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1 **Greater functional similarity in mobile compared to sessile assemblages colonizing**
2 **artificial coastal habitats**

3

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15

16 **Abstract:**

17 Among anthropogenic habitats built in the marine environment, floating and non-
18 floating structures can be colonized by distinct assemblages. However, there is little
19 knowledge whether these differences are also reflected in the functional structure. This study
20 compared the functional diversity of sessile and mobile invertebrate assemblages that settle
21 over 3 months on floating vs. non-floating artificial habitats, in two Chilean ports. Using
22 morphological, trophic, behavioral, and life history traits, we found differences between
23 mobile and sessile assemblages regarding the effect of the type of habitat on the functional
24 diversity. Compared to sessile assemblages, a greater functional similarity was observed for
25 mobile assemblages, which suggests that their dispersal capacity enables them to balance the
26 reduced connectivity between settlement structures. No traits, prevailing or selected in one
27 or the other habitat type, was however clearly identified; a result warranting for further
28 studies focusing on more advanced stages of community development.

29

30 **Keywords:** artificial structures, functional structure, mobile invertebrate, functional traits,
31 marine urbanization, diversity

32 **Introduction**

33 Increasing anthropogenic coastal activities around the world have resulted in the
34 construction of numerous man-made structures in the marine environment (Firth et al. 2016,
35 Bishop et al. 2017). These structures such as dikes, breakwaters, piers, mariculture lines,
36 offshore platforms, stand for a major driver of change in marine environments by replacing
37 many natural habitats (Airoldi et al. 2009, Bulleri and Chapman 2010, Firth et al. 2016).
38 While the rise of artificial structures in coastal and marine areas degrade, fragment, and
39 deplete natural habitats (Bulleri and Chapman 2010, Bishop et al. 2017), they provide new
40 surfaces available for the settlement, reproduction, and growth of many organisms.

41 Novel assemblages associated with marine artificial structures however commonly
42 differ from those found in natural habitats, and often include a large proportion of stress-
43 resistant or opportunistic species (Connell 2000, Perkol-Finkel et al. 2006, Aguilera et al.
44 2014). Because they are embedded in an expanding propagule transport network, much of
45 these species also appear to be non-indigenous or cryptogenic species (Glasby et al. 2007,
46 Dafforn et al. 2009, Johnston et al. 2017, Leclerc et al. 2021). Overall, artificial structures
47 facilitate the dispersal of a range of neocosmopolitan (*sensu* Darling and Carlton 2018)
48 species (Mineur et al. 2012, Adams et al. 2014, Airoldi et al. 2015) contributing to the
49 homogenization of coastal biota at regional and global scales (Villéger et al. 2011, Simberloff
50 et al. 2013, Leclerc et al. 2020b). The physical characteristics of these artificial structures
51 (e.g., material, roughness, structural complexity, inertia vs. movement capacity), and the
52 levels disturbance in their surroundings (Bulleri and Chapman 2010, Airoldi and Bulleri
53 2011) influence the composition of biotic assemblages (Connell 2000, Glasby and Connell
54 2001, Holloway and Connell 2002, Firth et al. 2016).

55 Comparing natural vs. artificial habitats, some studies documented differing species
56 compositions (Connell 2000, Glasby and Connell 2001, Holloway and Connell 2002, Sedano
57 et al. 2020) and contrasting functional patterns between them (Mayer-Pinto et al. 2018, Janiak
58 and Branson 2021). Similarly, among different types of artificial structures, differences in
59 community composition and biotic interactions have also been shown (Connell 2001, Firth
60 et al. 2016, Rogers et al. 2016, Strain et al. 2018, Giachetti et al. 2020). For instance, floating
61 structures, such as buoys, pontoons or floating longlines, present contrasting species
62 assemblages to those found on non-floating structures, such as the pillars of piers or docks
63 (Connell 2001, Glasby 2001, Holloway and Connell 2002), and can differ in their β -diversity
64 across multiple spatial scales (Leclerc et al. 2020a). The various studies that have tried to
65 understand the mechanisms behind these differences have attributed them not only to the
66 aforementioned physical properties of the structures but also to those to which these
67 structures are subjected (e.g., water motion, connectivity with the benthos, exposure to
68 predators and scavengers, disturbance regimes; Glasby 2001, Holloway and Connell 2002,
69 Giachetti et al 2020). Hence, the differing conditions to which floating *versus* non-floating
70 structures are subjected could act as filters for certain functional traits among the resulting
71 assemblages (see Piola and Johnston 2009, Zhan et al. 2015, Aronson et al. 2016, Johnston
72 et al. 2017). For instance, the establishment of certain species in a given artificial habitat may
73 result from specific traits that favor the recruitment of those species and increase their local
74 fitness in this specific habitat (Beauchard et al. 2017, Córdova and Zambrano 2015). Traits
75 allowing for rapid colonization of novel empty patches (e.g., high reproductive and growth
76 rates, large dispersal ability) may notably be favored on floating structures, which are prone
77 to physical disturbances (among others, Holloway and Connell 2002, Johnston et al. 2017)
78 due to their maintenance and replacement. Conversely, traits favoring competitive and

79 defensive abilities may rather be favored in non-floating structures, wherein stronger biotic
80 interactions can take place (Leclerc et al. 2020b, López and Freestone 2021).

81 The communities colonizing these artificial habitats are generally composed of
82 abundant sessile species, including habitat-formers for associated mobile species. Despite the
83 importance of the interactions among these two species groups (Sellheim et al. 2010,
84 Thomsen et al. 2014), only few studies examined the variations in the composition of the
85 mobile species assemblage (e.g., Karalis et al. 2003, Leclerc and Viard 2018, Martínez-Laiz
86 et al. 2019, Carvalho et al. 2013, Sedano et al. 2020). Thus, several questions are still
87 unanswered, such as whether differences in the composition of sessile species and habitat
88 formers are mirrored by changes in the composition of mobile species in the assemblage, and
89 whether these changes are strong enough to be reflected in the functional structure of the
90 resulting community. The few studies available suggest that the diversity and traits of habitat-
91 forming species affect the structure of their associated sessile and mobile species (Yakovis
92 et al. 2008, Sellheim et al. 2010, Leclerc and Viard 2018). However, unlike sessile species,
93 mobile species have the ability to disperse and relocate after settlement to colonize new
94 patches of habitat (e.g. Martins et al. 2017). This ability is advantageous under stressful
95 conditions or in variable environments, as it provides mobile species with a greater plasticity
96 in their use of habitats or micro-habitats. Therefore, variations in the mobile species
97 component, due to habitat types (exposed to differing conditions), are expected to be smaller
98 than in the sessile component of these communities.

99 The present study examined the species diversity and functional structure of sessile and
100 mobile invertebrate assemblages that settle on floating versus non-floating artificial habitats,
101 off the East Pacific coast, central Chile. Using morphological, trophic, behavioral, and life

102 history traits of sessile and mobile species, we particularly examined whether the functional
103 differences among sessile taxa between the two habitat types are mirrored among mobile
104 taxa. We predicted that the magnitude of the differences between habitats will be greater in
105 the assemblages of sessile species than in those of mobile species, given the post-settlement
106 dispersal capacity of the latter. To our knowledge, this is the first study dedicated to
107 comparing the functional structure of communities of different types of artificial coastal
108 habitats. The comparison of the composition, abundance, and diversity of functional traits
109 (functional diversity) among the assemblages colonizing these artificial habitats may reveal
110 mechanisms that determine the functional composition of these new arising man-made
111 ecosystems (see Bremner et al. 2006, Mouchet et al. 2010, Beauchard et al. 2017). This
112 knowledge could help predict how assemblages respond to habitat properties and aid
113 conservation managers in the prediction of changes in ecosystem functioning related to
114 coastal human activities.

115

116

117 **Materials and methods:**

118 *Study area*

119 The study area comprised two ports (separated by 30 linear km) of the Biobío Region,
120 Chile: San Vicente (36.7591° S, 73.1551°W) and Coliumo (36.5377°S, 72.9571°W). As a
121 sidenote, San Vicente is open to international trade, while Coliumo is only open to regional
122 traffic (see Leclerc et al. 2018, 2020b), although maritime traffic was not the scope of our
123 study. These two ports are located in two different bays (San Vicente and Coliumo bays)
124 characterized by distinct biotic compositions in either natural (e.g. for intertidal mollusks;
125 Aldea and Valdovinos, 2005) and artificial habitats, although little is known regarding soft
126 sediment habitats in ports (but see Leclerc et al. 2018 for rapid assessment surveys of
127 conspicuous taxa). Both ports present various types of artificial habitats that are part of the
128 coastal infrastructure, and which were categorized for this study as: (1) non-floating habitats:
129 those attached to the docks by rigid steel foundations/pillars and in direct contact with the
130 benthos; and (2) floating habitats: comprising longlines or buoys that remain in the water
131 column with a weaker, less prominent link to the benthos.

132

133 *Dataset overview, study design, sampling and species identification*

134 Our study capitalized on the sampling carried out between March and June, 2017, by
135 Leclerc et al. (2020b), who focused on sessile assemblages. In brief, the sampling consisted
136 of the deployment of a series of 15 cm x 15 cm black polypropylene settlement plates,
137 arranged in structures (experimental units) held by PVC tubes (for details, see Leclerc et al.
138 2020b). The plates were used to have a standardized substrate (surface and material) and new

139 available surface area (which is a main limiting resource, e.g. Sellheim et al. 2010) to be
140 colonized by sessile and mobile taxa (flora and invertebrates).

141 In each of the study ports and on the two types of habitats (floating vs. non-floating),
142 two experimental units bearing plates were placed vertically, separated by 20 m to 50 m, and
143 at approximately 3 m to 4 m depth. In the non-floating habitats of both ports, these were
144 placed on the pillars of the pier, while in floating habitats they were attached to buoys (San
145 Vicente) or longline (Coliumo) by ropes. Four plates per experimental unit were removed
146 three months after installation, which is sufficient time for the settlement and growth of the
147 sessile and mobile assemblages to take place on the plates (see Leclerc and Viard 2018,
148 Sellheim et al. 2010). The plates were individually transferred underwater in polypropylene
149 rubble bags (mesh size < 0.5 mm) to minimize the loss of the mobile fauna, and were kept
150 for 4 h in a tank with seawater until they were processed in the laboratory.

151 In the laboratory, sessile (Leclerc et al. 2020b) and mobile taxa (this study) were
152 identified under a dissecting microscope at the lowest possible taxonomic level. The
153 abundance of the sessile taxa was estimated as the coverage at 100 intersection points in an
154 area of 120 cm × 120 cm, as detailed in Leclerc et al. (2020b), while the abundance of the
155 mobile taxa was estimated by counting the number of individuals per plate. The mobile fauna
156 was sampled, after the identification of the sessile taxa, by washing the plate using a 500 µm
157 mesh sieve. The samples were preserved in 95 % EtOH for later identification. Most mobile
158 taxa were identified morphologically to the genus or family level due to a lack of taxonomic
159 literature for the South East Pacific taxa of many abundant groups (e.g., amphipods).

160

161 *Functional traits categorization*

162 After identification, the sessile and mobile taxa were classified according to several
163 functional traits related to their life history, behavior, and feeding habits. In this work, sessile
164 taxa were considered to be those species with no or low mobility, those considered as habitat
165 formers, and those which, after their settlement, do not migrate between plates. Their
166 functional traits were subdivided into different modalities as proposed by Bremner et al.
167 (2003) and Beauchard et al. (2017). The information on life history traits of the individual
168 taxa was extracted from different online sources, such as GBIF, NEMESIS, NIMPIS,
169 MarLIN, NAS, MSIP, BIOTIC, Polytraits, as well as bibliographic sources. Each trait was
170 categorized into three to five modalities (e.g., the trait “Larval development” was given three
171 modalities: pelagic planktotrophic, pelagic lecithotrophic or direct benthic) obtaining a total
172 of 11 traits and 46 modalities of traits, as detailed in the table 1. The affinity of each taxon
173 with the modalities of each trait was assigned, so that the "total affinity" of each trait equaled
174 1 (Chevenet et al. 1994). This fuzzy coding allows a taxon to display modalities of a trait to
175 different degrees (Chevenet et al. 1994). When information about a particular trait in a taxon
176 could not be obtained, the affinity value of a similar taxon within its taxonomic group (genus
177 or family, whichever closest available) was used as a proxy, however only whenever
178 variations of the trait within the taxonomic group chosen had not been reported. Otherwise,
179 an equal affinity value was assigned for all modalities of that trait for the taxon.

180 Functional trait data was analyzed separately for each assemblage (mobile vs. sessile).
181 From the trait matrix (“Traits-taxon matrix”) of the sessile and mobile assemblages,
182 respectively, an analysis of biological traits was performed (BTA; Bremner et al. 2003,
183 2006). This was based on combining this matrix with the taxa abundance matrix (“Taxon-

184 plate matrix") by means of a canonical scalar product that transforms and weights the scores
185 (between 0 and 1 following the fuzzy coding) of each trait modality by the abundance of each
186 taxon. This procedure allowed for the generation of a functional trait abundance matrix
187 ("Traits-plate matrix"), on which the subsequent functional structure analyses were based.

