March 27, 1981
Ala Moana Americana Hotel
Honolulu, Hawaii

Conserving Hawaii's Coastal Ecosystems Abstracts

Sponsored by: UH Sea Grant College Marine Advisory Program, Lyon Arboretum-UH Manoa, Lyon Arboretum Association, Leeward Community College: Office of Special Programs & Community Services • Sea Grant Cooperative Report-UNIHI-SEAGRANT-CR-81-01-June, 1981

CONSERVING HAWAII'S COASTAL ECOSYSTEMS

WORKSHOP ABSTRACTS

SEA GRANT COOPERATIVE REPORT
UNIHI-SEAGRANT-CR-81-01
JUNE, 1981

SPONSORED BY:
U.H. SEA GRANT COLLEGE MARINE ADVISORY PROGRAM
LYON ARBORETUM - U.H. MANOA
LYON ARBORETUM ASSOCIATION
LEEWARD COMMUNITY COLLEGE --
OFFICE OF SPECIAL PROGRAMS & COMMUNITY SERVICES

PREFACE

These proceedings provide summaries of presentations and group discussions at a workshop on Hawaii's strand ecosystems. We hope that the proceedings will be useful to individuals interested in specific presentations or discussions, or more importantly, in following up on recommendations. As the summary of evaluations indicates, the majority of respondents found the workshop useful in learning about strand ecosystems and associated problems and issues. The workshop also provided an opportunity to meet others with shared concerns and to learn about information sources.

Some of the specific recommendations resulting from the workshop were: (1) Establishment of a native coastal plants garden on Oahu, primarily for public education; (2) Public education regarding the cultivation of native coastal plants and their sale; and (3) Initiation of a volunteer steering committee to help implement workshop recommendations. Over a dozen participants volunteered for the steering committee and an initial meeting was held May 11, 1981, at the Lyon Arboretum to discuss future projects. Anyone interested in learning more about the steering committee and its activities can contact one of the workshop sponsors.

We would like to extend a Mahalo Nui Loa to the following individuals who helped to make the workshop a success: Dr. Yoneo Sagawa, Director of the Lyon Arboretum; Pikake Wahilani, Acting Director of the Office of Special Programs and Community Services, Leeward Community College; Sharon Bogue and Judy McCoy, Lyon Arboretum Association, who handled registration; Kathy Schmidt and Ginger Wright, Leeward Community College, who handled audio-visual needs and assisted with the publicity flyer; Blanche Klim, Wilfred Fujita, and graphic arts students, Leeward Community College, who produced the flyer; Brian Choy, Lyon Arboretum Association, who made a beautiful wili lei with cultivated native coastal plants for the luncheon speaker; and, of course, all the speakers and group leaders who generously shared information and generated useful discussion and interaction. Finally, we acknowledge the Pacific Sea Grant Advisory Programs (PASGAP), funded by the National Sea Grant Program, NOAA, U.S. Dept. of Commerce, for supporting Dr. Michael G. Barbour's travel under a talent-share agreement with the University of California at Davis.

This workshop was supported in part by the University of Hawaii Sea Grant College Program (under Institutional Grant No. NA79AA-D-00085), Harold L. Lyon Arboretum, Lyon Arboretum Association and Leeward Community College.

Printing of the workshop abstracts was funded by the Lyon Arboretum. The camera-ready copy was prepared by Helen Baligad, Leeward Community College.

Bert Kimura, Leeward Community College
Ken Nagata, Harold L. Lyon Arboretum
Ray Tabata, U.H. Sea Grant Marine Advisory Program

ABSTRACTS

Strand Ecosystems in Hawai'i, Winona Char 3

Resources, Values and Management (Panel Discussion)

Native Strand Flora, Ken Nagata 6

Seabird Habitat, Sheila Conant 8

Educational Values, John Hawkins 9

Cultural Values, Pat Kirch 10

Recreational Impacts, Ray Tabata 11

Shoreline Management Tools, Lorrie Chee 14

Natural Area Reserves, Robert Lee 16

Meeting Shoreline Recreation Needs, Steve Salis 17

Human Impacts on Coastal Ecosystems, Michael G. Barbour 18

WORKSHOP SUMMARIES

Biological/Ecological Research Needs, Carolyn Corn & Winona Char . . . 25

Educational Needs, Les Matsuura 26

Human Impacts & Management Needs, Irwin Lane & Michael Barbour 27

Propagation/Cultivation & Landscaping, Keith Woolliams & Derral Herbst 28

APPENDICES

Program 33

Workshop Evaluation 34

Workshop Participants 40

Steering Committee Volunteers 43

ABSTRACTS

STRAND ECOSYSTEMS IN HAWAI'I

Winona Char
U.H. Dept. of Botany

Recognition of the strand vegetation as a separate ecosystem began as early as the 18th century (Hillebrand, 1888). Rock (1913) recognized the strand as one of six botanical regions in the Hawaiian Islands. More refined classification systems have since followed (MacCaughey, 1918; Ripperton and Hosaka, 1942; Egler, 1947; Fosberg, 1972; Knapp, 1975). Each of these systems have emphasized different combinations of environmental factors. Egler (1947) described several maritime communities found on six types of habitats: (1) tidal flats; (2) rock shores; (3) spray-swept bluffs; (4) spray-swept uplands; (5) sand beaches; and (6) sand benches. Fosberg (1972) defined the strand as that portion of the vegetation along the shoreline and in the zone immediately back of the shoreline that is strongly influenced by saltspray and saltwater. Fosberg recognized four main subdivisions of the strand vegetation: (1) wet sandy; (2) wet rocky; (3) dry sandy; and (4) dry rocky.

In an in-depth study of the coastline ecosystems of O'ahu, thirteen ecosystem classes named after the dominant plant component and land form type have been recognized by Richmond and Mueller-Dombois (1972):

Hibiscus ecosystem
1. on beach flat

Scaevola ecosystem
2. on dunes
3. on raised coral rock
4. on rocky basalt coast
5. on talus and alluvium

Chloris-Sida ecosystem
6. on talus

Prosopis ecosystem
7. on talus and alluvium
8. on tuffaceous headland
9. on dunes

Chloris-Prosopis ecosystem
10. on dune and clay flat complex

Batis ecosystem
11. on mud flat

Rhizophora ecosystem
12. on tidal flat

Scirpus-Eichornia ecosystem
13. in pond

Three environmental factors -- precipitation, substrate, and exposure -- exert a strong influence on the types of plant communities present in the strand. There are striking differences in strand vegetation types between the windward and leeward sides of the islands. This is largely due to the greater amount of rainfall on the windward side of each island. On the windward shores, hala (Pandanus) may form dense forests. For example, along the Napali coast of Kaua'i and the Hana coast of Maui, hala forests cover the steep cliff walls almost down to the shore. The hala groves of Puna on the Big Island are mentioned many times in the mele (songs) of Hawai'i. Scattered clumps of hau (Hibiscus tiliaceus) can be commonly seen along the windward shores; hau may form dense thickets along the

stream banks that flow to the sea. On the high, rocky cliffs above the sea on the windward coasts of Kaua'i, Moloka'i, and Maui, the vegetation tends to be low and dwarfed due to exposure to wind and saltspray. Several rare, endemic plants can be found here. Among them is the unusual Brighamia citrina, often described by some botanists as "the cabbage on a pole."

On the sandy beaches, vegetation may consist of several native species such as pohuehue (Ipomoea brasiliensis), naupaka-kahakai (Scaevola taccada), and 'aki'aki (Sporobolus virginicus). Sand dunes can be found in several places in the islands such as Ka'ena on O'ahu, Polihale on Kaua'i, and Mo'omomi on Moloka'i. Native plants found in these areas include 'ōhai (Sesbania spp.), hinahina (Heliotropium anomalum var. argenteum), 'ilima (Sida fallax), pā'ū-o-Hi'iaka (Jacquemontia sandwicensis), and 'akoko (Euphorbia degeneri).

On the dry, rocky slopes and on the raised coral reef areas behind the sandy beaches of the leeward shores such as Ka'ena and Barber's Point on O'ahu, a large number of native plants may be found. These include nehe (Lipochaeta integrifolia), 'ilima, ma'o (Gossypium sandwicense), 'ōhelo-kai (Lycium carolinianum), maia-pilo (Capparis sandwichiana), 'ihi (Portulaca lutea), naio (Myoporum sandwicense), 'ili-ahi-alo'e (Santalum ellipticum var. littorale), and kauna'oa (Cuscuta sandwichiana).

