Appendix 5.1: Literature Review

The benthic offshore habitats on the Southwest Florida continental shelf are poorly understood but are thought to provide habitats for supporting macroalgal growth. Much of the previous research is largely descriptive with few long-term or wide-reaching investigations. The Hourglass expeditionary cruises, initiated by the Florida Board of Conservation Marine Research Lab, occurred from 1965-1967 (Joyce and Williams 1969). The Hourglass program provided the first characterization of the sediments and biology of the offshore benthic habitats. Hourglass cruises (Joyce and Williams 1969) sampled 20, 60, 120, 180, 240 ft. with trynet and otter trawl, naturalist dredge, plankton net, nekton net, van Dorn water sampler, traps, fishing, diving. Exploratory in nature, these occurred from 1965-67. Stations represented only a small area of the total shelf and were positioned offshore of Egmont Key and Sanibel Island. Shallow (20 ft.) stations were described as quartz and crushed shell with living and dead mollusks (*Atrina* sp., *Butrycon* sp.). Mid-depth stations (60 ft) contained abundant limestone outcroppings with up to 3 ft. of relief were colonized by sponges, alcyonarians, stony corals (*Solenastrea hyades* and *Cladocora arbuscula*). The featureless seafloor in between was typically quartz sand colonized by *Halophila decipiens* and *Caulerpa* spp.

A rich macroalgal flora were collected in the Hourglass study were comprised mostly seaweeds of tropical and subtropical genera (Dawes 1969). A large number of perennial, tropical species were collected in the 20-80 ft. depth range. Seasonal patterns indicated a late spring to summer growth period, maturing in late summer and disappearing in the early winter. The live bottom where the algae were found was characterized by the epifaunal assemblages associated with limestone outcroppings. Typically, the "live bottom" was covered by a thin veneer of sand, shell and carbonaceous silt from 1 to 10 cm in thickness.

The natural history and geology of the continental shelf was further elaborated in a recent review by Hine and Locker (in press). Many modern techniques were used to characterize the continental shelf including; hydroacoustic mapping, side-scan sonar, and drop video cameras. The shelf off Southwest Florida is described as a very wide, low energy, sediment-starved shelf seaward the west-central Florida barrier island system. This inner shelf presents a wide variety of sand ridges up to 4 m thick separated by extensive areas of exposed limestone. To the south, the shelf has small reef banks, and a linear shelf edge, and sand shoals and cays.

Several inventories containing species lists and descriptions of potential macroalgal habitats were completed due to benthic sand mining for renourishment of barrier island beaches. Culter (1988) sampled macrofauna from the sea floor for both ‘live bottom’ and soft bottom areas on the continental shelf. Similar to that described previously, the live bottom infaunal habitat consisted of the thin veneer of sediments overlying limestone bottom, marked by conspicuous epifauna, such as sponges, gorgonians, and corals. The soft bottom was adjacent to the live bottom habitat characterized by lack of conspicuous epifauna and a thicker layer of sediments, although similar in sediment. The Minerals Management Service (MMS) also funded a

biological inventory and sediment grain size analysis of an area offshore of Tampa Bay (Brooks et al. 2004, Brooks et al. 2006). The continental shelf contained many shoal and ridge features and supported a diversity of polychaetes, bivalves, and amphipods (Posey et al. 1998).

In one of the first published reports from Sanibel Island, pen shells were reported to be stranded on Sanibel beaches (Perry 1936). The abundance of these bivalve communities provided important attachment substrates for seaweeds and other invertebrates. Others have demonstrated that living and dead pen shell populations in St. Joe Bay provides important structure for mobile and sessile invertebrates (Munguia 2004, 2007). However, the role of the epibiotic community in life histories of macroalgae and their ecological role in macroalgal production remains poorly understood.

An often observed habitat supporting the growth macroalgae is within the protected bays and estuaries. Drift macroalgae is often associated with seagrasses and is usually not attached to any substrates or is growing in the surface of the sediment (psammophytic). These mobile habitats made up of *Hypnea cervicornis* (Rhodophyta) are valuable to amphipods and small crustaceans in Tampa Bay (Brooks and Bell 2001) and have been proposed as a mechanism of transport from seagrass areas across sand ecotones. *Digenia simplex*, *Gracilaria verrucosa*, *Gracilaria folifera*, and *Laurencia poitei* (Rhodophyta) were frequently found large clumps or windrows in protected areas throughout Florida (Hooks et al. 1976, Brown 2001). The movement and concentration of these large masses of algae are attributed to wind and tide but are also trapped in areas with seagrass. Brown (2001) found 14 dominant species of drift alga common to Tarpon Springs, Cockroach Bay, and Tarpon Bay on Sanibel Island. The drift algal species for the three distinct sites were similar and stable year around, with peak biomass occurring in late winter and spring. The most common taxa in contain species of the genera *Gracilaria, Hypnea, Chondria, Acanthophora,* and *Laurencia (*Rhodophyta*)*. In addition, the genera *Ulva (*Chlorophyta*)*, *Lyngbya majescula (*Cyanophyta*)*, and *Sargassum filipendula* and *S. pteropleuron* (Phaeophyta) were common. The growth rates of drift seaweeds residing in the bays and estuaries are not well understood, partly because of the transport and accumulation processes. Josselyn (1977) reported a wet weight increase of 2-5% d^{-1} during late fall and spring for the red alga *Laurencia poiteaui* in Card Sound and an annual production of 21 g dry wt m^{-2} $y^{-}1$. At Tarpon Bay, the daily growth rate for seven drift red algal species averaged 1.1% for *Spyridia filamentosa*, 2.0% for *Hypnea musciformis*, 4.5% for *Acanthophora spicifera*, and 7.7% for *Gracilaria caudata*, which was the highest rate measured. Daily growth rates indicated that at least half of the dominant drift algae could produce a high biomass within a short period.

Shifts in seaweed species composition can be a useful indicator in determining phase shifts (*sensu* Valiela et al. 1997) associated with coastal eutrophication and pollution (Littler 1973). Specifically, *Ulva* spp. and corraline algae became the dominant species in the community when subjected to sewage effluent (Kindig and Littler 1980). In mesocosm experiments macroalgae became the dominant macrophyte after nutrient enrichment (Short et al. 1995). However, a lack of coupling between eutrophication and relative abundance can occur because of light limitation

(Krause-Jensen et al. 2007). Shifts in species composition can also be indicative of other physical or biological processes. Grazer preference for a particular species because of feeding behavior or interactions with other species can change the abundance and distribution of macroalgal communities (Underwood 1980, Lewis 1986, Hauxwell et al. 1998). Invasive species have also negatively impacted native macroalgal communities (Meinesz 2001, Boudouresque and Verlaque 2002) resulting in changes in distribution and abundances. Introduction of non-native species has also led to large free-floating populations (Cecere et al. 2003) capable of washing up on the beach. A cryptic invasive species was found in Cheasapeake Bay (Thomsen et al. 2005) which was mis-identified as *Gracilaria tikvahiae*, a common species reported in this area (Lapointe and Bedford 2007). On the East Coast of Florida, an invasive *Caulerpa* (Chlorophyta) was reported on coral reefs (Lapointe and Bedford 2010), but there have been no reports of invasives on the Gulf Coast, but there is a strong possibility of cryptic invasive species. *Hypnea spinella* (Rhodophyta) is an invasive species on Hawaii's coral reefs (Vermeij et al. 2009), but is native to southwest Florida and is found in a variety of habitats. Physical disturbances, such as scouring (Sousa 1984), wave energy (Kraufvalin et al. 2010), and current velocities can also affect the distribution and abundances of macroalgae.

More recently, stable isotope analysis and nutrient content have been used extensively to determine nutrient sources for primary producers (Heaton 1986, Lapointe et al. 2005, Derse et al. 2007, Teichberg et al. 2010). Previous isotopic studies of algae collected on Sanibel beaches indicated slight enrichment in $\delta^{15}N$ (Lapointe and Bedford 2007), suggesting a human source of nutrients. Other samples of *Ceramium* were collected and had a $\delta^{15}N$ value of 5.84 and indicated that N was neither elevated nor depressed (Bartleson et al. 2006).

Appendix 5.2: Station Descriptions

CES11– Macroalgae was abundant at this inshore station during most months (see Fig. 5.24). There was a mixture of sand, silt and loosely consolidated shell with high densities of *Diopatra cuprea,* low densities of chaetopterid species, and no pen shells at this site. Video analysis also indicated an abundance of macroalgae with greater than 80% of the still frames containing algae. The species composition differed from offshore sites, dominated by *Gracilaria tikvahiae, Acanthophora spicifera*, and *Ulva lactuca*. It was the closest station to the Sanibel causeway and the mouth of the Caloosahatchee estuary (less than 5 km). Strong tidal currents were observed on most visits moving north and south to Matlacha Pass. There was greater seasonal variability in temperature and salinity than at other stations located in the Gulf of Mexico. Light attenuation was also higher as measured due to the suspended and colored dissolved organic matter (CDOM) in the water column.

GOM16 – Macroalgae was abundant at GOM16 (see Fig 5.25), another inshore station located North of the Sanibel Causeway in lower Pine Island Sound. This station had a mixture of silt and sand with no pen shells and patchy seagrass (mostly *Thalassia testudinum, Syringodium filiforme* and *Halodule wrightii*). The station was located at the southwest segment of Pine Island Sound and adjacent to the J.N. "Ding" Darling National Wildlife Refuge. It was positioned 11 km from the mouth of the Caloosahatchee Estuary and 8 km from the Sanibel Causeway on the Pine Island/San Carlos bay side. This station was relocated in January 2009 from the original placement around the lighthouse as a result of large amounts of algae reported by the seafloor mapping group (see Objective 4). Poor visibility was common and resulted in difficult diving conditions. Wind-driven resuspension of particulates is suspected as the primary driver for poor visibility conditions. However, periods of rainfall plus high discharges increased the CDOM, making the water appear yellow-brown. In June 2010, there was an unusually high abundance of *Spyridia filamentosa* which contributed heavily to the pattern of occurrence at this site. During the two-year study, *Acanthophora spicifera, Gracilaria tikvahae* and *Spyridia filamentosa* were the most common species. Mesocosm core samples were collected for Objective 2 (FGCU) at GOM16, GOM04 and GOM06.

GOM11 – This station was located offshore (18 km, bearing 206° from the Sanibel Lighthouse) and had abundant live bottom and macroalgae (see Fig. 5.26). GOM11 was a limestone patch reef with a thin veneer of overlying loose, unconsolidated sand, carbonate silt and shell. There were high densities of hard and soft corals and large barrel sponges providing many attachment sites for macroalgae. *Botryocladia occidentalis*, a reef-associated red algal species, was the dominant macroalga collected. Macroalgae biomass was modest compared to the inshore stations, possibly caused by low light and/or nutrient limitation. Analysis of the underwater video analysis indicated greater than 50% of the frames analyzed contained algae in four of 12 dates, and for 30% of frames for all other dates analyzed. GOM11 was located offshore, 18 km, (bearing 220°) from the Sanibel lighthouse.

GOM12 – This was another offshore station with abundant limestone outcroppings, live bottom, and abundant macroalgae (Fig. 5.27). Located 8 km west (bearing 270°) of Redfish Pass, this station had moderate relief limestone bottom with abundant reef fish, hard and soft corals, and a diversity of mobile invertebrates. Visibility was generally good, with a 1 m ledge where larger fish, such as grouper, sharks and trigger fish, were observed. This site was dominated by rocky outcroppings and frequently abundant algae. Algae were consistently found at this site, and in

two of 12 video transects, 100% of the frames analyzed contained algae. Algae were typically attached to the limestone bottom. Two species of greatest biomass (net g DW) were *Dictyota cervicornis* and *Caulerpa racemosa*, both species are commonly found on reefs.

GOM01 – Located near the Sanibel lighthouse beach (less than 2 km, bearing 180) GOM01 was a nearshore location where, in 2006, underwater video indicated abundant attached, branching macroalgae (data provided by J. Evans, City of Sanibel). There were abundant pen shells and shell fragments at this site which are potential attachment substrates for algae (Fig. 5.28). However, in this study, macroalgae was recorded only once (July 2009), despite the availability of substrate for attachment and proximity to the Caloosahatchee River and Sanibel causeway. Given also the initial hypothesis about the discharges from the Caloosahatchee fueling algal growth, it is surprising that algae at this location were comparatively rare. This site was selected for the grazer study as place to exclude grazers with cages and examine the algal response (see Objective 9). The only species recorded at this site was a drift piece of *Sargassum* spp. Additional dates with the presence of algae were recorded in the video analysis (March 2009 and March-June 2010) but in less than 5% of the total frames. Removed space after

GOM02 - This nearshore station was located west of Redfish Pass (bearing 270°) and had a limestone bottom with a thick layer of sand and medium-sized shell hash (Fig. 5.29). There was a mixture of reef epifauna with occasional small limestone rubble and abundant pen shells. There appeared to be frequent disturbance from wave action and scouring. During most of the study period, little to no algae was reported and collected. However, during June 2010, an unusually large amount of a single species, *Halymenia psuedofloresia*, was collected. This species was attached to the rocky outcroppings and covered 60-80% of the area sampled. This species (and only this species) was also found on the beaches of Sanibel (Rabbit Road) during the same month, suggesting that these nearshore patch reef habitats may be a source of algae on the west end of Sanibel. From the video analysis, approximately 56% of the still frames had algae found in a frame in June 2010. Macroalgae was present on several other dates, however, cover estimates were less than 6% for the entire 100 m transect.

GOM03 – There were two general locations visited with the name GOM03. The two stations differed in bottom type and in macroalgal abundance. Therefore, the locations were separated and described here as GOM03 and GOM03A. From November 2008 through January 2010, GOM03 (10 km, bearing 247° from Sanibel Lighthouse) was sampled bimonthly. This station contained packed sand with a rock outcroppings and a patchy live bottom (Fig. 5.30). Video analysis indicated approximately 60% of the still frames contained algae in November 2008 and January 2009. The dominant macroalgal species were typical reef species with well delineated holdfasts and include *Botryocladia occidentalis*, and *Sargassum filipendula*. Several large fish and *Arbacia puntulata* were also observed on the reef along with a diversity of sponges, gorgonians and soft corals.

GOM03A – This station was located nearshore, close to the beaches of Sanibel. While largely featureless, no algae were recorded or collected. The station was moved to GOM03 to capture live bottom and 20 cm of relief and sampled from November 2008 to January 2010. However, during the last two sampling events, GOM03A was visited unintentionally due to problems with the vessel GPS. Typically this station had strong currents and poor visibility with mostly packed fine to medium-sized sand/shell (Fig. 5.31).

GOM04 – This nearshore station was located west of Blind Pass (2.3 km; bearing 267°) and had abundant pen shells (Pinnidae) and urchins (Fig. 5.32). Mesocosm core samples were collected at this station for Objective 2. No macroalgae were collected at this station during the study. There were abundant sea urchins (*Lytechinus variagatus*) present at all times (432 per 100 m transect in January 2009); however, urchin densities were highly variable. This is not surprising given the relatively high mobility of these potential macroalgal grazers. This site was also chosen for the grazer exclusion project because of the consistent densities of pen shells and *Diopatra cuprea* (deemed potential attachment substrates) for macroalgae growth. There was one sampling event (March 2010) where the transect was deployed some distance away from the intended station due to problems with the vessel GPS (see Appendix for map). However, no differences in macroalgal abundance or bottom type were found in the underwater samples or video. Very difficult diving conditions and sampling conditions were common because of strong tidal and longshore currents and poor visibility. Thus, the video analysis was unable to be performed for four of 11 sampling dates. Less than 10% of the total number of frames analyzed contained macroalgae. Mesocosm core samples were collected at GOM04, GOM16, and GOM06 for Objective 2.

GOM05 – This offshore station (17 km, bearing 159° from the Sanibel Lighthouse) had a largely featureless bottom with sand/silt (Fig. 5.33) and numerous fighting conchs (*Strombus alatus*). There were no pen shells or worm tubes at this site. It was located offshore 11 km west of Bonita Beach. No algae were collected at this location and there were rare instances of macroalgae in the analyzed video transects.

GOM06 – This nearshore station was located near Estero Island (6 km, bearing 105° from the Sanibel Lighthouse) and at the north end of Estero Island (Fig. 5.34). It was located nearby a real-time water quality monitoring platform, RECON, maintained by SCCF. GOM06 contained packed sand with abundant pen shells. This site, at times, had large amounts of drifting algae, and it was difficult to discern whether the algae was attached and growing. Much of the drift algae was not amendable to quantitative sampling because it was difficult to determine what was in the quadrat as it drifted past. Macroalgae were collected and identified and later quantitated in the video analysis. The close proximity to the Sanibel Causeway and Matanzas Pass created difficult dive conditions with strong currents and very poor visibility as demonstrated in the frame image (Fig. 5.34). In March of 2009 and 2010, this station had large amounts of algae found by the video (92% and 50% of transect contained algae), but underwater observations by divers recorded only 1% cover. This descrepancy was caused by the difficulty in sampling the large drifting macroalgae and is further elaborated below. The most common species collected at this site were highly branched reds, and were similar in species composition to those found on the beaches of Sanibel and Fort Myers and at stations inshore of the Sanibel causeway in March 2010. The most abundant species were *Chondria collinsiana* and *Hincksia onslowensis*. This site also had abundant sea urchins.

GOM07 – This nearshore station was south of Estero Island, near Wiggans Pass (Fig. 5.35). It was 18 km from the Sanibel Lighthouse (bearing 130°) and was similar in character to GOM06. High densities of pen shells and occassionally high densities of the sea urchin *Lytechinus variagatus*. The sediment was packed sand/shell with abundant large shell fragments. There was very little algae collected at this station but the video analysis indicated several occurrances of drifting macroalgae. However, it was present in a very low percentage of the total frames

analyzed for the entire transect contained algae (<2% of the total transect). The only genus collected was *Ectocarpus*, a filamentous brown alga, collected in June 2010. This alga was seen at other sites in June 2010, suggesting a short-lived, but widespread occurrance. It was observed growing on and around other macroalgal species.

GOM08 – This offshore station had little to no algae and was largely featureless (Fig. 5.36). GOM08 (18 km, bearing 236° from the Sanibel Lighthouse) contained packed sand and was devoid of suitable macroalgal attachment sites. However, GOM08 did have evidence of sand overlying a limestone outcropping or limestone rubble. Video analysis found less than 10% of the frames contained algae for all dates sampled. Those few specimens collected were drift species such as *Sargassum vulgare* (June 2008). A red algal species common to live bottom reefs, *Botryocladia occidentalis*, was collected in July 2009 and may have been transported from a nearby live bottom area.

GOM09 – Station GOM09 was only visited twice (June 2008, September 2008) before discontinuation due to the difficulty in sampling it regularly (25 km, bearing 210° from the Sanibel Lighthouse). However, a dense population of *Halophila decipiens* (Div. Anthophyta) was observed at this site in June 2008 at a depth of 18 m. Others have reported ephemeral *H. decipiens* in deeper waters of Florida Bay (e.g. Fourqueran et al. 2002) and inshore in Pine Island Sound.

GOM10 – This offshore station (9 km, bearing 270 from Blind Pass) occasionally contained high densities of heart urchins (*Moira atropos*), sand dollars (*Mellita quinquiesperforata*) and bivalve shells (Fig. 5.37). The bottom consisted of loosely consolidated medium to large coarse shell (hash) and sand with large (greater than 20 cm wide) sand waves. Very little algae was collected overall, consisting of species typically found on live bottom reefs. The most abundant macroalgae collected was *Dictyota cervicornis*, a brown alga. Jawfish and calico crabs were frequently observed at this station, as were stomatopods (mantis shrimp). This site was chosen for the grazer exclusion cages because it had high numbers of *Lytechinus variagatus* and little algal growth (see Objective 9).

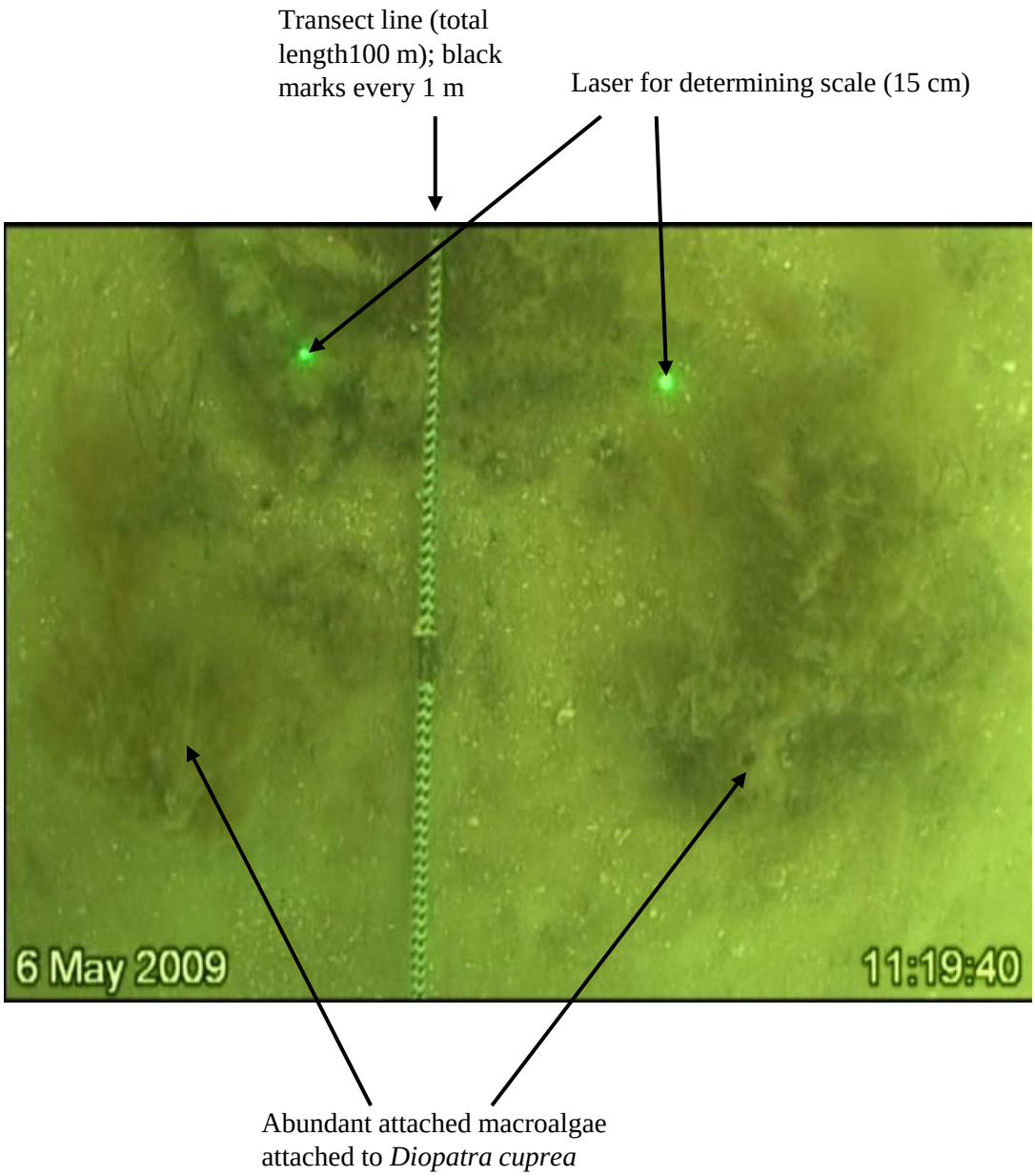

Fig. 5.2.1. Representative still frame of the video transect at CES11 highlighting features typical of the station.

Fig. 5.2.2. Representative still frame of the video transect at GOM16 highlighting features typical of the station. Mapping efforts in Objective 4 identified seagrass areas as high likelihood for trapping macroalgae. GOM16 was added in January 2009 based on initial surveys conducted for Objective 4.

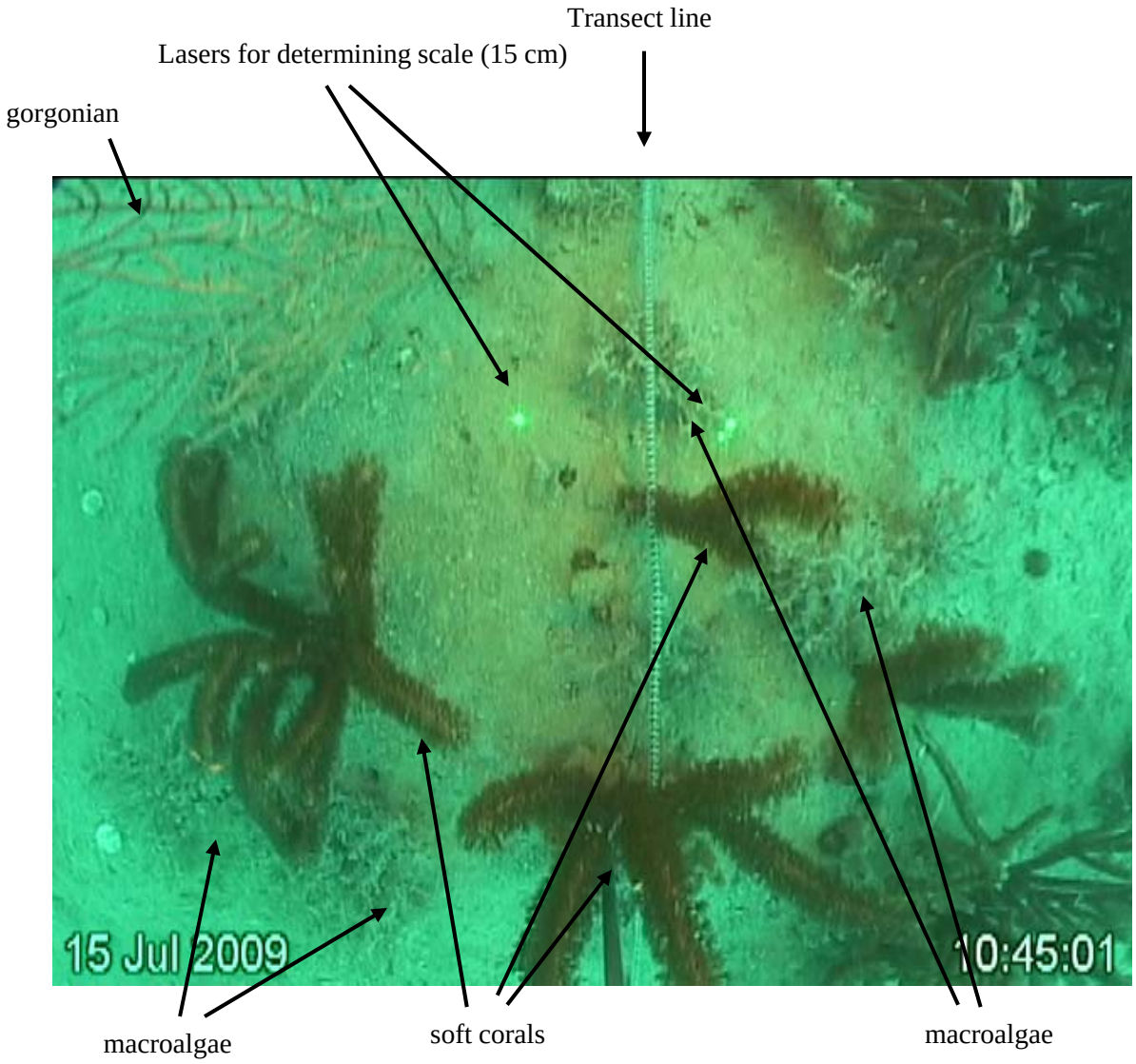

Fig. 5.2.3. Representative still frame of the video transect at GOM11 highlighting features typical of the station. Live bottom, as shown above, was provided habitat for the proliferation of macroalgae.

