University of Hawai'i Sea Grant College Program's

Hanauma Bay Education Program

Volunteer Handbook

Sea Grant
University of Hawai'i

SCHOOL OF OCEAN AND EARTH
SCIENCE AND TECHNOLOGY
UNIVERSITY OF HAWAI'I AT MĀNOA

Hanauma Bay Education Program

Aloha Hanauma Bay Education Program Volunteer,

In the days ahead, you will be introduced to the many faces of Hanauma Bay, people who work diligently to ensure that visitors to the Bay treat it with care and respect. This is no easy feat. These individuals will share their knowledge and experience as part of your volunteer training and many will work side by side with you during your time spent at Hanauma Bay. Training topics will range from the geological origins of southeast Oahu, to the current status of our marine resources and what steps are being taken to protect them.

Armed with this information, you will join a team of dedicated volunteers who work to insure that visitors to Hanauma Bay are educated in proper reef etiquette so as to minimize visitor impact at the Bay. Your efforts will not only create better visitors, you will be working to forge a greater appreciation for our marine environment that will extend far beyond Hanauma Bay.

I look forward to working with you and urge you to contact me at any time with any questions.

Mahalo for your time and commitment,

Morgan Mamizuka
University of Hawaii Sea Grant College Program
HBEP Volunteer Program Coordinator

Disclosure Statement

This volunteer handbook summarizes the policies, procedures and guidelines of the Hanauma Bay Education Program (HBEP), and will acquaint you with the benefits and responsibilities associated with being a volunteer. This manual does not pretend to address every issue or situation that you will encounter. As a volunteer for the program, however, we share a confidence that you will be able to meet new challenges as they arise and conduct yourself in a professional, ethical and friendly manner. It is important to remember that while serving as a volunteer, you represent Hanauma Bay, the University of Hawai`i, the City & County of Honolulu, the State of Hawaii and the people of Hawai`i.

The HBEP Volunteer Coordinator (Morgan Mamizuka) is responsible for administering the program's volunteers. She is available to answer any of your questions and to work with you to accomodate individual needs.

According to the state policy concerning the utilization of volunteer services, as outlined in Chapter 90 of the Hawai`i Revised Statutes, you have the right to volunteer your services to our program, and the program has the right to decline any voluntary offer of services, or if accepted, to release a volunteer who is no longer needed or who does not perform according to the program's standards.

The Hanauma Bay Education Program also reserves the right to change, eliminate or supplement the provisions of this handbook at any time. We will attempt to give you as much notice as possible of any anticipated alteration.

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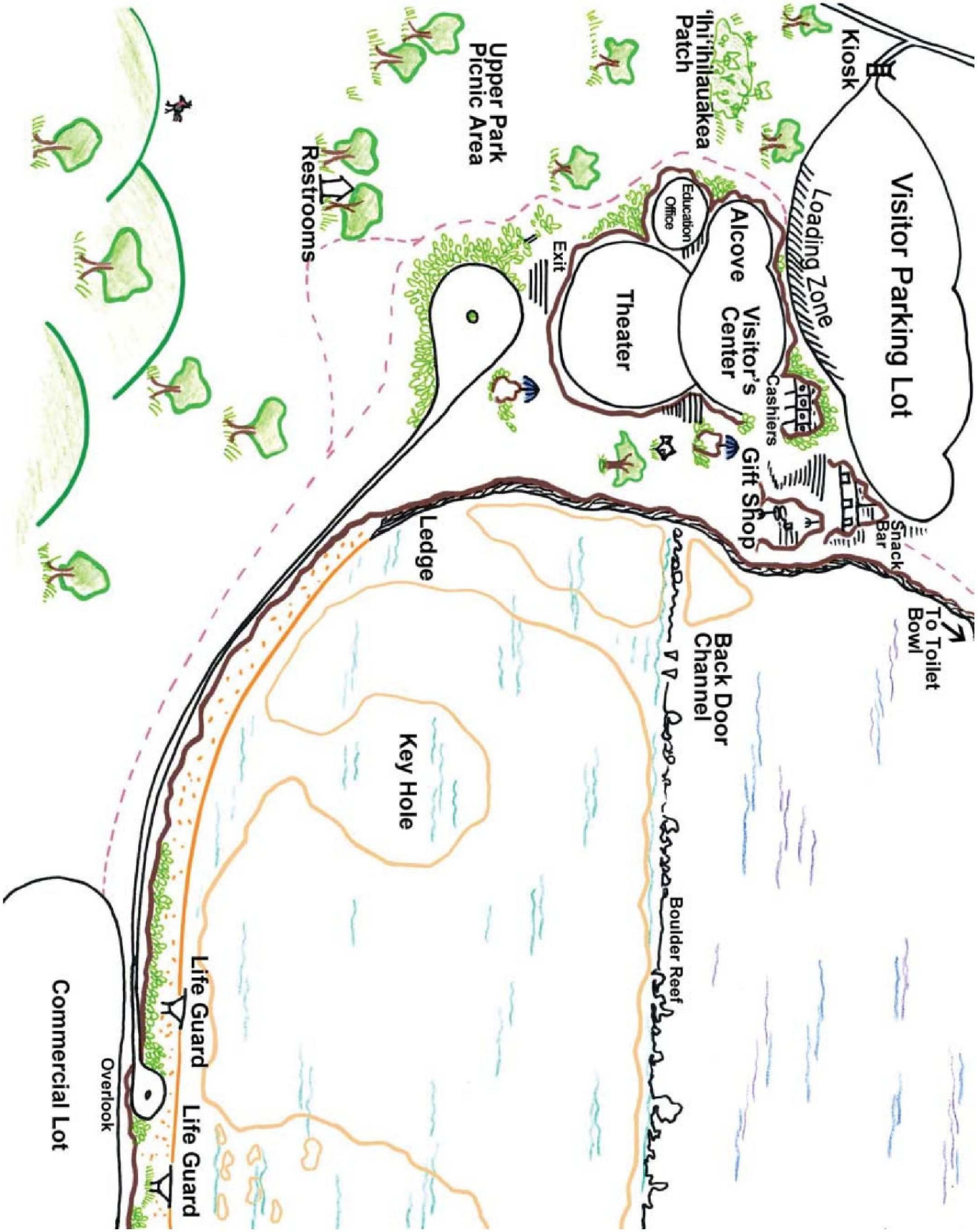
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Hanauma Bay Education Program Mission Statement

To enhance appreciation
and promote understanding and stewardship of
Hanauma Bay and Hawai'i's marine environment
through public education.

HBEP Historical Background

Hanauma Bay has come to symbolize the struggle between the expanding visitor industry and the need to conserve the natural resources of the Hawaiian Islands.

In 1928, Bishop Estate deeded Hanauma Bay to the City & County of Honolulu for use as a recreational area. As early as 1952, the Board of Public Parks and Recreation declared that Hanauma Bay was probably the most popular of all Oahu parks. In 1967, Hanauma Bay was designated Hawai`i's first Marine Conservation District (MLCD) in order "to permit people to see it as nature originally fashioned it, before irreparable damage is done." (Conservation at Hanauma Bay, *Honolulu Star-Bulletin*, 9/23/67)

The Bay's popularity continued to soar, especially with commercial tour operators. By 1988, the City & County, Department of Parks and Recreation estimated that an average of 10,000 people packed the beach at Hanauma Bay each day. The stress produced by such enormous crowds on the nearshore environment was evident. Visitors wading in the water stirred up clouds of sediment that blocked life-sustaining sunlight and created debris problems for the struggling coral. People walking on the reef unknowingly damaged the exposed corals, algae and other organisms. On numerous occasions, an oily sheen resulting from the use of non-waterproof sunscreen covered the water over the reef flat. The fishes were fed a variety of inapropriate and potentially harmful foods. Abundant litter on the beach and in the water constituted not only an eyesore, but a serious health hazard for green sea turtles who are known to ingest plastic debris. Many visitors urinated while swimming, creating a growing concern for elevated bacteria levels. This ugly scene did not reflect the vision of Hanauma Bay as a Marine Preserve. Instead, the Bay was suffering from ignorance, exploitation and carelessness.

Finally, in 1990, the City & County, Department of Parks and Recreation, took action to reduce visitor-related problems by restricting the number of people entering the Hanauma Bay. Although this vehemently contested measure reduced the visitor count by two-thirds , it really only affected the scale of the problem. There needed to be a way to educate visitors about the necessity of caring for the marine environment.

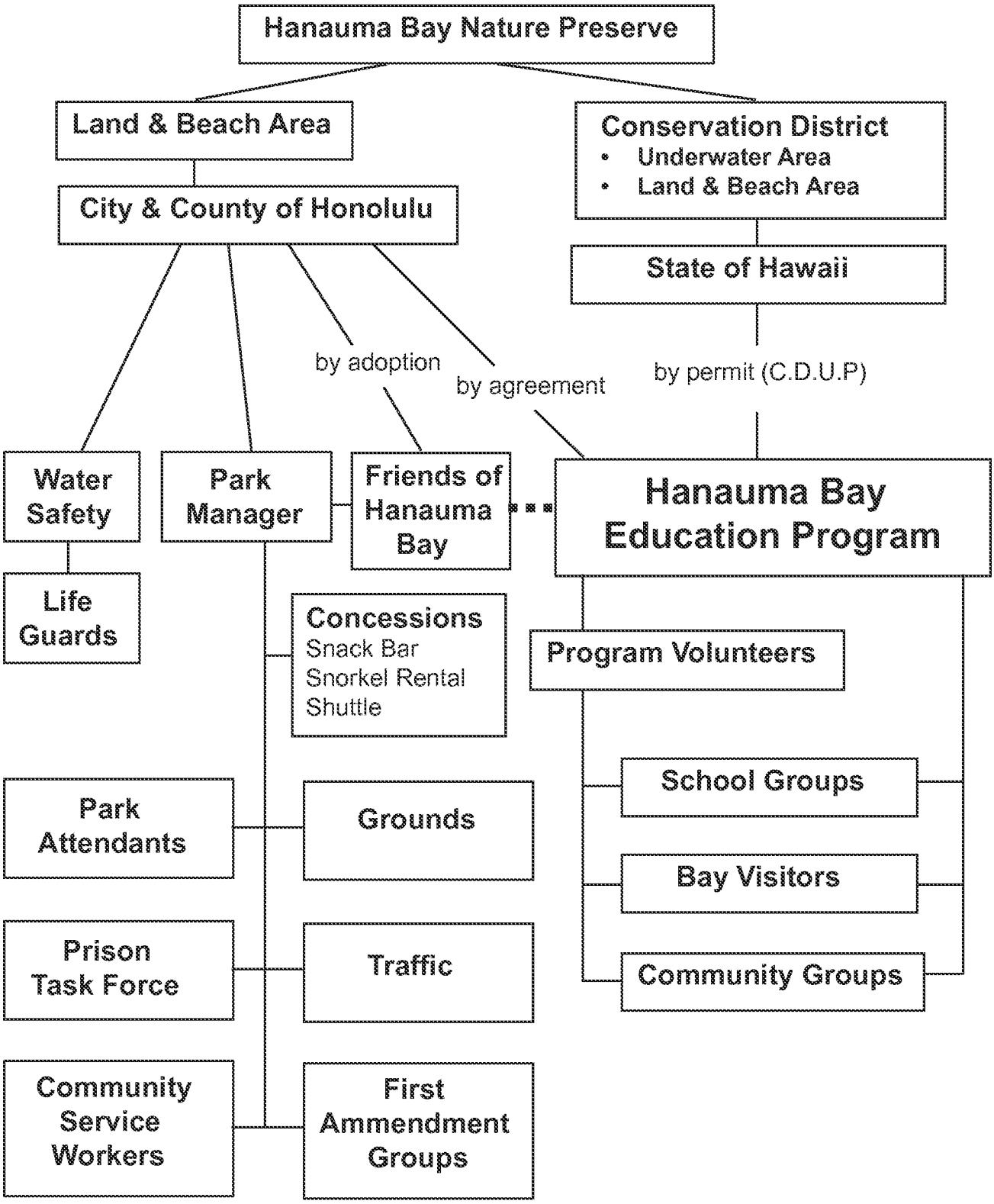
For years the University of Hawaii Sea Grant College Program had been following the plight of Hanauma Bay with the intent of intiating a beach-site education program aimed at promoting conservation among the visiting public. In the same year that the City & County restrictions went into effect, Sea Grant unveiled the Hanauma Bay Education Program. Consequently, limiting access and increasing public awareness through education evolved as the two key methods to preserve the Bay.

Today, the education program has a corps of over 100 active and seasonal volunteers, an eight member staff and has received numerous awards and recognition. During the last calendar year, volunteers donated 11,500 hours to educate and enhance the experience of the nearly one million visitors to the Bay. The program continues to grow as part of Hawaii

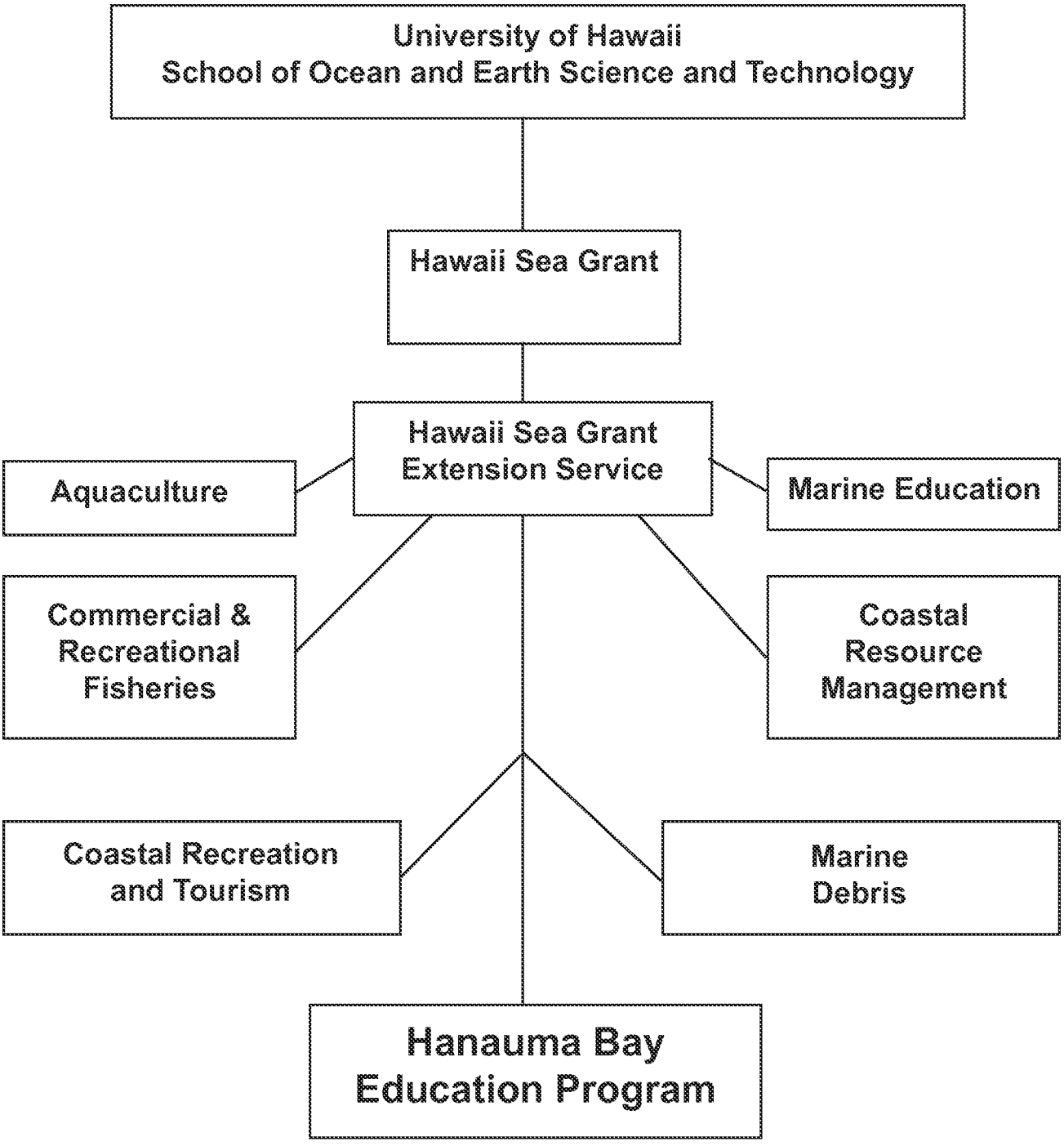
Sea Grant within the University of Hawai`i School of Ocean and Earth Science & Technology, and has non-profit status through the University of Hawai`i Foundation.

In addition to promoting stewardship of the Bay by park users, the Education Program also acts as a resource for the community. Staff and volunteers help to build and maintain our archives, host special events away from the Bay, and sponsor a weekly lecture series as a part of our growing Outreach Program. Volunteers are invited to participate in these and other community outreach activities, and are also needed to lead local school groups on tours during outings to the Bay.

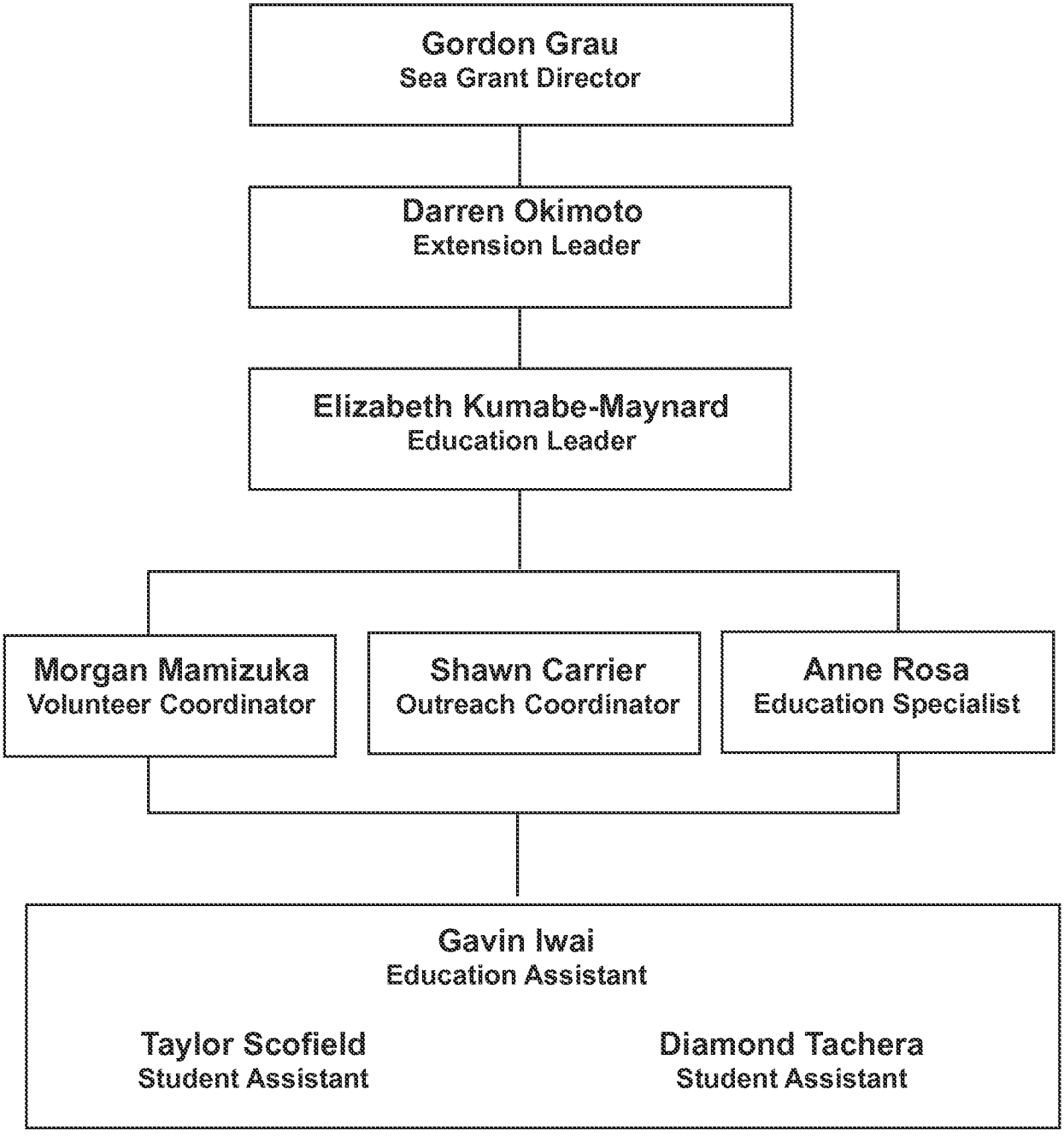
Organizational Overview within Hanauma Bay



Organizational Overview within the University of Hawaii



Organizational Overview within HBEP



Hanauma Bay Education Program Goals

1. To plan and develop a dynamic program in environmental education.

2. To train volunteers to represent the program's mission to the public and to assist in various program activities.

3. To implement appropriate educational activities.

4. To disseminate information about the program activities through newsletters and media releases.

5. To coordinate with the City & County of Honolulu Department of Parks and Recreation, the University of Hawaii Sea Grant Extension Service and private citizens' groups on matters of environmental education.

6. To seek funding in support of educational projects and activities.

Program Awards

- **Hawai`i's Fifteenth Annual First Lady's Outstanding Volunteer Award (1991)**, a certificate of recognition for outstanding voluntary service, presented by Mrs. John D. Waihee

- **The U.S. Department of the Interior's Volunteer Service Award (1992-3)**, for outstanding commitment to the stewardship of America's public lands and natural and cultural resources

- **Chevron Conservation Award (1993)**, a national award honoring outstanding contributions to the conservation of our nation's natural resources

- **Take Pride in America Certificate of Recognition (1993)**

- **Recipient of the Council of the City & County of Honolulu Certificate (1993)**, honoring and commending the Hanauma Bay Education Program

- **Earth Day, Every Day Environmental Award (1993)**

- **British Airways Tourism for Tomorrow Award (1998)**

  City & County of Honolulu Honored and Commended the HanaBay Education Program, for its committment and dedication in educating the public about the preservation and protection of Hanauma Bay **(2005)**

- **City & County of Honolulu recognized Hanauma Bay Volunteers for their Exemplary Service to the Community (2006)**

Friends of Hanauma Bay

1990 was a critical year for Hanauma Bay in terms of balancing conservation interests and visitor needs. The enactment of the City & County's public access regulations and the initiation of the Hanauma Bay Education Program served to coalesce the conservation effort to slow the destructive activities of the overwhelming crowds of the 1980s. These were important steps, however, the movement lacked visible broad-based support. Recognizing this, Peter Rosegg, of the Honolulu Advertiser, wrote an editorial requesting interested persons to call a hot-line and identify themselves as part of the community that supported the preservation initiatives. Those who called ultimately became the first of many citizens to form the Friends of Hanauma Bay.

The purpose of this non-profit organization is to:

- Develop, maintain and protect the natural qualities of Hanauma Bay Nature Preserve. The membership has agreed to:
- Conserve the fragile natural resources of this unique marine preserve
- Educate the public on the proper use and enjoyment of this unique site
- Assist government agencies in the development and management of Hanauma Bay
- Promote an atmosphere of enjoyment for local residents and visitors
- Promote and foster the development of other marine preserves providing similar experiences as Hanauma Bay for residents and visitors

(from the *Articles of Incorporation* of the Friendof Hanauma Bay)

The Friends of Hanauma Bay have proven to be effective environmental advocates in government, neighborhood boards, and public hearings. Members' efforts give vital support to the community through conservation and preservation initiatives.

The Department of Parks and Recreation has recognized the Friends of Hanauma Bay as the official adopting agency for Hanauma Bay. In this capacity, it is responsible for annual clean-up events and special projects performed in collaboration with the Hanauma Bay Park Manager.

Although the Friends of Hanauma Bay and the Hanauma Bay Education Program have a similar goal-- the preservation of the bay --they remain separate organizations. All HBEP volunteers, however, may receive a free membership to the Friends of Hanauma Bay. (A membership form is included in this handbook. Your membership will be activated if/when you fill out the membership form and submit it to an HBEP staff member, or mail it in. The membership fee is waived for HBEP Volunteers.)

Volunteer Rights & Responsibilities

As a volunteer your rights include:

- The perogative to volunteer your services regardless of your present economic condition, race, color, ancestry, sexual orientation, political affiliation, religious affiliation, sex, age, physical or mental handicap, or marital status
- An appropriate and meaningful job
- Training to enable you to effectively carry out your duties
- Suitable recognition and appreciation for your efforts

As a volunteer your responsibilities include:

- Understanding and fulfilling your job assignment and time commitment
- Ensuring that the information you share with the public is accurate and presented in a nonthreatening and understandable manner
- Arriving and leaving according to schedule (*see **Attendance Policy**, page 34*)
- Maintaining professional dress and behavior (*see **Appearance Policy**, page 35*)
- Keeping accurate records of your time (*see **Keeping Accurate Records**, page 37*)
- Informing an HBEP Staff member as soon as possible if you are unable to perform your duties
- Showing consideration and working as a member of a team with staff and other volunteers
- Following all the guidelines and policies established by HBEP

Volunteer Training

All formal training is designed to equip volunteers with the knowledge necessary to achieve the mission of the Hanauma Bay Education Program. Training will be offered three to four times per year. The sessions are generally held in the education center at the Bay, conducted by HBEP staff, and consist of a total of 16 hours of training offered on a rotating schedule of week days or weekends over the course of the year. Dates for the sessions will depend on the number of volunteers desiring the training and the availability of HBEP staff and guest speakers.

Subjects of the training may include (but is not limited to):

- Hanauma Bay Education Program's goals and objectives for the future
- Introduction to the Hawaiian language
- Cultural and historical background of the bay
- Geological record
- Reef fish biology and identification
- Invertebrate biology and identification
- Coral reef ecology
- Coastal plant identification
- Interpretive techniques
- Ocean Safety

Volunteer Benefits

- Free Hanauma Bay Education Program T-shirt (upon completion of probationary period)
- Free trips on the access road tram ***while you are on duty***
- Discount at the food concession stand ***while on duty***
- Invitations to special events and activities sponsored by HBEP (Past events have included night snorkels at Hanauma Bay, geology hikes, potlucks, Visits to Coconut Island (Hawaii Institute of Marine Biology), Chinatown Tour, Lyon Arboreteum Tour,and Winter and Spring volunteer parties
- Free membership to our sister organization, the Friends of Hanauma Bay
- Letters of recommendation or reference

And most importantly...the opportunity to work with and meet dedicated volunteers like yourself while engaging in preserving a natural treasure!

please note: in order to receive a discount at the food concession or ride the tram free of charge, you must be clearly identified as an HBEP Volunteer. (T-shirt and nametag) Also, remember that these benefits are courtesies extended by the concessionaires. If abused, any or all of these benefits could be discontinued for ALL HBEP volunteers.

****** To avoid any confusion for their paying customers, the tram operators have requested that volunteers wait in line to ride the tram rather than just hopping on.***

What to Expect Your First Day

Most new volunteers spend a day shadowing experienced volunteers before they attend the volunteer training. This experience gives you a good idea of what to expect during your shift. For those individuals who were unable to shadow a volunteer prior to training, the following information should be helpful.

Be Prepared

The weather at the Bay is typically hot and dry, and sometimes quite windy. Remember to:

- Wear your nametag
- Dress in cool and comfortable clothing
- Bring water and a snack
- Wear sunscreen
- Bring a hat and/or sunglasses

Also, many volunteers wade into the water during their shift, so you might want to wear a bathing suit or swim trunks. If you plan to snorkel before or after your shift, you are welcome to store your gear in the docent room while you are on duty.

What to Do

- Park in the Employee parking lot (adjacent to the commercial parking lot)
- Report to the education office
- A staff member or experienced volunteer will be assigned to help you learn your way around

Probationary Period

All volunteers go through a probationary period of three volunteer shifts. Upon completion of your first three volunteer shifts, you will receive your volunteer t-shirt. The probationary period helps new volunteers as well as the program. For your part, it helps staff to recognize you as a new volunteer who might need a little extra assistance. A volunteer in uniform is expected to be knowledgable of general operations and comfortable with their responsibilities.

Please continue to check-in at the Education Office for each shift during your probationary period. After probation, you are encouraged, but not required, to check in with education staff when you arrive for your shift.

Docent Room

Volunteers are encouraged to stop in the docent room before their shift. In the docent room you will find:

- Volunteer Time-sheets & Sign-In Book
- Daily Rotation Schedule
- Lockers to store belongings during your shift
- Postings of important announcements and upcoming events
- Materials and artifacts to use during tours
- A wall calendar with an updated volunteer schedule
- Microwave oven and sink
- A quiet place to take a break!

Volunteer Stations

Volunteers are expected to split their shift between the three stations as needed. A daily rotation schedule will be posted in the docent room, information desk, education office,theater and beach kiosk. Please check with an HBEP staff member if the schedule is missing or has not been posted.

Requirements: Volunteers need a working and accurate knowledge of the issues and concerns warranting the education program and a degree of fluency in the natural, cultural and historical aspects of the Bay. After training, you will be expected to orient visitors to the Park by staffing the upper and lower park volunteer stations and (in some cases) leading natural history tours. All volunteers who deal directly with the public must present a warm, friendly and professional attitude, combined with a willingness to meet and talk with new people. Keep in mind that your demeanor will often determine the effectiveness of the program.

