UNIHI-SEAGRANT-BB-01-02

26th Annual
Albert L. Tester Memorial Symposium

Sponsors

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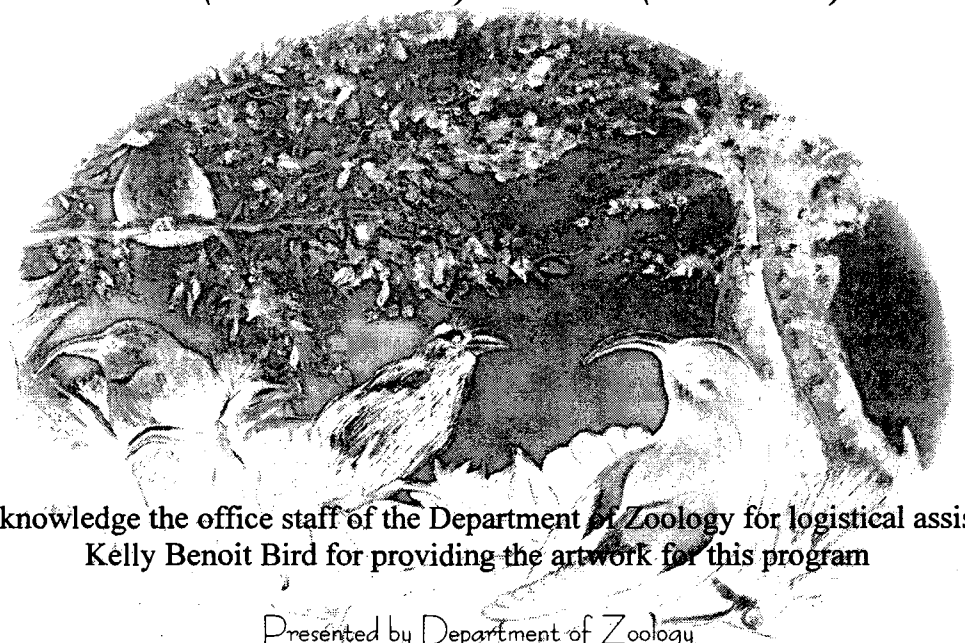


We also acknowledge the office staff of the Department of Zoology for logistical assistance and Kelly Benoit Bird for providing the artwork for this program

Presented by Department of Zoology
University of Hawai'i at Manoa

April 11-12, 2001

26th Annual Albert L. Tester Memorial Symposium
April 11-12, 2001

Distinguished Visitor Lecture

Dr. Steve Jones
University College, London

Thursday, April 12th
East West Center, Keoni Auditorium, 3:00 p.m.

"Rewriting Darwin: Is *Homo sapiens* just another animal?"

Student Seminar Sessions
East West Center, Keoni Auditorium

Wednesday, April 11th

8:15 **Introduction,** Dr. Alison Kay

Session I (Chaired by Dr. Sheila Conant)

8:30 **Larry Riley,** Department of Zoology
Hypothalamic regulation of growth hormone cell function in the tilapia, *Oreochromis mossambicus*

8:45 **Brian K. Branstetter,** Department of Psychology
Horizontal angular discrimination by an echolocating bottlenose dolphin

9:00 **Pong Kian Chua,** Pacific Biomedical Research Center
Modulation of adhesion molecules by TNF-α in human coronary artery endothelial cells: Kawasaki Syndrome

9:15 **Phillis Lam,** Department of Oceanography
Ammonia oxidizing bacteria in a hydrothermal plume

9:30 **Andrew McClung,** Department of Zoology
Mating system parameters and viable population sizes

9:45 **Patricia Lee,** Department of Zoology
Hox gene expression in the sepiolid squid, *Euprymna scolopes*

10:00 **Coffee Break**

Session 2	(Chaired by Dr. Greg Ahearn)	
10:30	**Marc Lammers,**	Department of Zoology
	Localizing dolphin acoustic signals using a hydrophone array: Preliminary findings	
10:45	**Buffy Cushman,**	Department of Geology and Geophysics
	Geochemistry of plume-ridge interaction at the Galapagos Spreading Center	
11:00	**Teresa Restom,**	Department of Botany
	The effects of forest species composition on rainfall interception in the Honouliuli Preserve watershed	
11:15	**Amber Whittle,**	Department of Zoology
	Nearshore currents in Hanauma Bay and their possible relationship to larval ecology	
11:30	**Ken Longenecker,**	Department of Zoology
	The role of food in the community structure of reef fish	
11:45	**Daniel S. Gruner,**	Department of Zoology
	Bottom-up influences in a Hawaiian arthropod community	
12:00	**Lunch Break**	
Session 3	(Chaired by Dr. Athula Wikramanayake)	
1:30	**Timothy Fitzgerald,**	Department of Zoology
	Electroreception in juvenile sandbar sharks, *Carcharhinus plumbeus*	
1:45	**Steve Eckert,**	Department of Zoology
	Effects of angiotensin II and natriuretic peptides on prolactin and growth hormone release from the pituitary of the tilapia, *Oreochromis mossambicus*	
2:00	**Carmen Bazua-Duran,**	Department of Oceanography
	Geographic variations in the whistle repertoire of Hawai'ian spinner dolphins (*Stenella longirostris*)	
2:15	**Caroline DeLong,**	Department of Psychology
	An acoustic analysis of objects ensonified by a bottlenose dolphin during a cross modal matching task	
2:30	**Aaron Hebshi,**	Department of Zoology
	Timing of breeding in a Hawaiian seabird: Why is it so predictable	
2:45	**Carl Meyer,**	Department of Zoology
	Are Hawaii's marine reserves large enough? The Waikiki MLCD as a case in point	

3:00	Coffee Break	
Session 4	(Chaired by Dr. Margaret McFall-Ngai)	
3:30	**Jennifer Kimbell,**	Department of Zoology
	Symbiont-induced changes in gene expression in the light organ of the host squid, *Euprymna scolopes*	
3:45	**Catherine Simonovich,**	Department of Zoology
	Ethical issues surrounding somatic cell gene therapy	
4:00	**Dianna Appelgate,**	Department of Public Health and Epidemiology
	Contact dermatitis outbreak on the University of Hawai'i campus	
4:15	**Geoffrey Garrison,**	Department of Geology and Geophysics
	Sea level change and deforestation on the Ewa plain of Oahu during Polynesian settlement: a case for coincidence	
4:30	**Dave Matus,**	Department of Zoology
	Where or where do arrow worms belong? A phylogenetic study of a marine chaetognath, *Fasciflagitta enflatta*	
4:45	**Andre Seale,**	Department of Zoology
	Osmoreception: The essential sensory modality for an euryhaline life	

Thursday, April 12th
East West Center, Keoni Auditorium

Session 5	(Chaired by Dr. Andrew Taylor)	
9:00	**Tim Male,**	Department of Zoology
	Rats versus bugs: The importance of seed predator biology for plants	
9:15	**Rebecca Rundell,**	Department of Zoology
	Aspects of the evolution and biogeography of endemic Hawaiian succineid land snails	
9:30	**Mindy Wilkinson,**	Department of Botany
	Asymmetric impacts of mycorrhizae and fire on competitive interactions among grasses	
9:45	**Fabio Moretzsohn,**	Department of Zoology
	Use of dried tissue and molluscan shell for molecular systematics of rare species of mollusks	
10:00	**Ross Langston,**	Department of Zoology
	Spawning dynamics of the Hawaiian sanddivers *Limnichthys donaldsoni* and *Crystallodytes cookei*	

10:15 Coffee Break

Session 6 (Chaired by Dr. Heinz Gert deCouet)

10:45 **Jennifer Garrison,** Department of Zoology
The effects of alien tree plantations on native Hawaiian forest plant germination and survival

11:00 **Hendrik Luesch,** Department of Chemistry
The search for new antitumor drugs from marine cyanobacteria

11:15 **Shelly Lammers,** Department of Botany
Resurrection and RAPD's; a new look at the endemic *Sophora chrysophylla*

11:30 **Thomas Leedom,** Animal Sciences
Effects of blood withdrawal on plasma prolactin, growth hormone, and drinking in the tilapia (*Oreochromis mossambicus*)

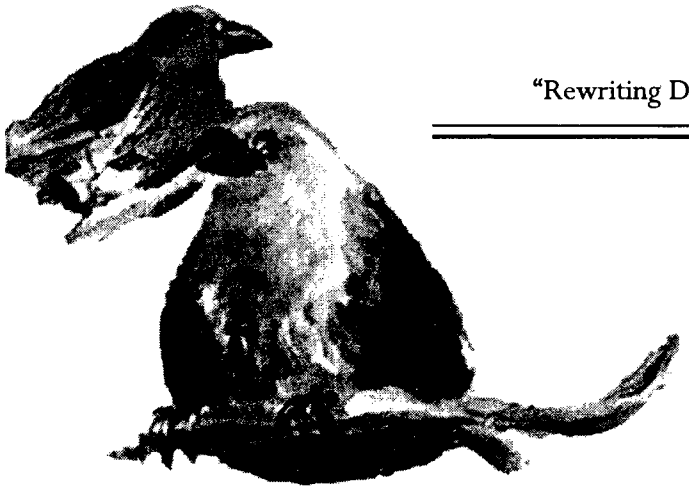
11:45 **Eric Brown,** Department of Zoology
Coral recruitment at selected sites off West Maui

3:00 Tester Symposium Distinguished Visitor's Address

East West Center, Keoni Auditorium

Dr. Steve Jones

"Rewriting Darwin: Is *Homo sapiens* just another animal?"