Along the leeward coasts such as Wai'anae on O'ahu and Makena on Maui, the kiawe (Prosopis pallida) forest can be found very close to the beach. The kiawe trees are usually reduced in statute due to the harsh environmental conditions of the strand.

Plants growing in the strand are subjected to a number of harsh environmental conditions such as shifting substrate, intense solar radiation, saltspray, dessication, etc., and as a result have developed adaptations for living under such conditions (Carlquist, 1970). Some plants like the 'ili-ahi-alo'e and the naupaka-kahakai, for example, have succulent, water-storing leaves; others such as the 'ōhai, hinahina, and ma'o have silvery, hairy leaves which reflect the sun's rays and also reduce transpiration (water loss); still others such as the kakonakona (Panicum torridum), and the kupala (Sicyos spp. are annuals which come up after the heavy winter rains.

Unfortunately, the native strand vegetation has been so greatly disturbed that it is difficult to tell what it was like originally; increasing use of the few remaining areas where there is good representation of native strand species by dunebuggies, motorcycles, and other off-road vehicles pose a very real threat to this ecosystem. Destruction of vegetation such as at Ka'ena hastens destruction of the sand dunes and makes it even more difficult for plants to reestablish.

References:

Carlquist, S. 1970. Hawaii: A Natural History. Natural History Press. New York. 463 pp.

Egler, F.E. 1947. Arid Southeast Oahu Vegetation, Hawaii. Ecol. Monogr. 17: 383-435.

Fosberg, F.R. 1972. Guide to Excursion III. Tenth Pacific Science Congress. Revised edition. Dept. of Botany, University of Hawaii. Honolulu. 249 pp.

Hillebrand, W.F. 1888. Flora of the Hawaiian Islands. Privately published. Heidelberg. Reprinted 1965 by Hafner Publishing Co. New York. 673 pp.

Knapp, R. 1975. "Vegetation of the Hawaiian Islands." Trans. A. Yoshinaga and H. Iltis. Haw. Bot. Soc. Newsletter 14(5): 95-118.

MacCaughey, V. 1918. "The Strand Flora of the Hawaiian Islands". Bull. Torrey Bot. Club. 45:259-277, 483-502.

Richmond, T. deA. and D. Mueller-Dombois. 1972. "Coastline Ecosystems on O'ahu, Hawaii." Vegetatio 25:367-400.

Ripperton, J.C. and E.Y. Hosaka. 1942. "Vegetation Zones of Hawaii". Haw. Agr. Expt. Sta. Bul. 89. 62 pp.

Rock, J.F. 1913. The Indigenous Trees of the Hawaiian Islands. Privately published. Reprinted 1974 by Pacific Tropical Botanical Garden. Lawai, Kauai, Hawaii. 548 pp.

NATIVE STRAND FLORA

Ken Nagata
Lyon Arboretum

Intensive urban, commercial, agricultural, and recreational development have taken their toll on our coasts and lowlands and fewer and fewer suitable habitats remain for our coastal flora. A few of our most common native species are able to survive in modified environments: beach naupaka (Scaevola taccada), ʻĀlena (Boerhavia diffusa), pohinahina (Vitex ovata), ʻĀkulikuli (Sesuvium portulacastrum), beach ʻilima (Sida fallax), nehe (Lipochaeta integrifolia), pāʻū-o-Hiʻiaka (Jacquemontia sandwicensis), and fimbristylis (Fimbristylis pycnocephala). Many more are not as widespread and several are considered rare and endangered. Continued development of our coastline may result in not only the extinction of some species but also the extinction of entire ecosystems.

Four coastal sites are selected to illustrate varying degrees of stress. The sand dunes, beach rock, and talus formations at Kaʻena on Oʻahu are relatively inaccessible. However, the dunes and their associated beach naupaka community as well as the surrounding areas of reef and beach rock are being devastated by unrestricted off-road vehicular traffic. This poses an immediate threat to the continued existence of the Oʻahu ʻōhai (Sesbania tomentosa) which grows in the area. Four other plants found just behind the beach and on the lower talus slopes are also considered rare: maʻo (Gossypium sandvicense), the lobed nehe (Lipochaeta lobata var. lobata), the Kaʻena ʻakoko (Euphorbia celastroides var. kaenana) and ʻili-ahi-aloʻe (Santalum ellipticum). Rocks on the talus are being stolen for building rock walls. Thus, the micro-environment of some of these species is being modified and plants are being crushed in the process.

On the windward side of two lithified sand dunes near Waiehu, Maui, can be found vestiges of an ecosystem which may have once extended far inland. Urban sprawl, agriculture, and ranching have all but obliterated this unique ecosystem. The remnant native vegetation consists mainly of beach ʻilima, fimbristylis, pāʻū-o-Hiʻiaka, Hawaiian nama (Nama sandwicensis), hinahina-ku-kahakai (Heliotropium anomalum var. argenteum), and the Maui koʻokoʻolau (Bidens mauiensis). Two rare plants are also found in this area: a variety of the Maui koʻokoʻolau (B. mauiensis var. cuneatoides) and a trailing beach naupaka (Scaevola coriacea).

Consolidated and unconsolidated sand dunes are also present on West Molokaʻi at Moʻomomi. There, in addition to such common species as beach ʻilima, pāʻū-o-Hiʻiaka, hinahina-ku-kahakai, and fimbristylis, can be found four rare plants: the Molokaʻi ʻenaʻena (Gnaphalium sandwicensium var. molokaiense), a small, mat-forming variety of ʻakoko (Euphorbia skottsbergii var. audens), the Molokaʻi ʻōhai (Sesbania molokaiensis) and Solanum nelsoni. Feral deer and occasionally, stray cattle graze on the dune vegetation but their impact has not yet been assessed. The land is privately owned and thus, disturbance by man is minimal.

The sea cliffs of the windward coast of Molokaʻi begin several miles

east of Mo'omomi near Ho'olehua. They are inaccessible to feral animals and have been generally undisturbed by man. Several exotic species have become established but the vegetation remains mostly native. Nehe, beach 'ilima, fimbristylis, the Moloka'i ko'oko'olau (Bidens molokaiensis), 'ōhelo-kai (Lycium sandwicense), and 'āheahea (Chenopodium oahuense) are common on the cliffs. Occasionally, scattered individuals of the rare Moloka'i 'ena'ena can be seen.

Suggested Readings

Anonymous. 1976. "Endangered and Threatened Species: Plants." Department of Interior, Fish and Wildlife Service. Federal Register 41: 24524-24572.

Anonymous. 1979. "Coastal Ecosystems: Native Coastal Plants Brought by Wind, Sea, Birds." Hawai'i Coastal Zone News. State of Hawaii, Dept. of Planning and Economic Development/ University of Hawaii Sea Grant College Marine Advisory Program. 4(2): 4-5.

Char, W.P. 1977. "Strand Vegetation of Hawaii." Hawai'i Coastal Zone News. State of Hawaii, Dept. of Planning and Economic Development/University of Hawaii Sea Grant College Marine Advisory Program. 1(12): 4-6.

deAusen, T.T. 1966. "Coastline Ecosystems in Oahu, Hawaii." MS thesis, University of Hawaii, Honolulu.

Kimura, B.Y. and K.M. Nagata. 1980. Hawaii's Vanishing Flora. Oriental Publishing Company. 88 pp.

Merlin, M.D. 1977. Hawaiian Coastal Plants and Scenic Shorelines. Oriental Publishing Company. 68 pp.

Nagata, K.M. and B.Y. Kimura. 1980. "Hawaiian Coastal Environments: Observations of Native Flora". Sea Grant Quarterly. University of Hawaii Sea Grant College Program. 2(2): 1-6.

SEABIRD HABITAT

Sheila Conant
U.H. Dept. of General Science

Much of our attention at this workshop focuses on coastal ecosystems found on the main Hawaiian islands. However, when we begin to consider the importance of these ecosystems for seabirds, our gaze shifts to the numerous offshore islands that constitute the Hawai'i State Seabird Sanctuary and also the Northwestern Hawaiian Islands, many of which are included in the Hawaiian Islands National Wildlife Refuge. These islands are an extremely important natural resource in that they provide the essential habitat for some of the world's largest seabird breeding aggregations. For some seabirds the largest breeding colonies in the world are found in the Hawaiian islands.

