`i. Our presentation will discuss further the traditional beliefs and practices of the Hawaiian people, their observance of natural processes, and how nature became an integral part of their culture and religion.

Reproductive Inhibition by Methyl Farnesoate in the Tadpole Shrimp Triops longicaudatus. **WILLIAM K. NELSON, JENNIFER ROSE and BRIAN TSUKIMURA** (Department of Biology, California State University, Fresno, Fresno, CA 93740–3963).

The effects of the crustacean hormone methyl farnesoate (MF) were examined on the invasive tadpole shrimp, *Triops longicaudatus*; a potential model organism based on its short life cycle and high fecundity. MF is structurally similar to the insect hormone Juvenile Hormone III (JHIII), which inhibits reproductive development in juvenile insects, but not in adults. To test for inhibitory reproductive effects, MF was administered to tadpole shrimp in a rice field, which they inhabit, and several trials in environmental chambers. Animals were collected after 5 days when weight, length, and ovary weight were recorded. As a delivery system for MF, pellets were coated in two MF concentrations (0.0001 and 0.001%), along with a control pellet with no MF. MF significantly decreased ovary weight from 5.3 mg to 3.4 and 2.9 mg, respectively. In lab trials, MF-coated pellets similarly reduced oocyte numbers. When MF (0.0001%) was incorporated internally into pellets, oocytes per ovary were reduced from 54.2 to 25.0. Other attempts at incorporating MF into pellets have been less successful. These data suggest MF inhibits ovarian development in juveniles. To determine the effect of MF on adult tadpole shrimp the 0.0001% MF pellets were administered days 5–10. No significant difference was found between the delayed exposure group and controls, suggesting that MF has no inhibitory effect on reproduction in adults as was hypothesized based on the JHIII model. This supports the contention that MF has juvenilizing activities. This project was funded by CATI-Agricultural Research Initiative and CSU Research Award.

Global Climate Change: Circum-Pacific and Global Net Ecosystem CO_2 Fluxes. **WALTER C. OECHEL, HYO-JUNG KWON, ROMMEL ZULUETA, STEVE HASTINGS, and JOE VERFAILLE JR.** (Global Change Research Group, San Diego State University, San Diego, CA 92182).

Net terrestrial ecosystem CO_2 fluxes vary by latitude, ecosystem type, climate, and inter- and intra-annual variability in climate. Here we present the inter- and intra-annual patterns of net ecosystem CO_2 flux from Barrow Alaska, to the chaparral of southern California, and the cardon/larrea deserts of La Paz, Baja California Sur, Mexico. Measurements are made using eddy covariance tower observations, extrapolated using models, and verified by flux measurements from SDSU's Sky Arrow 650 ERA flux aircraft. Stand age, fire cycle, climate variability, and secular climate change impact net ecosystem CO_2 flux, and open potential feedbacks on the rise of atmospheric CO_2 and global warming. Conversely, ecosystems can be managed for ecosystem health and carbon sequestration. The Pacific Rim provides an ideal situation to study the interactions of climate, ocean circulation, and land use patterns with terrestrial ecosystem CO_2 flux across major latitudinal and longitudinal gradients while maintaining a maritime terrestrial climate.

Production of High Value Products and Mineral Carbon from Smoke Stack Gases using Photobioreactor Grown Microalgae. **M. OLAIZOLA[1],E. MAZZONE[1], J. THISTLETHWAITE[1], T. NAKAMURA[2], and STEPHEN M. MASUTANI[3].** ([1]Aquasearch, Inc., Kailua-Kona, Hawai`i, USA, [2]Physical Sciences Inc., Andover, Massachusetts, USA, [3]University of Hawai`i, Honolulu, HI 96822).

The objective of this work is to determine under which conditions carbon sequestration by microalgal photosynthesis is economically attractive. Microalgal sequestration of CO_2 consists in growing microalgae photoautotrophically utilizing anthropogenic CO_2 as the source of carbon for biomass and biomineral production. We qualify a carbon sequestration scheme economically attractive if the process used matches or betters the US Department of Energy cost goal of $10 per ton of CO_2 avoided.

Our approach to carbon sequestration consists in growing microalgae in large-scale outdoor photobioreactors using flue gases as the carbon source. The species grown are chosen from among the hundreds of organisms already identified as producers of high value products (e.g., carotenoids). The cultures are grown under conditions that enhance the chemical precipitation of CO_3^{2-} with Ca^{2+} to produce $CaCO_3$.

The first step in our project consisted in establishing a microalgal collection (78 strains representing 68 species) and determining the temperature and pH tolerances of promising microalgal strains. The second step (on–going) consists in determining the tolerance of selected strains to different flue gases. Our standard culture conditions are 25ºC, 60 E m^{-2} s^{-1} under a 14:10 L:D cycle and 7.5 pH. The cultures are grown in 3.3 liter chemostats. High value product concentration (carotenoid pigments) is determined via HPLC. Based on those values and the productivity of the culture at steady state we calculate the productivity of the high value component of the biomass. The productivity of our light limited chemostat cultures is then extrapolated to that of cultures grown in outdoor photobioreactors, also light limited.

To determine the carbon mineralization potential of microalgal cultures we conducted experiments designed to test the effects of changing the CO_2 input rate on the precipitation of $CaCO_3$. We have found that, in the presence of high Ca^{2+} concentrations, the change in dissolved carbon species driven by photosynthesis does result in $CaCO_3$ precipitation.

From an industrial perspective, this process presents the possibility of decreasing carbon emissions in an economically attractive manner. We are currently scaling up our experiments to 25,000 liter outdoor photobioreactors to establish the working parameters and the economics of such a process.

Reducing Carbon Dioxide Emissions--False vs Valid Technology. **HENRY OMAN** (Consulting Engineer, 19221 Normandy Park Drive SW, Seattle, WA 98166).

