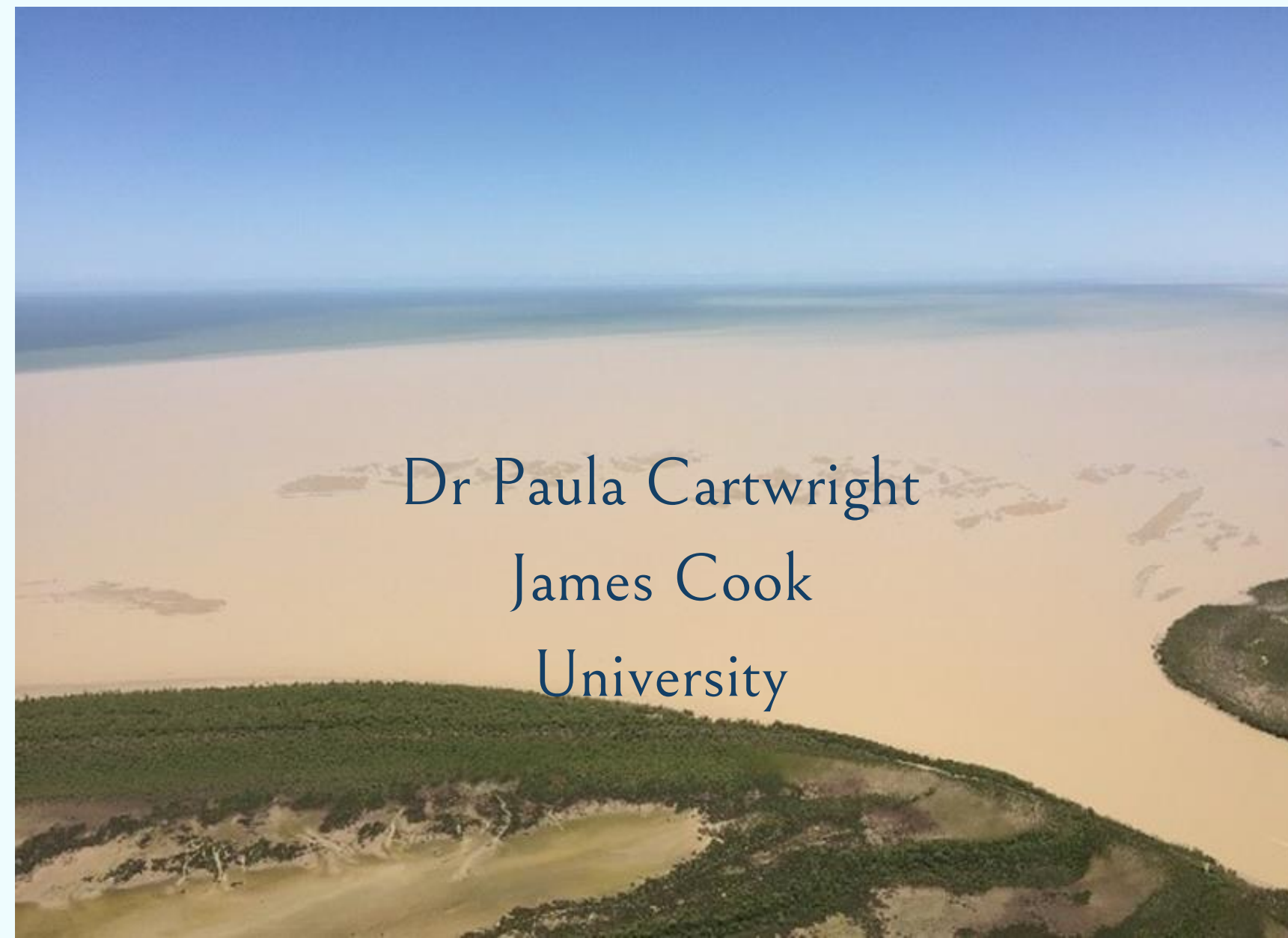


WET SEASON SEDIMENT PLUME DISTRIBUTION ACROSS NORTHERN AUSTRALIA; PRIMARY PRODUCTIVITY AND CLIMATE CHANGE.



Dr Paula Cartwright
James Cook
University



AUSTRALIA'S LARGE RIVER CATCHMENTS

MURRAY-DARLING BASIN (1,000,000 KM²)



