Organisms on and around the [redacted] platform

Introduction

There are many aging Oil and Gas (O&G) production platforms in the [redacted] that require decommissioning. Presently, it is assumed 'best practice' to remove disused platforms (OSC, 2019), however it has come to light that anthropogenic structures may provide important habitat for many ocean-dwelling organisms. Epibenthic taxa in the [redacted] are primarily sessile (Callaway *et al.*, 2002). Because some sessile invertebrates, such as the hard coral *Desmophyllum pertusum,* require a hard substrate in order to grow, structurally-complex anthropogenic structures like the [redacted] platform can provide this in contrast to the often featureless sedimentary sea floor. This creates an ecosystem around these structures when sessile invertebrates create complex communities as well as attracting motile invertebrates and fish. Studying these ecosystems informs potential Rigs-to-reefs (RTR) decommissioning operations, where O&G platforms remain *in situ* to continue providing habitat for sea creatures.

Materials and methods

Location

[redacted]

Footage sources

Subsea structures are subject to ROV Visual Inspections to ensure they are in a safe condition, as parts of them can corrode, posing a safety risk. Work-class ROVs were used to perform surveys in August 2017 on behalf of [redacted], with resulting footage provided to Ocean Science Consulting Limited (OSC) (OSC, 2019). This footage shows the platform structures while the ROV moves vertically through the water column.

Taxonomic identification

Still images were extracted from the footage mostly at random and filtered for quality (removing images too blurry) before being analysed in [redacted]. Organisms were outlined, then labelled to the lowest taxonomic level possible. Inorganic features such as water and the ROV were also labelled; the analyst aimed for full coverage of each image as their primary purpose was to train a Convolutional Neural Network (CNN) to perform a similar analysis. Unidentified organisms were labelled as such, however these were removed from the dataset along with non-organic classifications such as water in order to provide information solely about known organisms present.

Data processing

Outputs from [redacted] were converted from .json files describing labelled polygon location to .csv files of large matrices with values corresponding to labels and their locations. This enabled analysis using RStudio (RStudio Team, 2021) to show what percentage of organic matter within an image belonged to which organism. The packages dplyr (Wickham *et al.*, 2023) and reshape2 (Wickham, 2007) were used. Barplots were then created using ggplot (Wickham, 2016) and the palette Viridis (Garnier *et al.*, 2021) used.

Percentage cover for each image was calculated by excluding non-organism labels (water, ROV, etc) and unidentified areas. The number of cells in the matrix corresponding to each organism was divided by the number of cells of organisms overall. This information was then grouped by depth band and presented in scaled percentage bar plots to enable comparison between depths.

Depth bands and sample size

Depth (m)	Depth band
0-9.9	1
10-14.9	2
15-19.9	3
20-29.9	4
30-39.9	5
40-49.9	6
50-59.9	7
60-69.9	8
70-79.9	9
80-99.9	10
100-119.9	11
120-145	12

Table 1: Depth bands. The depth column shows metres below sea level. There were 614 images selected overall.

Depth bands were grouped similar to the previous [redacted] report (OSC, 2019), in generally smaller increments closer to the surface. However, depth band 1 is larger than depth band 2 due to there being under 10 images available at 0-5 m. Footage was generally lacking and too unclear due to waves near the surface.

