

## River-floodplain connectivity and food web subsidies in tropical rivers

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The connection of rivers to their floodplains is known to facilitate a significant food subsidy to aquatic consumers - the flood pulse advantage. Although rivers in northern Australia are largely unimpacted by water resource development, there is considerable natural variation in the pattern of hydrological connectivity with their floodplains - in both space and time. This has been shown to influence the strength of subsidies to river food webs. Large mobile consumers in particular show a high level of dependence on subsidies from outside of the river channels they inhabit for much of the time. Our recent work, using conservative isotope tracers, in the Alligator Rivers Region suggests that mobile consumers derive much of their somatic growth from feeding in specific locations within inundated floodplains. These tend to be deeper areas that retain open water with submerged macrophytes throughout the wet season. Submerged macrophytes support a high level of epiphytic algae production, an important basal food resource for aquatic consumers, compared with other structural types. Changes to flow regimes that diminish the depth or duration of inundation of these 'hotspots' of high quality food resources, or the presence of barriers that restrict access of mobile consumers to them, are likely to have a significant impact on this important subsidy to river food webs and fisheries.

## Can further regulation of the River Murray be used to promote ecosystem health? A fish ecology perspective.

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Despite the pervasive ecological impacts of river regulation, further regulation, in the form of weirs, levees and pumping, is being used to artificially inundate floodplains of the River Murray with an aim to improve floodplain health. In the lower River Murray, a 3 m high, 79 m wide regulator on Chowilla Creek has been constructed with the primary objective of maintaining or improving the condition of floodplain overstorey vegetation. The Chowilla Anabranch system comprises permanent lotic habitats that are now rare in the main channel of the lower Murray, and supports a regionally significant Murray cod (*Maccullochella peelii*) population. Operation of the Chowilla Regulator may alter the hydrodynamics of lotic habitats, interrupt connectivity, and decouple riverine and floodplain hydrographs. This presents risks for native fish whilst potentially facilitating recruitment of non-native fishes. During spring 2014, the Chowilla regulator was used to inundate ~3,000 hectares of floodplain during relatively low river flows ( $\leq 10,000$  ML/d). We quantified the hydraulic characteristics of perennial creeks, investigated the movement of Murray cod using radio-telemetry, and compared fish assemblages in ephemeral floodplain habitats between engineered and natural overbank flooding (discharge = 90,000ML/d). During regulator operation, mean water velocities and hydraulic complexity (strength and frequency of water circulation), were ~50% of those measured when the regulator was not in place. The regulator also obstructed the spawning movements of Murray cod. **In floodplain habitats, native fishes were rare and young-of-the-year carp comprised 97% of the catch.** During natural flooding, native fishes were numerically abundant, and carp represented 1% of the catch. Our results support the notion that engineered floodplain inundation simplifies and fragments aquatic habitats, and may benefit carp over native fishes. River regulation to promote ecosystem health represents an unparalleled experiment in lowland river restoration, requiring rigorous evaluation to provide feedback loops for adaptive management.

## Variable plasticity in shell morphology of some Australian freshwater mussels (Unionioda, Hyriidae)

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Shell shape varies markedly in freshwater mussels in the order Unionoida, with shells of the Australian unionid family Hyriidae varying in size and shape, beak and surface sculpture, hinge dentition, growth lines, erosion of the periostracum and the colour and thickness of the nacre. Freshwater mussels belonging to the genus *Velesunio* (Family Hyriidae) are distributed widely in the rivers and wetlands of Australia. Molecular evidence suggests there are at least three more species within the genus *Velesunio* than previously described using shell morphology. Morphological differences in shell shape between the species are difficult to detect and differences appear to differ between drainage basins. This study explored differences in shell morphology between and within two major drainage basins within Australia, the Murray-Darling Basin and the Lake Eyre Basin. For all species there were significant differences between basins and rivers within basins, however for shells from the Lake Eyre Basin differences in shell morphology between sites was low. In comparison greater species level differences in shell morphology were observed at the site scale in the Murray-Darling Basin. Although both drainages are essentially 'dryland' systems with highly variable flows, the extreme flow variability of Lake Eyre Basin rivers means they spend considerable time as lentic waterholes. In contrast the rivers of the Murray-Darling Basin, while still highly variable, spend a far greater time under flowing water conditions. Thus, the level of difference in shell morphology between sites may reflect local hydraulic variability rather than large scale flow variability

## Frogs, flows and rainfall: monitoring frog response to wetland flows in the northern Murray Darling Basin

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Considerable investment in managing water for the environment in the Murray Darling Basin relies on systematic monitoring at relevant spatial and temporal scale to assess the outcomes of environmental flows for wetland-dependent fauna, including frogs. Here we report on results of frog monitoring in the Northern Basin where we assess the ecological relevance of two key environmental water considerations: flow timing and flow magnitude.

We undertook systematic surveys during natural floods and during periods of low flows, when small environmental flows were delivered, in two large semi-arid floodplain wetland systems in northern MDB (the Macquarie Marshes and the Gwydir Wetlands). Both systems have wetlands that are Ramsar-listed and therefore considered wetlands of international significance. Survey sites were spatially stratified by vegetation type and flooding frequency. We identified all species, breeding behaviour, recorded habitat variables and local weather conditions. Inundation extent across the floodplain and individual wetland sites was calculated from Landsat imagery and matched with survey dates to determine flooding metrics.