A collaborative recruitment forecasting programme for the Northern Territory Mud Crab Fishery
Final project summary – November 2010

A collaborative research project involving the Northern Territory Seafood Council, the Fisheries Division of the Department of Resources, the NT Mud Crab Licensee Committee (formerly the NT Crab Fishermen's Association) and a number of Indigenous Sea Ranger Groups was completed in November 2010.

The aim of the study (funded by a Landcare Sustainable Practices grant under the Australian Government's Caring for our Country) was to collect information on when and where juvenile mud crabs are found and describe potential links between juvenile abundance and the subsequent commercial harvest of mud crabs.

The areas monitored included the Adelaide River, Junction Bay and surrounds (near the Liverpool River), Castlereagh Bay and surrounds (near the Glyde River) as well as the Limmen Bight, McArthur, Roper, Rose and Wearyan Rivers in the Gulf of Carpentaria (see Figure 1 for locations).

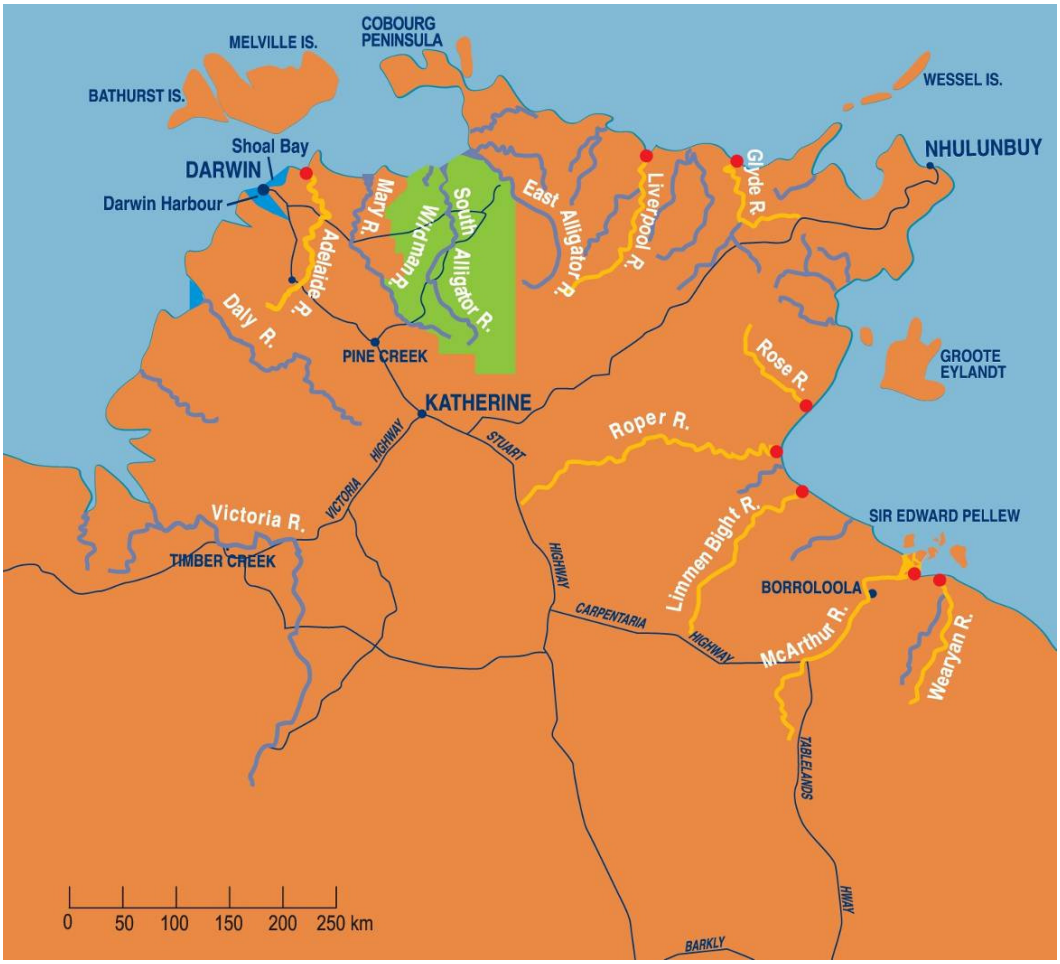

Figure 1. Approximate location of monitoring activities is indicated by red dots

Since the project began in August 2008, NT Fisheries staff in conjunction with Chris Calogeras (C-AID Consultants) conducted a number of training/review workshops with each of the project partners. Where necessary, these workshops covered how best to set and retrieve crab pots, mud crab handling techniques and data recording and reporting protocols.

