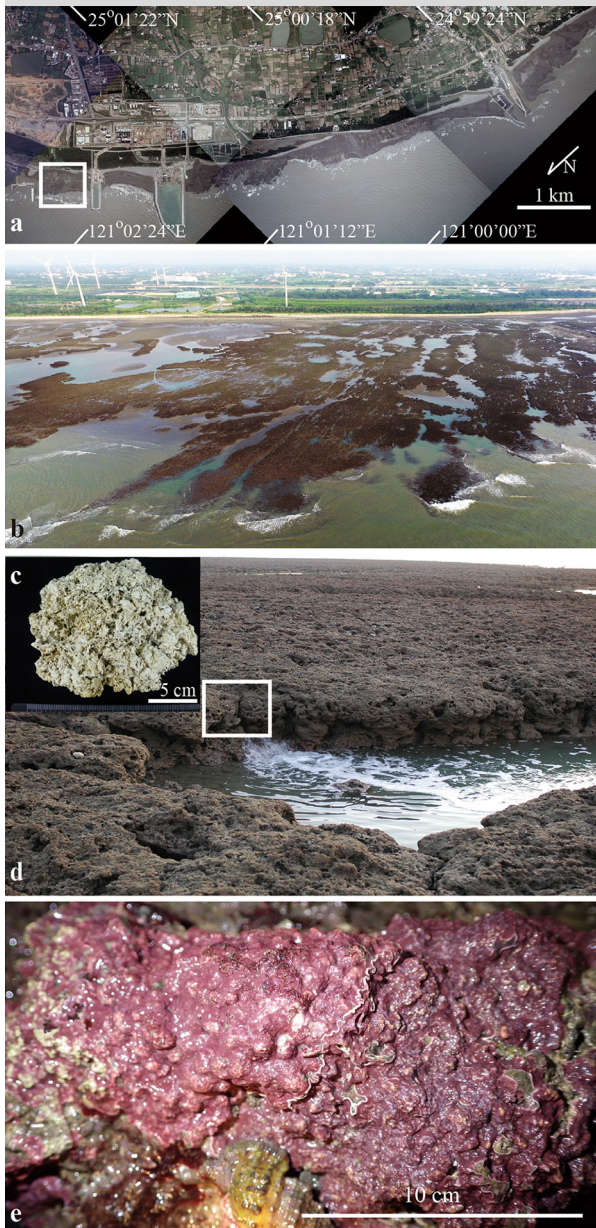


## Unprecedented calcareous algal reefs in northern Taiwan merit high conservation priority



**Fig. 1** a Aerial view of the southern part of the Taoyuan crustose coralline algal (CCA) reef (grey along the coastline, image by Aerial Survey Office, Forestry Bureau). The white square is b CCA reef during low tide with windmills in the background. c Vertical cross section of reef showing layers of CCA. d Porous algal reef exposed to the air. e Undescribed CCA species, *Phymatolithon* sp. nov. (left) and *Mesophyllum* sp. nov. (right)

Crustose coralline algae (CCA) concretions, or reefs, are mainly found below 10 m in temperate waters (Ballesteros 2006) and rarely in subtropical and tropical oceans. However, a massive CCA reef occurs on tidal flats extending continuously along the coastline of Taoyuan City, Northwest Taiwan ( $25^{\circ}07'00.11''\text{N}$ ,  $121^{\circ}14'22.23''\text{E}$  to  $24^{\circ}59'19.34''\text{N}$ ,  $121^{\circ}00'47.00''\text{E}$ ) (Fig. 1a). It is approximately 27 km long and a maximum of 450 m wide with a large tidal range of 4 m (Fig. 1b; Electronic supplementary video). Carbon-14 dating indicates that the reef dates from around 7500 BP; it consists of some sediment-tolerant corals, such as *Cyphastrea* and *Dipsastraea* (Dai et al. 2009). From 4400 BP to the present, CCA genera, such as *Mesophyllum*, *Phymatolithon*, and *Harveyolithon*, have contributed to the present algal reef through constant growth as stacked layers over the surface of the reef (Fig. 1c), which is porous (Fig. 1d). The Taoyuan CCA reef performs similar ecosystem functions to those of coral reefs. However, long-term industrial pollution and continuous habitat destruction by land reclamation for an industrial park (Liou 2017) and windmill constructions (Fig. 1b) threaten the future of this reef system. The discovery of a newly described endemic coral species, *Polycanthus chaishanensis*, two undescribed species of CCA (Fig. 1e), and changes in the composition of layers over time highlight the merit of prioritizing conservation of this unique ecosystem in Taiwan.

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