A Comparison of Benthic Habitat Survey Methodologies as part of an NCCOS Integrated Assessment within the Tortugas Ecological Reserve

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BACKGROUND

In 2005, NCCOS initiated a multiagency investigation to assess the resources of the Tortugas Ecological Reserve (TER). The goals of the Integrated Assessment (IA) are to determine existing or potential biological, human and socioeconomic benefits or impacts within the TER; evaluate the biological resources and management strategies and examine potential boundary expansion (Jeffrey et al, in press).

As part of the multiagency collaboration, NCCOS scientists for the Center for Coastal Monitoring and Assessment (CCMA) and the Center for Coastal Fisheries and Habitat Research (CCFHR) compared benthic habitat survey methods referenced within the IA during CCFHR's 2007 TER monitoring cruise aboard the *Nancy Foster*.

PURPOSE AND HYPOTHESIS

Two NCCOS benthic habitat survey methods were compared to investigate differences in estimates of percent cover of marine benthos (Figure 1a and 1b). This investigation focused on only two methods used within the Dry Tortugas IA and the advantages/disadvantages of those methods. We hypothesize no significant differences in estimates of percent cover between the two sampling methodologies.

Figure 1a). CCMA diver collecting in situ habitat data

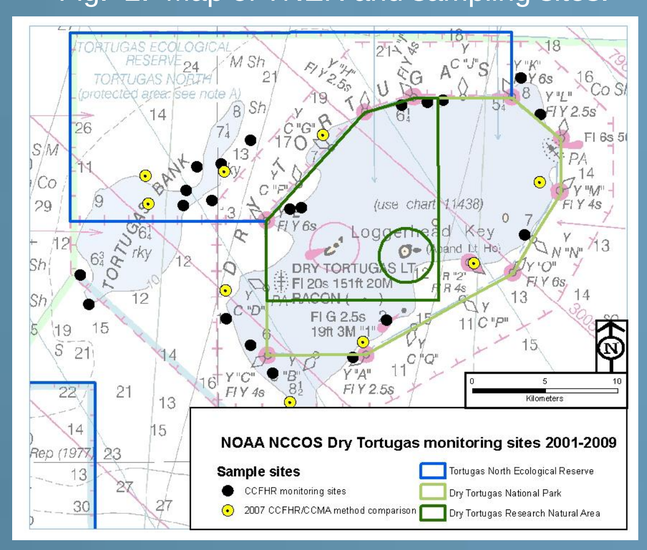
Figure 1b) CCFHR diver collecting photo transect habitat data

Surveys were conducted simultaneously by two separate divers along 30m linear transects at nine sites randomly selected within the Tortugas North Ecological Reserve (TNER). The nine sites represent a subset of 30 permanent stations monitored annually by CCFHR since 2001 (Burke et al, 2009).

MATERIALS AND METHODS

Established in 2001, the TER is located 70 miles west of Key West, Florida comprising a total area of 151 nm^2 (Fig. 2). The TER is comprised of two banks (Tortugas North and Tortugas South), known locally as Sherwood Forest and Riley's Hump, respectively (Jeffrey et al, 2009). Removal of marine life is prohibited from the TER and vessel activity is strictly monitored through regulations on anchoring and discharge (Jeffrey et al, 2009).

Fig. 2. Map of TNER and sampling sites.



A CCMA diver collected abiotic and biotic data by estimating percent cover of benthic habitat within four quadrats sampled randomly along the 30x2m reef transect, sampling 15% of the area (Fig. 1a) (Caldow et al, 2009). All quadrat data were averaged to extrapolate mean estimates of variables within each sample site for major species groups (i.e. corals, macroalgae and gorgonians, etc.) and select individual species (i.e. coral). A CCHFR diver collected abiotic and biotic data by capturing digital photo quadrats at every 1m at a fixed height of 40cm above the 30x2m transect. A photo taken over the quadrat estimated the photographed area at 0.18m^2 (Fig. 1b), thereby sampling 11% of the transect area. Habitat images were post processed using Coral Point Count (CPCe) software to extrapolate percent cover on major benthic species groups and select species within each site (Kohler and Gill, 2006).

Percent cover of species groups (corals, macroalgae and gorgonians) and major species were compared among methodologies within a site. Habitat categories were pooled as needed for comparison purposes between datasets. For example, CCFHR reports macroalgae to species within photo quadrats while CCMA reports macroalgae as a cumulative percentage per quadrat. Therefore, CCFHR macroalgae data were pooled for a group estimate.

Table 1. Average estimates of sampling metrics of each methodology per site.

	Survey (min)	Data entry (min)	QA/QC data (min)	Equipment costs ($)	Actual survey area (%)
CCMA	35	20	5	250	15
CCFHR	35	85	45	500	11

Percent cover data were not normally distributed and transformation attempts did not normalize all data, therefore potential differences among paired measurements were investigated using non-parametric Wilcoxon paired rank test on original data (Table 2). Results showed no significant differences among the estimated percent cover of any of the habitat groups within any site, as hypothesized. Despite no significant difference in the coral group between methodologies, the percent cover of individual coral species were tested using the Wilcoxon paired rank test to test the effect of low sample size. Again, no significant differences were found in species cover between methodologies within a site, as hypothesized.

