

Briefing Note # 9

Ocean20: Freshwater Flowing into the Ocean is not Wasted

Key Recommendations:

1. Recognise that the provision of freshwater to the marine environment is a shared mandate between the lead agencies mandated to regulate water, fisheries and the environment.
2. Formally incorporate marine environmental flow requirements into water resources allocation processes.
3. Develop new legislation and resource management tools under environmental legislation to secure coastal ecosystem integrity, processes and fisheries resources, and ensure cumulative impacts are considered when decisions on freshwater flow are made.
4. Address shortfalls in existing water resource allocation processes that fail to account for marine and coastal flow requirements (water quantity, quality and sediment loads).
5. Prioritise research funding to address critical knowledge gaps on linkages between aquatic systems, with consideration of international opportunities.
6. Further scientific research and capacity enhancement opportunities to expand global understanding of the impacts of freshwater reduction on the coast.

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Ocean20: Freshwater Flowing into the Ocean is not Wasted

1. Recognise the importance of freshwater flows to the marine environment

Freshwater flowing from rivers and groundwater into the sea is not wasted, and is essential for coastal and marine food production, livelihoods, tourism and future climate resilience. Adequate freshwater and sediment inputs play a key role in the functioning and health of marine and coastal ecosystems and in ensuring productive fisheries. Freshwater flows to the sea maintain important physical habitats (e.g., beaches and subtidal mudbanks); provide nutrients and detritus to coastal food webs; and support important ecological processes.

Freshwater inputs are essential not only for water but also for the sediment and nutrients they provide. Fluvial sediments transported to the coast are critical for ensuring healthy beaches and dunes, as well as creating offshore muddy habitats that support key fisheries. For example, within South Africa, sediment delivery to the coast through rivers and estuaries, and the natural movement of sand across land and in the ocean surf and inner shelf zones has not been well managed. Many beaches and dunes are in a state of erosion, and in some places, beaches are being lost as they erode to bedrock. Extensive beach erosion has significantly compromised critical infrastructure (e.g., coastal roads and rail lines), residences (e.g., Kwa-Zulu Natal Province) and has the potential to impact tourism. Without beaches and dunes in the littoral active zone, South Africa is more vulnerable to climate change impacts, such as ocean storms, sea level rise.

Many important offshore marine mud ecosystems on the South African continental shelf rely on land-derived sediment input to maintain their functioning. The west coast mud belt (60-120m depths) extends from the Namibian border to St Helena Bay covering more than 10 000 km². This mud belt is maintained through sediment deposition from the Orange and Olifants Rivers. It supports relatively high biodiversity and ensures food security as a nursery ground for juvenile hake, which makes up the largest proportion of the South African Fisheries catch.

uThukela sediment supply to the uThukela Banks MPA

Catchment-derived nutrients are an important component of coastal and marine foodwebs stimulating phytoplankton production. A KwaZulu-Natal study showed that suspended riverine particulate organic matter (e.g. terrestrial, aquatic plant material) plays an important role in supporting inshore filter-feeder communities such as red bait *Pyura stolonifera*, mussels *Perna perna*, and oysters *Striostrea margaritacea* and *Saccostrea cucullata*. It was found that up to a third of marine filter-feeder diets consisted of material introduced by rivers.

Mzimvubu plume

The trophic roles provided by rivers coupled with their influence on coastal turbidity and suspended sediment are thought to have a profound influence on the types of marine organisms characterising large areas of the coast. For example, along the northern KwaZulu-Natal coast in South Africa where there is a dearth of rivers, coral communities thrive due to the clear low nutrient waters. Further south, however, there is significantly more riverine input which results in communities dominated by filter-feeders and a paucity of light-reliant corals. Thus contributing to South Africa's high coastal diversity.

At local scales, sand introduced to the sea via rivers plays a role in structuring benthic communities by altering disturbance regimes. For example, reef communities growing on a vertical reef where there is limited sand inundation and disturbance are often dominated by monospecific stands of filter feeders, such as red bait, whereas communities growing on a horizontal reef where there is periodic sand inundation tend to have higher levels of diversity as they experience regular disturbance, thereby reducing the chance of monopolisation by one or a few competitive species.

Contrasting levels of turbidity characterising different bioregions of the KwaZulu-Natal coast has a profound effect on ecosystem structure and functioning

Fisheries resources globally are vulnerable to changes in freshwater inputs including soles, linefishes such as kobs and steenbras, and prawns. The ecological needs of transitional waters (i.e. freshwater dependent coastal and marine ecosystems) must be considered in the allocation of freshwater resources to ensure healthy functioning marine ecosystems that support productive and sustainable fisheries. For example, the loss of offshore muds is believed to have contributed to the poor catch rates of trawled soles of the Orange River Mouth after the construction of large dams in the 1970s and 1980s.

In short, freshwater flowing into the sea is not wasted. Changes in freshwater flow and associated variations in sediment supply, salinity, turbidity, nutrients and detritus can impact marine biodiversity and fisheries resources and decrease their socio-economic value.

