

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

Jennifer M. Durden\*, Brian J. Bett, Timm Schoening, Kirsty J. Morris, Tim W. Nattkemper, Henry A. Ruhl

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

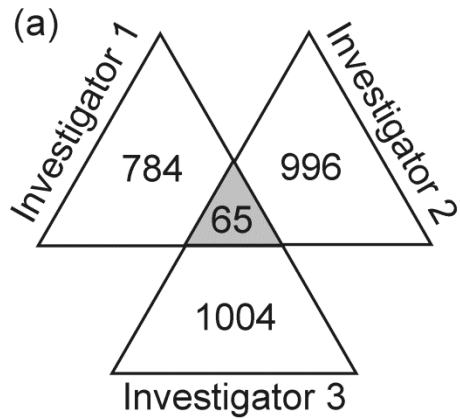
Marine Ecology Progress Series 552:61-70 (2016)

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

Group	Species name (if known)	Found by n investigators		Median size (pixels <sup>2</sup> )
		Common tiles	Large tile set	
Porifera	Unspecified Porifera	-	3	-
	Porifera type 2	2	3	1224
	Porifera type 3 <sup>L</sup>	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
	<i>Iosactis vagabunda</i> <sup>C,S,L</sup>	3	3	1472
	<i>Sicyonis biotrans</i>	-	2	-
	Actiniaria sp.4	-	2	-
	<i>Daontesia</i> sp.	3	3	3798
	<i>Actinauge abyssorum</i> <sup>L</sup>	3	3	6381
	Actiniaria sp.9 <sup>C,S,L</sup>	3	3	206
	<i>Amphianthus</i> sp. <sup>L</sup>	3	3	5049
	<i>Kadosactis</i> 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 <sup>L</sup>	3	3	875
	Cerianthid sp.2	3	3	12687
	Cerianthid sp.3 <sup>L</sup>	3	3	305
“Vermes”	<i>Echiura</i> <sup>E,L</sup>	3	3	23569

Annelida	Unspecified Annelida <sup>E</sup>	1	3	472
	Aphroditid <sup>E,C,L</sup>	3	3	1690
	Polynoid type 1 <sup>E</sup>	2	3	169
	Polynoid type 2 <sup>E</sup>	1	3	273
Decapoda	Squat lobster	-	2	-
Other Crustacea	Munnopsida sp.	-	1	-
Pycnogonida	<i>Colossendeis colossea</i>	-	3	-
Cephalopoda	<i>Grimpoteuthis</i> sp.	-	3	-
Asteroidea	Unspecified Asteroidea	1	2	50361
	<i>Freyaster</i> sp.	-	3	-
	Brisingid sp.2	-	2	-
	<i>Pythonaster atlantidis</i>	-	2	-
	<i>Styracaster</i> sp.	3	3	5557
	<i>Dytaster grandis grandis</i>	-	3	-
Ophiuroidea	Ophiuroidea <sup>C,S,L</sup>	3	3	1122
Holothuroidea	Unspecified holothurian <sup>E</sup>	1	3	1386
	<i>Amperima/Ellipinion/Kolga</i> sp. <sup>E,C,S,L</sup>	3	3	1161
	<i>Benthodytes lingua</i> <sup>E</sup>	3	2	8084
	<i>Benthodytes sordida</i>	-	1	-
	<i>Benthothuria</i> sp.	-	3	-
	<i>Deima validum</i> <sup>E</sup>	2	3	2619
	<i>Enypniastes eximia</i>	-	3	-
	Holothuria sp.3	-	3	-
	Holothuria sp.4	-	2	-
	Holothuria sp.5 <sup>E</sup>	1	3	6272
	<i>Molpadiedemas villosus</i> <sup>E,L</sup>	3	3	35269
	<i>Mesothuria</i> sp.	-	1	-
	<i>Oneirophanta mutabilis</i> <sup>E,L</sup>	3	3	10719
	<i>Paelopatides</i> sp.	-	2	-
	<i>Paroriza prouhoi</i>	-	3	-
	<i>Peniagone</i> sp. <sup>E,L</sup>	3	3	15737
	<i>Peniagone</i> sp.2	-	2	-
	<i>Pseudostichopus aemulatus</i> <sup>E</sup>	3	3	7192
<i>Psychropotes longicauda</i> <sup>E</sup>	3	3	39460	
Crinoidea	Commatulid	3	3	34552
	<i>Bathycrinus</i> sp. <sup>E,C,L</sup>	1	3	384
Tunicata	Unstalked tunicate	1	3	1697
	Stalked tunicate <sup>S,L</sup>	3	3	2163
Indeterminate	Unspecified indeterminate	2	3	1154
	Indet. – “Annelid” <sup>E</sup>	2	3	1681
	Indet. – “Scaphopod” <sup>E,L</sup>	3	3	13713
	Indet. – “Tube-dwelling invertebrate” <sup>S,L</sup>	3	3	1633
	Indet. – “Echinoid”	1	3	745
	Indet. – “ <i>Platyctenida</i> ”	-	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 ( $1\% \times 10 = 0.1$ ). Classification success is based only on cases of joint detection by all three investigators.



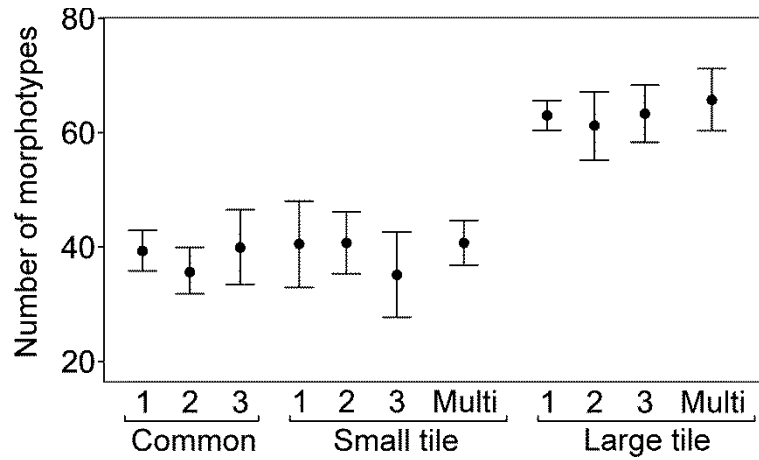
(b)

Specimen	Investigator			Found by all		
	1	2	3	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
<i>Common tiles</i>				
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
<i>Small tile set</i>				
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
<i>Large tile set</i>				
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 <sup>-2</sup> )	Per tile (min)
<i>Common tiles</i>			
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)
<i>Small tile set</i>			
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)
<i>Large tile set</i>			
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)