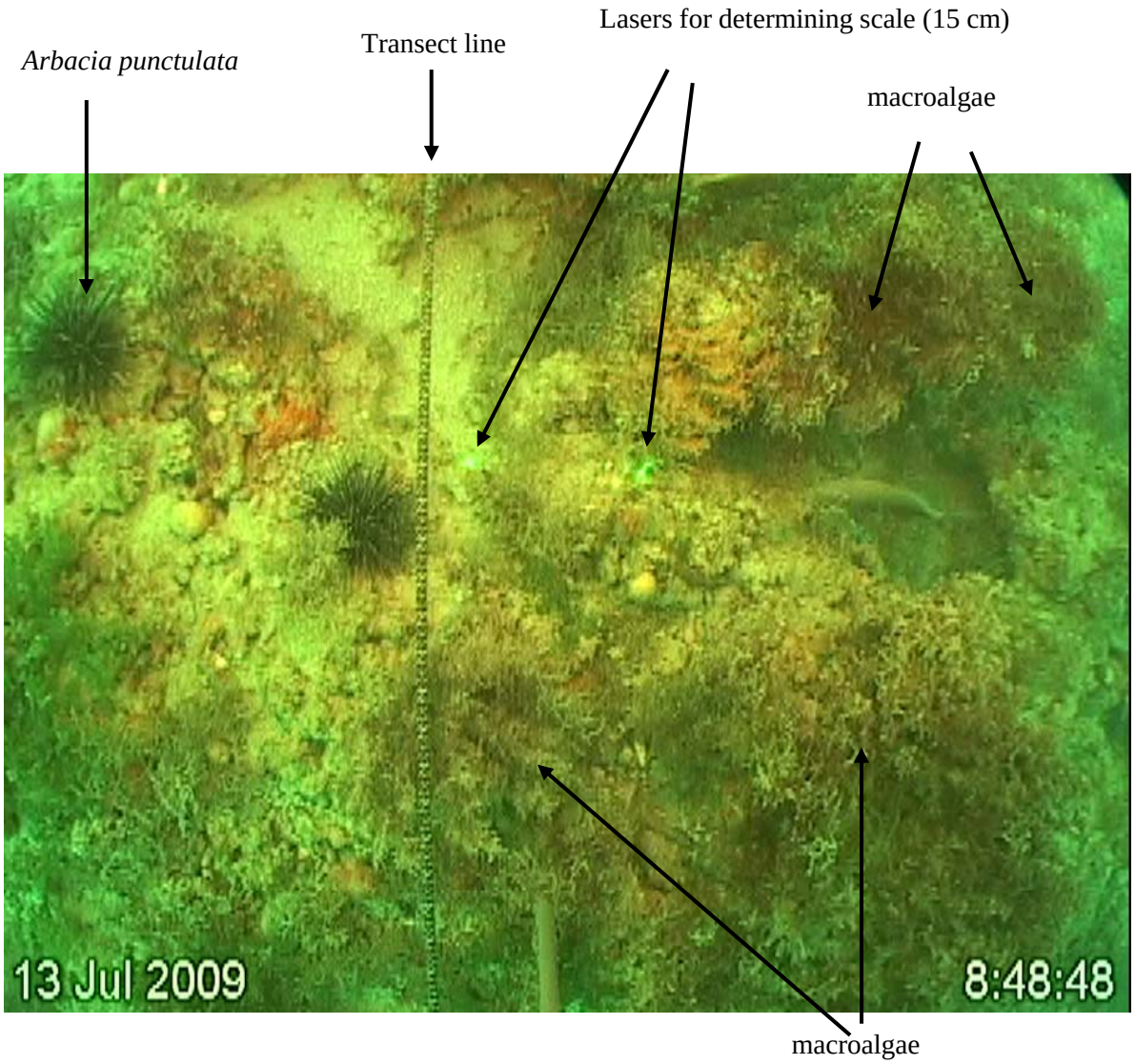

Fig. 5.2.4. Representative still frame of the video transect at GOM12 highlighting features typical of the station. Live bottom, as shown above, was typically productive habitat for macroalgae.

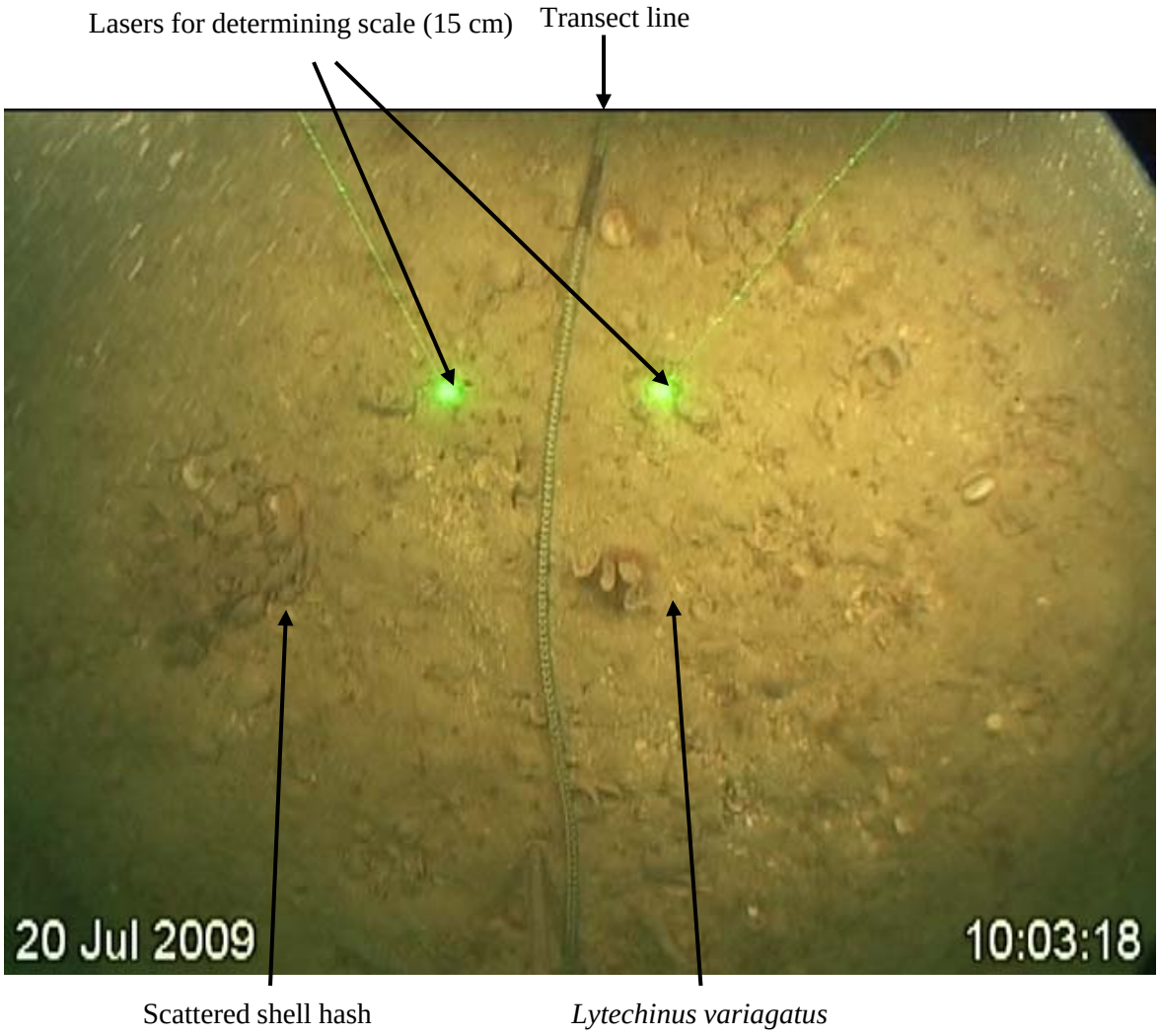

Fig. 5.2.5. Representative still frame of the video transect at GOM01 highlighting features typical of the station. Macroalgae was rare, the sediment was typified by scattered shell hash over siliclistic and carbonate muds with abundant *Lytechinus variagatus*.

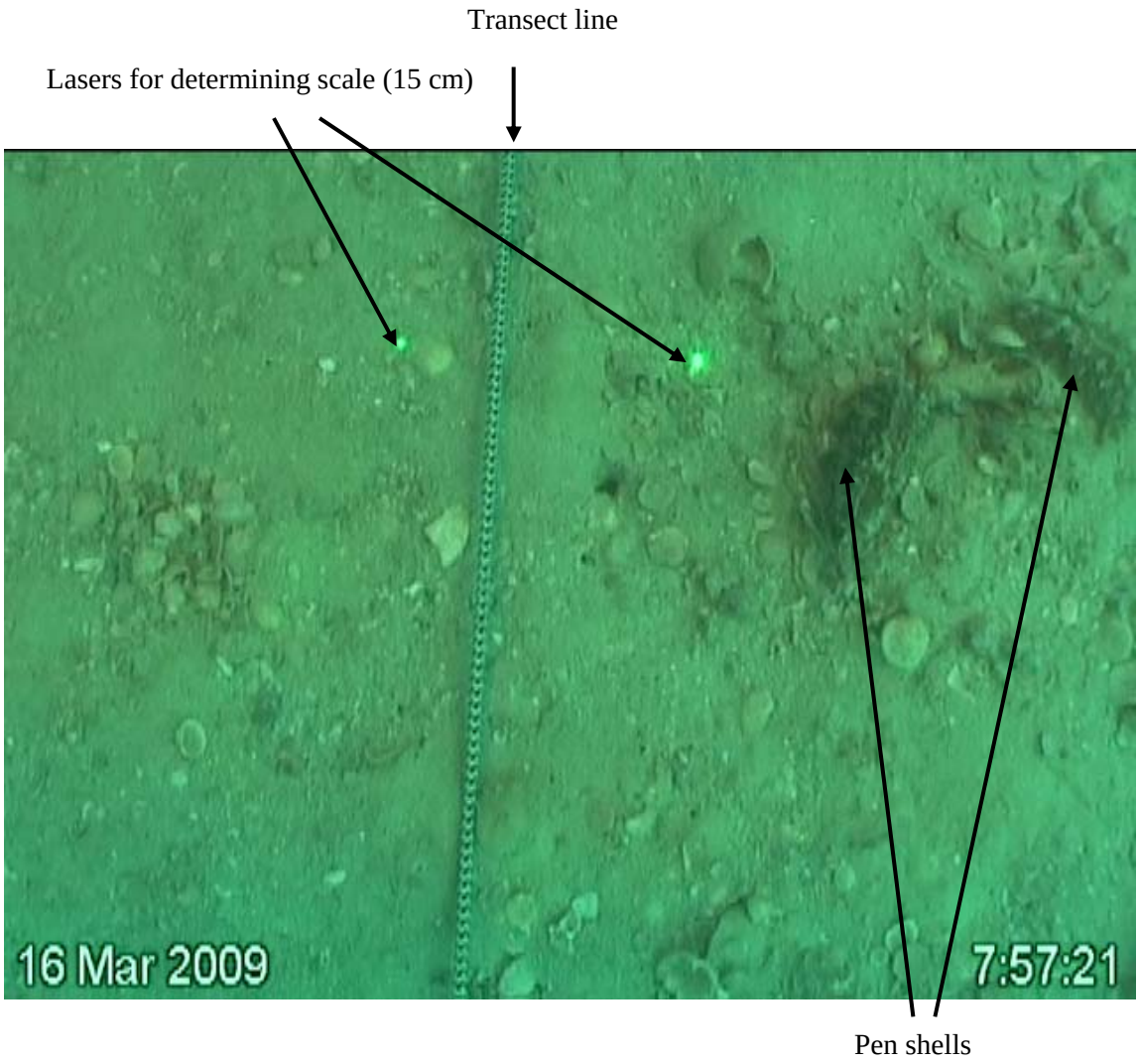

Fig. 5.2.6. Representative still frame of the video transect at GOM02 highlighting features typical of the station. Pen shells were present in addition to *Lytechinus variagatus;* macroalgae was rare.

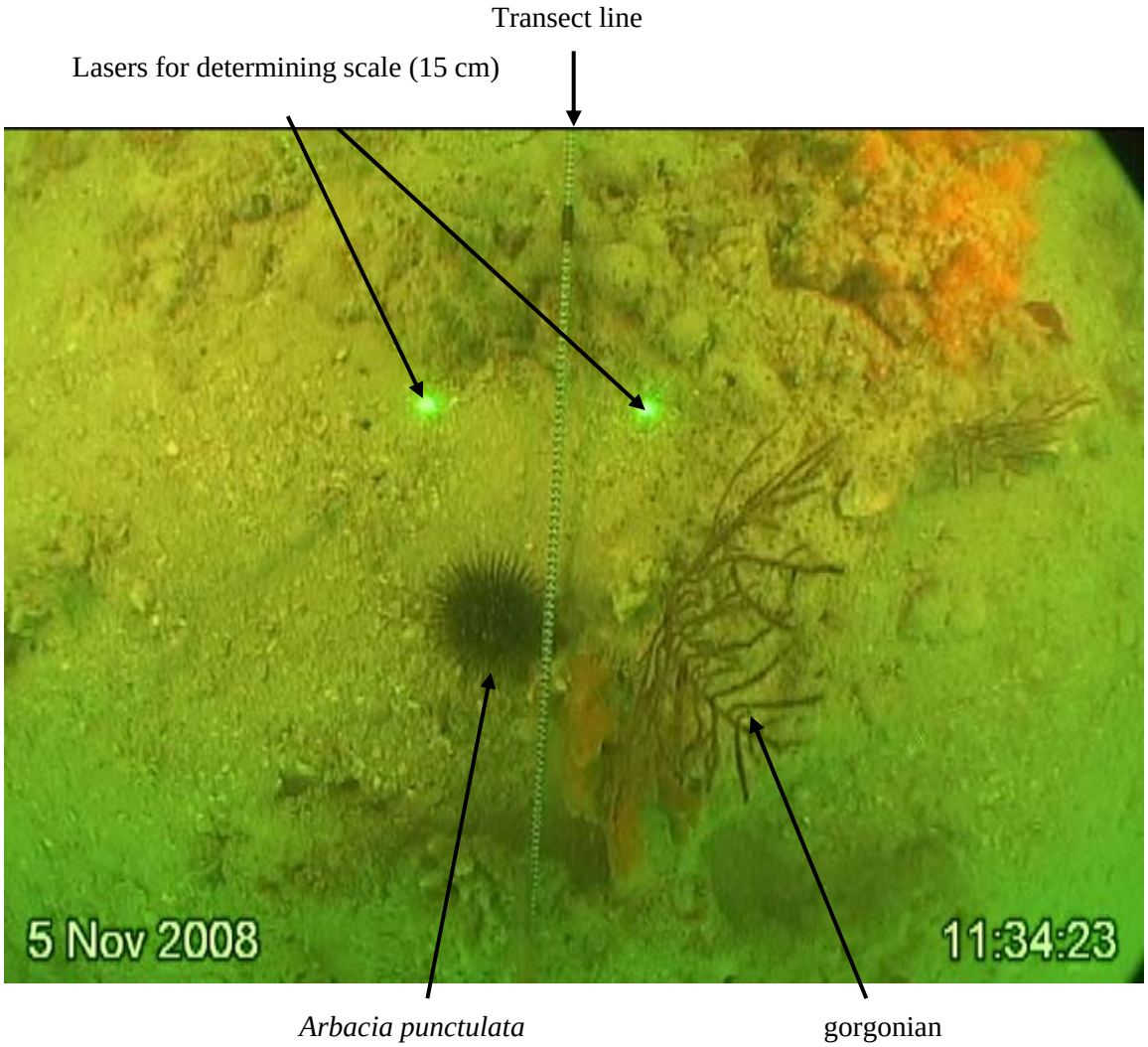

Fig. 5.2.7. Representative still frame of the video transect at GOM03 highlighting features typical of the station. Live bottom only comprised a small fraction of the entire transect. In areas away from the live bottom, there was typically sand and shell with little to no epibiota.

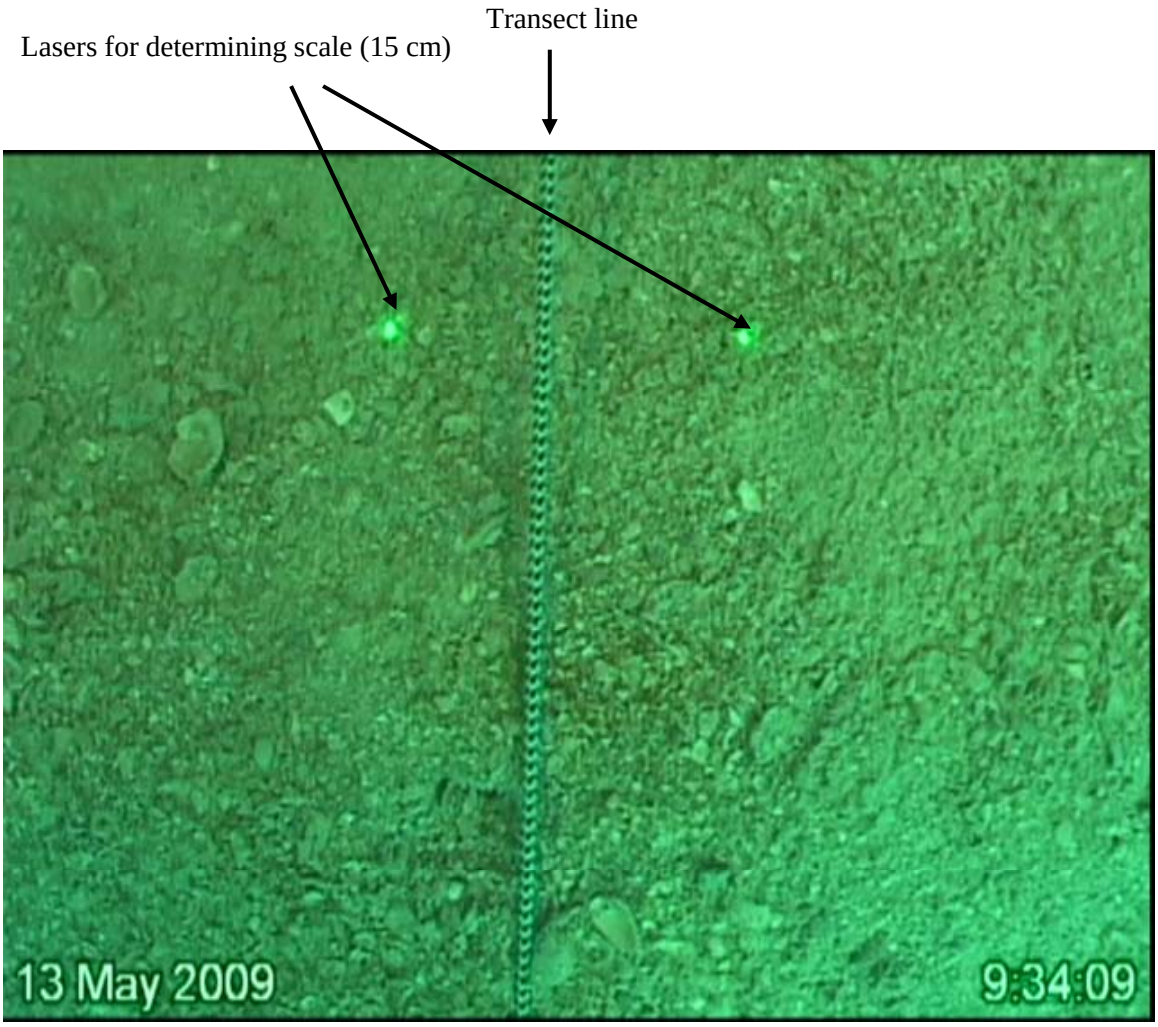

Fig. 5.2.8. Representative still frame of the video transect at GOM03A highlighting features typical of the station. GOM3A was largely featureless with scattered shell hash.

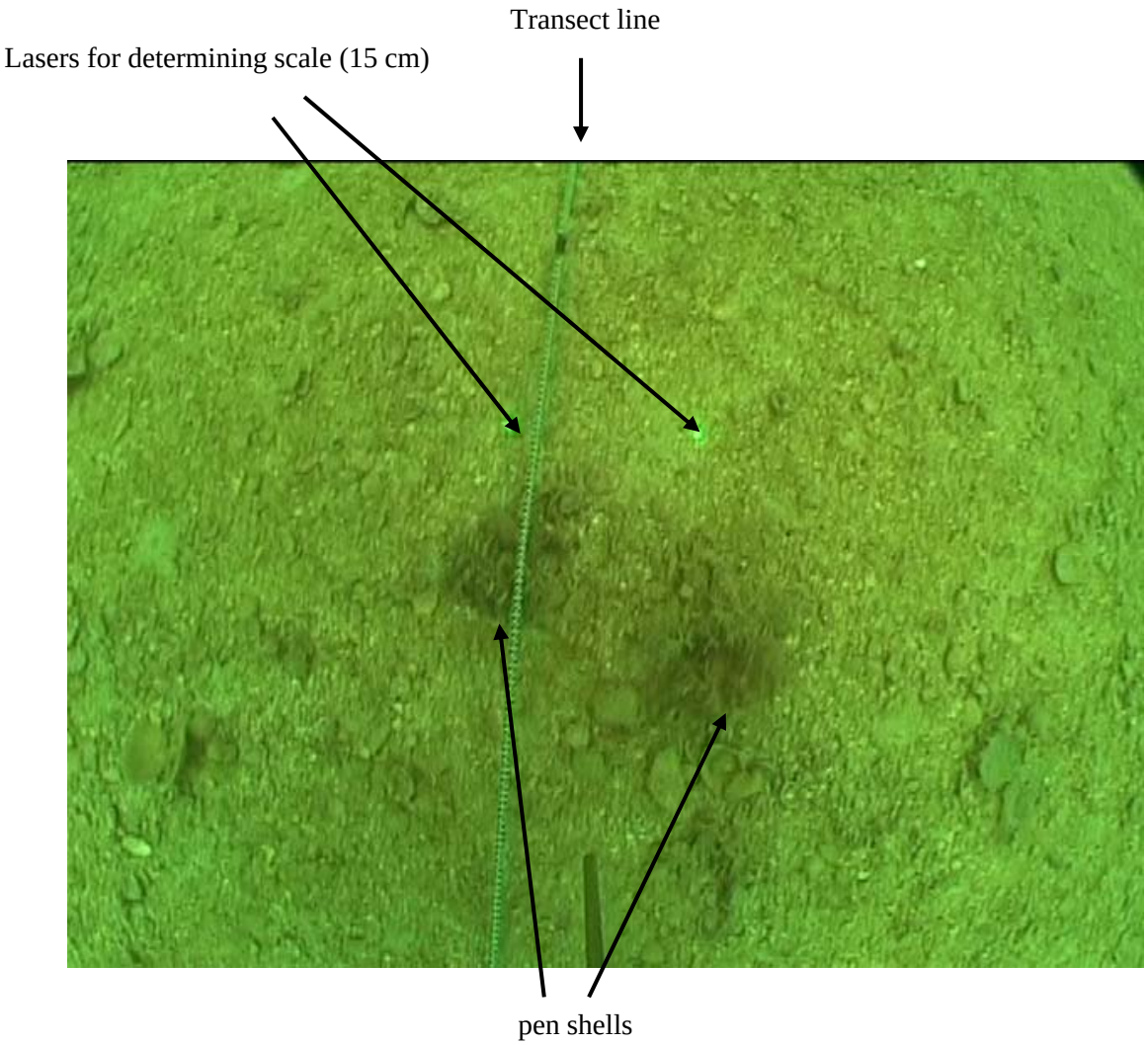

Fig. 5.2.9. Representative still frame of the video transect at GOM04 highlighting features typical of the station.

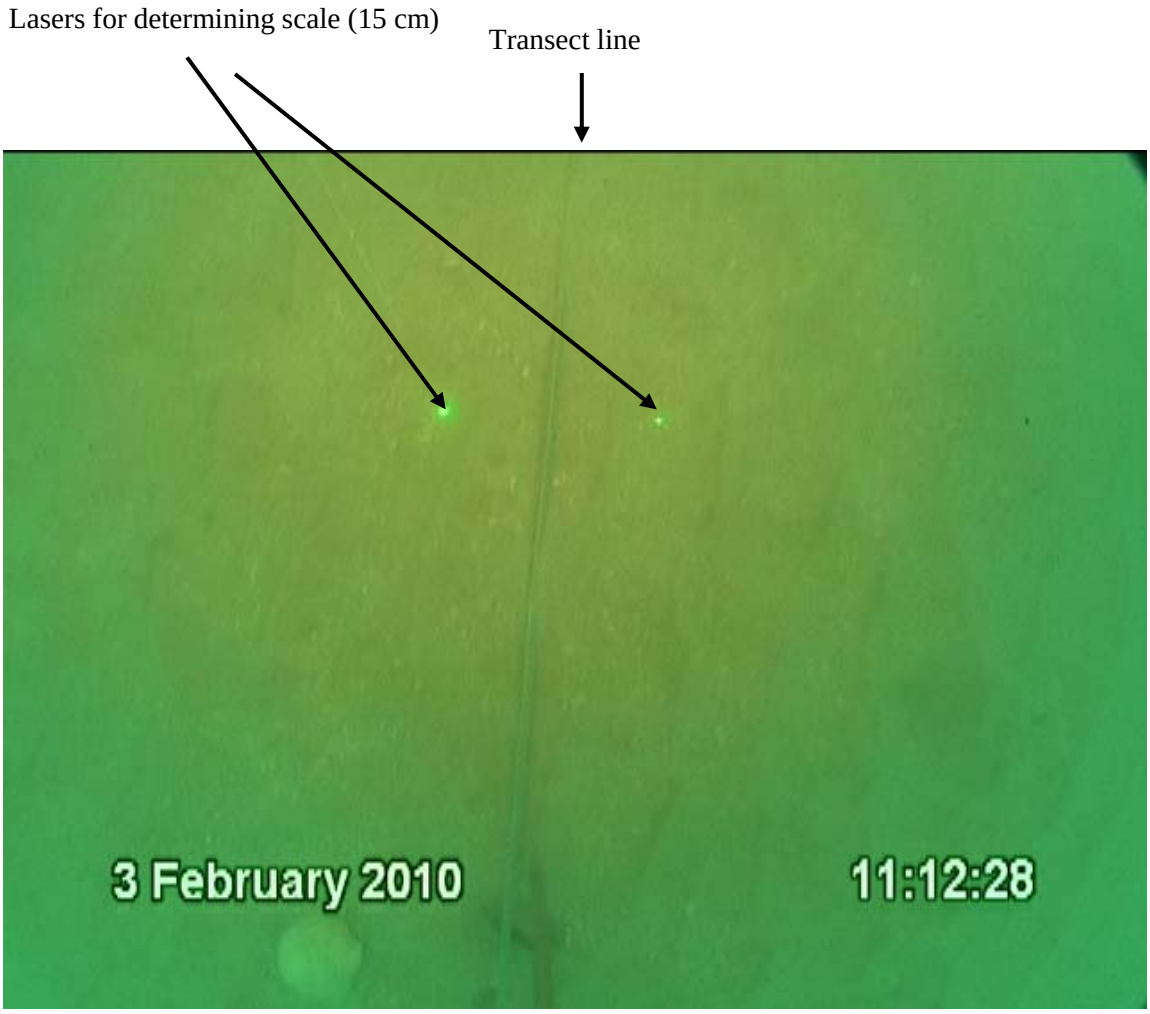

Fig. 5.2.10. Representative still frame of the video transect at GOM05 highlighting features typical of the station. GOM05 was mostly carbonate muds with little to no epibiota with the exception of the Florida fighting conch, *Strombus alatus*.