Seabirds are a significant natural resource for a number of reasons. They form the major land to sea link in the oceanic environment. Seabirds have long been valued by fishermen who often locate large fish schools by following feeding flocks of seabirds. Undoubtedly seabirds have played an important role in oceanic navigation in both prehistoric and contemporary times. The learning experiences afforded by a visit to a seabird colony provide excitement and stimulation to nature watchers of all ages and backgrounds.

The protection and wise management of coastal ecosystems will be of great importance to the survival of Hawaii's seabird species. Of particular importance in this regard are the devastating impacts that can be wrought by introduced mammals, among which we must include ourselves as the most significant species.

The accidental introduction of rats to some of the islands on which our seabirds breed has resulted in severe reduction of many bird populations, especially the smaller, burrowing species such as the Bonin and Bulwer's Petrels. A significant problem on offshore islands in the main part of the Hawaiian chain is disturbance caused by human visitation. A walk through a seabird colony can result in collapsed burrows and crushed birds as well as egg and chick mortality caused when frightened parents leave them unattended in the hot sun.

Two issues resource managers and conservationists are dealing with today are the use of Ka'ula Island as a bombing target by the Navy, and the proposal to open the waters surrounding the Northwestern Hawaiian Islands to commercial fishing. Ka'ula Island, which is part of the state seabird sanctuary, harbors the greatest proportion of seabird breeding habitat in the main islands. The proposed establishment of commercial fishing in the northwestern islands is presently undergoing an evaluative review. The first step in this process is research which biologists hope will allow them to assess the potential impact on food resources of seabirds. Another more difficult aspect of the problem is evaluating the potential impact a fishery may have in terms of the possibility of accidental introduction of exotic organisms to the islands via shipwrecks or unauthorized visits.

The way these two issues are resolved in the near future will be an extremely important influence on the success of management programs for our seabird resources.

EDUCATIONAL VALUES AND GOALS

John W. Hawkins
State Dept. of Education

The formulation and definition of the functions, priorities, and goals of education are dependent on philosophy and values, social or national needs, and specific requirements of individuals. Many efforts have been made in the past to develop principles for formulating educational goals.

The point of view presented is that the function of educational institutions in our society is to assist each individual to discover and develop his own unique potentials to achieve as high a quality of life as possible based on the student's evolving values in relationship to the needs of society.

The need for clear and realistic goals for students which provide direction and focus for classroom instruction is basic to the process of education. One of the needs of our society is to develop an "ethic" about the relationship of man to his natural ecosystems.

The nature and status of our natural ecosystems present an area where clearly defined goals and values are necessary for the understanding and survival of those ecosystems.

In dealing with these ecosystems, the opportunity is available to allow the students to interact with the various environments in establishing their appreciation for the esthetic qualities inherent in the environments; in developing their concerns for the environment; and in developing positive attitudes and values about the environment.

CULTURAL VALUES

Pat V. Kirch
Bishop Museum

In Hawaii, the ecologically diverse and productive interface between land and sea have been a focus for human activity since the initial settlement of these islands by Polynesians more than 1400 years ago. The coastal zone continues to be a culturally-valued resource for every ethnic group represented in the islands, for economic, religious, aesthetic, and other reasons. In the very brief time allotted me this morning, however, I will discuss only one aspect of the cultural value of coastal ecosystems: as an archaeological resource.

Prehistoric Polynesian cultures -- including that of Hawaii -- were inextricably linked to the sea. The littoral and inshore zones provided the greatest quantity and variety of protein in the Hawaiian diet, not to mention the important limu. The value of the sea to the Hawaiians, however, went far beyond that of a food source, to incorporate basic religious and cosmologic conceptions. Even the native polity was described in maritime terms, as in the proverb: "A chief is a shark who travels on the land."

Because of this intense interaction with the sea, prehistoric Hawaiian settlement was largely concentrated along the coastal margins of the islands. Consequently, a significant proportion of the archaeological sites which today constitute a major legacy of the ancient culture are distributed along the coasta zone (perhaps 80% of all Hawaiian archaeological sites are within 0.5 km of the shoreline).

Archaeological resources are finite; they are non-renewable. Once destroyed, the record of ancient culture contained in an archaeological site is lost forever. It is to be greatly regretted that vast coastal areas in the islands have been altered in modern times without any record of their archaeological resources. Fortunately, the picture has improved somewhat in recent years, with the advent of coastal zone management programs. The wealth of archaeological sites along Hawaii's shoreline have much to tell us of the prehistoric relations between man and the sea, but is we who must ask the questions.

RECREATIONAL IMPACTS

Raymond S. Tabata
U.H. Sea Grant College Marine Advisory Program

Hawaiian coastal plants and their habitats are today only a remnant of what existed prior to the arrival of Polynesians and subsequent immigrants. The significant decline of Hawaii's native coastal plants can be attributed to many factors including coastal settlements, agriculture, coastal roads and railways, military uses, and grazing. In the last few decades, increasing residential and resort development, as well as extensive beach parks, have eliminated many more habitats, especially on O'ahu. Of great concern today are the increasing impacts of coastal recreation -- particularly the growing use of off-road vehicles (ORVs) -- upon sensitive coastal environments.

Ecological impacts of coastal recreation depend on the nature of a specific activity, its intensity and duration, and the particular environmental setting. For example, nature walks involving small numbers of people will have relatively little impact except for cumulative trampling damage; on the other hand, four-wheel drives could destroy a dune ecosystem in no time. There are also many ocean activities such as surfing and shorecasting which in themselves have no impact, but significant impacts can result from these ocean users seeking access to the shoreline or parking nearby. Site development for certain public recreational purposes (like golfing, picnicking, softball, and camping) can displace native ecosystems. Finally, if resorts can be considered as providing recreation, strand ecosystems can be damaged by heavy beach use or destroyed by development without adequate setback.

Recreational activities which may have adverse effects upon coastal ecosystems can be summarized under the following categories: (1) elimination of habitats by recreational developments (e.g., golf course, parking lot, picnic grounds); (2) trampling by foot traffic, regular car traffic, and parking (e.g., by hikers, sunbathers, swimmers, fishermen, divers, surfers, etc.); (3) use of off-road vehicles upon dunes and other sensitive environments (e.g., dune buggies, motorbikes, four-wheel drives); (4) beach camping, especially upon dunes; (5) landscaping and irrigation within or adjacent to native vegetation; (6) rock collecting; (7) flower or plant collecting.

Some of the specific impacts resulting from coastal recreation include: (1) mechanical damage to plants; (2) elimination of herbaceous plants and other plants intolerant of trampling and vehicles; (3) soil changes, including compaction, increased moisture capacity, destruction of organic soil crust, decreased permeability and porosity; (4) wind erosion of stable dunes after destruction of vegetation cover, leading to "blowouts"; (5) invasion by exotic plants after disturbance or environmental change (e.g., koa haole); (6) soil erosion and runoff, affecting nearshore marine environments like tidepools; (7) damage to rare and endangered plant species; (8) reduction in plant species diversity and dominance by trampling-resistant plants; (9) mechanical destruction of dunes by vehicle wheels; (10) destruction of coastal archaeological sites (e.g., Ka'ena Point); and (11) trampling of seabird habitats (e.g., Shearwater nests on Moku'auia Island)

Unfortunately, there has been practically no research to study recreational impacts on Hawaiian strand ecosystems. However, ecological effects of recreation have been well documented in studies by Godfrey and Leatherman on the east coast, particularly at Cape Cod National Seashore.

Recommendations for reducing recreational impacts on native coastal ecosystems include: (1) federal, state, and county agencies need to identify areas under their jurisdiction having significant native ecosystems and take appropriate steps to protect sensitive areas from incompatible uses such as camping, parking, and traffic; (2) ORV use should be prohibited on all beaches and dunes, except in specially designated areas; (3) public education should be carried out to further increase public awareness of Hawaii's native coastal flora and fauna, as well as threats to their existence; (4) coastal arboreta should be established in selected county or state parks to help educate the public and foster the propagation of native plants (the Maui Zoo arboretum is an excellent example of a county-run operation); (5) conduct research to better understand the ecological impacts of various recreational activities on subtropical strand ecosystems, as well as long-term effects of disturbance; (6) construct dune walkover structures and barriers to "channel" people and vehicles away from sensitive areas in public parks; (7) institute restoration efforts in selected parks by stabilizing eroding dunes and revegetation with native plants.