188

189 *Data analysis*

190 The functional diversity of the community was estimated using the functional diversity
191 indices wFDc and FDc (Petchey and Gaston 2006), based on the Gower similarity matrix of
192 the FDiversity package (Casanoves et al. 2011), in R (R Development Core Team 2010).
193 These indices are estimated by summing the length of the branches of a functional
194 dendrogram of all the species from a cluster analysis, which uses profiles of multiple traits
195 either by including their abundance (wFDc) or excluding their abundance (FDc). At the taxon
196 level, we also estimated the richness (S) and the taxonomic diversity (Hill number $2 : 1 / \lambda$;
197 Hill 1973) of the sessile and mobile assemblages. To compare both the taxonomic and the
198 functional diversities between the factor levels, an analysis of variance (ANOVA) was
199 performed using the same, previously specified design. In addition, the effect size of each
200 factor was estimated using the Omega squared index (ω^2 , Hays 1963). Prior to each ANOVA,
201 normality and homogeneity of variances were checked using Shapiro-Wilk and Levene's
202 tests, respectively. The data were transformed (square root transformation) when these tests
203 resulted significant. These analyzes were performed using R version 4.0.3 (R Core Team
204 2016).

205 The relationship between richness and functional diversity can further inform about the
206 functional redundancy of communities (Micheli and Halpern 2005, Córdova and Zambrano

207 2015). Instead of summarizing the associated information in a single index (e.g. van der
208 Linden et al. 2016), we herein characterized these relationships in both habitats and compared
209 them using the Tsutakawa and Hewett Test (Tsutakawa and Hewett 1977) as a substitute for
210 the ANCOVA test due to the non-fulfillment of the assumption of independence between the
211 *Habitat* factor and the covariate richness of the species. This test allows to evaluate the
212 equality of two populations when the observations are bivariate (XY; in this study X:
213 Richness Y: Functional diversity) by determining whether the values of Y given X for one
214 population dominate the other for every value of X (Williams 1977). The test involved fitting
215 a regression line (the one that best fits using the Akaike criterion (AIC); in this case, a linear
216 regression, see results) to the entire data set, and then comparing, through a contingency table
217 analysis (using the χ^2 distribution), the distribution of bivariate data above and below the
218 regression line (Williams 1977, Muñoz and George-Nacimiento 2008). These analyzes were
219 performed using the PAST program, version 3.14 (Hammer et al. 2001).

220 To compare the functional structure between habitats of the sessile and mobile
221 assemblages, Permutational Multivariate Analysis of Variance (PERMANOVA, Anderson
222 2001) was performed with 4999 permutations. A three-way design was applied, considering
223 the following factors: "Habitat" (two fixed levels: floating vs. non-floating), "Port" (two
224 random levels: Coliumo vs. San Vicente), and "Experimental unit" (two random levels nested
225 within "Port" and "Habitat"). Separate analyses were performed for sessile and mobile
226 assemblages to avoid violation of independency, and because abundance was not estimated
227 in the same way. The analyses were based on the Bray-Curtis similarity matrices generated
228 from transformed data in order to downplay the importance of the most abundant traits and
229 homogenize multivariate dispersion. We used the fourth root for the abundance of traits of
230 mobile taxa and the square root for that of sessile taxa. Multivariate trait data were also

231 analyzed for their composition using a Jaccard's similarity matrix (i.e., presence-absence
232 data). The homogeneity in the dispersion of the data was verified between the levels of the
233 factors "Habitat" and "Port", using a Permutational Multivariate Dispersion Analysis
234 (PERMDISP; Anderson et al. 2008). Principal coordinate analysis (PCO) and cluster analysis
235 were performed to visualize and determine group similarity, respectively (Anderson et al.
236 2008). To determine if there are significant differences between the levels of each factor in
237 certain traits of the sessile and mobile assemblages, multivariate PERMANOVAs were
238 performed for each of the traits separately using trait modalities as response variables. The
239 analyzes were based on the Bray-Curtis similarity matrix generated from transformed data
240 using the fourth root for the abundance of traits of mobile taxa, the square root for that of
241 sessile taxa. All of these analyzes were performed using the PRIMER 6 program (Anderson
242 et al. 2008).

243 **Results**

244 *Overall assessment of taxonomic diversity and functional traits*

245 A total of 126 taxa were found, including 43 sessile and 83 mobile taxa (Supporting
246 information appendix S1). Sessile taxa were represented by 10 phyla (10 bryozoans, 9
247 cnidarians, 7 chordates, 6 rhodophytes, 5 mollusks, 2 arthropods, 1 annelid, 1 sponge and 1
248 chlorophyte, 1 ochrophyte), while mobile taxa comprised 5 phyla (43 arthropods, 24
249 annelids, 13 mollusks, 2 nemerteans, and 1 echinoderm). Of the sessile taxa, the most
250 represented taxonomic groups in terms of numbers of taxa and coverage were bryozoans (10
251 taxa, for an average of 31% coverage per plate), followed by hydroids (9 taxa and 27 % of
252 the coverage). Of the mobile taxa, the most represented taxonomic groups in terms of
253 numbers of taxa and abundance were amphipods (29 taxa, for an average of 54 % of the total
254 abundance per plate), followed by polychaetes (23 taxa and 21 % of abundance) and
255 gastropods (13 taxa and 5 % of abundance). Oppositely, copepods, isopods, tanaidaceans,
256 and echinoderms were the least present (only 1 or 2 taxa and less than 8 % of abundance).

257 The sessile assemblage, regardless of the habitat (non-floating and floating), was
258 mainly dominated in terms of numbers of taxa and cover by suspension-feeders (35 taxa and
259 97 % of the average total coverage per plate), as compared to autotrophs (8 and 3 %). These
260 assemblages were dominated by colonial taxa (22 taxa and 67 % of cover), erect taxa (23 and
261 81 %) and smaller than 50 mm taxa (31 and 91 %). These taxa had diverse reproductive
262 modes: asexual (30 taxa and 35 % of cover), sexual with spawning events (23 and 24 %) or
263 broadcasted developing larvae (22 and 41 %). Most larvae were lecithotrophic (35 taxa and
264 86 % of cover), with a pelagic larval duration most often of less than 1 day (30 and 72 %).
265 The longevity of the taxa was generally less than 1 year (30 taxa and 77 % of cover).

266 The assemblage of mobile invertebrates was equally distributed by predators (40 taxa
267 and 32 % of the average total abundance per plate), detritivores (49 and 30 %) and filter-
268 feeders (34 and 32 %). Their mobility was either low (46 taxa and 48 % of abundance) or
269 moderate (42 and 42 %) and associated with behavior as burrowing in micro-refuges (42 and
270 40 %), crawling (44 and 29 %) or crawling-swimming (36 and 30 %). Relatively elongated
271 individuals predominated (68 taxa), with sizes less than 10 mm (49 taxa and 77 % of
272 abundance), with a longevity less than 1 year (33 and 38 %) and 1 to 3 years (77 and 53 %).
273 Different reproductive modes were observed, but most of them (51 taxa and 59 % of
274 abundance) were sexual reproduction with parental egg care and the development of juvenile
275 phases. Most taxa developed directly in the benthos (54 taxa and 62 % of abundance) and of
276 the 38 % with larval development (49 taxa), 24 % had a pelagic larval duration of less than
277 1 day (18 taxa).

278 *Contrasting effects of the type of habitat (floating vs. non-floating) on the taxonomic*
279 *and functional diversity according to the assemblages (mobile vs. sessile)*

280 The taxonomic and functional diversity of the two categories of assemblages (i.e.,
281 mobile vs. sessile) varied between non-floating and floating habitats, whatever the variable
282 examined, and in the two ports (Fig. 1, Table 2). In sessile assemblages the differences
283 between habitats were contrasting between the two ports, as evidenced by significant
284 interactions (and associated effect sizes) *Habitat* and *Port* for all response variables (Table
285 2). In San Vicente, sessile richness, diversity and both functional diversity indices were
286 higher in the non-floating habitat, while the opposite was observed in Coliumo (Fig. 1).
287 Conversely, for mobile assemblages, the differences observed between habitats were
288 comparatively far more consistent in the two studied ports. With the exception of wFCD that

289 showed significant interaction, higher taxonomic and functional diversity (FDc only) of
290 mobile assemblages were observed in floating than in non-floating habitats in both ports
291 (Table 2, Fig. 1).

292 The functional diversity in non-floating and floating habitats showed a general positive
293 linear relationship with taxa richness for both sessile and mobile assemblages (Fig. 2),
294 although this relationship was better supported for sessile ($r^2 = 0.58$ $p < 0.001$) than for
295 mobile assemblage ($r^2 = 0.16$ $p = 0.023$, Fig. 2). According to the bivariate relationships
296 between taxa richness and functional diversity, a contrasting functional redundancy between
297 habitats for sessile assemblages was supported by the Tsutakawa and Hewett tests ($\chi^2 = 8.33$
298 $df = 1$; $p = 0.004$). A lower slope for the linear relationships in floating habitats than in non-
299 floating habitats was observed (Fig. 2; non-floating: slope = 0.29, $r^2 = 0.73$, floating: slope =
300 0.09, $r^2 = 0.73$). On the contrary, for mobile assemblage the bivariate relationships (richness,
301 functional diversity) suggested a similar functional redundancy between habitats ($\chi^2 = 1$ df
302 = 1; $p = 0.317$), with a similar slope between floating and non-floating habitats (Fig. 2; non-
303 floating: slope = 0.12, $r^2 = 0.22$, floating: slope = 0.04, $r^2 = 0.01$).

304 *Stronger effects of the type of habitat on the functional structure of sessile assemblages*
305 *compared to mobile assemblages*

306 The functional compositions (presence-absence) of the sessile and mobile assemblages did
307 not show significant differences between non-floating and floating habitats (Table 3).
308 However, the functional structure weighted by the abundance (wFDc) showed a significant
309 interaction between the factors, *Habitat* and *Port*, in both assemblages (Table 3). The PCO
310 results also showed distinct clusters, for both composition and abundance (Fig. 3).
311 Interestingly, in the sessile assemblages, when compared to the mobile, a greater

312 differentiation in the functional structure weighted by the abundance was observed between
313 both habitats (cf. similarity thresholds in Fig. 3), as well as a greater similarity within and
314 between the floating habitats of both ports. Likewise, the variation between plates in the
315 abundance of the functional traits of the sessile assemblage was significantly greater in non-
316 floating habitats than in floating habitats (PERMDISP $F = 32.69$ $p < 0.001$). In addition,
317 nested within habitat categories, experimental units display significant (and sizable) effects
318 only for the sessile assemblages, in their (functional composition and abundance structure;
319 Table 3). Overall, the mobile assemblages presented higher similarity in their composition
320 and functional abundance than the sessile assemblages, regardless of the habitat or port (80
321 % similarity, Fig. 3).

322 When analyzing the functional traits of the sessile assemblage separately, no effect of
323 the *Habitat* factor was detected on the functional structure of the traits. However, significant
324 interactions between *Habitat* and *Port* were observed for five (out of nine examined) traits,
325 namely body form, individual/colony size, lifespan, reproductive mode, and pelagic larval
326 duration (Table 4). It is also noteworthy that for the feeding trait (represented by two
327 modalities), the factor *Habitat* had a high effect size in the multivariate analysis. Although a
328 dominance of filter-feeders was observed in both habitats and ports (Fig. 4), their absolute
329 coverage on the plates was greater in floating habitats than in non-floating ones (Fig. S1).
330 Among the other functional traits evaluated, although the proportions of modalities varied
331 between habitats, the differences were not consistent between ports for which these traits did
332 not contribute to any further differentiation between the habitats, floating vs. non-floating
333 (Fig. 4). Consistently with the analysis of functional composition and abundance structure,

334 significant spatial effects of the experimental units were observed on the modalities, only for
335 the sessile assemblages (Table 4).

336 For the mobile assemblages, although all the traits had a high effect size of the *Habitat*
337 factor, this effect was only significant in interaction with the factor *Port* (Table 5). This is
338 also illustrated by the modality proportions of abundance within each functional trait across
339 habitats and ports (Fig. 5, Fig. S2), for which variations were observed, although these were
340 not as marked as for the sessile assemblage.

341

342 **Discussion**

343 The results of our study show that the differences reported by various authors in the
344 community structure between different types of artificial habitats (Connell 2001, Glasby
345 2001, Firth et al. 2016, Strain et al. 2018), including in the study area (Leclerc et al. 2020b),
346 are also found in the functional structure of sessile and mobile marine assemblages. However,
347 and in accordance with our predictions, these differences were not as noticeable in mobile
348 assemblages as opposed to sessile assemblages. Our results showed that the mobile
349 assemblages, unlike sessile ones, present a compositional structure and abundance of
350 functional traits more similar than that of sessile assemblages, suggesting that the functional
351 structure of these mobile assemblages is less affected by the type of artificial coastal
352 structures (floating vs. non-floating) than that of sessile assemblages.

