TROPICAL ROCK LOBSTER RESOURCE ASSESSMENT GROUP (TRL RAG)	MEETING No. 10 23-24 August 2011
Report of the 2011 mid-year survey (CSIRO)	**Agenda Item: 3.1**

PURPOSE

Absolute lobster stock abundance was estimated in 1989 using a non-stratified survey of 542 sites throughout the Torres Strait fishery. A sub-set of these sites was chosen for cost-effective long-term population monitoring. Annual fishery-independent monitoring of the Torres Strait ornate rock lobster *Panulirus ornatus* population has been carried out during 1990 to 2011. These surveys, conducted mid-year, provided the only long-term information on the relative abundance of recruiting (1+) and fished (2+) lobsters, since there has been no comprehensive monitoring of commercial catch and effort prior to 2003. The relative abundance indices and age composition data are used in the TRL fishery model for assessments of the status of the stock, and to set and evaluate new management regulations.

METHODS

The 22nd annual (mid-year) survey of the Torres Strait lobster population was conducted during June 2011 by four CSIRO staff, using the vessel M.V. *James Kirby*. A total of 73 sites were surveyed by divers and each site was re-located accurately using portable GPS.

As in the 1989 survey, measured belt transects (500 m by 4 m) were employed as the primary sampling unit, as they were found to give the greatest precision (p=SE/Mean) of lobster abundance. Transect distance was measured, to the nearest metre using a Chainman® device.

The sample design employed during the annual (mid-year) population survey in 2011 was the same as that employed since 2004 (Plaganyi et al, 2010). Of the thirteen sampling stratums (Figure 1), seven were sampled in 2011. No sampling has been done in PNG waters since 2007.

At the completion of each transect a diver recorded; the number of lobsters caught, the number and age-class of those missed, depth, visibility, distance swum, numbers of pearlshell (*Pinctada maxima*) and holothurian species observed, and percent covers of standard substratum and biota (including seagrass and algae species) categories.

The sampled lobsters were measured (tail width in mm), sexed and moult staged to provide size-frequency data. The year-class components in the size frequency distribution of sampled lobsters were determined using modal analysis (Mix; Macdonald and Pitcher, 1979). The resulting proportions of recruiting (1+) and fished (2+) year-classes were combined with the counts of missed 1+ and 2+ lobsters to estimate the age composition of the lobster population.

RESULTS

The distribution of recruiting (1+) lobsters recorded in June 2011 (Figure 2) was generally uniform across the study area; although low densities were recorded at many of the Warraber_bridge sites. Relatively low densities of recruiting lobsters in the Warraber_bridge stratum and the recovery in the Kircaldie_rubble stratum contrasted with distributions recorded in 2010. The density of recruiting lobsters was, in comparison to recent years, relatively high across the study area. The distribution of fished (2+) lobsters recorded in June 2011 was also generally uniform (Figure 2). In 2010 and 2011 the highest densities were recorded in the south-east area of the fishery, in contrast to 2009 when most fished lobsters occurred in the north-western area of the fishery.

