VII. Marine debris distribution

Background

Fishing constitutes one of the most significant threats to marine biodiversity and ecosystem function, documented by a growing body of information on the numerous impacts to populations, community structure, and habitats (Dayton et al. 1995; Roberts 1995; Jennings and Polunin 1996). Besides the more obvious effects on species population structure, fishing activities may also reduce the structural complexity of habitats or cause corresponding changes in ecological processes such as competition and predation (Russ 1991; Jones and Syms 1998; Auster and Langton 1999). These patterns are most obvious in areas where explosives, poisons, or other destructive fishing methods are used (Hatcher et al. 1989). However, ecological effects may occur in areas where traps, mobile fishing gear such as trawls, and potentially, even large numbers of recreational fishers operate (Russ 1991; Jennings and Lock 1996).

The Florida Keys have a long history of commercial and recreational fisheries that target a great diversity of fish and invertebrate species using a multitude of gears (Tilmant 1989; Bohnsack et al. 1994). In terms of volume of seafood landed, the Florida Keys is the most important area in the State of Florida in landings, dockside value, and numbers of commercial fishing vessels, especially for highly valued invertebrate fisheries such as shrimp, stone crab, and spiny lobster (Adams 1992). There are also significant, but largely undocumented effects of tens of thousands of recreational fishers, who target hundreds of species using mostly hook-and-line and spear guns (Davis 1977; Bohnsack et al. 1994).

Baseline data on marine debris and the biological impacts to coral reef benthic organisms were collected by our program during 2000 and 2001 (Chiappone et al. 2002c, 2004, 2005). These initial surveys included an assessment of 45 sites in the lower Keys from inshore to offshore during 2000, followed by sampling of 63 platform margin sites Keys-wide in 2001. These initial efforts addressed several questions pertaining to marine debris and its impacts to organisms and habitats in the study area. First, what is the spatial extent and frequency of remnant fishing gear at multiple spatial scales in the Florida Keys? Second, what factors, such as habitat type (depth) or management regime (closed or open to fishing) affect the spatial variability of marine debris occurrence? Third, what are the biological impacts of marine debris, especially from remnant commercial and recreational fishing gear, on reef biota such as hard corals and sponges? As a follow-up to these initial surveys, a major effort was expended during the 2008 sampling to document the different types, length (where applicable), weight, and impacts to benthic coral reef organisms (e.g. abrasion damage) at 145 sites partitioned by habitat type, regional sector, and management zone from northern Key Largo to SW of Key West. To our knowledge, these data represent the most comprehensive site-level assessment of marine debris and its corresponding impacts in the study

area. Our hope is that this information will help Federal and state resource managers to identify areas in dire need of debris removal. These data also demonstrate the ubiquitous and damaging characteristics of marine debris, particularly derelict fishing gear, even within "protected" no-fishing zones.

2008 Survey Results

At all 145 Florida Keys sites sampled during 2008, four belt transects 15-m x 4-m in dimension were used to quantify the type, length (where applicable), weight, and impacts of marine debris to benthic coral reef organisms. Figures 69 and 70 illustrate examples of marine debris, especially derelict trap fishing gear, encountered during 2008. From surveys of 34,800 m^2 of hard-bottom and coral reef habitat, a total of 686 marine debris items were encountered along belt transects, representing 59 different items or combinations of items (Table 20). Of these 59 different items, at least 15 (25.4%) were clearly hook-and-line angling gear, 11 (18.6%) were lost lobster/crab trap gear, and the remaining 33 items (55.9%) were designated as "other". Other marine debris included a range of metal, cloth, ceramic, and plastic items. Of the 686 total debris items counted and retrieved, 363 (53%) were hook-and-line gear (monofilament, wire leaders, hooks, lead sinkers, etc.), followed by 241 trap debris items (35%), and other debris (82 items, 12.0%). For hook-and-line gear, a total of 477.6 m of debris was measured and retrieved from the bottom, mostly represented by monofilament line and wire leader (Table 20). For trap debris, 944.3 m of rope, either free (not attached to something) or attached to wooden slats and/or metal gratings, was measured and retrieved. The 686 debris items recorded during the 2008 surveys caused abrasion damage to 448 different coral reef benthic organisms, represented by *Millepora* and scleractinian corals, gorgonians, sponges, and the colonial zoanthid *Palythoa* (Table 21). Lost hook-and-line gear caused impacts to 194 different organisms (43.3%). Trap debris, while representing 35% of all debris encountered, resulted in documented damage to 225 different benthic organisms (50.2%). This indicates that when trap debris was encountered, its effects on the benthic community were proportionally larger than for hook-and-line and other debris types.

The paragraphs below highlight four aspects of the two dominant debris types, lost hook-and-line fishing gear and lobster/crab trap gear, found in the Florida Keys study area: 1) the total number of debris items and mean densities of debris by site, habitat, regional sector, and management zone; 2) the total length of debris recovered at various spatial scales; 3) the average length of each debris incidence; and 4) the biological impacts caused by the debris to benthic coral reef organisms.

Lost Hook-and-line Gear

Hook-and-line gear was the most frequently category of marine debris in 2008 in terms of the number of sites and number of items encountered. Figures 71-76 illustrate the spatial distribution of lost hook-and-line fishing gear density (no. items per 60 m^2) throughout the Florida Keys study area. The distribution of hook-and-line debris indicates that it is ubiquitous throughout the study area in the habitat types sampled. Site-level mean (± 1 SE) densities of hook-and-line debris were as high as 8.50 items per 60 m^2 (Table 22). Hook-and-line debris was recovered from 86 out of the 145 sites (59.3%) and all five habitats: mid-channel patch reefs (16 sites, 66.7%), offshore patch reefs, (11 sites, 52.4%), inner line reef tract (4 sites, 57.1%), high-relief spur and groove (27 sites, 67.5%), and the deeper fore reef (28 sites, 54.9%). Differences in mean hook-and-line gear densities (no. items per 60 m^2) among habitats were evident, with mid-channel patch reefs (1.35 ± 0.49) and high-relief spur and groove (0.66 ± 0.15) yielding the greatest densities, while inner line reef tract sites had the lowest (0.18 ± 0.07) (Table 22). Figures 77-80 provide comparisons of lost hook-and-line gear densities among regions and management zones by habitat type. No-take zones and reference areas were roughly similar in terms of lost hook-and-line gear densities for several of the habitat types in particular regional sectors, and in several instances, hook-and-line gear densities were, in fact, greater within no-take zones (Table 22). Particularly noteworthy is the relatively high densities of hook-and-line debris documented at Hen and Chickens SPA, Cheeca Rocks SPA, Sombrero Key SPA, Conch Reef RO, and Alligator Reef SPA. On mid-channel patch reefs in the middle Keys, hook-and-line gear density was 1.25 greater within no-take zones (2.50 ± 1.32 items per 60 m^2) compared to reference areas (2.00 ± 1.32). On lower Keys offshore patch reefs, upper Keys inner line reef tract, and middle Keys high-relief spur and groove, hook-and-line gear densities between no-take zones and reference areas were roughly similar. On the deeper fore-reef, combined hook-and-line gear density was 2.7 times greater on middle Keys no-take zones (0.90 ± 0.41) compared to reference areas (0.33 ± 0.11).

Figure 81 illustrates the length distribution of lost hook-and-line gear recovered for all sites combined. Of the 347 hook-and-line gear items measured, nearly 86% were less than 2.0 m in length. The average (± 1 SE) length of all items recovered was 1.4 ± 0.1 m, ranging from 0.08 m to 19 m. Figures 82-87 illustrate the spatial distribution of lost hook-and-line gear length (total length recovered per site) throughout the Florida Keys study area. The length of hook-and-line gear recovered per site varied substantially among the five habitat types. Mid-channel patch reefs (6.2 ± 2.4 m per site), high-relief spur and groove (3.3 ± 0.9 m), and the deeper fore-reef (3.0 ± 0.8 m) yielded the greatest average total length of hook-and-line debris. Figure 88-91 compare lost hook-and-line gear length among regions and management zones by habitat type. Mid-channel patch reef no-take zones (9.8 ± 5.9 m per site) and reference areas (9.3 ± 5.6) were similar in the middle Keys, due to the substantial amount of hook-and-line gear recovered from Hen

and Chickens SPA and Cheeca Rocks SPA. No hook-and-line gear was recovered from mid-channel patch reefs in the Western Sambo Ecological Reserve in the lower Keys, but substantial amounts of gear (6.6 ± 6.4 m per site) was recovered from reference sites, especially north of Looe Key RO. On offshore patch reefs, less total hook-and-line gear was recovered from no-take zones compared to reference areas, except in the middle Keys, where gear length recovered per site was substantially greater (4.1 ± 4.1 m) in Coffins Patch SPA compared to reference sites (0.2 ± 0.2 m). On inner line reef tract, no-take zones and reference areas yielded similar lengths of hook-and-line gear. On high-relief spur and groove reefs, reference areas consistently yielded greater total lengths of gear. However, substantial lengths of hook-and-line debris was recovered from upper Keys (2.0 ± 0.9 m per site) and middle Keys (3.2 ± 2.4 m per site) no-take zones, especially Elbow Reef SPA, French Reef SPA, Molasses Reef SPA, and Sombrero Key SPA. On the deeper fore-reef, reference areas yielded greater total lengths of hook-and-line gear per site in two regions, while no-take zones in the middle Keys (3.4 ± 1.4 m per site) yielded more than reference areas (2.4 ± 0.9 m per site). This latter result reflected the substantial total lengths of hook-and-line gear recovered from Conch Reef RO, Alligator Reef SPA, and Tennessee Reef RO.

The 15 categories of lost hook-and-line fishing gear accounted for 363 out of the 686 incidences of marine debris encountered during 2008 (Table 20). The 363 hook-and-line debris items representing 47.8 m of debris caused abrasion damage to 194 different coral reef organisms among five major categories. Gorgonians (104 colonies impacted), followed by sponges (41 impacts), were the most frequently damaged by lost hook-and-line fishing gear (Table 21). This is not surprising, given the upright morphologies of these two taxonomic groups and their abundances in the habitats sampled. Both gorgonians and sponges were particularly susceptible to entanglement and abrasion damage from monofilament line and wire leaders.

Relative to the area sampled in each habitat, regional sector, and management zone, initial estimates can be derived for the Florida Keys sampling domain (northern Key Largo to SW of Key West) for hook-and-line gear, using gear density and total length of debris retrieved per site, as well as information on the spatial extent of habitats (see Smith et al. in press). For the Florida Keys sampling domain, the targeted habitats were divided by regional sector and management zone and estimates of the total area of each stratum was obtained based upon existing habitat and bathymetry maps (Table 1). Within each targeted 200-m x 200-m cell or block, four belt transects 15-m x 4-m in dimension (totaling 240 m^2 in area) were sampled, thus representing 0.6% of the total cell area. For each site, there are data on the number of debris items, the mean density of debris items, and total length of debris recovered (Table 22). Even if we do not scale up the transect data (60 m^2 x 4 per site) to the area of a block (40,000 m^2), and assume that all of the

debris in a 200-m x 200-m block only occurred within our transect boundaries, then a very conservative estimate of the total number of hook-and-line gear items and the total length can be obtained. These estimates only apply to the five habitat types that were actually sampled during 2008 and are as follows:

- Mid-channel patch reefs: 10,628 debris items with a total length of 83.8 km (~52.0 miles),
- Offshore patch reefs: 1,142 debris items with a total length of 97.5 km (~60.6 miles),
- Inner line reef tract: 463 debris items with a total length of 0.5 km (~0.32 miles),
- High-relief spur and groove: 101 debris items with a total length of 0.5 km (~0.30 miles),
- Deeper fore reef (6-15 m): 6,203 items with a total length of 14.7 km (~9.1 miles), and
- Total for the five habitats: ~18,503 hook-and-line debris items with a total length of 196.5 km (~122 miles). This is equivalent to stretching a single piece of monofilament line or wire leader from Key West to Florida City.

If the results were scaled up to assume the debris found within the 240 m^2 area comprised by the four transects is similarly distributed throughout the 40,00m^2 cell, then the estimated line or leader could stretch back and forth between the two cities 170 times.

It is important to note that these estimates are affected by the accuracy of the existing habitat and bathymetry maps for the Florida Keys, as well as the density and gear length estimates derived for each site. In addition, the values assume hook-and-line fishing effort, which affects the amount of hook-and-line gear lost, is evenly distributed throughout the study area, which is probably not the case. Nevertheless, these initial estimates illustrate the potential amount of lost hook-and-line fishing gear that may be present in the Florida Keys, not including Biscayne National Park, the Marquesas Keys, or the Dry Tortugas.

Lost Lobster/Crab Trap Debris

Next to hook-and-line gear, lobster/crab trap debris was the next most frequent category of marine debris in 2008 in terms of the number of sites where it was encountered and number of items retrieved (Table 20). Figures 92-97 illustrate the spatial distribution of trap debris density (no. items per 60 m^2) throughout the Florida Keys study area, consisting of rope, wooden slats, cement slabs, plastic pot openings, and metal mesh trap grating, not including intact, but unbuoyed, traps on the bottom. The distribution of trap debris indicates that it is ubiquitous throughout the study area in all of the habitats sampled. Site-level mean (± 1 SE) densities of trap debris were as high as 3.75 items per 60 m^2 (Table 23). Trap debris was recovered from 85 out of the 145 sites (58.6%) and all five habitats as follows: mid-channel patch reefs

(17 sites, 70.8%), offshore patch reefs, (21 sites, 91.3%), inner line reef tract (5 sites, 71.4%), high-relief spur and groove (14 sites, 35%), and the deeper fore reef (28 sites, 54.9%). Differences in trap gear mean densities (no. items per 60 m^2) among habitats were evident, with the three more inshore habitats, specifically mid-channel patch reefs (0.65 ± 0.17), offshore patch reefs (0.62 ± 0.11), and inner line reef tract (0.57 ± 0.21), yielding greater densities than offshore spur and groove (0.15 ± 0.04) and the deeper fore-reef (0.40 ± 0.10) (Table 23). Figures 98-101 provide comparisons of trap debris among regions and management zones by habitat type. Similar to lost hook-and-line fishing debris, no-take zones and reference areas were roughly similar in terms of trap debris for several of the habitat types in particular regional sectors, and in several instances, trap debris were greater within no-take zones (Table 23). Particularly noteworthy are the relatively high densities of trap debris documented at Grecian Rocks SPA, Hen and Chickens SPA, Tennessee Reef RO, Coffins Patch SPA, and Looe Key RO. On mid-channel patch reefs in both the middle and lower Keys, trap gear densities were lower in reference areas, although substantial densities of trap gear and total lengths of rope were recovered from some of the no-take zones (Table 23). On middle Keys offshore patch reefs, greater trap gear density (1.13 ± 0.88 items per 60 m^2) and average trap rope length per site (8.6 ± 8.6 m) were recorded from Coffins Patch SPA compared to reference areas (0.56 ± 0.28 per 60 m^2, 5.9 ± 2.5 m per site). On lower Keys offshore patch reefs, similar densities of trap debris were found between no-take zones (0.56 ± 0.28) and reference areas (0.56 ± 0.16), although substantially greater trap rope was recovered per site (43.0 ± 20.9 m) from reference areas. Even so, an average of 13.5 ± 7.9 m of trap rope was recovered from no-take zones, all of which was found in the Looe Key RO.

Figure 102 illustrates the length distribution of lost trap rope debris recovered for all sites combined. Of the 81 incidences of trap rope, ~21% were less than 5.0 m in length, while 53% of the rope items were between 5 m and 15 m in length. The average (± 1 SE) length of all trap rope debris recovered was 11.7 ± 1.0 m. Figures 103-108 illustrate the spatial distribution of trap rope length (total length recovered per site) throughout the Florida Keys study area. The length of trap rope recovered per site varied substantially among the five habitat types. Mid-channel patch reefs (13.8 ± 3.5 m per site) and offshore patch reefs (14.6 ± 4.6 m per site) yielded the greatest average length of rope per site, roughly four times or greater than for the remaining three habitats. Figure 109-112 illustrate comparisons of lost hook-and-line gear length among regions and management zones by habitat type. Reference mid-channel and offshore patch reefs were particularly noteworthy for the total length of trap recovered from many sites (Table 23). However, significant amounts (10+ m total length) of trap rope were recovered from several no-take zones, including Hen and Chickens SPA, Cheeca Rocks SPA, Coffins Patch SPA, Looe Key RO, and Tennessee Reef RO.

The 11 different types or combinations of trap debris accounted for 241 out of the 686 incidences of marine debris encountered during 2008 (Table 20). Trap debris resulted in 225 impacts to benthic coral reef organisms, so in comparison to hook-and-line gear, which was more frequently encountered, trap debris caused more damage. Similar to hook-and-line debris, lobster trap debris caused the most amount of abrasion damage to gorgonians (Table 21). In contrast, however, scleractinian corals were the second most frequently damaged group of organisms, followed by sponges. Trap rope in particular was the most damaging of the trap debris types encountered.

Relative to the area sampled in each habitat, regional sector, and management zone, initial estimates can be derived for the Florida Keys sampling domain (northern Key Largo to SW of Key West) for trap debris, using gear density and total length of trap rope retrieved per site, as well as information on the spatial extent of habitats (see Smith et al. in press). Even if we do not scale up the transect data (60 m^2 x 4 per site) to the area of a block (40,000 m^2), and assume that all of the debris in a 200-m x 200-m area only occurred within our transect boundaries, then a very conservative estimate of the total number of trap debris items and the total trap rope present can be obtained. These estimates only apply to the five habitat types that were actually sampled during 2008 and are as follows:

- Mid-channel patch reefs: 4,870 debris items with a total trap rope length of 31.4 km (~19.5 miles),
- Offshore patch reefs: 2,466 debris items with a total length of 16.0 km (~9.9 miles),
- Inner line reef tract: 157 debris items with a total trap rope length of 0.1 km (~0.06 miles),
- High-relief spur and groove: 119 debris items with a total trap rope length of 0.7 km (~0.44 miles),
- Deeper fore reef (6-15 m): 6,203 debris items with a total trap rope length of 14.7 km (~9.1 miles), and
- Total for the five habitats: ~16,512 debris items with a total trap rope length of 61.5 km (~38.2 miles).

The total trap rope length for the five habitats is equivalent to stretching a single piece of trap rope from Marathon to Tavernier.

It is important to note that these estimates are affected by the accuracy of the existing habitat and bathymetry maps for the Florida Keys, as well as the density and trap rope length estimates derived for

each site. In addition, the values assume that lobster/crab trapping effort, which affects the amount of gear lost, is evenly distributed throughout the study area, which is probably not the case. Nevertheless, these initial estimates illustrate the potential amount of lost trap gear that may be present in the Florida Keys, not including Biscayne National Park, the Marquesas Keys, or the Dry Tortugas. Given that trap fishing has been going on for decades, and the fact that upwards of 450,000 traps are deployed every single year, with perhaps a 20-25% trap loss rate, it is not surprising that this amount of gear could accumulate in the study area.

Other Marine Debris

Besides hook-and-line and trap gear fishing debris, an assortment of marine debris classified as "other" was documented and recovered during 2008. A total of 33 other debris types that were not included in hook-and-line and trap debris categories were found, and included a range of paper, plastic, ceramic, and metal objects (Table 20). The 82 incidences of other debris caused abrasion damage to 29 different benthic coral reef organisms, of which gorgonians were the most frequently damaged (Table 21). In contrast to the two major types of fishing gear debris, other marine debris was found in relatively low amounts and somewhat randomly distributed among sites (Table 24).

Total Marine Debris

Figures 113-118 illustrate the spatial distribution of all marine debris encountered in the Florida Keys during 2008. As total debris largely reflects lost fishing gear, the spatial distribution of total marine is similar to lost hook-and-line and trap debris. Table 24 lists the total marine debris densities by site. What are noteworthy are the widespread occurrence of debris among the different habitats sampled and the relatively high densities of debris encountered in many of the Sanctuary no-take zones (Figures 119-122). For most of the habitats, the total marine debris encountered was proportional to the sampling effort allocated to no-take zones and corresponding reference areas. Unfortunately, one would expect significantly lower marine debris densities in the no-take zones, especially for debris that is derelict fishing gear. On mid-channel patch reefs, no-take zones represented 25% of the total sampling effort, yet 27.6% of debris items and 10.3% of the total debris wet weight were found in the no-take zones. On offshore patch reefs, 34.8% of the sampling effort in this habitat was allocated to no-take zones, while 35.9% of the total debris and 29.0% of the total weight was recovered from the zones. On inner line reef tract, more debris than expected was recovered in the no-take zones, both in terms of the number of items (69.2%) and debris wet weight (73.9%), relative to the sampling effort (57.1%) allocated to no-fishing zones in this habitat. For both high-relief spur and groove and the deeper fore-reef, less debris than expected was found in the no-take zones, assuming that debris incidence was proportional to the sampling

effort. Overall, no-take zones represented 44.1% of the total sampling effort in 2008, yet 36.3% of the total debris items and ~30% of the total debris wet was recovered from the 22 no-take zones visited.

In addition to density and debris length estimates, all debris encountered during 2008 was recovered from the bottom and weighed. Table 25 provides site-level data for marine debris wet weight and Figures 123-128 illustrate the spatial distribution of debris weight recovered throughout the study area. A total of 443.098 kg of debris (~975 lbs.) was recovered from the 145 sampling locations. Total debris wet recovered per site reflects not the only the amount of debris, but also the debris type. Not surprisingly, those sites yielding the greatest densities and amounts of trap debris also yielded the largest debris weights, reflecting cement used to weight traps, as well as trap rope. Mid-channel (73.121 kg among 24 sites) and offshore patch reefs (122.864 kg among 23 sites), as well as the deeper fore reef (160.798 kg among 51 sites), yielded the greatest habitat-level weights of 3.047 ± 0.848, 5.342 ± 1.829, and 3.153 ± 0.735 kg of total debris per site, respectively (Figures 129-132). In a similar fashion to lost fishing gear, estimates of total weight of marine debris in the study area can be calculated by using site-level estimates (per 240 m^2) of debris weight and the number of available sites (200-m x 200-m blocks or cells) in a particular habitat. These estimates suggest that there may be as much as the following total marine debris by habitat in the study area:

- Mid-channel patch reefs: 7,052 kg (~7.76 tons),
- Offshore patch reefs: 5,990 kg (~6.59 tons),
- Inner line reef tract: 146 kg (~0.16 tons),
- High-relief spur and groove: 359 kg (~0.40 tons),
- Deeper fore reef (6-15 m): 15,079 kg (~16.59 tons), and
- Total for the five habitats: 28,627 kg (~31.49 tons).

These estimates illustrate the potential amount of total marine debris that may be present in the Florida Keys, not including Biscayne National Park, the Marquesas Keys, or the Dry Tortugas.

Discussion

Methods of fishing that cause habitat modification or damage to benthic organisms represent potentially serious consequences of fishing (Russ 1991; Benaka 1999). Although there is increasing recognition of the consequences to benthic habitats from the use of mobile fishing gear (Watling and Norse 1998; Auster and Langton 1999) and other destructive fishing practices (Saila et al. 1993; Jennings and Polunin 1996), only a handful of studies in the Florida Keys have quantified the spatial extent of marine debris, as well as

the biological impacts to organisms and habitats (Chiappone et al. 2002c, 2004, 2005). Recent investigations of lobster trap movement (T. Matthews et al. at FWRI) indicate the potential for extensive movement of deployed gear, especially during storms. Relative to surveys completed by our program in 2000 and 2001, the results from 2008 indicated the continued persistence of marine debris, especially lost fishing gear, throughout the Florida Keys.

Interpretation of the biological impact data is complicated by several factors. Both the debris density and the distribution of sessile invertebrates sampled in this study are related to habitat type, and secondarily by management type. Future efforts need to consider the scaling of debris occurrence with impacts relative to these two factors. For example, it is probable that a coral-dominated reef with a given amount of hook-and-line gear will not be affected in the same way as a gorgonian-sponge dominated reef with the same density of gear. Estimates of the proportion of different taxa impacted by debris relative to total abundance estimates are also useful for placing the debris impact assessment into context. In addition, the long-term impacts to biota and the degree of recovery are unknown. For example, we observed several instances where hook-and-line and trap gear, especially monofilament and trap rope, were overgrown by invertebrates, and it seems plausible that some debris will be incorporated into the habitat matrix. We also recognize that the future biological assessments would be more useful if data on the severity of each impact (e.g. amount of tissue damage) relative to the size of the organism were collected. We suggest that future debris surveys in the Florida Keys should compare debris densities between no-fishing zones and reference areas, as well as the impacts to sessile biota and whether fishing gear is relatively recent or biologically fouled. The site-level data presented in this report clearly indicate areas in the Florida Keys, including reefs heavily visited by divers and snorkelers, where public debris collection efforts such as “reef sweeps” should be focused. Results from this study suggest that overall estimates of biological impact from marine debris may be considerable, and such impacts are among a suite of factors that affect the structure and condition of Florida Keys reefs. In particular, lost trap rope, while lower in density than lost hook-and-line gear, causes a disproportionate amount of damage to benthic invertebrates. As visitation and fishing pressure increase in this area, it can be expected that the extent of marine debris and the impacts to organisms will also increase.

Considering the intensive fishing effort and the significant increases in registered recreational boats and angler days in the Florida Keys (Bohnsack et al. 1994), patterns in the distribution and frequency of marine debris recorded during this study, especially derelict fishing gear, are not surprising. We initially assumed that, independent of habitat type, the mean density of debris, especially fishing gear, would be lower in no-fishing zones “protected” since 1997 compared to reference areas. However, marine debris

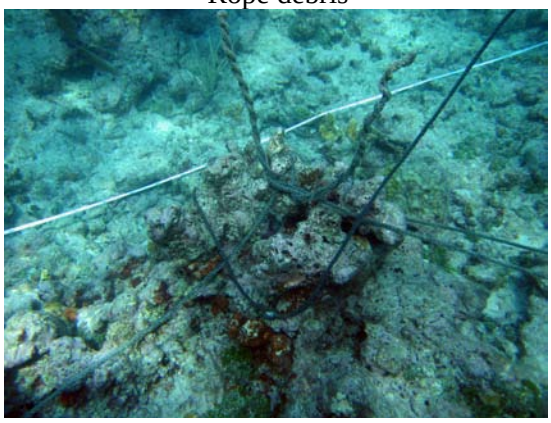
occurrence, most of which was derelict fishing gear in terms of the number of items and total weight, was more or less proportional to the sampling effort. This is similar to results obtained in 2000 (Chiappone et al. 2002c) and 2001 (Chiappone et al. 2004) in the study area. In other words, we did not find substantially less debris in the no-take zones compared to reference areas open to fishing, and, in fact, several of the no-take zones yielded greater densities and amounts (length, weight) of debris, particularly derelict fishing gear, compared to adjacent reference areas. There are several possible explanations for these patterns. First, non-compliance may have occurred in some of the no-fishing zones sampled. It was not uncommon to find "fresh" hook-and-line gear in the no-take zones. Second, the no-take zones may attract fishers to fish illegally or to fish close to the zone boundaries, otherwise known as "fishing the line". For example, substantial amounts of hook-and-line gear were found within the Research Only Area at Conch Reef, which has four yellow zone buoys, as well as several buoys in the interior marking the location of NOAA's Aquarius undersea habitat. Third, it is possible that storms distribute debris from areas where it is initially lost preferentially to the no-take zones. For example, while lobster traps are most commonly deployed in seagrass beds, with some deployed on the periphery of patch reefs, wave action from storms could have transport trap components elsewhere. It is quite likely that tropical storms during 2008 resulted in the destruction and transport of numerous lobster traps. For example, six complete lobster pots, together with buoys, were inside the Tennessee Reef RO for several weeks, but perhaps were set outside of the no-take zone initially.

Figure 69. Examples of plastic and trap rope debris documented in the Florida Keys during 2008.

Plastic debris

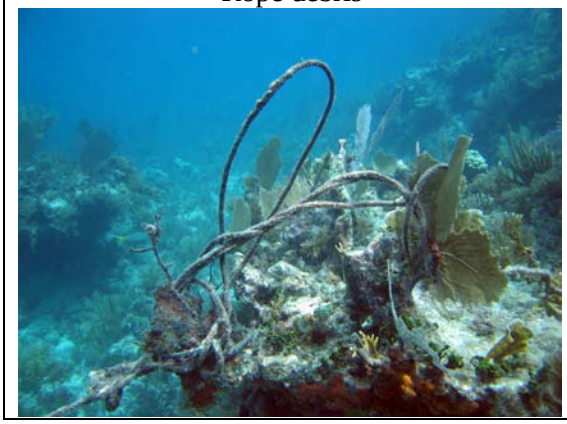
Rope debris

Rope debris



Rope debris

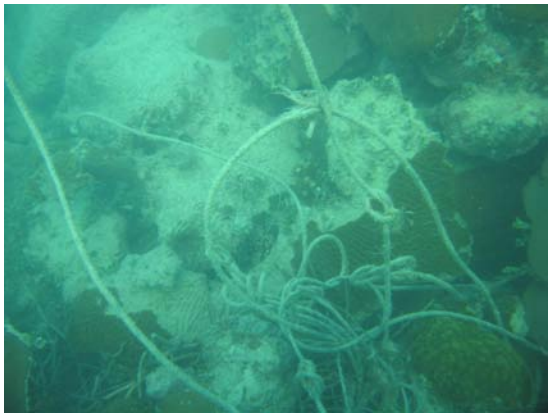
Rope debris



Rope debris

Figure 70. Examples of lobster/crab trap rope and derelict traps documented in the Florida Keys during 2008.

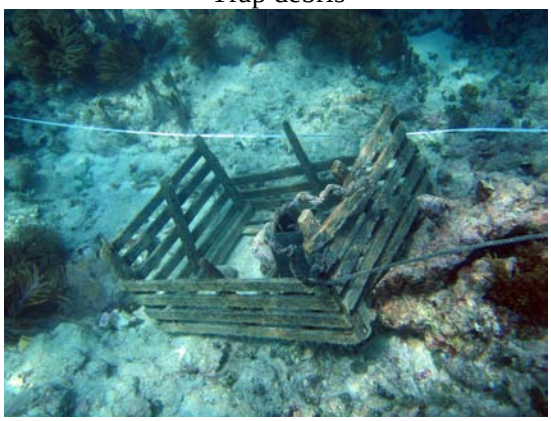
Plastic debris



Rope debris

Rope debris

Trap debris



Rope debris

Trap debris

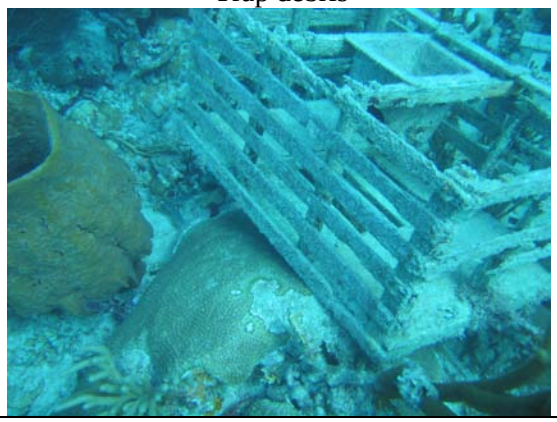


Figure 71. Densities (no. items per 60 m^2) of hook-and-line fishing gear in the upper Florida Keys (top) and from the southern BNP boundary to Carysfort Reef (bottom) during June-September 2008.

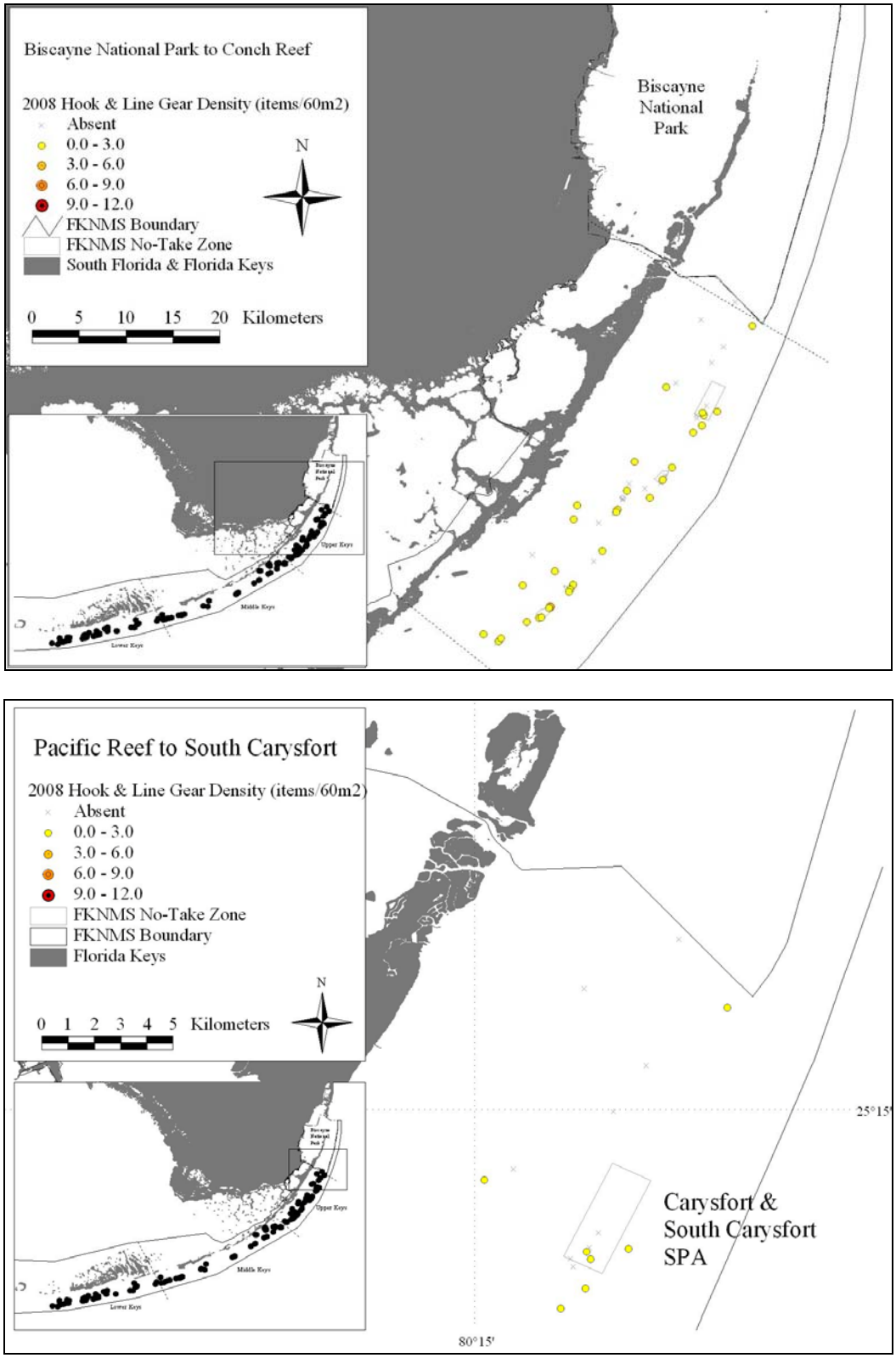


Figure 72. Densities (no. items per 60 m^2) of hook-and-line fishing gear in the upper Florida Keys from Elbow Reef to Pickles Reef (top) and in the middle Florida Keys (bottom) during June-September 2008.

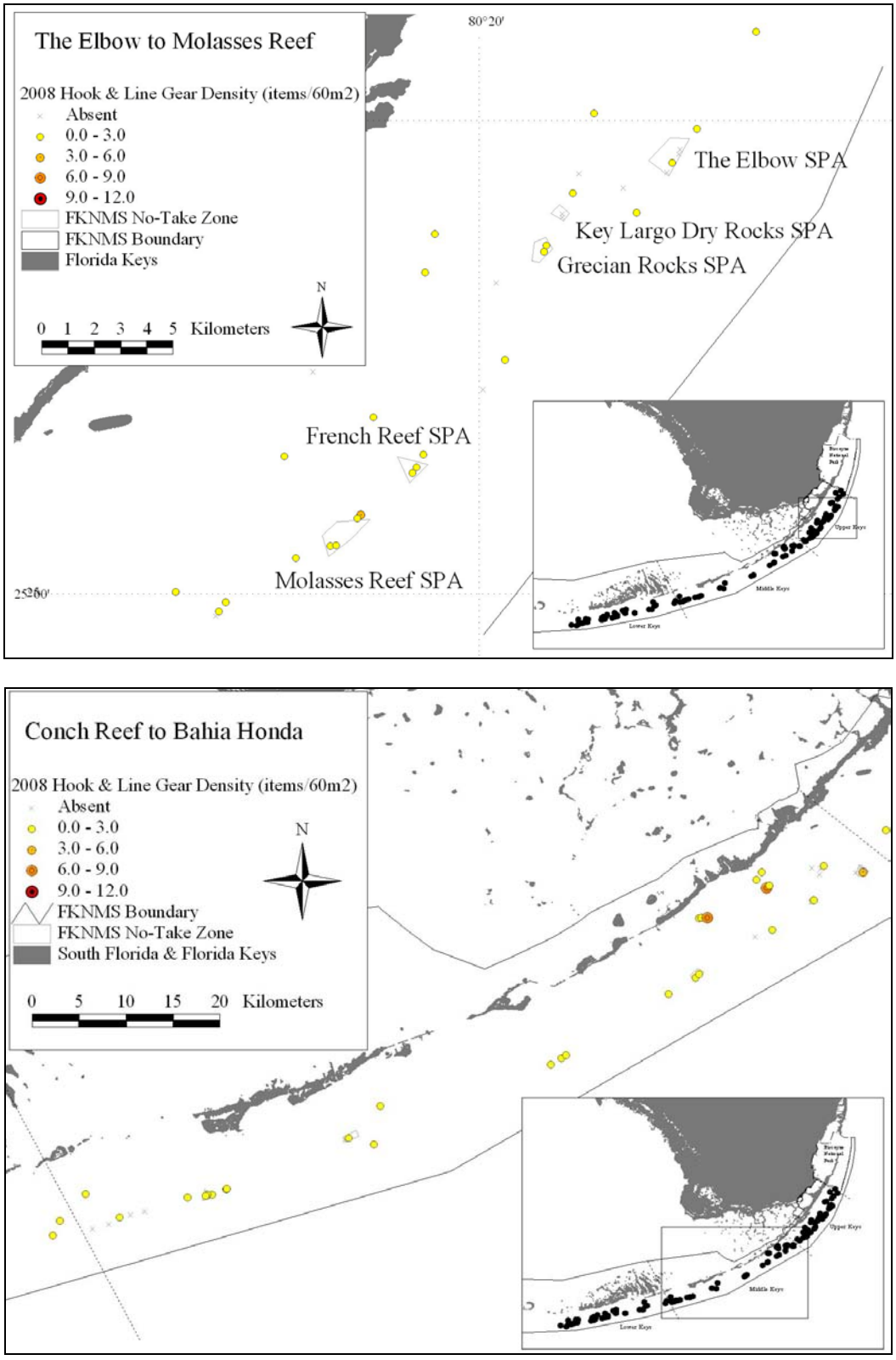


Figure 73. Densities (no. items per 60 m^2) of hook-and-line fishing gear in the middle Florida Keys from Conch Reef to Alligator Reef (top) and from Tennessee Reef to Coffins Patch (bottom) during June-September 2008.

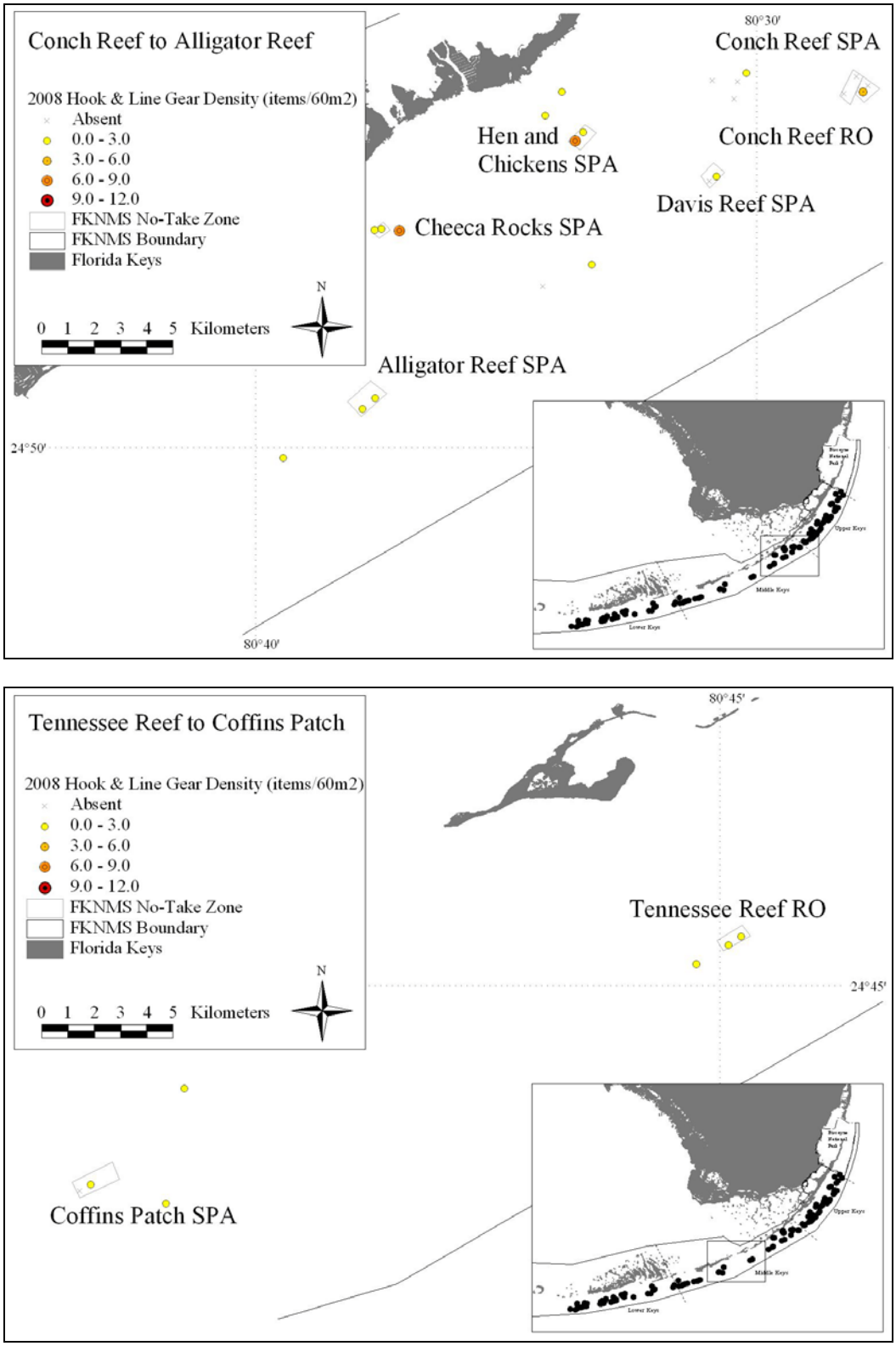


Figure 74. Densities (no. items per 60 m^2) of hook-and-line fishing gear in the middle Florida Keys from Sombrero Reef to Bahia Honda (top) and in the lower Florida Keys (bottom) during June-September 2008.

