1 Evaluation of sediment particle size selection during feeding by the holothurian

2 *Parastichopus regalis* (Cuvier, 1817)

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14
15 **Abstract**

16 *Parastichopus regalis* is an epibenthic holothurian common in the
17 Mediterranean Sea and the NE Atlantic, which feeds on the upper layer of the sediment
18 playing a significant role on soft-bottom dynamics. Whether or not *P. regalis* is able to
19 select the sediment ingested by size is the question of this study. For this purpose, a
20 comparison between grain size distributions of the seabed sediments and the digestive
21 contents of sea cucumbers were carried out. We performed the comparisons among
22 sediment distributions through the median diameter D_{50} and the granulometric
23 dispersion D_{84}/D_{16} . The results showed that the size of the sediment within the
24 holothurians was significantly smaller and more uniform than the ones in the seabed.
25 Evidence showed that *P. regalis* select sediment by particle size during feeding,

choosing the smaller particles. This finding reports novel information on the feeding behaviour of this species, a fishery resource of local interest and importance in the Western Mediterranean region.

Key words: Holothurian; feeding; grain size selection; Mediterranean Sea

1. Introduction

Holothuroidea is a conspicuous and diverse group of invertebrates in the world's oceans. Aspidochirotid holothurians provide important ecosystem services enhancing nutrient cycling and sediment dynamics through their feeding activities and bioturbation (Uthicke, 1999). Most species live on the sea bottom surface, where they ingest the upper layer of sediment from which they assimilate a fraction of its organic matter content. The capture of food is made with the tentacles, provided with contractile and adhesive elements on its surface. During feeding, the tentacles extend over the substratum, collect the particles, and contract and fold into the mouth to release the food (Roberts et al., 2000).

Bottom sediment characteristics, hydrodynamics, and depth are crucial factors affecting habitat preference of sea cucumbers (Sloan and Von Bodungen, 1980; Slater and Jeffs, 2010; Dissanayake and Stefansson, 2012). Sediment characteristics have a direct influence in feeding particle selection, which may be based on sediment grain size or organic-rich content, depending on species and habitats (Roberts, 1979). For example, no evidences of selectivity by size were found in *Parastichopus parvimensis* (Yingst, 1976), *Holothuria mexicana*, *H. arenicola* (Hammond, 1982), *Leptosynapta tenuis* (Powell, 1977), *H. atra* (Massin and Doumen, 1986), and *Isostichopus badionotus* (Sloan and Von Bodungen, 1980; Hammond, 1982). Coarser grain sizes

tend to be excluded by *H. atra*, *Bohadschia marmorata*, and *H. leucospilota* (Massin and Doumen, 1986; Dar, 2004). In addition, the burrower sea cucumber *Molpadia oolitica* preferred smaller grain sizes (Rhoads and Young, 1971). On the contrary, selection for larger grain sizes have been found in *Stichopus tremulus* (Hauksson, 1979) and *Holothuria scabra* (Baskar, 1994). Grain size selection varies between species and has been proposed as an important resource to establish niche separation between co-existing deposit feeders (Massin and Doumen, 1986; Mezali and Soualili, 2013). For instance, analyses of the digestive contents of the holothurian species *H. tubulosa*, *H. poli* and *H. stellate* revealed that these ingested coarse and fine sediment, whereas *H. forskali* and *H. sanctori* selected fine and very fine sediment (Mezali and Soualili, 2013). The size of the particles ingested influences the time needed for the holothurian gut to efficiently extract the organic matter (Hudson et al., 2004), with implications in the amount of sediment reworked by the holothurians and, by extension, in the evaluation of their role in the ecosystems.

The importance of sea cucumbers in reworking muddy and sandy bottoms has long been emphasized. Much of the work carried out worldwide on holothurian feeding has been focused on shallow water species, mainly on tropical reefs, for its easy accessibility and the high diversity of species (Yingst, 1976; Hauksson, 1979; Navarro et al., 2013). Knowledge on the feeding of deep-sea holothurians has increased recently given the improvement of deep-sea exploration methods, highlighting the abundance of sea cucumbers in such ecosystems (Wigham et al., 2003; Hudson et al., 2005; Navarro et al., 2013). Nevertheless, information on holothurian species inhabiting the continental shelf below 50 m depth is scarce. The sea cucumber *Parastichopus regalis* (Cuvier, 1817) belongs to the family Stichopodidae and is abundant in the Mediterranean Sea and the NE Atlantic, between 50 and 300 m depth (Ramón et al., 2010). Its five

longitudinal muscle bands are commercialized for human consumption in Catalonia (NW Mediterranean), where it is captured using bottom trawls (Ramón et al., 2010). Despite its ecological and economic importance, there is little information on its basic ecology. Understanding habitat use of *P. regalis* by studying feeding selectivity is a necessary step towards the knowledge of its ecological role in the Mediterranean continental shelf.

