

## Ke'e Beach biological resource assessment

### Site description

*Reef flat* – This area is shallow, usually less than 5 feet at high tide and exposed at extreme lows. The reef flat off Ke'e Beach is physically divided into two distinct areas. The northwest section off the flat has been undermined by wave action, and subterranean tunnels penetrate the reef through crevices 3 to 10 feet wide. The eastern section of the reef is flat with little variation in relief. Very little rubble or sand occurs on the reef flat. The only large quantity of sand lies off the beach to the west of the reef flat, where there is a small sandy moat.

*Inner lagoon* – Less than 10 feet deep with some small rocky outcrops. Minimal marine life present here.

*Forereef* – Seaward of the reef flat is an area characterized by irregular bottom topography. A series of limestone ridges parallels the shore and extends seaward for more than 1,200 feet. Depth ranges from 10 to 20 feet on the ridge crest to greater than 50 feet in the sand-filled troughs. The shoreward slope of the ridges is ca. 20-45 degrees, but the seaward slope is much steeper and is sometimes vertical. Ridge tops are 50 to 100 feet in width and have deep depressions, crevices, and trenches usually filled with limestone rubble. Very coarse sand accumulates in channels that are 3 to 50 feet and occasionally up to 120 feet wide between the ridges.

### Fish populations

#### *Assessment of fish populations*

Visual belt transects (25 x 5 m) were conducted in the lagoon and along the reef flat at Ke'e Beach to assess fish abundance in these habitats. Transects were confined to the area inside the reef crest (the area of breaking waves) because the vast majority of snorkeling and other recreational activities were concentrated in the lagoon and along the reef flat. Fish abundance inside the lagoon was very low except for a school of ~ 20 yellow goatfish (weke'ula, *Mulloidichthys vanicolensis*) observed foraging in the sand. These goatfish feed on shrimp, crabs, and other mobile invertebrates that inhabit the sandy lagoon floor.

Overall, fish species richness was low with only 40 species from 15 families observed in the area (Table 1). Wrasses, surgeonfishes, and damselfishes comprised the majority of the species observed in the lagoon and along the reef flat at Ke'e. Fish diversity is much greater on the seaward side of the reef crest and studies conducted nearby off Limahuli Stream and in Hanalei Bay recorded over 160 species of fishes in these areas.

The endemic saddle wrasse, hinalea lau-wili (*Thalassoma duperrey*) was the abundance species observed on visual belt transects in the lagoon and along the reef flat at Ke'e. This species occurred in 83% of all transects and accounted for nearly one half of all fishes observed. Another endemic species, the belted wrasse (omaka, *Stethojulis balteata*) was the second most abundance species observed on transects, accounting for slightly more than 20% of all fishes and

also occurring in 83% of all transects. The convict tang, manini (*Acanthurus triostegus sandvicensis*), is regarded as a hawaiian subspecies and was the third most abundant fish species and accounted for just over 9% of the fishes observed on transects. Most of the individuals of this species were juveniles in the 4 to 6 cm size range.

Most of the fishes observed at Ke'e were small in size and had a low biomass standing stock. Many of the wrasses and damselfishes are small as adults, usually less than 15 cm in length. This habitat appeared to provide good juvenile habitat for surgeonfishes and wrasses. The saddle wrasse also dominated the fish assemblage by weight accounting for 48.8% of the total reef fish biomass, followed by belted wrasse which accounted for 11.2% of total reef fish biomass. The third most abundant fish by weight (7.7%) was the brown surgeonfish, ma'i'i'i (*Acanthurus nigrofusus*). This was one of the few species that occurred in this habitat as an adult.

Table 1. Fish families and number of species observed in each family observed along Ke'e lagoon and reef flat, Ha'ena State Park, Kauai.

Family	Common name	Number of species
Labridae	Wrasses	9
Acanthuridae	Surgeonfishes	7
Pomacentridae	Damselfishes	5
Kyphosidae	Rudderfishes	3
Mullidae	Goatfishes	3
Balistidae	Triggerfishes	2
Blennidae	Blennys	2
Chaetodontidae	Butterflyfishes	2
Atherinidae	Silversides	1
Carangidae	Jacks	1
Cirrhitidae	Hawkfishes	1
Fistulariidae	Coronetfishes	1
Scaridae	Parrotfishes	1
Serranidae	Groupers	1
Tetraodontidae	Pufferfishes	1
Grand Total		40

Fish that feed on mobile invertebrates were the dominant trophic group by weight (78%) and number (82%) (Figure 1). This group was dominated by the wrasses, which feed primarily on small shrimp and crabs. Herbivores accounted for 16% of the total number of individuals and 21% of the total weight of fishes observed on transects. Surgeonfishes were the primary mobile grazers while damselfishes were the resident benthic herbivores.