Selected Readings:

Council on Environmental Quality. 1979. Off-Road Vehicles on Public Land. Washington, D.C. 84 pp.

Godfrey, P.J. 1977. "Recreational Impact on Shorelines: Research and Management". In Coastal Recreation Resources in an Urbanizing Environment. Cooperative Extension Service, Univ. Mass., USDA, MIT Sea Grant Program. 129 pp.

_____. 1978. "Management Guidelines for Parks on Barrier Beaches". Parks 2(4): 5-10

_____ and M.M. Godfrey. 1980. "Ecological Effects of Off-Road Vehicles on Cape Cod. Oceanus 23(4): 56-67.

Godfrey, P.J., S.P. Leatherman, and P.A. Buckley. 1978. "Impact of Off-Road Vehicles on Coastal Ecosystems." In Coastal Zone '78. Proceedings of Symposium on Coastal Zone Planning and Management, ASCE, pp. 581-600. San Francisco.

Jagschitz, J.A. and R.C. Wakefield. 1971 (reprinted 1976) How to Build and Save Beaches and Dunes: Preserving the Shoreline with Fencing and Beachgrass. Agricultural Extension Service Bulletin 408. University of Rhode Island. Kingston.

Leatherman, S.P. and P.J. Godfrey. 1980. The Impact of Off-Road Vehicles on Coastal Ecosystems in Cape Cod National Seashore: An Overview. Univ. Mass., National Park Service, Cooperative Research Unit Report 34.

Leatherman, S.P. and A.J. Steiner.(in press). "Recreational Impacts on Foredunes: Assateague Island National Seashore." In Proceedings of the Second Scientific Conference in the National Parks, November 1979. San Francisco.

Richmond, T. deA., and D. Mueller-Dombois. 1972. "Coastline Ecosystems on O'ahu, Hawaii." Vegetatio 25(5-6): 367-460.

Tabata, R.S. (in press). "The Native Coastal Plants of O'ahu, Hawai'i." In Proceedings of the Third Conference in Natural Sciences, Hawaii Volcanoes National Park, June 4-6, 1980. Honolulu.

Takemoto, R. 1977. "Ka'ena Point, A Study of the Change in Vegetation in the Past 11 Years, 1966-77." Paper for Botany 454 (Dr. Mueller-Dombois). May 9, 1977. University of Hawaii at Manoa. Honolulu.

Vogt, G. 1979. "Adverse Effects of Recreation on Sand Dunes: A Problem for Coastal Zone Management." Coastal Zone Management Journal 6(1): 37-68.

Walton, T.L. Jr., and T.C. Skinner. 1976. Beach Walkover Structures. Florida Cooperative Extension Service (SUSF-SG-76-006). University of Florida.

ADDENDUM

Elliott, M.E. and E.M. Hall. 1978. Vegetation of the Proposed Kuilima Resort Community Development Site, prepared for Belt, Collins and Associates. Honolulu.

SHORELINE MANAGEMENT TOOLS
Lorrie Chee
C&C Department of Land Utilization

Concern for environment and protection of coastal resources is not new to Hawaii. In 1961 Hawaii was one of the first states to adopt a land use which had emphasis on the protection of agricultural and conservation lands. The passage of Chapter 205, HRS, highlighted these concerns.

In 1971, this county adopted rules and regulations which restricted and controlled all development within the shoreline area, defined as "the upper reaches of the wash of waves, other than storm and tidal waves, usually evidenced by the edge of vegetation growth, or the upper line of debris left by the wash of wave".

The Federal Coastal Zone Management Act, passed in 1972, recognized the national concern and need to protect coastal resources from development pressures.

In November of 1975, in compliance with Federal and State mandates to develop Special Management Area boundaries, the City Council adopted Ordinance No. 4529 (Shoreline Protection Ordinance). This ordinance established the areas and the rules and regulations for development within the Special Management Area (SMA). The SMA boundary is generally an unbroken 100 yard band landward of the certified shoreline (vegetation line) around the island.

The City Council has the final authority over all major development within this area. The Department of Land Utilization has been delegated by the Council as the administering agency and holds the public hearings, reviews and makes recommendations to the Council for their decision.

The Federal document and the State law sets up guidelines and focus for review of development in this "special area". Effective utilization of Oahu's coastal areas is fraught with competing demands, conflicting priorities, and some have said over regulations.

The department's review of development proposals within the SMA is guided by the Federal document, the State law and the County ordinance.

The DLU's role is to review projects and their impacts on the SMA in accordance with objectives and policies of aforementioned regulation. The broad CZM Program is set up to insure effective implementation of various rules and regulations, rather than develop unnecessary new ones. This is the intent of the Shoreline Protection Ordinance. It is intended to regulate and assure through conditions "mitigating measures" if you will, that whatever development is permitted to occur, occurs with minimum adverse impacts on environment.

Specific review guidelines include:

1. Assuring that there is adequate access to publicly owned beaches and recreational areas;

2. That existing and potential wildlife preserves and recreational areas are protected;

3. That adequate provision for solid and liquid waste disposal are made and that such provisions do not have adverse impacts on coastal ecosystems, ground water resources and recreational areas;

4. That proposals for alterations of existing land forms and vegetation through grading and construction of structures would cause minimum adverse effects on historic resources, water quality, ground water, and coastal waters and have minimum visual impact on scenic and open spaces and recreational amenities.

Those specific review guidelines imply a genuine concern for the protection of the physical environment. They embody the concerns reflected in the objectives and policies of the State law which call for protection of recreational resources, historic resources, scenic and open spaces, coastal ecosystems, and coastal waters as well as reducing hazard to life and property from tsunami, flooding and erosion; providing coastal dependent facilities important to the state's economy and improving the development process and public participation in the management of present and future coastal zone development.

STATE LAWS

Chapter 343, HRS (Environmental Impact Statements)

Chapter 205, HRS, Part II (Shoreline Setbacks)

Chapter 205, A, HRS (Coastal Zone Management)

COUNTY REGULATIONS

Shoreline Setback Rules and Regulations

Ordinance No. 4529, as amended

NATURAL AREA RESERVES SYSTEM
Robert Lee,
Natural Area Reserves System, DLNR

Recognizing the need to set aside for preservation unique and representative samples of Hawaii's natural environment, the 1970 State Legislature authorized the establishment of a Natural Area Reserves System. It assigned implementation and administration functions to the Department of Land and Natural Resources. It also created an advisory commission of six scientists and five ex-officio representatives from various state agencies.

The system presently consists of 14 reserves that total 93,159 acres. The smallest reserve is 12 acres of a coastal dune ecosystem and the largest is 26,181 acres that encompass three major ecosystem types: dryland, mesophytic, and rainforest. With the 14 areas on hand, the system already contains diverse natural elements that range from marine and coastal ecosystems to high elevation rainforests and bogs. A coastal ecosystem -- dry and barren, wet cliffs and vegetated, or sand dune -- occurs in six reserves: Ahihi-Kinau (Maui), Kaena Pt. (Oahu), Puu o Omi (Hawaii), Manuka (Hawaii), Kipahoehoe (Hawaii), Hono o Na Pali (Kauai).

To date, 31 other areas have been recommended by the commission for inclusion in the Natural Area Reserves System. But increasing the size of the system is only the first step. We now face the challenge of proper management, without which the purpose of setting aside natural areas will be lost.

MEETING SHORELINE RECREATION NEEDS

Steve Salis
C&C of Honolulu, Dept. of Parks and Recreation

Current and potential problems and issues related to meeting shoreline recreation needs include over-use and misuse of existing developed and undeveloped sites, rising safety and crime problems, conflicts between recreation users, conflicts between other land users and inadequate management, support and education provisions and services.

Current State and County recreation plans adequately identify these and other problems and primarily address the need for additional land and development to meet current and future needs. The City and County's 20-Year Plan recommends the addition of over 300 acres by purchase or dedication to the existing inventory of coastal park land. The acquisition, planning, design, redevelopment or restoration of those shoreline parks of natural significance should receive priority attention.

