Identifying water quality and ecosystem health threats to the Torres Strait from runoff of the Fly River

Torres Strait *is a culturally unique area with a wet tropical climate. Seasons are: 1. Dry season/**SE trade winds** (May–Oct*), 2. Transition/ Winds backing N (Nov–Dec), 3. Wet season/**NW monsoon** (Jan–April*).*

Several rivers drain the southern PNG margin, including the Fly River, the 17th largest river worldwide. River sediment loads and pollutant loads from PNG to the Torres Strait area have increased since the 19th century.

This project aimed to provide greater certainty of the extent and frequency of the influence of runoff from the Fly River on important marine ecosystems and communities in the Torres Strait.

Zone 3 — North west (NW)

(Boigu, Saibai)

Fly River

Evidence

- Lower field salinity and higher salinity ranges measured. Historically, extensive salinity intrusion in August–September 1994.
- Modelling suggests that the influence of Fly River waters is a common occurrence during the SE trade wind season.
- Elevated trace metal concentrations in waters and sediments. Highest metal concentrations in waters and sediments detected in this zone.

On average (2008-2018)

- Exposure dominated by Primary (>10%) and Secondary waters (>80%). Primary waters were evident in most years in the monsoon season. This zone exhibited the greatest variability between years in the SE trade wind season.

Assessment

- ***Likely influence of Fly River waters at Saibai; potential influence of Fly River waters at Boigu.***
- ***Likely influence of southern PNG river waters (especially at Boigu).***

Zone 4 — North central (south) (NCS)

(Ugar, Masig)

Evidence

- Salinity measurements at Masig Island similar to average values for marine waters.
- At Masig Island, occasional reductions in salinity were measured in the trade wind seasons in 2016 and 2017. Comparison with the local rainfall data from the continuous loggers and satellite imagery, in addition to hydrodynamic modelling results, indicate that this may be influenced by the Fly River discharge.
- No evidence of elevated trace metal concentrations in waters and sediments.

On average (2008-2018)

- Exposure dominated by Tertiary waters (>50%) and to a lesser extent, Secondary waters (>19%). Very limited exposure to Primary waters, predominantly in the monsoon season. Greatest variability between years in the SE trade wind season.

Assessment

- ***Likely event-driven influence of Fly River waters in the SE trade wind season every few years.***

Water types *used in the exposure assessment are produced by reclassifying MODIS true-colour satellite imagery into three distinct types with characteristic combinations of optically active components — suspended sediment, coloured dissolved organic matter (CDOM) and chlorophyll-a.*

Primary waters are brownish-green waters typical of nearshore areas or inshore parts of river flood-plumes with higher suspended sediment concentrations.

Secondary waters are more greenish in appearance due to reduced suspended sediment and higher chlorophyll-a, and are typical of coastal waters or the mid-region of river plumes.

Tertiary waters are transitional, greenish-blue waters with slightly above ambient turbidity and CDOM concentrations.

Zone 1 — North central (NC) (Warrior Reef)

Evidence

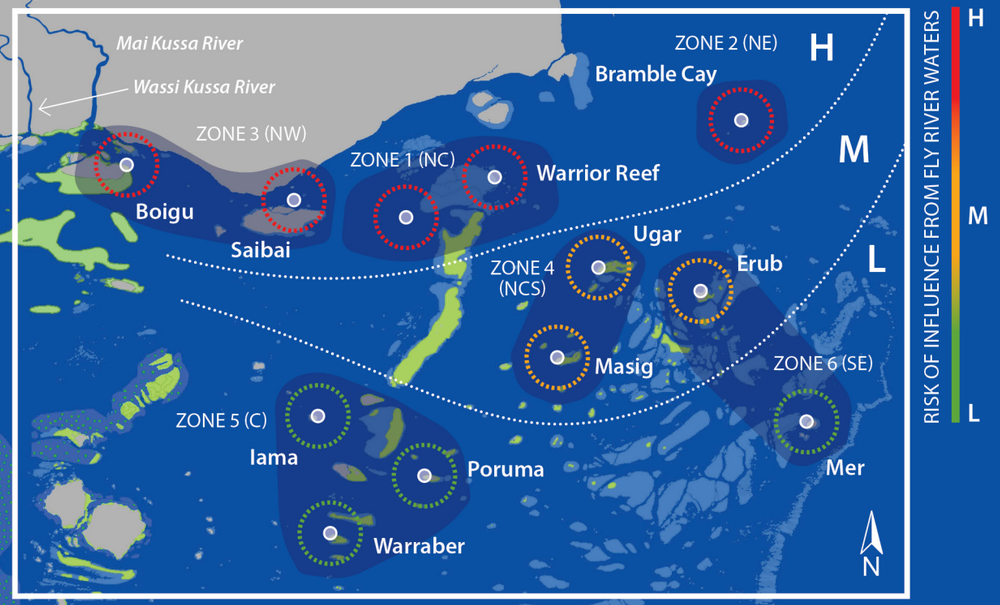
- Limited current field data available. Historical data (1994) shows evidence of Fly River influence. Modelling suggests that the influence of Fly River waters is common during the SE trade wind season.
- Preliminary sampling of seagrass metals suggests that levels are similar to those in unpolluted areas.
- Limited evidence of elevated trace metal concentrations in benthic sediments. Slightly elevated metal concentrations in waters and suspended sediments.

