Comparison Between Videographic and Photographic Methods in Assessing Coral Reef Benthic Communities

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Date submitted: April 7, 2006; Date accepted: October 3, 2006

ABSTRACT

Continuous degradation of coral reefs creates a need for techniques that can assess reefs condition rapidly and efficiently. The Video transect survey is commonly used to monitor benthic communities because it is rapid, provides a permanent historical record of the data, and can help minimize observer bias. But this technology is not readily available to most research institutions because of its high cost. In this study, a low cost photographic method was used to survey benthic communities in the subtidal flat inside Caniogan Marine Sanctuary, Tondol, Anda, Pangasinan. Results from this method were then compared with those from videographic methods. For the low cost photographic method, ten regularly spaced shots were directly taken from each 5m transect, totaling to 100 frames. Ten 5m x ~0.25m video transects were also run over each of the twenty selected patch reefs, covering the whole demarcated area. Ten regularly spaced frames were then taken from the videotape in each transect, totaling to 100 frames in each patch reef. In the laboratory, all frames were analyzed using the systematic 5-point method. Both methods yielded comparable time in field data collection. However, videographic method demanded more time in post-collection computer analysis and it is more costly due to the required additional computer software and hardware. Pairwise T-tests and Analysis of similarities (ANOSIM) revealed that both methods gathered similar results in terms of the diversity ($P>0.05$) and in terms of percentage composition ($P>0.05$) of life forms recorded, suggesting that both can be used interchangeably in benthic community surveys.

Keywords: transect methodology; coral reefs; point intercept techniques; video transects

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INTRODUCTION

Reefs around the world are continuing to decline due to constant disturbance brought about by both anthropogenic and natural disturbance (Wilkinson, 2004). Rapid and efficient techniques that can be used to assess reefs condition are needed. The Philippines is one of the pioneer countries that carried out a nationwide assessment of its reefs condition (Gomez, 1991; Gomez et al., 1994). During the 1980's, only professional marine biologists conducted surveys. At present, with the widespread establishment of Marine Protected Areas (MPA) to reverse the trend of reef degradation (Aliño et al., 2002), non-scientists like recreational divers and fisherfolks are becoming interested in conducting reef assessment by themselves. Thus, a low-cost technique that can record and produce data rapidly and efficiently in the field and in the laboratory; and can be used even with less supervision by field biologists, should be considered.

Video transect surveys are commonly used by reef scientists to monitor reef benthic communities because of its advantages over the Line intercept transect (LIT) method (Carleton and Done 1995). Video transect survey is more advantageous over the LIT method because: 1) it is rapid; 2) it can reduce time required for field data collection; 3) it provides a permanent historical record of the data; 4) it allows comparison between observers in the laboratory to minimize observer bias; 5) field data can be collected by people not trained in lifeform identification; and resampling on other biotas can be done later (Osborne and Oxley, 1997).

Similar to the LIT method, video transects are undertaken along a transect line with known length is laid along a depth contour. However, instead of having a researcher do the identification of the benthic community *in situ*, a video recording is taken along the entire transect and the identification is done in the laboratory with the use of frames or pictures extracted from the video tapes (English 1997).

But video transects also have disadvantages. The main constraint is that this technology is not readily available to most research institutions because of its high cost, which is at least 7 times more expensive. It requires regular maintenance because there are more moving parts and needs additional computer hardware and software. Also, reduced time in field data collection translates to more time in post-collection computer analysis. Video transects often produce low resolution pictures or frames that may limit identification (Uychiaco et al., 1992), though this may be improved with the availability of more advance technology in video processing and high definition cameras.

The said disadvantages of video transects can be addressed by using an alternative technique such as photographic method. Instead of swathing a video on laid transects and then extracting frames or photos from the video transects in the laboratory, the photographic method directly takes frames from the laid transect in the field. In this way, the time-consuming extracting of frames from the videos will be omitted. Photographic method can also provide pictures with better resolution that may allow identification of biota to finer taxonomic resolution (Aronson et al., 1994).

This study aimed to compare videographic and photographic methods in assessing reef benthic communities, more specifically to find out whether both can record the same number and percentage composition of life forms. The study also intended to compare the cost-effectiveness and the time spent in the field data collection and in data post collection between the two methods.

MATERIALS AND METHODS

Coral reef benthic communities in the subtidal flat inside Caniogan Marine Sanctuary, Tondol, Anda, Pangasinan (see Figure 1) were surveyed using videographic and photographic methods. Twenty patch reefs were identified and demarcated with permanent 5mx5m-plots. Patch reefs are at least 20 m away from each other and are interspersed among numerous other reefs. All surveys were only done inside the plots, to minimize the variability due to the movements of transects. Each permanent plot serves as the sampling unit.