HUMAN IMPACTS ON COASTAL ECOSYSTEMS

Michael G. Barbour
University of California at Davis

Introduction

Beach and dune vegetation is particularly sensitive to human activity. This may seem anomalous because of the severe environment which the plants withstand, but if we examine the ecological tolerance of some characteristic plants, the anomaly can be resolved. I'd like to spend some time discussing plant autecology, then return to human impacts.

First, some definitions. Beach is that sandy, open habitat between mean tide line and the furthest inland reach of storm waves. Usually this inland point is marked by a foredune ridge built by the sand-stilling abilities of low, herbaceous plants. The most efficient dune-building plants are grasses with vegetative reproduction and fibrous root systems; such plants are able to keep growing shoots above encroaching sand on the windiest beaches, accumulating 35-180 cm of sand a year, depending on the species. Some dune grasses even appear to require sand accumulation for maximum growth and reproduction. Dune is the semi-open, semi-mobile sandy habitat from the foredune to typically inland vegetation or to completely vegetated dunes. Wind, salt spray, sand blast, and substrate movement are less than on the beach; organic matter and species richness are higher. It is the dune region which has been most modified by man.

Plant autecology

Growth forms typically include perennial grasses and prostrate herbaceous perennial dicots. Most reproduce vegetatively by rhizomes or runners. Leaves in the temperate zone are usually mesic, broad, entire, with few obvious adaptations to the xeric, saline microenvironment. In tropical latitudes, shrubs and trees are more common, as is the C_4 photosynthetic pathway. Root systems are either tap-rooted, reaching to a fresh water table 3^{+}m below the surface, or fibrous and shallow. Latter roots may obtain moisture from "internal dew" in the sand. Despite the short stature, strand plants do modify the micro-environment: Ammophila (beach grass) species affect the wind profile to a height of 1-2 m, light attenuation near the ground is increased, and soil and air temperatures are decreased compared to the open or to canopies of other species such as Elymus (dune grass).

Prostration not only reduces exposure to sand blast, but to salt spray blown inland from the swash zone. When chloride enters plant tissue through lesions, it can accumulate to toxic concentrations, and it causes succulence in tolerant species. Measurements of salt spray with micro-salt traps reveals that there can be a 20-fold gradient of spray intensity within a 600 m^2 area of beach. The beach may appear open, homogeneous, and uniformly suitable for plant colonization, but minor topographic variations cause relatively large exposure differences. Further, growth chamber experiments show that not all beach species are equally tolerant

to salt spray and inundation by storm waves. Strand plants are more salt tolerant than inland plants, but less so than salt marsh or salt desert plants. Prostration results in a ten-fold decrease in salt deposition, compared to upright leaves 14 cm tall. Broad leaves tend to receive less salt than linear ones.

Strand soils are notoriously low in nitrogen, containing 60 ppm at most. Yet strand plant foliage contains 1.5-3.0% N, values as high as crop plants. The mechanisms for such efficient scavenging of N remain to be explained. All beach plants appear to respond to increased N with increased growth, photosynthesis, and respiration, but to different degrees.

It appears, from limited transplant studies, that strand plants tolerate their extreme environment, but grow best in richer, more protected soils providing competition from inland, overtopping species are removed. They exist on the strand at or near their tolerance limits, which is why modest disturbance such as trampling (leading to sand deflation) or shading (by introduced plants such as Ammophila) or leveling of the beach may easily lead to plant death.

Human impacts

As Dolan and others have pointed out for the North Carolina coast, the coastal system "is one of the most dynamic areas under the jurisdiction of the National Park service". Problems arise when people attempt to manipulate it; the results can be increased fragility, erosion, and expensive, continuous attempts to repair it. Human impact can be seen in home construction, creation of groins, road building, artificial plantings on the foredune, human and horse traffic along cliff edges, introduction of exotic plants, human trampling, and off-road vehicle traffic. Sometimes revegetation attempts have negative impacts, as illustrated along the Atlantic and Pacific coasts of the U.S.

Much of the Outer Banks off North Carolina were incorporated into Cape Hatteras National Seashore in 1957. The Park Service inherited a network of roads, and in order to stabilize them the Service began revegetation of 3000 acres (actually continuing work begun in the 1930s). More than 500 miles of sand fences and millions of plants were put in. Woodhouse and others completed an intensive 10 year experiment in revegetation in 1975. The conclusions were that plantings of Ammophila and Uniola (sea oats) created a steep foredune more easily eroded by severe storms because they bore more of the brunt of wind and overwash. Further, the steep foredune permitted normally inland shrubs to invade, and when these are subject to overwash these intolerant plants die, greatly opening up the strand to blowouts. Beach width narrowed from 150 m to 30-75 m. Monoculture plantings of Ammophila are discouraged because of blight and insect epidemics that open up patches of infected dune to blowout.

Plantings along the Texas coast by Dahl and others, mainly using Uniola and Panicum, also concluded that mixed plantings are best, but they pointed out the difficulties of first obtaining sufficient nursery stock. They rejected more than 15 other native and introduced species, showing that the choice of suitable reclamation species is limited.

Overwash areas require sand fencing first, to trap non-saline sand. Fertilization with 100-200 pounds per acre was required in addition.

The most extensive revegetation has been done along the Oregon coast. Many dune areas were covered by excellent grassland until grazing by livestock began in the 1850s. Overgrazing (or perhaps, simply normal grazing intensity on a fragile system) led to reduced plant cover and the creation of mobile dunes. The Clatsop Plain is an example of revegetation techniques. Ammophila shoots are mechanically planted and slow release fertilizer is added. Within two years, high plant cover is obtained, and additional species such as bush lupine (Lupinus), scotch broom (Cystisus), gorse (Ulex), and shore pine (Pinus) are added. A few natives, such as beach pea (Lathyrus) may also be planted. Gorse and scotch broom have become major weeds in adjacent vegetation types, however, and the Ammophila cover has led to decline in the abundance and diversity of native dune species. Dune topography is modified.

A few California experiments have tried to revegetate with natives, rather than Ammophila, with limited success. A small (less than 20 acre) dune area in Asilomar State Park near Monterey followed this procedure: first, planting with annual and perennial ryegrass and artificial watering and fertilizer treatment and surface coating with hydromulch; then withdrawal of watering and seeding or planting with several native perennials. As the ryegrass dies its roots still hold the sand, allowing the natives to become established. The experiment was costly, in terms of sprinkler system, hydromulching, contouring with bulldozers, and fertiler amendments; it is doubtful that such a scheme can be applied to a large area. Barbour and others attempted to use Elymus, Ambrosia (beach bur), and Abronia (sand verbena) natives at Point Reyes National Seashore, but found all to be inferior to Ammophila. Further, establishment of the natives with any success would require sand fences, fertilization, and possibly supplemental watering, in addition to seed pretreatment or treating vegetative segments with rooting hormone--all expensive additions.

In conclusion, we can state that the strand vegetation is fragile and that its revegetation, once disturbed, is both costly and difficult. The dynamic nature of the ecosystem makes it difficult to manage, with our current level of understanding and technical abilities.

SOME REFERENCES TO BEACH AND DUNE VEGETATION
Description and Manipulation, Conterminous US Coastline

Barbour, M.G., T.M. DeJong, and B.M. Pavlik. 1981. Autecology of marine beach and dune plant communities on Atlantic, Gulf, and Pacific coasts of North America. In: H.A. Mooney and B. Chabot (eds.), Physiological ecology of North American plant communities, Methuen, NY. (in press)

Barbour, M.G. and A.F. Johnson. 1977. Beach and dune, pp 223-259 in: M.G. Barbour and J. Major (eds.), Terrestrial vegetation of California, Wiley-Interscience, NY.

Cowan, B. 1975. Protecting and restoring native dune plants. Fremontia 3(2):3-7.

Dahl, B.E., B.A. Fall, A. Lohse, and S.G. Appan. 1975. Construction and stabilization of coastal foredunes with vegetation: Padre Island, Texas. United States Army Corps of Engineers, Coastal Engineering Research Center, Misc. Paper No. 9-75, Fort Belvoir, VA, 180 pp.

Diamond, L. and J. Kennedy. 1975. Bodega Marine Reserve: an environmental inventory and trail siting analysis. University of California Natural Lands and Water Reserves System, Berkeley, 151 pp.

Dolan, R., P.J. Godfrey, and W.E. Odum. 1973. Man's impact on the barrier islands of North Carolina. American Scientist 61: 152-162.