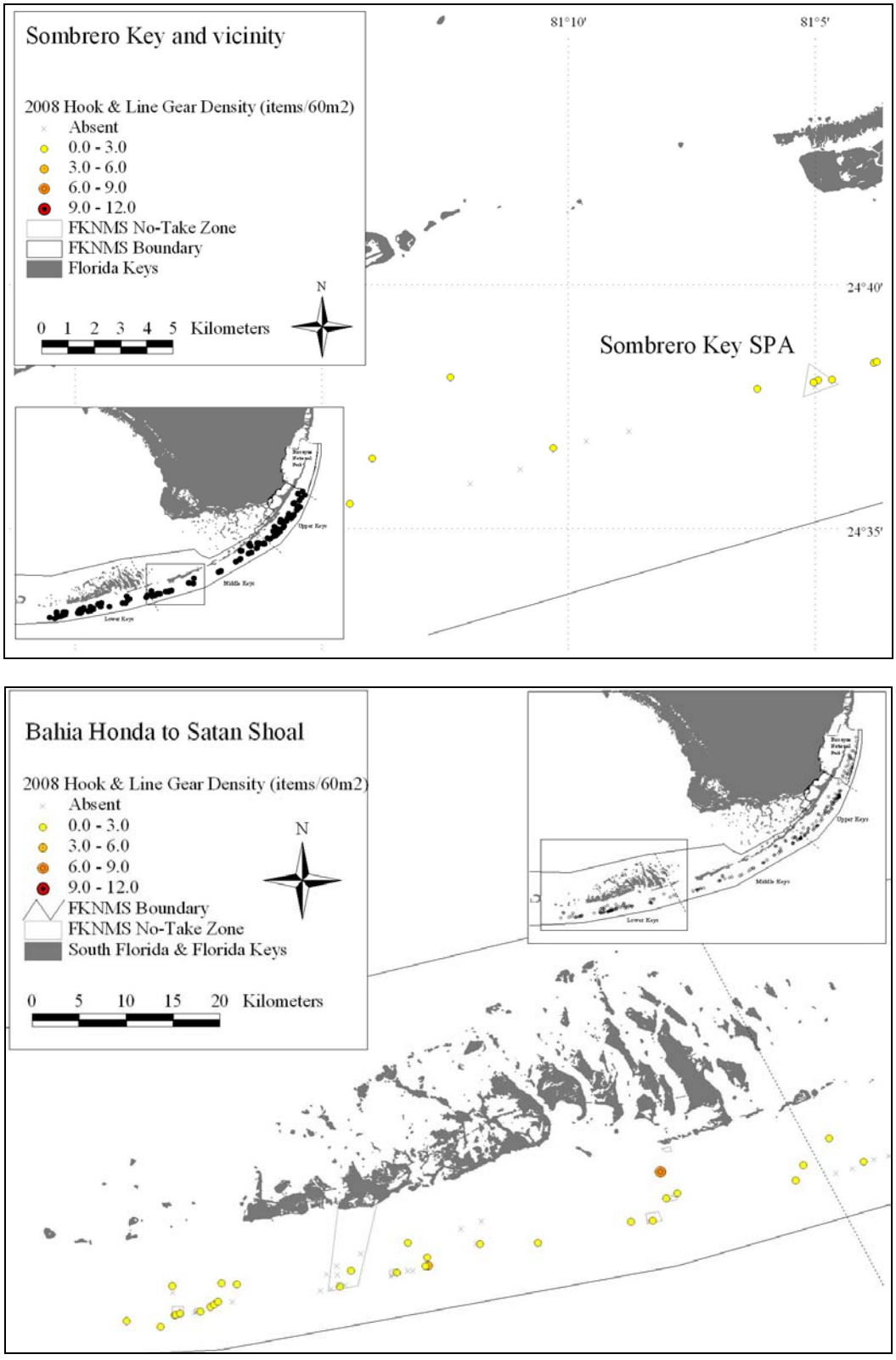


Figure 75. Densities (no. items per 60 m^2) of hook-and-line fishing gear in the lower Florida Keys from Bahia Honda to Looe Key (top) and from American Shoal to Western Sambo (bottom) during June-September 2008.

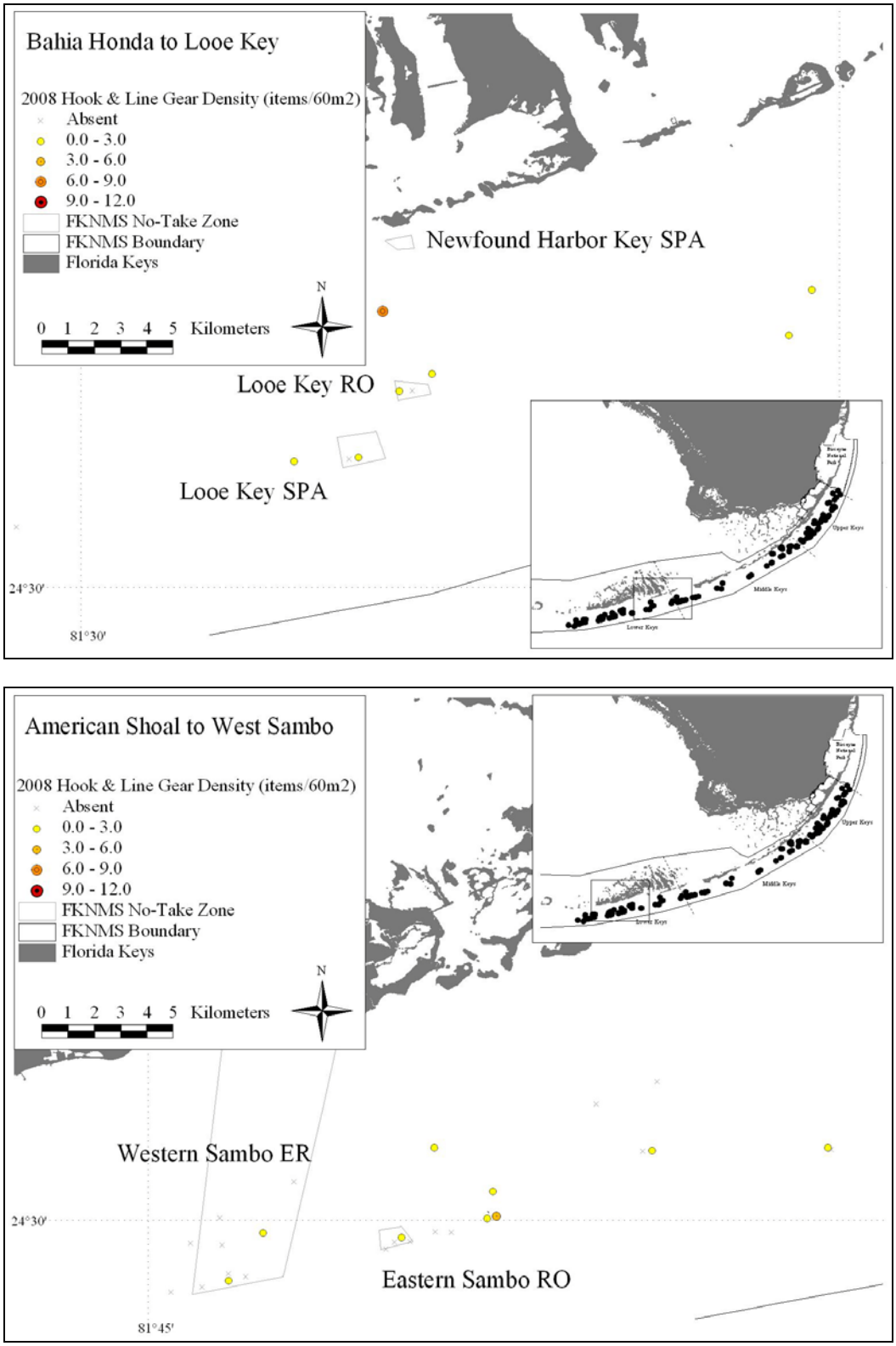


Figure 76. Densities (no. items per 60 m^2) of hook-and-line fishing gear in the lower Florida Keys from Eastern Dry Rocks to Sand Key during June-September 2008.

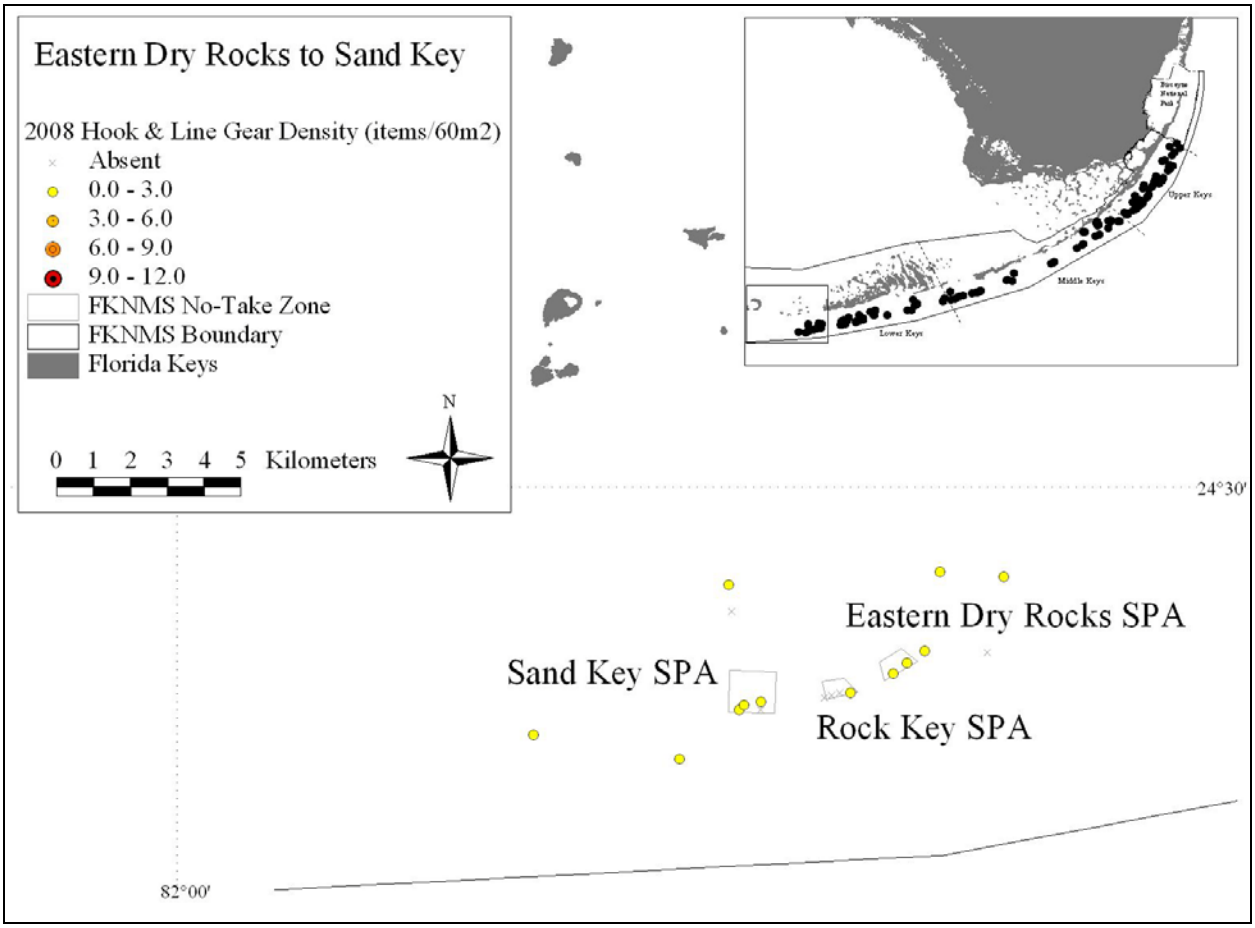


Figure 77. Mean (+ 1 SE) densities (no. items per 60 m^2) of hook-and-line fishing gear on mid-channel patch reefs (top) and variations in site-level densities relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

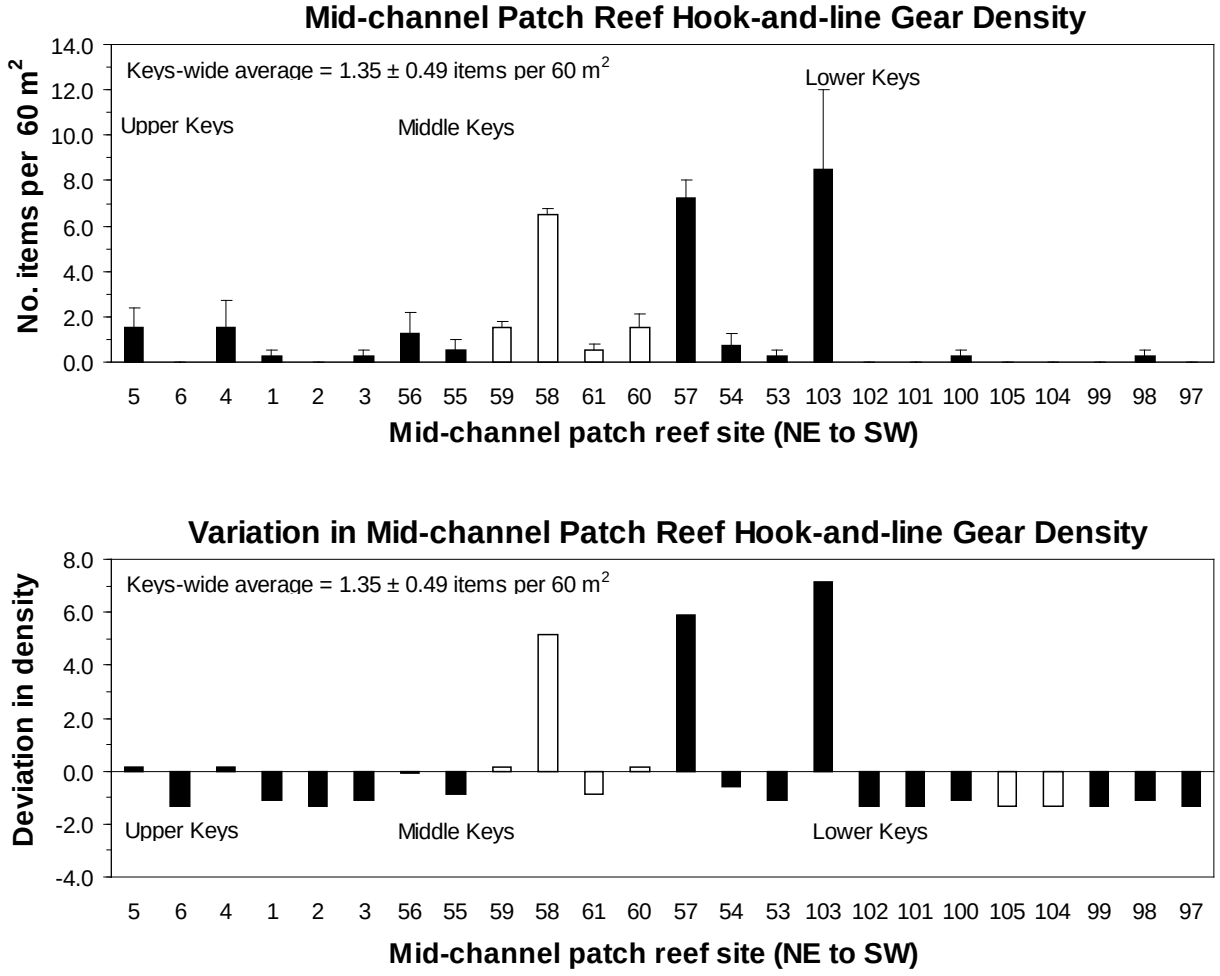


Figure 78. Mean (+ 1 SE) densities (no. items per 60 m^2) of hook-and-line fishing gear on offshore patch reefs (top) and variations in site-level densities relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

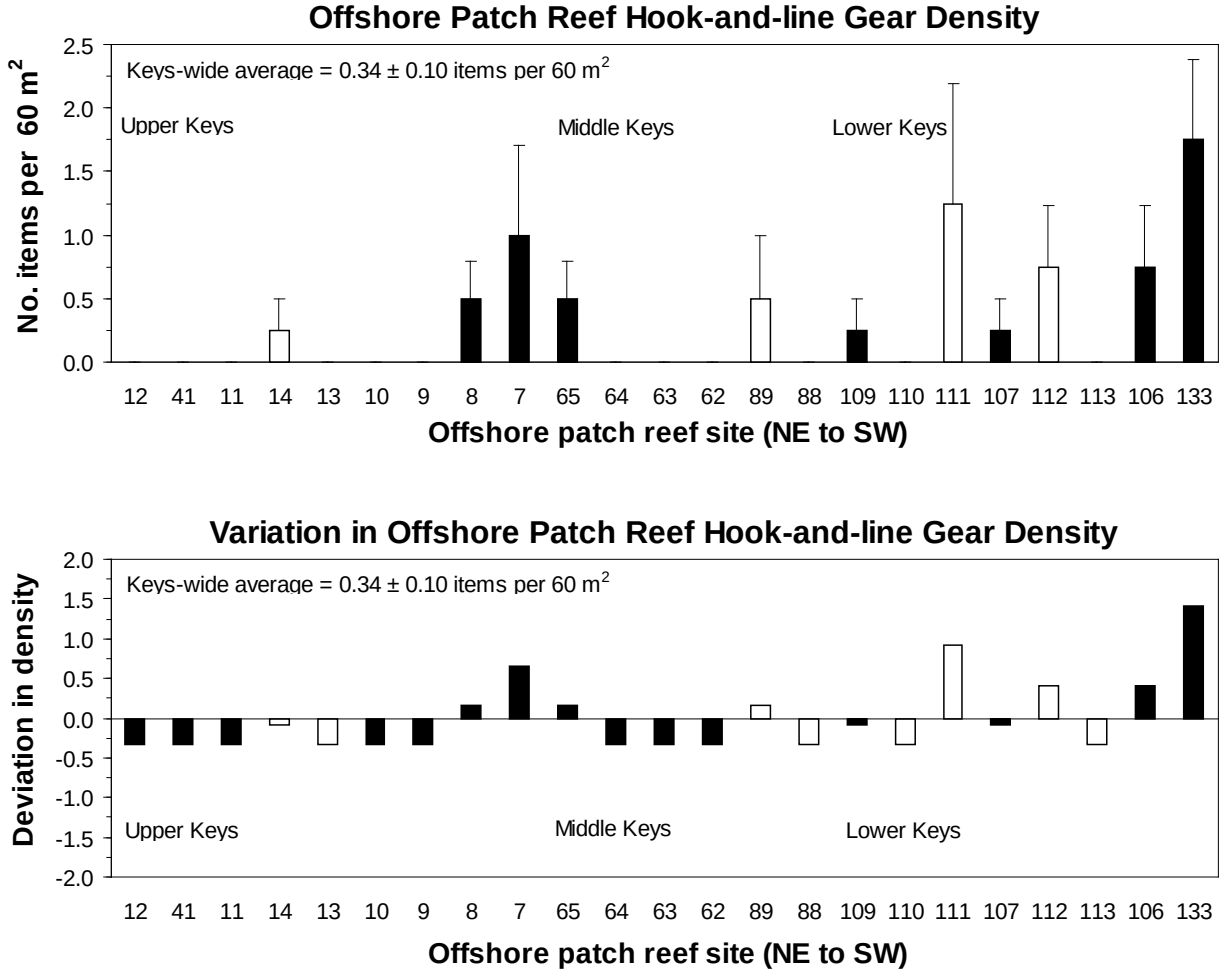


Figure 79. Mean (+ 1 SE) densities (no. items per 60 m^2) of hook-and-line fishing gear on shallow (< 6 m), high-relief spur and groove reefs (top) and variations in site-level densities relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

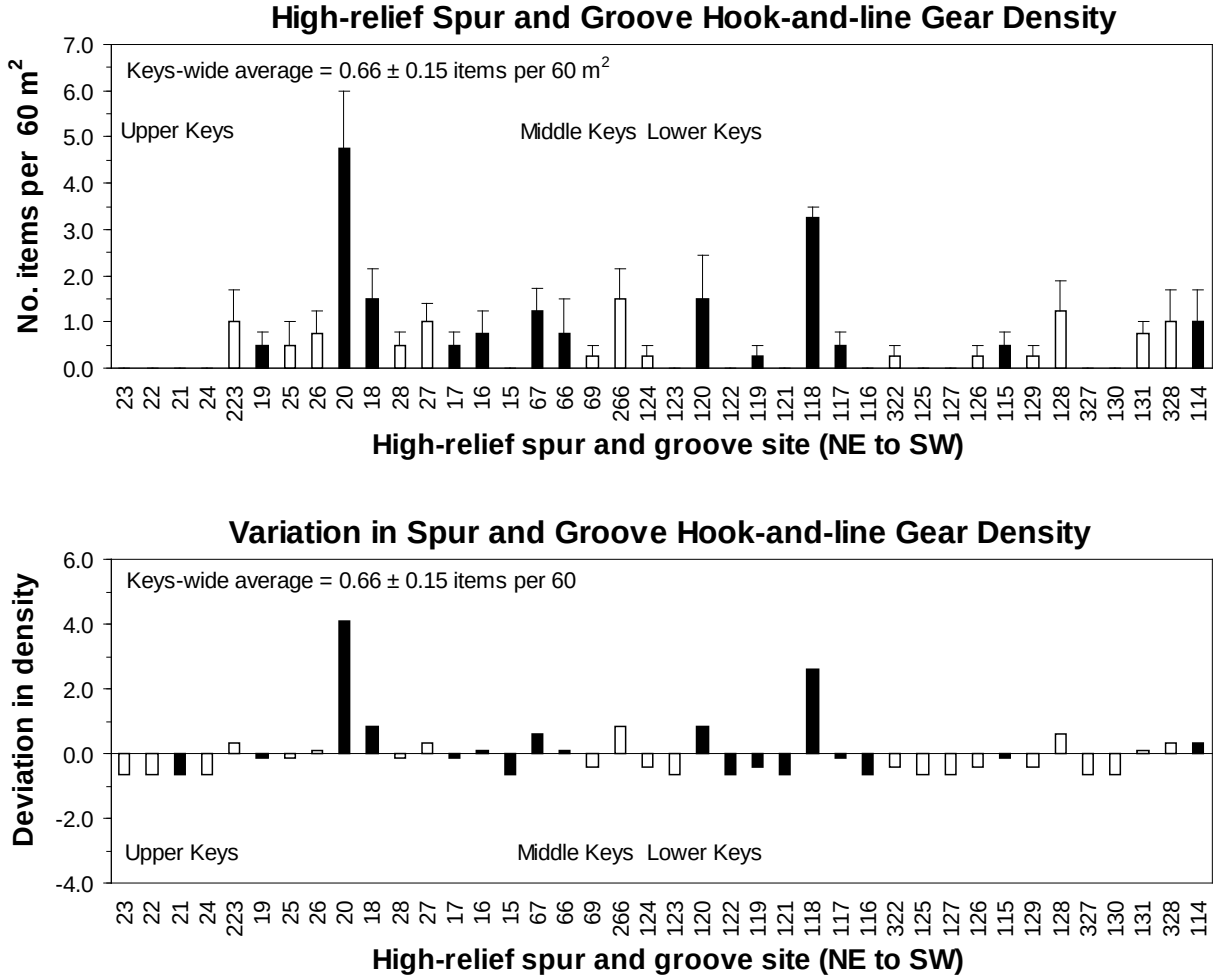


Figure 80. Mean (+ 1 SE) densities (no. items per 60 m^2) of hook-and-line fishing gear on deeper (6-15 m) fore-reef sites (top) and variations in site-level densities relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

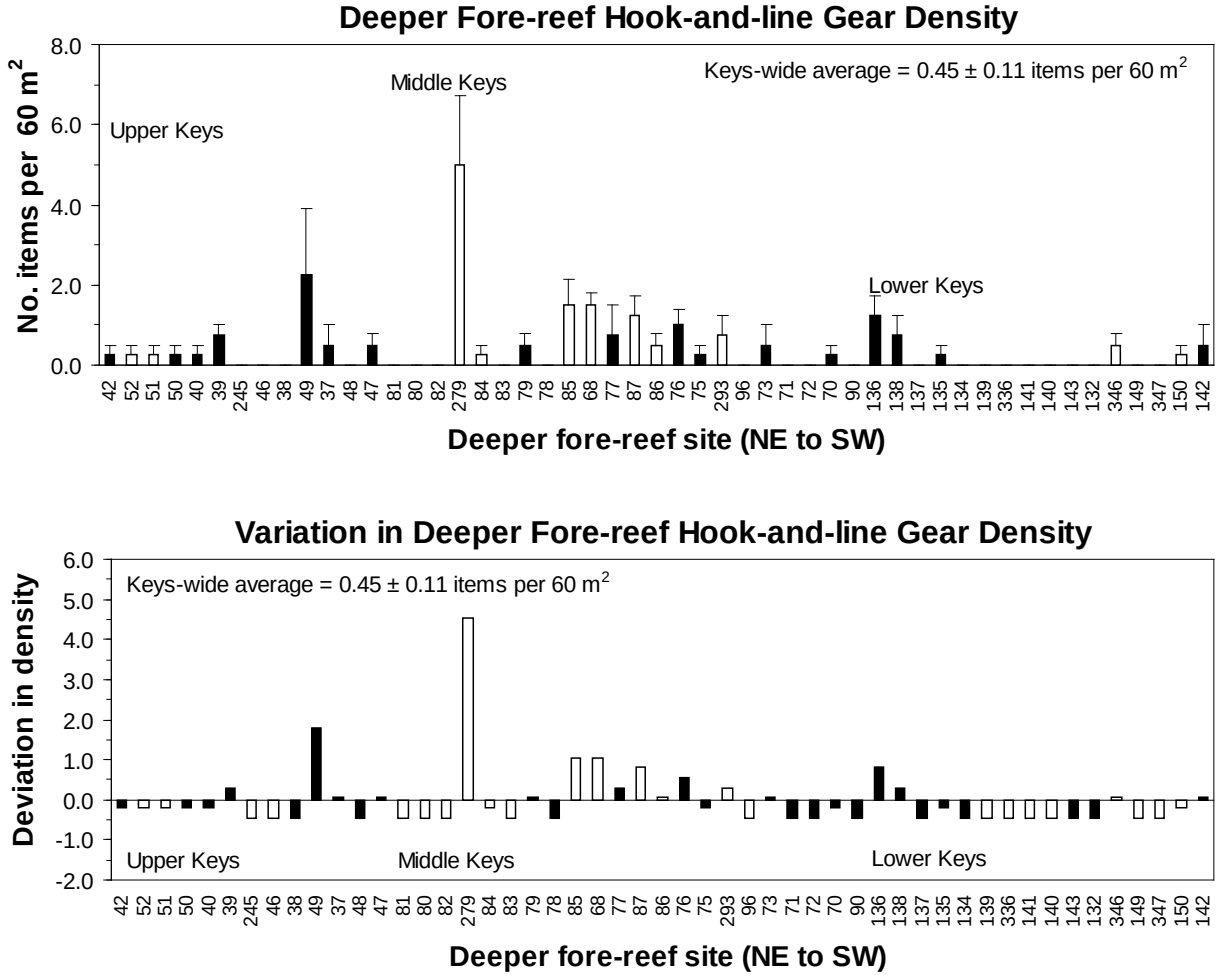


Figure 81. Length distribution (m) of derelict hook-and-line fishing gear retrieved from surveys of 145 sites in the Florida Keys National Marine Sanctuary during June-September 2008.

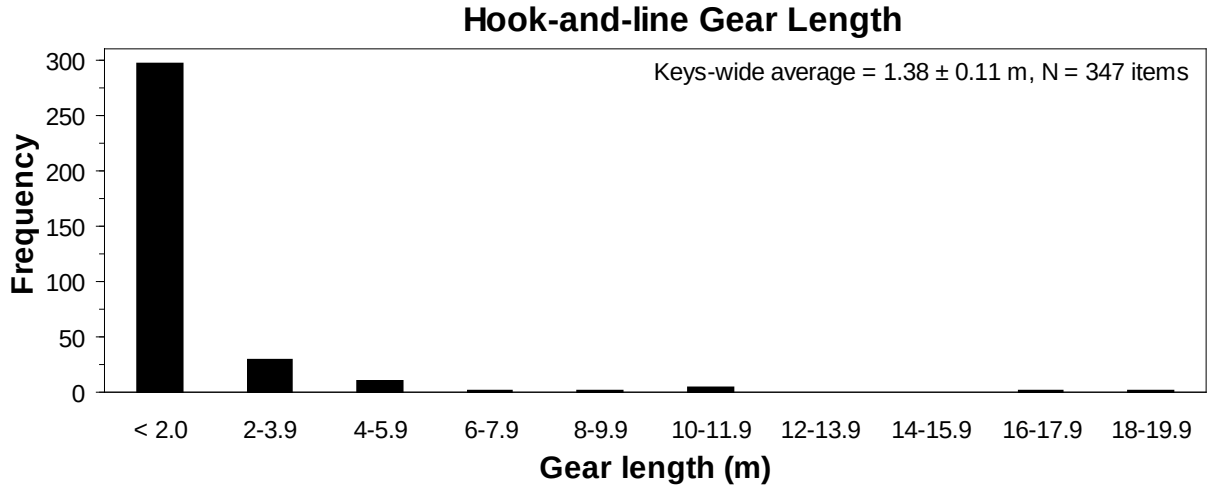


Figure 82. Total length (m) of derelict hook-and-line fishing gear retrieved from 240-m^2 search areas per site in the upper Florida Keys (top) and from the southern BNP boundary to Carysfort Reef (bottom) during June-September 2008.

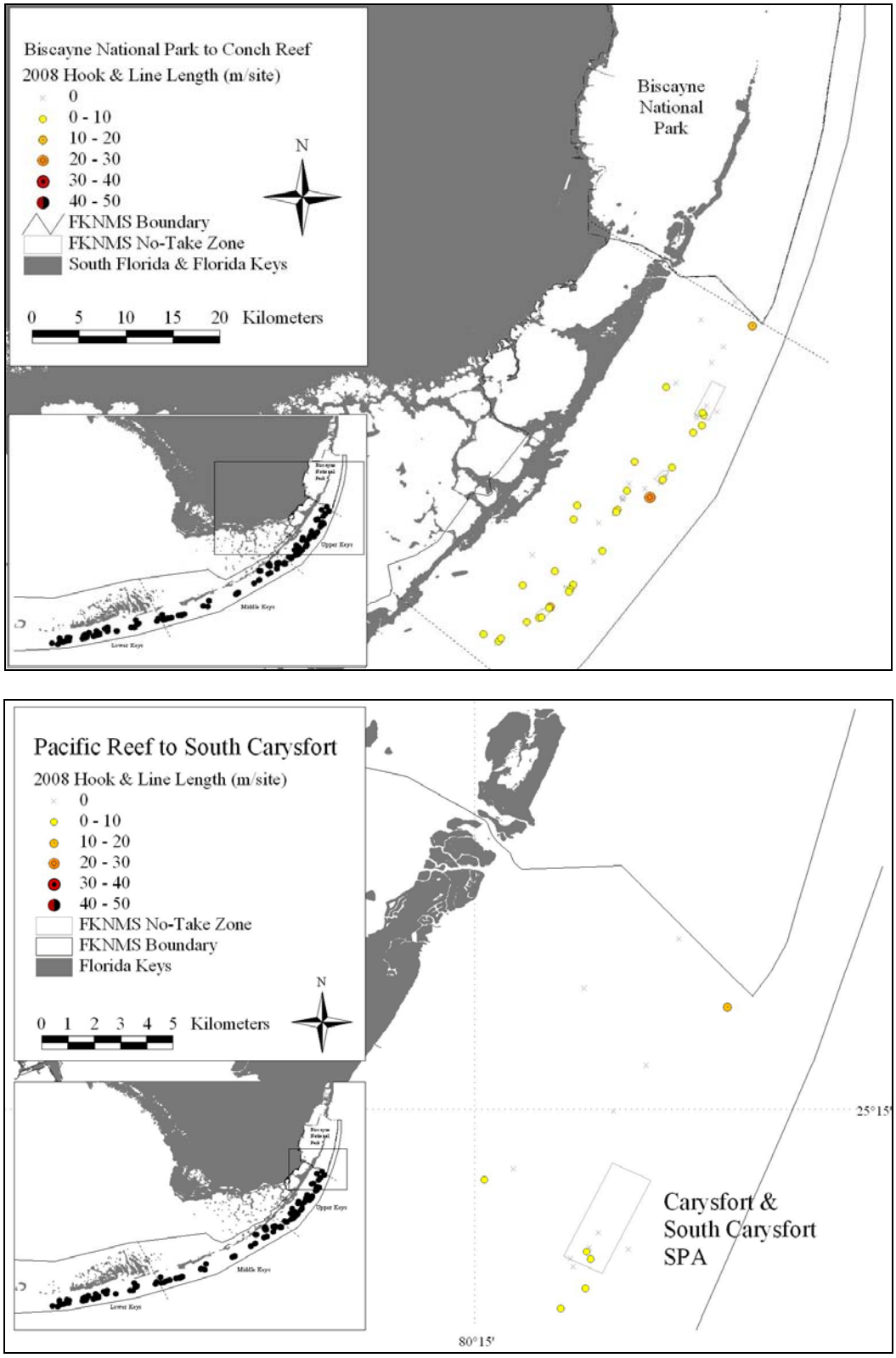
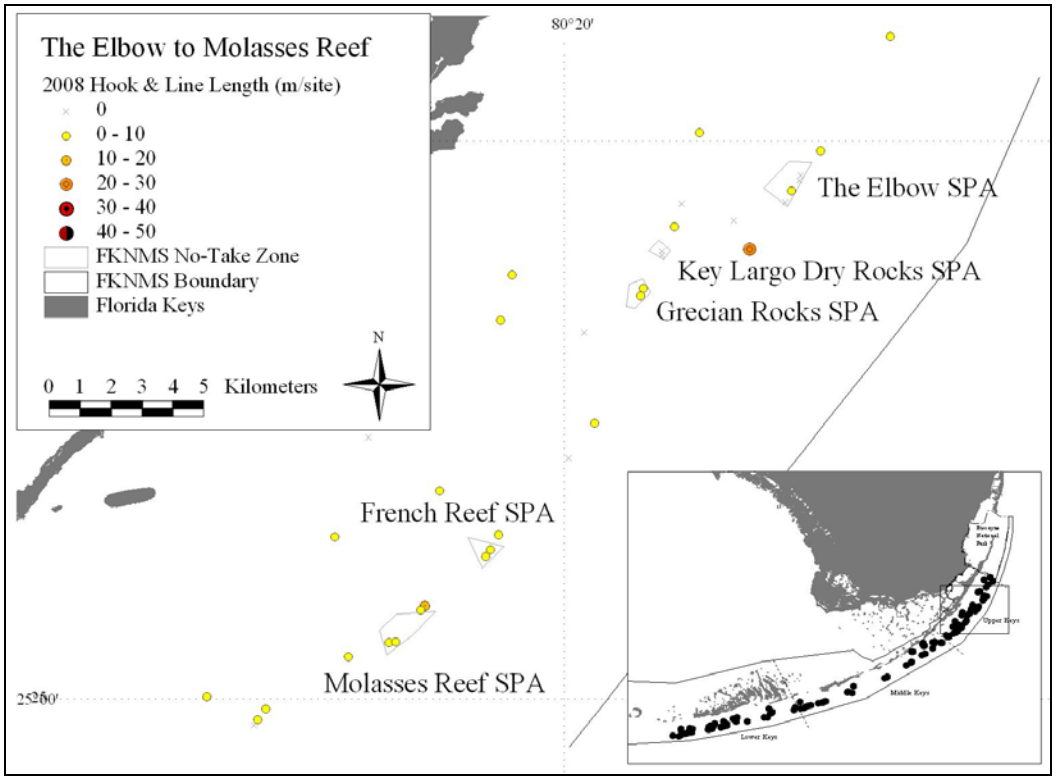


Figure 83. Total length (m) of derelict hook-and-line fishing gear retrieved from 240-m^2 search areas per site in the upper Florida Keys from Elbow Reef to Pickles Reef (top) and in the middle Florida Keys (bottom) during June-September 2008.



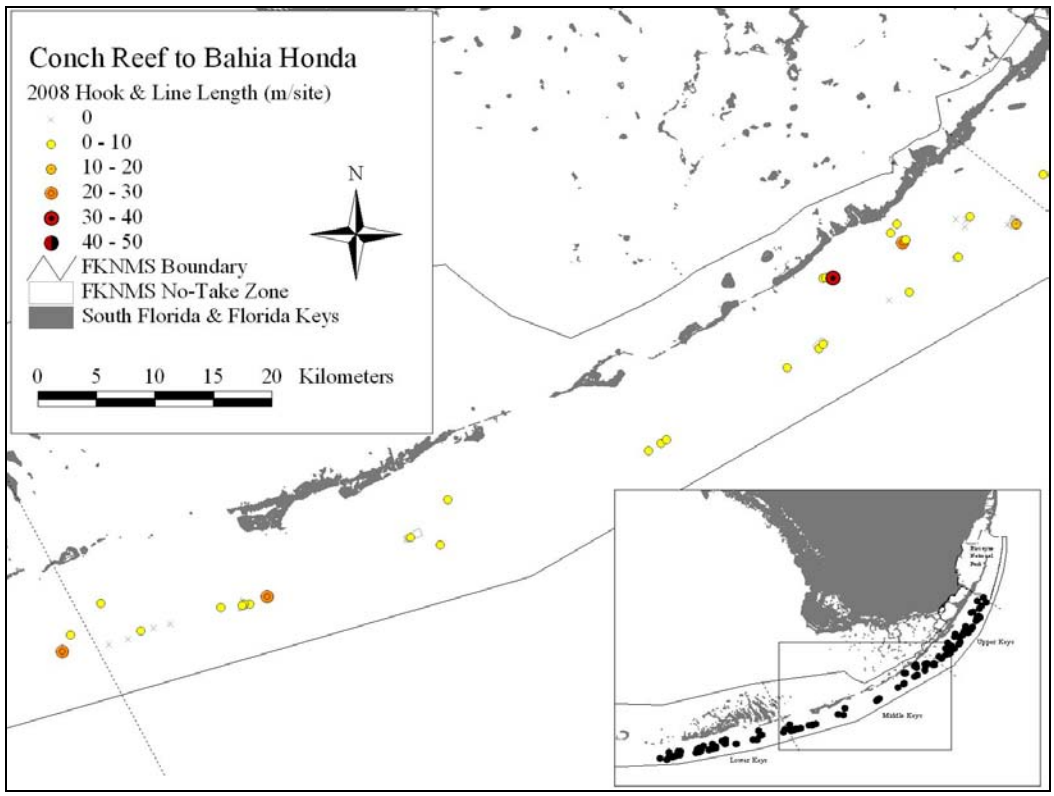
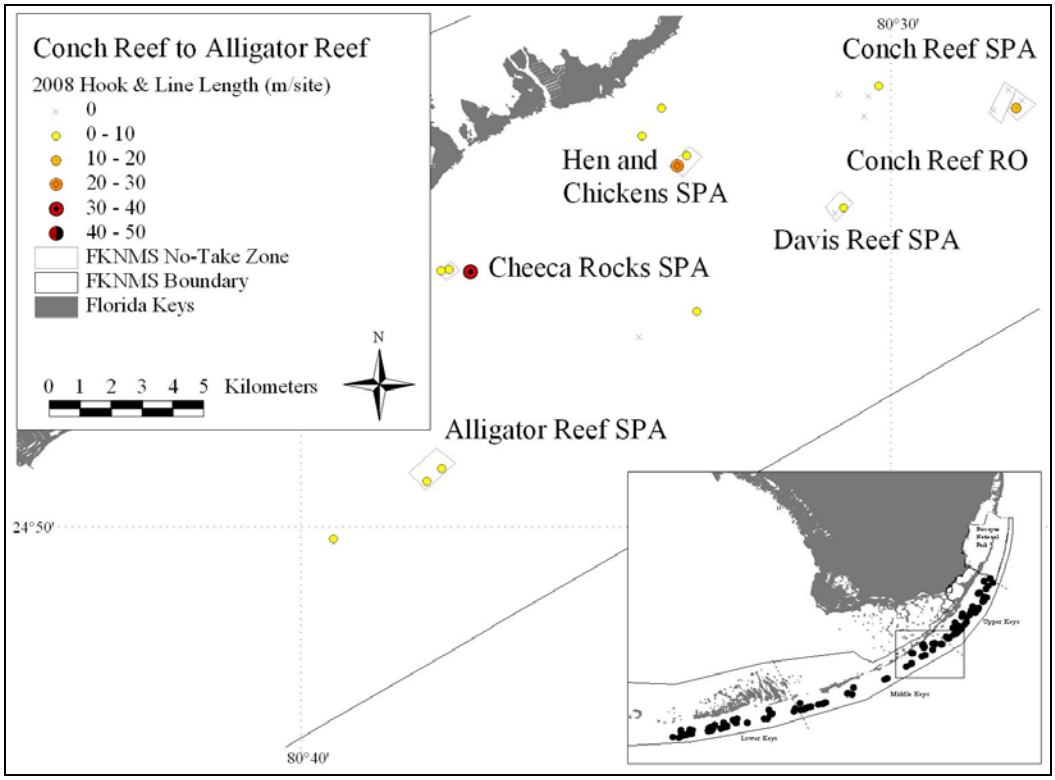


Figure 84. Total length (m) of derelict hook-and-line fishing gear retrieved from 240-m^2 search areas per site in the middle Florida Keys from Conch Reef to Alligator Reef (top) and from Tennessee Reef to Coffins Patch (bottom) during June-September 2008.