Entities that promote reduction of carbon dioxide (CO_2) release often hide pertinent facts that affect the validity of their proposals. For example, ethanol fuel that is derived from corn is claimed to reduce CO_2 emissions from automobiles. However, a source-to-product analysis must include emissions from the petroleum consumed in (1) manufacturing the ammonia fertilizer, (2) transporting the fertilizer to the corn-growing farms, (3) operating the farm machinery, (4) processing and transporting the corn, and (5) producing the ethanol. The energy available in one gallon of ethanol is less than the energy in the total petroleum consumed in its production. Opponents of nuclear power will stress the problems in storing exhausted fuel rods in Yucca Mountain. These fuel rods still contain over 96% of their initial energy. Neutron-absorbing fission products make these fuel rods useless in a nuclear reactor. In other nations this "used" nuclear fuel is reprocessed to remove the fission products, and then put back into reactors. Law in the United States prohibits such reprocessing. The auto industry has successfully delayed requirements for introducing low-emission cars. However, hybrid propulsion in which battery power helps accelerate the truck after each traffic stop now cuts a truck's CO_2 emissions in half. The efficiency of a gasoline-burning car engine is around 20%. Electricity for an electric car can be generated with 60% efficiency in a natural-gas burning combined-cycle power plant that can be built for $500 per kW. The batteries in early electric cars had short lifetimes in charge/discharge cycling service. New technologies are pro-

ducing long-life batteries. A nickel-hydrogen spacecraft battery, if charged and discharged only once each day, could last for 350 years. These and other CO_2 emission reducing technologies will be evaluated in this session.

Dementia as a Form of Language Disorder: Nosological Clarification. **FRED C. C. PENG** (Neurological Institute, Veterans General Hospital, 201 Shih-Pai Rd. Sec. 2,Taipei,Taiwan 11217).

The purpose is to re-define dementia, as it has been equated with Alzheimer's Disease (AD) which is then claimed by some neurologists to be aphasia. It is also to point out that, although both dementia and aphasia are actually sequelae of brain damage due to neurodegenerative disease and/or other vascular and/or non-vascular factors, because they present language disorders as prominent symptoms, AD designates only neurofibrillary tangles, senile plaques, and/or cerebral amyloid angiopathy, and not language disorders.

The method employed is literature review on: (1) the process of naming AD as an eponym; (2) recent claims of dementia as aphasia; and (3) language in the brain as behavior.

The conclusions are: (1) the claim of dementia as aphasia simply adds semantic confusion; (2) dementia is not a disease, as it is a consequence of neuronal loss caused by any cortical and/or subcortical degenerative disease; (3) therefore, dementia should not be synonymous with AD; (4) it follows that dementia (of any type) cannot be aphasia, any more than it can be equated with AD; and (5) if the insistence that dementia is aphasia is left unchecked, and if dementia continues to be regarded as a disease, aphasia also becomes a disease, a nonsensical notion that is totally unacceptable to most neuroscientists.

Nuclear Micronesian Words for 'Dog': An Ethnolinguistic Puzzle. **KENNETH L. REHG** (Department of Linguistics, University of Hawai`i at Manoa, 1890 East-West Road, Honolulu, HI 96822).

A careful investigation into the sources of the words for 'dog' in Nuclear Micronesian languages reveals much about the prehistoric movements of the peoples of this region. As Titcomb (1969) has observed, dogs were brought into the Pacific by man, "and the route(s) of one are those of the other." While in Micronesia there are several words for 'dog' that are widespread in usage, they are not obviously cognate. Therefore, it is not possible to reconstruct a word for 'dog' for Proto-Micronesian, meaning that there is no linguistic evidence for the presence of this animal in the Nuclear Micronesian homeland. It is especially noteworthy, then, that on some islands, bones of dogs are found very early in the archaeological record. Also interesting is the fact that the archeological record is not always in accord with the first-contact literature. Dogs were reported by European explorers to be absent from some islands where their earlier existence is indicated. The reverse is also true. Thus, the data relevant to explaining the origins of Micronesian dogs and the terms used for them are puzzling and sometimes contradictory. An interdisciplinary approach to this problem, however, suggests that, on most of the islands of this region, the presence of dogs was discontinuous, involving periods of extirpation followed by periods of repopulation. Further, it leads to the conclusion that the current distribution of the non-European words for 'dog' in Micronesia is the result of interisland voyaging and that, ultimately, these terms derive from contact with peoples speaking non-Micronesian languages.

*The Cold Tolerance of Two Species of Hawaiian Drosophila from the Big Island of Hawai`i.* **ANGELA REZA, MICHAEL R. DOHM, SHERYL MOORE, CEDRIC MUIR, WILLIAM J. MAUTZ, and DONALD PRICE** (Department of Biology, University of Hawai`i, Hilo, HI 96720).

Drosophila silvestris and *Drosophila heteronera* are two endemic Hawaiian picture wing fruit flies found on damp, volcanic slopes above 1000m elevation. Nighttime temperatures at this elevation can drop down below 10ºC. With more and more of their habitat being destroyed at lower elevations, there may be a need to look at cold tolerance as being a limiting factor in their expansion. We conducted an experiment on adult flies from laboratory populations to test their cold tolerance characteristics. Population used were 2 *D. silvestris*: SKFR, from the Kona side and PMAA, from the Hilo side of the island and we also used 1 population of *D. heteronera*. We gathered data on their knockdown time at 4ºC and their recovery at room temperature. To help with species comparisons a molecular, population-level phylogeny was made from the sequencing of the cytochrome oxidase subunit II obtained from wild caught flies of the same populations. We found that the PMAA *D. silvestris* population grouped more closely with *D. heteronera* than with its conspecific Kona population. We found species differences for log-knock-down times but not for log-wakeup times. Males and females had similar cold tolerance, and individual variation was repeatable. We found that the *D. heteronera* population was significantly less cold tolerant than the *D. silverstris* populations. Based upon their highly localized population structure, our results suggest that Hawaiian *Drosophila*, especially the rare *D. heteronera*, may be limited in their ability to expand their population upslope.

Colonization of the Insular Pacific by Herbivorous Insects: The Role of Host Shifts and Dispersal. **GEORGE RODERICK** (Environmental Science, Policy and Management, Division of Insect Biology, 201 Wellman Hall, University of California, Berkeley CA 94720-3112).

The factors that lead to adaptive radiation are currently receiving much attention, particularly the role of habitat specialization and a reduction in dispersal ability (for reviews, see Roderick & Gillespie 1998, *Molecular Ecology*; Gillespie & Roderick, *Ann. Rev. Entomology* 2002). Here, I use plant-feeding insects to examine (1) the association between colonization of new habitats and host-shifts and (2) whether reduced dispersal ability is important for host-shifts and subsequent adaptive radiation. Planthoppers in the genus *Nesosydne* (Hemiptera: Delphacidae) are one of the most specious groups of planthoppers and are found only in the Insular Pacific, particularly Hawai`i, the Marquesas, the Societies, the Australs as well as the Galapagos. In Hawai`i, the group numbers over 80 described species. Unlike their continental counterparts that are highly specialized monocot (grass, sedge) feeders, species in the Pacific have switched onto numerous plant species in many plant families, and primarily dicots. For example, the *Nesosydne* species in Hawai`i feed on plants in over 27 different families. However, like their continental counterparts, the species in the Pacific remain extremely specialized, feeding usually on only one host species. A phylogenetic analysis shows that although there is some historical constraint in the types of plant hosts that are used, island colonization is often associated with host-shifting. Many species of planthoppers in the Pacific show a reduction in flight ability as expressed by having reduced wings as adults. However, there is little evidence to tie this reduction in dispersal to adaptive radiation in the group.

