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Benthic Community Monitoring for the Little Venice Sewage Collection and Treatment Project in Marathon, Florida

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BENTHIC COMMUNITY MONITORING FOR THE LITTLE VENICE SEWAGE COLLECTION AND TREATMENT PROJECT IN MARATHON, FLORIDA

Final Report for SFWMD/FIU COOP Agreement #C-11258

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Technical Contribution #T-231 of the Southeast Environmental Research Center at Florida International University

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Executive Summary

This report includes cumulative benthic community data from 18 stations within the Little Venice subdivision collected quarterly during the period of record May 2001 – July 2004. Benthic sampling was conducted as transects away from canal nutrient sources. Four transects were selected to correspond with the water quality sampling. This included two reference sites outside of the treatment area. There were four sampling sites along each transect: the canal mouth (0 m), 50 m, 100 m, and 200 m from the mouth. Each of the transects were visited quarterly via small boat.

The inshore waters off the canals of Little Venice subdivision are clearly impacted by landuse and the associated septic treatment systems. It is clear that *Thalassia,* and *Halodule* abundance is highest in sites furthest from the canal mouth. Seagrass densities are lowest at the canal mouths. It is also evident that the sites closest to the canal mouths have the greatest abundance of green algae, which are typically considered to be strong indicators of elevated nutrient conditions. Brown algae are also primarily found at the nearshore area along with lowered DO.

This study lays the groundwork for futher benthic community characterizations after the sewage treatment plant comes online. We would expect that with decreased nutrient inputs, one would see a migration of *Thalassia* back into the nearshore waters off the canals.

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BACKGROUND

The ocean side area of Vaca key from Vaca Cut (east) to 94th Street (west), Marathon, Florida has a large percentage of houses and trailers that are currently serviced by inadequate septic tank systems or cesspit disposal. This are has been collectively called the "Little Venice" Service Area, whereas in fact, Little Venice Subdivision is located on the westernmost portion of the service area. The Little Venice Service Area includes approximately 540 residences (Figure 1).

The Little Venice Service Area was selected as the first phase of wastewater improvements for the Marathon Service Area because of the large number of homes on cesspits, the small average size of lots, the density of homes, and known water quality problems in the canals that occur in the area. Water quality of the 89th – 91st Street canals was thoroughly studied in 1984-1985 as part of the Florida Department of Environmental Regulation's Monitoring Study (FDER, 1987). That study demonstrated significant nutrient enrichment of the canals, high chlorophyll a content, and high coprostanol concentrations in sediments. Coprostanol is a break-down product of cholesterol and is an indicator of fecal contamination.

The Little Venice Service Area will receive a low-pressure, vacuum wastewater collection system that will transmit wastewater to a central treatment plant. The treatment plant will produce effluent that meets or exceeds the current advanced wastewater treatment (AWT) standards of 5:5:3:1 (BOD5, TSS, TN, TP) and will use a Class V injection well for disposal of treated wastewater. Central collection and treatment of wastewater will remove a substantial portion of nutrient loading into the canals by removing the sources of wastewater (poorly functioning septic tanks and cesspits).

SAMPLING PROGRAM

The purpose of this benthic community monitoring program was to document the current conditions of community structure prior to the installation of STP in the Little Venice Service Area. The monitoring program was conducted for three years prior to the initiation of operation of the central sewage treatment system.

Four canals within the Little Venice Service Area were sampled; the same ones as in the water quality monitoring project (Figure 1). Canal 1 is a connected "U-shaped" canal system located at 112th Street. This canal may receive better tidal flushing than other canals within the Service Area because of their flow-through design and their relatively short length. Canal 1 is lined with single-family residences that were constructed prior to 1970 and a high percentage of those residences are thought to have no sewage treatment systems (cesspits). Canal 2 is located adjacent to 100th Street, Canal 3 is adjacent to 97th Street and Canal 4 is adjacent to 91st Street.

Canals 2, 3 and 4 are dead-end canals that are lined with single-family houses and mobile homes. Many of these residences are thought to have poorly functional septic systems or cesspits. The 91st Street canal was selected as a reference canal and is located outside the Little Venice Service Area. Historic water quality and sediment data exist for this canal (FDER 1987).

Field Sampling Regime

Benthic sampling was conducted as transects away from canal nutrient sources. Four transects were selected to correspond with the water quality sampling (Fig. 1). This includes two reference sites outside of the treatment area. There were four sampling sites along each transect: the canal mouth (0 m), 50 m, 100 m, and 200 m from the mouth. Each of the transects were visited quarterly via small boat.

A rapid, visual assessment technique developed early in the 20th century by the plant sociologist Braun-Blanquet was used to assess abundance of seagrass and macroalgae. This method is very quick, requiring only minutes at each sampling site; yet it is robust and highly repeatable, thereby minimizing among-observer differences. At the beginning of the study period, GPS coordinates were recorded at each station which were marked by driving steel rods into the substratum. Ten quadrats (0.25 m^2) were haphazardly thrown within 10 m of the station. Each quadrat was examined by snorkeling or SCUBA diving. All seagrass species occurring in the quadrat were listed and scored according to the cover of the species in that quadrat (Table 1). Cover was defined as the fraction of the total quadrat area that is obscured by a particular species when viewed from directly above.

Three statistics were computed for each species from the raw observations of cover in each quadrat at each site: density, abundance, and frequency (Table 1). For any species, density can range between 0 and 5; the maximum Braun-Blanquet score. At any site, however, the sum of all taxa density values can be greater than 5 because of the relatively broad cover ranges for each Braun-Blanquet value and the fact that seagrass canopies are three dimensional. In addition to species-specific measures, seagrass species richness (S) will be calculated for each site by summing the number of seagrass species for which density $D > 0$.

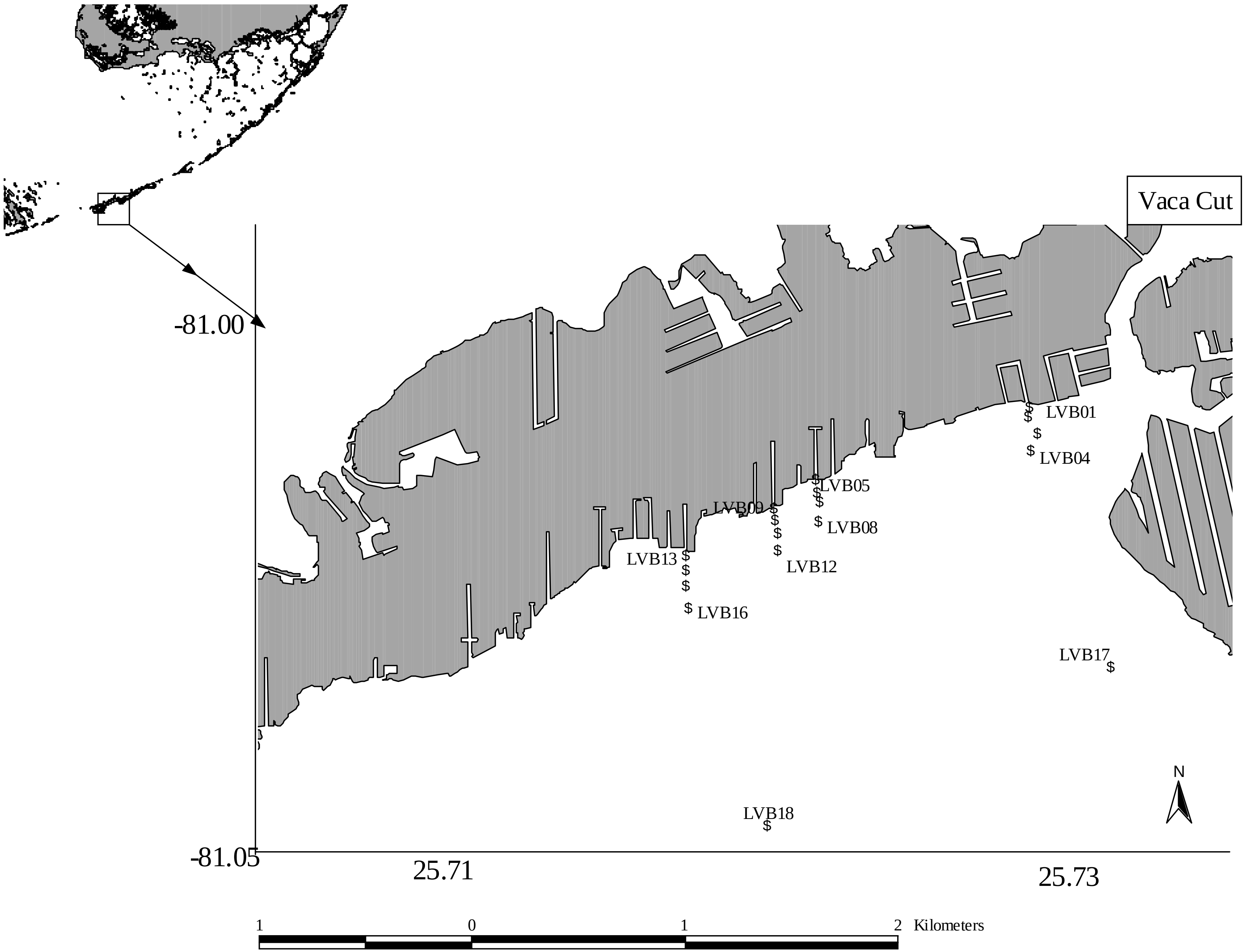
RESULTS

This report includes benthic community data from18 stations within the Little Venice subdivision collected during the period of record May 2001 – July 2004. This corresponds to the period prior to completion of the sewage treatment plant. Benthic community type was described by benthic sampling conducted as transects away from canal nutrient sources. The time series graphs of density, abundance and frequency for the major taxonomic groups are shown in Fig. 2-19.

The inshore waters off the canals of Little Venice subdivision are clearly impacted by landuse and the associated septic systems. It is clear that *Thalassia*, and *Halodule* abundance is highest in sites furthest from the canal mouth (Figs. 20-31). Box and whisker plots show seagrass densities are lowest at the canal mouths (Figs. 35-37). It is also evident that the sites closest to the canal mouths have the greatest abundance of green algae, which are typically considered as strong indicators of elevated nutrient conditions (Fig. 33). Brown algae are also primarily found at the nearshore area (Fig. 34) along with lowered DO (Fig. 32).

This study lays the groundwork for further benthic community characterizations, after the sewage treatment plant comes online. We would expect that with decreased nutrient inputs, there would be a migration of *Thalassia* back towards the canal mouths.

ACKNOWLEDGEMENTS
We thank all the field and laboratory technicians involved with this project. This project was possible due to continued funding by the SFWMD (Agreement #C-11258). This is Technical Report #T-231 of the Southeast Environmental Research Center at Florida International University.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LVB17
LVB18
N
1
0
1
2 Kilometers

Figure 1.

Table 1.

Abundance is the BB (Braun Blanquet) average score of quadrats that the taxa was present in	
Frequency is how many quadrats the taxa was found in, out of all 10	
Density is the taxa we found over all 10 quadrats	
Braun Blanquet Scores	
Table 1. Braun Blanquet density scores	
Score	**Cover**
0	Taxa absent from quadrat
0.1	Taxa represented by a solitary shoot, <5% cover
0.5	Taxa represented by a few (<5) shoots, <5% cover
1	Taxa represented by many (>5) shoots, <5% cover
2	Taxa represented by many (>5) shoots, 5 - 25% cover
3	Taxa represented by many (>5) shoots, 25 - 50% cover
4	Taxa represented by many (>5) shoots, 50 - 75% cover
5	Taxa represented by many (>5) shoots, 75 - 100% cover
Braun Blanquet Substrate Scores	
Score	***Substrate Type***
1	Mud
2	Sandy-Mud
2	Sandy-Mud Shell
3	Muddy-Sand
3	Muddy-Sand Shell
4	Sand
5	Course Sand
6	Halimeda Hash
7	Rubble
8	Rock
9	Live Coral
Note: substrate depths at 51 cm are an average meaning (>50cm)	
Calc. Note	D_i = SUM(S_{ij}/n); where D_i = Density of species i; j = quadrat number from 1 to n, the total number of quadrats sampled at a site, and S_{ij} = the Braun-Blanquet score for species i in quadrat j. For any species, D can range between 0 and 5, the maximum Braun-Blanquet score. At a site, however, the sum of all taxa D values can be greater than 5, because of the relatively broad cover ranges for each Braun-Blanquet value and the fact that seagrass canopies are three dimensional. It should also be noted that a species may be observed at a site by the sample collector, but unless the species falls within one of the randomly-placed observation quadrats, the species receives a D = 0. Abundance was calculated as A_i = SUM(S_{ij}/$N_{i)}$, where N_i is the number of quadrats at a site in which species i was present. For any species, A can range between 0 and 5, the maximum Braun-Blanquet score (note $D_i \leq A_i$). Frequency was calculated as $F_i = N_i/n$; $0 \leq F_i \leq 1$. In addition to species-specific measures, seagrass species richness S

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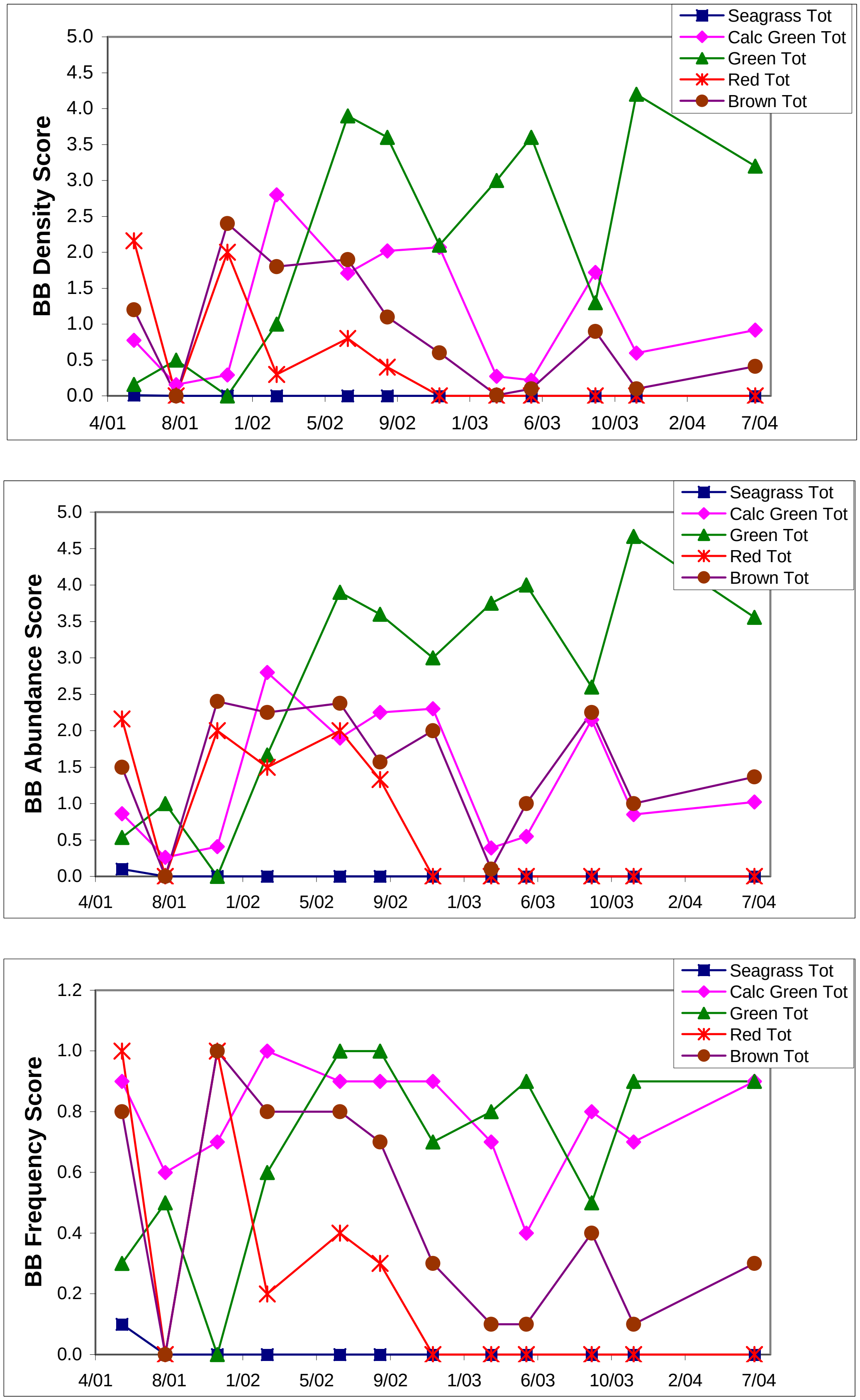

