NATIONAL PROGRAM FOR Sustainable Irrigation

Research Bulletin

Using ERA to measure the effects of irrigation on river health in the Ord Irrigation Area

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Background

The Ord Irrigation Area is unique in Australia, with no on-farm structures for retaining or re-using irrigation drainage. Most drainage and excess channel water returns directly together to the river, where dilution has been assumed to reduce any adverse impact. However, with the proposal for Stage 2 development impacts are likely to increase. At present 300-400 GL are used annually by irrigation, while full development of Stage 2 was estimated to require an additional 1235 GL per year (WRC 1999). See Map 1.

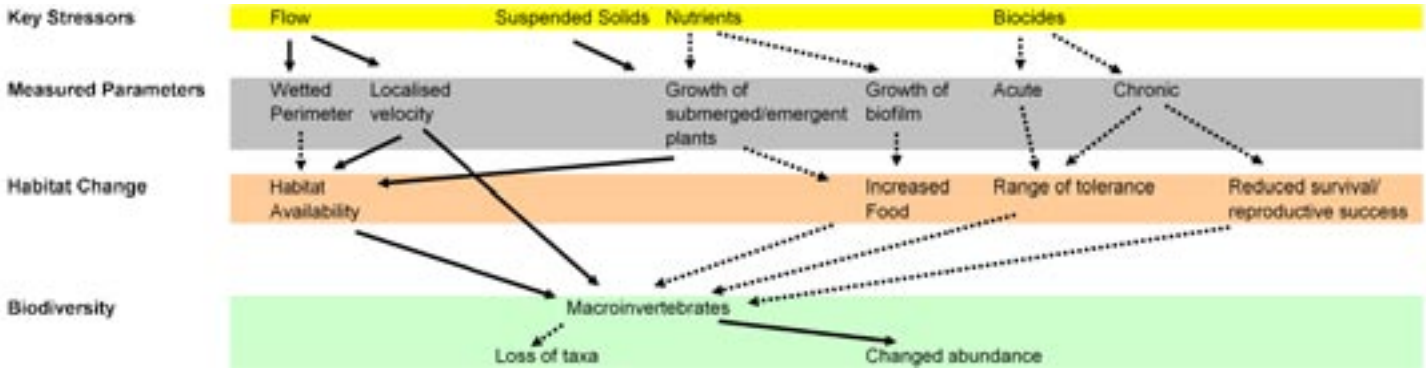
The flows in the lower Ord River are now regulated by the Ord River Dam (ORD) in the Carr Boyd Ranges and the Kununurra Diversion Dam (KDD) near Kununurra Township. The ORD forms Lake Argyle and KDD forms Lake Kununurra. Prior to regulation, the Ord River was reduced to isolated pools during the dry season and subject to large discharges during the wet season. The lower Ord River is now regulated to maintain a permanent flow (typically 70 m3s-1). To understand the effects of river regulation and irrigation drainage into the river, an Ecological Risk Assessment of the river was undertaken. This Research Bulletin describes the process of undertaking an extensive field sampling program, to understand if there has been a loss of biodiversity, and the risk of algal blooms.