Presented by the Department of Zoology, University of Hawaii at Manoa

April 11-12, 2001

The Albert L. Tester Memorial Symposium is held in honor of Professor Albert Tester who, at the time of his death in 1974, was Senior Professor of Zoology at the University of Hawaii. The faculty and students of the Department of Zoology proposed an annual symposium of student research papers as a means of honoring, in a continuing and active way, Dr. Tester's lively encouragement of student research in a broad range of fields within marine biology. Papers reporting original research on any aspect of science are solicited from students at the University and these papers are presented at the Symposium which takes place during the spring semester. Income from contributions to the Albert L. Tester Memorial Fund of the University of Hawaii Foundation is used to provide prizes for the two best papers, judged on quality, originality, and importance of research reported, as well as the quality of the public presentation. The Waikiki Aquarium presents the Mike Weekley Award, based on the same criteria. Judges include Department of Zoology faculty members and the previous year's student award winners. In addition, a distinguished scholar from another university or research institution is invited to participate in the Symposium as a judge and to present the major Symposium address.

This years guest is Steve Jones, from University College, London. Steve received his B.Sc and Ph.D. from Edinburgh University and undertook postdoctoral research at the University of Chicago. He has taught at universities in the United States, Australia, and Africa and is now Professor of Genetics at the Galton Laboratory, University College, London. He has become well known, not only for his science, but for his popular writing and broadcasting and was awarded the 1997 Faraday Medal for the Public Understanding of Science. He is author of "In the Blood"; "The Language of Genes: Biology, History, and the Evolutionary Future", (winner of the Rhône-Poulenc Science Book Prize); and "Darwin's Ghost". He is coeditor of The Cambridge Encyclopedia of Human Evolution and appears regularly on British television and radio. His research has focused on spatial heterogeneity and the maintenance of genetic polymorphism in *Drosophila* and land snails.

Albert L. Tester
Senior Professor of Zoology

This Symposium is dedicated to Dr. Albert Lewis Tester, scholar and teacher, who died in Honolulu, Hawaii, on November 27, 1974, his 66th birthday. He was a multi-talented man who developed an international reputation in not one, but several aspects of marine biology, as well as being an outstanding teacher of both university students and laymen. Dr. Tester was a delightful friend, a meticulous worker, and a valued colleague.

A native of Toronto, Canada, Dr. Tester received his doctorate from the University of Toronto in 1936. In 1931 he joined the Pacific Biological Station of the Biological (now Fisheries Research) Board of Canada where he conducted highly significant work on herring.

In 1948 Dr. Tester joined the Department of Zoology at the University of Hawaii where he remained, except for a short time away, until his death. From 1955 to 1958, he was director of the Pacific Oceanic Fisheries Investigations of the U.S. Fish and Wildlife Service in Honolulu. In 1957 he served as chief of the Service's Division of Biological Research in Washington, D.C., a job he found to be hectic and frustrating. Consequently, in 1958 Dr. Tester returned to the University of Hawaii as Senior Professor of Zoology.

At the University, Dr. Tester studied the life history of the baitfish used to catch tuna and the response of tuna to various stimuli as part of an overall program designed to improve tuna fishing in the Pacific. Long after Dr. Tester stopped active tuna research he continued his contributions in this area through his participation on the Governor's Task Force on Hawaii and the Sea, and on the Marine Resources Committee of the Pacific islands Development Commission.

Dr. Tester's most valuable and well known work were in the field of elasmobranch biology which he began in 1960 and continued until his death. He had, in fact, planned to do further work on sharks after his retirement. His interests in elasmobranch biology were broad and included studies on the ecology, behavior, and sensory biology of sharks as well as practical aspects of shark attack and control. From 1967 to 1969 Dr. Tester directed the Cooperative Shark Research and Control Program of the State of Hawaii, and in 1967 he was appointed to the Shark Research Panel of the American Institute of Biology Sciences.

Dr. Tester's major research interest was the shark sensory systems. He did significant morphological and behavioral studies of olfaction, vision, and the chemical senses. During the last 7 years of his life Dr. Tester intensively studied the acoustico-lateralis system, especially the innervation and morphology of neuromasts and the cupula structure in the lateral line, and broadened his interest to include the inner ear, especially that of the carcharinid sharks.

Al Tester was the author of more than 100 publications. In 1974, in acknowledgement of the excellence of his work, the University of Hawaii awarded him the University's Research Medal.

While Dr. Tester's scientific contributions are highly significant, many of us will remember him best as a dedicated teacher, who greatly enjoyed his work with students, and as an active and respected participant in the University community. Dr. Tester served a term as chairman of the Department of Zoology and then continued to be a major influence in many areas of college life. Warm and congenial, he had a winning sense of humor that surfaced at informal gatherings. Whether demonstrating the hula (which he led the Zoology faculty in learning in the '50s), or singing, or playing the organ, he was an affable host, the complete man.

This tribute to Al Tester was written by Arthur N. Popper, formerly of the Zoology Department, University of Hawaii, and now at the University of Maryland, Department of Zoology, and Claire and Perry W. Gilbert of the Mote Marine Laboratory, Sarasota Florida. It is modified from a tribute to Dr. Tester which appeared in American Zoologist, 1977, 17:289-291.

Selected Bibliography
Dr. Albert L. Tester

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Invited Speakers:

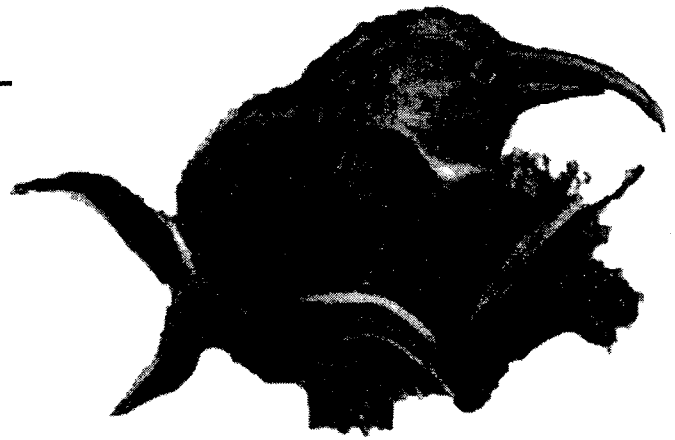
1976 A. A. Myrberg, Jr., University of Miami
1977 R. Glenn Northcutt, University of Michigan
1978 Karel F. Liem, Harvard University
1979 Edmund S. Hobson, Southwest Fisheries Center, Tiburon Laboratory
1980 Gareth Nelson, American Museum of Natural History
1981 Stephen Jay Gould, Museum of Comparative Zoology, Harvard University
1982 Howard A. Bern, University of California, Berkeley
1983 Robert T. Paine, University of Washington, Seattle
1984 Joseph Connell, University of California, Santa Barbara
1985 George W. Barlow, University of California, Berkeley
1986 Jared Diamond, University of California, Los Angeles
1987 Lynn Margulis, Boston University
1988 Eric Davidson, California Institute of Technology, Pasadena
1989 Jonathan Roughgarden, Stanford University, Palo Alto
1990 Corey S. Goodman, University of California, Berkeley
1991 John Maynard Smith, Univeristy of Sussex
1992 Robert Warner, University of California, Santa Barbara
1993 Stephen Hubbell, Princeton University
1994 Nancy Knowlton, Smithsonian Tropical Research Institute
1995 Mimi A.R. Koehl, University of California, Berkeley
1996 George L. Gabor Miklos, The Neurosciences Inst., La Jolla
1997 Stephen A. Wainwright, Duke University
1998 Kenneth B. Storey, Carleton University
1999 Robert E. Ricklefs, University of Missouri-St. Louis
2000 John A. Endler, University of California, Santa Barbara

2001 Symposium Invited Speaker

Steve Jones
University College, London

Judges

Steve Jones
Timothy Tricas
Kelly Benoit Bird
Timothy Male
Jennifer Smith
Jill Zamzow



Albert L. Tester Memorial Symposium

Past Symposia

Best Paper Awards

1976
Tina Weatherby
Dennis Gorlick & Paul Atkins

1977
Charles van Riper
Craig MacDonald & Bruce Thompson

1978
Jon Hayashi
James Wyban

1979
Gerald Heslinga
Frank Perron

1980
Stephen C. Kempf
Clyde S. Tamaru

1981
Carol N. Hopper
Michael Walker

1982
Ronaldo Ferraris
Evelyn Cox

1983
Thomas L. Smalley
Sharon Hendrix

1984
Janice Bell
Joan Canfield
Cynthia Hunter & Cedar Kehoe

1985
Karla McDermid
Hing-Chung Lee
Timothy Tricas

1986
James Howard
Charles Madenjian
Tom Hourigan

1987
Amy Ringwood
Joyce Rundhaug
Jeff Burgett

1988
Teresa Telecky
Randall Kosaki
Jay Jones

1989
Rachel Behnke
Catherine Hurlbut
Edward Metz

1990
Carol Reeb
Bailey Kessing
Kevin Hill

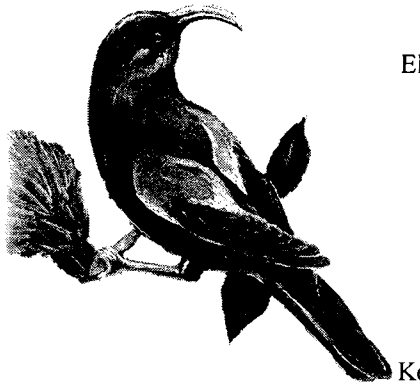
1991
Vanessa Gauger
Gary Jahn
Andrew Martin

