



National Environmental  
Research Program

NORTHERN AUSTRALIA HUB



# Fresh or salty?

SAMPLING BY **BRAD PUSEY** AND **MARK KENNARD** IS SHEDDING  
LIGHT ON THE TRUE EXTENT OF ESTUARINE FISH DIVERSITY  
IN KAKADU NATIONAL PARK.



Top: Returning from a successful sampling trip. Photo Mark Kennard.  
Above: Three common species (Streamer Threadfin, Threadfin Scat and  
Paperhead Jewfish) discovered during fish sampling. Photo Brad Pusey.

Fish are a critical component of the aquatic habitats of northern Australia, especially its rivers. They are essential to riverine food web dynamics, support viable fishing and tourism industries, and are of great recreational and cultural significance. Recent research investigated how many species of fish call Kakadu National Park home, and how their size and abundance varies between seasons.

Kakadu National Park is regarded as one of the richest biological and cultural regions in Australia. It encompasses several rivers almost in their entirety—a level of riverine protection no other national park in northern Australia can boast. These rivers and connected water bodies support an outstanding array of fish diversity, containing a quarter of Australia's estuarine and freshwater fish species. Climate change, especially sea level rise, threatens to put this unique biodiversity at risk.

As part of the Australian Government's National Environmental Research Program, tropical river scientists have extensively surveyed Kakadu's estuaries to better describe its fish fauna, and have undertaken an assessment of the potential impacts on them from sea level rise.

## Coastal fish

Estuaries are a distinctive and key feature of the northern Australian landscape, with 40 per cent of all fish recorded in the Northern Territory occurring in estuaries. Importantly, the Territory's estuaries are also in overwhelmingly good ecological condition, which is in stark contrast to elsewhere in Australia, or indeed the world.

Good ecological condition equates with high biodiversity. Kakadu contains almost 340 species of teleost or bony fish—about 80 per cent of which spend all or part of their life in estuarine habitats. In 2012, the team sampled the estuaries of the Park to document the species present, look for patterns in size and abundance, and learn how these vary between the wet and dry season. James Cook University Professor Brad Pusey says they collected 26 species of fish not previously recorded from the Park.

“Croakers and anchovies were more than three quarters of the fish collected. These fish are important in the diet of larger fish that are sought after for recreational fishing,” Brad said.

The research also demonstrated the significance of estuaries as breeding grounds for many freshwater species. “In northern Australia, about one third of freshwater fishes need access to estuarine areas to complete their life cycle. Over half of all species of estuarine fish collected during the Kakadu study were juveniles. Estuaries are vital nursery areas for many fish, including those that are of economic value such as the iconic Barramundi, and which therefore underpin the long-term sustainability of many commercial fisheries,” Brad said.

### Distinct seasons

Despite only two families dominating the catches, the project team found there were significant differences in the fish species present in the wet season compared to the dry season.

“We recorded 74 types of fish over the study—63 of which were recorded during the wet season, compared to only 43 during the dry season. Of the 26 new species we recorded from Kakadu, 10 were collected during the wet season, while six were collected during the dry season, and the remaining 10 were present in both seasons,” Brad said.

Prior to this project, all previous surveys of fish in the Park had only been undertaken during the dry season. “The large number of new fish we discovered leads us to believe that the biodiversity of estuarine fishes in Kakadu could still be higher. In particular, we would expect to discover more species in future wet season sampling.”

Brad says this incomplete inventory of biodiversity, combined with significant seasonal differences, has important management implications.

“The estuarine environment itself is notoriously challenging to predict because of its natural variability. Without clear patterns it is hard to know how these estuarine species would respond to habitat changes. In order to develop a useful monitoring program based on estuarine fish, more sampling would be needed to determine a more accurate reflection of fish biodiversity.”

A wet season beam trawl sample. Photo Brad Pusey.

#### FOR FURTHER INFORMATION

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### Changing tides

Kakadu is also among the most species rich areas in northern Australia for freshwater fish, with 62 species recorded in the Park. Griffith University principal research fellow Mark Kennard says many of these species are at risk of sea level rise. In the Kakadu region as sea level rises, large areas of freshwater wetlands will become inundated by salt water. As salinity goes up, freshwater plants die, causing areas affected by salt to change from wetlands to saline mud flats.

“While some estuarine species may benefit from expanded tidal habitat, some lowland freshwater species, especially those confined to floodplains, are particularly vulnerable,” Mark said.

The project team used existing predictions of sea level rise in Kakadu to predict the locations and areas of freshwater habitat that will be impacted. There are 55 freshwater fish in the areas that are predicted to be affected. Of these fish, those that also occur widely in upstream freshwater river reaches, or that are tolerant of a wider range of salinity levels, will be less vulnerable.

“In total we found 12 species of fish that we consider vulnerable, and six that are highly vulnerable. The most vulnerable species are fish that have a large part of their range covered by the wetlands that could be influenced by salt water and that cannot tolerate increases in salinity.”

Mark says the makeup of estuarine environments could also be impacted. “Freshwater wetlands produce a lot of food that flows into estuaries and coastal marine areas in the form of fish, plants, algae and nutrients. By changing wetlands, sea level rise could reduce the food sources within estuaries, and this could impact on estuarine and even coastal fisheries.”

### Building a complete picture

The importance of Kakadu’s rivers, wetlands and estuaries as valuable repositories of biodiversity is clear. This project has done much to improve the understanding of Kakadu’s fish fauna. Other research undertaken in the region is also looking at the processes within freshwater wetlands that underpin their incredible productivity, and the importance of fish movements and energy transfers between wetlands and estuaries.

“Northern Australia’s rivers and estuaries remain in good condition, in contrast to many parts of southern Australia and elsewhere in south east Asia, and we need to ensure they remain so into the future,” Brad said.

