BENTHIC MAP CLASSES

ALLEN CORAL ATLAS

Description of the shallow coral reef benthic mapping categories for **Allen Coral Atlas** global benthic habitat maps

The *Allen Coral Atlas* is a global-scale coral reef habitat mapping project that uses Planet Dove 3.7 m resolution daily satellite imagery (in combination with wave models and ecological data) to create consistent and high-detail global habitat maps to support reef-related science and conservation.

Global Benthic Habitat Maps characterise different coral reef bottom types. These bottom types include communities of living organisms attached to the reef (benthos), as well as sediments and underlying substrate.

The six *Allen Coral Atlas* Global Benthic Habitat Map classes described below were developed by Roelfsema *et al* 2013* with input from other coral reef benthic classifications. This classification maximizes the breadth of information available from Planet Dove remote sensing data to create the best set of classes we can to support users. Benthic classification for global scale reef mapping is still constrained by spatial resolution, quality and accessibility of biophysical earth observation data. The satellites we use are still fundamentally unable to distinguish some of the key measures that ecologists prefer to assess reef health (e.g., cover of living coral, cover of dead coral, cover of bleached corals and functional forms of algae) but broad classes like *Coral Habitat* and *Rubble* can still be informative for characterising the local ecology.

CORAL HABITAT (CORAL/ALGAE)

Coral Habitat is any hardbottom area supporting living coral and/or algae.
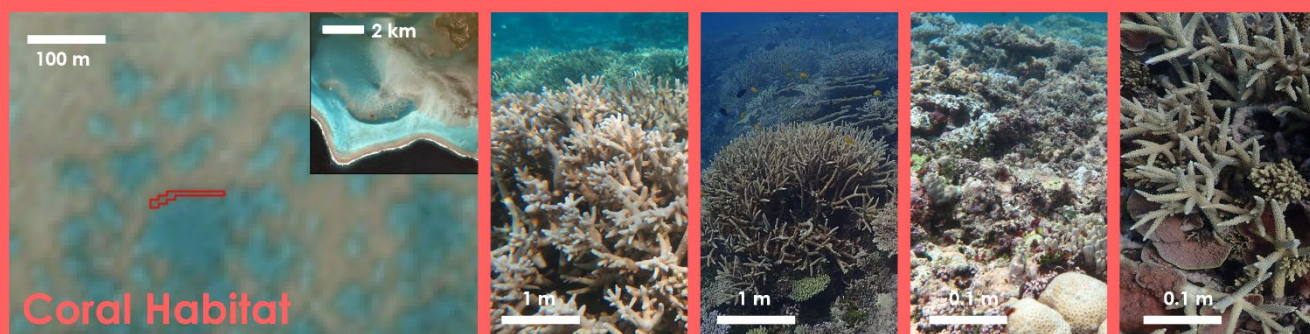
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Main features	Coral/Algae or Coral Habitat describes a benthic map class characterised by a hard underlying framework (usually coral-derived limestone framework, but may be non-carbonate) with a benthic covering of coral (including soft coral) and/or seaweeds (including macroalgae and turf algae). Benthic cover of coral or algae should be at least 1%, normally more than 5% and sometimes exceeding 40%, but does not necessarily have a dominance of any of these groups over non-living substrate. With average coral cover 10-20% globally, most reef habitats - even those supporting extensive coral growth - are unlikely to be quantitatively dominated by coral.
Where is it found?	This benthic habitat is commonly associated with Reef Front and Slope, Sheltered Reef Front and Slope, Patch Reefs and Outer Reef Flat classes.
Why do we care?	Coral Habitat is generally the most topographically complex class (sand, seagrass, rubble and rock are comparatively flat), supports the greatest amount of animal diversity and biomass. Coral abundance is a widely used proxy for reef health and a key metric for ecological monitoring. Most benthic classifications distinguish coral and algae and many move beyond this to classify coral morphology (e.g. branching, sheet, massive, encrusting), identify dominant taxa (e.g., Palmata zone, Cervicornis zone), or estimate proportional cover (<10% cover, >50% cover) – something that is still hard to achieve at the global scale. The photosynthetic nature of corals and seaweeds mean they are spectrally similar making them challenging to distinguish though remote sensing. The epilithic algal turf or film that quickly covers corals following death creates similar spectral signatures, meaning dead coral matrix cannot be reliably distinguished either, because of the speed at which it becomes covered.
Also goes by	Coral / Algae • Coral dominated • Coral framework • Hardbottom • Hard Coral • Stony Coral • Live Coral • Coral Reef • Mixed coral • Coral • Coral field • Carbonate framework

