Comparison of image annotation data generated by multiple investigators for benthic ecology

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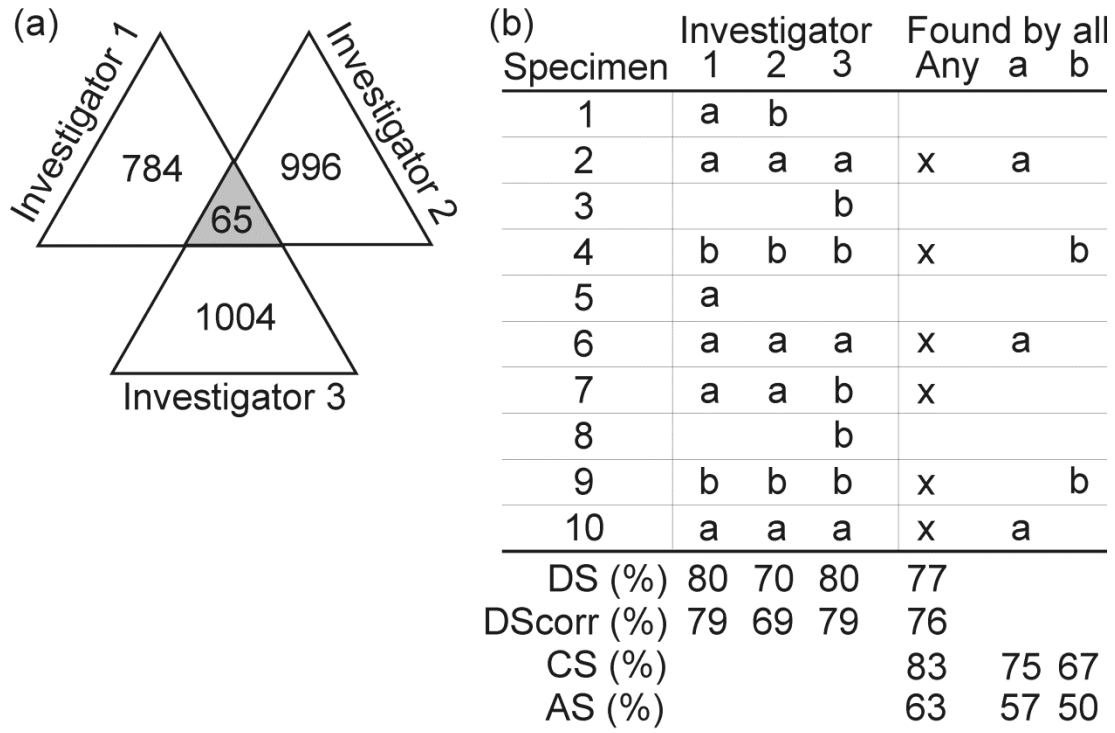*Corresponding author: jennifer.durden@noc.soton.ac.uk

Supplement 1. Megafaunal morphotypes annotated in all tiles with median square pixel dimensions. Elongate morphotypes denoted with [E], and morphotypes found in all replicates of the common tiles are denoted as [C], small tile set are denoted as [S], and those in the large tile set are denoted as [L]. Median size is reported from the common tiles.

| Group | Species name (if known) | Found by n investigators | | Median size (pixels^2) |
		Common tiles	Large tile set	
Porifera	Unspecified Porifera	-	3	-
	Porifera type 2	2	3	1224
	Porifera type 3[L]	3	3	616
	Porifera type 4	3	3	710
Octocorallia	Octocorallia sp.17	-	3	-
	Unspecified Umbellula	-	1	-
	Umbellula sp.1	3	3	1879
	Umbellula sp.3	2	2	4502
Actiniaria	Unspecified anemone	2	3	2655
	Actiniaria sp.1	1	3	7454
	Iosactis vagabunda [C,S,L]	3	3	1472
	Sicyonis biotrans	-	2	-
	Actiniaria sp.4	-	2	-
	Daontesia sp.	3	3	3798
	Actinauge abyssorum[L]	3	3	6381
	Actiniaria sp.9 [C,S,L]	3	3	206
	Amphianthus sp.[L]	3	3	5049
	Kadosactis sp.	3	3	1103
	Actiniaria sp.14	1	3	1248
	Actiniaria sp.15	2	3	601
	Actiniaria sp.16	-	1	-
	Actiniaria sp.18	3	3	597
	Actiniaria sp.19	2	3	6241
	Actiniaria sp.20	-	3	-
Other Hexacorallia	Cerianthid sp.1[L]	3	3	875
	Cerianthid sp.2	3	3	12687
	Cerianthid sp.3[L]	3	3	305
"Vermes"	Echiura [E,L]	3	3	23569

