



**ASSESSMENT OF NONINDIGENOUS SPECIES ON CORAL
REEFS IN THE HAWAIIAN ISLANDS, WITH EMPHASIS
ON INTRODUCED INVERTEBRATES**

January 2004

COVER

Introduced and cryptogenic marine invertebrates that occur on Hawaiian coral reefs. Top row, left to right: Orange Keyhole Sponge *Mycale armata* Thiel, Grey Encrusting Sponge *Gelliodes fibrosa* (Wilson), Christmas Tree Hydroid *Pennaria disticha* (Goldfuss); Second row: Snowflake Coral *Carijoa riisei* (Duchassaing & Michelotti), Upside-down Jellyfish *Cassiopea andromeda* Light, Branching Bryozoan *Schizoporella* cf. *errata* (Waters); Third row: Featherduster Worm *Sabellastarte spectabilis* (Grube), Slender Tubeworm *Salmacina dysteri* (Huxley), Philippine Mantis Shrimp *Gonodactylaceus falcatus* (Forsskal).

**ASSESSMENT OF NONINDIGENOUS SPECIES ON CORAL
REEFS IN THE HAWAIIAN ISLANDS, WITH EMPHASIS
ON INTRODUCED INVERTEBRATES**

Final report prepared for the Hawai'i Coral Reef Initiative

**S. L. Coles
L. G. Eldredge
F. Kandel
P. R. Reath
K. Longenecker**

**Bishop Museum
Hawai'i Biological Survey**

Bishop Museum Technical Report No 27

**Honolulu, Hawai'i
January 2004**

Published by
Bishop Museum Press
1525 Bernice Street
Honolulu, Hawai'i

Copyright © 2004 Bishop Museum
All Rights Reserved
Printed in the United States of America



ISSN 1085-455X

Contribution No. 2004-002 to the Hawaii Biological Survey

EXECUTIVE SUMMARY

Coral reefs on the islands of Kaua'i, Moloka'i, Maui, Hawai'i and O'ahu were surveyed for the presence and impact of marine nonindigenous and cryptogenic species (NIS) using a rapid assessment method that standardized search effort for approximately 312 m² at each site. A total of 41 sites were surveyed by three investigators for a total of approximately 120 hours search time on the five islands. Algae, invertebrate, and fish taxa were identified on site or returned to laboratory for identity confirmation. Only 26 NIS, comprised of three species of algae, 19 invertebrates, and four fishes were recorded from a total of 486 total taxa on the entire study, and 17 of the NIS occurred at only one or two sites. The most NIS that occurred at any site was six, and 21 of the sites had less than three. If the three species of fish that were introduced in the 1950s and known to occur throughout Hawai'i are excluded, over half the sites had less than two NIS.

The numbers of NIS occurring at each site were compared with values measured or assigned to a number of factors that may influence the spreading and proliferation of introduced marine species. These factors included distances from harbors, boat launching ramps, stream mouths and shorelines, and subjective ranking values on a scale of 1 to 5 for shoreline urbanization, artificial surfaces in the water, reef condition, and the degree to which sites were isolated from the open ocean (non-exposure). The number of total native taxa at each site determined from the reef assessments was also included as a predictor variable, on the basis that high species richness could act to limit the establishment of introduced species. A best subsets regression model explained over 65% of the variance in NIS from two predictor variables: non-exposure, number of native taxa and their interaction. Most of the variance was explained by a highly significant relationship of NIS with non-exposure to open ocean conditions, i.e. NIS increased going from open coastlines to embayments and semi-protected harbors. A highly significant interaction between ocean non-exposure and native species richness suggested that higher species diversity may act to restrict NIS occurrence in embayments and semi-enclosed environments where they are most likely to establish themselves.

Due to the relatively low frequency of occurrence and few invertebrate NIS found on these surveys, no eradication or control management efforts are recommended at this time. However, two introduced species encountered in the surveys, the Orange Keyhole Sponge, *Mycale armata* Thiele, and the Snowflake Octocoral, *Carijoa riisei* (Duchassaing & Michelotti), appear to be increasing in both abundance and distribution on some coral reef areas. These species should be considered invasive, monitored and research conducted to obtain basic biological and ecological information that may be utilized in their control. Other management efforts should focus on preventing the initial introduction of nonindigenous marine species into Hawaiian waters and their transport among the islands, and in preserving the integrity of coral reef species richness, especially in semi-enclosed embayments and other areas most likely to be the first locations to be colonized by introduced species.

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	i
LIST OF APPENDICES	iii
LIST OF TABLES	iv
LIST OF FIGURES	v
I. INTRODUCTION	1
III. METHODS	4
<i>Field Techniques</i>	4
<i>Precautionary Measures</i>	5
<i>Variables Influencing Introductions</i>	6
IV. RESULTS	8
<i>Station Locations and Characteristics</i>	8
<i>Numbers of NIS and Total Taxa</i>	8
<i>Relationships of NIS with Environmental and Anthropogenic Factors</i>	23
V. DISCUSSION	26
VI. MANAGEMENT CONSIDERATIONS	28
VII. REFERENCES	31
VIII. ACKNOWLEDGEMENTS	34

LIST OF APPENDICES

	Page
APPENDIX A. Rapid Assessment Site Descriptions for Kaua'i, Moloka'i, Maui, Hawai'i and O'ahu	35
APPENDIX B. Native, Nonindigenous and Cryptogenic Taxa Recorded on Rapid Assessment Surveys at 41 Coral Reef Sites on the Islands of Kaua'i, O'ahu, Moloka'i, Maui and Hawai'i, November 2002-October 2003.	44
APPENDIX C. Details of Surveys and Organisms recorded from Artificial Reefs and Sites Inspected without Using Rapid Assessment Protocol	103
APPENDIX D. Organisms Sent to Taxonomic Specialists to Determine Possible New Introductions	105

LIST OF TABLES

Table		Page
1	Numbers of marine nonindigenous (N), cryptogenic (C) and total species determined from Hawai'i and Johnston Atoll.	2
2	Factors considered potentially important in influencing NIS, their range of determined or estimated values and sign of anticipated correlation with number of NIS.	7
3	Description of characteristics for each category of index values.	7
4	Locations, dates, depths, coordinates and corresponding CRAMP sites for stations sampled.	9
5	Table 5. Nonindigenous and cryptogenic species frequencies of occurrence at all sites.	18
6	NIS species recorded at all sites.	19
7	Matrix of predictor variable values used in best subsets regression analysis for values of NIS at 41 reef sites.	24
8	Relationships determined between numbers of NIS and predictor variables by best subsets linear regression analysis.	25

LIST OF FIGURES		
Figure		Page
1	Kaua'i HCRI coral reef stations.	11
2	Moloka'i HCRI coral reef stations.	12
3	Maui HCRI coral reef stations.	13
4	Hawai'i HCRI coral reef stations.	14
5	Hawai'i HCRI coral reef stations.	15
6	Frequency histograms of estimated categories of factors potentially affecting NIS presence.	16
7	Distributions of total taxa with sites on each island surveyed.	17
8	Distributions of numbers of NIS with sites on each island surveyed.	21
9	Histograms of numbers of NIS at all sites with fish data included and excluded.	22
10	Three dimensional response surface illustrating relationships between numbers of NIS species, ocean exposure of the sites surveyed and native species richness (fish excluded).	25

I. INTRODUCTION

Introductions of nonindigenous or exotic species invasions, largely resulting from shipping activities, into harbors, ports, and other coastal ecosystems have been apparently been escalating around the world for the last 30 years, sometimes with serious negative consequences (See Carlton 1985, Carlton and Geller 1993, Ruiz et al. 1997, and Bax et al. 2001 for reviews). Introduced species can rapidly monopolize energy resources, act as voracious predators, overcome endemic species, or transmit parasites and diseases that can be passed to humans through the food chain or direct exposure. Because of these potential negative effects, marine species invasions have been ranked among the most serious potential perturbations of marine ecosystems (Carlton 1994).

Most surveys of nonindigenous species and studies of their impacts have been conducted in temperate marine and estuarine systems. However, because of research that has been underway at Bishop Museum for over six years and studies that have been conducted on invasive algae by researchers in the University of Hawaii Botany Department, more is known about introduced marine organisms in Hawai'i than any other tropical area. Previous studies on marine invertebrates and general nonindigenous species in Hawai'i have focused primarily on harbors and embayments (Coles et al. 1997, Coles et al. 1998, Coles et al. 1999a, Coles et al. 1999b) partly because of funding availability and partly due to the likelihood of introductions occurring initially in harbors by organisms from ballast water or hull fouling. However, a few nonindigenous species surveys have been conducted in coral reef areas in the Hawaiian Islands (Coles et al. 1998, DeFelice, et al. 1998b, 2002) and Johnston Atoll (Coles et al. 2001) which can be compared to the results obtained for harbors and embayments.

Table 1 summarizes the results that have been previously obtained from nonindigenous species surveys in the Hawaiian Islands and Johnston Atoll. Studies in Pearl Harbor and the five commercial harbors of south and west O'ahu have shown the harbor biota to include approximately 100 nonindigenous or cryptogenic (neither demonstrably nonindigenous nor native) taxa, comprising 17 to 23% of the total numbers of taxa identified in each study. A similar number of 116 nonindigenous or cryptogenic species have been determined for Kane'ohe Bay, equaling an introduced component of around 14% of the total number of taxa. By contrast, the three surveys on ocean-exposed reefs around the island of Kaho'olawe, Midway, and Johnston Atolls by the same investigators found only 3 to 10 nonindigenous or cryptogenic species among 300 to >660 taxa identified, for an introduced component of only about 1%.

Table 1. Numbers of marine nonindigenous (N), cryptogenic (C) and total species determined from Hawai'i and Johnston Atoll.

<i>Location</i>	(N)	(C)	Total N + C	Total Species	% N + C	Source
<u>Hawaiian Islands</u>						
O'ahu, Pearl Harbor	69	26	95	419	23.0	Coles et al 1997, 1999a
O'ahu, South Shore						
Commercial Harbors	73	27	100	585	17.0	Coles et al 1999b
Kane'ohe Bay	82	34	116	617	14.5	Coles et al 2002
Kaho'olawe	3	0	3	298	1.0	Coles et al. 1998
Midway	4	0	4	444	1.5	DeFelice et al. 1998
Johnston Atoll	5	5	10	668	1.5	Coles et al. 2001
French Frigate Shoals	2	0	2	617	0.3	DeFelice et al. 2002

The nonindigenous and cryptogenic (NIS) taxa sighted or sampled on these six comprehensive studies included most major phyla or classes of invertebrates ranging from 15 annelid taxa to 31 crustaceans, mostly amphipods. Most invertebrate NIS are filter-feeding, fouling organisms which are prone to vessel attachment and transport and thrive in the eutrophic condition of harbors and embayments, and few have been detected on the exposed coral reefs that had been previously surveyed. However, Kane'ohe Bay, as a semi-enclosed, estuarine embayment, shows characteristics of both harbor and coral reef conditions, has a greater number of introduced species than the harbors and is one of the areas in Hawaiian waters most impacted by alien invasive algae (Russell 1983, Russell 1992, Rodgers and Cox 1999, Woo et al. 1999, Smith et al. 2003). Elsewhere, no introduced algae or invertebrates were detected at seven reef locations around the island of Kaho'olawe (Coles et al. 1998), where the only nonindigenous organisms found were the three species of fishes purposely introduced in the 1950s (Brock 1960, Randall 1987). Similarly, the only nonindigenous species found at Midway Atoll (DeFelice et al. 1998b) were two bryozoans and the barnacle *Chthamalus proteus* Dando and Southward first reported in the Pacific on O'ahu in 1996 (Southward et al. 1998), and one introduced fish. Only two introduced invertebrates were recorded for a total of over 500 identified species at French Frigate Shoals from the 1998 NOWRAMP surveys of the Northwestern Hawaiian Islands (DeFelice et al. 2002).

These findings suggest that, in general, two principal factors may determine the presence and degree of invasiveness of most nonindigenous species in Hawai'i and in tropical areas. The first factor is isolation from likely sources of NIS. Kaho'olawe does not have any of the invasive macroalgae that have inundated the west and south coasts of nearby Maui, possibly due to restriction of visitors and boat traffic for over 60 years that helped isolate the island from both accidental and purposeful introductions. Likewise, the isolation of Midway, French Frigate Shoals and Johnston Atoll has probably helped to limit marine introductions, despite the fact that a small harbor at Midway was used for receiving supplies up to the mid 1990s, and that a docking facility at Johnston frequently received barge traffic from Honolulu.

A second set of factors that may act to limit introductions, especially invertebrates, on open ocean-exposed coral reef areas are the characteristics of the reef environment and the generally higher diversity of the native reef community. The oligotrophic conditions that generally pertain to reef areas probably do not provide sufficient suspended organic matter or plankton to support many of the filter feeding invertebrates that prevail among the nonindigenous organisms in Hawai'i. Also, the greater native species richness on ocean-exposed coral reefs may act to limit recruitment, growth, and reproduction of NIS below what might occur in the less biologically diverse communities of harbors or estuaries. Decreased species invasions with higher diversity systems in tropical regions has also been noted for surveys of ports on Australia's North Queensland coast (Hewitt et al. 1998, Hoedt et al. 2000, 2001), Guam (Paulay et al. 2002), and American Samoa (Coles et al. 2003) where species richness is substantially higher than in Hawai'i.

The available information indicating that few introduced invertebrate species occur on Hawaiian coral reefs has been based on limited data, mostly for sites remote from probable sources of NIS introduction. No systematic invertebrate surveys have been conducted on coral reefs in Hawai'i near harbors other than in Kane'ohe Bay and Waikiki. The need thus existed for a comprehensive survey of the presence of nonindigenous invertebrates on Hawai'i's coral reefs throughout the main Hawaiian Islands. The objectives of the present project were to determine whether nonindigenous marine invertebrates are present in significant numbers by species or abundance on coral reefs in the main Hawaiian Islands, to assess the impact and potential threat to native reef species, to evaluate the influence of potential causative factors in promoting or resisting invasions of reefs by nonindigenous species, and to determine the need, if any, for management procedures that would deal with introduced species as a source of reef disturbance.

II. METHODS

The methods used in biological sampling programs vary with the research questions being asked and require decisions pertaining to levels of effort directed toward two primary objectives. The first is to determine as completely as possible the total community species composition occurring at the sampling site. The second is to quantify the abundance or relative abundance of the various community components in an attempt to determine the numeric distribution of numbers of individuals or areal coverage of the various component species. These two objectives are somewhat opposing, especially where time is limited when sampling underwater. Most studies on coral reefs have focused on algal, coral, or fish assemblages and have utilized some variation of linear or belt transects, or, in the case of coral and algae, measurements with quadrats, either sampled once or repeatedly on permanently marked sections of reef surface. The power and efficacy of sampling coral coverage in Hawai'i have been reviewed by Brown et al. (in press). These approaches provide various levels of quantification and resolution that may enable time series analysis, but the area sampled must necessarily be small, and such studies sometimes also include "swim-arounds" on larger reef areas to detect species that are not encountered on the fixed transects or quadrats.

The purpose of the present study was to determine the presence and impact of nonindigenous (introduced) marine species on Hawai'i's coral reefs. Anticipating that these species were likely to be low in abundance, our approach was focused on examining large areas and on as many habitats as could be done within the time frame of scuba dives in water of intermediate depths of 10-20 m up to three times per day. In order to facilitate a comparable search effort among islands and sites within islands, we developed a standardized method that could be replicated on every survey. This approach utilized a variation on the belt transect and timed search methods that was modified to provide both a standardized search area, estimates of probability of encounter and a sufficiently large search area to assure that most species occurring at the site had been encountered and noted. Where feasible the locations of surveyed sites were at or near sites established by the Hawai'i Coral Reef Assessment and Monitoring Program (CRAMP) in order to provide further information on areas that will be periodically resurveyed for coral and fish abundance (Brown et al. in press).

Field Techniques

After recording the position by GPS of the reef to be surveyed, a 50-m transect line was used to delineate a triangular area within which observations were made during the first 30 minutes of the survey. The starting point for the transect line was established haphazardly and the line was laid along the reef parallel to the shore for 25 m, then turned at a right angle for the remaining 25 m, with the resulting triangular area established by the line thus approximating 312 m². Two observers (SLC and FK) swam in tandem along the line, noting and recording the first occurrence of all invertebrates, fishes and identifiable macroalgae occurring along a swath up to 2 m on either side of the transect within time periods of 5, 10, and 15 minutes from the start time of the transect. The next 15 minutes were spent recording organisms that occurred in the 312 m²

triangular area delineated by the legs of the transect line. Finally, 15 minutes were spent making observations outside of the triangle and recording all taxa not previously observed. In addition to the observations made by these two observers, on Kaua'i, Moloka'i, Maui, and Hawai'i a third diver (PAR) searched crevices and microhabitats throughout the triangular area, identifying small and cryptic organisms not observed by the first two divers on their roving searches. All organisms identifiable in the field were recorded on underwater paper, and samples of organisms were retained for identification in the laboratory where necessary.

Identified organisms were entered on spreadsheets coded 1 to 3 according to the 5 minute period in which they were first encountered in the first 15 minutes, or 4 if they were first encountered later inside or outside of the triangle. In the event that the organism was recorded at different times by the different observers, the first encounter was assigned priority. Status of the species as nonindigenous, cryptogenic or native was assigned according to their designation in Carlton and Eldredge (in prep.) and the Checklist of the Marine Invertebrates of the Hawaiian Islands (http://www2.bishopmuseum.org/HBS/invert/list_home.htm). (Species of uncertain identity but suspected to be introduced were collected and returned to the laboratory for identification and/or verification by taxonomic experts.

Precautionary Measures

It is a major objective of this study and all those associated with introductions of marine species that the processes of observation and sampling will not further spread introduced or invasive species beyond those locations where they already occur. To minimize the likelihood of this happening we have adopted the following procedures and recommend that they be used as a precaution in future such studies.

1. If a series of surveys involves sampling in areas of likely higher probability of occurrence of introduced marine species (i.e. harbors, enclosed embayments or shorelines) on the same day that surveys are to be made on coral reefs, the offshore reef areas should be surveyed first and the areas of higher probability of introduced species occurrence surveyed last. This will help to prevent the inadvertent transfer of introduced organisms that may be unknowingly acquired during the earlier survey to a coral reef habitat.
2. After surveying or sampling in an area of likely higher probability of occurrence of introduced marine species, all dive gear, sampling equipment and items used in transfer of any collected species of should be, at a minimum, soaked in fresh water and preferably washed in detergent before use on a subsequent day.
3. Precautions should be taken to assure that introduced organisms that have been collected are not dropped in a boat or in areas outside of their collecting area. If such organisms are inadvertently spilled in a boat, the boat should be thoroughly washed at the end of the dive day and any organisms in the washings isolated and collected for land disposal after assuring that they are not viable.

Variables Influencing Introductions

A number of both natural and anthropogenic influences have the potential to influence introduction, redistribution, and proliferation of nonindigenous marine species, and some of these were evaluated as part of this study (Tables 2 and 3). Hawaiian harbors have a large complement of introduced species (Coles et al. 1997, Coles et al. 1999a, Coles et al. 1999b) and proximity to harbors may increase the probability of introduced species occurrence. Similarly, small boats and their users may inadvertently transfer introduced species, so proximity to boat ramps may also be a factor in their spread. Studies in estuaries of O'ahu (Englund et al. 2000) have shown a high incidence of introduced species, so proximity to stream mouths was also considered a candidate for influencing introductions. Also frequent flooding and sedimentation from streams may result in a stressed environment more conducive to establishment of introduced species. Some introduced species, especially alien algae and the invertebrates that occur with them, are most abundant along or near shorelines. The distances of these four parameters from each site was measured using GIS based maps (Figures 1-5) and the range of values for each are shown in Table 3. Other potential determining factors considered were the amounts of artificial substrate in the water or along the shoreline, the degree to which the adjacent land area was urbanized, the degree to which the surveyed area was isolated from the open ocean, i.e. non-exposed, and the general condition of the coral reef itself, again on the assumption that a disturbed reef was more susceptible to introductions and invasions. The condition of these four factors was evaluated on site on a scale of 1 to 5 by the criteria in Table 3. Finally, based on the observations from previous studies that numbers of introduced species were inversely correlated with the numbers of non-introduced species, and that the ratio of NIS to native species tends to decrease going from enclosed to more exposed areas in Hawaiian harbors and embayments (Coles et al. 1997, Coles et al. 1998, 1999a, 1999b, 2002a, 2002b), the numbers of total native taxa at each site were included in analyses testing for relationships between numbers of NIS and predictor variables.

Table 2. Factors considered potentially important in influencing NIS, their range of determined or estimated values and sign of anticipated correlation with number of NIS.

Potential Determining Factor	Type	Range	Expected NIS Effect
Harbor Distance (km)	Measured	0.3-71	-
Ramp Distance (km)	"	0.2-27	-
Stream Distance (km)	"	0.3-26	-
Shore Distance (km)	"	0.1-4.7	-
Non-NIS Species Richness	"	42-138	-
Artificial Substrate	Estimated	1-5	+
Urbanization	"	1-5	+
Non-Exposure	"	1-5	+
Reef Condition	"	1-5	+

Table 3. Description of characteristics for each category of index values.

Index	Value	Parameter
Artificial substrate	1	No modification of shoreline or artificial structure in water.
	2	<25% of shoreline hardening no structure in the water.
	3	26-50% shoreline hardening or structures in the water (piers or dock).
	4	51-75% shoreline hardening.
	5	Shoreline >75% modified or hardened.
Urbanization	1	Remote: No habitation or shoreline development in view.
	2	Rural: 1 to 5 houses or buildings, no shoreline development.
	3	Residential: 6 to 30 houses or buildings, some development at or near shoreline.
	4	Urbanized: >30 houses or buildings, shoreline high development.
	5	Industrialized, commercial shoreline usage and development.
Ocean non-exposure	1	Open ocean.
	2	Semi-exposed coastline.
	3	Embayment.
	4	Semi-enclosed harbor.
	5	Highly enclosed harbor with narrow access.
Reef Condition	1	Excellent: >50%.
	2	Good: 25%>Coral Cover<50%, macroalgae rare.
	3	Fair: 10%>Coral Cover<25%, some algae present.
	4	Poor: 5%>Coral Cover.<10%, algae common to abundant.
	5	Highly degraded: Coral Cover.<5%: High sedimentation.

IV. RESULTS

Station Locations and Characteristics

The locations, dates of sampling, depths, latitude-longitude and UTM coordinates of the sites surveyed are shown in Table 4, and the site locations are shown on the maps in Figures 1-5. A total of 41 sites on five islands were surveyed using the rapid assessment technique, and another three sites on O'ahu were inspected using random searches. Twenty four of the 41 rapid assessment sites coincided with Hawai'i Coral Reef Assessment and Monitoring Program (CRAMP) sites and eight of the ten surveys on Hawai'i were made at West Hawai'i Aquarium Project (WHAP) sites.

The characteristics of the sites are described in Appendix A, which indicates that the stations encompassed a wide range of environmental conditions and proximity to anthropogenic influences on each island. The sites ranged from 100 m to 4.7 km from the shoreline and from 300 m to 26 km from the nearest stream mouth. Harbor distances ranged from 300 m to 71 km and boat launching ramps from 200 m to 27 km. The frequency histograms for the four subjectively evaluated indices potentially influencing the occurrence of introduced species are shown in Figure 6, which shows that most of the sites (18-25) were in the lowest index category 1 for artificial substrata, reef condition, and ocean exposure, i.e. most sites were in the category considered least likely to promote NIS for these indices. For the urbanization index, over half of the values were in categories 3 to 5, or greater than 6 houses or buildings visible on the shoreline.

Numbers of NIS and Total Taxa

All taxa identified at the 41 sites surveyed are listed in Appendix B, and the numbers of total taxa recorded at each station are shown in Figure 7. A total of 486 taxa were identified for the surveys overall, ranging from maximum of 151 taxa occurring at one station on Hawai'i to a minimum of 40 taxa at one station on Moloka'i. Of these, only 26 were cryptogenic or introduced species, approximately 5% of the total taxa identified. Most of these NIS, listed in Table 5 were infrequently observed. The most commonly seen were the introduced fishes *roi* (*Cephalopholis argus* Wooster) and *ta'ape* (*Lutjanus kasmira* (Forsskål)) the cryptogenic conical hoof shell *Hipponix australis* Lamarck, a didemnid ascidian *Didemnum candidum*? Savigny, the introduced sponges *Mycale armata*? Thiele, and *Gelloides fibrosa* (Wilson), and the introduced featherduster worm *Sabellastarte spectabilis* (Grube). The remaining 15 species occurred at only 1-2 sites, or less than 5% of the total sites surveyed.

The number of NIS recorded at each site for each island surveyed is listed in Table 6 and their distributions shown in Figure 8. A maximum of six NIS occurred at one site each at Port Allen Harbor Reef, Kaua'i, Kane'ohe Bay, O'ahu, and Mala Wharf, Maui, and five NIS occurred at the other Kane'ohe Bay site, one site on Kaua'i, and one on Hawai'i. The distributions of numbers of

Table 4. Locations, dates, depths, coordinates and corresponding CRAMP sites for stations sampled.