Linking K-6 Science Learning with Near-Real-Time Data. **DONNA ROSS, HOWARD COVEN, KEVIN CUMMINS, RUBEN PACHECO, CHRISTINE PROWD, ERIC FISHER, NANCY TAYLOR, and WALTER C. OECHEL** (San Diego State University, San Diego, CA 92120).

The internet allows students to observe the world, collect data, and understand the nature of science in ways never before imagined. *Linking K-6 Science Learning with Near-Real-Time Data* is a collaborative initiative by the Colleges of Science and Education at San Diego State University and the San Diego County Office of Education. The goal is to improve the understanding of environmental science, the work of scientists, and the opportunities for all students to enter the world of scientific inquiry by observing and utilizing scientific research and data in the context of K-6 science education. Teachers and university science students collaborate to teach hands-on science to K-8 students using kit-based curricula. A team of university students and faculty is developing internet-based lessons using near-real-time data to support the science teaching and learning. Web-based lessons, using near-real-time data and web-cam images, have already been completed to support standards-based science learning and teaching for the following units: Ecosystems, Air and Weather, Pebbles, Sand and Silt, and Mixtures and Solutions. More units are currently in development. Scientists from the Global Change Research Group at SDSU collect data from research sites in California, Alaska, and Baja California Sur, Mexico. The bilingual web-based lessons make the data from these locations accessible to the children in a format matching that of the kit-based science instruction. This paper will present findings associated with using real-time data, developing age-appropriate lessons based on global change data sources and using technology for scientific outreach in K-8 schools.

GIS Applicability to Agroecosystems Research: A Case Study Mapping the Insect Community of a Hawaiian Banana Patch. **CHRISTIAN A. RYGH** (University of Hawai`i Deptartment of Geography and Environmental Studies, 200 W. Kawili St. Hilo, HI 96720).

The numerous and spatially explicit variables in Agroecology beckon for the exploratory and communicative capacity of the Geographic Information System (GIS). The researcher believes the GIS to be highly applicable to research and long-term monitoring of agroecosystems due to its unique ability to store, manipulate, display, and animate multiple variables of spatial data. One of the primary factors holding back research in diversified agroecosystems management and design is the inherent statistical and analytical complexity that accompanies an increase in operative variables. The study revealed the following utilities of GIS (Arcview 3.2) with respect to agroecology and the sustainable agriculture endeavor: 1) a more encompassing analysis capability of the multiple agronomic and environmental effects and side-effects of various farming practices, 2) the capacity to communicate effectively and objectively that complex information to laypeople so that democratic initiatives can be engaged to implement the agroecological findings into agricultural policy and grassroots change, and 3) a new educational media capable of integrating and advancing the agroecological, geographic, and environmental epistemologies.

A major objective of the experiment was to apply geographic computing powers and extraordinary communicative abilities of the GIS to large-scale biogeographic mapping. The experiment involved trapping insects in a matrix of 6m x 6m sample plots roughly delineated by the predefined spacing of banana tree clusters. The minimal attainable EPE (estimated positional error) of the recorded GPS (Global Positioning System) waypoints averaged 4m–5m for open areas and somewhat higher under the canopy (the actual surveyed area) where the satellite transmission was partially blocked. Walking a meter or two away from the

location of the insect traps to attempt to get a clearer signal in the open areas between banana tree clusters added additional error to that process, so it was abandoned for one in which a larger framework of GPS points surrounding the study area was integrated with field measurement and estimation techniques to accomplish biogeographic mapping at scales slightly larger than is possible with a standard GPS unit (see insect maps). Thus, higher accuracy in terms of the relative spacing between data sampling locations was achieved, and unnecessary GPS readings for every data point were avoided. The study revealed that the tendency for agricultural production to be spaced in rows simplifies the processes of delineating sample plots, geographically coding the data observations, and projecting the results in such large-scale (1:320) cartographic applications.Various symbologies and spatial queries were explored to accentuate ecological/biogeographic relationships.

Cultural Contributions to Destination Competitive Advantage. **MARCIA SAKAI[1] and SONIA JUVIK[2]** ([1]Department of Tourism and Economics, University of Hawai`i, Hilo, HI 96720; [2]Department of Geography, University of Hawai`i, Hilo, HI 96720).

Tourism destinations derive their competitive advantage (Porter, Smeral) from factor conditions of relative abundance and productivity, the structure and integration of the supply network, the strength of demand, market structure conditions promoting efficiency, and government policy. Despite the growing interest by destinations in culture-based tourism, there has been little work to assess the contribution of culture to a destination's competitive position. This paper identifies the relevant cultural attributes (Hofstede), uses qualitative analysis to assess the role of culture in Hawai`i's destination competitiveness, and extends the policy debate on cultural preservation.

Forcing Shoot Growth from Rhizomes of Dendrobium Orchids for Off-Season Cutflower Production. **WILLIAM S. SAKAI, LEONARD GINES, and JASON C. EBERLY** (University of Hawai`i, Hilo, HI 96720, and Hawaiian Tropicals Direct, Kapoho, HI).

Production of *Dendrobium* orchid cutflower sprays in Hawai`i is mostly in the summer and fall. In this paper we present the results of research to force flower spray production in the winter off-season. Dendrobiums have a sympodial growth habit. Application of 10 ml of 500 ppm 6-benzylaminopurine (BA) drench to rhizome and roots, at the base of the youngest mature pseudobulb, resulted in new pseudobulb (lateral shoots from the rhizome) growth and cutflower spray production in late November and early December. Fifty to ninety-two percent of these treated plants produced 0.9 to 2.0 new pseudobulbs/treated plant. Addition of gibberellic acid (GA_{4+7}) or tri-iodobenzoic acid to the drench did not increase the number of new pseudo-bulbs produced.