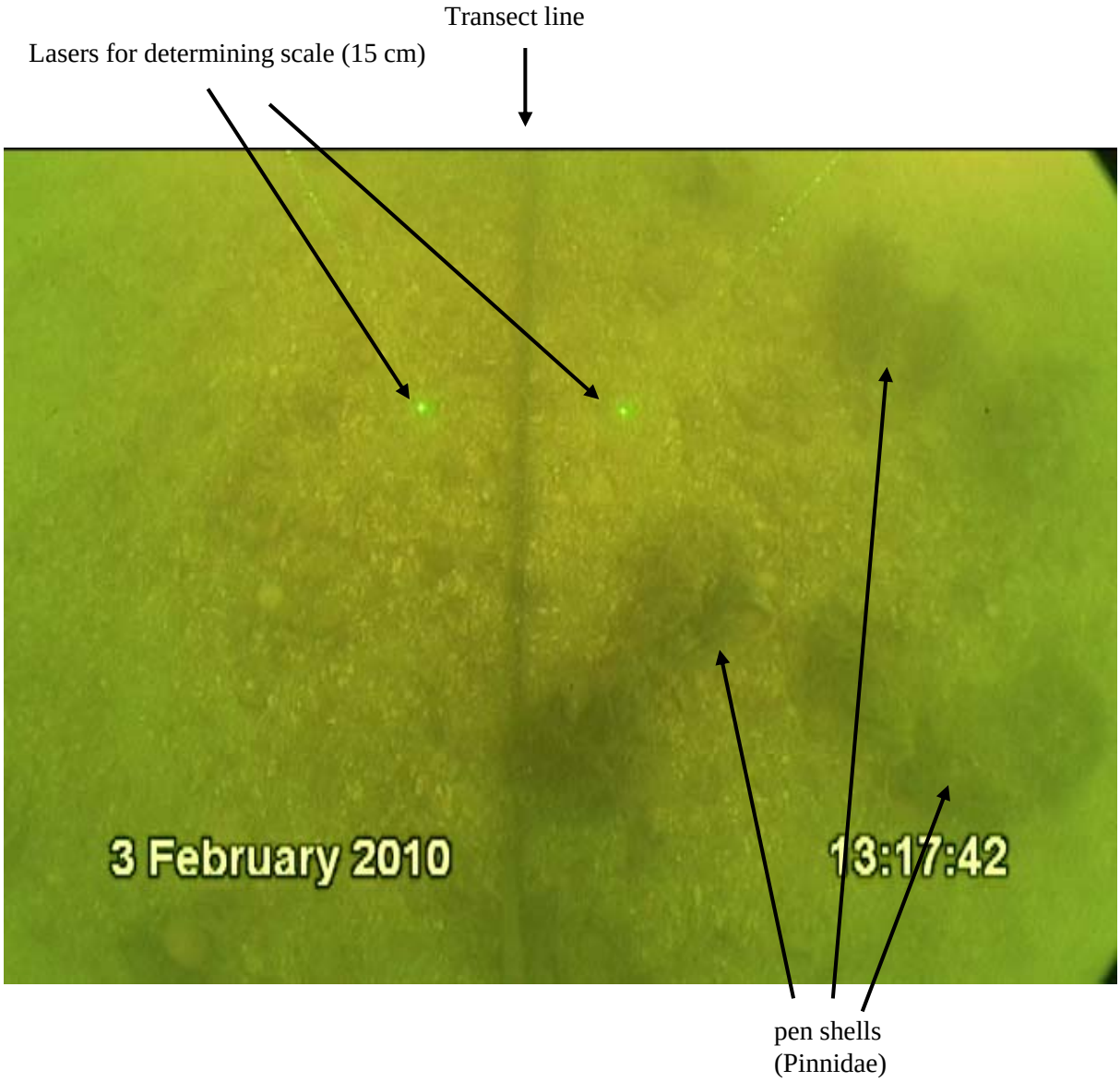

Fig. 5.2.11. Representative still frame of the video transect at GOM06 highlighting features typical of the station. There were large amounts of unattached, drift algae observed at this site which was quantified by the analysis of underwater video. There were abundant pen shells (Pinnidae) and urchins (*Lytechinus variegates*).

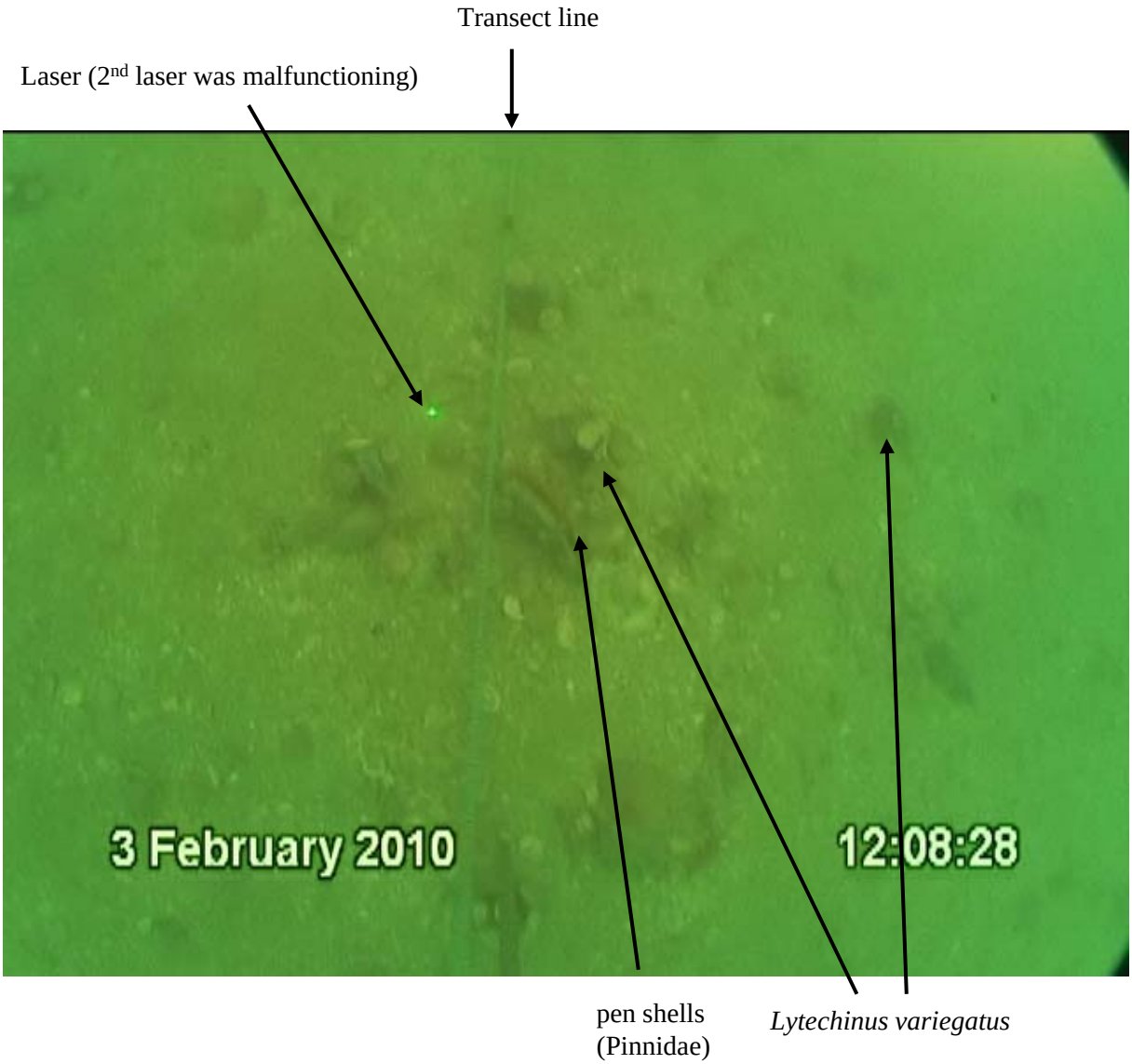

Fig. 5.2.12. Representative still frame of the video transect at GOM07 highlighting features typical of the station. GOM07 was very similar to GOM06 with occasional abundant drifting macroalgae.

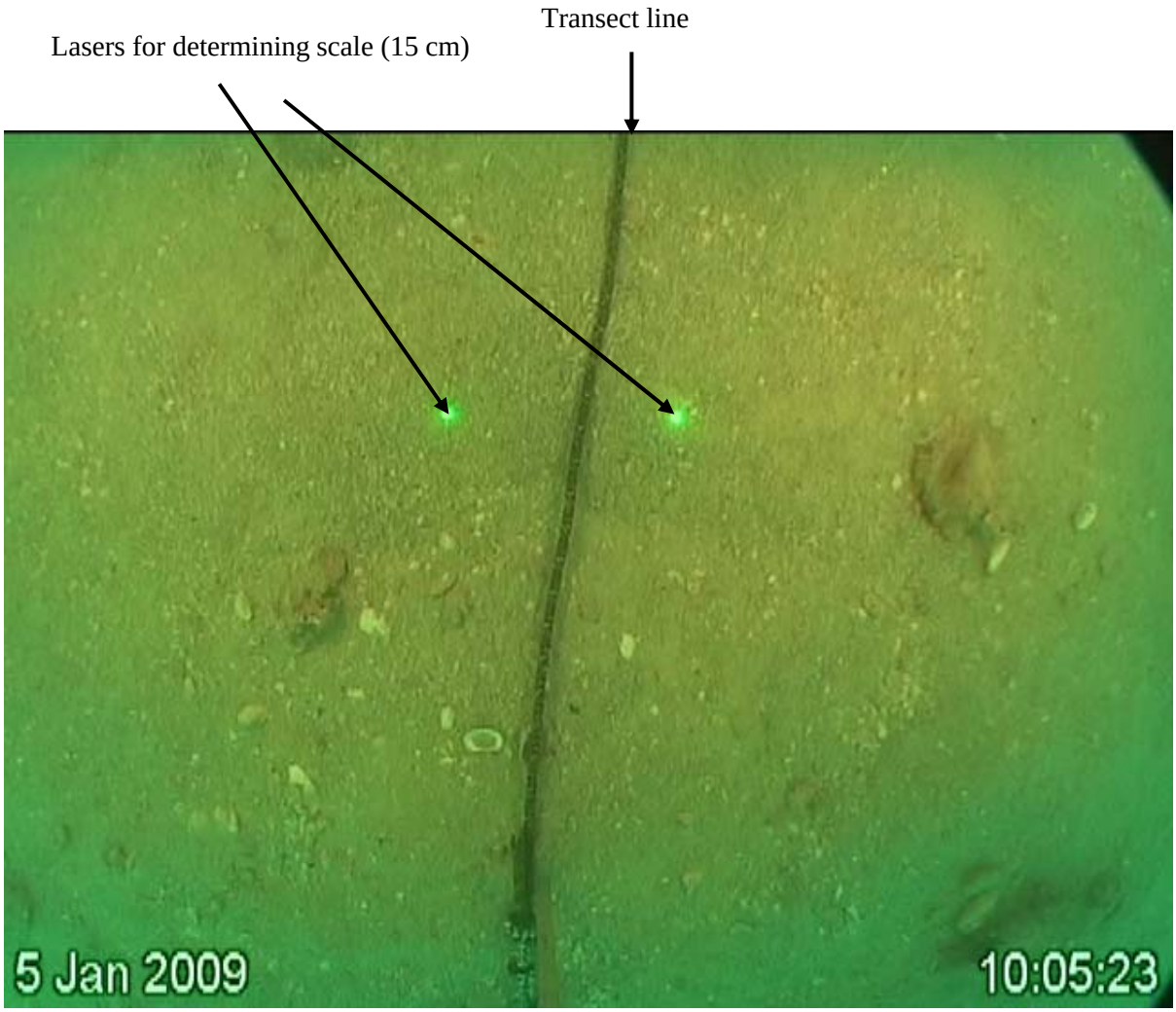

Fig. 5.2.13. Representative still frame of the video transect at GOM08 highlighting features typical of the station. GOM08 was similar to GOM05, a largely featureless seafloor with mostly and carbonate mud with little to no epibiota.

Fig. 5.2.14. Representative still frame of the video transect at GOM10 highlighting features typical of the station. There were large (> 20 cm) sand waves and larger shell hash.

Appendix 5.3: Color plates of the common macroalgae found during the study

Fig. 5.3.1. *Acanthophora spicifera* (Rhodophyta). This species is abundant in seagrass beds and inshore stations and was frequently collected at stations GOM16 and CES11.

Fig. 5.3.2. *Agardhiella subulata* (Rhodophyta). This species is associated with live bottom and typically has a large well-developed discoid holdfast. It was collected frequently at live bottom stations, such as GOM11 and GOM12.

Fig. 5.3.3. *Botryocladia occidentalis* (Rhodophyta). This species is associated with live bottom habitats and was collected frequently at GOM11 and GOM12. It typically has a discoid holdfast.

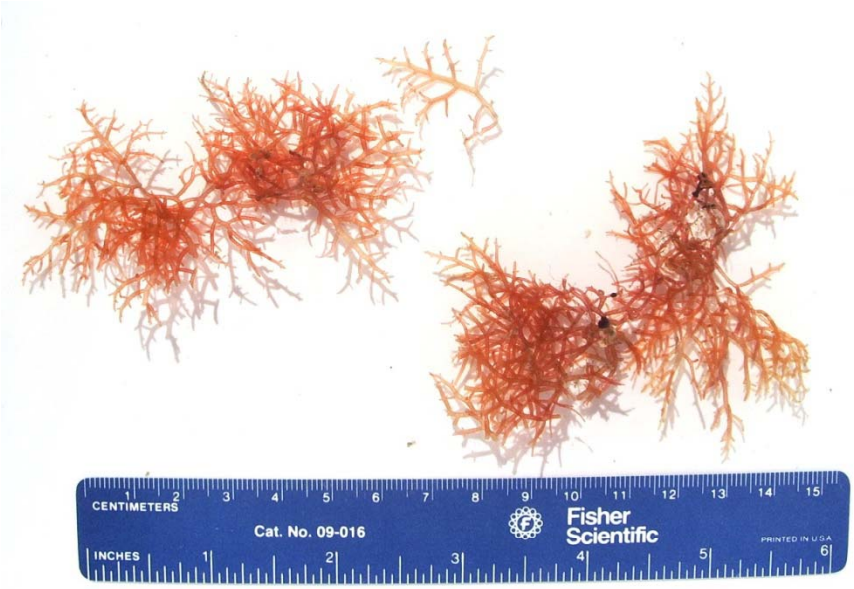

Fig. 5.3.4. *Champia parvula* (Rhodophyta) is a species found commonly throughout the study area. It was found in great abundance inshore at stations GOM16, CES 11 and stranded on Fort Myers Beach in March 2010.

Fig. 5.3.5. *Chondria collisiana* (Rhodophyta) was very abundant in March 2010 on Fort Myers Beach and CES11.

Fig. 5.3.6 *Gracilaria mammilaris* (Rhodophyta) is a species associated with live bottom and frequently collected at GOM11 and GOM12. It typically has a small discoid holdfast.

Fig. 5.3.7. *Dasya* spp. (Rhodophyta) are macroalgae with small branchlets called 'ramelli' which give the thallus the appearance of being blurry or fuzzy. *Dasya* spp. was found at both inshore and offshore stations.

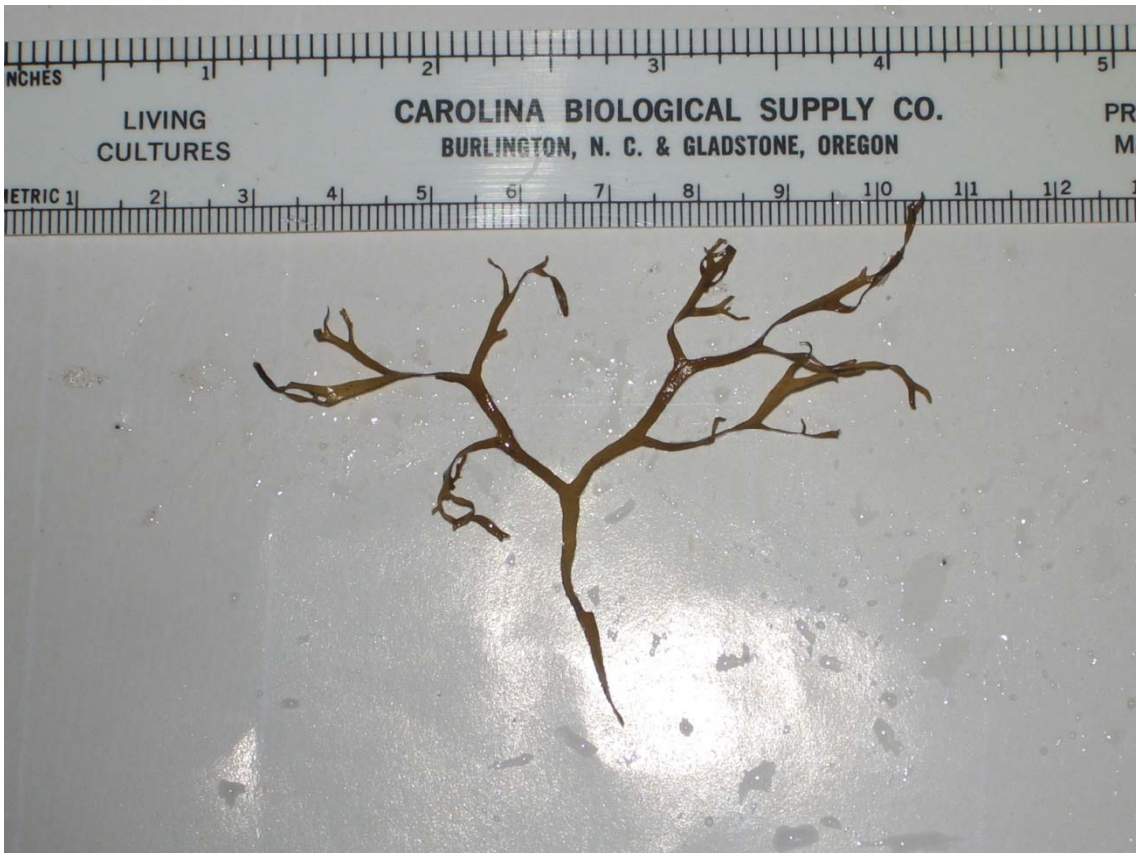

Fig. 5.3.8. *Dictyota cervicornis* (Phaeophyta) is a brown alga that is found at both inshore and offshore stations

Fig. 5.3.9. *Solieria filiformes* (Rhodophyta) was found offshore (GOM11, GOM12) and is associated with live bottom habitats.

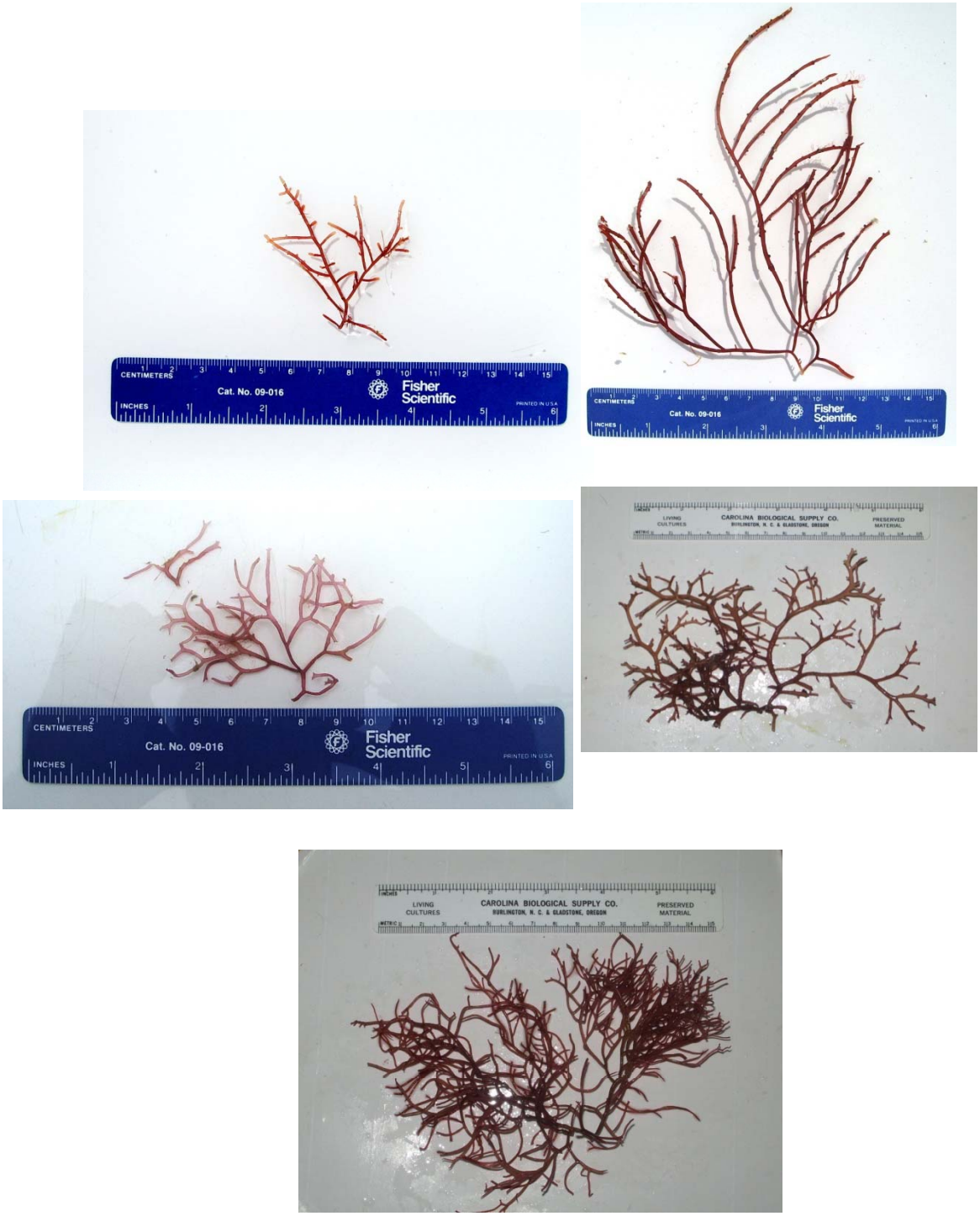

Fig 5.3.10. *Gracilaria* spp. (Rhodophyta) was found throughout the study area. There are 19 species of Gracilaria found in Florida (Dawes and Matheisson 2008) and may appear alike. Several species are shown above with distinctions depending on the degree of compression of the main axis and the branching patterns.

Fig. 5.3.11. *Eucheuma isiforme* (Rhodophyta) was collected at live bottom stations (GOM11, GOM12). It has a well-developed discoid holdfast and is associated with live bottom habitats.

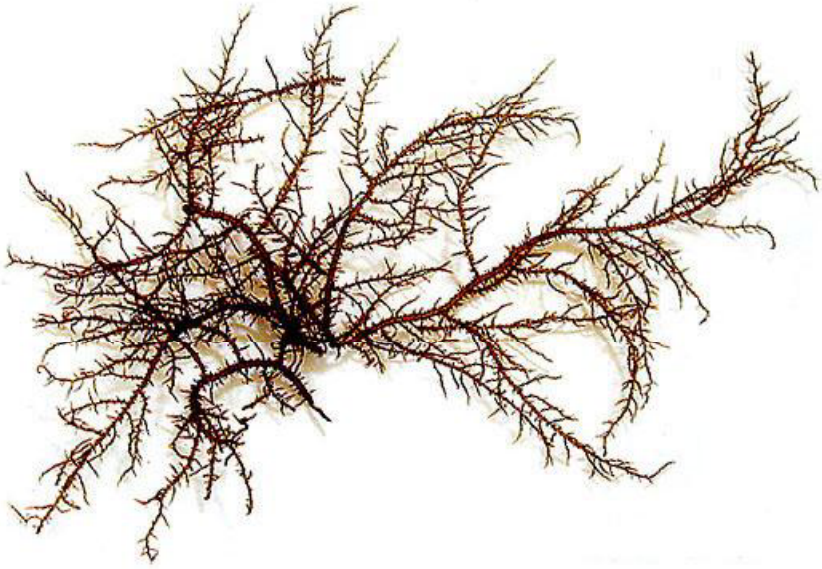

Fig 5.3.12. *Hypnea spinella* (Rhodophyta) was found throughout the study area including inshore and offshore stations. This species was reported to be in great abundances on area beaches during events from 2003-2007.

Fig. 5.3.13. *Lomentaria baileyana* (Rhodophyta) was abundant at inshore stations, GOM16 and CES11.

Fig. 5.3.14. *Sargassum* spp. (Phaeophyta) was found at CES11 and GOM12 and was associated with both inshore and live bottom habitats.