1992
Greta Aeby
Robert Feldman
J. Koji Lum

1993
Kazue Asoh
Deborah J. Gochfeld
Andrea Fleig

1994
Kevin Beach
Susan Murphy-Walker
Richard L. Pyle

1995
Eric Vanderwerf
Christopher Lowe
Gwen Lowe
Kabi Raj Neupane



1996
Scott Larned
Patrick Hart
Patricia Lee

1997
Aaron Bush
Angel Yanagihara
Ilsa Kuffner

1998
Elizabeth Nemeth
Jessica Garb
Jamie Foster

1999
Wendy Kuntz
Lisa Privitera
James Leary

2000
Kelly Benoit Bird
Timothy D. Male
Jennifer Smith
Jill Zamzow

Dianna M. Appelgate, Department of Public Health & Epidemiology
(Advisor: Dewolfe Miller)

CONTACT DERMATITIS OUTBREAK ON THE UNIVERSITY OF HAWAI'I CAMPUS

On Aug. 22, 2000 the University of Hawaii's Health Care Center received the first of several cases of contact dermatitis with clinical presentation similar to contact with plants of the *Rhus* genus (Poison oak, ivy, sumac). The majority of cases resided in a single dormitory (Noelani dormitory). Because Hawaii has few poisonous plants and no record of plants from the genus *Rhus*, an outbreak investigation was initiated. Cases were defined as anyone with contact dermatitis, after Aug. 7, on the University of Hawaii campus. A total of 106 students (53 cases/53 controls) from Noelani were asked questions regarding exposure to plants, exposure to other areas on campus, clothing, current oral medication and previous allergies. Gender and age were not significantly associated with contact dermatitis. Ethnically, 58.7% of cases were Caucasian, significantly different from controls (38% Caucasian) (Odds Ratio 3.2, 95% Confidence Interval 1.3-7.3). Rates for those who had recently been in the Noelani courtyard were 56.3% and 26.2% for those who had not (OR 3.7, 95% CI 1.2-11.7). UH botanical experts identified two *Semecarpus nigroviridis* (marking nut) trees in the Noelani courtyard. The trees were cut down on Sept. 22 and the last case was reported on Sept 24. The association with the courtyard, the removal of the trees, and that *S. nigroviridis* contains anacardic acid documented to cause contact dermatitis, strongly suggests that the trees were the source of the outbreak. The high percentage of Caucasian cases supports the possible effect of desensitization by previous exposure to plants in the same family consumed by local residents.

(Ning, L., Arrigo, N., Floyd, G., Lurie, G., Brown, E.)

Carmen Bazúa-Durán, Department of Oceanography
(Advisor: Whitlow W.L. Au)

GEOGRAPHIC VARIATIONS IN THE WHISTLE REPERTOIRE OF HAWAI'IAN SPINNER DOLPHINS (*STENELLA LONGIROSTRIS*)

(Hawai'i Institute of Marine Biology)

Studying geographic variations in the whistle repertoire of spinner dolphins (*Stenella longirostris*) will increase our understanding of the population structure of this species. In the present work, groups of spinner dolphins off five Hawai'ian Islands, Midway, Kaua'i, O'ahu, Lana'i, and Hawai'i, were studied, as well as groups of spinners off Mo'orea, French Polynesia. The whistle repertoire of dolphin groups from Kaua'i, O'ahu, Lana'i, and Hawai'i was compared to search for microgeographic variations and the whistle repertoire of all Hawai'ian Islands was compared to the repertoire of dolphins off Mo'orea to search for macrogeographic variations. Frequency and time information was extracted from the spectrogram of each whistle and this information was used to search for differences between groups. Results show that micro and macrogeographic variations exist in the whistle repertoire of spinner dolphins. Statistically significant differences were obtained by comparing the whistle repertoires using discriminant function analysis. Although macrogeographic variations were found, geographic differences may not exist in the spinner dolphin whistle repertoire. The existence of microgeographic variations indicate that dialects may exist in the spinner dolphin whistle repertoire and that Kaua'i may be a different population than the other main Hawai'ian Island spinner dolphins.

(This work was supported by a Leonida Memorial Scholarship, a Seed Money Grant from the University of Hawai'i, and a UH Foundation Grant. Graduate student is a Fulbright-García Robles-CONACyT and DGAPA fellow.)

Brian Branstetter, Psychology, Human and Animal Cognition
(Advisor: Louis Herman)

HORIZONTAL ANGULAR DISCRIMINATION BY AN ECHOLOCATING BOTTLENOSE DOLPHIN (*TURSIOPS TRUNCATUS*)

(Kewalo Basin Marine Mammal Laboratory)

A bottlenose dolphin was tested on its ability to echoically discriminate horizontal angular differences between two arrays of vertical, air-filled, PVC rods. The blindfolded dolphin was required to station in a submerged vertically-oriented hoop 2 radial meters from the stimuli and indicate if an array with four rods (S+) was to the left or the right of an array with two rods (S-) by pressing a corresponding paddle. The rods within each array were separated by 2 degrees and the two arrays were separated by eight different angles between 2.25 degrees and 6 degrees. A modified method of constant stimuli was used to test for angular discrimination ability. The results yielded a high-pass psychometric function with an arbitrary 75% correct threshold of 1.6 degrees. These data agree well with passive listening minimum audible angle thresholds of 0.9 degrees for click signals and 2.1 degrees for a pure tone signal (Renaud & Popper, 1975). Analyses of response times, number of clicks and inter-click intervals suggested no significant adaptive behavior was used as the task became more difficult. These results help define angular resolution capabilities of dolphin sonar that may play an important role in representing spatial information in the dolphin's environment.

(Thanks to the "Angular Res. Crew," the many interns, staff, participants and Docs at the Kewalo Basin Marine Mammal Lab, funding from Earthwatch and The Dolphin Institute).

Eric K. Brown, Department of Zoology
(Advisor: Paul L. Jokiel)

CORAL RECRUITMENT PATTERNS AT SELECTED SITES AROUND WEST MAUI

(Hawaii Institute of Marine Biology)

Recruitment, growth and mortality of coral larvae were examined using unglazed terracotta tiles as settlement plates. Seven settlement plate arrays (2 plate pairs affixed to a stake - one vertical, one horizontal) were installed in March 1999 at 6 reef areas (spatial scale 100m) across 3 sites (spatial scale 5-10km) on Maui. Arrays were retrieved every four to five months from each reef and analyzed for number of new coral recruits, size of individual colonies and mortality. Plates were returned to the reef and affixed to the array in the same location and orientation. A second set of plates was installed on the existing arrays in March-April 2000. At the site level, Puamana (mean ± SD: 16.1 ± 14.2 colonies/plate pair) had the highest number of recruits while Honolua (2.0 ± 1.9) had the lowest, with Olowalu intermediate (8.2 ± 6.1). There was no significant difference in number of recruits at the reef level. Vertical plates (11.7 ± 14.0 colonies/plate pair) had higher recruitment levels than horizontal plates (6.6 ± 5.0) but this was dependent on the reef. Colonies at Puamana had the greatest change in size (0.55mm ± 1.08mm) for all genera compared to Honolua (0.04 ± 0.09) with Olowalu intermediate (0.25 ± 0.33). Olowalu, however, had the highest proportion of mortality (0.61 ± 0.24) followed closely by Puamana (0.60 ± 0.24) with Honolua (0.28 ± 0.29) having the lowest. Total number of surviving recruits was significantly different among sites with Puamana (10.0 ± 8.2 colonies/plate pair) having the highest number followed by Olowalu (5.6 ± 6.2) and Honolua (2.1 ± 1.6). Sexual recruitment in the present study supports historical trends in coral cover over the last 6 years with cover increasing at Puamana (from 3 to 9%), staying constant at Olowalu (from 32 to 39%), and declining at Honolua (from 42 to 18%). This suggests that these sites may be recruitment limited.