Respiratory Pattern Changes in a Tropical Tree Frog (Eleutherodactylus coqui) Exposed to Ozone. **LONEY J. SALAS, RAYMOND MCGUIRE, MICHAEL. R. DOHM, and WILLIAM. J. MAUTZ** (Department of Biology, University of Hawai`i, Hilo, HI 96720).

Amphibians exchange respiratory gases across their lungs, but also cutaneously. Thus the amphibian body surface is effectively a large respiratory membrane. The respiratory function of amphibian's skin may also make the animal sensitive to airborne pollution. Ozone is a strong oxidant component of urban air pollution. Exposure to ozone in mammals causes respiratory irritation and breathing pattern changes, but little is known of ozone's effects to an amphibians respiratory physiology. Our experiment examined effects of ozone concentration and relative humidity on breathing patterns of tree frogs (*Eleutherodactylus coqui*). Frogs were exposed to 0, 0.4, or 0.8 ppm ozone at 3 different relative humidity conditions (<10%, 60%, and >90%). Lung ventilation frequency and buccal pumping frequency were monitored during exposures. Ozone decreased lung ventilation's and buccal pumping frequency during an exposure at all relative humidity conditions, and 0.8 ppm ozone had the most pronounced effect. In comparison, ozone elicits rapid and shallow breathing in rodents and other mammals. Thus, our results indicate that breathing patterns are also altered in amphibians exposed to ozone.

Revision of Haleakala's Late Volcanic History. **DAVID R. SHERROD** (U.S. Geological Survey, Hawaiian Volcano Observatory, PO Box 51, Hawai`i National Park, HI 96718).

New isotopic ages help to date landforms and lava flows at Haleakala, including features of interest to botanists, archeologists, and earth scientists. For example, lava flows scattered around the rim of the present Haleakala Crater indicate that postshield Kula eruptions persisted until 0.15 m.y. ago. The crater must have formed after these flows were emplaced. As the Kaupo "valley" grew headward, its upper montane slope collapsed and formed the Kaupo debris deposits. By 0.12 m.y. ago, lava flowed onto the Kaupo fan from vents in the crater. Thus, Haleakala Crater formed substantially between 0.15 and 0.12 m.y. ago. On the east flank of the volcano, lava on the older bench in Kipahulu Valley was also emplaced about 0.12 m.y. old, and the inner valley floor formed subsequently.

Haleakala remains in its postshield volcanic stage, not the rejuvenated stage as classically defined. This reinterpretation stems from the lack of a lengthy hiatus between youngest Kula Volcanics (0.15 m.y.) and oldest Hana Volcanics (0.12 m.y.), which is the stratigraphic unit thought to comprise rejuvenated-stage strata. Six ages are in

the range 0.15-0.12, suggesting that volcanism continued intermittently through that time. Ages from Hana Volcanics strata extend from 0.12 m.y to only 400 years ago. New radiocarbon ages of the youngest eruption, the Kalua o Lapa cinder cone near La Perouse Bay, suggest its lava and cinders were deposited between about A.D. 1485 and 1600, nearly 300 years earlier than the A.D. 1790 date commonly ascribed.

The Role of Vocational Identity in Satisfaction with Life. **VLADIMIR SKORIKOV, TAMIA MCKEAGUE, and TADASHI SERIKAWA** (University of Hawai`i at Hilo, 200 West Kawili St, Hilo, HI, 96720).

Previous research on the effects of work on life satisfaction has focused mostly on the objective parameters of work and working conditions. Little is known about the effects of the worker's attitudes and behavior. The goal of the present study is to examine the relationship between vocational identity, which theoretically is often considered a central aspect of career development, on life satisfaction while controlling for the confounding effects of various personality, occupational and demographic factors. The study was conducted on 164 working adults in Hawai`i, who volunteered to answer an anonymous survey comprised of standard, valid psychometric scales for life satisfaction, self-esteem, depression, anxiety, vocational identity, work attitudes, and occupational status. Additionally, we obtained information on the participants' age, education and income. We found that, indeed, life satisfaction was correlated with all of the variables studied, including vocational identity. However, all of the potential predictors of life satisfaction were also inter-correlated, thus making a conclusion about their relative effects impossible. Thus, we used Structural Equations Modeling to examine the multivariate relationships between life satisfaction and the hypothesized predictors as well as among predictors. A fitted path model (c^2=8.26, df=11, p=0.69, RMSEA<0.001, GFI=0.99) confirmed the theoretically predicted effects. Vocational identity had the strongest direct effect on life satisfaction, complemented by an indirect effect through self-esteem. In contrast, the objective characteristics of work did not have direct effects. The results imply that career development process can be a more important factor of satisfaction with life than work characteristics and personality variables.

Contrasting Patterns of Diversification in Hawai`i's Flightless Land Birds. **BETH SLIKAS, HELEN F. JAMES, S. OLSON, E. PAXINOS, M. SORENSON, A. COOPER, and ROBERT FLEISCHER** (Department of Systematic Biology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20008–0551).

The endemic avifauna of the Hawaiian Islands includes four distinct groups of flightless birds: ibises (2 spp.), ducks (i.e., moa-nalos, 4 spp.), geese (4 spp.), and rails (11-12 spp.). We used DNA sequence data to determine relationships among the Hawaiian taxa and a sampling of mainland relatives, to determine whether the species in each group were descended from distinct colonization events or radiations within the islands. The moa-nalos and ibises each appear derived from older, single colonization events and subsequent radiation. Genetic distances suggest colonization of moa-nalos occurred after about 3 mya. Phylogenetic trees suggest that a single volant ancestor independently and almost simultaneously gave rise to lineages on Kauai and Oahu. Later, moa-nalos might have colonized Maui-Nui via the Penguin Bank, a short-lived land bridge between Oahu and Molokai. DNA sequence data also support a single colonization event for the Branta geese in Hawai`i, but this group had a much more recent origin (<1mya). The timing of the split of the giant Hawai`i form from the lineage corresponds well to the age of Hawai`i, and suggests that a flighted form colonized Hawai`i and evolved flightlessness and large body size in less than 0.5 my. The flightless rails of Hawai`i show a very different pattern. The Porzana rails are descended from at least two separate colonizations by different ancestral lineages. The historically-known Hawaiian rail (*P. sandwichensis*) and 2-3 undescribed species known only from fossil remains on Hawai`i, form a clade that is sister to a widespread volant rail, *P. tabuensis*. The Laysan rail (*P. palmeri*) is paraphyletic with respect to *P. pusilla*, another widespread volant rail. This paraphyly suggests a recent descent and rapid evolution of flightlessness. Relationships of the flightless *P. severnsi*, from Maui, are not resolved, and it may have descended from a different, older colonization event than other rails.