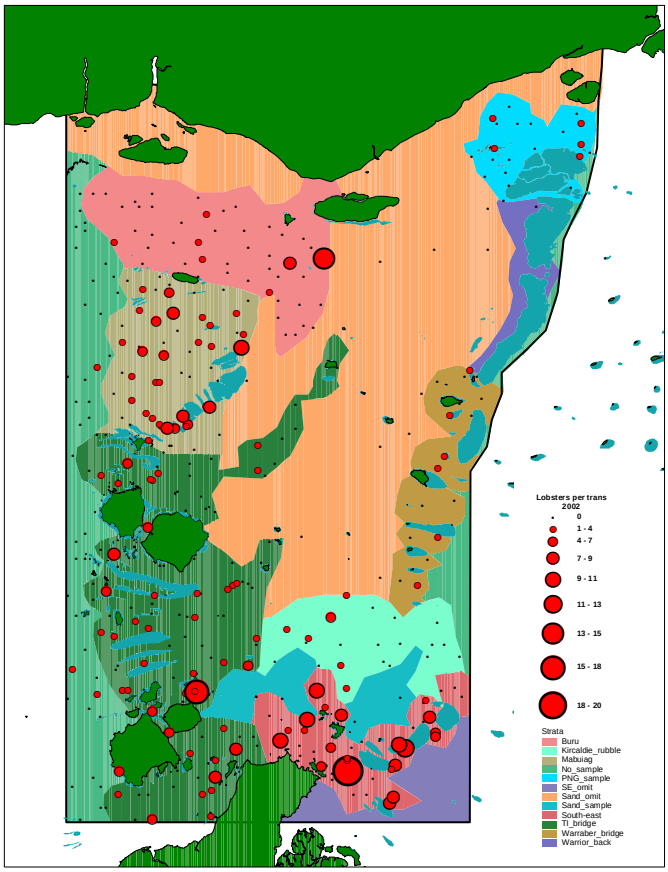

Figure 1. Map of western Torres Strait showing distribution of the sampling stratums used in the 2011 mid-year population survey, and ornate rock lobster *Panulirus ornatus* abundance recorded during the 2002 Benchmark Lobster Survey.

Standardized estimates of abundance indices for recruiting (1+) and fished (2+) lobsters are presented in Figure 3. Overall, the abundance of recruiting (1+) lobsters was extremely variable with a decreasing trend evident between the record high in 1994 and the record low in 2005. In contrast, since 2005 recruiting lobster abundance has been generally strong and above the long-term average, with the exception of the poor 2008 year-class.

The trends in abundance of fished (2+) lobsters were different from those of age 1+ lobsters, with much less variation. Overall, the abundance of fished lobsters was consistent in most years, but with anomalously high levels in 1989, 1992, 2003 and 2005 and very low levels during 1999-2001.

The 2011 recruiting (1+) year-class was well above the long-term average, and continued the increasing trend recorded since 2008 (Figure 3). New management measures were implemented in 2002 to aid stock recovery from the low levels recorded during 1999 to 2001. Since 2002 there has been a general increase in both stock and recruitment levels but

recruitment levels have been variable with well below average year-classes in 2005 and 2008. The long-term variability in recruitment to the fishery highlights how both stock levels and environmental conditions impact on the stock-recruitment relationship. Given recruitment levels are very difficult to forecast there is a need for annual monitoring of stock and recruitment levels to ensure the fishery catches are set at sustainable levels. Once the quota management system is in place it will be even more critical to determine recruitment levels so that TACs are set at appropriate levels.

The 2011 fished (2+) year-class was significantly greater than levels recorded since 2007 and the long-term average (Figure 3). This recent increase in stock abundance suggests the subsequent breeding population will also be above average. The stock increase was forecast given the increased recruitment observed in 2010, but the size of the increase was anomalous suggesting survival may have been high in 2010/2011. In general, the relationship between recruiting (1+) and fished (2+) year-classes is poor suggesting mortality rates are variable. In a dynamic environment like Torres Strait this is not surprising but drivers of this variability are not clear and likely include several factors including; temperature, food availability and indirect influences on productivity.

As the fishery targets almost exclusively 2+ lobsters, the 2011 commercial catch should be greater than the 2008, 2009 and 2010 catches. However, the overall catch will also be determined by the distribution of lobsters. In particular, high stock abundance in the Kircaldie_rubble stratum should heavily influence the TVH catch, but will have negligible influence on the TiB catch.