Island	Station	Location	GPS Code	Depth (m)	WGS84 Latitude N			Longitude W			Old Hawaiian UTM		Zone	CRAMP Site
					Deg	Min	Sec	Deg	Min	Sec	Northing	Easting		
Kaua'i	KARA1	Marriot Hotel Reef	KAUMAR	2.5-6	21	57	36.3	159	21	14.6	2428309	463442	4	
	KARA2	Beach House Reef	KAULAW	1-1.5	21	53	5.9	159	28	45.5	2420030	450543	4	KAHOA10
	KARA3	Ho'ai Bay	KAUOH1	7.5-10.5	21	52	48.7	159	28	28.3	2419501	450976	4	KAHOA03
	KARA4	Ho'ai Bay	KAUOH2	2.5-3.0	21	52	53.4	159	28	34.2	2419645	450808	4	
	KARA5	Port Allen Harbor	KAUPA2	7.5-10.5	21	54	3.5	159	35	49.5	2421844	438324	4	
	KARA6	"Tiger's"	KAUPAK	9.0-11.0	21	55	45.5	159	39	11.5	2425000	432542	4	
	KARA7	Nomilu Pond	KAUPAL	7.5-9.0	21	53	13.7	159	31	58.8	2420289	444938	4	
	KARA8	Kukui'ula	KAUKUK	6.5-7.5	21	53	8.4	159	29	16.8	2420111	449588	4	
Moloka'i	MORA1	Puko'o Nearshore	MOLPUK	1-6	21	4	18.8	156	48	6.1	2331542	728403	4	
	MORA2	Pala'au	MOLPAL	10	21	5	30.4	157	6	38.7	2333332	696257	4	MOPAL10
	MORA3	Hale o Lono Reef	MOLHLR	9-12	21	5	1.4	157	14	57.7	2332276	681864	4	
	MORA4	Puko'o Offshore	MOLPU2	1-3	21	3	55.8	156	47	38.4	2330846	729213	4	
	MORA5	Kamalo	MOLKAM	3-17	21	2	40.6	156	54	1.1	2328384	718194	4	MOKMO10
	MORA6	Kamiloloa	MOLKAM	5-7	21	4	18.2	157	0	9.7	2331249	707513	4	MOKMA10
	MORA7	Kaunakakai Reef	MOLKAR	7-10	21	4	59.6	157	2	34.9	2332470	703306	4	MOKAK01
	MORA8	Hotel Molokai	MOLHOT	0.25-1	21	4	28.7	156	59	49.7	2331580	708087	4	
Maui	MARA1	Kahekili	MAKAH	1.5-5	20	56	22.2	156	41	45.8	2317037	739595	4	MAKAH03
	MARA2	Olowalu	MAOLO	2.5-3	20	48	42.2	156	36	51.4	2303012	748313	4	MAOLO03
	MARA3	Papaula Pt.	MAPAO	9-12	20	55	39.3	156	25	44.0	2316141	767413	4	MAPAP10
	MARA4	Honolua Bay	MAHONW	2.5-8.5	21	1	8.9	156	38	33.2	2325937	745031	4	MAHON03
	MARA5	Puamana	MAPUA	3-3.5	20	51	29.9	156	40	8.4	2308087	742540	4	MAPUA03
	MARA6	Mala Wharf	MAMALA	3-9	20	53	23.2	156	41	26.8	2311539	740223	4	
	MARA7	Ma'alaea Reef	MAMARF	2.5-5.5	20	47	31.6	156	30	45.8	2301000	758921	4	MAMAA03
	MARA8	Kanahena Bay	MAKANA	3-8	20	37	14.9	156	26	30.8	2282144	766598	4	MAKAB03
	MARA9	Molokini Crater	MAMOLC	7-8.5	20	38	5.3	156	29	57.6	2283601	760585	4	MAMOL07

Table 4. (cont.)

Island	Station	Location	GPS Code	Depth (m)	WGS84 Latitude N			Longitude W			Old Hawaiian UTM		Zone	CRAMP Site
					Deg	Min	Sec	Deg	Min	Sec	Northing	Easting		
Hawai'i	HARA1	Kawaihae Reef	KAWAIR	4-9	20	1	55.5	155	50	9.4	2217417	203308	5	HAKAW03
	HARA2	Puako	PUAKO	6-9	19	58	23.2	155	51	4.4	2210912	201597	5	
	HARA3	Anaeho'omalu	ANAIHO	8.5-9	19	57	21.9	155	52	8.4	2209058	199703	5	
	HARA4	Keawaiki	KEAWAI	12-14	19	53	39	155	54	45.4	2202278	195016	5	
	HARA5	Kualani Point	KUALAN	9.5-10.5	19	33	5.7	155	57	54.2	2164428	188858	5	
	HARA6	Red Hill	REDHIL	5.5-13.5	19	30	28.8	155	57	19.5	2159583	189787	5	HANEN10
	HARA7	North Keauhou	NKEAHO	6-6.5	19	34	17.8	155	58	20.2	2166659	188138	5	HALAA10
	HARA8	South Oneo Bay	ONEOBY	8-9	19	38	4.8	155	59	44.7	2173687	185796	5	
	HARA9	Papawai Bay	PAPAWA	7-13.5	19	39	0.6	156	1	33.4	2173903	811897	5	
	HARA10	Lelewi Bay	LELELI	6.5-10	19	44	14.4	155	1	16.5	2183547	288181	5	HALEL03
O'ahu	OARA1	K-Bay Waiahole	KBAY1	1.0-5	21	28	35.2	157	49	55.0	2375190	621013	4	OAKAA02
	OARA2	K-Bay He'eia	KBAY2	0.5-6	21	26	48	157	48	37.0	2371911	623283	4	OAHEE02
	OARA3	Nanakuli Point	OANANA	4-5	21	22	20.3	158	8	32.1	2363456	588926	4	OAKPI03
	OARA4	Kahe	OAKAHE	3-4	21	21	34.1	158	8	6.1	2362040	589682	4	OAKPO03
	OARA5	Pupukea	OAPUPU	1-6	21	38	46.6	158	3	54.2	2393826	596748	4	OAPUP04
	OARA6	Hanauma Bay	OAHAHA	5-7	21	16	6.4	157	41	43.5	2352278	635351	4	OAHAN03
	OAHT	Haleiwa Trench	OAHALE	4-25	21	35	37.4	158	6	37.4	2387982	592090	4	
	OAMW	Mahi Wreck	MAHI	6-28	21	24	47.4	158	11	43.8	2368296	583092	4	
	OAZM	Waianae Z Module	WAIARF	18-20	21	24	55.8	158	11	31.2	2368556	583454	4	

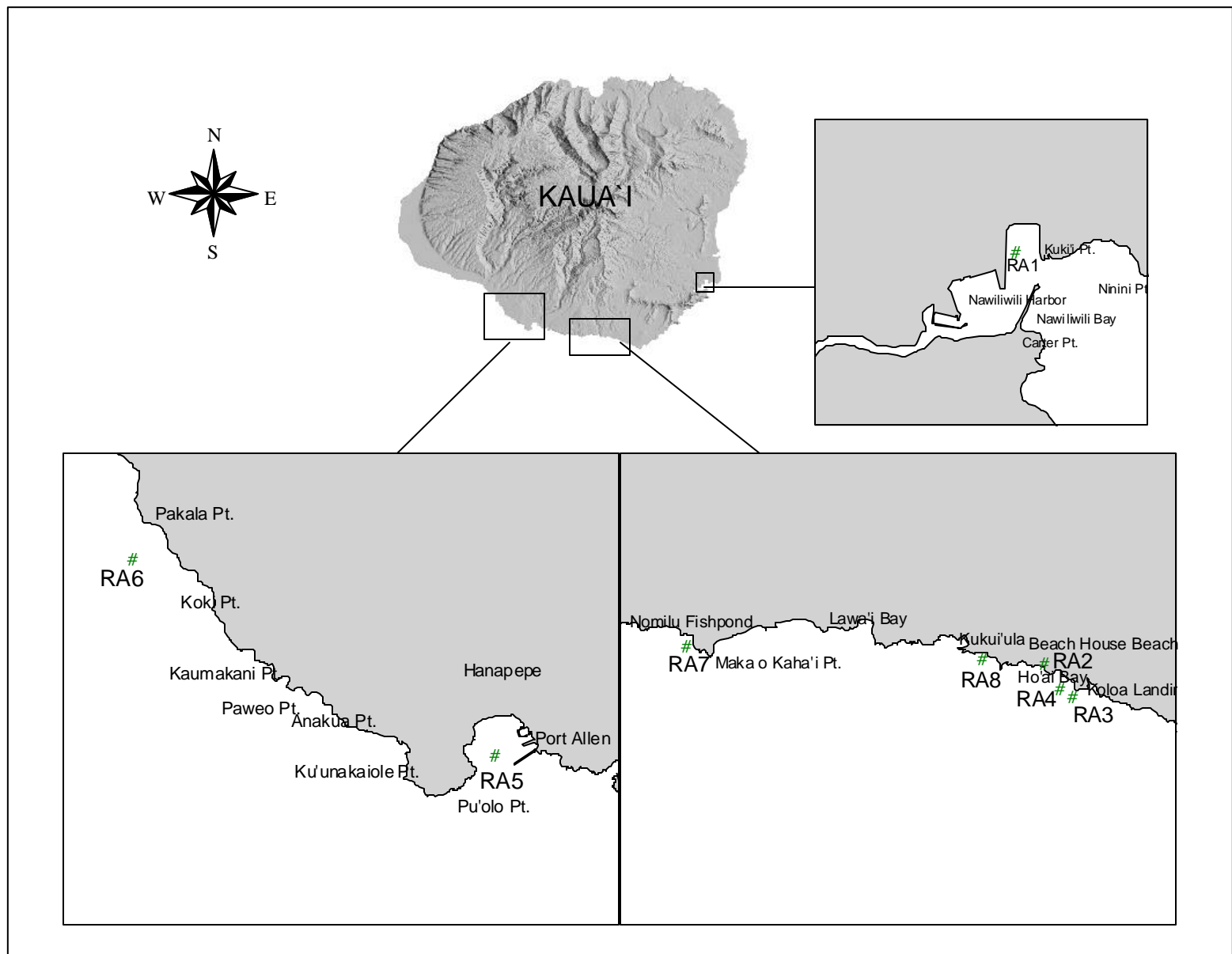


Figure 1. Kaua'i HCRI coral reef stations.

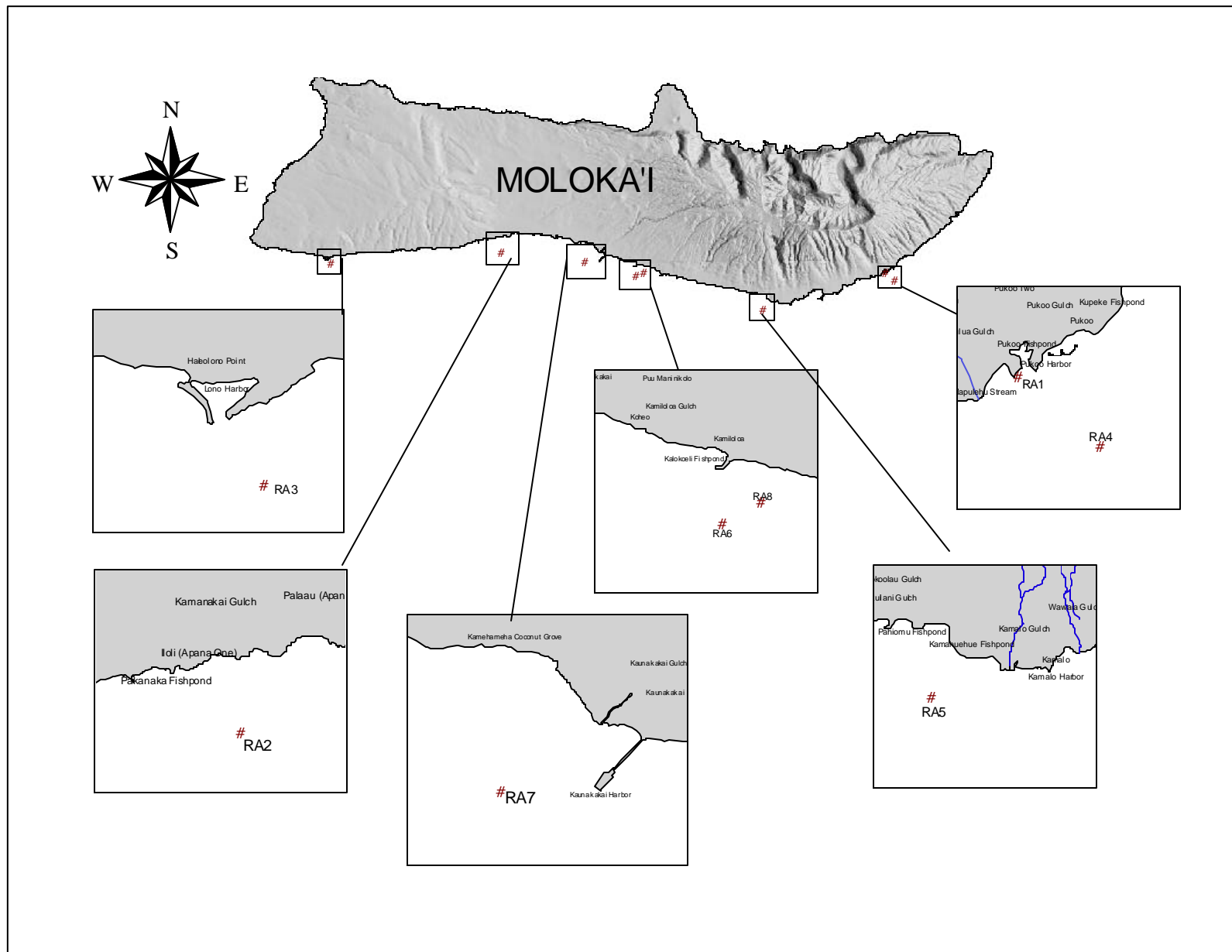


Figure 2. Moloka'i HCRI coral reef stations.

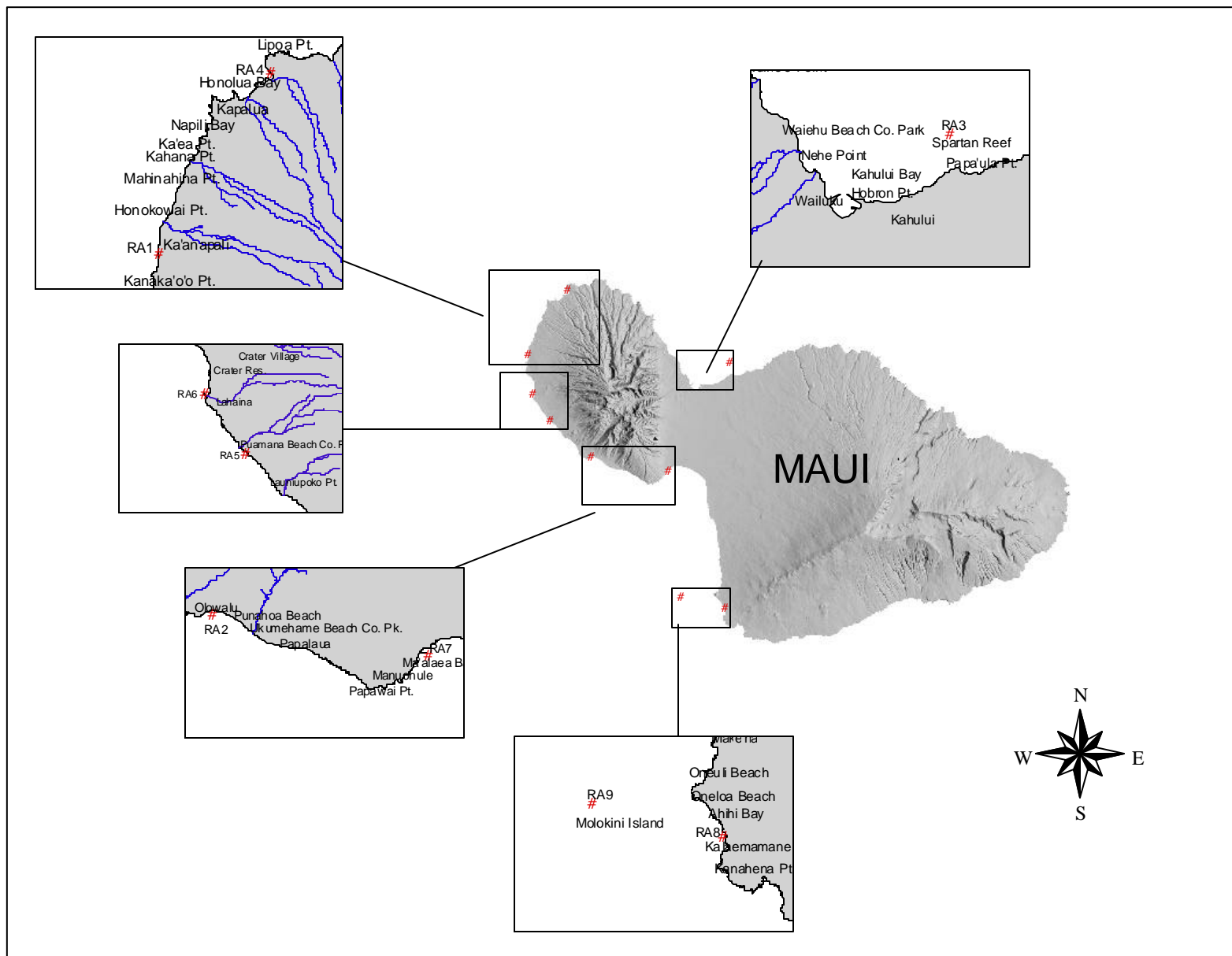


Figure 3. Maui HCRI coral reef stations.

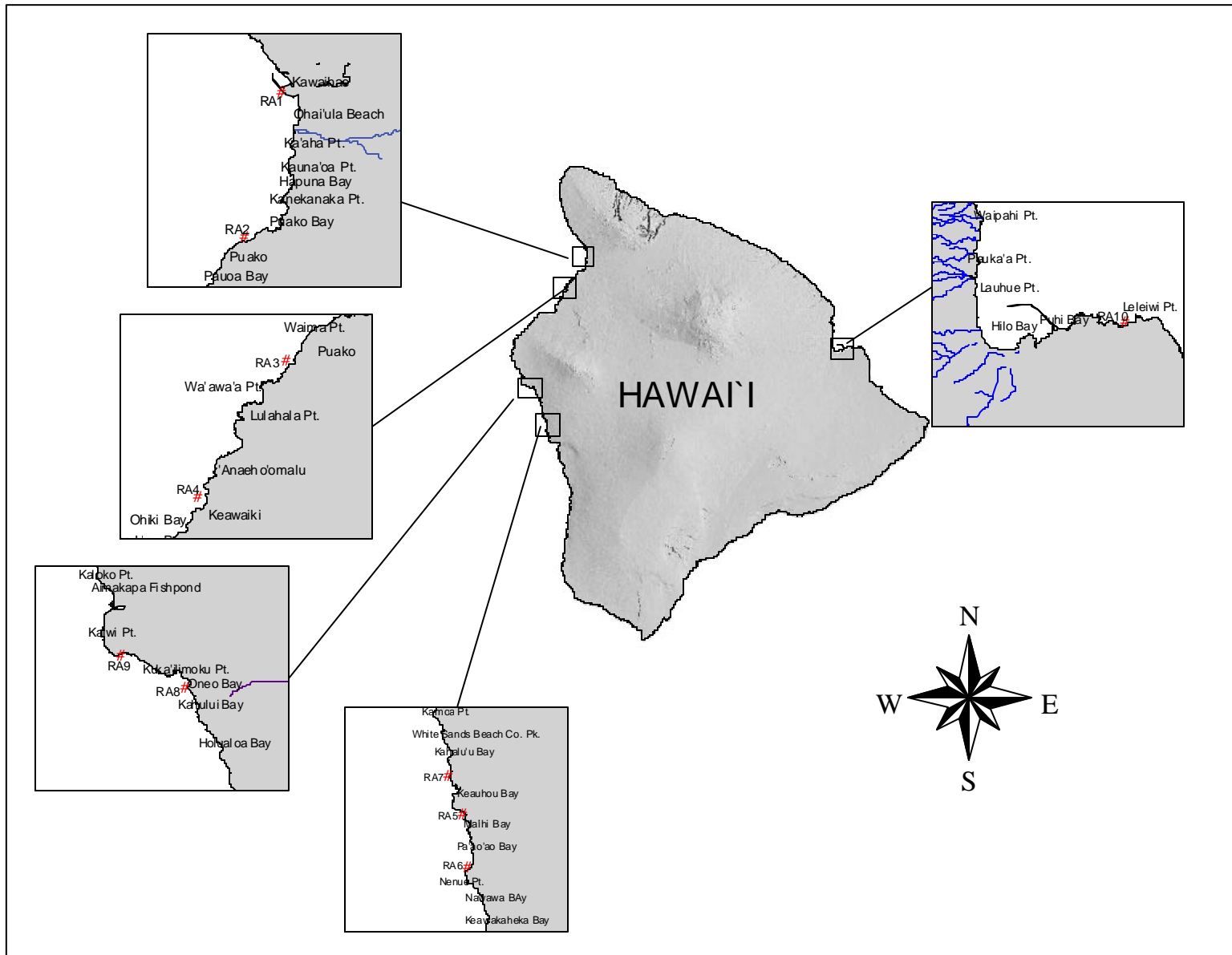


Figure 4. Hawai'i HCRI coral reef stations.

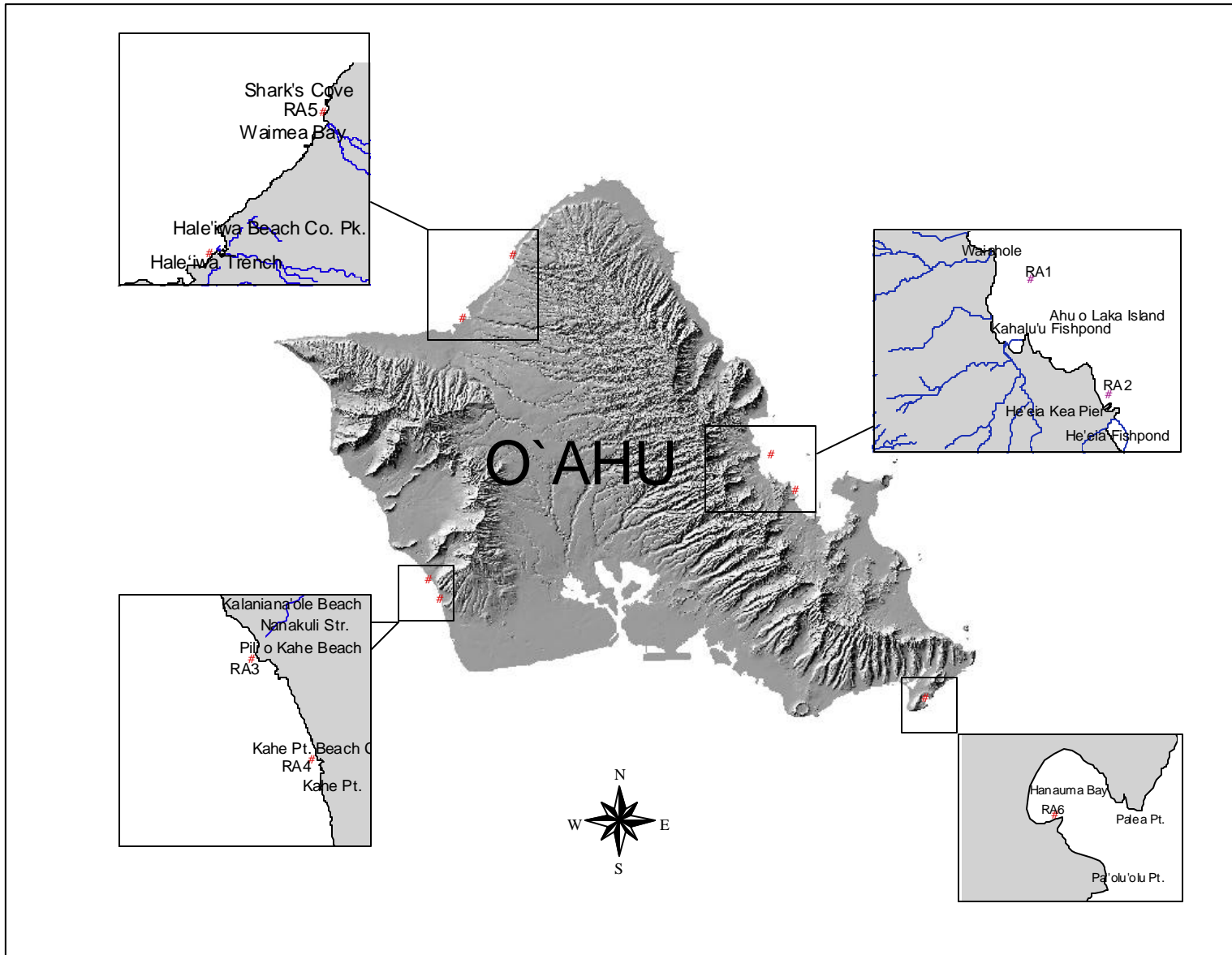


Figure 5. Hawai'i HCRI coral reef stations.

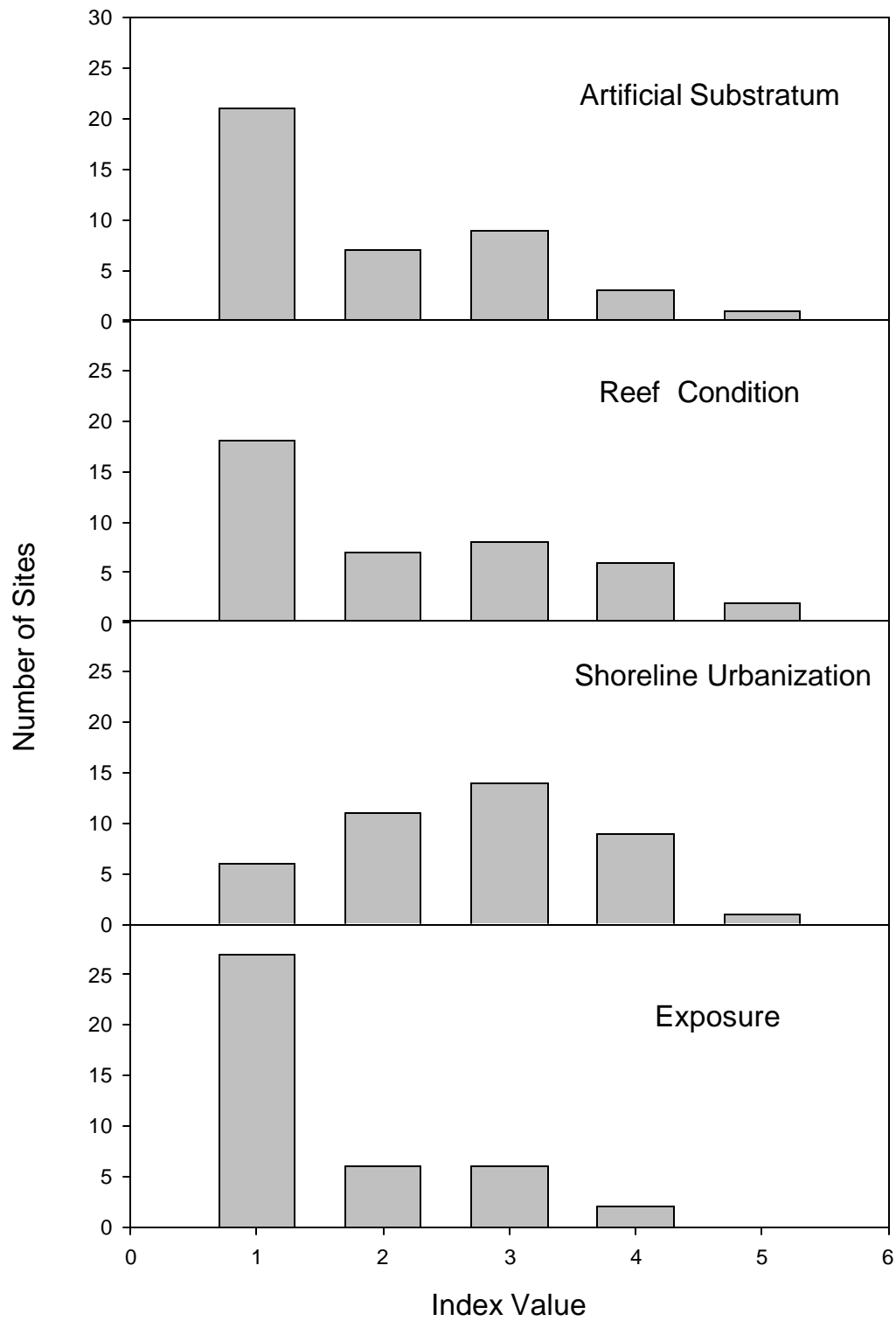


Figure 6. Frequency histograms of estimated categories of factors potentially affecting NIS presence.

