

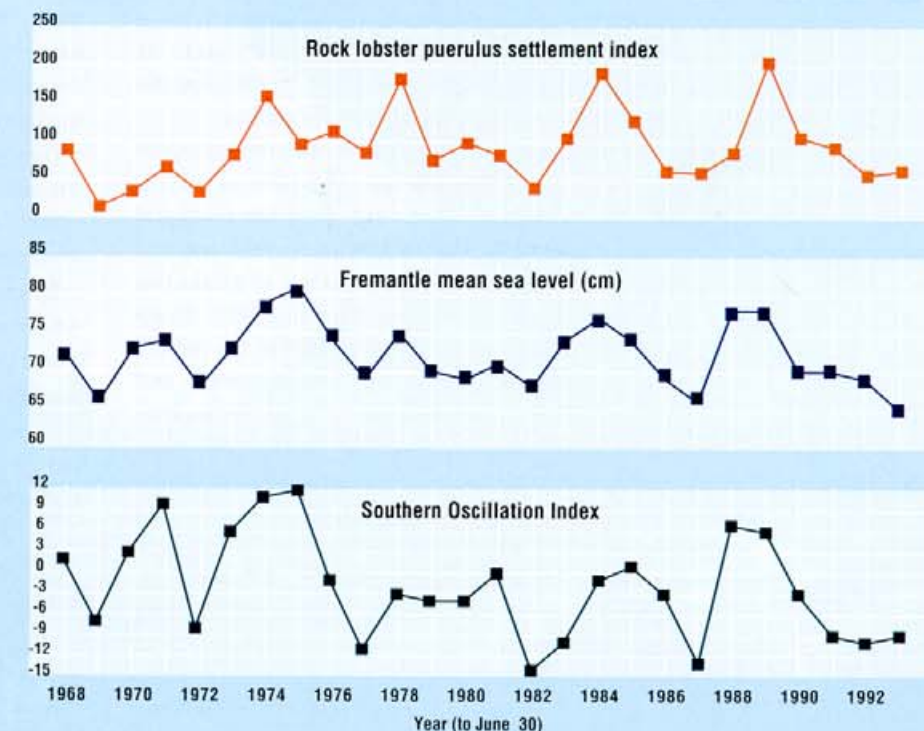
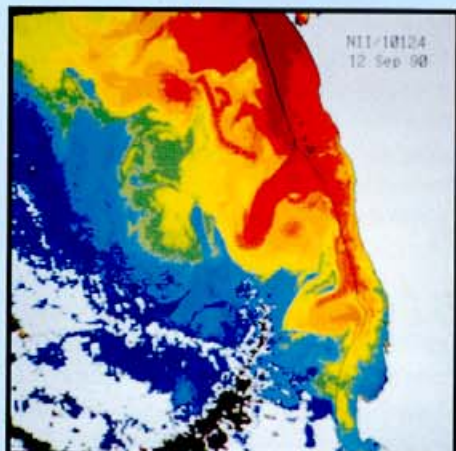
Reading the eddies

WHEN plotted from above, the major ocean currents surrounding Australia resemble the writhings of an octopus: tapering tentacles grasping and whirling their way from warm tropical waters to sub-Antarctic seas.

To the east of the continent is the East Australian Current, stretching to 200 km wide and 500 m deep as it ferries southward about 10 million cubic metres of water per second. The current begins as a surface stream tens of metres thick on the boundary of the Coral and Tasman seas. On its snaking journey it criss-crosses the continental shelf, delivering upwellings of nutrient-rich water off Cape Byron, Smoky Cape and Sugarloaf Point.

The East Australian Current and its influence was recorded as early as 1770 by James Cook, who found himself in a southward drift off Cape Byron, despite fresh winds from the south. More than two centuries later, oceanographers at CSIRO Marine Research are developing a profile of the current, from the surface to the ocean floor, and across the continental shelf. The profile will underpin advice on the current's influence given to fishers, ocean yacht racers, and marine rescue and environmental authorities.

To the west and south of Australia flows the Leeuwin Current, formed when warm water from the South Equatorial Current travels across the Pacific Ocean, then on into the Indian Ocean, via the Indonesian archipelago. Once past the archipelago, the warm equatorial water is at levels as much as 50 cm higher than the Southern Ocean. This warming, along with the earth's rotation, produces a southern flow of water down the WA coast.



Research by Alan Pearce has established direct links between the Leeuwin Current and the El Niño Southern Oscillation. These in turn affect recruitment of western rock lobster, Australia's largest single-species fishery. (Source: Australia State of the Environment, 1996)

Alan Pearce from CSIRO's Marmion laboratory has tracked and analysed the Leeuwin Current for the past 14 years. Once a week, Pearce visits Perth's Leeuwin Centre for Remote Sensing Technologies, selecting the less cloudy sea-surface temperature images from polar-orbiting NOAA satellites. Together with more conventional oceanographic data such as coastal sea levels, these have helped him establish direct links between the Leeuwin Current and the El Niño Southern Oscillation: during El Niño events the current appears to weaken, marginally reducing its water temperature.

Pearce's work has helped answer many questions about the life cycles and sustainable management of WA fisheries. The western rock lobster (*Panulirus cygnus*), Australia's highest value single-species fishery, is a good example.

Western rock lobsters begin life as larvae, hatched in the summer months on the ocean floor along the outer continental shelf, then float to the surface where they drift still further offshore, assisted by prevailing winds and surface currents. The voyage back to the coast can take as long

as 11 months, during which the larvae undergo a series of moults. By late spring they have changed to what is known as puerulus (tiny pre-juveniles, with the ability to swim) and settle in protected, shallow coastal waters.

Here, the Leeuwin Current has a major influence on the number of puerulus settling into the coastal reef system. Pearce and his team, together with the Fisheries Department of WA, have shown that in years when the current is stronger, and the water warmer, the settlement is improved, resulting in a better catch when the lobsters reach legal size in three to four years time.

Conversely, when the current is weaker, (in El Niño years), settlement is not so good and the catches which follow are down. 'The difference can mean tens of millions of dollars to the industry which is partly based upon predictions of catches up to four years ahead,' Pearce says.

Exactly how the Leeuwin Current affects puerulus settlement is unclear, but there are two hypotheses. Firstly, laboratory tests indicate that the warmer waters of the current could help the growth and survival of the larvae. Secondly, the current's eddies may assist in the transport of the late larval stages and puerulus across the continental shelf into coastal reef nurseries, especially in southern areas such as Cape Mentelle.

A NOAA satellite image of the Leeuwin Current off Western Australia showing the warmest water in red and the coolest in blue. (Image processed by Angela Way.)