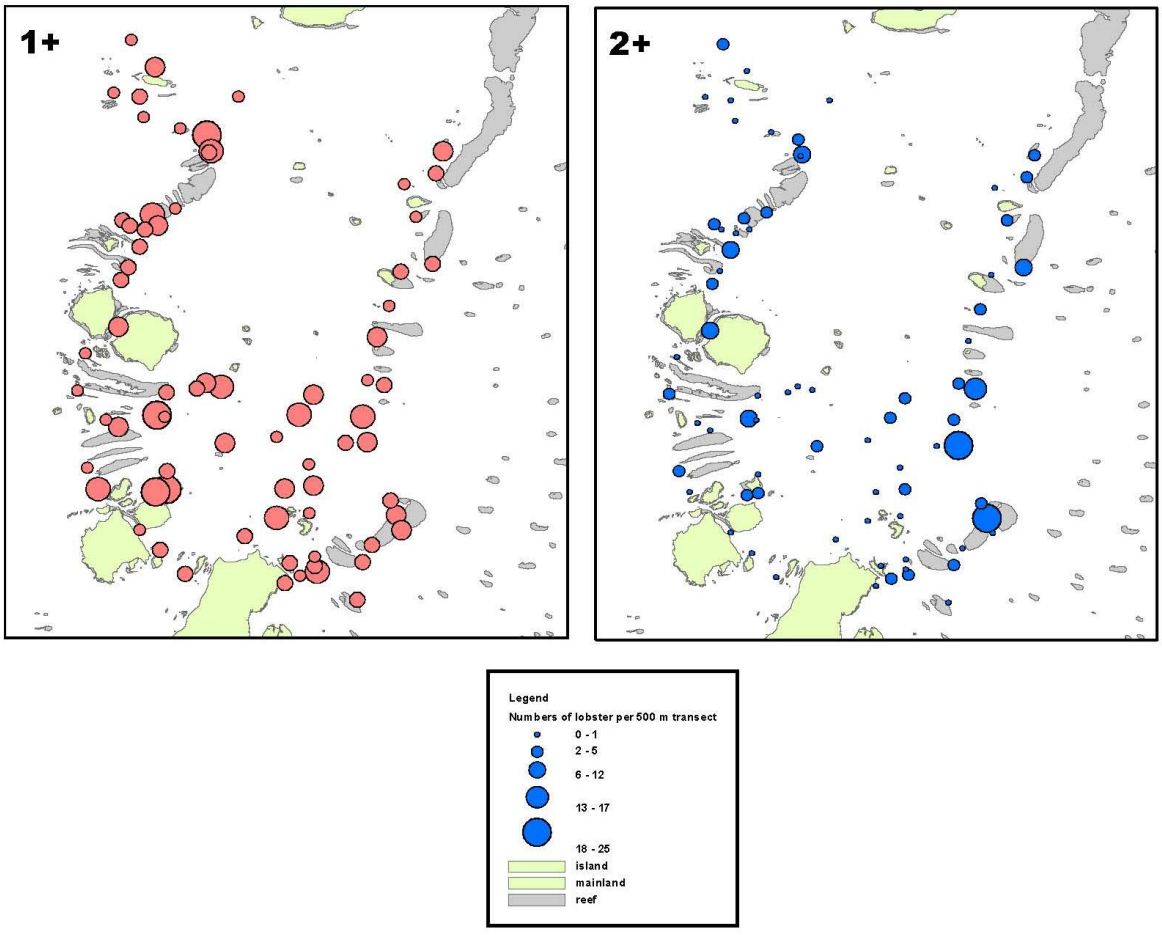

Figure 2. Densities of recruiting (1+) and fished (2+) ornate rock lobsters (*Panulirus ornatus*) recorded during the 2011 mid-year survey of the Torres Strait population.

The pattern of densities of recruiting (1+) lobsters amongst the sampling stratums in 2011 was divergent to most previous years, in particular the relatively low density in the Warraber_bridge stratum and recovery in the Kircaldie_rubble stratum (Figure 4). The

density in the Warraber_bridge stratum has tended downwards since strong levels recorded in 2005. In comparison densities of recruiting lobsters in all of the remaining stratums have tended upwards in recent years after lows in 2009.

Densities of fished (2+) lobsters increased in most stratums in 2011 to above average levels (Figure 4). However, there has been a general downward trend in the Mabuiag stratum since the record high in 2003. The density of fished (2+) lobsters in the Kircaldie_rubble stratum has increased sharply since the record low in 2009. Commercial TVH fishers also reported very high catch rates in the Kircaldie area of the fishery, with many vessels opting not to fish on the QLD east coast due to the favourable conditions.