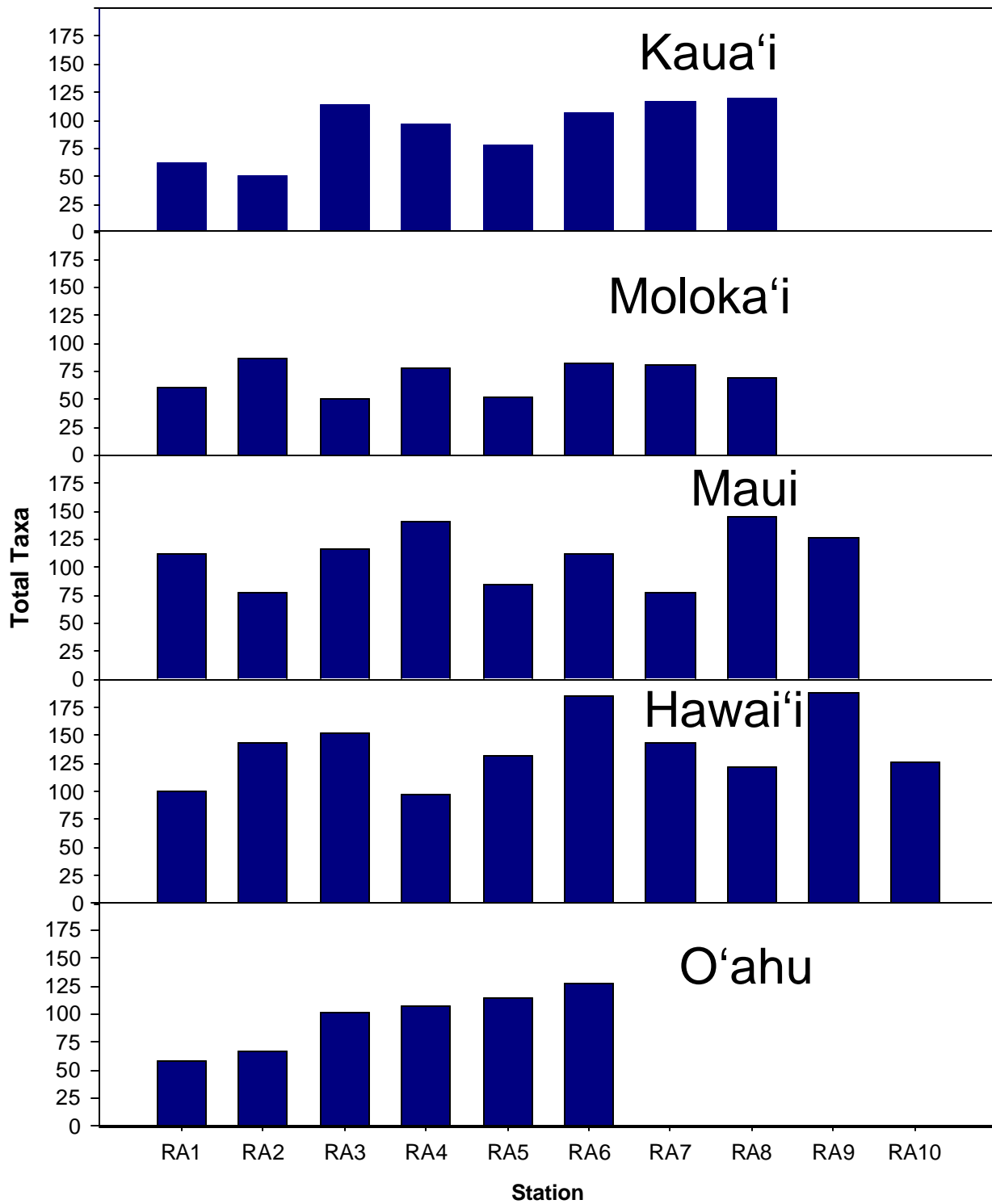


Figure 7. Distributions of total taxa with sites on each island surveyed.

Table 5. Nonindigenous and cryptogenic species frequencies of occurrence at all sites.

Taxa	Species	Status	No. Sites	Frequency
RHODOPHYTA	<i>Acanthophora spicifera</i>	Introduced	7	17.1%
	<i>Hypnea musciformis</i>	Introduced	1	2.4%
	<i>Kappaphycus alvarezii</i>	Introduced	2	4.9%
PORIFERA	<i>Mycale armata?</i>	Introduced	5	12.2%
	<i>Sigmatocia caerulea?</i>	Introduced	1	2.4%
	<i>Gelloides fibrosa?</i>	Introduced	1	2.4%
HYDROZOA	<i>Dynamena crisoides</i>	Cryptogenic	1	2.4%
	<i>Pennaria disticha</i>	Introduced	5	12.2%
	<i>Plumularia floridana</i>	Cryptogenic	2	4.9%
	<i>Plumularia strictocarpa</i>	Cryptogenic	1	2.4%
ANTHOZOA	<i>Carijoa riisei</i>	Introduced	1	2.4%
	<i>Sarcothelia</i> n. sp.	Cryptogenic	1	2.4%
SCYPHOZOA	<i>Cassiopea andromeda</i>	Introduced	1	2.4%
POLYCHAETA	<i>Chaetopterus</i> sp.	Cryptogenic	1	2.4%
	<i>Sabellastarte spectabilis</i>	Introduced	5	12.2%
	<i>Salmacina dysteri</i>	Introduced	1	2.4%
GASTROPODA	<i>Hipponix australis</i>	Cryptogenic	17	41.5%
BIVALVIA	<i>Crassostrea gigas?</i>	Introduced	1	2.4%
	<i>Anomia nobilis</i>	Introduced	2	4.9%
BRYOZOA	<i>Schizoporella cf. errata</i>	Introduced	1	2.4%
ASCIDIACEA	<i>Didemnum candidum?</i>	Cryptogenic	14	34.1%
	<i>Phallusia nigra</i>	Introduced	1	2.4%
OSTEICHTHYES	<i>Lutjanus fulvus</i>	Introduced	3	7.3%
	<i>Lutjanus kasmira</i>	Introduced	10	24.4%
	<i>Centropyge loricula</i>	Cryptogenic	1	2.4%
	<i>Cephalopholis argus</i>	Introduced	23	56.1%
Total NIS		26	41	
Total Taxa		486		
% NIS		5.3%		

Table 6. NIS species recorded at all sites.

Island	Genus_Species	Author_Date	Status	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9
Kaua'i	<i>Mycale armata?</i>	Thiele, 1903	Introduced	x								
	<i>Gelloides fibrosa?</i>	Wison, 1925)	Introduced	x								
	<i>Dynamena crisoides</i>	Lamaroux, 1824	Cryptogenic					x				
	<i>Pennaria disticha</i>	(Goldfuss, 1820)	Introduced	x		x		x				
	<i>Chaetopterus</i> sp.		Cryptogenic	x								
	<i>Sabellastarte spectabilis</i>	(Grube, 1878)	Introduced	x				x				
	<i>Salmacina dysteri</i>	(Huxley, 1855)	Introduced				x					
	<i>Hipponix australis</i>	(Lamarck, 1819)	Cryptogenic			x	x			x	x	
	<i>Schizoporella cf. errata</i>	(Waters, 1878)	Introduced						x			
	<i>Didemnum candidum?</i>	Savigny, 1816	Introduced		x	x	x	x	x	x	x	
	<i>Lutjanus kasmira</i>	(Forsskål, 1775)	Introduced			x		x		x		
	<i>Cephalopholis argus</i>	Bloch & Schneider, 1801	Introduced				x	x			x	
Total NIS				5	1	4	4	6	2	3	3	
Moloka'i	<i>Acanthophora spicifera</i>	(Vahl) Børgesen	Introduced	x			x					x
	<i>Cassiopea andromeda</i>	Light, 1914	Introduced	x								
	<i>Hipponix australis</i>	(Lamarck, 1819)	Cryptogenic						x			
	<i>Didemnum candidum?</i>		Introduced	x	x				x		x	
	<i>Cephalopholis argus</i>	Bloch & Schneider, 1801	Introduced		x	x				x		
Total NIS				3	2	1	1	0	2	1	2	
Maui	<i>Hypnea musciformis</i>	(Wulfen) J.V.Lamour.	Introduced							x		
	<i>Acanthophora spicifera</i>	(Vahl) Børgesen	Introduced	x		x				x		
	<i>Hipponix australis</i>	(Lamarck, 1819)	Cryptogenic	x			x	x	x			
	<i>Mycale armata?</i>	Thiele, 1903	Introduced						x	x		
	<i>Pennaria disticha</i>	(Goldfuss, 1820)	Introduced						x			
	<i>Sarcothelia</i> n. sp.		Cryptogenic			x						
	<i>Carijoa riisei</i>	(Duchassaing & Michelotti, 1860)	Introduced						x			
	<i>Crassostrea gigas</i> ?	(Thunberg, 1793)	Introduced							x		
	<i>Didemnum candi dum?</i>	Savigny, 1816	Introduced?	x		x						
	<i>Cephalopholis argus</i>	(Bloch, 1788)	Introduced	x		x	x		x		x	
	<i>Lutjanus kasmira</i>	(Quoy & Gaimard, 1825)	Introduced				x					
	<i>Lutjanus fulvus</i>	(Forster, 1801)	Introduced						x			
Total NIS				4	0	4	3	1	6	4	1	3

Table 6. (cont.)

Island	Genus_Species	Author_Date	Status	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Hawai'i	<i>Pennaria disticha</i>	(Goldfuss, 1820)	Introduced	x									
	<i>Plumularia floridana</i>	(Nutting, 1905)	Cryptogenic	x					x				
	<i>Plumularia strictocarpa</i>	Pictet, 1893	Cryptogenic						x				
	<i>Sabellastarte spectabilis</i>	(Grube, 1878)	Introduced		x								
	<i>Hipponix australis</i>	(Lamarck, 1819)	Cryptogenic		x	x	x	x	x	x	x	x	
	<i>Lutjanus fulvus</i>	(Forster, 1801)	Introduced		x								
	<i>Lutjanus kasmira</i>	(Forsskål, 1775)	Introduced		x			x	x	x			
	<i>Cephalopholis argus</i>	Bloch and Schneider, 1801	Introduced	x	x	x	x	x	x	x	x	x	x
Total NIS				3	5	2	2	3	5	3	2	2	1
O'ahu	<i>Acanthophora spicifera</i>	(Vahl) Børgesen	Introduced			x							
	<i>Kappaphycus alvarezii</i>	(Doty) Doty	Introduced	x	x								
	<i>Mycale armata?</i>	Thiele, 1903	Introduced	x	x								
	<i>Sigmatocia caerulea?</i>	Hechtel, 1965	Introduced					x					
	<i>Sabellastarte spectabilis</i>	(Grube, 1878)	Introduced	x	x								
	<i>Anomia nobilis</i>	Reeve, 1859	Introduced	x	x								
	<i>Phallusia nigra</i>	Savigny, 1816	Introduced		x								
	<i>Didemnum cf. candidum</i>	Savigny, 1816	Cryptogenic	x									
	<i>Lutjanus kasmira</i>	(Forsskål, 1775)	Introduced						x				
	<i>Centropyge loricula</i>	(Günther, 1873)	Cryptogenic		x								
	<i>Cephalopholis argus</i>	Bloch and Schneider, 1801	Introduced						x				
Total NIS				5	6	1	0	1	2				

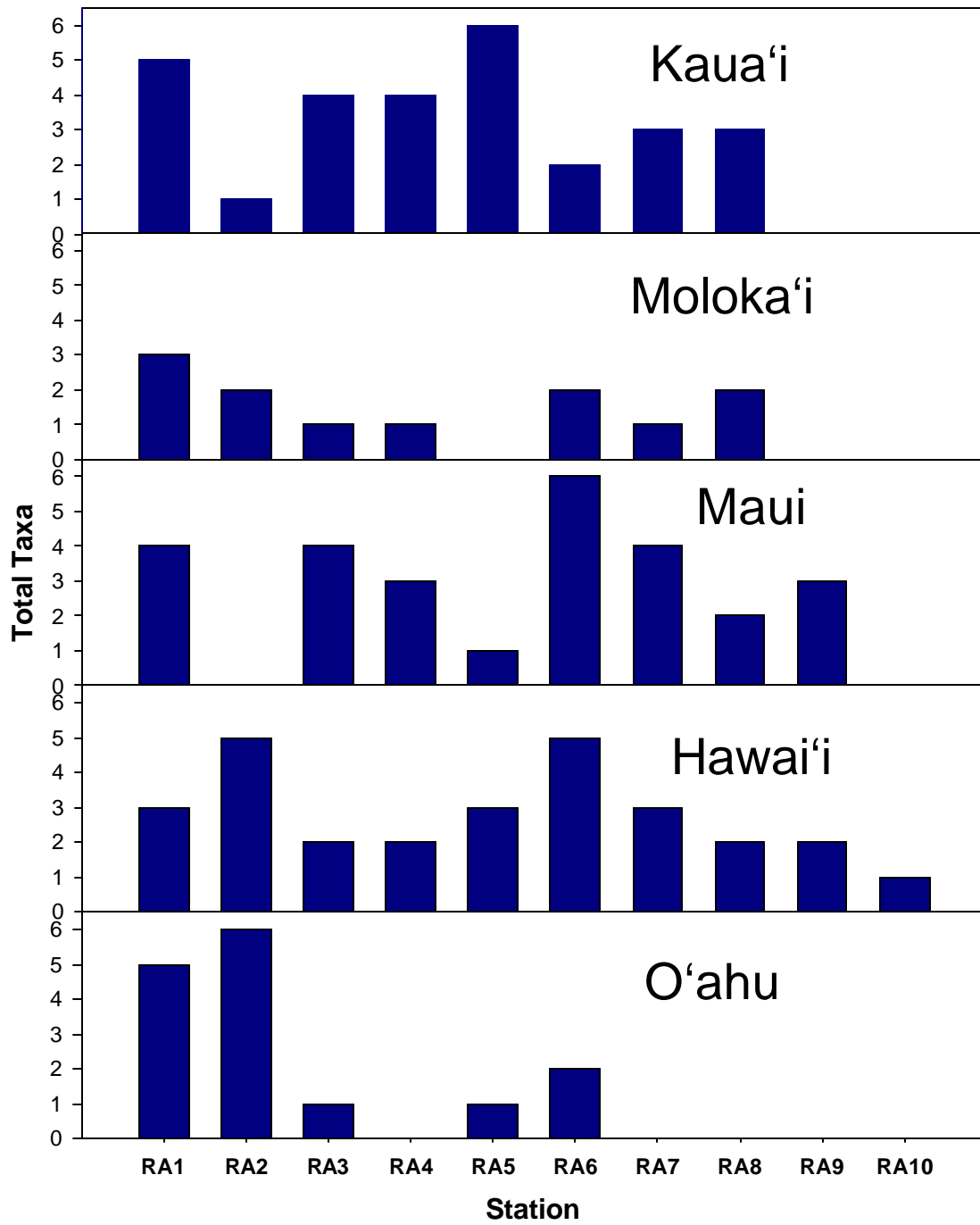


Figure 8. Distributions of numbers of NIS with sites on each island surveyed.

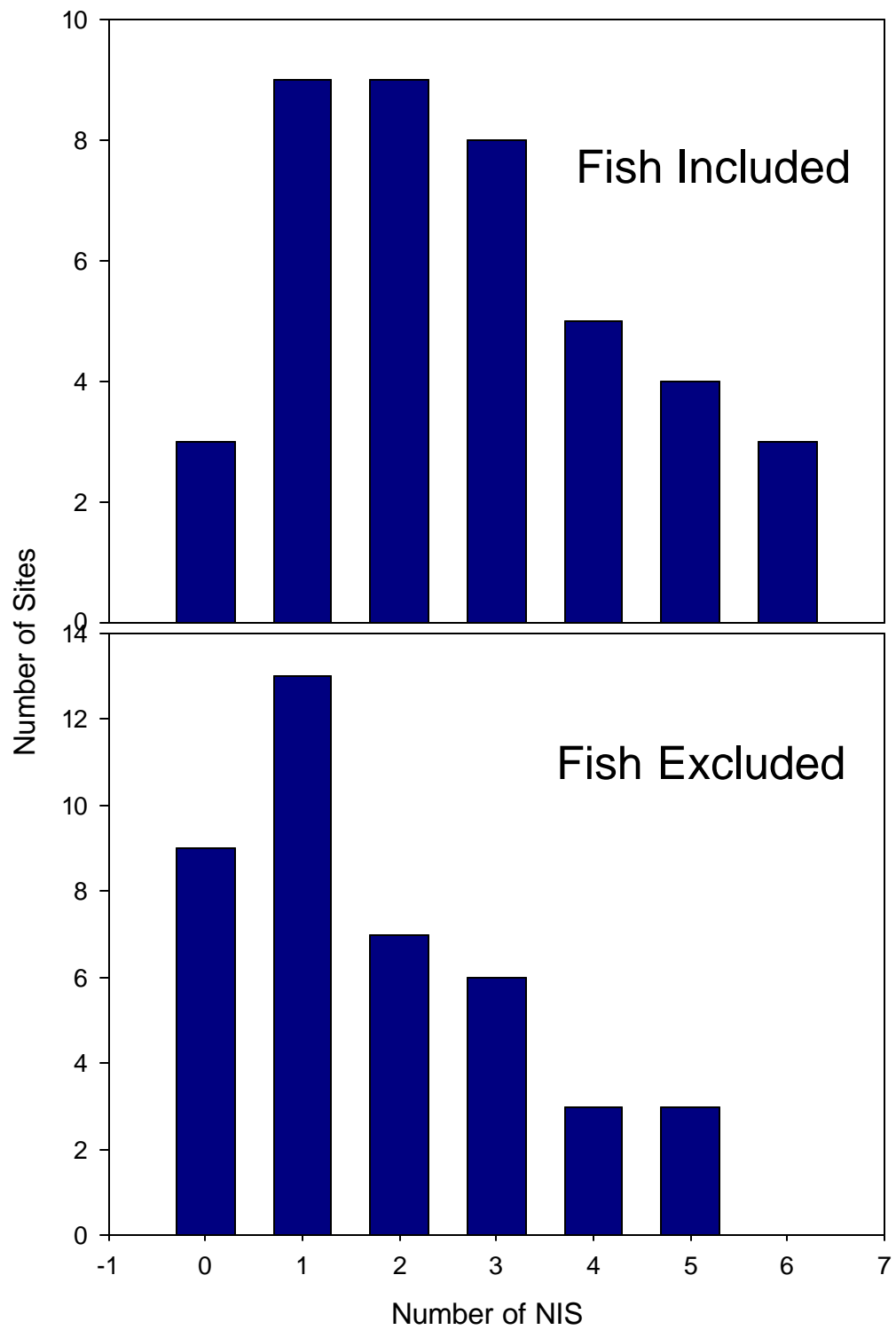


Figure 9. Histograms of numbers of NIS at all sites with fish data included and excluded.

NIS for combined sites is shown in Figure 9, which indicates that, for the full data set, 21 of the 41 sites, or more than 50% of the total, had fewer than three NIS. Many of these were sites where the introduced fishes *Lutjanus kasmira*, *Lutjanus fulvus* (Forster), and *Cephalophis argus* occurred. These three species were intentionally introduced in the 1950s, are already known to be widespread throughout the main Hawaiian Islands, and have the capacity for their own movement to new areas independent of man-related factors. When these fishes are excluded from the results (Figure 9) 22 of the 41 sites had less than 2 NIS.

Relationships of NIS with Environmental and Anthropogenic Factors

The data in Appendix B includes all identifications made at all the sites. However, at seven sites on neighbor islands (KARA1, KARA57, MORA3, MORA7, MARA7, HARA1 & HARA10) and all O'ahu sites, one of the field team (PAR) did not make rapid assessment observations. Therefore, in order to have data based on consistent effort throughout the study, the data from this observer at the other sites were not included in analyses of relationships between numbers of NIS and the factors in Table 7. Similarly, since some reef fishes are less permanent residents of reef and three of the four NIS from this group were purposely introduced, these were also excluded from analyses of relationships with determining factors. These exclusions resulted in the total number of taxa used in regression analysis being reduced to 208 from the 315 (excluding fish) reported by all three observers. However, the list of algae and invertebrate NIS (Table 5) was reduced by only three species, cryptogenic *Hipponix australis* that occurred at 20 sites, and the introduced polychaetes *Salmacina dysteri* (Huxley), and *Schizoporella australis* (Grube), both of which occurred at only one site each.

Using these data, best subsets regression analysis (Minitab[®]) was calculated to identify the best-fitting regression model explaining numbers of NIS that could be constructed using the station factor values in Table 6. The initial model with the most explanatory power (adjusted $R^2 = 0.52$) included the three predictor variables exposure, ramp distance, and native species richness (NSR) in their order of variance explained. These three predictor variables and all of their possible two-way interactions were then used in a best subsets regression analysis to identify the most logical model that included interaction (i.e. if an interaction term was included in the model, the variables used to calculate the interaction term were also included). This best regression model accounted for 67.2% of the variance explained and included as significant factors ocean exposure, NSR and their interaction (Table 8), and their relationship with numbers of NIS is illustrated graphically in Figure 10. A highly significant positive relationship ($p < 0.001$) was found between numbers of NIS and non-exposure to open ocean conditions, i.e. NIS increased significantly going from semi-enclosed locations to open coastlines. Contrary to the expected relationship, NIS increased slightly but significantly with increasing NSR. This positive relationship appears to be primarily due to values of 1-2 NIS that occurred at five open ocean sites with 55 to 90 native species (Figure 10). However, more significantly, the relationship between NIS and the non-exposure-NSR interaction was negative. This suggests that in more

Table 7. Matrix of predictor variable values used in best subsets regression analysis for values of NIS at 41 reef sites.

Sta. No.	Harbor Dist (km)	Ramp Distance	Shore Dist (km)	Stream Dist (km)	Art. Substr. Index	Reef Health Index	Urbanization Index	Nonexposure Index	NSR. (w/o Fish)	NIS (w/o Fish)
KARA1	1.2	1.5	0.3	0.3	4	3	3	3	27	5
KARA2	12.7	1.7	0.1	1.1	2	4	4	2	21	0
KARA3	13.1	2.1	0.2	0.5	1	2	3	1	23	2
KARA4	13.4	1.9	0.2	0.7	1	2	3	1	25	0
KARA5	0.6	0.7	0.4	0.7	4	5	2	4	29	3
KARA6	8.5	8.6	0.6	0.7	2	5	2	1	38	0
KARA7	3.9	4.0	0.1	3.1	1	3	1	1	30	0
KARA8	11.9	0.6	0.1	2.0	3	3	4	1	32	0
MORA1	0.3	0.3	0.1	0.4	3	4	3	2	18	2
MORA2	8.4	8.4	1.4	8.3	1	1	2	1	25	0
MORA3	0.6	22.7	0.5	23.1	3	1	3	1	11	0
MORA4	1.2	26.9	1.0	1.3	3	3	3	1	31	1
MORA5	12.0	15.3	1.5	1.7	2	1	4	1	13	0
MORA6	3.6	5.3	1.6	5.3	3	1	4	1	31	0
MORA7	1.1	1.5	1.4	1.5	3	1	3	1	26	0
MORA8	4.1	4.3	0.6	4.6	3	4	4	1	37	1
MARA1	32.3	6.0	0.1	1.6	1	2	4	2	32	2
MARA2	12.4	12.5	0.2	1.9	2	3	2	2	31	0
MARA3	6.2	6.3	1.6	2.7	1	1	1	1	48	2
MARA4	27.4	17.7	0.1	0.4	1	1	1	3	37	0
MARA5	21.1	5.3	0.1	0.5	1	3	2	1	32	0
MARA6	25.7	0.2	0.2	0.3	5	2	3	4	31	4
MARA7	0.3	0.4	0.3	10.4	3	4	4	3	47	4
MARA8	20.6	20.8	0.1	26.0	1	1	2	2	37	0
MARA9	17.7	17.9	4.6	23.0	1	1	1	1	22	0
HARA1	1.8	1.5	0.4	1.8	4	1	2	1	37	1
HARA2	8.2	7.9	0.2	5.4	2	1	3	1	35	1
HARA3	10.9	10.6	0.3	8.0	1	1	2	1	36	0
HARA4	18.8	18.5	0.5	16.4	1	1	2	1	21	0
HARA5	68.5	16.2	0.2	9.2	1	1	1	1	31	0
HARA6	71.0	18.9	0.1	12.0	1	1	2	1	37	0
HARA7	64.3	14.1	0.2	6.8	1	1	4	1	33	0
HARA8	57.4	7.4	0.2	1.2	2	1	5	2	25	0
HARA9	53.5	3.9	0.1	4.7	1	1	1	1	31	0
HARA10	8.8	8.9	0.1	8.0	1	2	3	1	35	0
OARA1	4.4	4.5	1.1	1.4	1	3	4	3	24	5
OARA2	0.3	0.5	0.3	0.7	2	4	3	3	27	5
OARA3	6.2	6.1	0.1	0.3	1	4	3	1	32	1
OARA4	3.4	3.3	0.1	3.2	3	3	3	1	34	0
OARA5	7.5	7.6	0.1	0.6	1	2	3	1	34	1
OARA6	5.4	5.6	0.1	5.8	1	2	2	3	30	0

Table 8. Relationships determined between numbers of NIS and predictor variables by best subsets linear regression analysis.