Pong Kian Chua, Retrovirology Research Laboratory
(Advisor: Vivek R. Nerurkar)

MODULATION OF ADHESION MOLECULES BY TNF-α AND SALICYLIC ACID IN HUMAN CORONARY ARTERY ENDOTHELIAL CELLS: PATHOGENIC MECHANISMS IN KAWASAKI SYNDROME

(Pacific Biomedical Research Center)

Kawasaki syndrome (KS), an acute febrile illness of unknown etiology affecting infants and young children, is characterized by vascular inflammation of coronary arteries and other medium-sized muscular arteries, leading to coronary aneurysms and thromboses. Infiltration of immune cells into the intima and adventitia are observed in autopsy tissues. Treatment for KS includes high-dose aspirin (salicylic acid) and IVIG. Using primary human coronary artery endothelial cell cultures (HCAEC), we performed semi-quantitative RT-PCR and cell-based ELISA and found TNF-α increased levels of adhesion molecules ICAM-1 and E-selectin as well as MCP-1 in a time- and dose-dependent manner, and this increase was inhibited by salicylic acid (NaSal). Furthermore, the signaling events involved the transcription factor NF-κB. These results indicate a possible pathogenic mechanism in KS, whereby immune cells are attracted to sites of inflammation, undergo extravasation, release enzymes, such as metalloproteinases, into the extracellular matrix that assist in vascular remodeling, thereby weakening the endothelium and hastening the process of aneurysm. NaSal, in addition to preventing thrombosis and lowering fever in KS, may also function in down-regulating adhesion molecules during the inflammatory stage in KS.

(Grant Support G12RR/AI-03061, RCMI Program, NCRR, NIH)

Buffy J. Cushman, Department of Geology and Geophysics
(Advisor: John Sinton)

GEOCHEMISTRY OF PLUME-RIDGE INTERACTION AT THE GALÁPAGOS SPREADING CENTER

To assess the effects of a near-ridge hotspot on the chemical characteristics of mid-ocean ridge basalts (MORBs), rock samples were collected from 91 stations along the Galápagos Spreading Center (GSC) between 90°30' W and 98° W. Basaltic glasses from these samples were analyzed for major elements by electron microprobe. Chemical trends define three types, based on K/Ti ratios: Enriched MORB (E-MORB), with K/Ti ratios >0.15 and K_2O contents >0.20 wt %; Transitional MORB (T-MORB), with K/Ti ratios between 0.09 and 0.15; and Normal MORB (N-MORB), with K/Ti ratios < 0.09. E-MORB rocks dominate the axial high portion of the GSC (90°50'W to 92°40'W), T-MORBs dominate the portion of the ridge with transitional morphology (92°40' W to 95°30' W), and N-MORBs dominate the axial deep region of the ridge west of 95°30'. MgO varies from 3 to 10 wt %, with the most fractionated E-MORBs occurring nearest the hotspot, between 91° and 92° W. In general, degree of differentiation increases with K/Ti. N-MORBs show the least differentiation, with MgO >7.0 wt.%. Relative to the other types, E-MORBs have higher K_2O, TiO_2, Al_2O_3, Na_2O, and P_2O_5 contents and lower SiO_2 and FeO* at a given MgO. In addition, E-MORBs have lower analytical totals, suggesting the likely presence of water and/or other volatiles. These chemical signatures are consistent with an interpretation that source variations, in addition to variable melting, must be involved in producing the incompatible element enrichment observed closest to the Galápagos hotspot.

Caroline M. DeLong, Department of Psychology
(Advisor: Herbert Roitblat)

ACOUSTIC ANALYSIS OF OBJECTS ENSONIFIED BY A BOTTLENOSE DOLPHIN (*TURSIOPS TRUNCATUS*) DURING A CROSS MODAL MATCHING TASK

(Hawaii Institute of Marine Biology)

A bottlenose dolphin performed a matching task in which he was presented with an object (e.g., tin cup) in one modality (e.g., vision) and then asked to choose the same object from a group of three objects using another modality (e.g., echolocation) or the same modality (e.g., vision). Object sets were presented in two cross-modal conditions (visual sample with echoic choices or echoic sample with visual choices) and two intra-modal conditions (visual sample with visual choices or echoic sample with echoic choices). Acoustic measurements of the objects were made to evaluate how the dolphin used the multiple cues that were available in the echoes to perform the task. Objects were ensonified by dolphin-like clicks from several different angles and the signals were captured and digitized (objects were aspect-dependent, thus producing different echoes at different angles). The pattern of errors made by the dolphin in the echoic-echoic condition revealed that the dolphin appeared to use the following properties of the echo signals to discriminate among objects: variations in echo highlight structure as a function of angle, variations in echo intensity as a function of angle, and absolute echo intensity. The dolphin seemed to use different cues for different object sets, which suggests he may have utilized the most optimal cue(s) available for each object set.

(Faculty sponsors: Heidi E. Harley (New College of USF, Sarasota, FL) & Whitlow W.L. Au (Hawaii Institute of Marine Biology). Funding for the cross-modal experiment provided by Walt Disney World.)

Steve M. Eckert, Department of Zoology
(Advisor: E. Gordon Grau)

EFFECTS OF ANGIOTENSIN II AND NATRIURETIC PEPTIDES ON PROLACTIN AND GROWTH HORMONE RELEASE FROM THE PITUITARY OF THE TILAPIA, *OREOCHROMIS MOSSAMBICUS*

(Hawaii Institute of Marine Biology)

Angiotensin II (Ang II) and natriuretic peptides (NPs) are hormones that have been shown to be an integral part of body fluid regulation in vertebrates. Not only do these hormones have direct regulatory effects, but their ability to indirectly regulate the release of other hormones is well known in higher vertebrates. Nothing, however, is known about the effect of Ang II and NPs on the release of prolactin (PRL) and growth hormone (GH) in fish, which are hormones required to maintain hydro-mineral balance. In this study, the effects of Ang II and three NPs, atrial natriuretic peptide, C-type natriuretic peptide and ventricular natriuretic peptide, were investigated on PRL and GH release from the pituitary *in vitro*. After preincubation in isotonic culture medium (330 mOsm) for 24 hrs, whole tilapia pituitaries were incubated in 0.1 to 100 nM of each hormone, and samples were taken at various intervals. PRL and GH levels were quantified by radioimmunoassays. Ang II stimulated PRL release at 1 hr, and the effect continued through 12 hrs. The effect was dose dependent. Ang II had no effect on GH release. The NPs had no effect on PRL release, but increased GH release in a dose-dependent fashion beginning at 4 hrs, and remained through 48 hrs. The present findings of a stimulatory effect of Ang II and NPs on PRL and GH release, respectively, suggests multiple levels of control of osmoregulation in fish, and provide a basis for further studies on the hormonal control of osmoregulation not only in fish but also for vertebrates in general.

Tim Fitzgerald, Department of Zoology
(Advisor: Kim Holland)

ELECTRORECEPTION IN JUVENILE SANDBAR SHARKS, *CARCHARHINUS PLUMBEUS*

(Hawaii Institute of Marine Biology)

Sharks possess a unique sensory system that enables them to detect the bioelectric fields emitted by prey items that are often hidden from other sensory modalities. These electric fields are usually low in both frequency (<10 Hz) and field strength (<500 μV/cm). Physiological studies have shown electroreceptors to be highly sensitive to such stimuli. This study aims to quantify the behavioral electrosensitivity of these sharks as it relates to detecting and locating prey. Juvenile sandbar sharks, *Carcharhinus plumbeus*, were caught outside of Kane'ohe Bay and transported to the laboratory for a series of experiments that exposed them to prey-simulating and non-prey-simulating fields. Electrical stimuli were varied in size, strength, and frequency. Sandbar sharks responded to prey-simulating DC fields at field strengths as low as a few nanovolts/cm (10^{-9} V/cm), which is in agreement with the lowest reported sensitivities for elasmobranchs. Response rates (attacks at an electric dipole) decreased as field strength decreased, and this trend disappeared when non-prey-simulating fields were presented. Sandbar sharks were also exposed to a variety of AC fields to determine their ability to detect frequencies other than those emitted by prey items. Sandbar sharks detected and successfully oriented to stimulus frequencies as high as 10 kHz, indicating sensitivity to electrical stimuli outside the range of prey items. The results suggest that sandbar sharks are capable of detecting a broad range of electric fields, and might use such information in a non-foraging capacity.

(Funding provided by Schlumberger Foundation. Special thanks to S. Kajiura and T. Tricas.)

Geoffrey H. Garrison, Department of Geology & Geophysics
(Advisors: Craig Glenn, Jane Tribble)

SEA LEVEL CHANGE AND DEFORESTATION ON THE EWA PLAIN OF OAHU DURING POLYNESIAN SETTLEMENT: A CASE FOR COINCIDENCE

Ordy Pond is a shallow closed basin on Oahu's Ewa Plain, containing a 9500-year record of continuous and well laminated sediment deposition. These sediments are almost entirely authigenic and thus primarily a function of local climate. The aim of this study has been to interpret Oahu's Holocene climate history through geochemical analysis of both this sediment record and the modern water column. A time series analysis of the water chemistry has shown the modern pond to be highly eutrophic and nearly entirely anoxic. Sediment chemistry indicates that the laminae are varves resulting from seasonal changes in water chemistry and authigenic productivity; carbonate laminae formed during hot dry seasons when respiration of organic matter is highest, while organic laminae formed in the wet seasons during elevated productivity. Previous study found the area became deforested 930 YR BP and coincident with arrival of the Polynesians. Thus, these workers believed the Polynesian rat as the most likely cause of forest decline. However, our findings indicate the area was undergoing significant change 500^{+} years prior to settlement. A drying trend in $\delta^{18}O_{carbonate}$ began as early as 1540 YR BP, followed by a shift in sediment mineralogy from calcite to aragonite at 1300 YR BP. We believe that forest decline was actually due to a ~2 m drop in sea level which would have lowered the water table, aridified the soil, and favored the spread of grass species. The subsequent steepening of the groundwater slope and seaward shift in the meteoric/marine groundwater interface could explain the $\delta^{18}O_{carbonate}$ freshening and the return to calcite precipitation from 1030 to 670 YR BP.