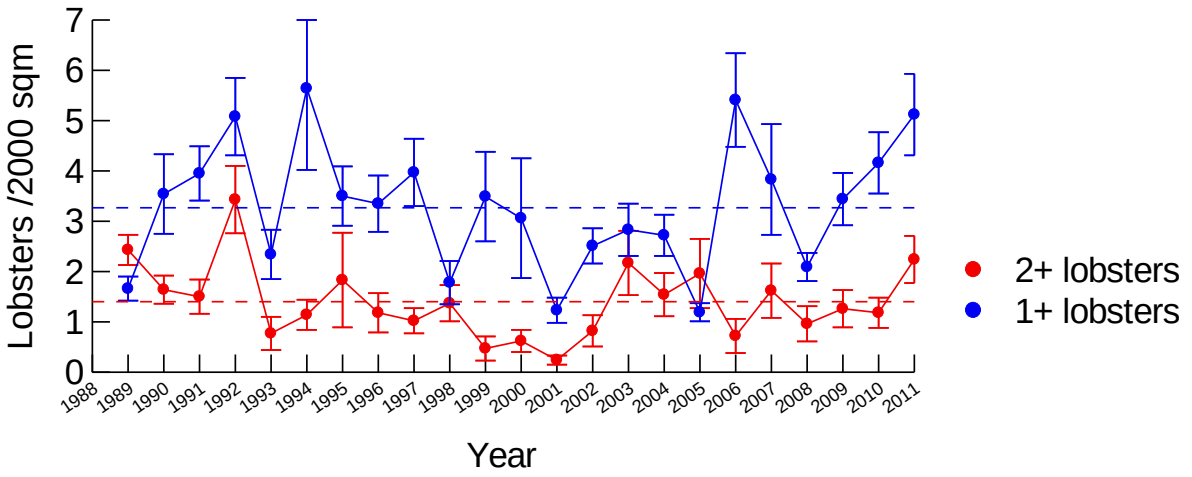

Figure 3. Relative abundance of recruiting (1+, blue) and fished (2+, red) ornate rock lobsters (*Panulirus ornatus*) recorded during annual (mid-year) population surveys conducted between 1989 and 2011. Error bars represent standard errors. Catch rates have been standardized to measured 500 × 4 m belt transect counts.

The size-frequency distributions of ornate rock lobsters *Panulirus ornatus* sampled during the annual (mid-year) population surveys between 1989 and 2011 were comprised of two modes, representing the recruiting (1+) and fished (2+) year-classes (Figure 5; only 2006-2011 shown for illustration). The size distributions show that virtually all recruiting lobsters are below legal size until after the seasonal closure ends in November. This protection is why commercial catches are comprised almost entirely of 2+ lobsters.

The size distributions of lobsters sampled in each of the sampling stratums and in PNG waters highlighted differences in the size and age structures (Figure 6). The size distributions in the South-east, TI_bridge and Mabuiag stratums were dominated by recruiting (1+) lobsters with an increasing modal size apparent from south to north. In contrast the size distributions in the Kircaldie_rubble and Warraber_bridge stratums were bi-modal.

The modal sizes of lobsters in the 2007 and 2008 commercial catches were well below 100 mm carapace length whereas in all other years during 2005-2010 the modal sizes were >100 mm CL and comparable (Figure 7).

Mean percent covers of abiotic and biotic substratum categories recorded during the mid-year surveys are shown in Figure 8, with the recruiting (1+) and fished (2+) lobster abundance indices. The influences of environmental conditions on lobster abundance are likely to be highly complex and varied throughout the life cycle. Nevertheless, the concurrent seabed habitat observations provide broad scale information on the status of several key features in Torres Strait that likely directly or indirectly influence lobster growth and survival. Seagrass cover, for example has increased almost linearly since a record low in 2001, after a declining trend (Figure 8). Although more variable, fished (2+) lobster abundance has also increased since 2001 after a declining trend. Habitat mapping also provides information on more pronounced influences, such as the coral bleaching event that occurred in 2010.