Results and discussion

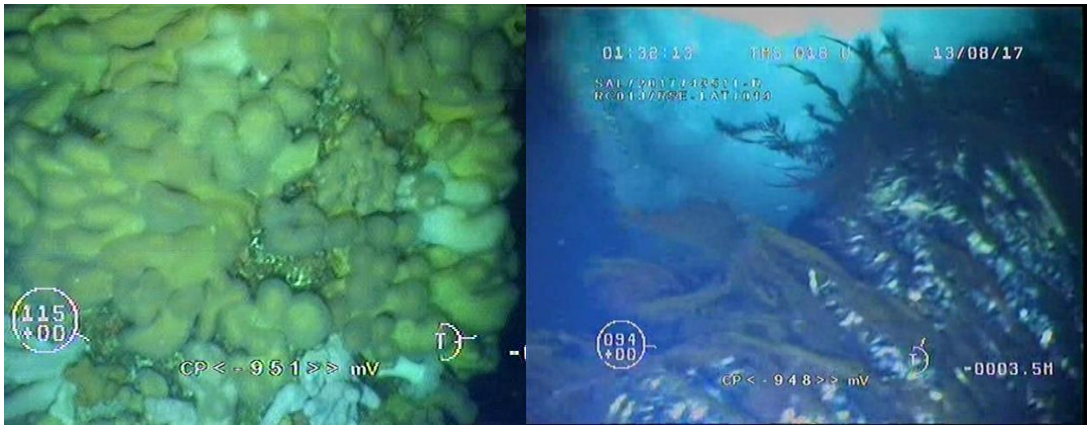
Taxa recorded

Phylum	Scientific name	Common name
Algae*		Algae
Annelida	*Serpulidae* [family]	
Arthropoda	*Cirripedia* sp.	Barnacle
		Crab
Bryozoa		Bryozoa/turf bryozoa
Chordata	*Pollachius virens*	Saithe
		Unidentified fish
Cnidaria	*Metridium senile*	Plumose anemone
	Alcyonium digitatum	Dead man's fingers coral
	Cylista elegans	Elegant anemone
	Urticina felina	Dahlia anemone
	Bolocera tuediae	Deeplet sea anemone
	Tubularia idivisa	Oaten pipes hydroid

		Unidentified anemone
Echinodermata		Brittle star^
	*Ophiothrix fragilis^*	Common brittle star^
	*Ophiocomina nigra^*	Black brittle star^
	Asterias rubens	Common starfish
	Echinus esculentus	Common sea urchin
Mollusca	*Mytilus edulis*	Blue mussel
Porifera	*Antho dichotoma*	Common sponge
		Sponge

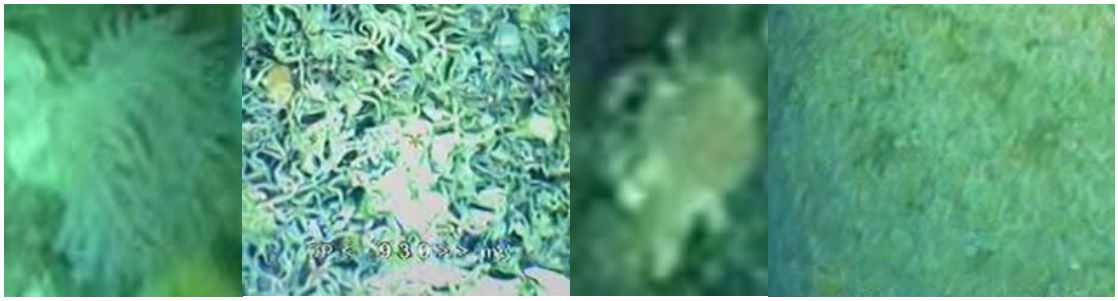
Table 2: Taxa observed in stills within the subset of images analysed for this report. *Algae is not a phylum, however it was not possible to identify to red or green algae status so it is used as phylum in this report. ^Brittle star were occasionally difficult to classify to species level, so for analysis here were grouped together under 'brittle star'.

Images of organisms



(a) *Alcyonium digitatum* (b) Algae

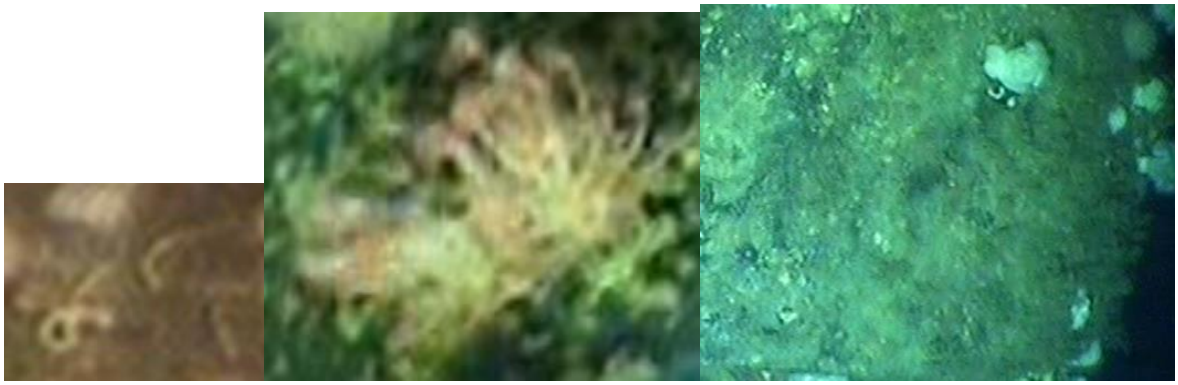
(c) *Antho dichotoma* (d) *Asterias rubens* (e) Barnacles