The schedule of training/review workshops delivered to Indigenous Sea Ranger Groups during this project is given in Table 1. In some cases, workshops for commercial fishers aligned with these events, but there were also many informal meetings with commercial fishers both in Darwin and at their camps.

Table 1. Schedule of training/review workshops

Indigenous Sea Ranger Groups (location)	Workshop dates
Numberindi (Numbulwar)	September 2008, March 2009
Li-Anthawirriyarra (Borroloola/Limmen Bight)	November 2008, March 2009, May 2009, September 2010
Djelk (Maningrida)	March 2010
Wanga Djakamirr (Ramingining)	August 2009, March 2010
Yugul Mangi (Ngukkur/Port Roper)	February 2010, July 2010

Participants were issued with a number of fine mesh research pots (Figure 2) and a scientific permit to use non-standard pots. The research pots were based on commercial crab pots but with the addition of rigid, V-shaped entry funnels wrapped with closely woven shade-cloth. The shade-cloth supports the fine legs of the small mud crabs as they enter the pot. The narrow opening of the funnel also restricted the entry of larger mud crabs which are cannibalistic.

Figure 2. Fine mesh research pot with shade-cloth funnel

Project partners were then asked to set three to five research pots in the different habitats that occur within their area of operation (e.g. on coastal mud flats, at the river mouth or next to salt pans/mangrove thickets within the river) and to check and re-bait them two to three times per week (see Figure 3 for examples). Some Sea Ranger Groups experienced difficulties collecting bait and so were provided with bait nets or frozen carcases of fish that had been processed for fisheries research in Darwin.

Figure 3. Indigenous Sea Rangers checking research pots. Clockwise from top left: Li-Anthawirriyarra Sea Ranger, Leonard Norman; Wanga Djakamirr Sea Ranger, Solomon O'Ryan; Yugul Mangi Sea Ranger, Benjamin Winifred; Numberindi Sea Rangers Henry (stern) and Eva (bow) Nunggumajbarr with Fisheries Division staff.

Each pot was individually numbered and participants were asked to take photos (using water-proof digital cameras) of every pot as it was checked, irrespective of whether or not it contained a crab/s. In many cases, participants also recorded the exact position of the pots by taking photos of their GPS units (either hand-held or hard-wired) at the point of retrieval (Figure 4).

Diaries to record the details of each monitoring trip (particularly the date/s) were issued but were rarely, if ever used. Instead, the "file properties" of each image were used to determine when photo was taken. This worked in most cases but there were instances when batteries were removed for extended periods of time (e.g. for overnight charging) and the time and date settings wiped from the camera's internal memory, resulting in incorrect "date created" details for all subsequent images. As soon as this problem was recognised we amended then re-released our training manual so that it clearly articulated the need to charge the spare battery then exchange it for the flat battery as soon as it was removed from the camera.

Figure 4. Digital image showing individual pot number and GPS readout

Crabs captured were emptied into a plastic tray onto which a checkerboard pattern had been applied for calibration purposes (Figure 5). Once photographs of the catch were taken the crabs were released. Images were returned to Darwin each month (either in person, by email or on a thumbdrive sent by post) for crab size estimation (as carapace width – from left to right across the widest point of the shell) using image analysis software (Figure 6)