Jennifer E. Garrison, Department of Zoology & EECB Program
(Advisor: Sheila Conant).

THE EFFECTS OF ALIEN TREE PLANTATIONS ON KOA GERMINATION AND SURVIVAL.

Foresters often plant non-native trees to speed rehabilitation of degraded lands. However, the value of these plantations for re-establishment of native plant communities remains debatable. I am investigating some of the ecological effects of mature plantations of *Casuarina equisetifolia, Eucalyptus robusta, Fraxinus uhdei & Grevillea robusta* in the Nature Conservancy's Honouliuli Preserve on Oahu. I conducted field seed planting experiments to study the effects of plantation type, litter depth, and vegetation structure on germination and survival of four native Hawaiian forest plants. In this paper, I present the results for *Acacia koa* (germination and survival for the other three species was too low to analyze further). I found that plantation species significantly affected germination, growth, and survival of *A. koa*. Vegetation structure varied between the plantations, which in turn affected koa seedling survival and growth. Removal of the litter layer before planting increased time until seed germination and reduced seedling height. Therefore, if direct seeding of koa is to be undertaken, leaf litter should be left in place. It appears that *Casuarina, Eucalyptus & Fraxinus* plantations are less likely to support koa regeneration than *Grevillea* plantations, which had seed germination rates similar to native plots. However, survival of koa seedlings was higher in native stands than in any of the alien plantations. Overall, germination and survival rates were quite low in the field. Direct planting of seeds does not seem to be a productive method of increasing koa density in dry lowland forests and alien tree plantations in Hawaii.

(Funding for this study was provided by EECB and by The Nature Conservancy's Ecosystem Research Grant to S. Conant and J. Garrison).

Daniel S. Gruner, Department of Zoology and EECB
(Advisor: Andrew D. Taylor)

BOTTOM-UP INFLUENCES IN A HAWAIIAN ARTHROPOD COMMUNITY

On young basaltic lava flows on the island of Hawaii, nutrients severely limit primary productivity and plant diversity, but higher-level trophic effects have yet to be evaluated. This study focuses on arthropods associated with the dominant species in these young successional systems, *Metrosideros polymorpha* (Myrtaceae), also the dominant tree in the Hawaiian Islands. In August and September of 1998 on a 120-year-old flow, nutrient limitation was removed by fertilization and combined with bird predator removal cages in a large-scale, well-replicated, crossed factorial design. After one year, foliar nitrogen content and several measures of *M. polymorpha* growth rate were increased in fertilized relative to unfertilized plots. Arthropod densities were measured from foliage clipping samples, and herbivory and gall densities were observed in situ over the course of the experiment. Arthropod densities, primarily detritivores, were increased in fertilized relative to unfertilized plots. In contrast, herbivory and gall (Homoptera: Psyllidae) densities were unaffected by the treatments. In both in situ and clipping samples, arthropods and their damage to plants were higher on glabrous rather than pubescent tree morphotypes. The effects of top avian predators on arthropods are not yet apparent--these processes probably operate on longer temporal scales. However, top-down effects may not be strong in this system because much of the plant biomass passes directly through arthropod and microbial detritivores that are not prominent components of bird diets in the region.

(The Hawaii Department of Land and Natural Resources provided field access. Funding: : Ecology, Evolution, and Conservation Biology program at UH Manoa, Environmental Protection Agency, Sigma Xi, Hawaii Audubon Society, David and Lucille Packard Foundation, and National Science Foundation DDIG program).

Aaron Hebshi, Department of Zoology
(Advisor: David Duffy)

TIMING OF BREEDING IN A HAWAIIAN SEABIRD. WHY IS IT SO PREDICTABLE?

Reproduction in birds is often timed to take advantage of peaks in resource abundance when the offspring is in its critical period. Seabirds have evolved two ways of timing their breeding to match peak resource (usually food) abundance: they pick up on variable environmental cues, or time their breeding to a rigid annual scale. Why should birds "choose" one strategy over the next? Specifically, why would the Wedge-tailed Shearwater, a Hawaiian seabird, choose the second strategy and begin breeding in mid-June each year? Using data from the literature, I am testing the hypothesis that species with a large foraging range can buffer against temporary food shortages, allowing birds with large foraging ranges freedom to nest predictably – on a rigid, annual schedule. In contrast, those species with small foraging ranges face a stronger selective pressure to pick up on environmental cues sensitive to future food availability. A comparison between foraging ranges and predictability of timing of breeding in the Hawaiian seabirds, and worldwide within the shearwater, booby, and tern families, supports this hypothesis. A computer simulation of food availability for different foraging-range sizes also shows that species with small foraging ranges must be more responsive to changes in food availability.

Jennifer Kimbell, Department of Zoology & CMNS
(Advisor: Margaret McFall-Ngai)

SYMBIONT-INDUCED CHANGES IN GENE EXPRESSION IN THE LIGHT ORGAN OF THE HOST SQUID *EUPRYMNA SCOLOPES*

(Kewalo Marine Laboratory)

The symbiosis between the squid *Euprymna scolopes* and the bioluminescent bacterium *Vibrio fischeri* is an exclusive partnership in which the squid host provides a nutrient-rich environment for the symbiont while the light produced by the bacteria is used by the host in antipredatory behavior. Cells of *V. fischeri* from the ambient seawater colonize the host's specialized light organ within hours of hatching. During embryogenesis of the organ, prior to exposure to the symbiont, a set of superficial ciliated fields develops on both sides of the organ. These structures function to direct bacteria-rich seawater toward sites of colonization. Upon colonization, the light organ undergoes a dramatic metamorphosis. At around 12 h after infection, the bacteria provide an irreversible signal that induces the loss of the ciliated fields through apoptosis. In efforts to begin characterizing the molecular "conversations" between the host and symbiont during this signaling, I constructed aposymbiotic and symbiotic cDNA libraries of 12-h juvenile light organs. I then performed subtractive hybridization between the libraries to identify populations of cDNA molecules that are preferentially expressed in the 12-h symbiotic cDNA library. Real time RT-PCR was used to confirm that cDNA clones of interest corresponded to mRNAs whose abundance was increased in symbiotic animals. One transcript that was upregulated in host tissue in response to bacteria was the C8 component of the proteasome. The proteasome is a multisubnit enzyme complex that is responsible for protein degradation via the ubiquitin pathway. This pathway is critical in signaling and tissue turnover, and may serve multiple functions in the early development of the host. Further investigation will reveal what precise role(s) the proteasome plays in the symbiont-induced morphogenesis of the light organ.

Phillis Lam, Department of Oceanography
(Advisor: James Cowen)

AMMONIA-OXIDIZING BACTERIA IN A HYDROTHERMAL PLUME

Ammonia oxidation has seldom been studied as an energy source for chemolithoautotrophy in deep-sea hydrothermal plumes. Previous studies reported anomalously high NH_4^+ content in both the hydrothermal fluids (640-950 mM) [1] and the subsequent hydrothermal plume (up to 400 nM) [2] at the Endeavour Segment, Juan de Fuca Ridge, despite its sediment-starved nature. The net NH_4^+ removal rates and turnover times were comparable to those of CH_4[2]; yet whether this NH_4^+ was partitioned into autotrophic oxidation or assimilation was then unclear. Here we report the first direct evidence for the former process, by showing the presence of the key players, the autotrophic ammonia-oxidizing bacteria, via fluorescence in situ hybridization (FISH) with 16S rRNA-targeted oligonucleotide probes. Populations of AOB in β-*Proteobacteria* were found to be positively correlated with NH_4^+ concentrations ($p<0.001$ ANOVA) and apparent autotrophic removal rates ($p<0.01$ ANOVA) . They comprised 1.6-32.5% total microbial community, whereas the upper end lay close to that in sewage treatment plants. Their abundance were similar to that of Type I methane-oxidizing bacteria, and their biomass could be as much as >300% of measured surface-derived organic carbon flux to this depth[3]. These findings imply that ammonia oxidation could be a significant *in situ* organic carbon production process in this deep-sea hydrothermal plume.

