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CRUISE REPORT[1]

VESSEL: NOAA Ship *Oscar Elton Sette*, Cruise SE-11-07

CRUISE PERIOD: 18−27 September 2011

AREA OF OPERATION: Maui, Hawaii

TYPE OF OPERATION: In support of a Pacific Islands Fisheries Science Center's (PIFSC) research project, made a fishery-independent methods comparison among autonomous underwater vehicle (AUV), baited underwater stereo-video cameras (BotCam) and, to a lesser extent, EK60 active acoustics and fishing.

ITINERARY:

18 Sept	1500 Start of cruise. Embarked Benjamin Richards, John Rooney, Kevin Piner, Elizabeth Clarke, Jeremy Taylor, Jeffrey Anderson, Clayton Kunz, James Thorson, Daniel Merritt, Marie Ferguson, Amy Comer, Aimee Hoover, Christopher Demarke, Bo Alexander, and Mary Donovan. Departed Pearl Harbor and proceeded to survey location "E" in Pailolo/Auau Channel between Molokai and Maui.
19 Sept	0800 Disembarked Christopher Demarke, Bo Alexander, Mary Donovan and small BotCam equipment via small boat to the R/V *Huki Pono*. Deployed BotCam frames, floats, and lines for recovery by the R/V *Huki Pono*.
19 Sept–20 Sept	Conducted deep reef fish/bottomfish surveys in location "E" in the Pailolo/Auau Channel between Molokai and Maui.

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20 Sept	1700 Embarked Joyce Miller and disembarked Clayton Kunz via small boat transfer with the R/V *Huki Pono*. Conducted towed-camera operations in evening.
20 Sept–23 Sept	Conducted deep reef fish/bottomfish surveys in location "E" in the Pailolo/Auau Channel between Molokai and Maui. Conducted towed-camera operations in evening.
23 Sept	0800. Embarked Hui-Hua Lee and disembarked Kevin Piner via small boat transfer with the R/V *Huki Pono*. Transferred additional food and bait to the R/V *Huki Pono*. Following transfer, conducted deep reef fish/bottomfish surveys in location "E" in the Pailolo/Auau Channel between Molokai and Maui. Conducted towed-camera operations in the evening.
24 Sept–26 Sept	Conducted deep reef fish/bottomfish surveys in location "B" in the Alenuihaha Channel south of east Maui. Upon completion of daily operations, proceeded to Pearl Harbor.
27 Sept	0800 Arrived Pearl Harbor. Upon arrival, disembarked Benjamin Richards, John Rooney, Hui-Hua Lee, Elizabeth Clarke, Jeremy Taylor, Jeffrey Anderson, Clayton Kunz, James Thorson, Daniel Merritt, Joyce Miller, Marie Ferguson, Amy Comer, and Aimee Hoover. End of cruise. Removed and off-loaded cruise equipment. Over-the-side-Pole (OTSP) and additional equipment were left aboard for the duration of cruise SE-11-08 to facilitate the fast turnaround between SE-11-07 and SE-11-08 (turnaround occurred on the same day).

MISSIONS AND RESULTS:

A. Research and develop methods to cross-compare or calibrate fishery-dependent (extractive) and fishery-independent (non-extractive) sampling methodologies for use in stock assessment.

1. Overall, the mission to cross-compare fishery dependent and fishery-independent sampling methodologies for stock assessment met with mixed success. All fishery-independent gears performed as or better than expected. Each method is detailed below. Post-mission data analyses, carried out in collaboration with Drs. Jerald Ault and Steve Smith of the University of Miami, Rosenstiel School of Marine and Atmospheric Science, will quantify the power of the data generated by each method and will make comparisons among methods. Strengths and weaknesses will be outlined and the usability of each method for stock assessment will be discussed.

The absence of the cooperative fisheries program contract fishers will, unfortunately, limit our ability to make comparisons between fishery-dependent and fishery-independent methods and to relate the fishery-independent data back to the fishery. This comparison should be a priority for future methods comparison missions.

2. Each member of the scientific party and the crew and officers of the NOAA Ship *Oscar Elton Sette* and R/V *Huki Pono* preformed their required duties exceptionally and should be commended. Significant logistical and scientific challenges were encountered throughout the mission, and each member of the team rose to the occasion.

B. Estimate deepwater reef fish (i.e., mesophotic) or bottomfish abundance using a variety of extractive and non-extractive methods including

1. Autonomous underwater vehicle (AUV)

The SeaBed Autonomous Underwater Vehicle (AUV), dubbed Lucille, performed well throughout the mission. Over the course of 8 days, she completed 7 transect surveys totaling 37.7 km in length and covering 70 survey grid cells (43 [22 km] in survey Box E and 27 [16 km] in B) (Fig. 3 and Fig. 2, Tables 1 and 2). The AUV was fouled on a visor of rock for more than an hour during one dive, but successfully responded to a command to abort to home and drove herself free. Developing obstacle avoidance behaviors for the SeaBed with a combination of hardware and software changes will be proposed to the National Marine Fisheries Service's Advanced Sampling Technology Working Group (ASTWG) for funding in FY 2012. Primary sensors aboard the AUV included:

- Forward-looking stereo-video cameras of the same make and model (ROS Navigator) as those used on BotCam
- Downward-facing 3 Megapixel, 12 bit dynamic range Prosilica GigE camera
- Novatech strobe with pressure switch and light sensor
- Sea-Bird Electronics, Inc. 19plus (CTD) conductivity-temperature-depth recorder
- RDI 1,200 kHz Doppler Velocity Log
- iXSea Octans Inertial Navigation Unit
- Paroscientific Corporation depth sensor
- LinkQuest TrackLink Ultrashort Baseline Navigation System (USBL) transponder
- Radion frequency (RF) Modem for surface communications

- Acoustic Modem for communications while submerged

2. Baited underwater video camera system (BotCam) (R/V *Huki Pono*)

   a. The baited remote underwater stereo-video camera system (BotCam) also performed well throughout the mission. In general, BotCam was deployed in each survey grid cell closely following the AUV's departure from that grid cell. The close temporal proximity in sampling should strengthen the pairwise comparison between methods. On occasion, logistical constraints necessitated BotCam deployment prior to the AUV entering the grid cell. Additionally, BotCam was able to survey a greater number of grid cells than the AUV and so was deployed in grid cells not sampled by the AUV. BotCam was deployed from the Sea Engineering R/V *Huki Pono* by cooperating scientists from the University of Hawai‘i at Mānoa and the PIFSC's Coral Reef Ecosystem Division. Over the 8-day mission, BotCam was deployed in 79 survey grid cells (45 in Box E and 34 in B) (Fig. 3 and Fig. 2, Tables 1 and 2).

   b. Within survey Box E, 15 of 45 deployments resulted in non-zero fish counts. The most common species were Lutjanid snappers (paka, kale, ehu, lehi, randall's and uku) found in 6 of15 deployments. Carangids (kahala and ulua) were found in 5 of 15 deployments. Various reef fish as well as sharks and rays were found in 4 of 15 deployments. Many of the deployments in Box E were in areas of soft substrate and low visibility.

   c. Within survey Box B, 25 of 34 deployments resulted in non-zero fish counts. The most common species again were Lutjanid snappers (paka, gindai, ehu, and onaga) found in 14 of 25 deployments. Carangids (kahala and ulua) were found in 7 of 25 deployments. Sharks and rays were found in 5 of 25 deployments. Various reef fishes were found in 4 of 25 deployments. Groupers (hapu'u) were seen in 2 of 25 deployments. A single BotCam became fouled in the substrate and was recovered after 3 hours of effort. Visibility was much improved in Box B and harder substrates were more common than in Box E.