SAND

Sand includes any soft-bottom area dominated by fine unconsolidated sediments.
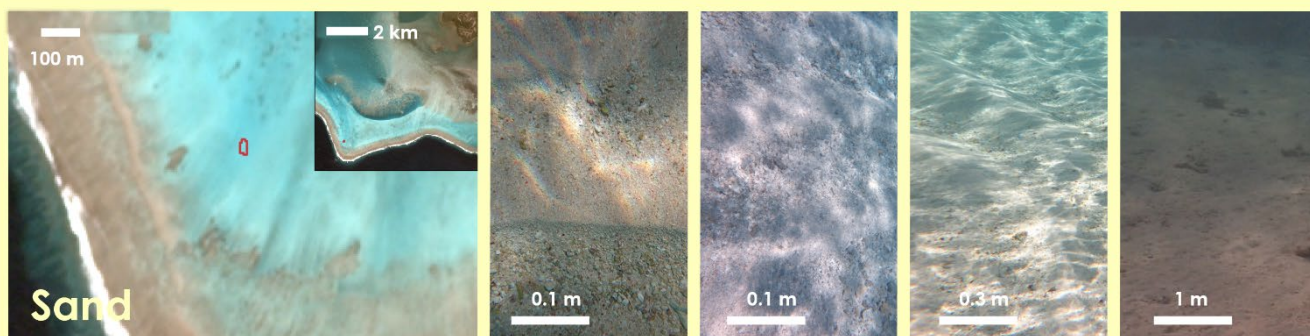
Pasir • Arena • Le Sable • رمال

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Main features	Sand class describes soft-bottomed reef areas where fine unconsolidated granular material (finer than coral rubble but coarser than muds) dominate, thickly obscuring any underlying bedrock. Sparse algae, scattered rocks or small, isolated coral heads may also occur in the Sand class, but these features do not exceed 10% of the area.
Where is it found?	Sand class is associated with Back Reef zones such as Inner Reef Flat, Back Reef Slope and Lagoon classes in particular, where it can occupy 80% of the area.
Why do we care?	Sand can tell us a lot about the age of the reef and biological activity. Most reef-associated sands are largely comprised of aragonite (50-80%) and magnesium calcite, although the size and source of the grain (including corals, coralline algae, molluscs, benthic foraminifers and Halimeda, among others) will vary and often shows strong cross reef zonation reflecting biogeographic and hydrodynamic factors.
Also goes by	Sand dominated • Bioclastic Sand • Sand and sparse algae • Coral Sand • Fine Sediment • Detrital Sand • Sand with Scattered Coral and Rock • Biogenic sand

UNKNOWN

Unknown may be assigned to an area on the map if a data constraint means it is not allocated a Global Benthic Class. This happens most commonly in the Global Benthic Habitat Map where a class has been assigned a Global Geomorphic Zone (up to 15 m), but the benthos is beyond the depth detection limit (10 m).

