National Environmental Research Program

NORTHERN AUSTRALIA HUB

Improving biodiversity conservation in northern Australia

Estuarine fishes of Kakadu National Park

Project aim

Fishes comprise the most species rich vertebrate group on the planet. They are a significant component of the biodiversity of aquatic ecosystems of northern Australia, especially its rivers. Fish are critical components at all levels of riverine food webs and some species such as barramundi are of great recreational and commercial significance.

Despite comprising only 2.2% of the area of the Northern Territory, estuaries are major repositories of biodiversity; 40% of all fishes recorded from the Northern Territory occur in estuaries and 33% of all northern Australian freshwater fishes require access to estuaries to breed. Estuaries are vital nursery areas for many fish species including many that are of economic importance. Importantly, northern Australian estuaries are in overwhelmingly good ecological condition, in stark contrast to elsewhere.

Kakadu National Park is unique in that it contains several rivers in their entirety; a level of riverine protection no other national park in northern Australia can boast. This research found 338 species of teleost or bony fish in Kakadu, of which 276 occur in estuarine habitats. This equates to over half the estuarine bony fish species of the Northern Territory and over a third of all freshwater teleosts fishes recorded from northern Australia. Although Kakadu National Park comprises less than 3% of the area of northern Australia, it contains a disproportionately large fraction of the region's fish diversity.

Weeds, feral animals and inappropriate fire regimes put the long-term maintenance of this diversity at risk and climate change, especially sea level rise, poses a potential future threat. This project, funded under the Northern Australia Hub of the Australian Government's National Environmental Research Program, undertook an in depth inventory of fishes within Kakadu, including beam trawl and plankton trawl sampling for fish in both wet and dry seasons in 2012 (photo above shows a wet season trawl sample). Previous surveys have only used beam trawls in the dry season.

A beam trawl was used to collect samples - Photo by Michael Pusey.

What did the project find?

Seventy six different fish species were collected in the present study in Kakadu estuaries, including 26 species not previously recorded in the Park. The fact that so many new species were identified within Kakadu strongly suggests the fish biodiversity in Kakadu's estuaries remains to be fully characterised.

The estuarine fish found in Kakadu were distinctive, being only 60% similar in composition to Northern Territory rivers to the west and only 45% similar to rivers located to the east of Coburg Peninsula (e.g. Arnhem Land and Gulf of Carpentaria).

Most of the fish and over half of all species collected were collected as the juvenile form, reinforcing the importance of estuaries as nursery areas. Twenty six families of fish were recorded. The most biodiverse were Engraulidae (anchovies - 12 taxa), Gobiidae (gobies - 11 taxa), Sciaenidae (croakers - 8 taxa) and Ariidae (sea catfishes - 6 taxa). Croakers and anchovies contributed more than 75% of the total number of fish collected. Some of these fish are important recreational fishing species, while others are important in the diet of recreational and commercial fisheries species like barramundi.

Seasonal comparisons

Despite only two families dominating the catches, the project detected significant differences between the fish present in the wet and dry seasons. Of the 76 unique fish taxa recorded, 56 were recorded during the wet season and only 40 during the dry season. Of these, 28 species were recorded exclusively from the wet season and 14 exclusively from the dry. These results reveal that studies aimed at quantifying estuarine diversity and characterising ecological processes require sampling across all seasons.

More fish were collected during the wet season than the dry season. While all samples were highly variable, wet season samples were more variable in terms of species composition and abundance. Such highly variable catches pose a significant challenge for the development of effective monitoring programs.

During the wet season, beam trawls collected large numbers of small crabs, prawns, and jellyfish including the box jellyfish Chironex fleckeri, and plankton trawls found very high numbers of planktonic crustaceans as well as the larvae of a variety of crustacean and fish species. In contrast, during the dry season both plankton and beam trawls lacked this abundant variety of organisms and larval fish and crustaceans.

The estuary appears to be highly productive during the wet season. Primary production in the water column of the lower estuary was high during the wet season despite high turbidity. Other NERP research has found that nutrients and energy derived from adjacent floodplains are important in fuelling this productivity; another example of the importance of floodplain/estuarine linkages for overall riverine productivity.