The aim of this study is to find out whether the sea cucumber *P. regalis* is able to select the sediment ingested by size and, if so, to elucidate if selection is affected by particle size availability. For this purpose, we compared the grain size distribution of the ambient sediments to that of the gut sediments in situ. The statistical treatment of the sediment grain distributions takes into account the particularity of the data set (each data is a distribution of the sizes of the sediment).

2. Materials and Methods

2.1. Sampling

Specimens of *Parastichopus regalis* were collected on board a commercial trawler from Arenys de Mar (41.5768°N, 2.5593°E, NW Mediterranean) using a bottom otter trawl operating around 100 m depth. They were transported to the laboratory in coolers with sea water. On arrival, the sea cucumbers had ejected their internal organs, making it impossible to perform feeding experiments in tanks therefore forcing a new experimental approach, an “in situ” study. Then, sediments were collected on the fishing ground, at the same time as sea cucumbers, using a stainless steel cylinder coupled to the fishing gear (Del Rio et al., 2012). This methodology has been demonstrated to collect superficial sediment, which is where the sea cucumbers feed on (Rufino et al., 2018). Once on board, holothurians were dissected, the gut extracted and

placed individually in plastic bags to be transported to the Institute of Marine Sciences (ICM-CSIC) in coolers with ice. A sample of 50g of sediment from each haul was kept on board and stored in the fridge after returning to the laboratory.

Five daily surveys were performed in 2013 in the fishing ground of Arenys de Mar. A total of eleven hauls were carried out at depths between 82 and 129 m. In addition, a sediment sample from a trawl belonging to the oceanographic cruise MEDITS_ES_CAL_13 on the Ebro river shelf (40.2983°N, 01.2682°E, NW Mediterranean) was added in order to analyze a different area. A total of 121 specimens were analyzed (Table 1).

2.2. Sediment analysis

Sediment samples analyzed included 12 samples of seabed (one for each case in table 1) and 121 of holothurians gut content, which allowed to perform a total of 133 analyses. Sediment was treated for size particle analysis, i. e., the organic matter was removed using hydrogen peroxide at 20%, followed with a treatment with pyrophosphate to disaggregate the sediment particles. Samples were analyzed using a Horiba LA940V2 Laser scattering particle size distribution analyzer. The instrument provides results of grain size grouped into 48 size intervals (or channels), from 0.031 µm up to 6 mm in a logarithmic scale. The organic matter (OM) content of the ambient sediment was quantified as weight loss on ignition at 475°C for 12 h. The limited amount of sediment inside the guts did not allow performing more analysis than size particle; thus, organic matter content was not calculated for these samples.

To determine whether the holothurian *P. regalis* selects by grain size while foraging it was necessary to perform a comparison of seabed and gut sediment distributions, and determine whether the differences were statistically significant. In the statistical