For the videographic method, ten 5m x ~0.25m video transects were run over each of the twenty selected patch reefs, covering the whole demarcated area. This

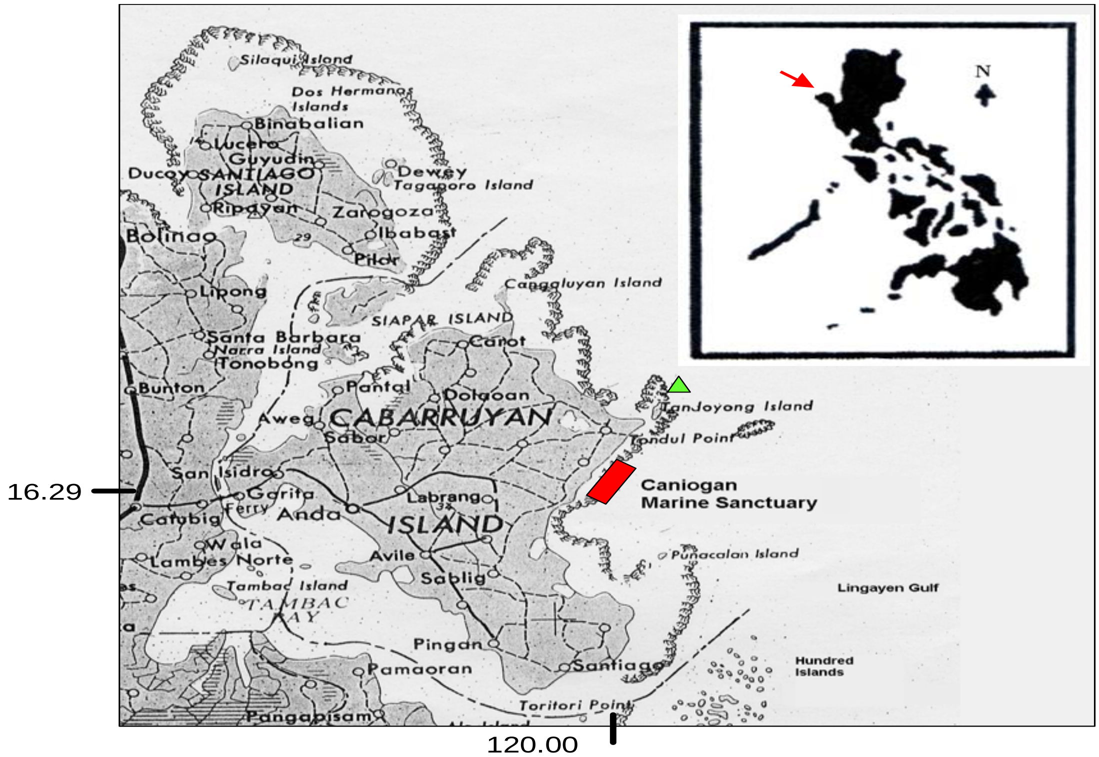

Figure 1. Map showing study site in the subtidal flats off Tondol, Anda, Pangasinan (northwestern Philippines).

is equivalent to 100m transect per patch reef. In the laboratory, ten regularly spaced frames were then taken from the videotape of each transect, totaling to 100 frames in each patch reef. In this study, Sony PC110 miniDV video camera was used. All video transects were first transferred to the computer via Firewire® link, with the use of Pinnacle 7® software. Virtualdub® was then used to extract frames from each video transect and was also used to automatically overlay 5 sampling points on all frames.The transfer of video transects to the computer is the part where time spent in post-collection computer analysis increases.

For the photographic method, 100 shots were directly taken from ten regularly spaced points along each 5m transect with the use of a Sony P8 digital camera. All frames were instantly transferred to the computer once the USB cable was connected. All frames with poor color balance and lighting were enhanced using Adobe® Photoshop® Elements by means of Auto Levels command. Both the video camera and the still camera were positioned ~0.25m away and parallel to the substratum during recording.

The benthic characteristics under each of the 5 marks on a frame were identified according to the life forms defined by English *et al.* (1997). Parameters such as 1) number of benthic life forms and 2) percentage composition of life forms recorded with the use of videographic methods were compared with the parameters recorded from photographic methods, using pairwise T-test and analysis of similarity (ANOSIM) respectively. Percentage composition of lifeforms were graphically represented in two-dimensional ordination plots by non-metric multidimensional scaling (nMDS) using the Bray-Curtis measure of similarity. Data were transformed to fourth root so that each lifeform contributed fairly evenly to each analysis. PRIMER (Plymouth Routines In Multivariate Ecological Research) v5® software was used to run ANOSIM and nMDS.