RUBBLE

Rubble is any habitat featuring loose, rough fragments of broken reef material.
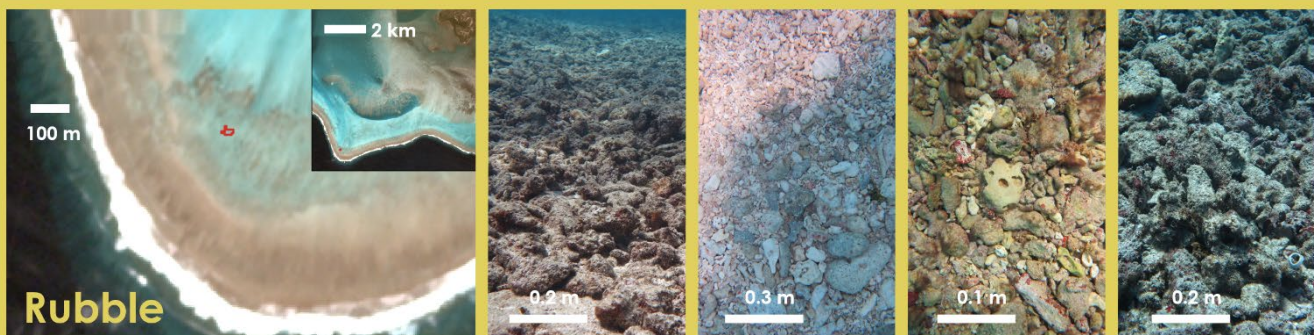
Dominan puing / pecahan karang • Substrato dominado por escombros de arrecifes
مرجانية بحطام ساند نطاق • Débris dominants

Main features	Rubble class describes any area featuring loose, cylindrical to irregularly shaped fragments of bedrock or clasts of corals, bivalves and coralline algae.
Where is it found?	This important habitat often occurs landward of well-developed reef formations in the Reef Crest, Back Reef or Reef Flat zones, and may be associated with some fringing reefs, and also rubble-dominated reef flats.
Why do we care?	Rubble pieces - while themselves are non-living - can be heavily encrusted by foraminifers, bryozoans or coralline algae, and contain boring organisms.
Also goes by	*Rubble-Dominated • Skeletal Rubble • Coral Gravel • Coral Rudstone • Reef Rubble • Rhodoliths • Unconsolidated substrate*

ROCK

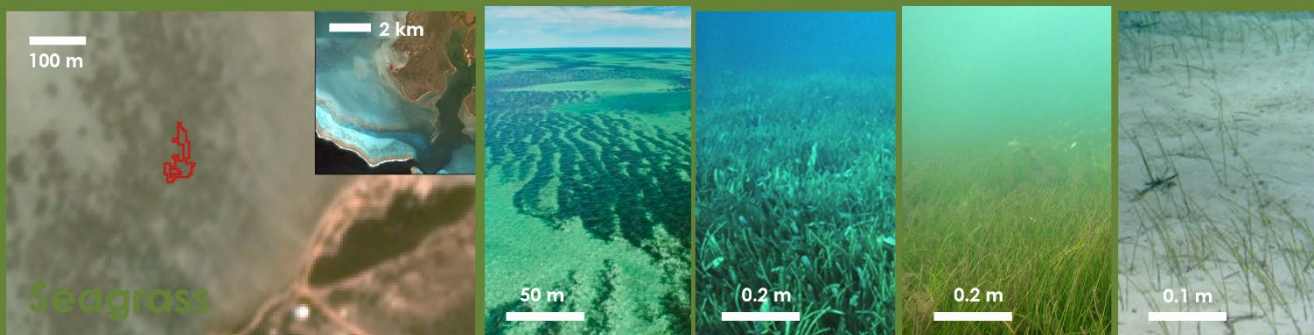**Rock is any exposed hardbottom area with uncommon to scarce corals and fleshy macroalgae.**

Batuan • Roca • Roches • صخر

Main features	Rock class describes any habitat dominated by "exposed areas of hard bare substratum without visible corallite structure". This habitat often has a near horizontal, pavement-like appearance and is usually associated with areas of high energy (e.g. Reef Crest) where the cover of living organisms is low (< 10%) - although it may have high coverage of crustose coralline algae. The class encompasses limestone reef matrix, but also underlying non-reefal bedrock and "beach rock" (calcarerite) - areas of coral sand cemented together which are difficult to distinguish by earth observations.
Also goes by	*Rock dominated • Bedrock • Pavement • Rock Outcrop • Boulder • Beach Rock • Uncolonised hardbottom*

