SUPPLEMENTARY MATERIALS

Text S1. The use of the IndVal procedure is a powerful tool to identify indicator species that, though not always dominant in terms of abundance, are characteristic of a habitat. This is especially true for the cumaceans *Cumopsis fagei* and *Bodotria scorpioides* (Montagu, 1804) in *Tide-dominated flats tending to tide-modified ultra-dissipative beaches*, *Hediste diversicolor* (O.F. Müller, 1776) and *Crepidula fornicata* (Linnaeus, 1758) in *Tide-dominated flats with fine sands*, the polychaetes *Melinna palmata* Grube, 1870 and *Spio decorata* Bobretzky, 1870 and the bivalve *Parvicardium scabrum* (R. A. Philippi, 1844) in *Tide-dominated flats with medium sands* and the crustacean *Diogenes pugilator* (Roux, 1829), the polychaetes *Sigalion mathildae* Audouin & Milne Edwards, 1832, *Magelona mirabilis* (Johnston, 1865) and *Magelona filiformis* Wilson, 1959 in *Extended flats tending to tide-modified ultra-dissipative beaches*.

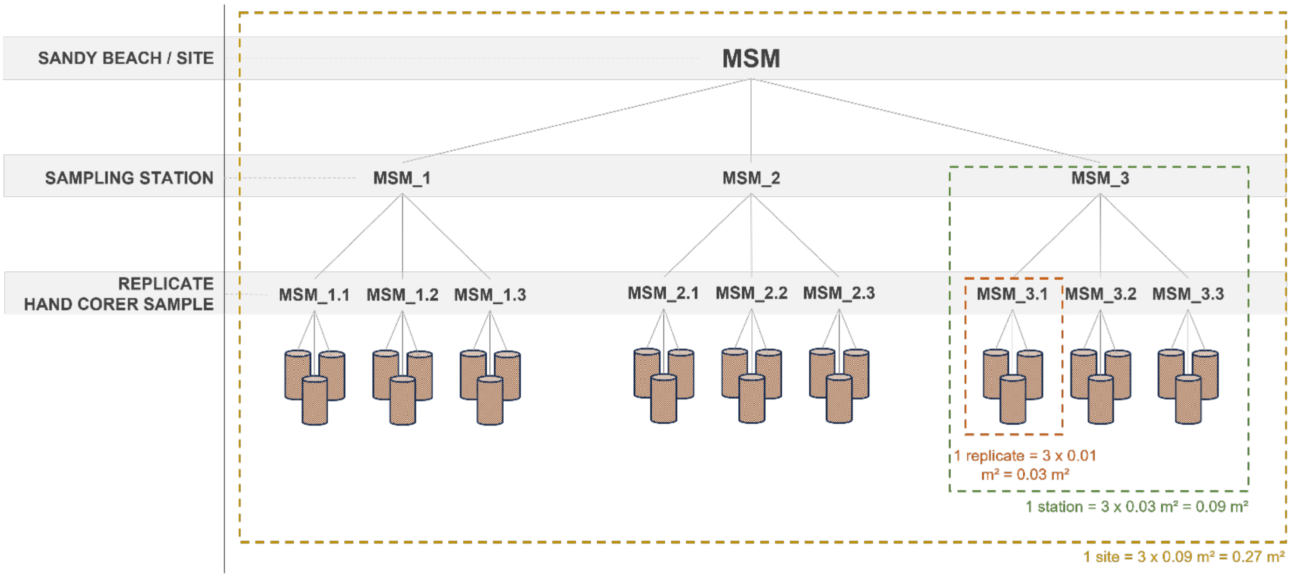

Fig. S1. Details regarding the REBENT (Réseau Benthique, https://rebent.ifremer.fr/) sampling protocol for sandy beaches monitoring in Brittany (France). An example is given for Mont Saint-Michel (MSM), but the same protocol applies to all sandy beaches. For each beach, three stationary sampling stations (characterized by x and y coordinates, here MSM_1, MSM_2 and MSM_3) were positioned on the lower shore a few metres or kilometres apart (depending on beach length). At each sampling station, 3 replicates (for station MSM_1: MSM_1.1, MSM_1.2, MSM_1.3) are sampled using a hand corer. For each replicate (MSM_1.1), the sediment is sampled three times using a 0.01m² hand corer, resulting in a 0.03m² sample. Sampled surfaces are given for one beach (3 x 0.09m² = 0.27m²), one station (3 x 0.03m² = 0.09m²) and one replicate (3 x 0.01m² = 0.03m²).