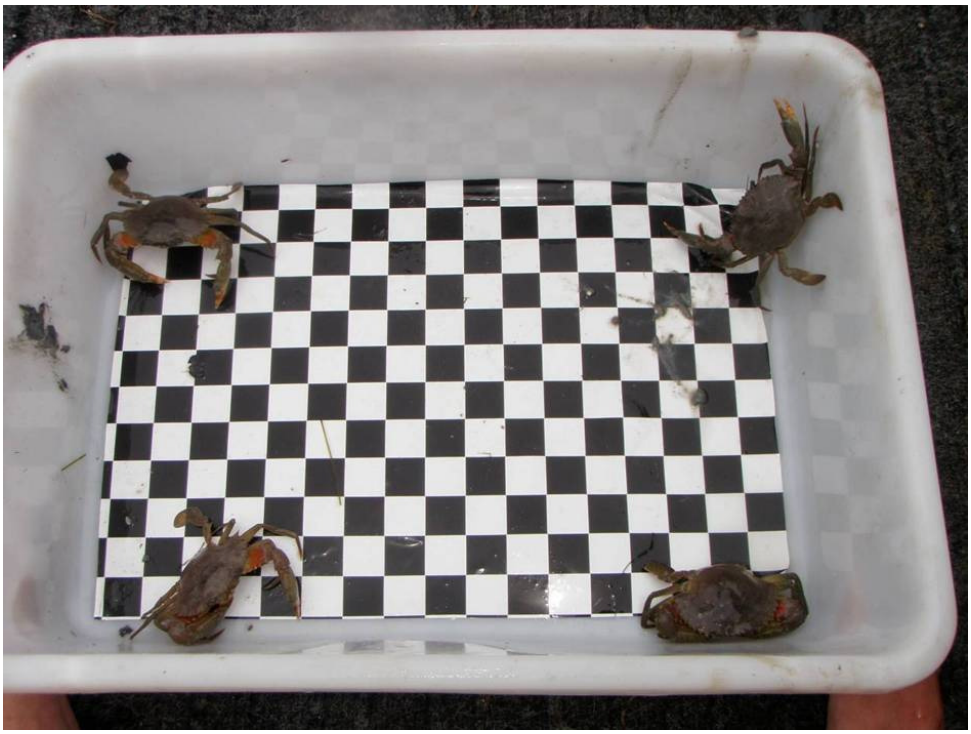

Figure 5. Calibrated plastic tray containing juvenile mud crabs

Figure 6. Juvenile mud crabs measured using image analysis software

A total of 633 images of juvenile mud crabs were taken during 166 fishing days (equating to roughly 900 potlifts) and measurements from 427 individuals obtained from these images. There may have been some measurement error due to different sized crabs being different distances from the inner surface of the tray (used for calibration during image analysis) when the images were taken. A system to compensate for this was unable to be developed during the course of the study. Hence, the data on crab size presented here are approximations only (estimated measurement error +1 to +5 mm).

The fact that images were taken at different distances and angles to the subject may also have resulted in measurement error. The idea of mounting each camera on a frame to standardise the field of view and camera angle was discussed but such a device was considered to be too bulky and impractical for use in small, open boats. The development and use of this apparatus would however limit the abovementioned problems and also reduce time spent calibrating images (as the field of view would be the same in each image).

The exact location of research pot deployment/retrieval was not recorded as often as we would have hoped. Likewise, participants tended to set all pots in the same habitat type rather than spreading them among habitats. These factors made it difficult to determine if and how habitat preferences of juvenile mud crabs change over time. That said, the most reliable data came from those pots set on mud flats in shallow waters around the mouths of rivers in the first three to four months of the year.

Monitoring activities in the Gulf of Carpentaria were severely hampered by flooding caused by Cyclone Paul in late March/early April 2010. Many centres recorded daily rainfall totals between 200 and 400 mm during this period. The cyclone and an unusually warm and humid dry season appear to have had a negative impact on both juvenile and adult mud crab catches in 2010 (although it should be noted that many commercial crab fishers attribute the moderate adult catch in 2010 to their inability to source quality weld mesh from which to build their pots – the only product available quickly fell apart allowing adult crabs to escape from or break out of pots.

In spite of these problems, this work represents the most significant advance in our ability to capture and document the distribution and abundance of juvenile mud crabs in the last 20 years. Figures 7 and 8 provide examples of the change in size frequency of juvenile crabs (which can be interpreted as growth from left to right down the page) caught (and released) from the Wearyan and McArthur Rivers in early 2009, respectively. These represent some of the more consistent and informative data sets gathered during the project.