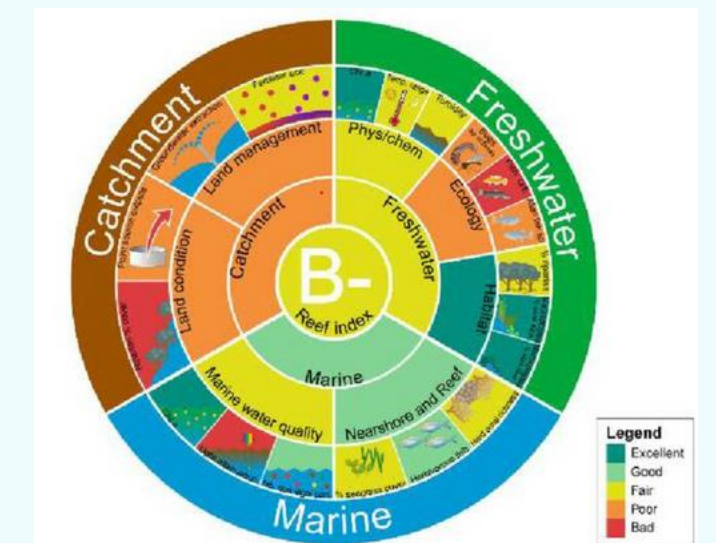
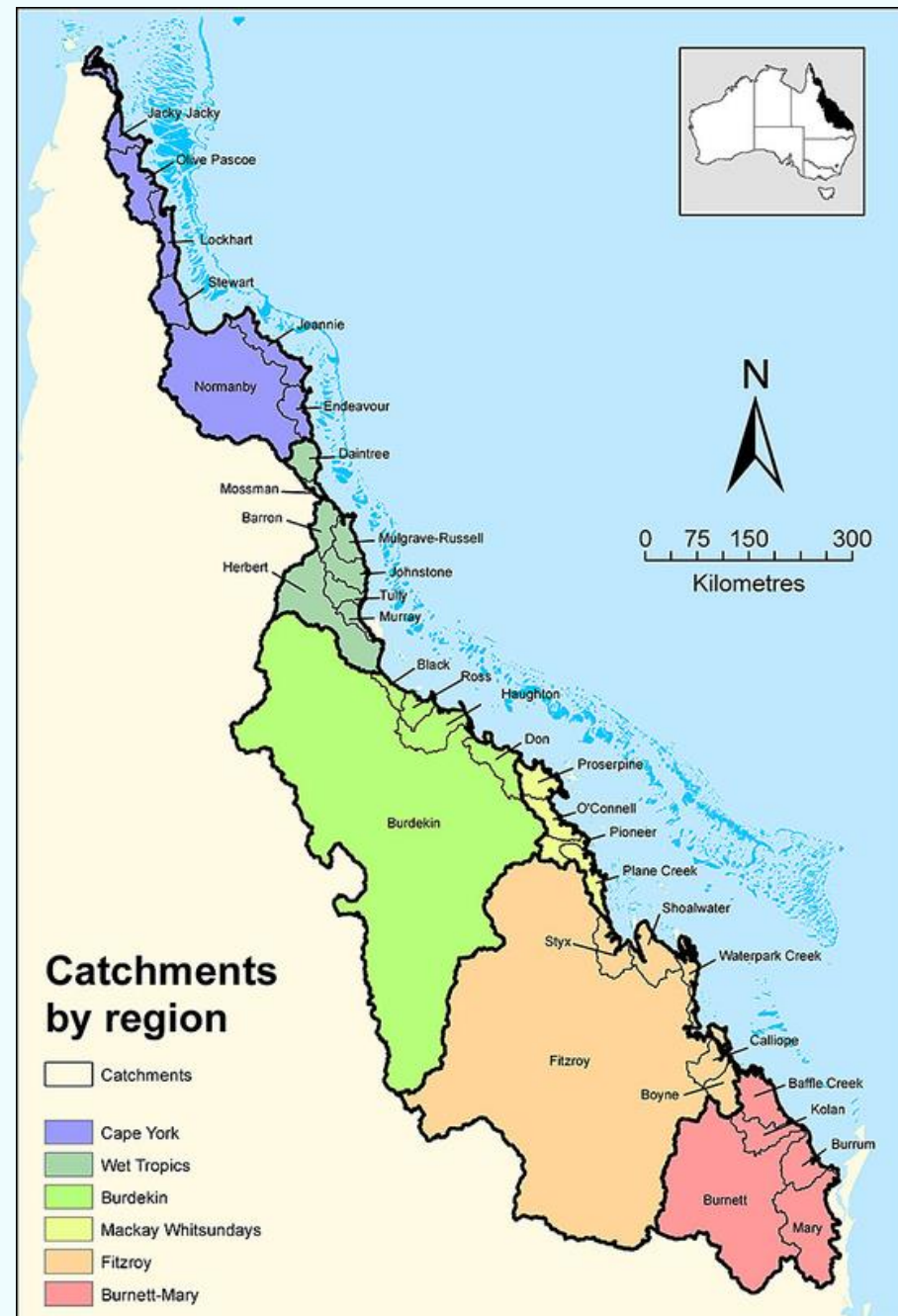
- **WATER OVER-ALLOCATION, DEGRADED ECOSYSTEMS, \$13B MISMANAGEMENT**
- **MARINE RECEIVING ENVIRONMENT CURRENTLY EXPERIENCING WORST HARMFUL ALGAL BLOOM IN HISTORY**



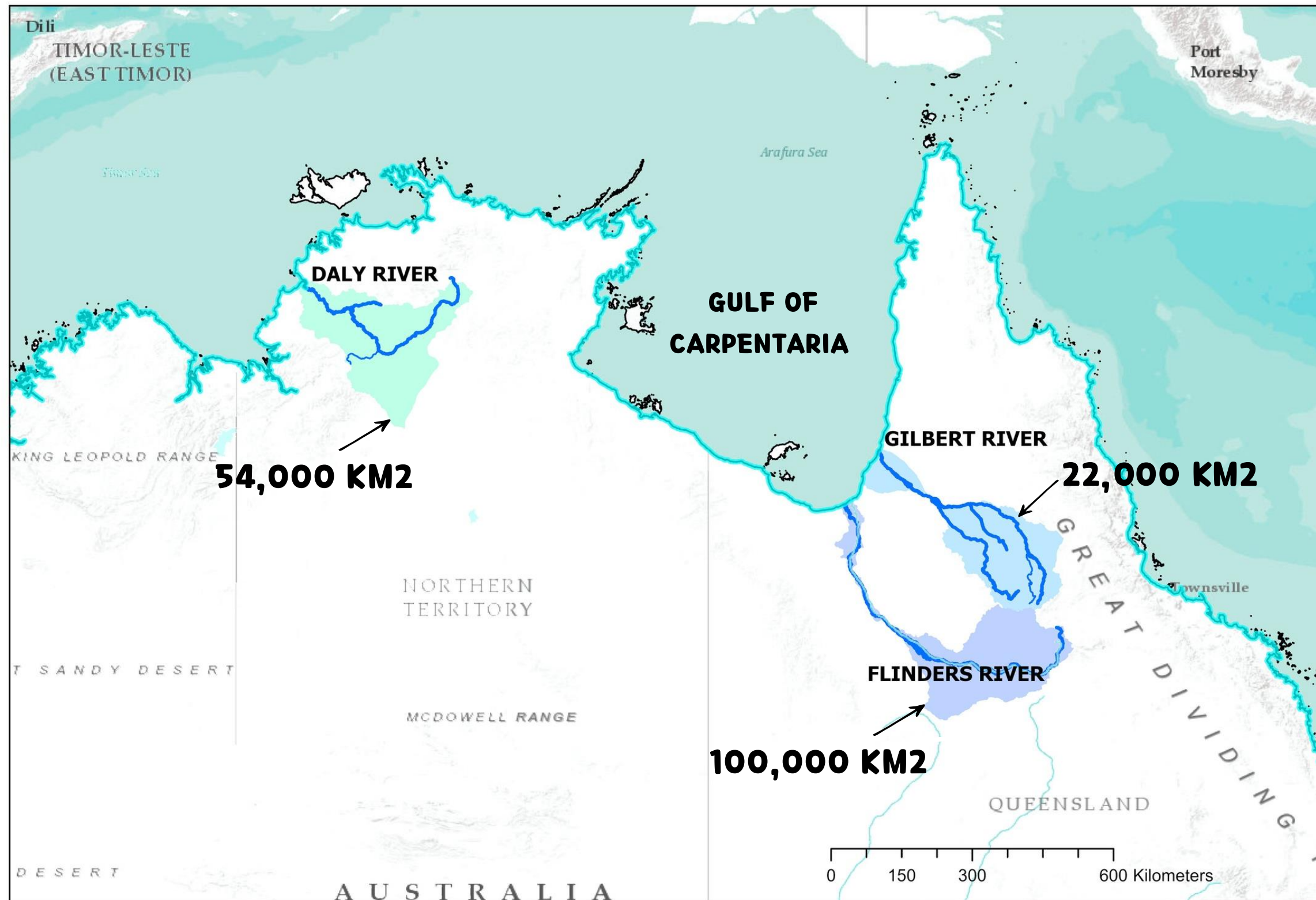
AUSTRALIA'S LARGE RIVER CATCHMENTS

GREAT BARRIER REEF COASTLINE CATCHMENTS: 423,000 KM2)