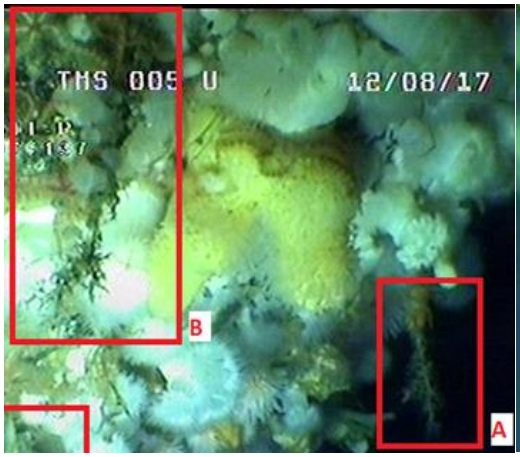
(f) *Bolocera tuediae* (g) Brittle star^ (h) Crab (i) *Cylista elegans*

(j) *Echinus esculentus* (k) *Metridium senile* (l) *Mytilus edulis*

(m) *^Ophiothrix fragilis* (n) *^Ophiocomina nigra* (o) *Pollachius virens*



(p) *Serpulidae* (q) *Tubularia indivisa* (r) Turf bryozoa



(s) Other Bryozoa (t) *Urticina felina*

Figure 1 (a-t): Images from ROV footage showing specific organisms.

Additionally, two colonies of *Desmophyllum pertusum* were observed during data collection. Although these images were not selected for analysis, it is important to mention as this hard coral is a species under threat (OSPAR, 2009) that grows slowly.

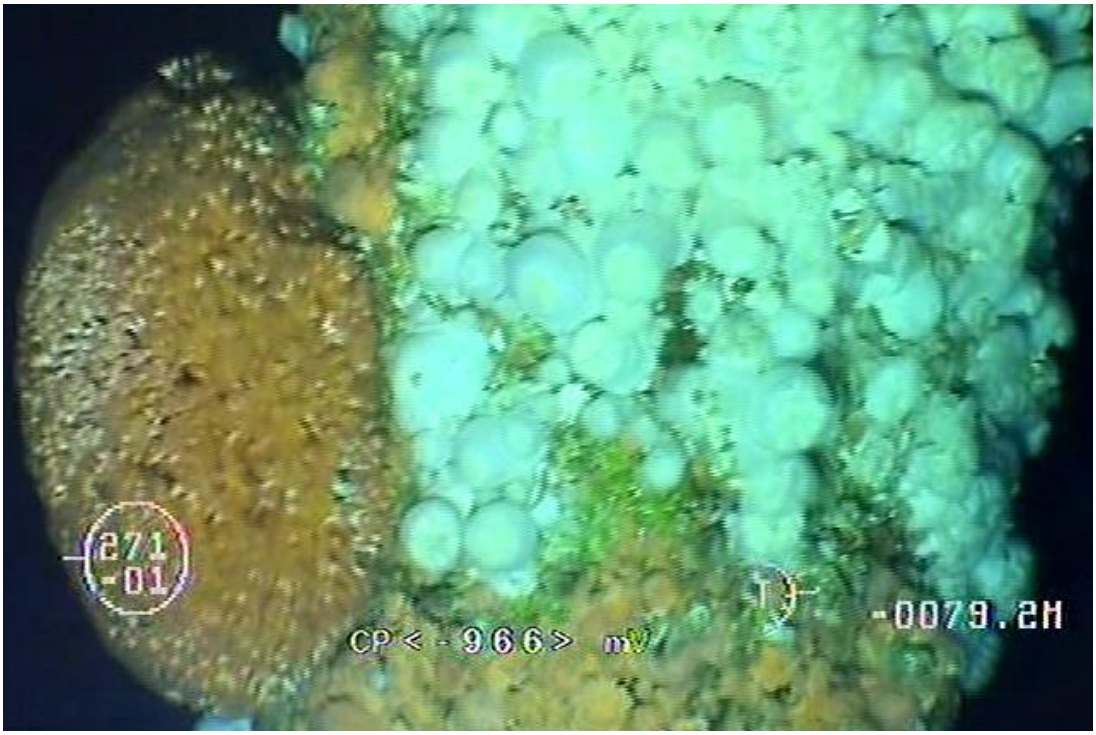


Figure 2 (above): An orange *D. pertusum* colony. **Figure 3 (below):** A white *D. pertusum* colony.