353 Floating and non-floating man-made marine structures have the potential to create
354 habitats that attract diverse organisms, including habitat-formers that develop on the empty
355 foundations of these structures (Connell 2000, Holloway and Connell 2002, Leclerc and
356 Viard 2018). These habitat-forming organisms, most often sessile, facilitate the recruitment
357 and the subsequent establishment of diverse sets of other species that use these taxa as a
358 source of food and/or shelter (see Bruno and Bertness 2001, Karalis et al. 2003, Sellheim et
359 al. 2010). Given these biotic interactions, changes in the species composition of sessile
360 assemblages may further determine the composition and changes of the associated mobile
361 assemblages (Sellheim et al. 2010, Sueiro et al. 2011, Leclerc and Viard 2018). For example,
362 on floating structures, Leclerc and Viard (2018) found correlations between the richness and
363 abundance of mobile fauna and the volume of interstices created by the sessile fauna. Other
364 studies in ports however only reported few correlations between the compositions of the

365 sessile and mobile assemblages (see Birdsey et al. 2011, Lavender et al. 2017), and variables
366 such as habitat cover, identity, and functional diversity of sessile assemblages did not predict
367 the variation of the associated mobile assemblages (Birdsey et al. 2011). In our study,
368 contrasting patterns were observed between sessile and mobile assemblages. In sessile
369 assemblages, the functional structure varied between habitats within each port, and among
370 experimental units (plots), with contrasting abundance of the functional traits. This pattern
371 could be explained because sessile assemblages may be influenced by local settlement
372 dynamics (e.g. Hedge and Johnston 2012, Leclerc et al. 2021), especially where taxa with
373 propagules displaying short pelagic duration (notably lecithotrophic larvae) dominate, as
374 upon our settlement plates. Conversely, in the mobile assemblages, the functional structure
375 was more similar and the modalities of the traits showed similar proportions of abundance in
376 habitats and ports, and seldom varied among experimental plots. Considering the prominent
377 role of species abilities to post-settlement dispersal on the community structure of novel
378 habitats (Palmer et al. 1996, Martins et al 2017), the intrinsic capability of movement among
379 taxa is likely to be a critical factor explaining the observed greater functional similarity
380 between habitats in mobile compared to sessile assemblages.

381 Moreover, while we observed complex variations in the richness and diversity
382 (taxonomic and functional) of the sessile assemblages between habitats and ports, the mobile
383 assemblages showed more consistent results, with the greatest richness and diversity found
384 in the floating habitats at both ports. This indicates that despite the putative lower
385 connectivity with the benthos of the floating habitats for many groups (especially non-
386 swimming taxa), a substantial dispersal of mobile species towards floating habitats and
387 between them is warranted. Considering that 60 % of the taxa has a direct development in

388 these habitats, dispersal of these mobile species is likely due to the migration of adults and
389 juveniles. However, larval dispersal and recruitment of post-larval stages, either from nearby
390 benthic habitats or from other artificial habitats (see Susick et al. 2020, Leclerc and Viard
391 2018) is likely to play an important role for benthic-pelagic or holo-pelagic species (Hudson
392 et al. 2016). In our experiments, the plates were deployed over 3 months, a time long enough
393 for colonization by mobile species (including tube-dwelling taxa) from rocky subtidal
394 habitats, especially during summer (Norderhaug et al. 2002, Waage-Nielsen et al. 2003).
395 Additionally, these mobile assemblages can redistribute after settlement, colonize new
396 patches of habitat in interconnected or nearby areas, becoming more diverse and abundant in
397 areas further away from their source habitat/reef (Virnstein and Curran 1986, Martins et al.
398 2017).

399 Floating habitats, being less accessible to non-swimming species, in particular non-
400 swimming predators, show a lower predation pressure (Dumont et al. 2011, Rogers et al.
401 2016, Leclerc et al. 2020a), which may in turn influence the diversity and structure of the
402 community. For instance, in temperate marinas, low predation pressure by benthic predators
403 in floating habitats had been shown to increase the biotic complexity of sessile assemblages,
404 which in turn could favor colonization by mobile species (Leclerc and Viard 2018). In our
405 study, the sessile assemblage had a 40 % greater coverage on the floating structures than on
406 the non-floating ones, and we also found a higher percentage of empty patches in the
407 settlement plates deployed on the non-floating structures. Although the present dataset does
408 not allow to evaluate the relationship between the richness/diversity of the mobile
409 assemblage and the functional composition of the sessile assemblage, it is likely that a greater
410 coverage of the sessile assemblage favors the associated mobile assemblage of floating

411 habitats by providing an increased availability of microhabitats and refuges, decreasing
412 predator-prey encounters for mobile species (Grabowski 2004, Scyphers and Powers 2013,
413 Leclerc and Viard 2018). Nonetheless, other mechanisms to the aforementioned, such as
414 differences of the biotic and abiotic stress gradients among habitats, may be responsible for
415 the richer and more functionally diverse mobile fauna we measured on floating structures,
416 for which further investigation is required. It is noteworthy that although remarkable
417 differences in taxonomic diversity and functional richness were found for mobile
418 assemblages between habitats, no difference in the functional structure could be detected
419 when abundances (here the number of individuals) were considered. As suggested elsewhere
420 (e.g. Hillebrand et al 2018, Boyé et al. 2020), this result warrants caution regarding blind
421 uses of diversity metrics and encourages more comprehensive analyses incorporating species
422 identity and the influence of their traits on the system dynamics to detect changes in
423 biodiversity and ecosystem functioning.

424 Floating habitats differ from their non-floating counterparts in a considerable number
425 of abiotic and biotic conditions (e.g., connection/link with the benthos, exposure to predators
426 and scavengers, orientation to currents, and disturbance regimes). These conditions could act
427 as a filter for certain functional traits (e.g., r-selected traits and/or tolerance to disturbance,
428 see Piola and Johnston 2009, Zhan et al. 2015, Johnston et al. 2017, Leclerc et al. 2020b).
429 When the filters are characteristic to a certain environment, then through similar selective
430 processes, large scale patterns in the composition and functions of the assemblages of these
431 environments may arise (Poff 1997, Statzner et al. 2004). However, among most of the traits
432 considered in this study, more differences were found among structures or harbors than
433 between habitats, and this may suggest that there was no differential selection of particular

434 traits between the types of habitats studied. However, our results showed a high percentage
435 of taxa with traits characteristics of early successional stages such as small sizes (sessile:
436 79% <50mm, mobile: 60% <10mm), short longevity (sessile 70% <1 year, mobile: 93% <3
437 years) and short pelagic larval duration (70% sessile <1 day, mobile 69 % none or <1 day)
438 (Giangrade et al. 1994, Odum 1969). Thus, the early stage of maturity of the study
439 communities or the broad array of putative processes influencing spatial patterns in coastal
440 biodiversity (see Benedetti-Cecchi 2001, Fraschetti et al. 2005, Chang and Marshall 2016)
441 could also generate such results. Hence, considering that a greater complexity of interactions
442 could occur in more advanced successional stages (e.g. Aguilera and Navarrete 2012),
443 evaluating changes in functional traits later during succession may give a better
444 approximation of the functional structure of these communities.

445 The dissimilarity of the relationships between the functional diversity of sessile taxa
446 and their richness suggests that floating habitats present a functional redundancy superior to
447 that of non-floating ones. Likewise, our results showed a greater functional similarity of the
448 sessile assemblages among the plates of the floating habitats and a greater multivariate
449 dispersion among those of the non-floating habitats. In general, disturbed environments can
450 favor the establishment of species with more similar combinations of traits (Poff 1997,
451 Leibold et al. 2004, Stutzner et al. 2004, Valdivia et al. 2017, Leclerc 2018). However, our
452 results do not allow us to know whether or not the environmental conditions in floating
453 habitats, may be responsible for the similarity we found among the traits of these habitats.
454 For example, the greater variability in the composition of traits among the plates of non-
455 floating habitats could possibly be linked to the more intense predation pressure reported in
456 these types of habitats (see Diaz and McQuaid 2011, Valdivia et al. 2017). In these habitats,

457 important variation in the effect of predation among patches and pillars had been previously
458 reported (Leclerc et al. 2020a). As any other disturbance (Sousa 1984, Connell and Slatyer
459 1977, Sousa 1979), predation at the microhabitat scale (within a single plate) on the one hand
460 can reduce the richness and abundance of species (and proportionally the functional diversity
461 of the community/assemblage), while on the other hand, the freed space on the plates, caused
462 by predation, can increase the richness and abundance of species by repeatedly opening new
463 patches/substrate available for the colonization by new species.

464 Likewise, it should be considered that greater similarities in the community structure
465 of sessile assemblages in floating versus non-floating habitats have been reported (Holloway
466 and Connell 2002, Leclerc et al. 2020), including on a regional scale (Leclerc et al. 2020b).
467 According to many authors, floating structures have assemblages of particular species, where
468 there is generally a greater abundance and richness of non-native species compared to no-
469 floating structures (Holloway and Connell 2002, Glasby et al. 2007, Dafforn et al. 2009,
470 Johnston et al. 2017, Leclerc and Viard 2018, Leclerc et al. 2020b). The susceptibility to
471 invasion and to biotic homogenization of these floating structures (Leclerc et al. 2020b)
472 might explain the greater similarity in the functional structure, diversity and redundancy, of
473 the sessile assemblages in floating habitats, a hypothesis to be further tested, for instance by
474 distinguishing native and non-native taxa at broader scales.

475 To conclude, our data showed that the functional structure of both sessile and mobile
476 assemblages varies between floating and non-floating artificial habitats. However, such
477 variations are minor among mobile assemblages as opposed to sessile ones. Dispersal ability
478 of mobile species is likely to be a major determinant of this pattern. Our results suggest that
479 despite the (almost) absence of any physical link between floating habitats and the benthos,

480 the dispersal capacity of much mobile species leads to richer and more diverse assemblages
481 than expected in these habitats. In this study, we however did not find a clear suite of
482 functional traits prevailing in one or the other habitat type, in either assemblages. As we only
483 examined functional traits at an early successional state of these communities, we
484 recommend evaluating their composition in more advanced stages of the community's
485 development to evaluate 1) whether the low functional differences in the mobile assemblage
486 are maintained, and 2) whether there is a selection over time of certain functional traits that
487 differs between the types of habitats, floating vs. non-floating.

488

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501 **Author's contributions**

502 JCL, NF, FV and AB conceived the working hypotheses and designed the study. JCL
503 led the fieldwork, sample collection and conducted the taxonomic analyses of the sessile
504 assemblages. NF realized the taxonomic analyses of the mobile assemblages. NF did
505 literature research to fill in the trait matrices and conducted all data analyses (taxonomic and
506 functional diversities, statistics). NF led the writing, with substantial contributions from the
507 other co-authors. All authors critically revised and edited the manuscript drafts.

508 **Data accessibility**

509 Some of the data are provided in the supplementary material associated with the
510 manuscript. Detailed data will be made publicly available in the Dryad repository.

511 **References**

512 Adams, T.P., Miller, R.G., Aleynik, D., Burrows, M.T., 2014. Offshore marine renewable
513 energy devices as stepping stones across biogeographical boundaries. *J. Appl. Ecol.* 51, 330–
514 338. <https://doi.org/10/ghmfbj>

515 Aguilera, M.A., Navarrete, S.A., 2012. Functional identity and functional structure
516 change through succession in a rocky intertidal marine herbivore assemblage. *Ecology* 93,
517 75–89. <https://doi.org/10.1890/11-0434.1>

518 Aguilera, M.A., Broitman, B.R., Thiel, M., 2014. Spatial variability in community
519 composition on a granite breakwater versus natural rocky shores: lack of microhabitats
520 suppresses intertidal biodiversity. *Mar. Pollut. Bull.* <https://doi.org/10/f6n43z>

521 Airoldi, L., Bulleri, F., 2011. Anthropogenic Disturbance Can Determine the Magnitude
522 of Opportunistic Species Responses on Marine Urban Infrastructures. *PLoS One* 6, e22985.
523 <https://doi.org/10/bq4gww>

524 Airoldi, L., Connell, S.D., Beck, M.W., 2009. The Loss of Natural Habitats and the
525 Addition of Artificial Substrata, In: Wahl, M. (Ed.), *Marine Hard Bottom Communities:
526 Patterns, Dynamics, Diversity, and Change*, Ecological Studies. Springer, Berlin, Heidelberg,
527 pp. 269–280.