RESULTS

Both videographic and photographic method yielded comparable time, 5.94+0.64 and 5.57+1.07 minutes respectively, in field data collection for every patch reef (see Table 1). But a substantial difference in time was experienced during the data post collection. Videographic method demanded additional time, about sixty-seven minutes, in the transfer of video transects from the video camera to the computer. In terms of cost, videorgraphic method is more expensive by about PhP 200,000 due to the additional computer software & hardware, and the video camera and housing itself.

Both videographic and photographic method identified similar number of lifeforms, 14.1 + 1.5 and 14.65 + 2.6 respectively (see Table 2). By means of pairwise T-test, a *p*-value of 0.49 was obtained when the two methods were compared. The similarity of the methods in terms of percentage composition of lifeforms was also analyzed (see Table 3 for benthic attributes). No differences were found in the community composition or levels of abundance of lifeforms between the two methods as shown in the MDS plot (see Figure 2). The ANOSIM resulted in a Global R value of 0.01 ($p = 0.37$). The near zero R value shows a very high level of similarity between the two methods.

Patch reef	Photographic method	Videographic method
1	15	18
2	13	18
3	14	15
4	16	18
5	12	12
6	14	13
7	12	14
8	11	12
9	14	14
10	13	11
11	14	11
12	14	15
13	17	15
14	14	13
15	13	13
16	16	18
17	15	19
18	16	14
19	14	12
20	15	18
average	14.1 ± 1.5	14.65 ± 2.6

Table 2
Abundance of lifeform categories recorded per patch reef

DISCUSSION

Both univariate (T-test) and multivariate (ANOSIM) analyses showed that both methods can record similar number and percentage composition of lifeforms, which are commonly used to characterize the condition of reefs (Loya, 1978; Carleton & Done, 1995). This suggests that both methods may be used interchangeably in benthic community surveys.

Thus, photographic method can be used as an alternative to the videographic method as it retains the advantages of video transects over LIT: rapid, objective, can keep permanent record (Osborne and Oxley, 1997). Constraints of videographic method are resolved by the photographic method: photographic method can save about sixty-seven minutes per patch reef in post-collection computer analysis (see also Uychiaco et al., 1992). Using the photographic method can reduce the cost of the field equipment by seven times cheaper and the cost of computer post-data collection.

Variables	Videographic method	Photographic method
Time underwater	5.94 ± 0.64 mins	5.57 ± 1.07 mins
Data post collection	92 mins	25 mins
Cost of hardware and software	220,000 to 230,000 Php	30,000 to 35,000 Php

Table 1
Comparison between videographic and photographic methods in terms of time in the field data collection and laboratory post-data collection, and cost estimate

The only limitation of the photographic method is that resampling of frames is not possible. On the other hand, videographic method allows further resampling of frames from each video transect. This means more frames can be collected in future, in addition to the initial number of frames intended to be extracted, for other purpose like analysis of other biota (Preskitt et al., 2004) or examination of increased sample size (Ryan, 2004). The videographic method does collect more images, albeit at lower resolution. The

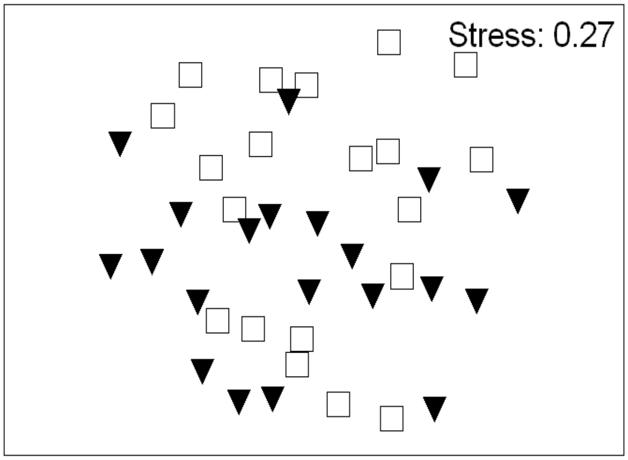

Figure 2. Non-metric Multidimensional scaling (nMDS) ordination on fourth root transformed lifeform percentage cover data collected using videographic (empty square) and photographic (inverted fill triangle) method.

highest dimension of pictures that can be extracted from the video clips is 640x480 while digital camera used in this study can take pictures with a dimension of up to 2048 x 1536. However, recent advancement of digital video may allow the extraction of pictures with higher dimension or resolution. Videographic method sometimes produces distorted pictures, especially when abrupt movements of video transects happened in the field. Pictures with higher dimension can be enlarged or magnified that allows identification of corals or other biota to finer taxonomic resolution (Aronson 1994).