Although there were so few crabs that they were grouped together rather than identified to species level, one crab was identified as the Northern stone crab, *Lithodes maja* (Figure 3). It was crawling along the shell pile on the sea floor, which is a mound of debris accumulated from matter fallen from higher on the platform.

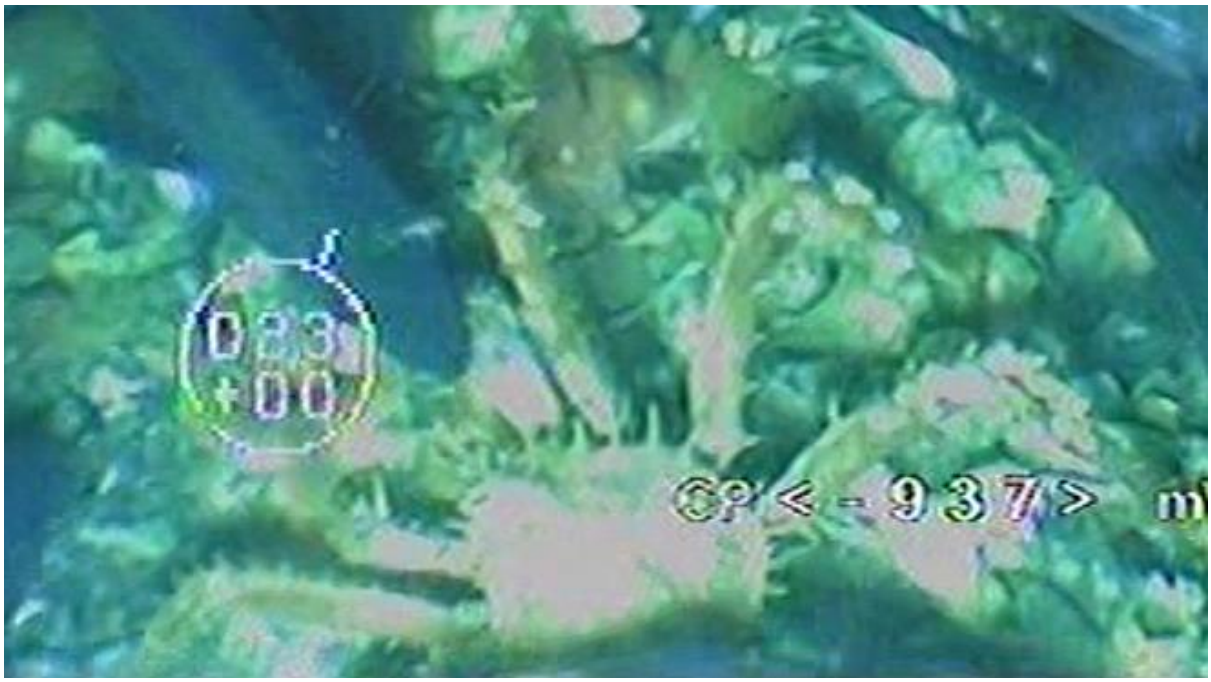


Figure 4: Northern stone crab.

General patterns

The most common species found on the [redacted] platform was *Metridium senile*, with 55.7% scaled percentage coverage overall. The second most common species was *Alcyonium digitatum* (Figure 6). In terms of phyla, Cnidaria had the highest percentage coverage of almost 90%, with Arthropoda as the second most abundant phylum (Figure 7).