- **DEGRADED WATER QUALITY TO THE GREAT BARRIER REEF**
- **AGRICULTURAL RUN-OFF: NUTRIFICATION**
- **\$500 MILLION IN LAST FIVE YEARS TO IMPROVE WATER QUALITY HAS HAD LITTLE EFFECT**



NORTHERN AUSTRALIA'S RIVERS

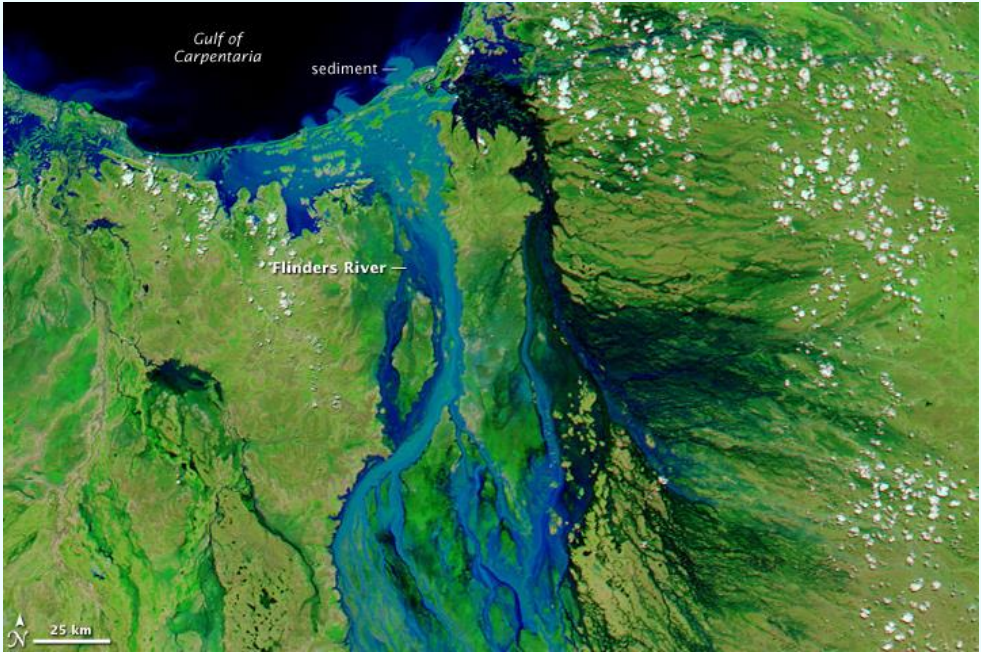


- **AMONG THE MOST INTACT GLOBALLY**
- **HOME TO SIGNIFICANT BIODIVERSITY AND INDIGENOUS CULTURAL HERITAGE**
- **INCREASING PRESSURE FROM AGRICULTURE AND MINING**