Before the collection of data in the field, environmental condition of the sites should be considered because there is greater chance of getting a photo with poor quality from both video and still camera, when water turbulence and sedimentation is high and light is low

Patch reef	1		2		3		4		5		6		7		8		9		10	
Lifeforms / Methods	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	V
TA	42.4	41.8	63.6	55.2	50.8	53.6	67.0	62.2	71.4	67.0	70.8	63.8	62.6	70.2	57.4	51.2	42.4	29.4	39.0	31.0
S	38.8	37.8	13.4	18.0	37.0	31.0	6.0	11.6	12.4	17.8	12.0	20.4	22.0	13.4	31.4	35.0	45.2	53.2	44.4	56.6
CM	6.0	4.6	6.8	7.2	3.0	4.2	6.6	5.4	7.4	6.0	6.2	3.8	3.8	4.0	2.0	3.6	4.4	6.8	5.8	3.8
CE	5.6	6.0	8.2	5.2	3.0	3.4	9.4	9.0	2.8	1.6	4.6	5.4	6.0	3.6	3.8	1.8	3.4	3.6	4.2	3.2
ACT	1.6	1.8	1.4	0.6	0.4	0.0	0.6	0.4	0.0	0.0	0.4	0.8	0.8	0.0	0.4	0.0	0.4	0.4	0.0	0.0
CB	1.2	0.4	0.8	1.8	0.2	0.4	0.6	2.0	1.6	0.8	1.0	0.4	0.4	0.4	0.0	1.0	1.0	1.2	0.4	0.6
DDD	1.2	0.8	0.0	1.4	0.0	2.0	0.0	0.8	0.0	0.8	0.2	0.2	0.0	2.0	0.2	1.2	0.4	1.0	0.0	1.0
DCA	0.8	1.0	1.8	3.0	0.0	0.8	0.2	1.4	0.0	0.0	0.6	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.6	2.0
R	0.6	0.8	0.0	1.2	0.8	1.0	2.8	1.6	0.0	0.4	0.0	0.4	0.2	0.6	0.4	1.8	0.0	1.0	0.8	0.4
CS	0.6	0.8	0.8	1.4	0.2	0.0	1.0	0.0	0.4	0.0	0.6	0.8	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0
MA	0.4	1.4	0.6	0.8	0.2	1.6	0.4	0.4	1.2	1.4	0.6	2.2	0.4	0.4	0.2	0.0	0.2	0.2	0.2	0.0
ACD	0.4	0.4	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CA	0.2	1.4	0.0	0.8	0.6	0.2	1.8	0.4	0.0	0.2	0.0	0.0	0.4	0.6	0.2	0.2	0.2	0.4	0.6	0.0
ACB	0.2	0.4	0.6	0.4	0.4	0.0	0.0	2.2	1.2	2.8	1.4	1.2	0.0	2.0	0.0	0.8	0.4	0.2	0.0	0.0
RCK	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.2	0.2
CME	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
CBT	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CF	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
CHL	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CMR	0.0	0.0	0.2	0.2	0.2	0.0	0.8	0.6	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.2	0.0
OT	0.0	0.2	0.2	0.2	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SC	0.0	0.2	1.6	2.0	3.0	1.2	1.8	1.0	0.8	1.0	1.2	0.4	2.2	2.2	3.8	3.0	1.2	2.0	1.6	1.2
SP	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	1.0	0.0
total percentage	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
abundance of lifeform	14	17	13	18	14	13	16	17	12	12	14	13	12	13	11	12	14	14	13	10

Table 3. Percentages of life forms identified using the photographic (P) and videographic (V) methods for every patch reef. Life forms are arranged from highest to lowest in terms of percentage cover. ACB=Acropora branching, ACD=Acropora digitate, ACS=Acropora submassive, ACT=Acropora table, CB=coral branching, CBT=coral Tubipora, CE=coral encrusting, CF=coral foliose, CHL=coral Heliopora, CM=coral massive, CME=coral Millepora, CMR=coral mushroom, CS=coral submassive, CA=coralline algae, MA=macroalgae, TA=turf algae, DCA=dead coral with algae, OT=other biota, SC=soft coral, SP=sponge, RCK=rock, S=sand, R=rubble, DDD=unidentified