*Algal Turf Composition at Two Sites on the Island of Hawai`i.* **BROOKE STUERCKE** (Marine Science Department, University of Hawai`i at Hilo, 200 W. Kawili St. Hilo, HI 96720).

Algal turfs, or mats of interwoven multispecific algae 1-3 cm in height, play an important role in the reef community in Hawai`i, and yet they are often overlooked. The algal turf communities of two coastal locations on the island of Hawai`i (Ke`aukaha and Puako) were sampled regularly from September 2000 to February 2001. The samples from quadrats along transect lines were analyzed to find percent abundance of each species. Specimens were examined microscopically to generate a species list. Over 50 different species of algae were identified, and red algae (Rhodophyta) dominated the samples at both sites. Several new records for the island of Hawai`i were found, including *Ceramium aduncum*, *Herposiphonia obscura*, and *Champia parvula*.

Developing Life Skills through First-Hand Experience: ESTP. **JUDY SUING, ANNA FRANKEL, MICHAEL GOODBLATT, KATHALYN TUNG, BONNIE WANG and WILLIAM B.N. BERRY** (Environmental Sciences Teaching Program, Division of Undergraduate and Interdisciplinary Studies, University of California, Berkeley, CA 94720).

The Undergraduate Research Apprenticeship Program (URAP) offered by the University of California at Berkeley provides students with an opportunity to learn outside of the typical classroom setting. The Environmental Sciences Teaching Program (ESTP), a program under URAP, lets undergraduates help middle schools and high schools develop and implement environmental science curricula. In addition, undergraduates are given a chance to write a formal research paper for publication. Through this program, undergraduates learn to think creatively, gain technical field experience, develop presentation skills, establish a more personal relationship with faculty, and network with other organizations of professional interest. All of these skills are applicable to graduate school or the workforce. When teaching younger students in the classroom, undergraduates must think creatively and modify their teaching strategies in order to be responsive to the needs of students. Undergraduates that research papers must use their creative thinking skills to design appropriate experiments. They must also use original thinking when analyzing and interpreting data. Writing research papers also gives undergraduates an understanding of technical field experience within a larger context as opposed to an isolated laboratory or classroom session. ESTP holds weekly meetings in the format of a graduate seminar. Here, undergraduates develop their presentation skills by presenting research papers related to their project or relating their field experiences with their peers and advisors. through ESTP, undergraduates develop a more personal relationship with their advisors that often leads to networks with organizations like AmeriCorp and the EPA.

*Vog Genesis and Effects on Hawai`i Volcanoes National Park Air Quality.* **A. JEFF SUTTON and TAMAR ELIAS** (U.S. Geological Survey, Hawaiian Volcano Observatory, PO Box 51, Hawai`i National Park, HI 96718).

Known as the drive-in volcano with spectacular lava fountains and flows, Kilauea is also the largest stationary source of irritating sulfur dioxide gas (SO_2) in the nation. Since mid-1986, when activity changed from episodic fountaining to continuous effusion, Kilauea has on average, released around 1600 tons of SO_2 per day. This is roughly 6000 times the daily amount considered by the EPA to classify an emitter as a major industrial source. When the brisk northeasterly trade winds, which prevail more than 75% of the year, are disrupted, volcanic emissions build up in east, rather than west Hawai`i. The emissions, which include $SO_2$ and its acidic oxidation products, are known locally as volcanic smog, or vog. The buildup of vog in east Hawai`i during disrupted trade winds degrades air quality for local residents and also for some of Hawai`i National Park's 2.3 million annual visitors.

The USGS Hawaiian Volcano Observatory, in collaboration with the National Park Service, has recently developed a real-time system to inform and advise park visitors and employees when vog levels, as approximated by ambient SO_2 concentration, exceed prescribed levels. Real-time information produced by the advisory is anticipated to become publicly available on the worldwide web in addition to the current notification system in place within the park. Once on the internet, the SO_2 advisory can help residents, especially those in east Hawai`i, avoid the obvious hazards of SO_2 over-exposure, as the island community works together with health care professionals, scientists and educators to better understand vog's health effects.

*Growth and Destruction of the Island of Hawai`i.* **DONALD A. SWANSON** (U.S. Geological Survey, Hawaiian Volcano Observatory, Hawai`i National Park, HI 96718).

Five volcanoes form the Island of Hawai`i. All five could erupt again, though Kohala, whose latest eruption was 120,000 years ago, is considered the least likely by most volcanologists. Mauna Kea had its latest eruption about 4,000 years ago and will probably erupt again; its history shows periods of inactivity longer than the current 4,000 years of quiet. Hualalai erupted in 1801; its recent history suggests the likelihood of an eruption within the next 100-200 years.

All three volcanoes are in the alkalic postshield stage of volcanism, characteristic of Hawaiian volcanoes as they move away from the feeding mantle plume. This stage is typified by the formation of cinder cones that collectively build a relatively steep-sided edifice surmounting the early, gently sloping shield.

In contrast, both Mauna Loa and Kilauea erupted many times in the past 200 years, a reflection of their presence directly above the plume, and are in the tholeiitic shield-building stage of volcanism. Mauna Loa, Earth's largest volcano, may be winding down. Both volcanoes are built of lava flows, with cinder cones and explosive deposits comparatively rare.

All five volcanoes are being destroyed by several processes. Wave erosion is obvious. Coseismic subsidence, and submarine landslides and debris flows, have removed parts of each volcano. Moreover, the entire island is slowly sinking, owing to the addition of mass to the oceanic crust; the measured rate is about 2.4 mm/yr in Hilo Bay.

The field trip to Kilauea will show examples of several processes of growth and destruction.

Explosive Eruptions at Kilauea. **DONALD A. SWANSON**[1], **RICHARD S. FISKE**[2] and **TIMOTHY R. ROSE**[2] ([1]U.S. Geological Survey, Hawaiian Volcano Observatory, Hawai`i National Park, HI 96718; [2]Department of Mineral Sciences, Smithsonian Institution, Washington DC 20560).

Explosions take place at Kilauea every few decades to centuries, about as often as they do at Mount St. Helens. The intensities range from mild burps that hurl rocks a few hundred meters to powerful explosions that throw 4-kg rocks 7 km from the summit caldera.

