

SUPPLEMENTARY MATERIAL

How Much Shallow Coral Habitat is there on the Great Barrier Reef ?

Chris M. Roelfsema¹, Mitchell B. Lyons¹, Carolina Castro-Sanguino¹, Eva M. Kovacs¹, David Callaghan², Magnus Wettle³, Kathryn Markey¹, Rodney Borrego¹, Paul Tudman¹, Meredith Roe¹, Emma V. Kennedy^{1,4}, Manuel Gonzalez-Rivero⁴, Nick Murray¹ and Stuart R. Phinn¹

¹ Remote Sensing Research Centre, School of Earth and Environmental Sciences, University of Queensland, QLD4072, Brisbane, Australia

² School of Engineering, University of Queensland, QLD4072, Brisbane, Australia

³ EOMAP Australia Pty Ltd, Sunshine Coast, 4558, QLD, Australia

⁴ Australian Institute of Marine Science, Townsville, School of Civil Engineering, University of Queensland, Brisbane, QLD, Australia.

* Correspondence: c.roelfsema@uq.edu.au

Supplementary Materials

Figure S1: Latitudinal distribution of reef area above 20 m MSL depth based on geomorphic zonation maps.

(A) Latitudinal distribution of total reef area (grey) and coral habitat (green) above 20 m MSL depth based on geomorphic zonation maps. Coral habitat = area of Reef Slope, Reef Crest, and Outer Reef Flat. (B) Spatial distribution of coral habitat along and across the GBR (each pixel is a 0.2×0.2 degree cell).

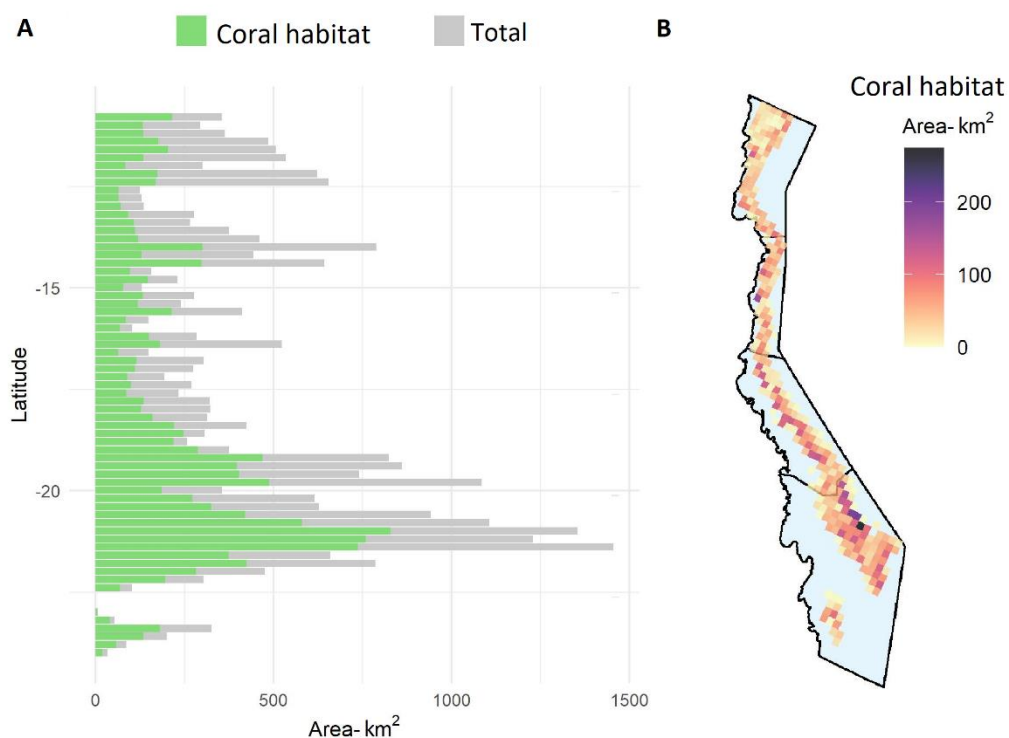


Table S1: Mapping category general description derived from Kennedy et al 2021.