3. EK60 Active acoustics

   a. EK60 active acoustic surveys were conducted in combination with ship-based fishing activities and with AUV sampling. Combined fishing and acoustic sampling was conducted for species validation of acoustic data. Combined acoustic and AUV surveys were conducted to first determine if the two methods can be fielded

simultaneously and secondly to see if the AUV can be used to optically validate acoustic data. Acoustic surveys totaled 35 hours 58 minutes, totaled 132.6 km in length and covered 84 survey grid cells (42 in "B" & 42 in "E") (Figs. 2 and 3, Tables 1 and 2).

- EK60 Frequencies used during cruise SE-11-07: 38 kHz, 70 kHz, 120 kHz

b. Interference tests carried out between the EK60 and AUV showed no significant interference was found on any frequency (38 kHz, 70 kHz, 120 kHz) at the depths (< 400 m) and AUV/ship distance (< 1 km) employed during this mission. Slight interference in AUV acoustic modem communication was noted at 38 kHz, but the level of interference was deemed insignificant. Intermittent and significant noise were noted in the EK60 on several occasions, but these instances could not be correlated with the AUV and are currently unresolved. This occurred on only one day of the mission. On all other days, EK60 data was clean and acceptable. On several occasions, the AUV is seen in the EK60 data (Fig. 19).

4. TOAD camera

The TOAD camera sled was deployed a total of 9 times and completed 34.7 km of survey (20.7 km off Kihei and 13.9 km in survey box "B") (Table 4 and Fig. 4). In general, TOAD operations were conducted between 1700 and 2300 (local time, all data collected on UTC time). Total bottom time was 13 hours and 26 minutes. During the 9th and last deployment, the TOAD sled hung up on an overhang in approximately 100 m water depth, but after ~ 64 minutes of ship maneuvering, the sled was successfully recovered with minor damage, thanks to the expertise of the crew of the NOAA Ship *Oscar Elton Sette*.

The camera sled was deployed from a J-Frame on the starboard side of the Sette from a dedicated winch with 350 m of cable. Equipment aboard the sled included:

- Two Deep Sea Power and Light Multi SeaCam 2060 low-light video cameras (downward- and forward-looking)

- One downward-facing Ocean Imaging System 1200 digital stills

- Two forward-facing 50 watt Deep Sea Power and Light LED Multi-SeaLites

- One downward-pointing SeaArc2 400 w HMI light
- A pair of Deep Sea Power and Light SeaLaser downward-pointing lasers
- Tritech PA200 Altimeter

The most common habitats and fish observed were as follows:

Sand and *Halimeda*: Depths from 36 to 95 m; widespread; very few fish in these areas but *Canthigaster coronata* was observed in areas of *Halimeda* sp. with sand. Other medium-sized unidentified species were also present.

Sand: Depths 36-185 m. Often associated with slopes; only small fish, *Xyrichtys* sp., seen in sandy areas.

Mesophotic corals (*Leptoseris*, wire, and black) corals and medium/high rugosity: Depths from 60 to185 m; medium/high habitat relief interspersed with sand. Fish observed were *Acanthurus* sp., *Naso* sp., *Myripristis* sp., *Sargocentron* sp., *Lutjanus* sp. and *Lutjanus kasmira*. *Heniochus diphreutes* was occasionally seen when black coral was present. One opakapaka was observed on MAI11004. Other large unidentified species were also present.

Branching *Montipora* coral: Depth 60 m; some algal overgrowth; tow MAI11002 only. Most fish observed in this habitat were Labrid species.

5. Cooperative fishing vessels

   a. Planned cooperative fishing operations were not conducted as part of cruise SE-11-07.

   b. Biosampling

      On several occasions, scientists and crew aboard the NOAA Ship *Oscar Elton Sette* conducted limited fishing operations during the early morning and evening hours. These operations were conducted in concert with EK60 active acoustic surveys. Seven fish (1, opakapaka, 3 ehu, and 2 hapu'u) were caught and were biosampled for length, otoliths, and gonads (Table 3).These data will be provided to the PIFSC's Fisheries Research and Monitoring Division to increase available life-history data on Hawai‘i deepwater bottomfish.

SCIENTIFIC PERSONNEL:

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Tables

Table 1.--Number of grid cells sampled by each method during cruise SE-11-07.

Survey Box	BotCam	AUV	Ek60
E	45	43	42
B	34	27	42

Table 2.--Distribution of sampling methods by grid cell during cruise SE-11-07.

Survey Box	Grid	Sample	Lat	Long	Depth (m)	Habitat	BotCam	AUV	Ek60	Methods
B	13	Primary	20.55	-156.40	-271	HB_H	0	0	1	**1**
B	14	Primary	20.55	-156.40	-100	HB_H	1	1	0	**2**
B	19	Primary	20.55	-156.39	-98	HB_L	1	1	1	**3**
B	24	Primary	20.55	-156.39	-99	SB_L	1	1	1	**3**
B	29	Primary	20.55	-156.38	-177	HB_H	1	0	0	**1**
B	30	Alternate	20.56	-156.38	-82	SB_L	1	1	1	**3**
B	34	Primary	20.55	-156.38	-174	HB_H	1	0	1	**2**
B	35	Alternate	20.56	-156.38	-73	HB_L	1	1	1	**3**
B	39	Primary	20.55	-156.37	-121	HB_H	1	1	1	**3**
B	40	Alternate	20.56	-156.37	-69	HB_L	0	0	1	**1**
B	45	Primary	20.55	-156.37	-192	HB_H	1	0	0	**1**
B	46	Primary	20.56	-156.37	-95	HB_L	1	1	1	**3**
B	51	Primary	20.55	-156.36	-262	HB_H	1	0	1	**2**
B	52	Primary	20.56	-156.36	-116	HB_H	1	1	1	**3**
B	53	Primary	20.56	-156.36	-90	SB_L	1	1	1	**3**
B	57	Primary	20.55	-156.36	-315	HB_H	1	0	0	**1**
B	58	Primary	20.56	-156.36	-109	SB_L	1	0	1	**2**
B	59	Primary	20.56	-156.36	-99	SB_L	0	0	1	**1**
B	60	Primary	20.57	-156.36	-81	SB_L	0	0	1	**1**
B	62	Primary	20.55	-156.35	-341	HB_H	0	0	1	**1**
B	63	Primary	20.56	-156.35	-114	HB_H	1	1	1	**3**
B	64	Primary	20.56	-156.35	-100	SB_L	0	0	1	**1**
B	65	Primary	20.56	-156.35	-82	SB_L	0	0	1	**1**
B	68	Primary	20.56	-156.35	-248	HB_H	1	0	1	**2**
B	69	Primary	20.56	-156.35	-106	SB_L	1	1	1	**3**
B	70	Primary	20.56	-156.35	-99	SB_L	1	1	1	**3**
B	73	Primary	20.56	-156.34	-325	HB_L	0	0	1	**1**
B	75	Primary	20.56	-156.34	-116	SB_L	1	1	1	**3**
B	79	Primary	20.56	-156.34	-187	HB_L	1	1	1	**3**
B	83	Alternate	20.56	-156.33	-330	HB_H	0	0	1	**1**
B	84	Primary	20.56	-156.33	-192	HB_L	1	1	1	**3**
B	89	Primary	20.56	-156.33	-232	HB_H	1	1	1	**3**
B	94	Primary	20.56	-156.32	-258	HB_H	1	1	1	**3**