A complex environment

Physical conditions in the South Alligator River estuary change greatly due to seasonal flows from upstream and tides. During the dry season, when freshwater input is minimal, most of the estuary is brackish or saline for its entire length. However during the wet season the water in the middle and upper reaches of the estuary may be almost fresh during the outgoing tidal phase, and fish have to adjust to hourly changes in salinity. These conditions influence the fishes present and distinct zonal differences were detected within the estuary.

Nursery fish *Kurtus gulliveri* is one of the species caught almost entirely in the dry season - Photo by Brad Pusey.

Beam trawling over hundreds of metres of substrate collected more fish species and individuals compared to when the trawl net was held in place (i.e. tidal current only passing through the net), nonetheless this method also collected many fish. Tidal velocities are so extreme that many small estuarine fishes (especially recently metamorphosed juveniles) wash back and forth with the tides. This behaviour may reduce the salinity variation that small fish experience. They are, however, travelling over a variety of habitat types making detection of relationships with other species or particular habitats difficult.

Paperhead croaker (*Johnius novaeguineae*) is one of the species collected almost entirely in the wet season only - Photo by Brad Pusey.

Fish taxa recorded from the estuary of the South Alligator River using beam trawls (BT) during the wet season (W) and dry season (D) of 2012. Also listed are fish taxa collected by other incidental sampling methods (O). Taxa of uncertain identification (likely comprising more than one species from the same family) are indicated by *.