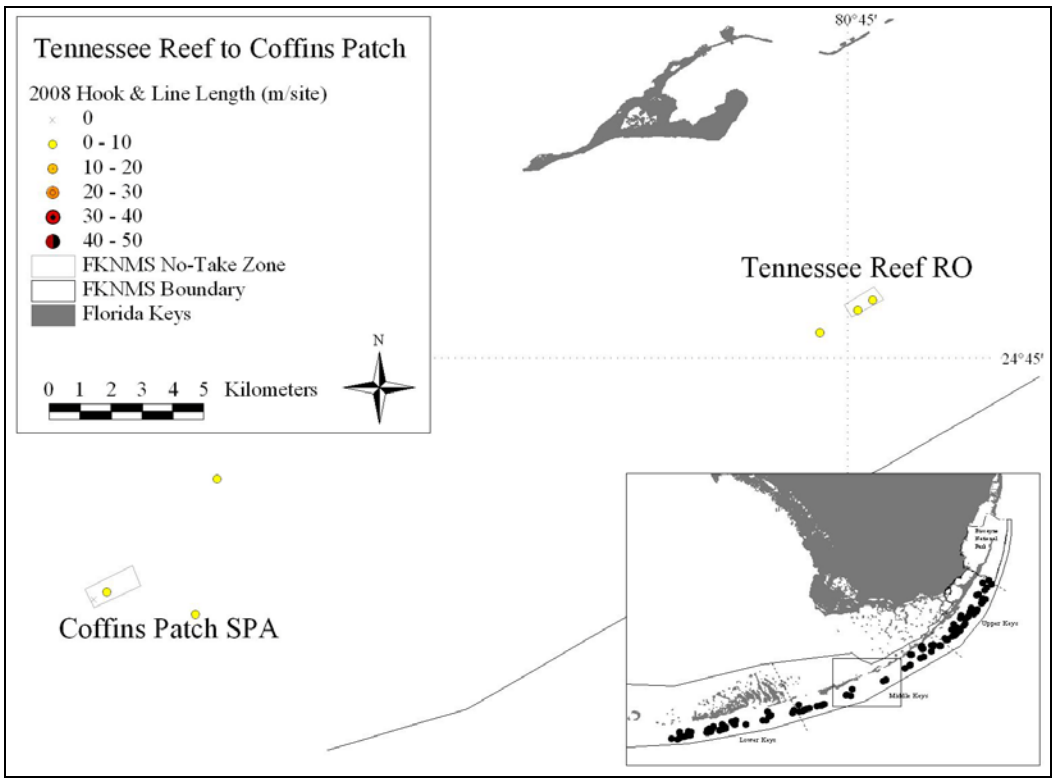


Figure 85. Total length (m) of derelict hook-and-line fishing gear retrieved from 240-m^2 search areas per site in the middle Florida Keys from Sombrero Reef to Bahia Honda (top) and in the lower Florida Keys (bottom) during June-September 2008.

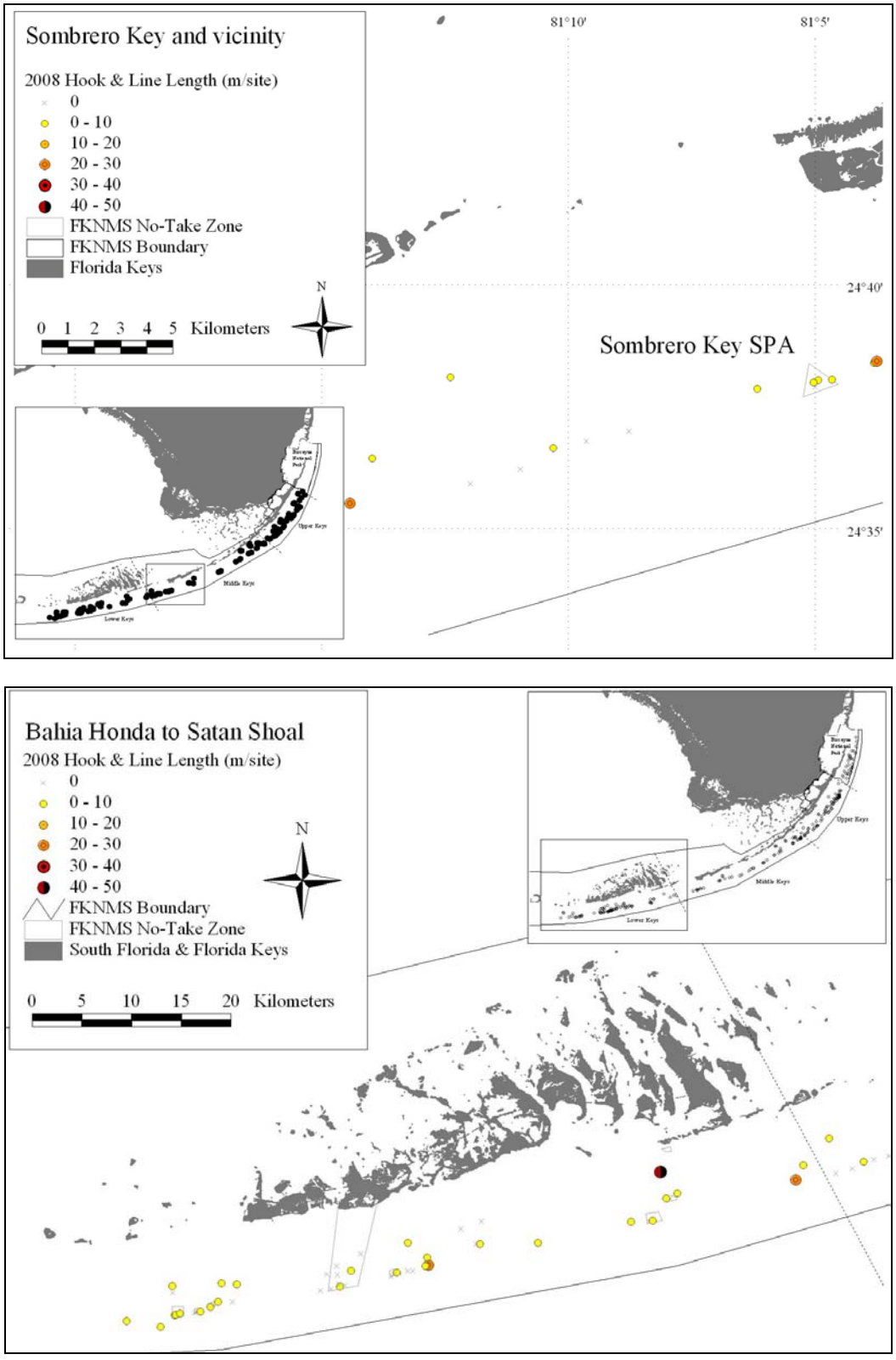


Figure 86. Total length (m) of derelict hook-and-line fishing gear retrieved from 240-m^2 search areas per site in the lower Florida Keys from Bahia Honda to Looe Key (top) and from American Shoal to Western Sambo (bottom) during June-September 2008.

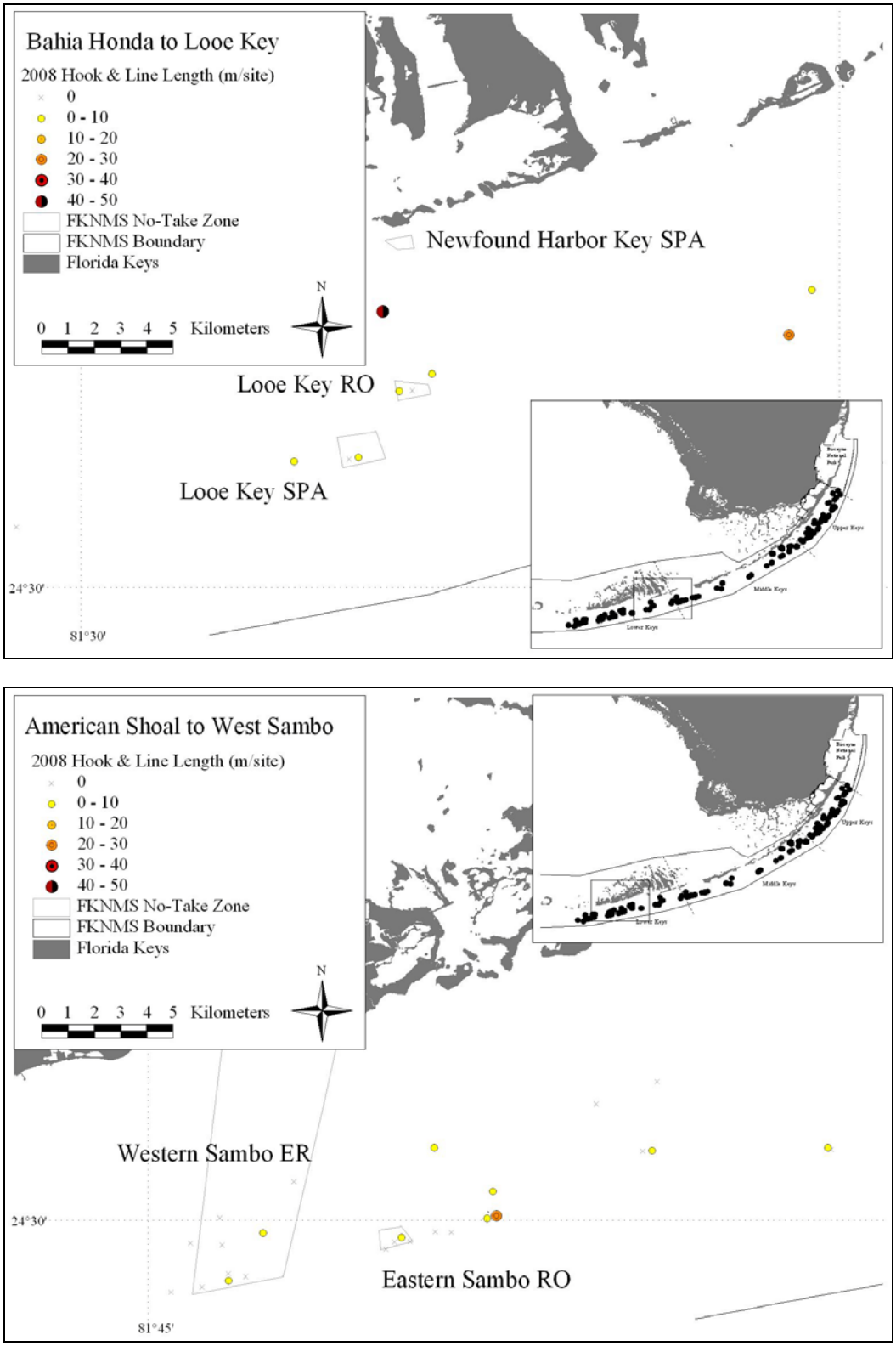


Figure 87. Total length (m) of derelict hook-and-line fishing gear retrieved from 240-m^2 search areas per site in the lower Florida Keys from Eastern Dry Rocks to Sand Key during June-September 2008.

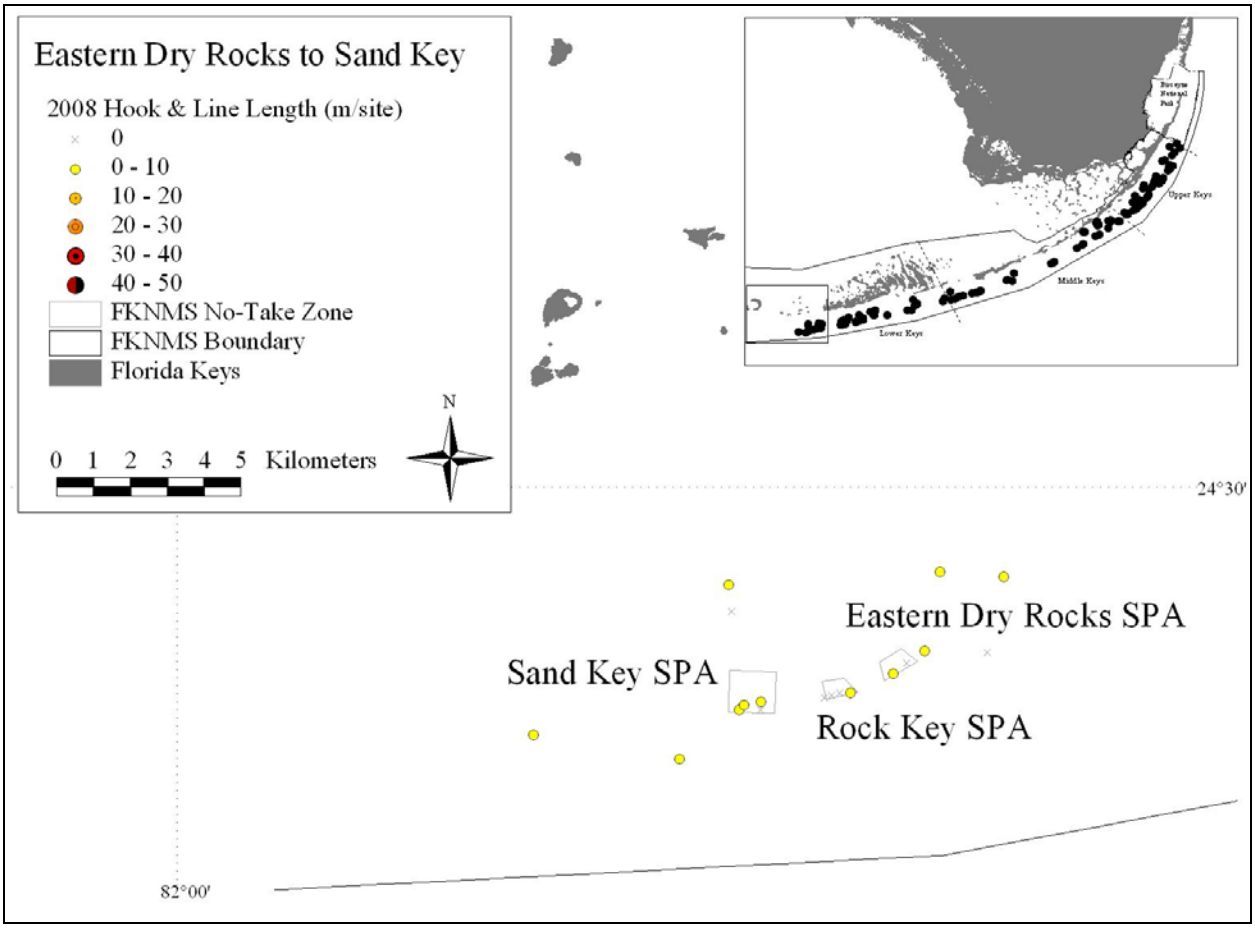


Figure 88. Total length (m) of hook-and-line fishing gear retrieved from 240-m^2 search areas per site on mid-channel patch reefs (top) and variations in total gear length retrieved relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

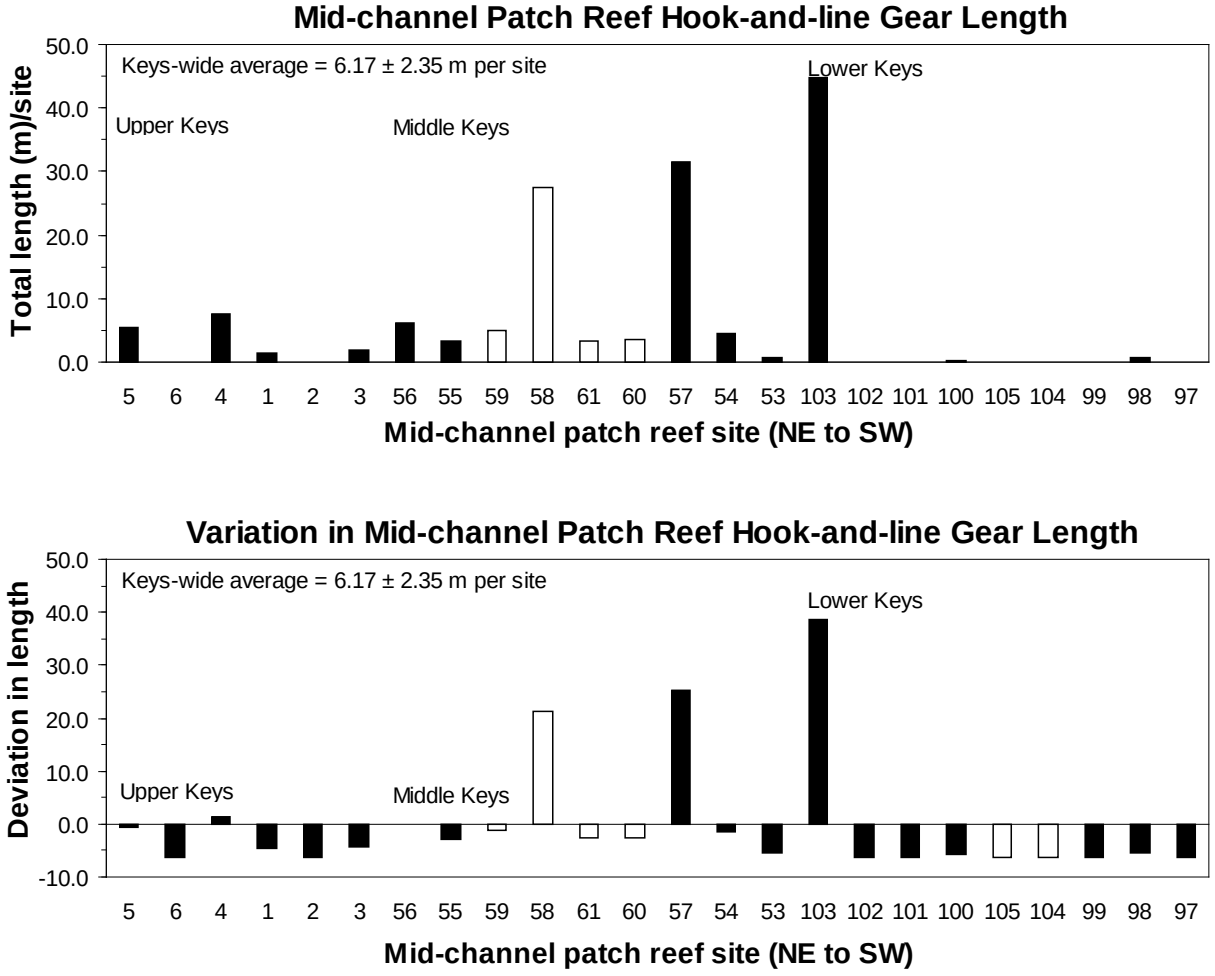


Figure 89. Total length (m) of hook-and-line fishing gear retrieved from 240-m^2 search areas per site on offshore patch reefs (top) and variations in total gear length retrieved relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

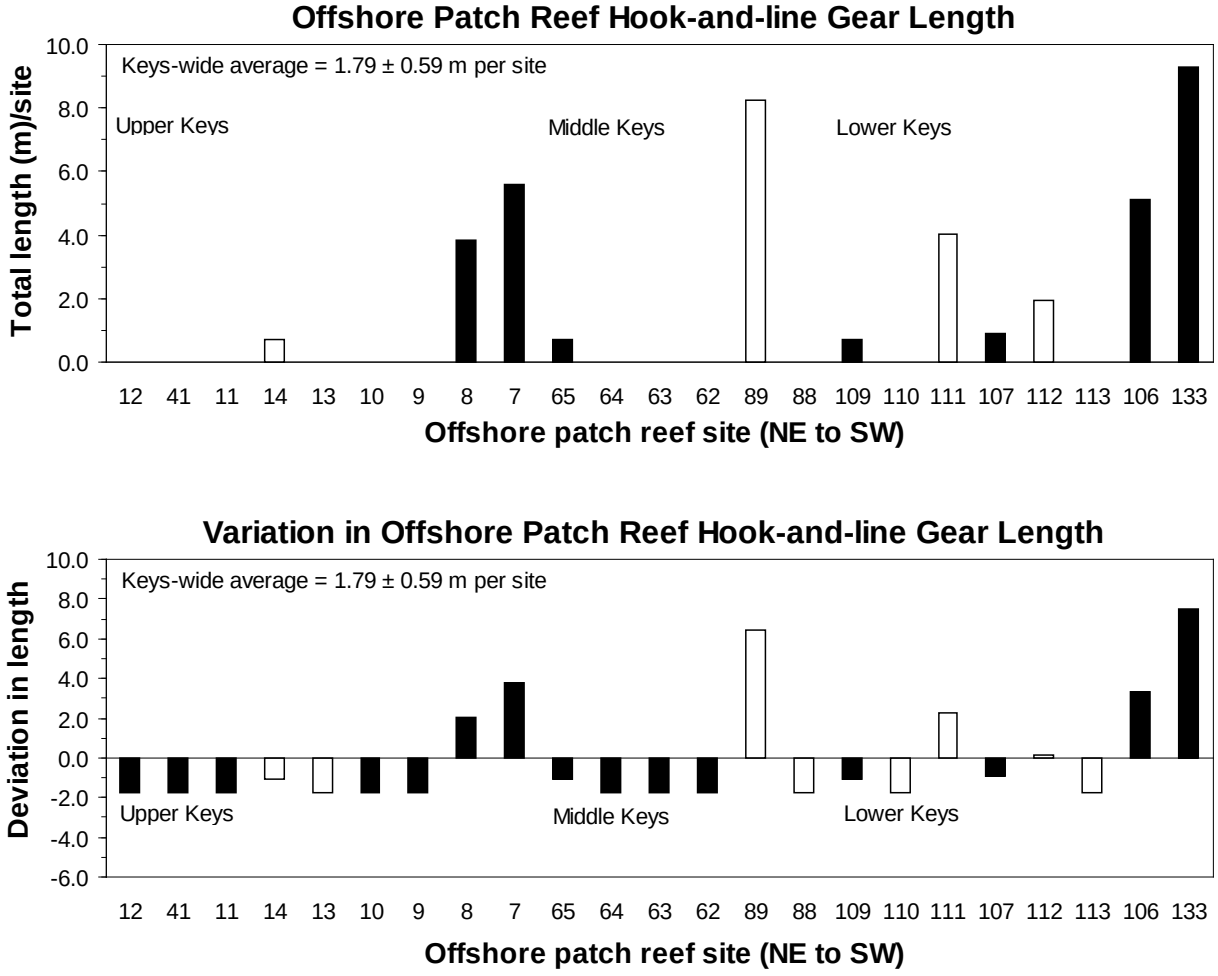


Figure 90. Total length (m) of hook-and-line fishing gear retrieved from 240-m^2 search areas per site on shallow (< 6 m), high-relief spur and groove reefs (top) and variations in total gear length retrieved relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

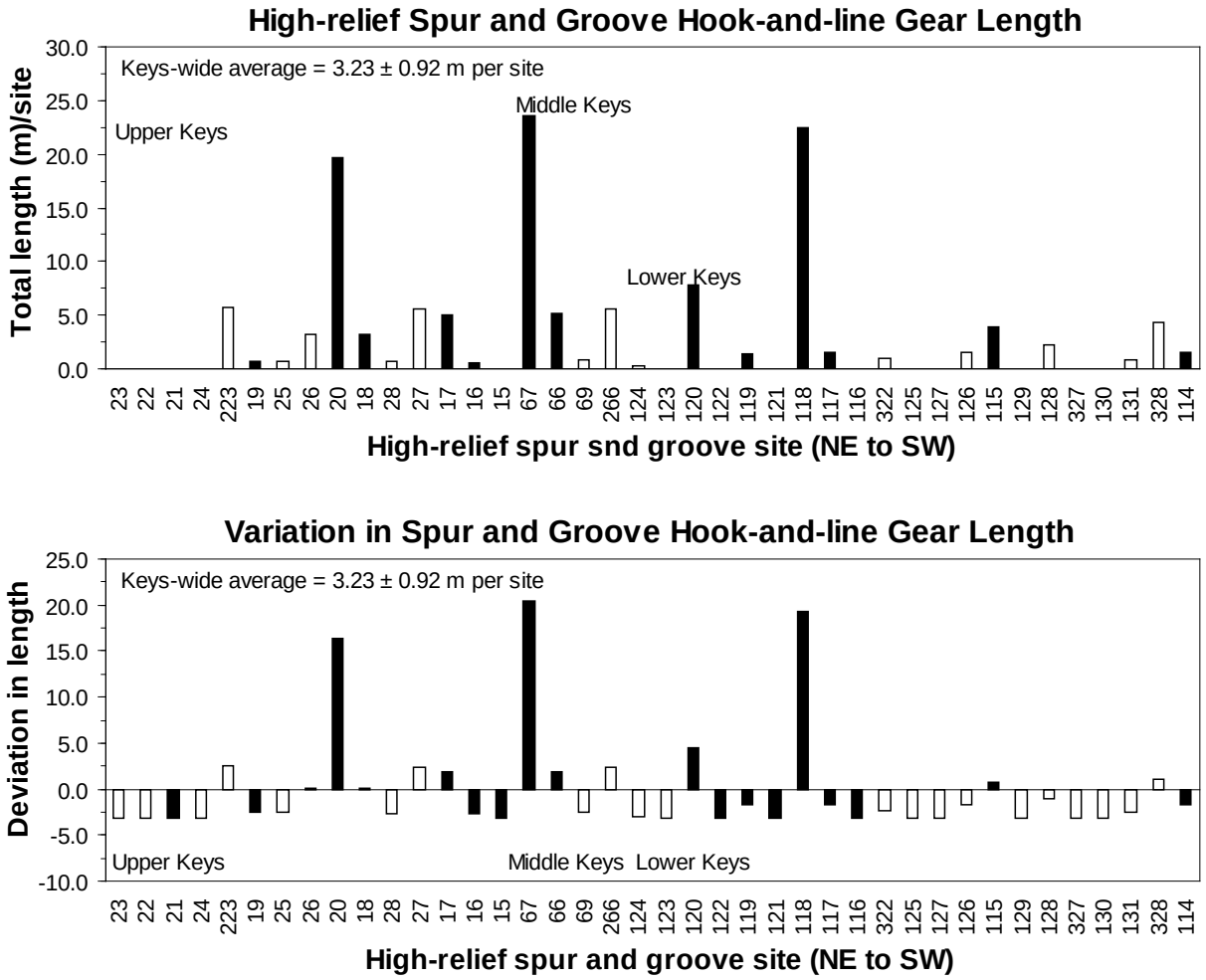


Figure 91. Total length (m) of hook-and-line fishing gear retrieved from 240-m^2 search areas per site on deeper (6-15 m) fore-reef sites (top) and variations in total gear length retrieved relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

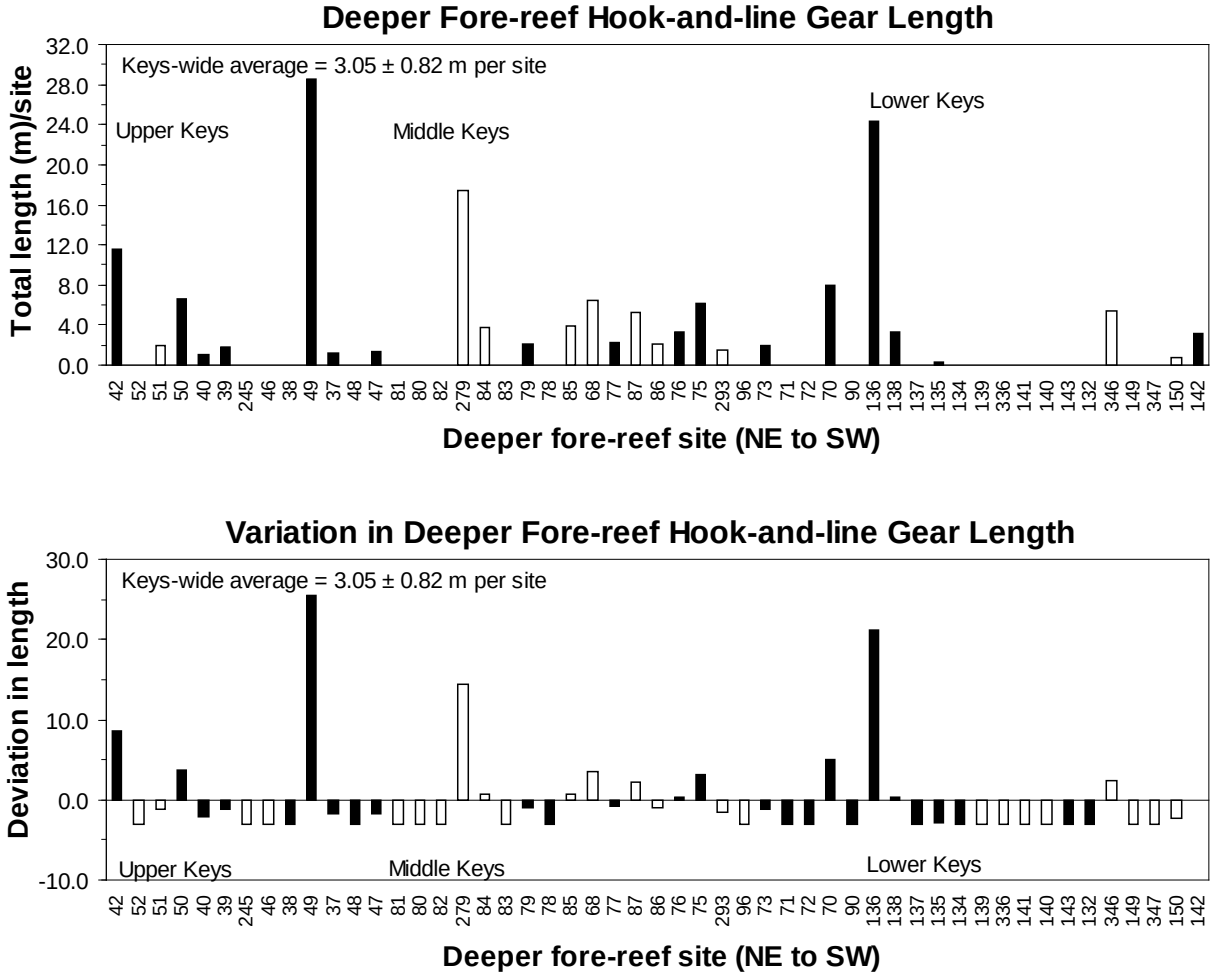


Figure 92. Densities (no. items per 60 m^2) of lobster/crab trap fishing gear in the upper Florida Keys (top) and from the southern BNP boundary to Carysfort Reef (bottom) during June-September 2008.

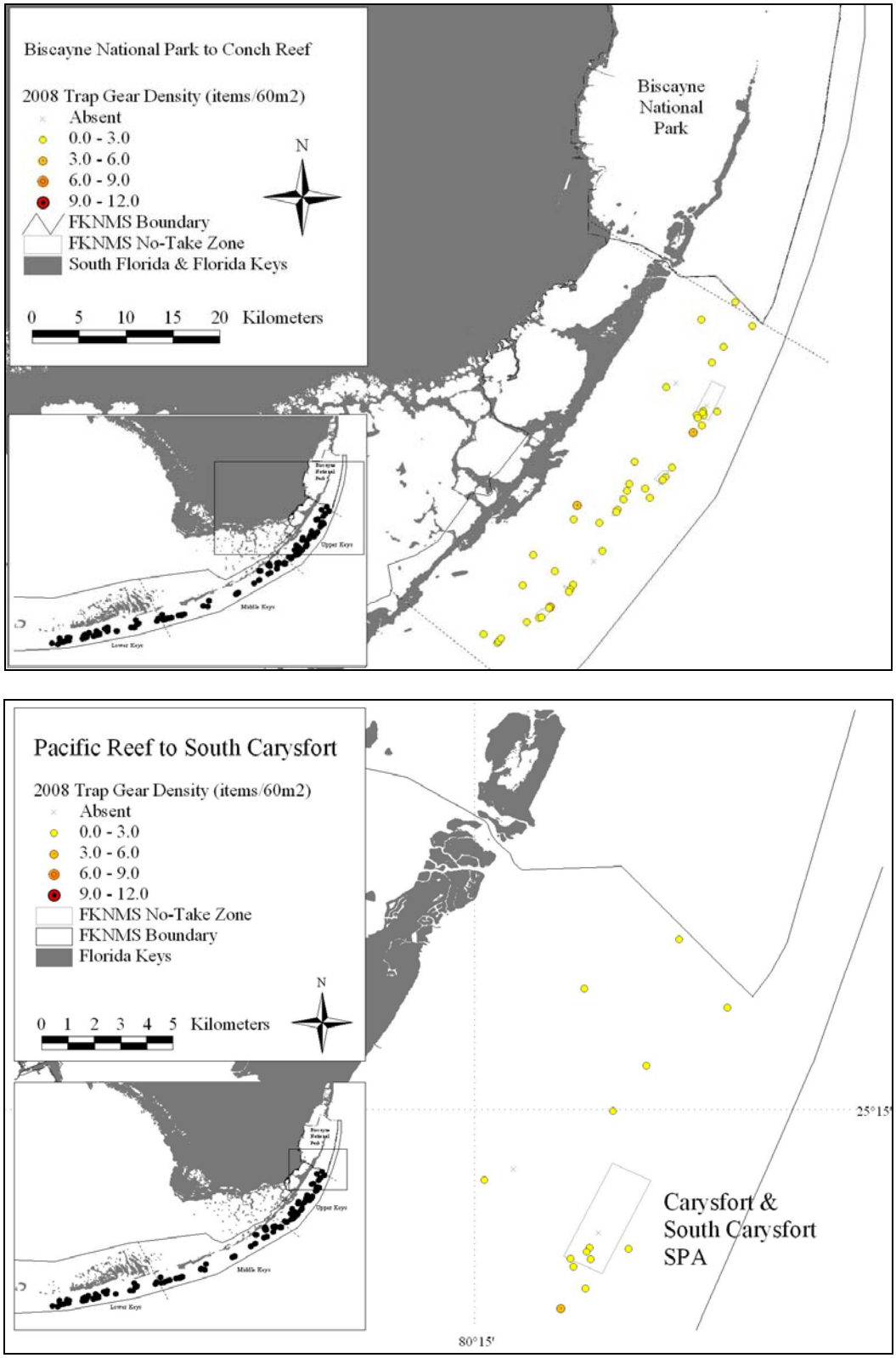


Figure 93. Densities (no. items per 60 m^2) of lobster/crab trap fishing gear in the upper Florida Keys from Elbow Reef to Pickles Reef (top) and in the middle Florida Keys (bottom) during June-September 2008.

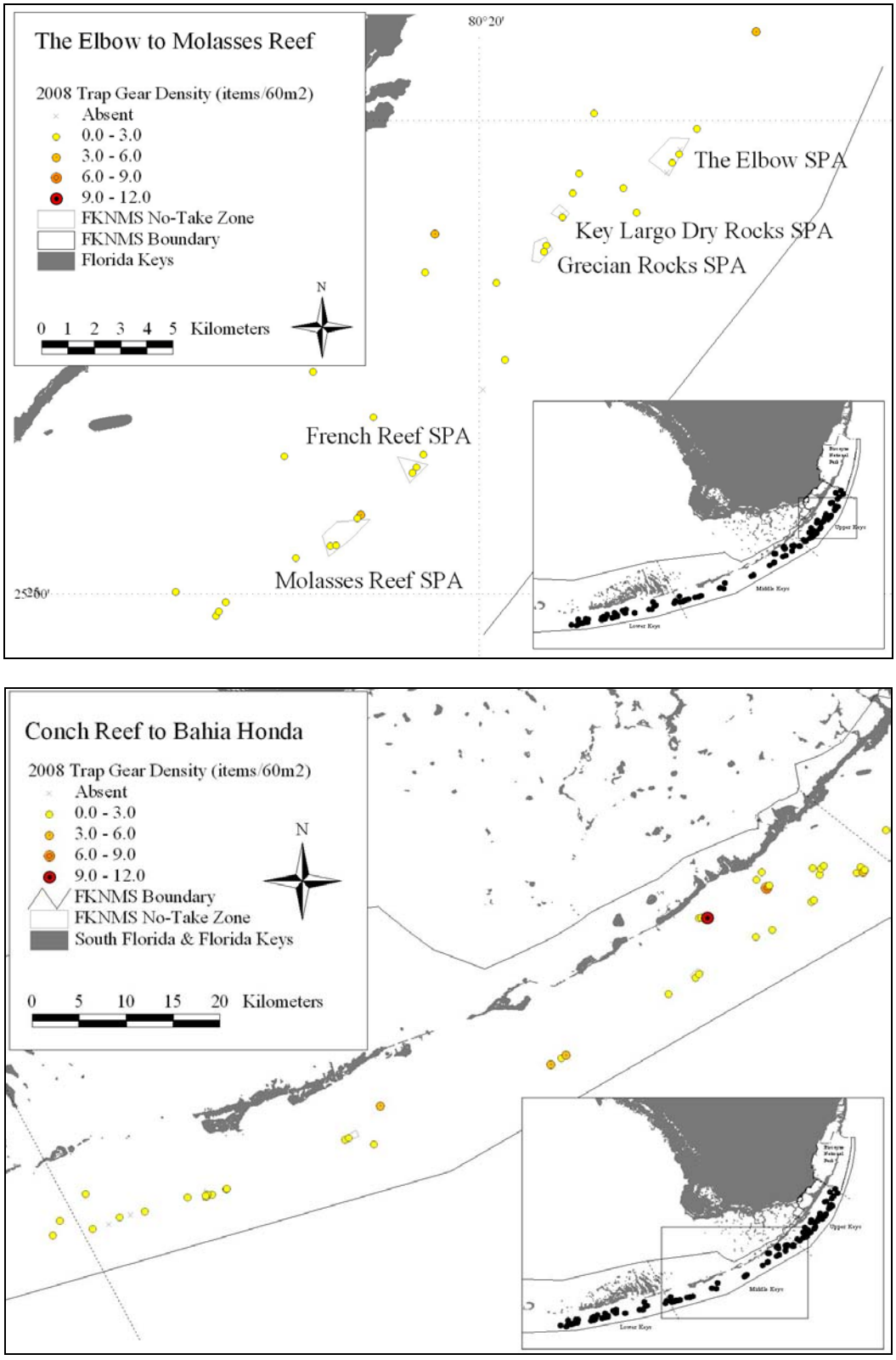
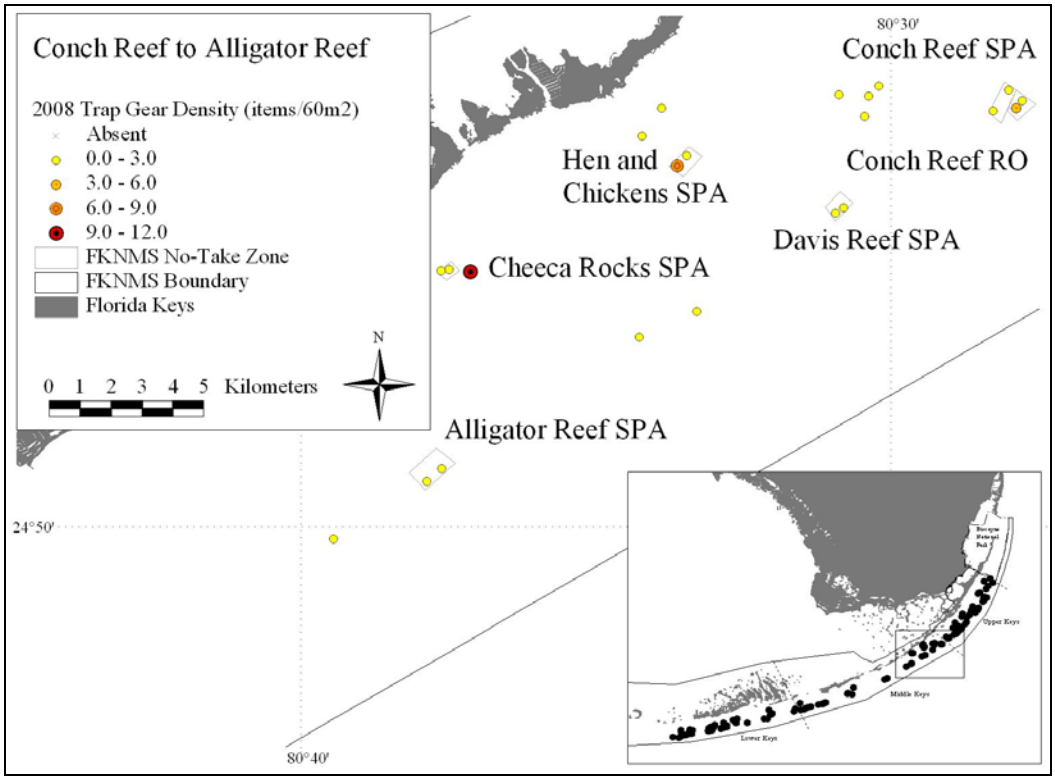


Figure 94. Densities (no. items per 60 m^2) of lobster/crab trap fishing gear in the middle Florida Keys from Conch Reef to Alligator Reef (top) and from Tennessee Reef to Coffins Patch (bottom) during June-September 2008.



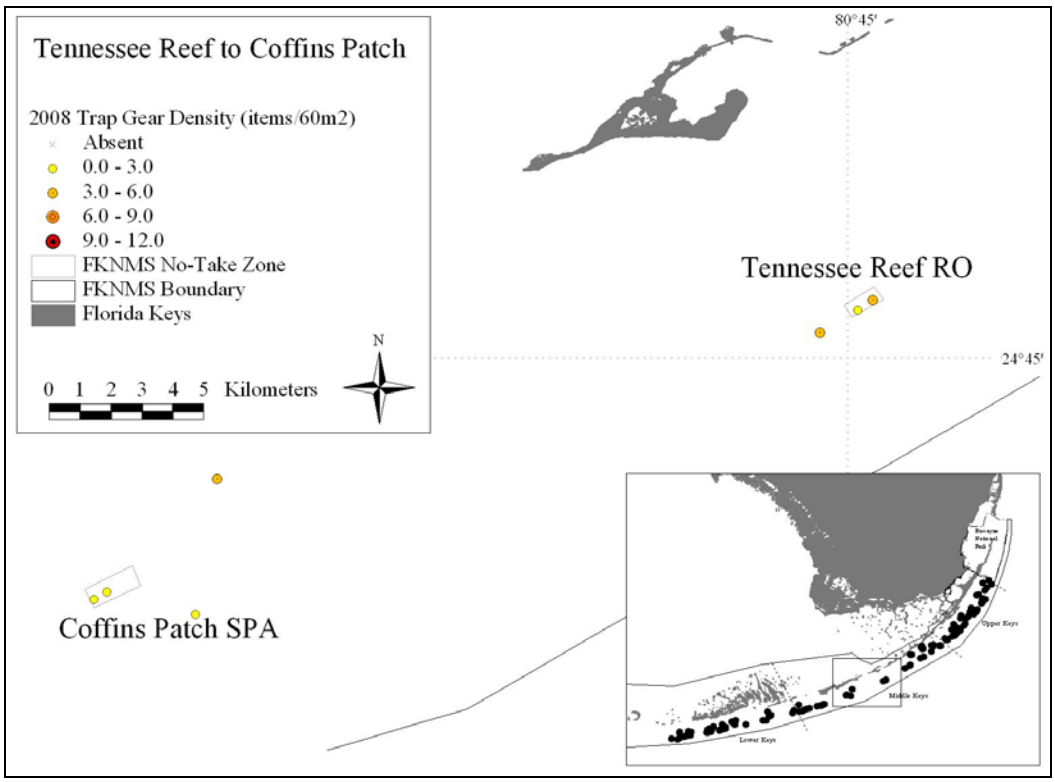


Figure 95. Densities (no. items per 60 m^2) of lobster/crab trap fishing gear in the middle Florida Keys from Sombrero Reef to Bahia Honda (top) and in the lower Florida Keys (bottom) during June-September 2008.