Survey Box	Grid	Sample	Lat	Long	Depth (m)	Habitat	BotCam	AUV	Ek60	Methods
B	95	Primary	20.56	-156.32	-122	SB_L	1	1	1	**3**
B	96	Primary	20.57	-156.32	-104	SB_L	1	1	1	**3**
B	100	Primary	20.56	-156.32	-244	HB_H	0	0	1	**1**
B	101	Primary	20.56	-156.32	-107	SB_L	1	1	1	**3**
B	106	Primary	20.56	-156.31	-173	HB_H	0	0	1	**1**
B	107	Primary	20.56	-156.31	-92	SB_L	1	1	1	**3**
B	111	Primary	20.56	-156.31	-145	HB_H	1	1	1	**3**
B	112	Primary	20.56	-156.31	-89	SB_L	1	1	1	**3**
B	115	Primary	20.56	-156.30	-324	HB_H	0	0	1	**1**
B	116	Primary	20.56	-156.30	-96	HB_L	1	1	1	**3**
B	121	Primary	20.56	-156.30	-111	HB_H	1	1	1	**3**
B	122	Primary	20.56	-156.30	-86	SB_L	1	1	1	**3**
B	123	Primary	20.57	-156.30	-80	HB_L	1	1	1	**3**
E	492	Primary	20.94	-156.80	-221	HB_L	1	1	1	**3**
E	493	Primary	20.95	-156.80	-224	SB_L	1	0	1	**2**
E	499	Primary	20.94	-156.80	-188	SB_H	1	1	1	**3**
E	500	Primary	20.94	-156.80	-221	HB_L	1	1	0	**2**
E	501	Primary	20.95	-156.80	-223	HB_L	1	0	0	**1**
E	502	Primary	20.95	-156.80	-226	SB_L	1	0	0	**1**
E	506	Primary	20.93	-156.79	-75	HB_L	1	1	1	**3**
E	507	Primary	20.94	-156.79	-212	HB_L	1	0	1	**2**
E	508	Alternate	20.94	-156.79	-219	SB_L	0	0	1	**1**
E	509	Primary	20.95	-156.79	-221	SB_L	1	1	0	**2**
E	514	Primary	20.93	-156.79	-76	HB_L	1	1	1	**3**
E	515	Primary	20.94	-156.79	-218	HB_L	1	0	1	**2**
E	516	Alternate	20.94	-156.79	-216	SB_L	0	0	1	**1**
E	517	Primary	20.95	-156.79	-218	SB_L	1	1	1	**3**
E	522	Primary	20.93	-156.78	-92	HB_L	1	1	1	**3**
E	523	Primary	20.94	-156.78	-218	SB_L	1	0	1	**2**
E	524	Primary	20.94	-156.78	-214	SB_L	1	1	1	**3**
E	530	Primary	20.93	-156.78	-84	HB_L	1	1	1	**3**
E	531	Primary	20.94	-156.78	-216	HB_L	1	0	1	**2**
E	532	Primary	20.94	-156.78	-211	SB_L	1	1	1	**3**
E	534	Primary	20.95	-156.78	-216	SB_L	1	0	0	**1**
E	538	Primary	20.93	-156.77	-76	HB_L	1	1	1	**3**
E	539	Primary	20.94	-156.77	-213	HB_L	0	0	1	**1**
E	540	Primary	20.94	-156.77	-208	SB_L	1	1	1	**3**
E	543	Primary	20.95	-156.77	-215	SB_L	1	0	0	**1**
E	545	Alternate	20.93	-156.77	-68	SB_L	0	0	1	**1**
E	546	Alternate	20.93	-156.77	-75	SB_L	0	0	1	**1**

Survey Box	Grid	Sample	Lat	Long	Depth (m)	Habitat	BotCam	AUV	Ek60	Methods
E	547	Primary	20.94	-156.77	-206	HB_H	0	0	1	**1**
E	548	Alternate	20.94	-156.77	-205	SB_L	0	0	1	**1**
E	549	Primary	20.95	-156.77	-206	HB_L	1	1	1	**3**
E	552	Primary	20.92	-156.76	-117	HB_L	1	1	1	**3**
E	553	Primary	20.93	-156.76	-112	HB_L	1	1	1	**3**
E	554	Primary	20.93	-156.76	-112	HB_L	0	0	1	**1**
E	555	Primary	20.94	-156.76	-153	HB_H	1	0	0	**1**
E	556	Primary	20.94	-156.76	-214	HB_L	1	0	0	**1**
E	557	Primary	20.95	-156.76	-202	HB_L	0	0	1	**1**
E	558	Primary	20.95	-156.76	-201	SB_L	1	1	1	**3**
E	560	Primary	20.92	-156.76	-95	HB_L	1	1	1	**3**
E	562	Primary	20.93	-156.76	-114	HB_L	1	0	0	**1**
E	563	Primary	20.94	-156.76	-112	HB_L	1	0	0	**1**
E	564	Primary	20.94	-156.76	-108	HB_H	1	0	0	**1**
E	565	Primary	20.95	-156.76	-205	HB_L	1	0	1	**2**
E	566	Primary	20.95	-156.76	-198	SB_L	0	0	1	**1**
E	568	Primary	20.92	-156.75	-88	HB_L	1	1	1	**3**
E	569	Primary	20.93	-156.75	-89	HB_L	1	1	1	**3**
E	570	Primary	20.93	-156.75	-80	SB_L	1	1	1	**3**
E	571	Primary	20.94	-156.75	-91	HB_L	1	1	1	**3**
E	572	Primary	20.94	-156.75	-103	HB_H	1	1	1	**3**
E	573	Primary	20.95	-156.75	-156	HB_H	1	0	1	**2**
E	574	Primary	20.95	-156.75	-191	HB_H	1	1	1	**3**
E	575	Primary	20.95	-156.75	-193	SB_L	1	1	1	**3**
E	581	Primary	20.95	-156.75	-83	HB_L	1	1	0	**2**
E	583	Primary	20.95	-156.75	-169	HB_L	1	1	1	**3**
E	591	Primary	20.95	-156.74	-113	HB_L	1	1	1	**3**
E	592	Primary	20.96	-156.74	-110	HB_L	1	1	0	**2**

Table 3.—Biosampling.

Date	Time (GMT)	Time (local)	Lat	Long	Species	FL (cm)	TL (cm)	NOTES
9/22/11	16:51	6:51	20.95	-156.76	Opakapaka	49.0	56.0	Caught on same line as the Ehu below
9/22/11	16:51	6:51	20.95	-156.76	Ehu	50.5	55.7	Caught on same line as the above paka; came off line; retrieved
9/23/11	16:09	6:09	20.95	-156.75	Ehu			Caught
9/23/11	16:14	6:14	20.95	-156.75	Ehu			Reeled in about 3 minutes after previous one; likely caught in same spot
9/26/11	2:01	16:01	20.55	-156.36	Hāpu'u	n/a	71.5	Visible Parasites. 14.5lbs; came up with a small unknown fish in its mouth
9/26/11	17:20	7:20	20.56	-156.32	Kahala	n/a	n/a	Thrown Back because it is not a target species
9/26/11	16:43	6:43	20.56	-156.35	Kahala	n/a	n/a	Thrown Back because it is not a target species
9/26/11	17:23	7:23	20.55	-156.35	Hāpu'u	n/a	58.5	8lbs

Table 4.--TOAD sampling metadata for cruise SE-11-07.