Figure 2

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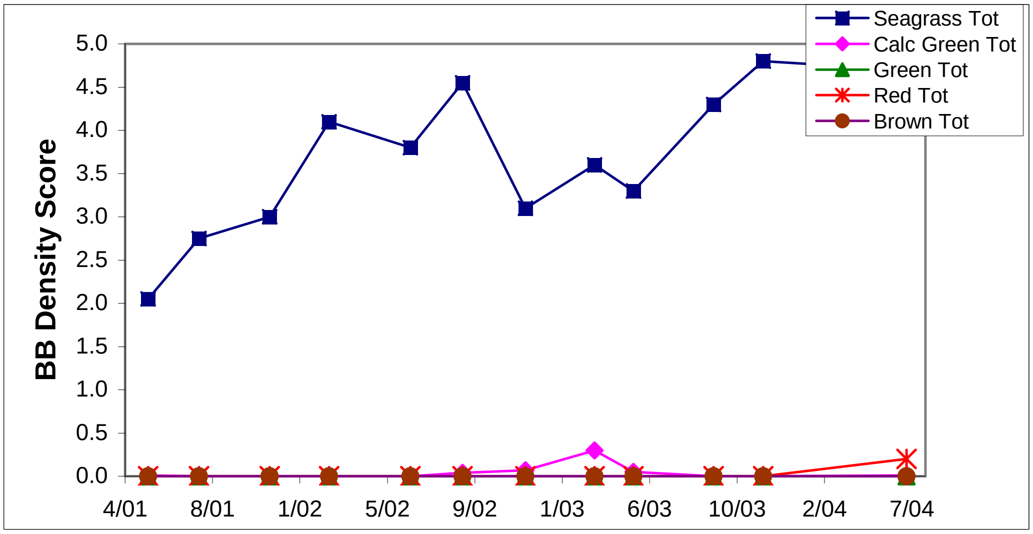

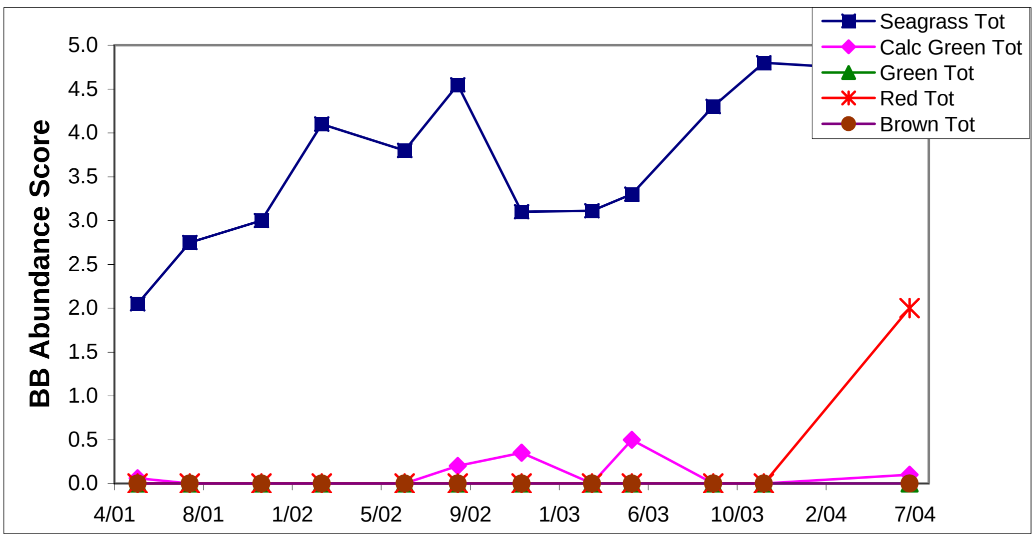

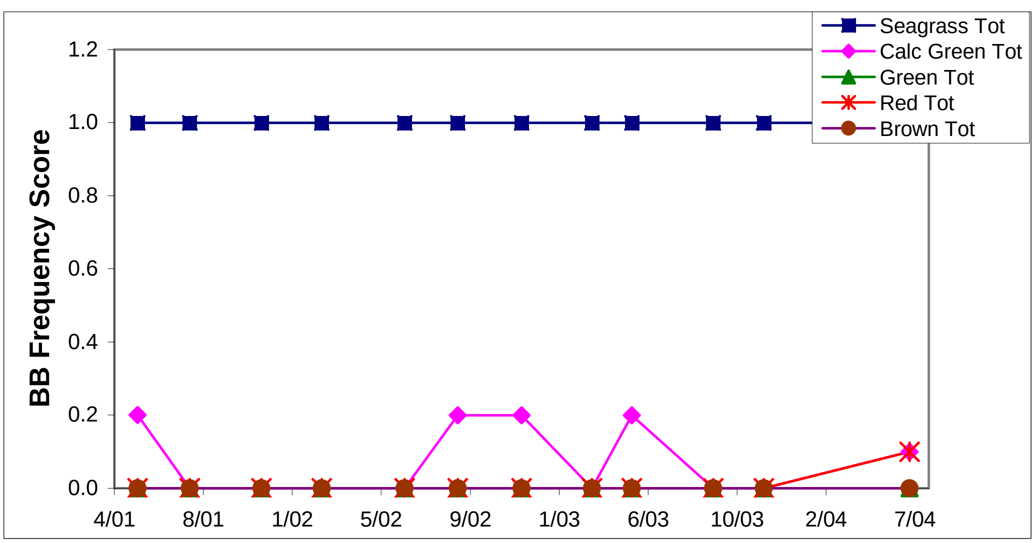

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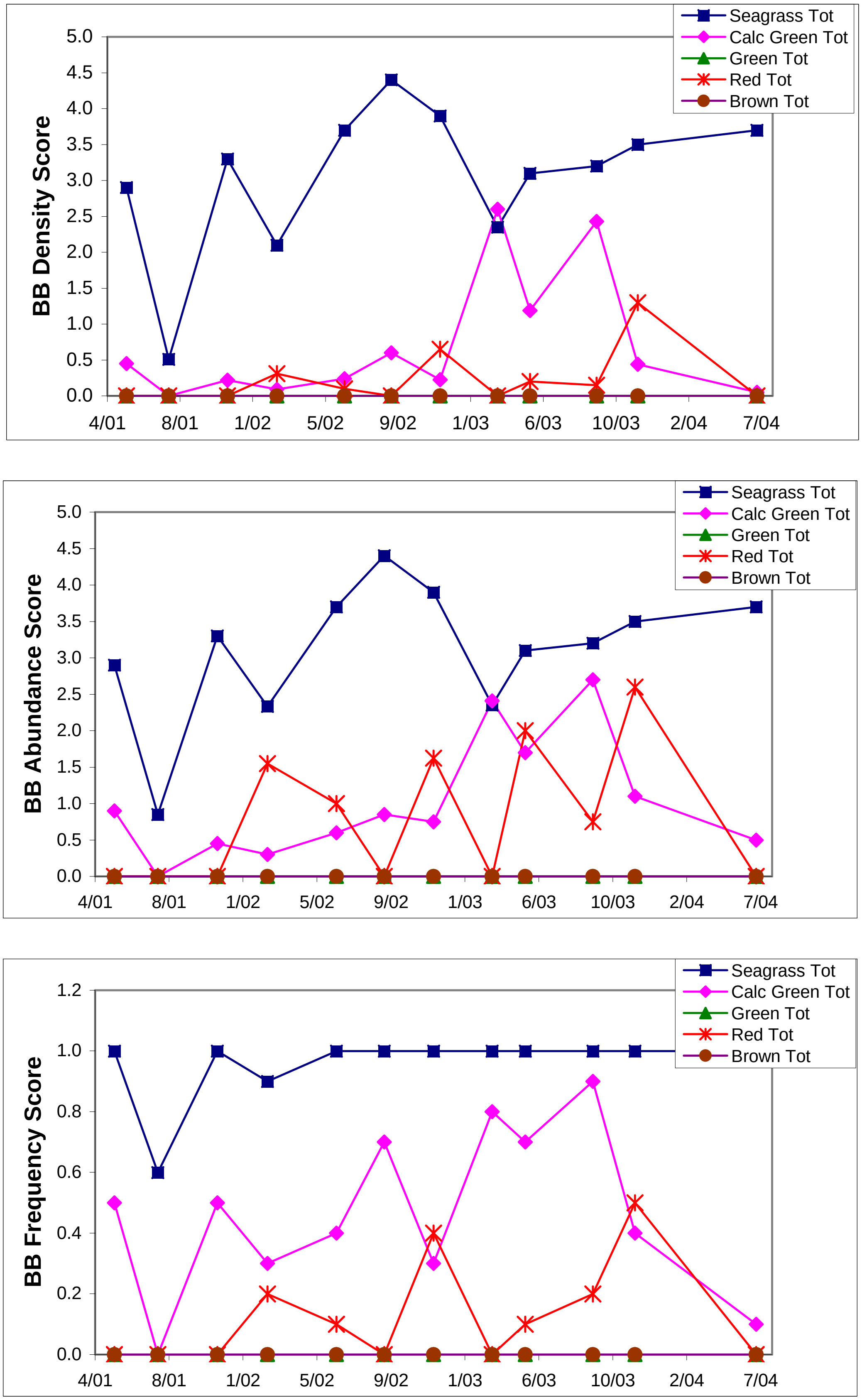

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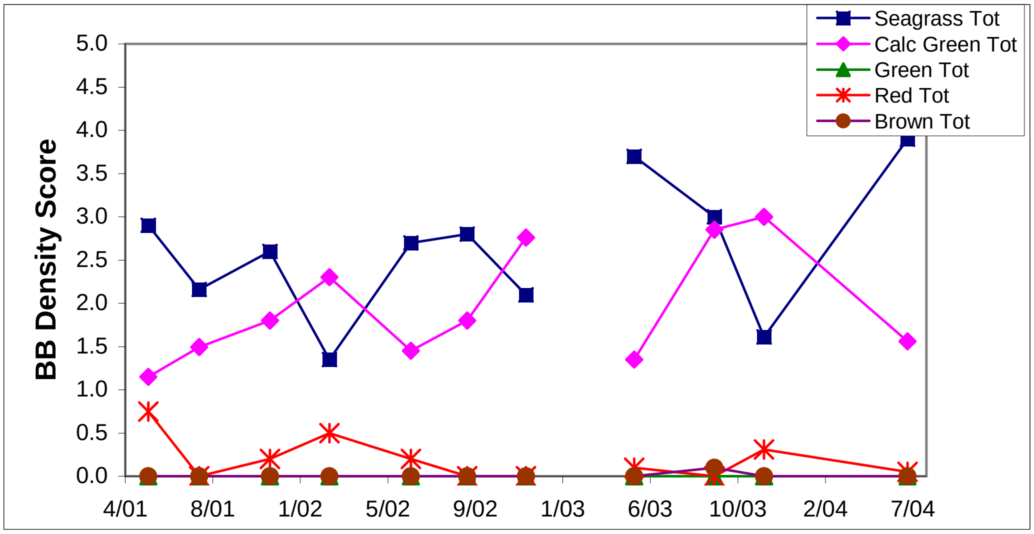

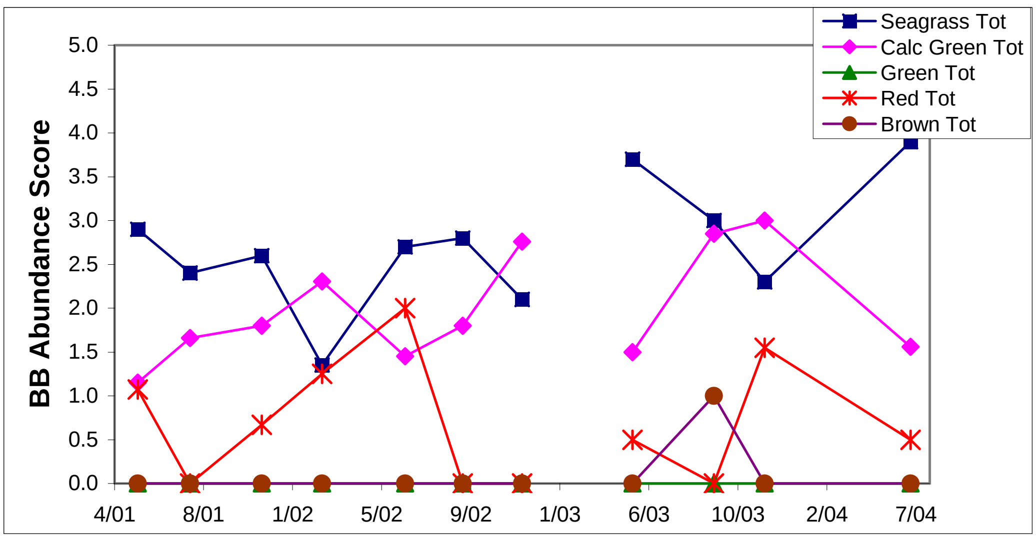

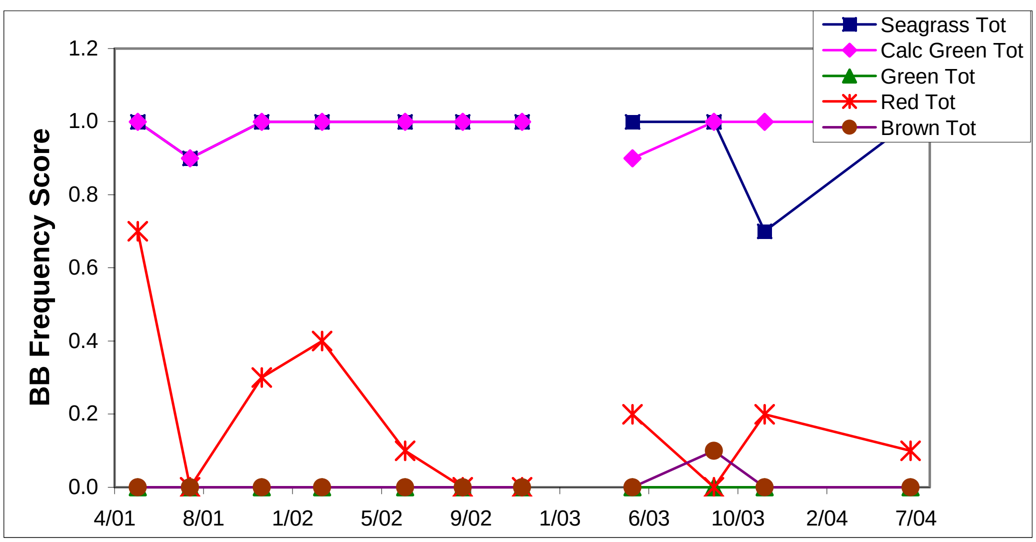

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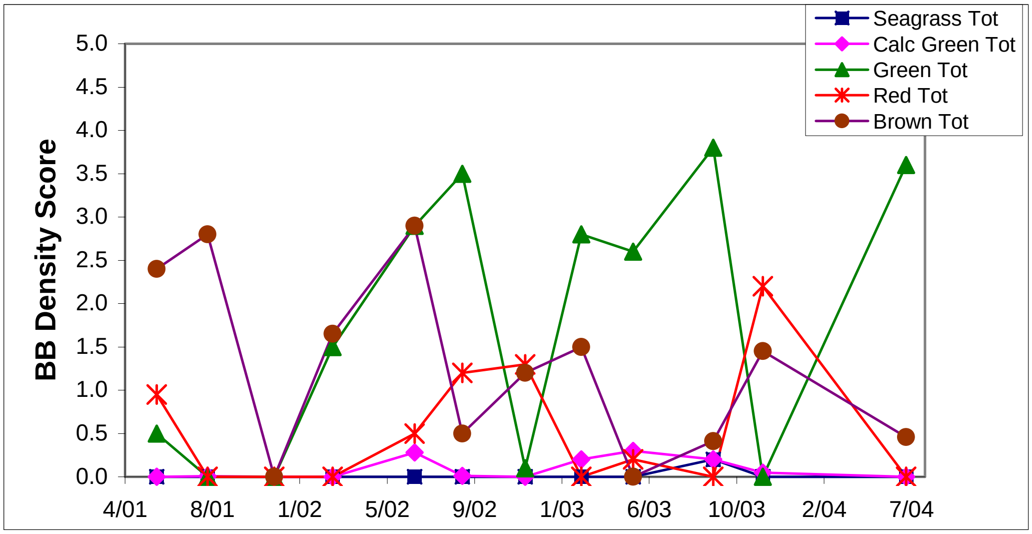