Potential Determining Factor	Type	Range	Expected NIS Effect	Result	% Variance Explained
Nonexposure	Estimated	1-5	+	+ p<0.001	45.3
Species Richness (NSR)	Measured	42-138	-	+ p<0.030	8.0
Nonexposure-SR Interaction				- p<0.001	13.9
Full Model				p<0.001	67.2

$$\text{NIS} = 3.81 * \text{Nonexposure} + 0.049 * \text{Species Richness} - 0.040 * \text{Interaction} - 4.19$$

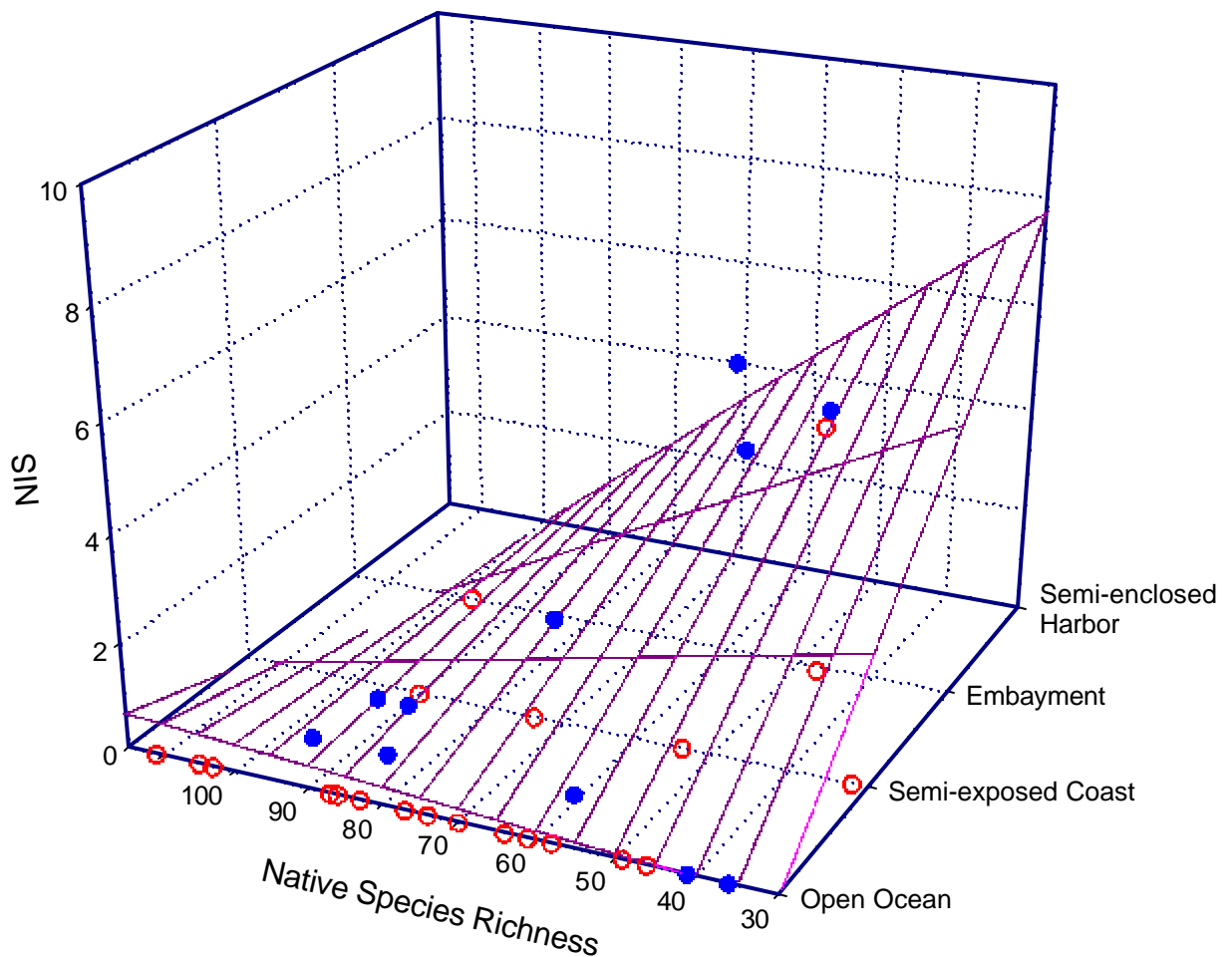


Figure 10. Three dimensional response surface illustrating relationships between numbers of NIS species, ocean exposure of the sites surveyed and native species richness (fish excluded). Blue solid dots indicate values above the response surface, red open circles indicate values below.

enclosed environments such as embayments and semi-exposed coastlines, fewer NIS occurred in locations with higher NSR than would otherwise be the case, and that this effect becomes more important with restriction from open ocean exposure.

V. DISCUSSION

The results support previous findings in the Hawaiian Islands, American Samoa, and Guam which have indicated that relatively few introduced marine invertebrates occur on open ocean coral reefs, especially compared to enclosed harbors and disturbed embayments. In contrast to the approximately 100 NIS that have been recorded for O'ahu's harbors and Kane'ohe Bay, the present study found a total of only 26 species, which included three algae and four fish, at 41 reef sites throughout the main Hawaiian islands, with a maximum of only six NIS at any one site. By comparison, observations within the harbors at these neighbor islands coinciding with the time of the reef surveys and made by the same investigators (Coles et al, in prep.) found NIS to range from lows of 6-8 in the relatively open and exposed harbors of Kawaihae, Hawai'i, Kaunakakai and Hale o Lono, Moloka'i, to highs of 18-24 NIS in the enclosed harbors of Nawiliwili, Kaua'i, Kahului, Maui, and Hilo, Hawai'i. Moreover, in contrast to the usual circumstances in harbors where invertebrate NIS are usually among the most common or dominant species, this was not case at any reef site on the present survey. The algae *Acanthophora spicifera* (Vahl) Boerg was abundant at Puko'o and at the Hotel Moloka'i site on Moloka'i, at Kahekili Beach Park, Papa'ula Point and Ma'alaea Reef on Maui and at one Kane'ohe Bay site. Another alga *Kappaphycus* cf. *alvarezii* (Doty) Doty was abundant at the two Kane'ohe Bay sites and the *ta'ape*, *Lutjanus kasmira*, was abundant at 10 sites throughout the survey. However, the only invertebrate NIS that was abundant at any site was the octocoral *Carijoa riisei* (Duchassaing & Michelotti) at Mala Wharf, Maui, where it occurred on the under sides of concrete posts and metal sheet pilings of the collapsed dock. All other invertebrate NIS were rare at any site and usually consisted of a single or few individuals or colonies in cryptic locations in the recesses of the reefs.

Some sites near harbors or boat ramps were among those having the maximum numbers of NIS, suggesting some influence of proximity to harbors and boat ramps that could act as sources or vectors for spreading of NIS. However, this pattern did not hold for the full array of sites, and some stations near harbors or boat ramps also showed NIS values among the lowest that occurred. This indicates that if these potential sources of NIS are important in their spreading and proliferation, that their influence is not consistent nor does it extend very far from their points of origin, since many sites within a few hundred meters showed few or no NIS and none exceeded a total of six species. Other factors considered likely candidates for propagating or supporting NIS, i.e. proximity to shorelines or streams mouths, presence of manmade structures in the water, development or alteration of the shoreline, and apparent declines in reef condition that would suggest environmental disturbance, all showed no significant relationship with the numbers of NIS that occurred.

The most clearly defined relationship between the low numbers of NIS that occurred and any predictor variable was with the degree to which the sites were enclosed or isolated from the open

ocean, which alone accounted for 45% of the variance in NIS numbers. This finding agrees with observations in harbors and embayments on O'ahu (Coles et al. 1997, Coles et al. 1998, 1999a, 1999b, 2002a, 2002b), which have found decreasing numbers of NIS in the more ocean-exposed areas of the respective study areas, corresponding with increasing species richness. These relationships were even more apparent in a recent study of NIS and total species richness on Tutuila, American Samoa (Coles et al. 2003), where NIS ranged from 5-17 in the semi-enclosed inner Pago Pago Harbor to 1-3 NIS on reefs distant from the harbor. By comparison, total taxa at the inner harbor sites were 102-185, and 403-449 on reef sites outside the harbor.

Contrary to the anticipated relationship of decreasing NIS with increasing native species richness, the results indicate a weak but significant positive relationship that is apparently primarily due to a number of cases of 1-2 NIS that occurred with higher numbers of total taxa at some open ocean sites. However, values of 5-6 NIS with low numbers of total taxa that occurred in embayments and a semi-enclosed harbor resulted in a highly significant interaction between ocean non-exposure and native species richness. This suggests that high species richness of the native population may provide some resistance to successful recruitment and/or survival of introduced species in those areas most susceptible to NIS invasion, i. e. embayments and semi-exposed environments.

Previous studies (Coles et al. 1999b, 2002a, Coles and Eldredge 2002) have concluded that coral reef systems may be more resistant to nonindigenous species introductions and disruptions of native populations and that greater species diversity and higher endemism of native biota in reef systems offer fewer opportunities for successful proliferation of new arrivals than is the case for lower diversity temperate areas (Hutchings et al. 2002, Paulay et al. 2002). In temperate waters increased species richness of sessile organisms has been empirically determined to significantly decrease invasion success in coastal New England habitats (Stachowicz et al. 1999). However, Hewitt (2002) did not find a significant relationship between species richness and decreased invasion success for eight port surveys in tropical to temperate waters around Australia, although invasion success was found to decrease significantly with latitude along with a linear but non-significant increase in species richness. The results from the present and previous surveys of nonindigenous species in Hawai'i indicate that overall, few introduced marine invertebrates have successfully penetrated Hawai'i's coral reefs, and even fewer are considered invasive, i. e. monopolizing habitats or displacing native species. For those few NIS that were found on reefs in this study, if these circumstances can be extrapolated to more generalized conditions, the results suggest that the relationships between native species diversity and nonindigenous species can be complex and depend primarily on the degree to which the reef or habitat is unrestricted from open ocean circulation, and secondarily to the species richness of the native biota.

VI. MANAGEMENT CONSIDERATIONS

The findings of this study are encouraging in that they do not indicate widespread occurrence or abundance of introduced marine invertebrates comparable to the proliferation and sometimes ecologically devastating impacts that have occurred on Hawaiian coral reefs from invasive marine algae (Brostoff 1989, Russell 1992, Rogers and Cox 1999, Woo et al. 1999, Smith et al. 2002). No NIS invertebrate found in this study, with the exception of *Carijoa riisei* on artificial surfaces at the collapsed Mala Wharf, was common or dominant, a maximum of only six introduced invertebrates was found at any site, and twelve of the sixteen NIS invertebrates occurred at only 1 or 2 sites. No management effort in terms of control or eradication of established populations at reefs surveyed for this study is therefore indicated.

These results should not, however, be interpreted to indicate that the potential for such invasions does not exist. Certain NIS invertebrates have already become established and their occurrences, although patchy in distribution, are problematical, with localized invasive proliferations on or near coral reefs. Three invertebrates considered invasive on Hawaiian coral reefs were discussed in Coles and Eldredge (2002) and two of these, the Philippine Mantis Shrimp *Gonodactylaceus falcatus* (Forsskål) and the Snowflake Coral *Carijoa riisei* occur in reef areas. *Gonodactylaceus falcatus* is common in Kane'ohe Bay (Coles et al 2003a) where it has displaced the native shrimp *Pseudosquilla ciliata* (Fabricius) from coral rubble habitats (Kinzie 1968) and it also occurs at Waikiki (Coles et al. 2002b). *Gonodactylaceus falcatus* was not observed on neighbor islands in the present surveys, but its cryptic habit of residing in burrows makes it difficult to detect with rapid assessments, so its occurrence cannot be discounted without studies targeted toward this species.

Coles and Eldredge (2002) concluded that the octocoral *Carijoa riisei* appeared to be "a relatively benign introduction that is occupying previously underutilized habitat and producing no recognized negative on the overall reef community" but with the caveat that its "rapid proliferation...suggests that equally fast growing and far more damaging introductions could occur at any time". Since that time of that writing, sufficient information has come available to warrant revising the status of *C. riisei* to an invasive species with potentially serious consequences environmentally and economically. We now know that *C. riisei* can occur in high densities from the intertidal zone (Coles et al. 2002b) to over 100 m deep in environments where reduced light and moderate current provide optimal growth conditions. It occurs under ledges and in caves at many reef sites throughout the main Hawaiian Islands and overgrows black coral beds off Maui between 75 and 100 m (Grigg 2003) that may be important sources of reproduction for black corals harvested in shallow water. Other observations suggest that *C. riisei*, which was first reported in Hawai'i in Pearl Harbor in 1972 (Evans et al. 1974, Devaney and Eldredge 1977) is highly fecund and has a rapid growth rate (S. Kahng, pers. comm.), and it continues to proliferate and spread. For example, many colonies were recently observed for the first time on the headwall between the thermal discharge pipes for the Kahe Power Station at a location which has been inspected annually for over 30 years (SLC, pers. obs.). It appears that, of the over 300 known marine NIS that have reached Hawai'i, this species is the most widespread and potentially

invasive invertebrate to Hawai'i's coral reefs, and further studies are needed to determine its genetic relationships, mechanisms of reproduction and spawning, growth rates, environmental constraints, and other information that may be utilized in its management and control.

Another introduced species that, based on observations made during the course of this study, should be considered for invasive status, is the Orange Keyhole Sponge *Mycale armata*. This sponge was observed at five of the 41 sites in the present study, but at all sites other than in Kane'ohe Bay it was a minor component of the sessile benthos and appeared neither abundant nor invasive. However, in Kane'ohe Bay and especially on reefs on or near Coconut Island, this sponge has become abundant and is growing at a sufficient rate to overgrow the dominant corals *Porites compressa* and *Montipora capitata* (cover photo). This may be a localized situation that could be due to elevated nutrient and particulate concentrations in the water that increase sponge growth. A study should be conducted to monitor the growth of this sponge and its competitive impact on corals in various parts of Kane'ohe Bay, and this species should be "red flagged" and watched for as a potential invasive on reefs elsewhere, especially on those close to harbors where it is often a dominant component of the harbor biota.

It is clear from efforts that have been conducted in Hawai'i and elsewhere that, unless nonindigenous marine species are detected soon after their introduction, cleanup and eradication programs have limited if any chance for successful removal of invasive species. Management efforts should therefore focus on stopping introductions at their sources, i.e. prevention of aquaculture or aquarium releases both accidental and intentional, and control of vessel ballast water and hull fouling. It is worth noting that the introduced algae and fishes that are considered among the most troublesome and invasive NIS largely consist of species that were purposely introduced for aquaculture or fisheries enhancement purposes, and such efforts should be severely scrutinized before they are permitted. Although ballast water is considered the main vector for movement of nonindigenous species worldwide, Hawai'i, with its reliance on imported goods, is a net exporter of ballast water, and hull fouling is a more likely pathway for movement NIS both into and among the Islands (Godwin and Eldredge 2001, Godwin 2003). Godwin and Eldredge (2004) have determined that 112 species, including 50 NIS already established in Hawaii and nine new, occurred on the hulls of 35 vessels from both outside Hawai'i and moving between the Hawaiian Islands. This indicates that ample opportunities for new introductions still exist and efforts should be made to minimize establishment and propagation of new NIS through adoption and implementation of the Aquatic Invasive Species (AIS) Management Plan for the State of Hawai'i (DLNR/DAR 2003).

Finally it appears from the results of the present study that efforts to maintain the integrity and species diversity of reef communities may also help to promote resistance to establishment of introduced species, especially in restricted or semi-enclosed embayments which are most vulnerable to perturbations and stresses related to man's activities. It is probably no accident that Kane'ohe Bay, with its history of environmental abuses (Smith et al. 1973, 1981, Coles et al. 2002a) has comparable numbers of introduced and invasive species as most harbors that have been surveyed in Hawai'i. Continued efforts to control land runoff, eliminate sewage and other

discharges, and control overfishing on Hawaii's coral reefs may have the added benefit of helping control the establishment and propagation of introduced and invasive species in areas where they do not presently occur.

VII. REFERENCES

- Bax, N., J. T. Carlton, A. Mathews-Amos, R. L. Haedrich, F. G. Howarth, J. E. Purcell, J. E. Rieser, and A. Gray. 2001. Conserving marine diversity through the control of biological invasions. *Conserv. Biol.* 451:145-176.
- Brock, V. E. 1960. The introduction of aquatic animals into Hawaiian waters. *Int. Rev. Ges. Hydrobiol.* 45: 463-480.
- Brostoff, W. N. 1989. *Avrainvillea amadelpha* (Codiales, Chlorophyta) from Oahu, Hawai'i. *Pac. Sci.* 43:166-169.
- Brown, E., E. F. Cox, P. Jokiel, K. Rodgers, W. Smith, B. Tissot, S. L. Coles, and J. Hultquist. In press. Development of benthic sampling methods for the Coral Reef Assessment and Monitoring Program (CRAMP) in Hawai'i. *Pac. Sci.*
- Carlton, J. T. 1985. Transoceanic and interoceanic dispersal of coastal marine organisms: the biology of ballast water. *Ocean. Mar. Biol. Ann. Rev.* 23:313-371.
- Carlton, J. T. 1994. Biological invasions and biodiversity in the sea: the ecological and human impacts of nonindigenous marine and estuarine organisms. Pages 5 - 11 in. *Nonindigenous Estuarine and Marine Organisms (NEMO)*, Proceedings of the Conference and Workshop. Government Printing Office No. 0208-C-04., Seattle, Washington.
- Carlton, J. T. and J. B. Geller. 1993. Ecological roulette: the global transport of nonindigenous marine organisms. *Science* 261:78-82.
- Carlton, J. T. and L. G. Eldredge. In prep. Marine bioinvasions of Hawai'i: the introduced and cryptogenic marine and brackish water invertebrates of the Hawaiian Archipelago. Bishop Museum, Honolulu.
- Coles, S. L., R. C. DeFelice, L. G. Eldredge, and J. T. Carlton. 1997. Biodiversity of marine communities in Pearl Harbor, Oahu, Hawaii with observations on introduced species. Bishop Museum, Tech. Rep. No. 10, Honolulu.
- Coles, S. L., R. C. DeFelice, J. E. Smith, and L. G. Eldredge. 1998. Determination of baseline conditions for introduced marine species in nearshore waters of the island of Kaho'olawe, Hawaii. Bishop Museum, Tech. Rep. No. 14, Honolulu.
- Coles, S. L., R. C. DeFelice, L. G. Eldredge, and J. T. Carlton. 1999a. Historical and recent introductions to non-indigenous marine species into Pearl Harbor, Oahu, Hawaiian Islands. *Mar. Biol.* 135: 1247-158.
- Coles, S. L., R. C. DeFelice, and L. G. Eldredge. 1999b. Nonindigenous marine species introductions in the harbors of the south and west shores of Oahu, Hawaii. Bishop Museum, Tech. Rep. No. 15, Honolulu.
- Coles, S. L., R. C. DeFelice, and D. Minton. 2001. Marine species survey of Johnston Atoll June 2000. U.S. Fish and Wildlife Service, Pacific Islands Area Office, Bishop Museum Tech. Rep. 19, Honolulu.
- Coles, S. L. and L. G. Eldredge. 2002. Nonindigenous species introductions on coral reefs: a need for information. *Pac. Sci.* 56: 191-209.
- Coles, S. L., R. C. DeFelice, and L. G. Eldredge. 2002a. Nonindigenous species in Kan'eohe Bay, Oahu, Hawai'i. Bishop Museum, Tech. Rep. No. 24, Honolulu.

- Coles, S. L., R. C. DeFelice, and L. G. Eldredge. 2002b. Nonindigenous marine species introductions at Waikiki and Hawai'i Kai, O'ahu, Hawai'i. Bishop Museum Tech. Rep. No. 25, Honolulu.
- Coles, S. L., P. R. Reath, P. A. Skelton, V. Bonito, R. C. DeFelice, and L. Basch. 2003. Introduced marine species in Pago Pago Harbor, Fagatele Bay and the National Park Coast, American Samoa. Bishop Museum Tech. Rep. No. 26, Honolulu.
- Department of Land and Natural Resources, Division of Aquatic Resources. 2003. Aquatic Invasive Species (AIS) Management Plan for the State of Hawai'i. Report prepared for the State of Hawai'i.
- DeFelice, R. C., S. L. Coles, D. Muir, and L. G. Eldredge. 1998. Investigation of the marine communities of Midway Harbor and adjacent lagoon, Midway Atoll, Northwestern Hawaiian Islands. Bishop Museum, Hawai'i Biological Survey Contr. No. 1998-014, Honolulu.
- DeFelice, R., D. Minton, and S. Godwin. 2002. Records of shallow -water marine invertebrates from French Frigate Shoals, Northwestern Hawaiian Islands with a note on nonindigenous species. Bishop Museum Tech. Rep. 23, Bishop Museum, Honolulu.
- Devaney, D. M. and L. G. Eldredge 1977. Subclass Octocorallia. p. 119-129 *in* D. M. Devaney and L. G. Eldredge, ed. Reef and Shore Fauna of Hawai'i. Section 1: Protozoa through Ctenophora. Bishop Museum Press, Honolulu.
- Englund, R. A. 2000. Nonindigenous freshwater and estuarine species introductions and their potential to affect sportfishing in the lower stream and estuarine regions of the south and west shores of O'ahu, Hawai'i. Bishop Museum Tech. Rep. No. 17, Honolulu
- Evans, E. C., III, N. L. Buske, J. G. Grovhoug, E. B. Guinther, P. L. Jokiel, D. T. O. Kam, E. A. Kay, T. J. Peeling, and S. V. Smith. 1974. Pearl Harbor Biological Survey - Final Report. Naval Undersea Center (NUC, Rep. No. NUC TN 1128, San Diego.
- Godwin, L. S. 2003. Hull fouling of maritime vessels as a pathway for marine species invasions to the Hawaiian Islands. *Biofouling* 19 (Supplement):123-131.
- Godwin, L. S. and L. G. Eldredge. 2001. South Oahu Marine Invasions Shipping Study (SOMISS). Bishop Museum Tech. Rep. No. 20, Honolulu.
- Godwin, L. S. and L. G. Eldredge. 2004. The assessment of hull fouling as a mechanisms for the introduction and dispersal of marine introduced species in the main Hawaiian Islands. Bishop Museum Tech. Rep. No. xx, Honolulu.
- Hewitt, C. L., M. L. Campbell, K. M. Moore, N. B. Murefet, and B. Robertson. 1998. Introduced species survey. Port of Hay Point, Queensland. CSIRO Centre for Research on Introduced Marine Pests to Ports Corporation of Queensland, Unpublished Report, Brisbane.
- Hoedt, F. E., J. H. Choat, J. Collins, and J. J. Cruz. 2000. Mourilyan Harbour and Abbot Point surveys: port marine baseline surveys and surveys for introduced marine pests. School of Marine Sciences and Aquaculture, James Cook University to Ports Corporation of Queensland, Brisbane.
- Hoedt, F. E., J. H. Choat, J. Collins, and J. J. Cruz. 2001. Port of Lucinda surveys: port marine baseline surveys and surveys for introduced marine pests. School of Marine Sciences and Aquaculture, James Cook University to Ports Corporation of Queensland, Brisbane.

- Hutchings, P. A., R. W. Hilliard, and S. L. Coles. 2002. Species introductions and potential for marine pest invasions into tropical marine communities, with special reference to the Indo-Pacific. *Pac. Sci.* 56:223-233.
- Kinzie, R. A., III. 1968. The ecology of the replacement of *Pseudosquilla ciliata* by *Gonodactylus falcatus* (Crustacea: Stomatopoda) recently introduced into the Hawaiian Islands. *Pac. Sci.* 22: 465-475.
- Kinzie, R. A., III. 1984. Aloha also means goodbye: a cryptogenic stomatopod in Hawaii. *Pac. Sci.* 38: 298-311.
- Paulay, G., L. Kirkendale, G. Lambert, and C. Meyer. 2002. Anthropogenic biotic interchange in a coral reef ecosystem: a case study from Guam. *Pac. Sci.* 56:403-421.
- Randall, J. E. 1987. Introductions of marine fishes to the Hawaiian Islands. *Bull. Mar. Sci.* 41: 490-502.
- Rodgers, S. K. and E. F. Cox. 1999. Rate of spread of introduced Rhodophytes *Kappaphycus alvarezii*, *Kappaphycus striatum*, and *Gracilaria salicornia* and their current distributions in Kane'ohe Bay, O'ahu, Hawai'i. *Pac. Sci.* 53: 232-241.
- Ruiz, G. M., J. T. Carlton., E. D. Grosholz, and A. H. Hines. 1997. Global invasions of marine and estuarine habitats by non-indigenous species: mechanisms, extent and consequences. *Am. Zool* 31:621-632.
- Russell, D. J. 1983. Ecology of the red seaweed *Eucheuma striatum* Schmitz on Coconut Island, Oahu, Hawaii. *Pac. Sci.* 37: 87-107.
- Russell, D. J. 1992. The ecological invasion of Hawaiian reefs by two marine red algae, *Acanthophora spicifera* (Vahl) Boerg. and *Hypnea musciformis* (Wulfen) J. Ag., and their association with two native species, *Laurencia nidifica* J. Ag. and *Hypnea cervicornis* J. Ag. *ICES Mar. Sci. Symp.* 194: 110-125.
- Smith, J. E., C. M. Hunter, and C. M. Smith. 2002. Distribution and reproductive characteristics of nonindigenous and invasive marine algae in the Hawaiian Islands. *Pac. Sci.* 53:299-315.
- Smith, S. V., K. E. Chave, and D. T. O. Kam. 1973. Atlas of Kane'ohe Bay: a reef ecosystem under stress. University of Hawai'i, Sea Grant Program, UHII-SEAGRANT-TR-72-01, Honolulu.
- Smith, S. V., W. J. Kimmerer, E. A. Laws, R. E. Brock, and T. W. Walsh. 1981. Kaneohe Bay Sewage Diversion Experiment: perspectives on ecosystem responses to nutritional perturbation. *Pac. Sci.* 35:279-402
- Southward, A. J., R. S. Burton, S. L. Coles, P. R. Dando, R. DeFelice, J. Hoover, E. Parnel, T. Yamaguchi, and W. A. Newman. 1998. Invasion of Hawaiian inner shores by an Atlantic barnacle. *Mar. Ecol. Prog. Ser.* 165: 119-126.
- Stachowicz, J. J., R. B. Whitlatch, and R. W. Osman. 1999. Species diversity and invasion resistance in a marine ecosystem. *Science* 286:1577-1579.
- Woo, M., C. M. Smith, and W. Smith. 1999. Ecological interactions and impacts of invasive *Kappaphycus striatum* in Kane'ohe Bay, a tropical reef. Pages 186-191 in J. Pederson, editor. *Marine Bioinvasions*. MIT Sea Grant Program, Cambridge, Mass.

VII. ACKNOWLEDGMENTS

Specimens of taxa that were possible new introductions or requiring species identification verification were sent to or seen by the following experts, who are gratefully acknowledged for their assistance.

Sponges: Ralph DeFelice, Los Angeles County Museum of Natural History

Hydrozoans: Dr. Dale Calder, Royal Ontario Museum, Toronto, Canada

Vermetid Gastropod Molluscs: Anuschka Fauci, Department of Zoology, University of Hawaii

Bryozoans: Chela Zabin, Department of Zoology, University of Hawaii

Ascidians: Scott Godwin, Bishop Museum, Department of Natural Sciences

The outreach workshop was organized with the assistance and cooperation of Dr. Cindy Hunter, Waikiki Aquarium, Dr. Celia Smith, Dr. Jennifer Smith, and Kim Payton, Department of Botany, University of Hawaii.