Tow #	Date (UTC)	Begin (UTC)	End (UTC)	Depth (m)	Dist. (km)	Location	Comments
MAI11001	9-21	05:55	07:22	57-70	3.9	S. of Kihei, Maui	Mostly sand and *Halimeda*; one *Leptoseris* coral patch, Branching coral
	9-22						TOAD operations aborted – no fwd. lights due to bad cable
MAI11002	9-23	03:27	06:50	45-52	7.8	"	Sand and *Halimeda*, branching coral with algae
MAI11003	9-23	03:23	04:27	55-90	4.5	"	Sand and *Halimeda*, plating coral and black coral
MAI11004	9-24	05:14	06:48	79-122	4.2	"	30 min. corals, one Opakapaka, one lobster, sand and *Halimeda*
MAI11005	9-24	07:44	09:20	77-92	3.2	"	Sand and *Halimeda*, plate, black and wire corals, sponges
MAI11006	9-25	03:25	04:09	93-150	2.7	Area B	Sand and *Halimeda*, drop-off to 117 m, then rugose habitat w/ boulders, corals and fish
MAI1107	9-25	05:11	05:55	81-185	2.5	Area B	Sand and *Halimeda*, steep slope, corals at depth
MAI1108	9-25	06:50	08:35	86-105	4.2	Area B	Sand
MAI1109	9-26	04:26	07:45	83-107	8.2	Area B	Mostly sand, occasional outcrops of rock and coral. TOAD stuck at 06:38.

Figures

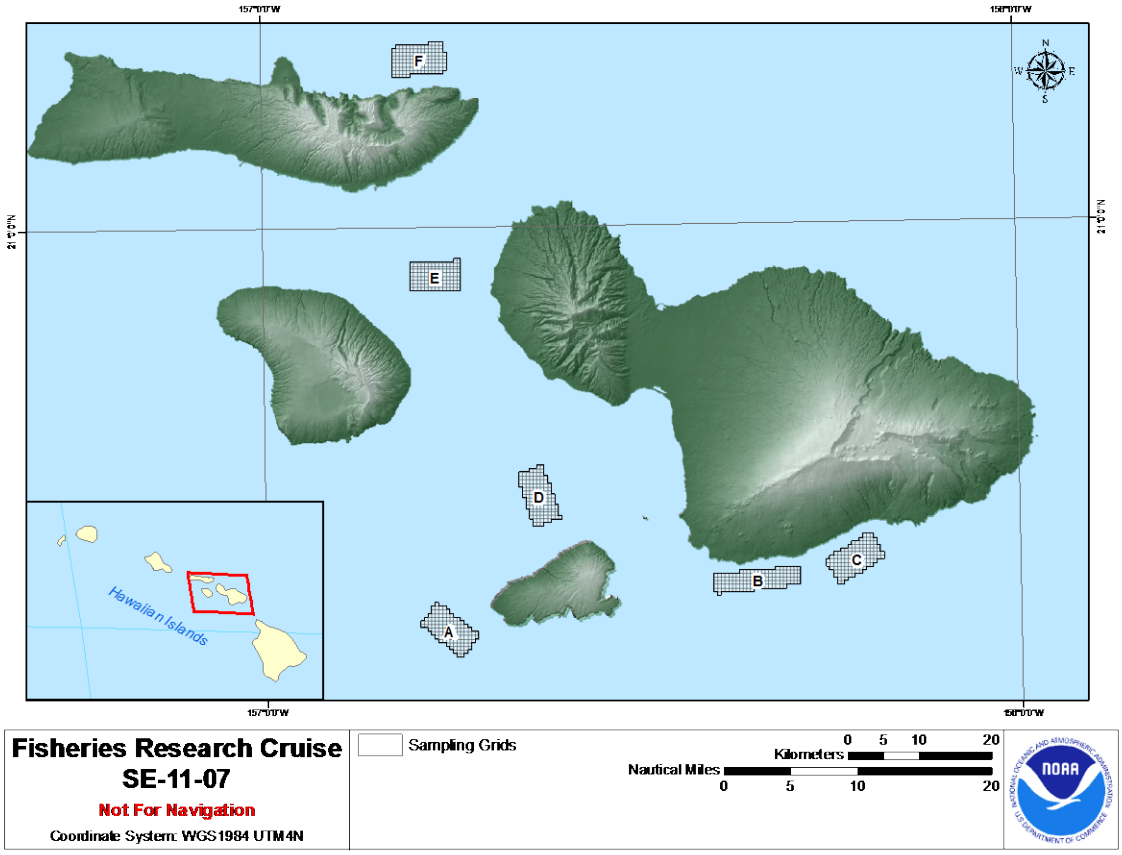

Figure 1.--Survey domain for SE-11-07. Candidate survey Boxes A-F were chosen a priori based on distribution of relevant habitat types (hard bottom or soft bottom and high rugosity or low rugosity) across relevant depth ranges (75-130 m and 145-300 m). Survey Boxes E and B were sampled during SE-11-07.