Fig. 5.3.15. *Spyridia filamentosa* (Rhodophyta) was abundant at inshore stations, such as CES11 and GOM16.

Fig. 5.3.16. *Ulva lactuca* (Chlorophyta) was found at CES11 and other inshore locations. It is an indicator of nitrogen pollution.

Appendix 5.4

The total biomass from the individual stations (all macroalgal species combined) is presented as dry weight biomass per quadrat (Figs. 5.4.1-5.4.5), wet weight biomass per quadrat (Figs. 5.4.6-5.4.10) and by percent cover (Figs. 5.4.11-5.4.12).

A series of pie charts by station and month depict the species composition by proportion (%) of the species biomass over the total biomass for the transect. Similarly, an emphasis was placed on those species found on area beaches in this study or previously. Species composition pie charts are also useful for demonstrating a spatial patterns of organization over the large target area sampled in this study.

The community composition at CES11 (Figs. 5.4.16-5.4.18) had three dominant red macroalgal species; *Acanthophora spicifera, Gracilaria tikvahae,* and *Spyridia filamentosa*. Similarly, the species composition at GOM16 (Figs. 5.4.19-5.4.20), also located near the Sanibel Causeway, had several of the same dominant three species including; *A. spicifera, G. tikvahae,* and *Soliera filiformis*. However, there was a sampling event when the rhodophyte *Lomentaria baileyana* was the only species found.

At the offshore, live bottom stations, there was greater diversity and evenness with the dominant species comprising a lower proportion of biomass to the total for the transect. At GOM11 (Figs. 5.4.21-5.4.23), several *Gracilaria* spp., *Botryocladia occidentalis, Soliera filiformis, Aghardhiella subulata,* and *Eucheuma isofirme* were typically found. A similar pattern was found at station GOM12 (Figs. 5.4.24-5.4.26), and when several other species with low contributions (e.g., *Dictyota cervicornis, Hypnea spinella*), those same species contributing to GOM11 comprised the majority of the total biomass of GOM12.

Pie charts of species composition at the 9 other stations were included for completeness (Figs 5.4.27-5.4.31), but given the diminutive amount of biomass collected over the study period, the results are not comparable to the four stations where the majority of macroalgae were collected.

Underwater video analysis was used as an independent check on the seafloor surveys. The results are listed here. CES11 had 32% mean percent cover (n = 139) of macroalgae in March 2009 per video analysis (Fig. 5.4.32) whereas mean percent cover was 15% (n = 20) when recorded in quadrats. GOM16 had a maximum mean percent cover in March 2010 of 26% (n = 137; Fig. 5.4.32). The percent cover was generally lower at offshore than at inshore stations where the maximum mean macroalgae cover at GOM11 in September 2009 was 13% (n = 211; Fig. 5.4.33). Maximum mean cover at GOM12 occurred in June 2010 (Fig. 5.4.33) and was 27% (n = 158), using the underwater video analysis. The percent cover observed in June 2010 at GOM12 was 26% (n = 20) as estimated by underwater observers (Fig. 5.4.33). A Kruskal-Wallis One-Way ANOVA comparing video transects to underwater observations indicated no significant differences in ranked cover at these stations.

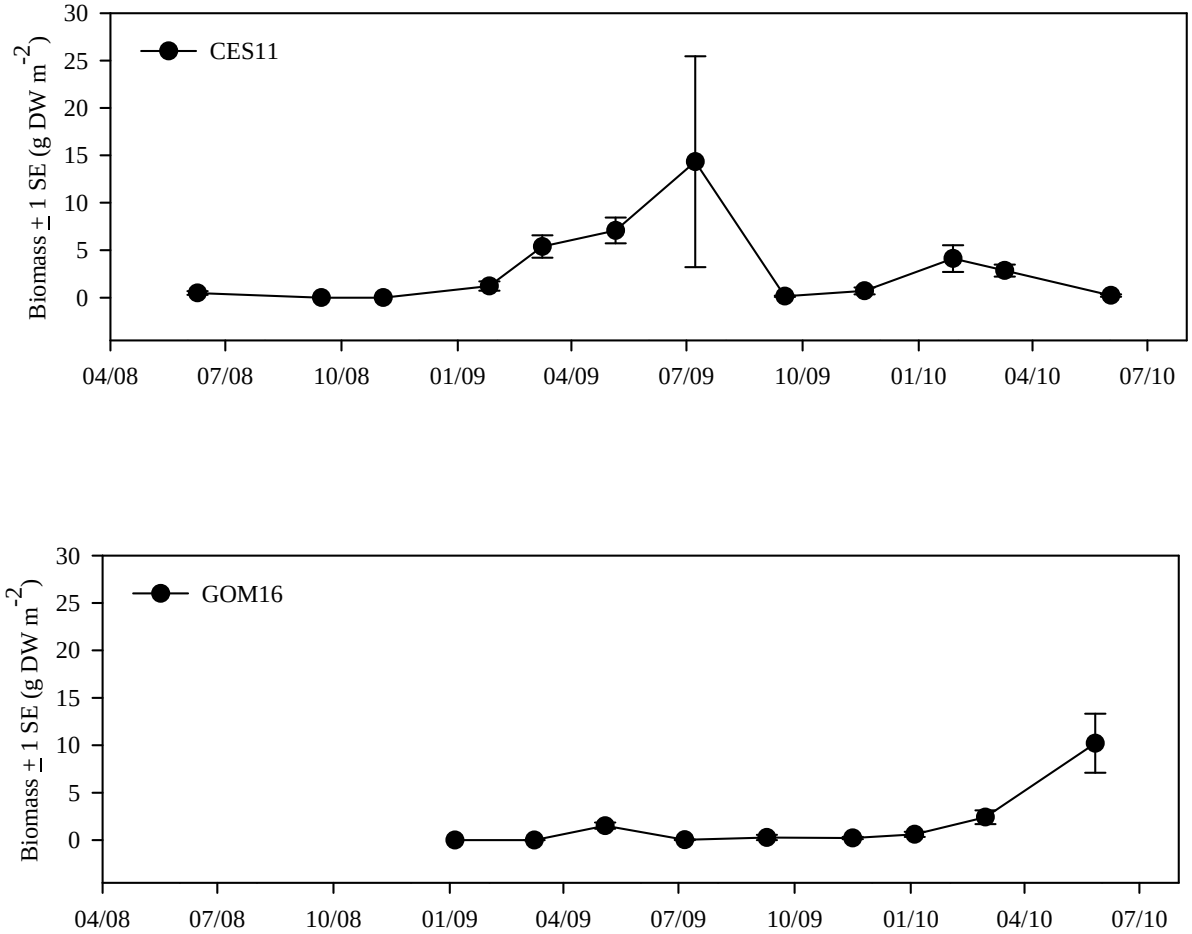

Fig. 5.4.1. Mean monthly biomass (g DW m^{-2}) by station with error estimates ($\pm$1 SE) for sites CES11 and GOM16. Note that the scale for CES11 is different than the others. Sampling size was 20 random quadrats per station except June 2008, where n = 30. These two stations routinely had an abundant macroalgal community, GOM16 also contained patchy seagrass. GOM16 was not added as a permanent station until January 2009. Detailed descriptions of the stations are provided in the text.

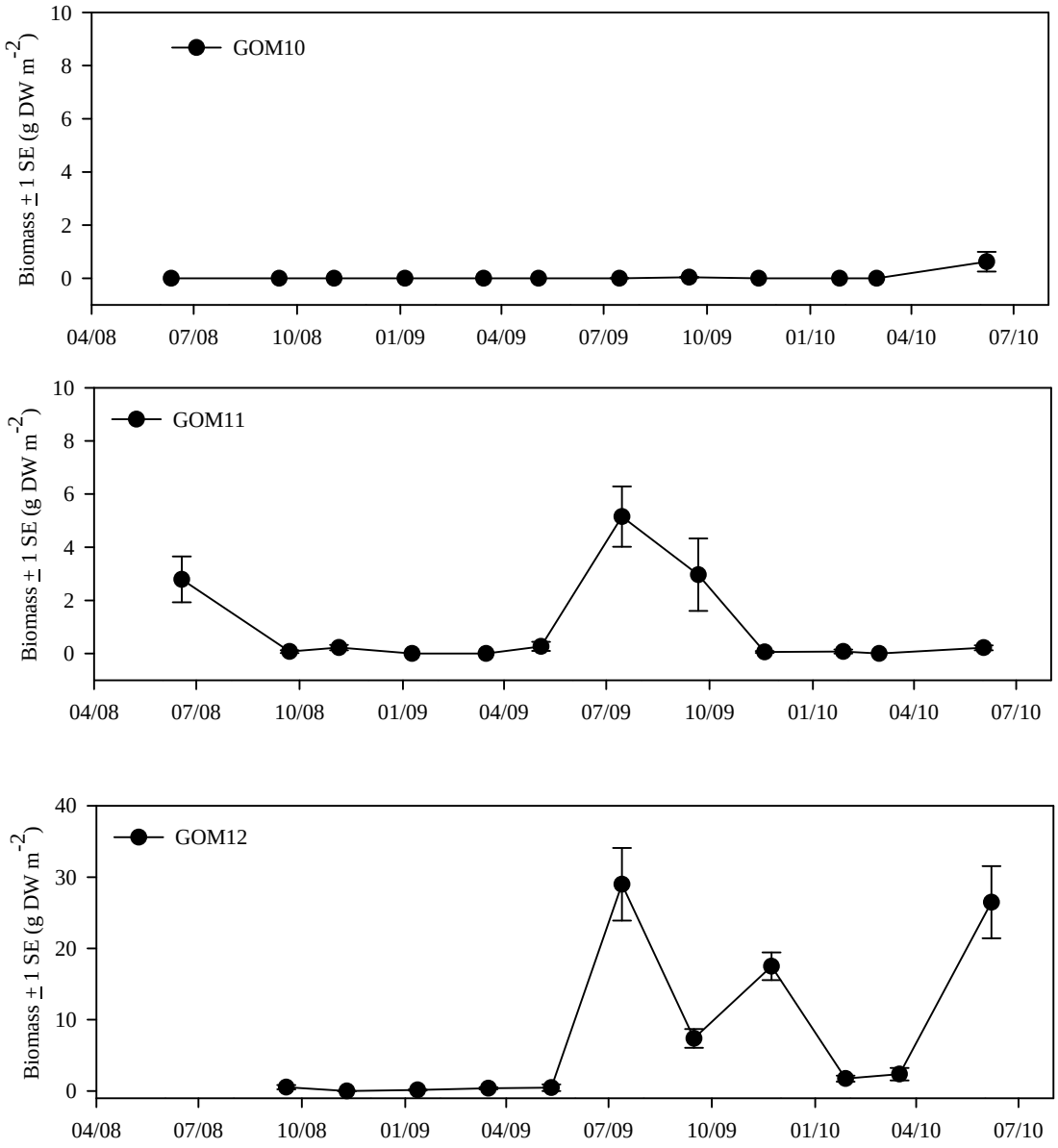

Fig. 5.4.2. Mean monthly biomass (g DW m^{-2}) by station with error estimates (±1 SE) for offshore sites GOM10, GOM11, and GOM12. Note that the scale for GOM 12 is different than the others. GOM12 was not added as a permanent station until September 2008 and samples were not collected at GOM12 in June 2008. Sampling size was 20 random quadrats per station except June 2008, where n = 30. Detailed descriptions of the stations are provided in the text.

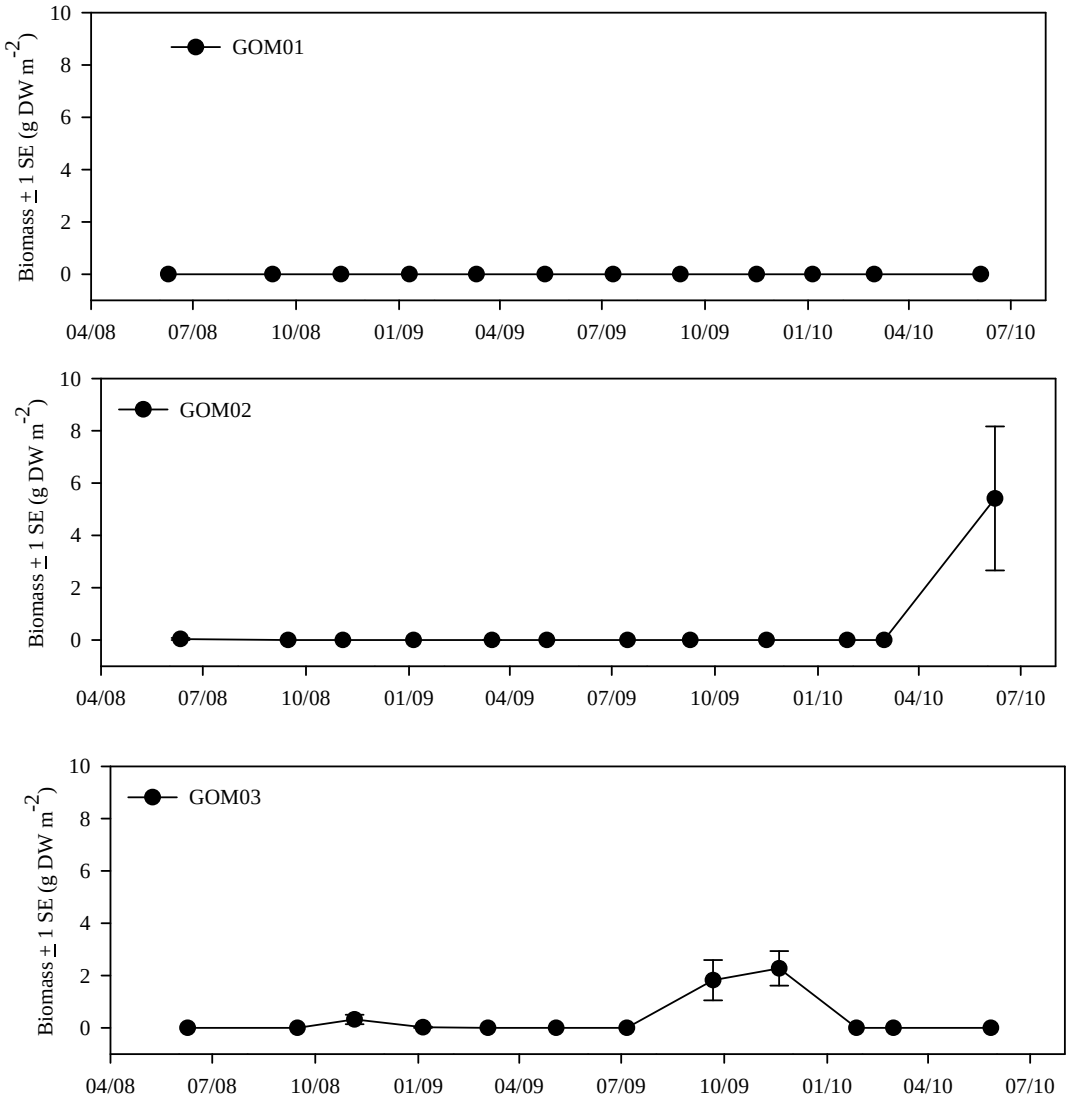

Fig. 5.4.3. Mean monthly biomass (g DW m^{-2}) by station with error estimates (±1 SE) for nearshore sites GOM01, GOM02, and GOM03. Sampling size was 20 random quadrats per station except June 2008, where n = 30. Detailed descriptions of the stations are provided in the text.

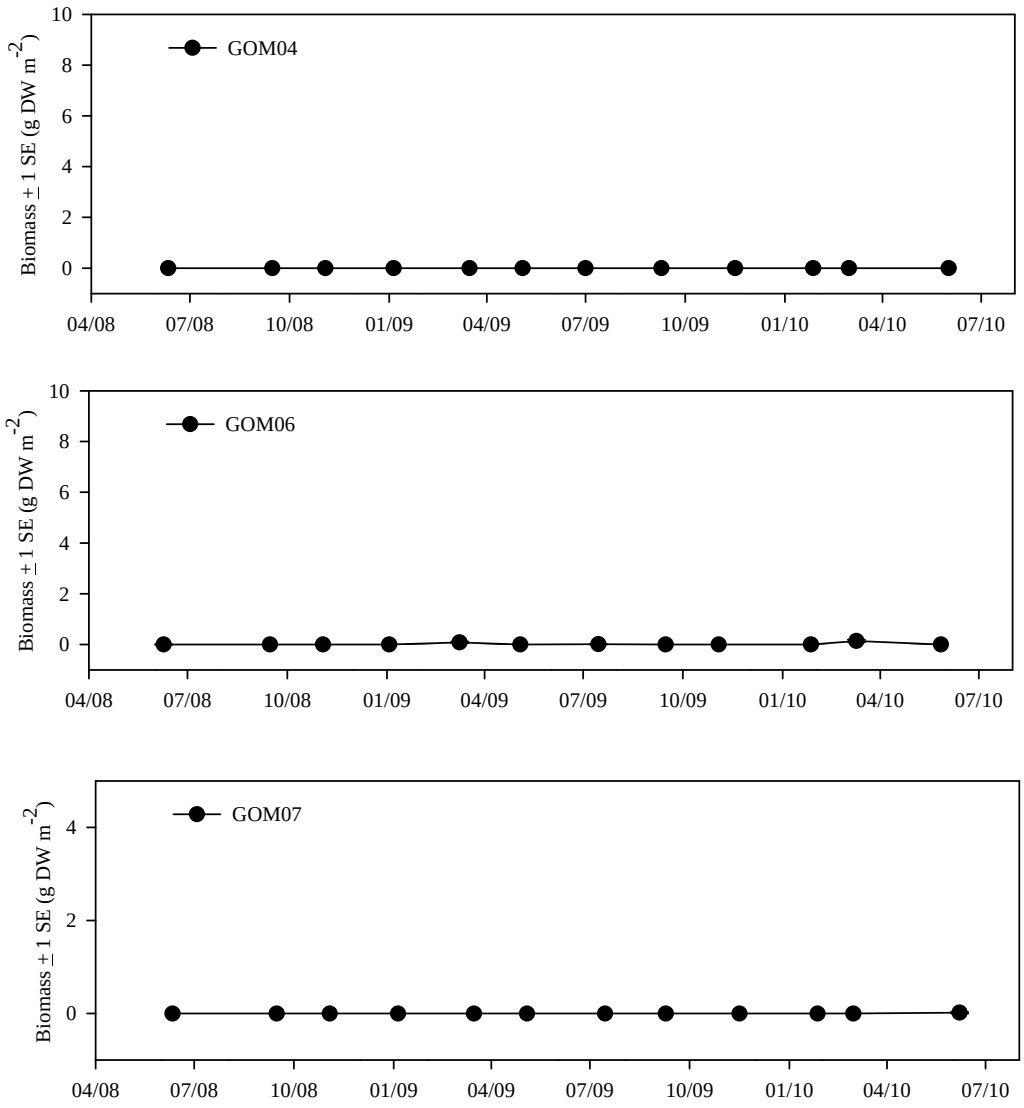

Fig. 5.4.4. Mean monthly biomass (g DW m^{-2}) by station with error estimates (±1 SE) for nearshore sites GOM04, GOM06, and GOM07. Sampling size was 20 random quadrats per station except June 2008, where n = 30. Detailed descriptions of the stations are provided in the text.

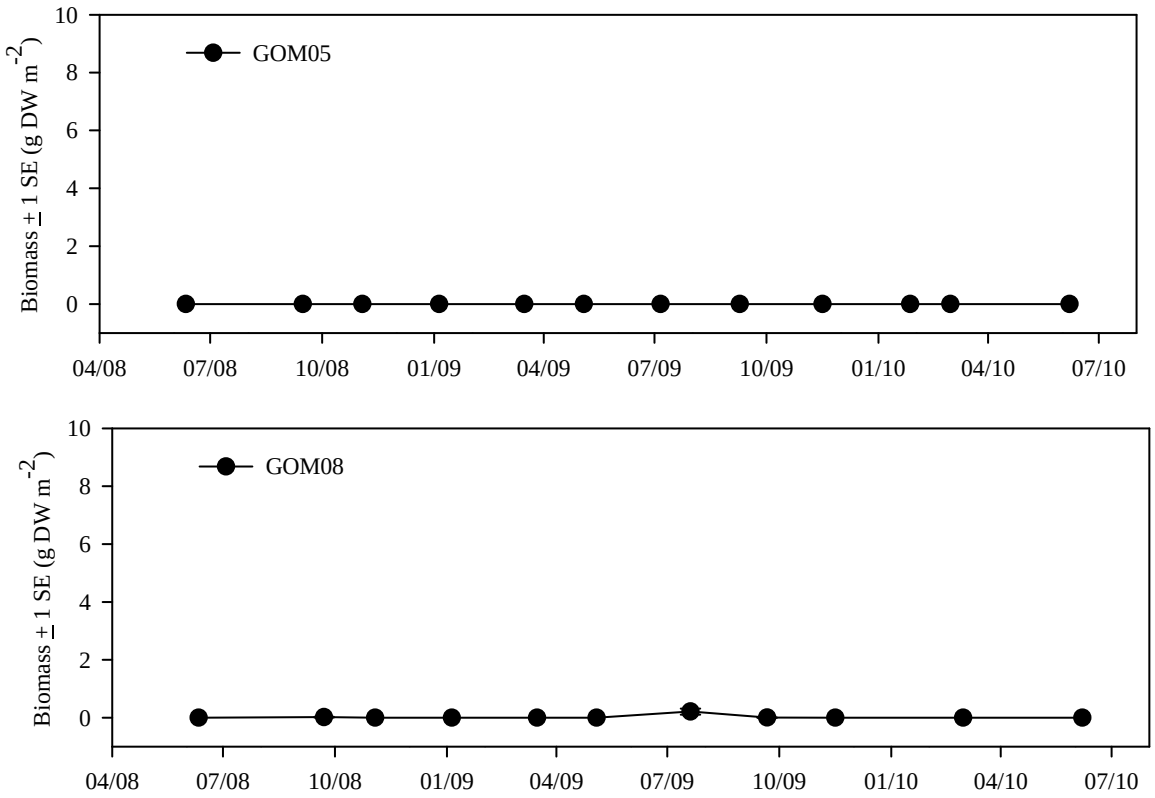

Fig. 5.4.5. Mean monthly biomass (g DW m^{-2}) by station with error estimates (±1 SE) for offshore site GOM05 and GOM08. Sampling size was 20 random quadrats per station except June 2008, where n = 30. Detailed descriptions of the stations are provided in the text.

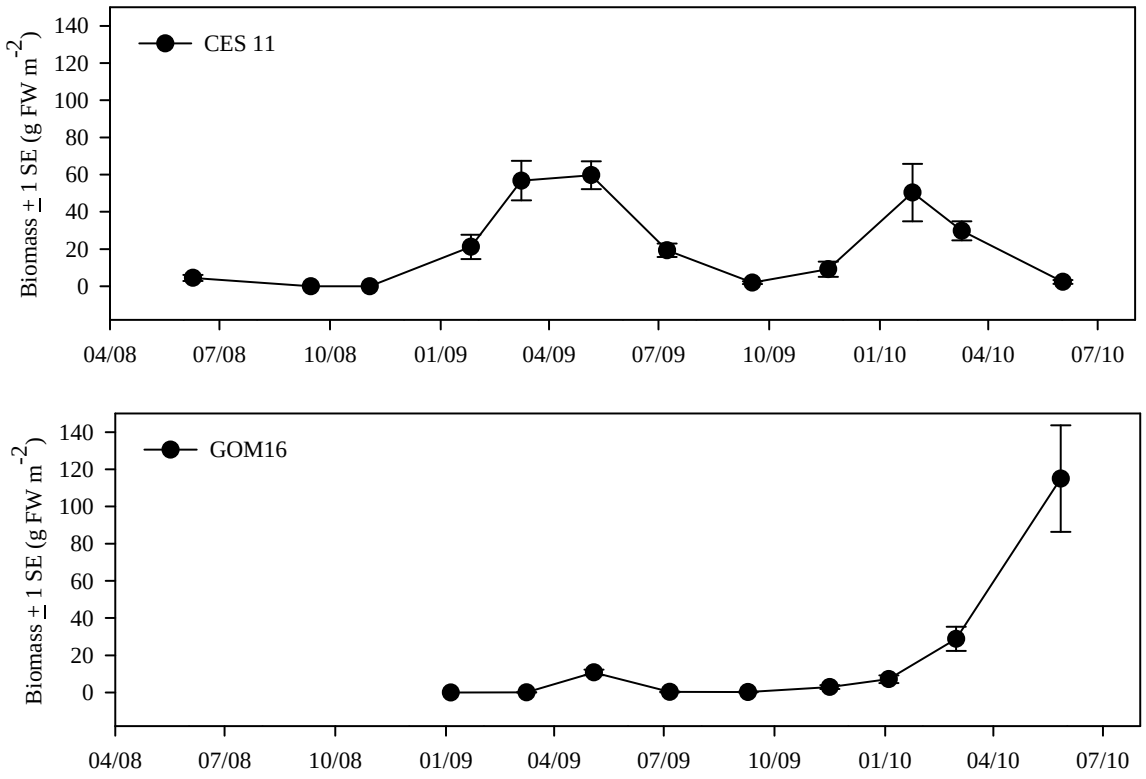

Fig. 5.4.6. Mean monthly wet weight biomass (g FW m^{-2}) by station with error estimates (±1 SE) for inshore stations CES11 and GOM16. Sampling size was 20 random quadrats per station except June 2008, where n = 30.