NORTHERN AUSTRALIA'S RIVERS – DRY SEASON

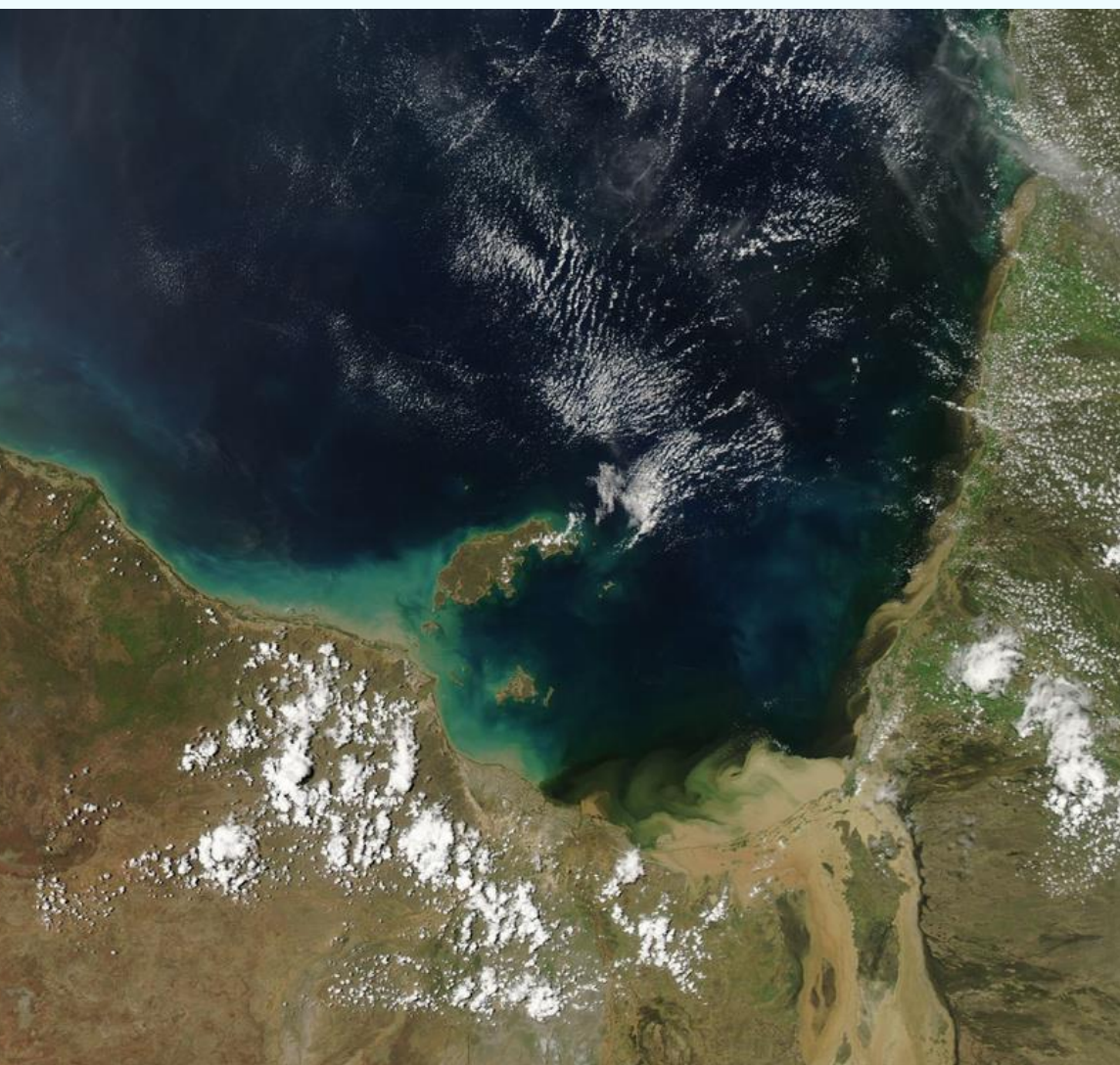


NORTHERN AUSTRALIA'S RIVERS – WET SEASON

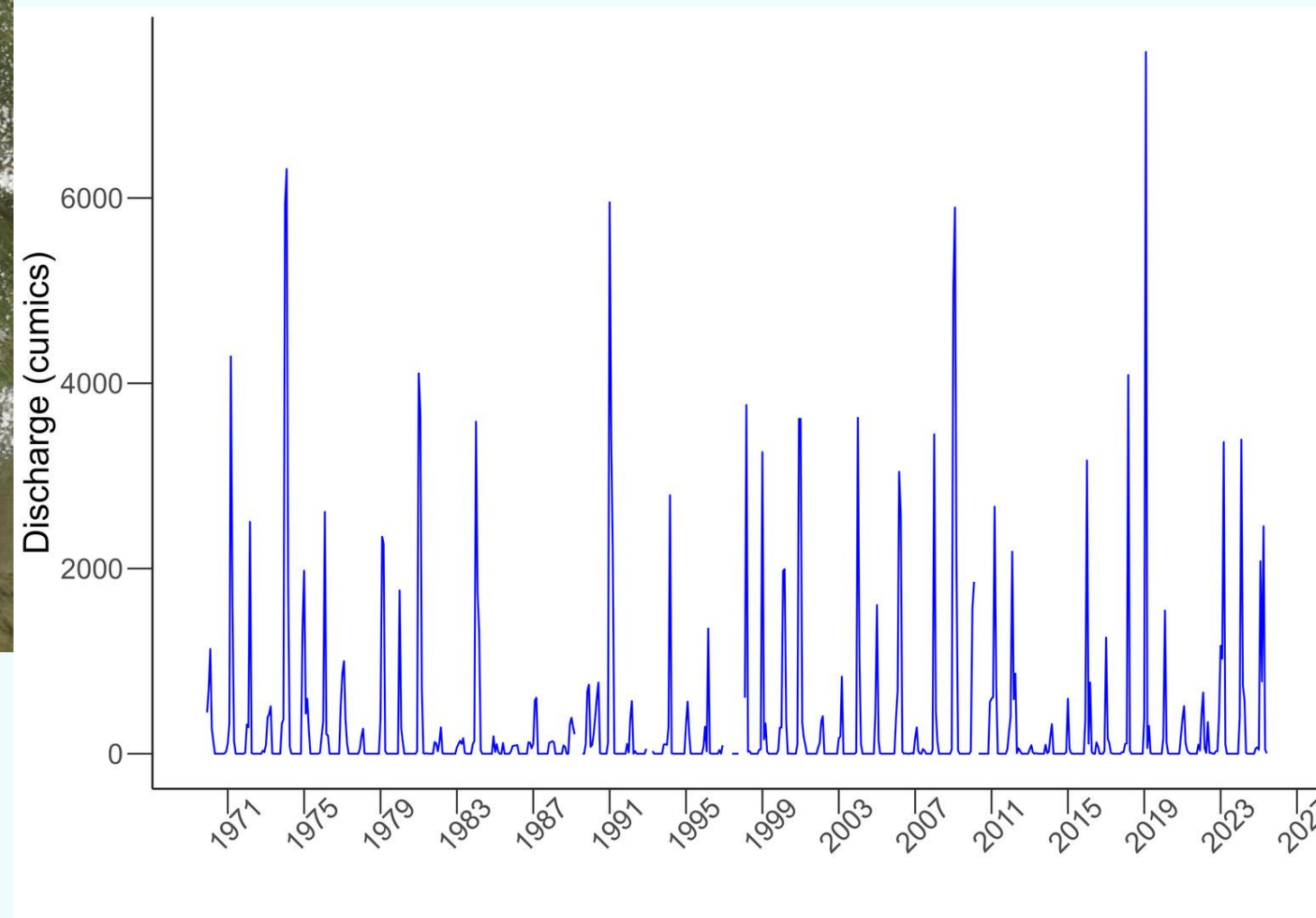


WHAT HAPPENS DURING WET SEASON FLOODING

- Rivers overflow onto floodplains and into estuaries
- Massive flood plumes extend into the sea
- Rainfall highly variable between wet seasons