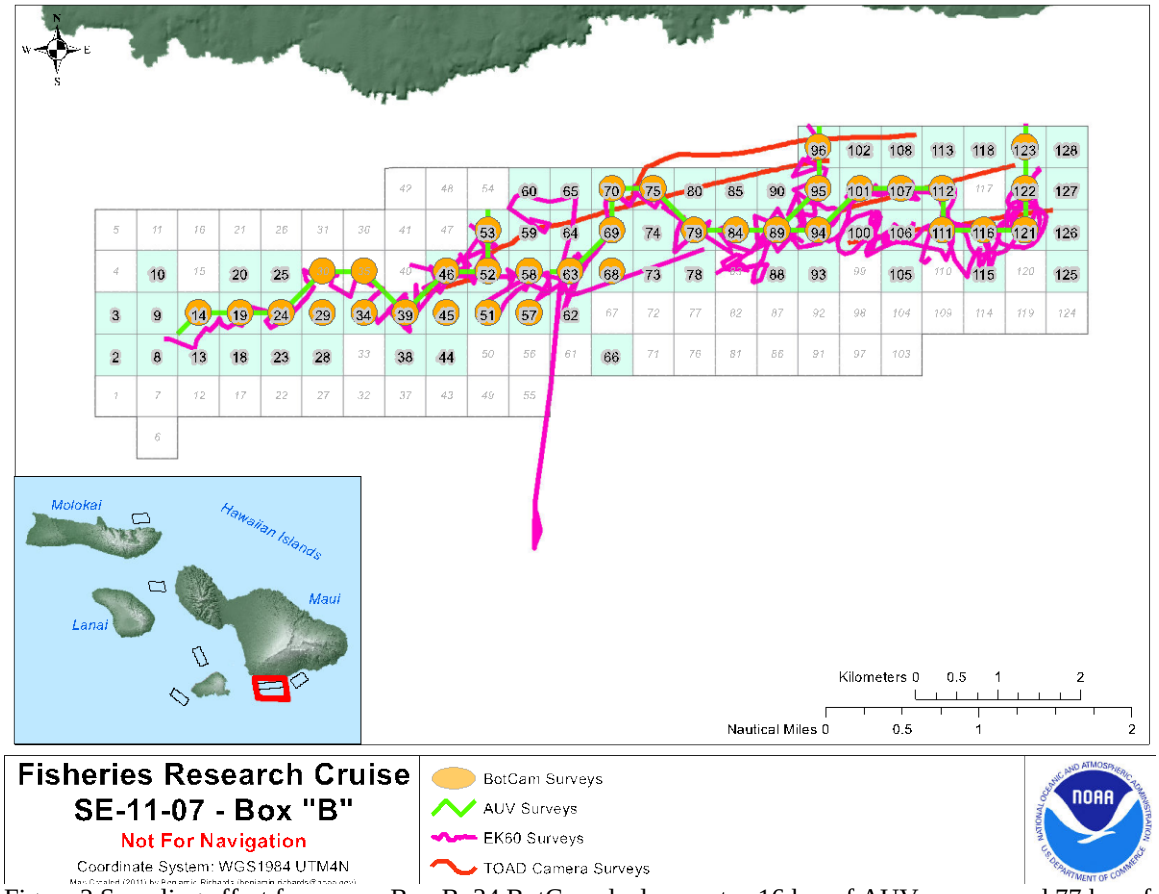

Figure 2 Sampling effort for survey Box B. 34 BotCam deployments , 16 km of AUV survey, and 77 km of EK60 survey were conducted across representative habitat types and depth ranges.

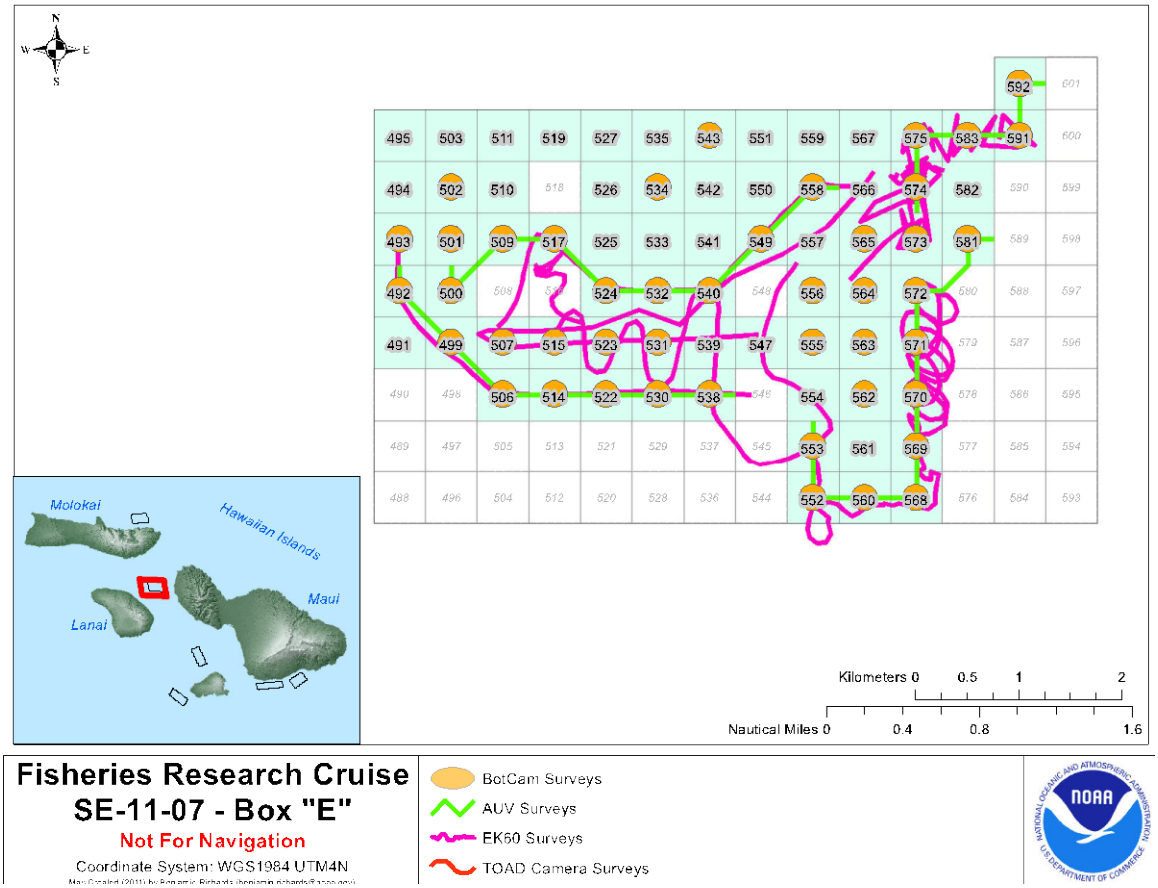

Figure 3.--Sampling effort for survey Box E. Forty-five BotCam deployments and 22.18 km of AUV survey, and 55 km of EK60 survey were conducted across representative habitat types and depth ranges.

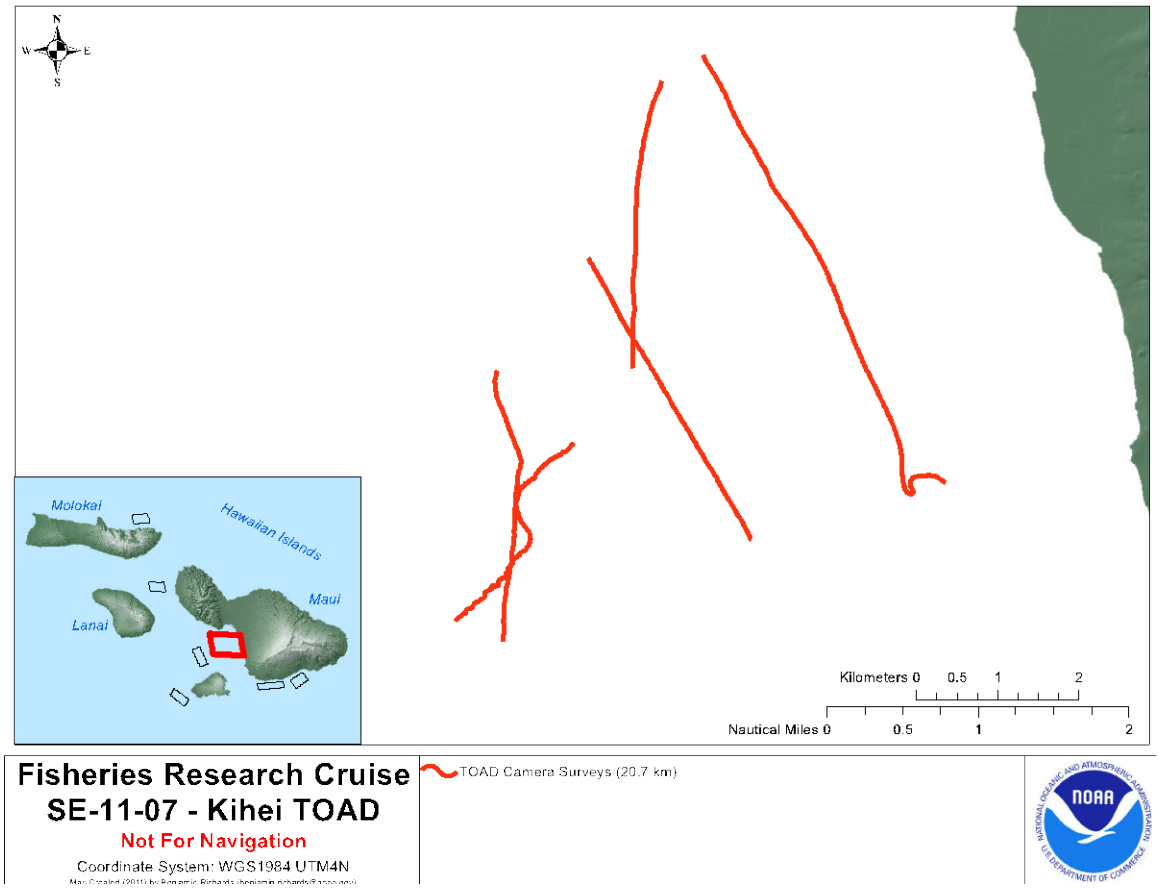

Figure 4.--TOAD camera surveys off Kihei, Maui. A total of 20.7 km of seafloor was surveyed.

