# Addressing challenges in long-term coral reef monitoring: Statistical tools to address the effect of new methods

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Tracking how coral responds to marine protected areas (MPA) is critical for the effective coral reef management. Ideally, one method would be employed consistently throughout monitoring, but such longitudinal sampling can pose problems of methodology. Some possible reasons include a possibility of a current method found inappropriate in the course of monitoring or development of new preferred approaches over time. What happens when procedures are suboptimal and must be changed? Our project evaluated how data from two reef survey methods, line intercept transect (LIT) and photoquadrat (PQ), estimated coral cover. We then explored a way of combining data from different sources as one time-series dataset.

Data used in this study were collected in a three-year period of 18-year monitoring, where both LIT and PQ were executed. Monitoring surveys were conducted between 1998 and 2016 in dry and wet seasons (March ~ April, and September ~ October, respectively) at eight MPAs. LIT was used in the first half of monitoring (1998 ~ 2010) and PQ in the later half (2008 ~ 2016). Both methods were used between 2008 and 2010 as a transition period. In LIT, two 20 m transects were set up as fixed transects in each MPA; however, this method was replaced with PQ due to difficulties in maintaining the transects as fixed. In PQ, ten 23 m transects were placed haphazardly at each MPA. The surveys were conducted at the depth shallower than 5 m. LIT data were also sampled from areas between 5 and 10 m, but data from the deep areas were not included in this study.

In a comparison of data from the transition period, LIT showed higher mean percent coral cover than PQ (LIT mean: 40.5 %, PQ mean: 31.1 %). However, a difference between the two methods became insignificant after increasing sample sizes of LIT data by resampling (LIT mean after resampling: 39.0 %). In resampling, two 20 m LIT transects were subsetted by 1 m and thus, 40 samples were generated. In an analysis of coral cover change over time, PQ showed significant results (5.8 % decrease / year) whereas LIT exhibited insignificant results (1.8 % increase / year). This difference can be attributed to characteristics of PQ, where larger sample sizes were collected from wider areas. Although temporal patterns of LIT did not significantly change even after resampling, a comparability between the two methods can increase by adding deep LIT data, given there is no depth effect. These results confirmed that a difference in sample sizes and areas need to be carefully considered when data form different sources are analyzed. In addition, they indicated that resampling can be effective to improve comparability of different datasets. The results from this study can help improve the quality of monitoring data and thus, contributed to more powerful coral reef conservation.

Keywords: Coral reef, Marine protected area, Long-term monitoring , Marine Conservation

 