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# Ecological studies on the freshwater fishes of the Alligator Rivers Region, Northern Territory: Autecology

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# Contents

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# Explanatory notes

This volume outlines the autecology of the fishes of the Alligator Rivers Region. It is designed to be read in conjunction with the other volumes in the series: Volume 1, *Outline of the study, summary, conclusions and recommendations*; and Volume 2, *Synecology*.

## Nomenclature changes

Since this manuscript was first completed (September 1980), the names of some fish species and billabongs have been revised. These changes have been incorporated into the text, appendixes, figures and tables of this volume.

### Fish genus and species names

| | |
|---|---|
| Osteoglossidae | *Scleropages jardini* → *S. jardinii* |
| Ariidae | *Hexanematichthys* → *Arius* |
| | *H. australis* → *A. graeffei* |
| Plotosidae | *Tandanus ater* → *Neosilurus ater* |
| Belonidae | *Strongylura kreffti* → *S. krefftii* |
| Melanotaeniidae | *Melanotaenia maculata* → *M. splendida inornata* |
| | *Melanotaenia australis* → *M. splendida australis* |
| Atherinidae | *Craterocephalus marjoriae* → *C. marianae* |
| Teraponidae = Terapontidae | *Pingalla* sp. → *Pingalla midgleyi* |
| Mugilidae | *Liza diadema* → *L. alata* |
| | *Liza dussumieri* → *L. parmata* |
| | *Squalomugil nasutus* → *Rhinomugil nasutus* |
| Eleotridae = Eleotrididae | *Hypseleotris compressus* → *H. compressa* |
| | *Oxyeleotris lineolatus* → *O. lineolata* |

### Fish family names

Pseudomugilidae replaces Atherinidae for *Pseudomugil tenellus*.
Ambassidae replaces Centropomidae for *Ambassis* spp. and *Denariusa bandata*.
Terapontidae replaces Teraponidae for all five species of this family discussed.
Eleotrididae replaces Eleotridae for all three species of this family discussed.

### Place names

| | |
|---|---|
| Baroalba crossing (coded BX) | → Malabanbandju Billabong |
| Nourlangie Rock (NR) | → Umbungbung → Anbangbang Billabong |
| Skull Rock (SR) | → Long Harry → Namandi Garrigorry → Noarlanga |
| Magela bore pool (II) | → Surshar Billabong |

## Names of animals and plants

Scientific and common names of fishes follow the recommendations of the Australian Museum, Sydney (but see above). Those of plants follow the recommendations of the Royal Botanic Gardens, Sydney (made in 1979/80).

## Abbreviations

| | | | |
|---|---|---|---|
| ARR | Alligator Rivers Region | LFM | length at first maturity |
| DO | dissolved oxygen | RM | Ranger Mine |
| GMSI | gonad maturity stage index | RUM | Ranger Uranium Mine |
| GSI | gonadosomatic index | RUPA | Ranger Uranium Project Area |
| LCF | length to caudal fork | TL | total length |

Sampling method and site abbreviations are found in section 2: Materials and Methods.

## Aquatic seasons

The system of seasons used in this report takes into account the main changes in aquatic habitats resulting from the Wet–Dry monsoonal climate. Five seasons are recognised, but they do not have clear time boundaries because of the variability in the starting and ending times of the 'the Wet'. Spatial variability of rainfall may also create a situation where separate catchments experience different seasons. Descriptions of the five seasons are given below, together with the equivalent Aboriginal names in Gundjehmi (Mayali) language in parentheses.

**Late-dry (*Gurrung* to early *Gunumeleng*)** Usually September to October; sometimes begins in August or ends in November or December. Waterbodies are isolated and have contracted greatly, owing to extensive evaporation. Many waterbodies disappear altogether, but the ones with considerable depth that persist and remain deep are important refuges for aquatic animals. Temperatures and turbidities rise to high levels in the shallower waterbodies. Water persists on the floodplain only in channel waterholes.

**Early-wet (*Gunumeleng*)** Usually November to December; sometimes begins in October or ends in January. Waterbodies receive first rains and surface inflows. Littoral grasses begin to grow. Temperatures in the littoral zone of the waterbodies are very high. Towards the end of this season, creek channels begin to flow, connecting the already replenished waterbodies, and the floodplains start to fill. Animals in the waterbodies can now move throughout the catchments.