Visitor Center (Upper Park Area)

Job description: Every visitor must pass this area before descending to the beach. The volunteers who staff this area can reach close to 100% of the visitors by doing the following:

- Introducing the orientation film that all visitors see before descending to the beach
- Making suggestions on how visitors can help preserve the reef environment
- Checking with visitors in the display area to see if they have any questions
- Giving group orientations when needed

While staffing this area, volunteers may also help maintain the display area by dusting off displays and sweeping the education center as necessary.

Beach Desk (Lower Park Area)

Job description: Working at the Beach Desk may include some of the following duties:

- Staffing the education desk-- Volunteers serve as nature interpreters, answer questions, give directions and promote marine life conservation
- Beach patrol-- Walk along the shoreline educating visitors about the Bay, removing litter along the way, remind visitors of park rules (i.e. no smoking, no bird or fish feeding, etc)
- Beach Tours-- Promote appreciation and stewardship of the Bay by discussing natural and cultural history, conservation concerns, fish identification and safety issues to interested individuals or groups. Tours average 15-30 minutes

Theater Procedures

1. Open makai doors and step outside to untie the blue rope at the bottom of the entrance steps.
2. Let everyone into the theater and handout translation headsets as needed.
3. After the last person has entered the theater, tie up the blue rope and close the en trance doors.
4. When you are ready to start your introduction:
   - Turn the power switch on for the microphone and move the other switch from MUTE to ON.
   - Begin your introduction!
   - When you have finished speaking:
   - MUTE the microphone and turn the power OFF.
   - Touch anywhere in the upper half of the touchscreen
   - Press the "START SHOW IN ENGLISH" button.
   - The lights will dim after a few seconds and the movie will start.
5. When the narrator says, "We hope you have a wonderful experience and thank you for visiting Hanauma Bay," make your way to the exit doors and press the red button on the wall to let everyone out of the theater.
6. As soon as everyone has exited the theater, press the STANDBY button on the touch-screen to stop the movie.
7. Be sure the exit doors are closed before opening the entrance doors and letting the next show into the theater.

Theater Script

Aloha! Welcome to Hanauma Bay.

My name is _____. I am a volunteer with the Hanauma Bay Education Program operated by University of Hawai'i Sea Grant College Program.

I will be showing you a brief (9 minute) movie that touches on the history of Hanauma Bay and how each of you can help to protect it during your visit today. Before we get started, I have a few quick tips that aren't included in the film:

1. The only food concession in the park is located in the upper park area. There is no food for sale on the beach.

2. Hanauma Bay is a no-smoking beach. If you would like to smoke, you will need to walk back up the hill from the beach, and outside the entrance of this Visitor Center.

3. There is a grass shack on the beach staffed by volunteers. They have a lot of great information about the marine life you will see while you are snorkeling and would be happy to answer any of your questions.

   Park visitors are only required to see this film one time per year. If you plan on returning to Hanauma Bay within the next twelve months and would like to bypass this movie, after the film you will need to come up to the front of the theater and print your name and zip code on one of these Repeat Visitors Lists.This will be your only opportunity to put your name on the list. Otherwise you will need to see the film again.

Thank you for your attention. Enjoy the movie and have a great day here at Hanauma Bay!

Additional Tips or Suggestions to include in your introduction:

You might choose to include additional information in your introduction. These are just suggestions; you do not have to use these examples. Think about what you think is important to include and what you would like to share with visitors to the Bay. Also, keep in mind that you will probably only have time to add one or two additional points to the main script. *(***Please remember that if you modify the script, you should give a copy to the Volunteer Coordinator for approval.)*

Beach Amenities
There are water fountains, bathrooms, and showers on the beach

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Snorkel Rental
The snorkel rental is on the beach and also provides storage unit services.

Trolley
The trolley charges $0.75 down, $1.00 up, or $2.50 for an all day pass

Protect the Reef
- You don't have to swim over the reef to see fish! Swim along the edges of the reef and you will see a variety of marine life without having to worry about getting stuck on the reef in shallow water.
- Walk only on the sand, swim over the reef.
- Everything in the water that looks like rock, is actually part of the living reef.
- Walking, standing, sitting or climbing on the reef can damage it. Also, the reef is quite sharp and doing any of these things can cause it to damage you too!

Tides
When the tide is particularly low, be sure to let people know… "Be aware that much of the inner reef flat will be too shallow to swim over this morning, but that's okay! You don't have to swim over the reef to see marine life, swim along the edges instead."

Park Hours
Good to mention at certain times of the day or on certain days of the week:
Hanauma Bay Nature Preserve is closed on Tuesdays (good to mention on Mondays)
The beach will be cleared at 5:30pm and the top gates will be locked at 6:00pm (winter)
The beach will be cleared at 6:30pm and the top gates will be locked at 7:00pm (summer)
There will be a free lecture at 6:30pm on ***Thursdays***.

Ledge status (as necessary)
Always Closed as of 2003

Jellyfish (when appropriate)

Ocean Conditions (when dangerous conditions exist or any area outside of the reef crest has been "closed")

Beach Kiosk

If you are working the morning shift and are the first volunteer scheduled at the beach kiosk, please stop by the education office to pick up the kiosk key, a hand-held radio, and a copy of the daily volunteer rotation schedule. If you know that you will be setting up alone or just need an extra hand, let an HBEP staff person know and we can assist you in setting up and/or staffing the beach kiosk.

Opening and closing procedures of the Beach Kiosk are the responsibility of the volunteers scheduled for duty. It is very important that items be maintained while in service and afterwards returned to their assigned locations for the next shift. If any serious irregularities are encountered, please contact the program staff as soon as possible.

Opening Procedures:

1. Unlock each of the 8 large brown doors, one at a time, carefully locking them to the corresponding post in the open position. *(Please be careful, or risk smashing your fingers between the door and the post if the wind catches the door!)*
2. Open the two cabinets inside the kiosk
3. Use dust-brush to clean any sand off counter tops
4. Display all educational materials
5. Be sure to take out the Volunteer Beach Desk Binder and red diary to record the days' happenings and statistics

*Please note: On your days off, or if you plan to snorkel before/after your shift, **please do not store your gear in the beach kiosk**. Please store it in the lockers in the docent room. When several people have a lot of bulky gear stored in and around the kiosk, it can get in the way and also stands a greater chance of "walking away."

While on Duty:

- Talk to visitors looking at the fish ID posters and ask them if you can help them indentify the fish they observed.
- Go on a beach patrol...walk the beach, pick up trash, answer visitor questions, remind visitors of the no smoking, no bird-feeding and no fish-feeding policies as necessary.
- Lead visitors on natural history tours.
- Wade out into the keyhole and talk to people standing on the reef.
- Learn how to read a tide chart.
- Work on your fish identification using the books available at the desk.
- Clean the sand out of the education desk and tidy up the area.

Closing Procedures:

1. Count number of visitors helped (final number on clicker at the end of the day) and number of tours given. Log the information in the red diary under the appropriate date.
2. Return all books and other supplies to the plastic storage bins in the two cabinets under the counter.
3. Leave the two wooden book displays on the counter top.
4. Close the two under-counter cabinets.
5. Carefully unlock doors (from the posts), close, and secure each of the eight large doors.
6. Remember to drop off the radio and key at the Education Office.
7. Log your hours in the Volunteer Sign-in binder (located in the Docent Room) before leaving the park.

Please remember to use the beach kiosk clicker to record each person who asks a question, peruses the marine life identification books or posters, or utilizes any service or information provided by the kiosk and/or the volunteers staffing it. The total number of beach desk contacts is recorded at the end of each day and these numbers contribute to the annual statistics used to calculate the overall impact of the education program at Hanauma Bay.

Hand-Held Radios (walkie-talkies)

While on duty at the beach desk, volunteers will have access to, and be responsible for, a hand-held radio so that they may stay in contact with park staff.

Responsibilities

- One radio per volunteer shift with responsibility to one individual on that shift
- Radio should never be left unattended
- Turn in radio to the Education Office (or to a education staff member) at the end of shift.

**For morning crew...when turning over beach desk responsibilities to afternoon crew, please hand over the radio to a member of the afternoon shift.*

Protocol

- Keep radio on at all times
- Radio should be set to "HBay" for general use
- Keep volume set at a reasonable level
- Push and hold down the black button on the left side of the radio (2nd button down)
- Speak clearly and directly into the radio speaker
- Release the black button when finished speaking
- Before using the radio, be sure to listen for any current radio traffic so that you do not interrupt someone else's communication. When the channel is clear, begin your transmission.
- Identify yourself and to the person you are trying to contact
  example: "*Beach desk to Education*" or "*Beach desk to Ranger Jack*"
- Give the party you are trying to contact a few seconds to respond. If you do not get a response, try again.
- If you are being contacted, reply to let others know you have heard the transmission and are standing by for further communication
  example: "*Beach desk standing by*"
- Use radio only for necessary communication with Education and park staff
- Keep communications as brief as possible (**When reporting a lost & found item, do not broadcast a description over the radio. Simply let the V/C office know that the item was turned in to you. A staff member/ranger can pick up the item, or if there is enough volunteer coverage, a volunteer may turn in the item to the V/C office*)

****Please note: Lifeguards and HPD are NOT on radio communication; use the radio to notify the education office or park office of any emergency so that they can call police, fire, or water safety personel as needed. On occasion, lifeguards may approach you and ask you to use the radio. Please assist them as necessary.***

Attendance

Please be there!

We exist first and foremost to preserve Hanauma Bay. To best serve the Bay and the visitors who come to enjoy it, each volunteer needs to fulfill his/her commitment.

Educating visitors and limiting public access are the most important means for protecting Hanauma Bay. The 1990 City & County restrictions have effectively cut the visitor traffic by two-thirds. The on-going process of educating the Bay's visitors is the responsibility of the Hanauma Bay Education Program. Without the volunteers' presence on the beach and in the education center, the Education Program's effectiveness is greatly diminished.

To insure that we have ample coverage for each shift, a monthly schedule is prepared and distributed to all HBEP Volunteers. To insure that the calendar accurately reflects volunteer coverage, please notify the Volunteer Coordinator of any anticipated absences. If, through unforeseeable circumstances, you are unable to work your shift at the last minute, please call HBEP Staff at 397-5840 or 394-1374 . Please take the time to call, even if it is the same day or after the fact.

Things come up, volunteers have other things to do, we know! All we ask is that you let us know when your schedule has changed or something has come up. Three ***unreported*** absences may be grounds for termination from the volunteer program.

Please be on time!

It is very important that you arrive in a timely fashion. Others are counting on you for help setting up and conducting the program. Tardiness creates problems for everyone. If you know that you will be late, please contact HBEP Staff, or if that is not possible, try contacting someone on your shift.

Appearance

To achieve our goals it is necessary that we influence human behavior at the Bay. Much of our credibility is predicated on how we appear to the public. For our message to carry weight, we must behave and appear as professional as possible.

Upon completion of training and a three-week probationary period, all volunteers are provided with an official Hanauma Bay Education Program T-shirt and a HBEP nametag. These identify you as part of our program to the City & County workers, lifeguards, concession personnel (food & trolley), and, most importantly, to the public. **Your t-shirt and name-tag are your uniform and should be worn at all times during your shift or any other time that you are acting as a HBEP Volunteer.** Abusing the privileges extended to volunteers in uniform, or lending your shirt to friends or family members is unacceptable and may result in your termination as an HBEP Volunteer.

**** If you volunteer more than one shift per week, or need a replacement shirt at any time, simply notify an education staff member. On occasion, long-sleeve shirts, polo shirts and tank tops are made available to volunteers at cost.*

Parking

Volunteers are expected to park in the employee parking lot (adjacent to the commercial lot) when they are to be on duty. If the staff parking lot is full, please drive to the public parking lot. Notify the parking booth cashier that you are a volunteer on duty and that the staff parking lot is full. You will be allowed to park in the public parking lot without paying the $1.00 fee only when the staff parking lot is full.

If you work the afternoon shift, or will be dropped off or picked up, you will occasionally be entering the park during periods when the public parking lot is full and the top entrance is closed to the public. The guards who staff the top gate will not let you into the park during a gate closure unless you identify yourself as a volunteer or as someone picking-up or dropping-off a volunteer. This is why it is very important that you wear your volunteer t-shirt and name-tag as it will identify you as a volunteer to other park staff.

Please recognize that it is YOUR responsibility to identify yourself, and remember to relay this information to anyone that may be picking you up or dropping you off. Do not take advantage of this arrangement. If you will be visiting the Bay for recreational purposes, you will be admitted to the park even during a top gate closure. This is a privilege of active Hanauma Bay Education Program Volunteers. Anyone else who enters the Bay under the pretext of being a volunteer (or picking up/dropping off a volunteer) and then parks in the public lot during a gate closure, will be asked to leave the park, or worse, their car may be towed. Please contact HBEP staff for further clarification.

Volunteers who visit the park for recreational purposes will be admitted through the top gate during gate closures. If you are not going to be on duty that day, you should park in the public parking lot and pay the $1.00 parking fee.

Keeping Accurate Records

To satisfy the Hawai`i State policy on volunteer services (Chapter 90, Hawai`i Revised Statutes), it is very important that you maintain accurate records of your donated hours. A Volunteer Sign-In is located in the Docent Room. You may log your hours at any time during your shift. A sample page from the log is provided below. Copies of your time sheets are available upon request.

For general program reporting and grant writing, we also keep track of the number of contacts with public, number of people given tours and other statistics as the need arises. These numbers may be used to help measure our effectiveness and to help justify the need for our program.

Hanauma Bay Education Program
Volunteer Log

Name : ____________________________

Date	Time In	Time Out	Total Hours	Activity (Interpretive Guide, [illegible], Beach Clean up...)

Safety

Read the Posted Signs

It is imperative that you obey all safety signs posted at Hanauma Bay and bring these signs to the attention of park visitors as the need arises.

Entering the Water

Volunteers are encouraged to swim or snorkel immediately ***before or after*** their shift, but ***should not enter the water beyond waist-deep while on duty***.

For the General Public

Part of the HBEP training covers safety for Park visitors. Rarely do visitors take the time to read the posted signs, and for many this is their first experience with the ocean. It is very important that the information they receive be accurate and come from the right source.

This is particularly important to remember when people ask for recommendations as to where to snorkel or how to get to the area outside the reef crest. You may be very comfortable swimming through the channels to the outer reef areas, but the majority of our visitors have no business being out there. ***Never make assumptions about a persons abilities no matter how young or fit they may appear. DO NOT advise any visitor on where they should go in the water. This is a major liability. You may describe the different habitats, but under no circumstances should you advise on where the visitor should go.***

Volunteers should NEVER act as water safety experts. All water safety questions and concerns should be directed to the Bay's lifeguards. This is their area of expertise and what they are trained and paid to do.

While at the Beach Desk you may be asked by visitors on snorkeling instruction or how to use the mask and snorkel. Please DO NOT advise any visitor on how to use their mask or snorkel. Once again this is a major liability. If they rented their gear from the snorkel rental stand please advise them to get instructions from the snorkel concession. If they brought their own gear please direct them to the lifeguards for instruction

Mahalo!

Injury

For Volunteers

See the lifeguards for First Aid.

Reporting Injuries:

1. Any injury incurred while you are on-shift, performing duties in your capacity as an HBEP volunteer, regardless of the nature of the injury/illness, must be reported to HBEP within 24 hours of its occurence.
2. HBEP must complete the 'Report of Industrial Injury or Illness' Form (OSHA Form 300) within 48 hours of the time the accident is reported, and the injured volunteer must sign the 'Employee/Claimant Consent' Form.
3. A copy of any medical certification slip(s) must be attached to the 'Report of Industrial Injury or Illness' Form.

For the General Public

First Aid: Please send all injured members of the public to the lifeguards for first aid. *Do **NOT** try to administer first aid yourself.*

If a visitor approaches you and notifies you of an emergency, ALWAYS send someone immediately to the nearest lifeguard tower to make sure they are aware of the situation and notify the V/C Office using the hand-held radio. In some cases, you may be called upon to assist with crowd control, otherwise return to the beach desk and resume your duties there.

Assisting Visitors in Other Ways

Volunteers are occasionally called upon to assist with locating lost items such as: wallets, keys, children, etc., or in other unusual situations as the need arises. In these situations, the hand-held radios will be useful to keep in contact with other park staff members, such as, the education staff (Shawn, Anne, Liz, Morgan, Gavin, Brooke, Charles, Dan and Adriana), park attendants (Jack, Ann, John, Rich, and William), Former Park Manager (Alan Hong) and Assistant Park Manager (Martha McDaniel).

Worker's Compensation

Worker's compensation insurance is intended to provide payment for medical care resulting from injuries on the job and illnesses caused by your work, but not for lost salary.

All volunteers who have been accepted by HBEP and have completed and submitted the **HBEP Application Form** are considered bona fide volunteers of the program. You will also be asked to sign an **HBEP Volunteer Agreement.** Together, these forms establish your eligibility for worker's compensation coverage *as long as you are performing functions laid out specifically in your volunteer position description.*

If you are injured while performing your duties, you must report immediately to an HBEP Staff member and have an accident report completed.

**Note: The hours you fill in on your time sheet are the only records we have of your service for insurance purposes.*

Smoking Policy

Smoking is NOT permitted in Hanauma Bay's lower park area.

In 1993, the Honolulu City Council passed Ordinance 93-92, prohibiting smoking in Hanauma Bay Nature Preserve, the Honolulu Zoo and Koko Crater Botanical Garden, except in specially marked zones. Cigarette butts have been found to constitute a major source of litter and there is concern for the potential health hazards of second-hand smoke, even in open areas. Although the possible detrimental effects of nicotine on Hanauma Bay's marine animals was a concern, it was not discussed at the council hearings.

Policing smokers is very difficult, and compliance with the ordinance may ultimately depend on self-regulation. Therefore, it is imperative that the members of the Hanauma Bay Education Program set the best possible example by not smoking and encouraging others to act likewise. Volunteers may approach smokers on the beach and notify them of the law. If the visitor refuses to comply, walk away and notify a Park Ranger.

Drug Policy

Alcohol

Hanauma Bay Education Program Volunteers shall not consume or posses alcoholic beverages while serving their capacity as volunteers. Volunteers who violate this policy are subject to immediate dismissal.

The Hanauma Bay Education Program will not provide or endorse the drinking of alcoholic beverages during volunteer gatherings, including functions clearly intended as 'parties.' However, consumption of alcohol at such functions is dependent on the house rules of the host and/or left to the discretion of individuals.

In addition, alcohol is not allowed on the beach or in the upper park at Hanauma Bay. Any violations should be reported to a Park Ranger.

Drugs

The State, City & Council of Honolulu and the University of Hawai`i fall under the federal Drug-Free Workplace Act. Any volunteer who possesses, is under the influence of, sells or attempts to sell or distribute any illegal drug is subject to immediate dismissal.

Disciplinary Policy

If it becomes necessary to discipline a volunteer for not fulfilling the obligations of their position or for unbecoming conduct, a standard four-tiered procedure will be followed. Each volunteer is an important and valued member of the team, making the first priority in any disciplinary measure the elimination of the problem related to the conduct or performance in question.

The four standard steps are*:

1. Conversation between the volunteer and the program staff regarding the basis of the problem
2. Written warning specifying objectionable behavior
3. Probation
4. Dismissal

**** In cases deemed extraordinary by HBEP Staff, any or all levels leading to dismissal may be by-passed.***

Program Dismissal

The Hawai'i State Policy Concerning the Ultilization of Volunteer Services, (Chapter 90, H.R.S.) states that, "an office has the right to decline any voluntary offer of services; or, if accepted, to subsequently release the volunteer who is no longer needed or who is found to be unacceptable." In accordance with this policy, HBEP may, at it's discretion, terminate an individual's participation in providing volunteer services if any of the following occur:

- The volunteer is no longer needed
- The volunteer no longer meets the minimum requirements for their position
- The volunteer fails to abide by the policies and procedures set forth by this handbook, their signed Volunteer Agreement, or the instructions of either the Education Program or park management.

Grievance Policy

Should any questions or problems arise during the course of your volunteer service, stop by the Education Office at the Bay or call 397-5840 to speak with a staff member. Concerns requiring in-depth examinations will be reviewed by the Hanauma Bay Education Program staff and administrators, and you and anyone else concerned may be called for further comment. All concerned will be notified of any response as soon as possible.

In general, issues involving volunteer service at Hanauma Bay will be resolved based on the following priority of impact:

1. Effect on Hanauma Bay
2. Effect on the effectiveness of the Hanauma Bay Education Program
3. Effect on the Volunteer Corps
4. Effect on the individual volunteers
5. Effect on the Hanauma Bay Education Program Staff

Each volunteer's concerns are important to the program and we will try to handle all issues promptly and equitably.

Table of Contents: The History of Hanauma Bay

Hanauma

Mahalo aÿe ana au i ka nani aÿo Hanauma
Ke kai küÿono hälaÿi pöÿai ÿia e nä pali.

Ua makemake nui ÿia ke alanui kïkeÿekeÿe
E iho aku ai i lalo i ke kahaone äkea.

He kahua na ka lehulehu e luana hauÿoli ai
E hoÿoluono like aÿe ana i ka leo hone o ke kai.

ÿOluÿolu i ka peÿahi a ka makani aheahe
E hoÿoluli mälie nei i nä lau aÿo ke kiawe.

Haÿina mai ka puana no ka nani aÿo Hanauma
Ke kai küÿono hälaÿi pöÿia ÿia e nä pali.

I am going to admire the beauty of Hanauma,
The calm bay surrounded by cliffs.

Greatly desired is the winding road
To descend down to the long stretch of sandy beach.

A place for the public to happily relax,
To listen together to the soft voice of the sea.

So pleasant is the fanning of the gentle breeze
That gracefully sways the leaves of the kiawe trees.

The story is told about the beauty of Hanauma,
The calm bay surrounding by cliffs.

*Source: Bishop Museum Archives. Words by Mary Kawena Pukui. This *mele hula* was composed sometime in the early 1950's. Translation by Kimo Alama.

Key Dates in Hanauma Bay's History

EARLY 1800'S	Queen Ka`ahumanu visits Hanauma Bay
1848	Hanauma Bay and surrounding lands given to Victoria Kamamalu, a de scendant of King Kamehameha
MID-1800'S	Hanauma Bay is considered a favorite fishing place of King Kamehameha V
1883	Land given to Bernice Pauahi Bishop
1884	Bernice Pauahi Bishop dies, all land holdings, including Hanauma Bay, are placed in her estate
1927	The road connecting Honolulu and Makapu`u is completed allowing access to the Bay
1928	On December 29th, Koko Head Regional Park land (including Hanauma Bay) is deeded to the City & County of Honolulu for $1 by the Bishop Estate for use as a recreational park
1941	Fearing the Bay would be used as a landing site by Japan, defensive posi tions were established by the army all along Oahu's eastern shore, including Hanauma Bay
1946	Worst recorded tsunami to hit Hawai`i, damage to Hanauma unknown
1950	The City & County dredges three large swimming holes and contructs a beach access road, lookout area, water tank and cliff trail. The existing parking lot is also improved to accomodate the growing number of park users
	Public bus service starts to and from the Bay on weekends and holidays
1952	"Probably the most popular of Oahu's parks" states the Board of Public Parks and Recreation
	Dr. Emory and Dr. Sinoto lead a team of University of Hawai`i students in excavating the Hanauma Shelter.
1956	A 200-foot wide channel is dynamited through the center of the Bay's inner reef flat to accomodate the first transpacific telephone cable, stretching from California to Hawaii

1959	Hawaii becomes the 50th State
1961	The movie "*Blue Hawaii*" starring Elvis Presley is filmed at Hanauma Bay
	Keo Nakama becomes the first person on record to swim the Ka`iwi channel swimming 27 miles from Molokai and coming ashore at Hanauma Bay
1966	A beach concession is opened at Hanauma Bay
1967	Hanauma Bay is designated Hawai'i's first Marine Life Conservation District by Governor John A. Burns and the State Department of Land & Natural Resources. Among other protections afforded by this designation, fishing and collecting at the Bay are no longer allowed
1970	The City & County of Honolulu builds a wave barrier on the reef crest to close off part of the 1956 cable channel and slow beach erosion. Sand is imported to restore the beach and a new swimming area is excavated near the Ewa end of the present beach
1979	Hanauma Bay is closed due to a visit by a six-foot gray shark
	The City & County contracts for trolley service to and from the beach area. It is now the only vehicle allowed to use the access road from the beach to the parking lot
1981	In the first two phases of a five phase plan intended to minimize siltation and improve drainage, $1,000,000 is awarded for landscaping, drainage improvements, upgrading the access road and building additional picnic areas
1983	A permit system for commercial use of Hanauma Bay goes into effect
	Magnus Construction begins a $1.4 million project to relocate the parking lot and improve the picnic area
MID-1980'S	The 1956 transpacific telephone cable is decommisioned
1987	A 1,000 gallon oil spill from an interisland barge closes the Bay for one day
	Due to further beach erosion, 3,500 cubic yards of sand is brought into the Bay from Kahuku, Oahu
1988	The Dept. of Transportation enacts a ban on private and commercial boats entering the Bay

	Park visitor numbers peak at a record 3.5 million for the year
	Severe erosion, due to the 1988 New Year's day flood, prompts the addi tion of 7,500 cubic yards of sand to the beach
1990	The City & County of Honolulu initiates a highly controversial, 8-point man agement plan. The new plan included: 1)Limiting tour buses to sightsee ing for 15 minutes at the top lookout; 2)Closing the park at night; 3)Hir ing a security firm to monitor parking; 4)Limiting fish feeding to permitted fish food; 5)Closing the Bay on Wednesdays till noon for maintenance
	Park manager Alan Hong is hired
	Friends of Hanauma Bay is formed in response to Peter Rosegg's editorial in the *Honolulu Advertiser*
	The Unviersity of Hawaii Sea Grant Extension Service founds the Hanauma Bay Education Program
1993	The City Council prohibits smoking on the beach at Hanauma Bay
1994	An entrance fee is instated for non-residents, only to be changed to a re quest for donations, an old E.K. Fernandez ticket booth is used to collect fee
	A park office and food concession building are built in the upper park
1997	The entrance fee is reinstated for non-residents, and a new parking fee is enacted
1998	Hanauma Bay park maintenance closures are changed from Wednesday mornings to all day on Tuesdays
	The Hanauma Bay Education Program opens an educational visitor center and office in an unused food concession structure
1999	The City unveils plans for Bay improvements, including a new marine education center and informational beach kiosk
	The State officially bans fish feeding at the Bay in November
2000	Ticket booth is replaced with a large air-conditioned kiosk
	Small, infrequent landslides close the Witch's Brew and Toilet Bowl ledges
2001	The City receives final approval for Conservation District Use permit by the DLNR Board

	The old concession stand and first restroom on the beach are demolished, construction begins on the new facilities and other park improvements
2002	A Visitor Center opens and visitors are required to watch a short orientation film before accessing the beach
2003	The entrance fee for non-residents (over 12 years of age) is raised from $3.00 to $5.00
2003	The ledges of the Bay leading to Witch's Brew and the Toilet Bowl are closed until further notice.
2007	Hanauma Bay celebrates its 40 year Anniversary for being an MLCD
2010	UH Sea Grant Hanauama Bay Education Program celbrates its 20 year Anniverary.
2011	Park Manager, Alan Hong, retires.

Hanauma Bay Shelter

In 1952, an archaeological site was excavated by a team of researchers from the Unversity of Hawai'i. This is the only significant archaelogical site ever uncovered within the bounds of the current Hanauma Bay Nature Preserve. Located under an overhang near the end of the beach access road, this sheltered site was probably used by fisherman seeking protection from the sun, wind or rain during expeditions to Hanauma Bay. Among the items discovered at the shelter during the excavation were numerous shells, dog and pig bones, shark's teeth, a carved bone, shell beads, a bone pick, cooking stones and fishhooks.

A Bernice P. Bishop Museum survey, conducted in 1931 by J. G McAllister, located several sites near Hanauma Bay, but none within the present park boundaries.[1]

The sites described by McAllister are listed below:

Site 44 = Petroglyphs in a cave on the Sandy Beach side of Toilet Bowl.
Site 45 = A platform on the side of Kohelepelepe Ridge, which McCallister was unable to locate
Site 46 = A fishing shrine consisting of a stone near the water.
Site 47 & 48 = Two fishing shrines, each roughly square in shape and about 17 feet across, located on the Honolulu side of Koko Head Ridge.
Site 49 = Keahupua-o-Maunalua Fishpond, also known as Kuapa Pond (now Hawaii Kai). McAllister states that in 1851 the pond was recorded by Webster as being 523 acres in size; and that in 1822, this pond was recorded by Mathi son as having a village of "perhaps one hundred huts" on its shore. (McAl lister, 1933:69)

[1] Connolly, Robert D. "Archaeological Reconnaissance Survey at the Hanauma Bay Beach Park Site, Hanauma Bay, Island of Oahu." Prepared for the City & County of Honolulu, Department of Parks and Recreation, September 1980.