The Hawaii State Department of Land and Natural Resources Division of Aquatic Resources generously provided logistic support and of boat transport on the islands of Maui, Hawai'i and O'ahu, and we want to especially thank Paul Murakawa, Tony Montgomery, Skippy Hau and Bill Walsh for providing this assistance

Finally, we wish to acknowledge Mike Hamnett and the staff of the Hawaii Coral Reef Initiative for financial support and encouragement for conducting this study.

APPENDIX A

Rapid Assessment Site Descriptions for Kaua'i, Moloka'i, Maui, Hawai'i and O'ahu

Kaua'i

Station KARA1. Marriott Hotel Reef, near Nawiliwili Harbor entrance. 11-Nov-02 (Latitude 21°57'36.3", Longitude 159°21'14.6"). Nearest harbor pier: 1.0 km. Nearest boat ramp: 1.5 km. Depth 2.5-6 m.

100 m east of jetty which forms east side of Nawiliwili docking area. Substratum consisted of wave disturbed reef with little relief and moderate patchy coral cover mostly of *Porites lobata* and *Pocillopora meandrina* and abundant algae in 2.5 to 5 m depth. Deeper areas >5 m along western side have greater relief with ledges and grooves providing habitat for diverse fishes and coral cover of ca. 50%. High exposure to tradewind generated waves caused limited visibility of around 5 m.

Station KARA2. Beach House Reef. 12-Nov-02 (Latitude 21°53'5.9", Longitude 159°28'45.5") Nearest harbor pier: 13.1 km. Nearest boat ramp: 2.1 km. Depth 1-1.5 m.

Shallow high energy reef about 1.5 m deep just inside the surf line east of Kukui'ula small boat harbor. Substratum is consolidated limestone pavement and rubble with sparse (ca. 5%) and patchy coverage of corals and thin growth of algae, mostly of a small iridescent species of *Dictyota*. Reef is highly exposed to wave turbulence subject to sand scour from surrounding sandy area. Conditions during survey were turbulent from north Pacific swell with visibility of 6-8 m.

Station KARA3. Ho'ai Bay 1. 12-Nov-02. (Latitude 21°52'48.7", Longitude 159°28'28.3"). Nearest harbor pier: 13.5 km. Nearest boat ramp: 2.3 km. Depth 7.5-10 m

Substratum is a mostly smooth, boulder-strewn reef pavement surrounded by sandy areas, with moderate coral cover primarily of scattered *Pocillopora meandrina* and intermittent 1-2 m² area cracks in reef. Large limestone outcrops are interspersed and form high relief with flat tops which provide surfaces where most coral cover occurs. Bottom depth ranged 7.5 to 10.5 m depth with abundant coral cover and high relief providing habitat for abundant and diverse fish and macroinvertebrates. Conditions calm and water clear with visibility of ca. 20 m.

Station KARA4. Ho'ai Bay 2. 12-Nov-02. (Latitude 21°52'53.4", Longitude 159°28'34.2"). Nearest harbor pier: 13.6 km. Nearest boat ramp: 2.2 km. Depth 2.5-3 m

Gently sloping, flat, algal dominated limestone bottom, boulder-strewn and cracked, with low coral cover of 5-10%, mostly of *Pocillopora meandrina* and intermittent outcrops with *Porites lobata*. Conditions calm and water clear with visibility of ca. 20 m.

Station KARA5. Port Allen Harbor Entrance. 13-Nov-02. (Latitude 21°54'3.5", Longitude 159°35'49.9"). Nearest harbor pier: 0.6 km. Nearest boat ramp: 0.7 km. Depth 7.5-10 m.

Limestone reef located at the base of a reef just inside of the harbor entrance ranging from area surveyed at reef base in 7.5-10.5 depth to top of reef in ca. 5 m. Bottom is mostly loosely consolidated cobble to boulder-size coral rubble surrounded by sand and cobble. All surfaces were covered by a thin coating of fine sand/silt, and hard surfaces were dominated by an abundant growth of *Sargassum* cf. *echinocarpum* algae. Coral coverage was low, ca. 1-5% with a few large colonies of *Porites lobata*. In shallower areas <5 m depth coral cover was higher at

around 25% with less sediment. Turbulent conditions and sediment-laden water from Hanapepe stream cause low visibility limited to ca. 5 m.

Station KARA6 "Tigers", ca. 1 km outside Pakala's Plantation. 14-Nov-02. (Latitude 21°55'45.5", Longitude 159°39'11.5"). Nearest harbor pier: 8.3 km. Nearest boat ramp: 8.4 km. Depth 9-11 m.

Bottom consolidated limestone platform with little relief surrounded by coarse sand. Major bottom cover was abundant macroalgae with sparse, small low-lying corals and total cover of 25%. Area is apparently influenced by sediment from small boat harbor construction on shore and from Olekele Sugar Mill outflow. These and turbulent conditions caused moderately reduced visibility of 10-15 m.

Station KARA7. Nomilu Pond. 14-Nov-02. (Latitude 21°53'13.7", Longitude 159°31'58.8"). Nearest harbor pier: 7.3 km. Nearest boat ramp: 4.5 km. Depth 7.5-9 m.

Site is ca. 200 m off red sandstone bluff near Nomilu Fishpond in a semi-sheltered embayment. Bottom is consolidated limestone pavement with low relief, algal cover dominated by *Melamansia glomerata* and widely spaced corals of ca. 5-10% coverage. Conditions quite calm and visibility ca. 20 m.

Station KARA8. Kukui'ula. 14-Nov-02. (Latitude 21°53'8.4", Longitude 159°29'16.8"). Nearest harbor pier: 12.0 km. Nearest boat ramp: 0.7 km. Depth 6.5-7.5 m.

Ca. 150 m from shoreline on flat consolidated limestone bench reef with light sand coating, sparse macroalgae and coral cover of ca. 5-10%, with abundant and diverse fish fauna. Conditions calm and clear with visibility. Conditions calm and water clear with visibility of ca. 20 m.

Moloka'i

Station MORA1. Puko'o Nearshore. 27-Jan-03 (Latitude 21°04'18.8", Longitude 156°48'16.1"). Nearest harbor pier: 0.3 km. Nearest boat ramp: 0.3 km. Depth 0.5-2 m. Visibility poor, ca. 1-3 m. Heavily silted reef flat with muddy/sandy bottom adjacent to stream that empties onto reef flat next to a fishpond. Coral cover ca. 10-25% dominated by *Montipora capitata*, *Porites compressa*, and *Porites lobata* along the reef edge above a sludgy sand. Abundant *Acanthophora spicifera* and *Halimeda* sp. on loose rubble and non-coral reef surfaces.

Station MORA2 Pala'au. 28-Jan-03 (Latitude 21°05'30.4", Longitude 157°06'38.7") Nearest harbor pier: 8.4 km. Nearest boat ramp: 8.4 km. Depth 3-7 m. Visibility very good, ca. 15 m. Flourishing reef area with high coral cover (ca. 70 - 90%) mainly composed of *Porites compressa*, *Porites lobata*, and *Montipora capitata*. Topography mostly level except for deep cut channels through the reef with coarse sand bottoms. Abundant turf algae and some crustose coralline algae

Station MORA3. Hale o Lono Reef 28-Jan-03 (Latitude 21°05'1.4", Longitude 157°14'57.7"). Nearest harbor pier: 0.6 km. Nearest boat ramp: 22.7 km. Depth 6-8 m. Visibility excellent ca. 20 m.

Forereef directly outside of Hale o Lono Harbor with high coral cover of 60-80%, mainly composed of *Porites lobata* and *Montipora capitata*. Little vertical relief except along the edges of sand-filled channels extending ca. 2 m below reef. Substratum mostly consolidated without much loose rubble. Abundant *Asparogopsis taxiformis* observed in one small areas and introduced *Cephalopholis argus* found primarily along the edges of sand patches and along channels where the greatest relief occurred.

Station MORA4. Puko'o Offshore. 29-Jan-03 (Latitude 21°03'55.8", Longitude 156°47'38.4"). Nearest harbor pier: 1.2 km. Nearest boat ramp: 1.2 km. Depth 0.5-1 m. Visibility poor, ca. 3-5 m. Shallow reef, heavily wave disturbed and scoured, located just inside of a "blue hole" and dominated by macroalgae. Coral cover was variable ca. 5-20%, composed of small *Porites compressa* and *Pocillopora damicornis* heads, and vertical relief was <1m. Fair amount of moderate sized coral rubble occurred with high turf and macroalgal cover (including *Turbinaria ornata*), and some sand patches, This is the type locality of *Porites pukoensis*, and some colonies were photographed at the edge of the blue hole, which had the best coral coverage, largest colonies, and relatively high species diversity in the area. Coral coverage increased slightly in breaker zone where some rubble lined channels added relief.

Station MORA5. Kamalo. 29-Jan-03 (Latitude 21°02'40.6", Longitude 156°54'1.1") Nearest harbor pier: 12.0 km. Nearest boat ramp 15.3 km. Depth 3-6 m. Visibility poor, ca. 1-3 m. Flourishing forereef with high coral coverage bordered on the shoreward side by a deep blue hole extending to 21 m depth with sides virtually a monospecific stand of *Montipora capitata*. Coral cover on reef top was patchy but mostly between 50–80% coverage and composed mainly of *P. lobata*, *P. compressa*, and *M. capitata*. Strong ground swell caused sand suspension and low visibility that is apparently atypical for this site.

Station MORA6 Kamiloloa 30-Jan-03 (Latitude 21°04'18.2", Longitude 157°00'9.7"). Nearest harbor pier: 3.6 km. Nearest boat ramp: 5.3 km. Depth 6-7 m. Visibility intermediate, ca. 5-6 m. Flat forereef area bisected by shallow sand channels and intermittent dead coral heads. Coral cover was sparse, ca. 5% of small *Pocillopora*, *Porites* and *Montipora* colonies, and *Halimeda* algae turf algae holding sediments abundant, with much of reef sand covered.

Station MORA7. Kaunakakai Reef. 30-Jan-03 (Latitude 21°04'59.6", Longitude 157°02'34.9"). Nearest harbor pier: 1.1 km. Nearest boat ramp: 1.5 km. Depth 7-10 m. Visibility excellent ca. 25 m.

Forereef on western side of channel to Kaunakakai Harbor. Coral cover lush and abundant, with ca. 80% cover mainly composed of stands of *Porites compressa*, *Porites lobata*, and *Montipora capitata*. Relief was generally low except for 2-3 m deep channels, usually more than 5 m wide with sandy bottoms and some rubble. Highest diversity of fish relative to other Moloka'i sites, and

this was the only site where the Hawaiian endemic soft coral *Sinularia molokensis* was found in two medium sized patches.

Station MORA8. Hotel Moloka'i. 31-Jan-03 (Latitude 21°04'28.7", Longitude 156°59'48.7"). Nearest harbor pier: 4.1 km. Nearest boat ramp: 4.3 km. Depth 0.2-1 m. Visibility intermediate, ca. 5 m

Very shallow reef flat inside of wave breaker line, with ca. 10-15% coral cover interspersed among sand channels with coarse sediment and coral rubble beds. Abundant macroalgae on dead reef rubble and abundant alpheid burrows visible in coarse sand.

Maui

Station MARA1. Kehekili Beach Park. 29-Mar-03. (Latitude 20°56'22.2", Longitude 156°41'45.8) Nearest harbor pier 32.3 km. Nearest boat ramp 6.0 km. Depth 1.5-5 m. Visibility high (ca. 15 m) Shallow reef in semi-exposed embayment about 50 m off heavily used beach area with high (ca. 50%) coral cover dominated by *Porites* and *Montipora* species. However, macroalgae was also abundant, especially introduced *Acanthophora spicifera*, which was greatest near the shoreline but also occurred to the reef edge, along with red turf algae.

Station MARA2. Olowalu. 30-Mar-03 (Latitude 20°48'42.2", Longitude 156°36'45.5) Nearest harbor pier: 12.4 km. Nearest boat ramp: 12.5 km. Depth 2.5-3.0 m. Visibility poor (ca. 5 m) Degraded reef with occasional grooves in midst of black sand with numerous dead corals and calcareous substratum coated with fine sediment and fine turf, but still with moderate coral coverage among of ca. 30% dominated by outcrops and heads of *Porites lobata* and *Porites evermanni* up to 2 m in diameter and patches of *Sarcothelia edmondsoni* soft coral.

Station MARA3. Papa'ula Point, outside of Spartan Reef. 31-Mar-03. (Latitude 20°55'39.3", Longitude 156°25'44.9"). Nearest harbor pier: 6.2 km. Nearest boat ramp: 6.3 km. Depth 9-12 m. Visibility high ca. 15 m

Very flat reef surface with intersecting channels providing the only relief, bottom characteristic of reef subject to high swell turbulence. Coral coverage high and dominated by encrusting *Montipora flabellata* and *Porites lobata*, with total coral coverage of 80-90%. Non-coral reef surfaces support abundant and diverse macroalgae, including *Acanthophora spicifera* and *Turbinaria ornata*

Station MARA4. Honolua Bay. 1-Apr-03. (Latitude 21°01'8.9", Longitude 156°38'334.2"). Nearest harbor pier: 27.4 km. Nearest boat ramp: 17.1 km. Depth 2.5-8.5 m. Visibility excellent, ca. 20 m. Coral reef in excellent condition in semi-enclosed embayment which provides shelter from open ocean swell turbulence but is well mixed with oceanic seawater. High abundance and diversity of corals and reef fishes found despite high tourist usage, as indicated by more than five large boats and over 50 snorkelers observed in the vicinity of the reef during two hours. Coral coverage totaled ca. 50-60 % of available substratum and was dominated by *Porites lobata* and *Porites*

evermanni. Macroalgae on non-coral reef surfaces dominated by *Turbinaria ornata* and *Melamansia glomerata*.

Station MARA5. Puamana. 1-Apr-03. (Latitude 20°51'29.9", Longitude 156°40'8.4"). Nearest harbor pier: 21.0 km. Nearest boat ramp: 5.3 km. Depth 3-3.5 m. Visibility very poor, ca. 2 m. Highly disturbed reef subject to turbulent conditions and sediment-laden water from south Pacific swells, resulting in very turbid water and marginal coral conditions with low coral coverage of only ca. 1-5%, mostly *Porites lobata*. Heavy cover of large variety of macroalgae.

Station MARA6. Mala Wharf. 1-Apr-03. (Latitude 20°53'23.2", Longitude 156°41'26.8"). Nearest harbor pier: 27.2 km. Nearest boat ramp: 0.2 km. Depth 3-9 m. Visibility excellent, ca. 30 m. Collapsed dock area in vicinity of reef provides numerous iron projections, concrete beams and other hard surfaces, providing high relief and substratum for development of abundant and diverse hard coral cover and reef fishes. Introduced octocoral *Carijoa riisei* was abundant on under surfaces of beams.

Station MARA7. Ma'alaea Reef 2-Apr-03. (Latitude 20°47'31.6", Longitude 156°30'45.8"). Nearest harbor pier: 0.3 km. Nearest boat ramp: 0.4 km. Depth 2.5-5.5 m. Visibility intermediate 5-6 m.

Degraded and disturbed reef near Ma'alaea Harbor entrance dominated by macroalgae, especially very abundant introduced *Acanthophora spicifera*. Reef highly impacted by south swells and sediment scour and deposition, with low coral coverage of ca. 10%, mostly *Pocillopora meandrina* and *Porites lobata*.

Station MARA8. Kanahena Bay 3-Apr-03. (Latitude 20°38'5.3", Longitude 156°29'57.6"). Nearest harbor pier: 20.6 km. Nearest boat ramp: 20.8 km. Depth 3-8 m. Visibility good, ca. 15-20 m. Patchy reef that is subject to moderate swell within semi-enclosed embayment. Reefs are intermittent among sand patches and have 50-75% coral cover, mostly composed of *Porites lobata* and *Porites evermanni* growing in clumps up to 5-10 m total diameter, but also abundant *Montipora capitata*, *Montipora patula*, and *Pocillopora meandrina*. Moderate alga coverage on non-coral reef surfaces most composed of calcareous species.

Station MARA9. Molokini Crater 3-Apr-03. (Latitude 20°37'14.9", Longitude 156°26'30.8"). Nearest harbor pier: 17.7 km. Nearest boat ramp: 17.8 km. Depth 7-8.5 m. Visibility excellent, ca. 30 m.

Remote reef in apparently natural state, despite frequent visits and high usage by snorkelers and scuba divers. Protection on south side by crater rim and north by Maui has restricted long period wave turbulence and promoted high coral growth. Coral coverage is ca. 75-90%, dominated equally by *Porites lobata*, *Porites evermanni*, *Montipora capitata*, and *Montipora patula*. High reef fish abundance and diversity, very little macroalgae.

Hawai'i

Station HARA1. Kawaihae Reef. 23-Jun-03. (Latitude 20°01'55.5", Longitude 155°50'09.4")
Nearest harbor pier 1.8 km. Nearest boat ramp 1.5 km. Depth 4-9 m. Visibility excellent, ca. 25+ m.

Flourishing reef with well developed spur and groove system just seaward of Kawaihae Harbor breakwater. High coral coverage of ca. 65-75% dominated by *Porites lobata*, *Porites evermanni*, and *Porites compressa*, with abundant and diverse fish and few macroalgae.

Station HARA2. Puako. 24-Jun-03 (Latitude 19°58'23.2", Longitude 155°51'04.4") Nearest harbor pier: 8.2 km. Nearest boat ramp: 7.9 km. Depth 6-9 m. Visibility excellent, ca. 25 m.
Pristine reef with very abundant coral dominated by three species of *Porites* totaling up to 90% cover, high relief from cliffs and channels, abundant fish, few macroalgae.

Station HARA3. 'Anaeho'omalu. 24-Jun-03. (Latitude 19°57'2.2", Longitude 155°52'08.4").
Nearest harbor pier: 10.9 km. Nearest boat ramp: 10.6 km. Depth 8.5-9 m. Visibility excellent, ca. 25 m.
Similar to HARA1 and HARA2, with very high coral cover and high relief from buttresses and channels.

Station HARA4. Keawaiki. 24-Jun-03.. (Latitude 19°53'39.0", Longitude 155°54'45.4"). Nearest harbor pier: 18.8 km. Nearest boat ramp: 18.5 km. Depth 12-14 m. Visibility excellent, 25+ m.
High coral cover, around 75%, mostly of *Porites compressa* with some *P. lobata* and *P. evermanni*. Relief intermediate.

Station HARA5. Kualani Point. 25-Jun-03. (Latitude 19°33'05.7", Longitude 155°57'54.2").
Nearest harbor pier: 68.5 km. Nearest boat ramp: 16.2 km. Depth 9.5-10.5 m. Visibility excellent, 25+ m.
Intermediate coral coverage of ca. 50%, mostly of *Porites lobata* and *P. evermanni*, with abundant coral rubble strewn in channels among large coral outcrops.

Station HARA6 Red Hill. 25-Jun-03. (Latitude 19°30'28.8", Longitude 155°57'19.5"). Nearest harbor pier: 71.0 km. Nearest boat ramp 18.9 km. Depth 5.5-13.5 m. Visibility excellent 25+ m.
Reef outside point descending from 5 to 10 m depth, out side of which drops-off to 13.5 m with numerous ledges and channels along edge. Upper reef dominated by *Pocillopora meandrina*, lower portion by *Porites lobata*, *P. evermanni*, and *P. compressa*. Surge but clear conditions, abundant and diverse fish population.

Station HARA7. North Keauhou. 26-Jun-03. (Latitude 19°34'17.8", Longitude 155°58'20.2").
Nearest harbor pier: 64.3 km. Nearest boat ramp 14.1 km. Depth 6-6.5. m. Visibility poor, 5-6 m
Intermediate coral cover (30-50%) dominated by *Porites lobata* and *P. evermanni* with moderate development of channels and ridges.

Station HARA8. South Oneo Bay. 26-Jun-03. (Latitude 19°38'04.8", Longitude 156°01'33.4"). Nearest harbor pier: 57.4 km. Nearest boat ramp: 7.4 km. Depth 8-9 m. Visibility good, ca. 15-20 m.

Reef in central section of a highly used bay with high degree of shoreline development. High coral cover of ca. 50% dominated by *Porites lobata*, *P. evermanni*, and *P. compressa*, intermediate development of relief and channels.

Station HARA9. Papawai Bay. 26-Jun-03. (Latitude 19°39'00.6", Longitude 156°01'33.4"). Nearest harbor pier: 53.5 km. Nearest boat ramp: 3.9 km Depth 7-13.5 m. Visibility excellent, ca. 30 m.

North side of bay with a steep fringing reef showing signs of storm damage with abundant coral rubble in cobble to boulder size ranges. Coral cover 30-50% dominated by *Pocillopora meandrina* and abundant and diverse fish.

Station HARA10. Leleiwi Bay. 28-Jun-03. (Latitude 19°44'14.3", Longitude 155°01'16.5"). Nearest harbor pier: 8.8 km. Nearest boat ramp: 8.9 km Depth 6.5-10 m. Visibility excellent, ca. 30 m. Reef in excellent condition just offshore of Leleiwi Beach Park. Intermediate coral coverage of ca. 50% with high diversity and abundant fish

O'ahu

Station OARA1. Kane'ohe Bay, Waiahole Reef 11-June-03. (Latitude 21°28' 35.2", Longitude 157°49' 55.0"). Nearest harbor pier 4.4 km. Nearest boat ramp 4.5 km. Depth 1.0-5 m. Visibility poor, ca. 5 m.

Along patch reef in central bay from reef edge at 1 m to slope at 5 m. Coral cover dominated by *Porites compressa* from high coverage of ca. 60% on reef slope to ca. 20% along reef edge. Brisk tradewinds generating small waves which stirred up sediment, increasing turbidity.

Station OARA2. Kane'ohe Bay, He'eia Reef. 11-June-03 (Latitude 21°26' 48.0", Longitude 157°48' 37.0") Nearest harbor pier 0.3 km. Nearest boat ramp: 0.5 km. Depth.5-6.0 m. Visibility poor, ca. 5 m.

Patch reef adjacent to He'eia Harbor channel with depths ranging 0.5 to 3 m from reef flat to mid reef slope. Moderate coral cover of *Porites compressa* and abundant *Dictyosphaeria cavernosa* on reef flat and slope.

Station OARA3. Nanakuli Point. 13 Aug-03. (Latitude 21°22' 20.3", Longitude 158°08' 32.1"). Nearest harbor pier: 6.2 km. Nearest boat ramp: 6.1 km. Depth 4-5 m. Visibility good, ca. 10 m. Nearshore reef in marginal condition interspersed with sand channels subjected to frequent ground swell turbulence and sand scour. Moderate coral cover of ca. 20% dominated by *Porites lobata* and *Pocillopora meandrina*; algae moderately abundant.

Station OARA4. Kahe Beach Park. 13 Aug-03. (Latitude 21°21' 34.1", Longitude 158°08' 6.1"). Nearest harbor pier: 3.4 km. Nearest boat ramp: 3.3 km. Depth 3-4 m. Visibility good, ca. 20 m. Reef edge next to large sand bed which was highly impacted by Hurricane *Iniki* in 1992 but has undergone rapid recovery to coral cover of ca. 35%. Diverse coral assemblage dominated by *Porites lobata*, *P. evermanni*, and *Pocillopora meandrina*. Reef fish abundant and diverse, algae coverage low.

Station OARA5. Pupukea Beach Park. 17-Sep-03. (Latitude 21°38' 46.6", Longitude 158°03' 52.4"). Nearest harbor pier: 7.5 km. Nearest boat ramp: 7.6 km. Depth 1-6 m. Visibility excellent, ca. 25 m.

Heavily scoured reef that is subjected to yearly high wave turbulence from North Pacific swells but supports moderate abundance of mostly encrusting corals dominated by *Porites* and *Montipora* species and a few *Pocillopora meandrina* colonies. Most of the reef surface is covered with a fine turf algae coated with fine sand. Outer edged of site has a vertical wall to ca. 6 m depth with caves and overhangs which provide habitat for abundant reef fishes.

Station OARA6. Hanauma Bay. 21-Oct-03. (Latitude 21°16' 6.4", Longitude 157°41' 43.5"). Nearest harbor pier 5.4 km. Nearest boat ramp: 5.6 km. Depth 5-7 m. Visibility excellent, ca. 25 m.

Shallow reef in excellent condition located near southwestern side of the bay adjacent to large central sand bed. High coral coverage of ca. 70% dominated by large colonies of *Porites lobata* and *P. evermanni*. Reef fishes very diverse and abundant, with macroalgae rare.

APPENDIX B

Native, Nonindigenous and Cryptogenic Taxa Recorded on Rapid Assessment Surveys at 41 Coral Reef Sites on the Islands of Kaua'i, O'ahu, Moloka'i, Maui and Hawai'i, November 2002-October 2003.