		BT		O			BT		O
Taxon	**Common name**	W	D		**Taxon**	**Common name**	W	D	
Engraulidae	**Anchovies**				**Soleidae**	**Soles**			
Setipinna tenuilfilis	Common hairfin anchovy	x	x		*Paradicula setifer*	Paradise's sole	x		
Thryssa aestuaria	Estuary anchovy	x			*Phillichthys sclerolepis*	Harescale sole	x		
Thryssa spp.? *		x	x		*Brachirus* sp.			x	
Thryssa brevicauda	Shortta ed anchovy	x	x		*Leptachirus* sp.			x	
Thryssa setirostris	Longjaw thryssa	x			*Rendahlia jaubertensis*			x	
Thryssa baelama (?)	Little pr est	x			**Clupeidae**	**Herrings**			
Thryssa hamiltoni	Hamilton s thryssa	x			*Escualosa thoracata*	Wh te sard ne	x	x	
Thryssa marasriae		x			Clupeid spp.? *		x		
Stolephorus brachycephalus	Broadhead anchovy	x	x		Herklotichthys sp.		x		
Papuaengraulis micropinna	Bareback anchovy	x	x		**Carangidae**	**Trevally**			
Engrau id spp.? *		x	x		*Alepes apercna*		x		
Stolephorus sp. 1		x	x		*Alepes cf melanoptera*	Blackfin scad	x		
Gobiidae	**Gobies**				*Alepes* spp.? *		x	x	
Caragobius rubristriatus	Red ee goby	x	x		**Tetradontidae**	**Puffers**			
Oxuderces wirzi	Peacock mudskipper	x			*Marilyna meraukensis*	Fine spine pufferfish	x	x	x
Periopthalmus darwini	Darwin's mudskipper	x			*Chelonodon patoca*	Milk spot toadfish	x		
Periopthalmus novaguineaensis	New Gu nea mudskipper	x			*Lagocephalus* sp.			x	
Perophthalmus takita				x	**Leiognathidae**	**Ponyfish**			
Boleopthalmus birdsongi	Birdsong's mudskipper	x			*Leiognathis* spp.? *		x		
Boleopthalmus cearuleamaculata	Bluespotted mudskipper			x	*Leiognathis equulus*	Common Ponyfish	x		
Boleopthalmus sp.			x		*Nuchequula gerreoides*	Black neck ponyfish	x		
Favonigobius			x		**Mugilidae**	**Mullet**			
Gobiidae spp.? *			x		Mugilidae sp.		x		x
Egglestonichthys ulbubuniti			x		*Rhinomugil nasutus*	Popeye mullet			x
Sciaenidae	**Croakers**				**Ephippidae**	**Scats**			
Austronibea oedogenys	yellowtail croaker	x	x		*Rhinoprenes pentanemus*	Threadfin scat	x	x	
Johnius australis	Little jewfish	x	x		*Zabidius novamaculeatus*	Shortfin batfish	x		
Johnius novaeguineae	Paperhead croaker	x	x		**Ambassidae**	**Glassfish**			
Otolithes ruber	Silver teraglin	x			*Ambassis interrupta*		x	x	
Nibea microgenys			x		*Ambassis nalua*		x		
Nibea soldado	Silver jewfish	x	x		**Eleotridae**	**Gudgeons**			
Sciaen d sp. A		x	x		*Prionobutis microps*	Small eyed gudgeon	x		
Sciaenic sp. (4 bars)		x			**Leptobramidae**	**Beach salmon**			
Ariidae	**Catfishes**				*Leptobrama muelleri*	Beach sa mon		x	x
Hemapteryx armiger		x	x	x	**Latidae**	**Sea perch**			
Hemiarius dioctes	Warrior catfish	x		x	*Lates calcarifer*	Barramundi	x		x
Hemiarius 'insidiator'	Flat cat sh	x			**Kurtidae**	**Nursery fish**			
Netuma proxima	Arafura catfish			x	*Kurtus gulliveri*		x	x	
Cinetodus froggatti	Small mouthed catfish	x			**Trichiuridae**	**Hairtail**			
Hexanamatichthys mastersi				x	*Lepturacanthus savala*		x	x	
Polynemidae	**Threadfins**				**Synodontidae**	**Lizard fishes**			
Polydactylus mulitradiatus	Austra an threadfin	x			*Harpadon translucens*	Glassy Bombay Duck	x	x	
Polydactylus macrochir	King salmon	x		x	**Callionymidae**	**Dragonets**			
Polydactylus nigripinnis			x		*Repomucenus macdonaldi*	Grey-spotted dragonet	x		
Eleutheronema tetradactylum	Blue salmon	x	x	x	**Apistidae**	**Waspfish**			
Parapolynemus verekeri	Streamer threadfin	x	x		*Cheroscorpaena tridactyla*	Humpback waspfish	x	x	
Cynoglossidae	**Tonguefishes**				**Hemiramphidae**	**Gars**			
Cynoglossus heterolepis	Freshwater tongue so e	x	x		*Zenarchopterus caudavittatus*	Longjaw r ver garfish			x
Cynoglossus kopsii	Long snouted sole	x	x		**Plotosidae**	**Eel-tailedCatfish**			
Cynoglossus cf *maculipinnis*		x	x		*Euristhmus microphthalmus*			x	
Paraplagusia longirostrus			x		**Apogonidae**	**Cardinal fish**			
Paraplagusia sinerama		x	x		*Siphamia rosigasta*			x	
					Bothidae	**Left-eye flounder**			
					Bothidae sp.			x	

