TOP FUELLED PREDATORS

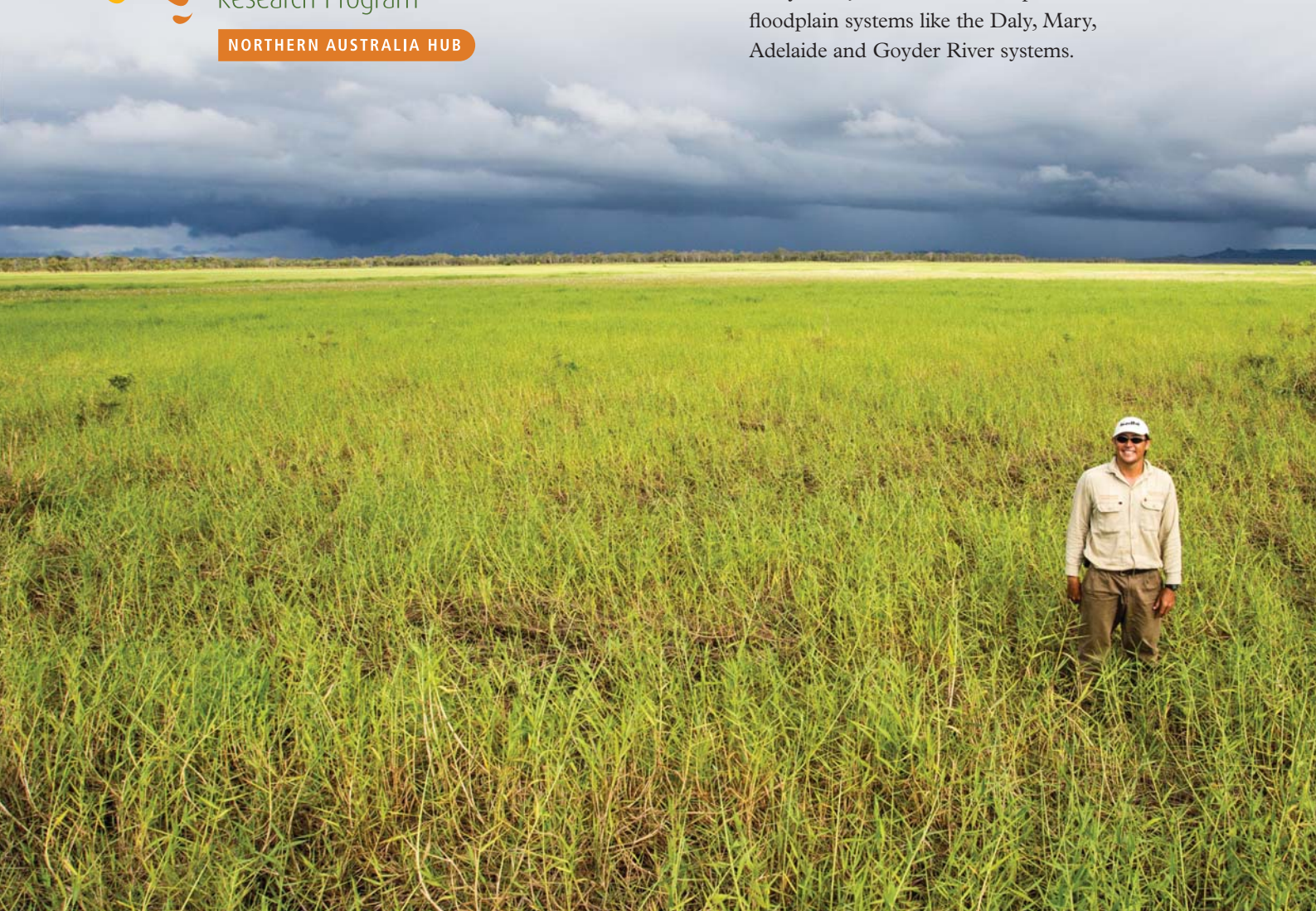
DOUG WARD AND OTHER RESEARCHERS HAVE BEEN SAMPLING EVERYTHING THAT CAN EAT OR BE EATEN IN KAKADU RIVERS AND WETLANDS TO BETTER UNDERSTAND FOOD WEBS IN NORTHERN AUSTRALIA'S FRESHWATER ECOSYSTEMS.

National Environmental Research Program

NORTHERN AUSTRALIA HUB

Any good Top End fisherman will tell you that floodplains are important to fish production, and that a big wet season results in more fish in rivers, estuaries and connected coastal areas. Until recently, however, there were still many gaps in our understanding of the natural processes underpinning this relationship.