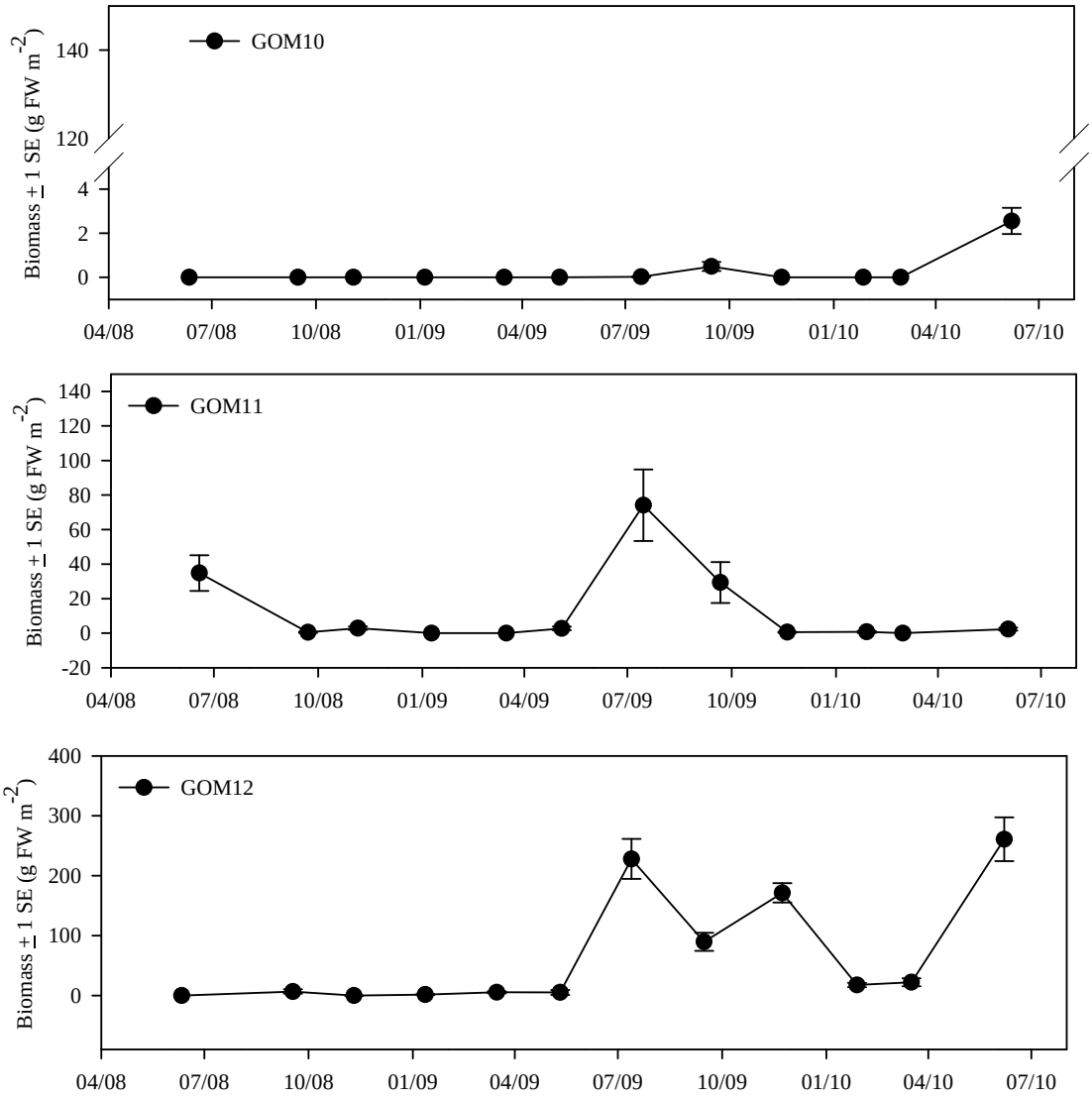

Fig. 5.4.7. Mean monthly wet weight biomass (g FW m^{-2}) by station with error estimates (±1 SE) for nearshore stations GOM10, GOM11, and GOM12. Note the difference in scale for GOM12. Sampling size was 20 random quadrats per station except June 2008, where n = 30.

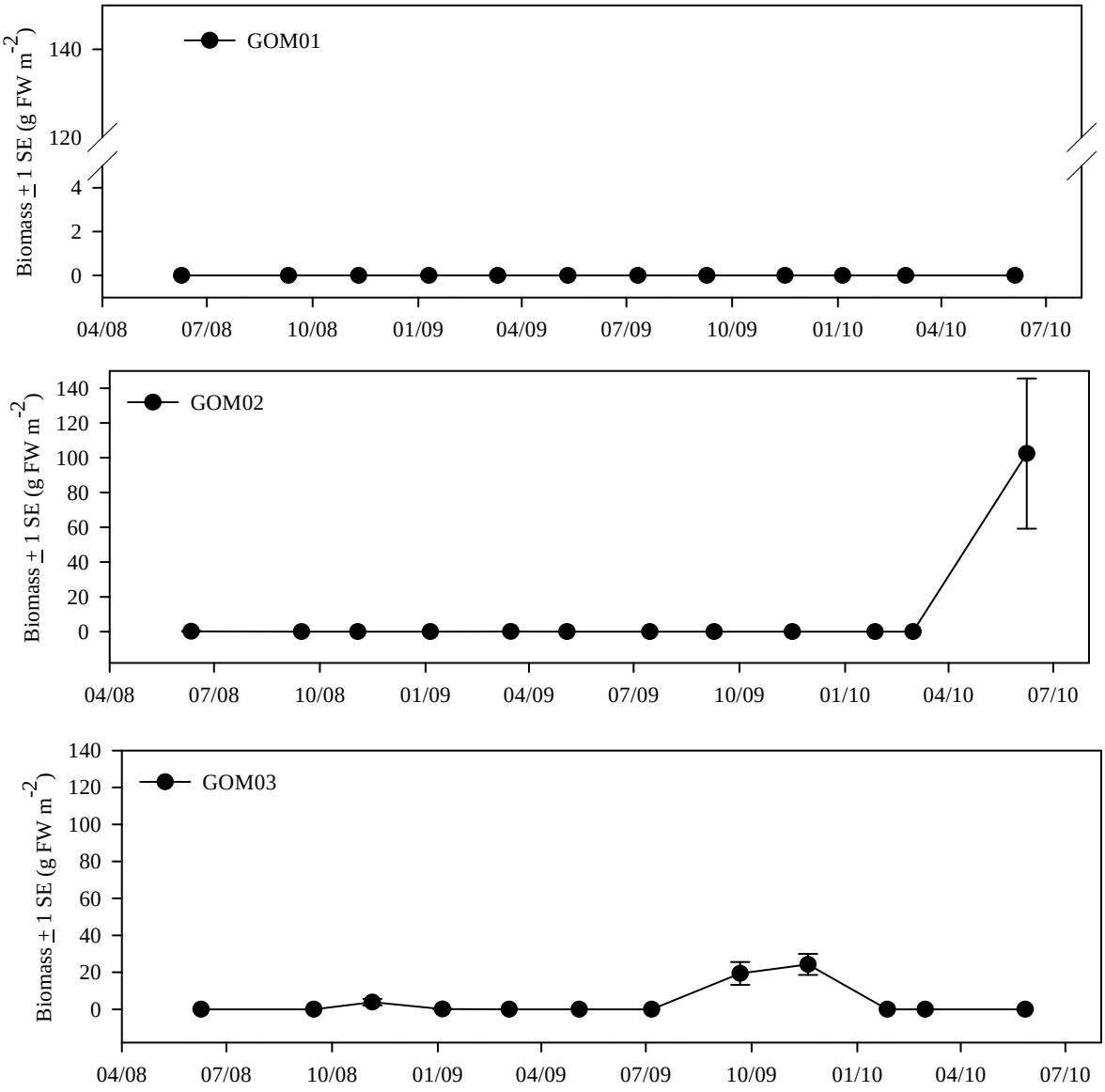

Fig. 5.4.8. Mean monthly wet weight biomass (g FW m^{-2}) by station with error estimates (±1 SE) for nearshore stations GOM01, GOM02, GOM03. Sampling size was 20 random quadrats per station except June 2008, where n = 30.

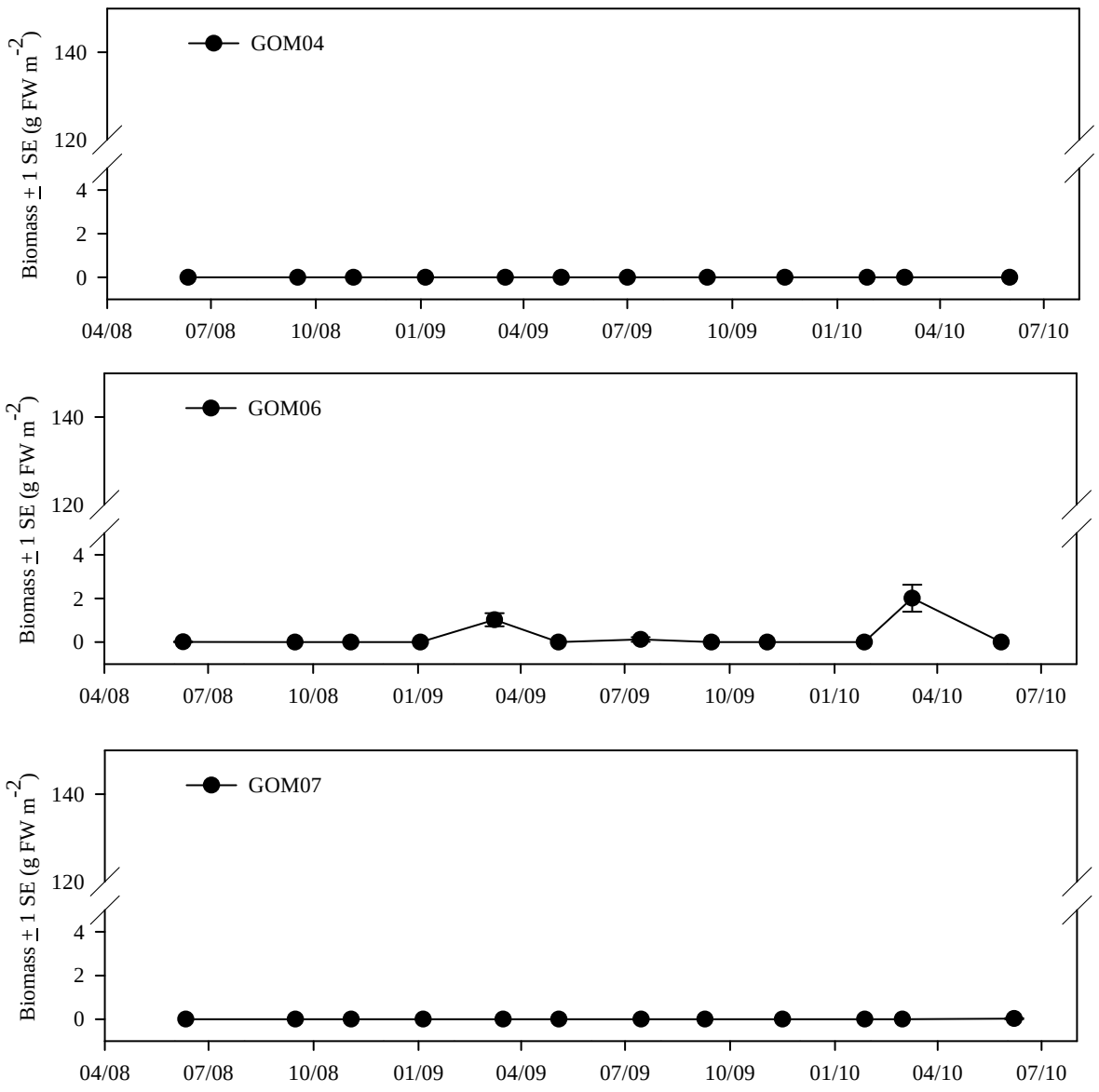

Fig. 5.4.9. Mean monthly wet weight biomass (g FW m^{-2}) by station with error estimates (±1 SE) for nearshore stations GOM04, GOM06, GOM07. Sampling size was 20 random quadrats per station except June 2008, where n = 30.

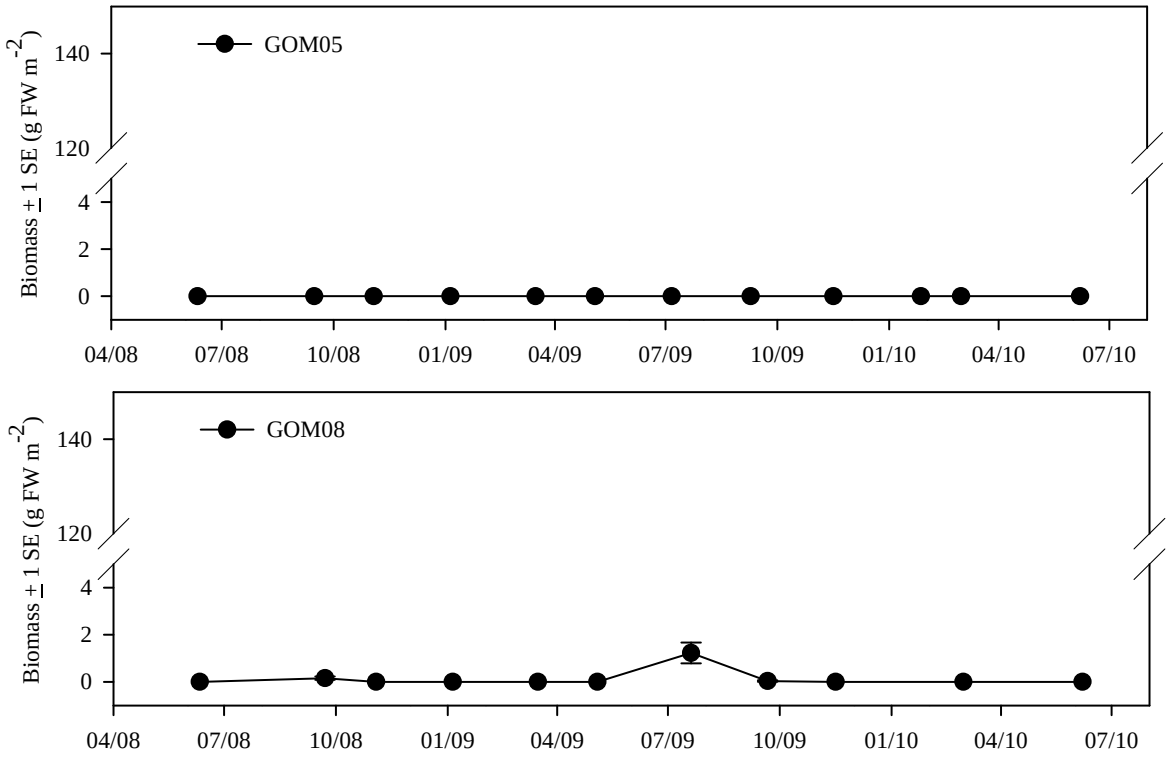

Fig. 5.4.10. Mean monthly wet weight biomass (g FW m^{-2}) by station with error estimates (±1 SE) for nearshore stations GOM05 and GOM08. Sampling size was 20 random quadrats per station except June 2008, where n = 30.

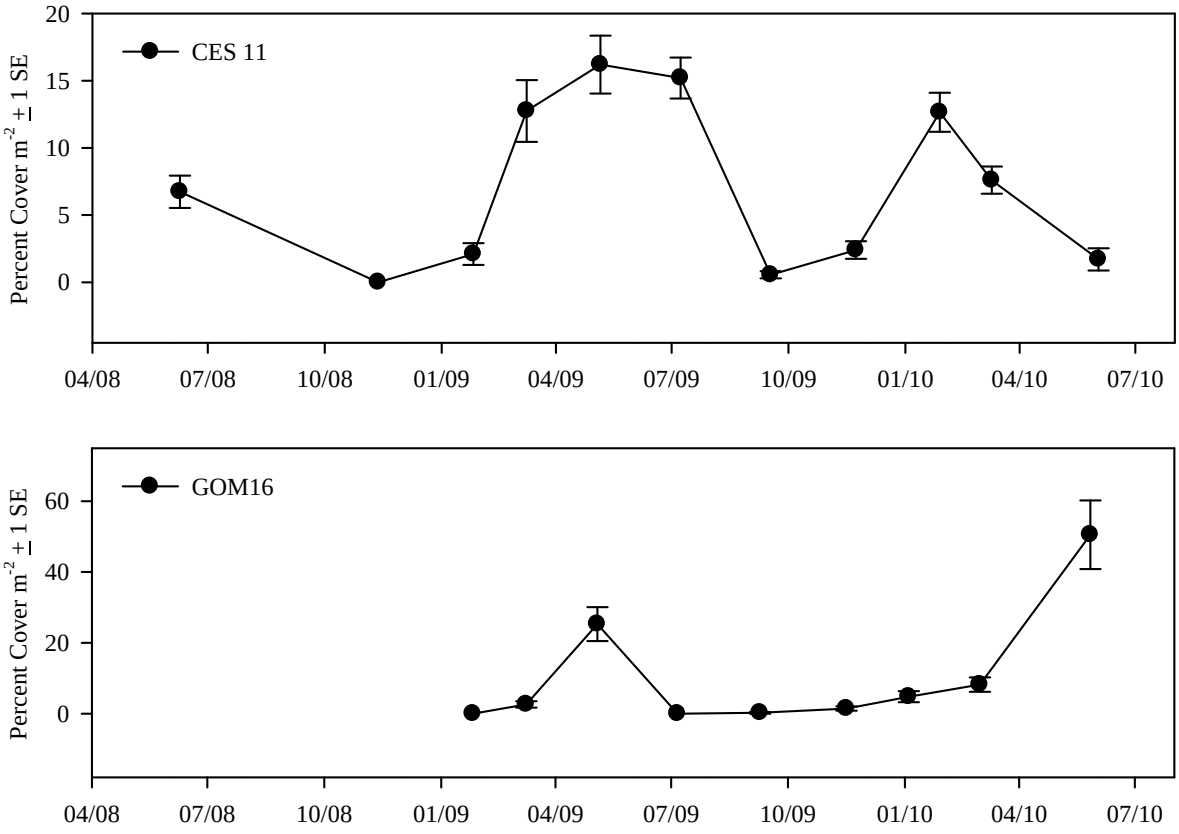

Fig. 5.4.11. Mean monthly percent cover by station with error estimates (±1 SE) for inshore sites CES11 and GOM16. Note the differences in scale among the two stations. Sampling size was 20 random quadrats per station except June 2008, where n = 30.

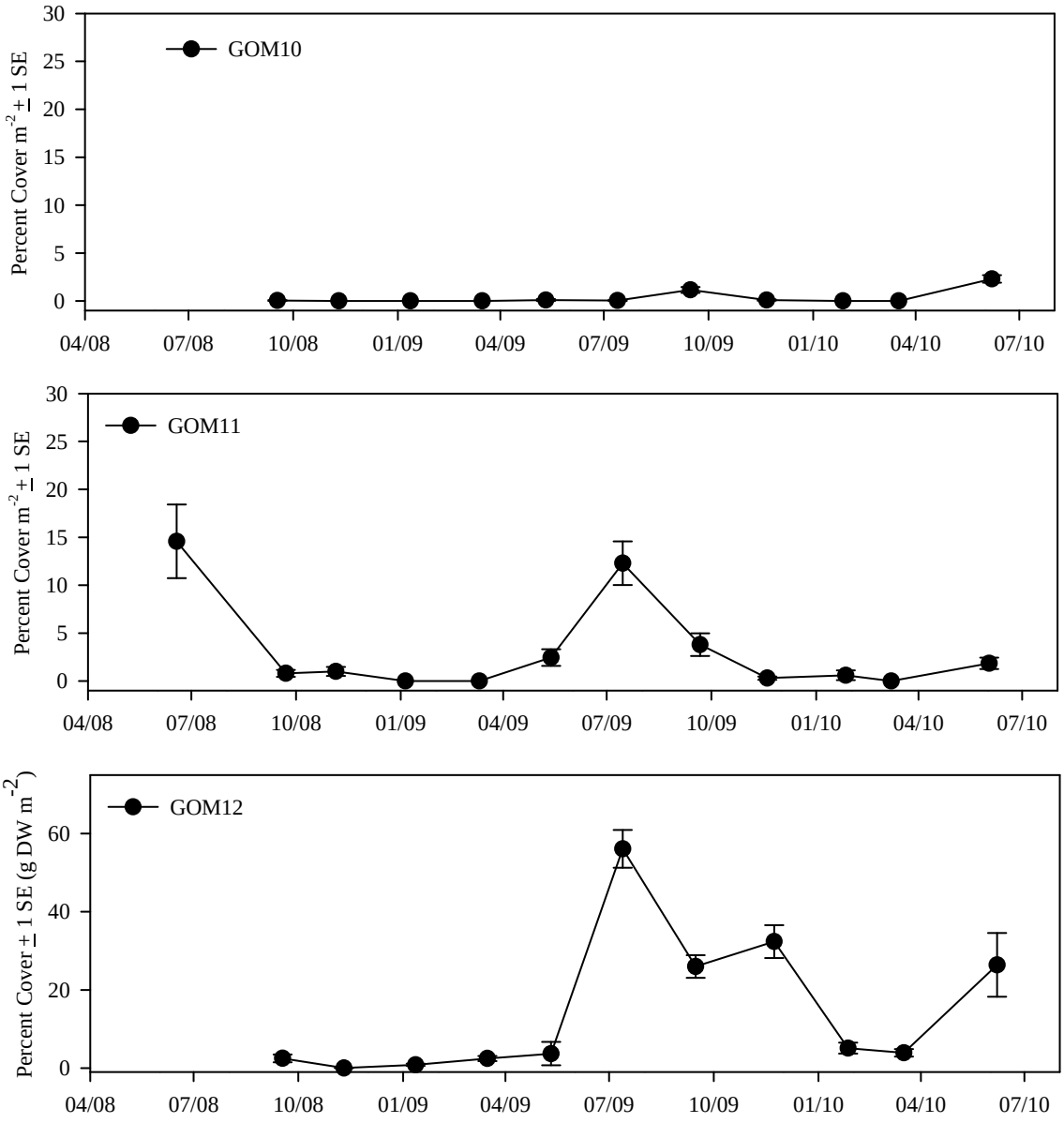

Fig. 5.4.12. Mean monthly percent cover by station with error estimates (±1 SE) for offshore sites GOM10, GOM11, GOM12. Note the difference in scale at GOM12. Sampling size was 20 random quadrats per station except June 2008, where n = 30.

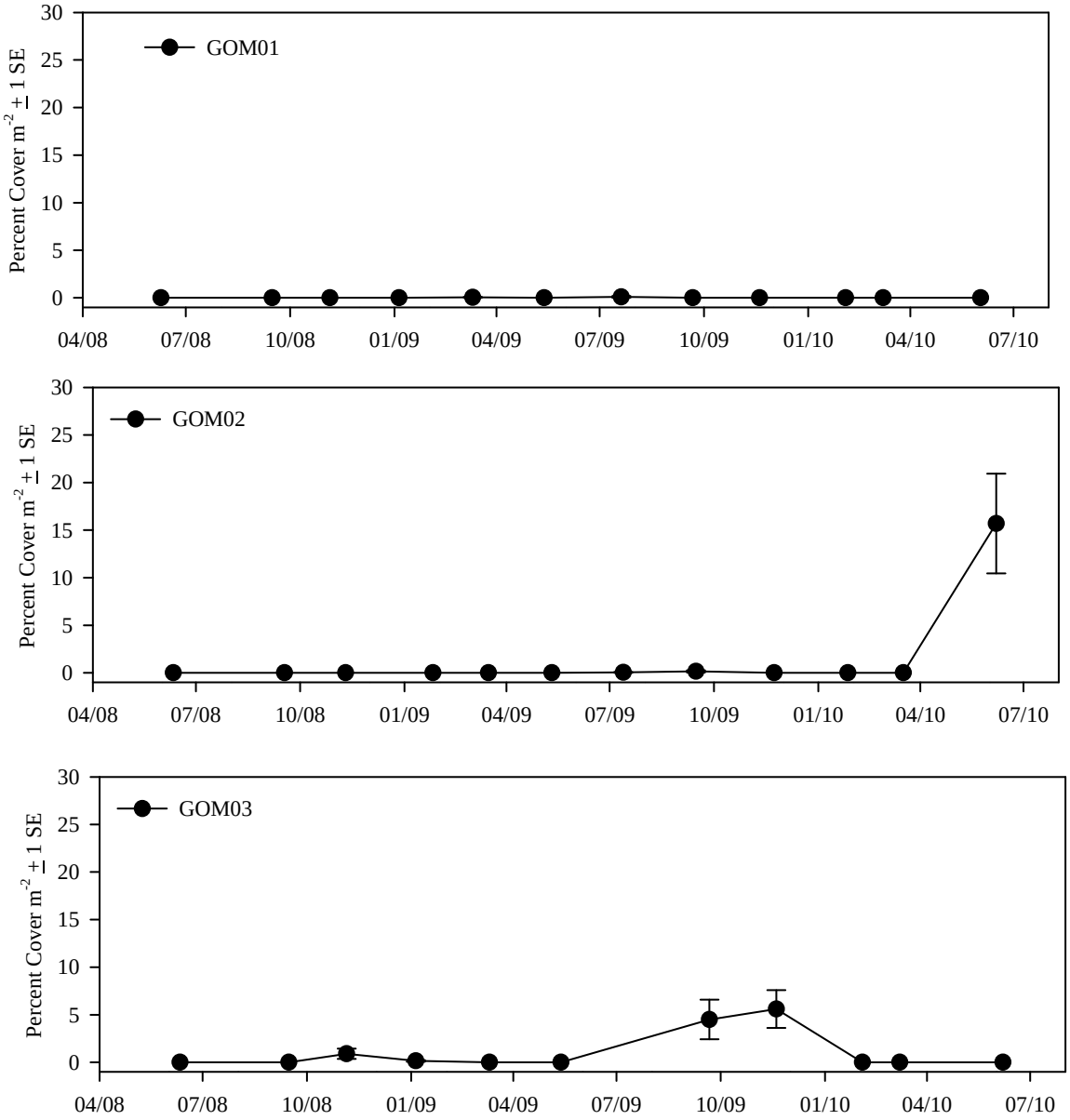

Fig. 5.4.13. Mean monthly percent cover by station with error estimates (±1 SE) for nearshore sites GOM01, GOM02, GOM03. Sampling size was 20 random quadrats per station except June 2008, where n = 30.