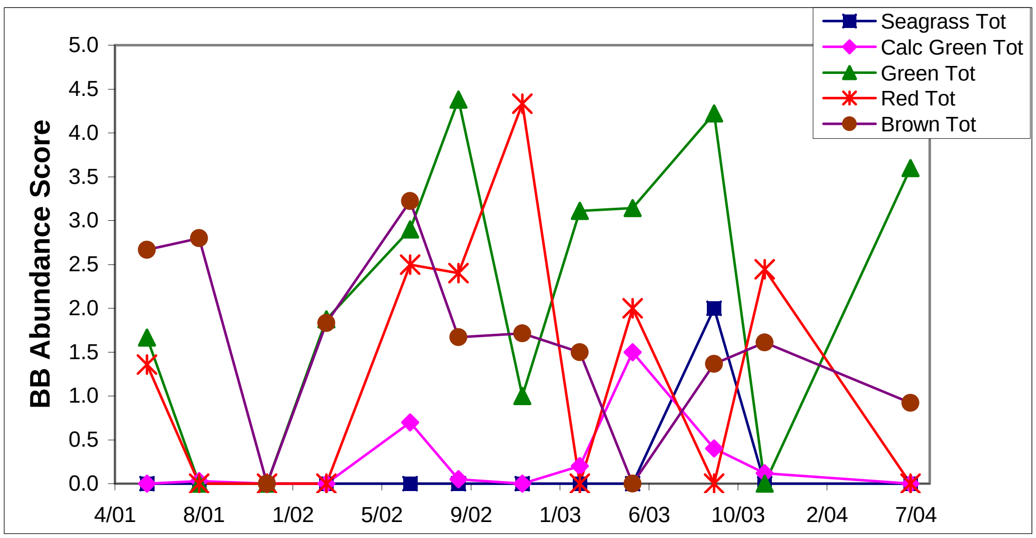

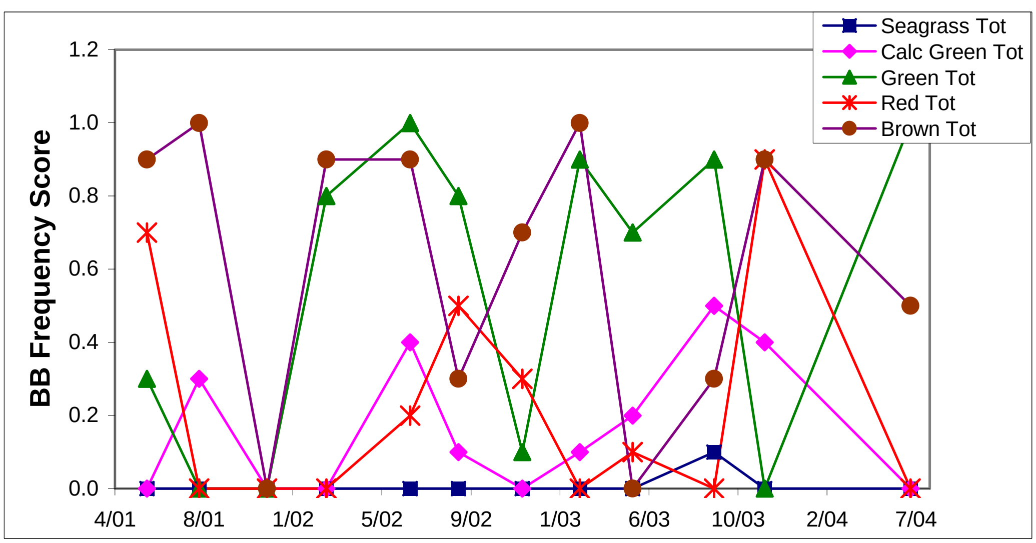

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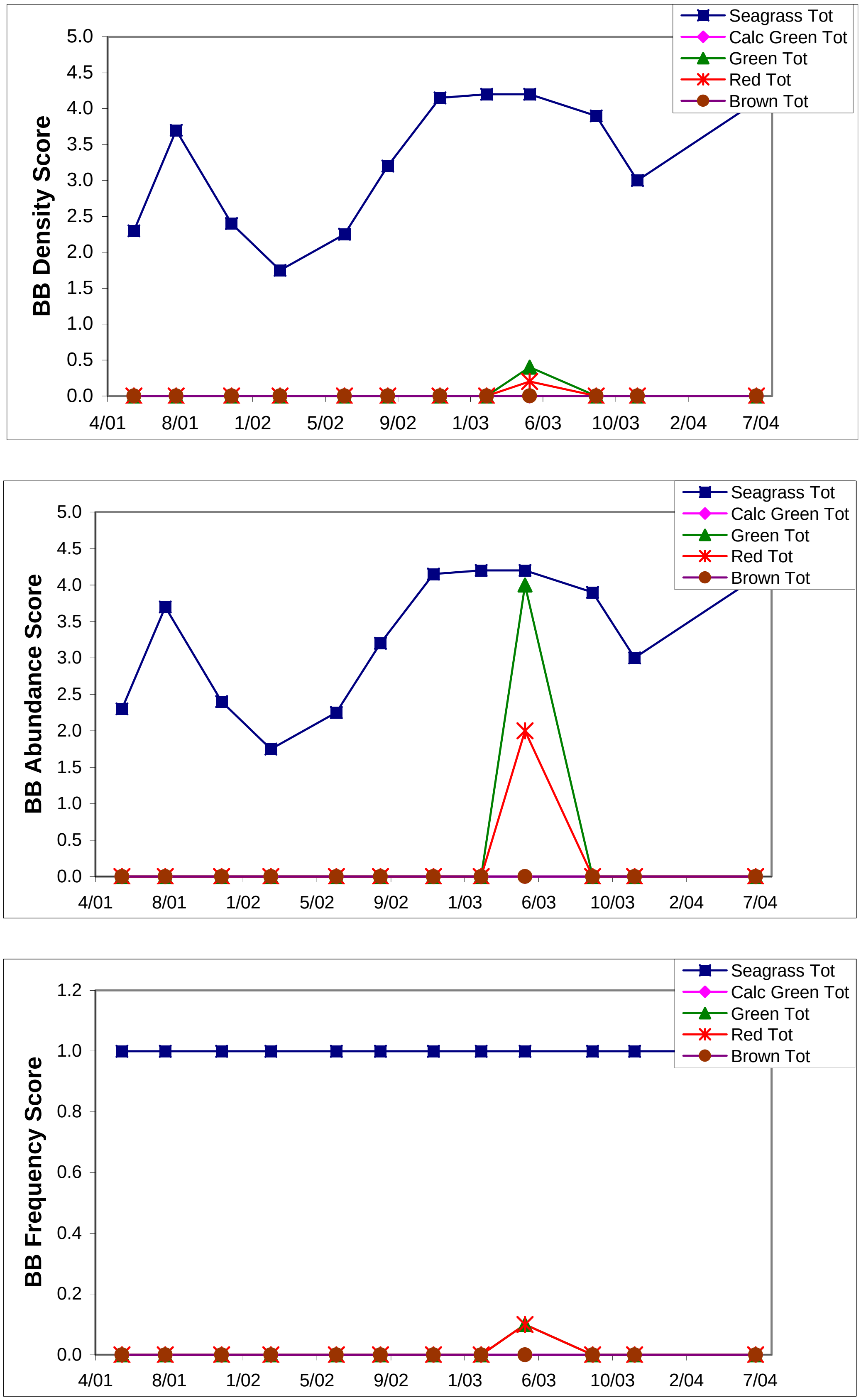

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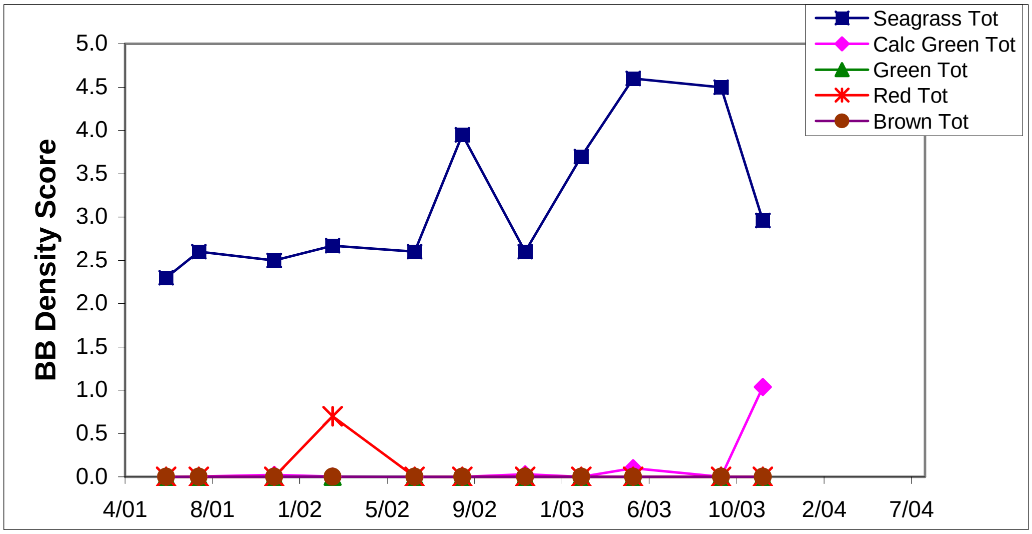

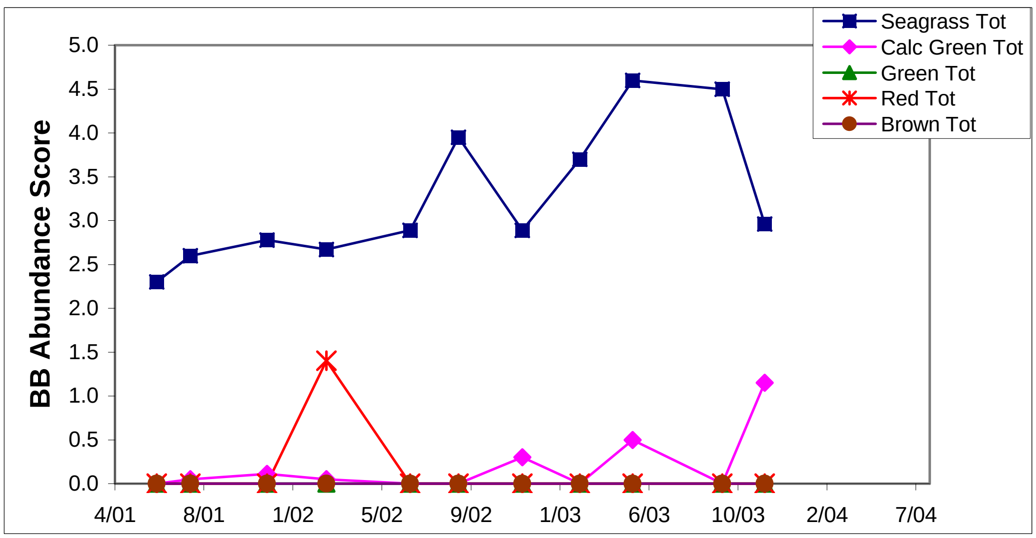

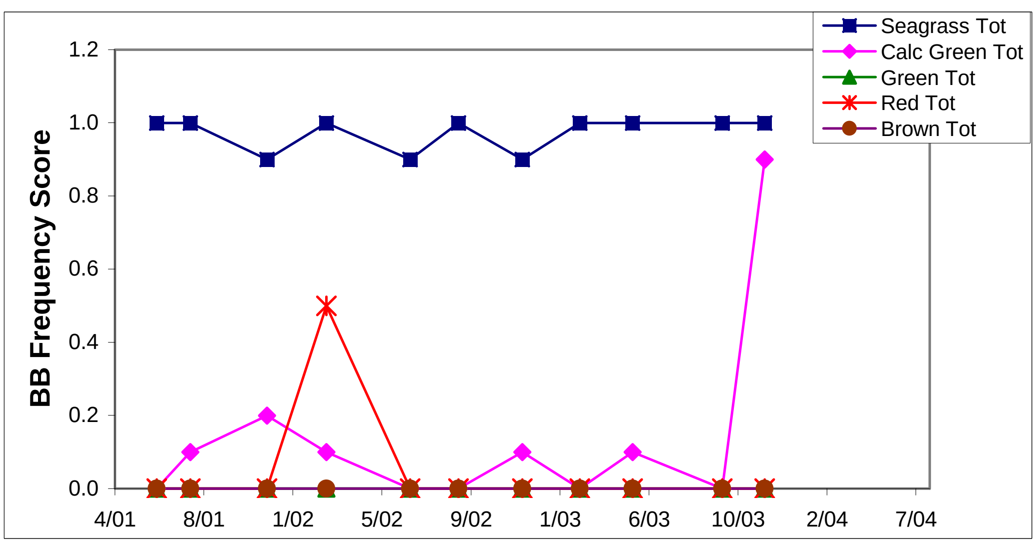

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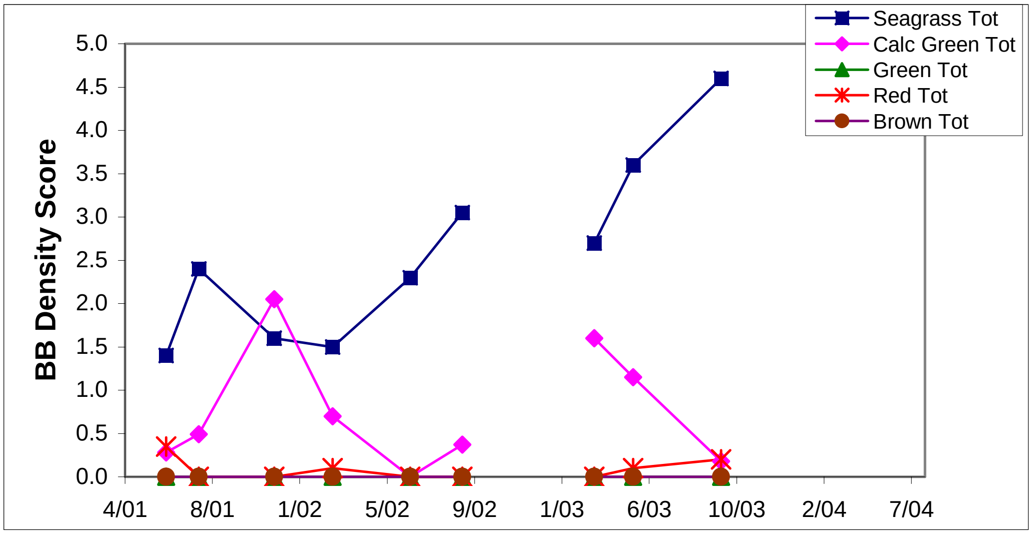