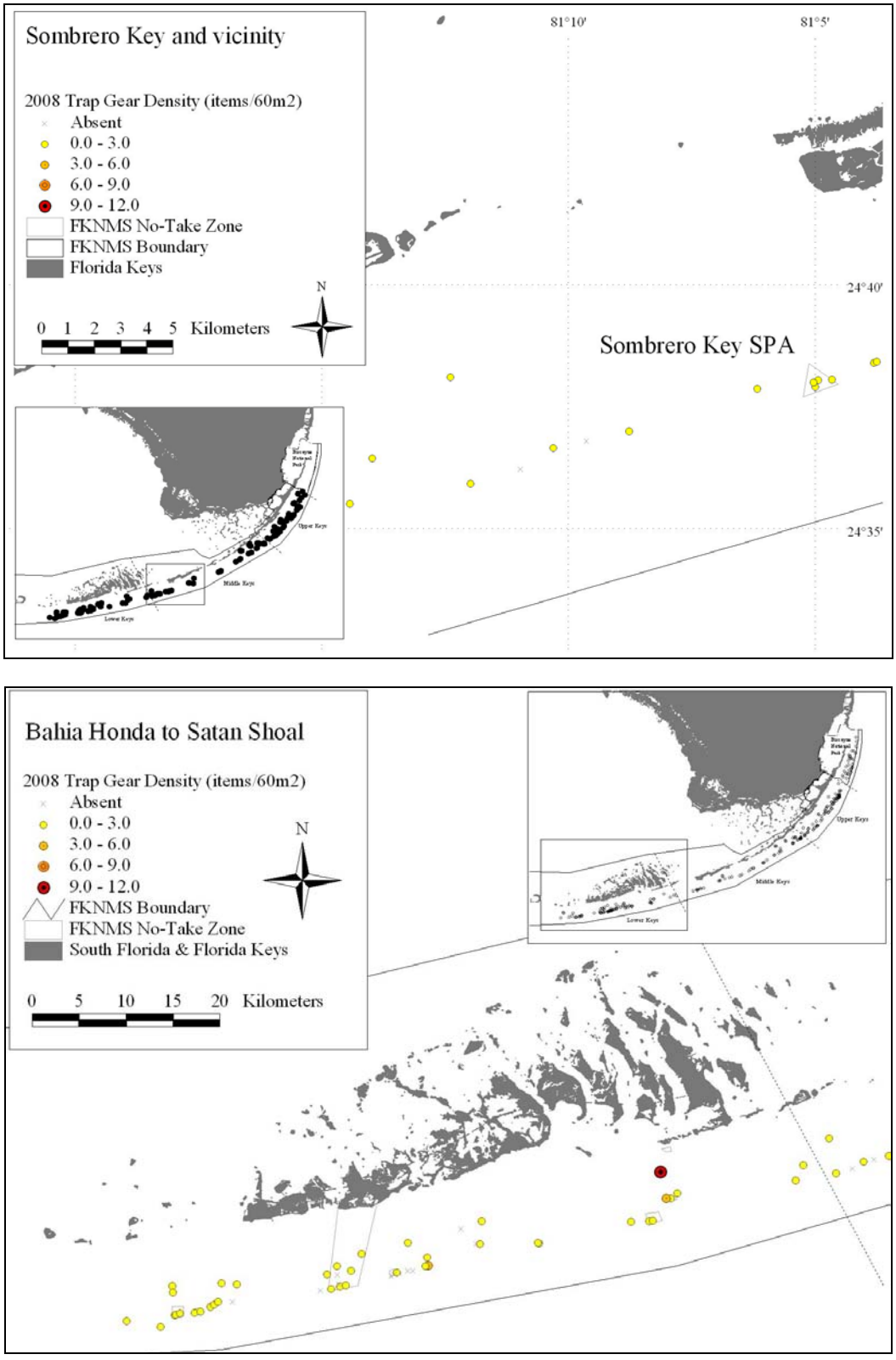


Figure 96. Densities (no. items per 60 m^2) of lobster/crab trap fishing gear in the lower Florida Keys from Bahia Honda to Looe Key (top) and from American Shoal to Western Sambo (bottom) during June-September 2008.

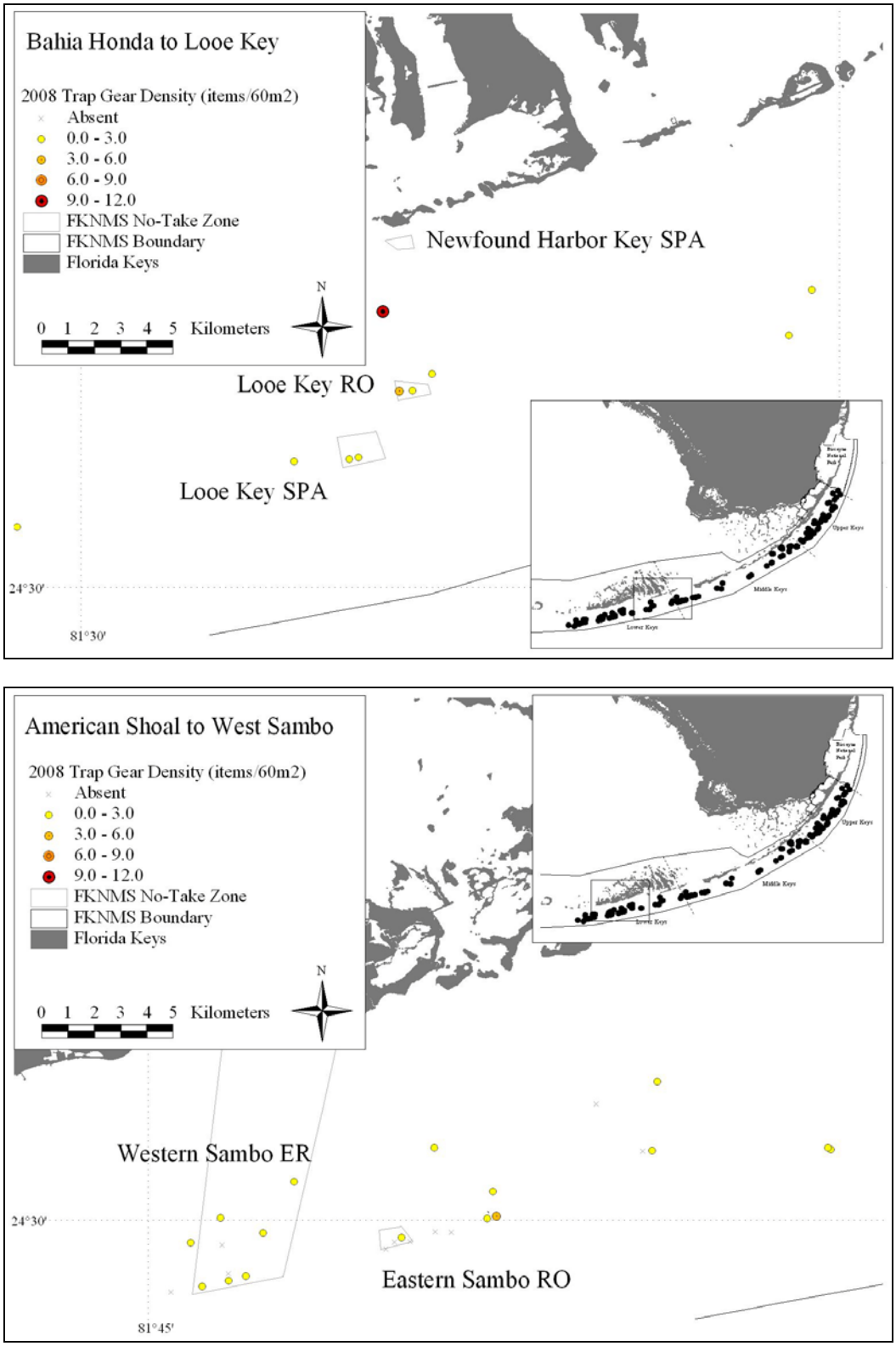


Figure 97. Densities (no. items per 60 m^2) of lobster/crab trap fishing gear in the lower Florida Keys from Eastern Dry Rocks to Sand Key during June-September 2008.

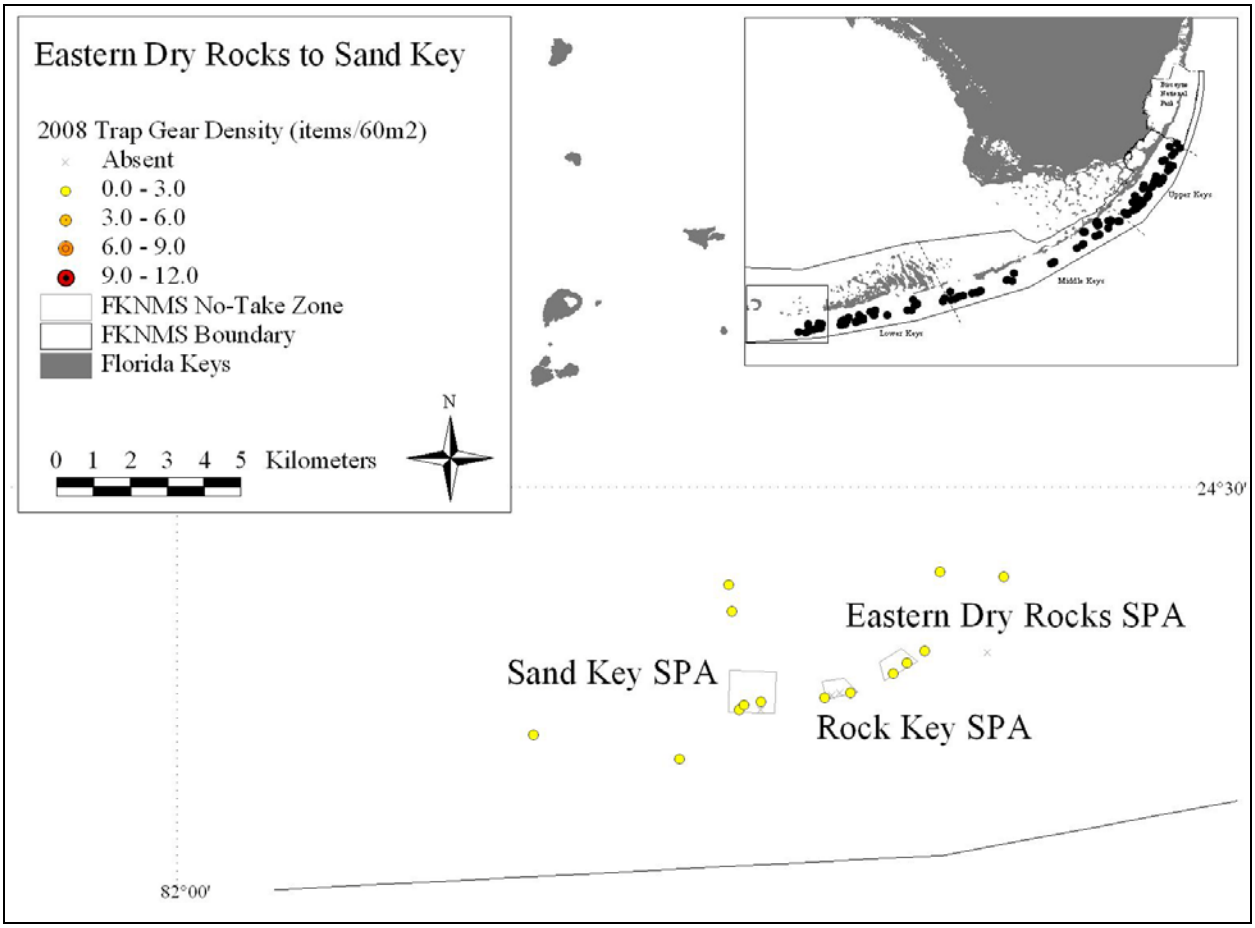


Figure 98. Mean (+ 1 SE) densities (no. items per 60 m^2) of lobster/crab trap fishing gear on mid-channel patch reefs (top) and variations in site-level densities relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

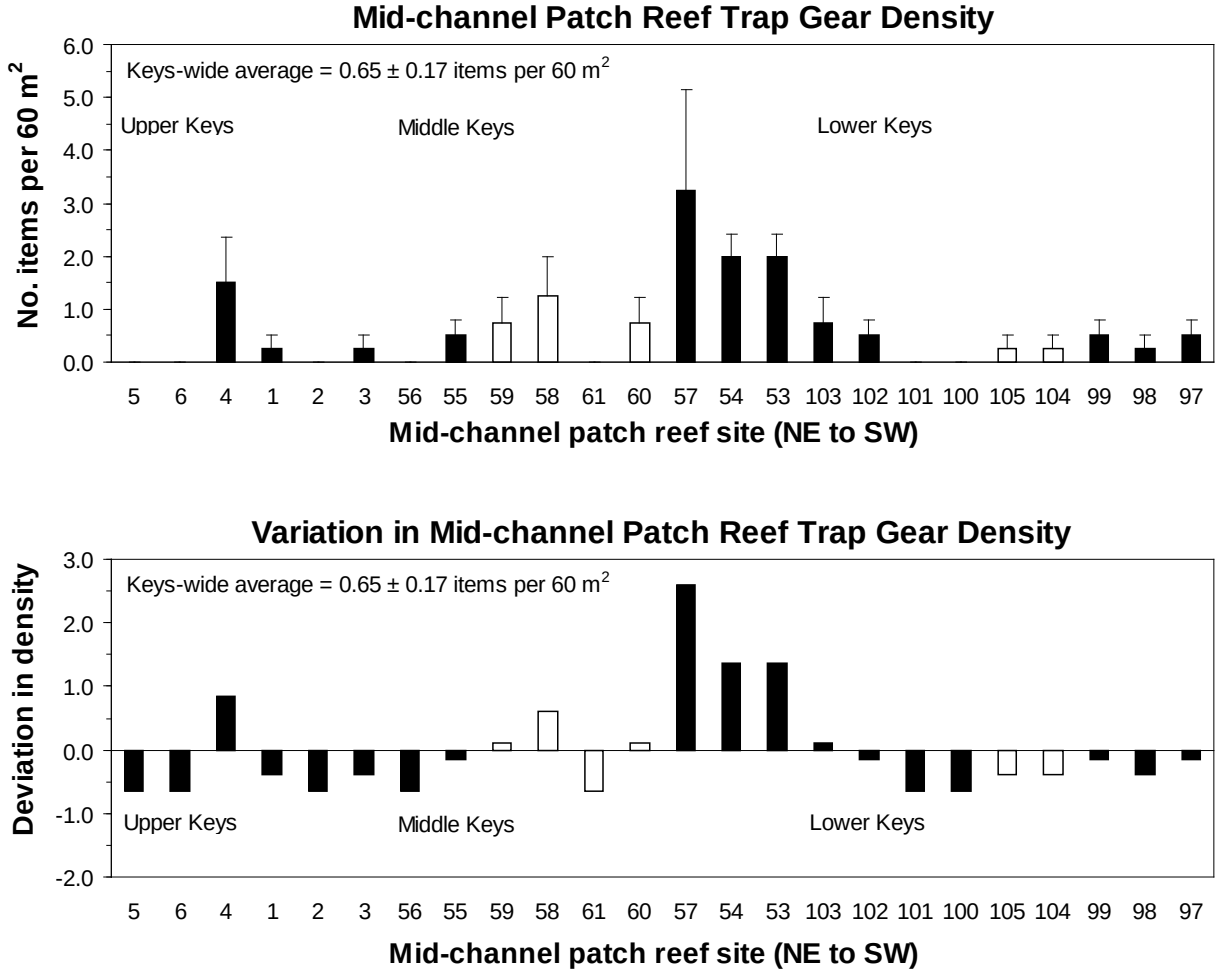


Figure 99. Mean (+ 1 SE) densities (no. items per 60 m^2) of lobster/crab trap fishing gear on offshore patch reefs (top) and variations in site-level densities relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

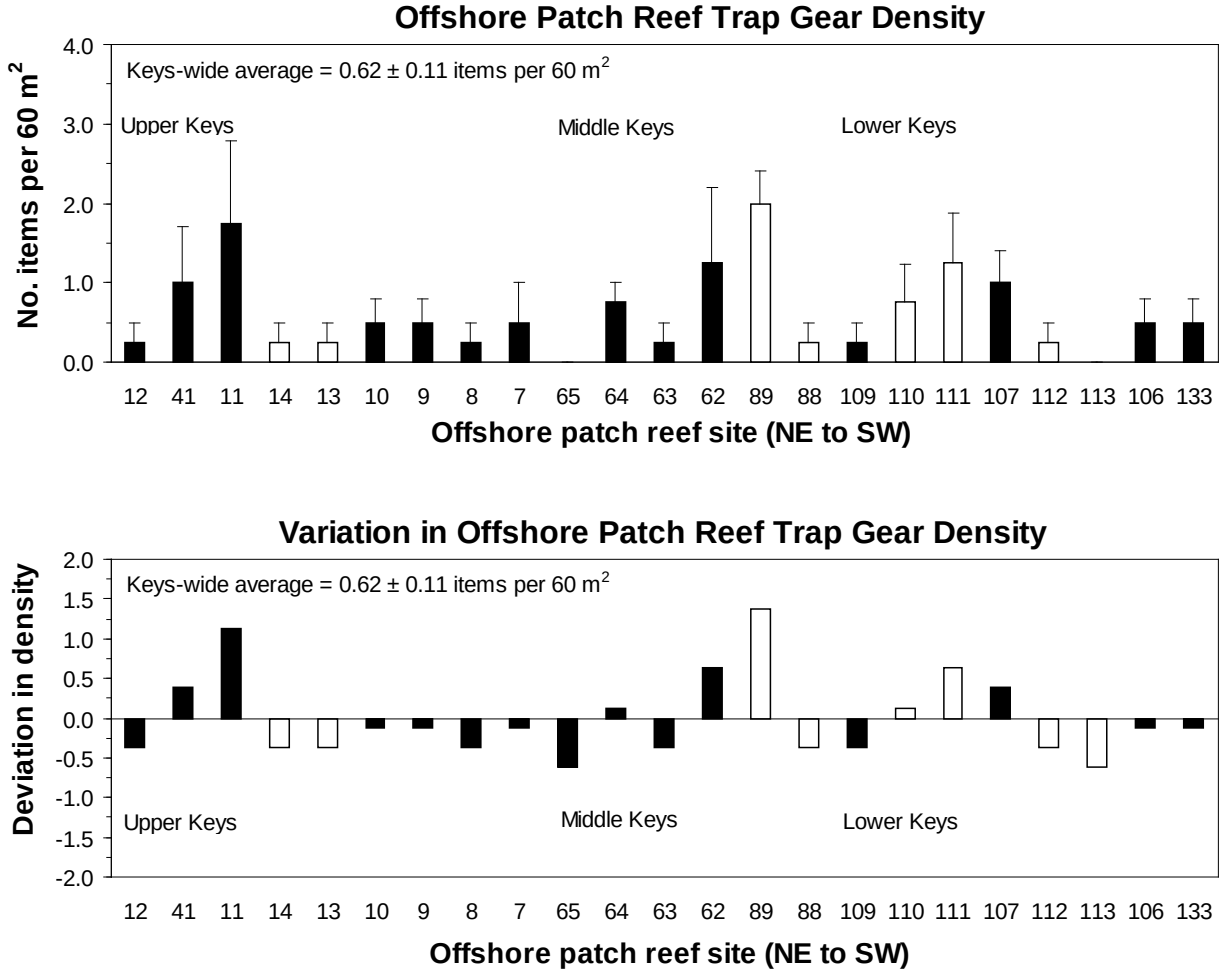


Figure 100. Mean (+ 1 SE) densities (no. items per 60 m^2) of lobster/crab trap fishing gear on shallow (< 6 m), high-relief spur and groove reefs (top) and variations in site-level densities relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

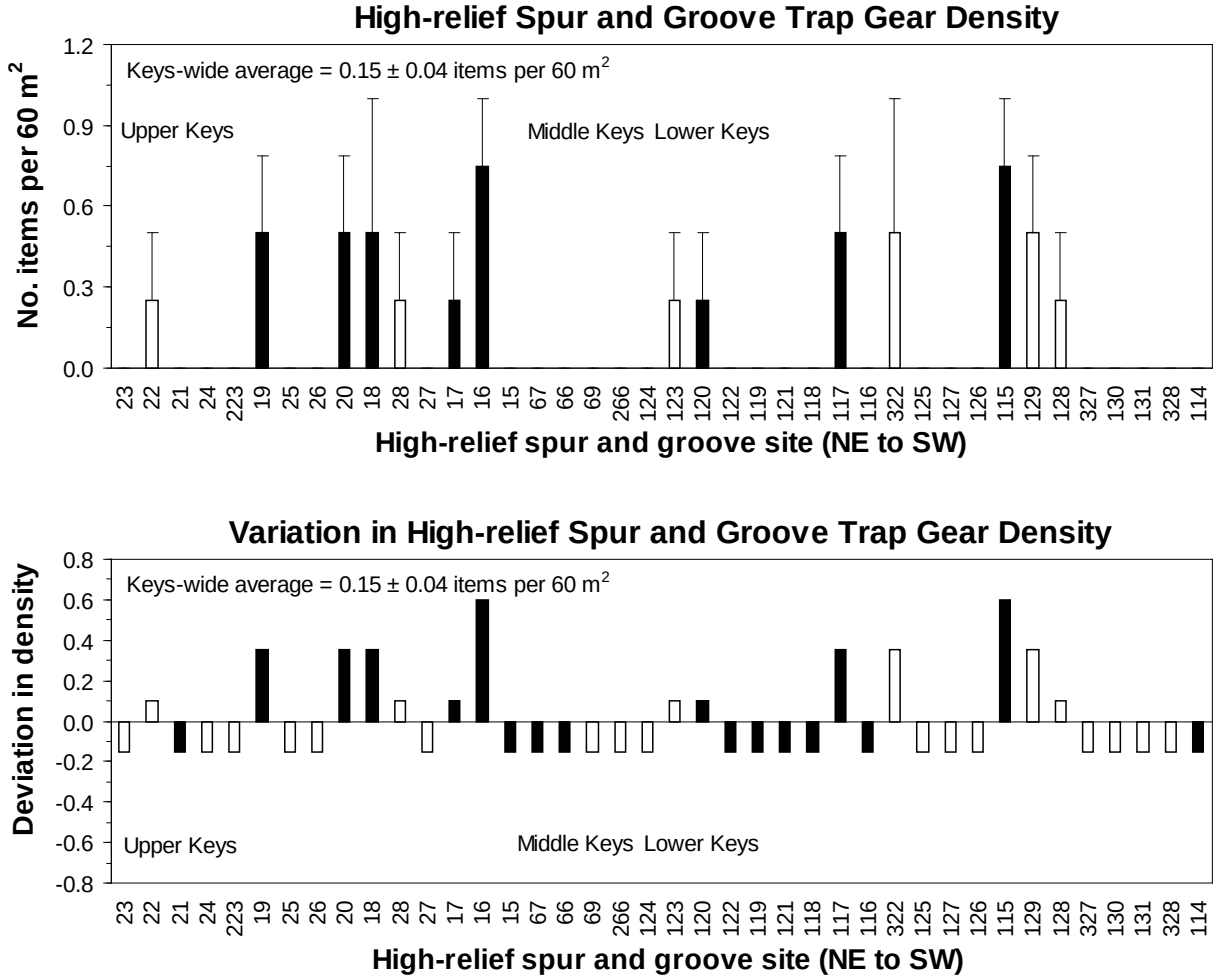


Figure 101. Mean (+ 1 SE) densities (no. items per 60 m^2) of lobster/crab trap fishing gear on deeper (6-15 m) fore-reef sites (top) and variations in site-level densities relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

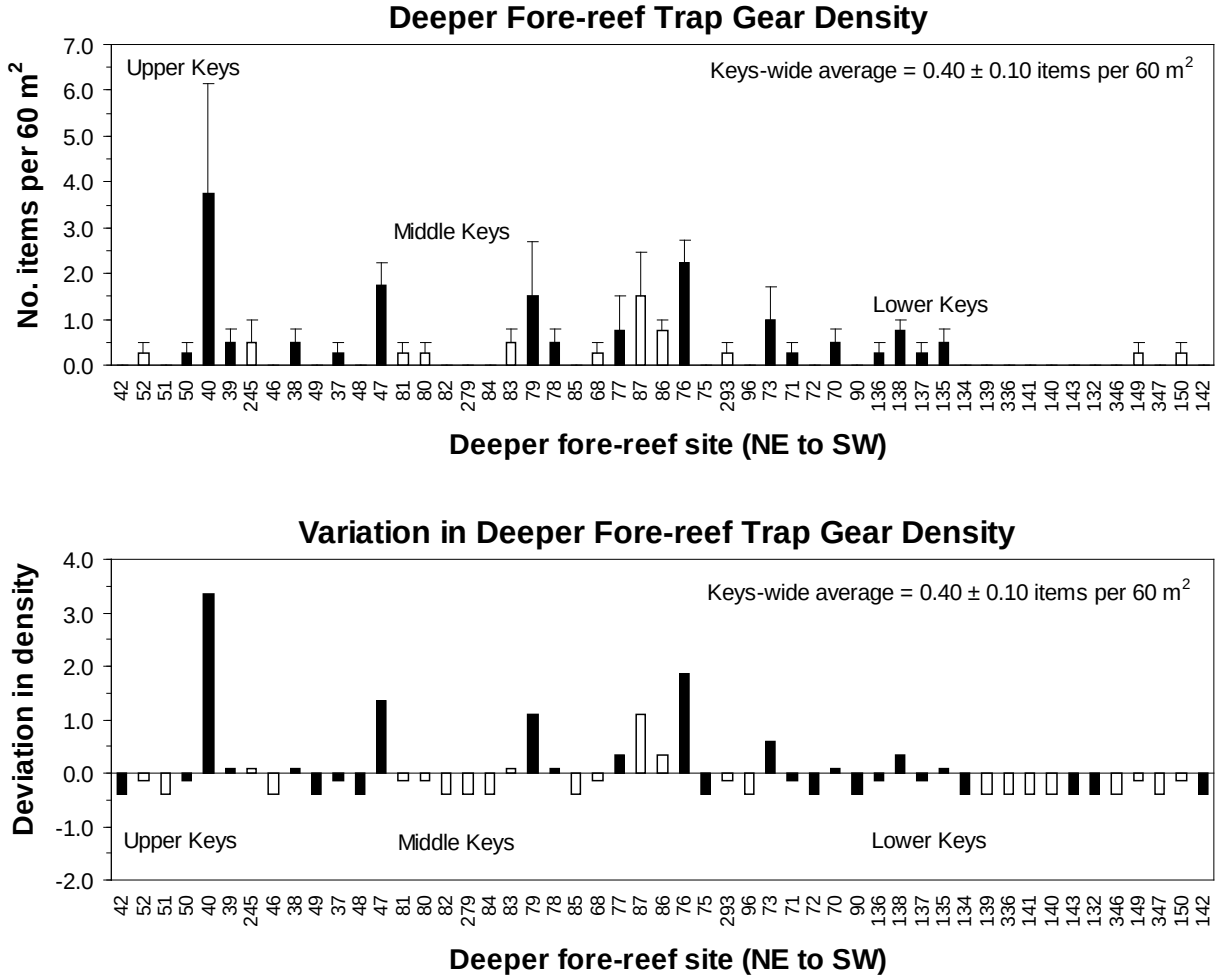


Figure 102. Length distribution (m) of derelict lobster/crab trap rope retrieved from surveys of 145 sites in the Florida Keys National Marine Sanctuary during June-September 2008.

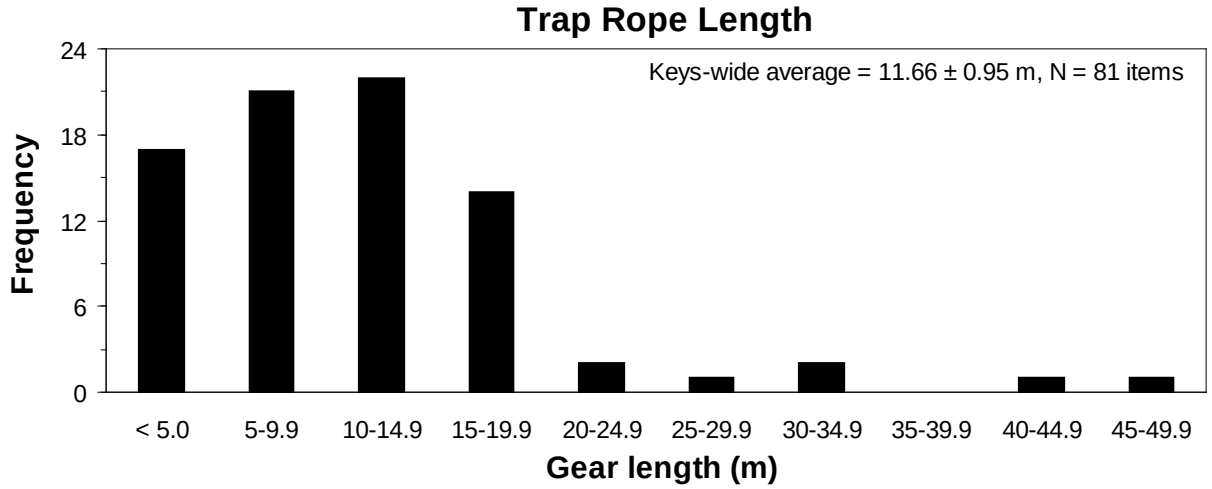


Figure 103. Total length (m) of derelict lobster/crab trap rope retrieved from 240-m^2 search areas per site in the upper Florida Keys (top) and from the southern BNP boundary to Carysfort (bottom) during June-September 2008.

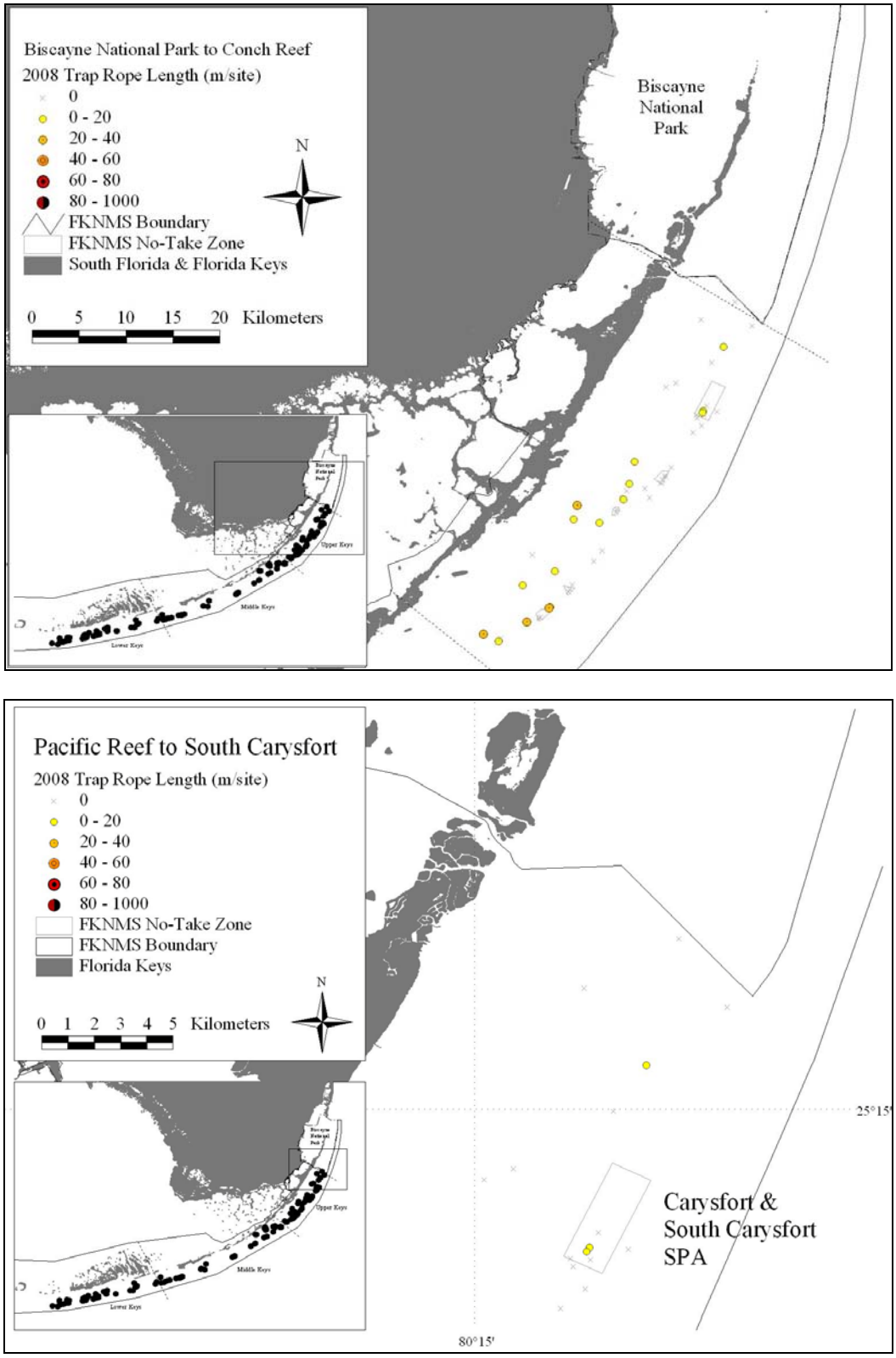


Figure 104. Total length (m) of derelict lobster/crab trap rope retrieved from 240-m^2 search areas per site in the upper Florida Keys from Elbow Reef to Pickles Reef (top) and in the middle Florida Keys (bottom) during June-September 2008.

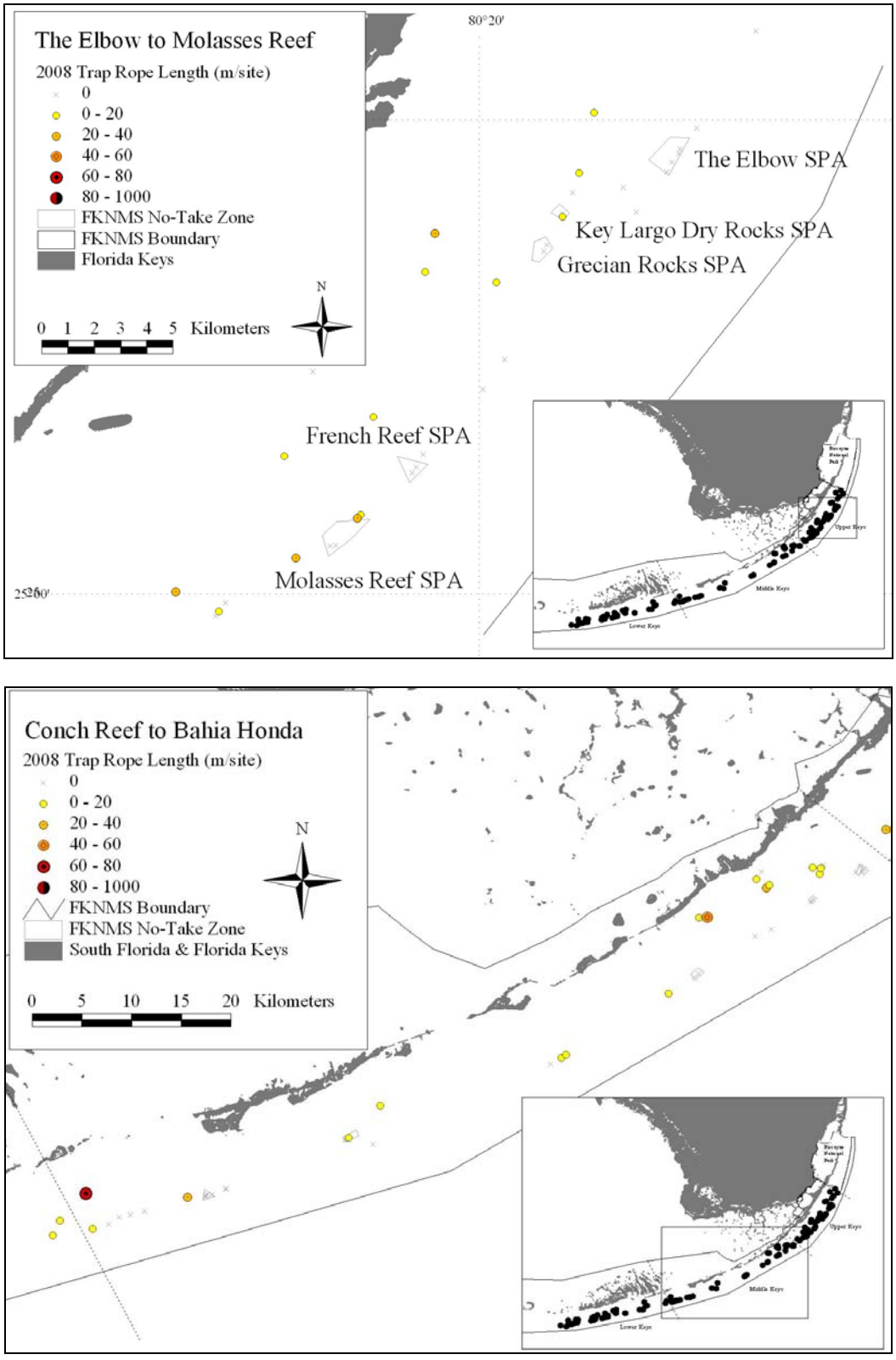
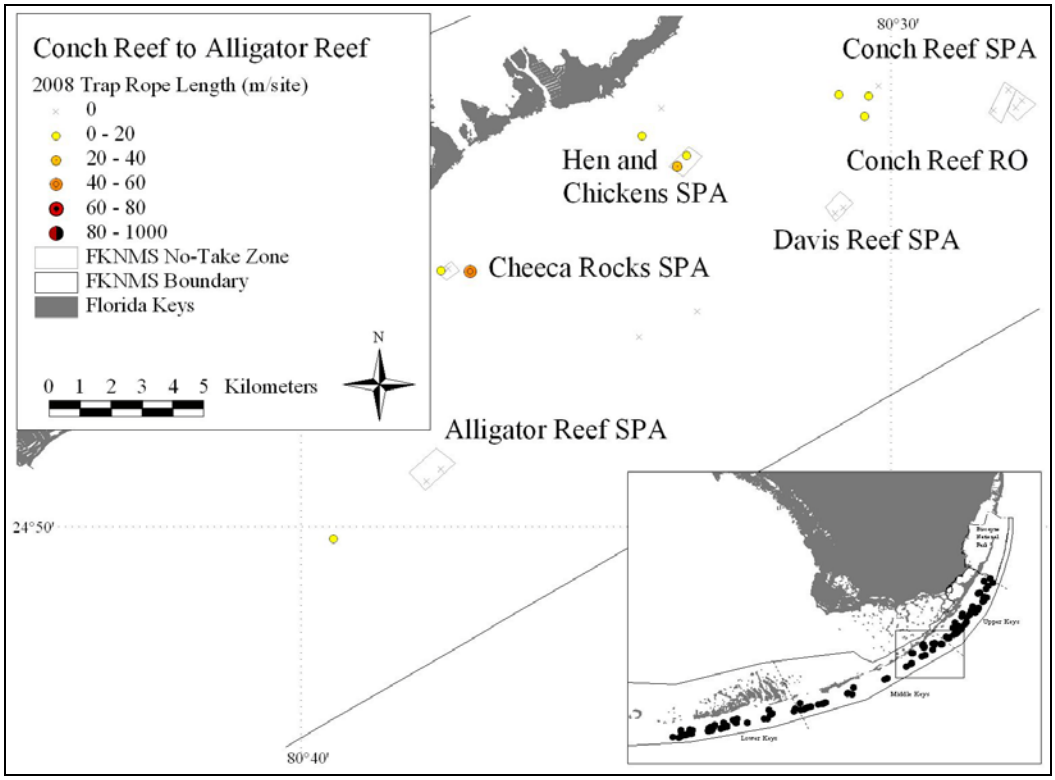


Figure 105. Total length (m) of derelict lobster/crab trap rope retrieved from 240-m^2 search areas per site in the middle Florida Keys from Conch Reef to Alligator Reef (top) and from Tennessee Reef to Coffins Patch (bottom) during June-September 2008.



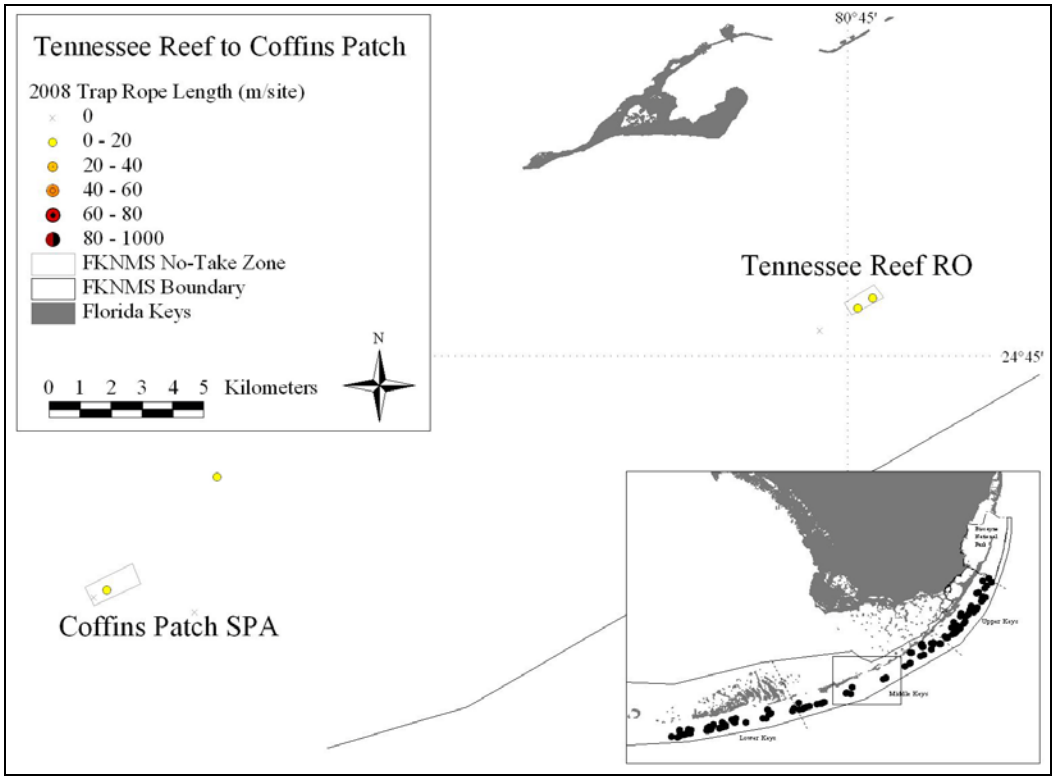


Figure 106. Total length (m) of derelict lobster/crab trap rope retrieved from 240-m^2 search areas per site in the middle Florida Keys from Sombrero Reef to Bahia Honda (top) and in the lower Florida Keys (bottom) during June-September 2008.