SEAGRASS

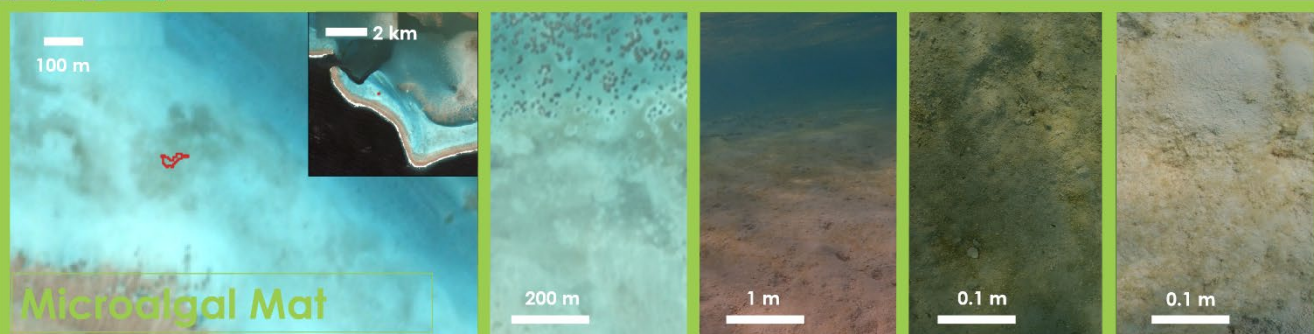**Seagrass is any habitat where seagrass is the dominant biota.**

Padang/ hamparan lamun • Pastos marinos / ceibadales
البحرية الأعشاب مرج • Herbiers marins / gazons algaux

Main features	Seagrass class describes a soft-bottomed habitat dominated by any single species of seagrass from the order Alismatales (e.g. *Syringodium* sp., *Thalassia* sp., and *Halophila* sp.) or any combination of species. This class also includes sparser or more spatially restricted seagrasses, as long as it is the dominant biota, and/or has a total cover >10%.
Where is it found?	Seagrass habitats are most commonly associated with *Shallow Lagoon* and *Back Reef Slope*.
Why do we care?	Seagrasses can form extensive beds, called meadows, which shelter abundant diverse species (epiphytes, small invertebrates and juvenile fish), support herbivory (e.g. of turtles and dugongs) and play an important role in trapping sediment, as well as biogeochemical cycling.
Also goes by	*Seagrass Meadow • Seagrass Bed • Seagrass Dominated • Phanerogam Beds*

MICROALGAL MAT

Microalgal Mats are visible accumulations of microscopic algae in sandy sediments.

Ganggang mikro bentik • Microalgas bénticas • Micro-algues benthiques • المجهرية القاعية الطحالب.

Main features	The Microalgal Mat class describes microscopic communities - abundant and spatially extensive enough to be visible as mats - growing on or in the top few centimetres of shallow, sandy sediments. The benthic microalgae that comprise these mats, also known as microphytobenthos, are primarily diatoms, but include cyanobacteria, chlorophytes, and other microscopic organisms that grow on sand, silts and muds in both marine and freshwater habitats.
Where is it found?	In shallow, sandy and sheltered reef areas, such as the leeside of islands and in Lagoons, benthic microalgae aggregate into mats which can be geographically extensive (up to several kilometers), and penetrate up to 15 cm into the sediment (although most biomass occurs in the upper centimetres).
Why do we care?	Benthic microalgal mats are productive habitats that play important roles in sediment stabilisation, trophodynamics and biogeochemical cycling. They may promote benthic recovery by rapidly re-oxygenating the sediment surface. In ecology, patterns of herbivory can create grazing halos in the mats, the size and number of which can indicate ecosystem health. These habitats are most often associated with sheltered Back Reef areas and Shallow Lagoons.
Also goes by	*Benthic Microalgae • BMA • Cyanobacterial Mats • Filamentous Algal Mat*