



THE CASE OF THE INVADDED REEF

EVIDENCE DATA SHEET 1

Team Name: _____

Date: _____

- Lay out the transect line in the area of the scene of the invaded reef. Have members of your team hold each end of the rope.
- Place the quadrat in the water at the beginning of the transect line.
- Use the species identification cards to identify suspects and record all species that you find within the quadrat. If you are unable to identify a species, sketch it and give it a name. (Make a detailed sketch so you can research it later.)
- Estimate and record the percentage of area that each species covers within the quadrat. Then move two meters along the line, place the quadrat down and record again. Repeat the process until you have sampled at least three areas.

Sample Area	Species Found	Percent Cover (For each species, estimate the percent cover)
1		
2		
3		
4		
5		

(Notes: On the other side of this sheet record your observations of the invaded reef.)



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EVIDENCE DATA SHEET 2

We will be measuring the concentration of nitrogen (in the form of nitrates) in the near shore water. The concentration is measured in mg/L, which is equivalent to parts per million (ppm).

Nitrates are important for living organisms to make proteins. Although important to living organisms, if nitrate levels are too high, this can upset the natural balance of life on the reef. The Environmental Protection Agency has set standards for the amounts of nitrate in the environment. Mā'alaea Bay is classified as Class A pristine waters with a standard for nitrates ranging between 0.08 mg/L (wet season) to 0.05 mg/L (dry season) (*Chapter 54 of Title 11 of the Hawai'i Administrative Rules*).

Method: Collect seawater samples from two sites along each transect line. Collect seawater at the beginning of each transect and at the end.

Follow the directions on the nitrate test kits. Use gloves and safety goggles when handling the chemicals in the test kits. Record your results below:

Data:

Transect 1	Site 1 Nitrates in mg/L	Site 2 Nitrates in mg/L
Transect 2	Site 1 Nitrates in mg/L	Site 2 Nitrates in mg/L

- Compute the average value for the four sites. What can you conclude from this data? How does it relate to the Case of the Invaded Reef?

1. If there is no evidence of nitrates at Kō'ie'ie Fishpond, can we assume that we would get similar measures at other areas in Mā'alaea Bay? Why or why not?

2. Where would you expect nitrate levels to be higher?

3. What conditions might contribute to higher nitrate levels at different times?

Note: Nitrate is the end result of the conversion by the nitrifying bacteria *Nitrobacter* and is considered to be relatively non-toxic to fish. However, if nitrates are continually present in an over abundant amount, fish will die. Nitrates become toxic to fish (and plants) at levels of 50-300 ppm, depending on the fish species. For young fish, much lower concentrations become toxic and nitrate levels should not exceed 40 ppm.



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LEARNING LOG - 6

Investigator's Name: _____

Date: _____

Your task:

- Find out who the invaders are!
- Gather evidence of what allowed this invasion to occur.

Hypothesis 1: Write your hypothesis about who the invaders are.

Hypothesis 2: Write your hypothesis about conditions that allowed the invasion to happen.

Method: Describe the method you will use to solve the case.

Summary of Evidence Gathered: Interviews: Summarize key points from interviews.



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CRIME SCENE REPORT

Preliminary Investigator: Dr. Pheelay O'Pheesh, Marine Biologist

Location: Kō'ie'ie Fishpond – Native Hawaiian Fishpond, Mā'alaea Bay (see map provided)

Crime Scene: Throughout Mā'alaea Bay, there has been a severe loss of living coral. Degrading reefs have changed from being actively growing and structurally-complex habitats, into eroding and relatively flat areas. Fish stocks are in very poor condition. New coral growth is inhibited. The reef around Kō'ie'ie Fishpond is also invaded. There is evidence of sediment from land in the fishpond.

Investigator's Notes: History of Mā'alaea Bay:

Mā'alaea Bay has witnessed many changes due to human activities over time. Prior to Western contact, early Hawaiians raised fish in at least four different fishponds constructed along the shoreline of the bay. The presence of fishponds is evidence that the area was very productive with reef fish and that coral reefs were healthy. In the late 1800s, rapid deforestation occurred along the slopes of Haleakalā and heavy rainfall and flooding spilled into the bay. A once bustling fishing community in South Maui quickly declined and the shores remained quiet for decades. After World War II, fishponds were damaged and silt continued to be deposited within the ponds.

In 1972, Mā'alaea reefs were described as being “striking in their diversity and in the presence of rare coral species” (Sparks, 2007).

Since the 1970s, the South Maui shoreline has experienced a rapid growth in urban development.

In 1994, Mā'alaea Bay had an estimated coral coverage (the amount of reef covered by living coral) of 50% to 75%.

Continued development of the South Maui shoreline led to the creation of sewage injection wells. Three wells were constructed in Kīhei to meet the demand of an increasing urban population. Treated wastewater from the sewage treatment plant is injected deep into the ground in these wells. There is evidence that some of the nutrient-rich water is seeping from these wells into the ocean.