(*Co-authors:* James P. Cowen and Ronald D. Jones)

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Marc O. Lammers, Department of Zoology
(Advisor: Whitlow W.L. Au)

LOCALIZING DOLPHIN ACOUSTIC SIGNALS USING A THREE-HYDROPHONE TOWED ARRAY: PRELIMINARY FINDINGS

(Hawaii Institute of Marine Biology)

Studies of animal behavior depend upon a researcher's ability to make accurate observations of the subject under investigation. This can be a considerable challenge for those not well adapted to their study animal's environment and sensory *umwelt*. A notable example is the investigation of underwater bioacoustic behavior among dolphins. Researchers interested in the use of sound as a communication tool by dolphins have traditionally faced two major challenges: 1) The inability to localize the source of a sound underwater and 2) a lack of hearing sensitivity at the high frequency bands associated with dolphin signaling. Not surprisingly, much remains uncertain about the propagation characteristics of many sounds and about how dolphins use specific signals to communicate. To overcome these limitations, a recording system was developed to localize broadband dolphin signals using a towed three-hydrophone array. This system uses a high-speed analog to digital converter to simultaneously sample three hydrophones spaced 12 m apart towed behind a boat. Using cross-correlation to establish a signal's time of arrival difference at each channel, the position of phonating animals can be geometrically inferred. Initial findings reveal that among spinner dolphins (*Stenella longirostris*) specific signals are sometimes shared between individuals. Evidence is also being found to suggest that dolphins, at times, synchronize their signaling behavior. While still preliminary, such results indicate that the array system does have the potential to significantly contribute to our understanding of the communication behavior of free-ranging dolphins.

Shelly J. Lammers, Department of Botany
(Advisor: Clifford W. Morden)

RESURRECTION AND RAPD'S; A NEW LOOK AT THE ENDEMIC *SOPHORA CHRYSOPHYLLA* (FABACEAE).

Sophora chrysophylla (mamane) is a Hawaiian endemic species in the pea (Fabaceae) family. This species is found in dry and mesic forests on all of the major Hawaiian islands. Mamane shows a wide diversity of physical attributes including variation in leaf type, growth form, flower and seed pod shape, leaf pubescence, and seed color. Although only one species is currently recognized in Hawaii, several different taxa have been recognized historically. A preliminary study of the genetic diversity of mamane was conducted using RAPD genetic analysis. Individuals from the islands of Oahu, Lanai, Maui, and two widely spaced populations on Hawaii (Mauna Kea and Hawaii Volcanoes National Park) were examined. Twenty four primers were screened for amplification, of these 20 produced well-defined bands that could be identified as discreet loci. A total of 173 loci were scored. Of these, 70 (40%) showed no variation between islands, 73 (42%) were unique to a particular island, and 30 (17%) were shared between multiple (but not all) islands. An additional aspect of the study involves the examination of a mamane with a unifoliolate leaf form. This form is presumed to be extinct in the wild, but seeds have been preserved at Bishop Museum on an 88-year-old herbarium specimen. Germination is currently being attempted using sterile tissue culture techniques in conjunction with Lyon Arboretum for both genetic analysis and conservation possibilities.

Ross Langston, Department of Zoology
(Advisor: David W. Greenfield)

SPAWNING DYNAMICS OF HAWAIIAN SANDDIVERS *LIMNICHTHYS DONALDSONI* AND *CRYSTALLODYTES COOKEI* (TELEOSTEI: CREEDIIDAE)

(Hawaii Institute of Marine Biology)

Lifetime fecundity in pelagic-spawning fishes is a product of batch size, spawning frequency, and adult life-span. Relative to larger species, lifetime fecundity of small reef fishes may be constrained by their presumptive short life-spans and small batch sizes. Small species may compensate for these factors either by extending their spawning season or increasing spawning frequency within the season. In this study I examine spawning seasonality and periodicity of two species of small (<60 mm), protandrous, sand-dwelling fishes common to Hawaiian waters, *Liminchthys donaldsoni* and *Crystallodytes cookei*. Specimens were collected weekly between June 1999 and January 2001. Relative maturity of females was assessed by dividing gonad weight by somatic weight (G/S). Based on the G/S index, *L. donaldsoni* and *C. cookei* both have a long reproductive season; peak G/S values occur in March through July followed by a decrease in the late summer months of September through October. Slight secondary peaks are visible for both species in November- December. Both species show three distinct peaks of gonad development over the lunar month; largest G/S values occur on the new moon and first quarter followed by a less distinct peak on last quarter. Despite their small size, *C.cookei* and *L.donaldsoni* have spawning cycles similar to larger-bodied Hawaiian reef fishes.

Patricia N. K. L. Lee, Department of Zoology
(Advisor: H. Gert de Couet)

HOX GENE EXPRESSION DURING DEVELOPMENT OF THE SEPIOLID SQUID, *EUPRYMNA SCOLOPES*

Cephalopods represent a highly derived group within the molluscs. They have evolved extensive alterations in the basic molluscan body plan, including reduction/loss of the shell, novel recruitment of the mantle for locomotion, and modification of the foot into a crown of prehensile arms around the head. The most striking modifications are those involving the anterior-posterior (AP) and dorsal-ventral (DV) axes. In cephalopods, the visceral mass has undergone extensive elongation along the DV axis, while the body along the AP axis has been greatly compressed. As a result, the functional AP axis corresponds to the embryonic DV axis.

To understand how morphological changes relative to the body axes have arisen in cephalopods, we examined *Hox* genes in the sepiolid squid, *Euprymna scolopes*. *Hox* genes are expressed along the AP axis in nested domains in bilaterians. As a result, they can be used as highly conserved molecular markers specific for the AP body axis.

Using RACE-PCR, we have cloned seven *Hox* orthologues from *E. scolopes*, and used these clones as probes for *in situ* hybridizations to examine their patterns of expression during development. Preliminary results for three *Hox* genes suggest that the nested expression pattern may be conserved in some regions along the AP axis, but not others.

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Thomas A. Leedom, Department of Animal Sciences
(Advisor: E. Gordon Grau)

EFFECTS OF BLOOD WITHDRAWAL ON PLASMA PROLACTIN, GROWTH HORMONE, AND DRINKING IN THE TILAPIA (*OREOCHROMIS MOSSAMBICUS*)

(Hawaii Institute of Marine Biology)

The effects of repeated blood withdrawal on plasma levels of prolactin (PRL) and growth hormone (GH) and drinking rate were examined in the euryhaline tilapia. Blood (350 µl/100 g body weight or 5% of estimated blood volume) was taken at 0, 1, 4, 8, 24, 48, 76, and 120 hrs. Blood withdrawal in tilapia acclimated to fresh water (FW) resulted in a marked increase in plasma levels of PRL in association with a decrease in plasma osmolality. A slight increase in GH was also observed. When blood was withdrawn from the fish in seawater (SW), a significant increase in plasma GH was observed accompanied by a marked increase in plasma osmolality. No effect of blood withdrawal was seen on plasma PRL levels, which were kept at lower concentrations than fresh water levels. In contrast, there was no change in plasma PRL and GH levels after blood withdrawal in fish acclimated to 30% SW. Blood withdrawal resulted in a significant reduction in hematocrit values in all treatments suggesting hemodilution. In a separate experiment, a single blood withdrawal (1.4 ml/100 g) stimulated drinking in tilapia acclimated to FW, 30% SW, and SW. Plasma PRL was also elevated following blood withdrawal in the fish acclimated to FW and 30% SW, however, no effect was seen in SW. These results suggest that increased PRL concentration in the fish in FW is correlated to hemodilution and a decrease in plasma osmolality. Growth hormone, on the other hand, is elevated in response to hemodilution and increased plasma osmolality, indicating and important role for GH in SW adaptation.

Ken Longenecker, Department of Zoology
(Advisor: Dave Greenfield)

THE ROLE OF FOOD IN THE COMMUNITY STRUCTURE OF REEF FISHES
(Hawaii Institute of Marine Biology)

Reef fish diversity models, unlike more general diversity gradient hypotheses, assume food does not influence community structure. This assumption appears to be an artifact of the low taxonomic resolution typically used in studies of fish diets. I performed detailed dietary analyses on eight small, cryptic, diurnal, fish species from the spur and groove outside Kaneohe Bay, Oahu, Hawaii to test whether dietary specialization may allow the high species richness observed in reef fishes. The majority of the diet of each fish species was a unique combination of 3.25 +/- 1.75 (SD) benthic prey species having traits that allow local long-term persistence. Mean dietary overlap (17.9%) among these fishes is similar to overlap among organisms from communities structured by fine-scale food resource partitioning. Regression analysis, using data from studies with high taxonomic resolution, indicates a significant decrease in dietary overlap among fishes as latitude decreases. These results, along with an increase in prey diversity toward the tropics, are consistent with diversity gradient hypotheses and suggest that food specialization may allow the local coexistence of many fish species on coral reefs. I used multiple regression to evaluate whether species evenness of reef fishes is influenced by prey availability. Although some relationships were complex, the densities of 5 of 6 fish species were positively related to densities of important prey. Combined, my results indicate food choice and availability influence both components of diversity (richness and evenness, respectively) in reef fishes and suggest reef fish communities may be structured in the same manner as other tropical communities.