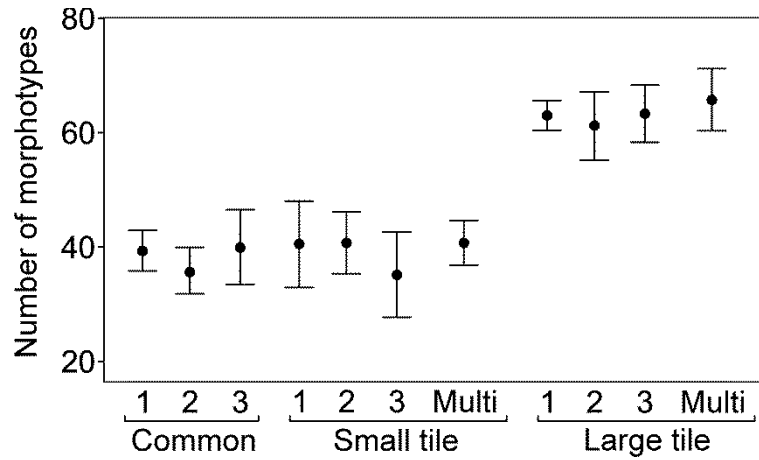|				
Annelida	Unspecified Annelida [E]	1	3	472
	Aphroditid [E,C,L]	3	3	1690
	Polynoid type 1 [E]	2	3	169
	Polynoid type 2 [E]	1	3	273
Decapoda	Squat lobster	-	2	-
Other Crustacea	Munnopsida sp.	-	1	-
Pycnogonida	*Colossendeis colossea*	-	3	-
Cephalopoda	*Grimpoteuthis* sp.	-	3	-
Asteroidea	Unspecified Asteroidea	1	2	50361
	Freyaster sp.	-	3	-
	Brisingid sp.2	-	2	-
	Pythonaster atlantidis	-	2	-
	Styracaster sp.	3	3	5557
	Dytaster grandis grandis	-	3	-
Ophiuroidea	Ophiuroidea [C,S,L]	3	3	1122
Holothuroidea	Unspecified holothurian [E]	1	3	1386
	Amperima/Ellipinion/Kolga sp. [E,C,S,L]	3	3	1161
	Benthodytes lingua [E]	3	2	8084
	Benthodytes sordida	-	1	-
	Benthothuria sp.	-	3	-
	Deima validum [E]	2	3	2619
	Enypniastes eximia	-	3	-
	Holothuria sp.3	-	3	-
	Holothuria sp.4	-	2	-
	Holothuria sp.5 [E]	1	3	6272
	Molpadiedemas villosus [E,L]	3	3	35269
	Mesothuria sp.	-	1	-
	Oneirophanta mutabilis [E,L]	3	3	10719
	Paelopatides sp.	-	2	-
	Paroriza prouhoi	-	3	-
	Peniagone sp. [E,L]	3	3	15737
	Peniagone sp.2	-	2	-
	Pseudostichopus aemulatus [E]	3	3	7192
	Psychropotes longicauda [E]	3	3	39460
Crinoidea	Commatulid	3	3	34552
	Bathycrinus sp. [E,C,L]	1	3	384
Tunicata	Unstalked tunicate	1	3	1697
	Stalked tunicate [S,L]	3	3	2163
Indeterminate	Unspecified indeterminate	2	3	1154
	Indet. – "Annelid" [E]	2	3	1681
	Indet. – "Scaphopod" [E,L]	3	3	13713
	Indet. – "Tube-dwelling invertebrate" [S,L]	3	3	1633
	Indet. – "Echinoid"	1	3	745
	Indet. – "*Platyctenida*"	-	3	-
	Indet. – "Hydroid"	3	3	3058

