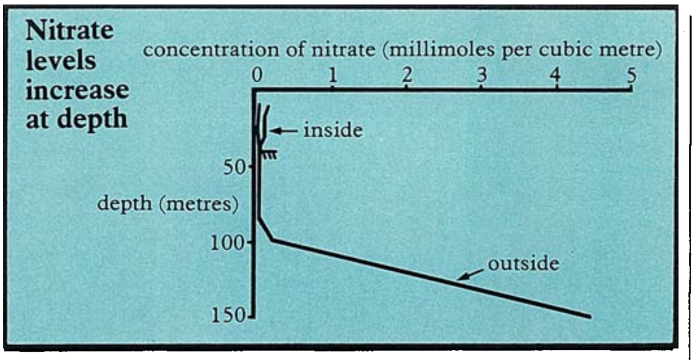
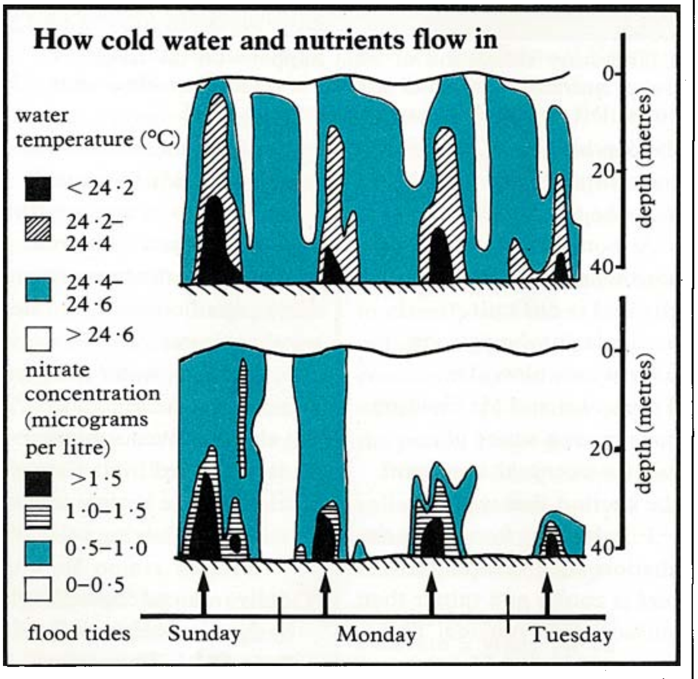


These readings were taken inside and outside Cook's Passage. There are plenty of nutrients below 100 m depth.



With 'Sprightly' anchored in Cook's Passage, the team continuously sampled the water. Cold water laden with nutrients flowed into the Passage on each flood tide.

Where the Great Barrier Reef gets its nutrients

Coral reefs such as the Great Barrier Reef present a puzzling paradox: they grow profusely, and support a rich collection of life forms, in a virtually sterile sea. Where do they get the necessary nutrients?

Dr Rory Thompson and Mr Terry Golding, of the CSIRO Division of Oceanography, believe they now know the answer. Measurements they have taken at Cook's Passage, not far from Cooktown, back up the theory that large tides bring nutrient-rich water from the ocean depths to the surface and wash it through the coral. The theory fits the known facts about coral reefs very well.

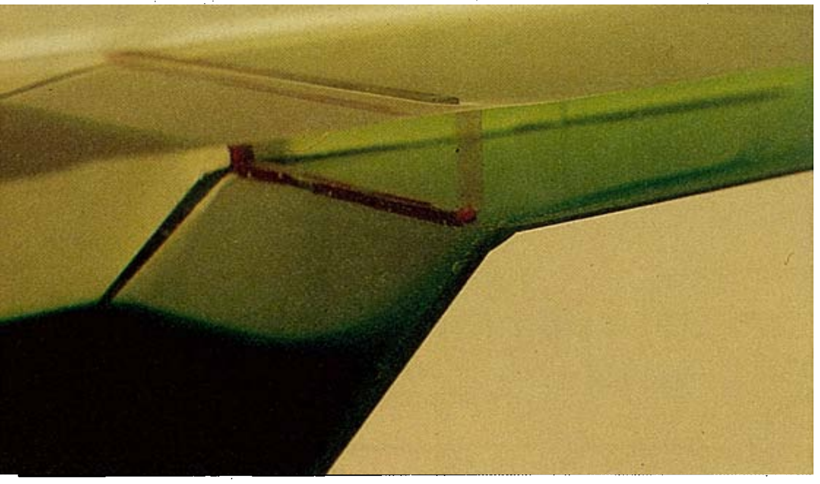
A reef grows most vigorously at its outer edge, where, at the rim of the continental shelf, it fronts onto a wide expanse of open sea. This suggests that the nutrients come from the ocean side rather than the land.

Yet the surface waters of the open ocean are very low in nutrients — virtual biological deserts — although nutrients are tantalizingly close, in deep, cold water beyond the reef. Measurements the researchers took showed that nitrates increase sharply below 100 m depth. And their calculations show that tidal currents on the reef are strong enough to suck up these nutrients.

The reef grows very densely, leaving only narrow channels for the tide to flow through. As a result, turbulent, jet-like flows of water surge through the channels when the tide is flooding, or ebbing. Tidal currents of up to 2 metres per second have been observed.

The effect rather resembles what happens when a bottle of wine is decanted too fast; the flow of wine through the neck sucks up sediment. For a normal tide giving a channel speed of 1·5 metres per second, Dr Thompson calculates that everything above a depth of 140 m should be sucked in.

If, at spring tide, the speed should double, suction would act to a depth of 160 m. The peak channel speed is very important. Not only does the volume of deep water sucked up increase in proportion to the square of this speed, but



A laboratory simulation of what happens on the Reef. Deep, nutrient-rich water (green) is sucked up when water flows (left to right) through a narrow channel.

the depth plumbed and the concentration of nitrate increase rapidly too.

Although navigating in a narrow, swift, turbulent channel is difficult, particularly when strong trade winds blow, Dr Thompson and Mr Golding have made a series of measurements that support the suction theory.

Firstly, they found that the shallow water inside the reef is cooler and saltier than surface water outside. This suggests deep cold water from outside is mixing with water inside the reef's edge. More substantial evidence comes from measurements taken in Cook's Passage itself. Profiles of temperature with depth show a distinct cool layer on the bottom during the flood tide, but not at other times.

In addition, water samples taken at the same spot in the channel over a number of days showed high nitrate levels near the bottom when the tide was flowing in.

Tidally induced 'upwelling' by the Great Barrier Reef. R. O. R. Y. Thompson and T. J. Golding. *Journal of Geophysical Research*, 1981, **86**, 6517–21.