**Mid-wet (*Gudjewg*)** Usually January to March; sometimes begins in December or ends in April. Heavy rains induce strong flows in the channels and flooding of the surrounding forest. Waterbodies are deepest at this time of year, large expanses of water cover the floodplain and, in the upper reaches, water levels may drop and rise rapidly. There are extensive connections between fresh and estuarine waters.

**Late-wet–Early dry (*Bang-gereng* and *Yegge*)** Usually April to early June; sometimes begins in May and continues to the end of June. Rainfall slackens and water levels begin to drop in channels and waterbodies. Dissolved oxygen levels drop in waterbodies as flow-induced mixing slows and organic matter decays. By the end of this season, channel flow has reduced considerably, making it difficult for larger aquatic animals to move between waterbodies, and considerable water level draw-down occurs on the floodplain, which becomes isolated from the estuary.

**Mid-dry (*Wurrgeng*)** Usually late June to August; can be early June to mid-August or mid-September. Rainfall stops completely and temperatures are at their lowest. 'Trickle' flows enable small animals to move to more secure (deeper) waterbodies, but these flows usually stop in the middle of this season and the waterbodies then become isolated. Draw-down continues on the floodplain as parts become very shallow.

# Abstract

The essential objective of the study was to identify the locations and timings of activities critical in the life cycles of each of the fish species considered. By cross-relating such knowledge to information on the location and timing of potential mining-induced physical and chemical (abiotic) impacts, the life-cycle components of species most at risk can be identified – an important task in impact risk assessment.

Primary biological/ecological information was obtained and analysed for each of the 37 freshwater fish taxa found in the Alligator Rivers Region in relation to the following generic species-account structure: size composition, environmental associations, reproduction and feeding habits. Each of these components revealed complementary information on the locations and timing of activities critical in the life cycles of the fish taxa considered.

**Size composition**. Smaller juveniles of the largest number fish species were found in lowland backflow billabongs and floodplain billabongs. These two habitats therefore appear to be particularly important as nursery areas. Larger species tended to have recruitment limited to a single season, primarily either the Early-wet or Mid-wet seasons. Smaller fish species tended to have continuous recruitments with a few peaks occuring during the year. The primary recruitment peaks of such species typically occurred in the Mid-wet season.

**Environmental associations**. Useful information indicative of the environmental associations of 32 fish species was obtained. Three main groups of species were distinguished by characteristic combinations of associated environmental factors. Escarpment-associated species are potentially the most vulnerable component of the fish fauna to mining induced abiotic impacts. They were usually associated with low temperature, high DO concentration, low conductivity, low turbidity and coarse substrate. These species therefore display a general 'clean water' association. Accordingly, they are at risk when they make incursions to the lowlands near mining areas in the Wet season, or are trapped therein throughout the Dry season. They are therefore likely to be the most useful candidates for monitoring and biological testing.