Habitat Map	Class Name	Class Description	Coral Habitat class
Geomorphic Zonation	Reef Slope	Reef Slope is a submerged, sloping area extending seaward from the Reef Crest (or Flat) towards the shelf break. Windward facing, or any direction if no dominant prevailing wind or current exists.	Yes
	Reef Crest	Reef Crest is a zone marking the boundary between the reef flat and the reef slope, generally shallow and characterised by highest wave energy absorbance.	Yes
	Outer Reef Flat	Adjacent to the seaward edge of the reef, Outer Reef Flat is a level (near horizontal), broad and shallow platform that displays strong wave-driven zonation	Yes
	Inner Reef Flat	Inner Reef Flat is a low energy, sediment-dominated, horizontal to gently sloping platform behind the Outer Reef Flat.	No
	Shallow Lagoon	Shallow Lagoon is any closed to semi-enclosed, sheltered, flat-bottomed shallow sediment-dominated lagoon area.	No
	Back Reef Slope	Back Reef Slope is a complex, interior, - often gently sloping - reef zone occurring behind the Reef Flat. Of variable depth (but deeper than Reef Flat and more sloped), it is sheltered, sediment-dominated and often punctuated by coral outcrops.	No
	Patch Reef	Patch Reef is any small, detached to semi-detached lagoonal coral outcrop arising from sandy bottomed area.	No
	Plateau	Plateau is any deeper submerged, hard-bottomed, horizontal to gently sloping seaward facing reef feature.	No
	Small reef	Small Reef refers to any detached (stand-alone) reef, surrounded by Deep Water and too small (generally 1 sq km) to show a central depression and/or other clear geomorphological zonation (e.g. crest, flat, backreef) besides a Reef Slope.	No
	Deep Lagoon	Deep Lagoon is any sheltered broad body of water semi-enclosed to enclosed by reef, with a variable depth (but shallower than surrounding ocean) and a soft bottom dominated by reef-derived sediment.	No
	Sheltered Reef Slope	Sheltered Reef Slope is any submerged, sloping area extending into Deep Water but protected from strong directional prevailing wind or current, either by land or by opposing reef structures.	Yes
Benthic Cover Type	Coral/Algae	Coral/Algae is any hardbottom area supporting living coral and/or algae.	Yes
	Sand	Sand is any soft-bottom area dominated by fine unconsolidated sediments.	No
	Rubble	Rubble is any habitat featuring loose, rough fragments of broken reef material.	No
	Rock	Rock is any exposed area of hard bare substrate.	Yes

Table S2: Accuracy measures including overall map accuracy and individual map-user and map-producer category accuracies are derived from a non-parametric bootstrap approach applied to traditional error matrix statistics [62]. Producer's accuracy is the probability of a reference data point being classified correctly, and user's accuracy is the probability of a classified pixel being correct

Geomorphic Zone (0-20 m MSL)			Benthic Cover Type (0-10 m MSL)		
Number of Samples	3948		Number of Samples	26148	
Overall Accuracy(%)	68		Map	62	
Category:	User(%)	Producer (%)	Category:	User(%)	Producer (%)
Shallow Lagoon	93	70	Coral/Algae	92	55
Deep Lagoon	70	89	Rock	47	72
Inner Reef Flat	81	87	Sand	43	84
Outer Reef Flat	52	80	Rubble	32	87
Reef Crest	83	40			
Sheltered Reef Slope	53	39			
Reef Slope	68	34			
Plateau	83	99			
Back Reef Slope	53	87			
Patch Reef					

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Table S3: Surface Area for Shallow Offshore GBR.

Mean estimates (and 95% Confidence Intervals) for Planar area (2D) and 3D Surface area (depth adjusted) for the geomorphic and benthic classes per mapping region (i.e. Management areas) and for the full extent of the offshore shallow reefs within the Marine Park (GBRMP). Note: Patch reef estimates are based only on size/position after the machine learning classification (i.e. there is no validation data).