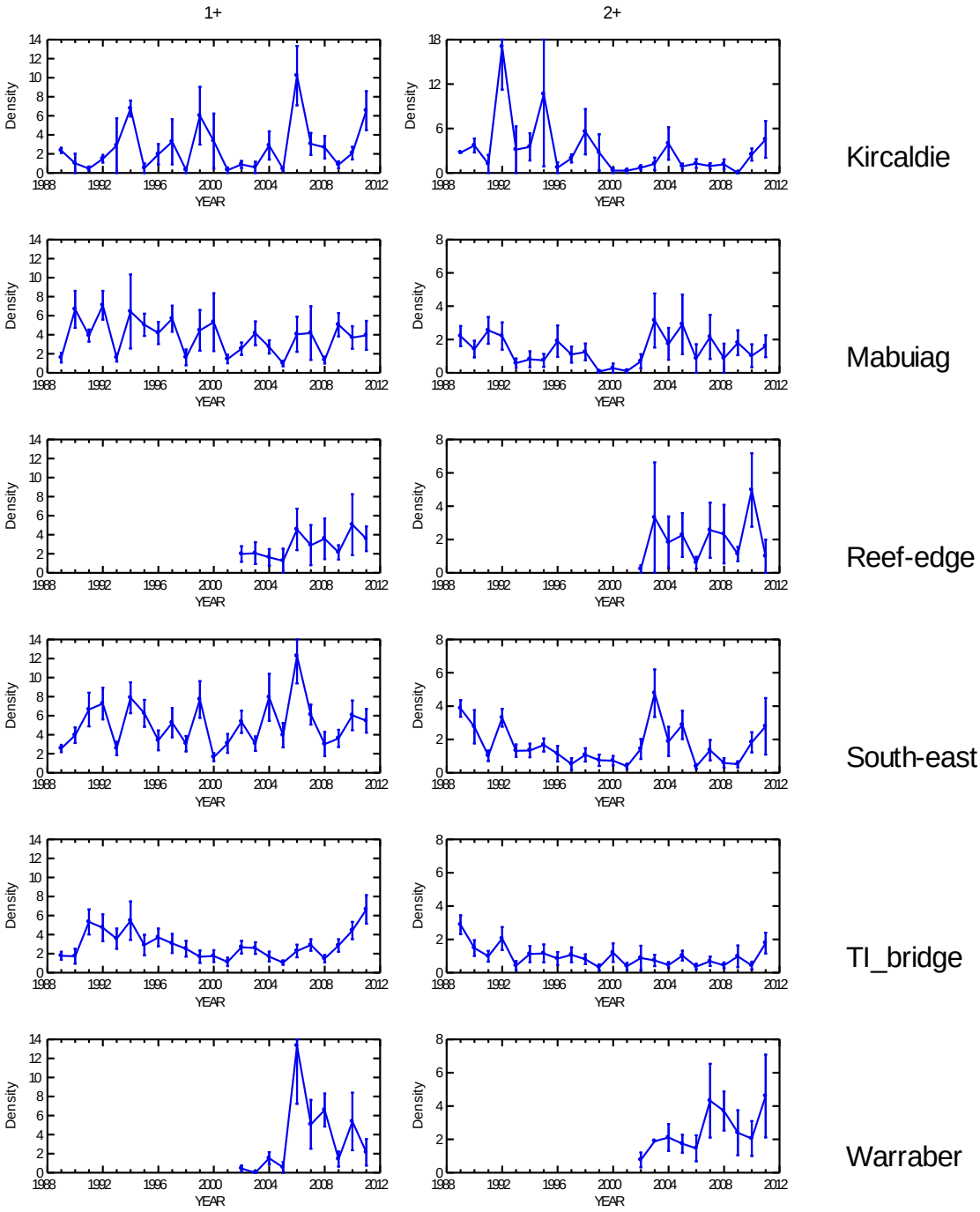

Figure 4. Densities of recruiting (1+) and fished (2+) ornate rock lobsters (*Panulirus ornatus*) in the sampling strata recorded during annual (mid-year) population surveys conducted in western Torres Strait since 1989;illustrating long-term trends in lobster abundance by stratum.

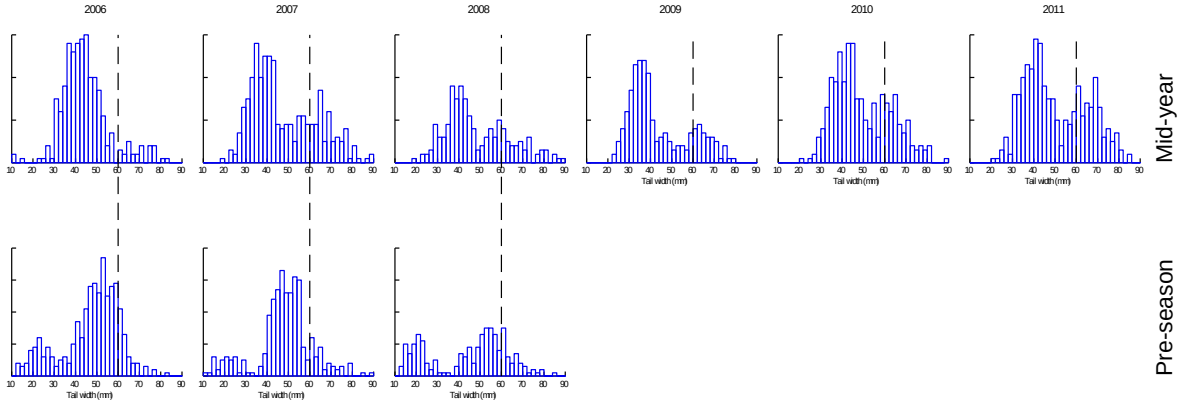

Figure 5. Size frequency distributions of ornate rock lobsters (*Panulirus ornatus*) sampled during the annual (mid-year) and pre-season population surveys in western Torres Strait between 2006 and 2011. The dashed lines indicate the minimum legal size limits.