Figure 5.--*Seriola demerlii* and *Seriola riviolana* imaged by the forward-facing stereo video cameras on the AUV.

Figure 6.--Kahala (*Seriola demerlii*) imaged by the forward-facing stereo video cameras on the AUV.

Figure 7.--High rugosity substrate imaged by the forward-facing stereo video cameras on the AUV.

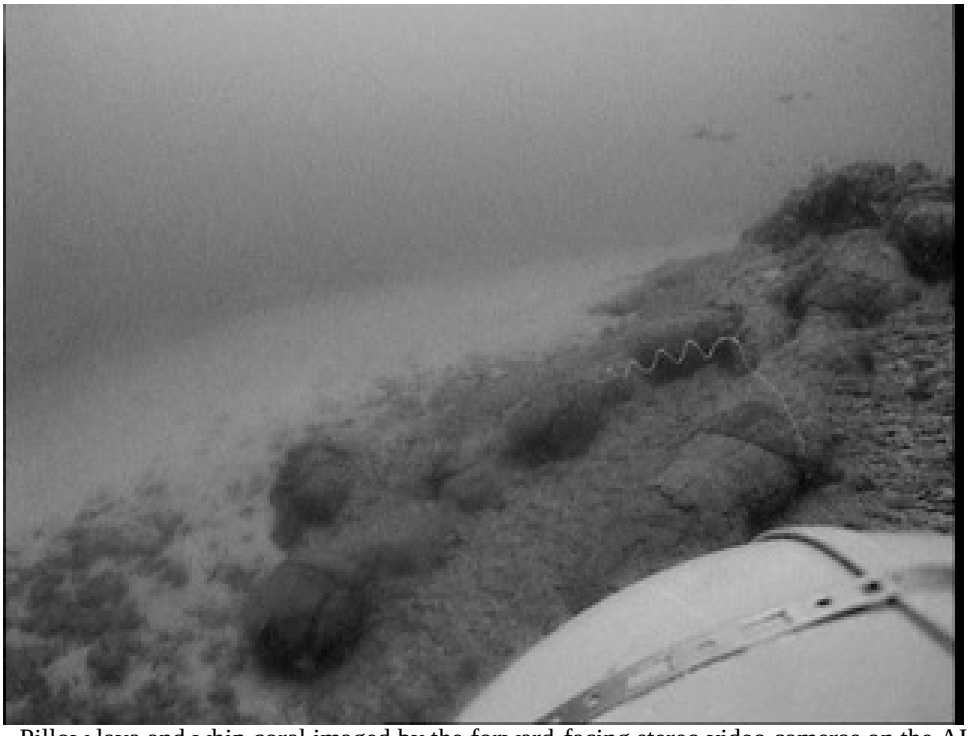

Figure 8.--Pillow lava and whip coral imaged by the forward-facing stereo video cameras on the AUV.

Figure 9.--Reef structure and clouds of reef fish imaged by the forward-facing stereo video cameras on the AUV.

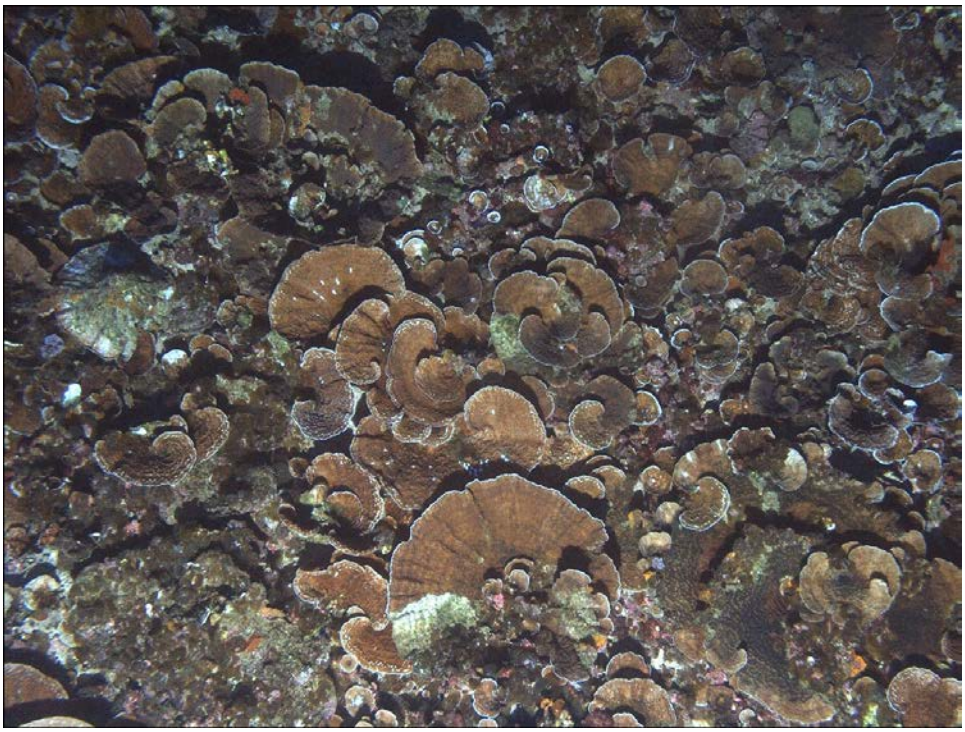

Figure 10.--*Leptoseris* sp. coral in 80 m of water (grids E571 and E572) imaged by the downward-facing camera on the AUV.