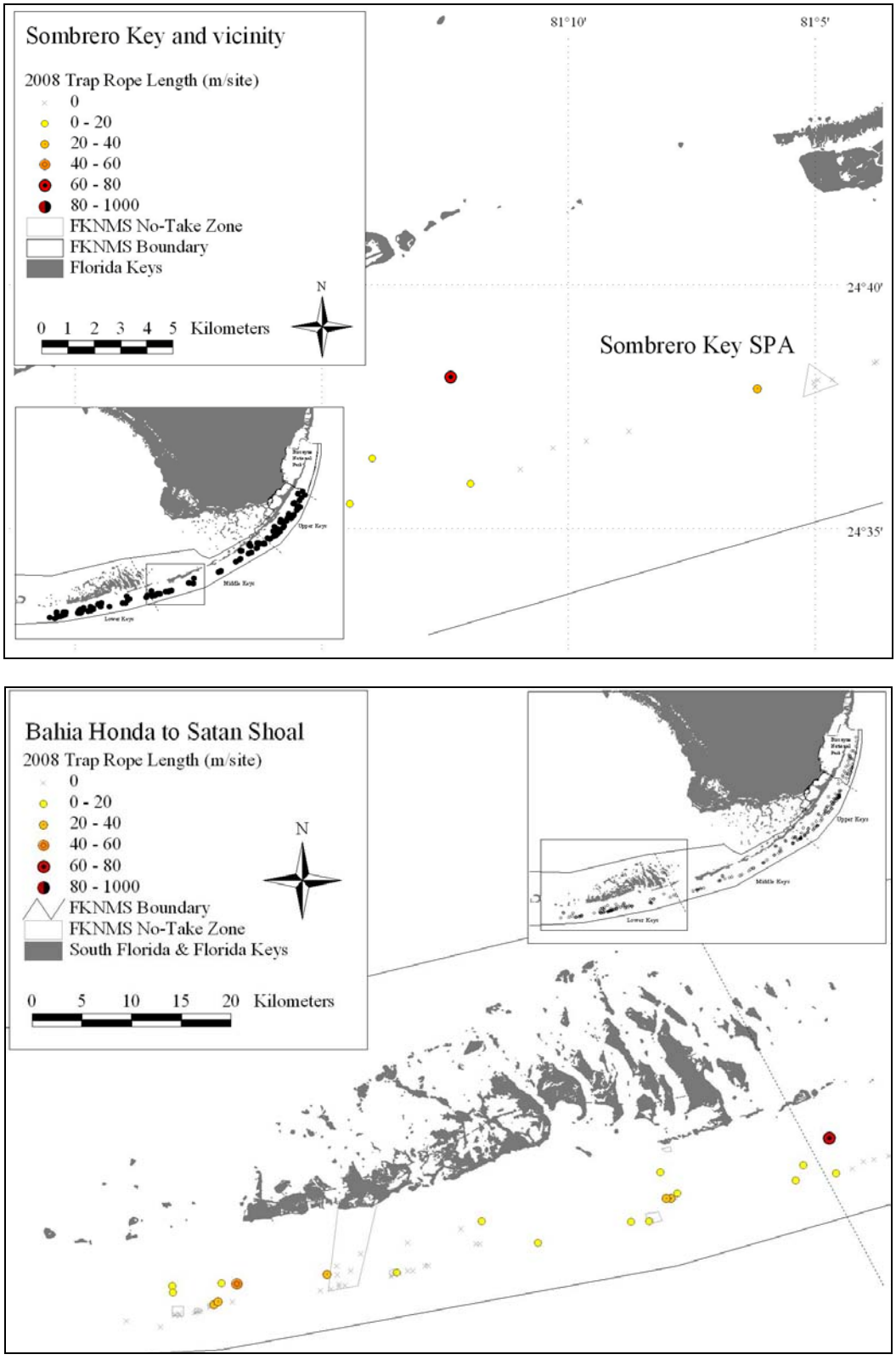


Figure 107. Total length (m) of derelict lobster/crab trap rope retrieved from 240-m^2 search areas per site in the lower Florida Keys from Bahia Honda to Looe Key (top) and from American Shoal to Western Sambo (bottom) during June-September 2008.

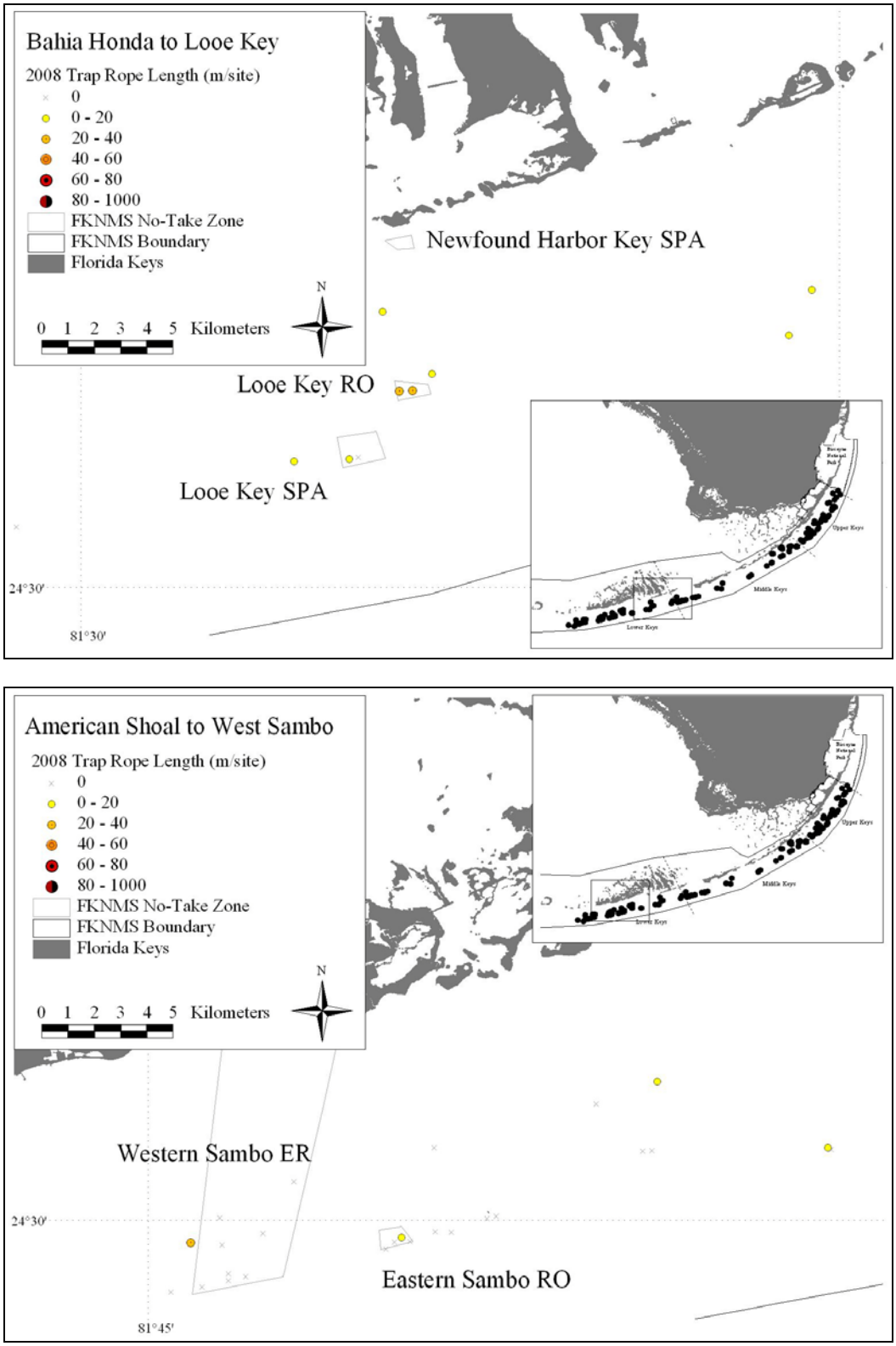


Figure 108. Total length (m) of derelict lobster/crab trap rope retrieved from 240-m^2 search areas per site in the lower Florida Keys from Eastern Dry Rocks to Sand Key during June-September 2008.

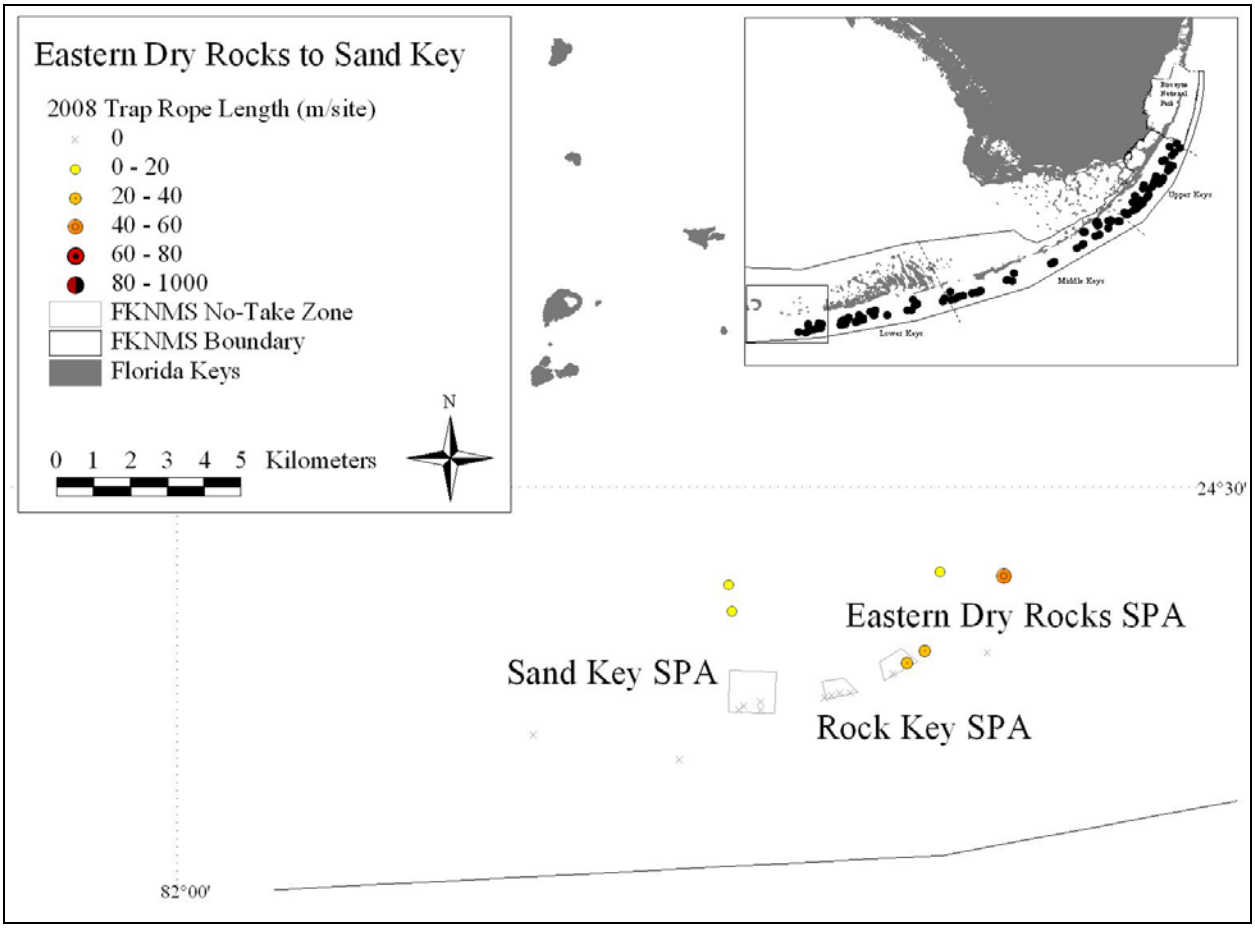


Figure 109. Total length (m) of lobster/crab trap rope retrieved from 240-m^2 search areas per site on mid-channel patch reefs (top) and variations in total gear length retrieved relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

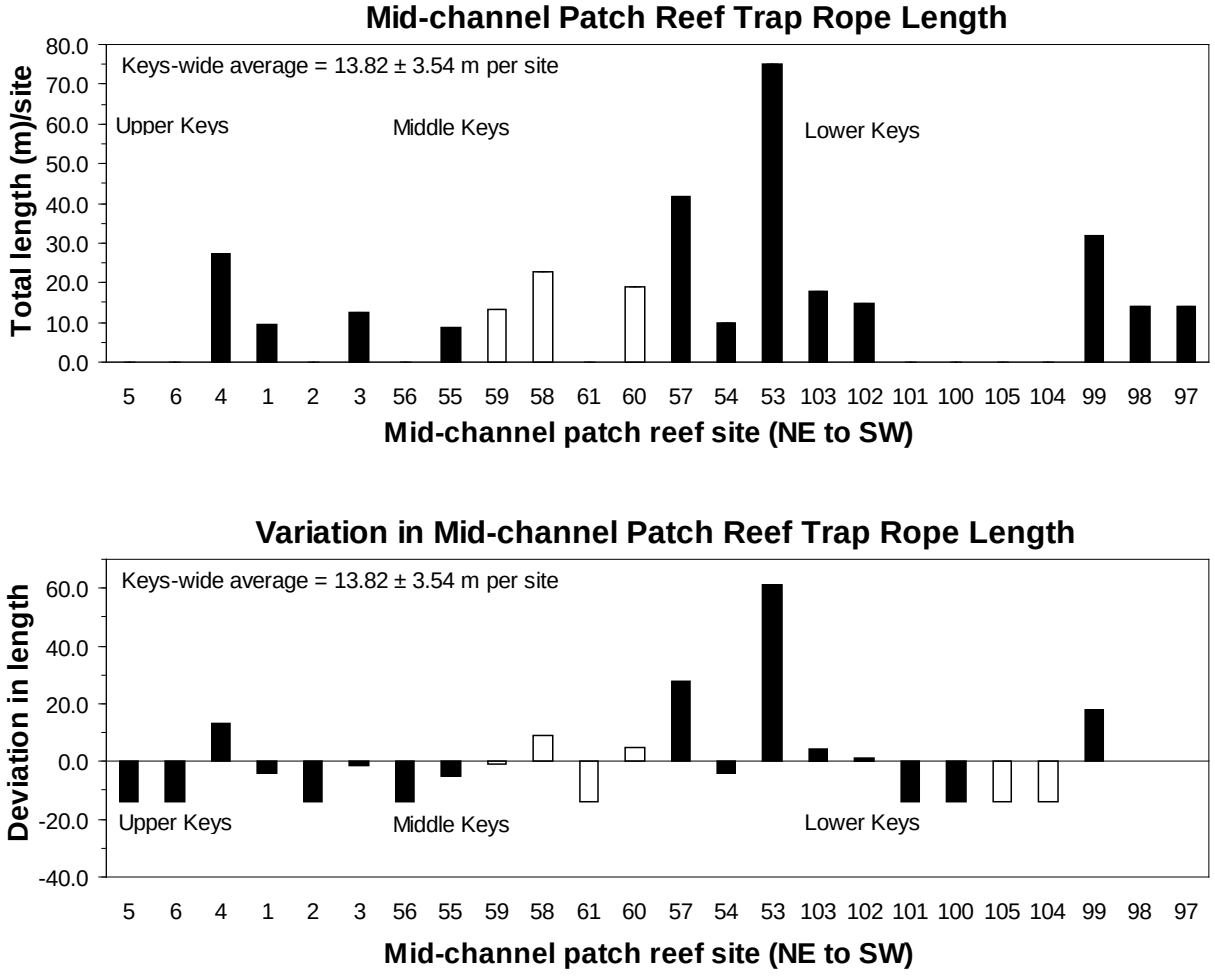


Figure 110. Total length (m) of lobster/crab trap rope retrieved from 240-m^2 search areas per site on offshore patch reefs (top) and variations in total gear length retrieved relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

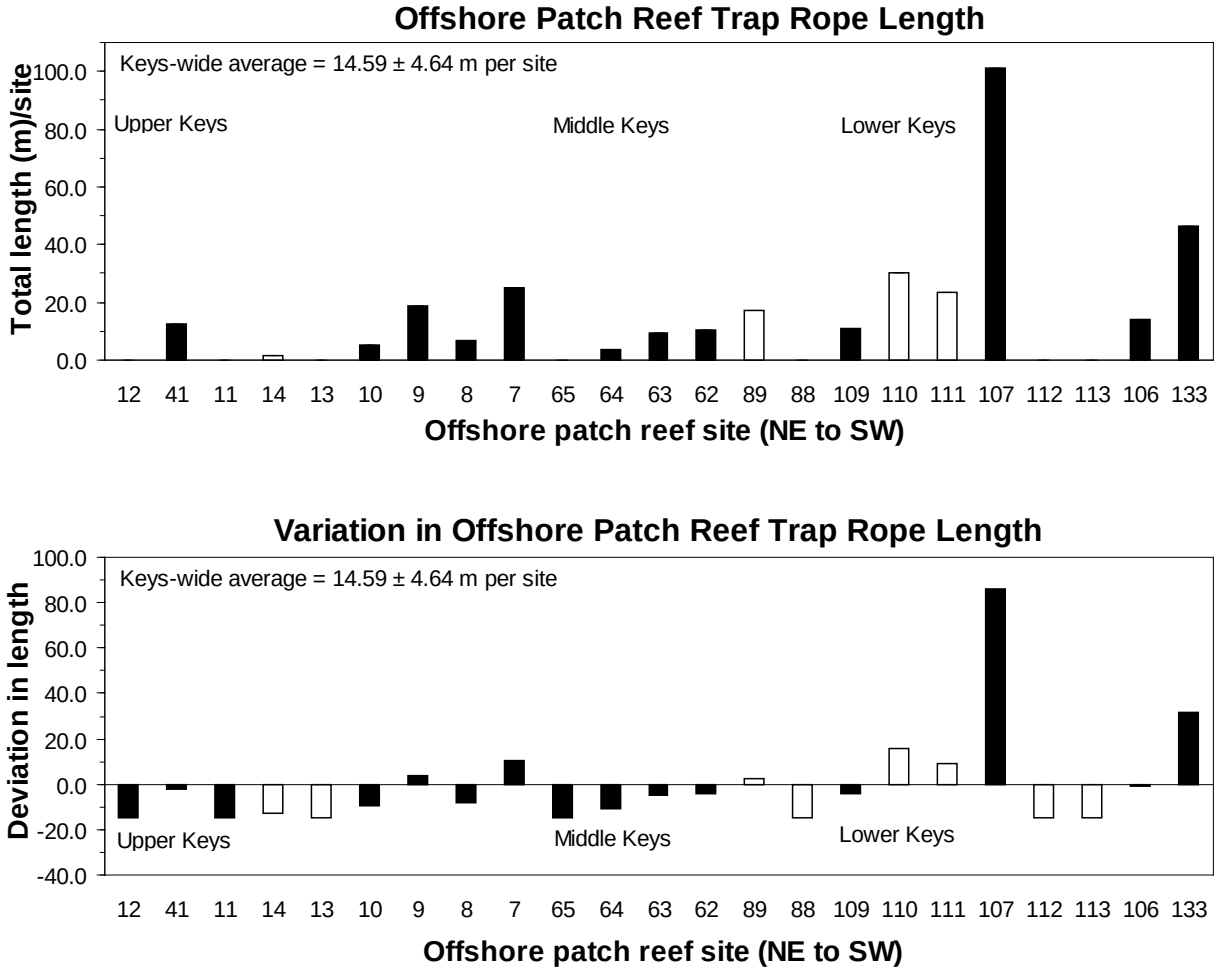


Figure 111. Total length (m) of lobster/crab trap rope retrieved from 240-m^2 search areas per site on shallow (< 6 m), high-relief spur and groove reefs (top) and variations in total gear length retrieved relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

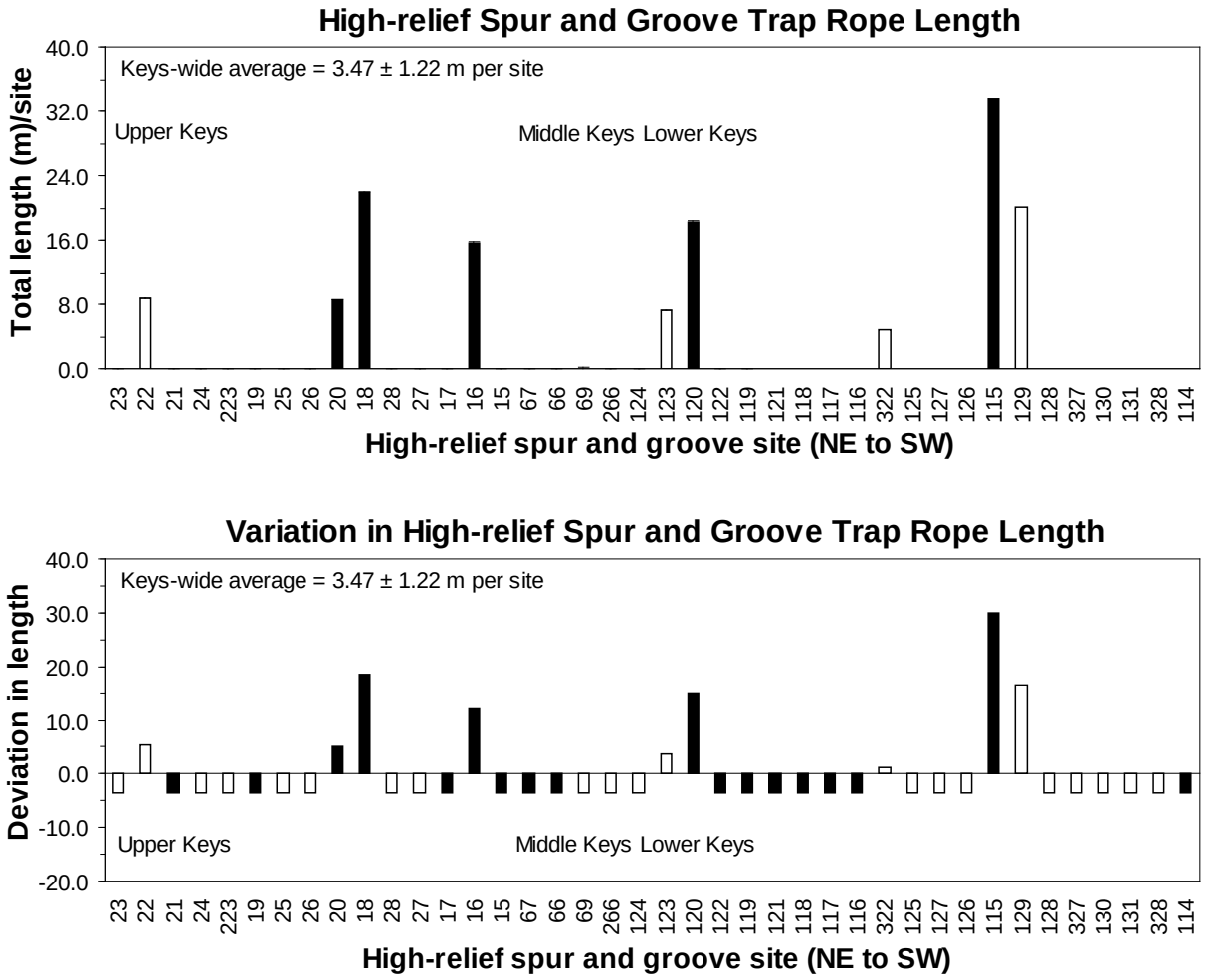


Figure 112. Total length (m) of lobster/crab trap rope retrieved from 240-m^2 search areas per site on deeper (6-15 m) fore-reef sites (top) and variations in total gear length retrieved relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

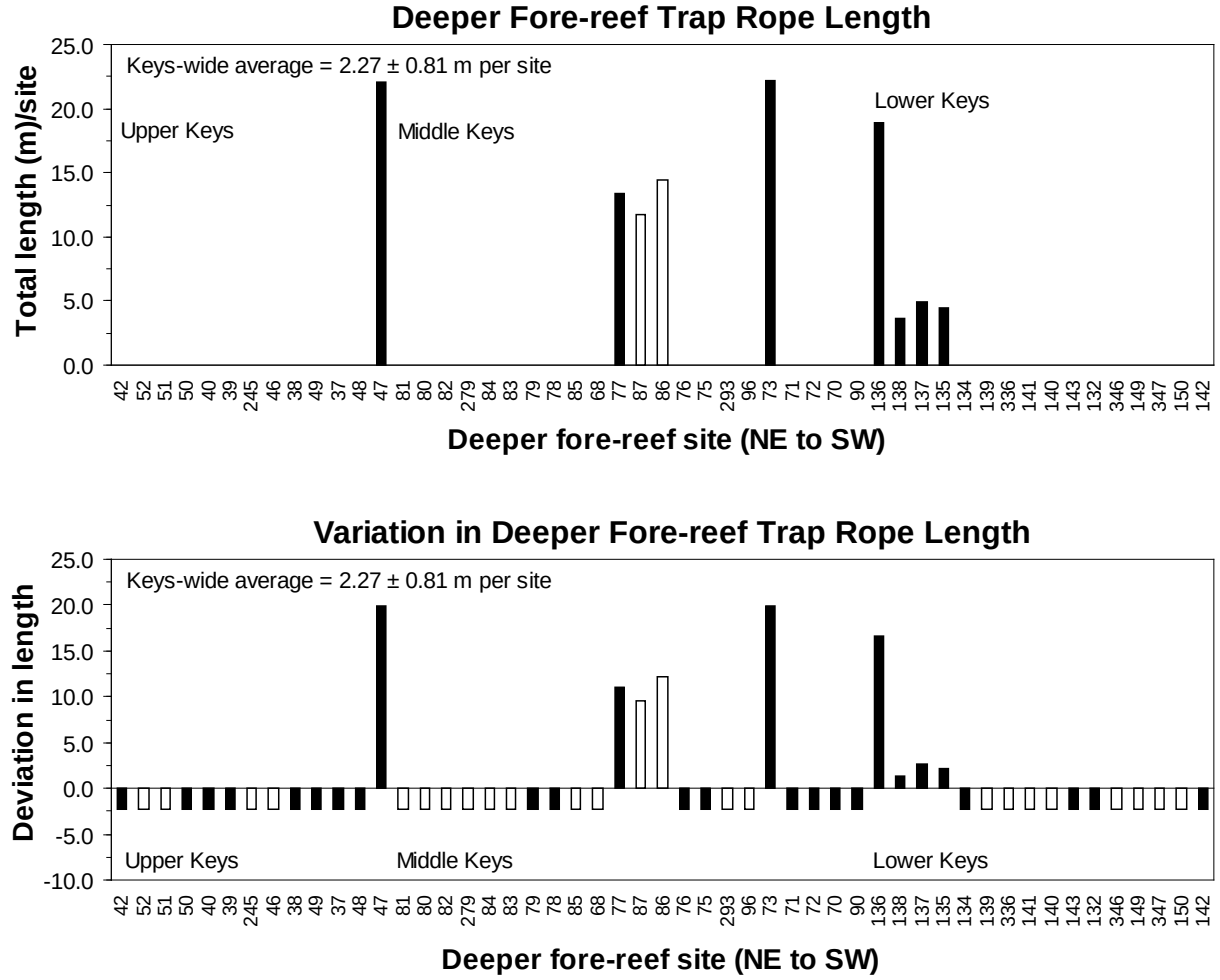


Figure 113. Total marine debris densities (no. items per 60 m^2) in the upper Florida Keys (top) and from the southern BNP boundary to Carysfort Reef (bottom) during June-September 2008.

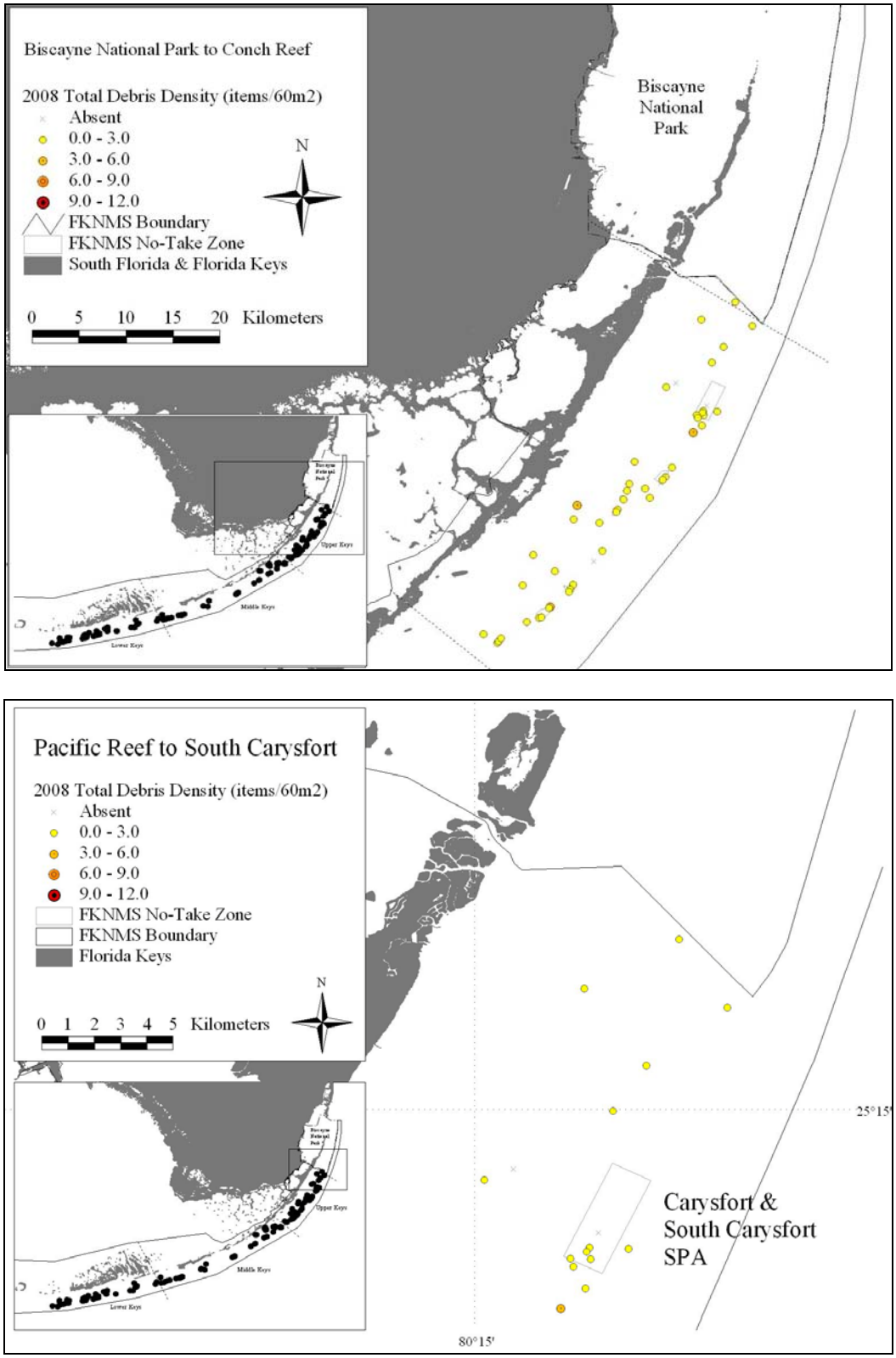


Figure 114. Total marine debris densities (no. items per 60 m^2) in the upper Florida Keys from Elbow Reef to Pickles Reef (top) and in the middle Florida Keys (bottom) during June-September 2008.

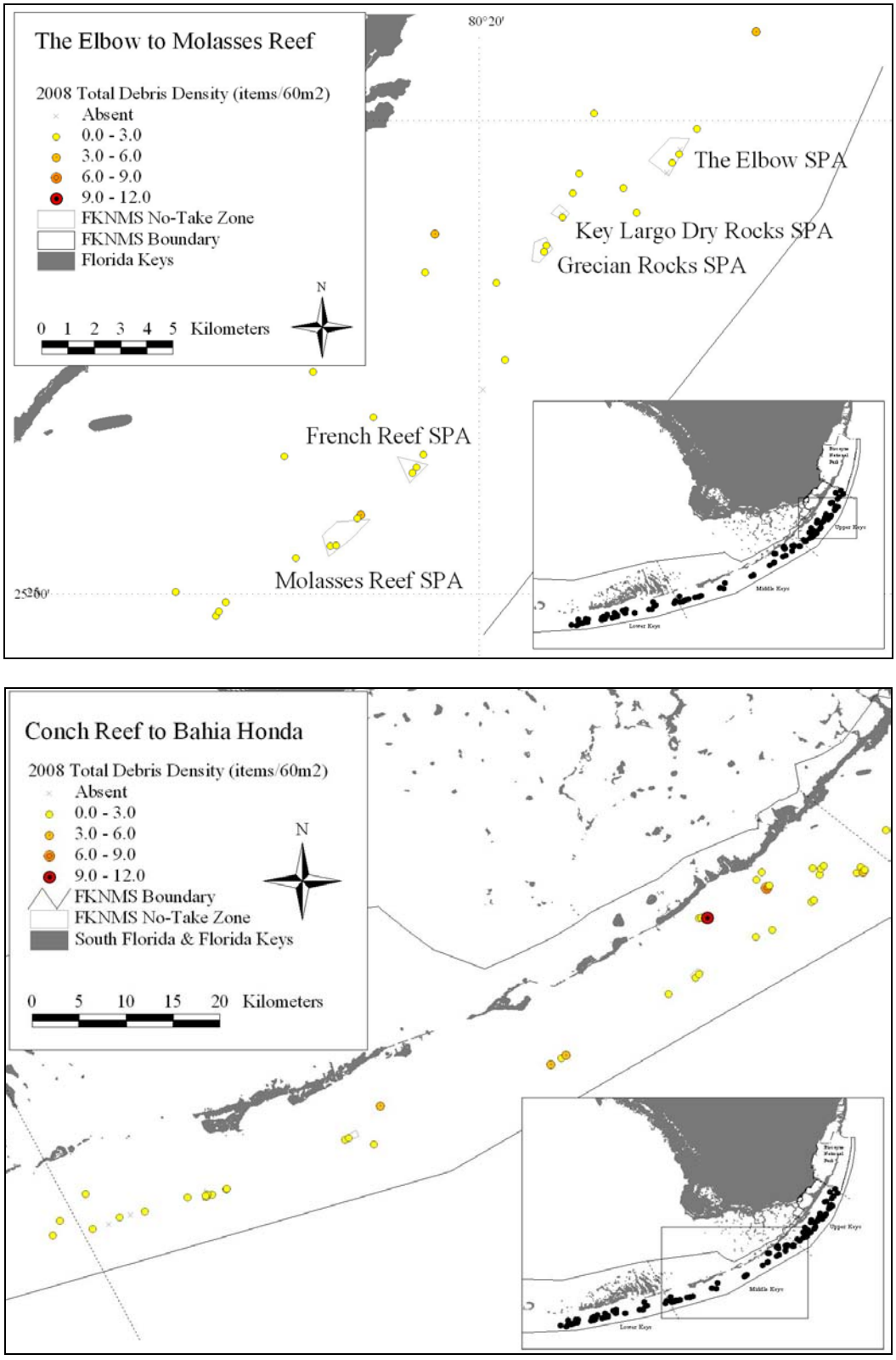


Figure 115. Total marine debris densities (no. items per 60 m^2) in the middle Florida Keys from Conch Reef to Alligator Reef (top) and from Tennessee Reef to Coffins Patch (bottom) during June-September 2008.

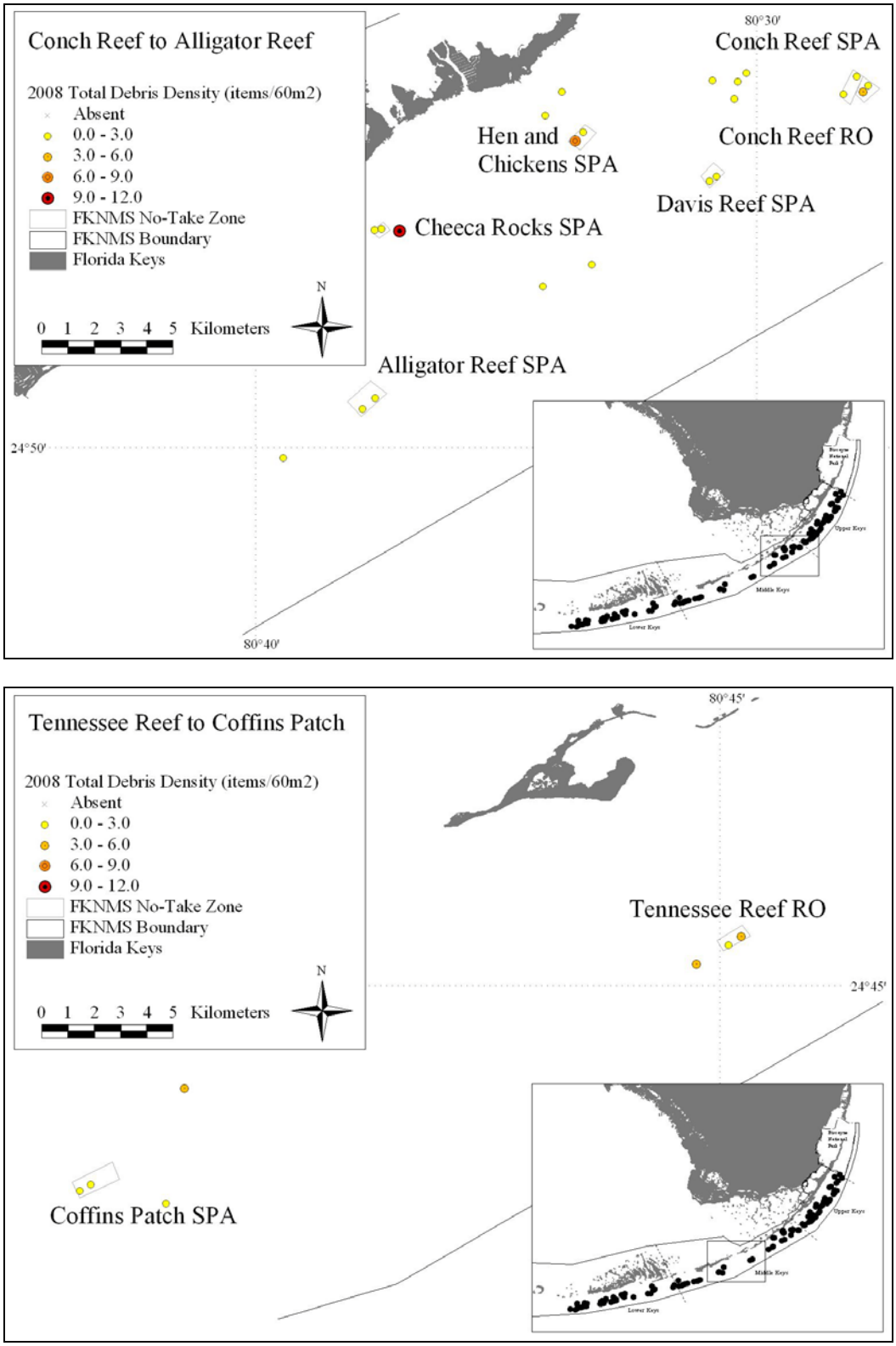


Figure 116. Total marine debris densities (no. items per 60 m^2) in the middle Florida Keys from Sombrero Reef to Bahia Honda (top) and in the lower Florida Keys (bottom) during June-September 2008.

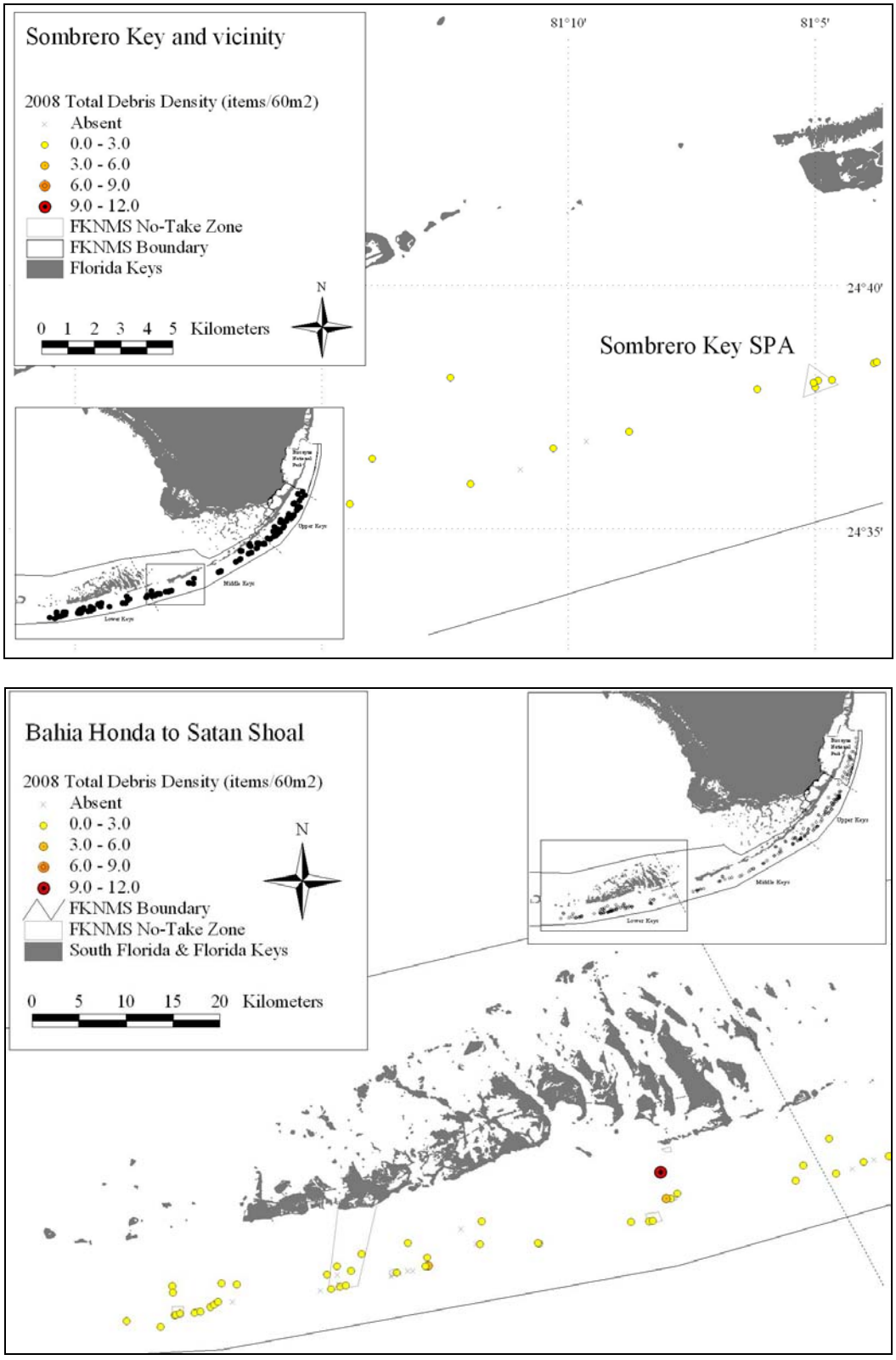


Figure 117. Total marine debris densities (no. items per 60 m^2) in the lower Florida Keys from Bahia Honda to Looe Key (top) and from American Shoal to Western Sambo (bottom) during June-September 2008.