Fig. S2. Relationship between species richness (for 0.09 m²) and (a) beach slope, (b) sediment sorting (Trask), (c) wave height, (d) exposure, (e) fetch, (f) mean grain size in phi unit, (g) wave frequency peak, (h) Beach Index, (i) beach width and (j) tide range. All models were significant ($p < 0.05$). R^2 and equation associated with linear models are given for each physical variable. Dashed grey lines indicate significant model but poor fit (low R^2).

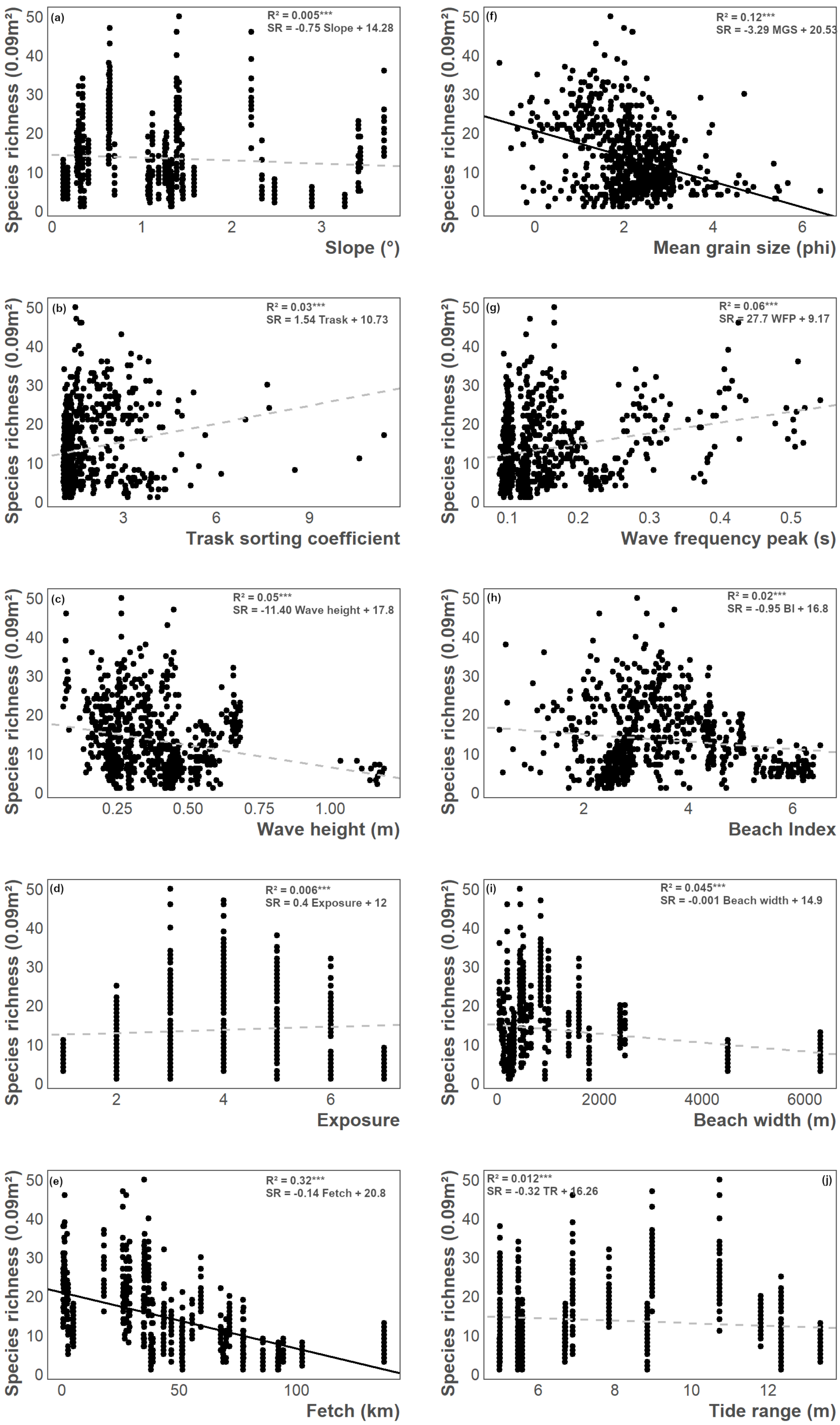

Fig. S3. Relationship between total abundance (for 0.09 m²) and (a) beach slope, (b) sediment sorting (Trask), (c) wave height, (d) exposure, (e) fetch, (f) mean grain size in phi unit, (g) wave frequency peak, (h) Beach Index, (i) beach width and (j) tide range. No linear model was tested since all model residuals showed autocorrelation (Durbin Watson test $p < 0.05$).