Kingdom: BACTERIA

Phylum: CYANOBACTERIA

Family: OSCILLATORIACEAE

***Lyngbya majuscula* (Dillwyn) Harvey**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x	x	x		x		x			
Oahu	x	x	x	x	x	x				
Molokai		x		x	x		x			
Maui	x	x	x	x	x			x	x	
Hawaii	x	x		x	x	x	x	x		x

Family: PHORMIDIACEAE

***Symploca hydroides?* Gomont**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai				x						
Maui			x							
Hawaii		x	x				x			

Kingdom: PROTOCTISTA

Phylum: CHLOROPHYTA

Family: CAULERPACEAE

***Caulerpa racemosa* (Forsskål) Agardh**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui				x						
Hawaii										x

***Caulerpa serrulata* (Forsskål) Agardh**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai		x								
Maui										
Hawaii		x								

***Caulerpa sertularioides* (Gmelin) Howe**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui				x				x		
Hawaii										

***Caulerpa taxifolia* (Vahl) Agardh**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu						x				
Molokai										
Maui										
Hawaii										

Family: CLADOPHORALES

***Cladophora* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x						
Oahu										
Molokai										
Maui		x						x		
Hawaii	x			x						

***Microdictyon* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu				x						
Molokai										
Maui										
Hawaii										

Family: CODIACEAE

***Codium edule* Silva**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii										

***Codium reediae* Silva**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x								
Oahu										
Molokai										
Maui										
Hawaii										

Family: DASYCLADACEAE

***Neomeris annulata* Dickie**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x		x		x				
Oahu			x	x						
Molokai						x		x		
Maui		x	x		x	x	x	x		
Hawaii			x		x	x			x	

Family: HALIMEDACEAE

***Halimeda discoidea* Decaisne**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x	x			
Oahu										
Molokai										
Maui		x	x							
Hawaii										

***Halimeda incrassata* (Ellis & Solander) Lamouroux**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai								x		
Maui					x		x	x		
Hawaii										

***Halimeda opuntia?* (Linnaeus) Lamouroux**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai					x	x	x			
Oahu										
Molokai	x	x		x	x		x	x		
Maui	x	x	x		x		x	x		
Hawaii					x					

***Halimeda* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai						x				
Maui										
Hawaii					x					

Family: SIPHONOCLADACEAE

***Dictyosphaeria cavernosa* (Forsskål) Børgesen**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x	x								
Molokai	x			x			x	x		
Maui			x		x					
Hawaii										

***Dictyosphaeria versluysii* Weber Bosse**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x	x								
Molokai				x				x		
Maui			x							
Hawaii										

Family: ULVACEAE

***Ulva fasciata* Delile**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui	x		x				x			
Hawaii										

***Ulva* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui			x							
Hawaii										

Family: VALONIACEAE

***Valonia* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai				x				x		
Maui										
Hawaii										

***Ventricaria ventricosa* (Agardh) Olsen & West**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x	x								
Molokai				x			x	x		
Maui				x						
Hawaii			x							

Phylum: PHAEOPHYTA

Family: DICTYOTACEAE

***Dictyota* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x			x				
Oahu	x									
Molokai	x			x			x	x		
Maui			x	x						
Hawaii	x	x								x

***Dotyella hawaiiensis?* (Doty & Wainwr.) Womersley & Shepley**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui								x		
Hawaii										

***Padina* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu			x							
Molokai								x		
Maui										
Hawaii										

Family: PHAEOPHYCEAE

***Hydroclathrus clathratus* (Agardh) Howe**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii			x							

Family: SARGASSEACEAE

***Sargassum polyphyllum* Agardh**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu					x					
Molokai										
Maui			x				x			
Hawaii										

<i>Sargassum</i> sp.											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu			x		x	x					
Molokai		x		x							
Maui											
Hawaii											
<i>Turbinaria ornata</i> (Turner) Agardh											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu	x				x						
Molokai				x				x			
Maui	x	x	x	x			x				
Hawaii					x	x	x				
Phylum: RHODOPHYTA											
Turf algae											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu					x	x					
Molokai											
Maui									x		
Hawaii	x		x				x		x	x	
unid. Coralline algae											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui	x	x	x				x				
Hawaii											
Family: BONNEMAISONIACEAE											
<i>Asparagopsis taxiformis</i> (Delile) Trevisan											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai	x			x				x			
Maui	x		x		x		x	x			
Hawaii	x						x			x	
Family: CERAMIACEAE											
<i>Melanamansia glomerata</i>? (Agardh) Norris											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai	x						x				
Oahu			x			x					
Molokai	x	x					x				
Maui				x	x						
Hawaii	x										
<i>Spyridia filamentosa</i> (Wulfen) Harvey											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui		x					x				
Hawaii											
<i>Wrangelia penicillata</i> (Agardh) Agardh											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui			x								
Hawaii											
Family: CORALLINACEAE											
<i>Hydrolithon breviclavium</i> (Foslie) Foslie											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii											

***Hydrolithon onkodes* (Heydrich) Penrose & Woelkerling**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x		x	x		x			
Oahu	x	x	x	x	x	x				
Molokai		x		x	x	x	x	x		
Maui		x	x	x			x	x		
Hawaii	x	x	x	x	x	x	x	x	x	x

***Hydrolithon* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu										
Molokai	x			x				x		
Maui		x								
Hawaii										

***Jania* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui	x						x			
Hawaii										

***Mesophyllum* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui		x								
Hawaii										

***Porolithon gardineri* (Foslie) Foslie**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x	x	x							
Molokai										
Maui					x			x		
Hawaii	x	x	x	x			x		x	x

Family: CRYPTONEMIACEAE

***Desmia hornemanni* Lyngbye**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai							x			
Maui			x		x					
Hawaii										

Family: DELESSERIACEAE

***Martensia fragilis* Harvey**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu			x							
Molokai	x					x				
Maui			x				x			
Hawaii										

Family: FLORIDEOPHYCEAE

***Gibsmithia hawaiiensis* Doty**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x	x			
Oahu			x	x						
Molokai										
Maui			x							
Hawaii	x	x								

Family: GALAXAURACEAE

***Galaxaura acuminata* Butters**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui		x	x	x			x			
Hawaii										

***Galaxaura rugosa* (Ellis & Solander) Lamouroux**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui			x	x			x			
Hawaii										

***Galaxaura* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu					x					
Molokai	x									
Maui										
Hawaii	x									

***Scinaia hormoides* Setchell**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui			x							
Hawaii										

Family: HALYMENIACEAE

***Grateloupia filicina* (Lamouroux) Agardh**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui							x			
Hawaii										

***Halymenia formosa* Harvey ex Kützinger.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu				x						
Molokai										
Maui					x		x			
Hawaii										

***Halymenia* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii		x			x					x

***Halymenia* sp. (greenish)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu										
Molokai										
Maui										
Hawaii										

Family: HYPNEACEAE

***Hypnea cervicornis* (Agardh) Howe**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu				x						
Molokai										
Maui										
Hawaii										

***Hypnea musciformis* (Agardh) Howe**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui							x			
Hawaii										

Introduced

Family: LIAGORACEAE

***Liagora* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai				x				x		
Maui										
Hawaii										

***Trichogloea requienii* (Montagne) Kützing**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu				x						
Molokai										
Maui			x							
Hawaii										

Family: NEMASTOMATACEAE

***Predaea weldii* Kraft & Abbott**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui				x						
Hawaii										

Family: PEYSONNELIACEAE

***Peyssonnelia rubra*? (Montagne) Kützing**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai					x	x				
Oahu										
Molokai		x								
Maui										
Hawaii										

Family: RHIZOPHYLLIDACEAE

***Portieria hornemannii*? (Lyngbye) Silva**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x									
Oahu										
Molokai										
Maui					x					
Hawaii										

Family: RHODOMELACEAE

***Acanthophora spicifera* (Vahl) Børgesen**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x							
Molokai	x			x				x		
Maui	x		x				x			
Hawaii										

Introduced

***Laurencia nidifica* Agardh**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu		x								
Molokai										
Maui	x		x							
Hawaii										

Family: RHODYMENIACEAE

***Botryocladia skottsbergii* (Børgesen) Levring**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui			x							
Hawaii										

***Dasya iridescens* (Schlech) Millar & Abbott**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui							x			
Hawaii	x									

Family: SOLIERIACEAE

***Kappaphycus alvarezii* (Doty) Doty**

Introduced

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x	x								
Molokai										
Maui										
Hawaii										

Kingdom: ANIMALIA

Phylum: PORIFERA

***Porifera* sp. (black encrusting)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii										

***Porifera* sp. (blue encrusting)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x								
Oahu										
Molokai										
Maui										
Hawaii										

***Porifera* sp. (green encrusting)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui				x						
Hawaii										

***Porifera* sp. (grey encrusting)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai	x									
Maui										
Hawaii										

***Porifera* sp. (light blue-green, branching)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui	x			x						
Hawaii										

***Porifera* sp. (light purple encrusting)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai	x									
Maui										
Hawaii										

***Porifera* sp. (orange encrusting)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x	x	x		x	x			
Oahu										
Molokai										
Maui										
Hawaii										

***Porifera* sp. (orange)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui						x	x			
Hawaii										

Porifera sp. (red encrusting)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai				x						
Maui										
Hawaii										

Porifera sp. (slimy, purple encrusting)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai	x									
Maui										
Hawaii										

Porifera sp. (smooth, elastic, light grey, encrusting)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui		x						x		
Hawaii										

Porifera sp. (yellow encrusting)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui									x	
Hawaii										

Class: CALCAREA

Order: CLATHRINIDA

Family: LEUCETTIDAE

Leucetta solida Schmidt, 1862

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x									
Molokai										
Maui										
Hawaii										

Leucetta sp.

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii			x				x		x	

Class: DEMOSPONGIAE

Order: DICTYOCERATIDA

Family: SPONGIIDAE

Spongia oceania de Laubenfels, 1950

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x							
Molokai										
Maui									x	
Hawaii						x			x	

Order: HADROMERIDA

Family: CHONDRILLIDAE

Chondrosia chucalla de Laubenfels, 1936

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x				x				
Oahu										
Molokai				x						
Maui	x	x		x				x		
Hawaii						x			x	

Family: SPIRASTRELLIDAE											
<i>Spheciospongia vagabunda</i> (Ridley, 1884)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai						x	x				
Oahu											
Molokai						x					
Maui	x		x		x			x			
Hawaii					x	x	x		x		
Order: HAPLOSCLERIDA											
Family: CALLYSPONGIIDAE											
<i>Callyspongia</i> sp.?											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai						x					
Oahu											
Molokai											
Maui											
Hawaii		x	x	x		x					
Family: CHALINIDAE											
<i>Sigmatocia caerulea</i>? Hechtel, 1965											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	Introduced
Kauai											
Oahu					x						
Molokai											
Maui											
Hawaii											
Family: NIPHATIDAE											
<i>Gelliodes fibrosa</i>? (Wilson, 1925)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	Introduced
Kauai	x										
Oahu											
Molokai											
Maui											
Hawaii											
Order: LITHISTIDA											
Family: AZORICIDAE											
<i>Leiodermatium</i> sp.											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii						x					
Order: POECILOSCLERIDA											
Family: ANCHINOIDAE											
<i>Phorbis</i> sp.? (orange encrusting)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu				x							
Molokai				x		x					
Maui									x		
Hawaii											
Family: MICROCIONIDAE											
<i>Clathria</i> sp. (red)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu				x							
Molokai											
Maui											
Hawaii											
Family: MYCALIDAE											
<i>Mycale armata</i>? Thiele, 1903											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	Introduced
Kauai	x										
Oahu	x	x									
Molokai											
Maui						x	x				
Hawaii											

<i>Stylinos</i> sp.										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										
Family: RASPAILIIDAE										
<i>Hamigera</i> sp.										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										
Phylum: CTENOPHORA										
unid. Ctenophora										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										
Phylum: CNIDARIA										
Class: HYDROZOA										
unid. Hydrozoa										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										
Order: HYDROIDA										
Family: AGALOPHENIIDAE										
<i>Gymnangium hians</i> (Busk, 1852)										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										
<i>Macrorhynchia philippina</i> Kirchenpauer, 1872										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										
Family: HALOCORDYLIDAE										
<i>Pennaria disticha</i> (Goldfuss, 1820)										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										
Family PLUMULARIIDAE										
<i>Plumularia floridana</i> (Nutting, 1905)										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

Introduced

Cryptogenic

											Cryptogenic
											</

Order: SCLERACTINIA
Family: SIDERASTREIDAE

***Psammocora* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii										

***Psammocora stellata* Verrill, 1864**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu					x					
Molokai								x		
Maui		x	x		x					
Hawaii	x						x			x

Family: ACROPORIDAE

***Montipora capitata* (Dana, 1846)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x	x	x	x			
Oahu	x	x		x	x	x				
Molokai	x	x	x	x	x	x	x	x		
Maui	x	x	x	x	x	x	x	x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

***Montipora flabellata* Studer, 1902**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x	x		x	x	x	x			
Oahu			x	x	x	x				
Molokai		x	x	x	x		x			
Maui	x	x	x	x	x		x	x	x	
Hawaii	x					x	x			

***Montipora patula* Verrill, 1864**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x	x	x	x	x	x	x			
Oahu			x	x	x	x				
Molokai	x	x	x	x	x	x	x	x		
Maui	x	x	x	x	x	x	x	x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

***Montipora* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai			x							
Maui										
Hawaii										

Family: AGARICIIDAE

***Leptoseris incrustans* (Quelch, 1886)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x						
Oahu										
Molokai					x					
Maui										
Hawaii						x		x		

***Pavona duerdeni* Vaughan, 1907**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x									
Oahu			x	x	x	x				
Molokai		x	x	x	x	x	x			
Maui	x	x	x	x	x	x		x		
Hawaii	x	x	x		x		x	x		x

***Pavona explanulata?* (Lamarck, 1816)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii					x					

***Pavona maldivensis* (Gardiner, 1905)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai					x					
Oahu										
Molokai										
Maui										
Hawaii				x						

***Pavona varians* Verrill, 1864**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x	x		x			
Oahu			x	x	x	x				
Molokai		x	x	x	x	x	x			
Maui	x	x	x	x	x	x		x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

Family: DENDROPHYLLIIDAE

***Tubastraea coccinea* Lesson, 1829**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii		x	x	x		x	x			

Family: FAVIIDAE

***Cyphastrea ocellina* (Dana, 1846)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x	x				x				
Molokai										
Maui										
Hawaii	x					x				x

***Leptastrea inaequalis*? Klunzinger, 1879**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii	x									

***Leptastrea purpurea* Dana, 1846**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x	x		x			
Oahu			x	x	x	x				
Molokai		x			x		x			
Maui	x	x	x	x	x	x	x	x		
Hawaii	x	x	x			x	x	x	x	x

***Leptastrea* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x							
Oahu										
Molokai										
Maui										
Hawaii	x									

Family: FUNGIIDAE

***Fungia scutaria* Lamarck, 1801**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x			x	x			
Oahu	x	x								
Molokai		x								
Maui				x	x					
Hawaii	x	x	x		x	x	x		x	x

Family: POCILLOPORIDAE

***Pocillopora damicornis* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x	x				x				
Oahu	x	x				x				
Molokai	x			x		x		x		
Maui		x	x	x	x	x				
Hawaii		x	x	x		x				x

***Pocillopora eydouxi* Milne Edwards & Haime, 1849**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x	x	x	x			
Oahu			x	x	x	x				
Molokai		x			x	x		x		
Maui	x	x	x	x		x	x	x	x	
Hawaii	x	x	x		x	x	x	x	x	x

***Pocillopora lingulata* Dana, 1846**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai								x		
Maui										
Hawaii										

***Pocillopora meandrina* Dana, 1846**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x	x	x	x	x	x	x			
Oahu			x	x	x	x				
Molokai		x	x	x	x	x	x	x		
Maui	x	x	x	x	x	x	x	x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

***Pocillopora* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai					x					
Maui										
Hawaii										

Family: PORITIDAE

***Porites (Synaraea) rus* (Forsskål, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x	x			
Oahu					x					
Molokai										
Maui				x						
Hawaii	x	x			x	x	x		x	

***Porites compressa* Dana, 1846**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x	x			x	x	x			
Oahu	x	x	x			x				
Molokai	x	x	x	x			x	x		
Maui	x	x	x	x	x			x	x	
Hawaii	x	x	x	x	x		x	x		x

***Porites evermanni* Vaughan, 1907**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x	x		x			
Oahu				x	x	x				
Molokai		x	x		x		x	x		
Maui	x			x		x	x	x	x	
Hawaii	x	x	x	x	x		x	x	x	x

***Porites lobata* Dana, 1846**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x	x	x	x	x	x			
Oahu				x	x	x				
Molokai	x	x	x	x	x	x	x	x		
Maui	x	x	x	x	x	x	x	x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

Order: TELESTACEA

Family: TELESTIDAE

***Carijoa riisei* (Duchassaing & Michelotti, 1860)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui						x				
Hawaii										

Introduced

Order: ZOANTHIDEA
Family: ZOANTHIDAE

***Palythoa caesia* Dana, 1848**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x	x	x	x		x	x			
Oahu			x	x		x				
Molokai		x				x	x	x		
Maui		x	x	x	x			x		
Hawaii	x	x	x		x	x	x	x	x	x

***Protopalythoa* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii						x				

***Zoanthus pacificus* Walsh & Bowers, 1971**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x									
Oahu										
Molokai										
Maui										
Hawaii										

***Zoanthus* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu					x					
Molokai										
Maui										
Hawaii										

***Zoanthus* sp. (pink)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x			x			
Oahu					x					
Molokai				x						
Maui										
Hawaii										

Phylum: PLATYHELMINTHES

Class: TURBELLARIA

Order: POLYCLADIDA

Family: PSEUDOCEROTIDAE

***Pericelis hymanae* Poulter, 1974**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai				x						
Maui										
Hawaii										

***Pseudobiceros* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii						x				

***Pseudoceros dimidiatus* von Graff, 1893**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii										

Phylum: ANNELIDA

Class: POLYCHAETA

Family: AMPHINOMIDAE

***Eurythoe complanata* (Pallas, 1766)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii										

Family: CHAETOPTERIDAE

***Chaetopterus* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x									
Oahu										
Molokai										
Maui										
Hawaii										

Cryptogenic

Family: EUNICIDAE

***Eunice* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu										
Molokai										
Maui				x						
Hawaii										

Family: SABELLIDAE

***Sabellastarte spectabilis* (Grube, 1878)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x				x					
Oahu	x	x								
Molokai										
Maui										
Hawaii		x								

Introduced

Family: SERPULIDAE

***Salmacina dysteri* (Huxley, 1855)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x						
Oahu										
Molokai										
Maui										
Hawaii										

Introduced

***Spirobranchus giganteus corniculatus* (Grube, 1862)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x		x				
Oahu						x				
Molokai					x	x	x			
Maui	x		x	x	x	x		x	x	
Hawaii	x	x	x	x	x	x	x	x	x	

unid. Serpulidae

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu										
Molokai										
Maui										
Hawaii										

Family: TERESELLIDAE

***Loimia medusa* (Savigny, 1818)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x				x	x	x			
Oahu		x		x						
Molokai						x				
Maui										
Hawaii									x	

Terebellid sp.											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai						x	x				
Oahu											
Molokai											
Maui	x										
Hawaii											
Phylum: ARTHROPODA											
Class: MALACOSTRACA											
Order: DECAPODA											
Family: ALPHEIDAE											
<i>Alpheus deuteropus</i> Hilgendorf, 1878											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai	x	x			x	x					
Maui		x	x	x	x			x	x		
Hawaii		x	x	x	x	x	x	x			
<i>Alpheus lottini</i> Guérin, 1829											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui								x	x		
Hawaii		x	x			x	x	x			
<i>Alpheus</i> sp.											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai								x			
Maui											
Hawaii											
Family: CALLIANASSIDAE											
<i>Corallianassa borradalei?</i> (DeMan, 1828)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui			x								
Hawaii											
Family: CARPILIIDAE											
<i>Carpilius maculatus</i> (Linnaeus, 1758)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui						x					
Hawaii											
Family: CRYPTOCHIRIDAE											
<i>Haplocarcinus marsupialis</i> Stimpson, 1859											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu	x	x									
Molokai								x			
Maui			x								
Hawaii			x								
Family: DIOGENIDAE											
<i>Calcinus argus</i> Wooster, 1982											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui	x			x		x					
Hawaii		x		x							

***Calcinus elegans* Milne Edwards, 1836**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x			x			
Oahu										
Molokai										
Maui	x									
Hawaii						x				

***Calcinus guamensis* Wooster, 1982**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai				x						
Maui		x		x	x	x		x	x	
Hawaii			x							

***Calcinus haigae* Wooster, 1982**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii			x		x	x	x	x		

***Calcinus hazletti* Haig & McLaughlin, 1984**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii			x		x	x	x	x		

***Calcinus latens* (Randall, 1839)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii								x		

***Calcinus laurentae* Haig & McLaughlin, 1984**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai		x			x	x				
Maui						x		x	x	
Hawaii		x	x	x	x	x		x		

***Calcinus* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x						
Oahu										
Molokai										
Maui			x			x				
Hawaii										

***Ciliopagurus strigatus* (Herbst, 1804)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x				x			
Oahu										
Molokai										
Maui						x		x		
Hawaii					x					

***Dardanus sanguinocarpus* Degener, 1925**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu										
Molokai										
Maui										
Hawaii			x							

***Dardanus* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii				x						

unid. Diogenidae											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu	x		x	x							
Molokai											
Maui											
Hawaii						x			x		
unid. hermit crab											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui	x					x		x			
Hawaii											
Family: GRAPSIDAE											
<i>Percnon planissimum</i> (Herbst, 1904)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii		x									
Family: HIPPOLYTIDAE											
<i>Saron marmoratus</i> (Olivier, 1811)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai				x		x					
Maui											
Hawaii						x	x				
Family: MAJIDAE											
unid. Majidae											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii											
Family: PALAEMONIDAE (PONTONIINAE)											
<i>Harpilopsis depressa</i> (Stimpson, 1860)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii		x		x			x				
Family: SCYLLARIDAE											
<i>Paribacus antarcticus</i> (Lund, 1793)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai				x							
Maui											
Hawaii											
Family: STENOPODIDAE											
<i>Stenopus hispidus</i> (Olivier, 1811)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu	x										
Molokai						x					
Maui											
Hawaii											
Family: TRAPEZIIDAE											
<i>Trapezia digitalis</i> Latreille, 1825											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii						x					

***Trapezia ferruginea* Latreille, 1825**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui			x		x	x		x	x	
Hawaii			x			x	x	x		

***Trapezia flavopunctata* Eydoux & Souleyet, 1842**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai						x				
Maui						x		x		
Hawaii						x	x			

***Trapezia intermedia* Miers, 1886**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui					x	x		x		
Hawaii		x	x			x	x			

***Trapezia* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu						x				
Molokai										
Maui										
Hawaii			x					x		

***Trapezia tigrina* Eydoux & Souleyet, 1842**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x	x			
Oahu				x						
Molokai						x				
Maui			x		x	x	x		x	
Hawaii		x	x	x	x	x		x		

Family: XANTHIDAE

***Pilodius areolatus* (Milne Edwards, 1834)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu										
Molokai										
Maui										
Hawaii										

***Pseudoliomera speciosa* (Dana, 1852)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui						x			x	
Hawaii						x				

Order: STOMATOPODA

Family: PSEUDOSQUILLIDAE

***Pseudosquilla ciliata*? (Fabricius, 1787)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai	x									
Maui										
Hawaii										

Class: MAXILLOPODA

Order: THORACICA

Family: BALANIDAE

***Balanus* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii									x	

Phylum: MOLLUSCA

Class: GASTROPODA

Order: ARCHAEOGASTROPODA

Family: TROCHIDAE (ENCYCLINAE)

***Gibbula marmorea* (Pease, 1861)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui		x								
Hawaii										

***Trochus intextus* Kiener, 1850**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai		x								
Maui										
Hawaii		x	x	x	x		x	x	x	

Family: TURBINIDAE (TURBININAE)

***Turbo sandwicensis* Pease, 1861**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii		x							x	

Order: BASOMMATOPHORA

Family: SIPHONARIIDAE

***Siphonaria normalis* Gould, 1846**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii		x								

Order: NEOTAENIOGLOSSA

Family: CASSIDAE (CASSINAE)

***Casmaria erinaceus kalosmodix* (Melvill, 1883)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui								x		
Hawaii										

***Cassia cornuta* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii						x				

Family: CERITHIIDAE

***Cerithium echinatum* Houbrick, 1992**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui	x			x	x	x		x	x	
Hawaii		x	x	x	x	x	x	x	x	

***Rhinoclavis sinensis* (Gmelin, 1791)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu										
Molokai										
Maui								x		
Hawaii										

Family: CYPRAEIDAE

***Cypraea caputserpentis* Linnaeus, 1758**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Cypraea granulata* Pease, 1863**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Cypraea helvola* Linnaeus, 1758**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Cypraea isabella* Linnaeus, 1758**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Cypraea maculifera* Schilder, 1932**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Cypraea mauritiana* Linnaeus, 1758**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Cypraea scurra* Gmelin, 1791**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Cypraea teres* Gmelin, 1791**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Cypraea tigris* Linnaeus, 1758**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

Family: HIPPONICIDAE

***Hipponix (Cochlear) imbricatus* Gould, 1846**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii		x		x	x		x	x	x	

***Hipponix australis* (Lamarck, 1819)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x			x			
Oahu										
Molokai						x				
Maui	x			x	x	x				
Hawaii		x	x	x	x	x	x	x	x	

Cryptogenic

Family: PERSONIDAE

***Distorsio* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii			x							

Family: RANELLIDAE (CYMATIINAE)

***Cymatium (Cymatium) nioboricum* (Röding, 1798)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii			x							

***Cymatium* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii				x						

Family: STROMBIDAE

***Strombus maculatus* Sowerby, 1842**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai						x				
Maui								x		
Hawaii										

Family: TONNIDAE

***Tonna perdix* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai						x				
Maui										
Hawaii										

Family: VERMETIDAE

***Dendropoma gregaria* Hadfield & Kay, 1972**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui		x								
Hawaii		x	x				x	x		

***Petalonchus keenae* Hadfield & Kay, 1972**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai	x									
Maui	x		x					x		
Hawaii		x			x		x	x	x	

***Serpularbis variabilis* Hadfield & Kay, 1972**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x	x	x		x	x			
Oahu	x	x	x	x	x	x				
Molokai	x	x		x	x			x		
Maui	x	x	x	x	x	x	x	x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x
Order: NEOGASTROPODA										
Family: BUCCINIDAE										
Buccinid sp.										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai						x				
Maui										
Hawaii										
Prodotia iostomus (Gray, 1834)										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui	x									
Hawaii										
Family: COLUMBELLIDAE										
Mitrella sp.										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii										
Family: CONIDAE										
Conus abbreviatus Reeve, 1843										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x						
Oahu										
Molokai										
Maui	x									
Hawaii										
Conus chaldaeus (Röding, 1798)										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										
Conus circumactus Iredale, 1929										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui					x					
Hawaii										
Conus ebraeus Linnaeus, 1758										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x					x			
Oahu										
Molokai										
Maui										
Hawaii										
Conus flavidus Linnaeus, 1758										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x	x				x			
Oahu										
Molokai						x				
Maui			x				x		x	
Hawaii						x	x		x	
Conus imperialis Linnaeus, 1758										
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										

70

***Conus sponsalis* Hwass, 1792**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x			x			
Oahu										
Molokai										
Maui				x						
Hawaii			x		x		x		x	

***Conus striatus* Linnaeus, 1758**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai						x				
Maui										
Hawaii										

Family: CORALLIOPHILIDAE

***Coralliophila violacea* (Kiener, 1836)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui			x	x	x			x		
Hawaii		x	x	x	x	x	x	x		

***Quoyula madreporarum* (Sowerby, 1834)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai						x				
Maui			x						x	
Hawaii						x	x	x	x	

Family: FASCIOLARIIDAE

***Latirus nodatus* (Gmelin, 1791)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu			x							
Molokai										
Maui										
Hawaii									x	

Family: HARPIDAE

***Harpa* sp. juv.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii			x						x	

Family: MITRIDAE (CYLINDROMITRINAE)

***Pterygia crenulata* (Gmelin, 1791)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii							x			

Family: MITRIDAE (IMBRICARIINAE)

***Imbricaria olivaeformis* (Swainson, 1821)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii					x					

Family: MITRIDAE (MITRINAE)