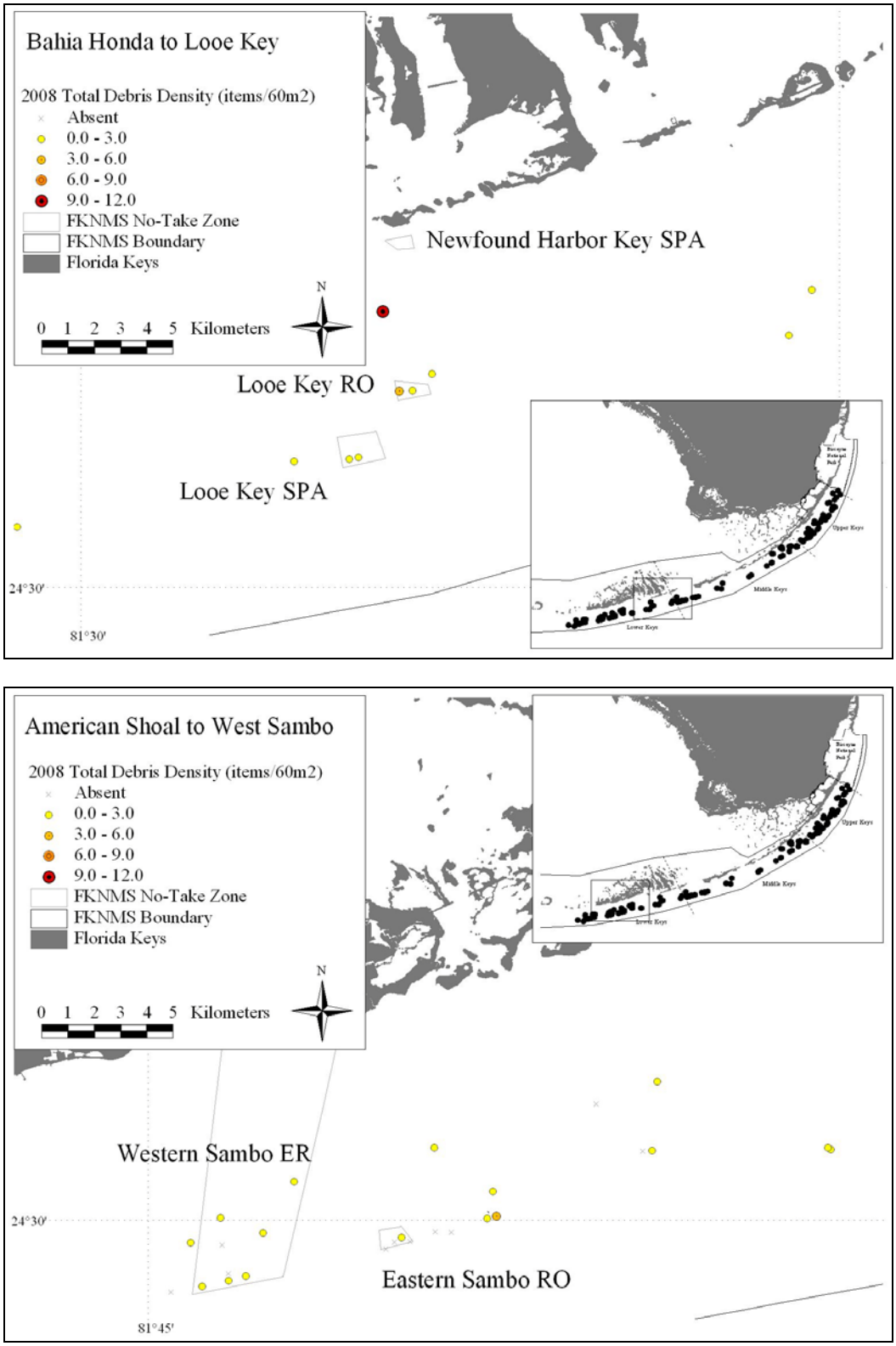


Figure 118. Total marine debris densities (no. items per 60 m^2) in the lower Florida Keys from Eastern Dry Rocks to Sand Key during June-September 2008.

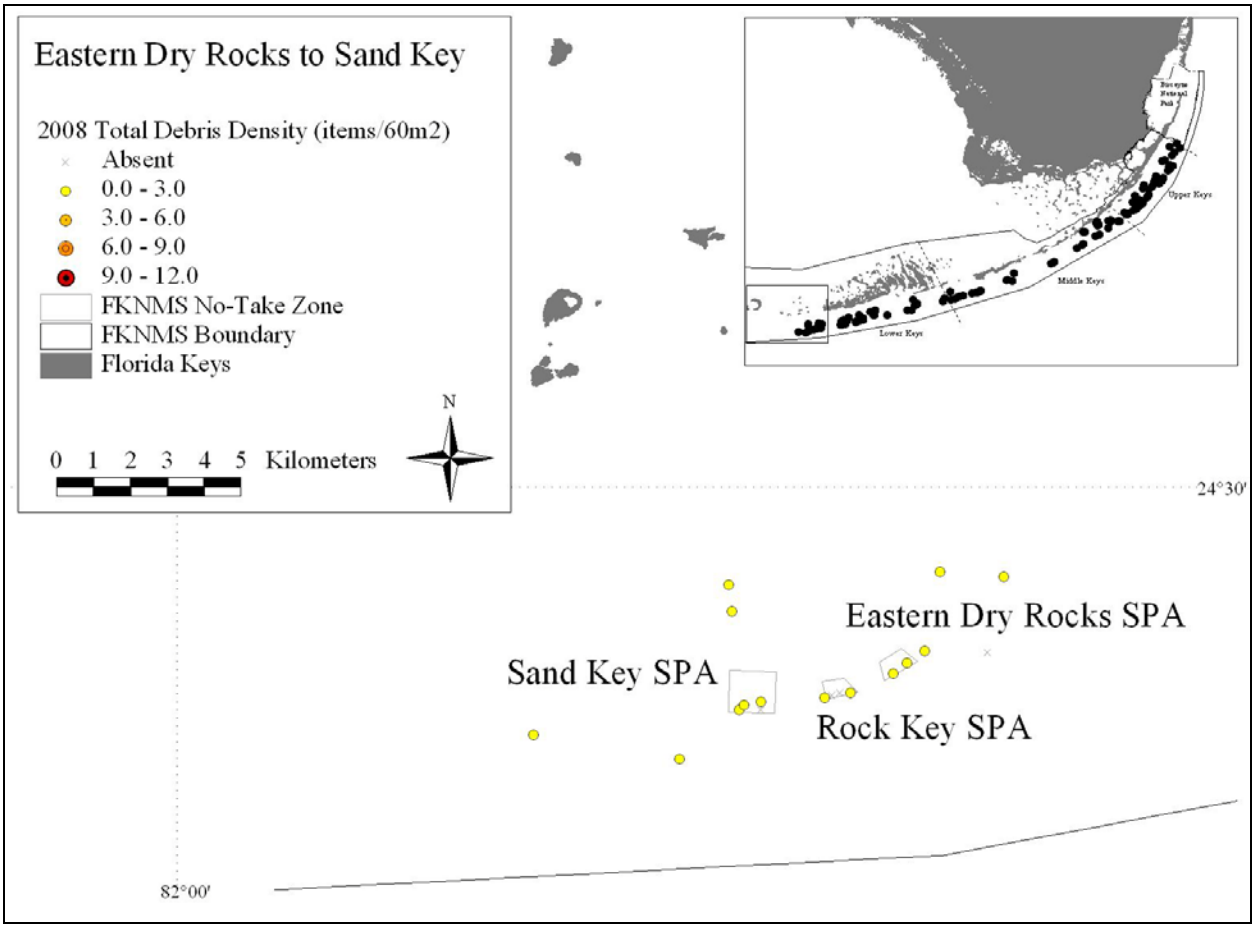


Figure 119. Mean (+ 1 SE) densities (no. items per 60 m^2) of total marine debris on mid-channel patch reefs (top) and variations in site-level densities relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

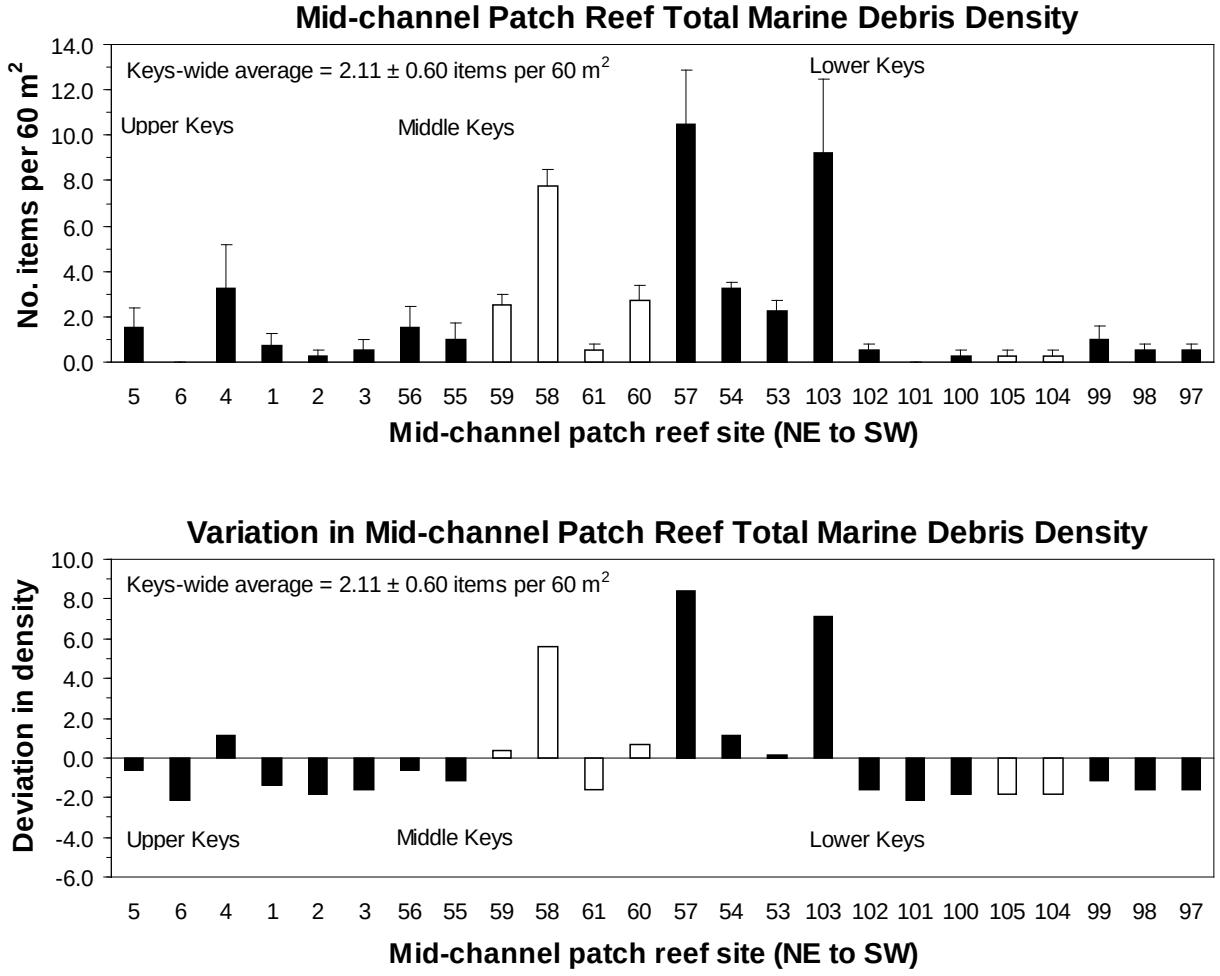


Figure 120. Mean (+ 1 SE) densities (no. items per 60 m^2) of total marine debris on offshore patch reefs (top) and variations in site-level densities relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

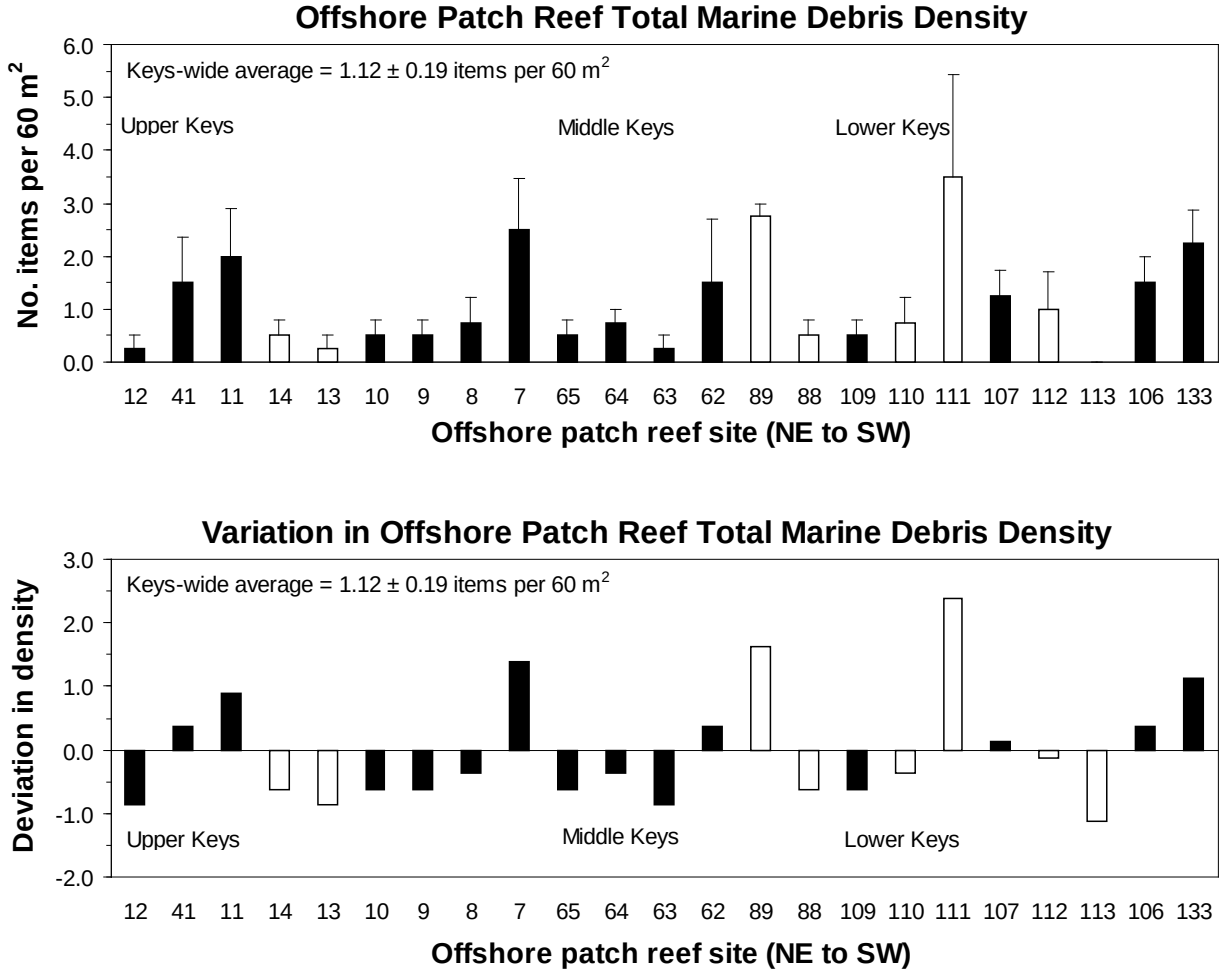


Figure 121. Mean (+ 1 SE) densities (no. items per 60 m^2) of total marine debris on shallow (< 6 m), high-relief spur and groove reefs (top) and variations in site-level densities relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

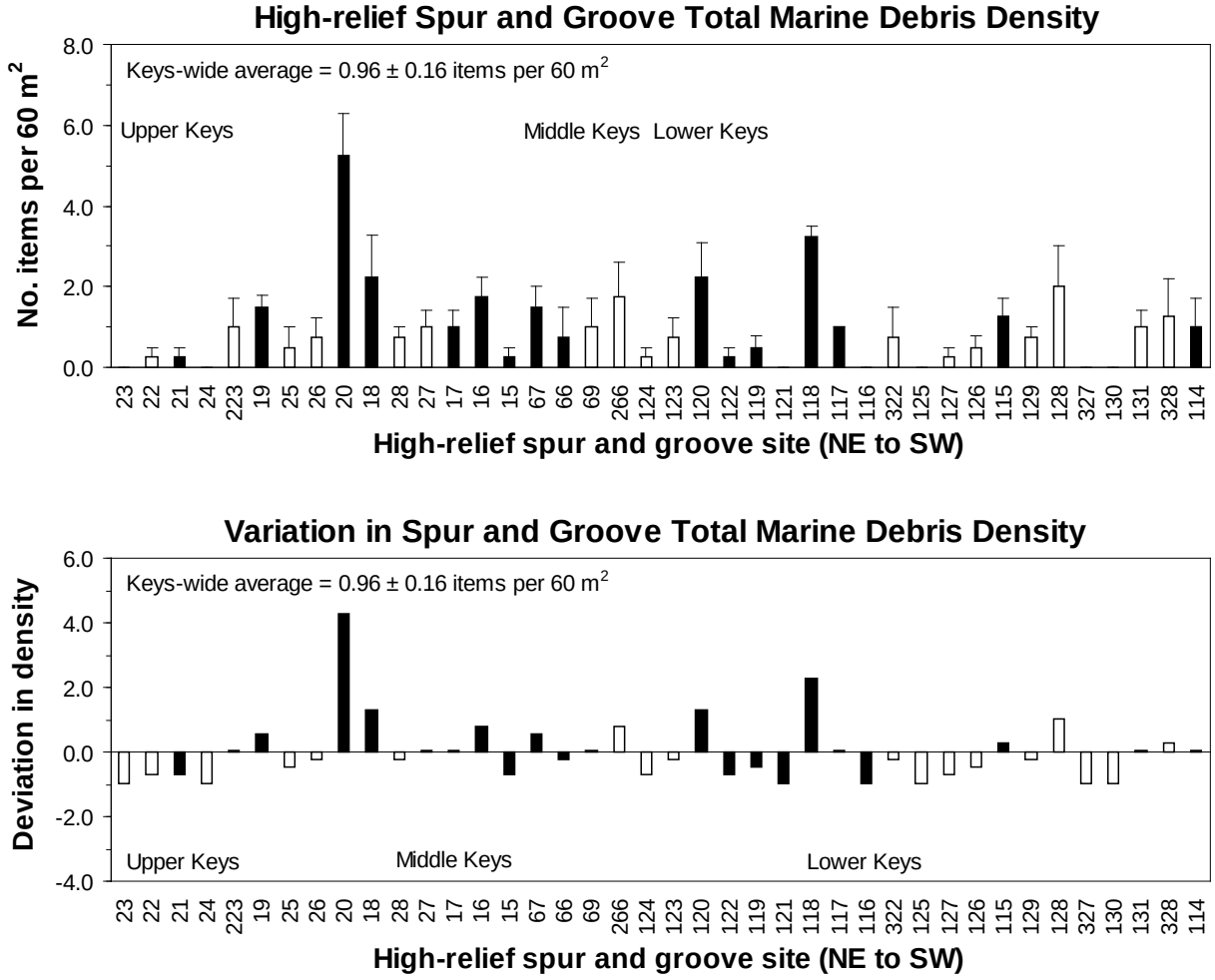


Figure 122. Mean (+ 1 SE) densities (no. items per 60 m^2) of total marine debris on deeper (6-15 m) fore-reef sites (top) and variations in site-level densities relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

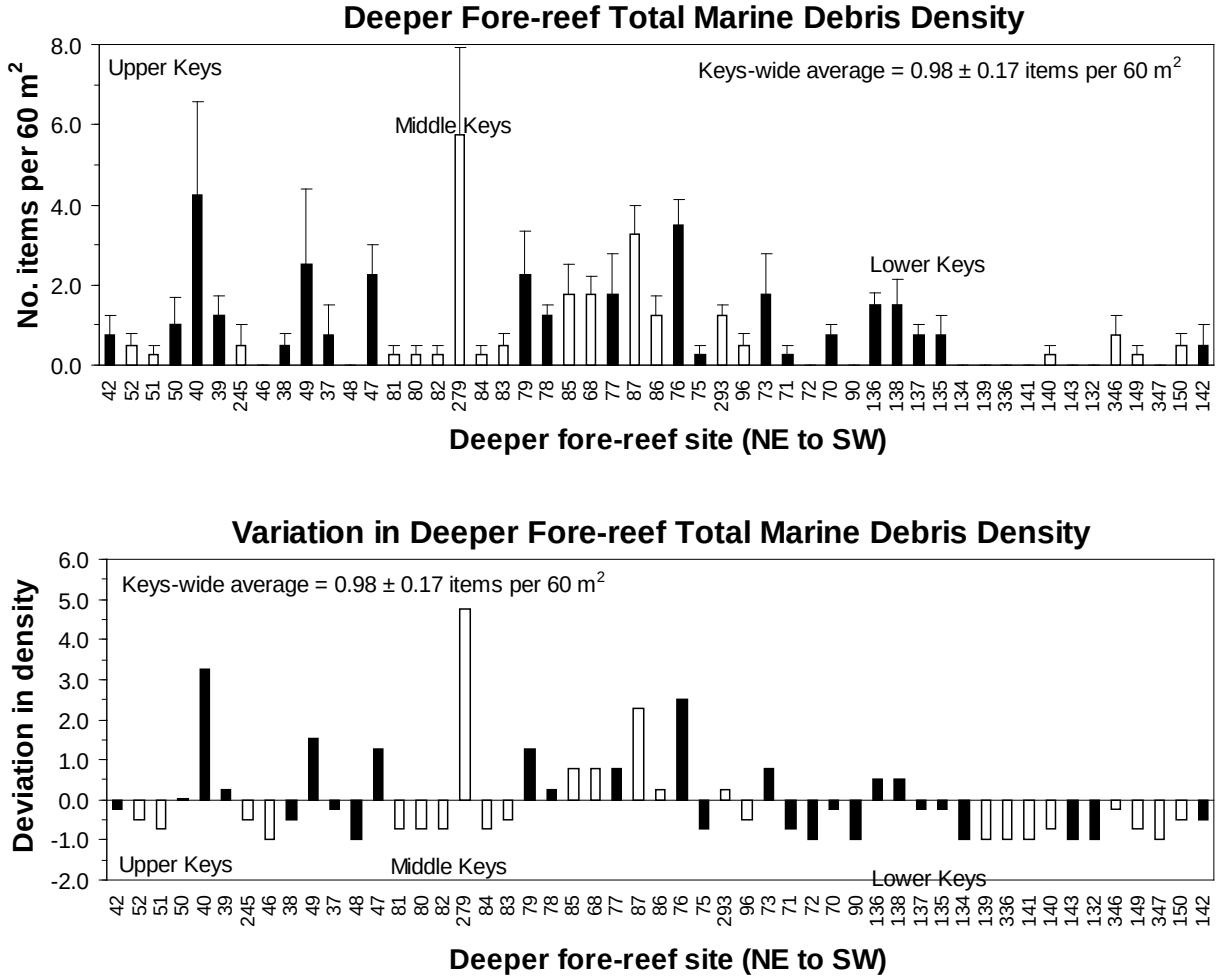


Figure 123. Total marine debris wet weight (kg retrieved per 240 m^2) in the upper Florida Keys (top) and from the southern BNP boundary to Carysfort Reef (bottom) during June-September 2008.

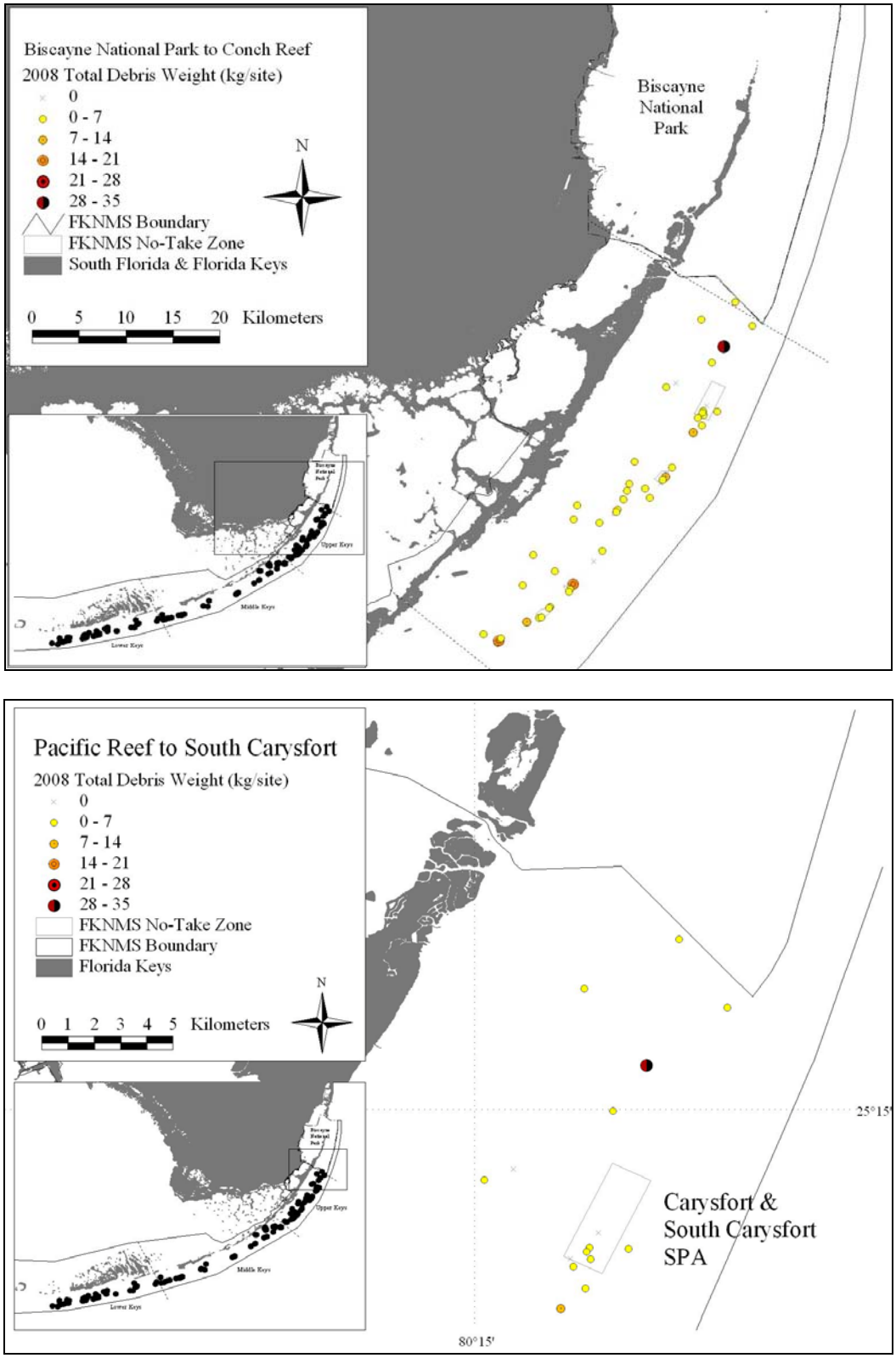


Figure 124. Total marine debris wet weight (kg retrieved per 240 m^2) in the upper Florida Keys from Elbow Reef to Pickles Reef (top) and in the middle Florida Keys (bottom) during June-September 2008.

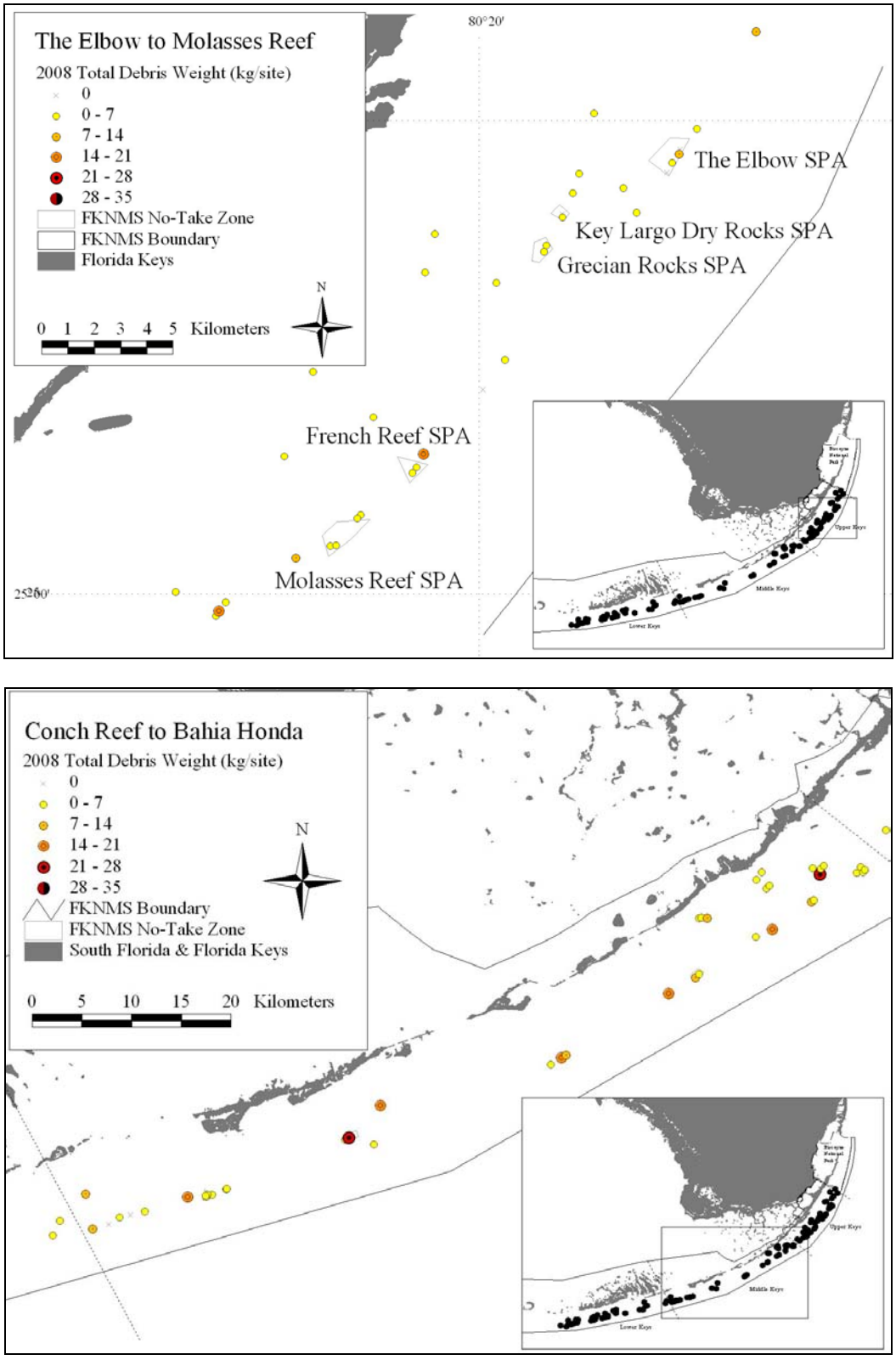
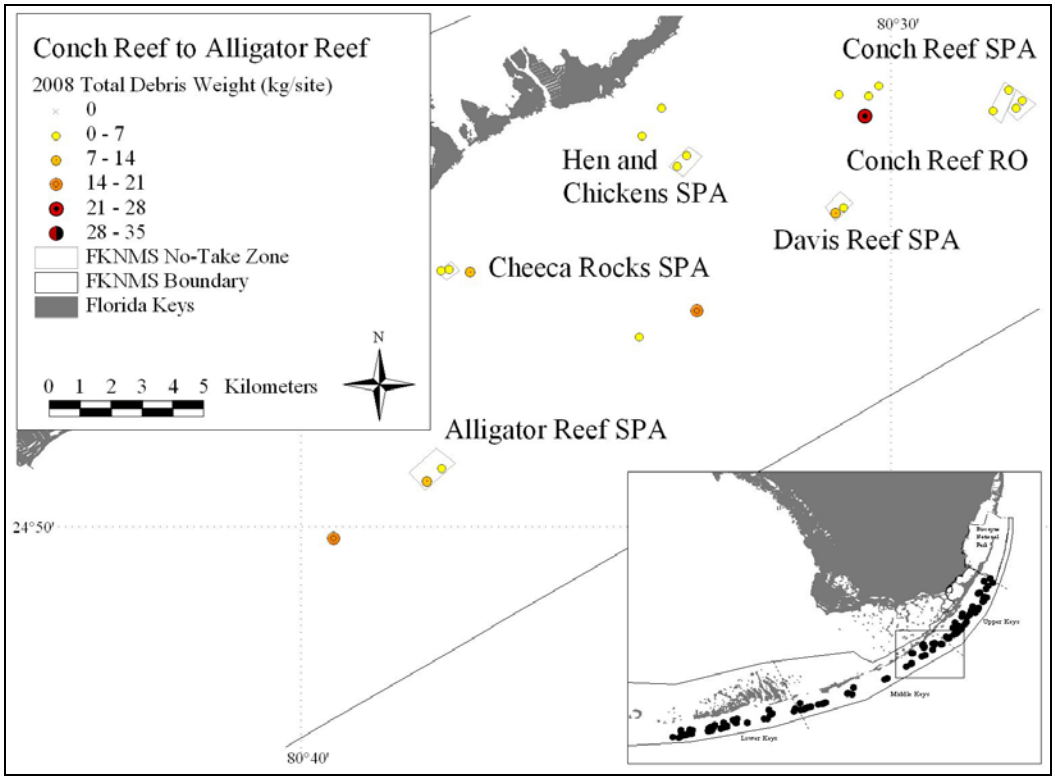


Figure 125. Total marine debris wet weight (kg retrieved per 240 m^2) in the middle Florida Keys from Conch Reef to Alligator Reef (top) and from Tennessee Reef to Coffins Patch (bottom) during June-September 2008.



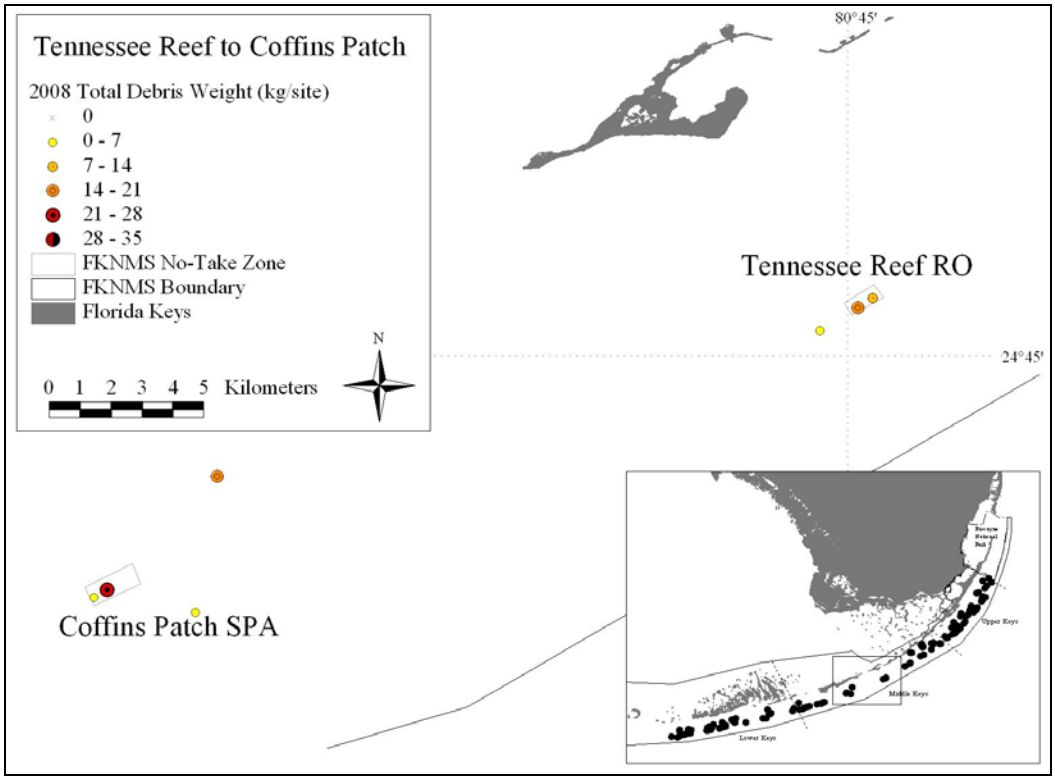


Figure 126. Total marine debris wet weight (kg retrieved per 240 m^2) in the middle Florida Keys from Sombrero Reef to Bahia Honda (top) and in the lower Florida Keys (bottom) during June-September 2008.

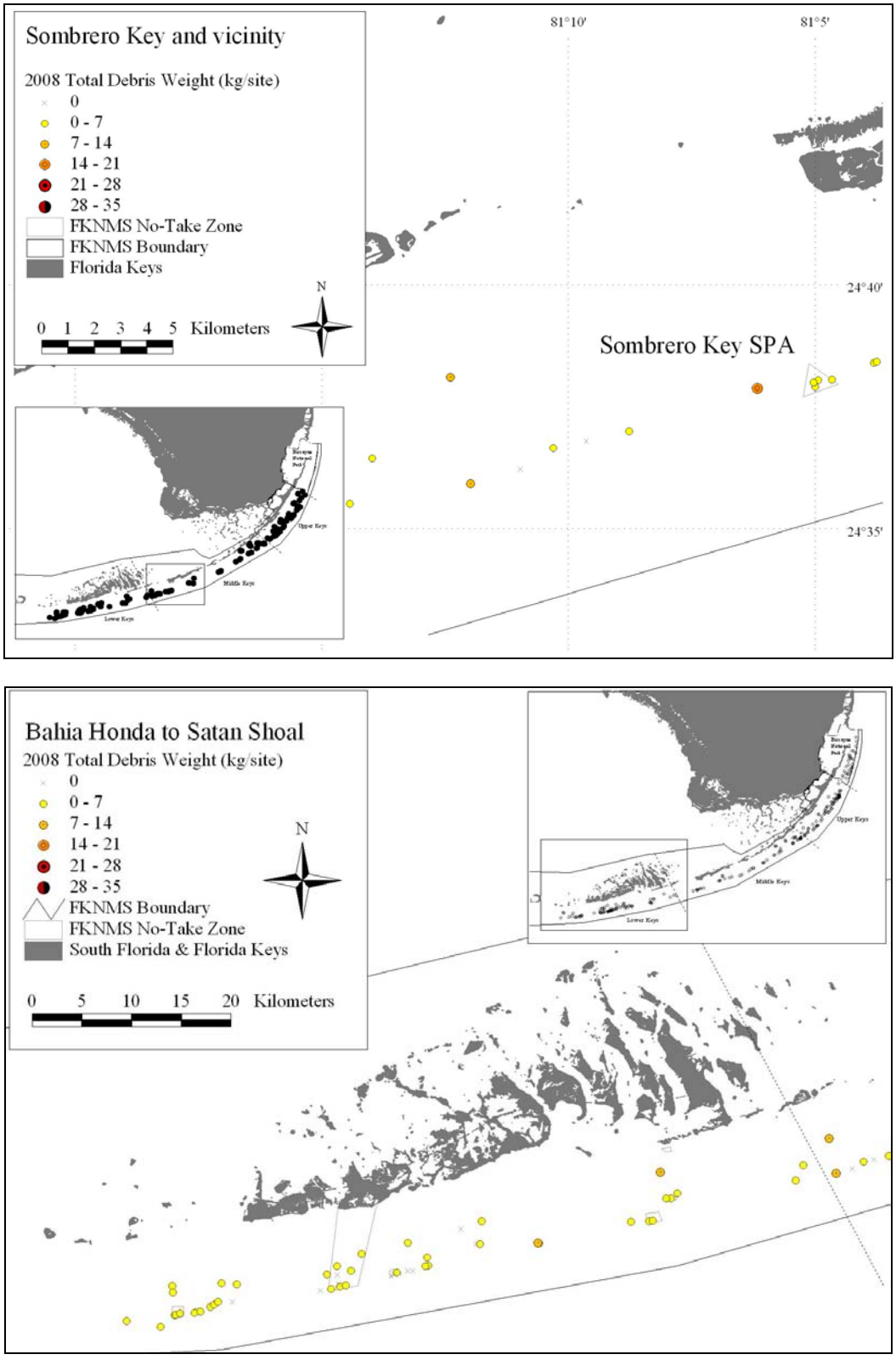


Figure 127. Total marine debris wet weight (kg retrieved per 240 m^2) in the lower Florida Keys from Bahia Honda to Looe Key (top) and from American Shoal to Western Sambo (bottom) during June-September 2008.