Gibson, M. 1974. What to do until the hurricane comes. Duke University Alumni Register (January):3-9.

Hanneson, B. 1961. Vegetation changes of the Oregon coastal dunes, pp 77-99 in: S.N. Dicken (ed.), Some recent physical changes of the Oregon coast, final report for project NR 388-062 between the Geography Department of the University of Oregon and the Office of Naval Research, United States Department of the Navy, Eugene, Oregon.

McLaughlin, W.T. and R.L. Brown. 1942. Controlling coastal sand dunes in the Pacific Northwest. United States Department of Agriculture, Circular No. 660, Washington, DC, 46 pp.

Sauer, J.D. 1976. Problems and prospects of vegetational research in coastal environments. Geoscience and Man 14 (June):1-16.

United States Army Corps of Engineers. 1973. National shoreline study, 5 volumes. Washington, D.C.

Woodhouse, W.W., E.D. Seneca, and S.W. Broome. 1976. Ten years of development of man-initiated coastal barrier dunes in North Carolina. North Carolina State University Agricultural Experiment Station, Bulletin 453, Raleigh, 53 pp.

Woodhouse, W.W., E.D. Seneca, and A.W. Cooper. 1968. Use of sea oats for dune stabilization in the southeast. Shore and Beach 36(2):15-21.

Dr. Michael G. Barbour is a professor in Botany at the University of California/Davis. He received a Ph.D. in Botany from Duke University in 1967. Much of his research has focused on ecological studies of desert and coastal plant communities. Author of more than 50 technical articles and books, he has conducted research in the eastern, southeastern, southwestern, and western United States, semi-arid Australia, and in arid Argentina and Israel.

WORKSHOP SUMMARIES

BIOLOGICAL/ECOLOGICAL RESEARCH NEEDS
Carolyn Corn & Winona Char

Very little research has been done on coastal areas in tropical/subtropical areas, including the Hawaiian Islands. Although the U.S. Fish & Wildlife Service is presently gathering data on birds, turtles, seals, and whales, little research information is available on coastal native insects, plants, and snails. Integrated research along interdisciplinary lines is particularly needed to make proper management decisions. For instance, little is known on where unique Hawaiian species occur, insect pollination of coastal plants, plant dispersal mechanisms, ecological physiology, disease, pollution effects and reversal, and competition of plants.

We need to identify areas where relic native ecosystems and rare endangered species occur to insure their survival. Likewise, we need to know what management actions will adversely affect these unique species. To do this we need to know their habitat requirements. Indirect actions may be as devastating as direct habitat modification. For example, the use of an insecticide may cause the demise of an insect needed to pollinate a plant which stabilizes the sand, which prevents the erosion of a beach park or pavilion.

Although research may not always have a direct application in management decisions, it leads to a better understanding of the processes and prediction. Through the increased knowledge of food webs, there arises a better understanding and appreciation of how man's interaction affects an area, which may influence his management of the area. When emergencies arise, such as oil spills, tsunamis, hurricanes, we are better able to resolve unpredictable problems that require immediate attention.

As the human population increases the demands on coastal areas will also increase causing additional problems, such as the effects and reversal of pollution processes. Little to no information is available on how various pollutants will affect our Hawaiian coastal biota. Reclamation of areas will also be necessary. Little is known on how to propagate many of our coastal plants. Research is needed to reduce failures in reclamation, cut monetary losses of repeated failures, and eliminate species extinctions. Through integrated research projects our knowledge grows and management decisions can be based upon accurate information that cuts cost, time, labor, and insures protection of our unique natural resources.

EDUCATION NEEDS
Les Matsuura

The group recognized the need to increase public awareness of the importance and uniqueness of Hawaii's Coastal Ecosystems and develop responsible attitudes and behavior in human interactions with these systems. Physical evidence throughout the islands indicates the need for structured education programs that do more than make passing reference to coastal and strand flora--programs that focus on their functions and requirements. It was the concensus of the group that education in the schools was not enough and that wide reaching efforts aimed at the general public were necessary.

Recommendations that came out of discussion are listed as follows:

1. Designate special areas, either natural or cultivated, where close observation and hands on experience can be conducted with minimal impact on surrounding or sensitive areas.

2. Provide classes and workshops for both schools and the general public to educate the community in the importance of Hawaii's coastal ecosystems. Teacher workshops offer other possibilities.

3. Stewardship of areas by public groups or organizations to monitor site usage and work towards preservation of sites.

HUMAN IMPACTS AND MANAGEMENT NEEDS

Irwin Lane & Michael Barbour

Approximately 15-20 people attended this workshop. The central theme of the discussion was the problem of balancing multiple demands by the public of parks mainly on Oahu. We concentrated on sites at Makapu'u Beach and at Ka'ena Point as case studies of this conflict. Potential user categories included: campers, hikers, biologists, drivers (both on- and off-road), and miscellaneous (e.g., swimmers, sitters, sightseers).

In order for appropriate local, state, and federal agencies to balance these diverse demands, management needs are:

1) Proper staffing, in particular interpretive staff and enforcement staff.

2) Time and appropriate staff to rank the major user categories for each park, and to determine whether any use is incompatible with others.

3) More knowledge about the impact of different levels of use for each category needs to be generated. For example, what should the level of camper density be, or the frequency of hikers along a trail be, what sensitivity do some plants or animals show to noise, soil compaction, etc. At present, decisions on camper density or on degree of vehicle access are being made intuitively.

4) More cooperation and integrated planning on a regional level which would cut across clusters of parks managed by different agencies. In this way, multiple and possibly incompatible uses could be apportioned by park in the same region, and the same individual park would not have to serve all the needs of the public.

5) To recognize that some uses are not compatible or that limited public land cannot be sacrificed to them, as it can be in larger states like California. Off-road vehicles may be incompatible, in Hawaii, with all other park uses, and it may be wise to prohibit their activity in all parks.

6) Similarly, conservation of rare, threatened, or endangered species may be incompatible with most other uses, and some thought to the creation of preserves--as is done in some other states such as California--should be done.

7) An educated, appreciative, sensitive public is necessary if parks are to serve multiple needs on islands with high human populations, as on Oahu. An expanded environmental education policy, continuous through all grades, is needed.

PROPAGATION/CULTIVATION AND LANDSCAPING
Keith Woolliams & Derral Herbst

SUMMARY OF DISCUSSIONS:

A. OBJECTIVES OF CULTIVATION & PROBLEMS.

* Many good ornamental plants suitable for landscaping and small garden use.
* No sustained source of supply from the nurseries; one problem raised was that nurserymen prefer to sell large plants, which may take time, but it was felt that this may not be a problem with strand plants.
* DOES THE PUBLIC WANT TO GROW THESE PLANTS? It was strongly felt that many do & more would if they knew more about them. Public education is needed.
* Availability of material was mentioned as a problem but it was pointed out that many botanical gardens & arboreta freely offer material for propagation. The group urged that government-operated gardens, parks & private institutions with native plants be urged to make it known that they are willing to supply material when available.

* Conservation of strand plants vs. cultivation: it was felt that cultivation can lead to an awareness of the value of coastal ecosystems and be of benefit; in addition, rare & endangered species could be perpetuated in cultivation.

  The question of mixing 'gene pools' by bringing plants into cultivation from different localities and especially islands, was raised. It was readily admitted that this could be a problem if gardeners & nurserymen became over-zealous in collecting and began to gather materials from the wild. On the 'plus side' it was pointed that the commoner & easier to grow species were abundant Statewide and were often found throughout the Pacific (e.g., naupaka, hau, ilima, etc.). The really rare species are so rare that cultivation can only help to save them. They are usually from isolated areas and it is hardly likely that cultivated material will get 'close enough' to contaminate wild plants, e.g., Sesbania molokaiensis from Moomomi Beach, Molokai is unlikely to contaminate the Sesbania at Kaena Pt., Oahu if cultivated on Oahu.

  It was suggested that it could be emphasized that plants propagated from cultivated plants are more likely to survive than those removed from the wild.

  Another potential problem from the conservation point of view was that constant propagation from cultivated plants can lead to excessive in-breeding and therefore limit the long-term conservation value.

B. EDUCATION

This topic was the most actively discussed, it being generally felt that there is a great need for public education on coastal ecosystems.