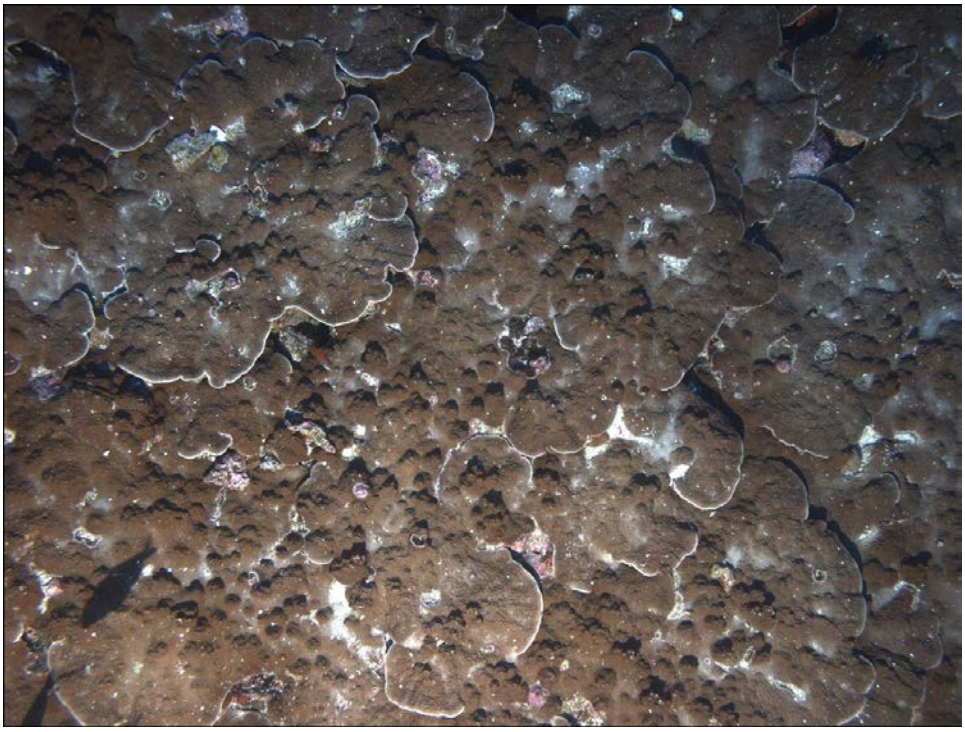

Figure 11.--*Montipora capitata* coral in 56 m of water (grid E568) imaged by the downward-facing camera on the AUV.

Figure 12.--Kahala (*Seriola demerlii*) imaged by the downward-facing camera on the AUV.

Figure 13.--A Dasyatid ray imaged by the downward-facing camera on the AUV.

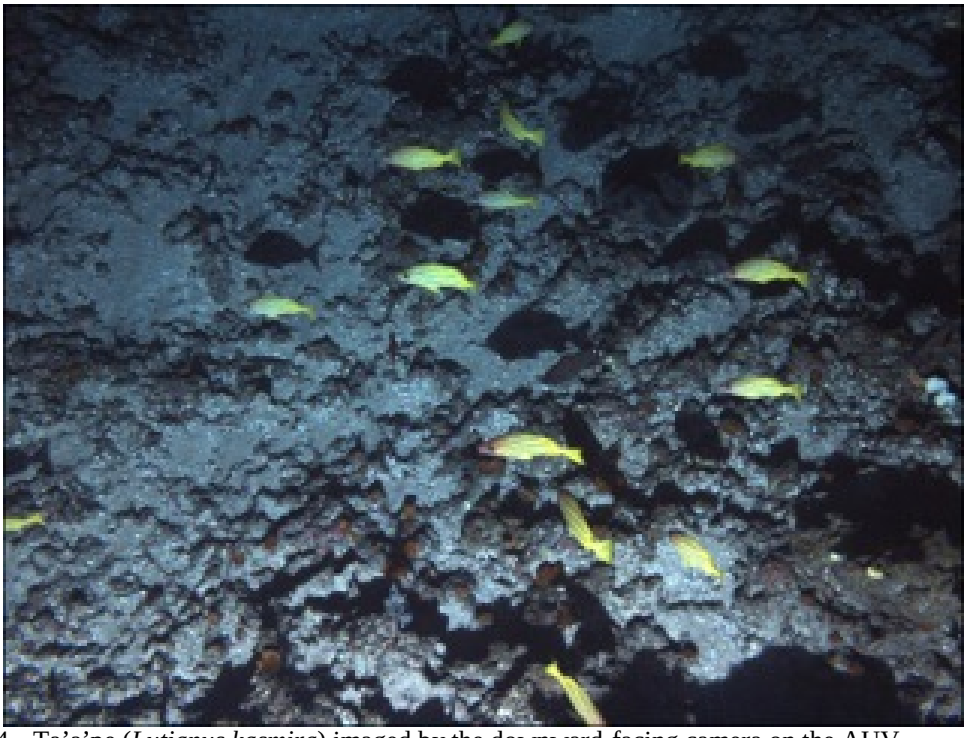

Figure 14.--Ta'a'pe (*Lutjanus kasmira*) imaged by the downward-facing camera on the AUV.

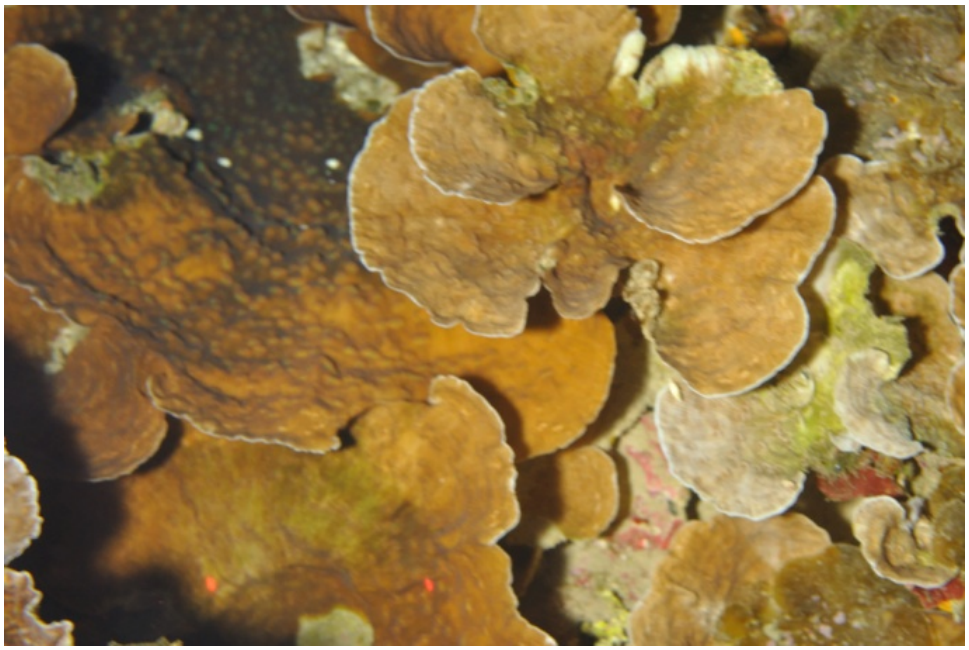

Figure 15.--Mesophotic corals (*Leptoseris hawaiiensis)* seen during TOAD camera surveys MAI11004 and MAI11005, Sept. 24, 2011.

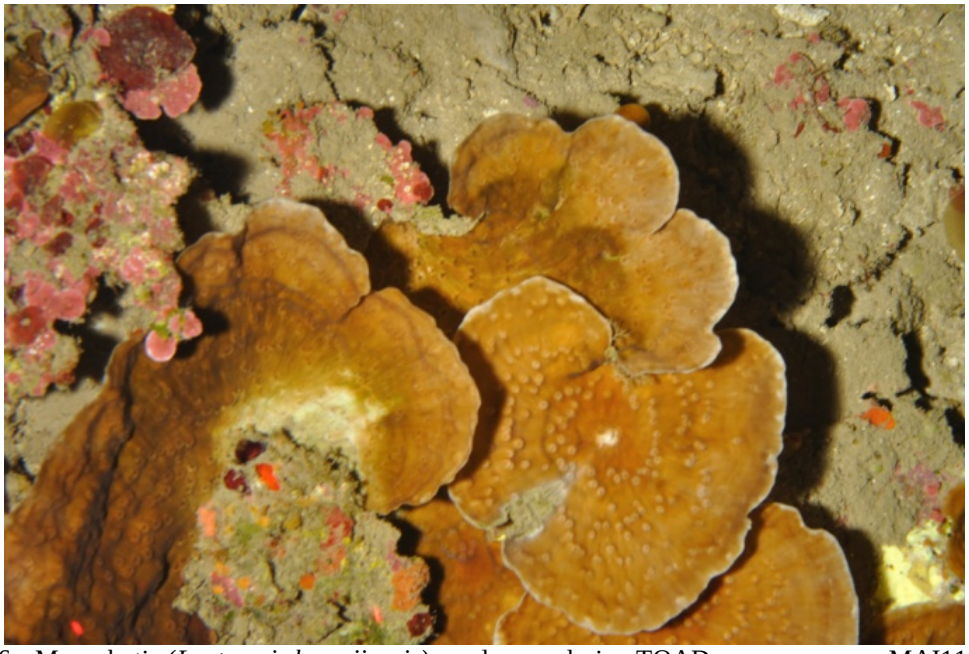

Figure 16.--Mesophotic (*Leptoseris hawaiiensis)* corals seen during TOAD camera surveys MAI11004 and MAI11005, Sept. 24, 2011.