Supplement 2. Schematic representations of the methods. (a) The total number of tiles annotated by each investigator in the common tiles (65) and large tile set (784 + 996 + 1004). (b) An example of the calculation of detection success (DS), corrected detection success (DScorr), classification success (CS) and annotation success (AS), considering 10 specimens of two taxa ('a' and 'b'). Note that corrected detection success considers the probability of joint non-detection ($[1-DS]^3$) = 1% and a number of unseen specimens (1% x 10 = 0.1). Classification success is based only on cases of joint detection by all three investigators.

(a)

(b)

Specimen	Investigator 1	2	3	Found by all Any	a	b
1	a	b				
2	a	a	a	x	a	
3			b			
4	b	b	b	x		b
5	a					
6	a	a	a	x	a	
7	a	a	b	x		
8			b			
9	b	b	b	x		b
10	a	a	a	x	a	
DS (%)	80	70	80	77		
DScorr (%)	79	69	79	76		
CS (%)				83	75	67
AS (%)				63	57	50

Supplement 3. The division of tiles into replicates for the assessment of the impact of multiple investigators on the resulting ecological metrics.

	Tiles	Seabed area (ha)	Replicates	No. Replicates x No. tiles per replicate
Common tiles				
Investigator 1	65	0.0813	4	3 x 16, 1 x 17
Investigator 2	65	0.0813	4	3 x 16, 1 x 17
Investigator 3	65	0.0813	4	3 x 16, 1 x 17
Small tile set				
Investigator 1	65	0.0815	4	3 x 16, 1 x 17
Investigator 2	65	0.0818	4	3 x 16, 1 x 17
Investigator 3	65	0.0821	4	3 x 16, 1 x 17
Multi	65	0.0814	4	3 x 16, 1 x 17
Large tile set				
Investigator 1	784	0.9880	8	8 x 98
Investigator 2	996	1.2534	10	6 x 100, 4 x 99
Investigator 3	1004	1.2629	10	4 x 101, 6 x 100
Multi	1000	1.2588	10	10 x 100

Supplement 4. Mean richness with 95% confidence intervals, shown for each investigator and the multi-investigator annotated tiles, rarefied to 500 individuals in the common tiles and small tile set, and to 5000 individuals in the large tile set.

Supplement 5. Time investment in the manual annotation of images, geometric means (95% confidence interval)

	Total (h)	Per seabed area (min m^{-2})	Per tile (min)
Common tiles			
Investigator 1	4.55	0.33 (0.28, 0.38)	4.20 (3.59, 4.82)
Investigator 2	8.03	0.75 (0.45, 1.06)	7.41 (4.86, 9.96)
Investigator 3	3.25	0.24 (0.20, 0.28)	3.00 (2.50, 3.50)
All investigators	15.83	0.39 (0.30, 0.48)	4.54 (3.78, 5.30)
Small tile set			
Investigator 1	5.33	0.42 (0.37, 0.48)	5.38 (4.71, 6.05)
Investigator 2	6.84	0.55 (0.44, 0.66)	6.96 (5.60, 8.33)
Investigator 3	3.55	0.28 (0.22, 0.35)	3.57 (2.74, 4.40)
All investigators	15.71	0.40 (0.33, 0.47)	5.10 (4.22, 5.98)
Large tile set			
Investigator 1	67.0	0.42 (0.39, 0.45)	5.38 (5.00, 5.76)
Investigator 2	113.9	0.55 (0.50, 0.61)	6.96 (6.29, 7.63)
Investigator 3	59.3	0.28 (0.25, 0.32)	3.57 (3.10, 4.05)
All investigators	240.1	0.40 (0.36, 0.45)	5.10 (4.55, 5.64)