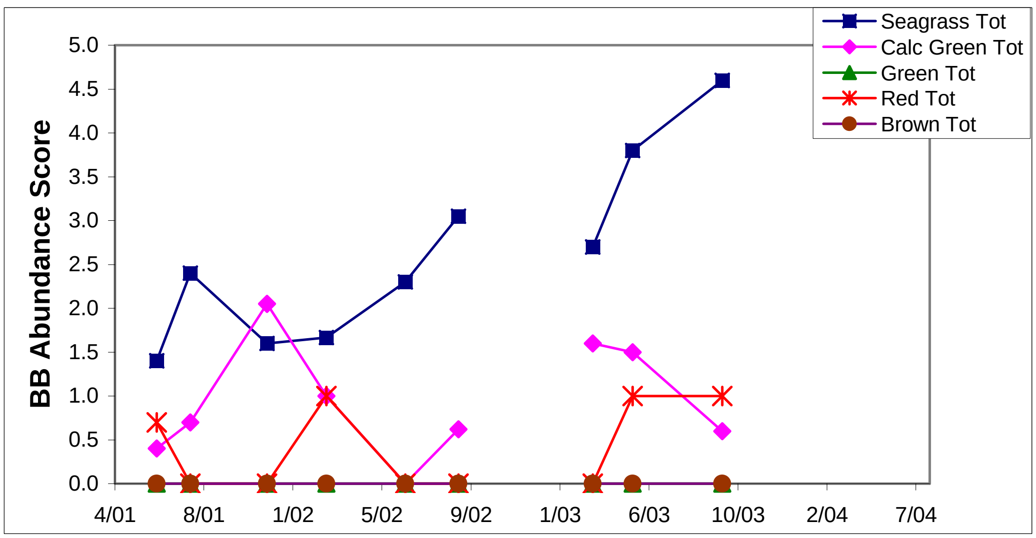

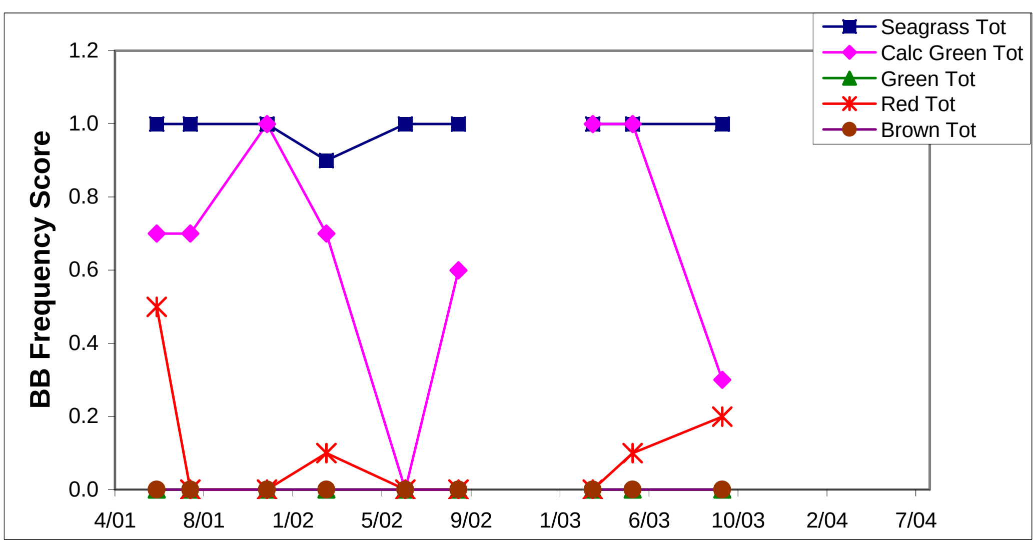

Figure 9

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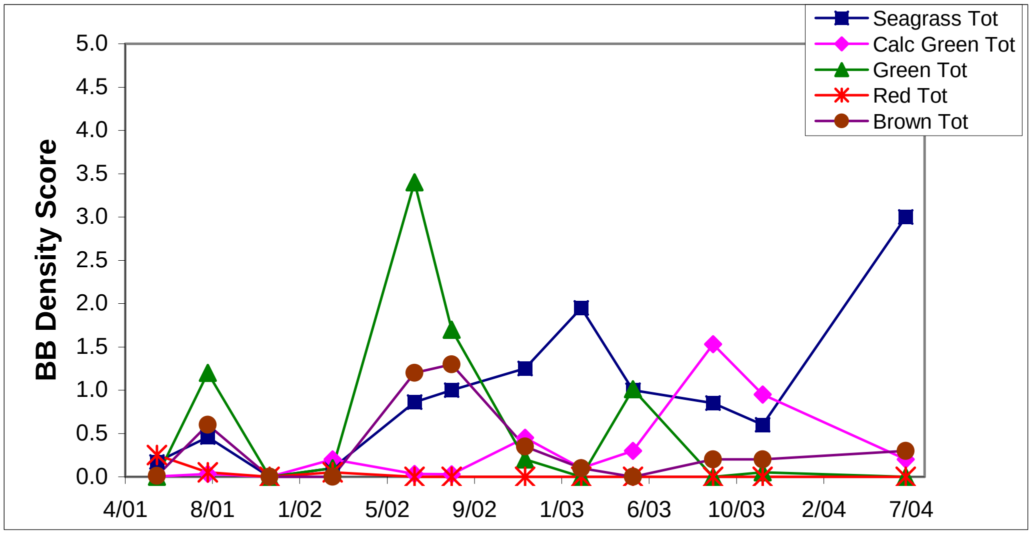

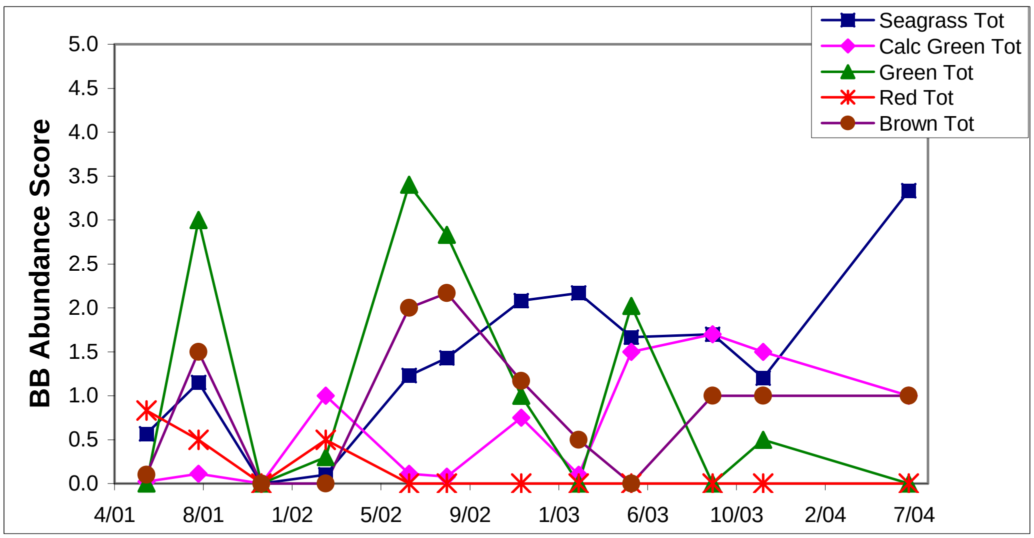

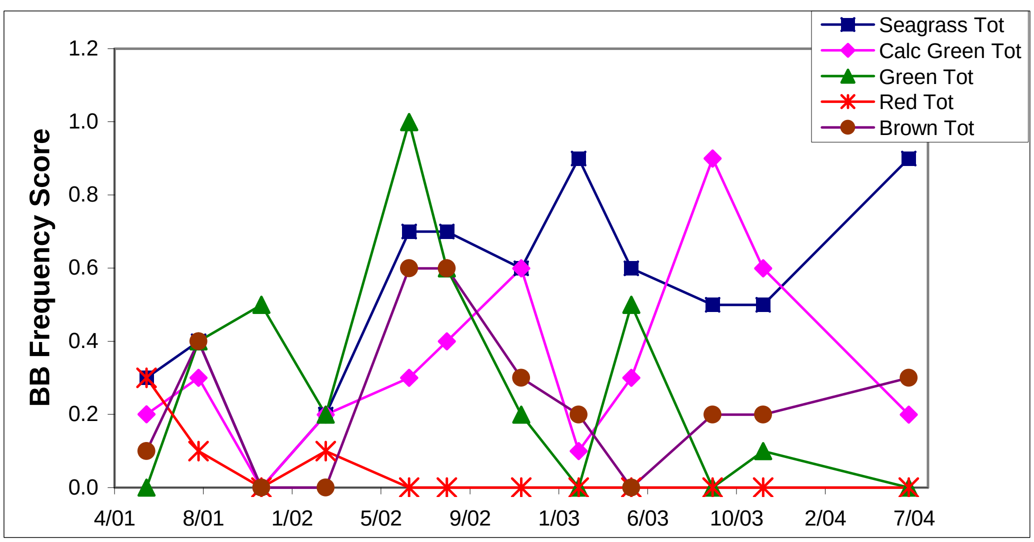

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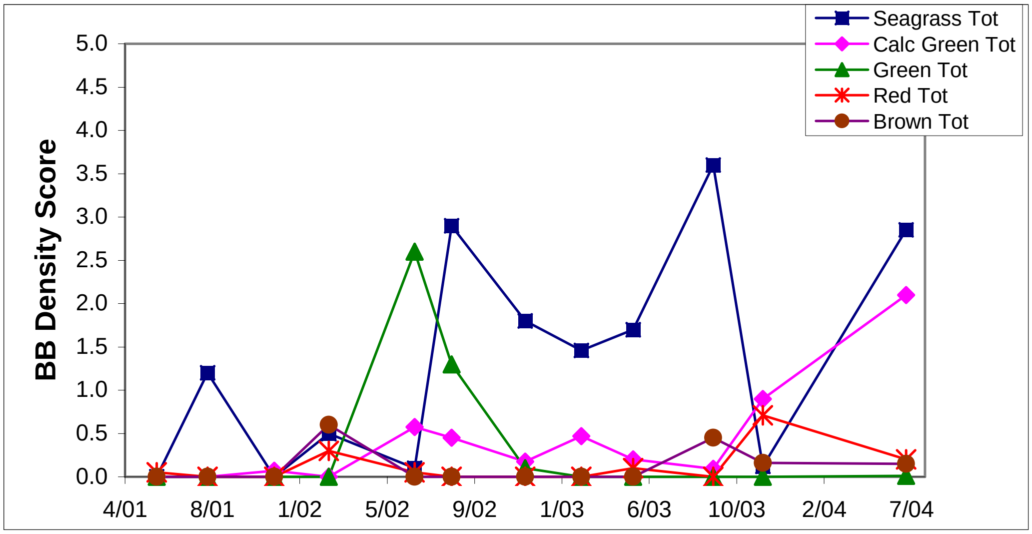

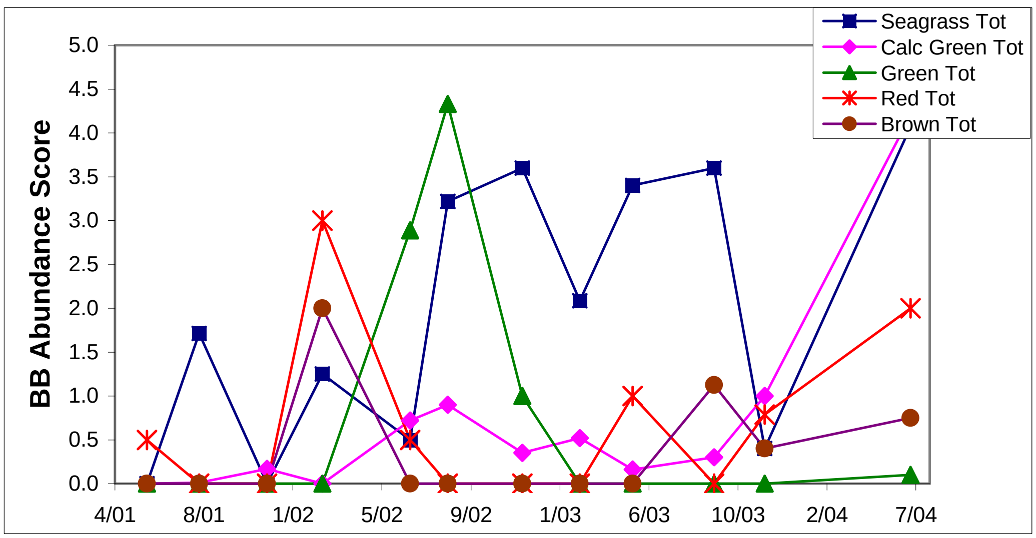

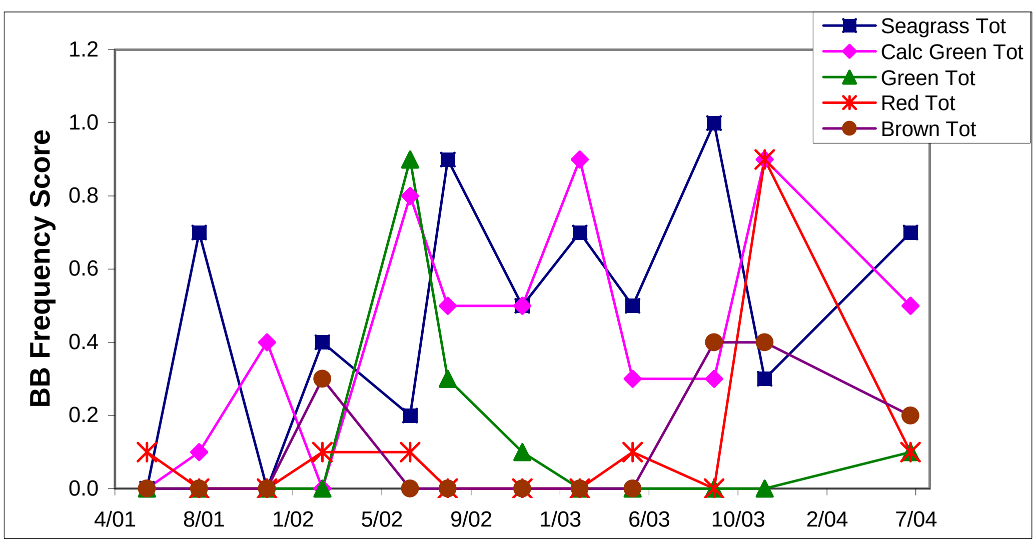

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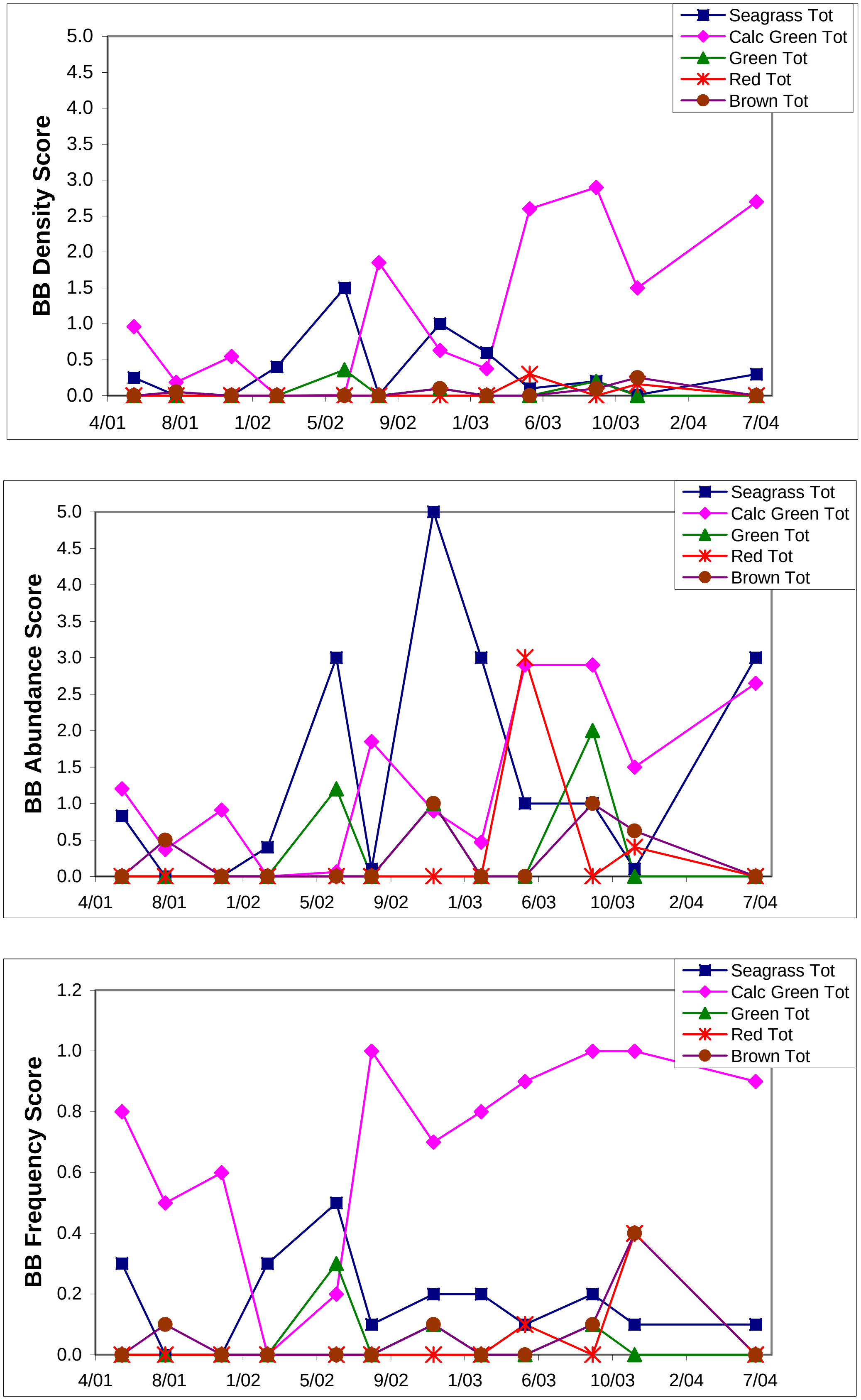