528 Airoldi, L., Turon, X., Perkol-Finkel, S., Rius, M., 2015. Corridors for aliens but not for
529 natives: effects of marine urban sprawl at a regional scale. *Divers. Distrib.* 21, 755–768.
530 <https://doi.org/10/gkms2t>

531 Aldea, C., Valdovinos, C., 2005. Moluscos del intermareal rocoso del centro-sur de Chile
532 (36° - 38°s): taxonomía y clave de identificación. *Gayana (Concepción)* 69, 364–396.
533 <https://doi.org/10/c7sq4z>

534 Anderson, M., 2001. Permutation tests for univariate or multivariate analysis and
535 regression. *Can. J. Fish. Aquat. Sci.* 58, 626–639. <https://doi.org/10/fscj4n>

536 Anderson, M.J., Gorley, R.N., Clarke, K.R., 2008. PERMANOVA+ for PRIMER: Guide
537 to Software and Statistical Methods. Plymouth, UK: PRIMER-E

538 Aronson, M.F.J., Nilon, C.H., Lepczyk, C.A., Parker, T.S., Warren, P.S., Cilliers, S.S.,
539 Goddard, M.A., Hahs, A.K., Herzog, C., Katti, M., La Sorte, F.A., Williams, N.S.G.,
540 Zipperer, W., 2016. Hierarchical filters determine community assembly of urban species
541 pools. *Ecology* 97, 2952–2963. <https://doi.org/10/f9bss6>

542 Beauchard, O., Veríssimo, H., Queirós, A.M., Herman, P.M.J., 2017. The use of multiple
543 biological traits in marine community ecology and its potential in ecological indicator
544 development. *Ecol. Indic.* 76, 81–96. <https://doi.org/10/gbrzw5>

545 Benedetti-Cecchi, L., 2001. Variability in abundance of algae and invertebrates at
546 different spatial scales on rocky sea shores. *Mar. Ecol. Prog. Ser.* 215, 79–92.
547 <https://doi.org/10/fsb6tr>

548 Birdsey, E.M., Johnston, E.L., Poore, A.G.B., 2012. Diversity and cover of a sessile
549 animal assemblage does not predict its associated mobile fauna. *Mar. Biol.* 159, 551–560.
550 <https://doi.org/10/bbj8ps>

551 Bishop, M.J., Mayer-Pinto, M., Airoidi, L., Firth, L.B., Morris, R.L., Loke, L.H.L.,
552 Hawkins, S.J., Naylor, L.A., Coleman, R.A., Chee, S.Y., Dafforn, K.A., 2017. Effects of
553 ocean sprawl on ecological connectivity: impacts and solutions. *J. Exp. Mar. Bio. Ecol.*, 492,
554 7–30. <https://doi.org/10/gbn3wg>

555 Boyé, A., Thiébaud, E., Grall, J., Legendre, P., Broudin, C., Houbin, C., Le Garrec, V.,
556 Maguer, M., Droual, G., Gauthier, O., 2019. Trait-based approach to monitoring marine
557 benthic data along 500 km of coastline. *Diversity and Distributions* 25,1879-1896.
558 <https://doi.org/10.1111/ddi.12987>

559 Bremner, J., Rogers, S.I., Frid, C.L.J., 2003. Assessing functional diversity in marine
560 benthic ecosystems: a comparison of approaches. *Mar. Ecol. Prog. Ser.* 254, 11–25.
561 <https://doi.org/10/b6srw3>

562 Bremner, J., Rogers, S.I., Frid, C.L.J., 2006. Methods for describing ecological
563 functioning of marine benthic assemblages using biological traits analysis (BTA). *Ecol.*
564 *Indic.* 6, 609–622. <https://doi.org/10/fh4d23>

565 Bruno, J., Bertness, M. D., 2001. Positive interactions, facilitations and foundation
566 species. In: Bertness, M.D. Gaines, S. and Hay, M. (eds) *Marine community ecology*. Sinauer
567 Associates, Inc Publishers, Sunderland, Massachusetts, 201-218.

568 Bulleri, F., Chapman, M.G., 2010. The introduction of coastal infrastructure as a driver
569 of change in marine environments. *J. Appl. Ecol.* 47, 26–35. <https://doi.org/10/dqnpwc>

570 Carvalho, S., Moura, A., Cúrdia, J., da Fonseca, L. C., and Santos, M. N., 2013. How
571 complementary are epibenthic assemblages in artificial and nearby natural rocky reefs? *Mar.*
572 *Environ. Res.* 92, 170–177. <https://doi.org/10/f5jrj>

573 Casanoves, F., Pla, L., Di Rienzo, J.A., 2011. Valoración y análisis de la diversidad
574 funcional y su relación con los servicios ecosistémicos. Serie técnica, Informe técnico, 384.

575 Chang, C., Marshall, D.J., 2016. Spatial pattern of distribution of marine invertebrates
576 within a subtidal community: do communities vary more among patches or plots? *Ecol. Evol.*
577 6, 8330–8337. <https://doi.org/10/f9b8jz>

578 Chevenet, F., Dolédec, S., Chessel, D., 1994. A fuzzy coding approach for the analysis
579 of long-term ecological data. *Freshw. Biol.* 31, 295–309. <https://doi.org/10/dzbfv6>

580 Connell, J.H., Slatyer, R.O., 1977. Mechanisms of Succession in Natural Communities
581 and Their Role in Community Stability and Organization. *Am. Nat.* 111, 1119–1144.
582 <https://doi.org/10/db44n5>

583 Connell, null, 2000. Floating pontoons create novel habitats for subtidal epibiota. *J. Exp.*
584 *Mar. Bio. Ecol.* 247, 183–194. <https://doi.org/10/dx8z4j>

585 Connell, S.D., 2001. Urban structures as marine habitats: an experimental comparison of
586 the composition and abundance of subtidal epibiota among pilings, pontoons and rocky reefs.
587 *Mar. Environ. Res.* 52, 115–125. <https://doi.org/10/fsm97r>

588 Córdova-Tapia, F., Zambrano, L., 2015. La diversidad funcional en la ecología de
589 comunidades. *Ecosistemas* 24, 78–87. <https://doi.org/10/gkms3h>

590 Dafforn, K.A., Johnston, E.L., Glasby, T.M., 2009. Shallow moving structures promote
591 marine invader dominance. *Biofouling* 25, 277–287. <https://doi.org/10/cww5b7>

592 Darling, J.A., Carlton, J.T., 2018. A framework for understanding marine
593 cosmopolitanism in the Anthropocene. *Frontiers in Marine Science* 5, 293.
594 <https://doi.org/10.3389/fmars.2018.00293>

595 Díaz, E.R., McQuaid, C.D., 2011. A spatially explicit approach to trophic interactions
596 and landscape formation: patchiness in small-scale variability of grazing effects along an
597 intertidal stress gradient. *J. Ecol.* 99, 416–430. <https://doi.org/10/bmd7qs>

598 Dumont, C.P., Gaymer, C.F., Thiel, M., 2011. Predation contributes to invasion
599 resistance of benthic communities against the non-indigenous tunicate *Ciona intestinalis*.
600 *Biol. Invasions* 13, 2023–2034. <https://doi.org/10/djg8fh>

601 Firth, L.B., Knights, A.M., Bridger, D., Evans, A.J., Mieszkowska, N., Moore, P.,
602 O'Connor, N., Sheehan, E., Thompson, R.C., Hawkins, S.J., 2016. Ocean sprawl: challenges
603 and opportunities for biodiversity management in a changing world, *Oceanogr. Mar. Biol.*
604 54, 189-262.

605 Frascchetti, S., Terlizzi, A., Benedetti-Cecchi, L., 2005. Patterns of distribution of marine
606 assemblages from rocky shores: Evidence of relevant scales of variation. *Mar. Ecol. Ser.* 296,
607 13–29. <https://doi.org/10/b5wrdf>

608 Giachetti, C.B., Battini, N., Castro, K.L., Schwindt, E., 2020. Invasive ascidians: How
609 predators reduce their dominance in artificial structures in cold temperate areas. *J. Exp. Mar.*
610 *Bio. Ecol.* 533, 151459. <https://doi.org/10/gjwdnx>

611 Giangrande, A., Geraci, S., Belmonte, G., 1994. Life-cycle and life-history diversity in
612 marine invertebrates and the implications in community dynamics. *Oceanogr. Mar. Biol.* 32,
613 305-333.

614 Glasby, T.M., 2001. Development of sessile marine assemblages on fixed versus moving
615 substrata. *Mar. Ecol. Prog. Ser.* 215, 37–47. <https://doi.org/10/ch6tnr>

616 Glasby, T.M., Connell, S.D., 2001. Orientation and position of substrata have large
617 effects on epibiotic assemblages. *Mar. Ecol. Prog. Ser.* 214, 127–135.
618 <https://doi.org/10/fn29vg>

619 Glasby, T., Connell, S., Holloway, M., Hewitt, C., 2007. Nonindigenous biota on
620 artificial structures: Could habitat creation facilitate biological invasions? *Mar. Biol.* 151,
621 887–895. <https://doi.org/10/dfsnmz>

622 Grabowski, J.H., 2004. Habitat Complexity Disrupts Predator-Prey Interactions but Not
623 the Trophic Cascade on Oyster Reefs. *Ecology* 85, 995–1004. <https://doi.org/10/cqkqxv>

624 Hammer, O., Harper, D., Ryan, P., 2001. PAST: Paleontological Statistics Software
625 Package for Education and Data Analysis. *Palaeontol. Electron.* 4, 1–9.

626 Hays, W.L., 1963. *Statistics for Psychologists*. Holt, Rinehart and Winston, New York.

627 Hedge, L.H., Johnston, E.L., 2012. Propagule pressure determines recruitment from a
628 commercial shipping pier. *Biofouling* 28:73-
629 85.<https://doi.org.10.1080/08927014.2011.652622>.

630 Hill, M., 1973. Diversity and Evenness: A Unifying Notation and Its Consequences.
631 Ecology 54, 427–432. <https://doi.org/10/d42q4v>

632 Holloway, M.G., Connell, S., 2002. Why do floating structures create novel habitats for
633 subtidal epibiota? Mar. Ecol. Ser. - Mar Ecol-Progr Ser 235, 43–52. <https://doi.org/10/dvrprz>

634 Hudson, J., Viard, F., Roby, C., Rius, M., 2016. Anthropogenic transport of species across
635 native ranges: unpredictable genetic and evolutionary consequences. Biol. Lett. 12,
636 20160620. <https://doi.org/10/gkms3x>

637 Janiak, D.S., Branson, D., 2021. Impacts of habitat and predation on epifaunal
638 communities from seagrass beds and artificial structures. Mar. Environ. Res. 163, 105225.
639 <https://doi.org/10.1016/j.marenvres.2020.105225>

640 Johnston, E.L., Dafforn, K.A., Clark, G.F., Rius, M., Floerl, O., 2017. Anthropogenic
641 activities promoting the establishment and spread of marine non-indigenous species post-
642 arrival, In: Hawkins, S.J., Evans, A.J., Dale, A.C., Firth, L.B., Hughes, D.J., Smith, I.P.
643 (Eds.), Oceanography and Marine Biology: An Annual Review. CRC Press, pp. 389–419.

644 Karalis, P., Chryssanthi, A., Chintiroglou, C., 2003. Structure of the artificial hard
645 substrate assemblages in ports Thermaikos Gulf (North Aegean Sea). Enzym. Microb.
646 Technol. 26, 215–224. <https://doi.org/10/bkg978>

647 Lavender, J.T., Dafforn, K.A., Bishop, M.J., Johnston, E.L., 2017. Small-scale habitat
648 complexity of artificial turf influences the development of associated invertebrate
649 assemblages. J. Exp. Mar. Bio. Ecol. 492, 105–112. <https://doi.org/10/gbn3kv>

650 Leclerc, J.-C., 2018. Patterns of spatial variability between contrasting substrata: a
651 boulder-field study. *Mar. Ecol. Prog. Ser.* 597, 23–38. <https://doi.org/10/gdsc26>

652 Leclerc, J.-C., Brante, A., Viard, F., 2021. Rapid recovery of native habitat-builders
653 following physical disturbance on pier pilings offsets colonization of cryptogenic and non-
654 indigenous species in a Chilean port. *Mar. Environ. Res.* 163, 105231.
655 <https://doi.org/10/gkms5c>

656 Leclerc, J.-C., Viard, F., Brante, A., 2019. Experimental and survey-based evidences for
657 effective biotic resistance by predators in ports. *Biol. Invasions.* <https://doi.org/10/gg3k4w>

658 Leclerc, J.-C., Viard, F., González Sepúlveda, E., Díaz, C., Neira Hinojosa, J., Pérez
659 Araneda, K., Silva, F., Brante, A., 2018. Non-indigenous species contribute equally to
660 biofouling communities in international vs local ports in the Biobío region, Chile. *Biofouling*
661 34, 784–799. <https://doi.org/10/gg3k4z>

662 Leclerc, J.-C., Viard, F., Sepúlveda, E., Díaz, C., Hinojosa, J., Araneda, K., Silva, F.,
663 Brante, A., 2020. Habitat type drives the distribution of non-indigenous species in fouling
664 communities regardless of associated maritime traffic. *Divers. Distrib.*
665 <https://doi.org/10/gg3k4v>

666 Leibold, M.A., Holyoak, M., Mouquet, N., Amarasekare, P., Chase, J.M., Hoopes, M.F.,
667 Holt, R.D., Shurin, J.B., Law, R., Tilman, D., Loreau, M., Gonzalez, A., 2004. The
668 metacommunity concept: a framework for multi-scale community ecology. *Ecol. Lett.* 7,
669 601–613. <https://doi.org/10/bkg384>

670 López, D.P., Freestone, A.L., 2021. History of co-occurrence shapes predation effects on
671 functional diversity and structure at low latitudes. *Functional Ecology* 35, 535-545.
672 <https://doi.org/10.1111/1365-2435.13725>

673 Martínez-Laiz, G., Ulman, A., Ros, M., Marchini, A., 2019. Is recreational boating a
674 potential vector for non-indigenous peracarid crustaceans in the Mediterranean Sea? A
675 combined biological and social approach. *Mar. Pollut. Bull.* 140, 403–415.
676 <https://doi.org/10/gkms5d>

677 Martins, G.M., Matias, M.G., Moniz, I., Rius, C., Sanderson, J., Neto, A.I., Jenkins, S.R.,
678 2017. Post-settlement dispersal ability determines structure of marine benthic
679 metacommunities. *Mar. Ecol. Prog. Ser.* 569, 15–23. <https://doi.org/10/f97p9m>

680 Mayer-Pinto, M., Cole, V.J., Johnston, E.L., Bugnot, A., Hurst, H., Airoidi, L., Glasby,
681 T.M., Dafforn, K.A., 2018. Functional and structural responses to marine urbanisation.
682 *Environ. Res. Lett.* 13, 14009. <https://doi.org/10/gkms5p>

683 Micheli, F., Halpern, B.S., 2005. Low functional redundancy in coastal marine
684 assemblages. *Ecol. Lett.* 8, 391–400. <https://doi.org/10/bx6qcq>

685 Mineur, F., Cook, E.J., Minchin, D., Bohn, K., MacLeod, A., Maggs, C.A., 2012.
686 Changing coasts: marine aliens and artificial structures. *Oceanogr. Mar. Biol. an Annu. Rev.*
687 Vol. 50 189–233.