The Cable Channel

The people of Hawai`i received big news in August of 1955. Hawaiian Telephone Company and American Telephone and Telegraph Company announced a joint venture which would connect the lonely islands in the Pacific, to the U.S. mainland via a submarine telephone cable. The 37 million dollar price tag reflected the ambitious nature of the project: lay 2,400 miles of cable across the yet uncharted floor of the Pacific Ocean. It would not only be the longest span of ocean ever traversed by cable, it required *two* cable ships and drops to depths over three miles in places.

In 1956, after a summer of charting a course, it was determined that Hanauma Bay was the most suitable site for the cable to come ashore. A terminal building was constructed and survey work began in the Bay. A channel would be blasted through the reef to accomodate the cable.

> *In mid-October the Hawaiian Dredging Company began dynamiting the tons of rock, and removing them from the channel. The entire job required about one month, during which the popular beach had to be closed to swimming. However, after it was finished and the debris had been cleared away, a vastly improved aquatic pool rewarded the public.*[1]

Or so they thought. Over the next few years, it became apparent that the nice new swimming area came at the expense of the sandy beach. With such a large section of the reef removed, the beach was exposed and soon severely eroded. By 1970, the City & County of Honolulu was forced to take action. A wave barrier was constucted to close-off a good part of the channel and sand was imported to restore the beach.

The cable itself was decommisioned sometime in the mid-1980's but can still be seen. In fact, it is used as a navigational aid by divers and snorkelers accessing the deeper waters of the Bay via the remaining, but much narrower, Cable Channel.

[1] Simonds, William A. *The Hawaiian Telephone Story*.

Bits of Oral History of Southeast Oahu

Story of Kuamo`okane

(as told by Almeda Goss, int. by: Mary Pukui, April 23, 1962)

In the long ago, three brothers came to that area. The three brothers were Kane, Kanaloa, and Kane a pua. And near the point on the west side of Hanauma and walked a little way. Then Kanaloa who was usually thirsty most of the time, wanted to stop and have a drink of awa. Then the older brother, the oldest brother Kane said to the third, to Kane a pua, he said there was a special spring of water up on that hill over there, on Lepelepe hill. That's that hill back of the Lunalilo home. He said you go up there, climb up there and get the water. But whatever you do, don't pause. Get the water and come straight back. And here is the container, and here is the coconut - a cup with which you are to dip that water.

So his brother ran up and found that spring. When he dipped up the water and filled up that coconut cup, that was when the water in the spring dried. All the water that was to be had was in that little container. So he came down part of the way. He was quite tired after this long voyage from across the sea that he thought he'd sit down and rest. And just as he sat down to rest a long trail, a gust of wind came and blew a cloud of dust, and blew some right in the water. And he sat there and worried about it, and worried about it, and worried about it instead of going straight down to his two brothers.

Well, Kanaloa was too impatient. He couldn't wait so he said to Kane, I cannot wait for that water. So you take your cane and thrust it into the side of the hill. You know how to get water. And that's what happened. (Kanaloa said that?) Yes, so Kane did that, he took his cane and poked a hole, right there. And I saw the hole, it was a round hole. And out of there water poured out of this hole, and down. And then they prepared their awa, and decided then to go on and not wait for Kane a pua, sitting up there on the hill and fretting about the dusty water.

So, they started off. Kane a pua then decided he would come down. And when he came down where his brothers were, he looked up and he saw their retreating backs. They were going away from him. In despair he threw himself face down there, and that is his body there. His spirit went back to Kahiki.

(later continues)

(And the spring?) Yes, came out again, but not as much. But, as people traveled down there and were not as, well, didn't have as much aloha for the water as the native people there who depended on that water for their drinking water. Makai side repeated this washing of soiled underwear there and the water, pau. I worked there myself, and saw the hole, and saw the pan. I saw all that.

And that Kuamo`okane is really the backbone of Kane a pua. The point of land way out at the tip of Kuamo`okane, that point is called Kawaihoa. And it's just inside of Kawaihoa that the water of Kane was. And Kawaihoa means the water of the companions. That's the name of that point way out there.

Learning Traditions of Kona, `O`ahu

(as told by Almeda Goss, int. by: Mary Pukui`i, April 23, 1962

1920's that I was going down there visiting, and the old man at whose shack we lived, old Ku`inahekekeokahekili, he was not a native there, he was from Kaua`i. But the last native was this Makea[1], this old lady who was going blind and wanted me to go with her so she can tell me about these native things. Well, I was in my twenties that's over forty years ago that I was there. Yes, I saw those stones. When this old lady told me, "You come, I want to tell you the stories of this area." She said, "You find somebody that would be willing to drive you and me around." So, I found a person who was willing to drive us around, Jane Winnie; she did the driving, and Makea did the talking. At that time the road did not go on the makai side, it went on the mauka side of the Kamilo`iki and Kamilonui, and those places there, and then out. And this old lady told how the people on the other side of that hill, at Wawamalo, grew sweet potatoes, lots of sweet potatoes. And

[1] Makea Napahi was also an informant for McAllister. She shared information about the Ke-ahu-pua-Maunalua fishpond

how the whaling ships used to stand out. And how her folks went out with canoes taking sweet potatoes out to the whaling ships out there. And she pointed, and said this whole place is Wawamalo. It's on the other side of Pu`ulepelepe, on the Waimanalo side.
(later adds)

Up in Hahaione valley was where they grew their taro. That's, inside, on the upper side of Kuapa pond. There's a spring of water there. I saw the spring there. She (Makea) took me there. And she says, "Here, in here they grew taro, and, fish. And if they were to travel into the Wawamalo side there were sweet potatoes. They had everything there, they did.

Pele's Canoe

(as told by Almeda Goss, int. by: Mary Pukui, April 23, 1962)

Well, at the Davis place, just this side of the Davis Place, was a long stone that went out into the sea, and Jane guessed it to be about 60 feet long. And it was shaped, the bottom like the keel of a canoe, and that old lady (Makea) pointed it to us and said, "Look, see that long stone? This is Pele's canoe. This is when on her migration, whe came and landed on `O`ahu. And that's the keel of her canoe."

It was on this side of Alan Davis' place, somewhere between Makapu`u point and Hanauma. And it was there on a sandy stretch that went down. Started from shore, went right out. And that's the canoe beached. (Can you see it now?)

No more because that big tidal wave that came in '46 that pummeled, and beat down, and just did awful damage to Davis' place broke up the canoe, and carried the canoe away. No canoe there anymore.

Bathing at Oku`u

(as told by Almeda Goss, int. by: Mary Pukui, April 23, 1962)

Where it's rocky and they have the blowhole, and where the rocky section stops and the sand begins, she (Makea) insisted on going in there to bathe. She had an extra mumu inside. She went out there, and she began bathing there. And after she came out I asked her, why is it that you are bathing here? She says, "Oh, my people always did. See that stone in the water?" And she pointed out there - but it's not too easily seen because the water washes over it - she said, "There is a stone named Oku`u, perch, and it gives out a healing influence. So, when people come here and they're not feeling very well they get into that water and bathe. And from Oku`u comes this great healing influence that makes people feel well and happy." So, whenever they travel they go to this place, where the stone of Oku`u was, and `au`au.

Ka Lae `O Koko

(as told by Almeda Goss, int. by: Mary Pukui, April 23, 1962)

Koko Head they call it, is Ka Lae `O Koko, Point of Blood. A long time ago there was a tragic story there.

At Wai`alea lived a chiefly family whose daughter was not reared with them, but with the grandmother in Palolo Valley. And these people were very fond of planting; sugar cane, and bananas, and it was quite work taking care of those things in that warm area, Wai`alea.

Then one day then they were absent, well, before they were leaving home they called to their shark aumakua in the sea, and said to this shark aumakua, "Keep an eye on our place, and if anyone comes in and takes our crops or touch anything, bite and destroy."

So they went and left. They had already given the command, or Kaumoha, to their shark aumakua to destroy, unknowing that their daughter was coming, or that the girl didn't know anything about this. She traveled with some of her friends, and seeing the parent's home, dropped in. Nobody there, so she helped herself to the sugar cane, and started chewing, and going way out there.

And she went into the sea, and she went out there to Ka Lae `O Koko. She went into the sea, where she was bitten, and there she died. And her blood washed ashore, and that's why it's called Ka Lae `O Koko. The point of blood.

When the parents returned, and heard the news of a young girl being bitten by a shark, they asked who she was, and why (she was) there. And they grieved tremendously because they thought they were responsible, and they were, for the death of their daughter.

Death of the Water at Kawaihoa

(as told by Mary Pukui, int. by: Oswald Bushnell, December 16, 1960)

...they would of course not be careless with water otherwise the water would die. And there's known cases of the water dying. There's a water hole. From the side of the hill, I saw the hole. Round hole, as though someone had taken a stick and shoved it in.

It's out there at Maunalua, and was said that the god Kane came there and pushed the cane into the hillside and the water came through there. That's Kane's water, so they treated it with a great deal of respect, and they never, never used it for laundry. Then somebody who came along and didn't think of the Hawaiian respect for that particular water, whereas the Native Hawaiian just used it for drinking purposes only, Kane's water, did some laundry there. And the water, (dried up) pau.

The water pau, so the Hawaiians, they were distressed. A Hawaiian from Maunalua told me this, an old lady, the last of the natives, who was born in Hahaione valley. She told me that the water went out. So, they looked for a girl that was ulapa`a. Ulapa`a is a girl who has not yet menstruated. So, they looked for a girl who was ulapa`a, and they found one that was seven years old, and she carried the offerings down there. And they had a ceremony down there, and the offering of a black pig. And the water came back, not with the same force. Again, somebody washed laundry there. Gone entirely. And the same too was another spring at Punalu`u beach in Ka`u, it dried entirely.

So, the Hawaiians had a great deal of respect for water. It was a gift of gods, Kane made it with his cane, (Where was the waterhole located?)

It is near Kawaihoa point. Some distance mauka of Kawaihoa point. It's pau now. (Is the puka still there?) Puka was there, but the last time I went down there after the Hawaiians were all gone, and 'ducks' were running all over. These mechanical army 'ducks.' I don't mean bird ducks, I mean the gadget 'ducks.' They were just going all over there, raising dust. And the place where they gave offerings of fish, this Ko`a where they brought the fish, where they place their first catch, all gone. Just, oh, the 'ducks' were going all over there, going up and (Worse than Henry Kaiser yeah?) (laughs) For 'improvement.' (laughs) (The Hawaiians leave because the water died?) No, they didn't.

Pronunciation of Hawaiian Vowels

Hawaiian Alphabet

The Hawaiian alphabet consists of only 12 letters -- 5 vowels and 7 consonants:

A -- (ah)
E -- (eh)
I -- (ee)
O -- (oh)
U -- (ooh)

H -- (hay)
K -- (kay)
L -- (lah)
M -- (moo)
N -- (noo)
P -- (pee)
W -- (vay)

Glottal Stop (ʻ - ʻokina)

This occurs between two or more different vowels following each other in the same word and indicates a distinct stop or catch of breath. (Represented by a reverse apostrophe.)

Macrons (kahako)

This indicates that the vowel sound is longer and dragged out.

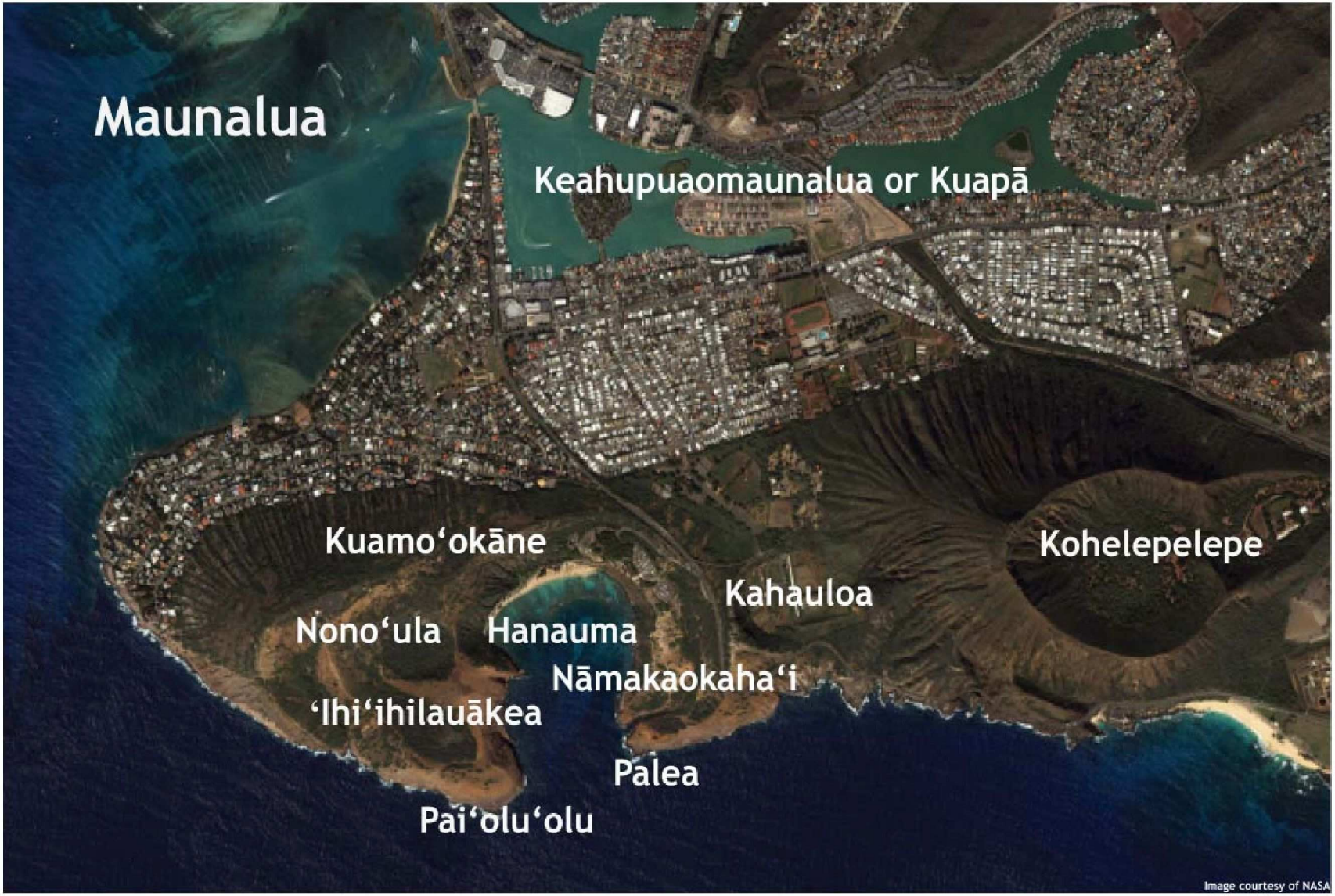
ā	pronounced like **a** in far	ē	pronounced like **a** in play
ī	pronounced like **e** in see	ō	pronounced like **o** in sole
ū	pronounced like **o** in moon		

Vowel Combinations

ae	pronounced like **i** in high	aʻe	pronounced **ah`-eh**
ai	pronounced like **i** in light	aʻi	pronounced **ah`-ih**
ao	pronounced like **ow** in how	aʻo	pronounced **ah`-oh**
au	pronounced like **ou** in ouch	aʻu	pronounced **ah`-ooh**
ea	pronounced **eh`-ya**	eʻa	pronounced **eh`-ah**
ei	pronounced like **a** in ate	eʻi	pronounced **eh`-ih**
eo	pronounced like **ayo** in bayonet	eʻo	pronounced **eh`-oh**
eu	pronounced **eh`-yoo**	eʻu	pronounced **eh`-ooh**
ia	pronounced **ee`-ya**	iʻa	pronounced **ih`-ah**
ie	pronounced like **ye** in yet	iʻe	pronounced **ih`-eh**
io	pronounced like **yo** in yodel	iʻo	pronounced **ih`-oh**
iu	pronounced **ih`-yoo**	iʻu	pronounced **ih`-ooh**
oa	pronounced **oh`-wah**	oʻa	pronounced **oh`-ah**
oe	pronounced **oh`-weh**	oʻe	pronounced **oh`-eh**
oi	pronounced **oh`-wih**	oʻi	pronounced **oh`-ih**
ou	pronounced like **o** in nose	oʻu	pronounced **oh`-ooh**
ua	pronounced **ooh`-wah**	uʻa	pronounced **ooh`-ah**
ue	pronounced **ooh`-weh**	uʻe	pronounced **ooh`-eh**
ui	pronounced **ooh`-wih**	uʻi	pronounced **ooh`-ih**
uo	pronounced **ooh`-woh**	uʻo	pronounced **ooh`-oh**

Nā wahi pana o Hanauma

The place names of Hanauma



Further Reading

Below you will find a list of resources utilized in the development of these materials. Few sources deal specifically with Hanauma Bay and its history. Much information was gathered by investigating general cultural history and practices and then seeking out individuals who could share oral history as well as their personal experiences and memories of Hanauma Bay. Many of these publications are good starting points if you are interested in doing further personal research. Happy hunting!

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Table of Contents: Geology of East Oahu

Geologic Map of O'ahu (modified from Stearns 1959)

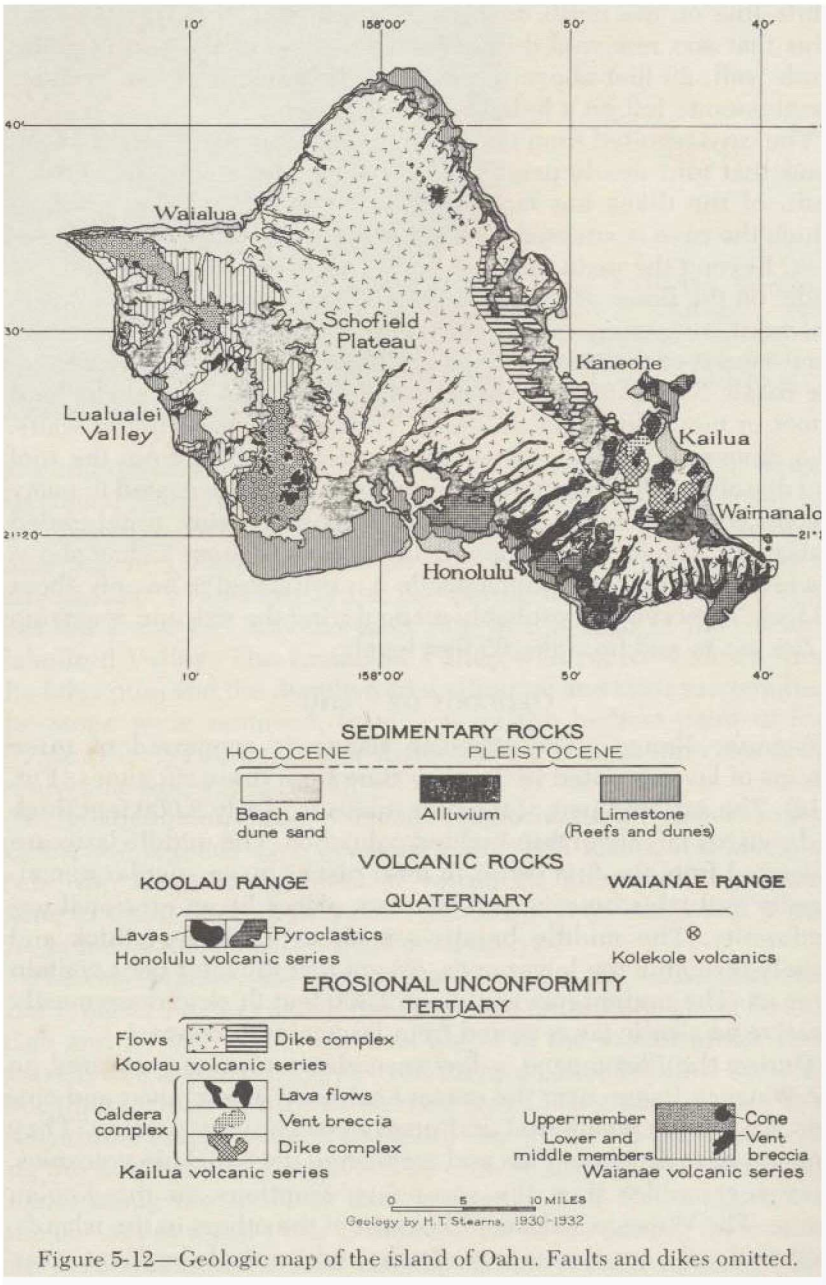


Figure 5-12—Geologic map of the island of Oahu. Faults and dikes omitted.

Geology of Oahu

I. Geologic History

A. Island consists of the tops of two large shield volcanoes: Wai'anae and Ko'olau (~85% of the volcano remains beneath the sea, standing more than 20,000 ft. above the sea floor)

1. Wai'anae Volcano in the west.
    a. Active ~3.9-2.8 million years ago.
    b. Went through shield and post-shield stages of volcanism
2. Ko'olau Volcano in the east. (Today, makes up eastern 2/3 of island)
    a. Active 2.7-1.8 million years ago.
    b. Went through only the shield stage of volcanism.
    c. Flows from the Ko'olau filled the ocean between the two volcanoes, joining the two as Schofield Plateau.
3. Shield-shaped cones formed by thousands of highly fluid, basaltic flows
4. Prominent rift zones formed. Dikes are nearly vertical and trend parallel to rift zone.
5. Headwall erosion of streams carved out great valleys (e.g. Nanakuli, Lualualei, Wai'anae, Makaha, and Kea'au in Waianae).

B. Giant submarine landslides

1. Since the extinction of the Ko'olau, the northeast side of the volcano has collapsed into the sea (the Nu'uanu-Wailau giant marine landslide)
2. The Pali is the eroded fault scarp of this giant landslide

C. Great submergence followed rather rapidly by partial re-emergence

1. Old shorelines are well preserved in emerged reefs and beach deposits
2. Major limestone deposits (old coral reefs) are found up to 7.5 m above present-day sea level in places like the Ewa Plains and in Honolulu.
3. Deposited during what is called the Waimanalo stand of the sea.
4. Great valleys were drowned, producing subsequent sedimentation and flat valley floors (e.g. Kawainui Marsh).

D. Volcanism renewed on Ko'olau (known as "rejuvenation" stage volcanism)

1. Approximately half a million years ago, monogenetic (only one eruptive episode) vents began appearing on the Ko'olau as craters, cones, and lava flows
2. More than 30 vents identified and collectively called the Honolulu Volcanic Group.

3. Some vents were explosive because either seawater or groundwater came into contact with the rising magma.
4. The youngest eruptions formed a line of craters known as the Koko Fissure.

II. Honolulu Volcanic Group—the Koko Fissure

A. Northeastward order of vents:

1. Koko Head (double vents: 'ihi'ihilauakea (makai) & Nono'ula (mauka))
2. Hanauma Bay (complex series of vents)
3. Kahauloa (Rifle Range)
4. Koko Crater (double)
5. Kalama
6. Kaupo
7. Kaohikaipu Island
8. Manana (Rabbit Island)
9. Submarine ridge extends 5 km southward, so series continued beneath the sea

B. Possible eruptive sequence and composition

1. Manana	tuff cone
2. Koko Crater	tuff cone
3. Kahauloa	tuff cone w/ lava flows
4. Hanauma	tuff ring, tuff cone(s) w/ lava flows
5. Koko Head	tuff cone w/ lava flows
6. Kalama	cinder cone w/ lava flow
7. Kaohikaipu	cinder cone w/ lava flow
8. Kaupo	spatter cone w/ lava flow

C. Evidence of explosive nature

1. tuff rings and tuff cones comprise of thousands of layers of consolidated ash (now palagonized)
2. Pieces of the old Koolau basalt and pieces of the coral reef (limestone) were torn up during the explosion and are preserved in the tuff
3. These phreatomagmatic or hydromagmatic explosions due to rising magma's interaction with seawater (water was flashed to steam)
4. Projectiles (pieces of basalt and limestone) landed in hot, soft ash to produce impact sags (or bomb sags)

III. Geology of Hanauma Bay

A. Outer crater wall breached by ocean ~10,000 years ago (or may not have completely formed)

B. Oldest coral in Hanauma ~7,000 years old.

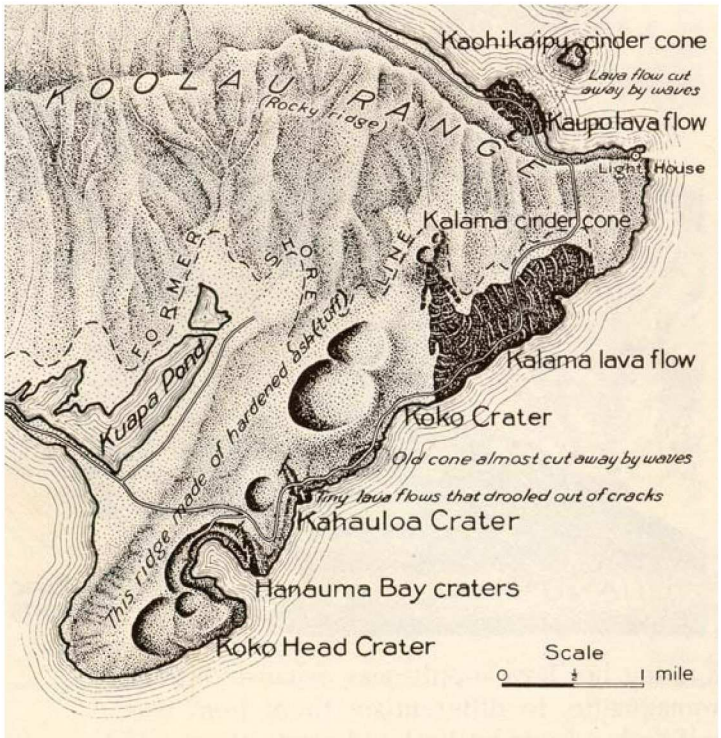
1. From 5,800-3,500 years ago, coral mainly grew upwards at ~0.3 cm/year average.
2. From 3,500 to the present, coral grew seawards.