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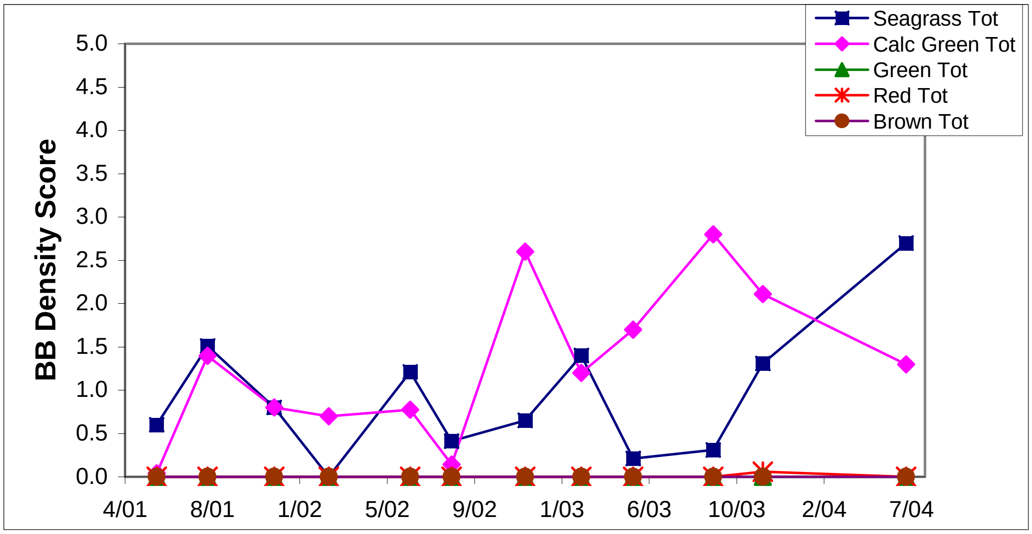

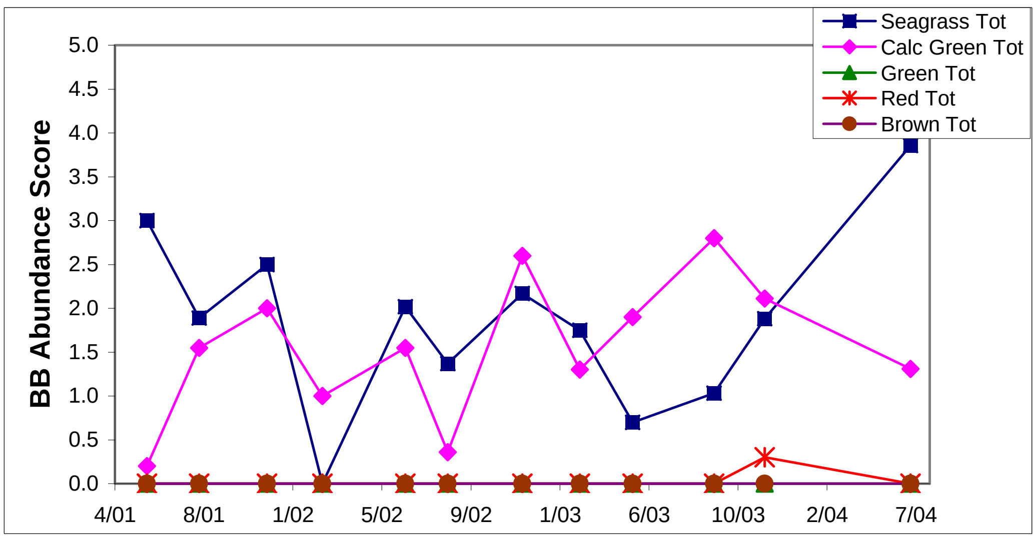

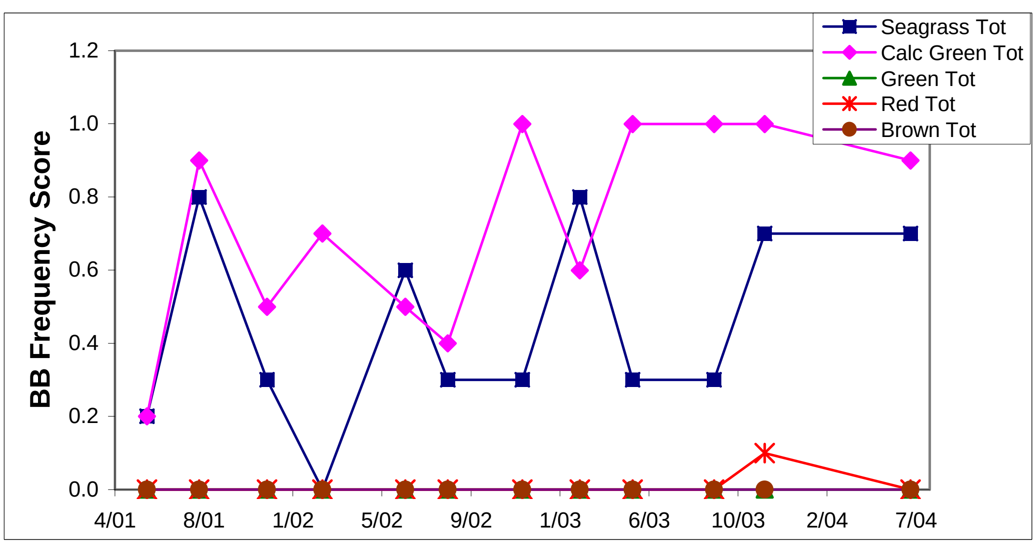

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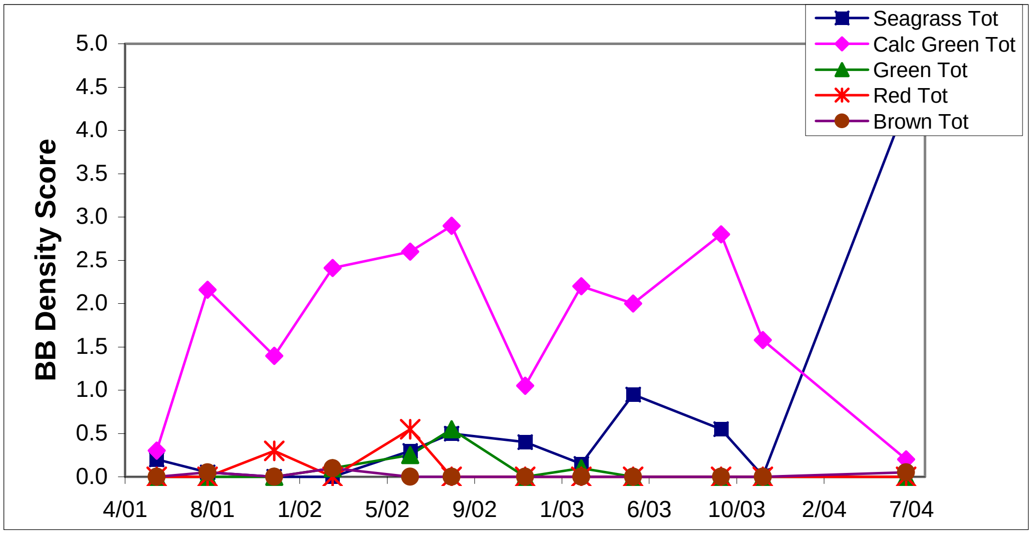

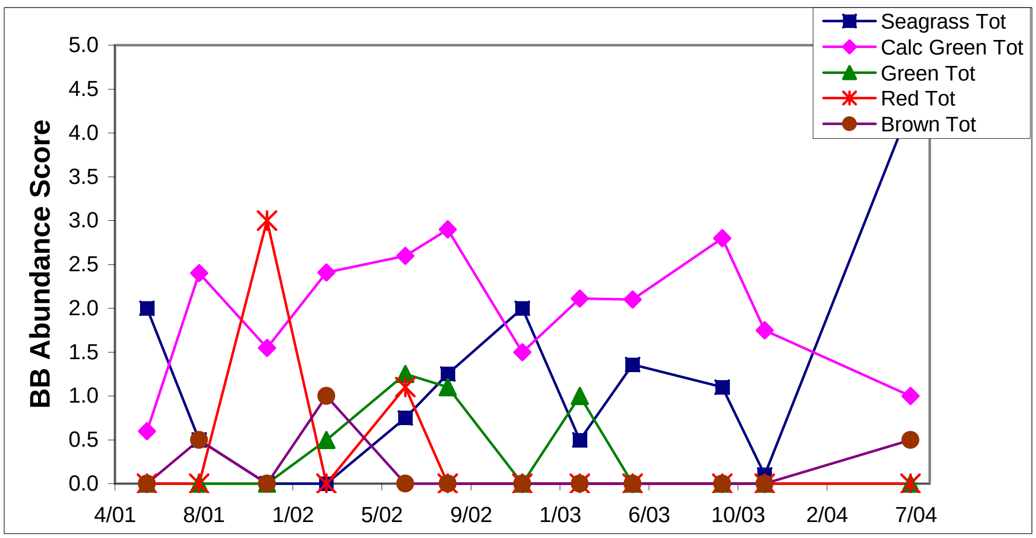

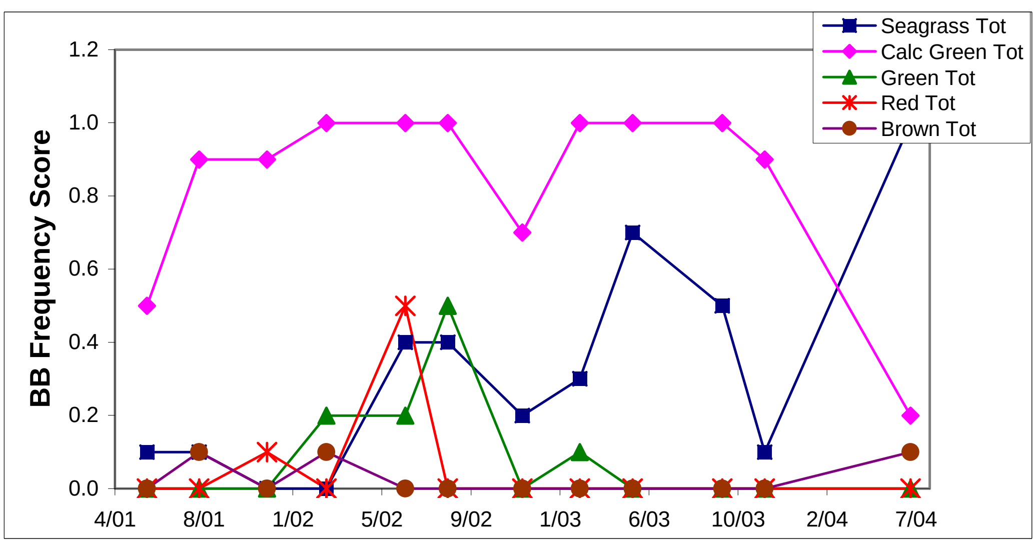

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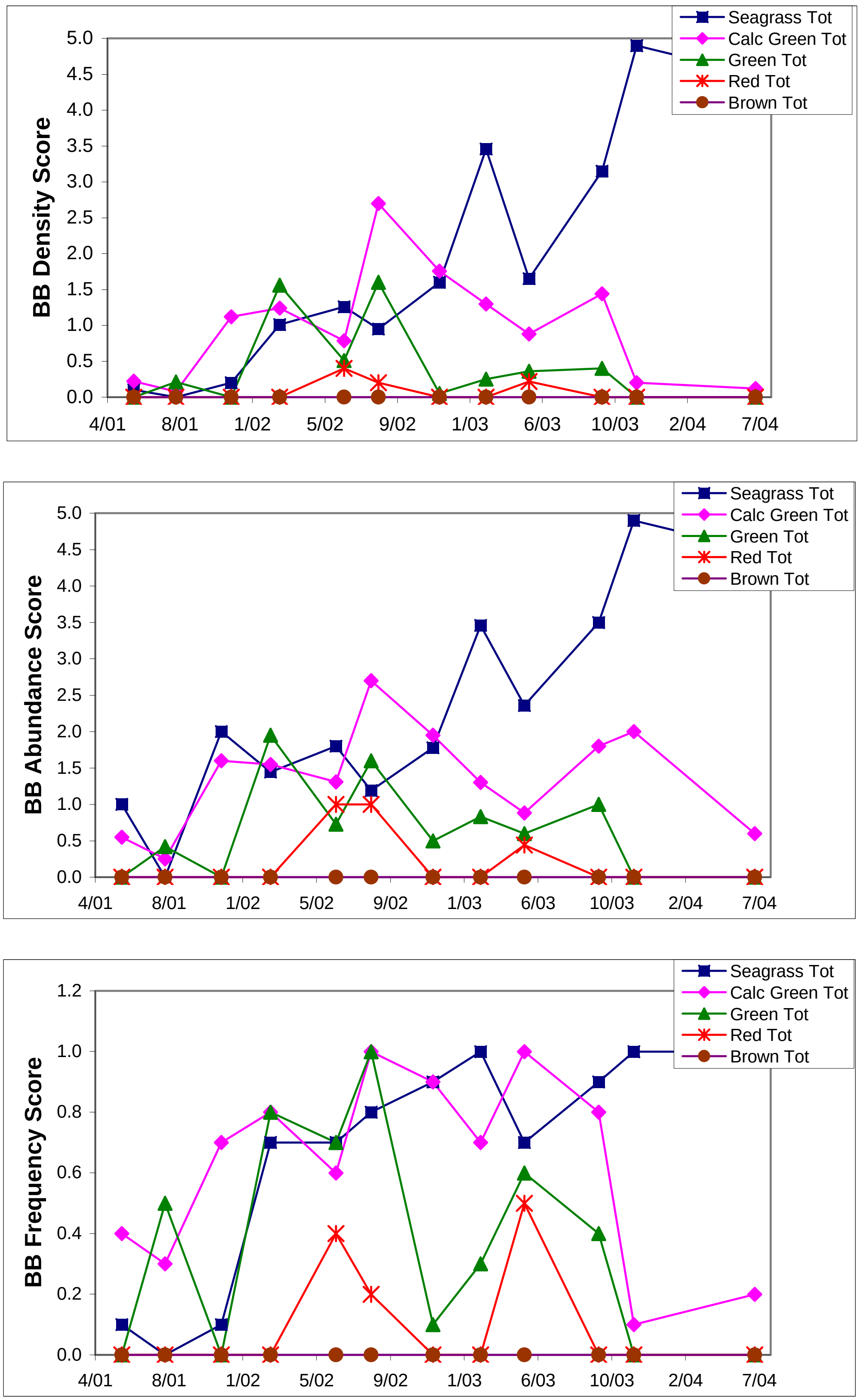