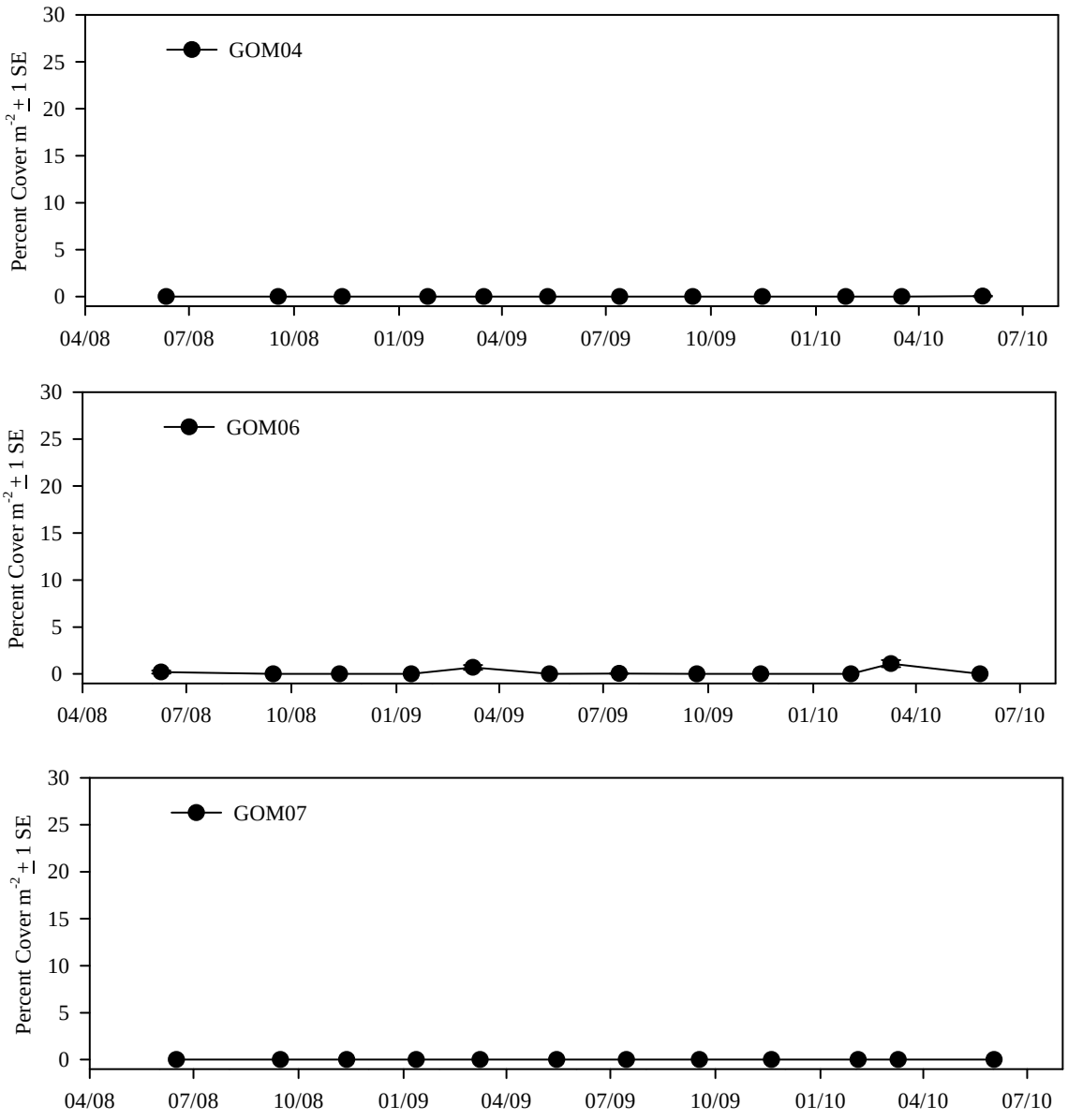

Fig. 5.4.14. Mean monthly percent cover by station with error estimates (±1 SE) for nearshore sites GOM04, GOM06, GOM07. Sampling size was 20 random quadrats per station except June 2008, where n = 30.

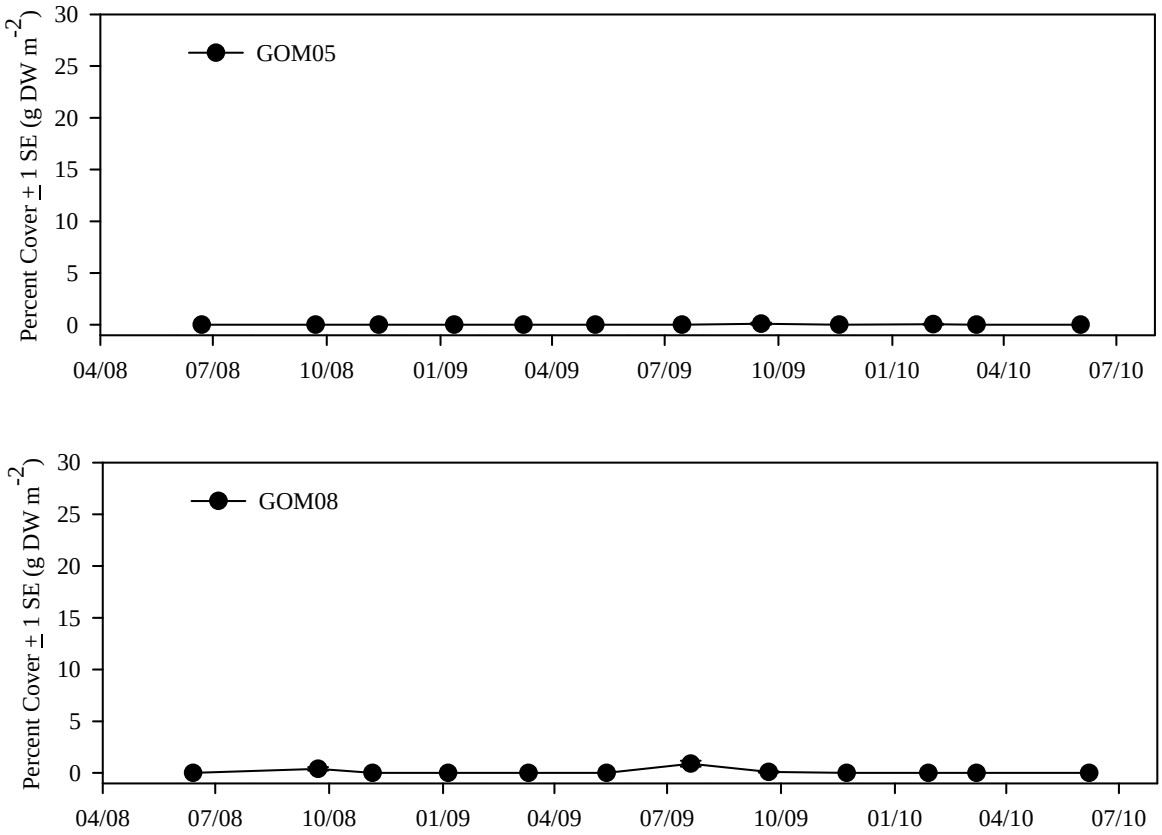

Fig. 5.4.15. Mean monthly percent cover by station with error estimates (±1 SE) for offshore sites GOM05 and GOM08. Sampling size was 20 random quadrats per station except June 2008, where n = 30.

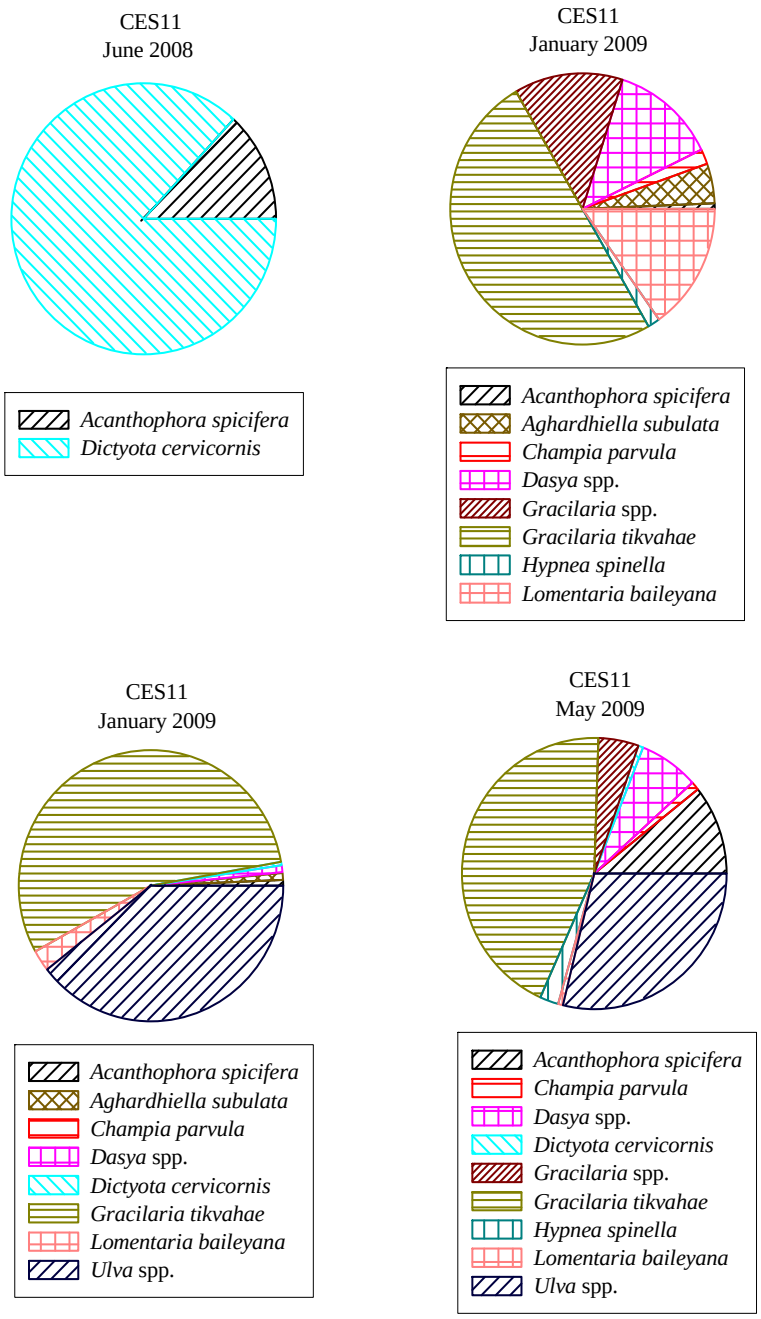

Fig. 5.4.16. Pie chart of species collected at CES11. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

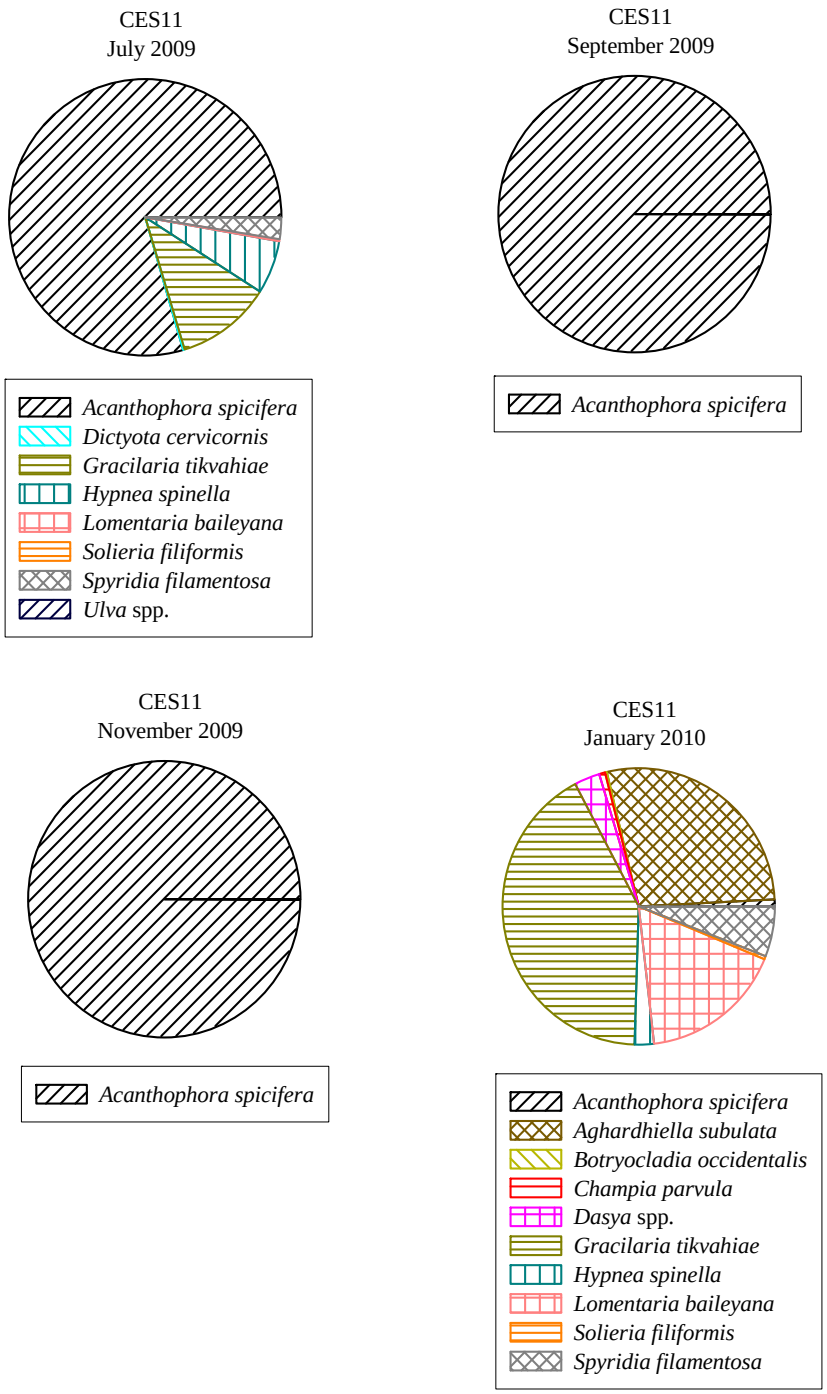

Fig. 5.4.17. Pie chart of species collected at CES11. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

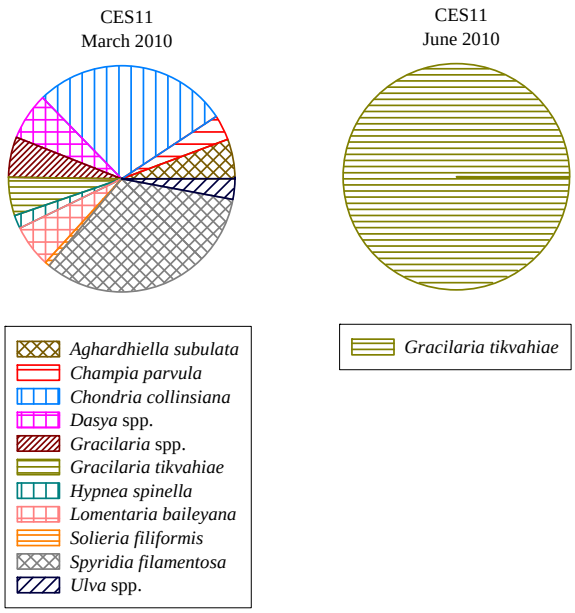

Fig. 5.4.18. Pie chart of species collected at CES11. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

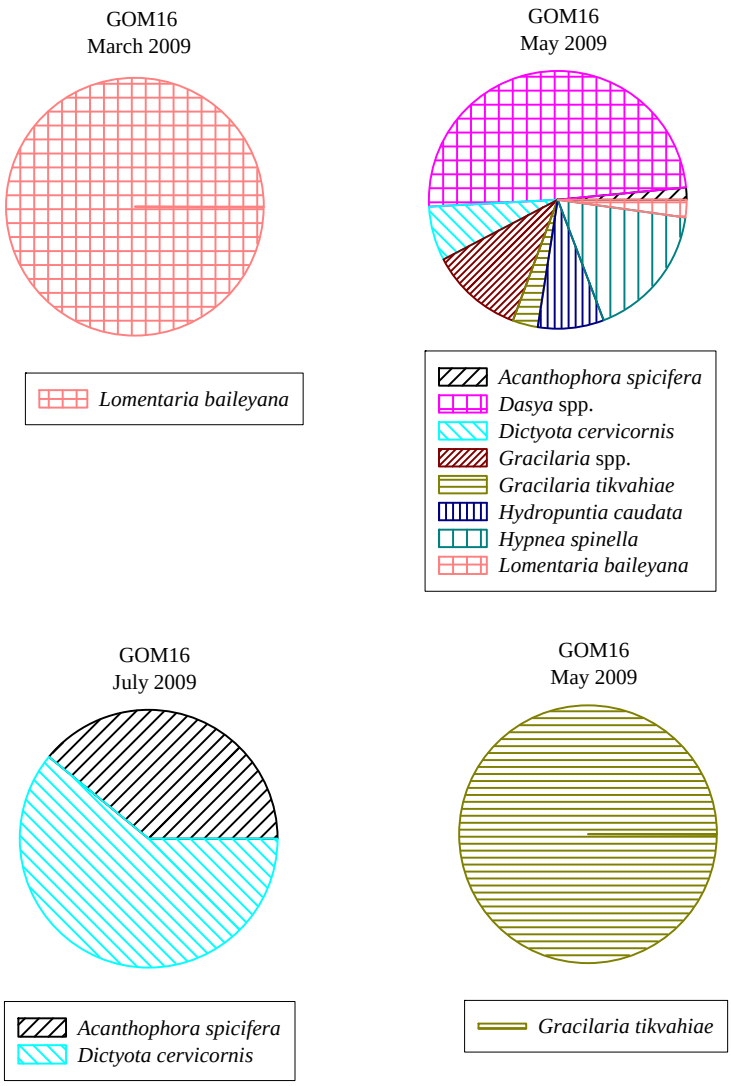

Fig. 5.4.19. Pie chart of species collected at GOM16. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

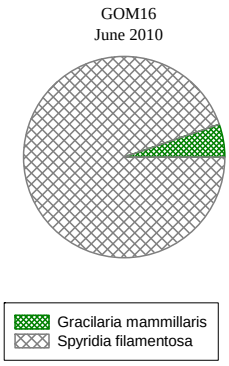

Fig. 5.4.20. Pie chart of species collected at GOM16. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

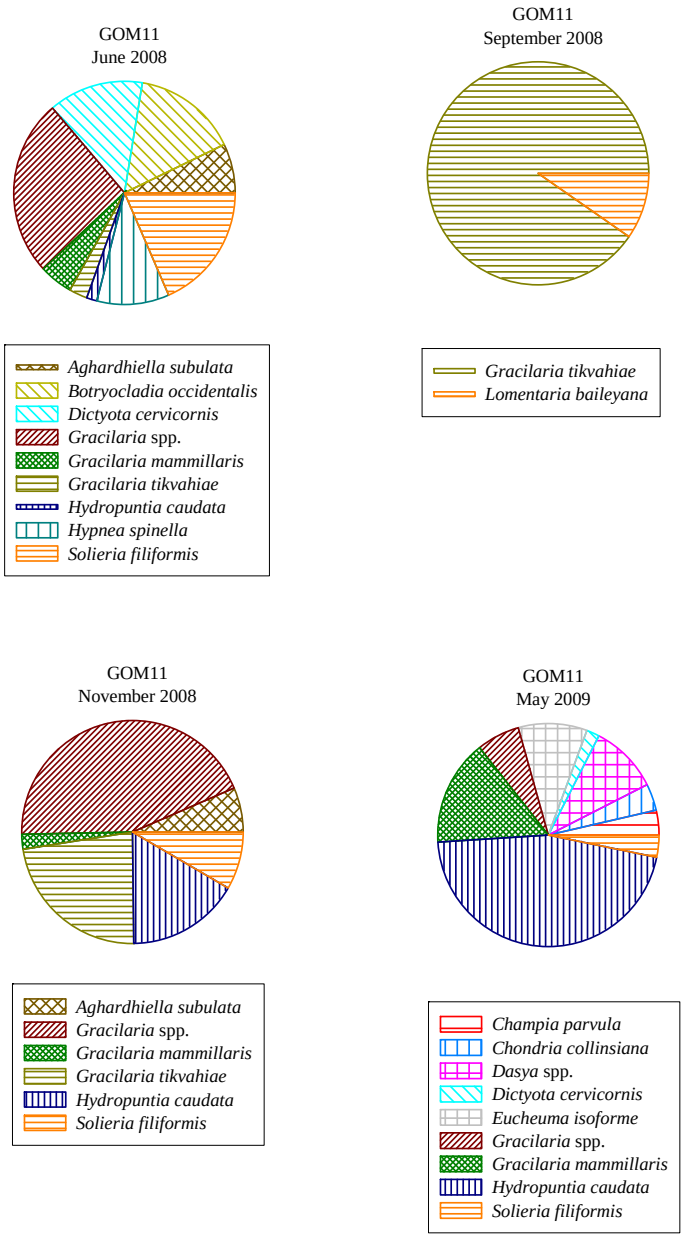

Fig. 5.4.21. Pie chart of species collected at GOM11. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

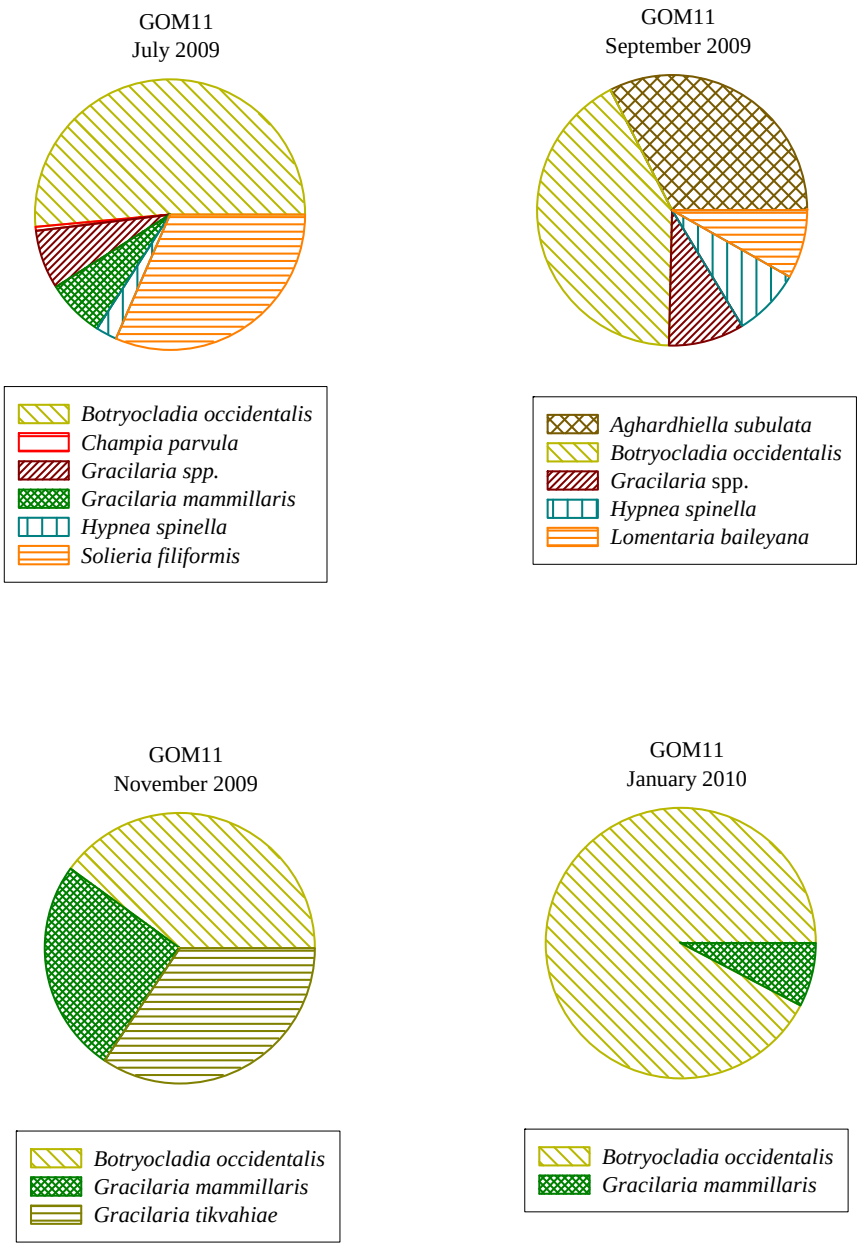

Fig. 5.4.22. Pie chart of species collected at GOM11. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

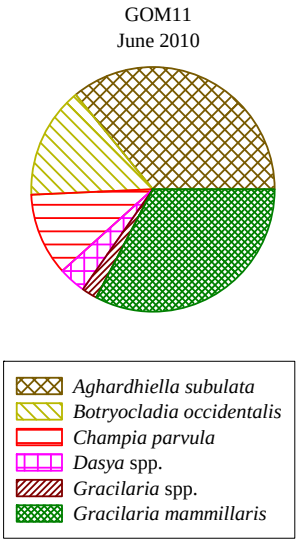

Fig 5.4.23. Pie chart of species collected at GOM11. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

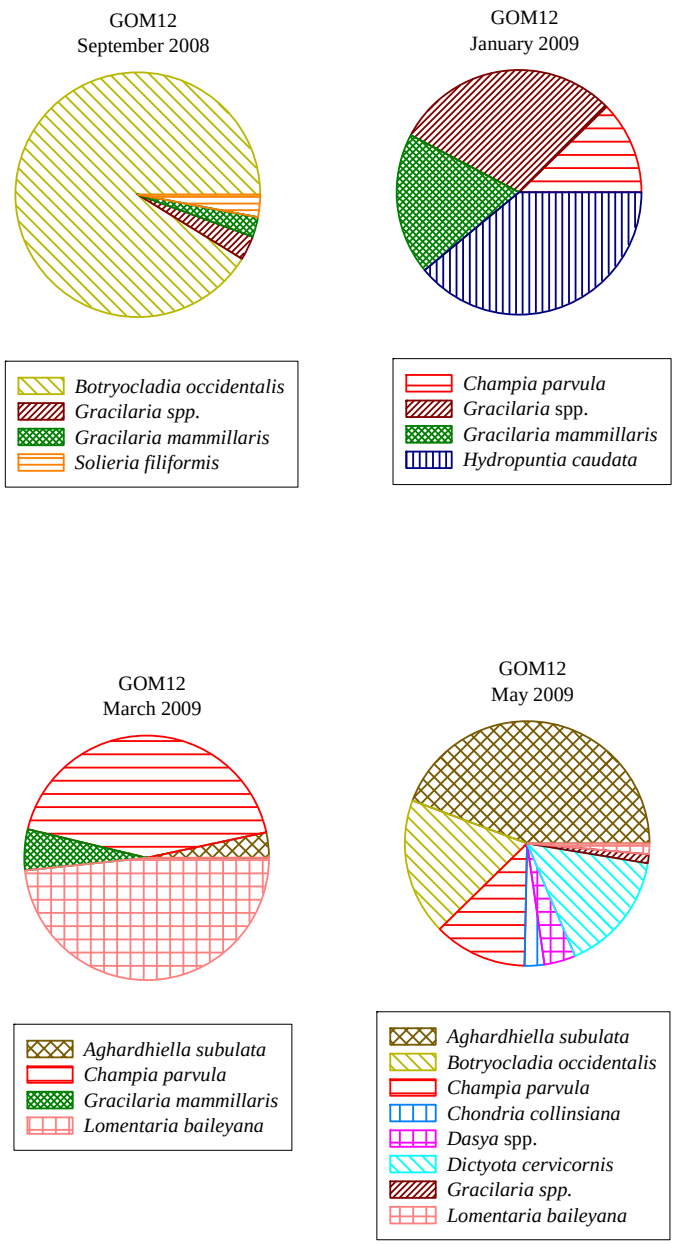

Fig. 5.4.24. Pie chart of species collected at GOM12. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