***Mitra (Mitra) mitra* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii										

<i>Mitra (Mitra) stictica</i> (Link, 1807)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai							x				
Oahu											
Molokai											
Maui											
Hawaii											
<i>Mitra (Nebularia) fulvescens</i> Broderip, 1836											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii			x								
<i>Mitra</i> sp.											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii					x						
Family: TEREBRIDAE											
<i>Hastula penicilata</i> (Hinds, 1844)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui									x		
Hawaii											
<i>Hastula strigilata</i> (Linnaeus, 1758)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai						x					
Oahu											
Molokai											
Maui											
Hawaii											
<i>Terebra maculata</i> (Linnaeus, 1758)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii						x					
Family: THAIDIDAE											
<i>Drupa (Drupa) morum</i> Röding, 1798											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai			x	x							
Oahu											
Molokai											
Maui											
Hawaii						x					
<i>Drupa (Drupa) ricina</i> (Linnaeus, 1758)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai				x							
Oahu											
Molokai											
Maui											
Hawaii						x					
<i>Drupa (Ricinella) rubusidaeus</i> Röding, 1798											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai				x							
Maui	x			x							
Hawaii						x					

<i>Drupa</i> sp.											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai				x							
Oahu											
Molokai											
Maui											
Hawaii					x		x				
<i>Drupella elata</i> Blainville, 1832											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui	x		x	x	x				x		
Hawaii			x	x	x		x				
<i>Drupella ochrostoma</i> (Blainville, 1832)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii									x		
<i>Morula granulata</i> (Duclos, 1832)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii						x					
<i>Morula</i> sp.											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai		x									
Oahu											
Molokai											
Maui											
Hawaii							x				
<i>Morula uva</i> (Röding, 1798)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii							x		x		
Family: TURRIDAE (MANGELIINAE)											
<i>Macteola segesta</i>? (Chenu, 1850)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui		x									
Hawaii											
Order: SACOGLOSSA											
Family: PLAKOBRANCHIDAE											
<i>Plakobranchus ocellatus</i> van Hasselt, 1824											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu		x									
Molokai					x		x				
Maui											
Hawaii											
Order: NUDIBRANCHIA											
Family: CHROMODORIDIDAE											
<i>Glossodoris rufomarginata</i> (Bergh, 1890)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai						x					
Oahu											
Molokai											
Maui											
Hawaii											

Family: DORIDIDAE (HALGERDINAE)

***Halgerda terramtuentis* Bertsch & Johnson, 1982**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii					x				x	

Family: HEXABRANCHIDAE

***Hexabranhus sanguineus* (Rüppell & Leuckart, 1831)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x								
Oahu										
Molokai										
Maui										
Hawaii										

Family: PHYLLIDIIDAE

***Phyllidia* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai						x				
Maui										
Hawaii										

***Phyllidia varicosa* Lamarck, 1801**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai					x	x				
Oahu										
Molokai						x				
Maui										
Hawaii					x	x				

***Phyllidiella pustulosa* (Cuvier, 1804)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai			x							
Maui										
Hawaii					x					

Class: BIVALVIA

Family: ANOMIIDAE

***Anomia nobilis* Reeve, 1859**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x	x								
Molokai										
Maui										
Hawaii										

Introduced

Family: ARCIDAE (ARCINAE)

***Arca ventricosa* Lamarck, 1819**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai	x					x				
Maui	x				x		x	x	x	
Hawaii		x	x	x	x		x	x	x	

***Barbatia divaricata* Sowerby, 1833**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui	x					x				
Hawaii		x	x		x	x	x		x	

***Barbatia* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x						
Oahu										
Molokai										
Maui										
Hawaii										

Family: CARDIIDAE

***Trachycardium orbita* (Sowerby, 1833)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui								x		
Hawaii									x	

Family: GASTROCHAENIDAE

***Gastrochaena* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai						x				
Maui			x		x					
Hawaii			x			x		x	x	

Family: ISOGNOMONIDAE

***Isognomon perna* (Linnaeus, 1767)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu		x	x							
Molokai								x		
Maui	x					x			x	
Hawaii										

Family: MYTILIDAE

***Brachidontes crebristriatus* (Conrad, 1837)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai						x				
Maui										
Hawaii										

***Septifer bryanae* (Pilsbry, 1921)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii										

Family: OSTREIDAE

***Crassostrea gigas*? (Thunberg, 1793)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui							x			
Hawaii										

***Dendostrea sandvicensis* (Sowerby, 1871)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu		x								
Molokai	x									
Maui										
Hawaii										

unid.Ostreidae

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui						x	x			
Hawaii										

unid.Ostreidae (juveniles)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui	x									
Hawaii										

Introduced

Family: PECTINIDAE

***Chlamys irregularis* (Sowerby, 1842)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii		x								

Family: PINNIDAE

***Streptopinna saccata* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x						
Oahu										
Molokai										
Maui										
Hawaii			x							

Family: PSAMMOBIIDAE

***Grammatomya kanaka* (Pilsbry, 1921)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

Family: PTERIIDAE

***Pinctada margaritifera* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu			x	x	x					
Molokai	x					x				
Maui	x			x		x	x	x		
Hawaii								x		x

Family: SPONDYLIDAE

***Spondylus violacescens* Lamarck, 1819**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x			x			
Oahu										
Molokai										
Maui						x		x	x	
Hawaii		x	x	x	x	x	x	x	x	x

Family: TELLINIDAE

***Tellina crucigera* Lamarck, 1818**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui								x		
Hawaii										

***Tellina scobinata* Linnaeus, 1758**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu										
Molokai										
Maui								x		
Hawaii			x							

Class: POLYPLACOPHORA

Order: CHITONIDA

Family: CHITONIDAE

***Ischnochiton petaloides* Gould, 1846**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui		x								
Hawaii										

[illegible]

Introduced

[illegible]

***Crisina radians*? (Lamarck, 1816)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x			x				
Oahu										
Molokai										
Maui										
Hawaii		x	x	x		x			x	

Dispirella violacea (Canu & Bassler, 1927)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii		x								

Acanthaster planci Linnaeus, 1758

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x		x					
Oahu										
Molokai										
Maui										
Hawaii	x					x	x		x	

***Linckia guildingi* Gray, 1840**

[illegible]

***Linckia multifora* (Lamarck, 1816)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x								
Oahu										
Molokai										
Maui										
Hawaii		x			x				x	

<i>Linckia</i> sp.											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui											
Hawaii									x		
Class: OPHIUROIDEA											
Order: OPHIURIDA											
Family: OPHIOCOMIDAE											
<i>Ophiocoma brevipes</i> Peters, 1851											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui				x							
Hawaii											
<i>Ophiocoma dentata</i> Muller & Troschel, 1842											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai						x					
Oahu											
Molokai											
Maui											
Hawaii											
<i>Ophiocoma erinaceus</i> Muller & Troschel, 1842											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai		x		x							
Oahu											
Molokai		x				x					
Maui											
Hawaii		x	x	x	x		x	x			
<i>Ophiocoma pica</i> Muller & Troschel, 1842											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai			x								
Oahu						x					
Molokai		x				x	x				
Maui			x	x	x	x		x	x		
Hawaii			x			x		x	x		
<i>Ophiocoma</i> sp.											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai					x						
Oahu											
Molokai											
Maui											
Hawaii											
Class: ECHINOIDEA											
Order: CIDAROIDA											
Family: CIDARIDAE											
<i>Chondrocidaris gigantea</i> Agassiz, 1863											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai											
Maui									x		
Hawaii		x	x	x		x	x	x	x		
<i>Eucidaris metularia</i> Lamarck, 1816											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai							x				
Oahu											
Molokai						x					
Maui								x	x		
Hawaii		x	x	x	x	x		x	x		

Order: CLYPEASTEROIDA

Family: CLYPEASTERIDAE

***Clypeaster (Rhaphidoclypus) reticulatus* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

Order: DIADEMATOIDA

Family: DIAEMATIDAE

***Diadema paucispinum* Agassiz, 1863**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Echinothrix calamaris* (Pallas, 1774)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Echinothrix diadema* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Tripneustes gratilla* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

Order: ECHINOIDA

Family: ECHINOMETRIDAE

***Echinometra mathaei* (Blainville, 1825)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Echinometra oblonga* (Blainville, 1825)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Echinostrephus aciculatus* Agassiz, 1863**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Heterocentrotus mammillatus* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

Order: SPATANGOIDA
Family: BRISSIDAE

***Brissus latecarinatus* (Leske, 1778)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

Order: TEMNOPLEUROIDA
Family: TOXOPNEUSTIDAE

***Pseudoboletia indiana* (Michelin, 1862)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

Class: HOLOTHUROIDEA

Order: ASPIDOCHIROTIDA

Family: HOLOTHURIIDAE

***Actinopyga mauritiana* (Quoy & Gaimard, 1833)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Actinopyga obesa* (Selenka, 1867)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Holothuria (Halodeima) atra* Jaeger, 1833**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Holothuria (Halodeima) edulis* Lesson, 1830**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Holothuria (Microthele) whitmaei* Bell, 1887**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

***Holothuria (Thymiosycia) hilla* Lesson, 1830**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										

Phylum: CHORDATA

Class: ASCIDIACEA

Order: ENTEROGONA

Family: ASCIDIIDAE

***Phallusia nigra* Savigny, 1816**

Introduced

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu		x								
Molokai										
Maui										
Hawaii										

Family: DIDEMNIDAE

***Didemnum candidum?* (white)**

Cryptogenic

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x	x	x	x	x	x			
Oahu	x									
Molokai	x	x				x		x		
Maui	x		x							
Hawaii					x	x		x		

***Didemnum* sp. (pink)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai		x								
Maui										
Hawaii			x							

Family: POLYCLINIDAE

***Aplidium* sp.?**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii										

Class: ACTINOPTERYGII

Order: ANGUILLIFORMES

Family: MURAENIDAE

***Gymnomuraena zebra* (Shaw, 1797)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui	x									
Hawaii										

***Gymnothorax flavimarginatus* (Rüppell, 1830)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x		x					
Oahu										
Molokai										
Maui										
Hawaii										

***Gymnothorax javanicus* (Bleeker, 1859)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x							
Molokai										
Maui										
Hawaii										

***Gymnothorax meleagris* (Shaw & Nodder, 1795)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai					x		x			
Oahu										
Molokai							x			
Maui										
Hawaii	x	x			x	x			x	x

***Gymnothorax rueppelliae* (McClelland, 1845)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai			x							
Maui										
Hawaii										

***Gymnothorax* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x							
Molokai		x	x							
Maui										
Hawaii	x	x			x				x	x

Order: AULOPIFORMES

Family: SYNODONTIDAE

***Saurida gracilis* (Quoy & Gaimard, 1824)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu				x						
Molokai										
Maui										
Hawaii										x

***Synodus dermatogenys* Fowler, 1912**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu					x					
Molokai										
Maui										
Hawaii										

***Synodus* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x						
Oahu		x	x	x						
Molokai								x		
Maui	x	x								
Hawaii		x					x			x

Order: LOPHIIFORMES

Family: ANTENNARIIDAE

***Antennarius commersoni* (Latreille, 1804)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x							
Oahu										
Molokai										
Maui										
Hawaii										

Order: BERYCIFORMES

Family: HOLOCENTRIDAE

***Myripristis berndti* Jordan & Evermann, 1903**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu						x				
Molokai										
Maui										
Hawaii	x	x	x	x						

***Myripristis* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui				x					x	
Hawaii			x			x		x	x	x

***Neoniphon sammara* (Forsskål, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii		x								

***Sargocentron* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii			x							

Order: SYNGNATHIFORMES
Family: AULOSTOMIDAE

***Aulostomus chinensis* (Linnaeus, 1766)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x	x					
Oahu			x	x	x	x				
Molokai										
Maui	x			x		x		x		
Hawaii		x			x	x		x	x	x

Family: FISTULARIDAE

***Fistularia commersonii* Rüppell, 1836**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x			x			
Oahu			x	x	x	x				
Molokai						x				
Maui	x									
Hawaii									x	x

***Fistularia petimba* Lacépède, 1803**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu						x				
Molokai			x			x	x			
Maui										
Hawaii										

Order: SCORPAENIFORMES
Family: CARACANTHIDAE

***Caracanthus typicus* Kroyer, 1845**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui									x	
Hawaii						x			x	

Family: SCORPAENIDAE

***Scorpaenodes parvipinnis* (Garrett, 1864)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii									x	

***Sebastapistes coniota* Jenkins, 1903**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu				x						
Molokai										
Maui										
Hawaii										

***Taenianotus triacanthus* Lacépède, 1802**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x							
Oahu										
Molokai										
Maui										
Hawaii										

Order: PERCIFORMES
Family: ACANTHURIDAE

***Acanthurus achilles* Shaw, 1803**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x			x				
Molokai										
Maui										
Hawaii	x		x		x	x	x	x	x	x

***Acanthurus blochii* (Valenciennes, 1831)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x	x	x		x	x				
Oahu	x	x	x	x	x	x				
Molokai		x	x			x		x		
Maui	x		x			x		x		
Hawaii	x					x				

***Acanthurus dussumieri* Valenciennes, 1835**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x		x					
Oahu						x				
Molokai	x	x	x					x		
Maui	x			x		x		x		
Hawaii			x			x			x	x

***Acanthurus guttatus* (Bloch & Schneider, 1801)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu						x				
Molokai	x		x							
Maui										
Hawaii						x				

***Acanthurus leucopareius* (Jenkins, 1903)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x							
Oahu			x	x	x	x				
Molokai		x	x							
Maui			x	x						
Hawaii	x	x				x	x			x

***Acanthurus nigricans* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu						x				
Molokai										
Maui									x	
Hawaii								x		

***Acanthurus nigrofusus* (Forsskål, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x	x	x	x			
Oahu		x	x	x	x	x				
Molokai		x		x	x	x	x	x		
Maui				x	x	x		x	x	
Hawaii	x	x	x	x	x	x	x	x	x	

***Acanthurus nigroris* Valenciennes, 1835**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x	x	x				
Oahu					x	x				
Molokai		x	x		x		x			
Maui		x	x	x				x		
Hawaii	x	x	x	x	x	x	x	x	x	x

***Acanthurus olivaceus* Bloch & Schneider, 1801**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x	x		x			
Oahu			x	x		x				
Molokai		x	x		x					
Maui	x		x			x		x	x	
Hawaii		x	x		x	x	x	x	x	

***Acanthurus thompsoni* (Fowler, 1923)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii									x	

***Acanthurus triostegus sandvicensis* Streets, 1877**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x	x	x		x		x			
Oahu	x	x	x	x	x	x				
Molokai	x	x		x	x	x	x	x		
Maui			x	x						
Hawaii	x	x	x				x	x		x

***Acanthurus xanthopterus* Valenciennes, 1835**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii			x			x			x	

***Ctenochaetus hawaiiensis* Randall, 1955**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x						
Oahu						x				
Molokai										
Maui										
Hawaii	x	x		x	x	x	x	x	x	x

***Ctenochaetus strigosus* (Bennett, 1828)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x						
Oahu	x	x	x	x	x	x				
Molokai	x	x		x	x		x			
Maui	x	x		x		x		x	x	
Hawaii	x	x	x	x	x		x	x	x	x

***Naso annulatus* (Quoy & Gaimard, 1825)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu					x					
Molokai										
Maui										
Hawaii										

***Naso brevirostris* (Valenciennes, 1835)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui								x	x	
Hawaii										

***Naso caesius* Randall & Bell, 1992**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii									x	

***Naso hexacanthus* (Bleeker, 1855)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x	x						
Molokai										
Maui			x							
Hawaii		x							x	

***Naso lituratus* (Forster & Schneider, 1801)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu			x	x	x	x				
Molokai		x			x	x	x			
Maui	x	x		x				x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

***Naso unicornis* (Forsskål, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu					x	x				
Molokai				x						
Maui			x	x		x				
Hawaii										

***Zebrasoma flavescens* (Bennett, 1828)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x		x					
Oahu	x	x	x	x		x				
Molokai	x			x						
Maui	x			x				x	x	
Hawaii	x	x	x	x	x	x	x		x	x

***Zebrasoma veliferum* (Bloch, 1797)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x	x				x				
Molokai	x									
Maui					x					
Hawaii						x		x		x

Family: APOGONIDAE

***Apogon kallopterus* Bleeker, 1856**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii										

***Apogon* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai				x						
Maui										
Hawaii										

Family: BLENNIIDAE

***Cirripectes vanderbilti* (Fowler, 1938)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x	x	x							
Molokai				x	x					
Maui	x	x						x		
Hawaii			x		x	x	x	x	x	

***Exallias brevis* (Kner, 1868)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x		x				
Oahu			x	x	x					
Molokai										
Maui			x	x				x		
Hawaii										x

***Plagiotremus* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii									x	

Family: CARANGIDAE

***Alectis ciliaris* (Bloch, 1788)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui						x				
Hawaii										

***Carangoides ferdau* (Forsskål, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii										

***Caranx lugubris* Poey, 1860**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui									x	
Hawaii										

***Caranx melampygus* Cuvier, 1833**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu					x	x				
Molokai										
Maui										
Hawaii						x	x			

***Caranx* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu										
Molokai		x	x							
Maui										
Hawaii										

***Scomberoides lysan* (Forsskål, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x			x				
Molokai										
Maui										
Hawaii										

Family: CHAETODONTIDAE

***Chaetodon auriga* Forsskål 1775**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x				x			
Oahu	x	x				x				
Molokai	x							x		
Maui	x			x				x	x	
Hawaii		x	x			x	x		x	x

***Chaetodon ephippium* Cuvier, 1831**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu		x								
Molokai										
Maui										
Hawaii										

***Chaetodon fremblii* Bennett, 1828**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu					x	x				
Molokai										
Maui						x				
Hawaii										

***Chaetodon kleinii* Bloch, 1790**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui									x	
Hawaii									x	

***Chaetodon lunula* (Lacépède, 1803)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x	x		x			
Oahu						x				
Molokai		x		x				x		
Maui		x		x		x		x	x	
Hawaii	x	x	x	x		x	x	x	x	x

***Chaetodon lunulatus* Quoy & Gaimard, 1825**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x	x	x			x				
Molokai	x	x	x							
Maui				x		x				
Hawaii		x								x

***Chaetodon miliaris* Quoy & Gaimard, 1825**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu		x			x	x				
Molokai			x							
Maui						x				
Hawaii									x	x

***Chaetodon multicinctus* Garrett, 1863**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x		x	x			
Oahu				x	x	x				
Molokai			x				x			
Maui				x				x		
Hawaii	x	x	x	x	x	x	x	x	x	

***Chaetodon ornatissimus* Solander, 1831**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x			x		x				
Molokai	x		x				x			
Maui	x	x		x		x		x	x	
Hawaii	x	x	x	x		x	x	x	x	x

***Chaetodon quadrimaculatus* Gray, 1831**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x			x			
Oahu			x	x	x	x				
Molokai		x								
Maui		x	x	x		x				
Hawaii	x	x			x	x	x	x	x	x

***Chaetodon unimaculatus* Bloch, 1787**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x									
Oahu			x	x	x	x				
Molokai		x	x				x			
Maui			x	x		x			x	
Hawaii					x		x	x		x

***Forcipiger flavissimus* Jordan & McGregor, 1898**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x						
Oahu				x		x				
Molokai		x			x		x			
Maui				x		x			x	
Hawaii	x	x	x	x	x	x	x	x	x	x

***Forcipiger longirostris* (Broussonet, 1782)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii	x	x	x	x		x		x	x	

***Hemitaurichthys polylepis* (Bleeker, 1857)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii									x	

***Hemitaurichthys thompsoni* Fowler, 1923**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii									x	

Family: CIRRHITIDAE

***Amblycirrhitus bimacula* (Jenkins, 1903)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui			x							
Hawaii										

***Cirrhitus pinnulatus* (Bloch & Schneider, 1801)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x			x			
Oahu	x					x				
Molokai			x				x			
Maui				x						
Hawaii		x				x				

***Paracirrhites arcatus* (Cuvier, 1829)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x	x	x	x			
Oahu			x			x				
Molokai		x				x	x			
Maui	x		x	x	x	x		x	x	
Hawaii	x	x	x		x	x	x	x	x	x

***Paracirrhites forsteri* (Bloch & Schneider, 1801)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x			x			
Oahu			x	x	x					
Molokai		x			x	x				
Maui	x			x	x	x	x			
Hawaii	x	x	x	x		x	x	x	x	x

Family: GOBIIDAE

***Asterropteryx semipunctatus* Rüppell, 1830**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai								x		
Maui										
Hawaii										

***Gnatholepis anjerensis* (Bleeker, 1850)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai	x									
Maui										
Hawaii										

***Psilogobius mainlandi* Baldwin, 1972**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai								x		
Maui										
Hawaii										

Family: KUHLIIDAE

***Kuhlia sandvicensis* (Steindachner, 1876)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai			x							
Maui										
Hawaii										

Family: KYPHOSIDAE

***Kyphosus bigibbus* Lacépède, 1801**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x						
Oahu					x	x				
Molokai										
Maui				x		x			x	
Hawaii						x			x	

***Kyphosus cinerascens* (Forsskål, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui				x		x			x	
Hawaii										

***Kyphosus* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x							
Oahu					x	x				
Molokai										
Maui										
Hawaii						x			x	

***Kyphosus vaigiensis* (Quoy & Gaimard, 1825)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii						x				

Family: LABRIDAE

***Anampses chrysocephalus* Randall 1958**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii										x

***Anampses cuvier* Quoy & Gaimard, 1824**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu				x	x					
Molokai										
Maui	x									
Hawaii							x			

***Bodianus bilunulatus* (Lacépède, 1802)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x		x		x			
Oahu			x							
Molokai		x	x			x	x			
Maui	x		x			x			x	
Hawaii										

***Cheilio inermis* (Forsskål, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x							
Molokai										
Maui							x	x	x	
Hawaii						x				

***Coris flavovittata* (Bennett, 1829)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x							
Oahu										
Molokai								x		
Maui									x	
Hawaii						x	x		x	x

<i>Coris gaimard</i> (Quoy & Gaimard, 1824)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai			x	x	x		x				
Oahu			x		x						
Molokai				x							
Maui								x	x		
Hawaii					x				x	x	
<i>Coris venusta</i> Vaillant & Sauvage, 1875											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai		x				x					
Oahu			x		x						
Molokai											
Maui											
Hawaii								x		x	
<i>Gomphosus varius</i> Lacépède, 1801											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai	x	x	x	x	x						
Oahu	x	x	x	x		x					
Molokai	x	x		x	x		x	x			
Maui	x	x	x	x				x	x		
Hawaii	x	x	x	x	x	x	x	x	x	x	
<i>Halichoeres ornatissimus</i> (Garrett, 1863)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai	x	x	x	x	x	x	x				
Oahu			x	x	x						
Molokai		x	x								
Maui	x		x					x	x		
Hawaii	x	x	x	x		x	x	x	x	x	
<i>Labroides phthiophagus</i> Randall, 1958											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai	x		x	x	x		x				
Oahu	x	x			x	x					
Molokai	x	x	x	x		x					
Maui		x	x	x			x	x	x		
Hawaii	x	x	x	x	x	x	x	x	x	x	
<i>Macropharyngodon geoffroyi</i> (Quoy & Gaimard, 1824)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu			x	x	x						
Molokai											
Maui					x						
Hawaii										x	
<i>Novaculichthys taeniourus</i> (Lacépède, 1801)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai			x								
Oahu											
Molokai											
Maui									x		
Hawaii									x	x	
<i>Oxycheilinus bimaculatus</i> (Valenciennes, 1840)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai						x					
Oahu											
Molokai											
Maui								x			
Hawaii				x	x	x	x	x	x	x	
<i>Oxycheilinus uni fasciatus</i> (Streets, 1877)											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai											
Oahu											
Molokai							x				
Maui	x			x					x		
Hawaii	x	x	x	x	x		x	x	x	x	
<i>Pseudocheilinus octotaenia</i> Jenkins, 1901											
	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	
Kauai			x			x					
Oahu											
Molokai							x				
Maui	x							x	x		
Hawaii		x	x	x	x	x	x		x	x	

***Pseudocheilinus tetrataenia* Schultz, 1960**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui	x		x				x			
Hawaii		x				x			x	

***Pseudojuloides cerasinus* (Snyder, 1904)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu										
Molokai										
Maui										
Hawaii										

***Stethojulis balteata* (Quoy & Gaimard, 1824)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x	x	x	x			
Oahu			x	x	x	x				
Molokai		x		x	x		x	x		
Maui	x	x		x	x	x	x	x	x	
Hawaii		x	x	x	x		x	x	x	x

***Thalassoma ballieui* (Vaillant & Sauvage, 1875)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x								
Oahu						x				
Molokai				x						
Maui		x		x					x	
Hawaii			x							

***Thalassoma duperrey* (Quoy & Gaimard, 1824)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x	x	x	x	x	x	x			
Oahu	x	x	x	x	x	x				
Molokai	x	x		x	x	x	x	x		
Maui	x	x	x	x	x	x	x	x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

***Thalassoma lutescens* (Lay & Bennett, 1839)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x							
Molokai										
Maui										
Hawaii										

***Thalassoma purpurum* (Forsskål, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x							
Molokai										
Maui										
Hawaii										

***Thalassoma quinquevittatum* (Lay & Bennett, 1839)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu					x					
Molokai										
Maui										
Hawaii										

***Thalassoma trilobatum* (Lacépède, 1801)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x		x					
Molokai										
Maui										
Hawaii										

Family: LETHRINIDAE

***Monotaxis grandoculis* (Forsskål, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui								x	x	
Hawaii			x						x	x

Family: LUTJANIDAE

***Aphareus furca* (Lacépède, 1802)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii					x	x			x	

***Lutjanus fulvus* (Forster, 1801)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui						x			x	
Hawaii		x								

Introduced

***Lutjanus kasmira* (Forsskål, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x		x		x			
Oahu						x				
Molokai										
Maui				x					x	
Hawaii		x			x	x	x			

Introduced

Family: MUGILIDAE

***Mugil cephalus* Linnaeus, 1758**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui				x						
Hawaii										

Family: MULLIDAE

***Mulloidichthys flavolineatus* (Lacépède, 1801)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x							
Oahu				x	x	x				
Molokai										
Maui				x		x		x		
Hawaii		x				x		x		x

***Mulloidichthys vanicolensis* Valenciennes, 1835**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x				x			
Oahu				x	x	x				
Molokai										
Maui				x		x				
Hawaii								x		

***Parupeneus bifasciatus* (Lacépède, 1802)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x	x		x			
Oahu			x	x	x	x				
Molokai							x			
Maui									x	
Hawaii	x		x		x	x	x		x	x

***Parupeneus cyclostomus* (Lacépède, 1801)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x	x	x					
Molokai							x			
Maui	x			x				x		
Hawaii	x									

***Parupeneus multifasciatus* Quoy & Gaimard, 1824**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x	x	x	x			
Oahu	x	x	x	x	x	x				
Molokai		x		x	x		x			
Maui		x		x		x		x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