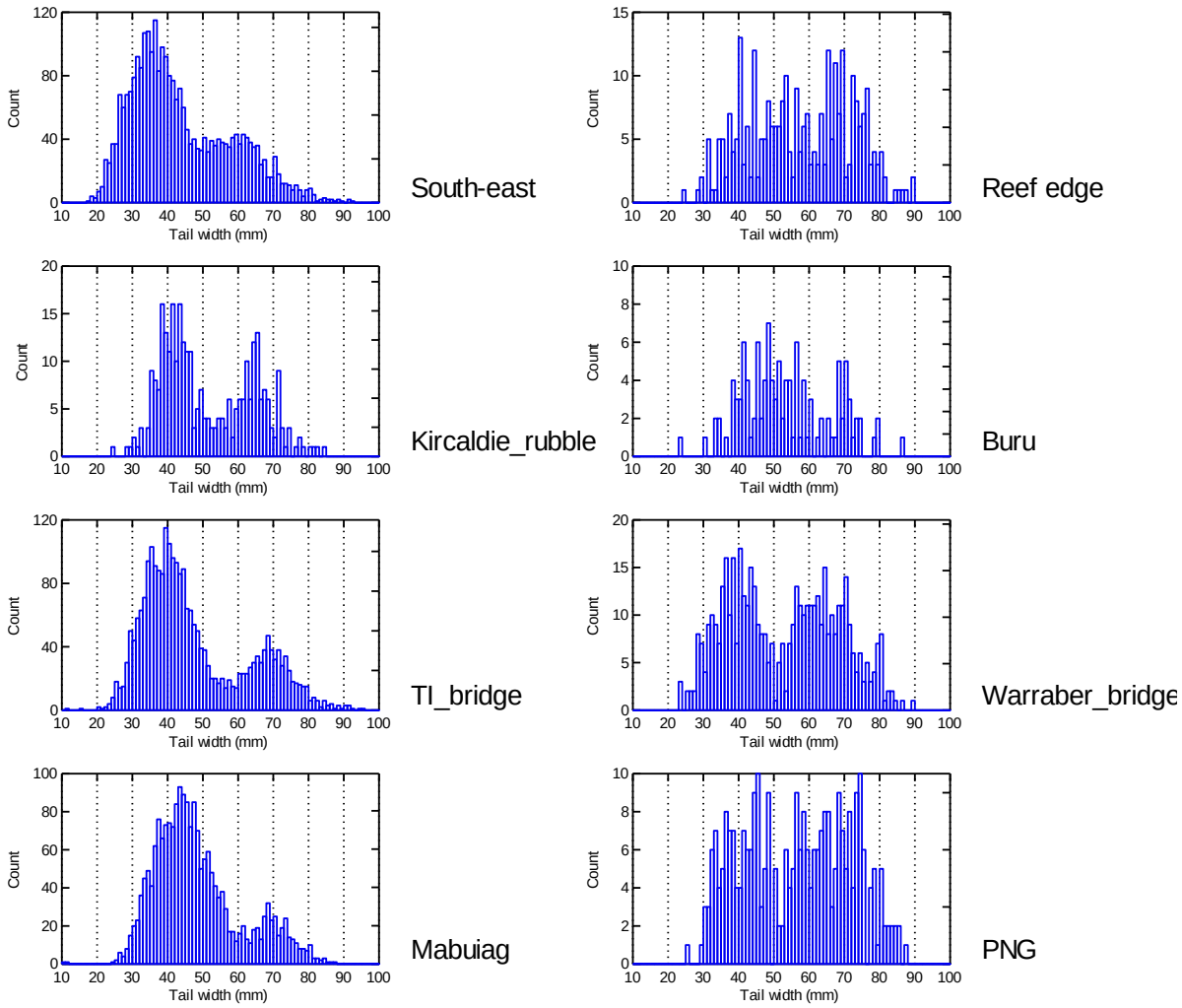

Figure 6. Size frequency distributions of ornate rock lobsters (*Panulirus ornatus*) sampled in seven sampling stratums and PNG during the annual mid-year population surveys in western Torres Strait between 1989 and 2011.