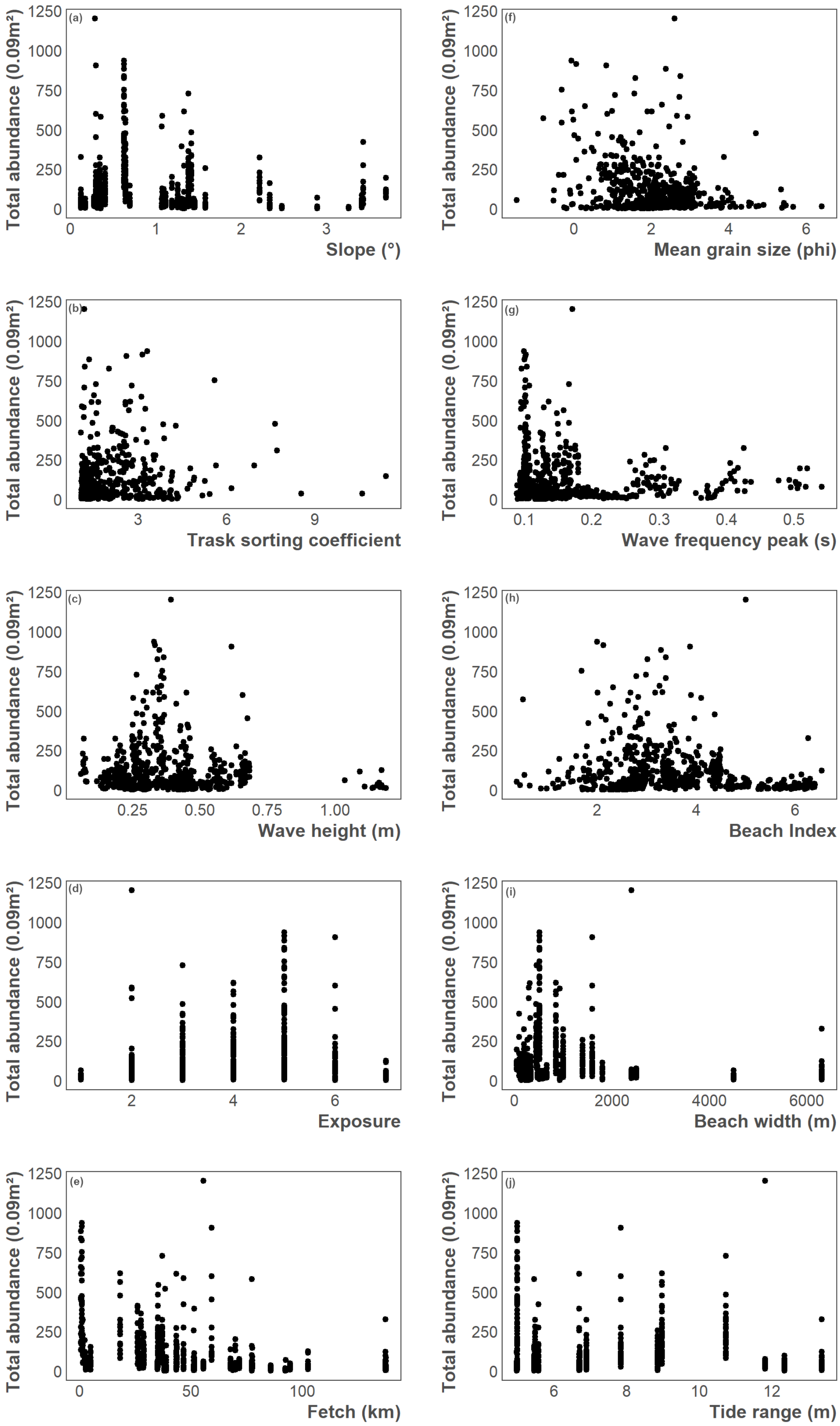

Fig. S4. Species richness (0.09 m²) observed for the four habitats identified in this study (I: *Tide-dominated flats tending to tide-modified ultra-dissipative beaches;* II: *Tide-dominated flats with fine sands;* III: *Tide-dominated flats with medium sands;* IV: *Extended flats tending to tide-modified ultra-dissipative beaches*). A Kruskal-Wallis test ($p < 0.05$) followed by Dunn's post-hoc were used to test for significant differences between habitats. Different letters indicate significant differences ($p < 0.05$)