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298 126 treatment of the data, to establish that two populations (i.e. a sample of bed sediment
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300 127 and a sample of gut sediment) were statistically different, the difference between the
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302 128 populations had to be much larger than the difference within each population, since each
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304 129 population is not uniform .
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307 130 In this study, we compared arrays of numbers because each measure has 48
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309 131 channels. Therefore, at first, a MANOVA should be employed. A first approach to
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311 132 estimate the variability within samples is to obtain several measurements (or
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313 133 “realizations”) of a same sediment with the laser particle analyzer. The above
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315 134 repetitions give an indication of the variance corresponding to the instrument, but not of
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317 135 the variance within the sediment. Hence, to estimate the “within” variance, several
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319 136 subsamples were obtained from the samples that contained more than 9 g of sediment,
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321 137 to get 3 subsamples of at least the 3 g required by the particle analyzer. Table 1 includes
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323 138 the number of specimens subsampled. Out of the 121 specimens analyzed, 23 of them
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325 139 allowed the subsampling, and correspond to 7 different cases (case 1, 2, 3, 6, 8, 9 and
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327 140 10, see Table 1). This constraint did not affect the seabed samples, available in high
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332 142 For each of the 30 above mentioned sediment samples (23 gut contents and 7
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334 143 seabed sediments), 3 subsamples were obtained, as mentioned. For each subsample, 20
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336 144 realizations were taken in order to compute the variability associated of the analyzer
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338 145 measurement process (Horiba LA940V2 laser). In summary, a total of 60 realizations (3
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340 146 subsamples x 20 realizations) for each of these 30 sediment samples allowed the
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342 147 variance-type analysis.
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345 148 To analyze whether two sediment samples were significantly different, and
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347 149 having 60 realizations of the size distribution for each sediment sample, a first possible
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349 150 approach would be to perform a Multivariate ANalysis Of VAriance (MANOVA). It is
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“Multivariate” because results for the samples are not just a given number but distributions with 48 channels (i.e., dimensions). However, each realization is built of 48 numbers that will always satisfy the condition that they sum up to 100, i.e., they are not independent but “compositional data” (Aitchison, 1982; Pawlowsky-Glahn and Egozcue, 2006). This dependency prevents from the use of classical statistical tools to the raw data. Recent works propose the use of complex compositional data techniques to transform the raw data so that statistical techniques can be employed (Flood et al., 2015; Martín-Fernández et al., 2015). A simpler approach shows to be useful for this data set, in particular to circumvent the composition data problem, while guaranteeing statistical rigor. Here, we consider D_{50} for comparison purposes, where D_{50} is the percentile 50% of the grain-sediment distribution: the size so that half of the distribution (in weight) is above and half below the value. Thus, the whole distribution (48 values that sum up to 100) is reduced to a single value (D_{50}) which, moreover, is not restricted to satisfy any condition (contrary to compositional data, which sum up to 100). A classical one-way ANOVA analyses was used to compare the D_{50} of different samples. This simplification implicitly assumes that two distributions are different (with statistical significance) if their D_{50} are different. However, the contrary is not always true: two distributions not having significantly different D_{50} values could be statistically different. Given the shape of the distributions in this study, this issue was not a limitation in our study. Even though it is not strictly necessary, the granulometric dispersion $\sigma_g = \sqrt{D_{84}/D_{16}}$ was also used to analyze the uniformity of the distributions. Recall that, by definition, the smaller the value of σ_g , the more uniform is the sediment (Blott and Pye, 2001).

3. Results

3.1. General description of sediment characteristics

The sediment from *P. regalis* habitat was mainly composed by a mix of sand and silt in different proportions, with a small amount of clay, as described in Table 2. Cases 1, 2, 11 and 12 were classified following (Folk, 1954) as muddy sands; cases 4, 5, 6, 7, 8, 9 and 10 as sandy muds and case 3 as gravelly mud. Gravel was only present in 2 of the 12 samples analyzed (case 3 and 6).

Note that in this section we use data for all 121 + 12 samples (subsampling analysis is considered below). The data used for calculations is one measurement (realization) for each of the 133 samples.

The size of the ingested particles by *P. regalis* ranged from 0.103 μm to $\sim 1\text{mm}$, while that of the seabed was 0.103 μm to $> 3\text{mm}$. The grain-size sediment distributions, both for seabed sediments ($N = 12$) and gut ($N = 121$ holothurians), had three main modes, around $10^{-0.5} \sim 0.3 \mu\text{m}$, $10^0 = 1 \mu\text{m}$, and $10^{2.5} \sim 300 \mu\text{m}$ (Figure 1).

As shown in Figure 1, for the largest D_{50} values of the seabed sediment (cases 1, 2, 10, 11 and 12), the values of D_{50} for the guts were much smaller than the environmental ones. From Table 3, which shows basic statistics of the samples, the differences in the D_{50} values among the bottom sediments are quite large, ranging from $10^{1.03} = 10.7 \mu\text{m}$ for case 5 to $10^{2.28} = 190.5 \mu\text{m}$ in case 12, i.e., one order of magnitude. In contrast, the range of mean values of the gut sediments (mean values computed for each case using the different specimens) was smaller: from $10^{1.00} = 10.0 \mu\text{m}$ for case 5 to $10^{1.59} = 38.9 \mu\text{m}$ in case 2.