Hendrik Luesch, Department of Chemistry
(Advisor: Richard E. Moore)

THE SEARCH FOR NEW ANTITUMOR DRUGS FROM MARINE CYANOBACTERIA

Cyanobacteria are a prolific source of secondary metabolites exhibiting a broad spectrum of bioactivities. Many of these compounds are cytotoxic and potentially useful as chemotherapeutic agents if selective against tumor cells. Our search for compounds with selective cytotoxicity led to the investigation of particular strains of the marine cyanobacteria *Lyngbya majuscula* and *Symploca hydnoides* collected at Guam, Palau, and Hawaii. Several novel and remarkably potent cytotoxins with unusual structural features were isolated from extracts of these organisms using bioassay-guided solvent partition followed by normal-phase chromatography and reversed-phase chromatographic steps. Their structures were determined by extensive application of NMR spectroscopy, analysis of degradation products, and other analytical methods. The new cytotoxins are of mixed peptidepolyketide biogenesis and have been termed lyngbyastatins, symplostatins, lyngbyabellins, and apratoxins. Some of them structurally resemble compounds previously isolated in low yields from marine invertebrates. The isolation of dolastatins, including the human clinical trial compound dolastatin 10, and the discovery of structural analogues support the proposal that many compounds originally isolated from the sea hare *Dolabella auricularia* are of cyanobacterial, dietary origin. The identification of the true source of these metabolites potentially allows the study of their biosynthesis and the heterologous expression of their biosynthetic genes. Towards the goal to isolate and characterize the biosynthetic gene clusters responsible for the formation of the cytotoxins, genomic DNA was isolated from the producing cyanobacteria. Conserved regions of genes encoding nonribosomal peptide synthetases and polyketide synthases have been targeted by PCR. The resulting specific PCR products are being used as probes to screen the genomic DNA/cosmid library.

Timothy D. Male, Department of Zoology
Ecology, Evolution, and Conservation Biology Program
(Advisor: Andrew Taylor)

RATS VERSUS BUGS: THE IMPORTANCE OF SEED PREDATOR BIOLOGY FOR PLANTS

Pre- and post-dispersal seed predators have an enormous potential to affect plant recruitment because they consume 60-100 % of seeds of many tropical plant species and there is broad consensus that such predation shifts recruitment patterns away from those that would be expected based on seed distribution alone. However, there has been little systematic work to document how the type of seed predator shapes recruitment. I set out to survey seed predation in an Australian subtropical forest to identify whether mammalian and invertebrate seed predators showed different responses to the dispersion of seeds of six canopy tree species. I found substantial mortality of all seed species during the study with only 22 % of seeds remained intact by the last seed survey conducted. Three species suffered substantial losses from mammalian seed predation ranging from 52-82 % while the other three species suffered losses from invertebrate predators ranging from 39-89 %. Seed species attacked by invertebrates had significantly higher seed survival at locations away from fruiting trees while species attacked by mammals showed no pattern between survival and distance from fruiting trees or a decrease in survival with distance. These results suggest that it is essential to identify the type of seed predators responsible for seed mortality before making predictions about spatial patterns of plant recruitment and forest dynamics.

David Matus, Department of Zoology
(Advisor: Mark Q. Martindale)

WHERE OR WHERE DO ARROW WORMS BELONG? A PHYLOGENETIC STUDY OF A MARINE CHAETOGNATH, *FASCIFLAGITTA ENFLATTA*

(Pacific Biomedical Research Center)

Chaetognaths (a.k.a. arrow worms) have at different times been placed phylogenetically as protostomes along with brachiopods, spiders, molluscs, and nematodes, or as a basal deuterostome based on morphological and embryological characters. They possess a tripartite body organization composed of a head, midbody, and a posterior transverse septum as well as a pseudocoelomate-like musculature composed of longitudinal muscles and a thick cuticle. Embryologically, arrow worms are characterized by enterocoely and radial cleavage.

Recent molecular data by Ken Halanych (1996) based on 18S RNA sequences suggest that chaetognaths belong in the Ecdysozoa, a major protostome bilaterian clade, clustered most strongly with nematodes. Due to the inherent problems with 18S data, we are investigating protein-coding genes in structural (e.g. actin, myosin, β-catenin) and developmental regulatory gene families such as Hox and ParaHox genes. Through sequence analysis and expression studies we can more accurately solidify chaetognath's place in the Ecdysozoa. Partial sequences have been determined via polymerase chain reaction (PCR) from genomic DNA of several Hox and ParaHox genes including, *ultrabithorax, labial, abdominal b, sex-combs reduced, Hox 3, xlox, Pax2* as well as a 1 kb fragment of an *actin* gene.

Andrew McClung, Department of Zoology &
Ecology, Evolution, and Conservation Biology Program
(Advisor: Sheila Conant)

MATING SYSTEM PARAMETERS AND VIABLE POPULATION SIZES

(University of California at Berkeley; Smithsonian Institution/National Zoological Park)

The Laysan finch (*Telespyza cantans*) is an endangered passerine bird, endemic to the Northwest Hawaiian Islands, whose mating system has long been considered monogamous. However, these birds are sexually dimorphic in both size and plumage coloration, suggesting some frequency of polygyny or extra-pair mating. In fact a polygynous male, along with two females and their nests, was observed in 1999, among one of the translocated populations at Pearl & Hermes Reef (PHR). After extracting DNA from the feathers of more than 200 PHR finches representing about 35 families, I amplified and sized alleles at eight microsatellite loci. The resulting genotypes permit comparison of behaviorally-assigned parentage to genetic assignments, and thus estimation of the frequency extra-pair matings. That information, in turn, leads to more detailed estimates of effective population size and extinction probabilities among the translocated populations.

Teresa Restom, Department of Botany &
Ecology, Evolution, and Conservation Biology Program
(Advisor. Guillermo Goldstein).

THE EFFECTS OF FOREST SPECIES COMPOSITION ON RAINFALL INTERCEPTION IN THE HONOULIULI PRESERVE WATERSHED.

The objectives of this study are to estimate the effect of species composition on the water cycle of forest ecosystems and the potential of stands dominated by each of three species to recharge groundwater. Components of the water cycle (canopy interception, transpiration, and soil moisture) have been studied in stands dominated by Casuarina equisetifolia, Eucalyptus robusta, and Fraxinus uhdei. Groundwater recharge will be estimated as the difference between rainfall and evaporation (canopy interception + transpiration). Data on canopy interception components, throughfall and stemflow, have shown that species characteristics influence the amount of evaporation per rainfall event. F. uhdei presented higher stemflow rates (average of 1.2 liters/tree/day) than E. robusta (0.6 liters/tree/day) or C. equisetifolia (0.4 liters/tree/day). Throughfall was significantly different only for one stand of F. uhdei (79% of rainfall), which was higher than the other two species (57% of rainfall) in the northern part of the preserve. These results suggest that the canopy of F. uhdei may intercept less rainfall than the other two species allowing higher groundwater recharges. This study demonstrates that species composition may affect the water cycle in forests, and thus is a factor that should be carefully taken into account when planing watershed restoration programs.

Carl Meyer, Department of Zoology
(Advisor: Kim Holland)

ARE HAWAII'S MARINE RESERVES LARGE ENOUGH? THE WAIKIKI MLCD AS A CASE IN POINT.

'No fishing' marine reserves (MR) are being increasingly suggested as useful tools for mitigating the negative effects of human activity on coral reefs. To date the choice of locations and boundaries for MR's has been opportunistic and based primarily on anthropocentric concerns. Unfortunately designing MR's in this way, rather than around the biology of the organisms that they are intended to protect, may limit the effectiveness of these areas. For example, many of the anticipated benefits of MR's are dependent upon these areas being large enough to effectively protect 'resident' populations of fish and other exploited organisms. In order to achieve this aim, MR's must be large enough and contain sufficient critical habitat to ensure that most resident individuals do not range beyond the boundaries into fished areas. The aim of the present study is to determine whether an existing MR (Waikiki Marine Life Conservation District) is large enough and contains sufficient suitable habitat to contain the home ranges of three species of coral reef fish that are representatives of a wide range of feeding and vagility guilds. In order to address this question fish movement patterns, habitat use and home range sizes in the Waikiki MLCD are being quantified using acoustic telemetry (tracking) and conventional ID tags. Results indicate that the Waikiki MLCD is only large enough to protect a resident population of one of the three species investigated (*Naso unicornis*). The other two species investigated (*Mulloides flavolineatus* and *Caranx melampygus*) frequently range beyond the reserve boundaries in the course of their daily movements.

Fabio Moretzsohn, Department of Zoology
(Advisors: E. Alison Kay & Gert H. de Couet)

USE OF DRIED TISSUES AND MOLLUSCAN SHELLS FOR MOLECULAR SYSTEMATICS OF RARE MOLLUSKS

When fresh or preserved specimens for molecular systematics study are difficult to obtain, the option of using museum specimens may be a viable alternative. One caveat is that the researcher cannot be certain of how quickly the tissue desiccated, or how the specimen was maintained over the years. Therefore, as with other sources of aDNA (ancient DNA), there is a risk of extraneous DNA and other contaminants that can inhibit PCR. Despite these potential problems, it is possible to recover PCR-amplifiable DNA that can be useful in molecular systematics. In a study of the *Cribrarula cribraria* species complex (Gastropoda: Cypraeidae), mostly museum specimens were used. Most specimens with dried tissue yielded the radula (or parts of it), and the DNA obtained from such tissues was usually degraded but amplifiable in a few cases (about 20% of samples). The calcareous molluscan shell was also investigated as a potential source of DNA. Appropriate care was taken to avoid contamination: solutions were autoclaved, shells and tools were treated with undiluted bleach, soaked in a strong solution of NaOH, rinsed in distilled water, and then exposed to UV light to rid any surface-clinging DNA. In all instances, spectrophotometer readings at 260nm detected a low DNA yield, but DNA was not visible in agarose minigels. One sample was eventually amplified and sequenced (313bp mtDNA), matching the sequence obtained from a fresh specimen, thus suggesting that authentic DNA was recovered. Although this result is not surprising, the lack of similar reports in the literature is interesting. If primers for shorter fragments and more accurate techniques to remove PCR-inhibitors are used, a larger proportion of samples may become viable. Though it is laborious and expensive to make shell and dried tissue samples work, the technique may be justifiable for studies of rare or extinct species.