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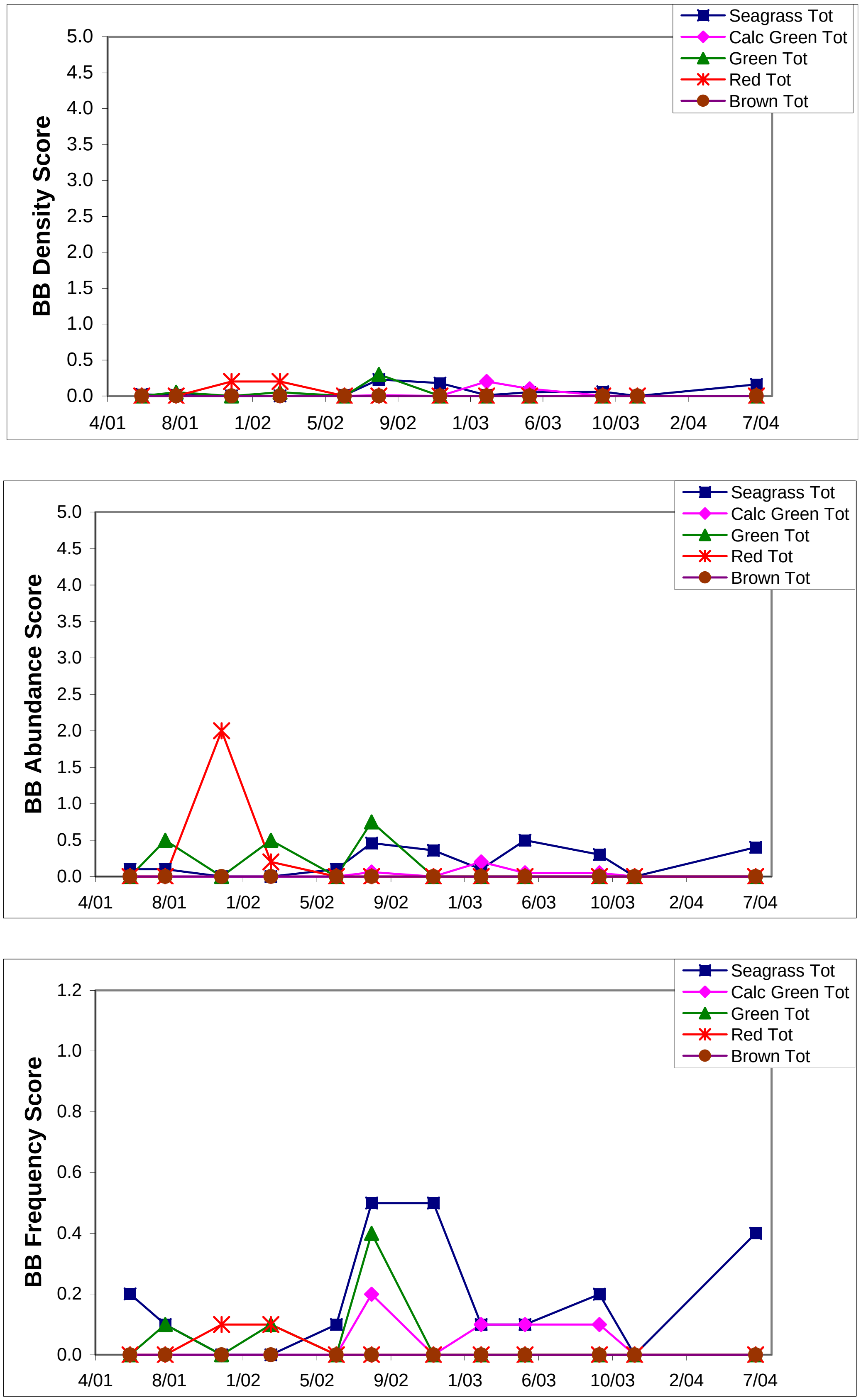

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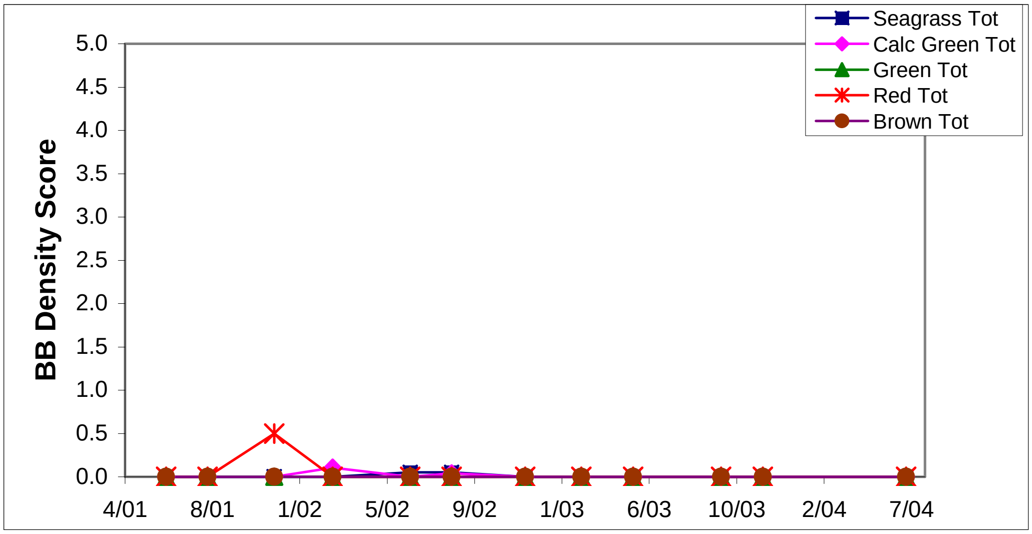

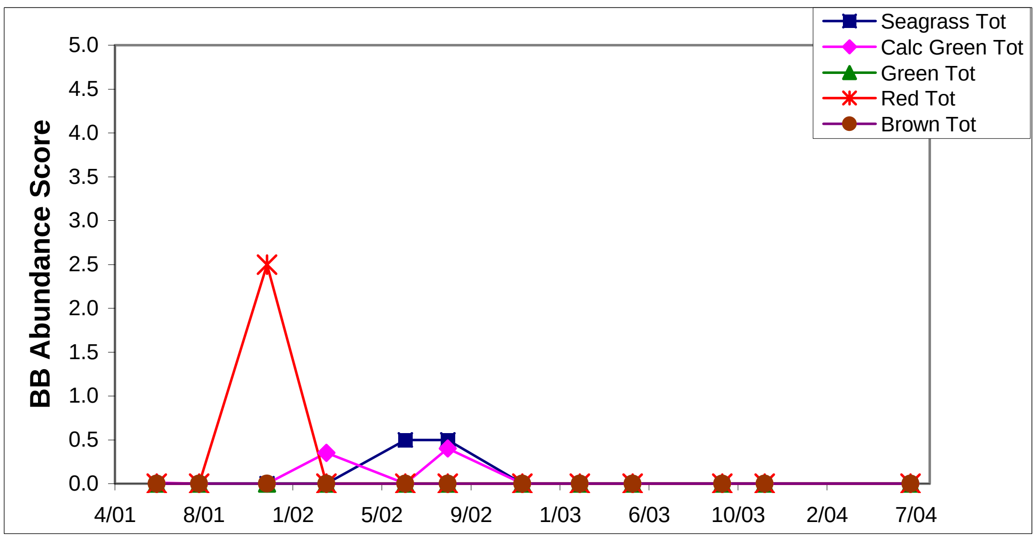

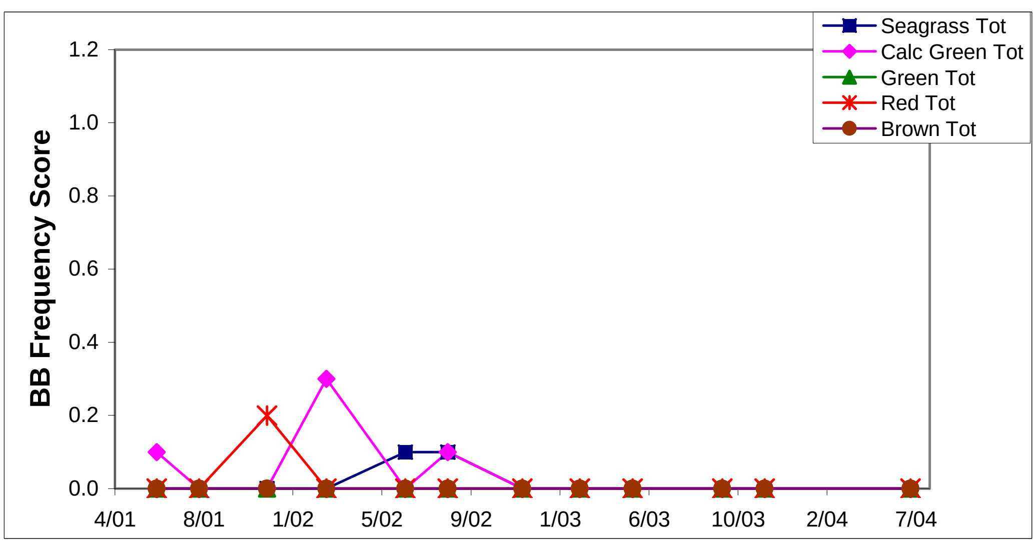

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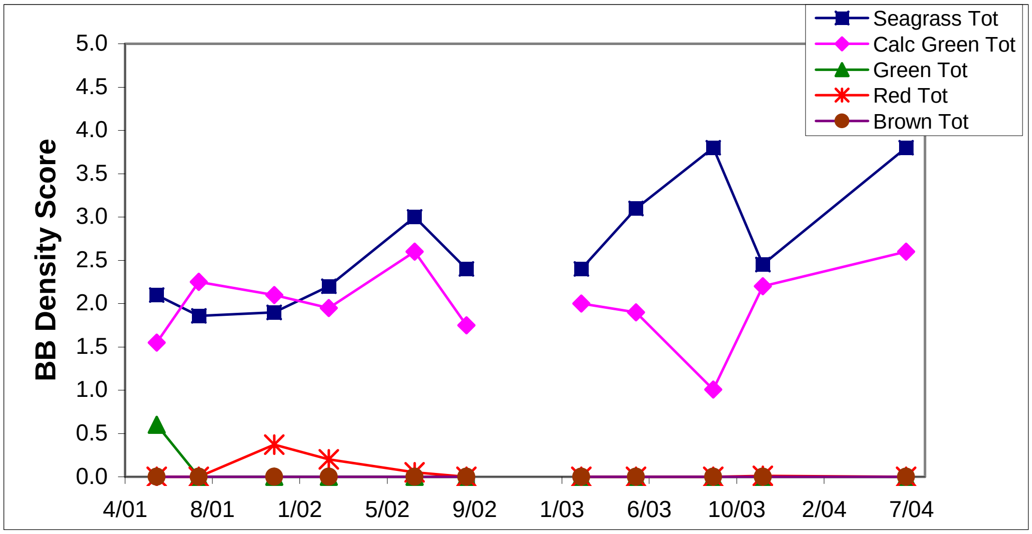

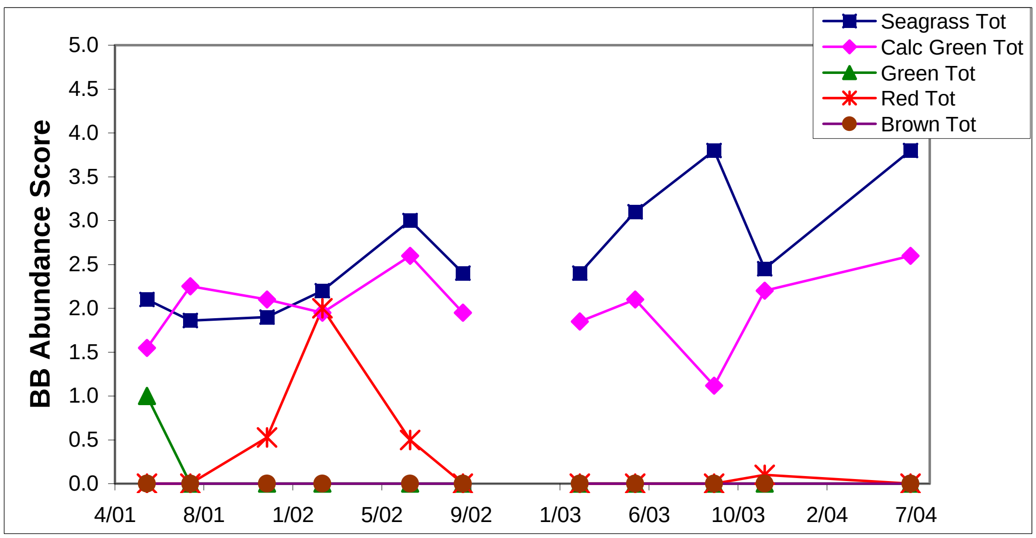

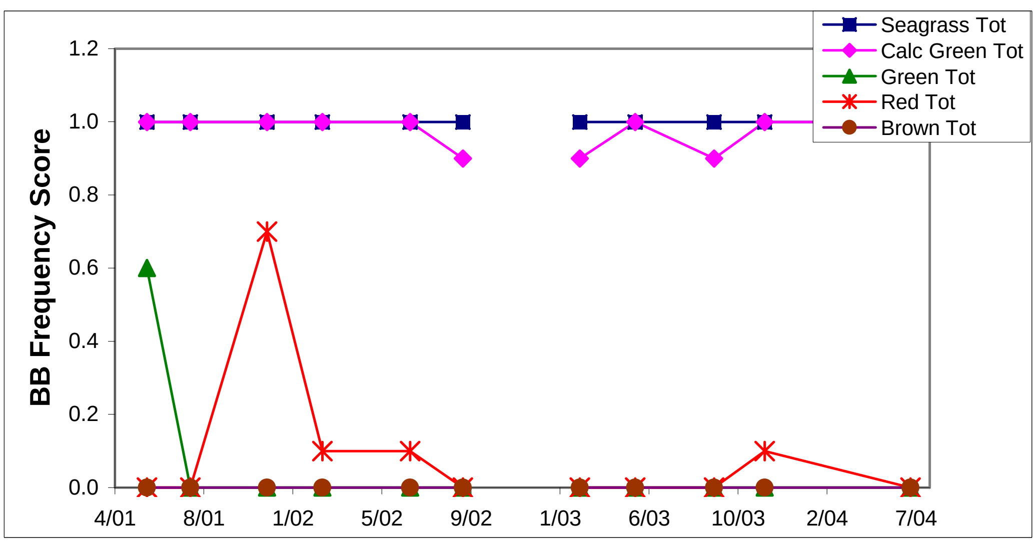

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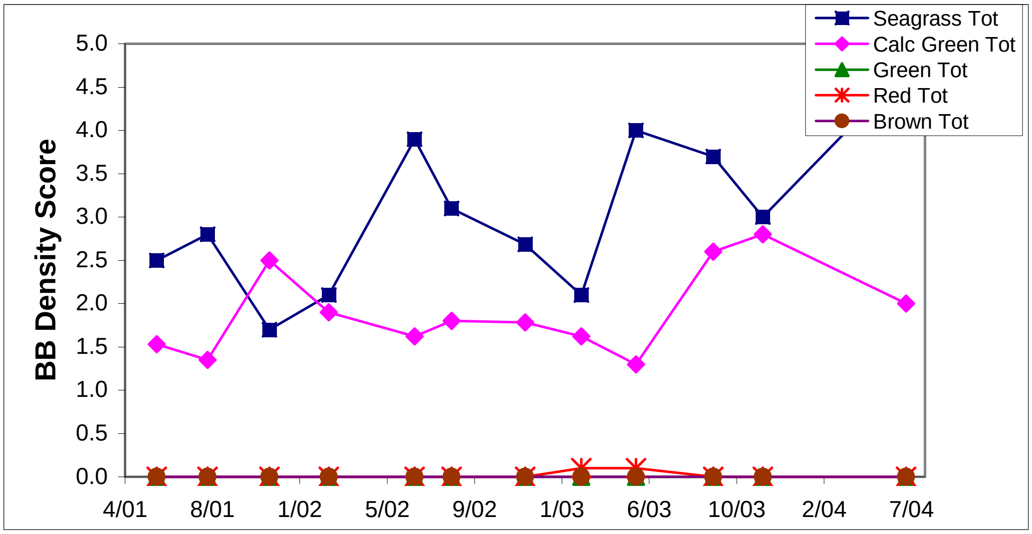