688 Mouchet, M., Villéger, S., Mason, N., Mouillot, D., 2010. Functional diversity measures:
689 an overview of their redundancy and their ability to discriminate community assembly rules.
690 *Funct. Ecol.* 24, 867–876. <https://doi.org/10/d3cknd>

691 Muñoz, S.A., George-Nascimento, M., 2008. The effect of *Anonchocephalus chilensis*
692 *Riggenbach* (Eucestoda: Bothriocephalidea) on infracommunity patterns in *Genypterus*
693 *maculatus* Tschudi (Osteichthyes: Ophidiidae). *J. Helminthol.* 82, 221–226.
694 <https://doi.org/10/b9k4w7>

695 Norderhaug, K., Christie, H., Rinde, E., 2002. Colonisation of kelp imitations by epiphyte
696 and holdfast fauna; a study of mobility patterns. *Mar. Biol.* 141, 965–973.
697 <https://doi.org/10/c8z4vv>

698 Odum, E.P., 1969. The Strategy of Ecosystem Development. *Science* 164:262-270

699 Palmer, M.A., Allan, J.D., Butman, C.A., 1996. Dispersal as a regional process affecting
700 the local dynamics of marine and stream benthic invertebrates. *Trends Ecol. Evol.* 11, 322–
701 326. <https://doi.org/10/fp5bz8>

702 Perkol-Finkel, S., Shashar, N., Benayahu, Y., 2006. Can artificial reefs mimic natural reef
703 communities? The roles of structural features and age. *Mar. Environ. Res.* 61, 121–135.
704 <https://doi.org/10/frqz38>

705 Petchey, O., Gaston, K., 2006. Petchey OL, Gaston KJ. Functional diversity: back to
706 basics and looking forward. *Ecol Lett* 9: 741-758. *Ecol. Lett.* 9, 741–758.
707 <https://doi.org/10/fvgtw3>

708 Piola, R.F., Johnston, E.L., 2009. Comparing differential tolerance of native and non-
709 indigenous marine species to metal pollution using novel assay techniques. *Environ. Pollut.*
710 (Barking, Essex 1987) 157, 2853–2864. <https://doi.org/10/d49g52>

711 Poff, N.L., 1997. Landscape Filters and Species Traits: Towards Mechanistic
712 Understanding and Prediction in Stream Ecology. *J. North Am. Benthol. Soc.* 16, 391–409.
713 <https://doi.org/10/d2nbw9>

714 R Core Team. 2016. R A Language and Environment for Statistical Computing. R
715 Foundation for Statistical Computing, Vienna, Austria. URL: <http://www.r-project.org>

716 Rogers, T., Byrnes, J., Stachowicz, J., 2016. Native predators limit invasion of benthic
717 invertebrate communities in Bodega Harbor, California. *Mar. Ecol. Prog. Ser.* 545.
718 <https://doi.org/10/f8ftz3>

719 Scyphers, S.B., Powers, S.P., 2013. Context-dependent effects of a marine ecosystem
720 engineer on predator-prey interactions. *Mar. Ecol. Prog. Ser.* 491, 295–301.
721 <https://doi.org/10/f5cw7x>

722 Sedano, F., Navarro-Barranco, C., Guerra-García, J.M., Espinosa, F., 2020. From sessile
723 to vagile: Understanding the importance of epifauna to assess the environmental impacts of
724 coastal defence structures. *Estuar. Coast. Shelf Sci.* 235, 106616. <https://doi.org/10/gkms5q>

725 Sellheim, K., Stachowicz, J.J., Coates, R.C., 2009. Effects of a nonnative habitat-forming
726 species on mobile and sessile epifaunal communities. *Mar. Ecol. Prog. Ser.* 398, 69–80.
727 <https://doi.org/10.3354/meps08341>

728 Simberloff, D., Martin, J.L., Genovesi, P., Maris, V., Wardle, D.A., Aronson, J.,
729 Courchamp, F., Galil, B., García-Berthou, E., Pascal, M., Pyšek, P., Sousa, R., Tabacchi, E.,
730 Vilà, M., 2013. Impacts of biological invasions: What’s what and the way forward. *Trends*
731 *Ecol. Evol.* 28, 58–66. <https://doi.org/10.1016/j.tree.2012.07.013>

732 Sousa, W.P., 1979. Experimental Investigations of Disturbance and Ecological
733 Succession in a Rocky Intertidal Algal Community. *Ecol. Monogr.* 49, 228–254.
734 <https://doi.org/10/brszvt>

735 Sousa, W. P., 1984. The role of disturbance in natural communities. *Annu. Rev. Ecol.*
736 *Evol. Syst.* 15, 353-391. <https://doi.org/10.1146/annurev.es.15.110184.002033>

737 Statzner, B., Dolédec, S., Hugueny, B., 2004. Biological trait composition of European
738 stream invertebrate communities: Assessing the effects of various trait filter types.
739 *Ecography (Cop.)*. 27, 470–488. <https://doi.org/10/bvdjwq>

740 Strain, E.M.A., Olabarria, C., Mayer-Pinto, M., Cumbo, V., Morris, R.L., Bugnot, A.B.,
741 Dafforn, K.A., Heery, E., Firth, L.B., Brooks, P.R., Bishop, M.J., 2018. Eco-engineering
742 urban infrastructure for marine and coastal biodiversity: Which interventions have the
743 greatest ecological benefit? *J. Appl. Ecol.* 55, 426–441. <https://doi.org/10/gfsqmx>

744 Sueiro, M.C., Bortolus, A., Schwindt, E., 2011. Habitat complexity and community
745 composition: relationships between different ecosystem engineers and the associated
746 macroinvertebrate assemblages. *Helgol. Mar. Res.* 65, 467–477. <https://doi.org/10/fsh7dg>

747 Susick, K., Scianni, C., Mackie, J., 2020. Artificial structure density predicts fouling
748 community diversity on settlement panels. *Biol. Invasions* 22, 1–22.
749 <https://doi.org/10/gkms53>

750 Thomsen, M., Byers, J., Schiel, D., Bruno, J., Olden, J., Wernberg, T., Silliman, B., 2014.
751 Impacts of marine invaders n biodiversity depend on trophic position and functional
752 similarity. *Mar. Ecol. Prog. Ser.* 495, 39–47. <https://doi.org/10/f5q5kv>

753 Tsutakawa, R.K., Hewett, J.E., 1977. Quick test for comparing two populations with
754 bivariate data. *Biometrics* 33, 215–219. <https://doi.org/10.2307/2529314>

755 van der Linden, P., Marchini, A., Dolbeth, M., Patrício, J., Veríssimo, H., Marques, J.C.,
756 2016. The performance of trait-based indices in an estuarine environment. *Ecological*
757 *Indicators*. 61, 378-389. <https://doi.org/10.1016/j.ecolind.2015.09.039>

758

759 Valdivia, N., Segovia-Rivera, V., Fica, E., Bonta, C.C., Aguilera, M.A., Broitman, B.R.,
760 2017. Context-dependent functional dispersion across similar ranges of trait space covered
761 by intertidal rocky shore communities. *Ecol. Evol.* 7, 1882–1891. <https://doi.org/10/f92rdc>

762 Villéger, S., Blanchet, S., Beauchard, O., Oberdorff, T., Brosse, S., 2011.
763 Homogenization patterns of the world’s freshwater fish faunas. *Proc. Natl. Acad. Sci.* 108,
764 18003–18008. <https://doi.org/10/cpm26h>

765 Virnstein, R. W., Curran, M. C., 1986. Colonization of artificial seagrass versus time and
766 distance from source. *Mar. Ecol. Prog. Ser.* 29, 279-288 <https://doi.org/10.3354/meps029279>

767 Waage-Nielsen, E., Christie, H., Rinde, E., 2003. Short-term dispersal of kelp fauna to
768 cleared (kelp-harvested) areas. *Hydrobiologia* 503, 77-91.
769 <https://doi.org/10.1023/B:HYDR.00000008490.51745.a9>

770 Williams, J.S., Tsutakawa, R.K., Hewett, J.E., 1977. Quick test for comparing two
771 populations with bivariate data. *Biometrics* 33, 215–219.

772 Yakovis, E.L., Artemieva, A. V, Shunatova, N.N., Varfolomeeva, M.A., 2008. Multiple
773 Foundation Species Shape Benthic Habitat Islands. *Oecologia* 155, 785–795.
774 <https://doi.org/10/ddb87r>

775 Zhan, A., Briski, E., Bock, D., Ghabooli, S., MacIsaac, H., 2015. Ascidians as models for
776 studying invasion success. *Mar. Biol.* 2449–2470. <https://doi.org/10/f724dn>

777

778

779 **Tables**

780 **Table 1.** Selected biological traits and categories used to describe the functional structure of
 781 sessile and mobile invertebrates assemblages in artificial marine habitats, in the Southeast
 782 Pacific, Chile; after Bremner et al., (2003) and Beauchard et al., (2017).

Traits		Modality		Traits		Modality	
Feeding Habit	Autotroph Filter/suspension feeder Deposit feeder Predator Opportunist/scavenger Grazer	Adult mobility	None Low Medium High				
Individual /colonial size	1-10 mm 10-50 mm 50-100 mm 100-300 mm	Lifespan	<1 year >1-3 years 3-5 years >5 years				
Body form	Flat Mound Erect Elongate Little elongate/ellipsoid	Reproductive mode	Asexual Sexual (broadcast spawner) Sexual (planktonic larvae) Sexual (direct-developer)				
Sociability	Solitary Colonial	Larval development	Pelagic planktotrophic Pelagic lecithotrophic Direct benthic				
Degree of attachment	None Behavioral Temporary Permanent	Pelagic larval duration	None <1 day 1-7days 7-30 days >30 days				
Motility	Sessile Burrower Crawler Crawler-swimmer Swimmer						

783

784

786 **Table 2.** Results of the ANOVA for the difference of taxonomic and functional diversity of sessile and mobile invertebrate assemblages
 787 associated to artificial marine habitats in two ports of the Southeast Pacific, Chile. The value of F and ω^2 and its significance at $\alpha = 0.05$
 788 in bold (*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$) is given for each factor (*Habitat vs. Port*), and their interactions. Tests of homogeneity
 789 of variances are summarized by their p values.

790

Response variable	ANOVA Factor (df, total = 31)						Levene		
	Habitat = H		Port = P		H × P		Experimental Unit		p
	F	ω^2	F	ω^2	F	ω^2	F	ω^2	
Richness(S)									
Sessile	0.90	0.00	2.92	0.03	34.74***	0.49	1.20	0.05	0,64
Mobile	53.64***	0.63	0.19	0.00	2.04	0.01	0.80	0.03	0,63
Taxa diversity (1/λ)									
Sessile (*)	1.35	0.00	19.02**	0.10	104.9***	0.58	1.27	0.06	0.11
Mobile	45.62***	0.60	0.70	0.00	0.00	0.00	0.68	0.02	0.37
Functional diversity (FDc)									
Sessile	1.12	0.00	2.39	0.02	33.08***	0.47	1.78	0.08	0.45
Mobile	32.30***	0.60	0.02	0.00	3.76	0.04	1.62	0.08	0.51
Functional diversity (wFDc)									
Sessile	4.47	0.03	0.23	0.26	91.32***	0.44	7.83	0.14	0.07
Mobile	6.84*	0.41	2.88	0.02	33.84***	0.46	0.66	0.02	0.41

791 (*) transformation Square-root

792

793 **Table 3.** PERMANOVA results for the differences in functional structure (composition and abundance) of the sessile and mobile
 794 assemblages. The pseudo-F of PERMANOVA and PERMDISP (H × P) are given along with significance at $\alpha = 0.05$ (*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$) and the effect size (ω^2) of each factor.
 795

Assemblage	Sessile						Mobile					
	Composition			Abundance			Composition			Abundance		
Transformation	None			Square-root			None			Fourth-root		
PERMDISP	F _{1,30} = 1.09 p = 0.354			F _{1,30} : 34.01 p < 0.001			F _{1,30} : 8.23 p = 0.012			F _{1,30} : 7.47 p = 0.013		
Source	df	Pseudo-F	ω^2	df	Pseudo-F	ω^2	df	Pseudo-F	ω^2	df	Pseudo-F	ω^2
Habitat = H	1	0.65	0,05	1	1.01	0,26	1	4.31	0,15	1	1.25	0,39
Port = P	1	3.02**	0,16	1	22.74**	0,50	1	6.97*	0,15	1	12.63*	0,08
H × P	1	1.19	0,05	1	10.87**	0,23	1	1.61	0,01	1	50.17**	0,32
Experimental Unit (H × P)	4	3.17***	0,21	4	5.92***	0,07	4	1.15	0,07	4	1.01	0,02
Res.	24			24			24			24		

796

797

798 **Table 4.** PERMANOVA results for the differences in the modality composition (weighted by abundances) of each functional trait of
799 taxa of the sessile assemblages of artificial marine habitats studied in two ports of the Southeast Pacific, Chile. The pseudo-F of
800 PERMANOVA and t value of PERMDISP (H × P) are given along with significance (in bold) at $\alpha = 0.05$ (*: $p < 0.05$, **: $p < 0.01$, ***:
801 $p < 0.001$) and the effect size (ω^2) of each factor.