Two small explosions occurred at Pu`u `O`o, on Kilauea's east rift zone, in the early 1990s, littering the cone with rocks weighing more than 1 kg. Much larger, steam-driven explosions took place on May 11–28, 1924, from Halemaumau Crater, in Kilauea's caldera. Blocks weighing 8–10 tons ended up as far as 1 km from the center of the crater.

Many explosions occurred between 1470 CE and 1790 CE. The final large one, in 1790, killed 80–800 people. Oral history describes some of the explosions, which may have helped give Pele—the Hawaiian goddess of volcanoes—her reputation for a terrible temper. The first explosions accompanied or just followed the formation of Kilauea's modern caldera. Most evidence suggests that the explosions were driven by steam, generated as ground water interacted with magma or hot rock.

Still larger explosions from Kilauea's summit occurred over a 100–200–year period centered around 800 CE. One of these explosions probably threw rocks into the jet stream, which distributed them southeastward, 2-cm rocks falling 18 km away. Some of these rocks are gabbros that formed at pressures of 1.3-2 kbar, deep within the volcano. Such powerful explosions probably are driven by magmatic gas, most likely CO_2.

*The Hawai`i Scientific Drilling Project: A Probe into the History, Structure, and Dynamics of an Ocean Island Volcano.* **DONALD M. THOMAS**[1], **D.J. DEPAOLO**[2], **and E.M. STOLPER**[3] ([1]Center for the Study of Active Volcanoes, University of Hawai`i at Hilo, 200 W. Kawili St., Hilo, HI 96720; [2]University of California at Berkeley, Berkeley, CA 94720; [3]California Institute of Technology, MS170-25, Pasadena, CA 91125).

The first phase of the Hawai`i Scientific Drilling Project (HSDP) was completed to a depth of 3,109 m into the flank of Mauna Kea volcano on the island of Hawai`i. The objective of the borehole is to collect a stratigraphically oriented sequence of eruptive products from Mauna Kea. This suite of samples provides a unique opportunity to define the chemical and isotopic evolution of a classic mantle-plume volcano and gain insight into the chemistry and dynamics of the processes occurring in the mantle plume. These samples will also enable us to gain a far more complete understanding of the structure and evolution of basaltic ocean island volcanoes. Analyses of the core from this borehole are still underway, but the results of the Phase I drilling have shown that: the flank of Mauna Kea has subsided by more than 1000 m since it first reached the ocean surface. The subaerial eruptive sequence on the southern flank of Mauna Kea is underlain by a ~900 m sequence of hyaloclastites. Thick sequences of soil and ash, as well as intervals of indurated hyaloclastites, form aquatards that enable freshwater to penetrate deeper into the basement rocks than recent models have predicted. The chemical and isotopic analyses of the lava flows are consistent with a concentrically zoned mantle plume but also suggest that the plume contains fragments of recycled oceanic crust with distinct chemical and isotopic compositions. Plans are currently underway to continue coring in this borehole to a depth of at least 4,500 m.

Biomonitoring of Toxic Heavy Metals: The Gastropod Biomphalaria glabrata, a Laboratory Model. **S. N. THOMPSON** (Analytical Chemistry Instrumentation Facility and Department of Entomology, University of California, Riverside, CA 92521).

Investigations were conducted to assess the potential of freshwater pulmonate gastropods as biomonitors of heavy metal pollution. The laboratory M line strain of *Biomphalaria glabrata* Say, a vector of human hepatosplenic schistosomiasis, was exposed to $PbCl_2$, $CdCl_2$ or $HgCl_2$, dissolved in artificial spring water within concentration ranges generally subhazardous to man. After 4 weeks or 8 weeks exposure at 17ºC or 28ºC snails were shelled, and their soft body tissues freeze-dried and extracted in hot nitric acid. Analysis of extracts of exposed and unexposed control snails for Pb and Cd were conducted by stabilized termperature graphite furnace atomic absorption spectroscopy and for Hg by cold vapor atomic absorption spectrometry. At both temperatures, exposed snails had significantly elevated levels of heavy metals. Exposure to heavy metals at the tested concentrations caused statistically significant but low levels of mortality. Viability of snails exposed for 4 or 8 weeks at the LC_{50} for 4 weeks exposure of each heavy metal, and of snails acutely exposed for 42 hours to concentrations several-fold higher than the LC_{50}, were examined by in vivo ^{31}P NMR spectroscopy. In neither case, did heavy metal exposure have significant effects on the relative levels of observable phosphorus metabolites in surviving snails. This species, therefore, appears highly tolerant to heavy metal exposure. Growth of snails was reduced by heavy metal exposure, but there was not statistically significant effect of exposure on reproduction. In conclusion, freshwater gastropods such as *B. glabrata* and close relatives exhibit characteristics indicating their potential value as pollution monitors.

The Rise and Fall of Science Education. **CARL TORKKO** (2105 SW 173rd Place, Seattle, WA 98166).

Over the past 50 years there have been many changes in the teaching of science. Way back in the early days of television (1950's) there were very few nationally televised science education programs aired. For example, Mr. Donald Herbert ("Mr. Wizard") was just about the only person doing demonstrations Following his show (1960's) there were early morning science TV productions. For example there was a production that focused on teaching techniques for teachers of high school chemistry. The stimulus of the Russians successfully rocketing Sputnik into an Earth orbit cause a response. The response was the pouring of a lot of money into: scholarships for teachers and the launching of four major new curricula (in the fields of earth science, biology, chemistry, and physics).

Moving on, standardized tests given twenty years ago reflected excellent learning. In 2001 tests reflected barely passable learning (scores had fallen about 20% lower). It is the purpose of this paper to give possible reasons for the decline of student performance on tests.

To Change or Not to Change Plant Genetics: Can We Find a Compromise? **CARL TORKKO** (2105 SW 173rd Place, Seattle, WA 98166).

During the last ten years a great deal of trouble has been generated by the activities of certain scientists—scientists who have altered the genes of food plants and trees. Their work has stimulated a vigorous response. A certain group, in the process of exercising their free speech rights, has taken issue with molecular biologists who have successfully changed original plant genes. Their response has manifested itself in certain sets such as carrying protest signs. It is the purpose of this paper to explore both sides of this issue in an attempt to reach a compromise.

Assessment of Potential Inbreeding Depression in the Nene (Branta sandvicensis or Hawaiian Goose). **ANNE VALLIET, R. TRIMBLE, B. FLESHER, CEDRIC MUIR, and DONALD PRICE** (Biology Department University of Hawai`i at Hilo, 200 West Kawili, Hilo, HI 96720).

