The effects of wind stress and temperature on the catchability of spanner crab (*Ranina ranina*) in South-East Queensland, Australia

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The spanner crab (above) inhabits subtropical shelf waters of the Indo-Pacific, caught using size- and species-selective tangle nets (below)

BACKGROUND

Catchability is an important parameter for stock assessment modelling and improving the economic efficiency of commercial fishing operations. Previous research found a positive relationship between bottom boundary layer temperature (BBLT) and catch rates of spanner crabs in the Australian fishery[1]. Our aim was to understand how local oceanographic processes, specifically wind-driven upwelling/downwelling, affected this relationship in South-East Queensland (SEQ), Australia.

METHODOLOGY

- Metocean parameters BBLT, sea surface temperature (SST), and wind data were sourced from three monitoring platforms (Fig. 1) for years 2011-2014
- Corresponding catch rate data were estimated by standardizing total catch (kg) using total net lifts as a measure of effort for the study region (Fig. 1)
- Alongshore wind stress was calculated[2] and low-pass filtered using a 7-day running mean ($\tau 7$)
- Generalised Linear Models (GLM) were used to model the effect of using SST or $\tau 7$ in lieu of BBLT and to measure seasonal interactions
- Each model and explanatory variable were assessed using explained deviance and confidence intervals

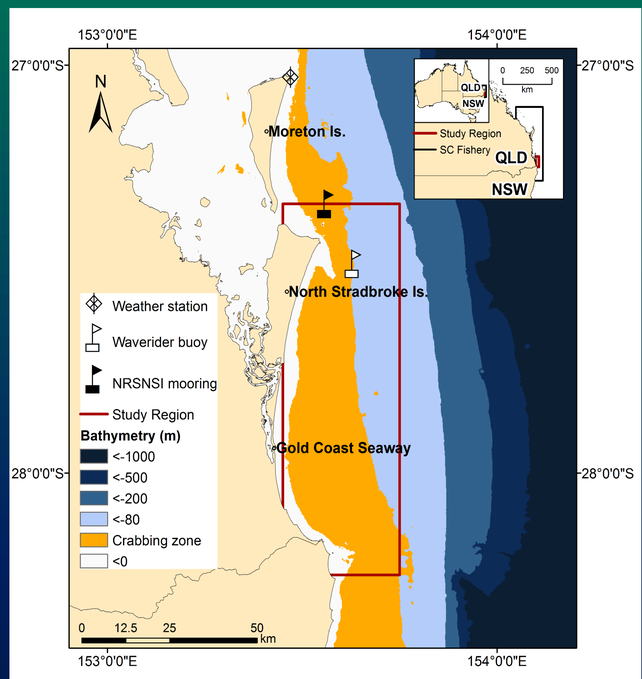

Fig. 1 – Study region inside Australian spanner crab (SC) fishery. BBLT data from NRSNSI mooring, SST from waverider buoy, and wind data from weather station. 'Crabbing zone' in 30-80 m

Table 1 – Seasonal effect of BBLT and $\tau 7$ on catch rates. CI: lower (2.5%) and upper (97.5%) confidence limits. ED(%): percentage of explained deviance

GLM	Season	CI (2.5%)	CI (97.5%)	*ED(%)*
BBLT + offset(Net lifts)	summer	-.10	.01	28
	autumn*	-.15	-.03	
	winter*	-.15	-.05	
	spring	-.09	.03	
$\tau 7$ + offset(Net lifts)	summer	-3.37	5.04	10
	autumn*	-18.57	-9.78	
	winter*	-21-69	-12.6	
	spring	-4.37	6.53	

* significant within the 95% CI

RESULTS

- SST a poor indication of BBLT and catch rates
- BBLT, $\tau 7$, and catch rates illustrated very similar seasonal cycles (Fig. 2)
- Catch rates spiked during seasonal BBLT cooling, more frequent northerlies, and annual mating aggregation (blue shaded area)
- Catch rates declined around the end of summer (orange shaded area) and were generally steady during autumn and winter
- BBLT and $\tau 7$ were significantly related and inversely proportional to catch rates during autumn and winter (Table 1)

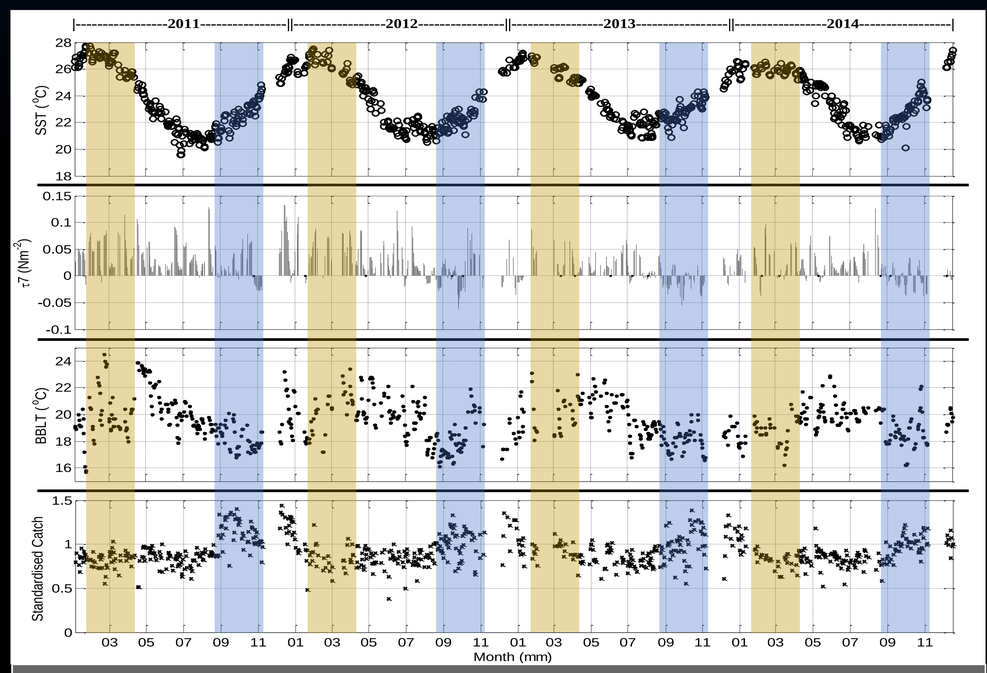

Fig. 2 –Daily SST, $\tau 7$, BBLT, and catch rate data from 2011-2014. Date ticks correspond with the middle of the labelled month (day 15). Positive and negative $\tau 7$ represents southerlies and northerlies, respectively. Blue shaded area highlight higher catch rates and seasonal upwelling. Orange shaded areas highlight the period when catch rates start to decline and BBLT warming

SUMMARY

- Our results oppose the previous study[1], which was conducted over a larger spatial scale
- Spanner crabs may be using upwelling as a cue for annual mating aggregation
- Off-season (autumn-winter) episodic BBLT cooling, occasionally attributed to wind-driven upwelling, can be useful in helping explain short-term fluctuations in catch rates

1. Brown IW et al. Ecological assessment - Queensland spanner crab fishery. Department of Primary Industries, Brisbane. 2001.

2. Large WG, Pond S. Open ocean momentum flux measurements in moderate to strong winds. Journal of physical oceanography. 1981