2. Understand the impact of present flow reduction on coastal environments

Reduced river inputs have a significant impact on coastal and marine ecosystems around coastline's globally. The impacts of altered freshwater flow reduction extend offshore with responses to flow patterns measured in catches of commercial linefish documented. For example, the total freshwater flow to the marine environment in South Africa has been reduced from 36 900 to 24 800 million m³/year (more than 12 000 million m³/year reduction). Globally larger river systems have experienced the greatest flow reduction and are therefore expected to have driven the most change in marine ecosystems. The reduction of river flow leads to a reduced sediment supply to the coast with

implications for beaches and subtidal habitats. Reduced sediment input can change beach dynamics, accelerating beach erosion and can even lead to the loss of beach habitat. In the subtidal environment, fluvial inputs provide important sediment inputs for the maintenance of submarine fluvial fans outside the mouth of large river systems. Many of these habitats are also important for ecological processes. For example, in South Africa the endemic and endangered white steenbras *Lithognathus lithognathus* is believed to spawn on submarine fluvial fans, a localised habitat of a limited extent. Changes in salinity and water temperature linked to flow alteration also impact thermohaline fronts which affect plankton feeding communities and the fish, birds and mammals that feed on the concentrated food associated with these habitats.

Important processes that can be compromised through altered freshwater flow include nursery functions, environmental cues, productivity and food web processes. Increased frequency of estuary mouth closures and associated conditions due to reduced freshwater flow can also disrupt lifecycles and connectivity, and deprive fish and invertebrates of the important nursery function of estuaries. Sediment input leads to turbidity providing an important refuge for fish which is a key component of estuarine, coastal and offshore nursery areas. Reduced turbidity can alter predation pressure and the catchability of fishes. Altered freshwater flow leads to changes in important environmental cues such as those relevant for spawning, recruitment and migration.

The impacts of reduced nutrient supplies will travel through coastal and marine ecosystems via foodwebs. Reduced detritus also impact marine food webs as river-associated detritus are important food sources for filter feeders, detritivorous fish and invertebrates.

3. Address the policy gaps in ensuring healthy, safe and productive coasts and resources

Freshwater flow allocations and Environmental Management Objectives (RMOs) are generally determined under national or regional water acts. Both surface and groundwater requirements need to be addressed. However, at present, the South African Water Act does not recognise river-influenced nearshore marine ecosystems as a 'water resource'. As a result, the flow requirement processes exclude freshwater allocations to these critically important estuarine-associated ecosystems, with serious implications/ knock-on effects to estuaries, offshore ecosystems and marine species, e.g. limited spawning habitat (subtidal fluvial fans) for White Steenbras. Concern thus also exists around ensuring ecosystem functionality to meet globally committed biodiversity protection targets and their associated freshwater flow requirements as conservation priorities are still simply viewed as 'another water user' in a catchment, rather than their freshwater allocations being given a higher priority to sustain the fabric of life and associated ecosystem services.

At present, the 'Classification' process seems to view existing water resource use as sacrosanct, while other forms of resource use, e.g. fishing or pollution, are treated as negotiables. To reach a truly balanced distribution of ecosystem benefits even existing lawful uses may need to be redistributed through compulsory licensing mechanisms.

Furthermore, globally, the objectives and principles of fisheries-related legislation include a commitment to implementing an ‘Ecosystem Approach to Fisheries Management’. These include the need to develop fisheries whilst maintaining a sound ecological balance, protecting marine biodiversity and the ecosystem as a whole. Implicit within this is the need to protect ecological processes and ecosystem functioning, including environmental flows. Consequently, the allocation of freshwater flows to fish and fisheries needs to be explicit in water resource management processes, and the current legislation needs to be adjusted to accommodate this.

Additional legislation that can be leveraged towards the protection and wise use of transitional waters include mandates relating to integrated coastal management and biodiversity protection.

4. Invest in future research and monitoring needs

Further scientific research and capacity building are needed to expand our understanding of the impacts of freshwater reduction on the coast:

- Improve scientific understanding of the role of freshwater flow in marine environments to support predictive capabilities in the assessment of the impact flow reduction have on the marine ecosystem, including the mapping of fluvial fans and identification of key beaches, the mapping of mud habitats and unique ecosystems, linking biological responses to flow patterns and linking fisheries management protocols to freshwater flows.
- The cumulative impacts of flow reduction, land-use change and climate change need urgent evaluation to inform future resource use, with a focus on sediment supply to estuaries, beaches and coastal ecosystems under future climate conditions (e.g. sea level rise, changing rainfall regimes and increased storminess).
- There is also a need to expand on the capacity of policymakers and governments to assess, monitor, and account for the climate mitigation and adaptation value of these ecosystems.

5. Urgent recommendations to ensure adequate freshwater flows to the ocean

Priority Actions for policy makers and resource managers:

- Recognise that the provision of freshwater to the marine environment is a shared mandate between the lead agencies mandated to regulate water, fisheries and the environment.
- Formally incorporate marine environmental flow requirements into water resources allocation processes.
- Develop new legislation and resource management tools under environmental legislation to secure coastal ecosystem integrity, processes and fisheries resources and ensure cumulative impacts are considered when decisions on freshwater flow are made.

- Address shortfalls in existing water resource allocation processes that fail to account for marine and coastal flow requirements (water quantity, quality and sediment loads).
- Prioritise research funding to address critical knowledge gaps with consideration of international opportunities.

The provision of freshwater to the marine environment is a wicked problem that straddles a range of sectoral mandates (i.e., water, fisheries, coastal management, biodiversity protection, waste management). It is thus critical that it be recognised as a shared mandate between the lead agencies mandated with water resources, fisheries and environmental management and protection.