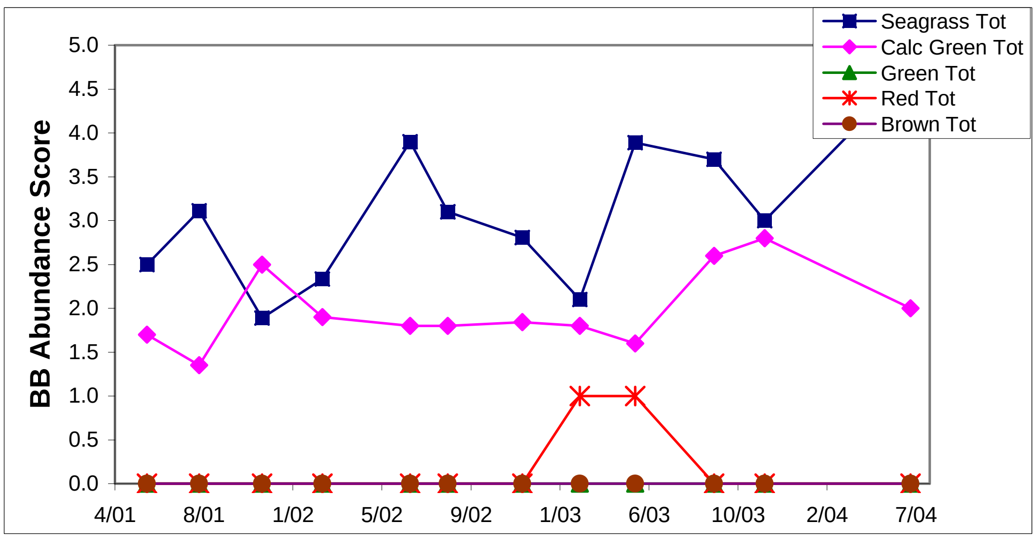

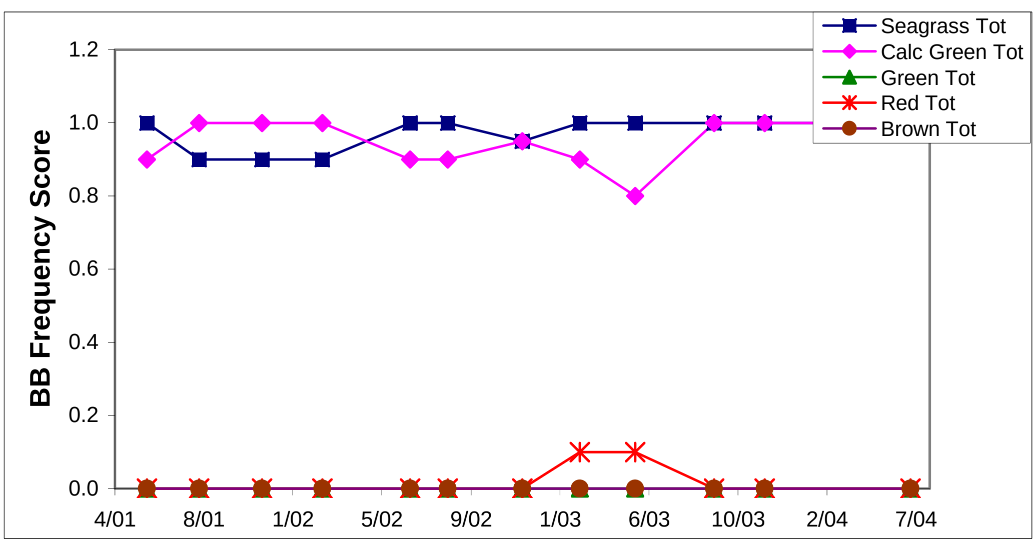

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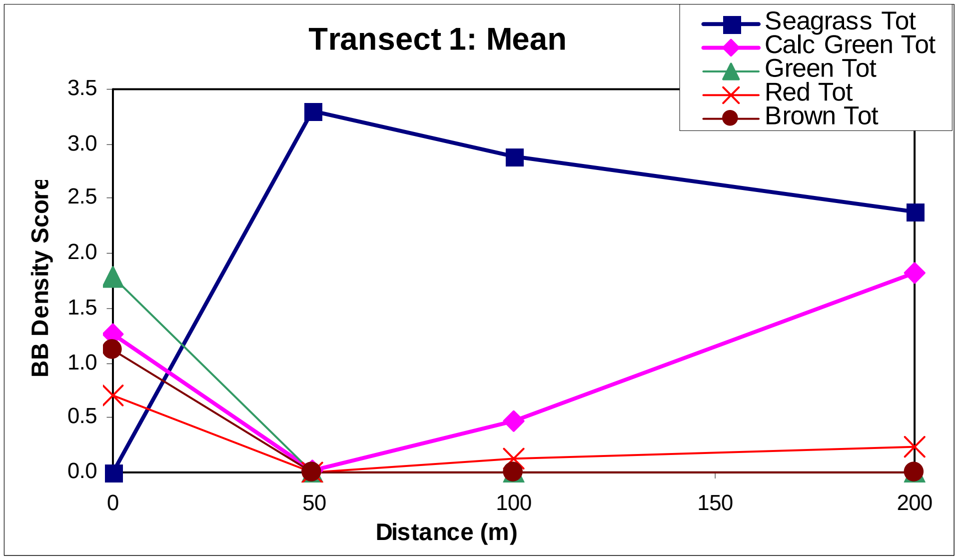

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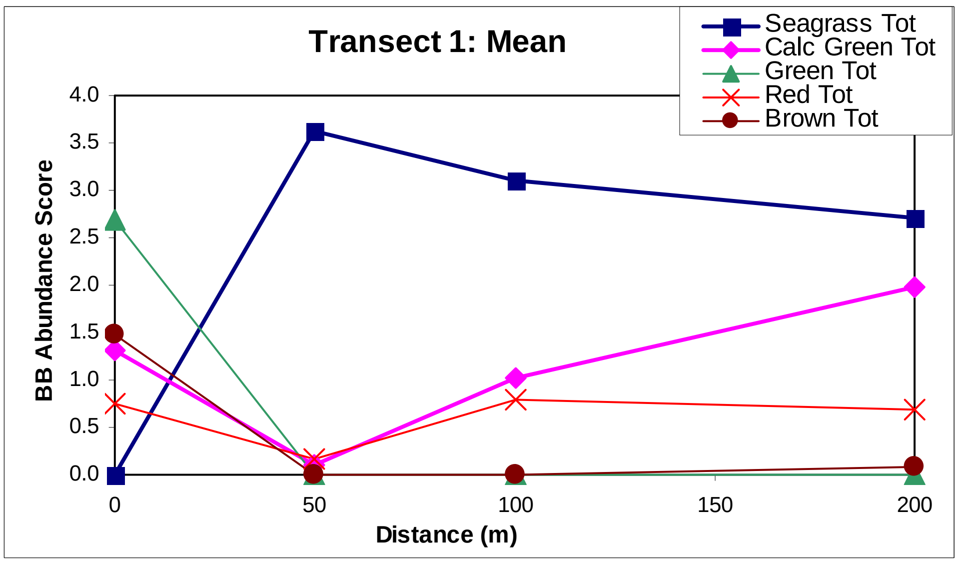

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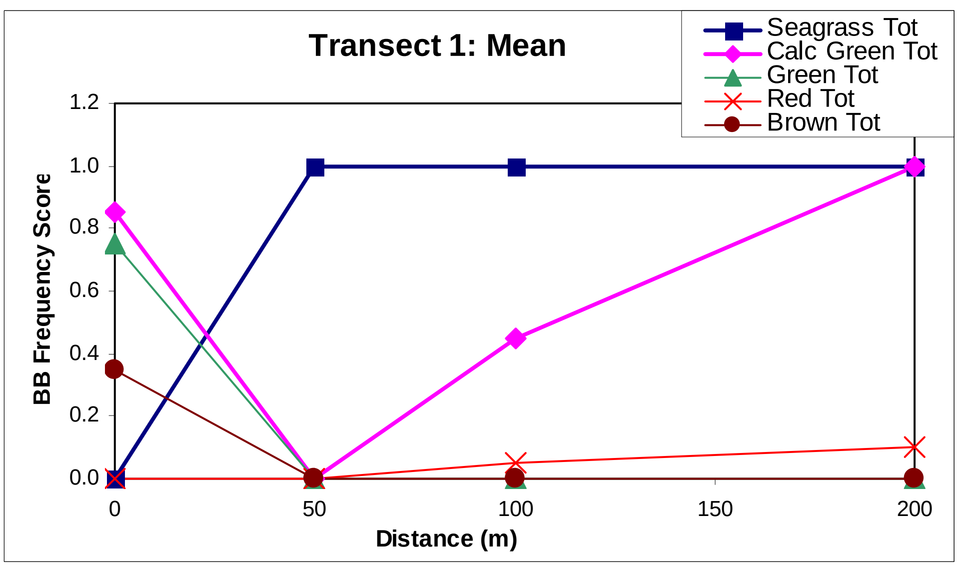

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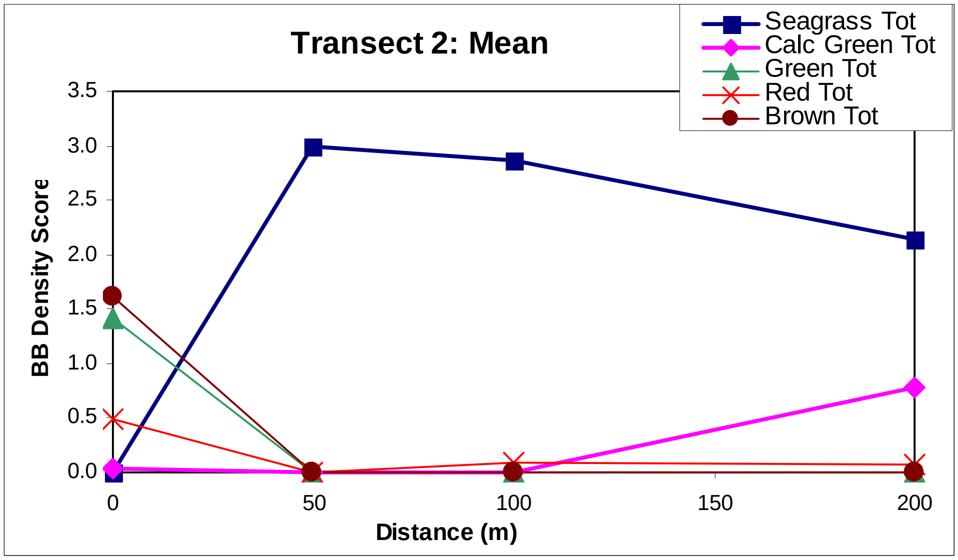

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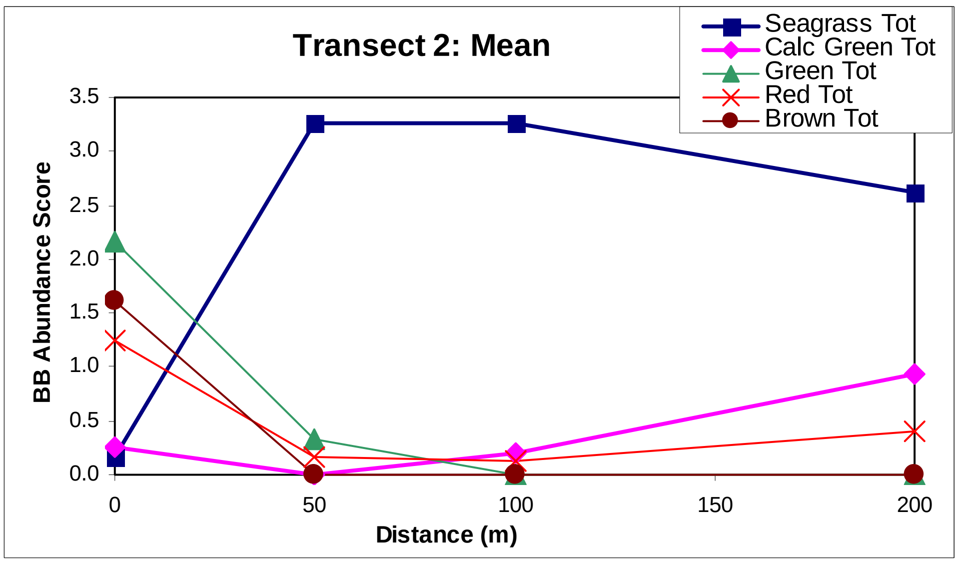