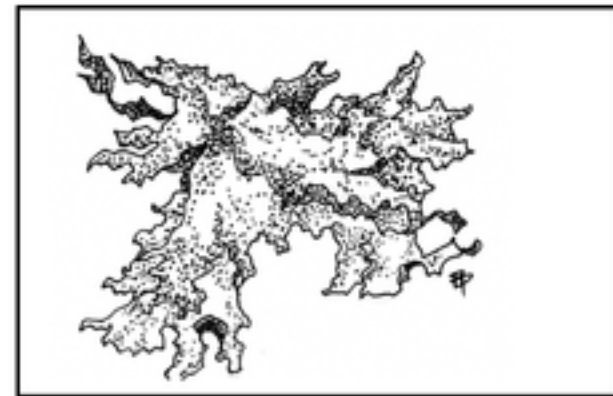
By 2006, the reefs of Mā'alaea Bay experienced a dramatic decrease in coral cover to only 4%. Populations of reef fish also declined dramatically.

The reef ecosystem has been invaded and it is now out of balance. Your task is to identify who has invaded the reef and what factors allowed the invasion to occur.

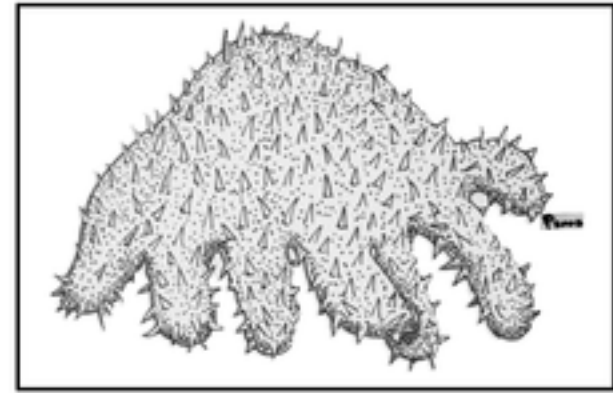


Suspects: All of the following species are suspected invaders!

1 Sea lettuce (*Ulva* spp.) This suspect is native to Hawai'i. It is one of the first seaweeds to establish in an intertidal zone area where fresh water is present. Suspect has reputation for quickly reproducing into thick mats that smother its victims.



2 Crown-of-thorns (*Acanthaster planci*) has been sited in exceptionally large numbers in certain areas of the Pacific. This thorny predator is known to prey on coral. Distinguishing features: barbed-like body that it uses in defense.



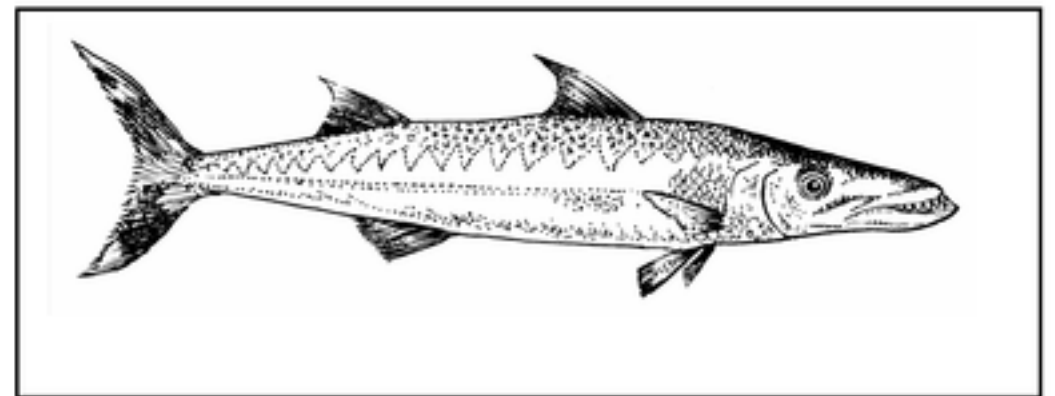
3 Hookweed (*Hypnea musciformis*) is a highly opportunistic invader and has been seen growing in Mā'alaea Bay. Introduced to Kāne'ohe Bay in 1974 for commercial consumption, hookweed has spread to Maui and Moloka'i. This suspect "hooks" itself onto other floating seaweeds and objects. It has a tremendously high reproductive rate and can double its biomass in just two days. Warning: Suspect aggressive. Apprehend with caution.



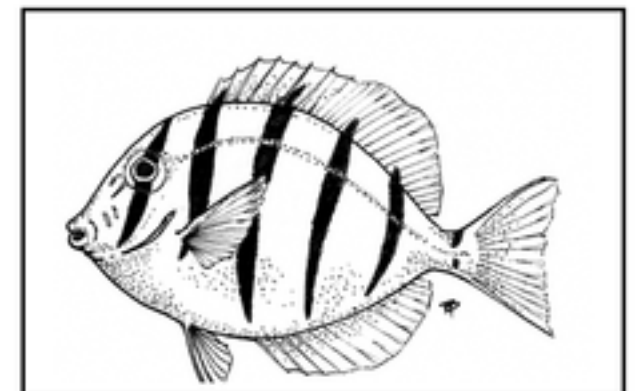
4 Prickly seaweed (*Acanthophora spicifera*) is very aggressive and it is reported to be the most widespread alien in the Islands.