C. Coastal benches

1. 3.6 m down to sea level
2. Recent studies indicate position and slope of bench seemed to be governed by level of water saturation of tuff
3. Heavy surf along more exposed parts of coast keeps rock face saturated.
4. Water-saturated tuff more resistant to erosion than unsaturated tuff above.
5. Latter is more rapidly cut away, especially by heat of sun, leaving behind the bench
6. Surface of bench pitted by "wager-level weathering" (loosening of grains in tuff by alternate wetting and drying around edges of water-filled hollows)

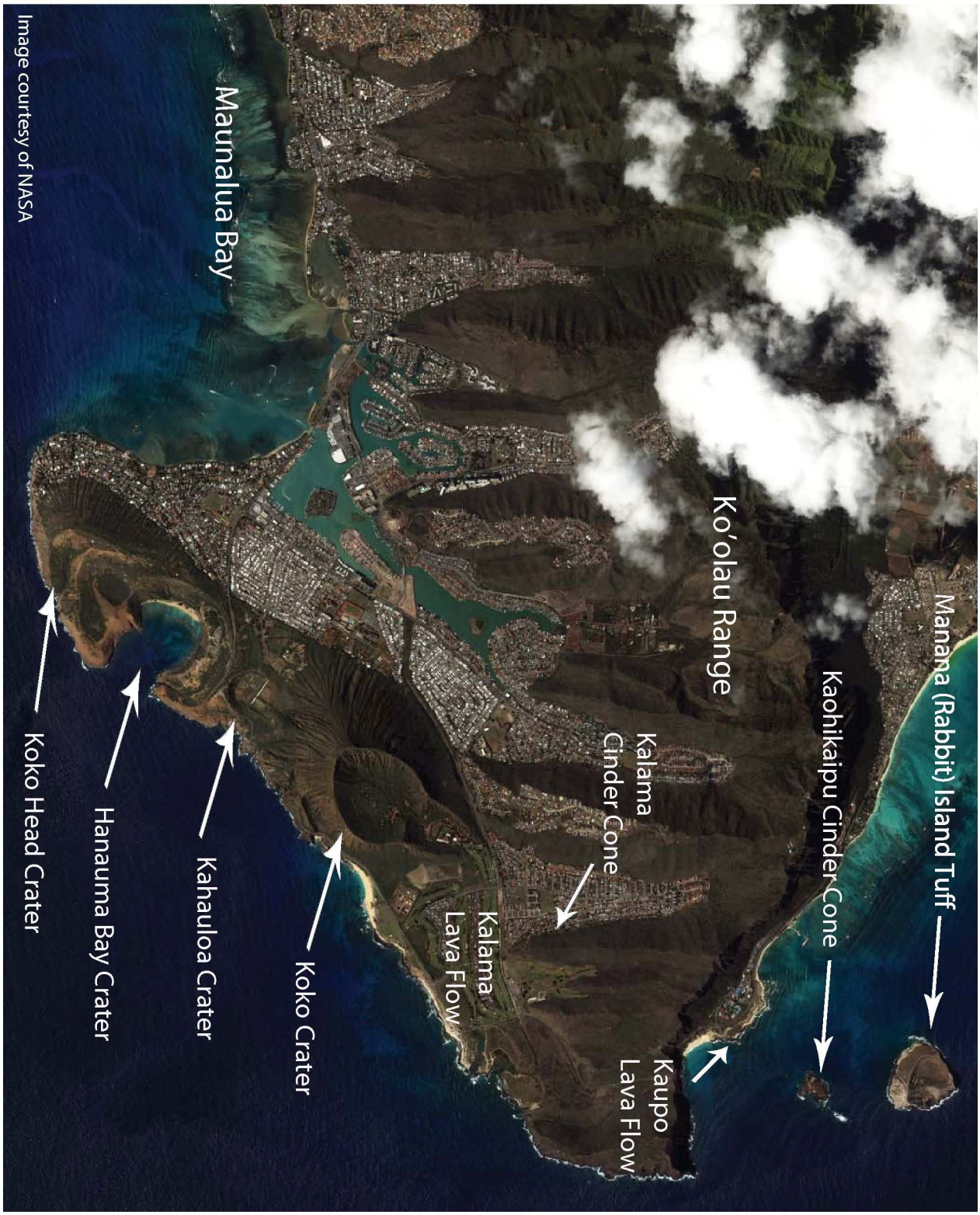
D. Three lava flows in Hanauma Bay

1. Witch's Brew end of beach (covered by vegetation)
2. Middle of Toilet Bowl Ledge (where you have to climb through the rocks)
3. In Toilet Bowl gully



Map of the Koko Fissure

(from Stearns 1939)


Manana (Rabbit) Island Tuff
Kaohikaipu Cinder Cone
Kaupo Lava Flow
Ko'olau Range
Kalama Cinder Cone
Kalama Lava Flow
Koko Crater
Kahauloa Crater
Hanauma Bay Crater
Koko Head Crater
Maunalua Bay
Image courtesy of NASA

Glossary of Geologic Terms

aa - Lava with a very rough, spiny, or rubbly surface - more viscous - clinkery surface

ash/tuff cones/rings - formed subaerially and/or in shallow water. Result from "wet" or phreatomagmatic eruptions (i.e. due to mixing of ascending magma with ground or surface water). Differences between tuff rings and tuff cones are controlled mainly by the magma/water ratio, the degree of magma/water mixing, and the depth of fragmentation (i.e. where the explosions occur with depth).

bomb - volcanic ejecta larger than 4 centimeters in diameter

cinder & spatter cones - cinders fall close around vent, building a steep, conical cone with a relatively small crater - liquid lava torn into irregular gobs and shreds by expanding gases fall back to the ground to build a heap of fragments around vent - many flatten out or splash when they hit, forming spatter

crater - a bowl-shaped pit at the summit of most volcanoes, around the central vent

chemical weathering - the set of all chemical reactions that can act on rock exposed to water and the atmosphere and so dissolve the minerals or change them to more stable forms

dike - a tabular igneous intrusion that cuts across structures of surrounding rocks

geology - the science of Earth - how it originated, how it evolved, how it works, and how human intervention can effect it

igneous rocks - a rock formed by the solidification of magma

lapili - water droplets coagulate (perhaps passing as clouds as well), surrounding ash and other micro-sized particles dispersed in the air. Ash cements itself together as water evaporates leaving behind bead sized masses, usually dark grey/black in the center and white on the outside. Preserved in sedimentary layers along with bombs, etc.

limestone - a sedimentary rock composed mainly of calcium carbonate ($CaCO_3$, ex. what much of the reef is made of), usually as the mineral calcite

lava - magma that has reached the surface

magma - molten rock material that forms igneous rocks upon cooling

mineral - a naturally occuring, inorganic, crystalline solid with a specific chemical composition. Minerals are the building blocks of rocks, which can be made up of varying assemblages of minerals

olivine - high temperature mineral that is the first to form out of basaltic magma, $(MgFe)_2SiO_4$. It is a tiny green crystal found in the sand at the leeward side of the bay and at the toilet bowl

pahoehoe - lava with a smooth, billowy, or ropy surface - more fluid, often shiny

palagonite - a brown, waxy, or earthy appearing substance formed by water descending through and cementing ash

pyroclast - fragment of volcanic material ejected during an eruption

sedimentary rocks - rocks formed by the accumulation and cementation of mineral grains by wind, water, or ice transportation to the site of deposition or by chemical precipitation at the site

tuff - formed when eruptions near seashore are moderately explosive due to abundant steam formed when hot magma encounters either sea water or water in pores of rocks close to surface - hydromagmatic because they involve both molten magma and water - rapidly expanding steam blows much of the magma apart, forming a spray of tiny fragments and droplets which harden in the air to particles of glassy ash, largely of sand or dust size - ash soon becomes cemented together into tuff. Large fragments (called bombs) striking unhardened ash may push down layers beneath them forming bomb sags.

tuff cones - characterized by higher profiles than tuff rings and have steeper external slopes with bedding dips greater than 25. Their crater floors are generally above the land surface.

tuff rings - commonly less than 50 m high. Defined by shallow craters and bedding dips less than 25. Tuff rings result from more intense explosions.

volcanic ash - a volcanic sediment of rock fragments, usually glass, less than 2 mm in diameter, that is formed when escaping gases force out a fine spray of magma

Table 5
(Geology of the State of Hawaii by Harold T. Stearns - 2nd Edition)

Ages in Millions of Years of Hawaiian Volcanoes

Island	*Island Volcano*	*Range of K-Ar Ages (millions of years)*
Midway Atoll	.....	27.0[a]
La Perouse Pinnacle	(French Frigate Shoals)	11.7[a]
Necker Island	.....	10.0[a]
Nihoa Island	.....	7.0[a]
Kauai Island	.....	5.6-3.8[b]
Niihau Isand	Paniau	3.0[c]
West Oahu	Waianae Range	3.4-2.7[b]
East Oahu	Koolau Range	2.5-2.2[b]
West Molokai	.....	1.8[b]
East Molokai	.....	1.5-1.3[b]
Lanai Island	.....	1.25[d]
West Maui	Wailuku Mountains	1.3-1.15[b]
East Maui	Haleakala	0.8[b]
Hawaii	Kohala Mountain	0.68[e]
	Pololu volcanic series	0.4[f]
	Hawi volcanic series	0.25-0.06[f]
Hawaii	Puu Waawaa	0.4[f]
Hawaii	Ninole volcanic series:	
	Mauna Loa	less than 0.5[g]
Hawaii	Laupahoehoe, Mauna Kea	0.6[h]

[a]Dalyrymple *et al.*[38]
[b]McDougall[125]
[c]Jackson *et al.*[84]
[d]Bonhommet et al.[20]
[e]Dalrymple[37]
[f]McDaougall and Swanson[129]
[g]Two sets made by Evernden *et al.*[57]
[h]Funkhouser *et al.*[64]

Further Reading

Below you will find a list of resources utilized in the development of these materials. Other publications of interest have been included to assist you in further independent study.

Bryan, W.B. and R.S. Stephens. *Coastal Bench Formation at Hanauma Bay, Oahu, Hawaii.* Geological Society of America. Bulletin, v. 105, pp.377-386.

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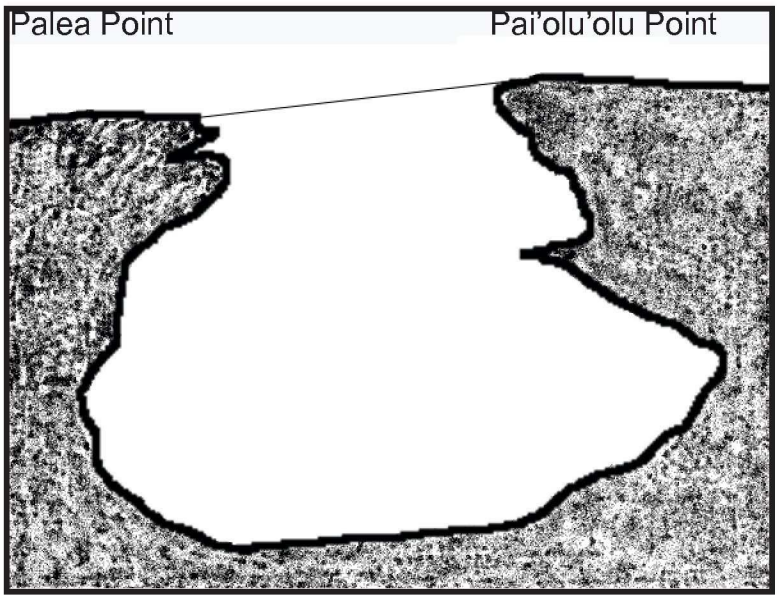
Table of Contents: Reef Ecology

Hanauma Bay Marine Life Conservation District

The **Hanauma Bay Marine Life Conservation District (MLCD)** was established in 1967 and encompasses 101 acres, extending from the high water mark seaward to a line across the mouth of the Bay from Palea Point (to the north) to Pai`olu`olu Point (to the south).

See diagram to the right ⇨



Hanauma Bay was the first of ten sites in Hawai`i to be designated as an MLCD, the others are listed below:

- **Pupukea** - north shore of O`ahu, 25 acres, est. 1983
- **Waikiki** - O`ahu, 76 acres, est. 1988
- **Kealakekua Bay** - near Captain Cook, Hawai`i, 315 acres, est. 1969
- **Lapakahi** - northwestern coast of Hawai`i, 146 acres, est. 1979
- **Waialea Bay** - western coast of Hawai`i, 35 acres, est. 1985
- **Old Kona Airport** - near Kailua-Kona, Hawai`i, 217 acres, est.1992
- **Manele-Hulopoe** - south shore of Lana`i, 309 acres, est. 1976
- **Molokini Shoal** - off Maui's southwestern coast, 77 acres, est. 1977
- **Honolua-Mokuleia Bay** - northwestern coast of Maui, 45 acres, est. 1978
- **Waiopae Tidepools** - southeastern coast of Hawaii, est. 2003

The Hawai`i State Department of Land and Natural Resources is responsible for establishing the regulations for each MLCD in Hawai`i. Regulations vary somewhat, but generally prohibit the taking of any type of living material or non-living habitat material.

At Hanauma Bay, prohibited activities include:

☒ fishing for, taking, or injuring any marine life (including eggs and shells)
☒ possessing any type of fishing gear
☒ introducing any food or other substance to feed or attract marine life
☒ taking or altering sand, coral, or other geological features
☒ possessing any equipment that may be used to collect or alter any geological fea tures
☒ boating.

The information on the following two pages is taken form the Department of Land and Natural Resources, Division of Aquatic Resources website. For more information, please visit **www.state.hi.us/dlnr/dar** *or contact them at:* Division of Aquatic Resources, 1151 Punchbowl Street, Room 330, Honolulu, HI 96813. Phone: (808)587-0100 Fax: (808)587-0115

The Administrative Rules Process

The Administrative Rules process enables DLNR to establish policies pertaining to the state's aquatic and other natural resources. The process begins with identification of an issue that needs to be addressed through resource management policy. This may be the result of a resolution passed by the state legislature. The process can also be started by the public. Individual calls to the department, petitions, calls from legislators on behalf of constituents, and requests from community groups are some of the actions that can begin creation of new rules for the purpose of sustaining our natural resources.

Once DLNR receives a request for new rules or changes to existing rules, the request is passed on to the appropriate division head for evaluation by staff. If the division agrees the proposal has merit, it will hold one or more public meetings to discuss it before drafting rules. The draft form of the new rule is reviewed by the department and various boards and commissions. Based on input received throughout the process, a draft of the rule is sent to the Attorney General's office for approval "as to form." The Board of Land and Natural Resources then gives approval to the division to conduct a public hearing on the proposed rule.

The public hearing occurs after a minimum 30 days notice. Persons unable to attend the hearing, or who wish to make comments after the hearing, may provide the department with written testimony for 10 to 15 days following the hearing. Based on this additional public input, the division prepares a final draft of the rule, which is also sent to the Attorney General's office for approval.

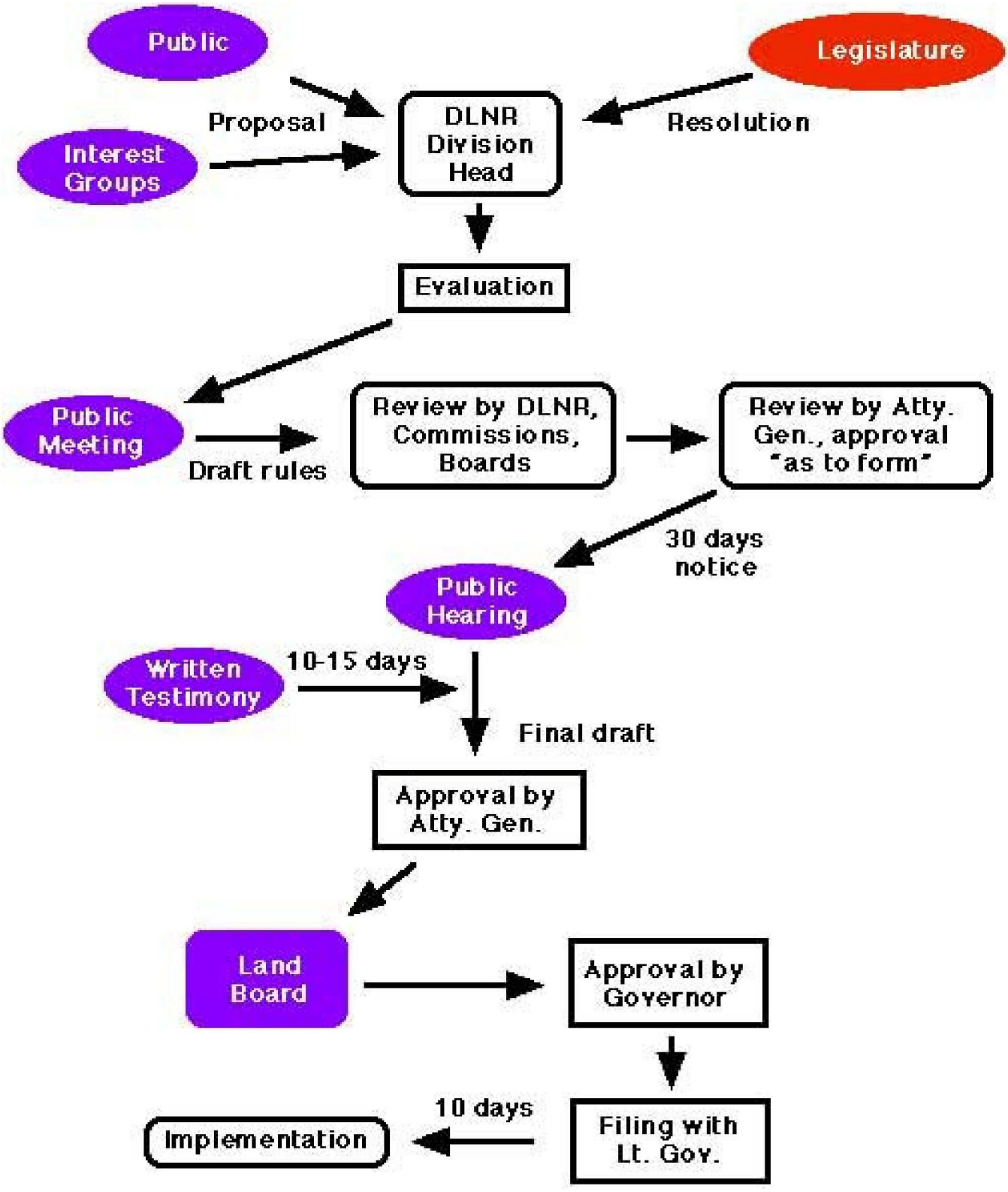
The final draft is then presented to the Land Board for approval. The public has one last opportunity to offer testimony related to the proposed rule. If the rule is approved by the Board, it is sent to the Governor's office for approval, then filed with the Lieutenant Governors office. 10 days after filing, the rule goes into effect.

The Division of Aquatic Resources' approach to policy making has changed during the past few years. More of an effort is now being made to get the public involved earlier in the process of drafting rules. In certain cases, this involves the establishment of working groups or task forces made up of representatives of various user groups and other concerned parties.

DAR is presently involved with groups on Kauai to establish new policies for akule fishing on that island. We are also working with the West Hawaii Fisheries Council on proposed amendments to rules for the West Hawaii Fishery Management Area. A gill net task force is in the process of finalizing new rules for use of gill nets. The is considering revisions to rules managing the Pupukea Marine Life Conservation District (MLCD).

Administrative rules currently under consideration, and for which public hearings have been scheduled, include proposed amendments to rules for Manele-Hulopoe MLCD and Manele Harbor on Lanai, and to rules establishing fees for aqualculture dealer licenses.

The administrative rules process is summarized in the following graphic. Purple shapes represent opportunities for public participation in the process.



HAWAII ADMINISTRATIVE RULES

TITLE 13

DEPARTMENT OF LAND AND NATURAL RESOURCES

SUBTITLE 4 FISHERIES

PART 1 MARINE LIFE CONSERVATION DISTRICTS

CHAPTER 28

HANAUMA BAY MARINE LIFE CONSERVATION DISTRICT, OAHU

Historical Note: Chapter 28 of Title 13 is based substantially upon Regulation 32 of the Division of Fish and Game, Department of Land and Natural Resources, State of Hawaii. [Eff. 10/23/67; R 5/26/81]

§13-28-1 Boundaries. The Hanauma Bay Marine Life Conservation District shall include that portion of the submerged lands and overlying waters of Hanauma bay beginning at the highwater mark at the shoreline and those lands described in the survey description entitled "Hanauma Bay Marine Life Conservation District, situated in the offshore waters of Maunalua, Honolulu, Oahu, Hawaii" and as identified as C.S.F. No. 15,309, dated August 16, 1967, on file with the departments of land services, and delineated in "Map of the Hanauma Bay Marine Life Conservation District, Oahu 8/16/67" attached at the end of this chapter. [Eff: 5/26/81; comp 4/15/99] (Auth: HRS §190-3) (Imp: HRS §§190-1, 190-2, 190-3)

§13-28-1.1 Definitions. As used in this chapter, unless otherwise provided:

"Hook-and-line" means a type of fishing gear consisting of a length of fishing line, to which is

and natural resources, and accounting and general attached one or more hooks or other device for capturing marine life. The gear is designed to be used by one person at a time but one person may use more than one such gear at a time.

"Knife" means a cutting instrument consisting of a sharpened blade with a handle.

"Net" means any of various fishing devices of mesh material made into various shapes, such as but not limited to, a bag, sack, pouch, or curtain, used to entangle, surround, or concentrate aquatic

life.

"Spear" means a type of fishing gear consisting of a straight, rigid, length of wood, fiberglass, metal or other such natural or composite material with one end sharpened into a point or points for impaling aquatic life. One person may propel the gear using arm strength, elastic, compressed gas, or other propellant.

"Take" means to fish for, catch, or harvest, or to attempt to fish for, catch, or harvest, aquatic life. The use of any gear, equipment, tool, or any means to
fish for, catch, capture, or harvest, or to attempt to fish for, catch, capture, or harvest, aquatic life by any person who is in the water, or in a vessel on the water, or on or about the shore where aquatic life can
be fished for, caught, or harvested, shall be construed as fishing.

"Trap" means any of various fishing devices of mesh, perforated, or solid material made into the shape of a box, container, or enclosure, with one or more openings that allow aquatic life to enter into the interior of the box, container, or enclosure, but restrict exit out, thereby capturing the aquatic life within. [Eff and comp: 4/15/99] (Auth: HRS §187A-5) (Imp: HRS §187A-5)

§13-28-2 Prohibited activities. Except as may be otherwise allowed, no person shall engage in the following activities in the Hanauma Bay Marine Life Conservation District:

(1) Fish for, catch, take, injure, kill, possess, or remove any finfish, crustacean, mollusk including sea shell and opihi, live coral, algae or limu, or other marine life, or eggs thereof;

(2) Take, alter, deface, destroy, possess, or remove any sand, coral, rock, or other geological feature, or specimen;

(3) Have or possess any fishing gear or device, including but not limited to any hook-and-line, rod, reel, spear, trap, net, crowbar, or other device, or noxious chemical that may be used for the taking, injuring, or killing of marine life, or the altering of geological feature or specimen, the possession of which shall be considered prima facie evidence in violation of this rule; or

(4) Introduce any food, substance, or chemical into the water, to feed or attract marine life. [Eff: 5/26/ 81; am and comp 4/15/99] (Auth: HRS §§190-3, 190-4.5) (Imp: HRS §§190-1, 190-3, 190-4.5)

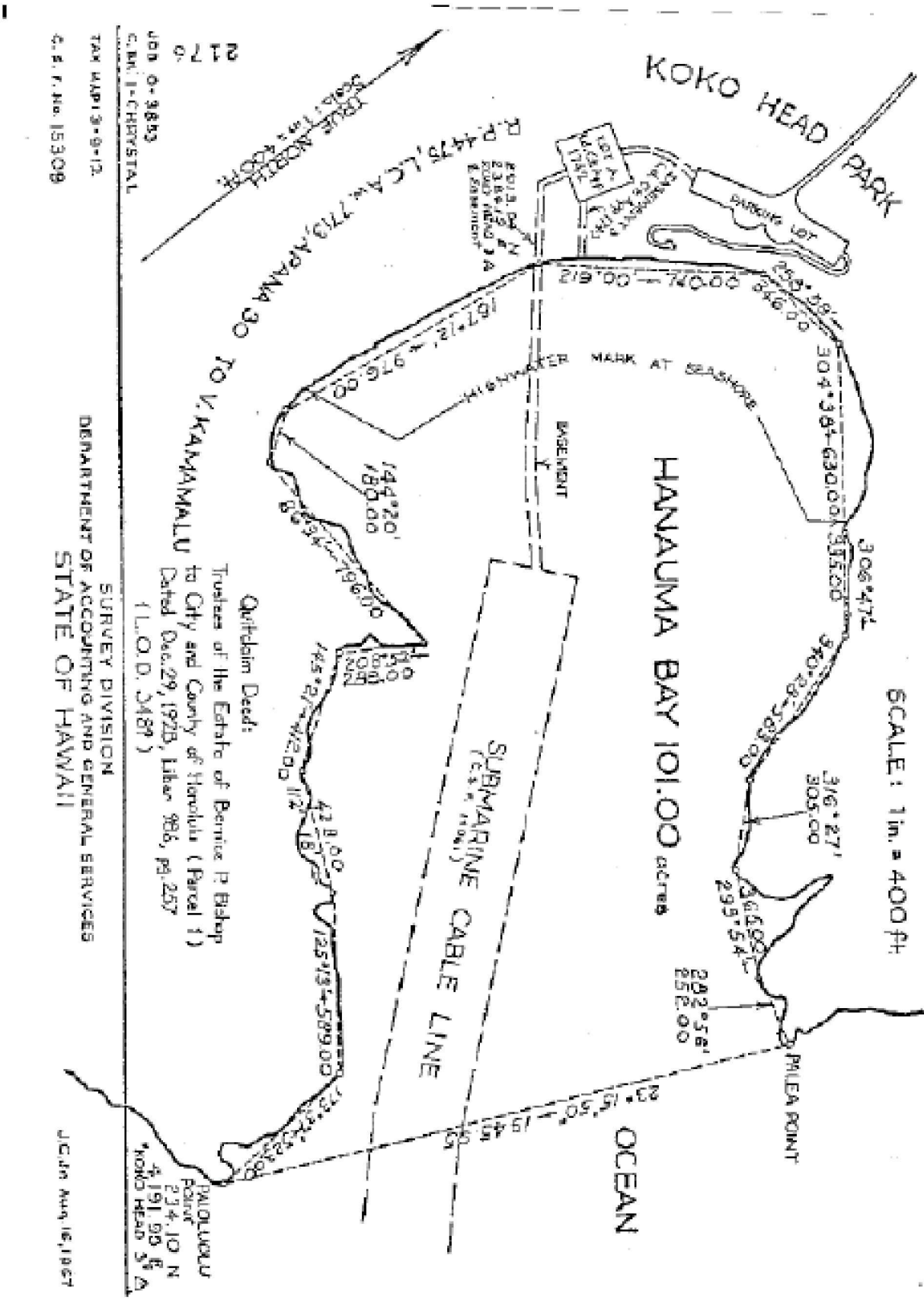
§13-28-3 Permitted activities. A person may possess in the water a knife for the sole purpose of personal safety. [Eff: 5/26/81; am and comp 4/15/99] (Auth: HRS §190-3) (Imp: HRS §§190-1, 190-3)

§13-28-4 Exceptions; permits. The department may issue permits to engage in activities otherwise prohibited by law and section 13-28-2 for scientific, propagation, or other purposes in accordance with chapter 190 and section 187A-6, Hawaii Revised Statutes, provided that:

(1) The board may impose terms and conditions it deems necessary to carry out the purpose of chapter 190, Hawaii Revised Statutes;

(2) The board may revoke any permit for any infraction of the terms and conditions of the permit; and

(3) A person whose permit was revoked shall not be eligible to apply for another permit until one year after the date of revocation. [Eff: 5/26/81; am 3/2/87; am and comp 4/15/99](Auth: HRS §190-3) (Imp: HRS §§187A-6, 190-4)


MAP OF THE HANAUMA BAY MARINE LIFE CONSERVATION DISTRICT, OAHU 8/16/67
SCALE: 1 in. = 400 ft.
KOKO HEAD PARK
HANAUMA BAY 101.00 acres
OCEAN
SUBMARINE (TEL. & TEL.) CABLE LINE
HIGH WATER MARK AT SEASHORE
BASEMENT
PALEA POINT
PALOLUMALU POINT
KOKO HEAD
TO V. KAMAMALU
Quitclaim Deed:
Trustees of the Estate of Bernice P Bishop
to City and County of Honolulu (Parcel 1)
Dated Dec. 29, 1928, Liber 986, pg. 257
(L.O.D. 3489)
SURVEY DIVISION
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
STATE OF HAWAII
TAX MAP: 3-9-12
C.S.F. No. 15309
JOB 0-3853
C.M. I-CHRYSTAL
J.C.Jr. Aug. 16, 1967

Coral Laws of Hawaii

State law prohibits the intentional taking of, breaking or damaging, with crowbar, chisel or any other implement, any live stony coral from the waters of Hawaii, including any live reef or mushroom coral. HRS 188-68

It is unlawful to intentionally take, break or damage, with crowbar, chisel or any other implement, any rock or coral to which marine life of any type is visibly attached or affixed. HRS 188-68

The taking of sand, coral rubble or other marine deposits is permitted in certain circumstances. The material may not exceed one gallon per person per day, and may be taken only for personal, noncommercial purposes. HRS 171-58.5, 205A-44

The sale of the following eight species of stony corals is prohibited in Hawaii:

- Rose or Cauliflower Coral (*Pocillopora meandrina*)
- Lace Coral (*Pocillopora damicornis*)
- Giant Finger Coral (*Pocillopora eydouxi*),
- Yellow-lobed Coral (*Porites lobata*)
- Finger Coral (*Porites compressa*)
- Bracket Coral (*Montipora verrucosa*)
- Mushroom or Razor Coral (*Fungia scutaria*)
- Orange or Cup Coral (*Tubastraea coccinea*)

Penalties

Most violations are subject to a fine of up the $500 and/or thirty days in jail, plus up to $100 per specimen taken illegally (first conviction).

Introduction to Hawaiian Coral Reefs

To understand coral reefs in Hawaii, one must first look at plate tectonics. More specifically, one should look at hotspot island formation. New ocean floor is formed at the oceanic ridges. As the ocean floor moves away from the ridges and toward the subduction zones, the once-molten ocean floor cools, settles, and compresses. The result is that the ocean is shallowest along the ridges and deepest along the subduction zones.

Hawaii lies on the pacific plate. This conveyor belt-like plate moves in a northwesterly direction. Hotspots are places along the ocean floor where molten magma melts through the plate and forms oceanic islands. They are thought to remain stationary as the plate moves overhead. Islands are formed, and then, in the Hawaiian example, move northwest off the hotspot. Subsequently, a new island is formed over the hotspot, then moves with the plate. As the islands move with the plate toward the subduction zones (where oceanic plates slip beneath the continental plates), they slowly subside (sink) and erode.

Charles Darwin combined his belief that islands sank, with what he knew about corals and came up with the theory of atoll formation. The island is formed, corals grow along the edges forming a fringing reef. As the island sinks and erodes, the corals continue to grow toward the surface and toward sunlight. A barrier reef is formed. In oceanic islands with barrier reefs one typically sees a circular reef surrounding a lagoon which in turn surrounds a high island. Eventually the high island erodes and subsides below the surface of the ocean, leaving only a reef. This is then called an atoll.

Looking at the Hawaiian archipelago, the youngest island is the southeast-most island and the oldest islands are atolls on the northwest end of the chain. The latitude at which the water is too cold for the coral growth to keep up with subsidence is called the Darwin Point.

What are reef-building corals? Reef building corals are in the phylum Cnidaria. Included in this phylum are aquatic organisms that have one major common feature, the presence of stinging cells called cnidae. Two examples of other organisms in this group that are periodically found in Hanauma Bay are: Portuguese man-of-war (Physalia) and box jellyfish (Cubomedusae).

Reef-building corals are colonial organisms that have a symbiotic or mutualistic (both parties benefit) relationship with a single-celled, plant-like organism called zooxanthellae. The zooxanthellae are housed in a thin layer of flesh which covers the calcium carbonate ($CaCO_3$) skeleton. The zooxanthellae produce food through photosynthesis. The excess food produced by the zooxanthellae is used by the coral animal. The coral produces waste which in turn is used by the zooxanthellae in growth and photosynthesis. Because this system is driven by sunlight, clear water tends to be better for coral growth.