Figure 24

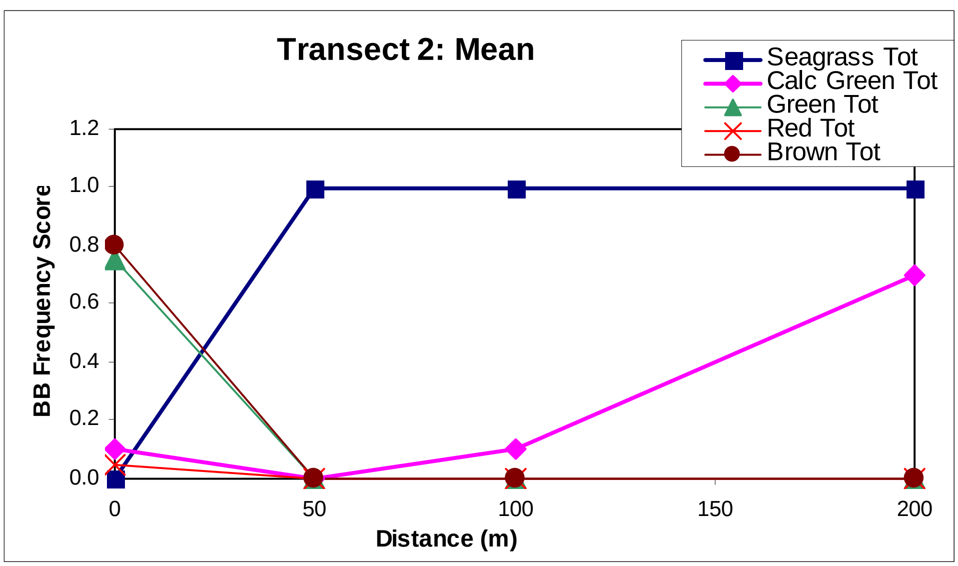

Figure 25

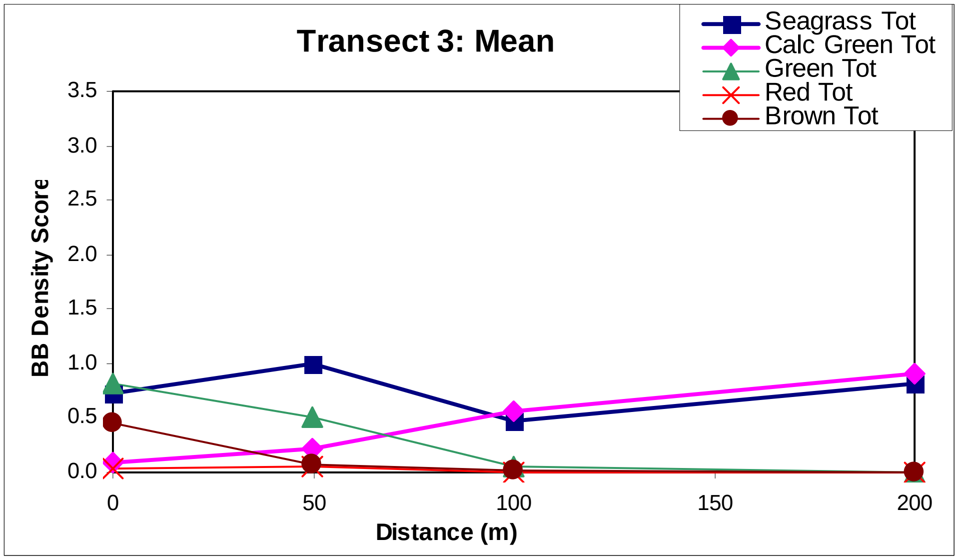

Figure 26

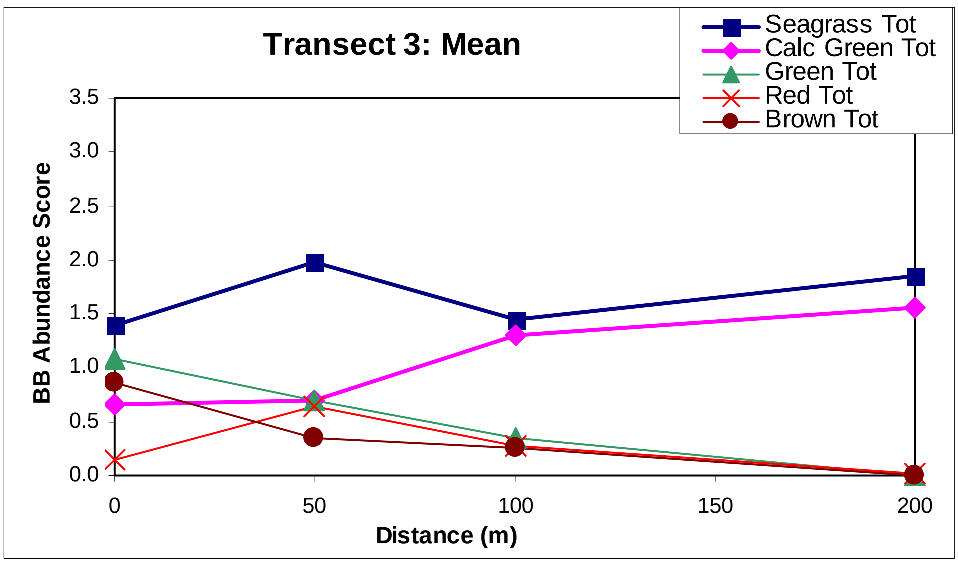

Figure 27

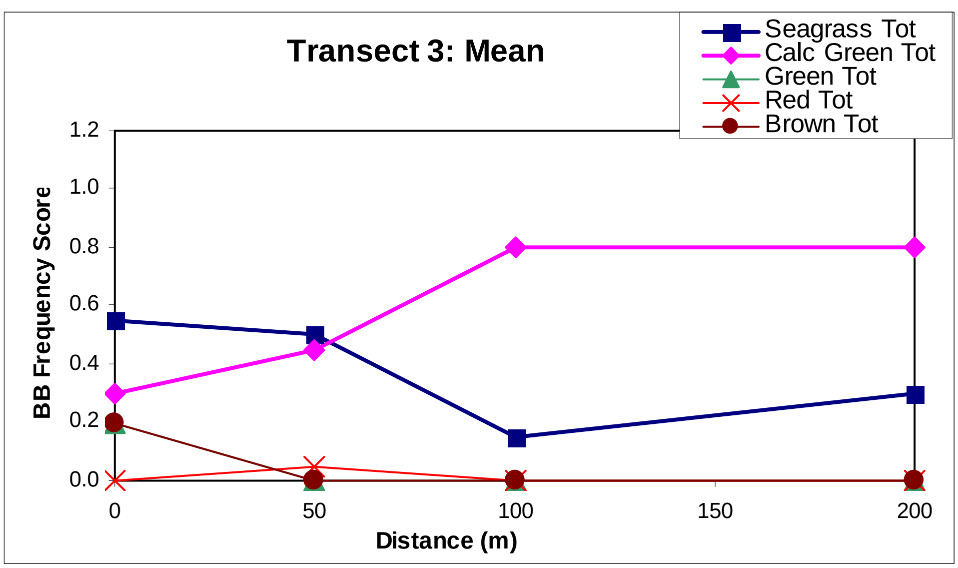

Figure 28

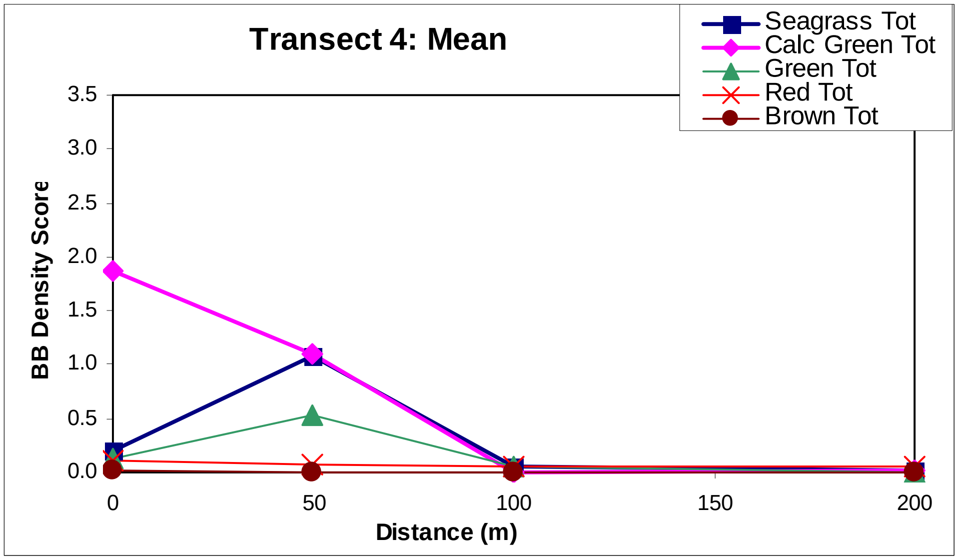

Figure 29

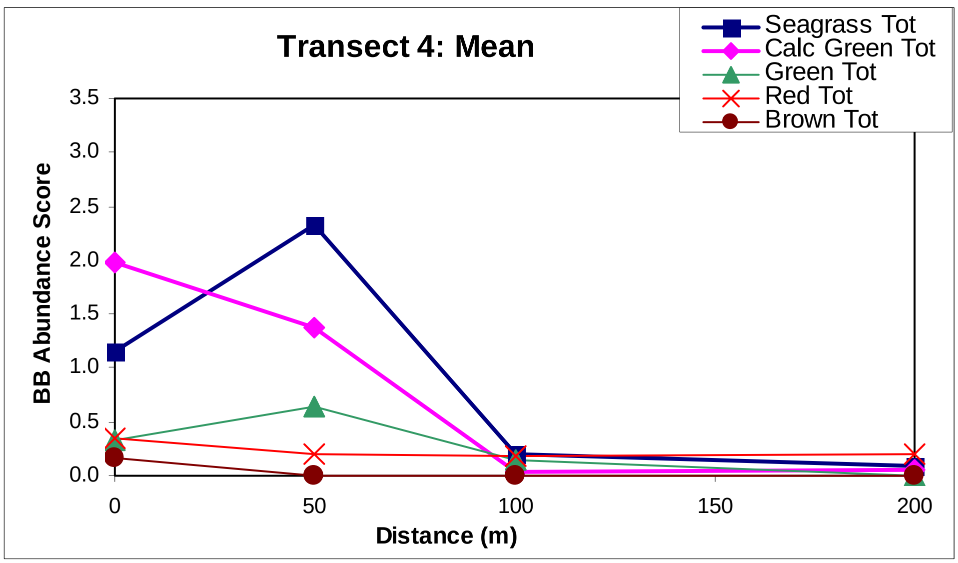

Figure 30

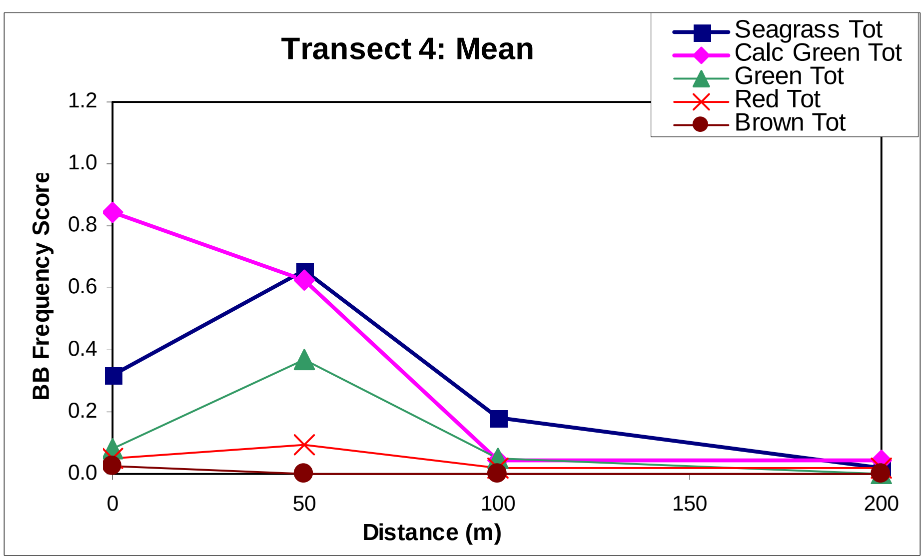

Figure 31

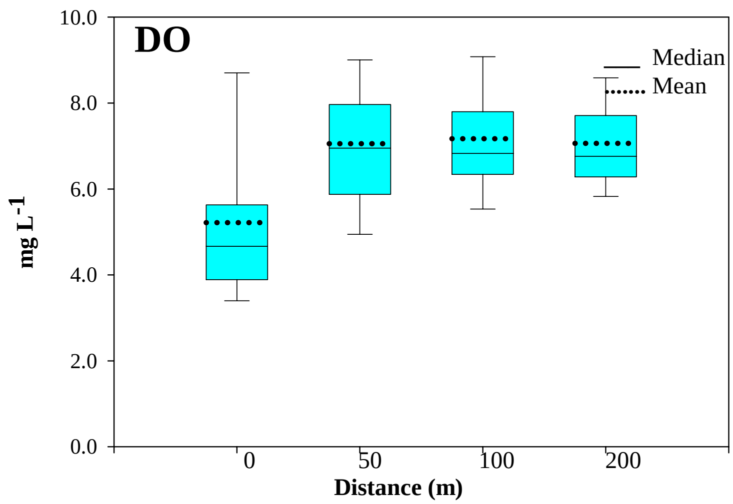

Figure 32

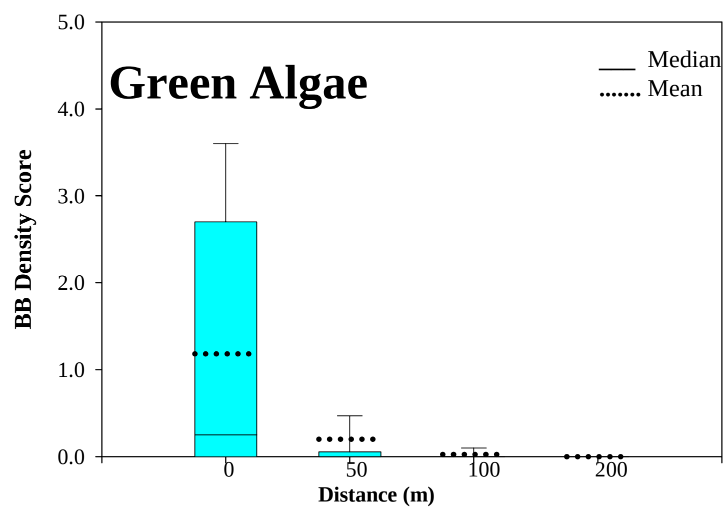

Figure 33

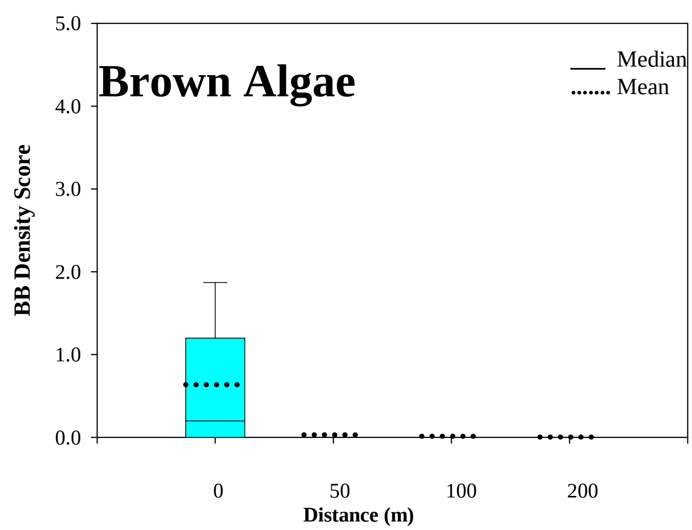

Figure 34

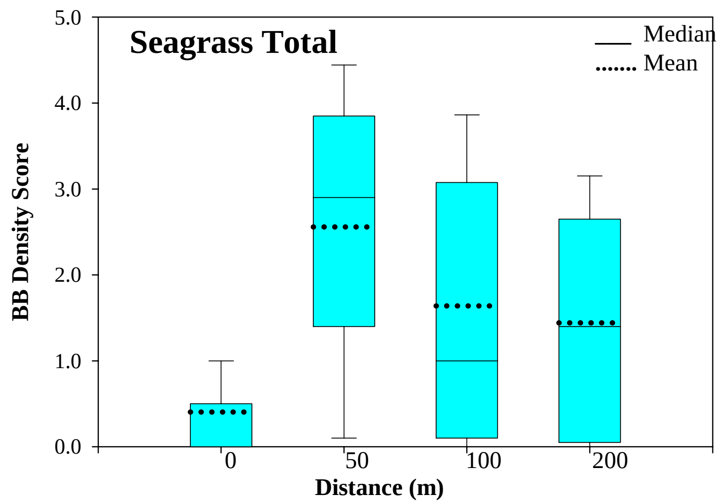

Figure 35

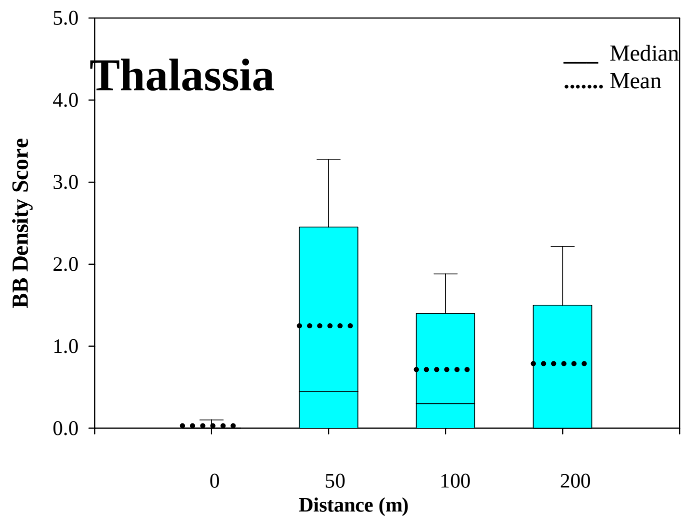

Figure 36

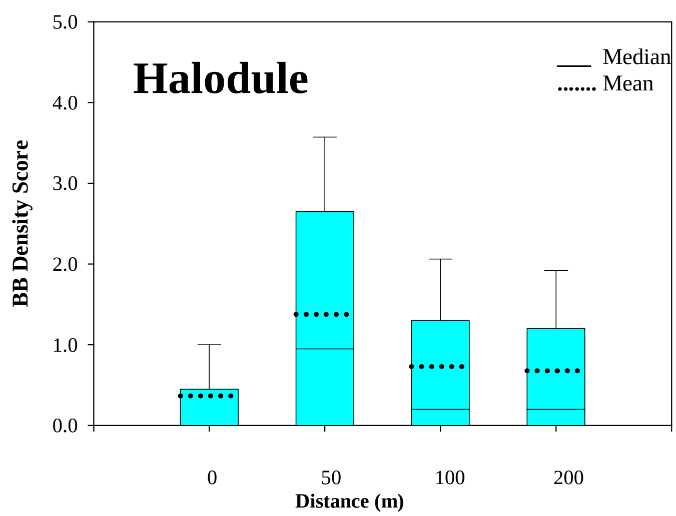

Figure 37