5 The barracuda (*Sphyraena barracuda*) is also known as *kākū*. Suspect is very efficient predator on the reef and has been spotted in Mā'alaea Bay. It is second only to sharks as a predator. It is attracted to shiny fish scales and shiny objects and have been known to be aggressive toward divers with shiny equipment.



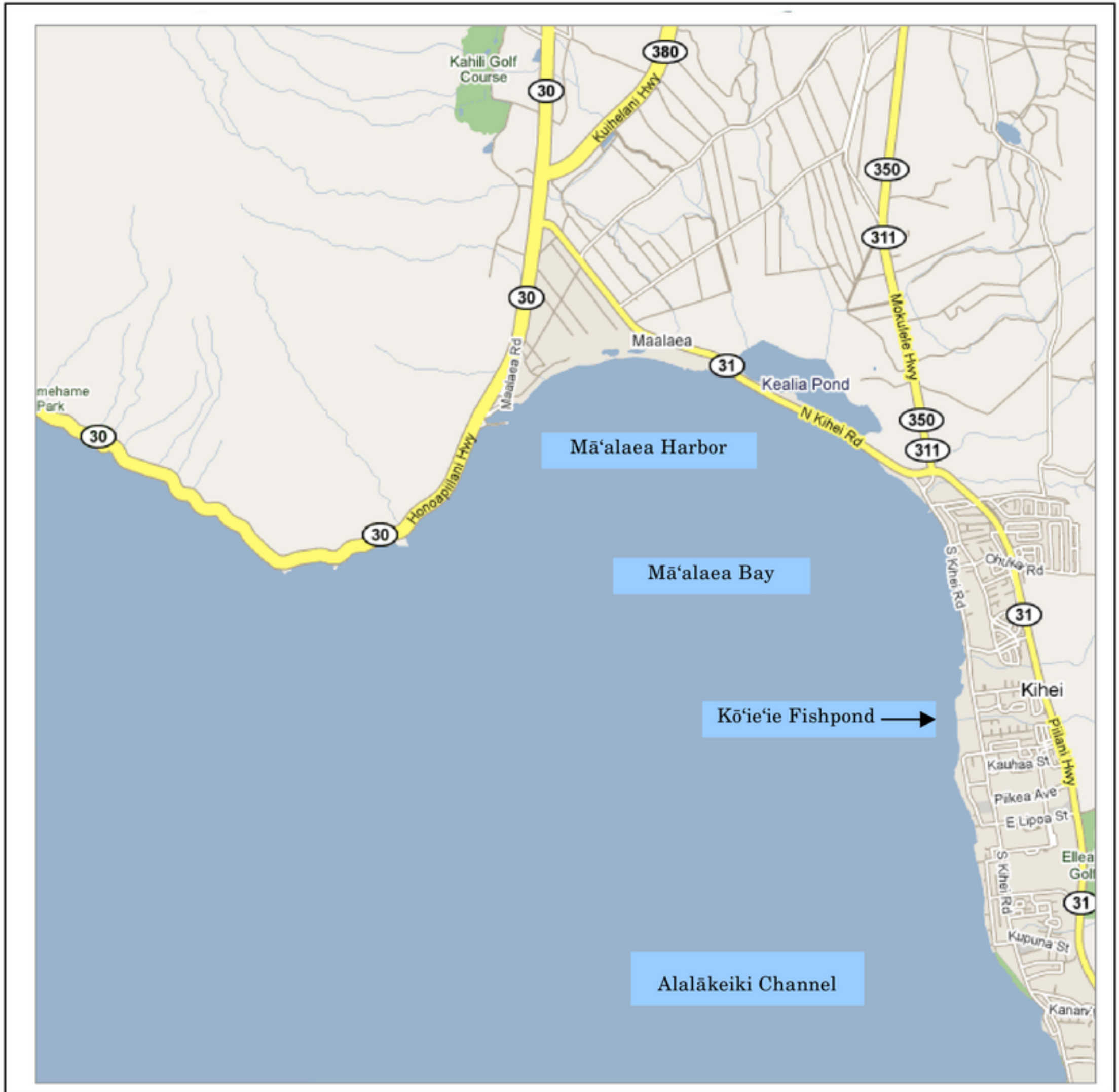
6 The convict tang (*Acanthurus triostegus*) is commonly found at Kō'ie'ie Fishpond. Suspect is often seen grazing the rocks and scavenging coral heads. Suspect has a reputation to hover in large groups. Young convict tangs find shelter within the crevices of the fishpond's wall.





Crime Scene Report

Map of Mā'ālaea Bay



Source: *Map of Mā'ālaea Bay by Google.*