From the above, the sediment within the guts of the holothurians was not much influenced by the grain-size distribution of the seabed (Figure 1 and Table 3). This is further emphasized in Figure 2, which shows the relationship between the values of D_{50}

of the environment (12 samples) and the guts (121 samples) sediment. Working in the logarithmic scale, the regression analysis yields $R^2 = 0.037$, confirming that such a dependence is very low. Furthermore, there was slightly more variability for the seabed sediment ($\log_{10}D_{50}$ (in μm) = 1.54 ± 0.36 , i.e. $15\mu\text{m} \lesssim D_{50} \lesssim 80\mu\text{m}$) than that within the guts ($\log_{10}D_{50}$ (in μm) = 1.26 ± 0.20 , i.e. $11\mu\text{m} \lesssim D_{50} \lesssim 28\mu\text{m}$), as mentioned above. In addition, the environmental sediment was larger, in average, than the sediment in the guts. Actually, only a 29.8% of the 121 holothurians had sediment D_{50} values larger than that of their environment, while the individuals with gut contents with smaller D_{50} values than the seabed were 70.2% (85 out 121).

In regard to using the diameter D_{50} (and not another percentile) to discriminate whether two distributions are similar or not, Figure 3, equivalent to Figure 1 but plotting the D_{75} of the distributions, shows how the trends are similar to those in Figure 1 for D_{50} . This is actually a general trend for all percentiles from 25 to 75 (not shown). It is worth noting that in case 9 the differences appear clearer using D_{75} than D_{50} . In fact, in order to show that two distributions are different, it would be enough to find significant differences for a percentile.

The organic matter content of the seabed ranged between 2.25 and 3.52% (Table 2).

3.2. Statistical analysis with subsamples

To determine whether the differences among sediment distributions are statistically significant or not, an ANOVA test was performed to the 23 subsampled holothurians (Table 1) and the seabed samples. Figure 4 shows the distribution of the $\log_{10}D_{50}$ both for the seabed sediment and the given holothurian specimen, obtained

from the 60 realizations for each sample (20 different measures for each of the 3 subsamples).

One-way ANOVA results showed that the values of $\log_{10}D_{50}$ of the seabed sediment were significantly different to those for the holothurian gut sediment, except for 2 individuals (case 03 – specimen N01 and case 06 – specimen N59). The size of the sediment within the holothurians is smaller than the ones in the seabed (Figure 4). Actually, as a general trend, the larger the size of the seabed sediment (cases 01, 02 and 10), the clearer the histograms are differenced. Furthermore, the two cases 03 and 06, for holothurians whose gut sediment was not significantly different to that of the seabed, coincided with seabed where the sediment particles were small. Similar results were obtained using D_{25} or D_{75} instead of D_{50} .

The distribution of the granulometric dispersion (σ_g) for the seabed and the holothurians gut sediment is shown in Figure 5. One-way ANOVA results showed that σ_g values are statistically different between the seabed sediment and holothurians gut content in all cases. Unless for very few exceptions (i.e. case 03-specimen N01 and case 06-specimen N59), the values of σ_g are smaller for the gut sediment than for the environment, indicating that the gut sediment is more uniform and that holothurians select the particle size of the sediment during feeding.

Results also show, for each case, significant differences between the specimens (all them considered as a whole) and the seabed sediment, both in D_{50} and σ_g (see last columns in Figures 4 and 5). Note that the vertical axis is scaled differently than in the 5 first columns, given that the number of measurements is increased. The gut sediment, taken as a whole and thus including the variance created by different specimens, is significantly different ($p < 0.001$) from the seabed sediment, with the only exception of σ_g values in case 06. Not surprisingly, the trends are the same as the ones observed for

each one of the specimens: D_{50} is smaller for the gut sediment than for the bottom sediment (particularly for the cases with larger particle size in the seabed) and the sediments within the guts of the animals are more uniform in size than that of the environment ones.

4. Discussion

Our results showed that *Parastichopus regalis* selected the sediment by size to obtain its food and that the use of D_{50} , complemented with σ_g , has shown to be, while rigorous, a simple way to compare grain size frequency distributions. The finer particles were ingested in preference to the larger ones in 85 specimens from a total of 121 analyzed. This pattern of selection was more evident in all the specimens collected in sediments composed of more than 45% sand. Holothurians collected in five of the seven sediments with sand content <45% showed the same behavior, with the exception of case 6 and 7, where gut sediment had higher values of D_{50} than the seabed, but selection of finer particles was the general trend found in most of the cases analyzed.