Each individual within the coral colony is called a polyp. In addition to a $CaCO_3$ skeleton, corals have a hydrostatic skeleton. This means that they can adjust the amount of water in their flesh to extend or retract their stinging tentacles. These tentacles are arranged in a ring around its mouth. Below the mouth lie the gonads, the digestive organs, and the mesentary filaments. Individuals share nutrients with their colony neighbors.

Corals reproduce both sexually and asexually. Asexually, they reproduce by methods

called binary fission, fragmentation, parthenogenic brooding, and budding. Binary fission is when one polyp splits to form two polyps. Fragmentation is when a piece of the colony breaks off, survives and forms a new colony. Parthenogenic brooding describes a process by which unfertilized eggs develop into swimming planula larvae. Certain environmental cues, such as a full or new moon, trigger the release of these larvae into the water column. These larvae, if lucky, eventually settle and form viable adult coral polyps. Budding occurs when a polyp "buds" off the adult like a mushroom out of a log. This bud falls off the adult and eventually forms another adult (colony or solitary).

Corals utilize at least two different modes of sexual reproduction: broadcast spawning and brooding. Broadcast spawning is when each sex ejects their gametes (sex cells) into the water column to mix and fertilize. During brooding, the eggs are fertilized within the female. The female holds onto the larvae until it receives certain environmental cues, then releases great numbers of swimming planula larvae into the water column. The advantages of sexual reproduction include increased dispersion of the new colonies and genetic variation.

The planula larvae will settle if it finds something hard on which to settle. This hard substratum must be in relatively shallow, warm water. If the polyp fails to find a suitable place to settle within a critical time period, it will die.

If it does, it will start to transform from a swimming amoeba-like larva to a sessile (attached to the bottom) organism. It will start to lay down a $CaCO_3$ cup or calyx. This early coral polyp is called a coralite. Through binary fission, this individual will eventually form a colony. Many of these colonies will form a major portion of the reef.

Coralline algae are very calcareous red algae which act as cement on the reef. They hold together dead coral, coral rubble, sand, rocks, and lays down its own CaCO3 to form the other major portion of the reef. The majority of Hanauma Bay's reef flat consists of this coralline algae conglomorate. Many believe that "coral reef" is a misnomer and call it either a "biotic" reef or a "coralgal" reef, giving life forms other than coral their due credit.

The coral reef forms a three dimensional structure on substrate that would otherwise be bland and featureless. This provides places for organisms to find both shelter and food, supporting greater biomass and biodiversity.

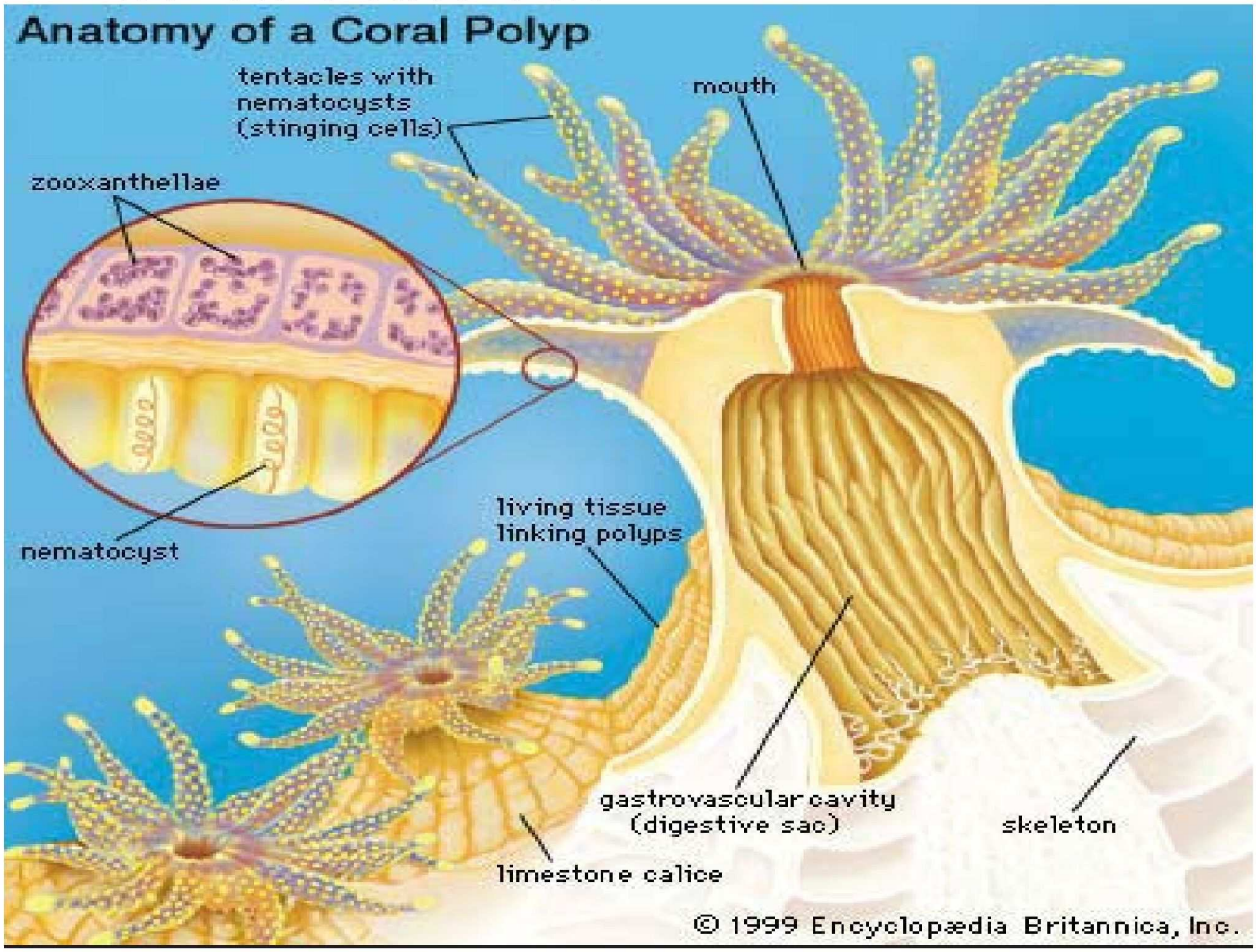
How does it all fit together? It fits together in a diagram commonly referred to as the food web. The primary producers convert the sun's energy to organic matter (food). The primary producers include: corals (zooxanthellae), macroalgae (limu), and microalgae (including phytoplankton). The herbivores eat the primary producers, and the carnivores/predatores eat the herbivores and other carnivores. It is more complex than was just explained, nonetheless, this is the basic structure.

Coral Reef Ecology
- The reef is alive!
- Corals build reefs
- Conditions corals need to survive
- Coral reefs provide food and shelter
- Coral reefs benefit us
- Threats to coral reefs

Hawai'i's Reef Ecosystems are Special and Unique
- Hawai'i's living reef ecosystem, sometimes referred to as the "rainforest" of the sea, has more than 7,000 known species of marine plants and animals.
- Hawai'i's coral reef ecosystem, because of its isolation, has more than 1,250 unique species of marine life that can be found only on Hawai'i's reefs.
- About 25% of all marine life is endemic to Hawai'i.

CNIDARIANS: Anemones, Zoanthids , Corals, Jellyfish

Coral animal & Zooxanthellae:
- Zooxanthellae – microscopic algae living inside coral animal
- Symbiotic relationship: photosynthesis-use the sun's energy to make food
- Zooxanthellae - Give corals their color



Source: The Incredible Coral Reef by Toni Albert. Trickle Creek Books, 500 Andersontown Road, Mechanicsburg, Pennsylvania 17055 Tel: 1-800-353-2791.

THE IMPORTANCE OF THE CORAL REEF

Directions: Read the sentences below. Which do you think states the most important reason for protecting coral reefs? Put an X next to the one you choose. Then find out what your choice says about you.

WHAT IS THE MOST IMPORTANT REASON FOR PROTECTING CORAL REEFS?

_____ 1. The coral reef is a special place with an incredible diversity of animal life. It is home to many endangered and threatened species of marine wildlife.

_____ 2. The coral reef attracts visitors from all over the world who like diving, boating, fishing, and exploring nature. Tourist dollars support many local businesses and are often crucial to local economies.

_____ 3. As our world population continues to grow, we look to the oceans as an important source of food. Many edible marine species depend on healthy coral reefs for breeding and nurs ery grounds in order to survive.

_____ 4. Scientists are discovering how to make new agricultural, industrial, and medical products from marine organisms. The coral reef has yielded new medicines, foods, fertilizers, and emulsifiers used in industry.

_____ 5. When thriving coral reefs become distressed, it is a warning sign that something is criti cally wrong -- something that will ultimately affect our own survival too. It alerts us to examine what we are doing to our air, water, and earth.

_____ 6. Reefs help protect tropical shores from erosion. Waves caused by tropical storms are weakened as they break on the reefs before reaching the shore.

(continued from previous page)

WHAT DOES YOUR CHOICE SAY ABOUT YOU?

1. If you chose the first reason, you are a nature lover. You know more about animals and plants than most of your friends do. You could help protect coral reefs by sharing what you know.

2. If you chose the second reason, you have a good mind for business. You could help protect coral reefs by raising funds for an environmental organization.

3. If you chose the third reason, you care about the basic needs of people. You could help protect coral reefs by writing letters to politicians and businessmen who make decisions that affect people's lives.

4. If you chose the fourth reason, you are a person who values science and technology. You could help protect reefs by coming up with a new idea for letting people know reefs are threatened.

5. If you chose the fifth reason, you "think big" and accept responsibility for actively caring for the earth. You could help protect coral reefs by taking practical steps in your own life, such as conserving resources and recycling.

6. If you chose the sixth reason, you are a practical person who respects the order and balance of nature. You could help others understand why coral reefs are important in the world.

(answers for pg. 85)

ANSWERS: **1.** N, **2.** H, **3.** H, **4.** N, **5.** H, **6.** H, **7.** N, **8.** H, **9.** H, **10.** N, **11.** H

Source: The Incredible Coral Reef by Toni Albert. Trickle Creek Books, 500 Andersontown Road, Mechanicsburg, Pennsylvania 17055 Tel: 1-800-353-2791.

THREATS TO THE CORAL REEF

Coral reefs have existed for millions of years. They have survived countless large and small changes in the environment. But today, coral reefs around the world are threatened as never before. Reefs in at least twenty countries, including the United States, Mexico, Indonesia, Japan, and Australia, are showing signs of stress and distress. Coral reefs in Florida are disappearing at an alarming rate. Coral diseases and coral bleaching occur when the water off Florida is no longer clear and clean, or when the water temperatures rise. In Hawaii, beautiful coral reefs have been damaged or killed by sewage pollution, dumped waste, or dredged mud. Many scientists agree that if the trend continues for another twenty or thirty years, there may not be any healthy coral reefs left on earth.

Directions: Read below about threats to coral reefs. Put an **N** next to the natural threats (caused by nature) and and **H** next to the human threats (caused by people). Which do you think are more dangerous to coral reefs -- natural events or the activities of people?

____ 1. Hurricanes and tropical storms break and topple coral and batter fish.

____ 2. Construction on or near the reef destroys coral or muddies the water, so that corals smoth er.

____ 3. Overfishing and destructive fishing methods (such as using dynamite, cyanide, bleach, fish traps, gill nets, or huge forty-mile-long drift nets) spoil the reef ecosystem.

____ 4. Too much rain dilutes the water, so that it isn't salty enough for corals.

____ 5. Marine debris is dangerous to corals, birds, sea turtles, fish, and other marine animals.

____ 6. Divers, snorkelers, and fisherman damage the reef with boats, anchors, and heavy gear. Even touching coral or standing on it can kill it.

____ 7. Changes in currents can smother corals in mud.

____ 8. Collecting tropical fish, corals, and shells strips the reef of life.

____ 9. Pollution from oil spills, chemical wastes, run-off from farms and factories, and sewage ruins the water quality that corals need.

____ 10. Natural predators, such as parrotfish, sponges, and sea urchins, eat corals or weaken it by boring into it.

____ 11. Warmer water caused by the greenhouse effect may cause coral bleaching, a dangerous condition that occurs when corals lose their algae partners.

This page reserved for note-taking...

Review of Sharks

How are they built?

a. no swim bladder
b. rigid fins/large oily livers/urea in blood - create lift and aid in buoyancy
c. heterocercal tail - lift
d. spiral valve intestine
e. teeth - replaceable rows
f. 5 -7 gill openings
g. spiracle - water intake for respiration

Feeding

a. ampullae of Lorenzini - innervated pores in the sharks snout. sensitive to electrical fields which all living organisms emit
b. tapetum - reflective layer beneath retina that increases low light vision
c. teeth - rows of very sharp teeth (skates and rays tend to have flattened pavement-like teeth for crushing hard-shelled invertebrates) which are really modified "placoid" scales which are constantly being shed and replaced
d. spiral valve intestine - increases surface area for digestion without increasing length of intestine

Life Cycle

a. internal fertilization with claspers
b. birth schemes
   1. Oviparous: young born from egg case externally
   2. Ovoviviparous: egg case hatched internally

Biology

a. Cartilaginous skeleton instead of bone
b. Elongate bodies
c. Gill slits instead of gill covers
d. Lack scales (i.e. have dermal dentricles)
e. Most are continual swimmers

Sharks Found in Hawaiian Waters

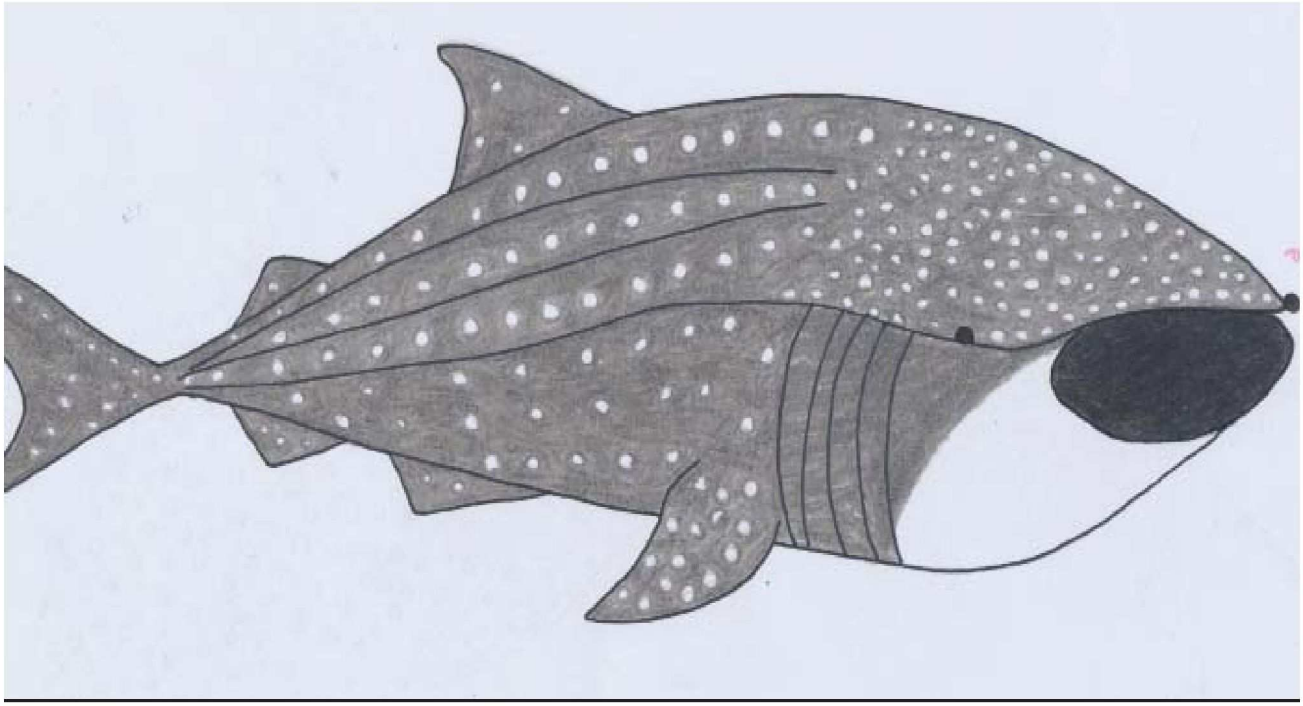
Note: The following information in this section came from the book Sharks and Rays of Hawaii by Gerald L. Crow and Jennifer Crites, Copyright 2002 by Mutual Publishing.

Illustrations done by Brooke Cleveland

Whale Shark – *Rhincodon typus*
Maximum length: 45 ft.
Reproduction:
- Live birth
- Pups hatch from egg cases inside the uterus
- One female was recorded to contain 300 egg cases
- Pups are usually found at 20 degrees north latitude in the North Pacific Ocean
- Females mature after reaching 18 feet in length

Habitat: Whale sharks are found in all oceans and the Red Sea. In Hawaii, whale sharks are rarely found north of Kaua'i
Biology: Whale sharks are filter feeders (eating zooplankton, squid and fish. They are usually seen alone, although at certain coral spawning events in Australia, whale sharks gather to feed and can be found 1 individual per 6/10 of a mile.
Economic Impact: Whale shark watching is a source of ecotourism dollars. Also, in India, Taiwan and the Philippines, the whale shark is a part of a seasonal fishery. The meat is salted and used as a staple food in many villages. As many as 100 whale sharks per year are reported killed by Taiwanese fisherman using harpoons.

References: Compagno, 1984; Joung et al., 1996; Kukuyev, 1996; Clark and Nelson, 1997; Winter, 2000; Eckert and Stewart, 2001.

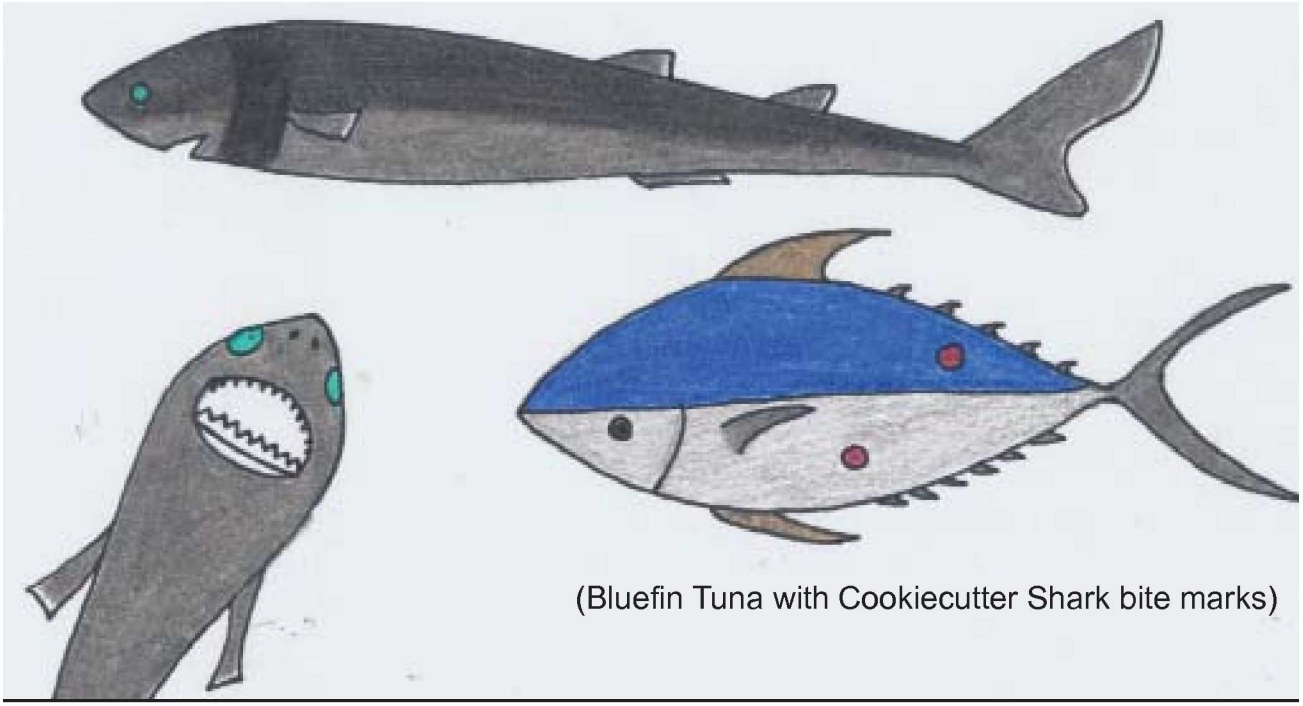


Cookiecutter Shark- *Isistius brasiliensis*
Maximum length: 20 inches
Reproduction:
- Live birth
- 6-12 pups per litter
- Females mature between the lengths of 15-17 inches

Habitat: Found in the Pacific, Atlantic, and Indian Oceans; it is caught at night, sometimes at the surface and sometimes at depths of up to 11,500 feet. The Cookiecutter shark is thought to be a vertical migrator (this shark climbs the equivalent of Japan's Mount Fuji every day).
Biology:
- Has bright green eyes
- Known as a parasitic shark (the cookiecutter shark feeds on plugs of flesh from fish and mammals much larger than itself. It attaches its sucker-type lips, drives its teeth into the victim, twists to cut a conical plug of flesh, and then pulls free with the plug held in its jaws. These "crater" wounds, the size of golf balls, are found on marlin, tuna, swordfish, other sharks, whales and dolphins. Cookiecutter sharks have also been known to try to take bites out of U.S. Navy submarines.
- A bioluminescent area covers most of the underside of the cookiecutter shark (making this shark glow green). It is thought that the bioluminescence is used as a lure to attract unsuspecting fish and marine mammals to an easy meal, whereupon the cookiecutter shark turns the tables and becomes the predator.

Notes: Danger rating is minimal since this shark is not found in nearshore coastal areas.
Economic impacts: Cookiecutter shark bites damage the flesh of market fish.

References: Jones 1971; Compagno 1984; Amorim et al, 1998.



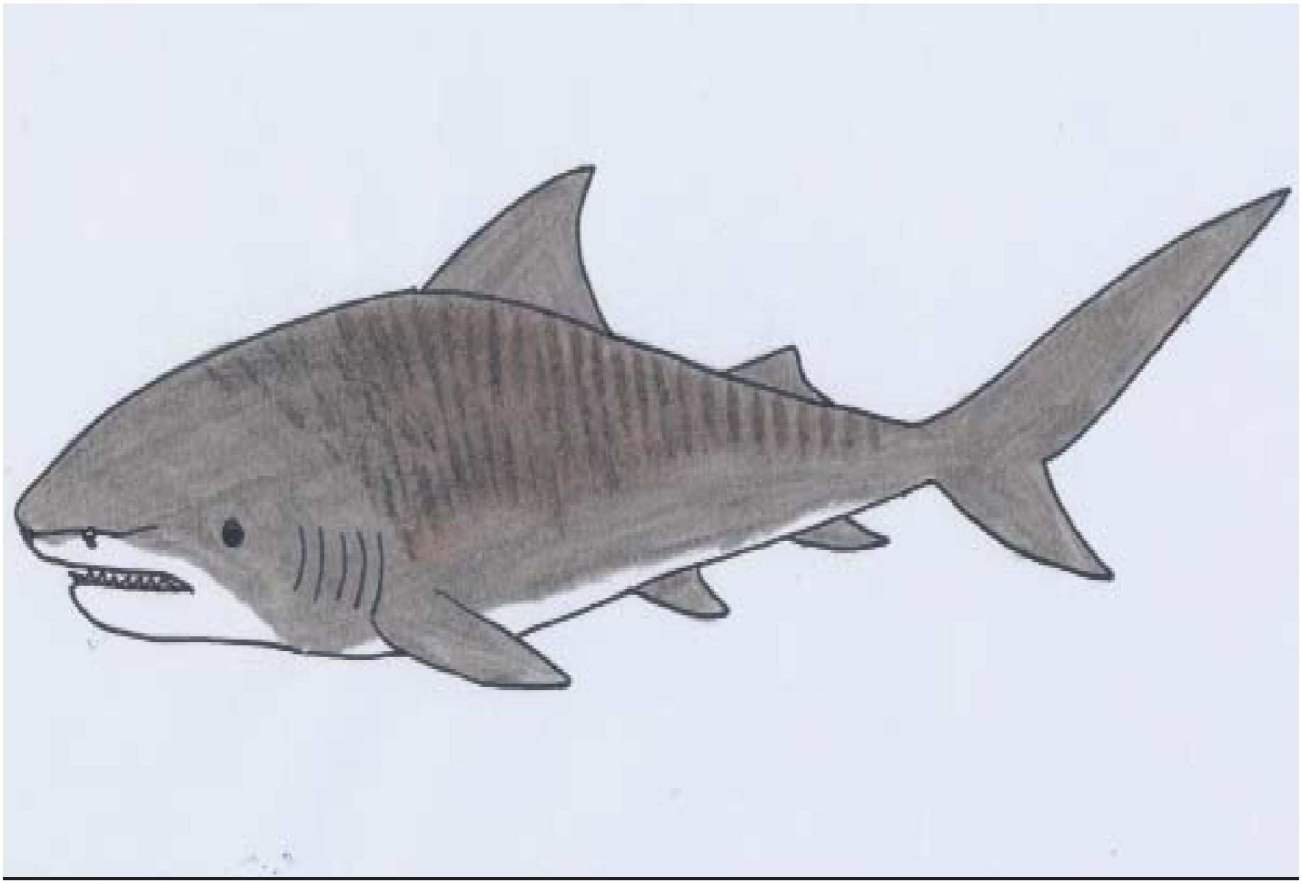
(Bluefin Tuna with Cookiecutter Shark bite marks)

Tiger Shark
Maximum Length: 19.6 feet
Reproduction:
- Live birth
- 10-82 pups per litter
- Ovulation to birth takes 15-16 months
- Tiger sharks are thought to reproduce once every 3 years
- In Hawaii, mating occurs in January
- In Hawaii, it takes most tiger sharks 10-12 years to reach reproductive maturity

Habitat: Tiger sharks are found in all tropical and temperate oceans and the Red Sea. They have the ability to swim 30 miles in a span of 24 hours. A tiger sharks average swimming speed is 2.4mph. They are a nomadic species with large home ranges. While in coastal waters, tiger sharks swim close to reef drop-offs at depths of 195ft-260ft, a depth that is usually above the thermocline.

Biology: Tiger sharks have a varied diet, and have been known to eat sacks of coal, raincoats, car license plates, chicken coops, and various other garbage items. It's natural diet consists of squid, octopus, crustaceans, other sharks, rays, bony fish, green sea turtles, birds, and dolphins.

References: Compagno, 1984; DeCosta et al., 1984; Polovina and Lau, 1994; Crow, 1995; Lowe et al., 1996; Holland et al., 1999.