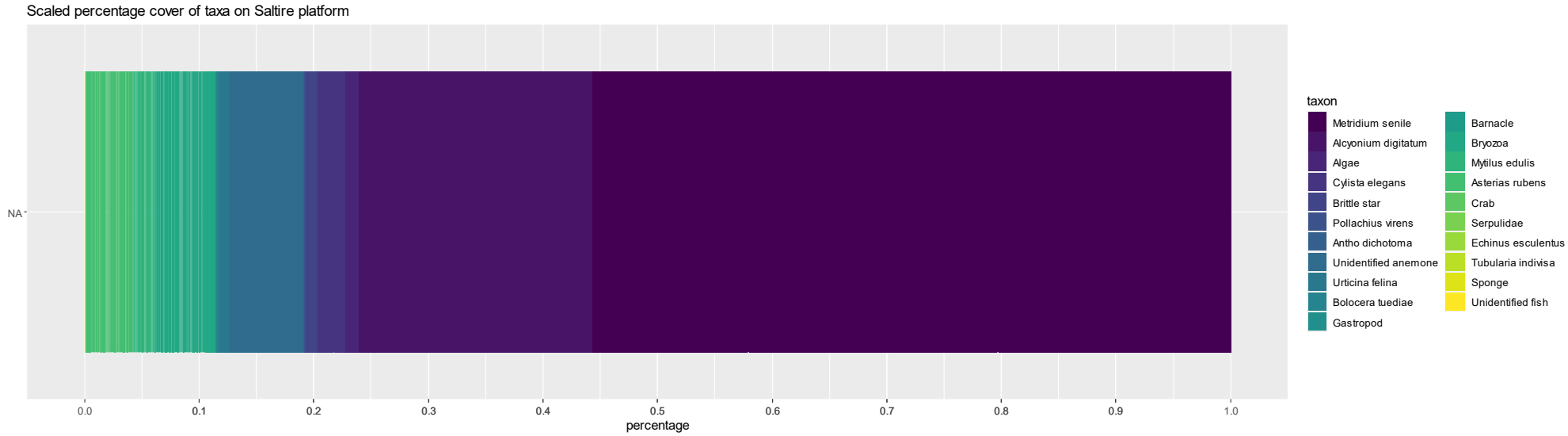


Figure 6: Scaled percentage cover of all taxa.

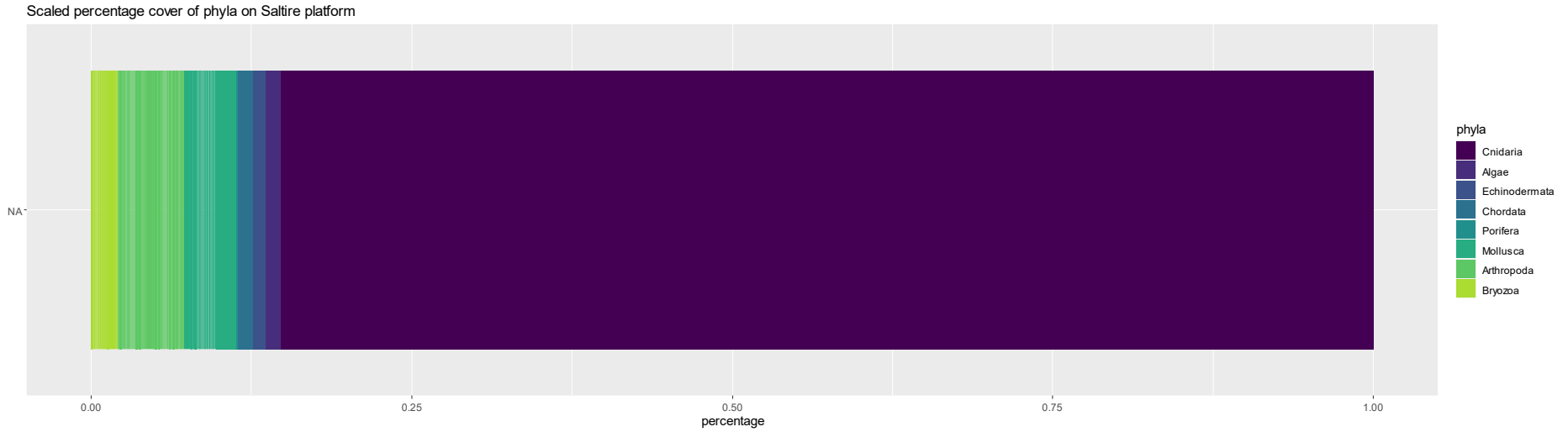


Figure 7: Scaled percentage cover of all phyla.