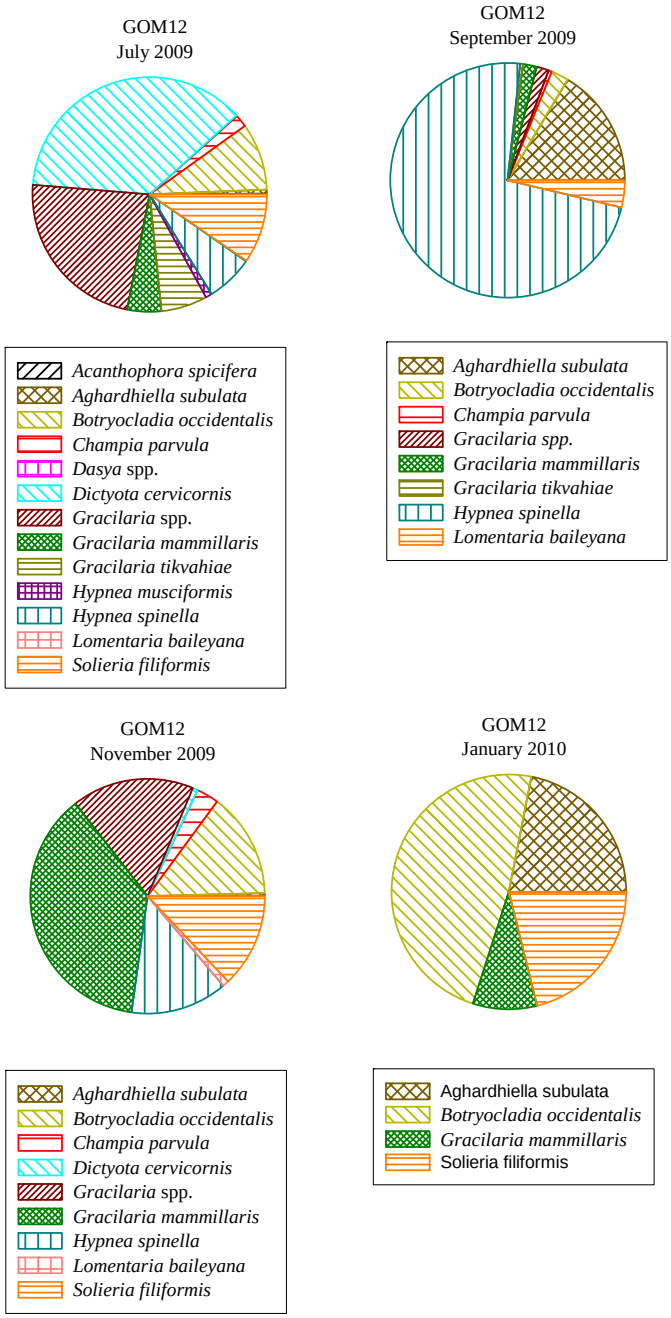

Fig. 5.4.25. Pie chart of species collected at GOM12. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

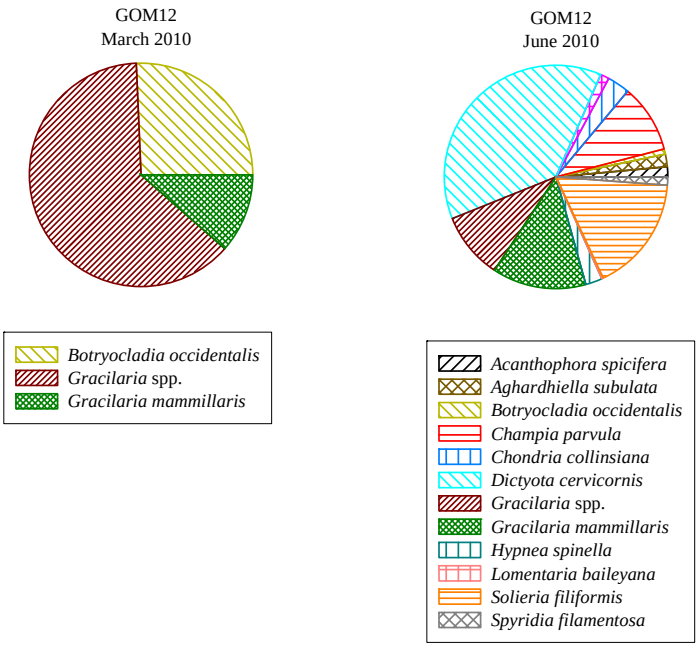

Fig. 5.4.26. Pie chart of species collected at GOM12. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

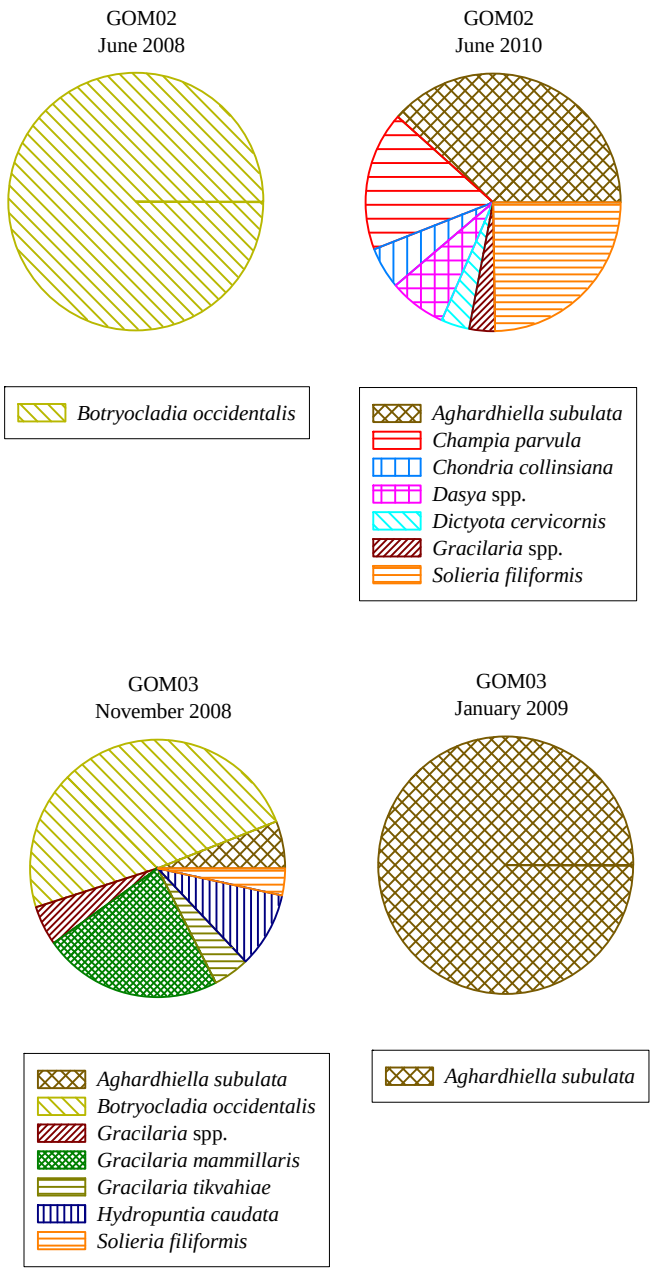

Fig. 5.4.27. Pie chart of species collected at GOM02 and GOM03. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

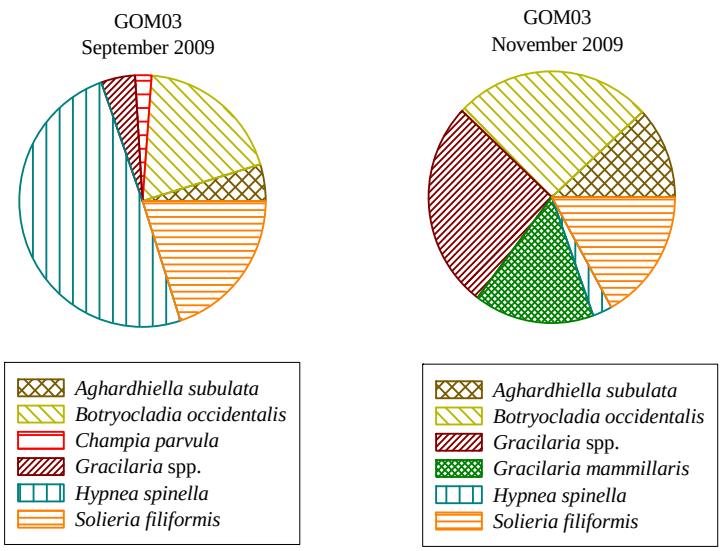

Fig. 5.4.28. Pie chart of species collected at GOM03. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

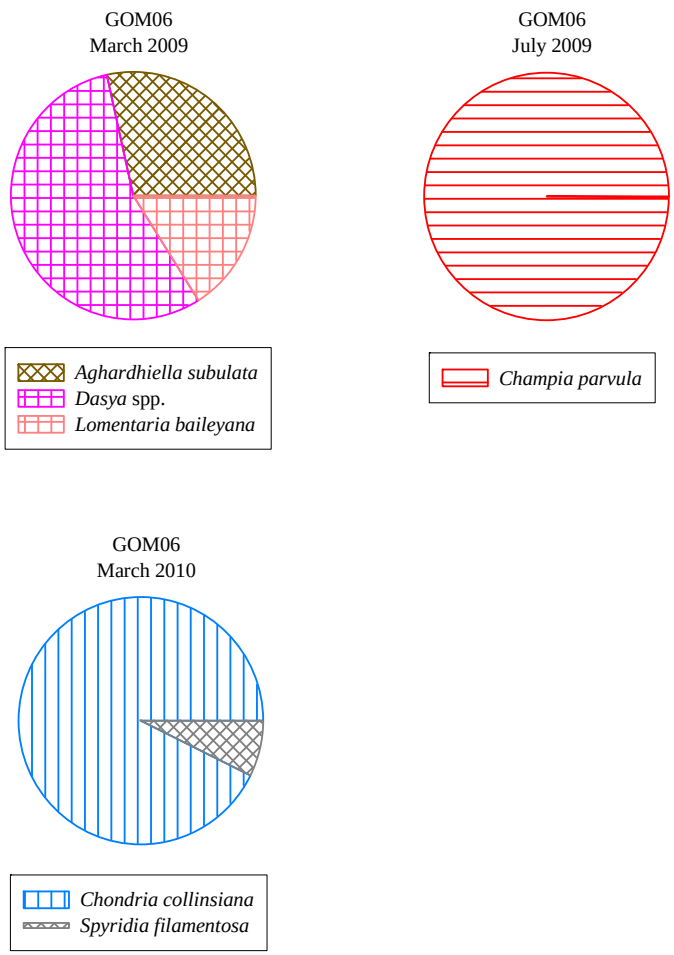

Fig. 5.4.29. Pie chart of species collected at GOM06. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

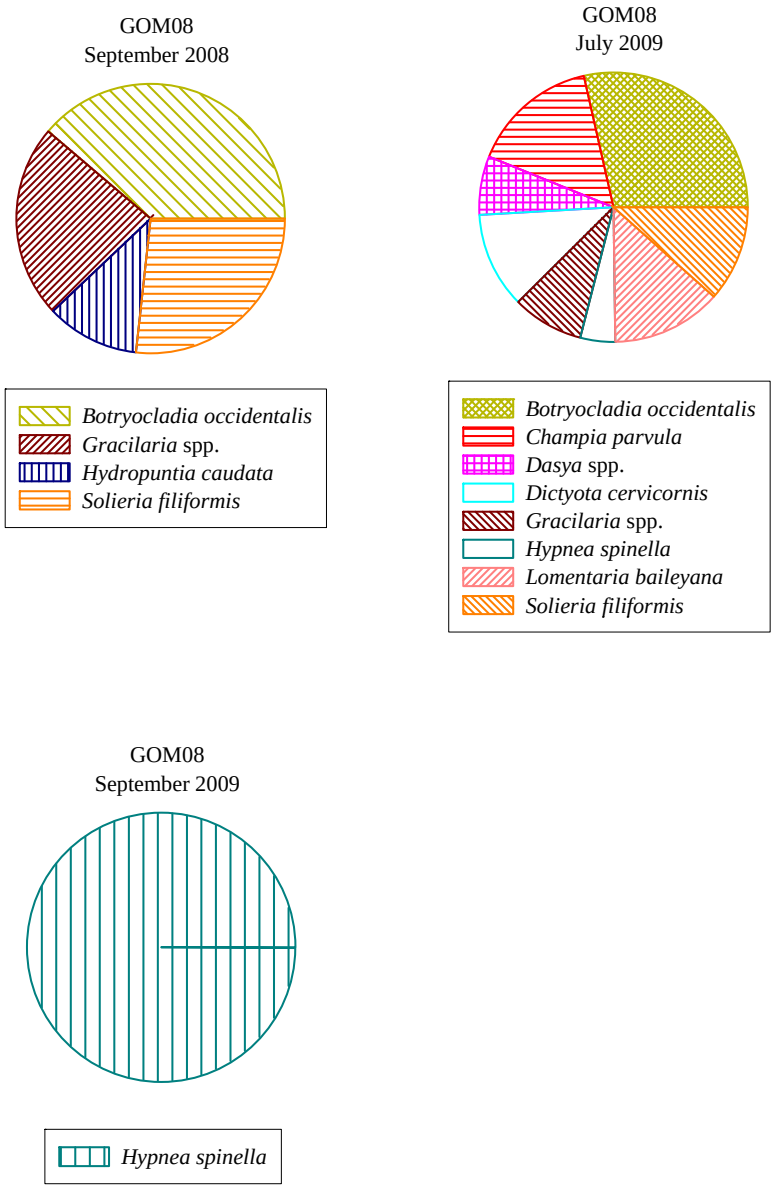

Fig. 5.4.30. Pie chart of species collected at GOM08. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

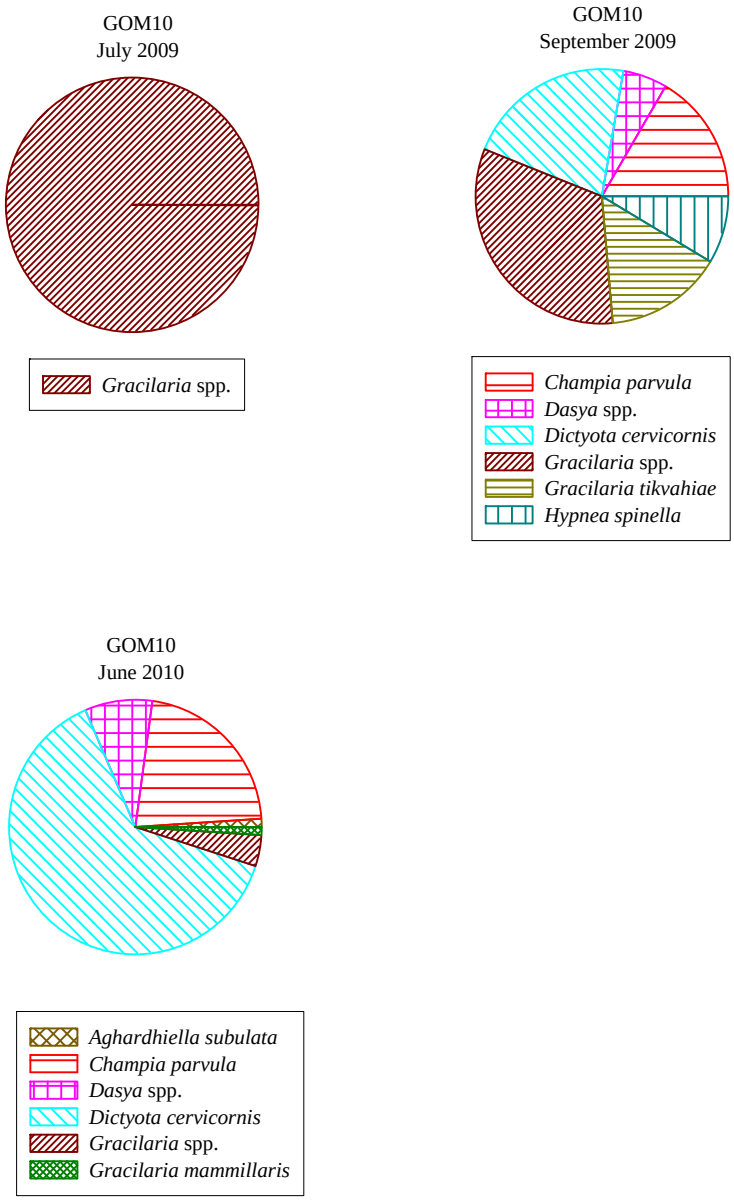

Fig. 5.4.31. Pie chart of species collected at GOM10. Dates indicate the month and year sampled. A sub-set of the most common species were selected for comparisons as many species may have only been collected rarely and are not indicative of the community composition.

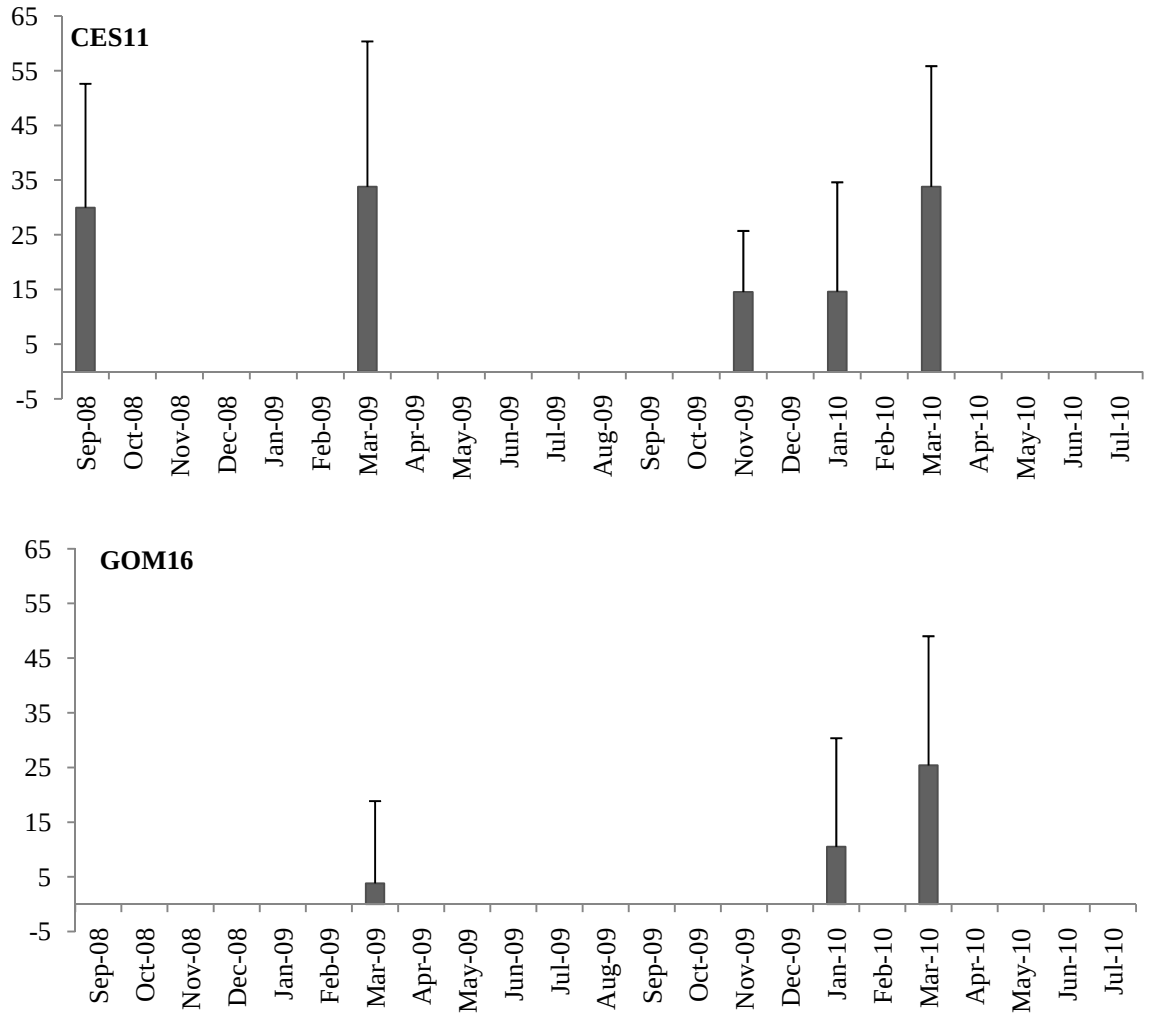

Fig. 5.4.32. Percent cover per frame based on video analysis data for entire transect for inshore soft bottom stations CES11 and GOM16. Note, video is unavailable for Sept 2008 through Jan 2009, May and July 2009 and June 2010 for CES11. Video is unavailable for GOM16 in May and July of 2009 and June 2010.

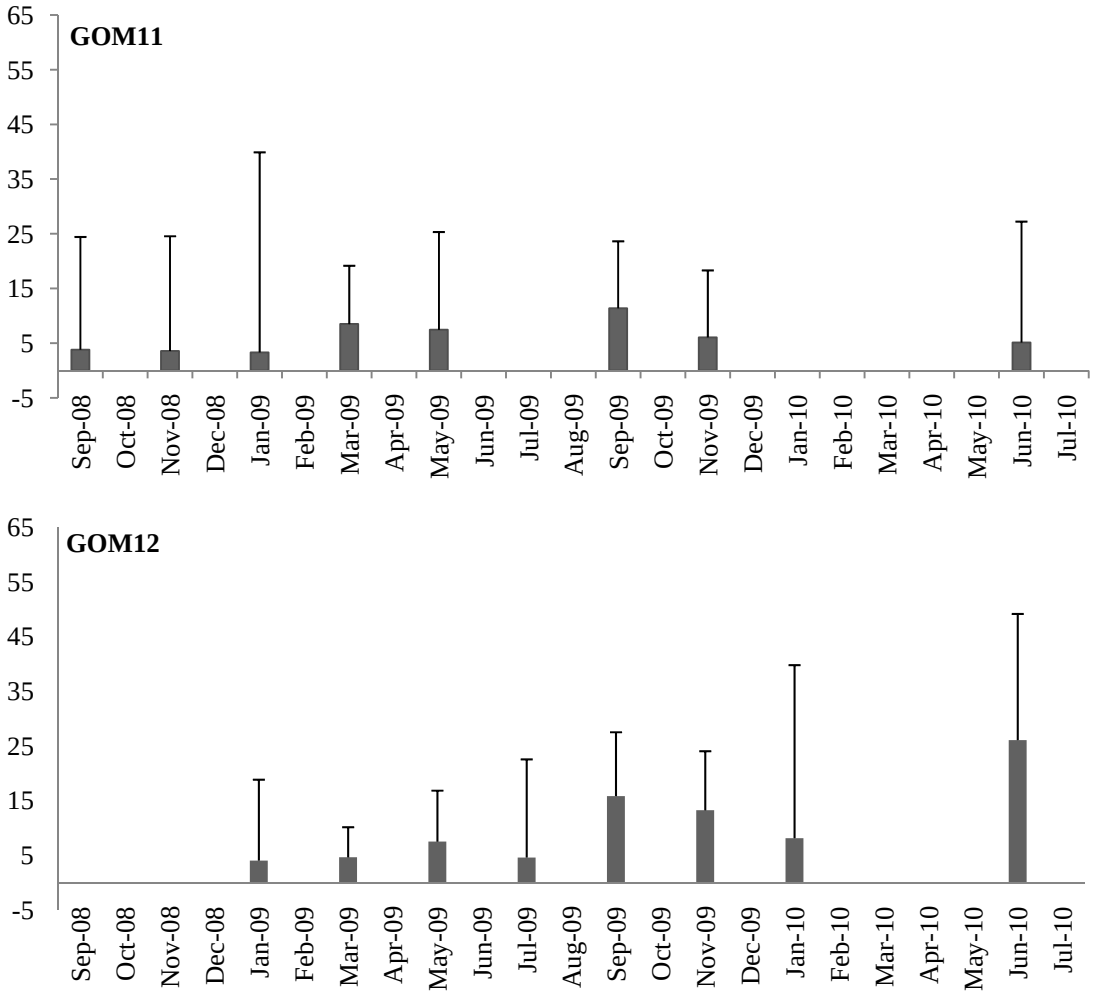

Fig. 5.4.33. Percent cover per frame based on video analysis for the entire transect for offshore live bottom stations GOM12 and GOM11. Note, video is unavailable for GOM12 in Sept and Nov 2008, and March 2010. Video is unavailable for GOM11 in July 2009.

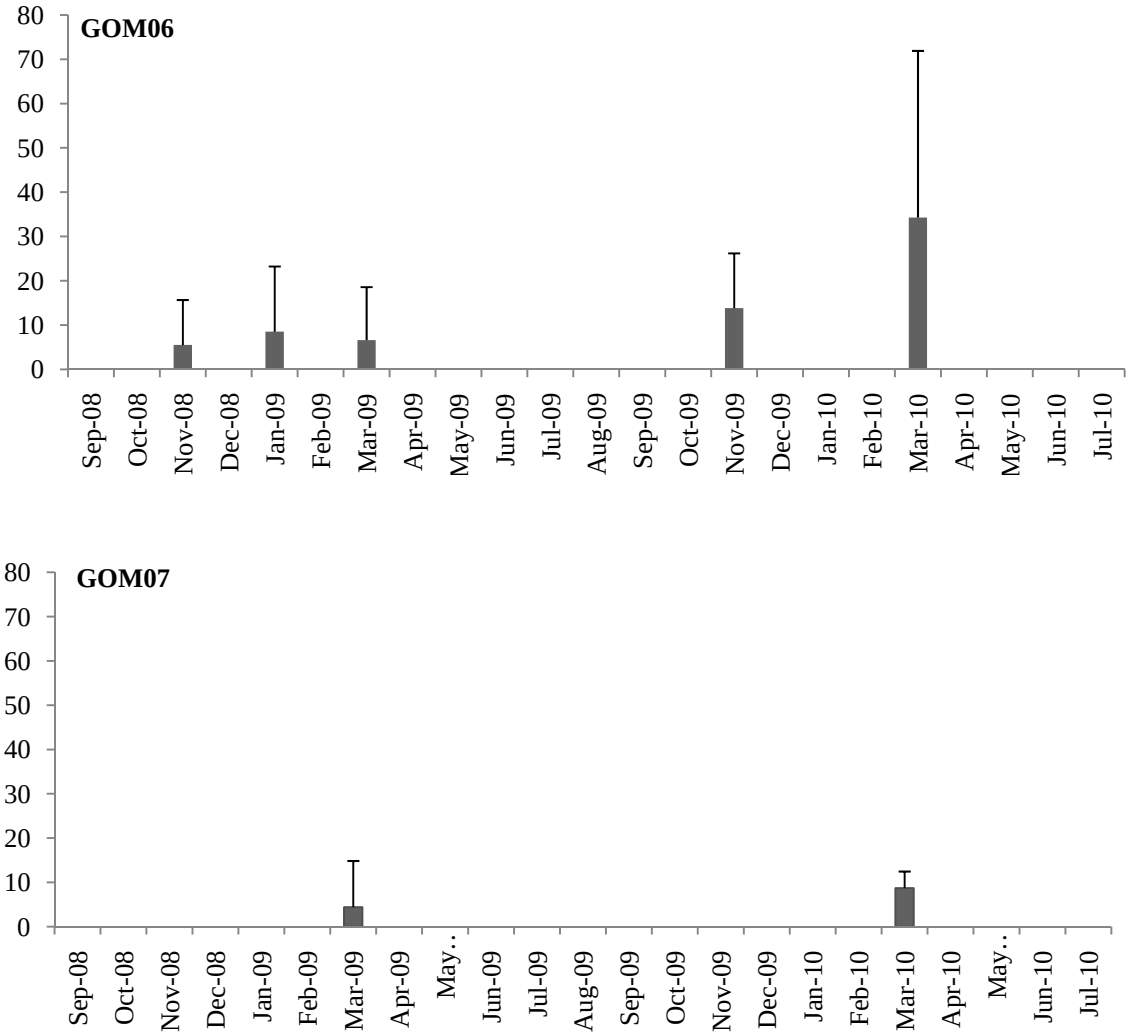

Fig. 5.4.34. Percent cover per frame based on video analysis for the entire transect for Nearshore soft-bottom station GOM07 and GOM06. Note video is unavailable for May 2009 and June 2010 for GOM06. Video is unavailable for January 2009 and September 2009 for GOM07.