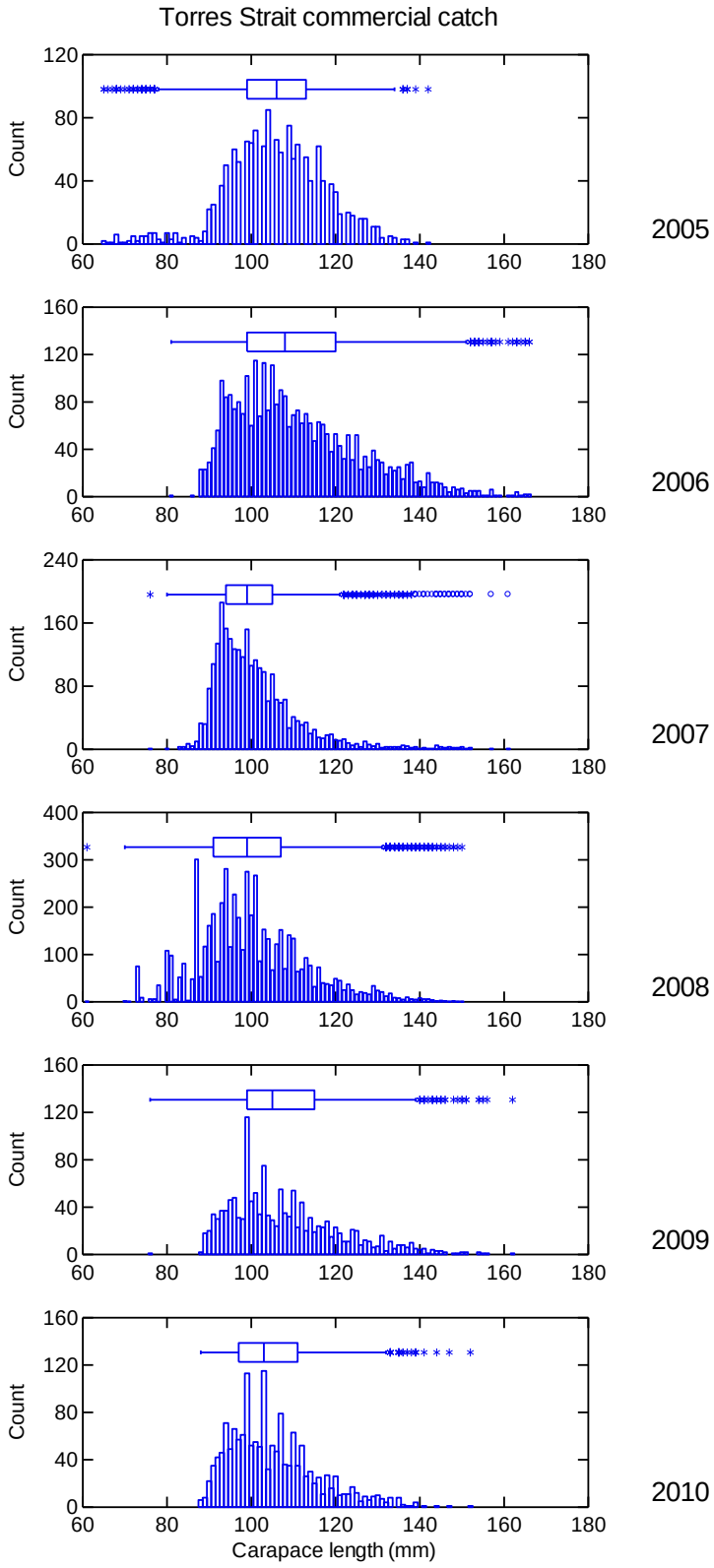

Figure 7. Size frequency distributions of ornate rock lobsters *Panulirus ornatus* measured from commercial catches taken in Torres Strait between 2005 and 2010. Box plots of the same data are displayed at the top of each pane.