The Hawaiian Goose, or Nene, (*Branta sandvicensis*) is an endangered species that once numbered approximately 25,000 individuals prior to European contact with the Hawaiian Islands. The Nene was nearly driven to extinction and by the early to mid 1900s there were less than 50 individuals known to exist. In the 1940s, a fraction of these birds were used to initiate breeding populations and most if not all of the now 890 individuals in Hawai`i are descendants from these individuals. Nene populations are still at serious risk of extinction due to low reproduction and juvenile survival that are keeping most of the populations on the different islands from expanding. Both ecological and genetic factors are potential causes of this reduced reproduction and survival. The low population sizes during the 1940s indicate that inbreeding depression must be considered a possible cause of this low reproduction and survival. We are using the DNA techinque AFLP to measure the genetic variation in a wild population of Nene in Hawai`i Volcanoes National Park. To date, our data support the hypothesis that the population is bereft of genetic diversity. AFLP analysis of breeding pairs will help to determine the genetic variation within the population, the relatedness of breeding pairs and the impact of that genetic variation has on offspring success. We hope this technique will help to design a breeding program that will capitalize on whatever diversity is available.

Globalization and Invasion of Oceania by the Red Imported Fire Ant (Solenopsis invicta): How Can It Be prevented? **ELLEN VANGELDER and LLOYD LOOPE** (USGS-BRD, Haleakala Field Station, P.O. Box 369, Makawao, HI 96768).

The red imported fire ant (RIFA) is arguably the worst ant pest in the world. Dispersed primarily via commerce activities, it is a notoriously destructive and aggressive stinging ant that is highly invasive and nearly impossible to eradicate once established. Although not currently present in Oceania, recent establishment of RIFA in California and Australia put all of Oceania at high risk of RIFA invasion. Trade patterns indicate several potential routes for RIFA invasion into and throughout the region from these two locales. A mild climate further puts the region at risk. Modeling of climate versus potential RIFA colony production in Hawai`i suggests that any island in Oceania with adequate moisture (>510mm/yr rainfall, or an equivalent fresh water source) will be susceptible to RIFA invasion. Without protective measures in place, it is highly likely that RIFA will establish a foothold in the region and subsequently expand its range across Oceania much like it has done across the West Indies. Based on impacts of RIFA in currently infested areas, the resulting impacts to biodiversity and economies in Oceania will be very serious. Immediate and innovative efforts will be required to prevent RIFA from establishing in the region. Recent efforts in Hawai`i, such as the risk assessment and new quarantine policy for keeping all new ants out of Hawai`i, might profitably be used by other Pacific island nations as models for implementing protective measures.

Spinosad as an Organophosphate Alternative for Areawide Fruit Fly Control in Hawai`i. **ROGER I. VARGAS, NEIL W. MILLER, and RONALD J. PROKOPY** (USDA-ARS).

Protein bait sprays and the highly attractive male kairomone lures methyl eugenol and cue-lure have been used in

conjunction with organophosphate insecticides in area-wide fruit fly campaigns worldwide. An effective spinosad protein bait spray (GF-120) without an organophosphate insecticide has recently been developed for area-wide control of oriental fruit fly and melon fly in Hawai`i. In addition a male annihilation spinosad treatment has been developed for area-wide suppression of oriental fruit fly and melon fly. These treatments will be tested further in a fruit fly area-wide program in the Waimea area of Hawai`i. They offer environmentally friendly alternatives to present organophosphate formulations for eradication or suppression of fruit flies not only in Hawai`i, but throughout the world.

*Evaluating Geographic Information Systems (GIS) as a Tool for Mariculture Site Selection Utilizing the Example of Pearl Oyster Farms in Hawai`i.* **LISA M. WEDDING** (Marine Science Department, University of Hawai`i at Hilo, 200 West Kawili St., Hilo, HI 96720).

The analysis of aquaculture potential is one of the primary obstacles confronted in the aquaculture planning process. A considerable amount of resources and effort has been put into the development of successful culture and marketing techniques. However, the process of site selection in the marine environment has been largely overlooked. This study explores a GIS based approach to mariculture site selection. The three main objectives of this project are: (1) Compile a comprehensive list of biophysical requirements of black pearl oysters from current literature; (2) Create a GIS database, and a series of maps that address mariculture site selection criteria; (3) Discuss strengths and weaknesses encountered in utilizing GIS for this application.

*Ciguatera in Hawai`i: Distribution of Toxigenic Dinoflagellates, Ciguateric Fish and Related Abiotic and Biotic Factors.* **DARLA J. WHITE AND MICHAEL L. PARSONS** (Marine Science Department, University of Hawai`i, Hilo, HI 96720).

Six sites around the Big Island of Hawai`i were sa mpled on a biweekly basis to study how toxigenic epiphytic dinoflagellate distributions are related to abiotic (salinity, temperature, nutrients) and biotic (macrophyte host) factors. Fish were also collected at 15 proximal sites and tested for the presence of ciguatoxins using a monoclonal immunoassay (MIA). Toxigenic dinoflagellates were present at all sites sampled, including *Gambierdiscus* spp. (*G. toxicus* and *G. polynesiensis*) and *Ostreopsis* spp. (*O. lenticularis* and *O. siamensis*) among others. *Gambierdiscus* cell abundances were highest in the late spring months (>2000 cells g^{-1} wet wt macrophyte) possibly responding to warming temperatures. *Ostreopsis siamensis* cell abundances were highest in winter months (>13000 cells g^{-1} wet wt macrophyte) possibly due to colder water temperatures. Dinoflagellate distributions do not appear as influenced by water column phosphate concentrations, although a link with ammonium concentrations is evident. Red turf algae were preferred hosts for all epiphytic dinoflagellates except *Ostreopsis siamensis*, which showed preference for *Ulva rigida*. MIA results demonstrate ciguateric fish were equally common in windward and leeward waters, indicating higher incidences of ciguatera in leeward waters may reflect greater fish catch rather than more toxic fish. MIA results also demonstrated fish had significantly higher concentrations of ciguatoxins in spring versus fall and winter months, possibly reflecting the peak abundance of *Gambierdiscus* in the spring.

*Landscape-Scale Conservation in Hawai`i: New Challenges and Partnerships.* **MARK L WHITE** (The Nature Conservancy of Hawai`i, P.O. Box 1716, Makawao, HI 96790).

