

POPULATION DYNAMICS OF THE SHARK BAY SAUCER SCALLOP FISHERY

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The development of population dynamics models for scallop fisheries is bedevilled by the problem of highly variable recruitment. This variability in recruitment is independent of breeding stock size and is generally considered to arise from environmental influences on the survival of larvae. In the development of models for scallop fisheries, one of the early tasks must be to try to determine the cause(s) of environmentally-induced recruitment variation.

In the fishery for saucer scallops (*Amusium balloti*) in Shark Bay in Western Australia, independent recruitment surveys have shown that there has been massive (over 50 times) variation in the recruitment index over the last ten years (Table 1). These variations, at least on the main grounds (Figure 1), are significantly correlated with variations in the Leeuwin Current, a major hydrographic feature of Western Australian coastal waters (Joll and Caputi in press; Joll in press). In years in which the Leeuwin Current is weak during the principal May to August spawning period (as measured by sea level at Fremantle), recruitment is high while in years in which the current is strong, recruitment is weak. The mechanics of the relationship between the variations in the Leeuwin Current and the variations in recruitment are not known. However, satellite imagery shows that jets of water sometimes shear off from the main stream of the Leeuwin Current and enter Shark Bay. Flushing of larvae from the Bay by these currents and/or the effects of the warm, low nutrient

waters of the Leeuwin Current may have a major influence on larval survival, with these effects being greater in years of strong Leeuwin Currents.

The degree of recruitment variation, however, is not directly related to the strength of the Leeuwin Current - or at least the index of the strength of the current (Fremantle sea level). Recruitment in 1990 was considerably higher than in other low sea level years, although sea level was not significantly lower than in the other low sea level years. This may indicate that there is another factor or factors affecting recruitment, but that these factors can only act within a low sea level environment already basically conducive to good larval survival. Alternatively, the Fremantle sea level index may not fully represent the strength or impact of the Leeuwin Current in the Shark Bay area, some 1000 km to the north. A programme to develop a long term database on water temperatures in the area where the Leeuwin Current jets enter Shark Bay has been instigated to provide a more direct measure of the current and its impacts in the Shark Bay area.

Development of a proper understanding of environmentally-induced recruitment variation will allow population dynamics models of the Shark Bay scallop stock to appropriately incorporate environmental effects. Model development is progressing as the understanding of the stock is improved, but so far it shows that the environmental influences totally dominate the

recruitment process. A more complete understanding of the environmental effects on recruitment is required before the effects of breeding stock levels can be determined, but at this stage breeding stock levels do not appear to significantly affect the level of recruitment.

References

Joll, L.M. (in press). Unusually high recruitment in the Shark Bay saucer scallop (*Amusium balloti*) fishery. *Memoirs of the Queensland Museum*.

Joll, L.M. and N. Caputi (in press). Environmental influences on recruitment in the saucer scallop (*Amusium balloti*) fishery of Shark Bay. In: Proceedings of "Shellfish life histories and shell fishery models". *ICES Marine Science Symposia (Actes du symposium)*.

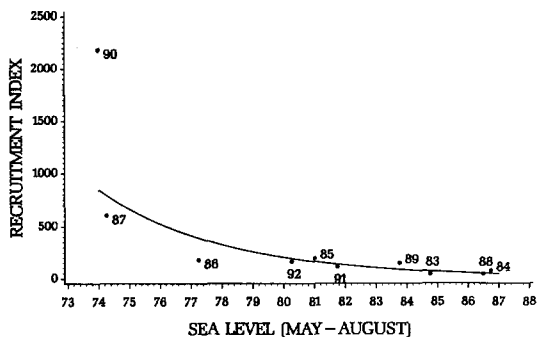


Figure 1. Relationship between the index of recruit abundance (mean number of scallops per nautical mile, 12 fm net towed at 3.4 kts) on the main grounds in Shark Bay and mean Fremantle sea level (cm) over the period May to August.

Table 1. Abundance indices of scallops from various sub-areas in Shark Bay from surveys in November 1983-92

(Data are scallops per nautical mile for 12 fathoms of net towed at 3.4 kts).

	MAIN GROUNDS				DENHAM SOUND	
	NORTHERN AREA		SOUTHERN AREA		REC	RES.
	REC.	RES.	REC.	RES.		
1983	47	237	32	301	65	158
1984	54	73	81	7	33	0.1
1985	134	91	247	2	30	0.5
1986	277	47	75	0.3	51	0.7
1987	598	133	609	35	32	7
1988	18	132	58	49	12	2
1989	97	45	19	2	32	1
1990	608	77	3 756	73	631	21
1991	169	2 411	50	4 253	100	683
1992	162	770	157	467	761	439

REC = RECRUITS

RES = RESIDUALS