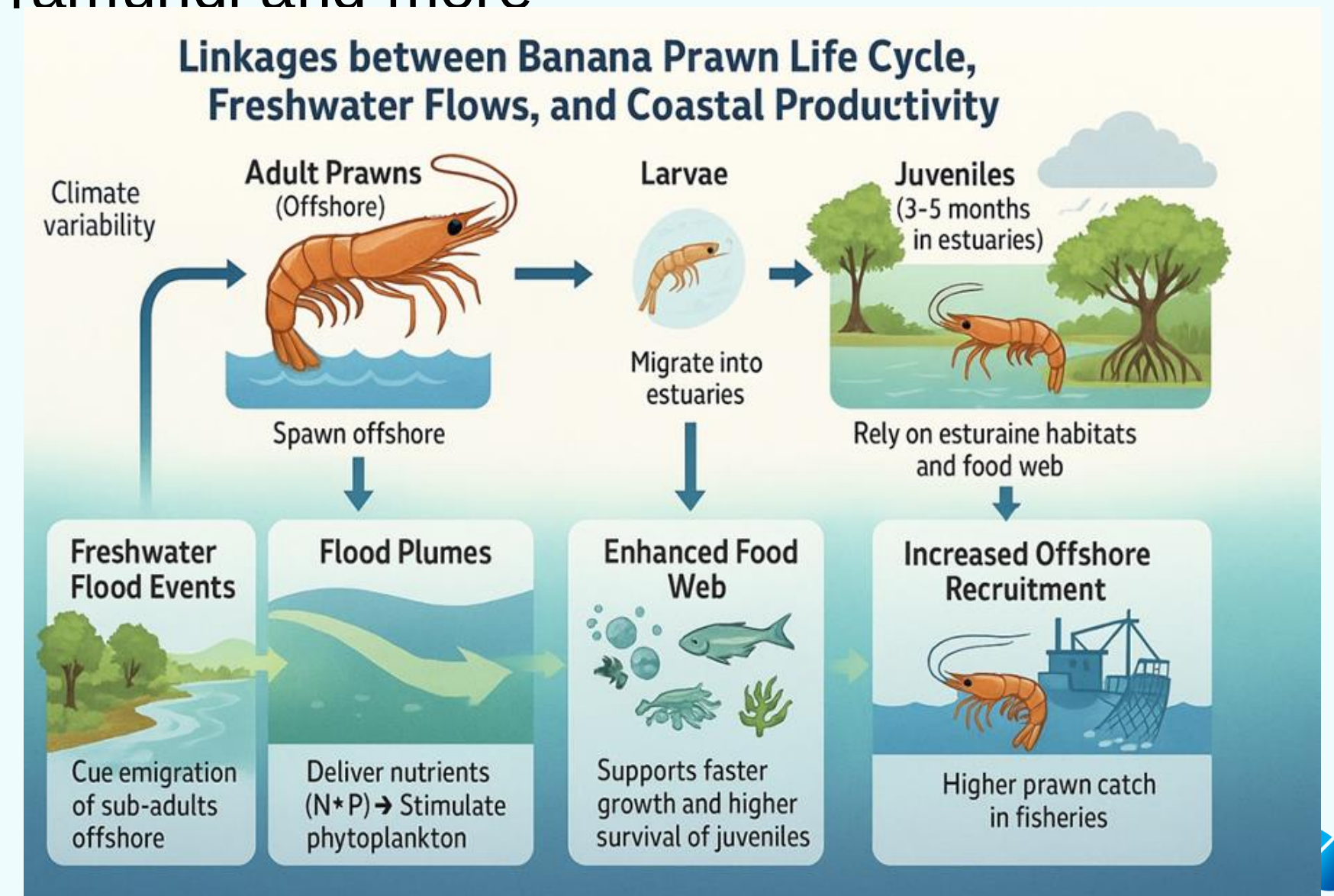
2019



2015

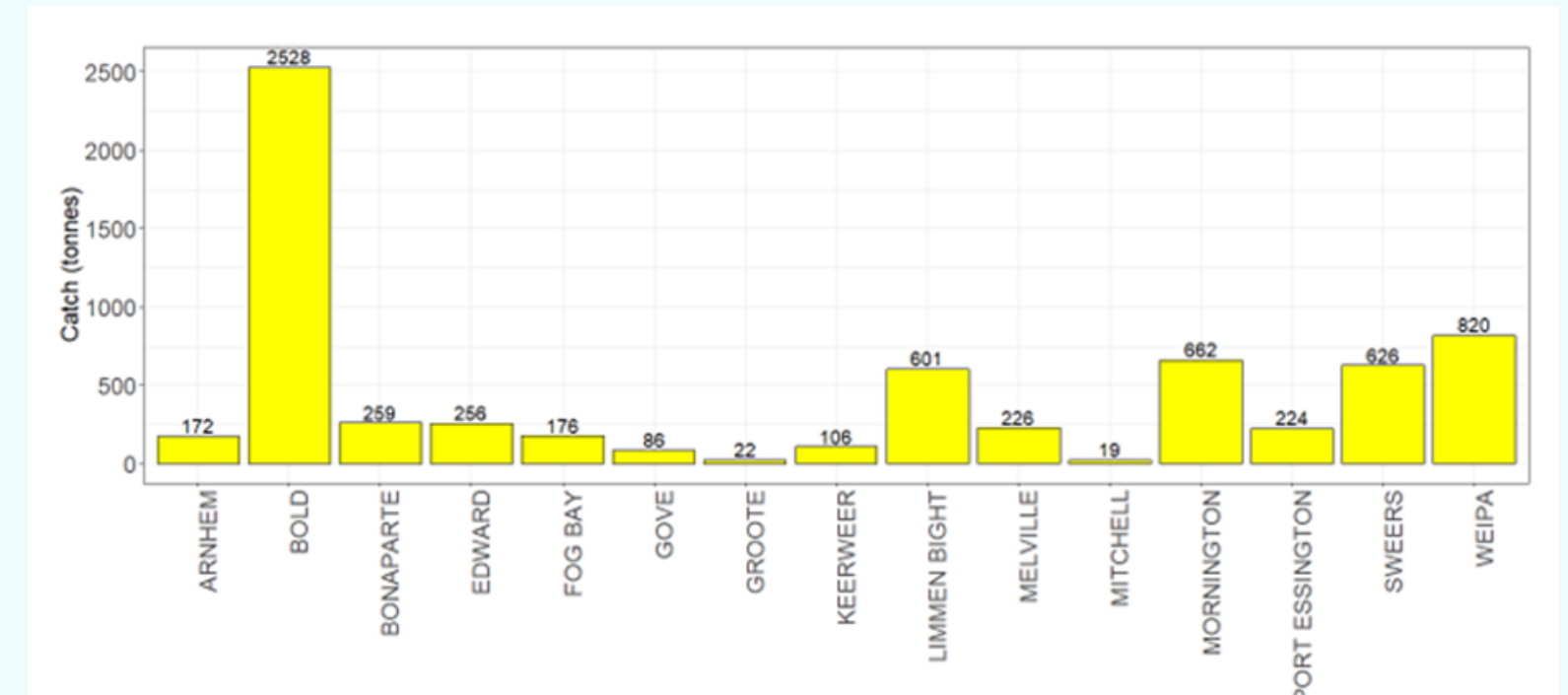
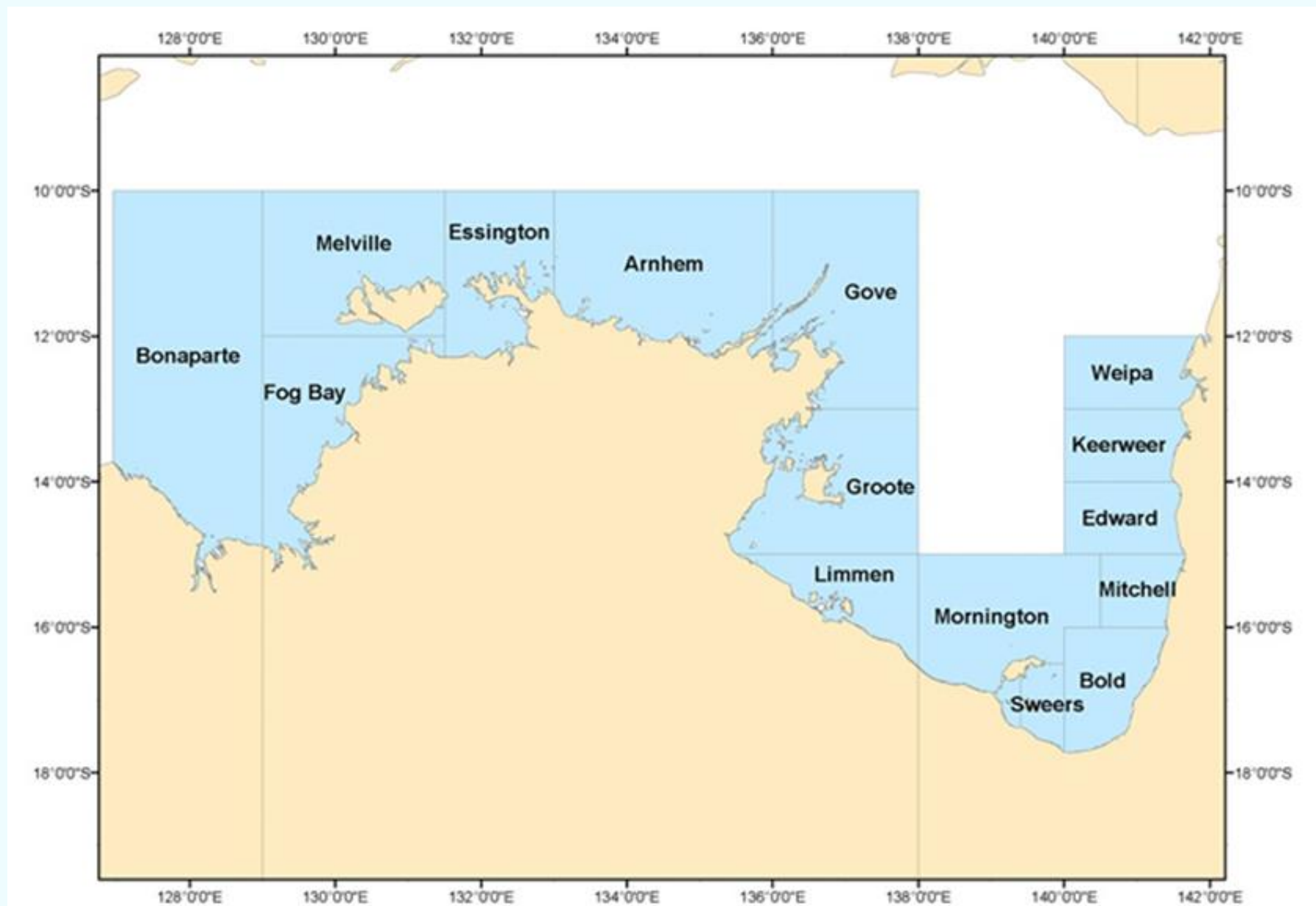
ECOLOGICAL IMPORTANCE OF FLOODPLAINS AND PLUMES TO THE GULF OF CARPENATRIA