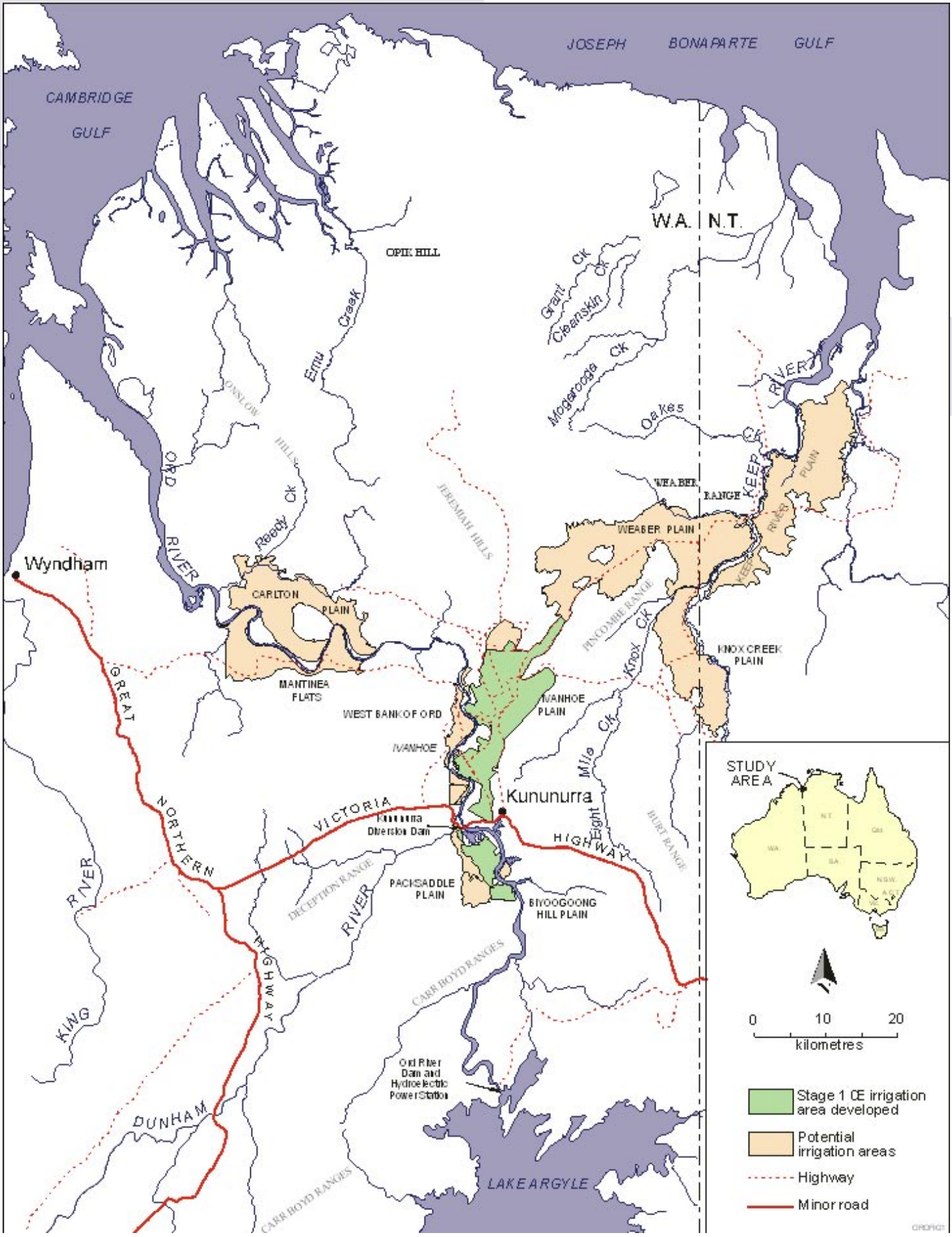
Ecological Risk Assessment

Ecological Risk Assessment is a process for describing the links between stresses on the environment, the likelihood of these stresses (or risks) occurring and the consequences of these occurring. The causes and effects are drawn out in the diagram below (see Figure 1).

The final model identified 4 key stressors that could result in loss of biodiversity in the lower Ord River. Three stressors are directly linked to the quality of irrigation return, and include suspended solids, nutrients and biocides. The fourth stressor, flow rate in the river, is likely to have a significant impact on macroinvertebrates. It is not directly the result of irrigation return but rather a result of

Figure 1: Conceptual model illustrating the relationship between stressors, parameters measured, how these impact on habitat and finally on macroinvertebrate biodiversity (dotted arrows show suspected links, solid arrows show links supported by collected data).





Map 1. Map of the Lower Ord River, indicating the location of existing irrigation areas (Stage 1) and proposed areas (Stage 2).

the timing of release flows from Lake Argyle that is influenced by the production of hydro electricity and the extraction of water for irrigation.

The study chose not to measure changes in birds, mammals, reptiles or fish as the highly mobile nature of these organisms makes it extremely difficult to relate changes in community composition to irrigation return. Instead the focus was on the diversity within the macroinvertebrate community (insects, aquatic spiders, shrimp & snails) as they have been shown to be highly responsive to pollution, likely to be diverse, and easy to process.