***Parupeneus pleurostigma* (Bennett, 1831)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x				x			
Oahu					x	x				
Molokai										
Maui						x				
Hawaii										

***Parupeneus porphyreus* (Jenkins, 1902)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x	x					
Oahu		x				x				
Molokai							x			
Maui				x		x				
Hawaii										

Family: POMACANTHIDAE

***Apolemichthys arcuatus* (Gray, 1831)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x							
Oahu										
Molokai										
Maui										
Hawaii										

***Centropyge loriculus* (Günther, 1860)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu		x								
Molokai										
Maui										
Hawaii										

Cryptogenic

***Centropyge potteri* Jordan & Metz, 1912**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x		x	x				
Oahu				x						
Molokai			x				x			
Maui	x			x				x	x	
Hawaii				x	x	x		x	x	x

Family: POMACENTRIDAE

***Abudefduf abdominalis* (Quoy & Gaimard, 1824)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x				x			
Oahu	x	x		x	x	x				
Molokai	x	x	x	x				x		
Maui						x				
Hawaii		x	x					x	x	x

***Abudefduf sordidus* (Forsskal, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu		x				x				
Molokai								x		
Maui				x						
Hawaii										

***Abudefduf vaigiensis* (Quoy & Gaimard, 1825)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x					x				
Molokai			x							
Maui						x				
Hawaii										

Chromis agilis Smith, 1960

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai							x			
Maui								x		
Hawaii	x	x	x	x	x	x	x	x	x	x

Chromis hanui Randall & Swerdloff, 1973

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x		x					
Oahu										
Molokai							x			
Maui			x	x				x	x	
Hawaii		x	x	x	x	x	x	x	x	x

Chromis leucura Gilbert, 1905

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui			x	x						
Hawaii										

Chromis ovalis (Steindachner, 1900)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai						x				
Oahu				x						
Molokai		x					x			
Maui				x	x	x		x		
Hawaii			x					x	x	

Chromis vanderbilti (Fowler, 1941)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x	x	x	x			
Oahu			x	x	x	x				
Molokai		x	x		x	x	x			
Maui			x	x	x	x	x	x	x	
Hawaii	x	x	x		x	x	x	x	x	x

Chromis verater Jordan & Metz, 1912

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x							
Oahu										
Molokai										
Maui										
Hawaii									x	

Dascyllus albisella Gill, 1863

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x	x		x						
Molokai	x					x	x	x		
Maui	x					x	x	x	x	
Hawaii				x						x

Plectroglyphidodon imparipennis (Vaillant & Sauvage, 1875)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x	x	x	x			x			
Oahu			x	x	x	x				
Molokai					x					
Maui		x	x	x						
Hawaii		x	x	x		x				

Plectroglyphidodon johnstonianus Fowler & Ball, 1924

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x			x			
Oahu	x	x	x	x	x	x				
Molokai	x	x		x	x		x			
Maui	x	x	x	x	x	x		x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

Plectroglyphidodon sindonis (Jordan & Evermann, 1903)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x			x		x			
Oahu	x	x	x	x	x	x				
Molokai		x		x	x		x	x		
Maui	x		x	x	x		x	x	x	
Hawaii	x							x		x

***Stegastes fasciolatus* (Ogilby, 1889)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai		x		x	x		x			
Oahu	x	x	x	x	x	x				
Molokai		x		x	x		x	x		
Maui	x		x	x	x		x		x	
Hawaii		x	x			x	x	x	x	x

Family: PRIACANTHIDAE

***Heteropriacanthus cruentatus* (Lacépède, 1801)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii						x				

***Priacanthus meeki* Jenkins, 1904**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu					x					
Molokai										
Maui						x				
Hawaii										

***Priacanthus* sp.**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai	x									
Maui										
Hawaii										

Family: SCARIDAE

***Calotomus carolinus* (Valenciennes, 1839)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu					x	x				
Molokai										
Maui										
Hawaii						x			x	x

***Chlorurus perspicillatus* (Steindachner, 1879)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu					x	x				
Molokai										
Maui				x						
Hawaii		x			x		x		x	

***Chlorurus sordidus* (Forsskål, 1775)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x	x				x				
Molokai	x	x		x	x		x	x		
Maui	x	x		x			x	x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

***Scarus dubius* Bennett, 1828**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x							
Molokai										
Maui										
Hawaii						x		x	x	

***Scarus psittacus* Forsskål 1775**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu					x					
Molokai										
Maui				x				x	x	
Hawaii					x	x	x			

Scarus rubroviolaceus Bleeker, 1849

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu	x					x				
Molokai				x	x					
Maui				x				x	x	
Hawaii					x				x	x

Scarus sp.

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui				x	x	x		x	x	
Hawaii										

Scarus sp. (juveniles)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu		x		x		x				
Molokai	x	x		x	x	x	x	x		
Maui	x	x	x		x			x	x	
Hawaii	x	x	x	x		x				x

Family: SERRANIDAE

Cephalopholis argus Bloch & Schneider 1801

Introduced

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x	x					
Oahu						x				
Molokai		x	x				x			
Maui	x		x	x		x		x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

Family: SPHYRAENIDAE

Sphyræna helleri Jenkins, 1901

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui									x	
Hawaii										

Family: ZANCLIDAE

Zanclus cornutus (Linnaeus, 1758)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x			x			
Oahu	x	x		x	x	x				
Molokai					x					
Maui				x		x		x	x	
Hawaii		x	x	x	x	x	x		x	x

Order: TETRAODONTIFORMES

Family: BALISTIDAE

Melichthys niger (Bloch, 1786)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai							x			
Oahu			x	x		x				
Molokai			x							
Maui	x	x						x	x	
Hawaii	x	x	x		x	x	x	x	x	x

Melichthys vidua (Solander, 1844)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x	x	x	x			
Oahu				x		x				
Molokai			x				x			
Maui	x		x	x			x	x	x	
Hawaii	x	x	x			x	x	x	x	

Rhinecanthus rectangulus (Bloch & Schneider, 1801)

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x	x	x				x			
Oahu			x	x	x	x				
Molokai										
Maui	x	x	x	x	x		x	x		
Hawaii										

***Sufflamen bursa* (Bloch & Schneider, 1801)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x	x					
Oahu				x		x				
Molokai		x								
Maui						x		x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

***Sufflamen fraenatus* (Latreille, 1804)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai					x	x	x			
Oahu						x				
Molokai										
Maui	x			x					x	
Hawaii						x			x	x

***Xanthichthys auromarginatus* (Bennett, 1831)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui									x	
Hawaii		x							x	

Family: DIODONTIDAE

***Diodon hystrix* Linnaeus, 1758**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii					x				x	

Family: MONOCANTHIDAE

***Aluterus scriptus* (Osbeck, 1765)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui	x								x	
Hawaii										

***Cantherhines dumerilii* (Hollard, 1854)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x	x	x	x				
Molokai		x	x				x			
Maui	x			x		x		x	x	
Hawaii	x	x	x	x	x	x	x		x	x

***Cantherhines sandwichiensis* (Quoy & Gaimard, 1824)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x							
Oahu				x	x	x				
Molokai										
Maui	x			x		x	x		x	
Hawaii										

***Pervagor aspricaudus* (Hollard, 1854)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu				x	x					
Molokai							x			
Maui	x									
Hawaii										

***Pervagor spilosoma* (Lay & Bennett, 1839)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu			x	x	x					
Molokai										
Maui										
Hawaii				x						

Family: OSTRACIIDAE

***Ostracion meleagris camurum* Shaw & Nodder, 1796**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x		x		x			
Oahu			x	x	x	x				
Molokai	x	x		x						
Maui		x				x	x	x		
Hawaii	x	x	x	x					x	x

Family: TETRAODONTIDAE

***Arothron hispidus* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu				x						
Molokai										
Maui										
Hawaii									x	x

***Arothron meleagris* (Bloch & Schneider, 1801)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x	x						
Oahu										
Molokai										
Maui							x	x		
Hawaii										

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu						x				
Molokai										
Maui										
Hawaii				x		x	x	x	x	

***Canthigaster amboinensis* (Bleeker, 1865)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai				x						
Oahu										
Molokai										
Maui		x	x		x					
Hawaii						x				x

***Canthigaster coronata* (Vaillant & Sauvage, 1875)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai			x							
Oahu										
Molokai										
Maui										
Hawaii										

***Canthigaster epilampra* (Jenkins, 1903)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii						x				

***Canthigaster jactator* (Jenkins, 1901)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai	x		x	x	x	x	x			
Oahu	x	x	x	x	x	x				
Molokai	x	x	x	x		x				
Maui	x	x	x	x	x	x	x	x	x	
Hawaii	x	x	x	x	x	x	x	x	x	x

Class: REPTILIA

Family: CHELONIIDAE

***Chelonia mydas* (Linnaeus, 1758)**

	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10
Kauai										
Oahu										
Molokai										
Maui										
Hawaii	x						x			x

APPENDIX C

Details of Additional Surveys and Organisms from Artificial Reefs and Sites Inspected without Using Rapid Assessment Protocol

By request from and with the assistance of staff from the Hawai'i State Department of Land and Natural Resources Division of Aquatic Resources (DLNR/DAR), surveys were made at artificial reef sites at the Mahi wreck site and the Z-module artificial reef site off Ma'ili Point on leeward O'ahu. Random searches instead of the rapid assessment protocol previously described were used at these sites and at Haleiwa Trench, just west of Haleiwa Harbor. Inspections for NIS were also made at the *moi* grow-out facility off Ewa beach, O'ahu and the "100 Foot Hole" off Waikiki. The characteristics of these sites are as follows:

Haleiwa Trench. 17-Sep-03. (Latitude 21°35' 37.4", Longitude 158°06' 37.4"). Nearest harbor pier: 0.2 km. Nearest boat ramp: 0.2 km. Depth 4-25 m. Visibility moderate, ca 10 m.

Shallow reef dominated by abundant algae drops off to a nearly vertical wall that extends to reef base and sand channel at ca. 25 m depth, with a similar vertical wall about 20 m on other side of the channel. Coral cover abundant at ca. 40% and dominated by large colonies of *Porites* and *Montipora* but high impacted by sedimentation with much recent mortality indicated.

Mahi Wreck. 5-Nov-03 (Latitude 21°24' 55.8", Longitude 158°11' 31.2") Nearest harbor pier: 3.6 km. Nearest boat ramp: 3.6 km. Depth 7.5-27 m. Visibility excellent, ca 30 m. Wrecked ship sunk to act as artificial reef site in ca 30 m depth surrounded by coarse sand. Metal surface of ship is moderately fouled and provides shelter for high abundance of fish

Waianae Z Module. 5-Nov-03 (Latitude 21°24' 43.4", Longitude 158°11' 43.8") Nearest harbor pier: 3.2 km. Nearest boat ramp: 3.2 km. Depth 7.5-27 m. Visibility excellent, ca 25 m.

Large concrete abutment dropped on reef surface and surrounding sand to provide three dimensional relief, but lack muck internal recesses to provide shelter and habitat. Surrounded by natural reef of coral cover of ca. 3-50 percent dominated by *Porites lobata* and *Pocillopora meandrina*.

Taxa recorded at these three sites are shown in Appendix Table C1. Only four NIS occurred at Hale'iwa Trench, three on the Mahi Wreck, and only one at the Z Module artificial reef. Total taxa at these sites were 74, 56, and 62 respectively, resulting in a percent composition of NIS of 1.6% to 5.4 %. The most abundant introduced species was *Carijoa riisei* at the Mahi Wreck where it covered much of the interior surfaces of the hull. *Lutjanus kasmira* was also abundant at this site as well as at the Z Module reef. One hydroid, *Halecium sibogae* Billard, which is a new report for Hawaii was observed and collected at the Mahi wreck, and this has been given tentative cryptogenic status. The introduced hydroid *Pennaria disticha* was also common at Hale'iwa Trench.

These preliminary observations suggest that, with the exception of *Carijoa riisei*, which appear to be highly adapted for settlement on metal surfaces under low light, artificial reef surfaces do not appear to support a greater variety or number of NIS than do nearby reef environments. Additional observations on the *moi* pens off Ewa Beach on 9 October 2003 also showed little occurrence of NIS, with only minor growth of *C. riisei* and *Salmacina dysteri* found on an inspection from 10 to 41 m depth. *Salmacina dysteri* was moderately abundant on the reef top in about 24 m depth at the "100 Foot Hole" off Waikiki on 13 January 2004. Despite the abundance of *C. riisei* that virtually covers the inside of the hull of the Y025 wreck less than 0.5 km away, none was found at the "100 Foot Hole".

Appendix Table C1. Taxa recorded at Hale'iwa Trench, Mahi Wreck and Z Module Artificial Reefs, Ma'ili Point.

Taxa	Family	Genus_Species	Author	Status	Hale'iwa Mahi		Z
					Trench	Wreck	Modules
CHLOROPHYTA	HALIMEDACEAE	<i>Halimeda cf. opuntia</i>	(Linnaeus) Lamouroux		x		
	DASYCLADALCEAE	<i>Neomeris annulata</i>	Dickie				x
PHAEOPHYTA	DICTYOTACEAE	<i>Dictyota acutiloba</i>	E.Y.Dawson		x		
	SARGASSEACEAE	<i>Sargassum polyphyllum</i>	JAgardh		x		
RHODOPHYTA	RHODOMELACEAE	<i>Acanthophora spicifera</i>	(Vahl) Børgesen	Introduced	x		
	BONNEMAISONIACEAE	<i>Asparogopsis taxiformis</i>			x	x	
	GALAXAURACEAE	<i>Galaxaura fastigata</i>			x		
	CORALLINACEAE	<i>Hydrolithon onkodes</i>	(Heydr.) Foslie		x		x
		<i>Hydrolithon reinboldi</i>			x		
	CERAMIACEAE	<i>Melanamansia glomerata</i>	(Agardh) R.E.Norris		x		
	PEYSONNELIACEAE	<i>Peysonellia rubra</i>	(Montagne) Kützing		x		
	CORALLINACEAE	<i>Porolithon onkodes</i>	(Heydr.) Foslie		x		
PORIFERA	LEUCETTIDAE	<i>Leucetta solida</i>	Schmidt, 1862		x		
HYDROZOA	CORYNIDAE	<i>Corydendrium corrugatum</i>	Nutting, 1905			x	
	HALECIIDAE	<i>Halecium sibogae</i>	Billard, 1929	Cryptogenic		x	
	HALOCORDYLIDAE	<i>Pennaria disticha</i>	(Goldfuss, 1820)	Introduced	x		
ANTHOZOA	TELESTIDAE	<i>Carijoa riisei</i>	(Duchassaing & Michelotti, 1860)	Introduced		x	
	XENIIDAE	<i>Sarcothelia edmonsoni</i>	Verrill, 1928		x		
	ACROPORIDAE	<i>Montipora capitata</i>	(Dana, 1846)		x	x	x
		<i>Montipora flabellata</i>	Studer, 1902		x		
		<i>Montipora patula</i>	Verrill, 1864		x		
	AGARICIIDAE	<i>Pavona duerdeni</i>	Vaughan, 1907		x		
		<i>Pavona varians</i>	Verrill, 1864		x		
	DENDROPHYLLIIDAE	<i>Tubastraea coccinea</i>	Lesson, 1829		x	x	
	FAVIIDAE	<i>Cyphastrea ocellina</i>	(Dana, 1846)		x		
		<i>Leptastrea inequalis</i>	Klunzinger, 1879		x		
		<i>Leptastrea purpurea</i>	Dana, 1846		x		
	FUNGIIDAE	<i>Fungia scutaria</i>	Lamarck, 1801		x		
	POCILLOPORIDAE	<i>Pocillopora eydouxi</i>	Milne Edwards & Haime, 1849			x	
		<i>Pocillopora meandrina</i>	Dana, 1846		x	x	x
	PORITIDAE	<i>Porites compressa</i>	Dana, 1846		x	x	
		<i>Porites evermanni</i>	Vaughan, 1907		x		
		<i>Porites lobata</i>	Dana, 1846		x	x	x
POLYCHAETA	CHAETOPTERIDAE	<i>Chaetopterus</i> sp.			x		
	TEREBELLIDAE	<i>Loimia medusa</i>	(Savigny, 1818)		x		
	SERPULIDAE	<i>Spirobranchus giganteus</i>	(Grube, 1862)				x
GASTROPODA	VERMETIDAE	<i>Serpulorbis variabilis</i>	Hadfield & Kay, 1972		x		
NUDIBRANCHIA	CHROMODORIDIDAE	<i>Hypselodoris andersoni</i>	Bertsch & Gosliner, 1989		x		
	PTERAEOLIDIDAE	<i>Pteraeolidia ianthina</i>	(Angas, 1864)			x	
BIVALVIA	OSTREIDAE	<i>Dendostrea sandvicensis</i>	(Sowerby, 1871)			x	x
	SPONDYLIDAE	<i>Spondylus violacescens</i>	Lamarck, 1819				x
ECTOPROCTA	SERTELLIDAE	<i>Reteporellina denticulata</i>	(Busk, 1884)			x	
ASTEROIDEA	ACANTHASTERIDAE	<i>Acanthastrea planci</i>	Linnaeus, 1758		x		x
OPHIUROIDEA	OPHIOCOMIDAE	<i>Ophiocoma pica</i>	Muller & Troschel, 1842			x	

Appendix Table C1 (cont.).

Taxa	Family	Genus_Species	Author_Date	Status	Hale'iwa Mahi		Z
					Trench	Wreck	Modules
ECHINOIDEA	CIDARIDAE	<i>Chondrocidaris gigantea</i>	Agassiz, 1863		x		
	DIADEMATIDAE	<i>Echinothrix calamaris</i>	(Pallas, 1774)			x	x
	DIADEMATIDAE	<i>Echinothrix diadema</i>	(Linnaeus, 1758)		x	x	x
	TOXOPNEUSTIDAE	<i>Tripneustes gratilla</i>	(Linnaeus, 1758)		x	x	x
	ECHINOMETRIDAE	<i>Echinometra mathaei</i>	(Blainville, 1825)		x	x	
		<i>Heterocentrotus mammillatus</i>	(Linnaeus, 1758)		x		
HOLOTHUROIDEA	HOLOTHURIIDAE	<i>Actinopyga mauritiana</i>	(Quoy & Gaimard, 1833)		x		
		<i>Holothuria atra</i>	Jaeger, 1833				x
		<i>Holothuria whitmaei</i>	Bell, 1887		x		
OSTEICHTHYES	HOLOCENTRIDAE	<i>Myripristis</i> sp.					x
	HOLOCENTRIDAE	<i>Sargocentron</i> sp.			x		
	AULOSTOMIDAE	<i>Aulostomus chinensis</i>	(Linnaeus, 1766)		x		x
		<i>Fistularia commersonii</i>	Rüppell, 1836		x		
	PRIACANTHIDAE	<i>Heteropriacanthus cruentatus</i>	(Lacépède, 1801)			x	
		<i>Priacanthus meeki</i>	Jenkins, 1904		x		
	CARANGIDAE	<i>Scomberoides lysan</i>	(Forsskål, 1775)				x
	LUTJANIDAE	<i>Lutjanus fulvus</i>	(Forster, 1801)	Introduced	x	x	
		<i>Lutjanus kasmira</i>	(Forsskål, 1775)	Introduced		x	x
	LETHRINIDAE	<i>Monotaxis grandoculis</i>	(Forsskål, 1775)		x		x
	MULLIDAE	<i>Mulloidichthys flavolineatus</i>	(Lacépède, 1801)			x	x
		<i>Mulloidichthys vanicolensis</i>	(Valenciennes, 1831)		x		x
		<i>Parupeneus bifasciatus</i>	(Lacépède, 1802)		x		x
		<i>Parupeneus multifasciatus</i>	(Quoy & Gaimard, 1825)			x	x
		<i>Parupeneus pleurostigma</i>	(Bennett, 1831)				x
		<i>Parupeneus porphyreus</i>	(Jenkins, 1902)			x	x
	CHAETODONTIDAE	<i>Chaetodon auriga</i>	Forsskål 1775		x		
		<i>Chaetodon fremblii</i>	Bennett, 1828			x	x
		<i>Chaetodon kleinii</i>	Bloch, 1790			x	x
		<i>Chaetodon lunula</i>	(Lacépède, 1803)		x		
		<i>Chaetodon miliaris</i>	Quoy & Gaimard, 1824		x	x	x
		<i>Chaetodon multicinctus</i>	Garrett, 1863			x	x
		<i>Chaetodon ornatissimus</i>	Solander, 1831		x		
		<i>Chaetodon quadrimaculatus</i>	Gray, 1831			x	
		<i>Chaetodon unimaculatus</i>	Bloch, 1787		x		
		<i>Forcipiger flavissimus</i>	Jordan & McGregor, 1898			x	x
		<i>Forcipiger longirostris</i>	(Broussonet, 1782)			x	
		<i>Hemitaenichthys polylepis</i>	(Bleeker, 1857)				x
	POMACANTHIDAE	<i>Centropyge potteri</i>	Jordan & Metz, 1912		x		x
	CIRRHITIDAE	<i>Paracirrhites arcatus</i>	(Cuvier, 1829)			x	x
		<i>Paracirrhites forsteri</i>	(Bloch & Schneider, 1801)		x		
	POMACENTRIDAE	<i>Chromis agilis</i>	Smith, 1960			x	x
		<i>Chromis hanui</i>	Randall & Swerdloff, 1973			x	x

Appendix Table C1 (cont.).

Taxa	Family	Genus_Species	Author_Date	Status	Hale'iwa Trench	Mahi Wreck	Z Modules
OSTEICHTHYES	POMACENTRIDAE	<i>Chromis ovalis</i>	(Steindachner, 1900)			x	x
		<i>Dascyllus albisella</i>	Gill 1862			x	x
		<i>Plectroglyphidodon johnstonianus</i>	Fowler & Ball, 1924		x		
		<i>Plectroglyphidodon sindonis</i>	(Jordan & Evermann, 1903)				x
		<i>Stegastes fasciolatus</i>	(Ogilby, 1889)		x	x	x
	SERRANIDAE	<i>Cephalopholis argus</i>	Bloch & Schneider, 1801	Introduced	x		
	LABRIDAE	<i>Bodianus bilunulatus</i>	(Lacépède, 1802)				x
		<i>Coris flavovittata</i>	(Bennett, 1829)				x
		<i>Coris gaimard</i>	(Quoy & Gaimard, 1824)			x	x
		<i>Coris venusta</i>	Vaillant & Sauvage 1875				x
		<i>Gomphosus varius</i>	Lacépède, 1801		x	x	
		<i>Halichoeres ornatissimus</i>	(Garrett, 1863)		x		x
		<i>Labroides phthirophagus</i>	Randall, 1958		x	x	x
		<i>Macropharyngodon geoffroyi</i>	(Quoy & Gaimard, 1824)				x
		<i>Pseudocheilinus octotaenia</i>	Jenkins, 1901			x	
		<i>Stethojulis balteata</i>	(Quoy & Gaimard, 1824)		x		
		<i>Thalassoma ballieui</i>	(Vaillant & Sauvage, 1875)				x
		<i>Thalassoma duperrey</i>	(Quoy & Gaimard, 1824)		x	x	x
	BLENNIDAE	<i>Exallias brevis</i>	(Kner, 1868)			x	
	ACANTHURIDAE	<i>Acanthurus blochii</i>	Valenciennes, 1835		x		
		<i>Acanthurus dussumieri</i>	Valenciennes, 1835		x		
		<i>Acanthurus leucopareius</i>	(Jenkins, 1903)		x		
		<i>Acanthurus nigrofuscus</i>	(Forsskål, 1775)		x	x	x
		<i>Acanthurus nigroris</i>	Valenciennes, 1835			x	x
		<i>Acanthurus olivaceus</i>	Bloch & Schneider, 1801				x
		<i>Acanthurus triostegus</i>	Streets, 1877		x		x
		<i>Ctenochaetus strigosus</i>	(Bennett, 1828)		x	x	x
		<i>Naso caesius</i>	Randall & Bell, 1992			x	
		<i>Naso hexacanthus</i>	(Bleeker, 1855)			x	x
		<i>Naso lituratus</i>	(Forster & Schneider, 1801)			x	x
		<i>Zebrasoma flavescens</i>	(Bennett, 1828)		x	x	x
	ZANCLIDAE	<i>Zanclus cornutus</i>	(Linnaeus, 1758)		x	x	x
	BALISTIDAE	<i>Melichthys vidua</i>	(Solander, 1844)			x	x
		<i>Sufflamen bursa</i>	(Bloch & Schneider, 1801)		x	x	x
	OSTRACIIDAE	<i>Ostracion meleagris</i>	Jenkins, 1901			x	x
	TETRADONTIDAE	<i>Canthigaster amboinensis</i>	(Bleeker, 1865)				x
		<i>Canthigaster coronata</i>	(Vaillant & Sauvage, 1875)			x	x
		<i>Canthigaster jactator</i>	(Jenkins, 1901)		x	x	x
	DIODONTIDAE	<i>Diodon hystrix</i>	Linnaeus, 1758		x	x	x
Total Taxa					74	56	62
Total NIS					4	3	1
% NIS					5.4%	5.3%	1.6%

APPENDIX D

Organisms Sent to Taxonomic Specialists to Determine Possible New Introductions

Specimens from the following locations were sent to the listed taxonomic specialist to verify identifications or check for possible new introductions:

Sponges: Ralph DeFelice, Los Angeles County Museum of Natural History. Specimens from Stations KARA2, KARA6, KARA7, KARA8, MORA1, MORA2, MARA2, MARA4, MARA9.

Hydrozoans: Dr. Dale Calder, Royal Ontario Museum, Toronto, Canada, specimens from Stations KARA5 determined to be cryptogenic *Dynamena crisoides* Lamaroux, MORA3 to be native *Macrorhynchia philippina* Kirchenpauer, HARA1 to cryptogenic *Plumularia floridana* (Nutting), and HARA6 to be cryptogenic *Plumularia floridana* and *Plumularia strictocarpa* Pictet.

Gastropods: Anuschka Fauci, Department of Zoology, University of Hawaii. Specimens from Station MARA6 verified to be native *Serpulorbis variabilis* Hadfield & Kay.

Bryozoans: Chela Zabin, Department of Zoology, University of Hawaii. Specimens from Stations KARARA3, KARA6, HARA2, HARA3, HARA4, HARA6 and HARA9 confirmed to be *Crisina radians*? (Lamarck), specimens from KARA6 and HARA2 confirmed to be native *Disporella violacea* (Canu and Basseler), specimens from KARA2 confirmed to be introduced *Schizoporella errata*? (Waters).

Ascidians: Scott Godwin, Bishop Museum, Department of Natural Sciences. White didemnid from Stations KARA2-KARA8, OARA1, MORA1, MORA2, MORA6, MORA8, MARA1, MARA3, HARA5, HARA6 and HARA8 to be cryptogenic *Didemnum candidum*? as far as can be determined.