The role of other sediment characteristics in the particle selection of *P. regalis*, such as OM content, has not been analyzed in the current study. Nonetheless, our results showed high selection in case 11, related to sediment with 3.52% OM (the highest in our study), and also in case 10, corresponding to sediment with 2.31% OM (the lowest in our study). The OM content values of the seabed sediments here analyzed were quite similar among them, so OM was not expected to affect the holothurians selection.

The ability of holothurians to select food is believed to vary between species and habitats (Roberts et al., 2000) with some contradictory results found in the literature when studying the same species. For example, selectivity by size has been shown in *Stichopus variegatus* (Roberts, 1979), *Holothuria atra*, and *H. leucospilota* (Massin and

274 Doumen, 1986). However, no selectivity by size was also reported for these same
275 species by (Levin, 1989). Information related to feeding rate and sediment reworking on
276 Mediterranean species is limited to *H. tubulosa*, *H. poli*, and *H. forskali* (Massin and
277 Jangoux, 1976; Coulon and Jangoux, 1993) .

278 Holothurians feed on the particles available at the surficial layer of the sediment.
279 It should be expected that the particles found inside *P. regalis* were a reflection of the
280 available particles on the seabed, with potential differences derived from the preferential
281 selection of a certain range of particles. Our results showed that the correlation between
282 the values of D_{50} of the seabed and the gut sediments was very low. The bigger the
283 seabed grain size, the more the animals select the sediment. Accordingly, in seabed
284 sediments with small grain sizes, the holothurian seem not to select by size as their
285 preferred sizes are already available. Our results showed that for seabed with larger
286 sediment sizes, the differences in D_{50} values found among the bed and guts' sediments
287 were up to an order of magnitude. The values of σ_g showed that gut sediments were
288 more uniform than seabed sediments, which confirms particle size selection during
289 feeding.

290 The particles ingested by *P. regalis* in the studied area showed a wide size
291 range; from 0.103 μm up to 1 mm. Khripounoff and Sibuet (1980) suggested that deep-
292 sea holothurians ingest finer sediment fractions than their shallow water counterparts.
293 Many abyssal species select particles between 20–60 μm (i.e., $\log_{10}D$ from 1.30 to 1.78)
294 (Sokolova, 1972; Khripounoff and Sibuet, 1980) whereas some reef dwelling
295 holothurians (e.g. *Holothuria atra*) can select sizes bigger than 500 μm (i.e., $\log_{10}D >$
296 2.70) (Hauksson, 1979; Uthicke, 1999; Uthicke and Karez, 1999). The influence of
297 habitat was understood when analyzing the results of two studies carried out with the
298 same species in two different habitats: (Hauksson, 1979)) concluded that shallow-water

specimens *Stichopus tremulus* had a preference for fecal pellets (500 μm), whereas Hudson et al. (2004) found that the majority of particles ingested by deep-sea specimens were $<50 \mu\text{m}$ ($\log_{10}D$ 1.70). It is known that deep-sea sediments generally consist of finer particles than coastal ones, a fact that can explain these differences in selection between habitats.

P. regalis is the most abundant species of holothurians found in the continental shelf between 50-300 m depth in the NW Mediterranean. Thus, the species does not have to compete for food resources with other deposit feeding holothurians, as usually occurs in tropical shallow waters (Roberts, 1979). This would explain its wide range of preferential particle size as there is no need of partitioning of substrata by different species.

The optimal foraging model assumes that the food abundance of a particle is proportional to its surface area; i.e., smallest particles are more nutritious (Taghon et al., 1978). Then, the preference for small grains in *P. regalis* should be expected and it was confirmed by this study. However, we did not have information on the OM content of the gut sediment for comparisons with the one from the seabed.

In conclusion, the edible sea cucumber *P. regalis* has selective feeding toward fine sediment particles, being this preference more evident in thick-textured than in fine-grained sediments. This conclusion was reached by the use of D_{50} , complemented with σ_g , which analysis has shown to be a simple way to compare grain size frequency distributions. These results are of importance to understand the ecological role of a valuable seafood resource in the Mediterranean continental shelf.

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Figure 1. Seabed sediment distributions (thick red line) and *Parastichopus regalis* gut sediment distributions (thin black line). Particle diameters (in μm) at the horizontal axis (in log-10 scale). Vertical lines indicate D_{50} value.

Figure 2. Diameter D_{50} of the environmental sediment versus D_{50} of the gut sediment.