Whitetip Reef Shark
Maximum Length: 5.6 feet
Reproduction:
- Live birth
- Gestation lasts a little over a year
- Females reproduce every 2 or 3 years
- Mating has been observed in June
- Whitetip reef sharks take between 7-9 years to reach reproductive maturity
- A normal litter size is between 1-5 pups

Habitat: A coastal shark found in the Indian and Pacific Oceans and the Red Sea, particularly in coral reef areas. This shark can be seen resting in caves throughout the Hawaiian Islands, and may take up residence in a specific cave for extended periods of time.
Biology: The whitetip reef shark is a nocturnal predator. Its diet includes octopus, crustaceans, and bony fish

Notes: Minimal danger rating under non-threatening conditions
References: Compagno, 1984;, Uchida et al., 1990; Kajiura, personal communication

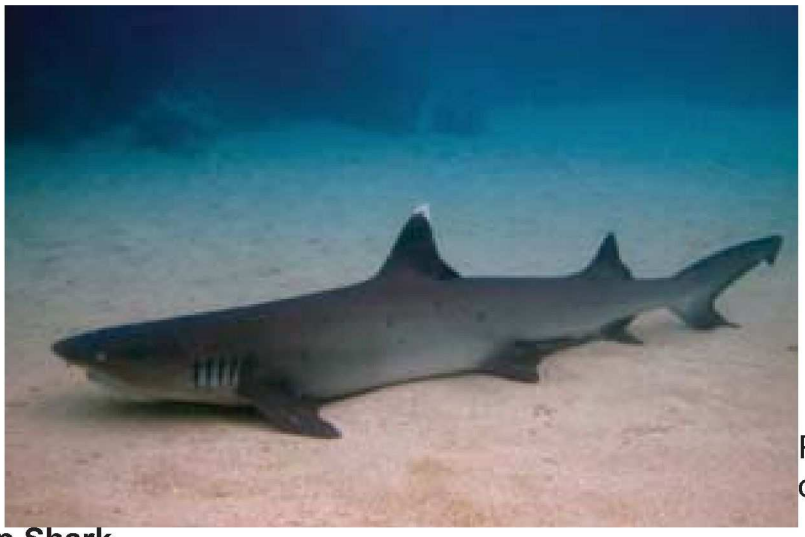
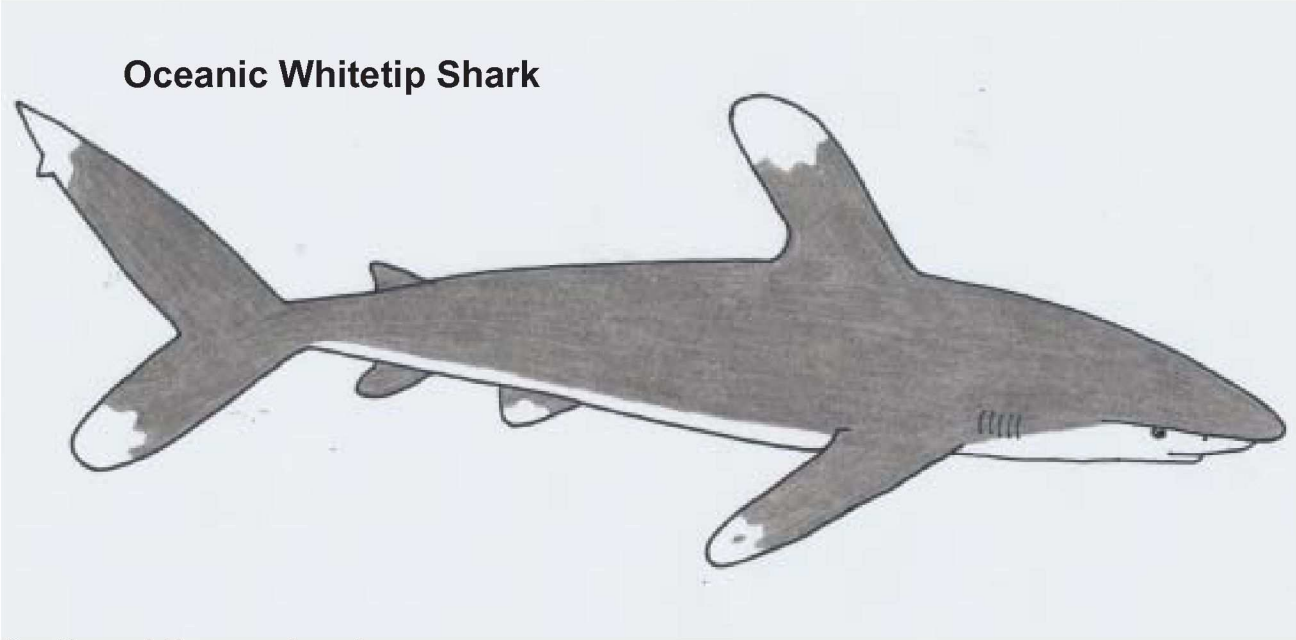


Photo Courtesy of Gavin Iwai

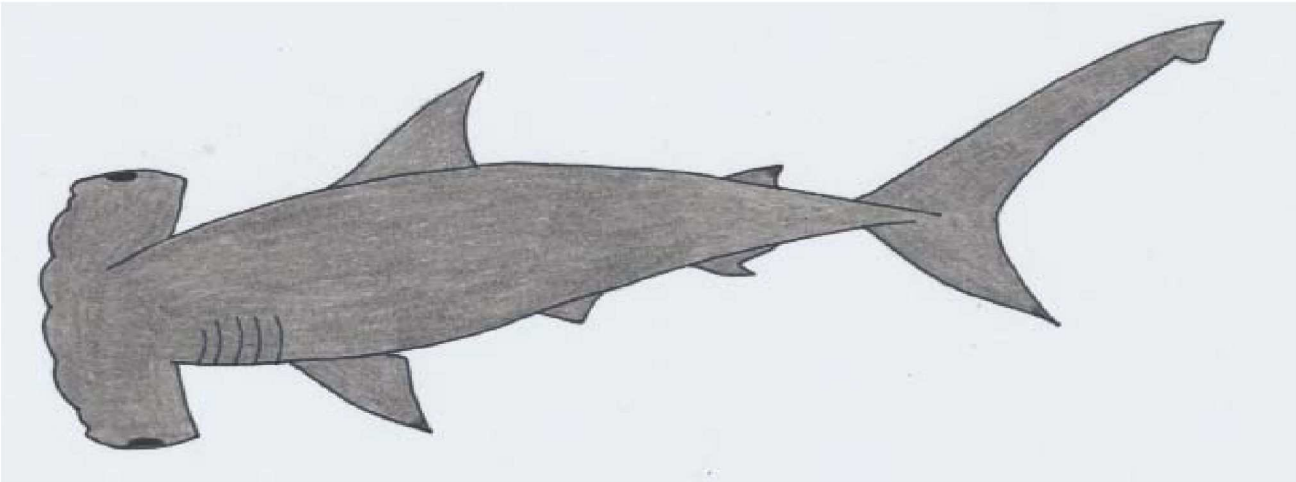
Oceanic Whitetip Shark
Maximum Length: 11.5 ft
Reproduction:
- Live birth
- Gestation time is 11-12 months
- Litter sizes vary between 1-15 pups
- Oceanic Whitetip sharks reach reproductive maturity between 5-6 years
- Specific pupping areas are in the central North Pacific Ocean from the equator to 15degrees north latitude

Habitat: A wide-ranging pelagic shark found in all oceans and the Red Sea. In Hawaii, the Oceanic Whitetip shark is found mostly around the Big Island
Biology: The Oceanic Whitetip shark can be an aggressive and curious shark that is known to bump divers. It feeds on squid, pelagic sting rays, bony fish, birds, sea turtles, and marine mammals
References: Compagno, 1984; Seki et al., 1998



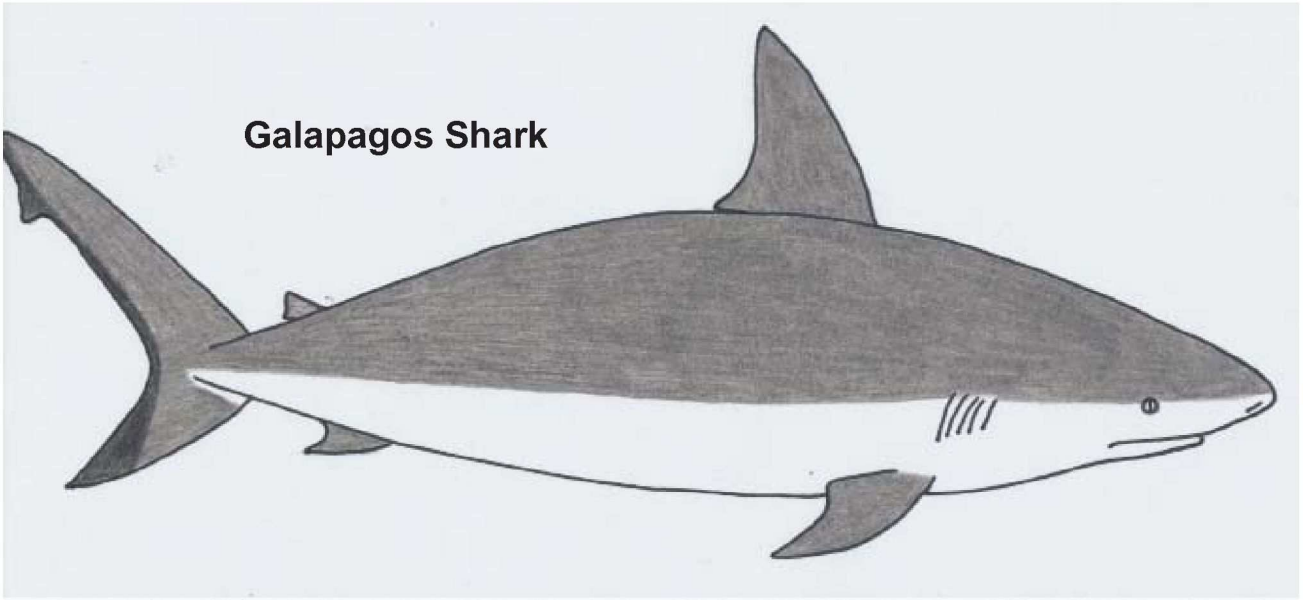
Scalloped Hammerhead
Maximum Length: 12 feet
Reproduction:
- Live birth
- Litter size can be from 15-31 pups
- In Kane'ohe Bay, pupping takes place from May to July
- Age at maturity varies in different parts of the world (in Taiwan, where the growth rate is faster, scalloped hammerhead sharks reach reproductive maturity at 4 years. But in Hawaii and the Gulf of Mexico, they reach this maturity between 10-15 years)

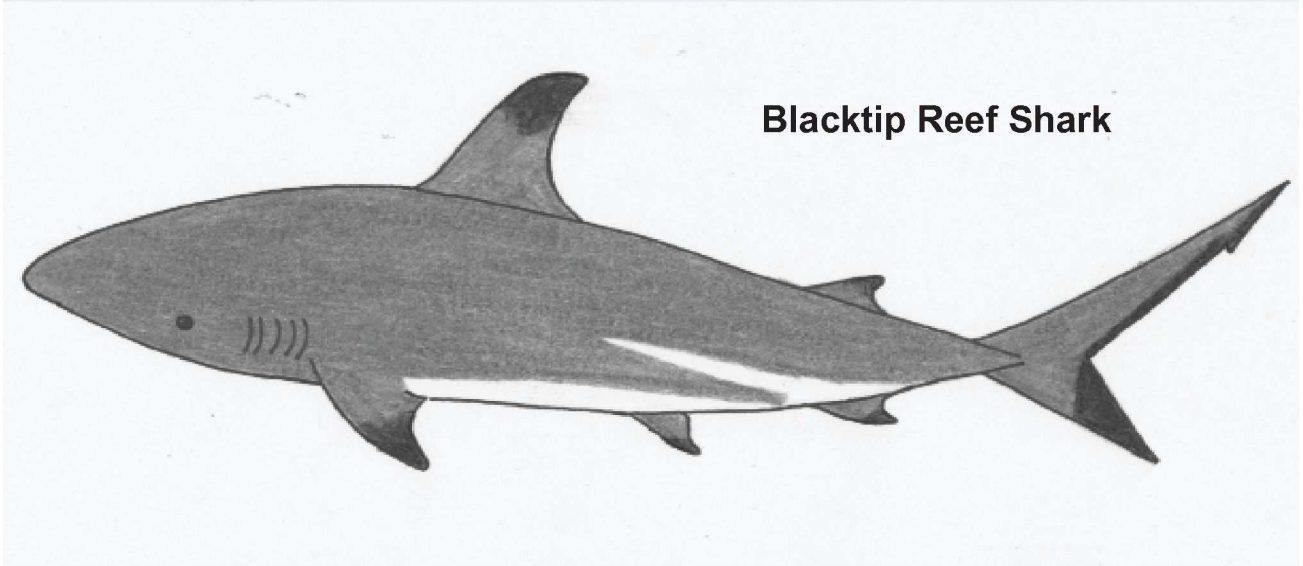
Habitat: A coastal and pelagic shark found in all oceans and the Mediterranean and Red Seas.
Biology: Adults live off-shore and come into shallow waters in the Hilo Bay, Kane'ohe Bay and Waimea Bay to pup. Juveniles are sometimes seen in Hanauma Bay in the summer months. They feed in bottom areas, mostly on shrimp and bony fish. Adults eat mostly bony fish, squid, other sharks and rays
References: Clarke, 1971; Compagno, 1984; Branstetter, 1987; Chen et al., 1993; Last and Steves, 1994; Crow et al., 1996; Bush, 1998



Other sharks found in Hawaii:

Great White Shark
Silky Shark
Shortfin Mako
Long Fin Mako
Bigeye Thresher Shark
Pelagic Thresher Shark
Gray Reef Shark
Bignose Shark
Galapagos Shark
Smooth Hammerhead Shark
Blacktip Shark
Blacktip Reef Shark
Sandbar Shark
Blue Shark





Rays Found in Hawaiian Waters

Notes about rays:

a. Depressed Bodies
b. "Wing-like" pectoral fins
c. Long thin tail, some with venomous spines
d. Skeleton cartilaginous

Pelagic Sting Ray

Maximum Size: Reported to reach 2.6ft. disc width

Reproduction: Live birth. Litter size ranges between 4-7 pups. Males are much smaller than females.

Habitat: This open-ocean ray is found in very deep water. In Hawaii, the only confirmed depth catch record is 328ft.

Biology: Diet consists of squid, crustaceans, bony fish and possibly jellyfish.

Notes: Danger rating is minimal due to offshore, deep-water habitat. However, this ray's tail spine is venomous and should be avoided..

References: Coles, 1916; Boggs, 1992; Last and Stevens, 1994; Yano et al., 1999; Mollet, personal communication.

Brown Sting Ray

Maximum Size: May reach up to 5ft disc width

Reproduction: Live birth. Litter size ranges from 3-4 pups. Pups are born in the summer.

Habitat: Known from Taiwan to Hawaii in the Pacific Ocean, this ray prefers sandy bottoms and is abundant in Kaneohe Bay, Oahu. In Hawaii, it has been caught from 1-700 feet.

Biology: A bottom feeder, the brown sting ray eats crabs, shrimp and bony fish.

Notes: Danger rating is minimal, although this ray's tail has a venomous spine.

References: Struhsaker, 1973; Nishida and Nakaya, 1990.

Manta Ray

Maximum length: 22ft wingspan

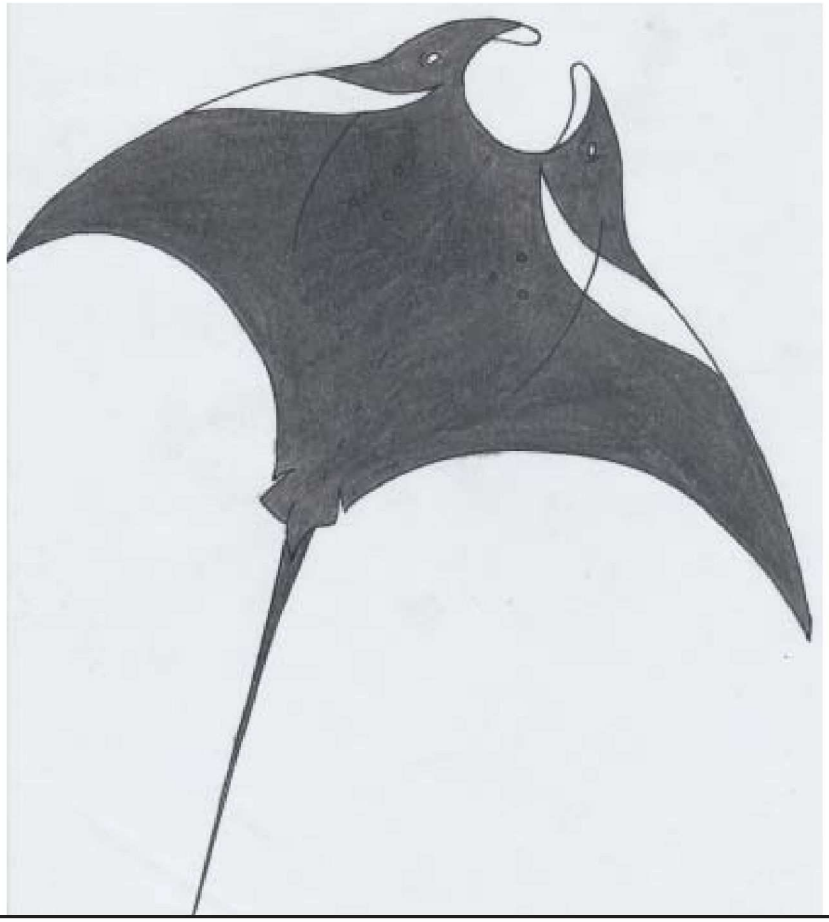
Reproduction:
- Live birth
- Females don't reach reproductive maturation until they have reached an 11ft wingspan

Habitat: In Hawaii, they are seen along the Kona Coast of the Big Island at depths of 10-120 ft. Based off the unique underside blotch patterns and body size, dive master Keller Laros has identified 55 manta rays in the vicinity of Kona. However not much is known about their movements and habitat.

Note: Manta rays are occasionally seen in Hanauma Bay.

Biology: Manta rays are filter feeders and trap food using gill rakers, although they have tiny teeth not used for feeding. Their diet of plankton consists of copepods, mysid shrimp, crab larvae, mollusk larvae and fish eggs.

References: Coles, 1916; Last and Stevens, 1194; Yano et al., 1999; Eric Beyer, manuscript.



Spotted Eagle Ray

Maximum length: 6ft. wing span

Reproduction: Live birth with uterine milk. Litter size ranges between1-4. On Oahu, spotted eagle rays are born in October, November and December in Pearl Harbor and Kaneohe Bay. During the birthing process these rays have been seen leaping from the water and dropping their young in midair.

Habitat: A coastal ray found in the Atlantic, Indian, and Pacific Oceans. They feed in soft sandy sediments, frequently digging pits on the sandy floor.

Biology: Spotted eagle rays feed on oysters, clams, crabs, shrimp and worms.

References: Coles, 1913; Gudger, 1914; Tricas 1980; Uchida et al, 1990; Last and Stevens, 1994.

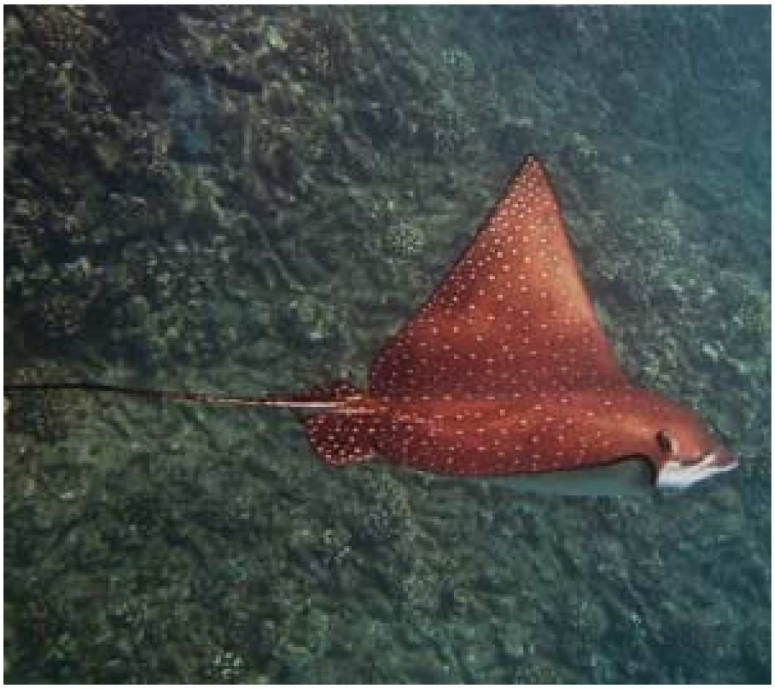


Photo Courtesy of Gavin Iwai

Review of Bony Fishes

Anatomy

Body
1. fusiform/elongate (mullet)
2. anguilliform/eel-like/greatly elongate/attenuated (morey eel)
3. ovate/truncated (trigger fish)
4. compressed/compressiform/narrow/thin (butterfly fishes)
5. depressed/depressiform/flattened (flounder)
6. globiform/subcircular/hemispherical (gobi/lizard fish)

Fins
1. dorsal - used for stability while swimming
2. anal - used for stability while swimming
3. pectoral - variable uses: manueverability, propulsion, display, gliding, flying
4. pelvic - varied in location. The more primitive fishes have anal fins located more toward the caudal fin
5. caudal (tail) - used for propulsion
    a. truncate - ends abruptly, trailing edge is flat
    b. lunate - quarter moon shaped
    c. forked - trailing edge forms a "V"
    d. rounded - trailing edge rounded outward
    e. heterocercal - one lobe of tail is longer than the other (sharks)

Scales - mostly used for protection
Mouth - location and shape say something about behavior
Gills - where gas exchange occurs. Bony fishes tend to have only one gill opening
Operculum - hard protective covering of the gills found only on bony fishes
Caudal Peduncle - base of the caudal (tail) fin
Lateral Line - sensory organ that detects changes in pressure

Habits

Feeding
a. herbivores - feed on plant life such as phytoplankton and algae. They have longer digestive tracts for better digestion of cellulose
b. planktivores - feed on plankton
c. carnivores - feed on other animals
d. omnivores - feed on both plants and animals (generalists)

Reproductiona. external fertilization
b. brooding - lay a nest of eggs, then protect them
c. broadcast spawning - mix eggs and sperm in the water column

Hawaiian Coral Reef Fishes

This list is by no means comprehensive, but will give you a solid introduction to some of the common families of fish occurring in Hawaiian waters. For each family, you will find a few defining physical and behavioral characteristics, followed by examples. Most of the examples provided are frequently seen in Hanauma Bay.

The groups listed are not arbitrary. Families of fishes are comprised of a group of closely related fishes. These families are determined by the science of Taxonomy, the formal system for naming and classifying the diversity of animal life. Taxonomic Classification is a hierarchical system by which all living things are grouped into categories (taxa) sharing increasing evolutionary heritage. The system begins with the Kingdom, the most inclusive category and ends with the species, the most distinct.

Taxonomic Classification
ex: Spectacled Parrotfish, *Scarus perspicillatus*
Kingdom: Animalia (Animal)
Phylum: Chordata (Chordates)
Subphylum: Verbatrata (Vertebrates)
Class: Osteichthyes (Bony Fishes)
Order: Perciformes
Family: Scaridae
Genus: Scarus
Species: perspicillatus

Note: All photos in the following section are courtesy of Gavin Iwai

Lizardfishes Found on reef or in sand
Use camouflage to escape predation
Ambush predator
Long cylindrical body
Needle-like teeth on tongue
Ex: Reef Lizardfish (*Synodus variegates)* - **ʻulae**

Slender Lizardfish

Moray Eels No pectoral/pelvic/caudal fins
Lives in holes & crevices of reef
Nocturnal Feeder
Poor Eyesight
Good sense of smell
Feed on fish & hard-shelled invertebrates
Snake-like body
Ex: Whitemouth moray (*Gymnothorax meleagris)* - **pūhi ʻōniʻo**
Ex:Snowflake moray (*Echidna nebulosa*) - **pūhi kāpā**

Snowflake Eel

Yellowmargined Moray Eel

Whitemouth Moray Eel

Undulated Moray Eel

Trumpetfishes

Greatly elongate, compressed body
Rounded caudal fin
Utilize stealth and camouflage
Able to change coloration
Tubular snout with minute teeth
Preys on small fish late afternoon & early morning
Expands oral cavity and sucks up all that is in front
Ex: Trumpetfish (*Aulostomus chinensis*) - **nūnū**

Trumpetfish (gray coloration)

Trumpetfish (yellow coloration)

Cornetfishes

Greatly elongate, globiform
Long-trailing filament from middle of forked caudal fin
"Stalk & ambush" predator
Feeding method similar to trumpetfish
Ex: Cornetfish (*Fistularia commersonii*) - **nūnū peke**

Cornetfish

Squirrelfishes

Fusiform body/Compressed
Spiny Operculum
Red coloration & big eyes indicate nocturnally active
Frequent ledges & overhangs
Emit distinctive grunting sound
Feed on invertebrates
Ex: Spotfin Squirrelfish (*Neoniphon samara*) - **'ala 'ihi**
Ex: Hawaiian Squirrelfish (*Sargocentron xantherythrum*) - **'ala 'ihi**

Hawaiian Squirrelfish

Scorpionfishes

Large spiny head
Venomous spines on fins
Back of pectoral fins can be brightly colored (orange, red, yellow)
Ambush predator that uses camouflage to hide
Feeds on fish
Ex: Devil Scorpionfish (*Scorpaenopsis diabolus*) - **nohu 'omakaha**

Helmet Gurnards

Bottom-dwelling
Occur over sand or rubble
Feed on crustaceans and mollusks
Extend long pectoral fins like wings when alarmed
Ex: Flying Gurnard (*Dactyloptera orientalis*) - **loloa'u** or **pinao**

Flying Gurnard

Bigeyes

Fusiform, compressed
Continuous dorsal
Large eyes & red color indicate nocturnal activity
Nocturnal planktivore
Ex: Glasseye (*Heteropriacanthus cruentatus*) - **ʻāweoweo**
Ex: Hawaiian Bigeye (*Pricanthus meeki*) - **ʻāweoweo**

Hawaiian Bigeye

Cardinalfishes

Fusiform
Red coloration
Hunt nocturnally for zooplankton, small crustaceans & fish
Mouth Brooders (males)

Ex: Iridescent Cardinalfish (*Apogon kallopterus*) - **‘upāpalu**
Ex: Bay Cardinalfish (*Foa brachygramma*) - **‘upāpalu**

Iridescent Cardinalfish

Hawkfishes

Fusiform
Ambush predatos
Tend to perch on coral heads & high-standing rocks
Filamentous tufts on ends of dorsal spines
Ex: Stocky Hawkfish (*Cirrhitus pinnulatus*) - **po’opa’a**
Ex: Blockside Hawkfish (*Paracirrhites forsteri*) - **hilu pili ko’a**
Ex: Redbarred Hawkfish (*Cirrhitops fasciatus*) - **pili ko’a**
Ex: Arc-eye Hawkfish (*Paracirrhites arcatus*) - **pili ko’a**

Blackside Hawkfish

Redbarred Hawkfish

Snappers

Fusiform
Midwater predator
Smaller ones tend to school by day
Disperse at night to feed on small fish & crustaceans
Two of the more abundant species were introduced for commercial purposes

Ex: Bluestripe Snapper (*Lutjanus kasmira*) - **ta’ape**
Ex: Blacktail Snapper (*Lutjanus fulvus*) - **to’au**

Blacktail Snapper

Bluestripe Snapper

Emperors

Fusiform
Dark bars more pronounced in young
Teeth resemble human molars
Large eyes
Feed nocturnally, hover midwater during day
Ex: Bigeye Emperor (*Monotaxis grandoculis*) - **mū**

Bigeye Emperor

Chubs

Greyish coloration
Ovate, compressed
Swim in schools
Herbivores
Ex: Grey Chub (*Kyphosus bigibbus*) - **nenue**
Ex: Highfin Chub (*Kyphosus cinerascens*) - **nenue**

Grey Chub

Goatfishes

Fusiform
Chin barbels have taste buds
Able to change coloration of body

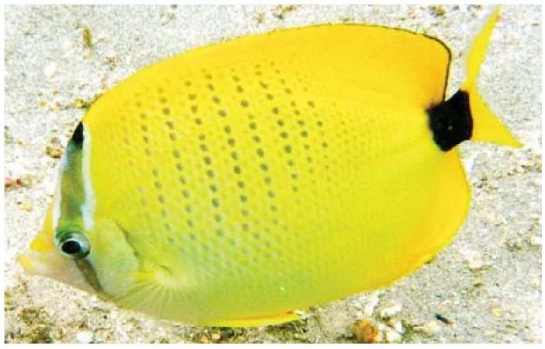
Bottom-dwellers
Feed on crustaceans, mollusks and other invertebrates
Ex: Yellowfin Goatfish (*Mulloidichthys vanicolensis*) - **weke'ula**
Ex: Manybar Goatfish (*Parupeneus multifasciatus*) - **moano**
Ex: Square-Spot Goatfish (*Mulloidichthys flavolineatus*) - **weke'ā**

Sidespot Goatfish

Manybar Goatfish

Butterflyfishes

Ovate, strongly compressed
False eye-spots in young
Eyebar
Brightly colored usually yellow
Feed on corals, plankton, small invertebrates
Ex: Milletseed (Chaetodon miliaris) - lau wiliwili
Ex:Raccoon (C. lunula) - kīkākapu
Ex:Threadfin (C. auriga) - kīkākapu
Ex:Fourspot (C. quadrimaculatus) - lau hau
Ex:Teardrop (C. unimaculatus) - lau hau
Ex: Ornate (C. ornatissimus) - kīkākapu
Ex:Forceps longnose (Forcipiger flavisimus) - lauwiliwilinukunukuoi'oi



Milletseed Butterflyfish

Ornate Butterflyfish

Threadfin Butterflyfish

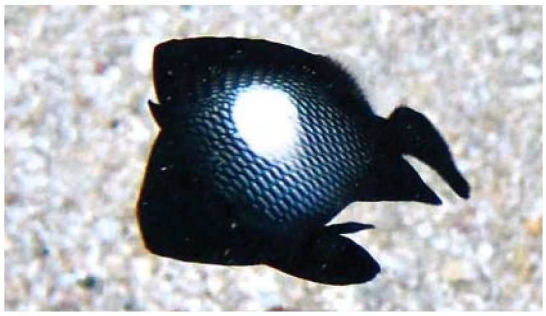
Raccoon Butterflyfish

Angelfishes

Ovate, compressed
Preopercal spine
Feed on small crustaceans, zooplankton, worms & other inverts
Ex: Potter's Angelfish (*Centropyge potteri*)

Damselfishes

Ovate, compressed
Aggressive
Feed on filamentous algae or plankton
Some are brooders
Ex:Hawaiian sergeant (*Abudefduf abdominalis*) - **mamo**
Ex: Blackspot sergeant (*A. sordidis*) - **kūpīpī**
Ex: Yelloweye damselfish (*Stegastes fasciolatus*)