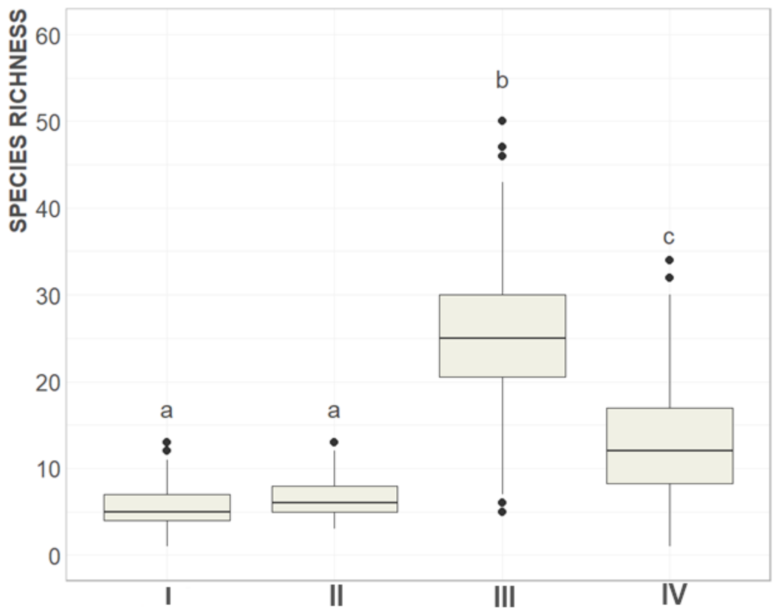

Fig. S5. Total abundances (0.09 m²) observed for the four habitats identified in this study (I: *Tide-dominated flats tending to tide-modified ultra-dissipative beaches;* II: *Tide-dominated flats with fine sands;* III: *Tide-dominated flats with medium sands;* IV: *Extended flats tending to tide-modified ultra-dissipative beaches*). A Kruskal-Wallis test ($p < 0.05$) followed by Dunn's post-hoc were used to test for significant differences between habitats. Different letters indicate significant differences ($p < 0.05$)

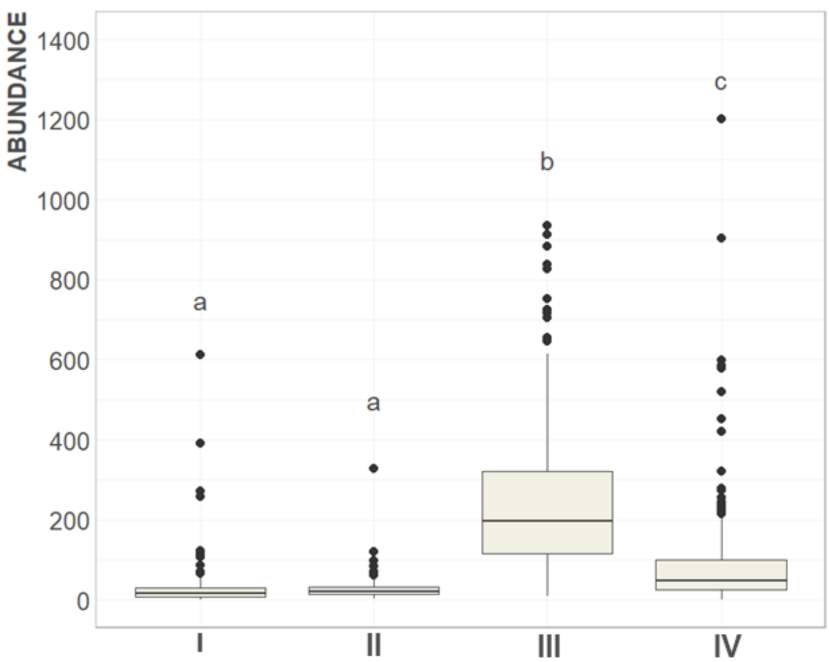

Table S1. Beach characteristics regarding their benthic communities, sediment and morphodynamics. For the benthic community, the mean species richness (± standard error; S), mean abundance (± standard error; AB) and mean Shannon index (± standard error; H') are given for 0.09 m². The Trask sorting coefficient (± standard error; So), the mean grain-size (± standard error; D50) and the percentages of gravel, mud, sand and organic matter (± standard error for each variable) are given for the sediment characteristics. The fetch, slope, wave height, wave frequency peak (all mean ± standard error), the tidal range, the mean beach index (±SD) and the exposure score are given for the beach morphodynamics properties.