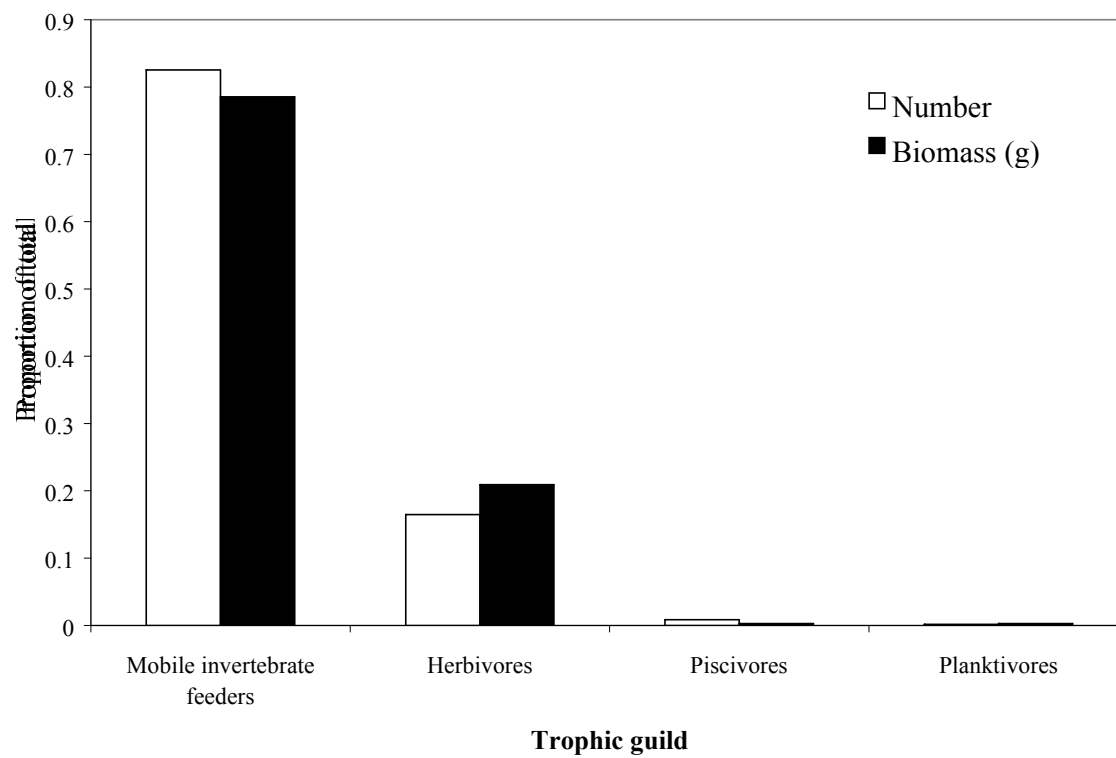


Figure 1. Trophic comparisons for reef fish assemblage at Ke'e Beach, Kauai.

Table 2. Rank abundance of dominant species observed on transects (25 x 5 m) in the lagoon and along the reef flat at Ke'e Beach. Species are ranked according to Index of Relative Dominance (IRD = Frequency of occurrence x relative abundance).