Hawaiian Dascyllus

Blue-eye Damselfish

Wrasses

Fusiform
Pectoral swimmers
Sexual dichromatism
Sequential hermaphroditism is common
Continuous dorsal fin
Bright, gaudy color patterns that vary with age and sex
Feed on small invertebrates
Initial phase & Terminal phase
Ex: Christmas Wrasse (*Thalassoma trilobatum*) - **ʻāwela**
Ex: Old Woman Wrasse (*Thalassoma ballieui*) - **hīnālea luahine**
Ex: Bird Wrasse (*Gomphosus varius*) - **hīnālea ʻi'iwi**

Old Woman Wrasse

Female Bird Wrasse

Parrotfishes

Fusiform
Pectoral swimmers
Sexual dichromatism common
Sequential hermaphrodism common
Mouth non-protractile
Teeth fused (beak-like)
Feed on algae and coral
Ex:Star-eye (*Calotomus carolinus)* – **pānuhunuhu**
Ex: Palenose (*Scarus psittacus*) – **uhu**
Ex: Redlip (*S. rubroviolaceus*) - **uhu palukaluka** (female) **uhu ʻele ʻele** (male)
Ex: Bullethead (*Chlorurus sordidus*) - **uhu**
Ex: Spectacled (*C. perspicillatus*) - **uhu'ahu'ula** (female) **uhu uliuli** (male)

Redlip Parrotfish

Bullethead Parrotfish

Surgeonfishes

Ovate
Compressed
Fixed or retractable spine/scalpel on caudal peduncle
Herbivores (and some planktivores)
Colorful
Pectoral swimmers
Schooling Behavior
Ex: Yellowfin (Acanthurus xanthopturus) - pualu
Ex: Eyestripe (A. dussumieri) - palani
Ex: Convict Tang (A. triostegus) - manini
Ex: Brown Tang (A. nigrofuscus) - mā'i'i'i
Ex: Yellow Tang (Zebrosoma flavescens) - lau ʻī pala
Ex: Sailfin Tang (Z. veliferum) - māne'one'o
Ex: Achilles Tang (A. Achilles) - pāku ʻiku'i
Ex: Orangespine Unicornfish (Naso lituratus) - umauma lei

Orangeband Surgeonfish

Orangespine Unicornfish

Yellow Tang

Goldring Surgeonfish

Achilles Tang

Brown Surgeonfish

Moorish Idols

Ovate, compressed
No spine on caudal peduncle
Feeds on sponges
Only species of the family
Pectoral swimmers
Ex: Moorish Idol (*Zanclus cornutus*) - **kihikihi**

Moorish Idol

Blennies

Blunt head
Globiform
Pelvic fins forward of pectorals
No scales
Feeds on scales, mucous, & flesh of fishes (Sabertooth, Ewa Blennies)
Some feed on corals & algae
Bottom-dwellers vs. Free swimmers
Ex: Zebra rockskipper (*Istiblennius zebra*) - **pāo'o**
Ex: Shortbodied rockskipper (*Exallias brevis*) - **pāo'o kauila**

Shortbodied Blenny

Triggerfishes

Ovate
3 dorsal spines; start behind eye (locking mechanism)
No pelvic fins; something pelvic spine
Feed on plankton, drifting algae and invertebrates (urchins)
Swim using dorsal and anal fins
Ex: Reef Triggerfish (*Rhinecanthus rectangulus*) -
humuhumu-nukunuku-ā-pua'a

Reef Triggerfish

Lagoon Triggerfish

Filefishes

Ovate, compressed
1 or 2 dorsal spines; first over eye
No pelvic fins, sometimes pelvic spine
Like triggers-will lodge itself into rocks and raise spine
Utilize camouflage
Ex: Fantail (*Pervagor spilosoma*) - **ʻōʻili uwīʻuwī**
Ex: Scrawled Filefish (*Aluterus scriptus*) - **loulu**

Barred Filefish

Scrawled Filefish

Boxfishes

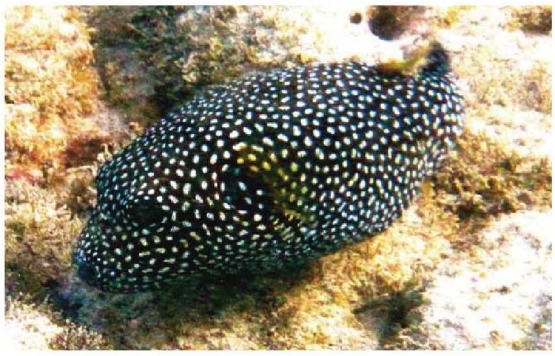
Fused bony body plates
No pelvic fins, no spinous dorsal
Sexual dichromatism in spotted boxfish
Ex: Spotted Boxfish (*Ostracion meleagris*) - **moa**

Spotted Boxfish

Pufferfishes

Able to inflate bodies by sucking in water or air - (defensive mechanism)
Contain neurotoxin (tetrodoxin)
Lack scales and pelvic fins
Ex: Hawaiian Whitespotted toby (*Canthigaster jactator*)
Ex: Spotted Puffer (*Arothron meleagris*) - **ʻoʻopu hue**

Spotted Puffer



Hawaiian Whitespotted Toby

Porcupinefishes

Completely covered with sharp spines
Able to inflate bodies by sucking in water or air (defensive mechanism)
Contain poisonous toxin (i.e. tetrodoxin)
Lack scales and pelvic fins
Ex: Porcupinefish (*Diodon hystrix*) - **kōkala**
Ex: Spiny Balloonfish (*Diodon holocanthus*) - **kōkala**

Spotted Porcupinefish

Jacks

Swift, Strong swimming predators
Streamlined bodies
Deeply forked tail
Tail reinforced by strengthened scales (i.e. scutes)
Small groups or solitary
Ex: Bluefin Trevally (*Caranx melampygus*) - **ʻōmilu**
Ex: Giant Trevally (*Caranx ignobilis*) - **ulua aukea**

Bluefin Trevally

Flagtails

Caudal fin banded mostly in juveniles
Nocturnal feeders
Feed on plankton, polychaetes & algae
Schooling individuals
Deep, compressed body
2 spines on opercle
Ex: Hawaiian Flagtail (*Kuhlia sandvicensis*) - **āholehole**

Hawaiian Flagtail

Tenpounders

Deeply forked tail
Consists of single genus, *Elops*
Euryhaline(i.e. able to tolerate wide range of salinities)
Ex: Hawaiian Ladyfish (*Elops hawaiensis*) - **awa'aua**

Bonefishes

Inferior mouth
Deeply forked tail
Lacks spines on fins
Feeds on crustaceans, worms, and mollusks
Flesh full of small bones
Ex: Bonefish (*Albula sp.*) - **ō'io**

Shortjaw Bonefish

Milkfishes

Name refers to milky white underside of body
Able to attain lengths of 6 feet
Deeply forked tails
Lack teeth
Only 1 genus and 1 species in family
Single "shark-like" dorsal fin
Ex: Milkfish (*Chanos chanos*) - **awa**

Milkfish

Threadfins

Modified threadlike rays of pectoral fins
Schooling type
Feeds on crustaceans
Protandric hermaphrodites (i.e. sex-reversal)
Body uniformly silver w/faint dark stripes longitudinally
Ex: Six-fingered Threadfin (*Polydactylus sexfilis*) - **moi**

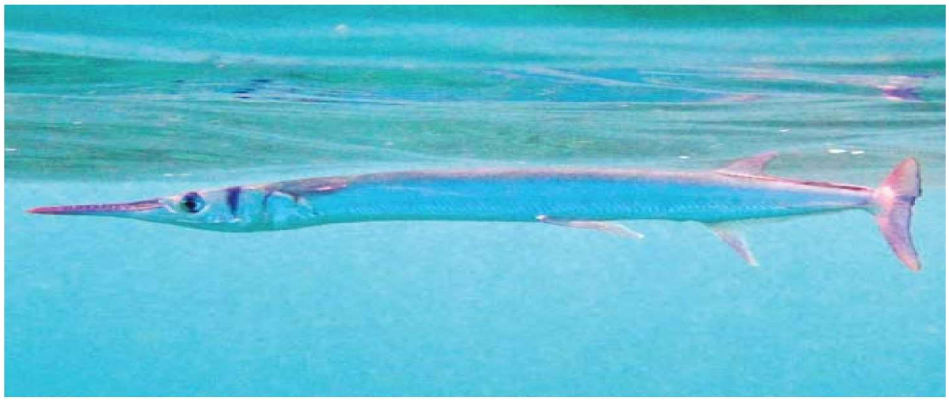
Pacific Threadfin

Mullets

Adipose eyelid
2 dorsal fins widely separated
cylindrical/torpedo shaped bodies
feed on detritus and algae
Ex: Striped Mullet (*Mugil cephalus*) - **'ama'ama**

Needlefishes

Beak-like jaws armed with sharp teeth
Surface swimmers
Greatly elongate jaw
Feed on smaller fish
Ex: Crocodile Needlefish
(*Tylosurus crocodiles crocodilus*) - **'aha**



This page reserved for note-taking...

Tips for Identifying Fish

Visitors to the Bay are often anxious to identify the many fish they see while snorkeling. The best way to help answer these identification questions is to spend a little time in the water getting aquainted with the many fish inhabiting the Bay. Armed with the following tips, you should have an easier time when you leave the water in search of a name for the beautiful creatures you have observed, and be more comfortable assisting visitors with their questions. Good Luck!

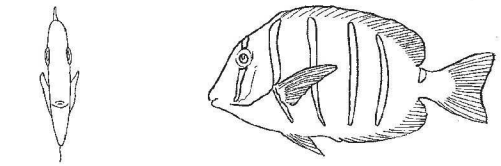
Try to observe the fish as a sum of its parts

In other words, don't try to "see" the whole fish -- break it into parts. Notice the form of its body, the shape of its tail and fins. This might seem difficult, especially when you only get a quick look at a fish before it darts away, but give it a try. You will be surprised at how much you can see, even with just a glimpse!

Compressed

Thin, squished side-to-side

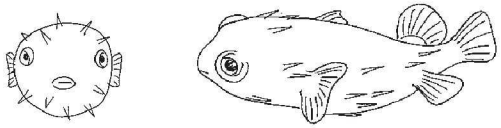
examples: Surgeonfish
Butterflyfish



Sphere

Round

examples: Pufferfish
Porcupinefish



Depressed

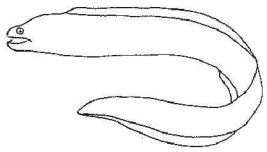
Flattened

examples: Manta ray
Flounder

Ribbon

Snake-like

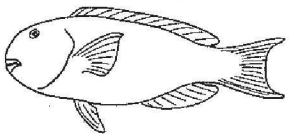
example: Morey eel



Fusiform

Spindle-like

examples: Parrotfish
Wrasse

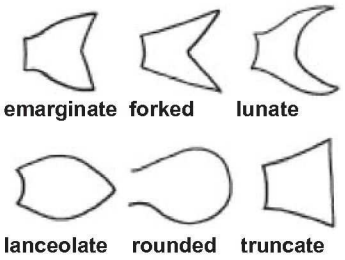


Rod or Elongate

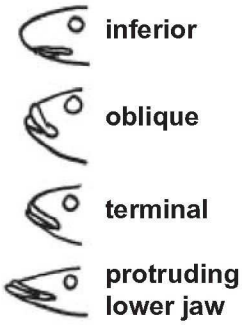
Stick-like, elongated

examples: Trumpetfish
Cornetfish

Types of Caudal Fins



Mouth Position



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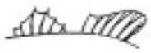
Types of Dorsal Fins:

continuous

notched



seperate dorsal fins

Is the fish alone or in a school?

It is useful to note whether a fish was seen swimming by itself, in a pair, small group or a large school. Anything else you notice about its behavior can also be helpful... Was the fish eating anything? Perched on the reef? Swimming near the surface or the bottom? For examples of these behaviors, please refer to the HBEP O-Fish-all Identification Card included in the front pocket of this binder. (examples: schooling behavior = manini and aholehole; perched = hawkfish)

Does the fish have an unusual marking or color pattern?

Color is the most common characteristic snorkelers tend to focus on when trying to identify a fish. Keep in mind that males, females and juveniles of the same species can all be very different in color. Individuals of some species can even exhibit subtle color changes minute to minute. Photographs in fish identification books can look different due to variations in lighting or the use of flash photography. Therefore, color is not always the most helpful attribute when you begin your search.

General color and color markings are most helpful when you already know the type (or family) of fish you are dealing with -- i.e. butterflyfish, surgeonfish, parrotfish -- and want to determine the species. For instance, look at the different butterflyfish on the front side of the “O-Fish-all Identification Card.” Notice that they all have the same general shape and appearance, each species having its own coloration. If you turn the card over you will see the dramatic color variations between the male and female of several species of parrotfish.

Importance of Color

(The following information comes from Wikipedia, Oct. 2011)

Camouflage

Protective resemblance

1) Special: the whole animal looks like some other object, for example when a caterpillar resembles a twig or a bird dropping. This is now called Mimesis

2) General: the animal's texture blends with the background, for example when a moth's color and pattern blend in with tree bark. This is now called crypsis.

Aggressive resemblance

1) Special: a predator (or parasite) looks like something else, luring the prey to approach, for example when a flower mantis resembles a particular kind of flower, such as an orchid

2) General: a predator or parasite blends in with the background, for example when a leopard is hard to see in long grass

Adventitious protection: an animal uses materials such as twigs, sand, or pieces of shell to conceal its outline, for example when a Caddis Fly larva builds a decorated case, or when a crab decorates its back with seaweed, sponges and stones

Variable protective resemblance: an animal such as a chameleon, flatfish, squid or octopus changes its skin pattern and colour using special chromatophore cells to resemble whatever background it is currently resting on (as well as for signalling).

The main mechanisms of camouflage coloration:

Cryptic, blending into the background so as to become hard to see (this covers both special and general resemblance)
Disruptive, using colour and pattern to break up the animal's outline (this relates mainly to general resemblance)
Countershading, using graded colour to create the illusion of flatness (this relates mainly to general resemblance).

Countershading, in which an animal's pigmentation is darker dorsally, is often thought to have an adaptive effect of reducing conspicuous shadows cast on the ventral region of an animal's body. In essence the distribution of light on objects that are lit from above will cause unequal reflection of light on a solid body of uniform colour; such shadows could provide predators with visual cues to a prey's shape and projection. Countershading therefore reduces the ease of detection of prey by potential predators by counterbalancing the effects of shadowing. Countershading is observed in a large variety of animals, such as pronghorn antelope, White-tailed deer, squirrels, birds, and various lepidopteran larvae. Alternatively, in many marine animals (including various species of fish such as marlins and sharks, penguins and cephalopods) this form of camouflage may work through background matching; when seen from the top, the darker dorsal area of the animal blends into the darkness of the water below, and when seen from below, the lighter ventral area blends into the sunlight

from the surface. Furthermore, countershading could also result from differential selection pressures on dorsal and ventral surfaces, from the need to protect against the damaging properties of UV light or abrasion. Countershading was first described by the American artist Abbott Handerson Thayer, a pioneer in the theory of animal coloration. Thayer observed that whereas a painter takes a flat canvas and uses coloured paint to create the illusion of solidity by painting in shadows, animals such as deer are often darkest on their backs, becoming lighter towards the belly, creating (as zoologist Hugh Cott observed) the illusion of flatness, and against a matching background, of invisibility. Thayer's observation "Animals are painted by Nature, darkest on those parts which tend to be most lighted by the sky's light, and vice versa" is called Thayer's Law.

Warning coloration (aposematism) is effectively the "opposite" of camouflage. Its function is to make the animal, for example a wasp or a coral snake, highly conspicuous to potential predators, so that it is noticed, remembered, and then avoided. As Peter Forbes observes, "Human warning signs employ the same colours - red, yellow, black, and white - that nature uses to advertise dangerous creatures." Warning colours work by being associated by potential predators with something that makes the warning-coloured animal unpleasant or dangerous. This can be achieved in several ways:

1) Distasteful- example: a Cinnabar moth caterpillar has bitter-tasting chemicals in its blood
2) Foul-smelling- example: the skunk can eject a liquid with a long-lasting and powerful odour
3) poisonous- example: a wasp can deliver a painful sting, while a viper can deliver a fatal bite

Warning coloration can succeed either through inborn ("instinctual") behaviour on the part of potential predators, or through a learned avoidance. Either can lead to various forms of mimicry.

Mimicry

The existence of warning coloration (aposematism) makes it possible for mimicry to evolve, because it enables natural selection to drive slight, chance, resemblance to progressively more perfect mimicry. There are numerous possible mechanisms, of which by far the best known are:

Batesian mimicry, the resemblance of edible to distasteful animals, most commonly insects such as butterflies; a familiar example is the resemblance of harmless hoverflies (which have no sting) to bees.

Batesian mimicry was first described by pioneering naturalist Henry W. Bates. When an edible prey animal comes to resemble, even slightly, a distasteful animal (not necessarily closely related to it), natural selection favours those individuals that even very slightly better resemble the distasteful target. This is because even a small degree of protection reduces predation and increases the chance that an individual mimic will survive and reproduce. For example, many species of hoverfly are coloured black and yellow like bees, and are in consequence avoided by birds (and people).

Müllerian mimicry, the mutual resemblances among distasteful animals, most commonly insects such as wasps and bees (hymenoptera)

Müllerian mimicry was first described by pioneering naturalist Fritz Müller. When a distasteful animal comes to resemble a more common distasteful animal, natural selection favours individuals that even very slightly better resemble the target. For example, many species of stinging wasp and bee are similarly coloured black and yellow. Müller's explanation of the mechanism for this was one of the first uses of mathematics in biology.
Müller's argument runs basically as follows:

1) Suppose there are, say, 100 wasps of rare species A and 1000 wasps of common spe cies B in a place.
2) Suppose that wasps are eaten by young inexperienced birds, which quickly learn after one trial, by getting stung in the mouth, not to eat wasps again.
3) Suppose there are 10 young birds in the place.
4) If species A does not resemble B (to the birds), then each young bird must eat one A and one B to learn to avoid them. 10 out of 100 wasps of species A, and 10 out of 1000 wasps of species B perish in the training process. Note that in this example, A is 10 times rarer than B, and therefore suffers 10 times as heavily.
5) Now suppose that species A resembles B perfectly, so the young birds cannot distinguish them. Each young bird now needs only to eat one wasp - A or B, it doesn't matter - to learn to avoid both of them.
6) The advantage gained by species A of resembling species B is that where before 10 in dividuals of species A perished, now only about 1 perishes, as most of the wasps sam pled by the young birds at random will belong to the commoner species B. Note that there is a large gain from the resemblance in the rare species, and a small gain (1 fewer individual out of 1000 perishes) in the common species: in fact, A's gain is 100 times as much as B's, comparing before and after.

Other Defense Mechanisms
Eye Spots- An eyespot (sometimes ocellus) is an eye-like marking. They are found on butterflies, reptiles, birds and fish. The foureye butterflyfish gets its name from a large dark spot on the rear portion of each side of the body. This spot is surrounded by a brilliant white ring, resembling an eyespot. A black vertical bar on the head runs through the true eye, making it hard to see. This can result in a predator thinking the fish is bigger than it is, and confusing the back end with the front end. The butterflyfish's first instinct when threatened is to flee, putting the false eyespot closer to the predator than the head. Most predators aim for the eyes, and this false eyespot tricks the predator into believing that the fish will flee tail first.
Advertising Coloration- Advertising coloration (or advertising colouration) refers to semantic colours seen in numerous organisms. It is the opposite of camouflage, 'advertising' the location of an organism or part of its anatomy. These signals are significant for their receivers. Within species, they might serve as signals of aggression or indicate a female is receptive to mating. They may also attract other organisms, such as the bright colours of flowers and fruit. In the case of the Hawaiian Cleaner Wrasse, the advertising coloration says, "Don't eat me, I help you by removing parasites from your body."

Examples of Coloration Adaptations
(Photos courtesy of Gavin Iwai)

Camouflage
Peacock Flounder

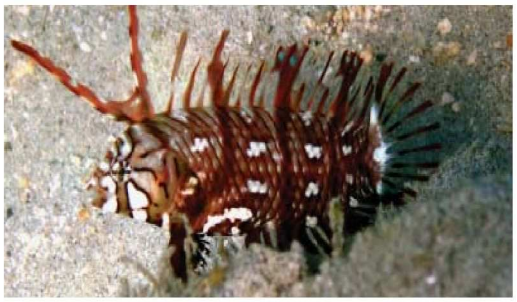
Cryptic
Slender Lizardfish

Disruptive
Hawaiian Lionfish

Countershading
Spotted Eagle Ray

Warning Coloration
Orangespine Unicornfish

Mimicry
Juvenile Rock Mover Wrasse
(trying to mimic a leaf)



Eye Spots
Raccoon Butterfly Fish

Advertising Coloration
Hawaiian Cleaner Wrasse

Invertebrates of Hanauma Bay

Cnidarians (Phylum Cnidaria)

Stony Corals
- Antler Coral, *Pocillopora eydouxi*
- Cauliflower Coral or Rose Coral, *Pocillopora meandrina*
- Lace Coral, *Pocillopora damicornis*
- Rice Coral, *Montipora capitata*
- Blue Rice Coral, *Montipora flabellate*
- Finger Coral, *Porites compressa*, **pōhaku puna**
- Lobe Coral, *Porites lobata*, **pōhaku puna**
- Evermann's Coral, Porites evermanni, **pōhaku puna**
- Spreading Coral, *Montipora patula*

Jellyfish
- Box Jellyfish, *Carybdea alata*

Siphonophores
- Portuguese Man-of-War, *Physalia physalis*, **paʻimalau**

Zoanthids (Colonial Anemones)
- Rubber Coral, Pillow Coral or Blue-Gray Zoanthid, *Palythoa caesia*
- *Protopalythoa* spp.
- *Zoanthus* spp.

Anemones
- Glass Anemone, *Aiptasia pulchella*

Sponges (Phylum Porifera)

Sponges
- Vermilion Clathria, *Clathria (Microciona) sp.*

Worms (Phyla Platyhelminthes & Annelida)

- Flatworms
- Spaghetti Worm, *Loimia medusa*, **kaunaʻoa**
- Featherduster Worm, *Sabellastarte sanctijosephi*
- Christmas Tree Worm, *Spirobranchus giganteus*, **kio**

Molluscs (Phylum Mollusca)

Sea Snails
- Black-foot `Opihi or Limpet, *Cellana exarata*, **ʻopihi makaiaūli**
- Yellow-foot `Opihi or Limpet, *Cellana sandwicensis*, **ʻopihi ʻālinalina**
- Black Nerite, *Nerita picea*, **pipipi**

- Dotted Periwinkle, *Littoraria pintodo*, **pipipi kōlea**
- Tiger Cowry, *Cypraea tigris*, **leho kiko**
- Snakehead Cowry, *Cypraea caputserpentis*, **leho kupa**
- Humpback Cowry, *Cyprea mauritiana*, **leho ahi**
- Cone Shells, *Conus sp.*, **pūpū'alā**

Sea Slugs
- Sea Hares, **kualakai**
- Spanish Dancer (Nudibranch), *Hexabranchus sanguineus*

Octopus
- Day Octopus, *Octopus cyanea*, **he'e mauli**
- Night Octopus, *Octopus ornatus*, **he'e pūloa, he'e mākoko**

Squid
- Oval Squid, *Sepioteuthis lessoniana*, **mūhe'e**

Crustaceans (Phylum Arthropoda)

Shrimps
- Banded Coral Shrimp, *Stenopus hispidus*, **'ōpae ohune**
- Marbled Shrimp, *Saron marmoratus*, **'ōpae kai**

Lobsters
- Spiny Lobster, *Panulirus marginatus*, **ula koa'e**
- Sculptured Slipper Lobster, *Parribacus antarcticus*, **ula pāpapa**

Crabs
- Rock Crab, *Grapsus tenuicrustatus*, **'a'ama**
- Pallid Ghost Crab, *Ocypode pallidula*, **'ōhiki**
- Horn-eyed Ghost Crab, *Ocypode ceratophthalma*
- Hermit Crab, **pāpa'i iwi pūpū**

Echinoderms (Phylum Echinodermata)

Sea Stars
- Spotted Linkia, *Linckia multifora*, **i'a hōkū**
- Crown-of-Thorns Star, *Acanthaster planci*
- Cushion Star, *Culcita novaeguineae*, **hāwa'e**
- Brittle Star, *Ophiocoma spp.*, **pe'ape'a**

Urchins
- Rock-boring Urchin, *Echinometra mathaei*, **'ina kea**
- Black or Oblong Urchin, *Echinometra oblonga*, **'ina 'ele 'ele**
- Collector Urchin, *Tripneustes gratilla*, **hāwa'e maoli**
- Banded Urchin, *Echinothrix calamaris*, **wana**
- Blue-black Urchin, *Echinothrix diadema*, **wana**
- Slate Pencil or Red Pencil Urchin, *Heterocentrotus mammillatus*, **hā'uku'uke 'ula'ula**
- Shingle or Helmut Urchin, *Colobocentrotus atratus*, **hā'uke'uke kaupali**

Sea Cucumbers
- Black Sea Cucumber, *Holothuria atra*, **loli okuhi kuhi**
- White-spotted Sea Cucumber, *Actinopyga mauritiana*, **loli**

~~~~~~

General Hawaiian names for coral:	**ʻākoʻakoʻa** **hākoʻakoʻa** **koʻa** **koʻakoʻa** **koʻa kea** **puna kea**
General Hawaiian name for crabs:	**pāpaʻi**
General Hawaiian name for starfish:	**iʻa hōkū**
~~~~~~

Tides

What are tides?

Each day, the surface of the ocean --and those bodies of water that are connected to the ocean (such as gulfs, bays and deltas) --rises and falls. Most ocean shorelines experience high tide and low tide every day. High tide is often referred to as "when the tide comes in;" and low tide as "when the tide goes out."

What causes the tides?

Tides are created by the gravitational pull of our only natural satellite, the Moon, and to a lesser extent, our Sun. Due to its close proximity to the Earth, the Moon's tide-raising power is 2.2 times the tidal influence of the Sun. Because the Moon pulls on the Earth's oceans more than the Sun, the tides usually follow the Moon's cycle.

What is a tidal range?

A tidal range is the difference in the height of the ocean between high tide and the next low tide. The average tidal range around the world is about 6 to 10 feet (2 to 3 meters). In comparison, the tidal range in Hawaii is much smaller, as it typically does not exceed 3 feet. The greatest difference ever recorded between high and low tide was at Burntcoat Head, Nova Scotia, Canada. The tidal range measured 53.38 feet (16.27 meters) in the Bay of Fundy's Minas Basin.

Source: The Handy Ocean Answer Book. Thomas E. Svarney & Patricia Barnes-Svarney, 2000

Further Reading

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Table of Contents: Native Plants

Plants of Hanauma Bay

Aloe barbadensis (A)	ʻAloe, Aloe, Pānini ʻAwaʻawa
Argemone glauca (E)	Pua Kala, Prickly Poppy
Asystasia gangetica (A)	Chinese Violet, Coromandel
Atriplex semibaccata (A)	Australian Saltbush, Creeping Saltbush
Batis maritima (A)	ʻĀkulikuli Kai, Pickleweed, Saltwort
Boerhavia repens (I)	Alena, Anena, Nena
Bougainvillea spp. (A)	Purple Bougainvillea
Calophyllum inophyllum (P)	Kamani, Kamanu, Tamanu
Capparis sandwiciana (E)	Maiapilo, Pilo, Pua Pilo, Native Caper Bush
Cocos nucifera (P)	Niu, Coconut Palm
Colocasia esculenta (P)	Kalo, Taro
Conocarpus erectus (A)	Buttonwood
Cordia subcordata (P)	Kou
Cordyline fruticosa (P)	Kī, Ti
Crinum asiaticum (A)	Grand Crinum
Erythrina indica (A)	Wiliwili Haole, Tiger's Claw, Indian Coral Tree
Ficus benjamina (A)	Weeping Fig
Ficus microcarpa (A)	Chinese Banyan
Gnaphalium sandwicencium (E)	ʻEnaʻena, Pūheu, Native Cudweed, Everlasting
Gossypium tomentosum (E)	Maʻo, Huluhulu
Heliotropium curassavicum (I)	Nena, Kīpūkai, Hinahina, Seaside Heliotrope
Heteropogon contortus (I)	Pili, Twisted Beardgrass
Hibiscus tiliaceus (I) or (P)	Hau
Hibiscus rosa sinensis (A)	Red Hibiscus, Chinese Hibiscus
Ipomoea pes caprae (I)	Pōhuehue, Beach Morning Glory
Jacquemontia ovalifolia (I)	Pāʻū o Hiʻiaka, Kākua o Hiʻiaka, Kaupoʻo
Lantana camara (A)	Lantana, Lākana, Lāʻau Kalakala, Mikinolia Hihiu, Mikinoli Hohono...
Leucaena leucocephala (A)	Koa Haole, Ēkoa, Lilikoa, Wild Tamarind
Lycium sandwicense (I)	ʻAeʻae, ʻĀkulikuli ʻAeʻae, ʻĀkulikuli ʻŌhelo, ʻŌhelo Kai
Melanthera integrifolia (E)	Nehe
Nama sandwicensis (E)	Hinahina Kahakai, Hawaiian Nama
Nephrolepsis cordifolia (I)	Kupukupu, ʻŌkupukupu, Niʻaniʻau
Nototrichium sandwicense (E)	Kuluʻī
Operculina tuberosa (A)	Wood Rose Vine
Pandanus tectorius (I)	Hala, Lauhala, Pū Hala, Pandanus, Screwpine
Phymatosorus scolopendrium (A)	Lauaʻe, Maile Scented Fern
Pittosporum rubra (A)	Japanese Pittosporum
Plumeria rubra (A)	Mexican Yellow Plumeria
Pritchardia beccariana (E)	Loulu, Noulu, Hāwane, Wāhane
Prosopis pallida (A)	Kiawe, Mesquite, Algaroba
Scaevola sericea (I)	Naupaka Kahakai, Huahekili, Aupaka
Schiedea globosa (E)	Hawaiian Schiedea, (Māʻoliʻoli)
Schinus terebinthefolius (A)	Christmas Berry, Wilelaiki
Sesuvium portulacastrum (I)	ʻĀkulikuli, Sea Purslane
Sida fallax (I)	ʻIlima, ʻIlima Papa, ʻIlima Kū Kahakai
Stapelia nobilis (A)	Carrion Flower Plant
Tamarindus indica (A)	Tamarind
Terminalia catappa (A)	Kamani Haole, False Kamani, Tropical or Indian Almond
Thespesia populnea (P)	Milo, Portia Tree
Tournefortia argentea (A)	Tree Heliotrope, Tahinu
Vitex rotundifolia (I)	Pōhinahina, Kolokolo Kahakai
Waltheria indica (I)	ʻUhaloa, ʻAlaʻalapūloa, Hiʻaloa, Kanakaloa
Wikstroemia uva ursi (E)	ʻĀkia, Kauhi

A = Alien E = Endemic I = Indigenous P = Polynesian Introduction

`Ihi`ihilauakea Preserve

The following information has been reproduced with permission from materials developed by the Nature Conservancy of Hawaii. If you would like further information about the preserve, you can reach the Nature Conservancy of Hawaii at: (808)537-4508 or 923 Nuuanu Avenue, Honolulu, HI 96817.