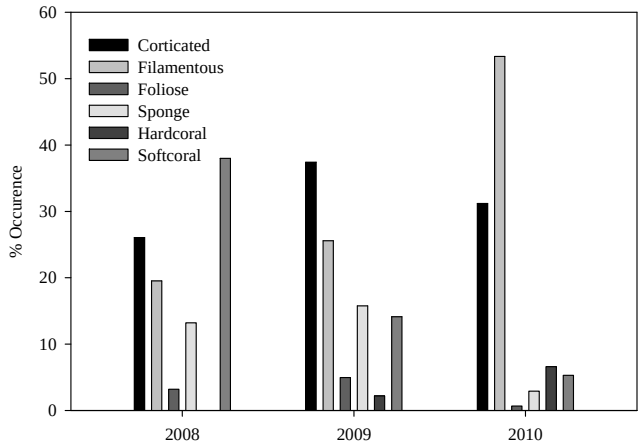

Fig. 5.4.35. Total percent occurrence of sponges, hard coral, soft coral and algal functional classes from analysis of underwater video. Underwater video analysis used a modified functional group classification (Steneck and Dethier 1996).

Appendix 5.5

May 2009 Seaweed collections around Sanibel Island Florida
Identified by Clinton Dawes (07/18/09).

1. A red alga (GOM 11; 5/13/09)
As "*Dasya rigidula*"
Cannot identify because the material was disintegrated. A few pieces had uniseriate (?) axes with cells 110 by 425 µm.

2. *Dictyota mertensii* (Maritius) Kützing (Roosevelt Channel; date?)
As "*Dictyota cervicornis*"
Fragment was about 4.5 cm long. Axes are distinct, flattened, 100 µm thick, with alternately branching tips, and with lateral branching off main (old?) axis. Medulla is 1 cell thick.

3. Probably *Scinaia halliae* (Setchell) Huisman (GOM 12; 5/11/09)
As "*Sebdenia flabellata*"
Plant was entire, small (ca 25 mm tall), and may be *S. complanata* when larger. Axes are flabellate, dichotomously branched without constrictions, and with rounded tips and a discoid base. Medulla has a core of loosely arranged filaments, which cortex is 2 cells thick with outer hexagonal ones and inner tear-shaped ones.

4. *Gracilaria bursa-pastoris* (S. G. Gmelin) P. C. Silva (CES 11; date?)
As "*Gracilaria venezuelensis*"
Fragments are highly broken up, bleached, easily squashed, and disintegrated when pressed. Axes are terete, not compressed at forks, and irregularly dichotomously branched. Medulla is parenchymatous, larger cells 125 to 150 µm in diam. and with a gradual transition between medulla and cortex. Cortex is 2 cells thick.

5. *Chondria leptacremon* (Melville) De Toni (CES 11; date?)
As "*Gracilaria cylindrica*"
Four short (3.5-1.5 cm) old, bleached, and partially broken down fragments of upper axes. Axes are not stiff, 0.2-0.4 mm in diam., with blunt tips that have a small tuft of hairs. Branchlets are club shaped and constricted at bases.

6. *Spyridia filamentosa* (Wulfen) Harvey in W. J. Hooker (Blind Pass, 5/20/09)
As "*Dasya crouaniana*"
Fragments are upper parts of old, bleached plants and with debris. Axes are uniseriate; main axes are densely corticated while branchlets are corticated only at nodes and end in a single spine.

7. *Polysiphonia subtilissima* Montagne (Colooschatchee, near Ft. Myers; 04/09)
As "*Polysiphonia subtilissima*"
Filaments are epiphytic on blades of "Tapegrass". Axes have 4 pericentral cells and branch tips lack trichoblasts so that the large apical cell is visible.

8. *Gracilaria venezuelensis* W. R. Taylor (GOM 11; 5/15/09)
As "*Gracilaria flabelliformis*"
Fragments appear to be an old and are bleached, easily squashed, but with a firm basal part. Axes are compressed at forks, with dichotomous branching near tips and irregularly alternate below; tips are pointed. Axes are parenchymatous, larger medullary cells are oval and 150 by 100 µm, and with an abrupt transition between medulla and cortex.

9. *Cladosiphon occidentalis* Kylin (Collected on *Thalassia testudinum*; "SAV")
As "*Cladosiphon occidentalis*"
Upper fragment about 8 cm long. Plants are gelatinous, soft, multiseriate, with a multiaxial filamentous medulla and radially arranged cortical filaments.

10. *Dasya collinsiana* M. Howe (GOM12; 5/11/09)
As "*Dasya ocellata*"
Fragments partially broken up and pressed together
Estimate: plants are less then 12 cm tall. Fragments of main axes are uniseriate, covered with spirally arranged and dichotomously branched branchlets, and heavily corticated in older parts. Branchlets are less than 2 mm long, in a spiral around main axes.

11. *Udotea looensis* D. Littler and M. Littler (GOM 12; 5/11/09)
As "*Udotea abbottiorum*"
An intact and very small (14 mm) plant.
Cap filaments are free (not fused into solid blade), with out appendages, and 20-25 µm in diam.; cortical siphons of stipe have pointed lateral appendages.

12. *Hypnea spinella* (C. Agardh) Kützing (GOM 12; 5/11/09)
As "*Hypnea valentiae* or *H. cornuta*"
Fragment of upper axis 5 cm long and with worm tubes attached.
Main axis alternately branched, all tips with one apical cell and the central siphon visible in cross section; axes terete, not crozier tips present (but sample is small), branching off axis is somewhat cervicorn.

13. *Chondria collinsiana* M. Howe (GOM 11, 5/13/09)
As "*Chondria collinsiana*";
Beach fragments were to 2+ cm long and bleached.
Branches and branchlets constricted at bases, tips blunt and with a tuft of hairs; younger branches have internal bands. Cystocarps are oval, ca 600 µm in diam.

July and September 2009 seaweed collections around Sanibel Island, Florida
Clinton Dawes (11/22/09)

1.*Cladophora vadorum* (Areschoug) Kützing (collected 10/06/09, NWR)
As "*Cladophora albida*"
Main axes distinct, 84 µm in diam.; apical cells 33 µm in diam.; branching flexuous.
Also: *Chaetomorpha minima* Collins and Hervey (entangled among branches).
Unbranched filaments 6.6 µm in diam; cells to 26 µm long, no rhizoids

2. *Dictyopteris polypodioides* (De Candolle in J. V. Lamouroux) J. V. Lamouroux GOM1220090915
A fragment: Veinlets absent; blades transparent, < 1.5 cm wide

3.*Gymnogongrus griffishsiae* (Turner) Martius GOM1220090915
As "*Gelidiella trinitatensis*"
Axes stiff and terete; branching dichotomous; tips tapering; medullary cells thick walled and compact.

4. *Solieria filiformis* (Kützing) P. W. Gabrielson (no collection data)
As "*Chrysymenia*"
Plants soft, densely branched; branches elongated, constricted at forks; medulla with loosely intertwined filaments.

5. *Agardhiella subulata* (C. Agardh) Kraft and M. J. Wynne CESW1120090708
As "*Eucheuma denudatum*"
A fragment only, in poor condition, and too small to press. Branching radial, irregular; medulla consists of loosely entangled filaments; cystocarpic.

6. *Gracilaria armata* (C. Agardh) Greville? GOM1220090713
As "*Gracilaria flabelliformis*?"
Fragment only, in poor condition, and too small to press. Axes slightly compressed, 1.0-1.5 mm wide; somewhat spiny.

7. *Eucheuma isiforme* var. *denudatum* D. P. Cheney (No collection data)
Axes densely and irregularly branched at base; medulla has a compact filamentous center.

8. As "*Champia parvula*" GOM1220090713 (#6 ECM0
Fragment was dried up and too damaged to identify or press

9. *Laurencia chondrioides* Børgesen GOM1220090713 (#10 AJM)
As "*Laurencia filiformis*"
Axes red; tip blunt, with projecting hairs; surface cells 20+ µm in diam.; 4 pericentral cells.

10. *Scinaia halliae* (Setchell) Huisman GOM 1220090713 (#4 ECM)
Axes red, gelatinous; branching dichotomous, cortex 2 cells thick

11. *Caulerpa ashmeadii* Harvey GOM1220090713 (#4 ECM)
Branchlet tips are blunt.

12. *Hypnea musciformis* (Wulfen in Jacquin) J. V. Lamouroux GOM1220090713 (#7 JS)
A number of hemate branches, branch tips with a single apical cell.

13. *Gracilariopsis lemaneiformis* (Bory) Dawson *et al*. GOM12—(#8 JS)
Cystocarpic; axes tough, cartilaginous; branching irregular; medullary cells to 500 µm in diam.

14. *Chondria littoralis* Harvey GOM1220090713 (#6 KP)
As "*Chondria sedifolia*"
Branchlets smaller than 0.5 mm, constricted at bases, pointed and with apical cell exposed beyond small tuft of hairs.

15. *Gracilaria tikvahiae* McLachlan GOM08—
As "*Gelidiopsis lemaneiformis*"
Fragment too small to press. Tips with # cells, medulla with thick-walled cells, parenchymatous; medullary ells to 160 µm in diam., polygonal; cortex 1-3 layers with abrupt transition.

16. *Gracilaria armata* (C. Agardh) Greville GOM1220090713 (#4 ECM)
As "*Gracilaria flabeliformes*"
A young plant; tips have # cells, medulla parenchymatous, cells to 280 µm in diam.; cortex 2-3 layers; transition is gradual.

17. *Jania adhaerens* J. V. Lamouroux GOM1220090113 (#7 could not read initials)
As "*Jania rubens*"
A small fragment, too small to press. Calcified; branching dichotomous, ca <30° angle; axes 112 µm in diam.; conceptacles in forks.

18. *Laurencia sp*? CESII 7/8/2009.
Fragment too small and in poor shape to ID or press.

19. *Gracilaria tikvahiae* McLachlan GOM1220090713 (# 8 AT)
As "*Gracilaria bursa-pastoris*"
Pale pink; tips with # apical cells; axes compressed to flat; branching irregular to alternate; medulla parenchymatous, larger cells to 140 µm in diam.; cortex 2-layered, transition abrupt.

20. *Hypnea spinella* (C. Agardh) Kützing? GOM1220090713 (#7 JS)
Not certain, small fragment; no hemate branches.

21. *Gracilaria armata* (C. Agardh) Greville GOM112009015 (#4 JS)
As "*Gracilaria venezuelensis*"
Fragment was an upper branch; main axes slightly compressed; branching pseudodichotomous, without constrictions; ultimate branching secund; axes parenchymatous, medullary cells to 240 µm in diam.; cortex 2-3 layers, transition gradual.

22. *Agardhiella ramosissima* (Harvey) Kylin GOM1220090713 (#1 ECM)
Plant had holdfast; medulla with loosely entangled filaments.

23. *Dasya antillarum* (M. Howe) A. Millar? GOM1220090713 (#4 KP)
As "*Dasya collinsiana*"
Fragments dried, too poor to press, and uncertain on identification. Mixed in with dried material were fragments of *Ceramium* sp. and *Gracilaria* sp. Main axes corticated; branches uniseriate, spiraled.

24. *Wurdemannia miniata* (Sprengel) Feldman and Hamel GOM 12020090713 (#12 AJM)
Tips had multiple apical cells; branches terete, branching dichotomous; medulla lacked rhizines but had thick-wall medullary cells.

25. *Udotea looensis* D. Littler and M. Littler GOM1220090713 (#6 KP)
Blades thin, delicate, with numerous interwoven siphons that lack lateral appendages; stipe siphons have appendages with pointed tips.

26. *Gracilaria venezuelensis* W. R. Taylor GOM1220090713 (#4 ECM)
AS "*Gracilaria intermedia*"
Axes slightly compressed, < 2mm wide; branchlets spiny; tips with multiple apical cells; branching mostly in one plane, from margins, irregular to alternate, and delicate at tips; Medulla parenchymatous, larger cells to 210 µm in diam.; cortex 2 cells thick, transition abrupt.

27. *Dictyota cervicornis* Kützing GOM12 7/13/09 (#3 KP)
Fragment pressed together and difficult to separate without damagea. Branching cervicorn, with many proliferations; margins smooth, fronds narrow only slightly after each fork, < 3 mm wide, and ca 70 µm thick (but probably thicker when fresh); medulla 1 cell thick.

28. *Caulerpa mexicana* Sonder *ex* Kützing GOM1220090713 (#1 ECM)

29. *Acanthophora muscoides* (Linnaeus) Bory GOM1220090713 (#4 KP)
Spines are on spur branchlets and all axes.

30. *Gracilaria blodgettii* Harvey GOM1120090715 (#8 ECM)
As "*Lomentaria baileyana*"
Fragment of upper branches, shrunken (previously dried?). Axes elongated, < 1mm wide; tips with many apical cells; branches constricted at bases; medulla parenchymatous, larger cells to 350 µm in diam.; cortex with 2 layers; transition abrupt.

31. *Gracilaria flabelliformis* (P. Crouan and H. Crouan) Fredericq and Gurgel. Beach collection 07/24/09, West Gulf
As "*Dictyopteris* stage of *Padina*"
Eroded bases of dense clusters of axes covered with *Acrochaete microscopica*. Basal axes flattened, to 3 mm wide; branchlets terete with multiple apical cells; branching irregular; medulla parenchymatous, medullary cells to 240 µm in diam.; cortex with gradual transition.

Report #3: June 2010
August 2009 to May 2010 Macroalgal collections around Sanibel Island, Florida
Identified by Clinton Dawes with herbarium specimens included

1.*Gracilaria tikvahiae* McLachlan. Not Pressed
As: "unnamed", GH1, #10, 08/29/09,VSR
A decomposed fragment, bleached out, axes compressed, parenchymatous medulla, abrupt transition to cortex

2. *Agardhiella subulata* (C. Agardh) Kraft and M. J. Wynne Pressed
As: "*Agardhiella subulata*?" 35, Ledge, #7, 08/08/09, VSR
Large, robust plant, axes terete, abundant radial branching, filamentous medulla

3. *Codium decorticatum* (Woodward) M. Howe Pressed
As: "unidentified green", Sherman's Barge, #5, 0808/09, VSR
A fragment, branching dichotomous, axes 1.5-2.0 mm in diam., utricle outer wall to 3 µm thick

4. *Wurdemannia miniata* (Sprengel) Feldmann and Hamel Pressed
As: "*Dasya*?", Sherman's Barge, #4, 08/08/09, VSR
Bleached out turf, wiry axes, # apical cells per tip, mostly little branching, dense filamentous medulla with thick-walled cells

5. Cannot identify, material disintegrated Not Pressed
As: "keyed to *Gracilaria* sp.", 35 Ledge #6, 08/08/09, VSR

6. *Agardhiella subulata* (C. Agardh) Kraft and M. J. Wynne Pressed
As: "similar to red, decomposed", Bowditch #30, 01/26/10
Plant large, robust, axes terete, abundant radial branching, loose filamentous medulla, same as #2

7. *Agardhiella subulata* (C. Agardh) Kraft and M. J. Wynne Not Pressed
As: "#1", Bowditch #31, 01/26/10, TWW
Bleached out, 2 fragments, cystocarpic, terete axes, radial branching, the same as #2, 6

8. *Chondria floridana* (Collins) M. Howe Pressed
As: "*L. intricata*?", 35 Ledge, #3, 08/08/08, VSR
Fragment densely branched, branchlets with apical pits and not constricted, the 5 pericentral cells obscured in cross section

9. *Caulerpa mexicana* Sonder *ex* Kützing Pressed
As: “most like *Caulerpa mexicana*”, 35 Ledge #2, 08/08/09, VSR
A fragment, but clearly the species

10. *Gracilaria tikvahiae* McLachlan (best estimate) Not Pressed
As: “#3”, 53 Ledge, #21, 09/09/09, VSR
Fragments are small, bleached, broken up, axes appear compressed, medulla is parenchymatous with abrupt transition at cortex

11. *Caulerpa ashmeadii* Harvey Pressed
As: “#4”, 53 Ledge, #22, 09/09/09, VSR
A small part of a plant with three erect axes, bleached

12. *Hypnea spinella* (C. Agardh) Kützing Pressed
As: “Green (#1), Decomposed”, Sandpiper, #28, 01/19/10, TWW
Fragments bleached out, partially decomposed, branch tips in poor shape but appear to have single apical cells, spinosa axes

13. *Sargassum filipendula* C. Agardh Pressed
As: “green (#1)”, 53 Ledge, #27, 10.27/08, VSR
Perennial bases only, leaves long, serrate, stems smooth

14. *Wurdemannia miniata* (Sprengel) Feldmann and Hamel Pressed
As: “red (#3)”, Sherman’s, #25, 10/10/09, VSR
A turf of small size, see #4

15. *Agardhiella subulata* (C. Agardh) Kraft and M. J. Wynne Not Pressed
As: “red (#2)”, 53 Ledge, #26, 10/24/09, VSR
Bleached fragment at base, secund branchlets, an old poorly preserved plant

16. *Hypnea cornuta* (Kützing) J. Agardh Pressed
As: “green, decomposed”, Sandpiper, #29, 01/19/10, TWW
Two bleached fragments, tip with a single apical cell, spines cornute; also with epiphytic branching bryozoans (orange pigment)

17. *Hypnea spinella* (C. Agardh) Kützing Pressed
As: “—(#1)”, 53 Ledge, #23, 09/19/09, VSR
A dense, bleached from, tips with 1 apical cell, axes parenchymatous, spinosa

18. Dichotomously branching bryozoans Not Pressed
As: "— (#10)", 53 Ledge, #20, 09/19/09, VSR
A colonial bryozoan that is a common epiphyte of seagrasses

19. *Gracilaria* sp. Not Pressed
As: "— (#8a)", 53 Ledge, #24, 09/19/09 VSR
Probably *Gracilaria tikvahiae*, But too decomposed to identify

20. *Halymenia floresia* (Clemente y Rubio) C. Agardh Pressed
As: "— (#2)", 53 Ledge, #19, 09/19/09, VSR
Bleached out base of small plant, flat, foliose, blade divided alternately, filamentous medulla

21. *Agardhiella subulata* (C. Agardh) Kraft and M. J. Wynne Not Pressed
As: "— (#6)", 53 Ledge, #18, 09/19/09, VSR
Bleached out base of plant with filamentous medulla

22. *Codium isthmocladum* Vickers Pressed
As: "most similar to *Codium* sp. (#2)", 60 ft Ledge, #15, 09/19/09, VSR
Small entire plant, bleached out, dichotomous branching, main axis 3 mm in diam, utricle outer wall ca 2-3 µm thick

23. *Dictyopteris delicatula* J. V. Lamouroux Pressed
As: "— (#8)', 53 Ledge, #17, 09/19/09, VSR
Two fragments, blades to 5 mm wide, medulla 2-celled, no veinlets

24. *Agardhiella subulata* (C. Agardh) Kraft and M. J. Wynne Pressed
As: "*Agardhiella subulata*?", 35 Ledge, #1, 08/08/09, VSR
Large, well preserved plant, see #2, 6, 7

25. Probably a *Dasya* sp., but fragment too decomposed Not Pressed
As: "*Dasya crouaniana*; sparsely covered with fine branchlets" CESII, #2, JS

26A. Two different algae:
Agardhiella subulata (C. Agardh) Kraft and M. J. Wynne Pressed
As: "*Gracilaria* sp.?, 35 Ledge, #9, 08/08/09, VSR
Filamentous medulla, a more delicate plant, see #2, 6, 7, 24

26B. A mixed set of algae:
Gracilaria damaecornis J. Agardh Pressed
As: "*Gracilaria* sp.?" 35 Ledge, #9, 08/08/09, VSR
Main branching dichotomous below, irregular above, axes spiny, medullary cells to 200

27. *Sargassum hystrix* J. Agardh Pressed
As: "keyed to *Sargassum* sp." GHI, #11, 08/29/09, VSR
A plant base, axes smooth, blades serrate and lanceolate, cryptostomata few

28. A "non-alga", some sort of fibers without internal structure Not Pressed
As: "filamentous red in color (#1)", 60ft Ledge, #14, 09.19.09, VSR
Reddish-brown filaments, non algal

29. *Wurdemannia miniata* (Sprengel) Feldmann and Hamel Pressed
As: "filamentous red in color (#1)", 60 ft Ledge, #14, 09/19/09, VSR
Bleached turf, axes terete, wiry, medulla with densely packed filaments with thick walls and polygonal in cross section.

30. *Lomentaria baileyana* (Harvey) Farlow Pressed
As: "*Hincksia mitchelliae*", GOM16, JS #2
Bleached out mat, badly preserved, hollow axes, pointed tips, with abundant filamentous epiphyte *Acrochaetium microscopicum* that has monosporangia

31. *Gracilaria tikvahiae* McLachlan. Pressed
As: "*G. tikvahiae*, x-section, flat axis, abrupt transition in medullary cells" CESII, #10, KP
Large fragments, decomposed, cystocarpic cortex is abrupt from medulla, compressed at forks

32. Non-alga, a hydroid with brown color Not Pressed
As: "?", Edison #13, 08/29/09, VSR

33. *Eucheuma isiforme* (C. Agardh) J. Agardh Pressed
As: "*Gracilaria tikvahiae*", Beach sample, 02/23/10
Medulla has densely packed filamentous center, unlike shallow water, Florida Keys plants, this one is densely branched and with secund branchlets.

34. *Hydropuntia caudata* (J. Agardh) Gurgel and Fredericq Pressed
As: "*G. tikvahiae*? Most similar to", 35 Ledge #8, 08/08/09, VSR
Large plant, densely branched throughout, alternate to irregular, medulla parenchymatous with abrupt transition to cortex

35. Cannot identify the decomposed fragment Not Pressed
As: "*Polysiphonia flaccidissima*", CESII, #2, JS
Material totally decomposed, fragments appear to have 5 pericentral cells, axes ecorticate

36. *Chondria capillaris* (Hudson) M. J. Wynne Pressed
As: "*Champia parvula*, segmented, not holdfast", CESII, #2, JS
Two fragments, bleached out, branchlets with basal constrictions, tips withy tuft of short hairs, apical cell exposed

37. *Lomentaria baileyana* (Harvey) Farlow Pressed
As: "*Lomentaria baileyana*", CESII, #2, JS
Bleached out, axes hollow, tubular, with irregular branching, pointed tips

38. *Palisdada poiteaui* (J. V. Lamouroux) Nam Not Pressed
As: "*Laurencia filiformis*, no obvious cells in terminal pits, vegetative", GOM12, #10, JS
Fragments, slightly decomposed, with hydroid epiphyte, also a mix of algae (*Lomentaria baileyana*, *Champia parvula*, *Ceramium* sp.)

39. *Sargassum filipendula* C. Agardh Pressed
As: "*Sargassum ramifolium*, no spines on thallus or air bladder, holdfast", GOM12, #8, KP
A small entire plant (20 cm long) with holdfast, also a fragment of *Caulerpa mexicana*, blades are serrate, ca 10 widths long, axes smooth, cryptostomata scattered, vesicles stalked, lack spines

40. *Caulerpa mexicana* Sonder *ex* Kützing Pressed
As: "*Caulerpa taxifolia*", GOM12, #10, KP
A fragment, blades flat, divided into bladelets with a spine at tip

41. *Solieria filiformis* (Kützing) Gabrielson Pressed
As: "*Solieria filiformis*", GOM12, #10, KP
Axes delicate, to 1.5 mm in diam., subdichotomously branched, medulla with loose filaments and a central pack, filaments not intertwined

42. *Hypnea spinella* (C. Agardh) Kützing Pressed
As: "*Hypnea spinella*", GOM12, #10, KP
See #12, tips have a single apical cell, axes spiny; also *Solieria filiformis* and *Palisdada poiteaui*,

43. *Champia parvula* (C. Agardh) Harvey Pressed
As: "*Champia parvula*", GOM12, #10, KP
Bleached out entire plants, axes segmented, hollow

44. *Polysiphonia subtilissima* Montagne Pressed
As: "*Polysiphonia* sp.", CESII, #1, KP
Fragments decomposed, axes ecorticate, 4 pericentral cell, apical cells exposed, tetrasporic, with basal creeping axes

45. *Codium isthmocladum* Vickers Pressed
As: "*Codium taylorii*, one point of attachment", GOM12, #5, JS
Entire young plant, ca 7 cm tall, upper axes dichotomously branched, utricle to 250 µm in diam. and outer wall thin

46. *Spyridia filamentosa* (Wulfen) Harvey Not Pressed
As: "*Spyridia filamentosa*- collection at end of branchlets", GOM15, #2, EM
Fragments decomposed, branchlets mostly lost but nodal banding evident

47. *Spyridia filamentosa* (Wulfen) Harvey Not Pressed
As: "*Spyridia filamentosa* filaments bushy, attenuate branching, CESII, JS #2
Fragments decomposed, typical branchlet nodal cortication and single terminal spine

48. *Gracilaria damaecornis* J. Agardh Pressed
As: "*Gracilaria venezuelensis* – x section: parenchymatous medullary cells, delicate tips", GOM032009, 1119
Two entire plants, densely, alternately to irregularly branched, medulla parenchymatous, cells to 180 µm in diam.

49. *Caulerpa mexicana* Sonder *ex* Kützing Pressed
As: "*Caulerpa mexicana*", GOM12, #10, KA
A mat-clump of plants with typical erect flat, divided blades