Functional traits	PERMANOVA Factor (df, total = 31)								PERMDISP
	Habitat = H		Port = P		H × P		Experimental units		
	Pseudo F	ω^2	Pseudo F	ω^2	Pseudo F	ω^2	Pseudo F	ω^2	
Feeding habit	4.06	0.43	3.72	0.08	4.31	0.10	2.37*	0.09	4.27
Body form	1.31	0.26	7.89*	0.26	6.10*	0.20	6.41***	0.12	8.15**
Body size	0.33	0.16	14.01*	0.22	31.73**	0.49	6.47***	0.06	77.24***
Sociability	4.51	0.25	36.64**	0.60	3.38	0.05	11.86***	0.06	17.85***
Lifespan	0.64	0.14	23.69**	0.48	11.36**	0.23	7.87***	0.07	22.00***
Degree of attachment	7.14	0.59	1.16	0.03	2.44	0.07	5.91***	0.13	0.90
Reproductive mode	1.05	0.35	11.14**	0.17	21.93**	0.33	5.03***	0.06	1.13
Larval development	-	0.24	56.82**	0.68	-	0.03	5.75***	0.05	29.48***
Pelagic larval duration	0.00	0.05	106.37**	0.74	12.47*	0.08	2.30	0.03	44.92**

802 The data were previously transformed (square root transformation) and was used the Bray-Curtis Index to generate the similarity matrix.

803 **Table 5.** PERMANOVA results for the differences the functional structure (weighted by abundances) of each functional trait of the taxa
804 of the mobile assemblages in non-floating and floating habitats. The pseudo-F of PERMANOVA and t value of PERMDISP (H × P) are
805 given along with the respective significance (in bold) at $\alpha = 0.05$ (*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$) and the effect size (ω^2) of
806 each factor.

Functional traits	PERMANOVA Factor (df, total = 31)								PERMDISP
	Habitat = H		Port = P		H × P		Experimental Unit		
	Pseudo F	ω^2	Pseudo F	ω^2	Pseudo F	ω^2	Pseudo F	ω^2	
Feeding habit	0.95	0.36	9.41*	0.05	61.68**	0.25	0.97	0.01	0.17
Body form	1.08	0.26	26.98**	0.23	27.23**	0.24	1.05	0.03	0.21
Body size	1.73	0.44	6.49	0.04	34.90*	0.25	0.86	0.02	0.00
Mobility	1.31	0.42	6.60*	0.04	45.86**	0.32	1.07	0.02	7.64**
Adult mobility	0.93	0.34	29.36*	0.12	85.01**	0.28	0.79	0.01	0.77
Lifespan	0.96	0.38	3.30	0.01	52.75*	0.40	1.38	0.02	1.13
Degree of attachment	1.31	0.43	9.08*	0.04	55.93**	0.32	0.96	0.01	3.61
Reproductive mode	1.64	0.46	9.79*	0.05	45.65**	0.27	0.98	0.43	5.79*
Larval development	1.22	0.40	11.21*	0.06	57.85**	0.33	0.96	0.02	4.09*
Pelagic larval duration	0.00	0.38	9.40*	0.07	36.40**	0.30	1.14	0.02	5.43*

807

808 **Figure legends**

809

810 **Figure 1.** Indices of taxonomic and functional diversity of the sessile and mobile
811 assemblages associated with non-floating vs floating habitats in the two ports: San Vicente
812 and Coliumo, Southeast Pacific, Chile.

813

814 **Figure 2.** Relationship between functional diversity and taxa richness of sessile and mobile
815 assemblages in non-floating vs. floating habitats. Data are pooled across ports.

816

817 **Figure 3.** Principal coordinates analysis (PCO) of the composition (presence-absence) and
818 abundance of functional features of sessile and mobile assemblages on non-floating vs.
819 floating habitats in two ports (San Vicente vs. Coliumo) in the Southeast Pacific, Chile.

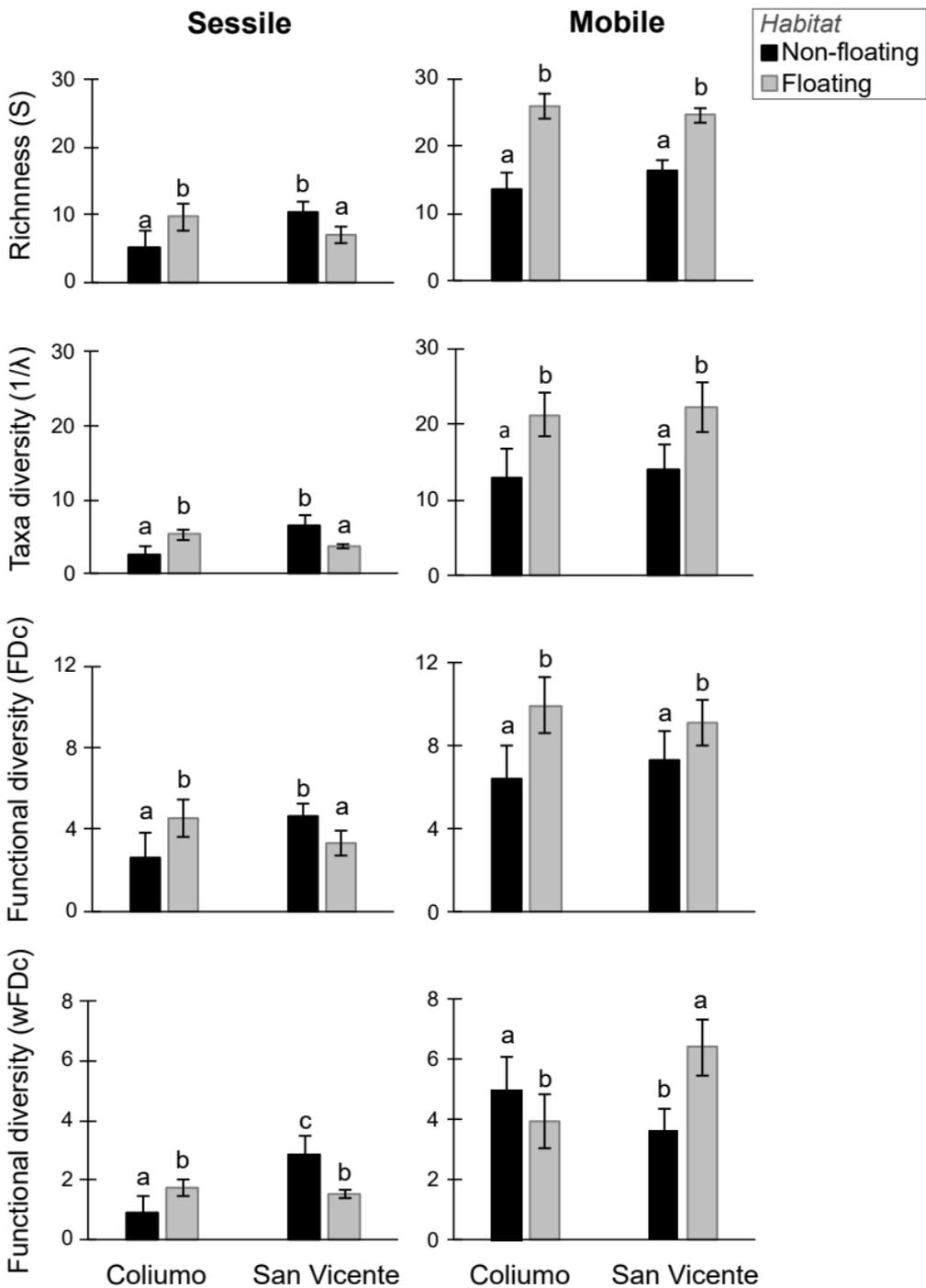
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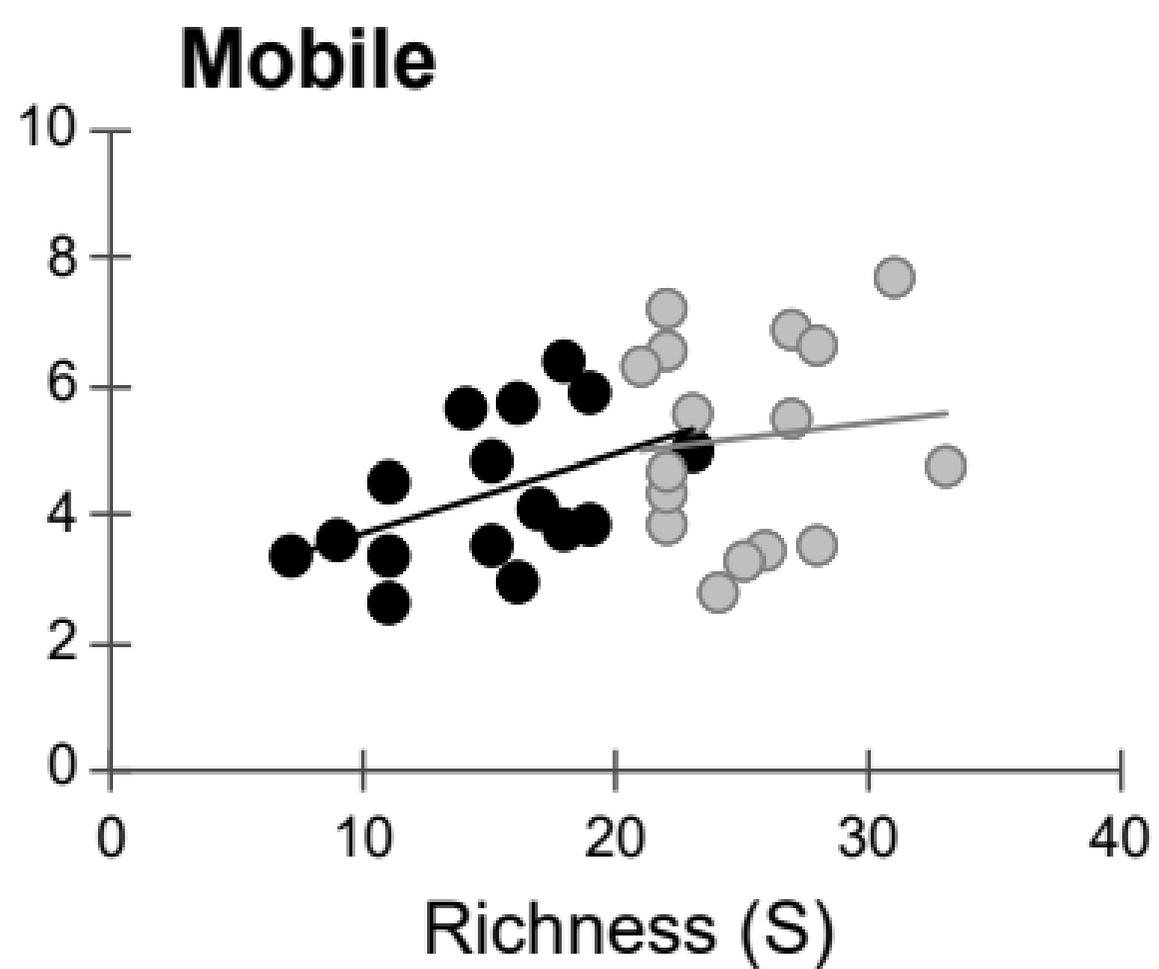
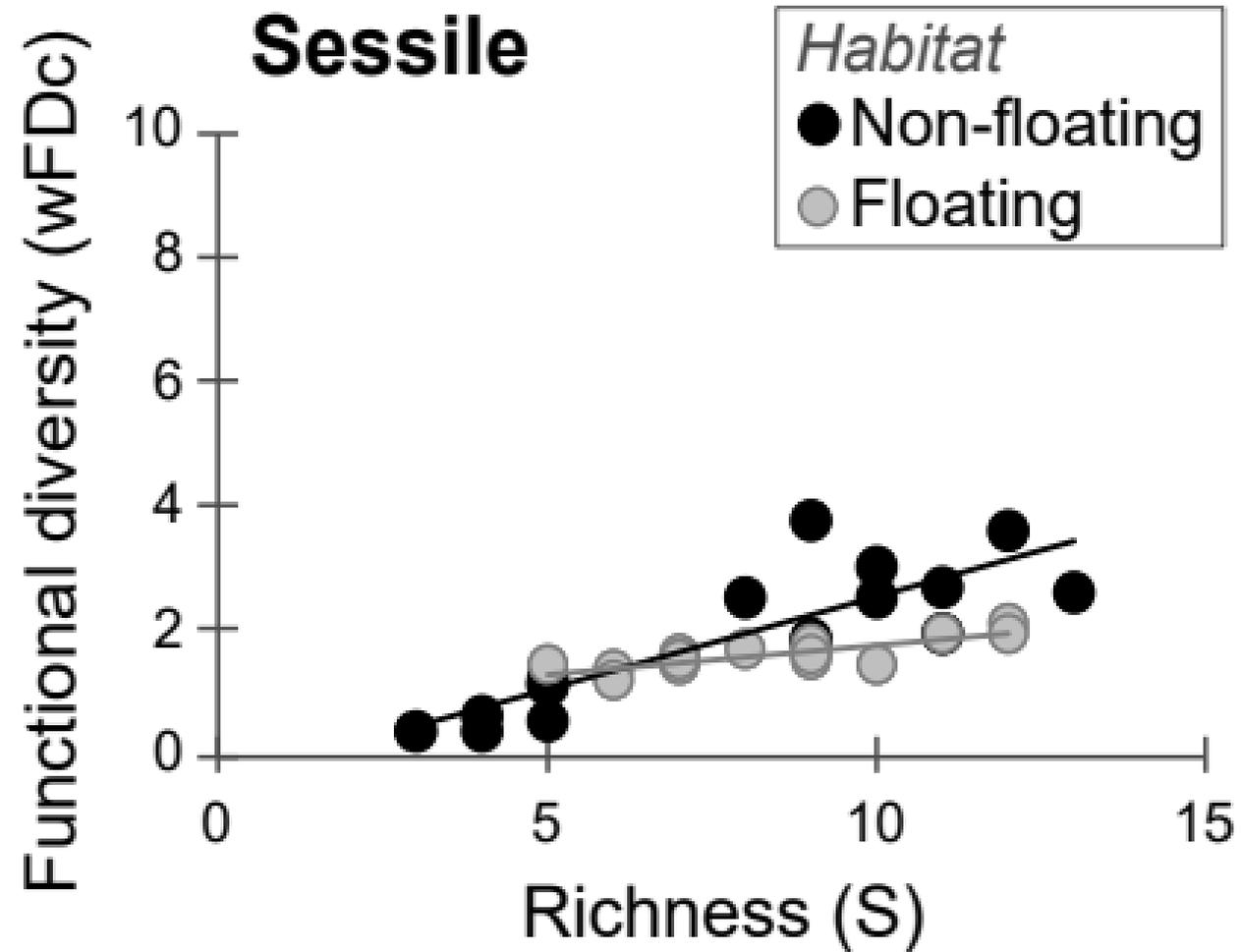
821 **Figure 4.** Proportion of the average abundance of each category of functional traits of the
822 sessile assemblages of two types of habitats (NF: non-floating vs. F: floating) in two ports:
823 San Vicente vs. Coliumo, Southeast Pacific, Chile.