Taxa varying by depth

The distribution of different species varies across the depth bands. Algae requires sunlight so is present only between 0-19.9 m, dominating in the first band. *Mytilus* also grows in the shallower regions. *Metridium senile,* being the most prominent organism, is present in all depth bands, flourishing in the middle depths, especially between 70-79.9 m. *Alcyonium digitatum* is also prominent in all depths, with its highest percentage cover between 30-39.9 m, being less common in the shallowest and deepest areas. Bryozoa is present in depths below 60 m, with its highest incidence in the deepest areas. Barnacles similarly thrive best at depth band 12 (Figure 8).

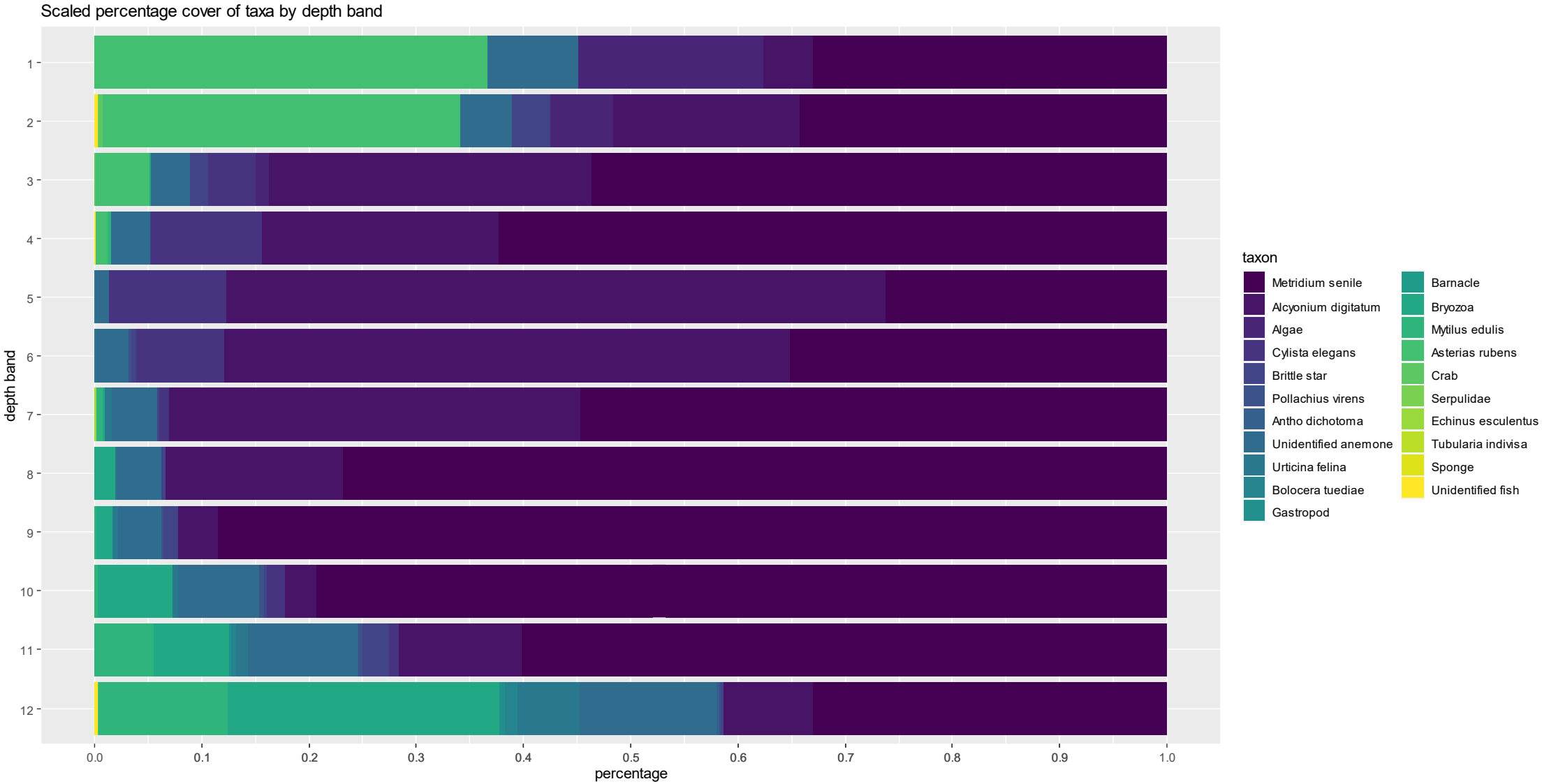


Figure 8: Bar plot showing the scaled percentage cover of taxa grouped by depth band.