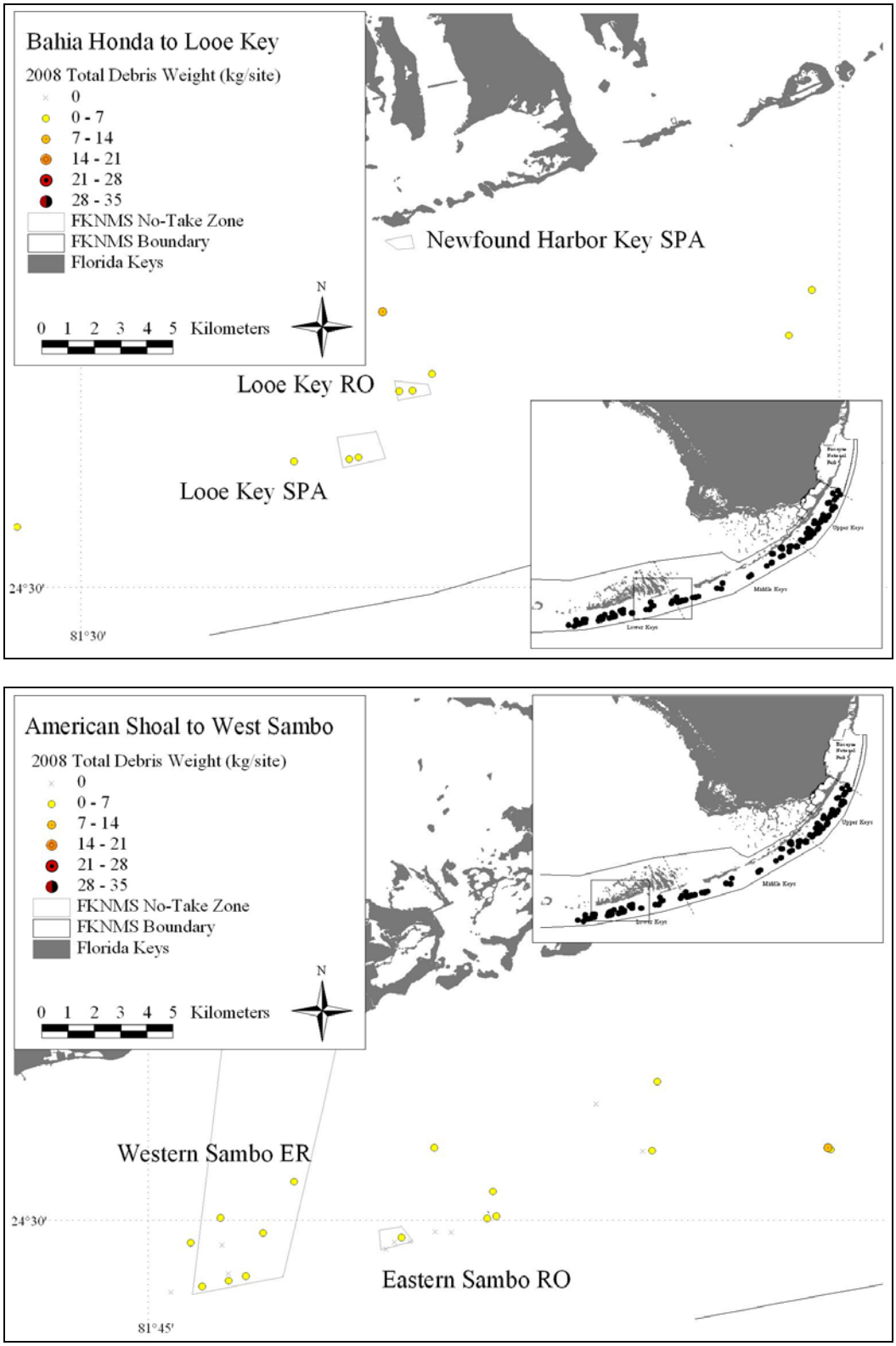


Figure 128. Total marine debris wet weight (kg retrieved per 240 m^2) in the lower Florida Keys from Eastern Dry Rocks to Sand Key during June-September 2008.

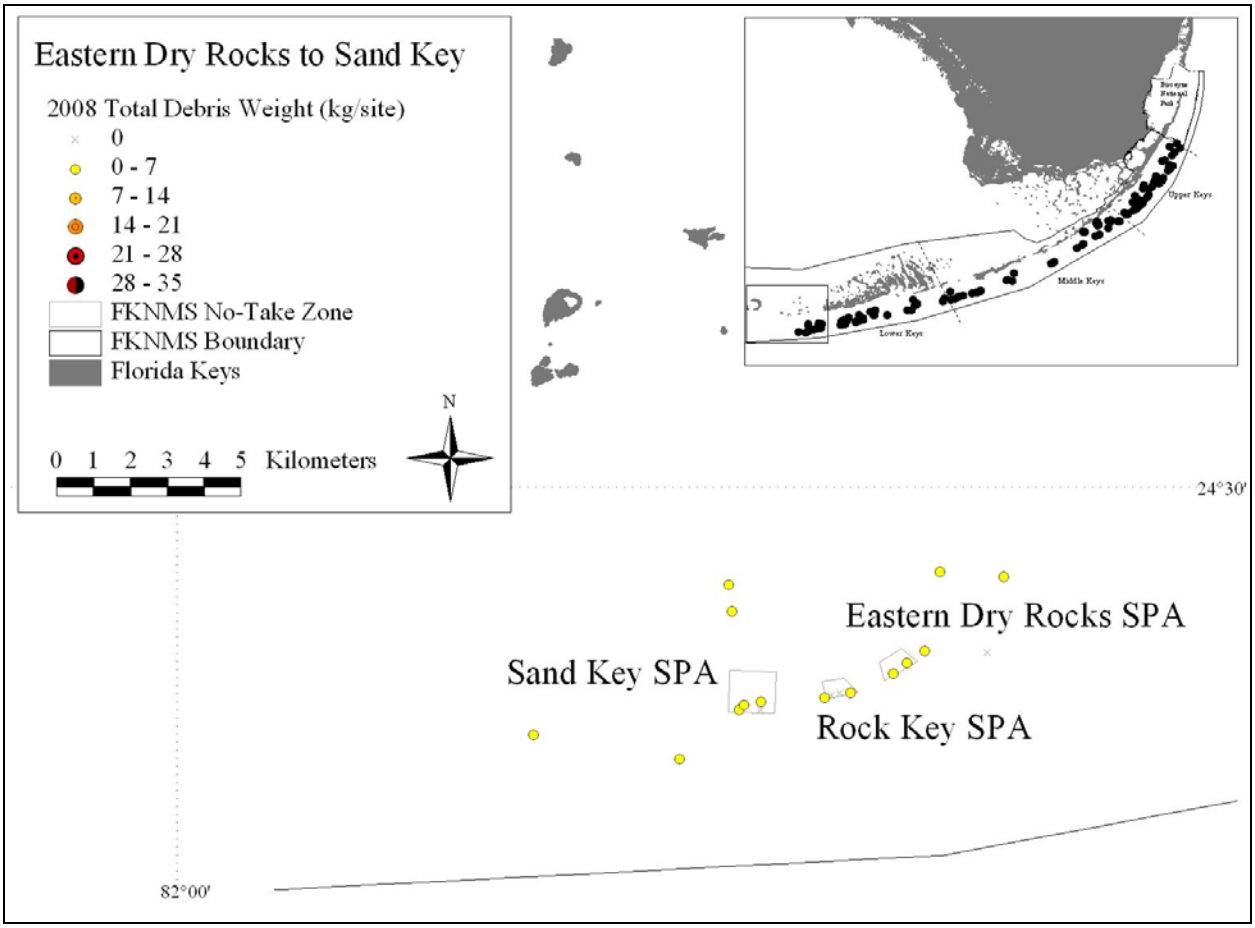


Figure 129. Total marine debris wet weight (kg retrieved per 240 m^2) on mid-channel patch reefs (top) and variations in site-level values relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

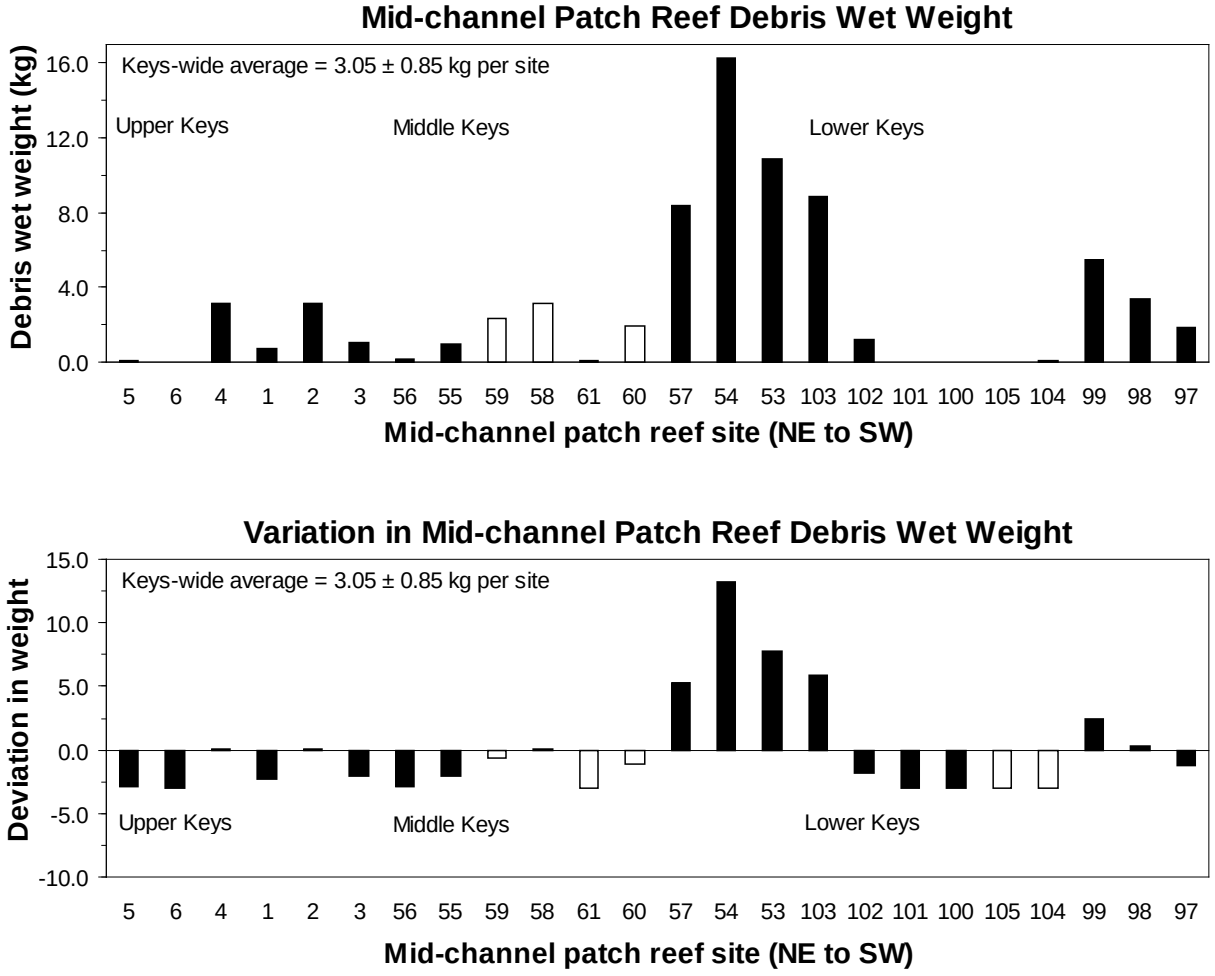


Figure 130. Total marine debris wet weight (kg retrieved per 240 m^2) on offshore patch reefs (top) and variations in site-level values relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

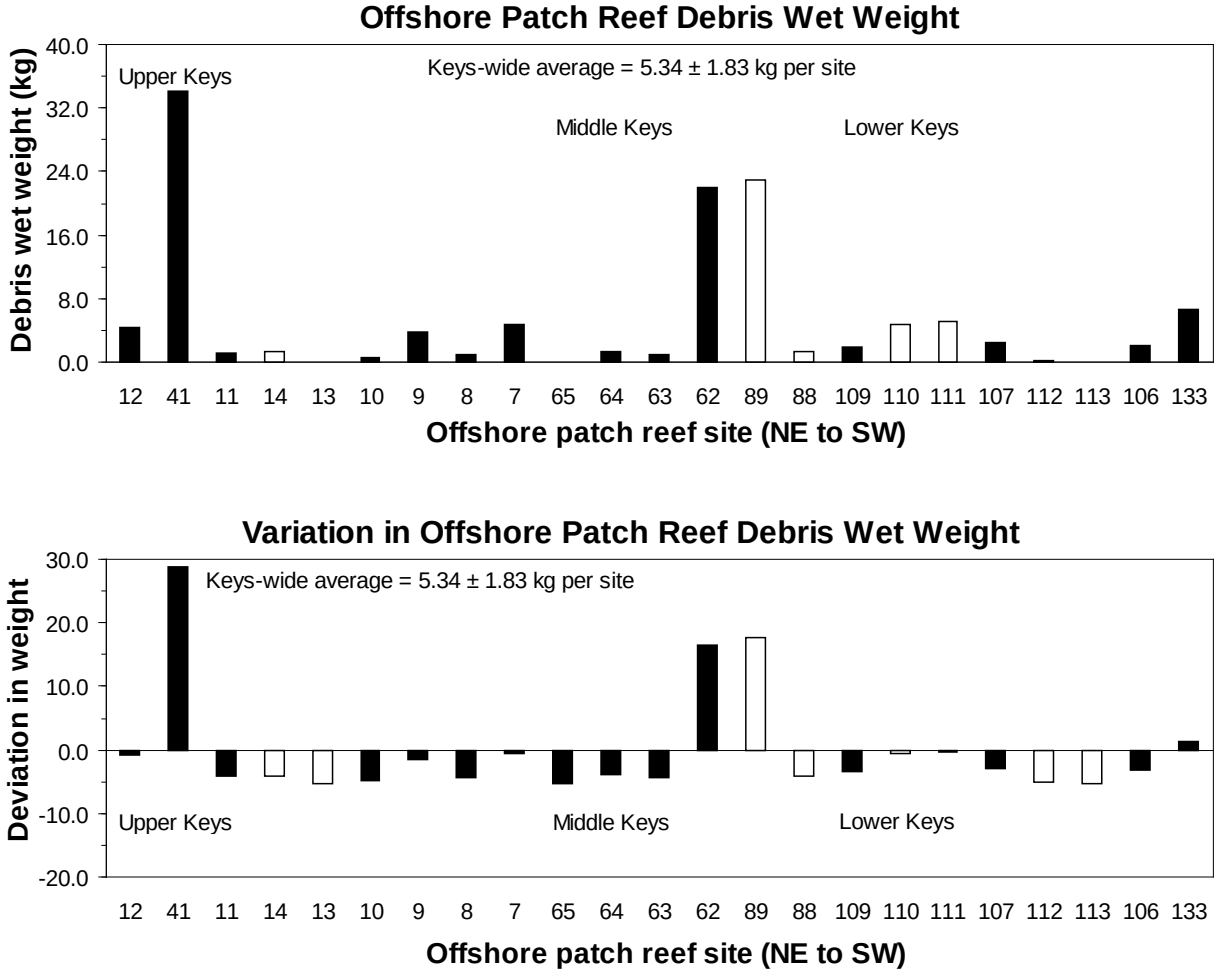


Figure 131. Total marine debris wet weight (kg retrieved per 240 m^2) on shallow (< 6 m), high-relief spur and groove reefs (top) and variations in site-level values relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

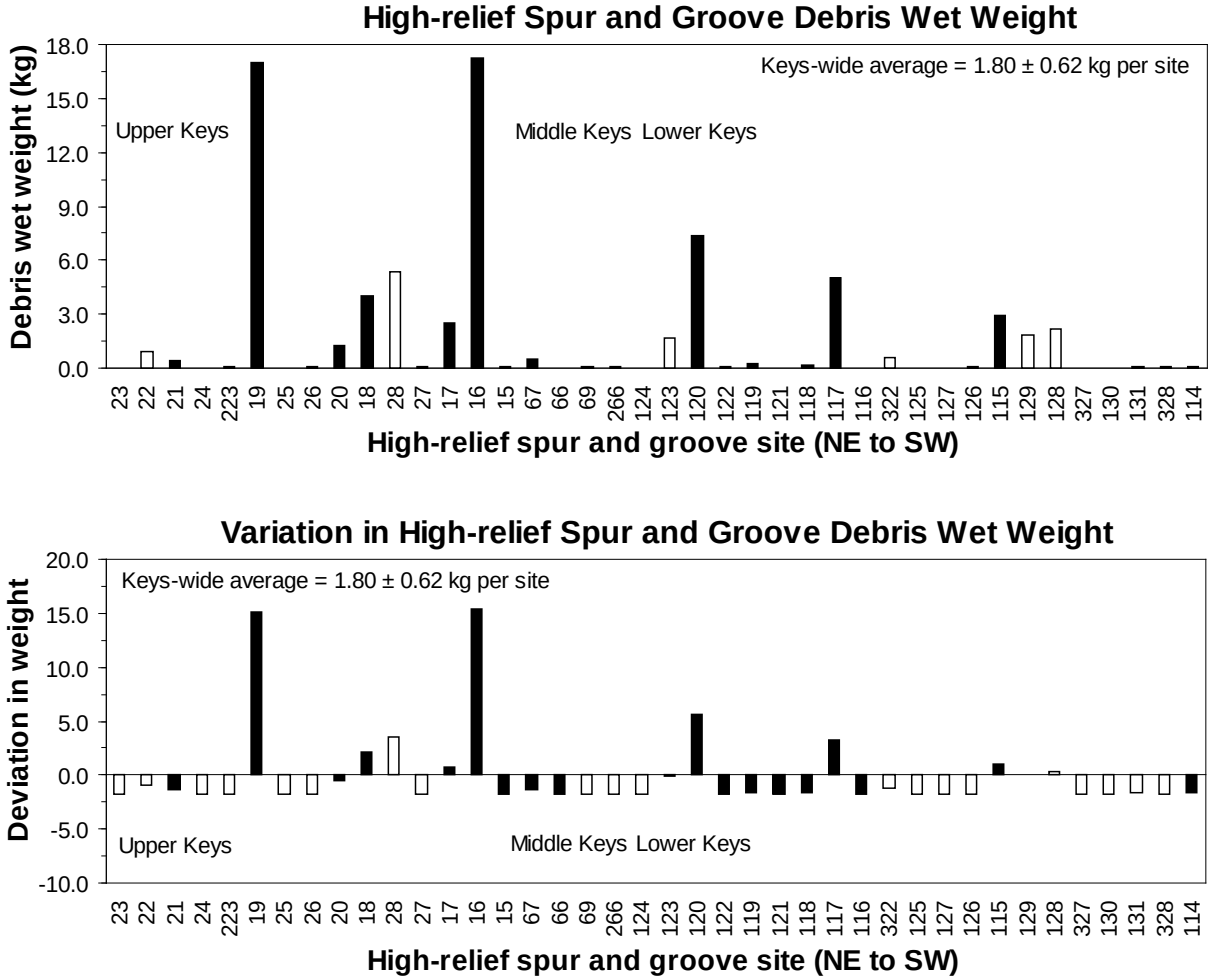


Figure 132. Total marine debris wet weight (kg retrieved per 240 m^2) on deeper (6-15 m) fore-reef sites (top) and variations in site-level values relative to the Keys-wide average (bottom). Open bars = FKNMS no-take zones; filled bars = reference areas.

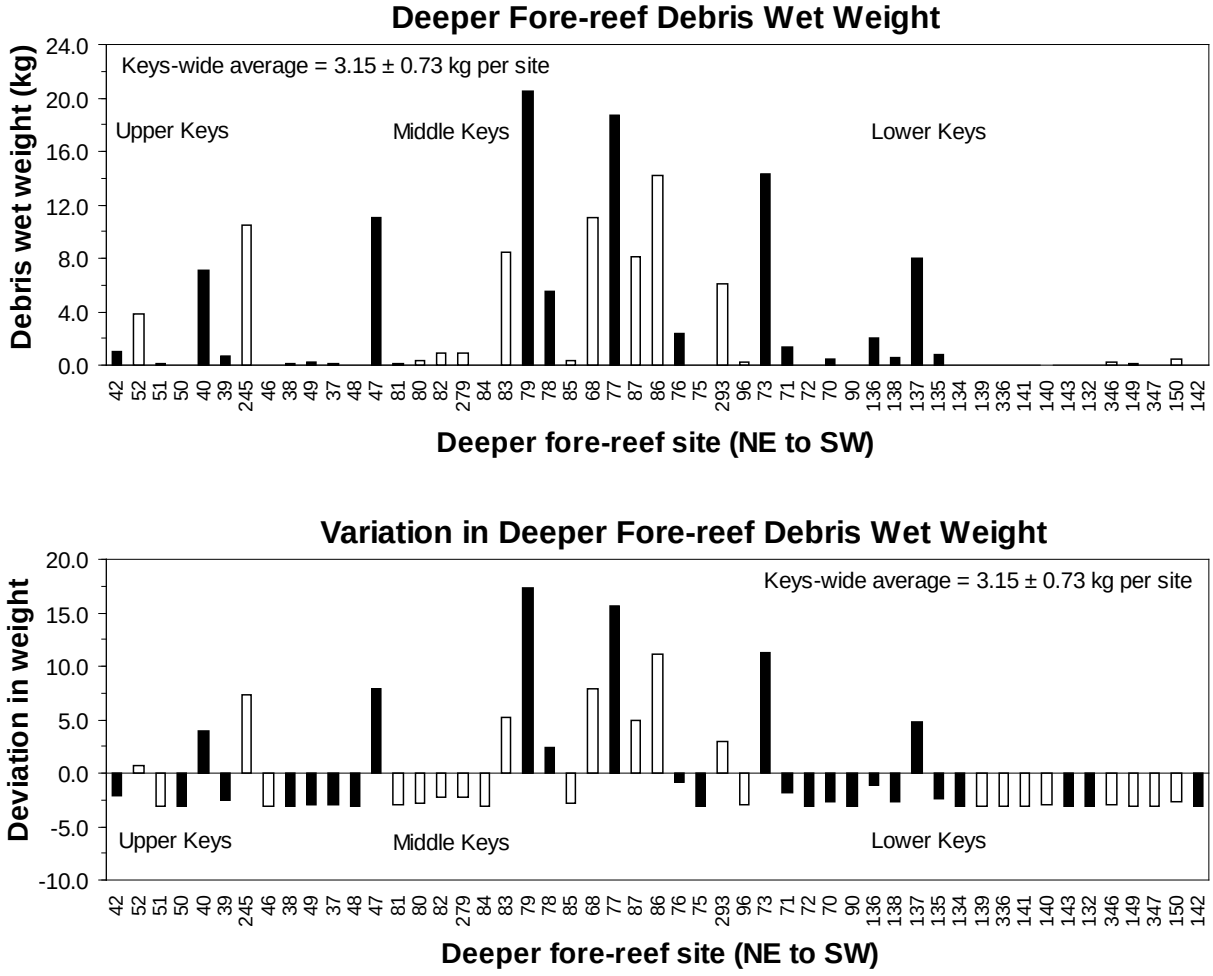


Table 20. Frequency and total length of marine debris in the Florida Keys National Marine Sanctuary, as determined from surveys of four 15-m x 4-m belt transects per site at 145 sites during June-August 2008.

Debris type	Frequency	Length (m)
Hook-and-line gear		
Fishing rod	2	3.0
Lead sinker	14	0.0
Lure	1	0.0
Monofilament	145	248.4
Monofilament + hook	36	63.4
Monofilament + leader	13	14.1
Monofilament + lure	2	3.8
Monofilament + sinker	17	16.4
Monofilament + swivel	1	1.0
Wire cable	4	29.2
Wire leader	104	74.8
Wire leader + hook	12	13.8
Wire leader + hook + sinker	1	0.7
Wire leader + lure	3	2.5
Wire leader + sinker	8	6.5
Total hook-and-line gear	**363**	**477.6**
Lobster/crab trap gear		
Cement block	40	0.0
Cement block + grating	1	0.0
Metal trap grating	7	0.0
Plastic pot opening	3	0.0
Rope	75	845.5
Rope + grating	2	24.4
Rope + trap	2	46.1
Rope + wood	3	28.3
Wood	106	0.0
Wood + cement	1	0.0
Wood + pot opening	1	0.0
Total trap gear	**241**	**944.3**
Other debris		
Aluminum can	2	0
Anchor line + block	1	0
Anchor line + rope	1	8.2
Bolt	1	0
Bottle cap	1	0
Brick	2	0.4
Cable tie	2	0
Cardboard	1	0
Ceramic plate	1	0
Cloth	1	0
Coins	10	0
Computer cable	1	1.6
Cord/thin rope	3	5.2
Filet knife	1	0
Garden hose	1	0
Glass bottle	17	0
Hex nut	1	0
Mesh bag	1	0
Mesh rope	2	1.1
Metal bracket/other metal	4	2.5
Nylon cord	1	4.3
Plastic bag	7	0
Plastic band	3	7.7
Plastic bottle	1	0
Plastic cord	2	3.4
Plastic cup	2	0
Plastic jug	2	0
Ree-bar stake	1	0
Rope/string	5	12.6
Sardine can	1	0
Spear gun handle	1	0.5
Spear gun shaft	1	0
Spear gun tubing	1	0.7
Total other debris	**82**	**48.3**
Total debris	**686**	**1,470.2**

Table 21. Impacts to coral reef benthic organisms from marine debris in the Florida Keys National Marine Sanctuary, as determined from surveys of four 15-m x 4-m belt transects per site at 145 sites during June-August 2008. Values represent the number of organisms with abrasions and/or partial mortality caused by various types of marine debris.

Debris type	***Millepora***	**Scleractinia**	**Gorgonians**	**Sponges**	***Palythoa***	**Total**
Hook-and-line gear						
Fishing rod	0	1	0	0	0	1
Lead sinker	0	0	0	0	0	0
Lure	0	0	0	0	0	0
Monofilament	18	7	73	26	0	124
Monofilament + hook	1	2	10	9	3	25
Monofilament + leader	0	0	2	2	0	4
Monofilament + lure	0	2	0	0	0	2
Monofilament + sinker	0	3	3	0	0	6
Monofilament + swivel	0	0	0	0	0	0
Wire cable	0	0	2	1	0	3
Wire leader	2	7	12	4	0	25
Wire leader + hook	0	0	2	0	0	2
Wire leader + hook + sinker	0	0	0	1	0	1
Wire leader + lure	0	0	0	0	0	0
Wire leader + sinker	0	0	0	1	0	1
Total hook-and-line gear	**21**	**22**	**104**	**44**	**3**	**194**
Lobster/crab trap gear						
Cement block	0	0	1	0	0	1
Cement block + grating	0	0	0	0	0	0
Metal trap grating	0	0	0	0	0	0
Plastic pot opening	0	0	0	0	0	0
Rope	10	39	140	18	4	211
Rope + grating	1	0	1	0	0	2
Rope + trap	0	0	1	0	0	1
Rope + wood	0	0	1	0	0	1
Wood	0	4	4	1	0	9
Wood + cement	0	0	0	0	0	0
Wood + pot opening	0	0	0	0	0	0
Total trap gear	**11**	**43**	**148**	**19**	**4**	**225**
Other debris						
Aluminum can	0	0	0	0	0	0
Anchor line + block	0	0	0	0	0	0
Anchor line + rope	0	0	2	1	0	3
Bolt	0	0	0	0	0	0
Bottle cap	0	0	0	0	0	0
Brick	0	0	0	0	0	0
Cable tie	0	0	0	0	0	0
Cardboard	0	0	0	0	0	0
Ceramic plate	0	0	0	0	0	0
Cloth	0	0	0	0	0	0
Coins	0	0	0	0	0	0
Computer cable	0	0	2	0	0	2
Cord/thin rope	1	0	0	0	0	1
Filet knife	0	0	0	0	0	0
Garden hose	0	0	0	0	0	0
Glass bottle	0	0	0	0	0	0
Hex nut	0	0	0	0	0	0
Mesh bag	0	0	0	0	0	0
Mesh rope	0	1	3	0	0	4
Metal bracket/other metal	0	0	1	0	0	1
Nylon cord	0	2	1	0	0	3
Plastic bag	2	1	0	0	0	3

Debris type	*Millepora*	Scleractinia	Gorgonians	Sponges	*Palythoa*	Total
Plastic band	0	1	1	0	0	2
Plastic bottle	0	0	0	0	0	0
Plastic cord	0	0	3	0	0	3
Plastic cup	0	0	0	0	0	0
Plastic jug	0	0	0	0	0	0
Ree-bar stake	0	0	0	0	0	0
Rope/string	1	1	4	0	1	7
Sardine can	0	0	0	0	0	0
Spear gun handle	0	0	0	0	0	0
Spear gun shaft	0	0	0	0	0	0
Spear gun tubing	0	0	0	0	0	0
Total other debris	**4**	**6**	**17**	**1**	**1**	**29**
All marine debris	**36**	**71**	**269**	**64**	**8**	**448**

Table 22. Number of items, mean ± 1 SE no. items per 60 m^2, total length (m), and mean ± 1 SE length per item for derelict hook-and-line gear in the Florida Keys National Marine Sanctuary, as determined from surveys of four 15-m x 4-m belt transects per site at 145 sites during June-August 2008. Sites are arranged by habitat from northeast to southwest and asterisked locations (**) are no-take marine reserves.

Site number/site location	Hook-and-line density		Hook-and-line gear length (m)		
	N	No. items/m^2	N	Total length	Mean length
Mid-channel patch reefs					
Upper Florida Keys NMS					
6 - Basin Hill Shoals	0	0 ± 0			
5 - Basin Hill Shoals	6	1.50 ± 0.87	6	4	92 ± 4
4 - Inshore of Grecian Rocks	6	1.50 ± 1.19	6	23	125 ± 23
3 - South of Cannon Patch Reef	1	0.25 ± 0.25	1		193
2 - Mosquito Bank	0	0 ± 0			
1 - Inshore of Molasses Reef	1	0.25 ± 0.25	1		151
Upper Florida Keys Total (6)	14	0.58 ± 0.29	14	21	140 ± 21
Middle Florida Keys NMS					
56 - Tavernier Rocks	5	1.25 ± 0.95	5	608	122 ± 24
55 - Tavernier Rocks	2	0.50 ± 0.50	2	340	170 ± 100
59 - Hen and Chickens SPA**	6	1.50 ± 0.29	6	488	81 ± 11
58 - Hen and Chickens SPA**	26	6.50 ± 0.29	26	2,746	106 ± 12
61 - Cheeca Rocks SPA**	2	0.50 ± 0.29	2	343	172 ± 139
60 - Cheeca Rocks SPA**	6	1.50 ± 0.65	6	356	59 ± 21
57 - NE of Cheeca Rocks SPA	29	7.25 ± 0.75	29	3,145	108 ± 14
54 - South of Duck Key	3	0.75 ± 0.48	3	458	153 ± 101
53 - South of Ohio Key	1	0.25 ± 0.25	1	80	80
Middle Florida Keys Total (9)	80	2.22 ± 0.89	80	8,564	117 ± 14
Lower Florida Keys NMS					
103 - North of Looe Key RO	34	8.50 ± 3.52	34	4,488	132 ± 20
102 - North of Maryland Shoal	0	0 ± 0			
101 - North of Maryland Shoal	0	0 ± 0			
100 - North of Eastern Sambo	1	0.25 ± 0.25	1	30	30
105 - Western Sambo ER**	0	0 ± 0			
104 - Western Sambo ER**	0	0 ± 0			
99 - West of Western Sambo	0	0 ± 0			
98 - Middle Ground	1	0.25 ± 0.25	1	81	81
97 - Middle Ground	0	0 ± 0			
Lower Florida Keys Total (9)	36	1.00 ± 0.94	36	4,599	81 ± 29
Mid-channel Patch Reef Total (24)	**130**	**1.35 ± 0.49**	**130**	**14,807**	**116 ± 11**
Offshore patch reefs					
Upper Florida Keys NMS					
12 - South of BNP boundary	0	0 ± 0			
41 - North of Carysfort Reef SPA	0	0 ± 0			
11 - North of Carysfort Reef SPA	0	0 ± 0			
14 - Carysfort Reef SPA**	1	0.25 ± 0.25	1	73	73
13 - Carysfort Reef SPA**	0	0 ± 0			
10 - North of Dry Rocks SPA	0	0 ± 0			
9 - SW of Grecian Rocks SPA	0	0 ± 0			
8 - Inshore of French Reef SPA	2	0.50 ± 0.29	2	385	193 ± 143
7 - Inshore of Pickles Reef	4	1.00 ± 0.71	4	558	140 ± 26
Upper Florida Keys Total (9)	7	0.19 ± 0.12	7	1,016	135 ± 35
Middle Florida Keys NMS					
65 - North of Davis Reef SPA	2	0.50 ± 0.29	2	72	36 ± 11
64 - North of Davis Reef SPA	0	0 ± 0			

Site number/site location	Hook-and-line density		Hook-and-line gear length (m)		
	N	No. items/m^2	N	Total length	Mean length
63 - North of Davis Reef SPA	0	0 ± 0			
62 - North of Davis Reef SPA	0	0 ± 0			
89 - Coffins Patch SPA**	2	0.50 ± 0.50	2	826	413 ± 158
88 - Coffins Patch SPA**	0	0 ± 0			
Middle Florida Keys Total (6)	4	0.17 ± 0.11	4	898	225 ± 189
Lower Florida Keys NMS					
109 - East of Looe Key RO	1	0.25 ± 0.25	1	73	73
110 - Looe Key Research Only**	0	0 ± 0			
111 - Looe Key Research Only**	5	1.25 ± 0.95	5	402	80 ± 28
107 - North of Pelican Shoal	1	0.25 ± 0.25	1	90	90
112 - Western Sambo ER**	3	0.75 ± 0.48	3	195	65 ± 15
113 - Western Sambo ER**	0	0 ± 0			
106 - NE of E. Dry Rocks SPA	3	0.75 ± 0.48	3	514	171 ± 129
133 - NE of E. Dry Rocks SPA	7	1.75 ± 0.63	7	927	132 ± 19
Lower Florida Keys Total (8)	20	0.63 ± 0.22	20	2,201	102 ± 17
Offshore Patch Reef Total (23)	**31**	**0.34 ± 0.10**	**31**	**4,115**	**133 ± 32**
Inner line reef tract spur & groove					
Upper Florida Keys NMS					
32 - Turtle Rocks	0	0 ± 0			
31 - Inshore of Elbow Reef SPA	1	0.25 ± 0.25	1	90	900
30 - North Dry Rocks	1	0.25 ± 0.25	1	40	40
34 - Dry Rocks SPA**	0	0 ± 0			
33 - Dry Rocks SPA**	0	0 ± 0			
36 - Grecian Rocks SPA**	1	0.25 ± 0.25	1	65	65
35 - Grecian Rocks SPA**	2	0.50 ± 0.50	2	171	86 ± 20
Upper Florida Keys Total (7)	5	0.18 ± 0.07	5	366	70 ± 11
Inner Line Reef Tract Total (7)	**5**	**0.18 ± 0.07**	**5**	**366**	**70 ± 11**
High-relief spur & groove					
Upper Florida Keys NMS					
23 - Carysfort Reef SPA**	0	0 ± 0			
22 - Carysfort Reef SPA**	0	0 ± 0			
21 - Maitland grounding site	0	0 ± 0			
24 - Elbow Reef SPA**	0	0 ± 0			
223 - Elbow Reef SPA**	4	1.00 ± 0.71	3	577	192 ± 144
19 - North of French Reef SPA	2	0.50 ± 0.29	2	71	36 ± 10
25 - French Reef SPA**	2	0.50 ± 0.50	2	66	33 ± 7
26 - French Reef SPA**	3	0.75 ± 0.48	2	326	163 ± 108
20 - Sand Island	19	4.75 ± 1.25	14	1,968	141 ± 78
18 - Sand Island	6	1.50 ± 0.65	6	325	54 ± 15
28 - Molasses Reef SPA**	2	0.50 ± 0.29	2	64	32 ± 8
27 - Molasses Reef SPA**	4	1.00 ± 0.41	4	565	141 ± 96
17 - Pickles Reef	2	0.50 ± 0.29	2	504	252 ± 222
16 - Pickles Reef	3	0.75 ± 0.48	2	55	28 ± 3
15 - Pickles Reef	0	0 ± 0			
Upper Florida Keys Total (15)	47	0.78 ± 0.31	39	4,521	107 ± 26
Middle Florida Keys NMS					
67 - Delta Shoal	5	1.25 ± 0.48	5	2,361	472 ± 295
66 - Delta Shoal	3	0.75 ± 0.75	3	515	172 ± 70
69 - Sombrero Key SPA**	1	0.25 ± 0.25	1	80	80 ± 0
266 - Sombrero Key SPA**	6	1.50 ± 0.65	6	554	92 ± 12
Middle Florida Keys Total (4)	15	0.94 ± 0.28	15	3,510	204 ± 92
Lower Florida Keys NMS					

Site number/site location	Hook-and-line density		Hook-and-line gear length (m)		
	N	No. items/m^2	N	Total length	Mean length
124 - Looe Key SPA**	1	0.25 ± 0.25	1	30	30
123 - Looe Key SPA**	0	0 ± 0			
120 - American Shoal	6	1.50 ± 0.96	6	780	156 ± 92
122 - American Shoal	0	0 ± 0			
119 - Maryland Shoal	1	0.25 ± 0.25	1	146	146
121 - Maryland Shoal	0	0 ± 0			
118 - Pelican Shoal	13	3.25 ± 0.25	13	2,253	173 ± 73
117 - Pelican Shoal	2	0.50 ± 0.29	2	160	80 ± 27
116 - No Name Reef	0	0 ± 0			
322 - Eastern Sambo RO**	1	0.25 ± 0.25	1	95	95
125 - Eastern Sambo RO**	0	0 ± 0			
127 - Western Sambo ER**	0	0 ± 0			
126 - Western Sambo ER**	1	0.25 ± 0.25	1	150	150
115 - East of E. Dry Rocks SPA	2	0.50 ± 0.29	2	397	199 ± 182
129 - Eastern Dry Rocks SPA**	1	0.25 ± 0.25			
128 - Eastern Dry Rocks**	5	1.25 ± 0.63	2	226	113 ± 87
327 - Rock Key SPA**	0	0 ± 0			
130 - Rock Key SPA**	0	0 ± 0			
131 - Sand Key SPA**	3	0.75 ± 0.25	2	80	40 ± 15
328 - Sand Key SPA**	4	1.00 ± 0.71	4	430	108 ± 32
114 - Western Dry Rocks	4	1.00 ± 0.71	4	159	40 ± 12
Lower Florida Keys Total (21)	44	0.52 ± 0.17	39	4,906	111 ± 16
Spur & Groove Total (40)	**106**	**0.66 ± 0.15**	**93**	**12,937**	**124 ± 19**
Fore-reef (6-15 m)					
Upper Florida Keys NMS					
42 - South of BNP boundary	1	0.25 ± 0.25	1	1,161	1,161
52 - Carysfort Reef SPA**	1	0.25 ± 0.25			
51 - Carysfort Reef SPA**	1	0.25 ± 0.25	1	190	190
50 - SW of Carysfort Reef SPA	1	0.25 ± 0.25	1	668	668
40 - SW of Carysfort Reef SPA	1	0.25 ± 0.25	1	100	100
39 - North of Elbow Reef SPA	3	0.75 ± 0.25	3	183	61 ± 12
245 - Elbow Reef SPA**	0	0 ± 0			
46 - Elbow Reef SPA**	0	0 ± 0			
38 - SW of Elbow Reef SPA	0	0 ± 0			
49 - South of Elbow Reef SPA	9	2.25 ± 1.65	9	2,852	317 ± 137
37 - Dixie Shoal	2	0.50 ± 0.50	2	124	62 ± 2
48 - Dixie Shoal	0	0 ± 0			
47 - SW of Molasses Reef SPA	2	0.50 ± 0.29	2	133	67 ± 27
Upper Florida Keys Total (13)	21	0.40 ± 0.17	20	5,411	328 ± 140
Middle Florida Keys NMS					
81 - Conch Reef SPA**	0	0 ± 0			
80 - Conch Reef SPA**	0	0 ± 0			
82 - Conch Reef RO**	0	0 ± 0			
279 - Conch Reef RO**	20	5.00 ± 1.73	19	1,745	92 ± 22
84 - Davis Reef SPA**	1	0.25 ± 0.25	1	381	381
83 - Davis Reef SPA**	0	0 ± 0			
79 - SW of Crocker Reef	2	0.50 ± 0.29	2	205	103 ± 50
78 - SW of Crocker Reef	0	0 ± 0			
85 - Alligator Reef SPA**	6	1.50 ± 0.65	6	384	64 ± 38
68 - Alligator Reef SPA**	6	1.50 ± 0.29	6	653	109 ± 52
77 - SW of Alligator Reef SPA	3	0.75 ± 0.75	3	225	75 ± 46
87 - Tennessee Reef RO**	5	1.25 ± 0.48	5	521	104 ± 36
86 - Tennessee Reef RO**	2	0.50 ± 0.29	2	204	102 ± 48
76 - NE of Tennessee Light	4	1.00 ± 0.41	4	332	83 ± 28
75 - East of Coffins Patch SPA	1	0.25 ± 0.25	1	612	612
293 - Sombrero Key SPA**	3	0.75 ± 0.48	3	155	52 ± 12
96 - Sombrero Key SPA**	0	0 ± 0			

Site number/site location	Hook-and-line density		Hook-and-line gear length (m)		
	N	No. items/m^2	N	Total	Mean length
73 - West of Sombrero Key SPA	2	0.50 ± 0.50	2	195	98 ± 43
71 - South of Moser Channel	0	0 ± 0			
72 - South of Moser Channel	0	0 ± 0			
70 - South of Moser Channel	1	0.25 ± 0.25	1	800	800
90 - South of Moser Channel	0	0 ± 0			
Middle Florida Keys Total (22)	56	0.64 ± 0.23	55	6,412	206 ± 67
Lower Florida Keys NMS					
136 - South of Bahia Honda Key	5	1.25 ± 0.48	5	2,428	486 ± 461
138 - South of Bahia Honda Key	3	0.75 ± 0.48	3	331	110 ± 77
137 - South of Bahia Honda Key	0	0 ± 0			
135 - West of Looe Key SPA	1	0.25 ± 0.25	1	24	24
134 - West of Pelican Shoal	0	0 ± 0			
139 - Eastern Sambo RO**	0	0 ± 0			
336 - Eastern Sambo RO**	0	0 ± 0			
141 - Western Sambo ER**	0	0 ± 0			
140 - Western Sambo ER**	0	0 ± 0			
143 - West of Western Sambo	0	0 ± 0			
132 - East of E. Dry Rocks SPA	0	0 ± 0			
346 - Rock Key SPA**	2	0.50 ± 0.29	2	544	272 ± 210
149 - Rock Key SPA**	0	0 ± 0			
347 - Sand Key SPA**	0	0 ± 0			
150 - Sand Key SPA**	1	0.25 ± 0.25	1	72	72
142 - SW of Sand Key SPA	2	0.50 ± 0.50	2	309	155 ± 41
Lower Florida Keys Total (16)	14	0.22 ± 0.09	14	3,708	186 ± 69
Fore-reef Total (51)	**91**	**0.45 ± 0.11**	**89**	**15,531**	**238 ± 54**

Table 23. Number of items, mean ± 1 SE no. items per 60 m^2, total rope length (m), and mean ± 1 SE rope length for lost lobster/crab trap gear in the Florida Keys National Marine Sanctuary, as determined from surveys of four 15-m x 4-m belt transects per site at 145 sites during June-August 2008. Sites are arranged by habitat from northeast to southwest and asterisked locations (**) are no-take marine reserves.