There are roughly 2 million acres of native-dominated habitat remaining in the main Hawaiian Islands. The vast majority of Hawai`i's unique plants and animals survive in these native dominated areas. These large relatively intact areas also have the greatest chance of supporting diverse assemblages of native species into the distant future. Approximately 80% of the 859 rare plants and animals recorded on the main Hawaiian islands since 1975 occur in these sites, including all remaining habitat for Hawai`i's 19 endangered forest birds. All of these landscapes, excluding a few well managed state, federal and private areas, continue to be degraded by feral animals, weeds, wildfire and other threats. The majority of these native-dominated landscapes support important watersheds or aquifer recharge areas that have enormous economic value. Removing feral animals, weeds, and other threats through the combined efforts of contiguous landowners can significantly benefit both biodiversity and watershed conservation. Landowner based partnerships are one of our best hopes for sustaining biological conservation in Hawai`i because they greatly leverage individual landowner and partner efforts to mitigate threats at the landscape scale. Since 1991, six formal landscape-scale partnerships have formed that are currently implementing landscape-scale natural area and watershed management projects. This paper describes why these partnerships are so important to conservation, some of the successes they are achieving, and new challenges they face.

Seasonal Variation in Benthic Community Structure of the Bighorn River. **STANLEY M. WIATR, BENJAMIN S. MARTIN and BRYAN J. KNAUB** (Dept. Biological & Physical Sciences, Montana State University at Billings, 1500 North 30th St., Billings, MT 59101).

Seasonal variation in standing crop and community structure of both macrophytes and macroinvertebrates was determined for a tailwater section of the Bighorn River located in south-central Montana. *Cladophora, Potamogeton*, and *Fontinalis* were the dominant benthic flora with maxi-

mal standing crops observed in June harvests of 1.18, 1.88, and 0.54 kg/m^2 dw, respectively. Lowest seasonal standing crops of 0.17, 0.25 and 0.13 kg/m^2 dw, respectively, were spread over the winter months; *Cladophora* in December, *Potamogeton* in December-February, and *Fontinalis* in February. Macroinvertebrate species diversity was greatest in *Potamogeton* (12 taxa) and least in *Fontinalis* (9 taxa). Common macroinvertebrates observed in all macrophytes were *Asellus* (sowbugs), Chironomids (midges), and Baetidae (mayflies). Habitat preference was variable. Some species such as aquatic muscids were restricted to *Fontinalis*, while *Crangonyx* habitat included both *Cladophora* and *Potamogeton*. Chironomids were common at all harvests, while other taxa such as aquatic annelids were seasonally abundant. *Hydropsyche* (caddis) populations found in *Cladophora* and *Potamogeton* had greatest density and biomass in early summer and least in fall. In contrast, chironomid and *Asellus* in *Fontinalis* had a constant population size, with an increase in biomass during the summer months. Our data suggest that benthic vegetation in the Bighorn River creates seasonally diverse habitats with quite different levels of primary productivity and a trailing detritus discharge. Differences in producer activity then create habitat with concomitant seasonal variation in *de novo* and residual detrital carbon to accommodate an assemblage of macroinvertebrates having diverse temporal and spatial niche requirements.

Bringing Field Stations and Global Change Technology into Large Classes to Enhance College Ecology Education. **KATHY WILLIAMS** (Department of Biology, San Diego State University, San Diego, CA 92120).

Students in large classes at San Diego State University ask open-ended research questions and collect data on CO_2 flux and microclimate from diverse remote field locations to learn about global change ecology and experience the scientific process. NSF funded state-of-the-art instruments measuring eddy covariance and other environmental variables are located on campus, at two SDSU field stations in Mediterranean-type ecosystems, and at a partner institute, CIBNOR, in the desert ecosystem of La Paz Baja California. Students also compare data from similar instruments located in the arctic tundra of Alaska. Data are transmitted via Internet to campus where they are posted on course websites. With this curriculum revision, students form their own hypotheses comparing environmental conditions within or among sites and seasons. They then collect and analyze data to learn ecological concepts, and also to enhance their understanding of statistical inference and develop high level critical thinking skills. Students present their findings in a course symposium of oral and poster presentations. Outcomes from three semesters indicate that undergraduates gain a deeper understanding of diverse scientific concepts, such as those related to processes of ecophysiology and global climate change, and also of the scientific process, compared to previous classes. Student attitudes about the relevance of ecology to society and interest in working at field stations changed as well.

Association of a Low-Phycourobilin Containing Phycoerythrin with Upwelling-Influenced Waters in the Gulf of California. **A. MICHELLE WOOD[1], SCOTT PEGAU[2], HELMUT MASKE[3], CHUCK TREES[4], JIM MUELLER[4] and W.K.W. LI[5],** ([1]Ecology and Evolution, University of Oregon, Eugene, Oregon 97403; [2]COAS, Oregon State University, Corvallis, Oregon; [3]CICESE/Ecología, Ensenada, B.C., Mexico; [4]CHORS, San Diego State University 97331, [5]Bedford Institute of Oceanography, Dartmouth, N.S., B2Y4A2 Canada).

Phycoerythrin (PE) is the predominant light harvesting pigment of *Synechococcus*, a ubiquitous picocyanobacterial group. The pigment is highly fluorescent in vivo, Em_{Max} ~560-570 nm and harvests green and blue-green wavelengths with varying efficiency depending on the chromophore composition of the form of phycoerythrin being synthesized. Most oceanic forms of *Synechococcus* are thought to produce a PE composed of higher concentrations of the blue-light absorbing chromophore, phycourobilin (PUB, Abs_{Max} ~495nm), than the green-light absorbing chromophore, phycoerythrobilin (PEB, Abs_{Max} ~550nm). Recent studies in the Arabian Sea have shown that spectral forms of PE characterized by a relatively low PUB:PEB ratio dominate the PE fluorescence signature in upwelling-influenced waters, even when these waters are transported far offshore. In this study we examine a range of water mass types in the Gulf of California to test the hypothesis that these low PUB PEs are typically associated with Case I waters, under conditions of increased productivity when the attenuation of blue light is greater than that of green light. We also evaluate the data for the degree of correlation between parameters of the PE fluorescence signature and other optical parameters of surface water that would influence the interpretation of remotely sensed data on ocean color.

INDEX TO AUTHORS

Non-bolded numbers refer to pages which cite titles and times of presentations.
Bolded numbers refer to page numbers of abstracts.