- Deliver nutrients → fuel phytoplankton → feed fisheries → migratory birds
- Enhance seagrass and mangrove health
- Nursery habitat for banana prawns, barramundi and more



FISHERIES DEPENDENCE – THE BOLD FISHERY

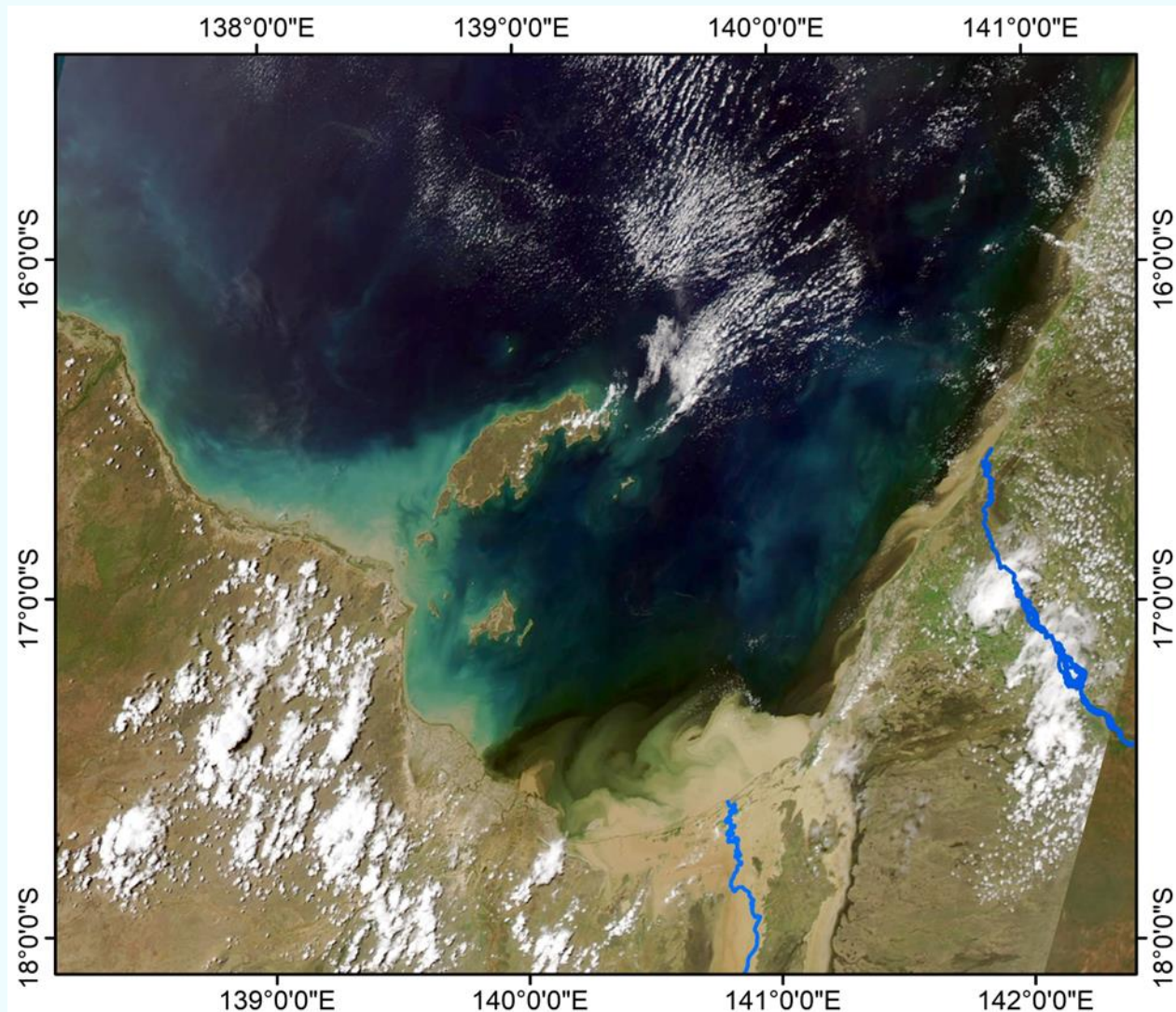
- Gulf prawn fishery = Australia's highest-value fishery
- Bold region (Flinders/Gilbert) outperforms other NPF zones (65–200% more catch)
- Plumes likely 'trap' nutrients in shallow Gulf head