* It was suggested that attention be drawn to botanic gardens, parks & hotels, where native plants are growing.
* State & County parks who are presently feeling economic restraints, should be asked to utilize existing stands of native vegetation & to encourage the spread of these, thus reducing park maintenance costs and affording the public more access to native plants and more exposure to them.

  If the above was to be done, these areas would then have great educational benefit for schools and other groups which in turn can benefit the parks.

* As the City of Honolulu's official 'tree' is a shower tree, and the State's official flower is any Hibiscus ('aloalo') it was felt that there is a great deal that needs to be done to persuade government officials to take note of our native plant life!

* It was suggested that efforts be made to encourage County & State officials to plant more Hawaiian plants around their buildings and other public places.

* An educational slide or movie presentation (or two) on the use of Hawaiian plants as cultivated plants and also their place in the ecosystem was needed and the group felt strongly that such a program should be developed.

* The group also felt strongly that an 'educational display' garden of Hawaiian plants should be made in at least one place in Honolulu; two places mentioned were a) Honolulu Aquarium grounds, where there are some plantings already and a group is actively trying to improve the Hawaiian plantings there, b) The Honolulu Zoo grounds or in the vicinity of the main entrance on unused land.

* In order to increase public exposure to Hawaiian plants it was suggested that concession stands be allowed in beach parks that would be allowed to sell plants. Such groups as non-profit, educational or nurseries might be allowed to do this. This would be especially valuable in areas with good natural stands of Hawaiian plants and would serve to take the pressure off wild plants once the public's interest in them was aroused.

C. NURSERY SUCCESSES & FAILURES

* Although discussions veered in this direction from time to time, it was not really considered seriously in depth. This was mainly because of lack of time but also because it was felt that in any case only the easier grown plants would initially be cultivated.

* It was suggested that a list of plants suitable to be cultivated be drawn up under. 'Easy to grow'; 'moderately easy to grow' headings, etc.

Some plants suitable for cultivation in one category or the other:

Achyranthes spp.
Canthium odoratum
Erythrina sandwicensis
Euphorbia celastroides vars.
Gossypium sandvicense
Lipochaeta spp.
Myoporum sandwicense vars.
Osteomeles anthyllidifolia
Portulaca lutea
Sesuvium portulacastrum
Tetraplasandra spp.
Vitex ovata
Wikstroemia spp.

plus Polynesian introductions. There are many others!

D. RECOMMENDATIONS:

1) Every effort be made to encourage cultivation of Hawaiian plants and this be done by establishing demonstration garden(s) in Honolulu.

2) The sale of Hawaiian plants be permitted in County & State parks, by nurserymen and interested groups.

3) Slide and/or movie presentations should be produced to show the uses of Hawaiian plants in cultivation and their place in the coastal ecosystems. These should be made available to schools, society's, etc.

APPENDICES

CONSERVING HAWAII'S COASTAL ECOSYSTEMS
March 27, 1981, Ala Moana Americana Hotel, Honolulu, Hawaii

PROGRAM

8:00 REGISTRATION

8:30 STRAND ECOSYSTEMS IN HAWAI'I: Winona Char, U.H. Dept. of Botany

9:00 PANEL DISCUSSION: "RESOURCES, VALUES, AND MANAGEMENT"
(Bert Kimura, Leeward Community College, moderator)

NATIVE STRAND FLORA: Ken Nagata, Lyon Arboretum

SEABIRD HABITAT: Sheila Conant, U.H. Dept. of General Science

EDUCATIONAL VALUES: John Hawkins, State Dept. of Education

CULTURAL VALUES: Pat V. Kirch, Bishop Museum

10:00 MORNING BREAK AND DISPLAYS

10:30 PANEL DISCUSSION (continued):

RECREATIONAL IMPACTS: Ray Tabata, U.H. Sea Grant

SHORELINE MANAGEMENT TOOLS: Lorrie Chee, C&C of Honolulu, Dept. of Land Utilization

NATURAL AREA RESERVES: Robert Lee, State Natural Area Reserves System, Dept. of Land and Natural Resources

MEETING SHORELINE RECREATION NEEDS: Steve Salis, C&C of Honolulu, Dept. of Parks and Recreation

11:30 QUESTIONS AND DISCUSSION

12:00 LUNCH *(Luncheon Speaker: Dr. Michael Barbour, University of California at Davis, "Human Impacts on Coastal Ecosystems")*

1:30 WORKSHOP SESSIONS:

A. BIOLOGICAL/ECOLOGICAL RESEARCH NEEDS: Discussion Leaders -- Carolyn Corn, State Division of Forestry and Wildlife; Winona Char, U.H. Dept. of Botany; Robert Shallenberger, U.S. Fish & Wildlife Service.

B. EDUCATION NEEDS: Discussion Leaders -- Bert Kimura, Leeward Community College; Les Matsuura, Waikiki Aquarium.

C. HUMAN IMPACTS AND MANAGEMENT NEEDS: Discussion Leaders -- Irwin Lane, C&C Dept. of Parks & Recreation; Michael Barbour, UC/Davis.

D. PROPAGATION/CULTIVATION AND LANDSCAPING: Discussion Leaders -- Ken Nagata, Lyon Arboretum; Keith Woolliams, Waimea Falls Arboretum; Derral Herbst, U.S. Fish & Wildlife Service.

3:00 AFTERNOON BREAK AND DISPLAYS

3:30 SUMMARY AND DISCUSSION: Bert Kimura, moderator

4:30 EVALUATION AND ADJOURN

Dr. Michael Barbour's participation is supported by the Pacific Sea Grant Advisory Programs (PASGAP) with funding provided by the Sea Grant College Program, NOAA, U.S. Dept. of Commerce.

WORKSHOP EVALUATION

NOTE: Out of 60 paid registrants and 20 guests (80 total participants), 30 evaluations were returned.

1. PRIMARY AFFILIATIONS (more than one item checked by some respondents):

a.	college/university faculty or staff		2
b.	primary/secondary school teacher		3
c.	community organization		5
d.	government agency/commission		
	federal	2	
	state	6	
	county	1	
	total government		9
e.	private industry/business		2
f.	professional consultant		2
g.	interested individual		5
h.	student		5
i.	other (including 2 from Bishop Museum)		3
	TOTAL RESPONSES		36

2. What did you like BEST about the workshop?

1) Well-planned, not too long presentations, combined with interesting material & excellent illustrations

2) Discussion Groups--final resolutions

3) Guest speaker's presentation

4) Enthusiasm of the speakers and the wide range of topics on coastal ecosystem components

5) Panel discussions

6) The variety of its scope

7) Discussion group

8) Good mix of presentations and participants

9) Everything

10) First two panel discussions and handout materials

11) Filmstrip presentation

12) Communication between concerned persons

13) The format for presentation

14) Attracted some interesting participants

15) Luncheon presentation by Barbour; meeting there (at the hotel)

16) I liked it all

17) Luncheon speaker, who I feel communicated information very well

18) Luncheon presentation by Dr. Barbour

19) Excellent speakers and slides

20) Professional information well presented

21) Good to have other speakers from other geographical areas where problems are similar and solutions have been tried

22) Guest speaker--good to have new speakers from out-of-state. Speakers were well prepared

23) Char's presentation--very educational

24) All parts helpful

25) Luncheon speaker

26) Varied speakers, slides for all areas, displays same

27) The opportunity to meet and talk with new people

28) The cross communication of management/business/conservationists

3. What did you like LEAST about the workshop?

1) Hard to see panel members. Next time have them sit on high stools. Need eye contact with them.

2) Maybe a little too formal.

3) Will the information presented and conclusions/recommendations reached be used to effect legislation or other action of agencies?

4) Room, chairs

5) Not as concise as possible

6) Not enough pastries

7) Irwin Lane was not a good choice for moderator

8) Workshop session--not much progress/too indefinite

9) Speeches without slides

10) Too much left out, but not enough time to cover everything

11) Floral part greatly emphasized, fauna almost completely ignored, except for sea birds. Would liked to have learned more about animals associated with plants (insects, mollusk, worms, etc.)

12) Other than naming the plant by its common Hawaiian name and genus and species, the speaker should also mention family. It helps.

13) The state presentations

14) The session conducted by Irwin Lane should have included a resource manager rather than an administrator if the subject is management.