Challenges for future management

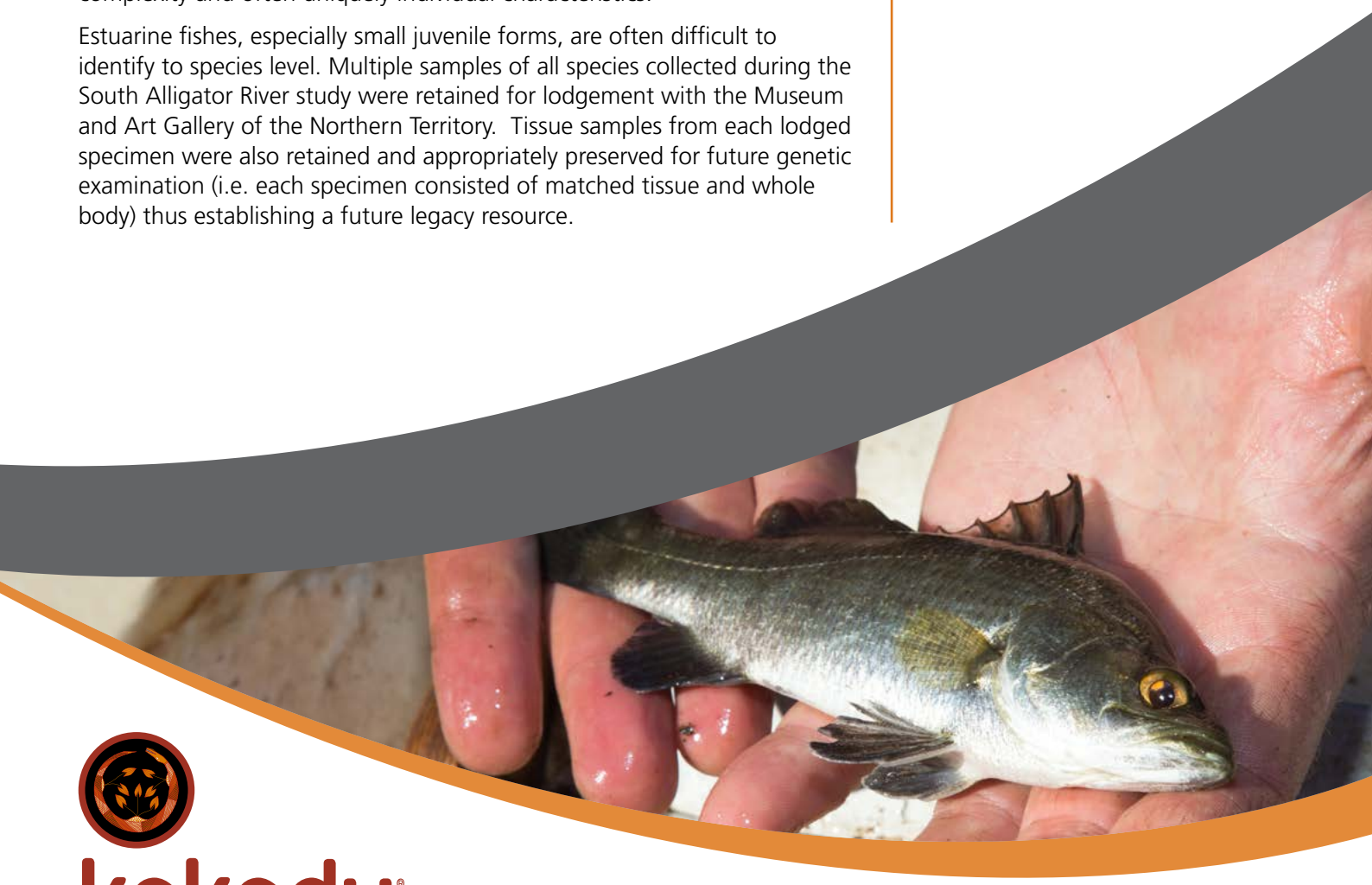
The high variability observed between seasons and even across habitats poses a challenge for both the design of monitoring programs and the ability to predict the impacts of many changes. Monitoring programs are useful only when they can detect changes beyond the natural level of variation present. Estuaries are notoriously difficult environments in which to implement rigorous monitoring programs due to their innate variability, complexity and often uniquely individual characteristics.

Estuarine fishes, especially small juvenile forms, are often difficult to identify to species level. Multiple samples of all species collected during the South Alligator River study were retained for lodgement with the Museum and Art Gallery of the Northern Territory. Tissue samples from each lodged specimen were also retained and appropriately preserved for future genetic examination (i.e. each specimen consisted of matched tissue and whole body) thus establishing a future legacy resource.

Further information

Contact Brad Pusey at bpusey@westnet.com.au

You can also visit http://www.nerpnorthern.edu.au/research/projects/33



kakadu NATIONAL PARK

MUSEUM AND ART GALLERY NORTHERN TERRITORY

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Email: nerp.northern@cdu.edu.au *Phone: 08 8946 6761*

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