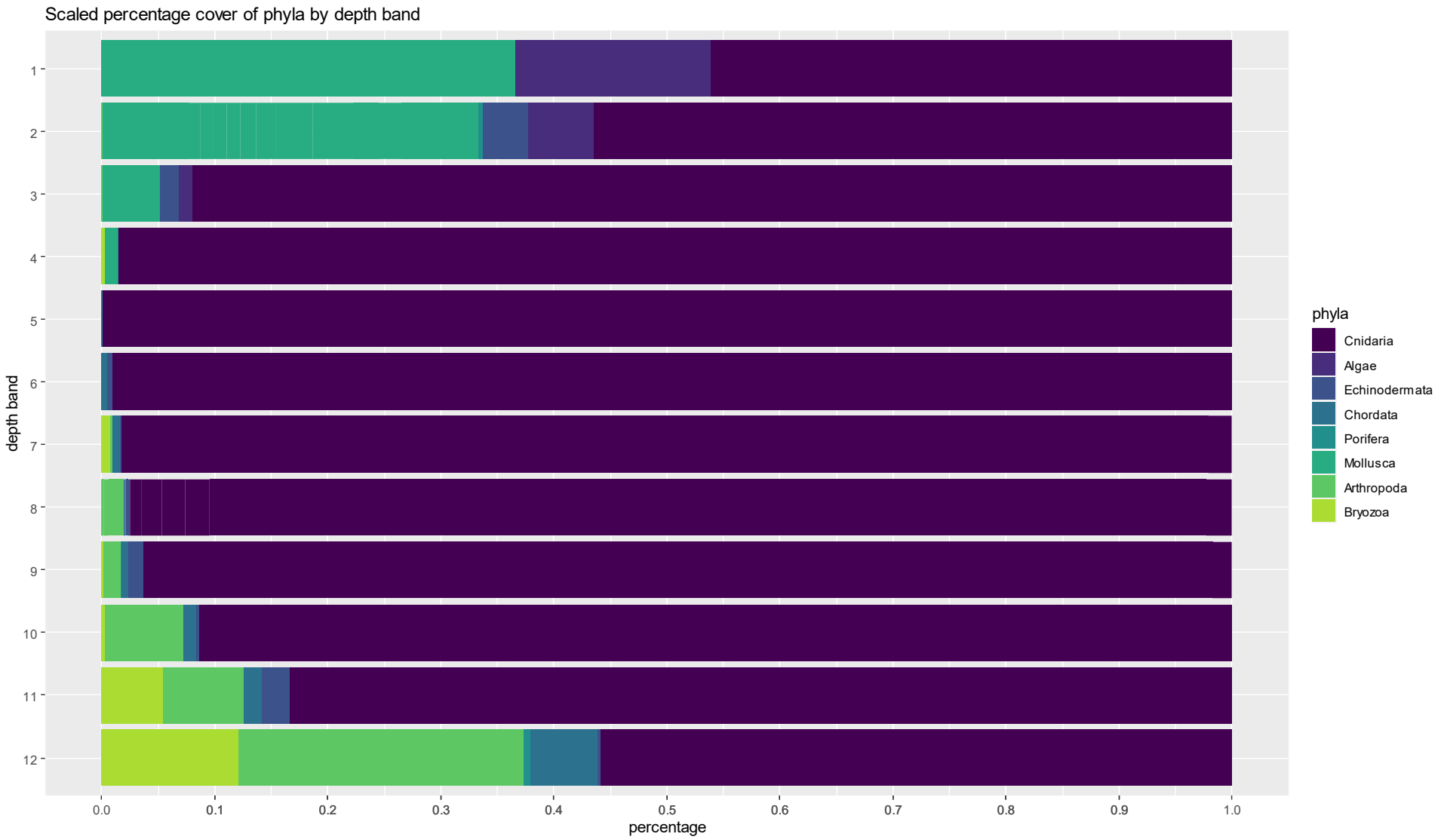


Figure 9: Bar plot showing scaled percentage cover of phyla* grouped by depth band. *Algae is not a phylum but is used as such within this report.

References

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