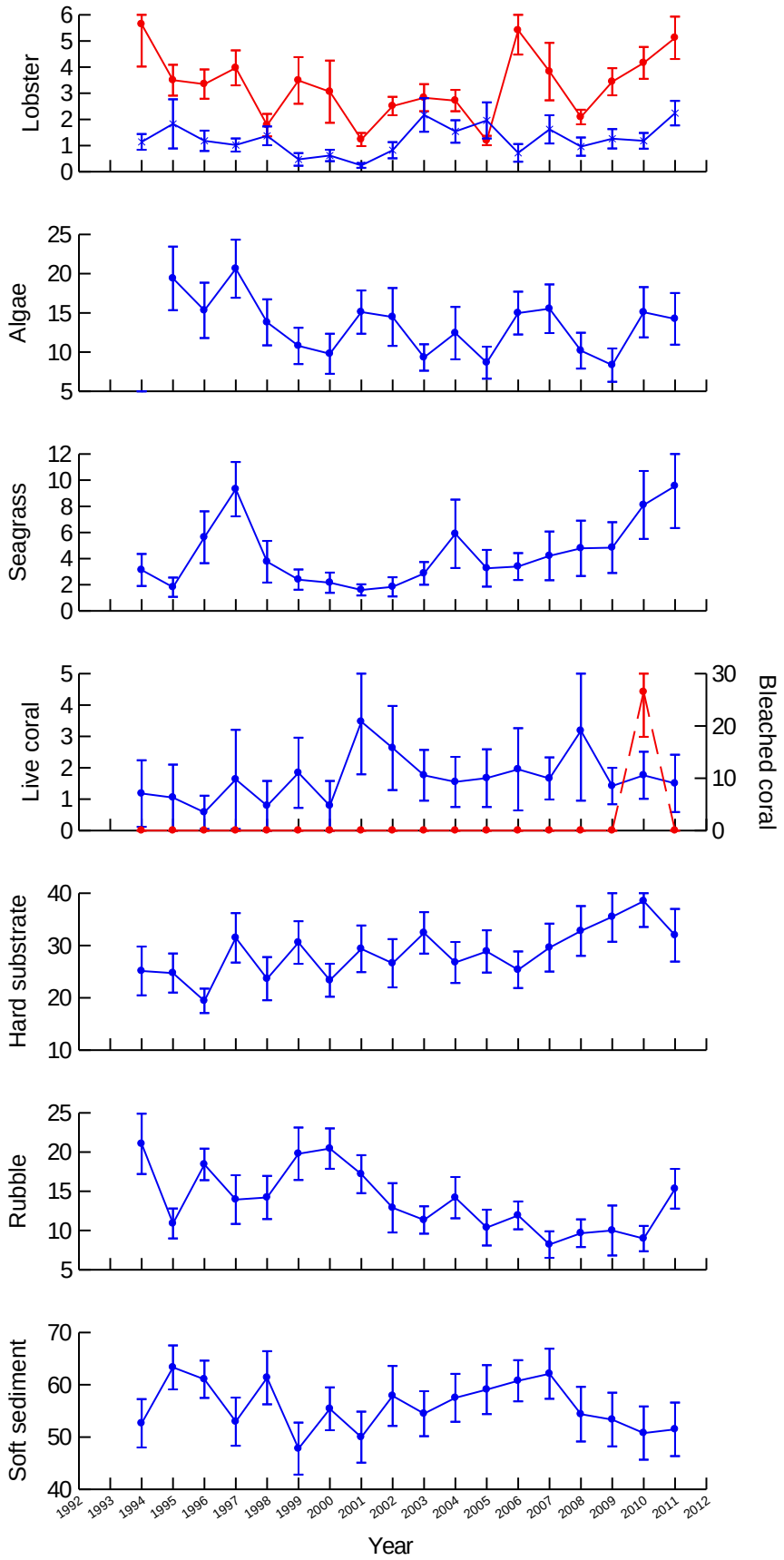

Figure 8. Mean percent covers of the main abiotic and biotic habitat categories estimated during the mid-year population surveys since 1994. Error bars represent standard errors.

DISCUSSION

The annual (mid-year) surveys of the Torres Strait lobster population provide key data for assessment of the status of the Torres Strait lobster stock including; relative abundance of recruiting (1+) and fished (2+) lobsters and age composition. Commercial CPUE data have been shown to be a useful alternative proxy for 2+ lobster abundance but there are no alternative sources of mid-year recruit (1+) abundance. The TRL RAG recommended continuing the mid-year surveys only whilst the fishery continues to be managed using input controls.

Both the recruiting (1+) and fished (2+) year-classes were above the long-term average in 2011. The increased 2011 recruiting year-class suggests that providing the 2010 survival rate persists the 2012 stock would also be above the long-term average.

The mid-year relative abundance data continues to be used to inform the stock-recruitment relationship which is a critical component of the new integrated fishery model used to assess the status of the lobster stock and provide TAC recommendations for management. Given the delay to the introduction of the quota managed system the TRL RAG decided to continue the mid-year surveys into 2011. However, once the QMS is introduced it is likely a single population survey will be undertaken each year to allow an estimate of TAC due to the prohibitive cost of two annual surveys.

FINANCIAL IMPLICATIONS

Nil