Sampling & Methods

The river was sampled at 12 sites at approximately 3-monthly intervals. Each site was classified into a broad habitat type, namely slackwater, backwater, riffle and channel sites. Slackwaters were sites alongside the main channel that had low water flow through them. Backwaters received no flows with their entries facing downstream. Channels consisted of a braid off the main channel that had water flowing through it. Riffle sites were located in the main river channel, where water depth was less than 0.5m. The sites were also classified according to whether they received drainage flows, and whether they were directly, visibly affected by drainage plumes where they entered the river. At each site, the following stressors were measured:

- total suspended solids (TSS)
- flow
- nutrients
- water chemistry
- biocides
- biofilm
- macroinvertebrates
- submerged plants.

Results

The results did not show a demonstrable increase in fine sediments (suspended solids) in high impact areas, which may be due to the insensitivity of the measures used to detect the change, or because there was minimal deposition in these areas. The lack of detection may also be due to the river still recovering from previous floods.

Nutrient addition from irrigation drainage return was expected to increase biomass of the submerged plants. However, the two plume sites did not show any increase in submerged plants compared to the others. The main differences that occurred in water chemistry, nutrient levels and temperature occurred seasonally, rather than between plume sites and others. Current drainage into the river from irrigation does not appear to influence water chemistry (pH, salinity, dissolved oxygen) sufficiently to produce a detectable impact. However, plumes may be reducing plant growth because of reduced light levels.

No biocides were detected during the course of the sampling program at levels above detection limits, except for April 2003 where 0.0013 and 0.0041 mg.kg-1 of DDE (an organochlorine pesticide) were measured in two of the drains. While the data from this study would suggest that biocides are not a problem for macroinvertebrates, on-going vigilance against chemical entry into the river is vital.

The localised flow rate of the water appeared to be very important in determining the type of macroinvertebrate taxa that would occur there.

The high turbidity and nutrient concentrations in the drainage plumes do not appear to be having a detectable impact on the macroinvertebrate community. Total abundance dropped in the very high impact sites between measurement dates compared to the high impact sites. This does not appear to be due to any change in drainage total suspended solids or nutrient levels, suggesting that a biocide release might have been responsible, although this was not detected in the sediments collected at the time.

Taking the results into account, the overall risk posed by irrigation return to biodiversity in the lower Ord River is considered to be low for areas receiving diluted drainage (see Table 1). Biocides in plumes are considered to present a medium risk under current conditions, with both TSS and nutrients presenting a low risk. However, in the scenario of Stage 2 of the Ord Irrigation Scheme opening up (with an estimated 1235 GL/annum water use), reduced dilution rates for plumes will occur because of less excess channel flows. This will increase the area receiving undiluted drainage and increase the risk of TSS impacting primarily on submerged macrophytes to medium. Nutrients become a high risk, as high concentrations may alter biofilm and submerged macrophyte biomass. Greater potential exposure to acute and chronic levels of biocides in the drainage water make the plume area, under reduced flows, a higher risk to biodiversity.

Table 1. Overall risks of loss of biodiversity under current and possible Ord Stage 2 flows and in reaches of the river receiving diluted return or in the discharge plume, overall risk is the product of the likelihood and consequence (L ≤6, 7< M ≤12, H ≥13)

Location	Driver	Likelihood	Consequence	Overall Risk
Current Conditions				
Plume	Biocides	4	3	6-12 M
	TSS	3	1	2-6 L
	Nutrients	2	1	2-4 L
Diluted	Biocides	1	2	2 L
	TSS	1	1	1 L
	Nutrients	2	1	2 L
Under reduced flow (Ord Stage 2)				
Plume	Biocides	5	5	8-25 M-H
	TSS	4	2	4-12 L-M
	Nutrients	4	4	6-16 L-H
Diluted	Biocides	1	4	2-8 L
	TSS	1	1	1-2 L
	Nutrients	3	2	6-9 L-M

Conclusion

Under the initial risk assessment of Lund and McCrea (2001), loss of biodiversity was considered a medium risk under current flows and medium to high risk under Ord Stage 2 flows. The additional data collected in this study has allowed these risks to be reconsidered and reduced to low under both scenarios for the majority of the river.

Figure 2. Example of a sampling site on the Ord River, MD2, classified as riffle habitat, medium impact type

Figure 3. Example of a sampling site on the Ord River, HD2, classified as slackwater habitat, high impact, as it is located on the periphery of a drainage plume.

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