Family	Species	Common name	Hawaiian name	Frequency occurrence	Relative abundance	biomass	IRD
Labridae	<i>Thalassoma duperrey</i>	Saddle wrasse	hinalea lau-wili	83.33%	49.44%	48.82%	41.20
Labridae	<i>Stethojulis balteata</i>	Belted wrasse	omaka	83.33%	20.11%	11.19%	16.76
Acanthuridae	<i>Acanthurus triostegus</i>	Convict tang	manini	83.33%	9.08%	2.07%	7.57
Labridae	<i>Thalassoma trilobatum</i>	Christmas wrasse	awela	83.33%	5.31%	7.03%	4.42
Pomocentridae	<i>Plectroglyphidodon imparipennis</i>	Brighteye damselfish		66.67%	5.31%	1.03%	3.54
Pomocentridae	<i>Stegastes fasciolatus</i>	Pacific gregory		50.00%	4.19%	6.77%	2.09
Acanthuridae	<i>Acanthurus nigrofuscus</i>	Brown surgeonfish	ma'i'i'i	66.67%	2.51%	7.75%	1.68
Fistulariidae	<i>Fistularia commersonii</i>	Cornetfish	nunupeke	50.00%	0.70%	0.22%	0.35
Labridae	<i>Coris venusta</i>	Elegant coris		33.33%	0.84%	0.39%	0.28
Balistidae	<i>Rhinecanthus rectangulus</i>	Reef triggerfish	humuhumu-nukunuku-a-pua'a	50.00%	0.42%	2.67%	0.21
Labridae	<i>Gomphosus varius</i>	Bird wrasse	aki-lolo	33.33%	0.28%	0.45%	0.09
Acanthuridae	<i>Acanthurus leucopareius</i>	Whitebar surgeonfish	maikoiko	16.67%	0.28%	1.52%	0.05
Mullidae	<i>Mulloidichthys vanicolensis</i>	Yellowfin goatfish	weke'ula	16.67%	0.28%	2.70%	0.05
Pomocentridae	<i>Abudefduf abdominalis</i>	Hawaiian sergeant	maomao	16.67%	0.14%	0.26%	0.02
Pomocentridae	<i>Abudefduf sordidus</i>	Blackspot sergeant	kupipi	16.67%	0.14%	0.98%	0.02
Acanthuridae	<i>Acanthurus achilles</i>	Achilles tang	paku'iku'i	16.67%	0.14%	0.31%	0.02
Cirrhitidae	<i>Cirrhitops fasciatus</i>	Redbar hawkfish	pili'ko'a	16.67%	0.14%	0.15%	0.02
Labridae	<i>Coris flavovittata</i>	Yellowstripe coris	hilu	16.67%	0.14%	0.05%	0.02
Kyphosidae	<i>Kyphosus species</i>	Rudderfish species	nenu	16.67%	0.14%	1.53%	0.02
Mullidae	<i>Parupeneus porphyreus</i>	Whitesaddle goatfish	kumu	16.67%	0.14%	1.42%	0.02
Blennidae	<i>Plagiotremus goslinei</i>	Scale eating blenny		16.67%	0.14%	0.04%	0.02
Labridae	<i>Thalassoma purpuraceum</i>	Surge wrasse	hou	16.67%	0.14%	2.67%	0.02

### *Human impacts*

Ke'e lagoon and reef flat, while not a highly diverse area for reef fishes, provides an excellent habitat for juvenile reef fishes. The reef flat provided a good habitat for grazing surgeonfishes as well. Fishing is probably the major human activity that negatively impacts fishes at Ke'e. Indiscriminant use and discard of inexpensive monofilament gillnets has had a major effect of reef fish throughout the state of Hawaii. This method of fishing takes even unwanted species and also leads to habitat destruction. Spear fishing on SCUBA and excess take of prized resources species has led to severe declines in fish populations. Traditional fisheries management practices in Hawaii and throughout the Pacific relied on a variety of activities to ensure that the resources would be harvested in a sustainable manner (Table 3). There is a need to involve the community and develop a code of fishing conduct that will lead to sustainable fishing practices in the future.

**Table 3. Traditional management of fisheries resource in the Pacific**

- Community reef tenure
- Closed areas
- Closed seasons
- Allow portion of catch to escape
- Hold excess catch in enclosures
- Ban on small individuals
- Lagoon fishing restricted to poor weather conditions
- Restrict number of fishing gear

Fish feeding did not appear to be a major concern at Ke'e. The abundance and behavior of fishes that are attracted to feeding activities such as rubberfishes were not substantially higher than observed in other areas. Down the road at Tunnels, a popular snorkeling and diving location, the rudderfishes appeared much more abundant and readily approached divers and snorkelers.

### Benthic resources

Carl, this is your gig here. Low coral cover. Robust reef development.

Seventeen species of coral are recorded, and all but one genera (*Pocillopora*) are of the encrusting type. The predominance of encrusting corals may be an indication that periodic storm waves restrict coral development. *Porites lobata* is relatively common, and abundant on offshore slopes. Algae and the burrowing sea urchin (*Echinometra mathaei*) are relatively abundant on the reef flat. Sea urchins comprise most of the conspicuous macroinvertebrates. Small *Conus* spp. are also common on the reef flat.

