Supplement 1

Quality assessment of photographic analyses

The community data used in our manuscript originated from the analysis of photos obtained from different experiments. Even if the work presented here highlights a set of interesting results from the study of the harbor fouling communities present in the marina, the methods used include certain biases that makes essential to discuss the quality of the photo analysis. Some biases inherent to the image-analysis method, like the underestimation of the presence of certain taxa, could constitute a problem for interpretation. For this reason, certain measures were taken to assure that the quality of our analysis is adequate in regard to our scientific question.

Methods

We projected 144 identification points on each panel (18 x 18 cm; as 1 cm of the border is excluded to avoid a border effect) in a random stratified design, which is above the recommended number of 0.4 points per cm^2 recommended by Taormina et al. (2020) for a 95% confidence interval for species covering > 5% of the surface. The photo observer was able to practice species identification with an expert by working on recruitment panels, which were part of a transplantation experiment conducted in 2019. Thus, the very same settlement plates were analyzed by photo analysis and by a taxonomic analysis in the laboratory, allowing to compare both analyses and to check the quality of the photo analysis method.

The taxonomic analysis was conducted by superposing a 144-point grid on life communities, counting all individuals (overlapping individuals included) on the intersections. This allowed to account for epibionts as well as individuals of the same or different species on different strata. All species present but not on an intersection were considered present at 0.7% cover (1 count). Species were identified to the lowest possible taxonomic level (Hayward & Ryland 1979, 1985, 1995, 1998, Brunetti & Mastrototaro 2017). This analysis constitutes a very in-depth analysis of the community structure.

Results and Discussion

A comparison of image-analysis and laboratory methods was carried out with the 2 different sets of community data. The species lists and the mean cover of the present species of both were compared (Table S1). The photo analysis detected 42% of the species that were identified in the taxonomic analysis (14 out of 33), leading to a highly reduced overall diversity, largely underestimating the number or present species. This has two main reasons: First, species that were covered by other species could not be identified by the photo analysis. This mainly concerns small, encrusting species like Spirorbinae and encrusting bryozoans. Second, many of the species identified in the taxonomic analysis, were species with very low cover that likely escaped detection in the photo analysis. It is possible to observe that species detected in the taxonomic analysis, but not in the photo analysis were exclusively species with ≤ 1% cover (Table S1). All species with a cover > 1% (green) and two more were detected in the photo analysis, with however lower cover (as overlap counts are not possible in the photo analysis).

To observe if this underestimation of the number of species and the cover of several species affects the overall results of a community analysis we chose to analyze both community data with the "vegan" (version 2.5-6; Oksanen et al. 2018) package in R (R core Team 2020, version 3.5.1). The two data sets were transformed into Bray-Curtis dissimilarity matrices and visualized with two nMDS (Fig. S1). For both, a pairwise PERMANOVA (10^4 permutations) was performed with the "pairwiseAdonis" package (version 0.3; Martinez Arbizu 2019), applying a Benjamini-Hochberg adjustment method (Benjamini & Hochberg 1995) to test for differences between the treatments which were considered to be composed by the date and the location in the marina. For the Taxonomic analysis, all communities are significantly different from each other (PERMANOVA; $R^2 > 0.49$; $p < 0.009$). The same tendencies can be observed for all ($R^2 > 0.46$; $p < 0.028$) except Inner vs Middle in August ($R^2 = 0.15$; $p = 0.3$). These two pairs are however also very close in the projection, even for the taxonomic analysis (Fig. S1).

Table S1: Species list for the taxonomic assessment and the photographic analysis. The mean cover for each species is given for each analysis. Species above 1% in cover in the taxonomic assessment are indicated in green. Introduced species are marked by an asterisk*.

Taxonomic assessment		**Photographic assessment**	
Species	**Mean cover**	**Species**	**Mean cover**
Anomia ephippium	1%	*Anomia ephippium*	< 1%
Ascidiella aspersa	2%	*Ascidiella sp.*	< 1%
*Austrominius modestus**	2%	*Austrominius modestus**	1%
Botrylloides leachii	< 1%		
Botryllus schlosseri	3%	*Bortyllus schlosseri*	2%
*Bugula neritina**	23%	*Bugula neritina**	12%
Bugulina flabellata	6%	*Bugulina flabellata*	1%
Bugulina fulva	2%	*Bugulina fulva*	< 1%
Cellepora pumicosa	0%		
Ciona intestinalis	34%	*Ciona intestinalis*	22%
*Ciona robusta**	< 1%		
Circeis armoricana	< 1%		
Circeis spirillum	< 1%		
Clavelina lepadiformis	< 1%		
*Corella eumyota**	< 1%		
Cradoscrupocellaria ellisii	< 1%		
*Cryptosula pallasiana**	2%	*Cryptosula pallasiana**	< 1%
Diplosoma listeranum	18%	*Diplosoma listeranum*	8%
Electra pilosa	7%	*Electra pilosa*	4%
Janua heterostropha	< 1%		
Laomedea flexuosa	1%		
Lissoclinum perforatum	< 1%		
Membranipora membranacea	< 1%		
*Neodexiospira brasiliensis**	1%		
Obelia geniculata	< 1%		
Perforatus perforatus	< 1%		
Plagioecia patina	< 1%		
Spirobranchus triqueter	< 1%	*Spirobranchus triqueter*	< 1%
Spirorbis sp.	< 1%		
*Styela clava**	< 1%		
*Tricellaria inopinata**	20%	*Tricellaria inopinata**	7%
Tricellaria peachii	< 1%		
*Watersipora subatra**	9%	*Watersipora subatra**	5%