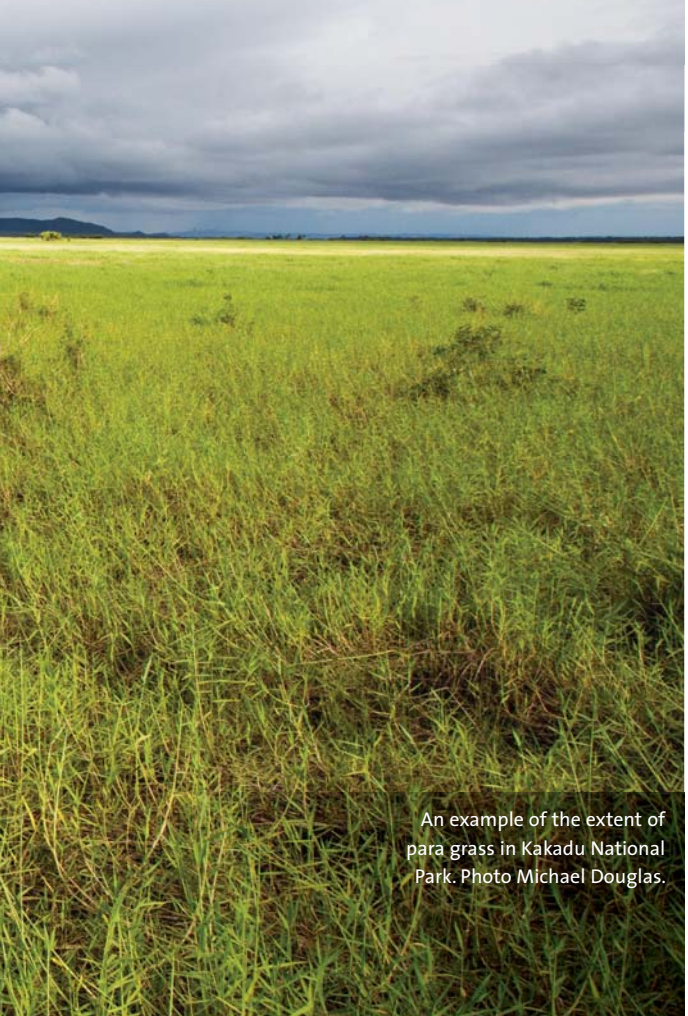
Under the Australian Government's National Environmental Research Program, researchers at Griffith University have been working to unpick the science behind Kakadu National Park's highly productive and diverse aquatic ecosystems. The answers will not only provide a more detailed understanding of the importance and function of floodplains to freshwater biodiversity, but will also help managers to better protect the biodiversity and fisheries of Kakadu's iconic wetland ecosystems, as well as other Top End floodplain systems like the Daly, Mary, Adelaide and Goyder River systems.



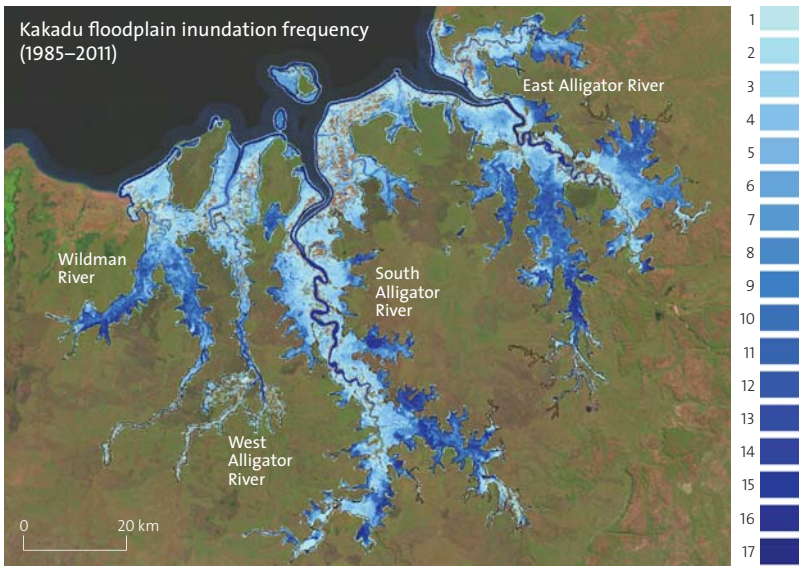
The big wet

The amount of floodplain inundated over the wet season greatly influences the extent of habitat available to aquatic animals. Analysis of satellite images from 1985 to 2011 (see map) shows that after each wet season (March/April), on average, some 1800 square kilometres (km^2) of the entire Alligator Rivers region are underwater. This ranges between about 1300 km^2 in a drier year, to nearly 2300 km^2 in a wet year. On average, the flood extent recedes to about 25–30 per cent by August/September.

Earlier work has shown that at a broad scale, larger flooding areas and longer duration does increase productivity, however, researchers wanted to find out more about what is happening in these flooded areas that fuels the food chain, and whether some food sources or specific locations on floodplains are more important than others in supporting aquatic food webs in the north. The study area was the Alligator Rivers region which is located entirely within the Kakadu National Park, and has no dams or water extraction. In systems where water is caught in dams or extracted for agriculture, reducing the extent and duration of water on floodplains would be expected to reduce fish productivity.



An example of the extent of para grass in Kakadu National Park. Photo Michael Douglas.