824

825 **Figure 5.** Proportion of the average abundance of each category of functional traits of the
826 mobile assemblages of two types of habitats (NF: non-floating vs. F: floating) in two ports:
827 San Vicente vs. Coliumo, Southeast Pacific, Chile.

828





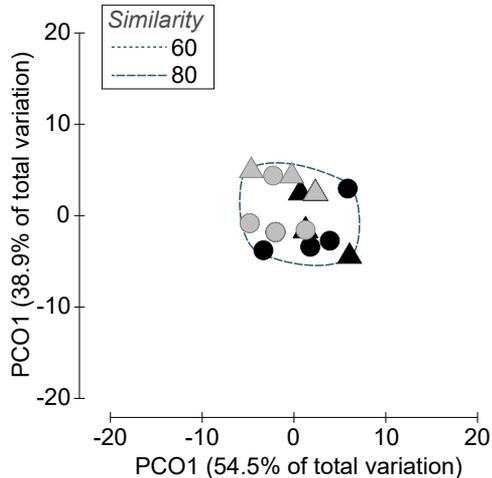
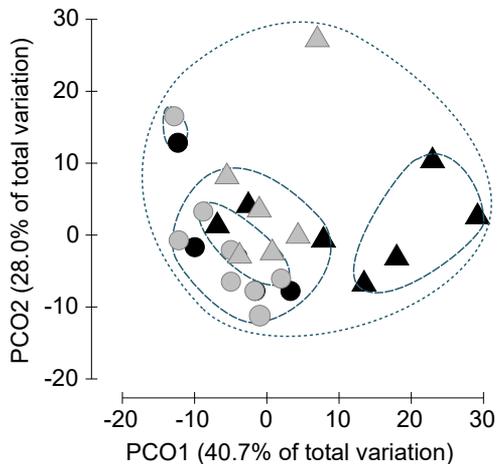
Habitat-port

- Non-floating-San Vicente
- ▲ Non-floating-Coliumo
- Floating-San Vicente
- ▲ Floating-Coliumo

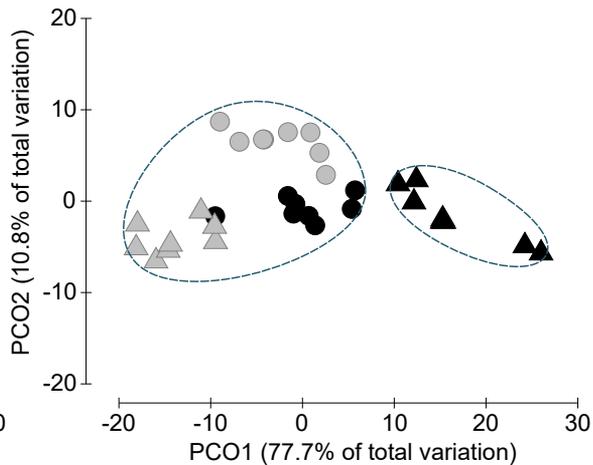
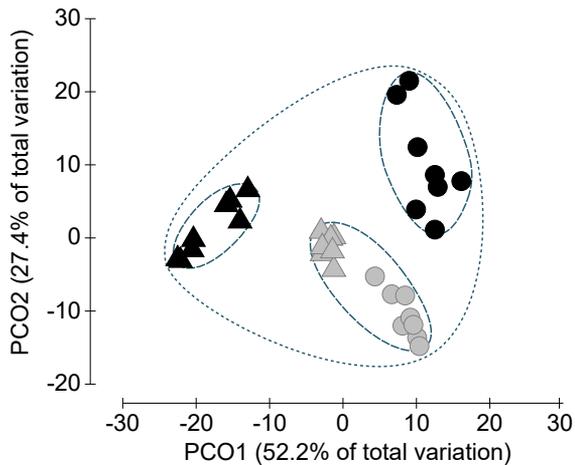
Sessile

Mobile

Composition

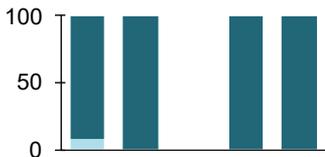


Abundance



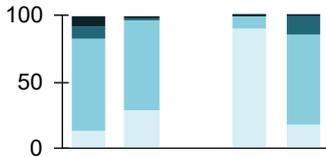
Feeding Habit

Filter/suspension
Autotroph



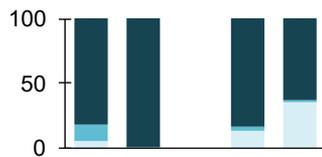
Individual /colonial size

1-10mm 10-50mm
50-100mm 100-300mm



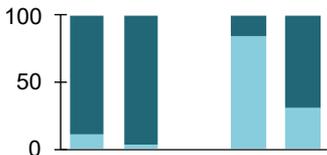
Body form

Flat Mound Erect



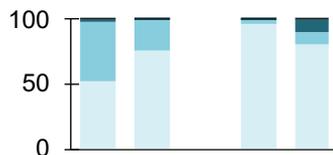
Sociability

Solitary Colonial



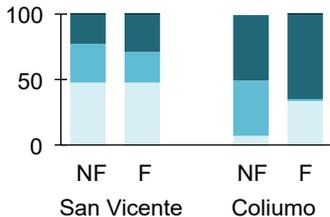
Lifespan

<1 year >1-3 years
3-5 years >5 years



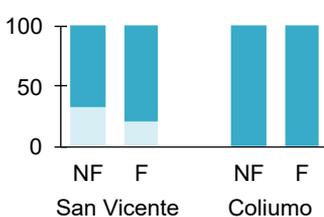
Reproductive mode

Sexual (direct-developer)
Sexual (planktonic larvae)
Sexual (broadcast spawner)
Asexual



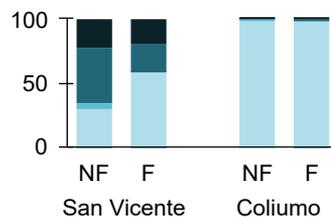
Larval development

Direct benthic
Pelagic lecithotrophic
Pelagic planktotrophic



Pelagic larval duration

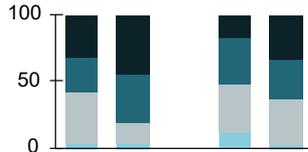
None <1 day
1-7days 7-30 days
>30 days



Abundance proportion (%)

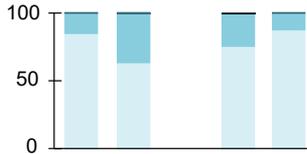
Feeding Habit

- Predator
- Filter/suspension
- Deposit feeding
- Opportunist/scavenger
- Grazer



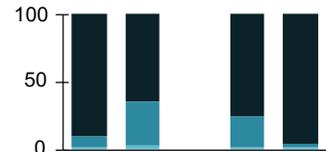
Individual / colonial size

- 1-10mm
- 10-50mm
- 50-100mm
- 100-300mm



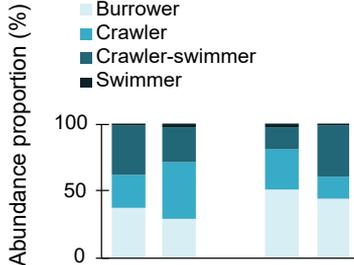
Body form

- Mound
- Little elongate/ellipsoid
- Elongate



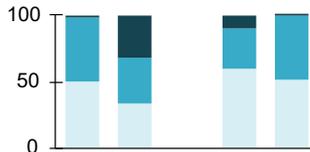
Motility

- Burrower
- Crawler
- Crawler-swimmer
- Swimmer



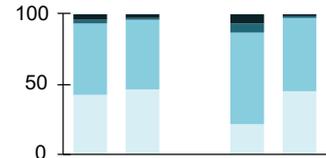
Adult mobility

- Low
- Medium
- High



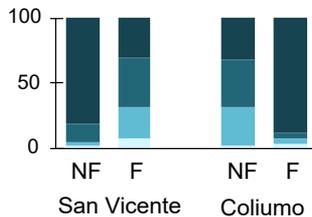
Lifespan

- <1 year
- 3-5 years
- >1-3 years
- >5 years



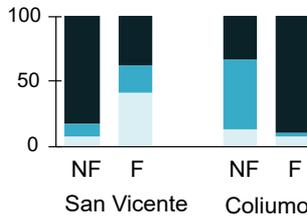
Reproductive mode

- Sexual (direct-developer)
- Sexual (planktonic larvae)
- Sexual (broadcast spawner)
- Asexual



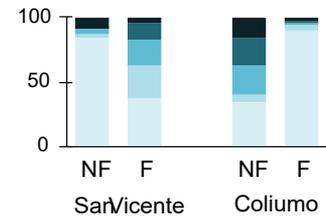
Larval development

- Direct benthic
- Pelagic lecithotrophic
- Pelagic planktotrophic



Pelagic larval duration

- None
- <1 day
- 1-7 days
- 7-30 days
- >30 days



Supplementary material accompanying:

Greater functional similarity in mobile compared to sessile assemblages colonizing distinct artificial coastal habitats

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Table S1. Complete list of sessile and mobile taxa settled on plates