	BENTHIC COMMUNITY			SEDIMENT CHARACTERISTICS						BEACH MORPHODYNAMIC PROPERTIES							
Beach	**$S_{mean \pm sd}$**	**AB_{mean}**	**H'_{mean}**	**Trask sorting coefficient (So)**	**D_{50} (µm)**	**Gravel (%)**	**Mud (%)**	**Sand (%)**	**Organic Matter (%)**	**Fetch (km)**	**Slope (degrees)**	**Wave height *(hs)***	**Wave frequency peak *(fp)***	**Tidal range (m)**	**Beach Index[1] (BI)**	**Exposure score [2]**	**Beach width (m)**
Arcouest	26 ± 8	237 ± 117	1.99 ± 0.46	2.18 ± 0.86	293.35 ± 99.73	14.37 ± 7.72	6.58 ± 5.27	79.05 ± 10.6	1.1 ± 0.29	33.26 ± 4.11	1.4 ± 0.01	0.26 ± 0.01	0.16 ± 0.01	10.7	2.93 ± 0.21	3	451 ± 5
Audierne	5 ± 2	28 ± 25	1.17 ± 0.47	1.19 ± 0.07	200.47 ± 28.25	1.38 ± 2.18	1 ± 0.2	97.62 ± 2.16	1 ± 0.14	94.22 ± 6.9	1.29 ± 0.15	0.73 ± 0.3	0.09 ± 0	4.98	2.55 ± 0.16	7	247 ± 38
Baie de Saint-Brieuc	13 ± 3	62 ± 181	2.17 ± 0.46	1.31 ± 0.38	169.48 ± 18.99	5.6 ± 4.39	1.63 ± 1.5	92.77 ± 4.6	1 ± 0.18	66.28 ± 7.6	0.28 ± 0.01	0.39 ± 0.03	0.19 ± 0.01	11.81	4.93 ± 0.14	2	2433 ± 58
Baie du Mont Saint-Michel	7 ± 2	40 ± 52	1.38 ± 0.41	3.07 ± 1.93	330.72 ± 312.6	9.25 ± 8.84	22.29 ± 13.43	68.46 ± 13.05	2.53 ± 1	137.38 ± 0.02	0.12 ± 0	0.45 ± 0.02	0.16 ± 0.01	13.37	5.91 ± 0.45	3	6300
Blancs Sablons	7 ± 2	64 ± 116	1.38 ± 0.53	1.32 ± 0.14	207.23 ± 16.56	0.31 ± 0.33	1.13 ± 0.2	98.56 ± 0.38	0.69 ± 0.34	48.7 ± 3.76	1.41 ± 0.13	0.45 ± 0.02	0.1 ± 0	6.69	2.71 ± 0.09	4	304 ± 31
Callot	28 ± 6	223 ± 141	2.33 ± 0.48	2.74 ± 1.04	350.50 ± 227.64	18.45 ± 8.77	4.18 ± 7.87	77.38 ± 10.4	0.89 ± 0.56	26.54 ± 7.28	0.64 ± 0	0.39 ± 0.06	0.13 ± 0.01	8.97	3.4 ± 0.31	4	855
Damgan	9 ± 5	57 ± 94	1.47 ± 0.68	2.11 ± 1.87	216.01 ± 266.75	11.26 ± 12.18	3.65 ± 5.42	85.69 ± 14.66	1.08 ± 0.66	74.18 ± 4.54	0.81 ± 0.43	0.23 ± 0.01	0.12 ± 0	5.46	3.17 ± 0.63	2	550 ± 353
Erdeven	8 ± 3	69 ± 118	1.43 ± 0.58	1.37 ± 0.52	160.42 ± 31.37	5.17 ± 4.42	1.31 ± 1.75	93.51 ± 4.51	0.57 ± 0.15	51.41 ± 13.52	1.11 ± 0.05	0.34 ± 0.04	0.1 ± 0	4.99	2.72 ± 0.13	2	289 ± 17
Gâvres	25 ± 7	441 ± 237	1.52 ± 0.51	2.85 ± 1.52	531.75 ± 427.96	19.8 ± 15.12	3.02 ± 1.15	77.18 ± 15.1	0.79 ± 0.2	0.91 ± 0.18	0.63 ± 0	0.35 ± 0.01	0.1 ± 0	4.99	2.62 ± 0.62	5	510
Kerjouanno	9 ± 5	66 ± 89	1.45 ± 0.57	1.71 ± 0.96	240.65 ± 295.14	11.65 ± 11.38	0.87 ± 0.22	87.48 ± 11.27	0.43 ± 0.16	41.22 ± 3.98	2.36 ± 0.88	0.29 ± 0.01	0.12 ± 0	5.58	1.99 ± 0.44	3	169 ± 82