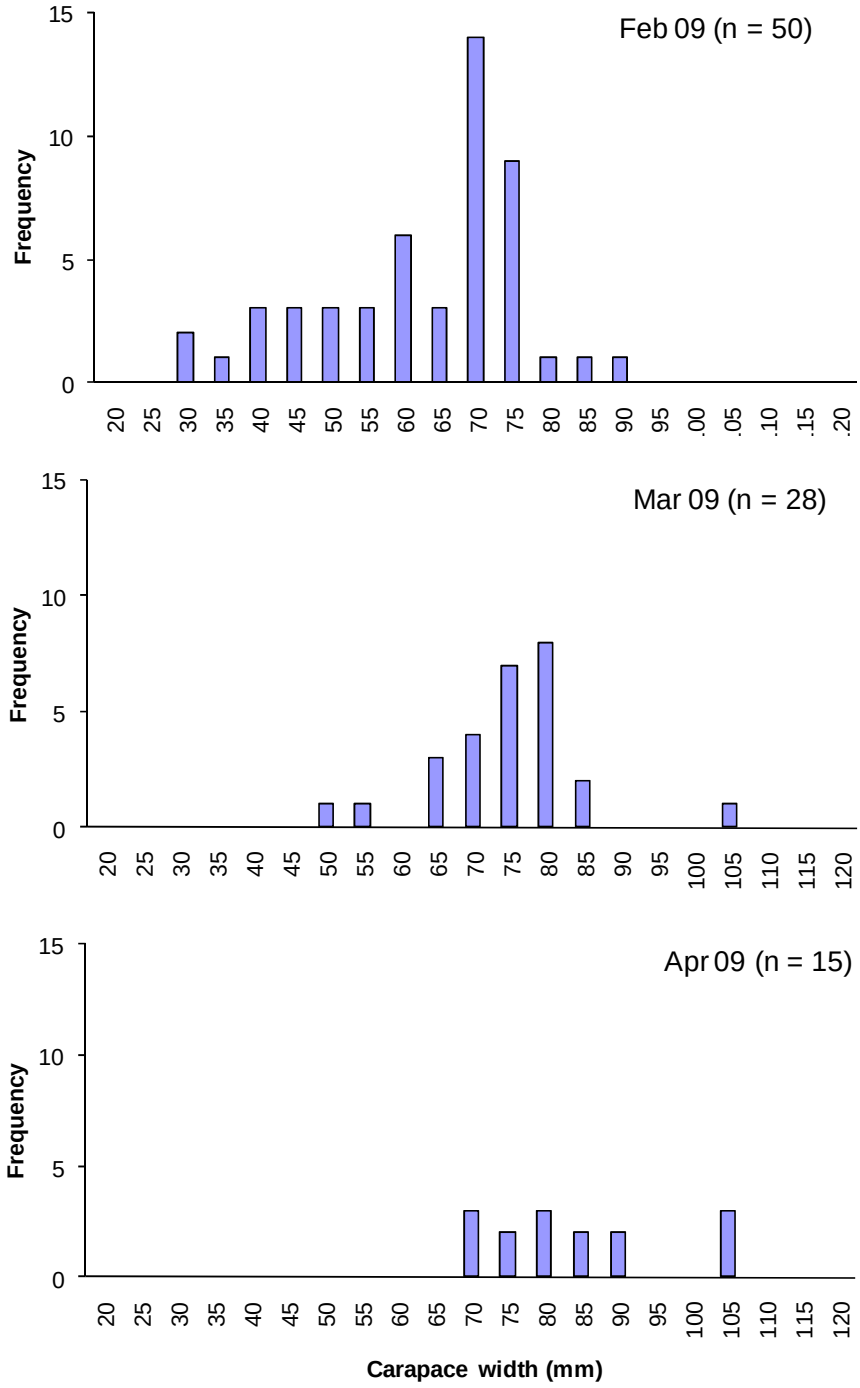

Figure 7. Change in monthly size frequency (as carapace width) of juvenile mud crabs caught in the Wearyan River from February to April 2009.