Flood inundation frequency can be used to represent the duration of flood inundation—the deeper 'blue' areas are inundated for the longest periods. Inundation frequency was calculated by assigning 1 to a flooded state and 0 to a non-flooded state, then adding the incidence of inundation over 17 image captures.

Food cycles

Stable isotope analysis is a technique that allows researchers to trace the chemical signatures of different plants and algae up the food chain. In 2012, the team began collecting samples of plants, algae, leaf litter, plankton, insects, prawns and fish from across the rivers and floodplains of Kakadu National Park. They also worked with Traditional Owners to obtain samples of crocodiles, wallabies and magpie geese eggs.

Senior research fellow Doug Ward says the chemical analysis shows that animals at the top of Kakadu's aquatic food webs are highly dependent on food resources that originate from floodplains or the surrounding savannas. As much as 80 per cent of the diet of larger fish and crocodiles came from floodplain sources. At the top of the food chain, half of the crocodiles' diets were made up of mammals from the surrounding savanna—mainly wallabies and pigs.

Interestingly, the research found that while the small insects and fish at the bottom of the food chain were consuming a wide variety of plants and algae, as you moved further up the food chain, one type of food source became increasingly important—epiphytic algae.

"This indicates that epiphytic algae is a higher quality food resource than other plants and algae," Doug said.

Plant architecture and light

Epiphytic algae grows as a film over the submerged leaves and stems of plants. The quantity of algae produced is strongly influenced by the amount of light that can reach the algae, rather than the surface area of the plants.

"Submerged aquatic plants, such as hornwort, bladderwort and najas, with lots of branching and open structures, produced the most algae—up to four times more than dense grasses. On the other hand, aquatic grasses and, in particular two very dense exotic grasses, para grass and olive hymenachne, are the least productive to algae," Doug said.

"These two highly invasive species are now established in parts of the Kakadu floodplains. If they continue to spread and become denser, we would expect fish productivity to decline due to a reduction in epiphytic algae."

Hotspots for productivity

By drawing together all of the different parts of the research, the team has been able to identify the most productive floodplain areas: these are the back water swamps on the edges of the floodplains, like Nourlangie, Yellow Water, Boggy Plains and the Magela Creek floodplain. The things that characterise these areas and lead to their high productivity are that they are deeper and hold water for much longer than the areas dominated by grasses.

"For most of the year large parts of these back swamps are between one and four metres deep. This is ideal for the floating plants that support the highest amounts of epiphytic algae growth," Doug said.

"The greatest risk to productivity in these areas is in the shallower areas between one and two metres deep—a depth suitable for either submerged aquatic plants or grasses. If para grass or olive hymenachne took over large areas of submerged aquatic plants, we would expect to see a reduction in productivity throughout the food web, which is an important consideration for floodplain management."

FOR FURTHER INFORMATION

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Lessons learnt

Kakadu National Park has been working closely with the researchers as part of the Park's biodiversity management approach under the Kakadu Management Plan. Park Manager Sarah Kerin welcomed the findings, and says Kakadu is adapting its weed management approach to take account of these new understandings of floodplain ecosystems.

"The link between invasive grasses and reductions in floodplain aquatic food chain productivity is another new piece of information for us to integrate into our floodplain planning and weed management strategy," Sarah said.

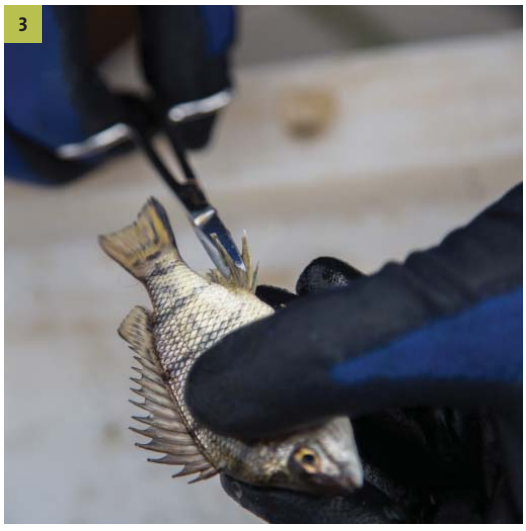
Doug says the research has led to a better understanding of the key factors underpinning the productivity of Kakadu's aquatic food webs, and their most significant threats.

The research is also relevant to the current interest in developing northern Australia. This knowledge can be used to predict how proposed changes, like water extraction or dams, will impact on the productivity of other northern Australian floodplain river systems.

"In general, we found that hydrologic connectivity between the dry season refuges, such as billabongs, floodplains and river systems is critical for the maintenance of biodiversity in these tropical floodplain systems. The impacts of changes in hydrologic connectivity can cascade through the entire flood chain which has the potential to significantly affect the aquatic biodiversity in these types of river-floodplain systems," Doug said.

PHOTOS 1 AND 3: MICHAEL LAWRENCE-TAYLOR.

PHOTO 2: MICHAEL DOUGLAS.



1. Researchers used stable isotope analysis to trace the chemical signatures of different fish. 2. Sampling epiphytic algae. 3. Sampling fish tissues.