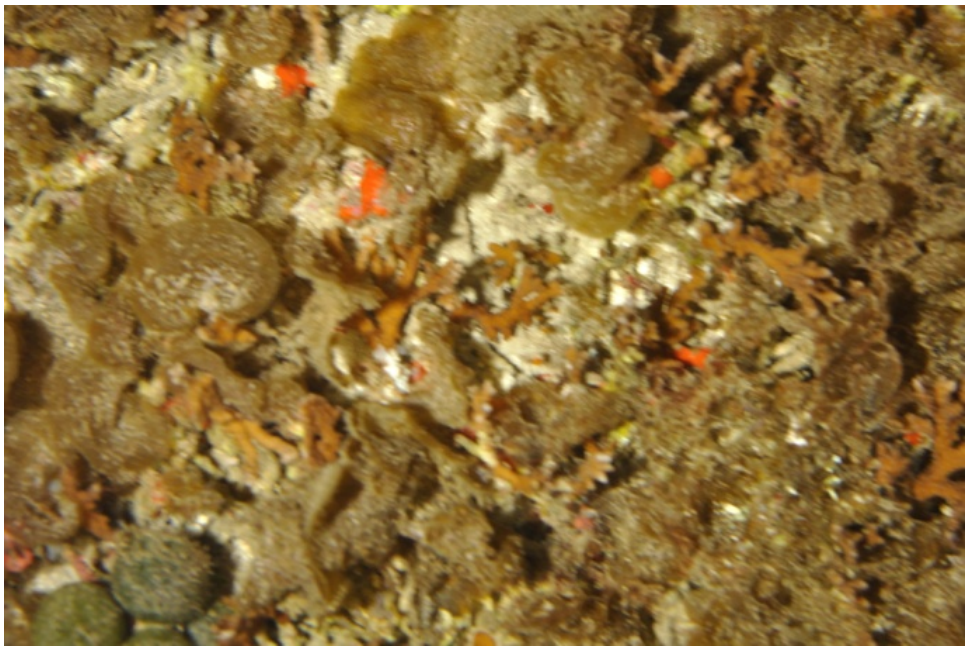

Figure 17.--Overgrown branching *Montipora capitata* coral seen in TOAD camera surveys (MAI11001).

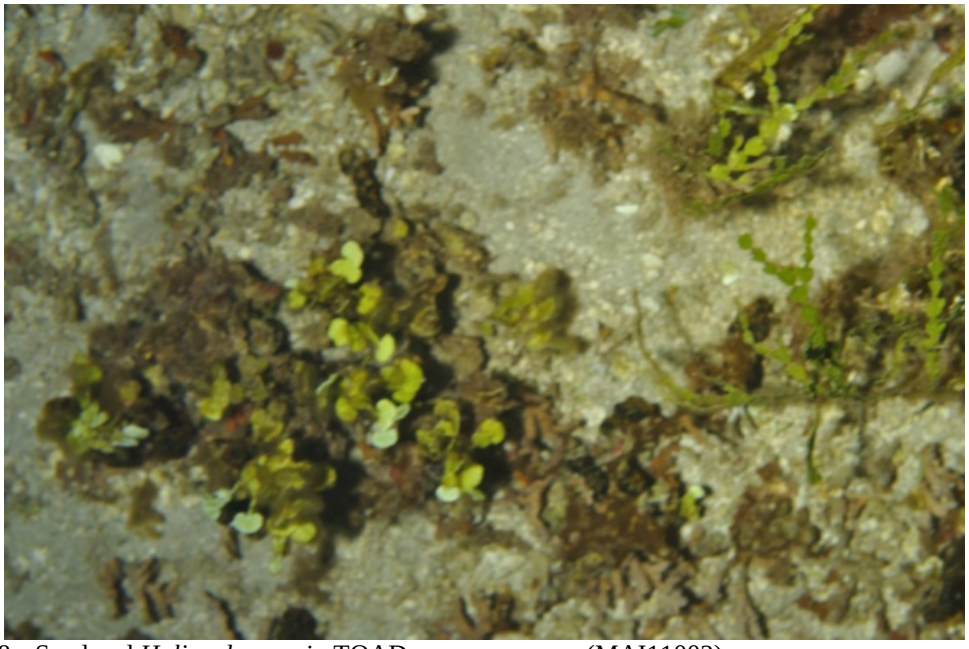

Figure 18.--Sand and *Halimeda* seen in TOAD camera surveys (MAI11002).

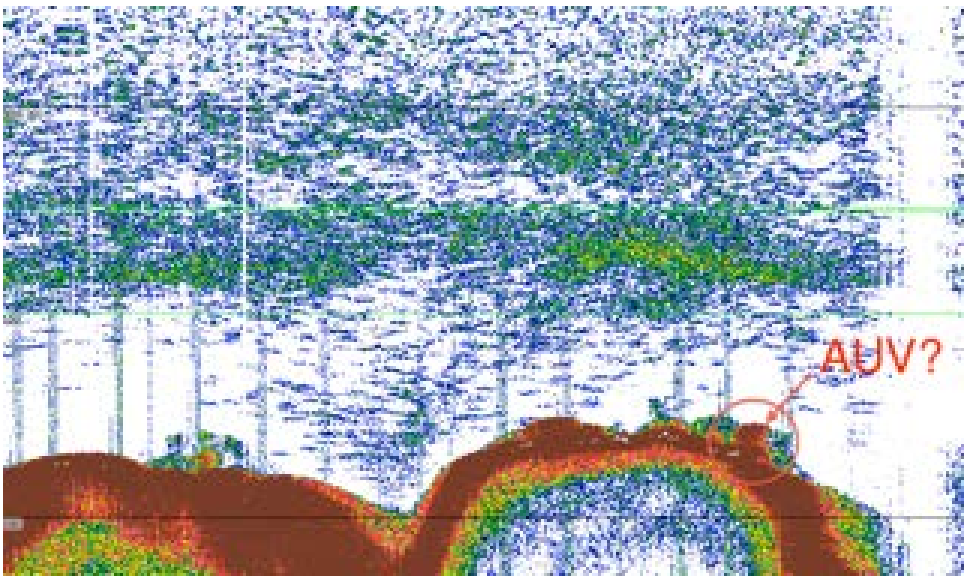

Figure 19.--EK60 active acoustic readout, possibly showing the AUV during a transect on the seafloor.