Flood Plume Mapping in the Gulf of Carpentaria

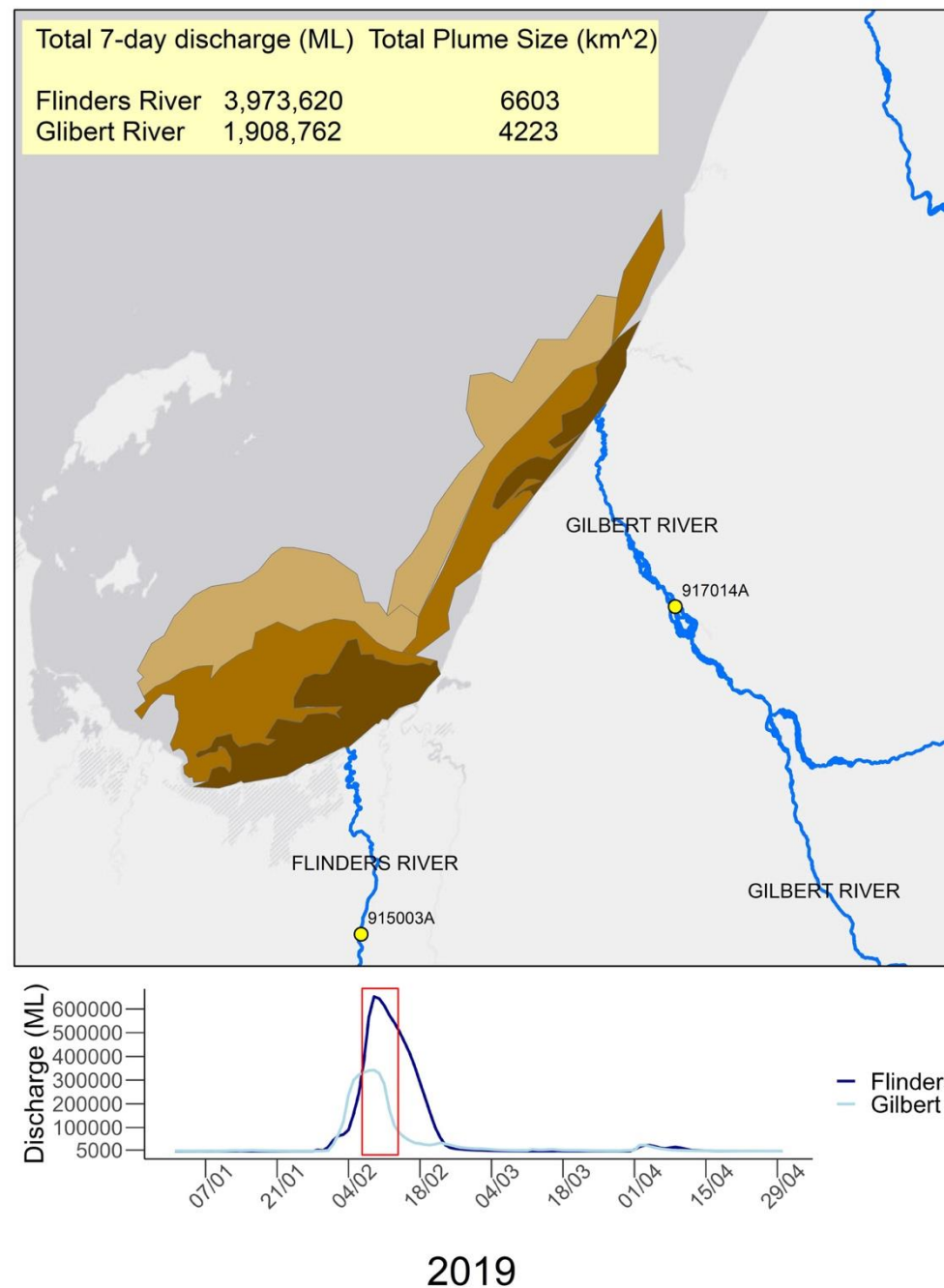
Study objectives

1. Quantify how wet season flood events contribute to plume size in the marine receiving environment?
2. Quantify how wet season flood events contribute to primary productivity in the marine receiving environment?
3. Assess how climate change might affect flood plume extent and primary productivity