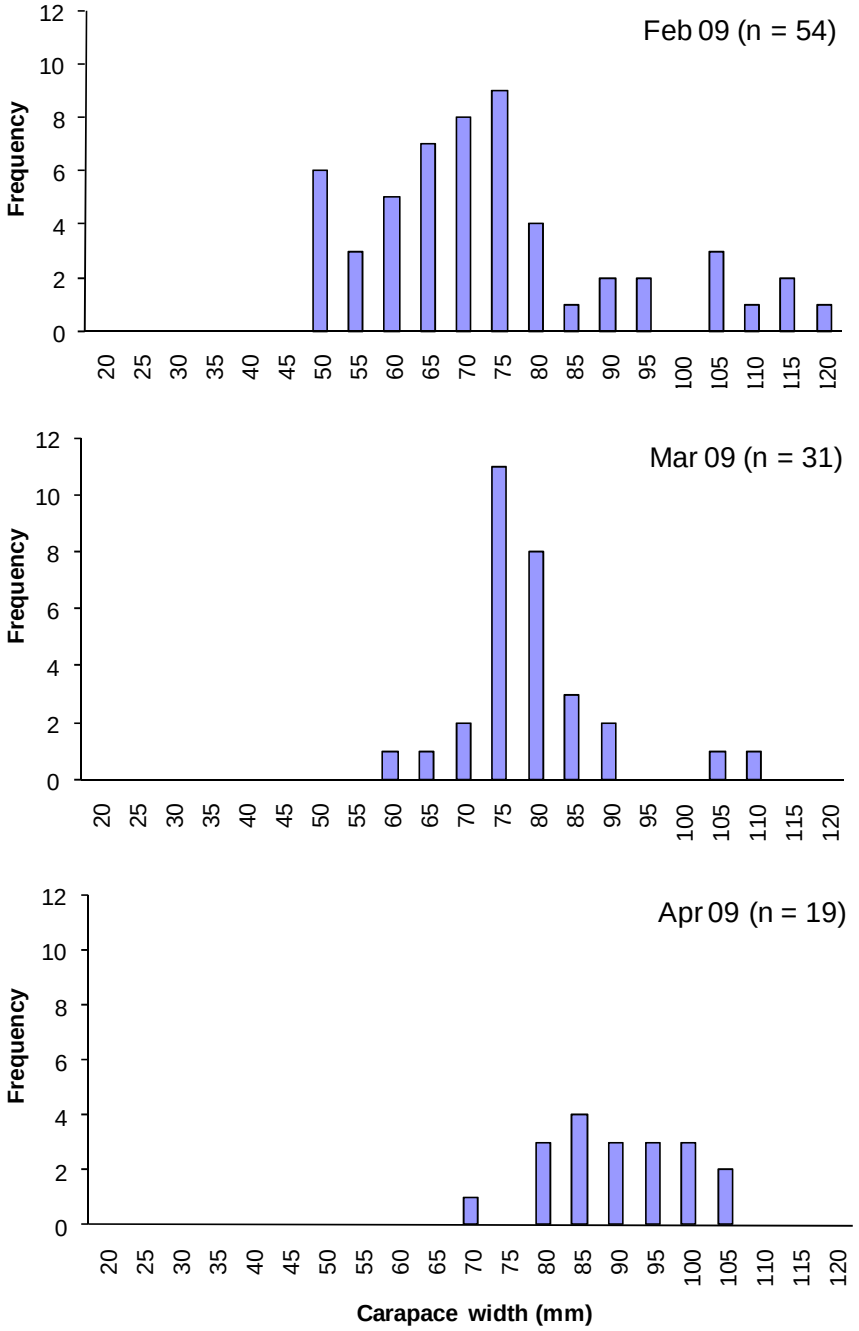

Figure 8. Change in monthly size frequency (as carapace width) of juvenile mud crabs caught in the McArthur River from February to April 2009.

Our immediate success in capturing significant numbers of small mud crabs generated interest in the project among crab biologists in both Queensland and Western Australia. The project methodology and results were also presented through meetings, workshops and conferences held locally (Darwin, NT), nationally (Bribie Island, QLD and Fremantle, WA) and internationally (Anchorage, Alaska, USA and Vancouver, British Columbia, Canada).

There is no doubt that the sampling gear and reporting protocols developed during this project worked and that these could be used to forecast recruitment in the NT Mud Crab Fishery. The challenge now is to encourage stakeholders to participate in a voluntary monitoring project even in years when adult catches are low (as was the case in 2010). These activities will need to be undertaken for a number of years before we can confidently describe any relationship between juvenile abundance and the subsequent commercial harvest of mud crabs.

Maintaining an appropriate level of scientific rigour (such as the recording of date, time, location and number of potlifts per trip) in the program may also be a challenge in future. This should be mitigated to some degree by the increasing use of the Cybertracker (a rugged, waterproof handheld computer with an inbuilt GPS and camera – Figure 9) by Indigenous Sea Ranger Groups as this device captures all necessary information using a few simple commands. Records of each monitoring trip can then be transferred to a PC and emailed to the Fisheries Division.

Figure 9. Djelk Sea Ranger Justin Cooper using Cybertracker device.

If the program is to continue it should focus on the first three to four months of the year as this is when the bulk of the small crabs are caught. Limiting the sampling period will also reduce the burden on commercial fishers and Indigenous Sea Ranger Groups (who are often pressed for time) and lessen the technical and analytical demands on Fisheries Division staff.

The Northern Territory Seafood Council and the Fisheries Division of the Department of Resources thanks the many groups and individuals involved in the project and looks forward to future collaborations of this nature.

Special thanks go to:

Indigenous Sea Ranger Groups	Mud crab fishers/licence holders
Djelk Sea Rangers	Neil Bradley
Li-Anthawirriyarra Sea Rangers	Patrick Coyne
Numberindi Sea Rangers	Peter Fraser
Wanga Djakamirr Sea Rangers	Greg Quayle
Yugul-Mangi Sea Rangers	Doug Neville
	Sherwood Thorbjornsen
	Tam van Nguyen
	Vu van Nguyen

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