15) Workshop session too short

16) Not enough interaction among panelists

17) Presentations without any visual materials

18) The opportunity to meet and talk with new people

19) Not enough times to go to the bathroom

4. Overall, how would you rate the workshop?	No. of responses
1) Excellent	10
2) Good	17
3) Fair	3
4) Poor	0
Total	30

5. Regarding your work or interest area, how useful was the workshop?

1) Very useful	12
2) Somewhat useful	18
3) Not useful	0
Total	30

6. To what extent did the workshop increase your knowledge of Hawaii's coastal ecosystems and management concerns?

1) Very much	13
2) Some	17
3) Not sure	0
4) Not at all	0
Total	30

7. To what extent did the workshop make you aware of new sources of information useful to you?

1) Very much	8
2) Some	21
3) Not Sure	1
4) Not at all	0
Total	30

8. Due to the workshop, will you be doing anything new or different in the future?

1) Yes	15
2) No	5
3) Not sure	9
4) No response	1
Total	30

If yes, can you specify?

1) Will try to make others appreciate the problems and their responsibilities more.

2) Try to focus organization's support on funding for operations as opposed to always specific projects.

3) More contact with government agencies.

4) Notify other members of the Bishop Museum

5) Increased awareness of coastal ecosystems, more respect for plants in strand environments.

6) More conscientious awareness of its existence and prominance.

7) Try to keep track of legislative actions and make my concerns known to legislators.

8) Specifically setting up a teaching unit in endangered coastal ecosystems.

9) Incorporating information in presentations utilizing new sources of information.

10) Move people on a one-to-one basis on how valuable our ecosystems are.

11) Awareness of strand system in planning decisions.

12) Making more information available to others through new channels I have learned about here.

13) Make people more aware of how fragile the coastal systems are.

14) Will be more aware of materials presented in this area.

15) Add information gained to my classes, study coastal ecosystem.

9. How did you learn about the workshop?

1) Newspaper	1
2) Radio spot	0
3) MAKAI Newsletter	1
4) Posted Notice	1
5) Direct flyer	17
6) Friend/colleague,	12
Total	32

10. How would you rate the physical comfort and general set-up for the workshop?

1) Excellent	6
2) Good	18
3) Fair	5
4) Poor	1
Total	30

11. OTHER COMMENTS OR SUGGESTIONS:

1) Don't forget neighbor islands

2) Have State/Federal personnel give their views

3) Flyer should go out sooner--a 4-week advance notice would be appreciated.

4) Having the display (esp. DOE's) and manning them during the breaks was a good idea. I picked up some new info and leads on a couple of reports which will be helpful in my job.

5) Air conditioning poor in a.m. in Plumeria Room.

6) Program was well planned and organized, showed a lot of work was put in ahead of time. Now what?

7) Left out marine ecosystems entirely.

8) There should be a workshop in the afternoon for participants to learn to handle the depression resulting from the information learned in the morning session. There are too many demands for use of coastal ecosystems. Population pressures, ORV's, development, even passive recreation. There isn't enough money to do the proper management of coastal areas. Damaged areas are not very likely to be repaired.

9) Enjoyed wide variety of topics, expertise of speakers, and the opportunity to communicate with people involved in this area. Your workshops are well planned and run very smoothly. Very well coordinated and shows a great deal of time and effort has been spent to create a well-rounded and informative workshop. I felt the varied backgrounds of the leaders and participants allows for a more stimulating and informative day. Good job!

10) If a unit could be set up for use in the public schools--with an accompanying workshop field trip.

11) Environment of workshop was too crowded, hot, unable to see speakers and complete slides from back of room.

12) Morning session of workshop was a bit crowded.

13) It would be helpful to have an amptheatre type of meeting room for the general meeting. Those toward the back had a hard time seeing the front. Impress upon workshop leaders that a discussion session is not a solo performance. Participants in #3 had to almost fight to get a word in edgewise.

WORKSHOP PARTICIPANTS

Stanley Ah Nin	Division of Forestry, DLNR
Ed Arrigoni	Kaiser High School
Karen Asherman	UHM Botany
Janet Ashman	UHM Zoology
William Barrera, Jr.	Chiniago, Inc.
Sharon Bogue	Lyon Arboretum Association UHM Genetics
Chuck Burrows	Kamehameha Schools
William Cambra	Windward Community College
Lynn Carey	Sea Life Park
Mark Charbonneau	Sea Life Park
Brian Choy	State Department of Health Lyon Arboretum Association
Frank Conkey	Lyon Arboretum Association Better Business Bureau
Michael Creagh	C & C Department of Parks & Recreation
Miriam Davis	Lyon Arboretum Association
Dennis Devaney	Bishop Museum
Patty Doi	
Kinu Ecklor	Alexander & Baldwin, Inc.
Genevieve Eggleston	Lyon Arboretum Association
John Engbring	U.S. Fish & Wildlife Service
Ann Fielding	Seabury Hall
Robert Fletcher	Division of State Parks, DLNR
Michael Gawel	EWC Environmental & Policy Institute
Ruth Gay	UHM Botany

Kuaika Gendrusch	Hui Kokua No Na Mea Kanu Maole O Hawaii
Suzanne Harada	Moanalua Gardens Foundation
Derral Herbst	U.S. Fish & Wildlife Service
Lisa Holt	Windward Community College
Alan Hong	C & C Department of Parks & Recreation, Ocean Recreation Section
Alyce Ikeoka	Lyon Arboretum Association State DOE
Lester Inouye	EDAW, Inc.
Anna Kaohelaulii	Sierra Club, Hawaii Chapter
Frank Kahala	Windward Community College
Bert Kimura	Lyon Arboretum Association Leeward Community College
Joan Kodani	Environmental Quality Commission
Ernest Kosaka	U.S. Fish & Wildlife Service
George Krasnick	Aecos, Inc.
Beatrice Krauss	Lyon Arboretum
Ed Lee	
William Lennan, II	U.S. Fish & Wildlife Service
Judy McCoy	Lyon Arboretum Association
Hans Megens	Bishop Museum
Doug Meller	VTN Pacific, Inc.
Marilynn Metz	Group 70, Inc.
Terry Meyer	Mid-Pacific Institute
Susan Miller	Sierra Club, Hawaii Chapter
Ken Nagata	Lyon Arboretum

Jim Nakasone	Parks & Recreation
Dorothy Niimoto	Windward Community College
Jean Nishida	State Department of Land & Natural Resources
Mae Oda	Department of Education
Audrey Oi	Moanalua Gardens Foundation
Velma Omura	Lyon Arboretum Association
Vernon Pang	Department of Parks & Recreation, C & C
Leilani Pyle	Lyon Arboretum Association
David A. Ross	Windward Community College
Christa Russell	UHM Botany
William Saeger	Division of Forestry, DLNR
Kathy Schmidt	Leeward Community College
Richard Scudder	Office of Environmental Quality Control
George Shiroma	Leeward Community College
Wayne Souza	Division of State Parks, DLNR
Maile Stemmerman	UHM General Science
Ray Tabata	Sea Grant Marine Advisory Program
Roy Takemoto	M & E Pacific
Francis Tanaka	Pacific Resources, Inc.
Marilyn Tomita	Kaimuki High School, DOE
Dan Vitiello	Honolulu Zoo Oceanic Institute
Julia Williams	UHM Botany
Ginger Wright	Leeward Community College
Joan Yim	State Department of Planning & Economic Development
Peter Zakar	Planners Collaborative

STEERING COMMITTEE VOLUNTEERS

Keith Woolliams	Waimea Arboretum 59-865 Kam Hwy, Haleiwa	638-8655
Beatrice H. Krauss	Lyon Arboretum	988-6761
Frank Conkey	Lyon Arboretum Assn.	531-4964
Ginger Wright	Leeward Community College	455-0392
Kathy Schmidt	Leeward Community College	455-0262
Kuaika Jendrusch	5020 Maunalani Circle	734-2003
Brian Choy	Lyon Arboretum Assn.	548-6455
Velma Omura	Lyon Arboretum Assn.	537-2636
Maile Stemmerman		948-8103
Les Matsuura	Waikiki Aquarium	923-4725
Ray Tabata	UH Sea Grant	948-8191
Suzanne Harada	Moanalua Gardens	839-5334
Audrey Oi	Moanalua Gardens	839-5334
Ken Nagata	Lyon Arboretum	988-3177
Bert Kimura	Leeward Community College	455-0261