Location: `Ihi`ihilauakea Crater on Koko Head, `Oahu, is one of the best tuff cone examples in Hawaii. The preserve is near the marine life conservation district at Hanauma Bay.

Acreage: 30 acres

Ownership: The City & County of Honolulu

Established: March 1987

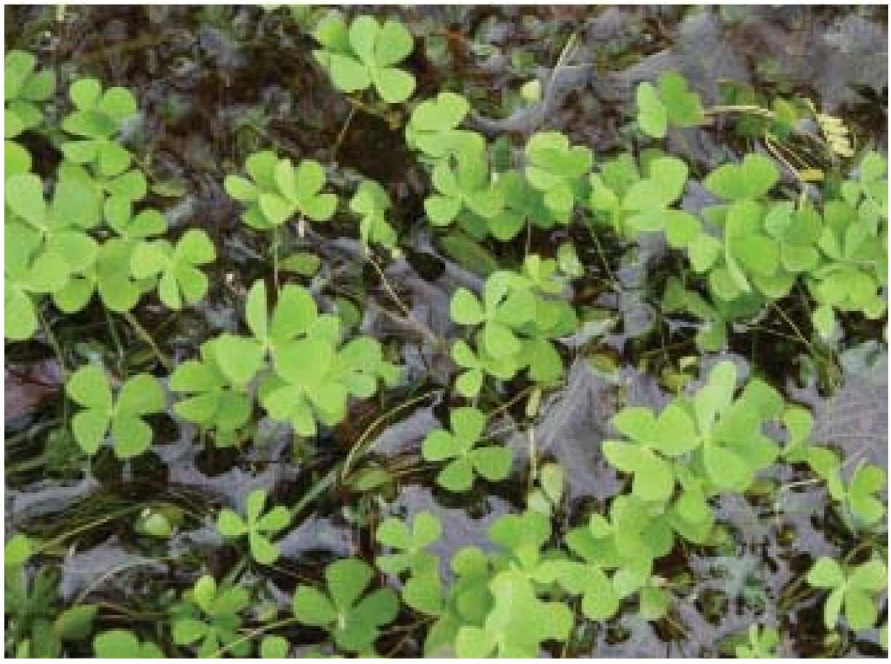
Management: The Nature Conservancy of Hawaii protects the area under a coopera tive management agreement with the City & County of Honolulu. The Hawaiian Botanical Society provides botanical expertise and volunteer labor under agreement with TNCH .

Access: Restricted at City & County request; access permission may be granted by the Nature Conservancy. All groups or individuals must be accompanied by a qualified TNCH or HBS member.

Precipitation range: Annual average: less than 32 inches
January average (wettest month): under 5 inches
July average (driest month): less than 1 inch

Biological *Marsilea villosa* (‘ihi’ihi) is an aquatic fern shaped like a four-leaf clover, and is found only in one other place in the world (also on Oahu). The fern lies dormant in its normally dry environment but needs standing water to reproduce, and therefor depends on an ephemeral (tempor ary) pool for its survival. *Marsilea* reproduced for the first time in a decade after the heavy winter rains of 1987/1998 formed the ephemeral pool in the ‘ihi’ihilauakea Crater. Crustaceans, a tadpole shrimp and crab shrimp species, were also discovered; it is thought that these crustaceans have been dormant in the soil since the ephem eral pool last formed. Non-native kiawe trees partially surround the *Marsilea* population.

Primary threats: Off-road vehicles cause disturbance to the crater’s soil; non-native weeds grow in disturbed areas and crowd out the native *Marsilea*.



`Ihi`ihilauakea

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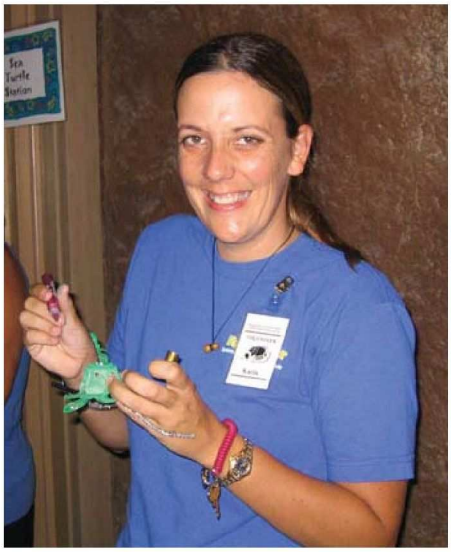
Table of Contents: Interpretive Techniques

The following article appeared in the July/Auguest 2004 issue of Ha'ilono 'o Hanauma...

Reefs Are Alive!

By KARIN FLYNN, HBEP Volunteer

G'day everyone, my name is Karin Flynn and I'm a new volunteer here at the Bay. I have thoroughly enjoyed my first summer helping out at the Nature Preserve. With the help of the education staff, I have developed a short presentation called "Reefs Are Alive". It is a really simple (and hopefully fun!) presentation to give. We have put together a great box of props that contains everything from coral specimens and a plastic jellyfish, to cool close-up pictures of polyps and a very basic script. The props box is usually located in the Docent Room and is clearly labeled "Reefs Are Alive". I usually give the "Reefs Are Alive" talk at the metal humuhumunukunukuapua'a sculpture near the Theater entrance. I find that by standing here it is possible to entertain the visitors enough that it takes their mind off the fact that they are standing in a queue and it's a great way to help visitors understand how they can help to protect the reef. Anyone can do this talk, it is so simple and fun! If you are interested in giving it a try, or you are keen in developing a similar presentation on another topic, have a chat with Morgan. It would be fantastic to get some more environmental education talks going and to educate our visitors about the beauty and diversity that is Hanauma Bay.



Karin joined the volunteer program in May of 2004 shortly after relocating to Kailua, Hawaii from Australia where she worked with the Great Barrier Reef Marine Park Author-

Please see the next 3 pages for an outline and script for Karin's talk...

Reefs Are Alive! *(Example Speech, by Karin Flynn – HBEP Volunteer)*

Objectives:

- To introduce visitors to the living world of Hanauma Bay
- To allow visitors to discover basic yet factual information about corals
- To help visitors recognize their role in the protection and conservation of corals at Hanauma Bay.
- To introduce the volunteers of Hanauma Bay as a source of information
- To help visitors to focus on the marine life at Hanauma Bay and not on the queue.

Preparation:

- Gather any props or pamphlets that you require.
- Do a quick lap of the information centre (at top) and determine the best place to conduct the presentation. At the entry to theater or at the coral display.
- Encourage people in the line (to theatre) to come along and listen (explain to them that if they have their card they will not loose their place in the queue and you will have them back in time to see their film session.

Points to be covered:

- Brief explanation as to what corals are.
- Explanation of polyps, Zooxanthellae

Main Message:

- Coral is a unique yet fragile living organism.
- It is up to all of us to ensure that Hanauma Bay is here for future generations to enjoy, and it is the responsibility of everyone to achieve this important goal.

Props:

- Coral skeleton with large pores eg, lobe coral, mushroom coral
- Plastic jelly fish
- Coral spicules (if possible)
- Picture of bay and or different types of reefs platform etc (if possible)
- Cart (if possible)

Time: 5 – 7 Minutes

Reefs Are Alive! *(Example Speech, by Karin Flynn – HBEP Volunteer)*

Aloha! My name is …….. and I am a volunteer here at Hanauma Bay. Firstly, I would like reassure you that I will be done in time for those of you who have (*time*) tickets. I simply thought it would be a great idea since we are all just standing around waiting that we could all learn something about the marine life here at Hanauma Bay.

I'm going to begin by asking you all a question!!!!
(Hold up a piece of coral and pass it around)
What do you think a coral is: Plant, Animal or Mineral (rock)????
(Wait and encourage responses by looking at people and prompting if necessary. Remember that no responses are wrong as a coral is a unique animal that consists of all three components previously mentioned.)

Well to be honest you are all correct!!! Corals are truly amazing organisms. Corals are technically classified as living animals, but are fairly unique in that they also have a plant and mineral component to them. Confused? Yeah, I was.

The animal part of the coral is called a coral polyp! What is a polyp you say? Well…. Does everyone know what a jellyfish is??? ***(hold up plastic jellyfish).*** Coral polyps are just like an upside down jellyfish (***turn plastic jellyfish upside down).*** Like Jellyfish, they are generally soft and fleshy and have tentacles that they grab their food with, and then feed into their mouth. ***Use tentacles to grab food out of air and put into mouth.***

Living inside the flesh of most corals are thousands of teeny tiny algae called Zooxanthellae *(Zo zanne thal ae).* Like the trees beside us here, the Zooxanthellae algae transform sunlight, carbon dioxide and nutrients found in ocean water, into sugars or food. What I find fascinating is that these Zooxanthellae provide food to the coral polyp, in fact they can produce up to 85% of the coral polyps' food *(in the form of sugars and starches).*
As the coral polyp grows, the zooxanthelle helps it to produce its skeleton. This makes the third component of a coral. Some corals produce a calcium carbonate skeleton on the outside, like this one!! ***(pass around a hard coral skeleton).*** If you look closely at the coral I'm passing around you can see small indentations or holes, each of these holes is home to an individual coral polyp. The polyp excretes the calcium carbonate *(a mineral)* skeleton as it grows. A piece of coral like this, is in fact a colony of hundreds or even thousands of animals.

Some corals take a different form. Some are soft, fleshy and quite flexible. So soft and flexible, that they can often be seen swaying in the ocean currents and waves. Soft corals don't excrete a hard skeleton, instead they have very small splinter like pieces of calcium carbonate called spicules, inside their tissue to give them support and flexibility.

One last thing before you go, please remember that while corals may look like a rock is in fact living reef. What might look like bear rock may actually be the home of a baby coral or a food source for other reef animals like turtles. So when you get down to the bay, please please please do not stand on anything but the sand, as some corals can take decades to

grow back. If any of you see anyone standing on the reef or rocks down at the bay please encourage them to get off as everything down there is living rock and help us protect and conserve the corals of Hanauma Bay for future generations.

Well that's about it folks. Thank you for allowing me the opportunity to inform you about these fascinating animals that have algae in their skin and sometimes have their skeletons on their outsides and look like rocks!

Remember that the volunteers here at Hanauma Bay are here to help and answer any questions you may have. Please do not hesitate to ask anyone wearing one of these blue t-shirts how we can help. Thank you once again for your time and enjoy the short film and your time at the bay.

Ho‘okipa Cart

Ho‘okipa is a Hawaiian word which can mean:

- to entertain
- to show hospitality
- to treat hospitably

When there are volunteers to staff it, the Ho‘okipa Cart will be stationed near the entrance to the Visitor Center so that volunteers can answer visitors’ questions and provide them with an opportunity to learn about the marine environment they will be exploring when they get through the admission area and down to the beach.

During busy times of the year, volunteers are recruited and trained specifically for this job (Ho’okipa Cart Helper). However, all Interpretive Guide volunteers are invited to wheel the cart out into the Visitor Center, or out to the admission line when no Ho’okipa Cart Helpers are scheduled . (This is another great way to spend your time when you are scheduled to help out in the Visitor Center!) When there are long admission lines, a prime spot to position the cart is near the loading zone in the public parking lot, in the shaded area next to the park benches.

If you use the Ho’okipa Cart during your shift, please be sure all of the specimens are put safely away in the cart drawer and cabinet BEFORE wheeling the cart back to the Visitor’s Center where it is stored.

List of potential specimens on the Ho’okipa Cart:

- **Mushroom Coral**
- **Caulifower Coral**
- **Cowry** shell
- **Red Pencil Urchin** spines
- **Collector Urchin** test (= skeleton)
- **Orangespine Unicornfish** tails with spines
- **Shark** jaw
- Juvenile **Hawksbill Sea Turtle**
- Subadult **Green Sea Turtle**

Attached to the Ho’okipa Cart are two sets of **Critter Cards** which have photographs of each specimen, and a corresponding photograph of the living animal. A seperate set of cards, which also includes a brief natural history for each animal, was developed as a learing tool for volunteers. These flashcard sets are available to any HEBP volunteer upon request.

Group Orientation Script *(Sample)*:

(At the commercial lot/loading zone):

Hello and welcome to Hanauma Bay Nature Preserve. My name is _____ and I am a volunteer for the education program and I am going to spend some time talking to you about this special place. First, let's get away from these noisy busses and move over to the shade. Please follow me.

(Under trees between commercial lot and restrooms)

How many of you are visiting Hanauma Bay for the first time? Some of you may already know that Hanauma Bay is Hawaii's first marine life conservation district. Do you know what that means? Since 1967 all of it's marine life has been protected by law. Because no fishing has been allowed for over 35 years, what do you expect to see here that is different from anywhere else on Oahu?

(wait for answers from group)

Right, we have larger fishes, a greater variety of marine life, and denser fish populations than at any other beach on Oahu…and yes, we have a lot of those fishes that people like to catch and eat. It also means that there are lots of rules our visitors must follow to help us protect it. Please follow me to the lookout for a better view.

(At any lookout):

Now, I'd like you all to line up along the wall and take a look around. Tell me what you see.

(wait for answers from group)

If you look closely, you can see that you are entering a compound volcanic crater that is open on one side to the ocean. By compound, I mean that there are at least two craters, one outside of the other. How many of you have seen video of those flowing orange lava eruptions from the Big Island? Well, this was much different. Before all this was here, we would have been standing in the ocean. About 35,000 years ago, that molten magma – or liquid rock – came into contact with water-bearing rock right under where we are standing. Any guesses on what happens when really hot liquid rock meets water that is locked up in rock? The water expands really quickly, blowing the rock apart...extremely explosive. These explosive eruptions blasted through an existing coral reef and through the underlying basalt, shooting chunks of each up into the air and depositing them around the rim in a bed of ash. When you walk down the road, take a look into the walls. The white rocks you see are parts of that coral reef that blew up about 35,000 years ago. The black chunks are pieces of the koolau basalt (lava rock) that pre-date the formation of this bay by about 2 million years.

There is some debate whether or not a seaward wall ever formed, but about 7,000 years ago the ocean rose to about where it is now, bringing with it all that you see below (aside from the snorkelers and the man-made things). If you look down you will see that we now have a nicely developed fringing reef...a reef that starts from shore and grows outward. The area inside of where the waves are breaking is called the reef flat and consists mostly of coralline algae, a plant-like organism that lays down a hard calcium carbonate (or limestone) deposit. All those rocks in the water are really part of a living reef. Those "rocks" are made from living things – and are still alive. Walking and sitting on the reef can damage it, so we are asking that you all help us protect it by walking only in the sandy areas if you have to stand at all. We would prefer that you swim only. Additionally, the reef may be sharp and eels do live in and around the reef, so avoiding contact with the reef may also keep you from harm.

For you adventurous types who insist on exploring the deeper waters beyond the reef flat, there are two deeper channels that allow you to swim out without having to walk or crawl over the reef. One channel is at the seaward end of the last sand channel on the left hand side of the Bay. The other is just to the right of the black rocks sticking out of the water in the middle of the Bay. Please keep in mind that waves bring water over the reef. That water leaves through the deeper channels, so there is always a current that runs out... never back in. At times, the current is so strong that it resembles a river. Can you see the current? This is where even strong swimmers get into trouble.

If you decide to go out there we have a few recommendations:

- you should be a strong swimmer
- you should be a competent snorkeler
- wear swim fins
- you should save lots of energy to fight a current on your way back in
- you should always swim with a buddy
- **and lastly, you should talk to the lifeguards about the conditions before heading out. They are, after all, the ones who will have to save you should you exceed your limits!**

Please follow me to our next stop.

(Stop by the "no smoking" sign at entrance)

One of our major problems today is that Hanauma Bay is far too popular for its own good. We receive about a million people annually, most come from places like _____ or _____ where there are no living reefs. They have no idea how delicate this place is, so they don't know how to visit this place without damaging it.

We feel that most of the visitors come here to enjoy our beautiful reef ecosystem, not to damage it. They just don't know any better. If they knew how to help protect it, they would. Our job is to raise the visitors' awareness on the reef's delicate nature, protecting the reef through education.

To accomplish this we have this new education center. Its centerpiece is a small theater where visitors are shown a short video addressing some of our major concerns. Additionally, there are lots of great displays that visitors can check out either before or after they go to the beach. This provides great opportunities for those who want to learn more about Hanauma Bay.

(have the group wait in front of the tile mural while you check them in w/the cashiers)

(At the Mural)

This mural shows how the bay really looks in certain places. As you can see, there is a great variety of fishes and reef life out there. I'd like to point out a few of the inhabitants. Here (top right) you see one of many kinds of surgeonfishes. They call these surgeonfishes because of the sharp blade or scalpel at the base of the tail. They use this as a weapon in self-defense.

There are also many interesting interactions on the reef. (point at the cleaner wrasse and parrotfish) Here you can see a cleaner wrasse cleaning a parrotfish. This is a nice type of symbiotic relationship called "mutualism," one in which both participating individuals benefit. In this case, the parrotfish has harmful parasites and unhealthy tissue removed from its body and the cleaner wrasse gets a meal.

One of the meanings of Hanauma can be "arm wrestling bay." *Hana* means bay and *Uma* can mean arm wrestling (it can also mean "curved" or "the stern of a canoe"). Here you can see that the artist shows the reef in an arm wrestling clench. Just below the wrestling reef is the shape of our island, Oahu. And he placed Hawaii's former state fish, the humuhumunukunukuapua`a, kissing Hanauma Bay. (teach group how to say humuhumunukunuku-apua`a)

Please follow me into the Education Center.

(Stop in front of the coral reef model)

This is our imitation reef. This is all made from synthetic material. We ask that you all refrain from touching this because like the real reef, what do you think will happen if a million people a year touch this? You got it, it would be damaged pretty quickly.

(This a good spot to show people not only what living coral looks like but also to show that even the underlying rocky material is alive.)
This stuff that looks like rock is made of crustose coralline and filamentous algae and often has small invertebrates living on it. Much of this is very delicate and can be damaged by walking or sitting on it. You all can help us protect it by walking only in the sandy areas while in the water.

We have a number off different displays throughout this building. I encourage you to check them out at some point today. Right now, I'd like to take you into our classroom to show you a video. Please come with me.

(In Classroom after everyone sits down)

I've mentioned that we have about a million visitors each year. One way we're trying to protect this place is through public education. The video I'm about to show you is also shown to everyone visiting the Bay. This video was designed to give you all an idea of how this place formed, what you're likely to see, and how to help protect this place.

I'd like you all to relax and enjoy this video, but I'd also like you to pay close attention to the messages given. After the film is over, we'll review these messages to make sure you understand them and then I'll set you free.

(after video)

So tell me, what were the important messages in the video? (let them go through answers)

(after reviewing)

I want you all to have a good, safe time while you're here. Please keep in mind that the people of Hawaii have invited you all to enjoy this place with one condition: that you treat Hanauma Bay with respect. Have fun and thank you for listening. Follow me and I'll show you the way to the beach.

(lead them down the back stairwell)

Green Turtles: a complex past and troubling future

A. Set the stage: introduction and where are you from?
B. One of the most popular "Where are the…" type questions is "Where are the restrooms." Probably the second most popular question is "Where can I see the turtles?"
    a. It is very rare for a visitor to ask "Where are the teardrop butterflyfish" or "Where are the orangespine unicornfish?"
    b. Although sea turtles are reptiles, like snakes and lizards, many people describe their encounters with sea turtles using expressions of awe and endearment. To see them is a goal, to be near them is a wish, and to commune with them is a dream. I doubt other snakes and lizards receive such a standing ovation when they make a sudden appearance!
C. There are seven species of sea turtles world-wide:
    a. Green turtle (honu)
    b. Hawksbill
    c. Loggerhead
    d. Olive ridley
    e. Kemp's ridley
    f. Australian Flatback
    g. and the Leatherback
D. Presence in Hawaii:
    a. Of these, the Flatback and Kemp's ridley have never been observed in Hawaiian waters (Flatback in Australia; Kemp's ridley in the Atlantic).
    b. The Olive ridley and the Loggerhead are found in the Pacific, but are very rare in nearshore Hawaiian waters.
    c. The Leatherback, although not nesting on Hawaiian Islands, is an inhabitant of pelagic Hawaiian waters.
    d. The Hawksbill is a resident of these isles, and an occasional nester on the Big Island, Moloka'i, and Maui.
    e. The Green turtle is our most common turtle, in Hanauma Bay and elsewhere on the Hawaiian Islands.
    f. All are threatened or endangered, and protected by state and federal laws, and by international treaties regulating international trade of wildlife.
E. Which is which?
    a. Basic anatomy (use model)
        i. Carapace (top shell)
        ii. Plastron (bottom shell)
        iii. Non-retractable head and flippers
        iv. Scutes, or "scales" on carapace
        v. Claws on flippers
        vi. Prefrontal scales

vii. Overall size and appearance

b. Leatherback (model skull)
   i. Lacks scute-covered shell ("leathery shell"
   ii. Lacks head scales
   iii. Lacks claws
   iv. Large! (model)
   v. Pelagic
   vi. Jellyfish primary food

c. Hawksbill (model)
   i. 2 pair prefrontal scales
   ii. 2 claws on each flipper
   iii. Overlapping scutes
   iv. Head nearly 2x as long as wide (model skull)
   v. Eats primarily sponges and other invertebrates

d. Green turtle (model)
   i. 1 pair prefrontal scales
   ii. 1 claw on each flipper
   iii. 4 pairs lateral scutes
   iv. Non-overlapping scutes
   v. Common in Hawaiian nearshore waters
   vi. Eats algae/limu in Hawaiian foraging pastures (juveniles inverts and fish eggs)
   vii. The term "green" in the name refers not to carapace color, but to the color of the turtle's subdermal fat.

F. Green turtles and their eggs have been eaten, and esteemed, by natives of the Pacific region for centuries. From Recovery Plan, page 6: "Religious, ceremonial, and other traditional restrictions on the capture, killing, distribution and consumption of green turtles played an important role in their utilization. For example, in the Hawaiian Islands there were families that considered the green turtle to be a personal family deity or "aumakua", not to be eaten or harmed. One legendary turtle in particular named Kauila was believed to be able to change at will into human form to watch over village children playing along the shoreline. Artistic elements of green turtles have also been featured prominently in some cultures of the region, such as in petroglyphs and tattoo designs." (trace in sand)

G. The complex life history of sea turtles, along with their legendary migration patterns, captures our imagination. Here is one story.
   a. On a partly overcast night on French Frigate Shoals, a classic atoll (eroded volcano surrounded by coral reefs with numerous small sandy islands) approximately 600 miles WNW of where we stand, a female honu pokes her head through the surf and looks toward shore. She was last here 25 years ago, emerging from her nest with 100 other brothers and sisters and making a dash to the sea. Her mother, after laying her eggs, disappeared from her life, forever, as do all mother sea turtles.
   b. Since hatching, she has traveled thousands and thousands of miles, swim-

ming in the mid Pacific, but except for a few times hauling her body onshore on the Big Island to bask in the sun, she had not been on dry land in 25 years. Over the past few years, she has lived here in Hanauma Bay. Mating offshore near the nesting beaches is literally a wild ride, as an experienced male approached her from above, settled on her back, and clasped her with his front claws gripping the edge of her carapace, and his long tail wrapped between her hind flippers. With the eggs fertilized and mature, they need to be laid. She chooses, through a process only she can understand, a particular stretch of beach.

i. The surf deposits her on the slick sand, and she uses her flippers in tandem, front, then back, front, then back, to haul her 200 plus pounds up the beach (flippers superbly adapted for swimming, not crawling). She picks her spot, not too close to the water for her eggs to drown (she is an air breather, remember, and so are the eggs), nor too far away for the hatchlings to be able to return to the sea. After selecting her spot and clearing it with her front flippers, she uses her hind flippers to scoop out a chamber as far as she can reach. Then, after a pause, the eggs begin to drop 1-3 at a time, with a slight pause between each drop, After 100-110 eggs fall, she pauses again, then uses her hind flippers to fill in the egg chamber. When filled, she throws sand around with her front flippers, probably hiding her nest and diluting the odor of the eggs. She may move away and throw sand around again, perhaps making a false nesting area to throw off egg predators, until finally, after a couple of hours on dry land, she returns to the sea to recover her strength. She does all this from instinct.

ii. A honu at French Frigate Shoal lays eggs;

1. 1-6 clutches of eggs (mean 1.8)
2. approximately 12 days apart
3. sex ratio about 50-50 here? Temperature of egg at critical time determines sex ("temperature-dependent sex determination"). 27 degrees c and less, all males; 31 degrees C and above all females
4. incubation for about 2 months (54-88 days)
5. 90% + success rate for hatching?
6. 200-700 females nest annually

iii. Finally she returns to Hanauma Bay, to feed and rest until the next breeding attempt in 2-3 years (males every year?). In 1991, 3 females were satellite-tracked from FFS to O'ahu. They traveled "beyond sight of land in water thousands of meters deep, two of them against prevailing winds and currents" (Recovery Plan, page 15). Amazing feat of navigation!

c. Meanwhile, back on the ranch…

i. The eggs hatch within 1-2 days of each other. They use an "elevator technique" to move to the surface. Sensing a cooling of the sand, they "erupt", and move toward the brighter horizon ("photopositive"). Hitting the water, they:
   1. get through the surf
   2. begin app. 24 hours of frenzied swimming through the coastal currents
   3. move into the oceanic currents, or gyres
   4. need to escape ghost crabs, some birds (rare at night), and especially the predacious and voracious reef fish.
   5. they disappear for some time (2-5 years?) until the survivors (very few, est. 1-2 out of 100) return to the main Hawaiian Islands about dinner plate size (35 cm SCL)

ii. Until they reach maturity (carapace about a yard/meter long, average 92 cm SCL), and for years afterward (70-100 years?), they will roam the main islands. They show some site fidelity to a particular feeding and resting area. They will grow about an inch per year. There are cleaning stations where they are "groomed" by fish to remove ectoparasites.

iii. While growing, green turtles need to watch out for their natural predators, tiger sharks. Note coloration (dark above and light below) that probably is an adaptation for reducing this predation risk. Also, they are very agile in water, which also helps them avoid predation.

iv. Unnatural predation: for all species
   1. boats and propellers
   2. fishing lines
   3. fishing nets
   4. use of turtles as meat, leather, or ornaments
   5. use of eggs as food.. note impacts on eggs and adults, located in very different areas with different laws and customs
   6. destruction of nesting sites
   7. loss of foraging habitats
   8. pollution (entanglement, ingestion, toxic spills)
   9. locally, concern over tumorous disease, fibropapillomatosis, caused by herpes virus, but why? Key effect is interference with swimming, feeding, breathing, or seeing. (50% infection rate in Kanehoe Bay).

H. How can you help?
   a. Don't purchase products made of turtles.
   b. Don't contribute to pollution in the sea.
   c. Encourage utilization of turtle-friendly fishing and conservation practices.
   d. Education yourself and your friends.
   e. Protect the reefs.

I. For more information:

a. National Marine Fisheries Service (NMFS) website
b. Books
    i. Fire in the Turtle House, by Osha Gray Davidson
    ii. Anything by Archie Carr
    iii. Great local book by Waimanalo artist Patrick Ching
c. Any presentation by George Balazs, NMFS, Honolulu
d. NMFS turtle recovery plans… really quite readable

Robert H. Schmidt (HBEP Volunteer)
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