Table 3. cont'd

Lifeforms / Patch reef / Methods	11 P	11 V	12 P	12 V	13 P	13 V	14 P	14 V	15 P	15 V	16 P	16 V	17 P	17 V	18 P	18 V	19 P	19 V	20 P	20 V
TA	33.6	49.2	36.2	52.4	44.6	61.2	65.4	69.0	46.6	47.0	75.8	70.6	70.0	62.0	61.8	58.2	74.0	62.0	62.6	54.4
S	51.8	39.2	40.4	25.2	34.8	20.8	19.6	12.6	29.4	37.2	8.4	8.6	12.4	16.0	18.2	25.0	12.8	23.6	25.6	30.8
CM	5.0	5.4	4.6	5.0	6.6	6.8	6.2	7.8	6.8	4.2	5.0	5.8	1.6	3.6	7.4	7.6	2.4	4.0	2.8	4.0
CE	3.2	3.4	6.8	5.6	4.8	4.0	3.0	3.0	7.2	2.8	3.4	5.6	8.2	8.4	7.0	4.0	3.4	3.8	2.4	1.6
ACT	0.8	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0
CB	1.0	0.4	1.6	0.4	0.6	0.0	0.6	0.2	0.2	0.0	0.6	0.6	1.0	2.4	0.0	0.0	0.4	0.4	1.0	0.8
DDD	0.2	0.6	0.6	1.2	0.2	1.0	0.0	0.2	0.0	0.8	0.2	1.2	0.0	0.6	0.4	0.6	0.4	0.2	0.2	0.6
DCA	0.0	0.0	1.6	1.8	0.8	1.2	0.0	1.4	1.0	0.8	0.2	0.8	0.0	0.6	0.4	0.0	0.0	0.0	0.2	0.6
R	1.4	0.8	1.2	3.2	0.4	1.6	0.8	1.8	2.0	1.2	0.2	0.8	1.0	1.0	0.6	0.4	0.6	1.2	0.0	1.2
CS	0.2	0.2	0.2	0.4	0.4	0.0	0.2	1.2	0.2	0.2	0.6	0.6	0.6	0.2	0.4	0.0	0.4	0.2	0.0	0.0
MA	0.2	0.4	0.0	0.0	0.4	0.2	0.6	0.0	0.4	0.2	0.0	0.8	0.2	0.0	0.2	0.2	0.4	0.0	0.0	0.0
ACD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CA	0.4	0.0	0.8	0.0	0.4	0.0	0.2	0.2	0.2	0.0	0.4	0.4	0.0	0.2	0.2	0.2	0.8	0.0	0.2	0.2
ACB	0.0	0.0	0.0	0.2	1.0	0.0	0.4	0.0	0.2	0.8	1.0	1.4	1.6	0.2	1.2	0.8	0.6	1.2	0.2	0.6
RCK	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
CME	0.0	0.0	0.2	1.2	0.0	0.0	0.2	0.2	0.0	0.2	0.0	0.0	0.2	0.2	0.2	0.2	0.6	0.0	0.4	0.4
ACS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.2	0.4	0.6	0.0	0.2	0.0	0.4
CBT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CF	0.4	0.0	1.2	0.4	0.2	0.2	0.2	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.0	0.8
CHL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.2
CMR	0.0	0.2	0.2	0.0	0.4	0.2	1.0	0.6	0.4	0.0	1.2	0.8	0.6	0.2	0.4	0.0	1.0	1.4	0.8	0.6
OT	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.4	0.0	0.2	0.0	0.0	0.2	0.2
SC	1.6	0.2	4.4	3.0	3.2	2.6	1.6	1.8	5.4	4.4	1.8	1.2	1.6	2.6	1.0	1.8	2.2	1.8	2.2	2.6
SP	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.2	0.0
total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
abundance of	14	11	14	13	17	12	14	13	13	13	16	17	15	19	16	14	14	12	15	17

although, post processing of digital images can overcome some of this. Poor quality of frames may alter the results of the analysis.

The availability of this low cost photographic method provides an alternative technique to local resource management projects by non-government and local government units. This can allow rapid assessment and monitoring of reef condition by non-biologists without losing the scientific value of the collected data. The information that can be provided by the photographic method would be important to stakeholders and decision makers to better manage and conserve their reefs.

ACKNOWLEDGEMENTS

We would like to thank Conservation International for the student's travel grant and PAMS for the opportunity to present and publish this paper. Much of the data used in this paper are from the baseline surveys of the project, "Coral reef habitat and productivity enhancement through coral transplantation and giant clam restocking" of Prof. Edgardo D. Gomez, a Pew Fellow in Marine Conservation.

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