Plage de l'Aber	13 ± 4	54 ± 36	1.96 ± 0.46	1.32 ± 0.27	167.63 ± 39.6	4.43 ± 3.49	1.12 ± 0.24	94.45 ± 3.45	1.3 ± 0.5	4.85 ± 0.14	1.26 ± 0	0.38 ± 0.1	0.1 ± 0.01	6.71	2.88 ± 0.11	2	335
Plouharnel	21 ± 6	120 ± 70	2.22 ± 0.36	1.5 ± 0.67	270.57 ± 308.72	6.72 ± 10.84	1.19 ± 0.3	92.08 ± 10.72	0.49 ± 0.13	31.53 ± 3.98	0.34 ± 0	0.2 ± 0.01	0.29 ± 0.02	5.48	3.81 ± 0.36	5	1000
Rade de Brest	21 ± 9	97 ± 69	2.42 ± 0.38	2.18 ± 0.99	482.15 ± 635.73	15.58 ± 14.66	9.95 ± 8.75	74.47 ± 14.41	2.89 ± 0.43	2.13 ± 0.57	3.08 ± 0.66	0.12 ± 0.04	0.43 ± 0.06	6.89	1.66 ± 0.6	4	126 ± 75
Saint-Benoit	6 ± 2	18 ± 11	1.53 ± 0.31	1.99 ± 1.11	117.49 ± 47.77	2.94 ± 3.06	21.4 ± 18.55	75.66 ± 17.89	2.42 ± 0.92	74.32 ± 4.04	0.17 ± 0	0.24 ± 0.01	0.23 ± 0.02	13.37	5.82 ± 0.26	1	4500
Saint-Briac	4 ± 2	8 ± 11	1 ± 0.55	1.32 ± 0.15	270.69 ± 47.92	0.96 ± 1.81	0.94 ± 0.21	98.1 ± 1.79	0.82 ± 0.22	92.34 ± .011	2.88 ± 0.32	0.42 ± 0.02	0.13 ± 0.01	12.35	2.5 ± 0.15	6	261 ± 36
Saint-Cast	14 ± 5	36 ± 21	2.22 ± 0.32	1.47 ± 0.48	159.39 ± 64.05	3.92 ± 3.7	2.28 ± 1.04	93.8 ± 3.67	1.45 ± 0.32	37.74 ± 10.36	1.28 ± 0.14	0.22 ± 0.03	0.14 ± 0.01	12.35	3.51 ± 0.23	2	588 ± 76
Saint-Efflam	10 ± 4	95 ± 66	1.5 ± 0.56	1.15 ± 0.04	135.98 ± 12.77	0.22 ± 0.28	2.23 ± 0.78	97.56 ± 0.94	2.36 ± 1.3	43.34 ± 6.8	0.38 ± 0.04	0.56 ± 0.03	0.1 ± 0	8.85	4.53 ± 0.11	5	1533 ± 231
Sainte-Marguerite	19 ± 4	156 ± 157	2.16 ± 0.37	1.42 ± 0.38	259.52 ± 54.23	4.51 ± 6.6	1.67 ± 0.54	93.82 ± 6.73	1.23 ± 0.25	43.09 ± 13.63	0.3 ± 0	0.66 ± 0.02	0.1 ± 0	7.84	4.3 ± 0.16	6	1600

[1] From McLachlan & Dorvlo 2005. <1.5: Reflective beach, 1.5 - 3: Intermediate beach, and >3: Dissipative beach.

[2] From McLachlan, 1980. 1 – 5: Very sheltered (virtually no wave action; shallow reduced layers; abundant macrofaunal burrows), 6 – 10: Sheltered (Little wave action; reduced layers present; usually some macrofaunal burrows), 11 – 15: Exposed (Moderate to heavy wave action: reduced layers deep if present; usually no macrofaunal burrows), 16 – 20: Very exposed (Heavy wave action; no reduced layers; macrofauna only of tough motile forms).

References

McLachlan A (1980) The definition of sandy beaches in relation to exposure: a simple rating system. S Afr J Sci 76:137–138

McLachlan A, Dorvlo A (2005) Global patterns in sandy beach macrobenthic communities. J Coast Res 21: 674– 687