RESULTS

Fig. 3. Chart displays absolute differences in % cover of habitat types by site

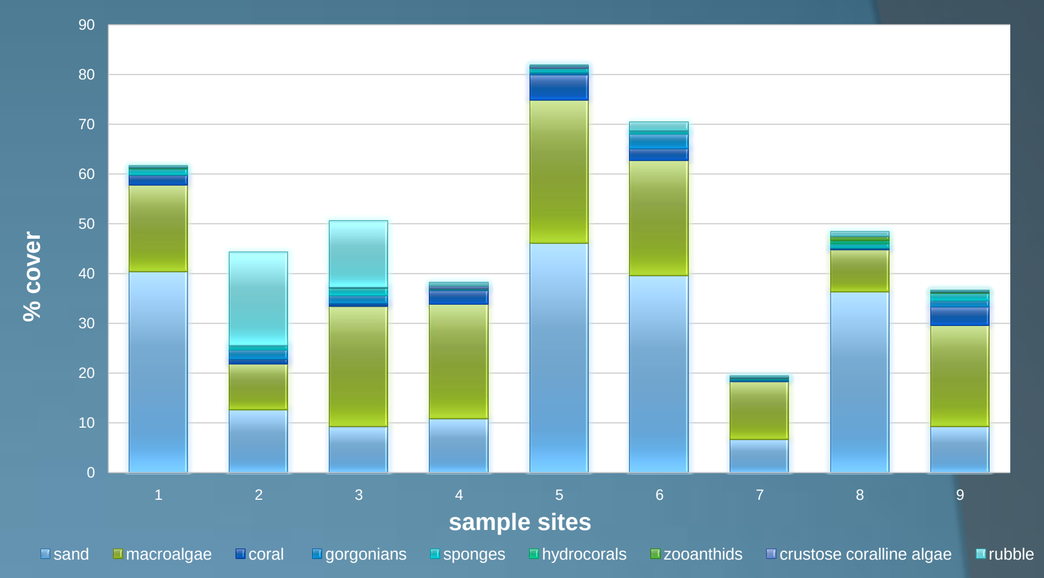


Table 2. Table shows results of Wilcoxon Paired Rank Test on percent cover data by site (p-value).

#	Site	W+	W-	N	p-value
1	PS2780	10	35	9	0.16
2	ON5527	21	15	8	0.74
3	PS4671	26	10	8	0.31
4	OS7675	22	14	8	0.64
5	RN9498	28.5	7.5	8	0.15
6	RN9807	27	18	9	0.65
7	RS9162	29	16	9	0.50
8	RN1915	12	16	7	0.81
9	PS6493	21	15	8	0.74

From this gross scale analysis, differences lie in initial equipment costs, processing time and training, not habitat estimates. CCFHR's equipment cost is 2x > than CCMA and CCFHR's post processing time is ~4x > than CCMA (Table 1). Prior to data collection, CCMA must train divers for an ~2 weeks while new CCFHR divers can immediately take photos as in situ identification skills are not necessary.

CCFHR visits permanent stations to monitor change in the TER using a method established by the FL Fish & Wildlife and its historical data. Reef depths (~56-104ft) and limited bottom time structured CCFHR 's methodology. CCMA focused on a standardized method for regional comparisons within its Caribbean Ecosystem Monitoring project. CCMA dive sites are shallower (≤99 ft) and allow for more time at depth.

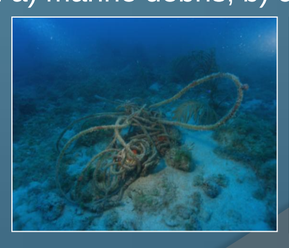
CONCLUSIONS

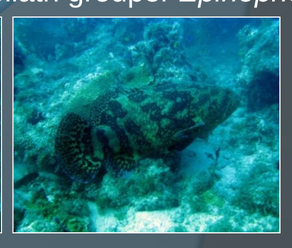
The primary advantage between surveys is CCMA's data is ready for use with minimal post-processing, while CFFHR must commit to post-processing time. On the other side, CCFHR has archived data for reference. It is hard to compare and contrast methodologies when projects are devised with specific goals and biological questions in mind. While no one survey method is better than another, one with rapid results and minimal cost is ideal for producing materials for the client. Hence, the overall goal of this investigation is to create a single survey approach that addresses multiple user needs and makes comparisons easier between studies.

Further analyses will be investigated on individual species data within all major benthic groups to note further potential differences. Sand habitat in particular, differs in its classification between Centers. The small sample size (n=9) is also a limitation in this comparison and it is advisable that more sites be sampled in the future for more robust analysis between methodologies.

Since 2008, CCFHR has collected data on marine debris at monitoring sites by recording qualitative data on type of debris, size and colonizing fauna (Fig. 4a). Given the density of recreational visitors to the TER, monitoring debris is a high priority for local managers as well as increased concern in coral bleaching and disease incidence (Fig. 4b). Given the fishing closure in 2001, it is important to continuously monitor changes in abundance or size of commercially important species (i.e. groupers, lobster) to quantitatively addresses faunal changes, assess reef health and determine reserve efficacy (Fig. 4c).

Fig. 4a-c. a) marine debris, b) coral bleaching, c) goliath grouper *Epinephelus itajara*.





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