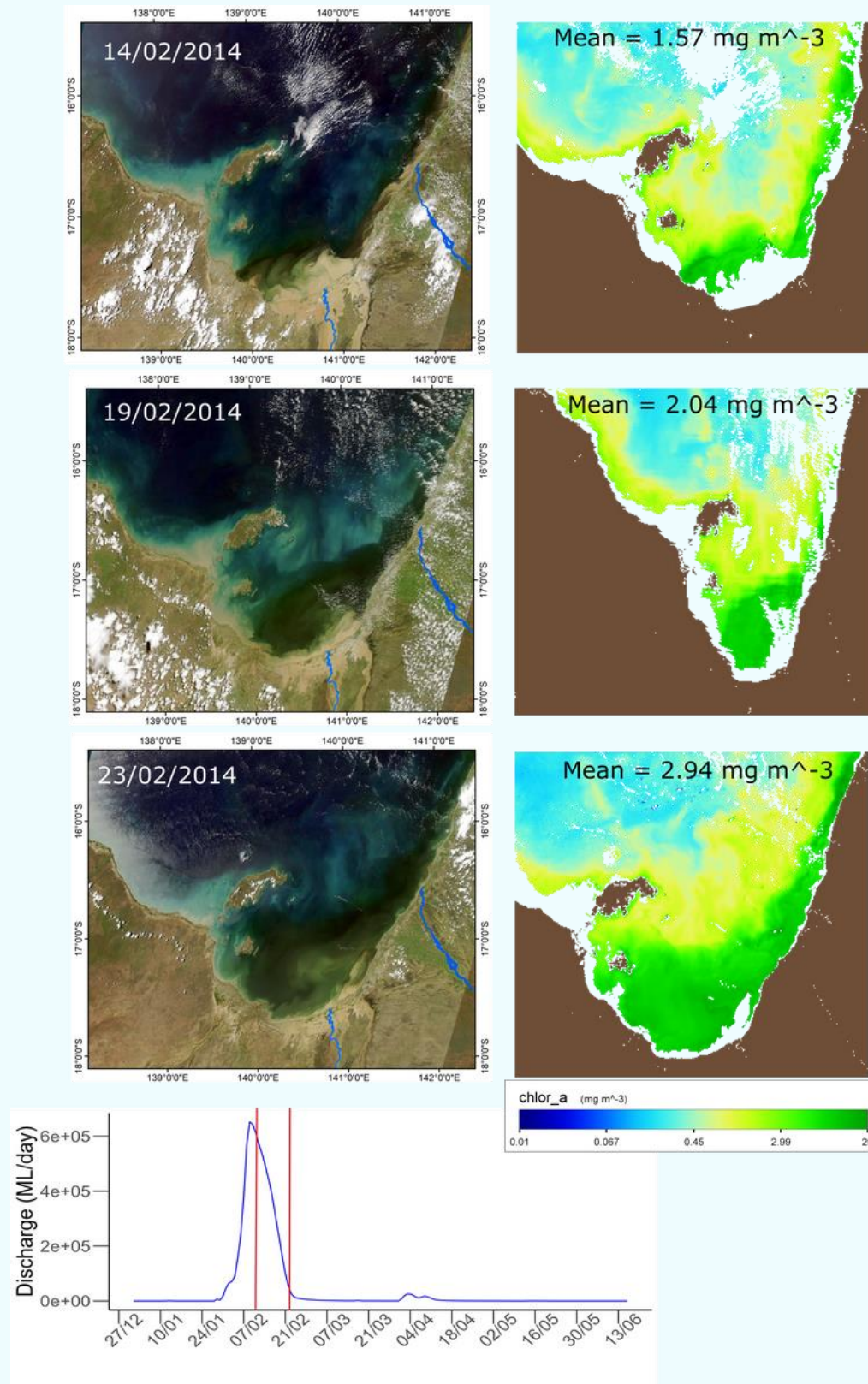


RIVER FLOWS & PLUME SIZE

- MODIS satellite data 2003–2023 following peak flood events each year - measured plume
- Strong correlation: 7-day flow and flood plume size ($r = 0.86$)
- Calculated regression model i.e., Gilbert plume size (sq km) = $436.4 + 0.0017 * 7\text{-day flow (ML)}$



RIVER FLOWS & PRODUCTIVITY



- Tertiary plume size and chlorophyll-a, r-squared = 0.38, 0.52 and 0.72 respectively (Flinders, Daly, Gilbert Rivers)
- Larger plumes = more chlorophyll-a = more productivity
- Chlorophyll-a increases as plume dissipates

CLIMATE CHANGE ADDS PRESSURE

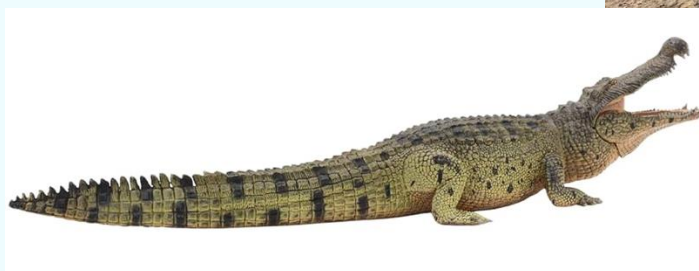
PRECIPITATION ANOMALIES (2077–2099)

SP5-8.5											
	Ann	SD	JFM	SD	AMJ	SD	JAS	SD	OND	SD	
CESM2-WACCM	-277	21	-210	15	-19	5	3	10	-59	3	-22.5
FGOALS-G3	-117	61	-75	36	-13	13	1	2	-37	6	-14
INM-CM5-0	62	68	93	8	-19	3	-14	2	30	22	6.9
ACCESS-CM2	-119	13	-56	13	-39	7	-20	5	-6	3	-30
MRI-ESM2-0	15	22	61	33	-32	10	-11	1	-21	8	4.7
NorESM2-MM	-239	25	-43	11	-9	4	-23	7	-145	18	-22.6
Ensemble	-112	35	-38	19	-22	7	-11	5	-40	10	-13.8

- Projections suggest reduced wet-season rainfall, extended dry seasons
- Regression model shows reduction in flood plumes up to 448 km²
- Smaller plumes equals reduced productivity, reduced fisheries, ecosystem services

POLICY CONTEXT — WHAT'S AT STAKE

- Queensland's Gulf Water Plan currently under review
- Major opportunity for this and other research to be incorporated
- Call to recognise floodwaters as ecosystem infrastructure (not wasted water to be captured).



RELATED PUBLICATIONS

Technical report – Project 3.4



Better management of catchment runoff to marine receiving environments in northern Australia

Burford MA, Waltham N, Irvine D, Cartwright P, Brooks A, Faggotter SJ (2024). Better management of catchment runoff to marine receiving environments in northern Australia. Report to the Reef and Rainforest Research Centre, Cairns, Queensland.



Scholar articles

The effect of wet season river flows on flood plume distribution across northern Australia; contribution to coastal productivity, and future extent under climate change

P Cartwright, A Genson, N Waltham - Regional Studies in Marine Science, 2025