Assessing Photographic Techniques for Quantifying Fouling Community Development and Biodiversity

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INTRODUCTION

Epifaunal communities (fouling communities) are important components of coastal ecosystems. There are several environmental and ecological factors that affect the species composition of the epifaunal community, such as selectivity of larvae at settlement, biological interactions between species, size and distribution of patches, and frequency of disturbance (Osman, 1977). Patterns of community stability occur when there is a constant level of disturbance, either by predation or harsh weather. The communities can change or disappear due to continued recruitment, overgrowth or sloughing off (Sutherland, 1981).

Recently, biofouling in hulls of ships has been considered an important vector for the introduction of exotics (Ferreira, 2006). Sub-tidal communities can be dominated by nonnative species, especially in ports where human-mediated colonization is frequent (Cascade, 2010). Many invasive species are fouling organisms, which can cause direct or indirect changes in local community composition and diversity, dramatically altering ecosystem function (Stachowicz, 2002).

Photography has long been used to monitor environmental changes. Digital technology has expanded its use in field research and the ease of collecting and disseminating images. More recent advances in digital photographic technology have made it easier and more cost-effective to create higher resolution macro images in the field that can be analyzed off-site and disseminated without loss of image quality.

Objectives:

- To evaluate the capabilities of digital imaging techniques and camera types for data collection in studies of epifaunal community composition and biodiversity on settling plates.
- To compare the data collected by cameras for two different resolutions, each at different magnifications.
- To determine the efficacy of these approaches on fouling communities in different regions of Long Island Sound.
- To determine effective protocols for using digital imaging to collect data about epifaunal community development on settling plates.

METHOD & MATERIALS

- Tiles were attached to PVC pipes and suspended at fixed depths from docks at both locations.
- Tiles were removed weekly, attached to a base in a pan of seawater, and photographed under controlled and repeatable lighting and specific magnifications.
- Full tile photographs were taken using a Nikon D3200 camera with a 55mm macro lens, and a Nikon D800 with a 105mm macro lens.
- 12 photographs were taken of overlapping contiguous 3x4cm sections of each tile using the D3200 camera with a 105mm macro lens, and the D800 with a 105mm macro lens and a 20mm extension tube.
- Photographs were made in RAW format to maximize data captured and then adjusted in Adobe Lightroom 6 to maximize clarity.
- CPCE was used to analyze percent cover of organisms on photographs.

RESULTS

- There was a distinct difference in community composition between the tiles at Norwalk and Avery Point.
- An analysis of the camera's ability to identify species revealed no difference for photographs taken at Norwalk, but revealed a difference for photographs taken at Avery Point.
- Two species were found to settle in Norwalk (*Membranipora membranacea, Balanus spp.*).
- Seven species were found to settle in Avery Point (*Botrylloides violaceus, Botryllus schlosseri, Mogula spp., Bicellariella ciliata, Bugula simplex, Membranipora membranacea,* & *Spirobis spirillum*).

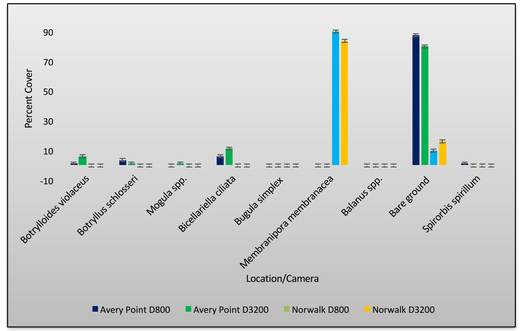

Figure 1. Average percent cover of tiles from both locations on 7/6/17 & 7/7/16.

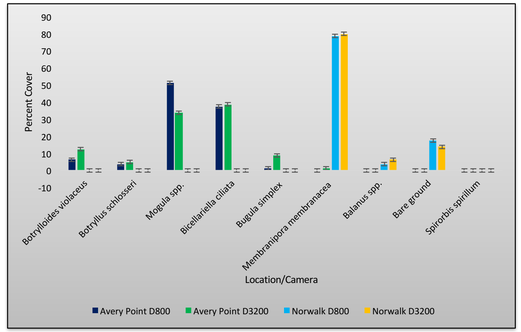

Figure 4. Average percent cover of tiles from both locations on 7/26/16 & 7/27/16.

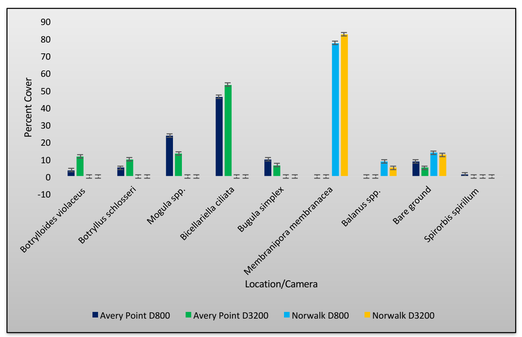

Figure 2. Average percent cover of tiles from both locations on 7/19/16 & 7/21/16.

Figure 3. The area of study, with markers indicating tile drop locations.

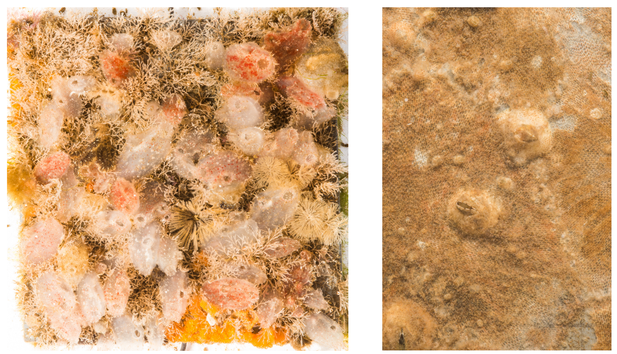

Figure 5(a &b) (a) on the left, an example of a full tile image taken at Avery Point on 7/26/16. (b) on the right, an example of a 3x4cm image taken at Norwalk on 7/27/16.

DISCUSSION

- When comparing the D800 to the D3200 to evaluate their ability to differentiate organisms there was a significant difference ($p < 0.05$) for tiles at Avery Point, and there was not a significant difference ($p > 0.50$) for the tiles at Norwalk.
- This likely is due to the complexity and simplicity of the communities. The community composition of Norwalk was simple with only 2 species taking up the majority of the space, while at Avery Point the tiles were completely covered with multiple species competing for the space.
- Differences in community composition based on locations is due to the proximity of Avery Point to the entrance of Long Island Sound, which allowed for more diversity, and invasive species (*Botrylloides violaceus)* to be present on the tiles.
- The higher resolution provided by the D800 was not needed to determine species. For identification of some species of bryozoans, a microscope was needed to differentiate zooids, therefore the use of a camera for identification was insufficient for identification purposes. The 3x4cm images didn't provide enough detail to determine certain species.
- Using photography to analyze community development has the ability to reveal information that cannot be seen from routine examination of tiles. Percent cover and species interactions could be tracked over time. The use of 3x4cm images allowed for more detailed examination of intraspecific and interspecific interactions.

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