		Shallow Offshore Reefs mapped within the GBRMP									
		GBRMP		Marine Park Management Regions							
				Far North		Cairns/Cooktown		Townsville/ Whitsundays		Mackay/Capricorn	
Map type	Class	2D Planar area mean (95% CI) km2	3D (depth adjusted) Surface area mean (95% CI) km2	2D Planar area mean (95% CI) km2	3D (depth adjusted) Surface area mean (95% CI) km2	2D Planar area mean (95% CI) km2	3D (depth adjusted) Surface area mean (95% CI) km2	2D Planar area mean (95% CI) km2	3D (depth adjusted) Surface area mean (95% CI) km2	2D Planar area mean (95% CI) km2	3D (depth adjusted) Surface Area mean (95% CI) km2
Geomorphic Zonation (0-20 m depth)	Shallow Lagoon	379 (144-483)	454 (172-579)	233 (88-297)	255 (97-325)	48 (18-62)	63 (24-80)	19 (7-24)	25 (9-32)	79 (30-101)	111 (42-142)
	Deep Lagoon	1684 (1469-1832)	3363 (2933-3659)	735 (641-800)	1213 (1058-1319)	203 (177-221)	388 (338-422)	278 (243-303)	591 (516-643)	468 (408-509)	1172 (1022-1274)
	Inner Reef Flat	2255 (1918-2503)	3291 (2799-3652)	924 (786-1026)	1202 (1022-1333)	322 (274-358)	401 (341-445)	279 (237-310)	459 (390-509)	730 (621-810)	1230 (1046-1365)
	Outer Reef Flat	1949 (1526-2281)	3564 (2791-4171)	684 (535-800)	1110 (869-1299)	289 (226-339)	442 (346-517)	324 (254-379)	697 (546-816)	652 (511-763)	1315 (1029-1539)
	Reef Crest	543 (539-543)	1464 (1453-1464)	79 (78-79)	164 (163-164)	100 (99-100)	235 (233-235)	102 (101-102)	293 (291-293)	262 (260-262)	773 (767-773)
	Sheltered Reef Slope	796 (282-1264)	3787 (1340-6012)	231 (82-367)	1082 (383-1717)	92 (33-147)	412 (146-654)	163 (58-258)	747 (264-1186)	310 (110-492)	1547 (547-2455)
	Reef Slope	1183 (787-1512)	4866 (3238-6221)	118 (79-151)	401 (267-513)	221 (147-282)	878 (584-1122)	442 (294-565)	1765 (1175-2257)	401 (267-513)	1822 (1212-2329)
	Plateau	1673 (544-2703)	1961 (638-3168)	878 (286-1419)	954 (310-1540)	166 (54-269)	225 (73-364)	428 (139-691)	519 (169-838)	201 (65-325)	264 (86-426)
	Back Reef Slope	2875 (982-4597)	5476 (1871-8757)	844 (288-1349)	1303 (445-2084)	593 (203-949)	1192 (407-1907)	789 (270-1262)	1530 (523-2447)	648 (222-1037)	1450 (495-2319)
	Coral Habitat*	4471 (3134-5600)	13682 (8821-17868)	1112 (774-1397)	2757 (1681-3693)	703 (505-868)	1966 (1309-2528)	1031 (707-1305)	3502 (2275-4551)	1626 (1148-2031)	5456 (3556-7096)
	Total Area	13351 (8203-17731)	28261 (17267-37716)	4728 (2865-6289)	7689 (4618-10301)	2038 (1234-2728)	4241 (2498-5751)	2828 (1606-3898)	6636 (3892-9030)	3756 (2497-4816)	9694 (6258-12634)
	Number of reefs		2164		586		240		419		919
Benthic Category (0-10 m depth)	Sand	3918 (2119-5613)	6348 (3434-9096)	1527 (826-2188)	2001 (1082-2866)	599 (324-858)	919 (497-1317)	601 (325-861)	1141 (617-1635)	1190 (644-1705)	2287 (1237-3277)
	Rubble	595 (416-749)	1428 (997-1798)	174 (122-219)	336 (235-424)	116 (81-146)	266 (186-335)	135 (94-170)	336 (235-423)	170 (119-214)	489 (341-615)
	Rock	2015 (1609-2274)	5567 (4445-6282)	574 (458-647)	1174 (937-1325)	379 (303-428)	968 (773-1092)	433 (346-489)	1380 (1102-1557)	629 (502-710)	2045 (1633-2308)
	Coral/Algae	2310 (1946-2539)	5046 (4251-5547)	883 (744-971)	1731 (1459-1903)	336 (283-369)	669 (564-736)	382 (322-420)	902 (760-991)	708 (597-779)	1744 (1469-1917)
	Coral Habitat**	4325 (3555-4813)	10613 (8696-11828)	1457 (1202-1618)	2906 (2396-3228)	715 (586-797)	1637 (1337-1828)	816 (668-909)	2282 (1861-2548)	1337 (1099-1488)	3788 (3102-4224)
	Total Area	8837 (6089-11175)	18388 (13127-22722)	3159 (2150-4026)	5242 (3713-6518)	1430 (990-1801)	2822 (2020-3480)	1551 (1087-1940)	3759 (2714-4607)	2698 (1862-3408)	6564 (4680-8117)
	Number of reefs		1946		539		226		369		812
Current baseline	Total Area		21654		8486		3033		4872		5262
(Lewis et al 2003)	Number of reef polygons		2600		645		251		489		1215

*Reef Slope+sheltered Slope+Reef Crest+Outer Reef Flat **Rock + Coral/Algae