Axis in logarithmic scale for D_{50} expressed in μm .

Figure 3. Seabed sediment distributions (thick red line) and *Parastichopus regalis* gut sediment distributions (thin black line). Particle diameters (in μm) at the horizontal axis, in log-10 scale. Vertical lines indicate D_{75} value.

Figure 4. Histograms of D_{50} (in μm) corresponding to the 60 realizations for seabed (red) and gut (black) sediment for the subsampled samples. The first five columns correspond to a different specimen each (up to 5 for cases 6 and 9), coded as NNo. The sixth column corresponds to the merging of the realizations of all the specimens. The vertical axis is not to scale. Note that the seabed (red) histograms are the same within each case. One-way ANOVA results are displayed inside each graph: significant differences are indicated by ($p < 0.05$) *, ($p < 0.01$) **, ($p < 0.001$) *** and “n.s.” stands for “no significant”.

Figure 5. Histograms of σ_g corresponding to the 60 realizations for seabed (red) and gut (black) sediment for the subsampled samples. The first five columns correspond to a different specimen each (up to 5 for cases 6 and 9), coded as NNo. The sixth column corresponds to the merging of the realizations of all the specimens. The vertical axis is not to scale. Note that the seabed (red) histograms are the same within each case. One-way ANOVA results are displayed inside each graph: significant differences are indicated by (p < 0.05) *, (p < 0.01) **, (p < 0.001) *** and “n.s.” stands for “no significant”.

Table 1. Case, number of *P. regalis* analyzed, sampling depth and number of gut sediment samples that allowed to analyze the “within” variance. Case 7 correspond to the Ebro river shelf sampling, the rest of samples were collected in Arenys de Mar.

Case	Number of specimens	Depth (m)	Number of subsampled specimens
01	4	103	2
02	5	107	4
03	5	92	2
04	10	111	0
05	10	93	0
06	24	99	5
07	11	132	0
08	15	113	2
09	10	108	5
10	9	91	3
11	12	129	0
12	6	82	0
Total 12	Total 121		Total 23

Table 2. Percentage of each one of the size fractions, textural group (following Folk, 1954) classification) and organic matter content of the sediment where the holothurians *P. regalis* were captured, with indication of depth, by case.

Case	Depth (m)	% gravel (>2mm)	% sand (2mm-63µm)	% silt (63µm-4µm)	% clay (<4 µm)	Textural group	% organic matter
01	103	0	52.05	34.52	13.44	Muddy sand	2.78
02	107	0	53.03	34.24	12.73	Muddy sand	2.96
03	92	14.81	37.17	33.93	14.09	Gravelly mud	2.25
04	111	0	16.55	63.97	19.48	Sandy mud	3.1
05	93	0	31.44	52.44	16.12	Sandy mud	3.37
06	99	6.08	32.79	46.36	14.77	Sandy mud	2.90
07	132	0	39.46	41.35	19.19	Sandy mud	---
08	113	0	34.09	54.07	11.84	Sandy mud	2.65
09	108	0	33.87	50.48	15.65	Sandy mud	2.98
10	91	0	46.99	42.81	10.2	Sandy mud	2.31
11	129	0	52.34	35.12	12.55	Muddy sand	3.52
12	82	0	65.48	24.76	9.76	Muddy sand	2.98

Table 3. D₅₀ values of the seabed and holothurian guts sediment by case.

case	log ₁₀ D ₅₀ seabed (μm)	D ₅₀ seabed (μm)	log ₁₀ D ₅₀ guts (mean ± standard deviation, in μm)	Mean D ₅₀ guts (μm)	Number of guts analyzed
01	1.85	70.79	1.39 ± 0.05	24.55	4
02	1.89	77.62	1.59 ± 0.13	38.90	5
03	1.52	33.11	1.48 ± 0.25	30.20	5
04	1.25	17.78	1.05 ± 0.13	11.22	10
05	1.03	10.72	1.00 ± 0.05	10.00	10
06	1.24	17.38	1.39 ± 0.17	24.55	24
07	1.25	17.78	1.31 ± 0.15	20.42	11
08	1.31	20.42	1.20 ± 0.07	15.85	15
09	1.29	19.50	1.24 ± 0.08	17.38	10
10	1.70	50.12	1.16 ± 0.10	14.45	9
11	1.87	74.13	1.33 ± 0.20	21.38	12
12	2.28	190.55	1.16 ± 0.13	14.45	6