Sessile taxa	
Chlorophyta	<i>Aulacomya atra</i> (Molina, 1782)
<i>Ulva</i> Linnaeus, 1753	<i>Mytilus galloprovincialis</i> Lamarck, 1819
	<i>Semimytilus algosus</i> (Gould, 1850)
	<i>Hiatella</i> Bosc, 1801
	<i>Crepidatella fecunda</i> (Lamarck, 1822)
Ochrophyta	Crustacea
Diatoms and Ectocarpales	<i>Austromegabalanus psittacus</i> (Molina, 1788)
	<i>Balanus laevis</i> Bruguière, 1789
Rhodophyta	
<i>Antithamnionella</i> Lyle, 1922	
Calcareous crusts	
<i>Ceramium</i> Roth, 1797	
<i>Polysiphonia</i> Greville, 1823	
Red turf (other)	
Rhodymeniales Schmitz in Engler, 1892	
Porifera	Chordata
<i>Leucosolenia</i> Bowerbank, 1864	<i>Didemnum</i> Savigny, 1816
	<i>Diplosoma listerianum</i> (Milne Edwards, 1841)
	<i>Asterocarpa humilis</i> (Heller, 1878)
	<i>Ciona robusta</i> Hoshino & Tokioka, 1967
	<i>Corella eumyota</i> Traustedt, 1882
	<i>Paramolgula</i> Traustedt, 1885
	<i>Pyura chilensis</i> Molina, 1782
Cnidaria	Mobile taxa
<i>Bougainvillia muscus</i> (Allman, 1863)	Annelida
<i>Amphisbetia operculata</i> (Linnaeus, 1758)	<i>Chone rosea</i> Hartmann-Schröder, 1965
<i>Coryne eximia</i> Allman, 1859	<i>Perkinsiana magalhaensis</i> (Kinberg, 1867)
<i>Hydractinia</i> Van Beneden, 1844	<i>Nereis callaona</i> (Grube, 1857)
<i>Obelia dichotoma</i> (Linnaeus, 1758)	Nereididae Blainville, 1818
<i>Obelia geniculata</i> (Linnaeus, 1758)	<i>Pholoe polymorpha</i> (Hartmann-Schröder, 1962)
<i>Orthopyxis</i> L. Agassiz, 1862	<i>Harmothoe magellanica</i> (McIntosh, 1885)
<i>Phialella quadrata</i> (Forbes, 1848)	<i>Paleanotus chrysolepis</i> Schmarda, 1861
<i>Plumularia setacea</i> (Linnaeus, 1758)	<i>Syllis pectinans</i> Haswell, 1920
	<i>Autolytus</i> Grube, 1850
Bryozoa	<i>Autolytus maclearanus</i> McIntosh, 1885
<i>Alcyonidioides mytili</i> (Dalyell, 1848)	<i>Proceraea micropedata</i> (Hartmann-Schröder, 1962)
<i>Amathia gracilis</i> (Leidy, 1855)	<i>Sphaerosyllis hystrix</i> Claparède, 1863
<i>Bugula neritina</i> (Linnaeus, 1758)	<i>Dipolydora socialis</i> (Schmarda, 1861)
<i>Bugulina flabellata</i> (Thompson in Gray, 1848)	<i>Polydora rickettsi</i> Woodwick, 1961
<i>Celleporella hyalina</i> (Linnaeus, 1767)	<i>Polycirrus multisetigerus</i> Hartmann-Schröder, 1962
<i>Chaperia acanthina</i> (Lamouroux, 1825)	<i>Nicolea chilensis</i> (Schmarda, 1861)
<i>Exochella</i> Jullien, 1888	Terebellini Johnston, 1846
<i>Schizoporella maulina</i> Moyano, 1983	Terebellidae sp1 Johnston, 1846
<i>Schizoporella</i> Hincks, 1877	Terebellidae sp2 Johnston, 1847
<i>Scruparia ambigua</i> (d'Orbigny, 1841)	<i>Nereiphylla</i> Blainville, 1828
	<i>Phyllodoce longipes</i> Kinberg, 1866
Annelida	<i>Eulalia</i> Savigny, 1822
<i>Spirorbis nordenskjoldi</i> Ehlers, 1900	
Mollusca	

Diplocirrus Haase, 1915
Oligochaeta Grube, 1850

Mollusca

Doto sp1 Oken, 1815
Doto sp2 Oken, 1815

Phidiana lottini (Lesson, 1831)
Hancockia Gosse, 1877
Orienthella trilineata (O'Donoghue, 1921)
Nudibranchia sp1
Nudibranchia sp2
Thecacera darwini Pruvot-Fol, 1950
Tegula Lesson, 1832
Patellidae Rafinesque, 1815
Alia unifasciata (G. B. Sowerby I, 1832)
Mitrella Risso, 1826
Nodilittorina Martens, 1897

Crustacea

Amphilochoidea sp1 Boeck, 1871
Amphilochoidea sp2 Boeck, 1871
Amphilochoidea sp3 Boeck, 1871
Stenothoidae Boeck, 1871
Aora Krøyer, 1845
Aoridae sp1 Stebbing, 1899
Aoridae sp2 Stebbing, 1899
Aoridae sp3 Stebbing, 1899
Aoroides Walker, 1898
Caprella equilibra Say, 1818
Deutella venenosa Mayer, 1890
Thoridae Kingsley, 1879

Pycnogonida Latreille, 1810

Echinodermata

Patiria chilensis (Lutken, 1859)

Monocorophium acherusicum (Costa, 1853)
Corophiidae Leach, 1814
Eurystheus Spence Bate, 1856
Photidae sp1 Boeck, 1871
Photidae sp2 Boeck, 1871
Photidae sp3 Boeck, 1871
Photidae sp4 Boeck, 1871
Photidae sp5 Boeck, 1871
Photidae sp6 Boeck, 1871
Ischyroceridae Stebbing, 1899
Ischyrocerus sp1 Krøyer, 1838
Ischyrocerus sp2 Krøyer, 1838
Ischyrocerus sp3 Krøyer, 1838
Jassa slatteryi Conlan, 1990
Jassa marmorata Holmes, 1905
Jassa justii Conlan, 1990
Elasmopus Costa, 1853
Dexaminidae Leach, 1814
Zeuxoides Sieg, 1980
Copepoda sp1 Milne Edwards, 1840
Copepoda sp2 Milne Edwards, 1840
Janiridae G. O. Sars, 1897
Munnidae G. O. Sars, 1897
Pachycheles Stimpson, 1858
Romaleon setosum (Molina, 1782)
Halicarcinus planatus (J.C. Fabricius, 1775)
Eurynome Leach, 1814 [in Leach, 1813-1815]
Majidae Samouelle, 1819
Pilumnoides perlatus (Poëppig, 1836)
Nauticaris magellanica (A.Milne-Edwards, 1891)

Nemertea

Nemertea sp1
Nemertea sp2

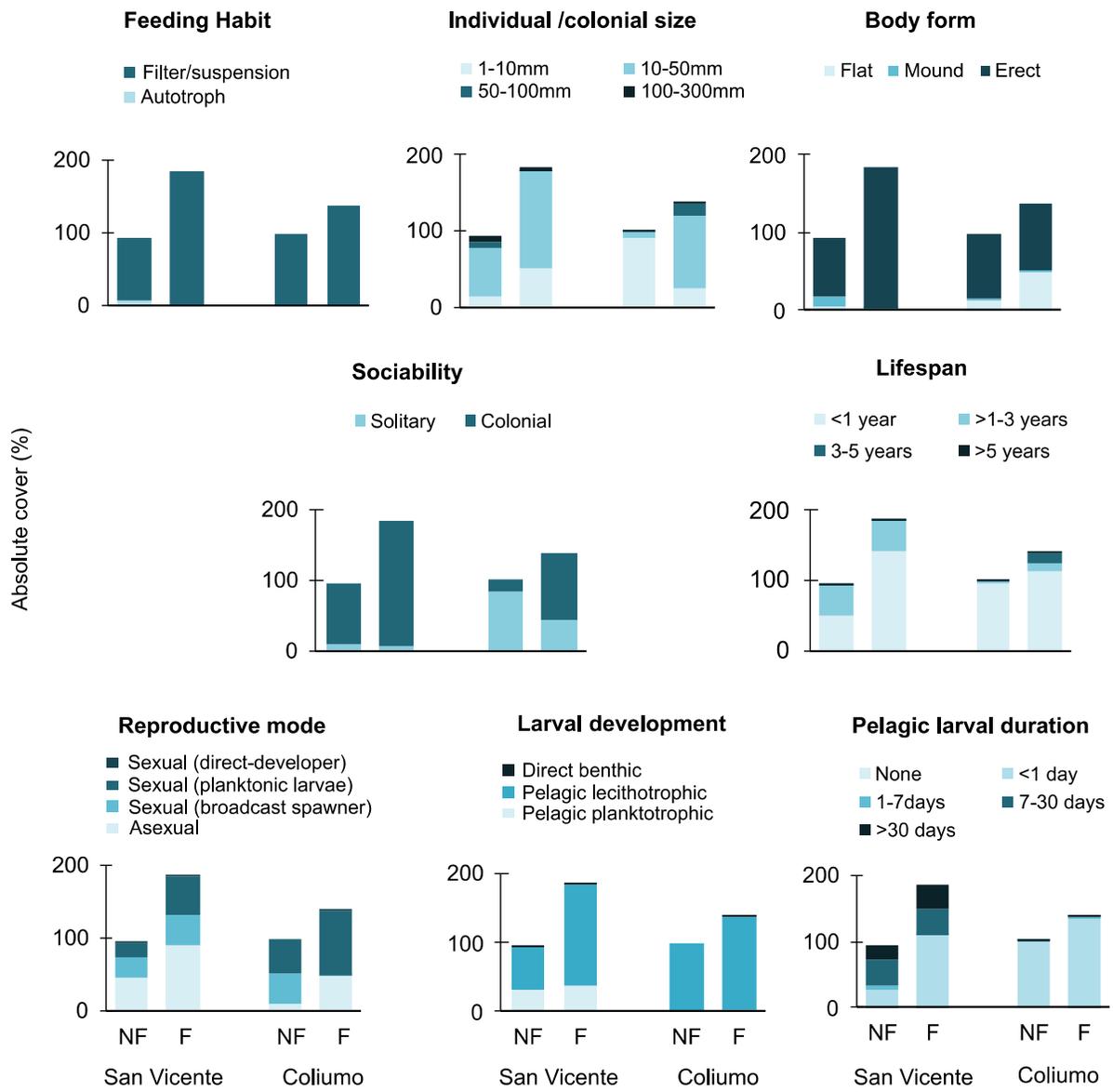


Figure S1. Absolute coverage of each category of functional traits of the sessile assemblages on two types of habitats (NF: non-floating vs. F: floating) in two ports: San Vicente vs. Coliumo, Southeast Pacific, Chile.

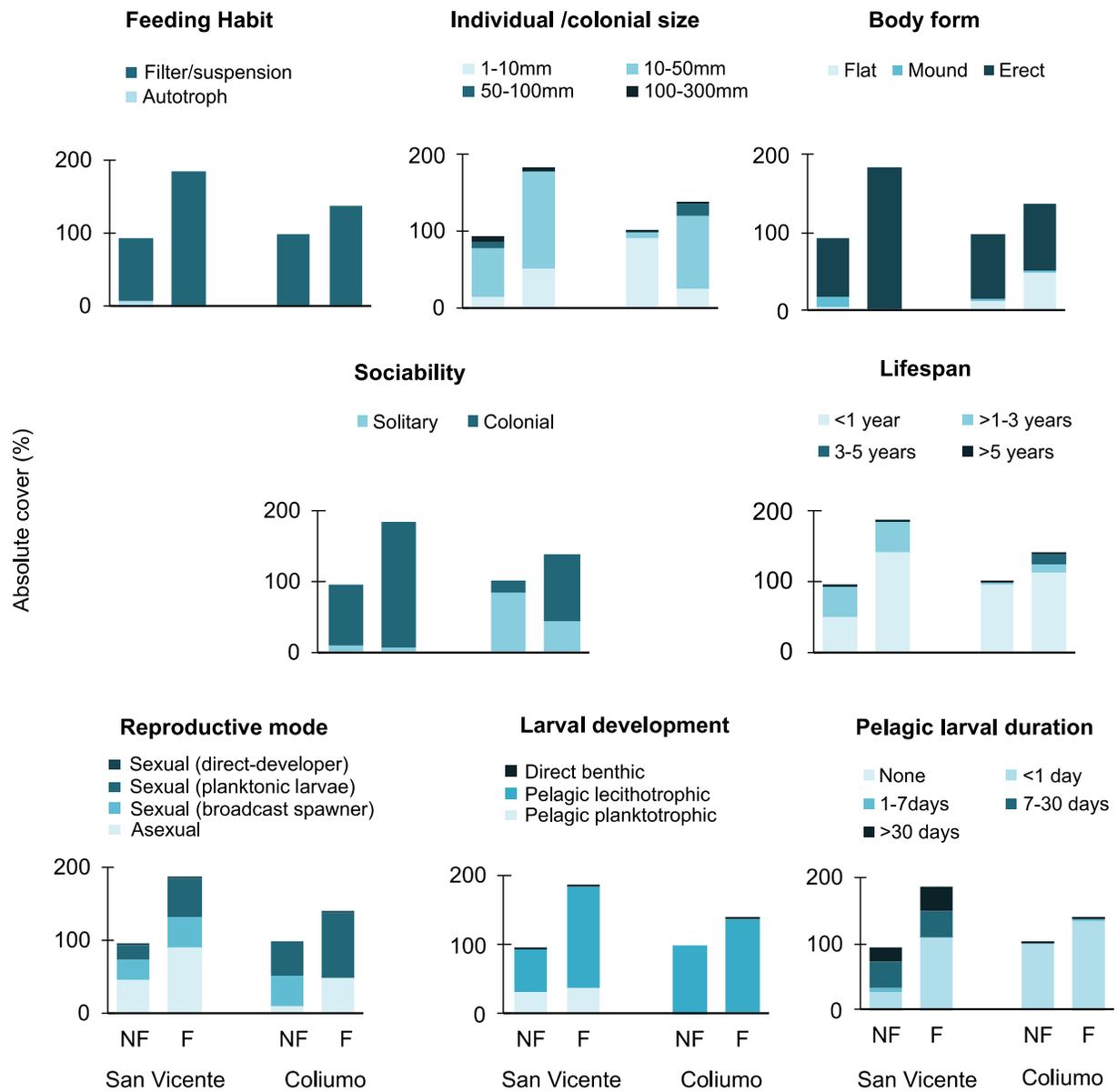


Figure S1. Absolute abundance of each category of functional traits of the mobile assemblages on two types of habitats (NF: non-floating vs. F: floating) in two ports: San Vicente vs. Coliumo, Southeast Pacific, Chile.