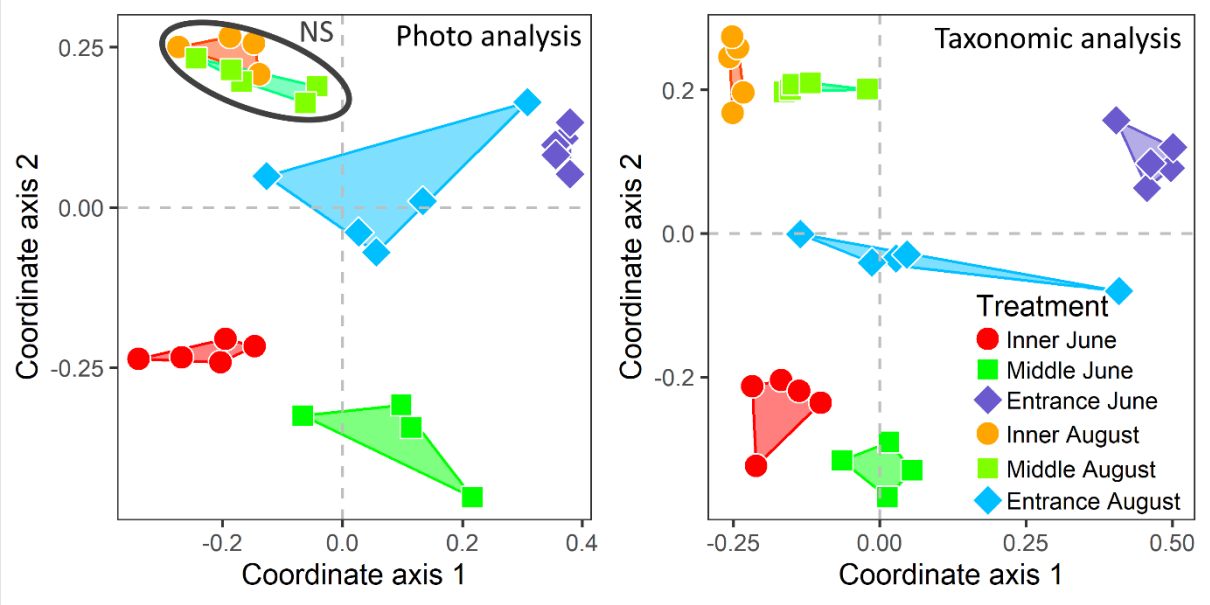

Fig. S1: nMDS of the community structure of the same panels analyzed with photo analysis and taxonomic analysis. All communities outside the NS ellipse are significantly different from each other (PERMANOVA; $R^2 > 0.46$; $p < 0.028$)

The results illustrate that the image-analysis has it associated biases and that it loses resolution compared to a highly in-depth taxonomic analysis. This most notably concerns the biodiversity aspect as many species are missed or underestimated. Our data is thus not suitable for discussing the presence/absence of certain species or to assess biodiversity patterns in the marina. However, the very similar distribution of the community structures in the community analysis suggests that the use of the image-analysis method would not induce a bias significant enough to result in profoundly different conclusions concerning variations of the overall community structure. All major species of the taxonomic analysis were also detected on the image-analysis, thus providing a good proxy of the community structure. This shows that the photo analysis is a robust tool for the scientific questions treated in our manuscript, as it does not aim to provide an exhaustive species list but rather focuses on how the overall community varies between different sites of the marina.