### *Human impacts*

Walking on reef but may be more perception than problem due to nature of reef

Appendix I. List of fish species observed in the lagoon and on the reef flat at Ke'e Lagoon, Ha'ena State Park, Kauai. Species are listed in phylogenetic order.

Family	Species	COMMON	Hawaiian
Atherinidae	<i>Atherinomorus insularum</i>	Hawaiian silverside	'iao
Fistulariidae	<i>Fistularia commersonii</i>	Cornetfish	nunupeke
Serranidae	<i>Cephalopholis argus</i>	Blue spotted grouper	roi
Carangidae	<i>Caranx Melampygus</i>	Blue jack	omilu
Mullidae	<i>Parupeneus porphyreus</i>	Whitesaddle goatfish	kumu
Mullidae	<i>Mulloidichthys vanicolensis</i>	Yellowfin goatfish	weke'ula
Mullidae	<i>Parupeneus multifasciatus</i>	Manybar goatfish	moana
Kyphosidae	<i>Kyphosus species</i>	Rudderfish	nenu
Kyphosidae	<i>Kyphosus bigibbus</i>	Brown chub	nenu
Kyphosidae	<i>Kyphosus vaigiensis</i>	Lowfin chub	nenu
Chaetodontidae	<i>Chaetodon unimaculatus</i>	Teardrop butterflyfish	lau-hau
Chaetodontidae	<i>Chaetodon lunula</i>	Raccoon butterflyfish	kikakapu
Pomocentridae	<i>Plectroglyphidodon imparipennis</i>	Brighteye damselfish	
Pomocentridae	<i>Stegastes fasciolatus</i>	Pacific gregory	
Pomocentridae	<i>Abudefduf abdominalis</i>	Hawaiian sergeant	maomao
Pomocentridae	<i>Abudefduf sordidus</i>	Blackspot sergeant	kupipi
Pomocentridae	<i>Plectroglyphidodon sindonis</i>	Rock damselfish	
Cirrhitidae	<i>Cirrhitops Fasciatus</i>	Redbar hawkfish	pili'ko'a
Labridae	<i>Thalassoma trilobatum</i>	Christmas wrasse	awela
Labridae	<i>Coris flavovittata</i>	Yellowstripe coris	hilu
Labridae	<i>Gomphosus varius</i>	Bird wrasse	aki-lolo
Labridae	<i>Stethojulis balteata</i>	Belted wrasse	omaka
Labridae	<i>Thalassoma Duperrey</i>	Saddle wrasse	hinalea lau-wili
Labridae	<i>Coris venusta</i>	Elegant coris	
Labridae	<i>Thalassoma Purpureum</i>	Surge wrasse	hou
Labridae	<i>Labroides phthirophagus</i>	Hawaiian cleaner wrasse	
Labridae	<i>Thalassoma Ballieui</i>	Blacktail wrasse	hinalea luahine
Scaridae	<i>Calotomus carolinus</i>	Stareye parrotfish	ponuhunuhu
Blennidae	<i>Plagiotremus gosline</i>	Scale eating blenny	
Blennidae	<i>Cirripectes vanderbilti</i>	Scarface blenny	
Acanthuridae	<i>Acanthurus nigrofusus</i>	Brown surgeonfish	ma'i'i'i
Acanthuridae	<i>Acanthurus triostegus</i>	Convict tang	manini
Acanthuridae	<i>Acanthurus achilles</i>	Achilles tang	paku'iku'i
Acanthuridae	<i>Acanthurus leucopareius</i>	Whitebar surgeonfish	maikoiko
Acanthuridae	<i>Acanthurus guttatus</i>	Whitespotted surgeonfish	'api
Acanthuridae	<i>Naso unicornis</i>	Bluespine unicornfish	kala
Acanthuridae	<i>Acanthurus blochii</i>	Ringtail surgeonfish	pualu
Balistidae	<i>Rhinecanthus rectangulus</i>	Reef triggerfish	humuhumu-nukunuku-a-pua'a
Balistidae	<i>Melichthys niger</i>	Black durgon	humuhumu-'ele'ele
Tetraodontidae	<i>Canthigaster amboinensis</i>	Ambon toby	