On average (2008-2018)

- Exposure dominated by Secondary waters (>50% of the time), and Tertiary waters (>36%). Some exposure to Primary waters in the monsoon season in most years, and occasionally in the SE trade wind season.

Assessment

- ***Very likely periodic influence of Fly River waters during the SE trade wind season.***



Zone 5 — Central (C)

(Iama, Warraber, Poruma)

Evidence

- Highest mean salinities and lowest salinity ranges were measured at these sites.
- No evidence of elevated trace metal concentrations in waters and sediments.

On average (2008-2018)

- Exposure dominated by Secondary waters, particularly in the monsoon season, and Tertiary waters in the SE trade wind season. Some limited exposure to Primary waters in some years, particularly in the monsoon season.

Assessment

- ***Likely no influence from the Fly River waters.***

Zone 2 — North east (NE) (Bramble Cay)

Evidence

- Coral cores showed freshwater influence and several pulses of freshwater each year (1781-1993).
- Higher than expected levels of field turbidity and exposure to satellite turbid waters for a remote offshore reef. Time-series of salinity data in August-September 1994 show the Fly River plume readily reaching Bramble for several months at low salinity.
- Episodic turbidity events are evident that cannot be linked to in-situ processes and may represent Fly River impacts.
- No evidence of elevated trace metals in benthic sediments. Slightly elevated dissolved copper and elevated suspended sediment associated copper concentrations detected at this site.

On average (2008-2018)

- Exposure dominated by Tertiary (38%) and marine waters (34%) and to a lesser extent, Secondary waters (26%). Limited exposure to Primary waters in some years, predominantly in the monsoon season. Patterns between seasons and between years are reasonably consistent.

Assessment

- ***Regular "pulses" of Fly River waters potentially driven by wind intensity and direction (inter-annual variability) with higher chance of exposure during periods of intense SE trade winds.***

Zone 6 — South east (SE) (Erub, Mer)

Evidence

- Coral cores showed no freshwater influence at Erub.
- There was insufficient salinity data collected at Erub at the time of reporting.
- Modelling indicates occasional intrusion of Fly River waters.
- No evidence of elevated trace metal concentrations in waters and sediments.

On average (2008-2018)

- Exposure dominated by Secondary waters, particularly in the monsoon season, and Tertiary waters in the SE trade wind season. Some limited exposure to Primary waters in some years, particularly in the monsoon season.

Assessment

- ***Influence of Fly River waters unlikely to be significant at Mer Island, but further investigation is required at Erub Island due to modelling results and proximity to Zone 4.***

* For the exposure assessment, data for the NW monsoon season are from Feb-Mar and for the SE trade wind season from Jul-Aug.

Citation: Waterhouse, J., Apte, S., Brodie, J., Hunter, C., Petus, C., Bainbridge, S., Wolanski, E., Dafforn, K.A., Lough, J., Tracey, D., Johnson, J.E., Angel, B., Jarolimek, C.V., Chariton, A.A., Murphy, N. (2018). *Identifying water quality and ecosystem health threats to the Torres Strait and Far Northern GBR from runoff of the Fly River: Synthesis Report for NESP Project 2.2.1 and NESP Project 2.2.2.* Report to the National Environmental Science Programme. Reef and Rainforest Research Centre Limited, Cairns.