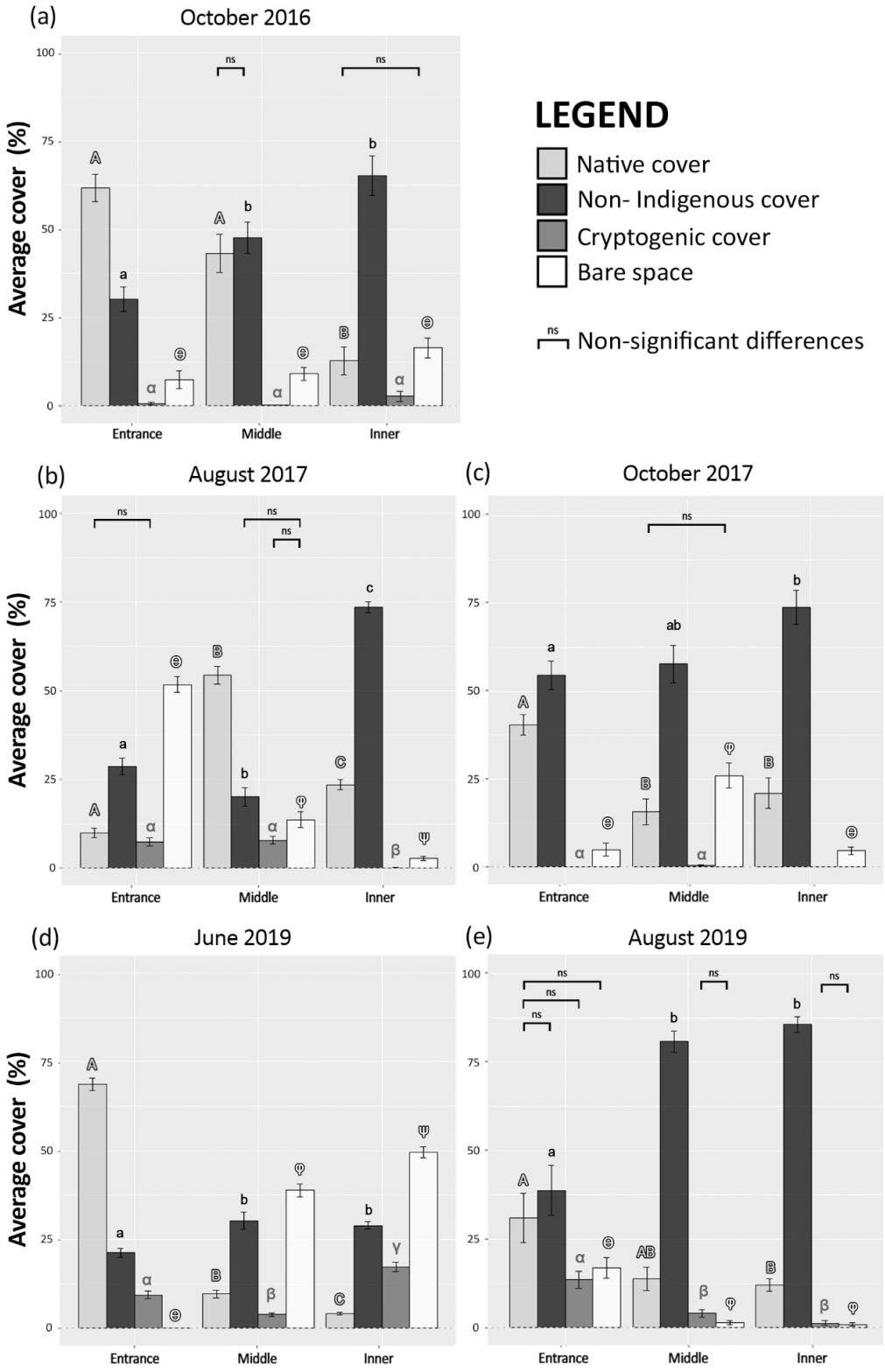

Fig. S2: Comparisons of average cover between different species categories at 3 locations within the marina du Château (Brest) in (a) October 2016, (b) August 2017, (c) October 2017, (d) June 2019 and (e) August 2019. Significant differences (Pairwise Wilcoxon-Test) within each category are indicated using symbols, and significant differences between categories within the same location are indicated using brackets for non-significant groups. An absence of a bracket indicates significant differences between intra-location groups. Error bars indicate the error type.

Literature cited

Benjamini Y, Hochberg Y (1995) Controlling The False Discovery Rate - A Practical And Powerful Approach To Multiple Testing. J R Stat Soc Ser B 57:289–300.

Brunetti R, Mastrototaro F (2017) Ascidiacea of the European waters. Edagricole NBM (ed) Edagricole - New Business Media.

Hayward P., Ryland JS (1985) Cyclostome Bryozoans (Synopses of the British Fauna 34) . Field Studies Council, London.

Hayward PJ, Ryland JS (1979) British ascophoran bryozoans. Linnean Society of London (ed) Academic press, London.

Hayward PJ, Ryland JS (1998) Cheilostomatous bryozoa (Part 1). The Linnean Society of London and The Estuarine and Coastal Sciences Association (ed) Field Studies Council, London.

Hayward PJ, Ryland JS (1995) Handbook of the Marine Fauna of North-West Europe. Hayward PJ, Ryland JS (eds) Oxford university press, Oxford, New York and Tokyo.

Martinez Arbizu P (2019) PairwiseAdonis: Pairwise multilevel comparison using adonis. R package version 0.3.

Oksanen J, Blanchet FG, Kindt R, Legendre P, Minchin PR, O'hara RB, Simpson GL, Solymos P, Stevens MHH, Wagner H, Oksanen MJ (2018) Vegan: community ecology package. R Packag Version 2 4-6.

Taormina B, Marzloff MP, Desroy N, Caisey X, Dugornay O, Metral Thiesse E, Tancray A, Carlier A (2020) Optimizing image-based protocol to monitor macroepibenthic communities colonizing artificial structures. ICES J Mar Sci.