Site number/site location	Trap gear density		Trap rope length (m)		
	N	No. items/m^2	N	Total length	Mean length
Mid-channel patch reefs					
Upper Florida Keys NMS					
6 - Basin Hill Shoals	0	0 ± 0			
5 - Basin Hill Shoals	0	0 ± 0			
4 - Inshore of Grecian Rocks	6	1.50 ± 0.87	3	2,718	906 ± 160
3 - South of Cannon Patch Reef	1	0.25 ± 0.25	1	1,266	1,266
2 - Mosquito Bank	0	0 ± 0			0 ± 0
1 - Inshore of Molasses Reef	1	0.25 ± 0.25	1	961	961
Upper Florida Keys Total (6)	8	0.33 ± 0.24	5	4,945	1,044 ± 112
Middle Florida Keys NMS					
56 - Tavernier Rocks	0	0 ± 0			
55 - Tavernier Rocks	2	0.50 ± 0.29	1	866	866
59 - Hen and Chickens SPA**	3	0.75 ± 0.48	2	1,310	655 ± 405
58 - Hen and Chickens SPA**	5	1.25 ± 0.75	2	2,267	1,134 ± 424
61 - Cheeca Rocks SPA**	0	0 ± 0			
60 - Cheeca Rocks SPA**	3	0.75 ± 0.48	1	1,880	1,880
57 - NE of Cheeca Rocks SPA	13	3.25 ± 1.89	4	4,172	1,043 ± 761
54 - South of Duck Key	8	2.00 ± 0.41	1	976	976
53 - South of Ohio Key	8	2.00 ± 0.41	6	7,502	1,250 ± 249
Middle Florida Keys Total (9)	42	1.17 ± 0.36	17	18,973	1,115 ± 147
Lower Florida Keys NMS					
103 - North of Looe Key RO	3	0.75 ± 0.48	3	1,791	597 ± 519
102 - North of Maryland Shoal	2	0.50 ± 0.29	1	1,480	1,480
101 - North of Maryland Shoal	0	0 ± 0			
100 - North of Eastern Sambo	0	0 ± 0			
105 - Western Sambo ER**	1	0.25 ± 0.25			
104 - Western Sambo ER**	1	0.25 ± 0.25			
99 - West of Western Sambo	2	0.50 ± 0.29	2	3,174	1,587 ± 73
98 - Middle Ground	1	0.25 ± 0.25	1	1,420	1,420
97 - Middle Ground	2	0.50 ± 0.29	2	1,391	696 ± 96
Lower Florida Keys Total (9)	12	0.33 ± 0.08	9	9,256	1,156 ± 210
Mid-channel Patch Reef Total (24)	**62**	**0.65 ± 0.17**	**31**	**33,174**	**1,114 ± 95**
Offshore patch reefs					
Upper Florida Keys NMS					
12 - South of BNP boundary	1	0.25 ± 0.25			
41 - North of Carysfort Reef SPA	4	1.00 ± 0.71	1	1,237	1,237
11 - North of Carysfort Reef SPA	7	1.75 ± 1.03			
14 - Carysfort Reef SPA**	1	0.25 ± 0.25	1	150	150
13 - Carysfort Reef SPA**	1	0.25 ± 0.25			
10 - North of Dry Rocks SPA	2	0.50 ± 0.29	1	498	498
9 - SW of Grecian Rocks SPA	2	0.50 ± 0.29	1	1,870	1,870
8 - Inshore of French Reef SPA	1	0.25 ± 0.25	1	663	663
7 - Inshore of Pickles Reef	2	0.50 ± 0.50	2	2,480	1,240 ± 1,010
Upper Florida Keys Total (9)	21	0.58 ± 0.17	7	6,898	943 ± 254
Middle Florida Keys NMS					
65 - North of Davis Reef SPA	0	0 ± 0			
64 - North of Davis Reef SPA	3	0.75 ± 0.25	1	366	366

Site number/site location	Trap gear density		Trap rope length (m)		
	N	No. items/m^2	N	Total length	Mean length
63 - North of Davis Reef SPA	1	0.25 ± 0.25	1	963	963
62 - North of Davis Reef SPA	5	1.25 ± 0.95	1	1,040	1,040
89 - Coffins Patch SPA**	8	2.00 ± 0.41	2	1,715	858 ± 623
88 - Coffins Patch SPA**	1	0.25 ± 0.25			
Middle Florida Keys Total (6)	18	0.75 ± 0.31	5	4,084	807 ± 152
Lower Florida Keys NMS					
109 - East of Looe Key RO	1	0.25 ± 0.25	1	1,070	1,070
110 - Looe Key Research Only**	3	0.75 ± 0.48	1	3,042	3,042
111 - Looe Key Research Only**	5	1.25 ± 0.63	4	2,340	585 ± 250
107 - North of Pelican Shoal	4	1.00 ± 0.41	3	10,092	3,364 ± 1,097
112 - Western Sambo ER**	1	0.25 ± 0.25			
113 - Western Sambo ER**	0	0 ± 0			
106 - NE of E. Dry Rocks SPA	2	0.50 ± 0.29	2	1,388	694 ± 656
133 - NE of E. Dry Rocks SPA	2	0.50 ± 0.29	2	4,635	2,318 ± 633
Lower Florida Keys Total (8)	18	0.56 ± 0.15	13	22,567	1,845 ± 499
Offshore Patch Reef Total (23)	**57**	**0.62 ± 0.11**	**25**	**33,549**	**1,247 ± 234**
Inner line reef tract spur & groove					
Upper Florida Keys NMS					
32 - Turtle Rocks	0	0 ± 0			
31 - Inshore of Elbow Reef SPA	3	0.75 ± 0.25	1	316	316 ± 0
30 - North Dry Rocks	1	0.25 ± 0.25			
34 - Dry Rocks SPA**	0	0 ± 0			
33 - Dry Rocks SPA**	4	1.00 ± 0.41	2	1,964	982 ± 106
36 - Grecian Rocks SPA**	6	1.50 ± 0.65			
35 - Grecian Rocks SPA**	2	0.50 ± 0.29			
Upper Florida Keys Total (7)	16	0.57 ± 0.21	3	2,280	649 ± 333
Inner Line Reef Tract Total (7)	**16**	**0.57 ± 0.21**	**3**	**2,280**	**649 ± 333**
High-relief spur & groove					
Upper Florida Keys NMS					
23 - Carysfort Reef SPA**	0	0 ± 0			
22 - Carysfort Reef SPA**	1	0.25 ± 0.25	1	879	879
21 - Maitland grounding site	0	0 ± 0			
24 - Elbow Reef SPA**	0	0 ± 0			
223 - Elbow Reef SPA**	0	0 ± 0			
19 - North of French Reef SPA	2	0.50 ± 0.29			
25 - French Reef SPA**	0	0 ± 0			
26 - French Reef SPA**	0	0 ± 0			
20 - Sand Island	2	0.50 ± 0.29	1	855	855
18 - Sand Island	2	0.50 ± 0.50	2	2,190	1,095 ± 5
28 - Molasses Reef SPA**	1	0.25 ± 0.25			
27 - Molasses Reef SPA**	0	0 ± 0			
17 - Pickles Reef	1	0.25 ± 0.25			
16 - Pickles Reef	3	0.75 ± 0.25	1	1,570	1,570
15 - Pickles Reef	0	0 ± 0			
Upper Florida Keys Total (15)	12	0.20 ± 0.07	5	5,494	1,100 ± 0
Middle Florida Keys NMS					
67 - Delta Shoal	0	0 ± 0			
66 - Delta Shoal	0	0 ± 0			
69 - Sombrero Key SPA**	0	0 ± 0			
266 - Sombrero Key SPA**	0	0 ± 0			
Middle Florida Keys Total (4)	0	0 ± 0			
Lower Florida Keys NMS					

Site number/site location	Trap gear density		Trap rope length (m)		
	N	No. items/m^2	N	Total length	Mean length
124 - Looe Key SPA**	0	0 ± 0			
123 - Looe Key SPA**	1	0.25 ± 0.25	1		720
120 - American Shoal	1	0.25 ± 0.25	1		1,8320
122 - American Shoal	0	0 ± 0			
119 - Maryland Shoal	0	0 ± 0			
121 - Maryland Shoal	0	0 ± 0			
118 - Pelican Shoal	0	0 ± 0			
117 - Pelican Shoal	2	0.50 ± 0.29			
116 - No Name Reef	0	0 ± 0			
322 - Eastern Sambo RO**	2	0.50 ± 0.50	1		480
125 - Eastern Sambo RO**	0	0 ± 0			
127 - Western Sambo ER**	0	0 ± 0			
126 - Western Sambo ER**	0	0 ± 0			
115 - East of E. Dry Rocks SPA	3	0.75 ± 0.25	3	103	1,118 ± 103
129 - Eastern Dry Rocks SPA**	2	0.50 ± 0.29	2	794	1,007 ± 794
128 - Eastern Dry Rocks**	1	0.25 ± 0.25			
327 - Rock Key SPA**	0	0 ± 0			
130 - Rock Key SPA**	0	0 ± 0			
131 - Sand Key SPA**	0	0 ± 0			
328 - Sand Key SPA**	0	0 ± 0			
114 - Western Dry Rocks	0	0 ± 0			
Lower Florida Keys Total (21)	12	0.14 ± 0.05	8	229	1,031 ± 229
Spur & Groove Total (40)	**24**	**0.15 ± 0.04**	**13**	**139**	**1,062 ± 139**
Fore-reef (6-15 m)					
Upper Florida Keys NMS					
42 - South of BNP boundary	0	0 ± 0			
52 - Carysfort Reef SPA**	1	0.25 ± 0.25			
51 - Carysfort Reef SPA**	0	0 ± 0			
50 - SW of Carysfort Reef SPA	1	0.25 ± 0.25			
40 - SW of Carysfort Reef SPA	15	3.75 ± 2.39			
39 - North of Elbow Reef SPA	2	0.50 ± 0.29			
245 - Elbow Reef SPA**	2	0.50 ± 0.50			
46 - Elbow Reef SPA**	0	0 ± 0			
38 - SW of Elbow Reef SPA	2	0.50 ± 0.29			
49 - South of Elbow Reef SPA	0	0 ± 0			
37 - Dixie Shoal	1	0.25 ± 0.25			
48 - Dixie Shoal	0	0 ± 0			
47 - SW of Molasses Reef SPA	7	1.75 ± 0.48	1	2,210	2,210
Upper Florida Keys Total (13)	31	0.60 ± 0.29	1	2,210	2,210
Middle Florida Keys NMS					
81 - Conch Reef SPA**	1	0.25 ± 0.25			
80 - Conch Reef SPA**	1	0.25 ± 0.25			
82 - Conch Reef RO**	0	0 ± 0			
279 - Conch Reef RO**	0	0 ± 0			
84 - Davis Reef SPA**	0	0 ± 0			
83 - Davis Reef SPA**	2	0.50 ± 0.29			
79 - SW of Crocker Reef	6	1.50 ± 1.19			
78 - SW of Crocker Reef	2	0.50 ± 0.29			
85 - Alligator Reef SPA**	0	0 ± 0			
68 - Alligator Reef SPA**	1	0.25 ± 0.25			
77 - SW of Alligator Reef SPA	3	0.75 ± 0.75	1	1,336	1,336
87 - Tennessee Reef RO**	6	1.50 ± 0.96	1	1,176	1,176
86 - Tennessee Reef RO**	3	0.75 ± 0.25	1	1,440	1,440
76 - NE of Tennessee Light	9	2.25 ± 0.48			
75 - East of Coffins Patch SPA	0	0 ± 0			
293 - Sombrero Key SPA**	1	0.25 ± 0.25			
96 - Sombrero Key SPA**	0	0 ± 0			

Site number/site location	Trap gear density		Trap rope length (m)		
	N	No. items/m^2	N	Total	Mean length
73 - West of Sombrero Key SPA	4	1.00 ± 0.71	2	2,215	1,108 ± 108
71 - South of Moser Channel	1	0.25 ± 0.25			
72 - South of Moser Channel	0	0 ± 0			
70 - South of Moser Channel	2	0.50 ± 0.29			
90 - South of Moser Channel	0	0 ± 0			
Middle Florida Keys Total (22)	42	0.48 ± 0.13	5	6,167	1,265 ± 75
Lower Florida Keys NMS					
136 - South of Bahia Honda Key	1	0.25 ± 0.25	1	1,895	1,896
138 - South of Bahia Honda Key	3	0.75 ± 0.25	1	360	360
137 - South of Bahia Honda Key	1	0.25 ± 0.25	1	490	490
135 - West of Looe Key SPA	2	0.50 ± 0.29	1	451	451
134 - West of Pelican Shoal	0	0 ± 0			
139 - Eastern Sambo RO**	0	0 ± 0			
336 - Eastern Sambo RO**	0	0 ± 0			
141 - Western Sambo ER**	0	0 ± 0			
140 - Western Sambo ER**	0	0 ± 0			
143 - West of Western Sambo	0	0 ± 0			
132 - East of E. Dry Rocks SPA	0	0 ± 0			
346 - Rock Key SPA**	0	0 ± 0			
149 - Rock Key SPA**	1	0.25 ± 0.25			
347 - Sand Key SPA**	0	0 ± 0			
150 - Sand Key SPA**	1	0.25 ± 0.25			
142 - SW of Sand Key SPA	0	0 ± 0			
Lower Florida Keys Total (16)	9	0.14 ± 0.06	4	3,196	799 ± 367
Fore-reef Total (51)	**82**	**0.40 ± 0.10**	**10**	**11,573**	**1,163 ± 216**

Table 24. Number of items (N) and mean ± 1 SE no. items per 60 m^2 for other marine debris (non-angling and non-trap) and total marine debris in the Florida Keys National Marine Sanctuary, as determined from surveys of four 15-m x 4-m belt transects per site at 145 sites during June-August 2008. Sites are arranged by habitat from northeast to southwest and asterisked locations (**) are no-take marine reserves.

Site number/site location	Other marine debris		Total marine debris	
	N	No. items/m^2	N	No. items/m^2
Mid-channel patch reefs				
Upper Florida Keys NMS				
6 - Basin Hill Shoals	0	0 ± 0	0	0 ± 0
5 - Basin Hill Shoals	0	0 ± 0	6	1.50 ± 0.87
4 - Inshore of Grecian Rocks	1	0.25 ± 0.25	13	3.25 ± 1.93
3 - South of Cannon Patch Reef	0	0 ± 0	2	0.50 ± 0.50
2 - Mosquito Bank	1	0.25 ± 0.25	1	0.25 ± 0.25
1 - Inshore of Molasses Reef	1	0.25 ± 0.25	3	0.75 ± 0.48
Upper Florida Keys Total (6)	3	0.13 ± 0.06	25	1.04 ± 0.49
Middle Florida Keys NMS				
56 - Tavernier Rocks	1	0.25 ± 0.25	6	1.50 ± 0.96
55 - Tavernier Rocks	0	0 ± 0	4	1.00 ± 0.71
59 - Hen and Chickens SPA**	1	0.25 ± 0.25	10	2.50 ± 0.50
58 - Hen and Chickens SPA**	0	0 ± 0	31	7.75 ± 0.75
61 - Cheeca Rocks SPA**	0	0 ± 0	2	0.50 ± 0.29
60 - Cheeca Rocks SPA**	2	0.50 ± 0.29	11	2.75 ± 0.63
57 - NE of Cheeca Rocks SPA	0	0 ± 0	42	10.50 ± 2.40
54 - South of Duck Key	2	0.50 ± 0.50	13	3.25 ± 0.25
53 - South of Ohio Key	0	0 ± 0	9	2.25 ± 0.48
Middle Florida Keys Total (9)	6	0.17 ± 0.07	128	3.56 ± 1.11
Lower Florida Keys NMS				
103 - North of Looe Key RO	0	0 ± 0	37	9.25 ± 3.25
102 - North of Maryland Shoal	0	0 ± 0	2	0.50 ± 0.29
101 - North of Maryland Shoal	0	0 ± 0	0	0 ± 0
100 - North of Eastern Sambo	0	0 ± 0	1	0.25 ± 0.25
105 - Western Sambo ER**	0	0 ± 0	1	0.25 ± 0.25
104 - Western Sambo ER**	0	0 ± 0	1	0.25 ± 0.25
99 - West of Western Sambo	2	0.50 ± 0.29	4	1.00 ± 0.58
98 - Middle Ground	0	0 ± 0	2	0.50 ± 0.29
97 - Middle Ground	0	0 ± 0	2	0.50 ± 0.29
Lower Florida Keys Total (9)	2	0.06 ± 0.06	50	1.39 ± 0.99
Mid-channel Patch Reef Total (24)	**11**	**0.11 ± 0.04**	**203**	**2.11 ± 0.60**
Offshore patch reefs				
Upper Florida Keys NMS				
12 - South of BNP boundary	0	0 ± 0	1	0.25 ± 0.25
41 - North of Carysfort Reef SPA	2	0.50 ± 0.29	6	1.50 ± 0.87
11 - North of Carysfort Reef SPA	1	0.25 ± 0.25	8	2.00 ± 0.91
14 - Carysfort Reef SPA**	0	0 ± 0	2	0.50 ± 0.29
13 - Carysfort Reef SPA**	0	0 ± 0	1	0.25 ± 0.25
10 - North of Dry Rocks SPA	0	0 ± 0	2	0.50 ± 0.29
9 - SW of Grecian Rocks SPA	0	0 ± 0	2	0.50 ± 0.29
8 - Inshore of French Reef SPA	0	0 ± 0	3	0.75 ± 0.48
7 - Inshore of Pickles Reef	4	1.00 ± 0.41	10	2.50 ± 0.96
Upper Florida Keys Total (9)	7	0.19 ± 0.12	35	0.97 ± 0.27
Middle Florida Keys NMS				
65 - North of Davis Reef SPA	0	0 ± 0	2	0.50 ± 0.29
64 - North of Davis Reef SPA	0	0 ± 0	3	0.75 ± 0.25
63 - North of Davis Reef SPA	0	0 ± 0	1	0.25 ± 0.25

Site number/site location	Other marine debris		Total marine debris	
	N	No. items/m^2	N	No. items/m^2
62 - North of Davis Reef SPA	1	0.25 ± 0.25	6	1.50 ± 1.19
89 - Coffins Patch SPA**	1	0.25 ± 0.25	11	2.75 ± 0.25
88 - Coffins Patch SPA**	1	0.25 ± 0.25	2	0.50 ± 0.29
Middle Florida Keys Total (6)	3	0.13 ± 0.06	25	1.04 ± 0.38
Lower Florida Keys NMS				
109 - East of Looe Key RO	0	0 ± 0	2	0.50 ± 0.29
110 - Looe Key Research Only**	0	0 ± 0	3	0.75 ± 0.48
111 - Looe Key Research Only**	4	1.00 ± 0.58	14	3.50 ± 1.94
107 - North of Pelican Shoal	0	0 ± 0	5	1.25 ± 0.48
112 - Western Sambo ER**	0	0 ± 0	4	1.00 ± 0.71
113 - Western Sambo ER**	0	0 ± 0	0	0 ± 0
106 - NE of E. Dry Rocks SPA	1	0.25 ± 0.25	6	1.50 ± 0.50
133 - NE of E. Dry Rocks SPA	0	0 ± 0	9	2.25 ± 0.63
Lower Florida Keys Total (8)	5	0.16 ± 0.12	43	1.34 ± 0.39
Offshore Patch Reef Total (23)	**15**	**0.16 ± 0.06**	**103**	**1.12 ± 0.19**
Inner line reef tract spur & groove				
Upper Florida Keys NMS				
32 - Turtle Rocks	1	0.25 ± 0.25	1	0.25 ± 0.25
31 - Inshore of Elbow Reef SPA	0	0 ± 0	4	1.00 ± 0.41
30 - North Dry Rocks	1	0.25 ± 0.25	3	0.75 ± 0.48
34 - Dry Rocks SPA**	0	0 ± 0	0	0 ± 0
33 - Dry Rocks SPA**	1	0.25 ± 0.25	5	1.25 ± 0.48
36 - Grecian Rocks SPA**	2	0.50 ± 0.50	9	2.25 ± 0.25
35 - Grecian Rocks SPA**	0	0 ± 0	4	1.00 ± 0.71
Upper Florida Keys Total (7)	5	0.18 ± 0.07	26	0.93 ± 0.28
Inner Line Reef Tract Total (7)	**5**	**0.18 ± 0.07**	**26**	**0.93 ± 0.28**
High-relief spur & groove				
Upper Florida Keys NMS				
23 - Carysfort Reef SPA**	0	0 ± 0	0	0 ± 0
22 - Carysfort Reef SPA**	0	0 ± 0	1	0.25 ± 0.25
21 - Maitland grounding site	1	0.25 ± 0.25	1	0.25 ± 0.25
24 - Elbow Reef SPA**	0	0 ± 0	0	0 ± 0
223 - Elbow Reef SPA**	0	0 ± 0	4	1.00 ± 0.71
19 - North of French Reef SPA	2	0.50 ± 0.29	6	1.50 ± 0.29
25 - French Reef SPA**	0	0 ± 0	2	0.50 ± 0.50
26 - French Reef SPA**	0	0 ± 0	3	0.75 ± 0.48
20 - Sand Island	0	0 ± 0	21	5.25 ± 1.03
18 - Sand Island	1	0.25 ± 0.25	9	2.25 ± 1.03
28 - Molasses Reef SPA**	0	0 ± 0	3	0.75 ± 0.25
27 - Molasses Reef SPA**	0	0 ± 0	4	1.00 ± 0.41
17 - Pickles Reef	1	0.25 ± 0.25	4	1.00 ± 0.41
16 - Pickles Reef	1	0.25 ± 0.25	7	1.75 ± 0.48
15 - Pickles Reef	1	0.25 ± 0.25	1	0.25 ± 0.25
Upper Florida Keys Total (15)	7	0.12 ± 0.04	66	1.10 ± 0.34
Middle Florida Keys NMS				
67 - Delta Shoal	1	0.25 ± 0.25	6	1.50 ± 0.50
66 - Delta Shoal	0	0 ± 0	3	0.75 ± 0.75
69 - Sombrero Key SPA**	3	0.75 ± 0.48	4	1.00 ± 0.71
266 - Sombrero Key SPA**	1	0.25 ± 0.25	7	1.75 ± 0.85
Middle Florida Keys Total (4)	5	0.31 ± 0.16	20	1.25 ± 0.23
Lower Florida Keys NMS				
124 - Looe Key SPA**	0	0 ± 0	1	0.25 ± 0.25

Site number/site location	Other marine debris		Total marine debris	
	N	No. items/m^2	N	No. items/m^2
123 - Looe Key SPA**	2	0.50 ± 0.50	3	0.75 ± 0.48
120 - American Shoal	2	0.50 ± 0.29	9	2.25 ± 0.85
122 - American Shoal	1	0.25 ± 0.25	1	0.25 ± 0.25
119 - Maryland Shoal	1	0.25 ± 0.25	2	0.50 ± 0.29
121 - Maryland Shoal	0	0 ± 0	0	0 ± 0
118 - Pelican Shoal	0	0 ± 0	13	3.25 ± 0.25
117 - Pelican Shoal	0	0 ± 0	4	1.00 ± 0.00
116 - No Name Reef	0	0 ± 0	0	0 ± 0
322 - Eastern Sambo RO**	0	0 ± 0	3	0.75 ± 0.75
125 - Eastern Sambo RO**	0	0 ± 0	0	0 ± 0
127 - Western Sambo ER**	1	0.25 ± 0.25	1	0.25 ± 0.25
126 - Western Sambo ER**	1	0.25 ± 0.25	2	0.50 ± 0.29
115 - East of E. Dry Rocks SPA	0	0 ± 0	5	1.25 ± 0.48
129 - Eastern Dry Rocks SPA**	0	0 ± 0	3	0.75 ± 0.25
128 - Eastern Dry Rocks**	2	0.50 ± 0.50	8	2.00 ± 1.00
327 - Rock Key SPA**	0	0 ± 0	0	0 ± 0
130 - Rock Key SPA**	0	0 ± 0	0	0 ± 0
131 - Sand Key SPA**	1	0.25 ± 0.25	4	1.00 ± 0.41
328 - Sand Key SPA**	1	0.25 ± 0.25	5	1.25 ± 0.95
114 - Western Dry Rocks	0	0 ± 0	4	1.00 ± 0.71
Lower Florida Keys Total (21)	12	0.14 ± 0.04	68	0.81 ± 0.18
Spur & Groove Total (40)	**24**	**0.15 ± 0.03**	**154**	**0.96 ± 0.16**
Fore-reef (6-15 m)				
Upper Florida Keys NMS				
42 - South of BNP boundary	2	0.50 ± 0.50	3	0.75 ± 0.48
52 - Carysfort Reef SPA**	0	0 ± 0	2	0.50 ± 0.29
51 - Carysfort Reef SPA**	0	0 ± 0	1	0.25 ± 0.25
50 - SW of Carysfort Reef SPA	2	0.50 ± 0.50	4	1.00 ± 0.71
40 - SW of Carysfort Reef SPA	1	0.25 ± 0.25	17	4.25 ± 2.32
39 - North of Elbow Reef SPA	0	0 ± 0	5	1.25 ± 0.48
245 - Elbow Reef SPA**	0	0 ± 0	2	0.50 ± 0.50
46 - Elbow Reef SPA**	0	0 ± 0	0	0 ± 0
38 - SW of Elbow Reef SPA	0	0 ± 0	2	0.50 ± 0.29
49 - South of Elbow Reef SPA	1	0.25 ± 0.25	10	2.50 ± 1.89
37 - Dixie Shoal	0	0 ± 0	3	0.75 ± 0.75
48 - Dixie Shoal	0	0 ± 0	0	0 ± 0
47 - SW of Molasses Reef SPA	0	0 ± 0	9	2.25 ± 0.75
Upper Florida Keys Total (13)	6	0.12 ± 0.05	58	1.12 ± 0.34
Middle Florida Keys NMS				
81 - Conch Reef SPA**	0	0 ± 0	0.25	0.25 ± 0.25
80 - Conch Reef SPA**	0	0 ± 0	0.25	0.25 ± 0.25
82 - Conch Reef RO**	1	0.25 ± 0.25	0.25	0.25 ± 0.25
279 - Conch Reef RO**	3	0.75 ± 0.48	2.17	5.75 ± 2.17
84 - Davis Reef SPA**	0	0 ± 0	0.25	0.25 ± 0.25
83 - Davis Reef SPA**	0	0 ± 0	0.29	0.50 ± 0.29
79 - SW of Crocker Reef	1	0.25 ± 0.25	1.11	2.25 ± 1.11
78 - SW of Crocker Reef	3	0.75 ± 0.25	0.25	1.25 ± 0.25
85 - Alligator Reef SPA**	1	0.25 ± 0.25	0.75	1.75 ± 0.75
68 - Alligator Reef SPA**	0	0 ± 0	0.48	1.75 ± 0.48
77 - SW of Alligator Reef SPA	1	0.25 ± 0.25	1.03	1.75 ± 1.03
87 - Tennessee Reef RO**	2	0.50 ± 0.50	0.75	3.25 ± 0.75
86 - Tennessee Reef RO**	0	0 ± 0	0.48	1.25 ± 0.48
76 - NE of Tennessee Light	1	0.25 ± 0.25	0.65	3.50 ± 0.65
75 - East of Coffins Patch SPA	0	0 ± 0	0.25	0.25 ± 0.25
293 - Sombrero Key SPA**	1	0.25 ± 0.25	0.25	1.25 ± 0.25
96 - Sombrero Key SPA**	2	0.50 ± 0.29	0.29	0.50 ± 0.29
73 - West of Sombrero Key SPA	1	0.25 ± 0.25	1.03	1.75 ± 1.03
71 - South of Moser Channel	0	0 ± 0	0.25	0.25 ± 0.25

Site number/site location	Other marine debris		Total marine debris	
	N	No. items/m^2	N	No. items/m^2
72 - South of Moser Channel	0	0 ± 0	0	0 ± 0
70 - South of Moser Channel	0	0 ± 0	0.25	0.75 ± 0.25
90 - South of Moser Channel	0	0 ± 0	0	0 ± 0
Middle Florida Keys Total (22)	17	0.19 ± 0.05	0.30	1.31 ± 0.30
Lower Florida Keys NMS				
136 - South of Bahia Honda Key	0	0 ± 0	6	1.50 ± 0.29
138 - South of Bahia Honda Key	0	0 ± 0	6	1.50 ± 0.65
137 - South of Bahia Honda Key	2	0.50 ± 0.29	3	0.75 ± 0.25
135 - West of Looe Key SPA	0	0 ± 0	3	0.75 ± 0.48
134 - West of Pelican Shoal	0	0 ± 0	0	0 ± 0
139 - Eastern Sambo RO**	0	0 ± 0	0	0 ± 0
336 - Eastern Sambo RO**	0	0 ± 0	0	0 ± 0
141 - Western Sambo ER**	0	0 ± 0	0	0 ± 0
140 - Western Sambo ER**	1	0.25 ± 0.25	1	0.25 ± 0.25
143 - West of Western Sambo	0	0 ± 0	0	0 ± 0
132 - East of E. Dry Rocks SPA	0	0 ± 0	0	0 ± 0
346 - Rock Key SPA**	1	0.25 ± 0.25	3	0.75 ± 0.48
149 - Rock Key SPA**	0	0 ± 0	1	0.25 ± 0.25
347 - Sand Key SPA**	0	0 ± 0	0	0 ± 0
150 - Sand Key SPA**	0	0 ± 0	2	0.50 ± 0.29
142 - SW of Sand Key SPA	0	0 ± 0	2	0.50 ± 0.50
Lower Florida Keys Total (16)	4	0.06 ± 0.04	27	0.42 ± 0.13
Fore-reef Total (51)	**27**	**0.13 ± 0.03**	**200**	**0.98 ± 0.17**

Table 25. Total marine debris weight wet per site (240 m^2) and mean ± 1 SE wet weight (kg) per 60 m^2 recovered from surveys of four 15-m x 4-m belt transects per site at 145 sites in the Florida Keys National Marine Sanctuary during June-August 2008. Sites are arranged by habitat from northeast to southwest and asterisked locations (**) are no-take marine reserves.

Site number/site location	No. items	Total wet weight (kg)	Mean wet weight (kg)	SE
Mid-channel patch reefs				
Upper Florida Keys NMS				
6 - Basin Hill Shoals	0	0	0	0
5 - Basin Hill Shoals	6	0.113	0.028	0.012
4 - Inshore of Grecian Rocks	13	3.150	0.788	0.375
3 - South of Cannon Patch Reef	2	1.022	0.255	0.255
2 - Mosquito Bank	1	3.121	0.780	0.780
1 - Inshore of Molasses Reef	3	0.738	0.184	0.166
Upper Florida Keys Total (6)	25	8.144	0.339	0.146
Middle Florida Keys NMS				
56 - Tavernier Rocks	6	0.170	0.043	0.025
55 - Tavernier Rocks	4	0.936	0.234	0.207
59 - Hen and Chickens SPA**	10	2.355	0.589	0.334
58 - Hen and Chickens SPA**	31	3.121	0.780	0.412
61 - Cheeca Rocks SPA**	2	0.057	0.014	0.008
60 - Cheeca Rocks SPA**	11	1.901	0.475	0.381
57 - NE of Cheeca Rocks SPA	42	8.371	2.093	1.159
54 - South of Duck Key	13	16.287	4.072	3.312
53 - South of Ohio Key	9	10.839	2.710	1.008
Middle Florida Keys Total (9)	128	44.038	1.223	0.472
Lower Florida Keys NMS				
103 - North of Looe Key RO	37	8.881	2.220	1.260
102 - North of Maryland Shoal	2	1.220	0.305	0.286
101 - North of Maryland Shoal	0	0	0	0
100 - North of Eastern Sambo	1	0.028	0.007	0.007
105 - Western Sambo ER**	1	0.028	0.007	0.007
104 - Western Sambo ER**	1	0.057	0.014	0.014
99 - West of Western Sambo	4	5.505	1.376	0.798
98 - Middle Ground	2	3.348	0.837	0.828
97 - Middle Ground	2	1.873	0.468	0.273
Lower Florida Keys Total (9)	50	20.940	0.582	0.258
Mid-channel Patch Reef Total (24)	**203**	**73.121**	**0.762**	**0.212**
Offshore patch reefs				
Upper Florida Keys NMS				
12 - South of BNP boundary	1	4.427	1.107	1.107
41 - North of Carysfort Reef SPA	6	34.164	8.541	7.728
11 - North of Carysfort Reef SPA	8	1.220	0.305	0.130
14 - Carysfort Reef SPA**	2	1.333	0.333	0.324
13 - Carysfort Reef SPA**	1	0	0	0
10 - North of Dry Rocks SPA	2	0.511	0.128	0.128
9 - SW of Grecian Rocks SPA	2	3.717	0.929	0.556
8 - Inshore of French Reef SPA	3	0.908	0.227	0.218
7 - Inshore of Pickles Reef	10	4.795	1.199	1.067
Upper Florida Keys Total (9)	35	51.075	1.419	0.902
Middle Florida Keys NMS				
65 - North of Davis Reef SPA	2	0.057	0.014	0.008
64 - North of Davis Reef SPA	3	1.419	0.355	0.211
63 - North of Davis Reef SPA	1	0.993	0.248	0.248
62 - North of Davis Reef SPA	6	21.934	5.483	5.296

Site number/site location	No. items	Total wet weight (kg)	Mean wet weight (kg)	SE
89 - Coffins Patch SPA**	11	23.012	5.753	2.481
88 - Coffins Patch SPA**	2	1.249	0.312	0.303
Middle Florida Keys Total (6)	25	48.663	2.028	1.137
Lower Florida Keys NMS				
109 - East of Looe Key RO	2	1.873	0.468	0.459
110 - Looe Key Research Only**	3	4.682	1.170	1.105
111 - Looe Key Research Only**	14	5.079	1.270	0.444
107 - North of Pelican Shoal	5	2.497	0.832	0.419
112 - Western Sambo ER**	4	0.227	0.057	0.048
113 - Western Sambo ER**	0	0	0	0
106 - NE of E. Dry Rocks SPA	6	2.128	0.532	0.424
133 - NE of E. Dry Rocks SPA	9	6.640	1.660	0.954
Lower Florida Keys Total (8)	43	23.126	0.749	0.209
Offshore Patch Reef Total (23)	**103**	**122.864**	**1.345**	**0.457**
Inner line reef tract spur & groove				
Upper Florida Keys NMS				
32 - Turtle Rocks	1	0.454	0.114	0.114
31 - Inshore of Elbow Reef SPA	4	0.482	0.121	0.121
30 - North Dry Rocks	3	2.781	0.695	0.579
34 - Dry Rocks SPA**	0	0	0	0
33 - Dry Rocks SPA**	5	2.525	0.631	0.344
36 - Grecian Rocks SPA**	9	6.555	1.639	1.285
35 - Grecian Rocks SPA**	4	1.419	0.355	0.276
Upper Florida Keys Total (7)	26	14.216	0.508	0.214
Inner Line Reef Tract Total (7)	**26**	**14.216**	**0.508**	**0.214**
High-relief spur & groove				
Upper Florida Keys NMS				
23 - Carysfort Reef SPA**	0	0	0	0
22 - Carysfort Reef SPA**	1	0.936	0.234	0.234
21 - Maitland grounding site	1	0.454	0.114	0.114
24 - Elbow Reef SPA**	0	0	0	0
223 - Elbow Reef SPA**	4	0.085	0.021	0.014
19 - North of French Reef SPA	6	16.968	4.242	2.604
25 - French Reef SPA**	2	0.028	0.007	0.007
26 - French Reef SPA**	3	0.057	0.014	0.008
20 - Sand Island	21	1.277	0.319	0.216
18 - Sand Island	9	4.001	1.000	0.610
28 - Molasses Reef SPA**	3	5.335	1.334	1.315
27 - Molasses Reef SPA**	4	0.085	0.021	0.007
17 - Pickles Reef	4	2.525	0.631	0.575
16 - Pickles Reef	7	17.252	4.313	2.950
15 - Pickles Reef	1	0.085	0.021	0.021
Upper Florida Keys Total (15)	66	49.088	0.818	0.377
Middle Florida Keys NMS				
67 - Delta Shoal	6	0.482	0.121	0.102
66 - Delta Shoal	3	0.028	0.007	0.007
69 - Sombrero Key SPA**	4	0.057	0.014	0.008
266 - Sombrero Key SPA**	7	0.057	0.014	0.008
Middle Florida Keys Total (4)	20	0.624	0.039	0.027
Lower Florida Keys NMS				
124 - Looe Key SPA**	1	0.028	0.007	0.007
123 - Looe Key SPA**	3	1.646	0.411	0.402
120 - American Shoal	9	7.406	1.851	1.165
122 - American Shoal	1	0.085	0.021	0.021

Site number/site location	No. items	Total wet weight (kg)	Mean wet weight (kg)	SE
119 - Maryland Shoal	2	0.227	0.057	0.048
121 - Maryland Shoal	0	0	0	0
118 - Pelican Shoal	13	0.170	0.043	0.014
117 - Pelican Shoal	4	4.994	1.249	1.101
116 - No Name Reef	0	0	0	0
322 - Eastern Sambo RO**	3	0.568	0.142	0.142
125 - Eastern Sambo RO**	0	0	0	0
127 - Western Sambo ER**	1	0.028	0.007	0.007
126 - Western Sambo ER**	2	0.057	0.014	0.008
115 - East of E. Dry Rocks SPA	5	2.894	0.724	0.270
129 - Eastern Dry Rocks SPA**	3	1.816	0.454	0.317
128 - Eastern Dry Rocks**	8	2.156	0.539	0.492
327 - Rock Key SPA**	0	0	0	0
130 - Rock Key SPA**	0	0	0	0
131 - Sand Key SPA**	4	0.113	0.028	0.012
328 - Sand Key SPA**	5	0.085	0.021	0.014
114 - Western Dry Rocks	4	0.113	0.028	0.020
Lower Florida Keys Total (21)	68	22.386	0.267	0.106
High-relief Spur & Groove Total (40)	**154**	**72.099**	**0.451**	**0.156**
Fore-reef (6-15 m)				
Upper Florida Keys NMS				
42 - South of BNP boundary	3	1.021	0.255	0.246
52 - Carysfort Reef SPA**	2	3.859	0.965	0.955
51 - Carysfort Reef SPA**	1	0.057	0.014	0.014
50 - SW of Carysfort Reef SPA	4	0.028	0.007	0.007
40 - SW of Carysfort Reef SPA	17	7.122	1.781	1.209
39 - North of Elbow Reef SPA	5	0.624	0.156	0.111
245 - Elbow Reef SPA**	2	10.470	2.618	2.618
46 - Elbow Reef SPA**	0	0	0	0
38 - SW of Elbow Reef SPA	2	0.085	0.021	0.014
49 - South of Elbow Reef SPA	10	0.227	0.057	0.048
37 - Dixie Shoal	3	0.141	0.035	0.035
48 - Dixie Shoal	0	0	0	0
47 - SW of Molasses Reef SPA	9	11.066	2.767	1.204
Upper Florida Keys Total (13)	58	34.700	0.667	0.288
Middle Florida Keys NMS				
81 - Conch Reef SPA**	1	0.142	0.035	0.035
80 - Conch Reef SPA**	1	0.341	0.085	0.085
82 - Conch Reef RO**	1	0.908	0.227	0.227
279 - Conch Reef RO**	23	0.851	0.213	0.141
84 - Davis Reef SPA**	1	0.028	0.007	0.007
83 - Davis Reef SPA**	2	8.399	2.100	2.081
79 - SW of Crocker Reef	9	20.515	5.129	3.444
78 - SW of Crocker Reef	5	5.562	1.390	1.074
85 - Alligator Reef SPA**	7	0.284	0.071	0.052
68 - Alligator Reef SPA**	7	11.010	2.752	2.724
77 - SW of Alligator Reef SPA	7	18.728	4.682	4.213
87 - Tennessee Reef RO**	13	8.144	2.036	1.171
86 - Tennessee Reef RO**	5	14.244	3.561	2.583
76 - NE of Tennessee Light	14	2.355	0.589	0.298
75 - East of Coffins Patch SPA	1	0.028	0.007	0.007
293 - Sombrero Key SPA**	5	6.072	1.518	1.461
96 - Sombrero Key SPA**	2	0.170	0.043	0.034
73 - West of Sombrero Key SPA	7	14.358	3.589	2.750
71 - South of Moser Channel	1	1.362	0.341	0.341
72 - South of Moser Channel	0	0	0	0
70 - South of Moser Channel	3	0.482	0.121	0.071
90 - South of Moser Channel	0	0	0	0
Middle Florida Keys Total (22)	115	113.982	1.295	0.354

Site number/site location	No. items	Total wet weight (kg)	Mean wet weight (kg)	SE
Lower Florida Keys NMS				
136 - South of Bahia Honda Key	6	1.986	0.497	0.468
138 - South of Bahia Honda Key	6	0.539	0.135	0.066
137 - South of Bahia Honda Key	3	7.973	1.993	1.489
135 - West of Looe Key SPA	3	0.738	0.184	0.121
134 - West of Pelican Shoal	0	0	0	0
139 - Eastern Sambo RO**	0	0	0	0
336 - Eastern Sambo RO**	0	0	0	0
141 - Western Sambo ER**	0	0	0	0
140 - Western Sambo ER**	1	0.142	0.035	0.035
143 - West of Western Sambo	0	0	0	0
132 - East of E. Dry Rocks SPA	0	0	0	0
346 - Rock Key SPA**	3	0.170	0.043	0.034
149 - Rock Key SPA**	1	0.057	0.014	0.014
347 - Sand Key SPA**	0	0	0	0
150 - Sand Key SPA**	2	0.482	0.121	0.111
142 - SW of Sand Key SPA	2	0.028	0.007	0.007
Lower Florida Keys Total (16)	27	12.115	0.189	0.124
Fore-reef Total (51)	**200**	**160.798**	**0.788**	**0.184**