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Larry G. Riley, Department of Zoology
(Advisor: E. Gordon Grau)

HYPOTHALAMIC REGULATION OF GROWTH HORMONE CELL FUNCTION IN THE TILAPIA, *OREOCHROMIS MOSSAMBICUS*

(Hawaii Institute of Marine Biology)

In teleosts, growth hormone (GH) is involved in the regulation of several physiological processes. These include growth, osmoregulation, metabolism, reproduction and development. These processes constantly influence each other within the animal making our understanding of regulatory mechanisms of GH release from the pituitary difficult to investigate. In teleosts, several factors have been implicated in stimulating GH release such as growth hormon releasing factor (GRF), gonadotrpin-releasing hormone (GnRH), pituitary adenylate cyclase-activating polypeptide (PACAP). Recently, a newly isolated peptide from the rat stomach, termed ghrelin, was identified and shown to stimulate GH release in the rat. The present study was conducted to examine the effects of mammalian ghrelin, GRF and PACAP on GH release from the tilapia pituitary *in vitro*. Rat ghrelin and human PACAP significantly stimulated GH release dose dependently at concentrations of 1-300 nM. The effect was significant as early as 4h of incubation and lasted for 24 h. Human GRF significantly stimulated GH release also but was less effective than ghrelin and PACAP. NO effect of ghrelin, PACAP and GRF was seen on gene expression of GH after 24 h of incubation. These results indicate for the first time that ghrelin stimulated GH release in teleosts and also that the effect of ghrelin is equipotent with PACAP and more potent that GRF.

Rebecca J. Rundell, Department of Zoology &
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ASPECTS OF THE EVOLUTION OF HAWAIIAN ENDEMIC SUCCINEID LAND SNAILS

The Hawaiian land snail fauna is incredibly speciose and ecologically diverse. There are 763 nomenclaturally valid species, and they inhabit vitually every ecological zone in the Hawaiian islands. The Hawaiian endemic species of the worldwide family Succineidae illustrate this diversity. There are 41 species and these inhabit a wide variety of ecological zones, including montane rainforest and coastal dunelands. A sequencing study of the Hawaiian endemic succineids was undertaken to investigate the evolutionary relationships of these species. A 680- base pair region of the mitochondrial COI gene was sequenced for the following species: *Catinella explanata* (Kauai), *Catinella rotundata* (Oahu), *Catinella baldwini* (Maui), *Succinea canella* (Molokai) and *Succinea rubella* (Lanai). A neighbor-joining tree using a Kimura 2 parameter model was produced, using the Hawaiian achatinellid *Auriculella ambusta* as an outgroup. *Auriculella ambusta* differs genetically from the ingroup by 30 %. Pairwise interspecific genetic distance within the ingroup ranges from 4.6 % to 16.6 %. The average genetic distance is 13.6 %. Groupings within the tree do not follow the traditional taxonomic groupings of *Catinella* and *Succinea*.

André P. Seale, Department of Zoology
(Advisor: E.Gordon Grau)

OSMORECEPTION: THE ESSENTIAL MODALITY FOR AN EURYHALINE LIFE
(Hawaii Institute of Marine Biology)

In the tilapia (*Oreochromis mossambicus*), as in many euryhaline teleosts, prolactin (PRL) plays a central role in freshwater adaptation, acting on osmoregulatory surfaces to reduce ion and water permeability and increase solute retention. Consistent with these actions, PRL release is stimulated as extracellular osmolality is reduced both *in vitro* and *in vivo*. The ability of osmolality to directly control the osmoregulatory output of the PRL cell provides an excellent model to elucidate the mechanisms by which an osmotic signal is transduced in an osmoreceptive cell. Moreover, tilapia PRL cells are arranged into a nearly homogeneous tissue within the *rostral pars distalis* of the pituitary gland and therefore can be easily separated for *in vitro* studies. In the tilapia, hyposmotically induced PRL release *in vitro* is dependent on extracellular calcium, and is tightly correlated with an increase in cell size and a rise in intracellular free calcium. We hypothesize that reduced osmolality elicits an increase in PRL release through the opening of stretch-gated channels that are tied to an increase in cell size. We investigated the effects of ouabain and nystatin, known to elicit cell swelling in the absence of an osmotic gradient, on PRL release. Also, we assessed the presence of stretch-activated cation channels in the tilapia PRL cells using gadolinium (Gd^{3+}) and chlorpromazine. Ouabain, nystatin and chlorpromazine treatments significantly increased PRL release within 1 hr of static incubation. PRL was inhibited under hyposmotic conditions by 18 hrs of static incubation with Gd^{3+} (100 and 1000μM). These results support the hypothesis that an increase in cell size is a critical step in the transduction of an osmotic signal into PRL release, suggesting the involvement of stretch activated ion channels.

Catherine J. Simonovich, Department of Zoology
(Advisor: H. Gert de Couet)

ETHICAL ISSUES SURROUNDING SOMATIC CELL GENE THERAPY (SCGT)

Somatic cell gene therapy (SCGT) comprises a number of potential medical treatments that are currently the subject of intense interest in the biomedical research community. SCGT will probably be available clinically in the future, and its impact will be felt worldwide with potential negative consequences for humanity if ethical issues are not adequately addressed. This presentation will provide information about ethical issues surrounding SCGT, the scientific basis of SCGT, and the regulations and history of SCGT research. Concerns about the research methods and practices of SCGT and ethical issues regarding other potential societal consequences will be discussed. Specifically, the issue of treatment vs. enhancement in the potential uses of SCGT will be addressed.

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Amber Whittle, Department of Zoology
(Advisor: David Greenfield)

NEARSHORE CURRENTS IN HANAUMA BAY, OAHU, HAWAII AND THEIR POSSIBLE RELATIONSHIP TO LARVAL ECOLOGY

Both nearshore and offshore larval ecology has often been viewed as a "black box." In the past, scientists have hypothesized that fish larvae are passive entities carried by currents, but recent evidence has shown that fish larvae may have the ability to actively orient and swim against the current. Other studies have shown that larvae may be retained in their natal habitats. I am currently studying the larval ecology of fishes in Hanauma Bay, a Marine Life Conservation District on Oahu, Hawaii. I undertook, along with 12 volunteers, the mapping of the nearshore currents in the Bay. I hypothesized that more larvae would be found in the retention areas of the Bay (the NNW corner) than in the other areas, including the outer portion. I combined drogue and light trap studies. The drogue study used volunteers at four stations recording time and compass headings of six, individually marked drogues in the Bay. This study was conducted on a calm, incoming tide on10 November 2000. The mapped nearshore currents showed a definite retention of all drogues in the NW portion of the Bay (in Witches' Brew or nearer shore). Over the past year, I have, twice monthly, placed 2-3 light traps in fixed areas in the Bay: in the sandy center of the Bay near the outer boundary, in the sandy outer boundary of Witches' Brew, in the coral NNW nearshore area, and in the inner, rubble area of Witches' Brew. So far, my hypothesis has been proven false: I have found an almost equal amount of fish larvae in the inner Witches' Brew and the outermost positions, and relatively no larvae in the outer Witches' Brew and inner NNW positions. I have also found a similar distribution of the neotenic fish, *Schindleria.*

Mindy Wilkinson, Department of Botany
(Advisor: Curt Daehler)

ASYMMETRIC IMPACTS OF MYCORRHIZAE AND FIRE ON COMPETITIVE INTERACTIONS AMONG GRASSES

Fire and arbuscular mycorrhizal (AM) fungi can potentially affect survival and competitive interactions between invasive and native plants. We used greenhouse experiments to test the effects of AM fungi and drought on intra- and interspecific competition among two invasive bunchgrasses (*Hyparrhenia rufa* and *Melinis repens*) and an indigenous bunchgrass (*Heteropogon contortus*) that co-occur in an arid Hawaiian grassland. We also monitored survival, aboveground biomass and recruitment of these species in response to prescribed fires at two sites in Hawai'i Volcanoes National Park. At the first site, *Melinis* mortality was increased by fire while the mortality of burned *Hyparrhenia* and *Heteropogon* was not different from unburned controls. One year following fire the density of *Melinis* individuals was reduced while *Heteropogon* and *Hyparrhenia* densities were not affected. At the second site, the fire was more intense and all species experienced high and similar mortality rates. After one year *Heteropogon* densities declined more than the densities of *Hyparrhenia* and *Melinus*. In the greenhouse *Heteropogon* produced less biomass in interspecific competition than in intraspecific competition under all treatments; however, the magnitude of the difference between *Heteropogon* and its competitors was reduced 95% in the AM fungal treatment. Under some conditions, fire appears to selectively reduce populations of one of the invaders (*Melinis*), while AM fungi mediate competition between the native *Heteropogon* and the invasive species by differentially increasing the growth of the native, resulting in reduced competitive impact of the invaders.