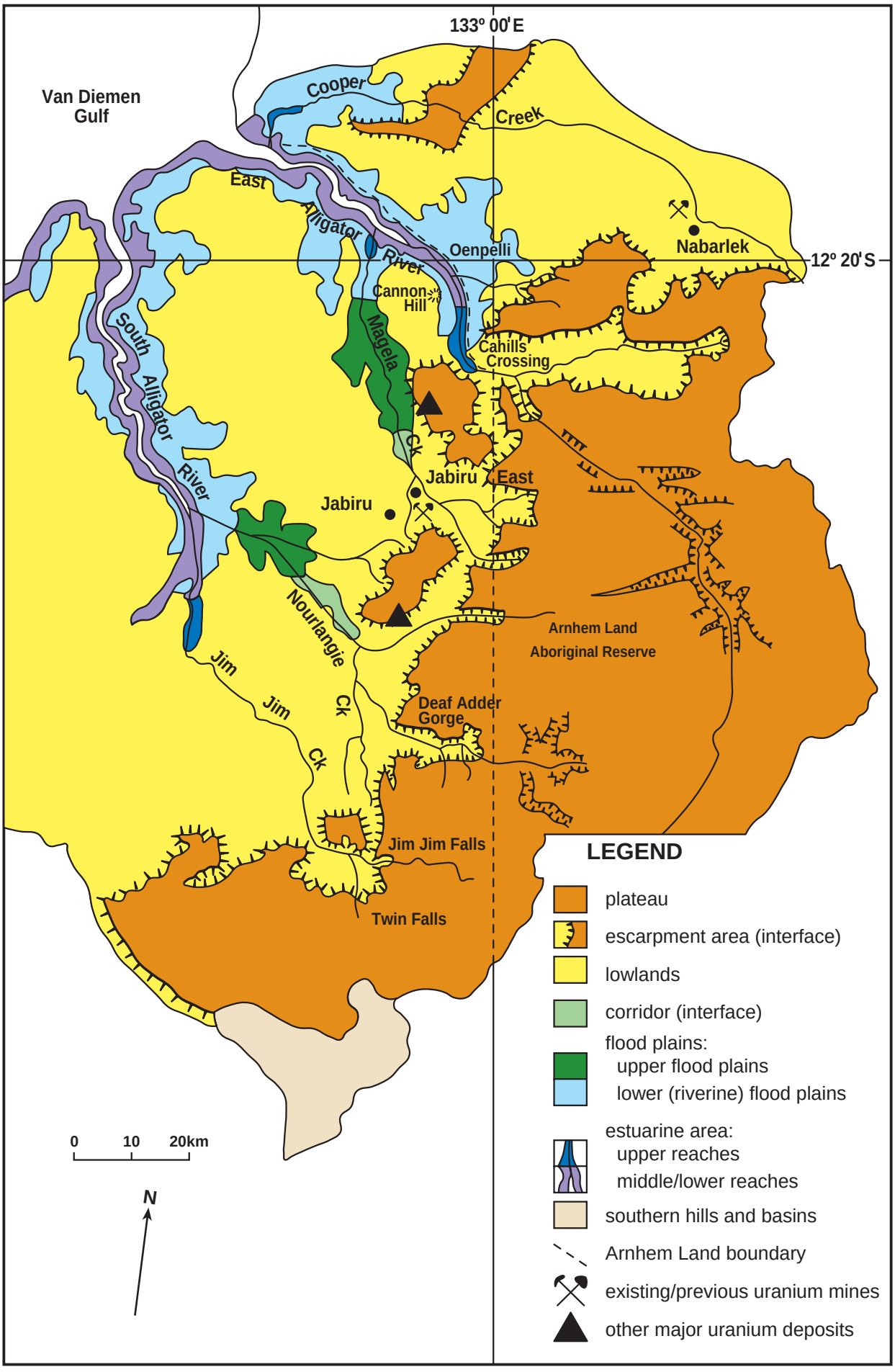
**Reproduction**. Six breeding strategies were exhibited by the fishes studied. Species which lay demersal eggs are most prone to impacts associated with siltation, and/or the release of toxic materials from sediments when anoxic conditions develop at depth within waterbodies. Accordingly, such species are therefore likely to be the most useful candidates for monitoring and biological testing. The most important spawning habitat was the lowland backflow billabongs, where 19 species showed evidence of spawning. Most fish species (25) bred around the onset of the Wet season. This is the time when initial flooding hugely increases the area and diversity of aquatic habitats available as well as initiating major increases in plankton and other foods.

**Feeding habits**. Nine feeding guilds were identified. If biomagnification effects are the focus of future investigations then the peak carnivores are the most suitable candidates for monitoring. Similarly, if exposure to disturbed contaminated sediments is a key factor, then the herbivore/detritivores, omnivores and/or benthic carnivores are the most suitable candidates. Downstream of the Ranger Uranium Mine (RUM) the highest feeding activity was recorded in lowland backflow billabongs followed by floodplain billabongs. Upstream of RUM the highest feeding activity was recorded in escarpment mainchannel waterbodies followed by lowland billabongs. The season of greatest feeding activity was, as other researchers in tropical seasonal rivers have found, the Wet season. Feeding activity thus increased most dramatically between the Late-dry season and the Early-wet season. By the

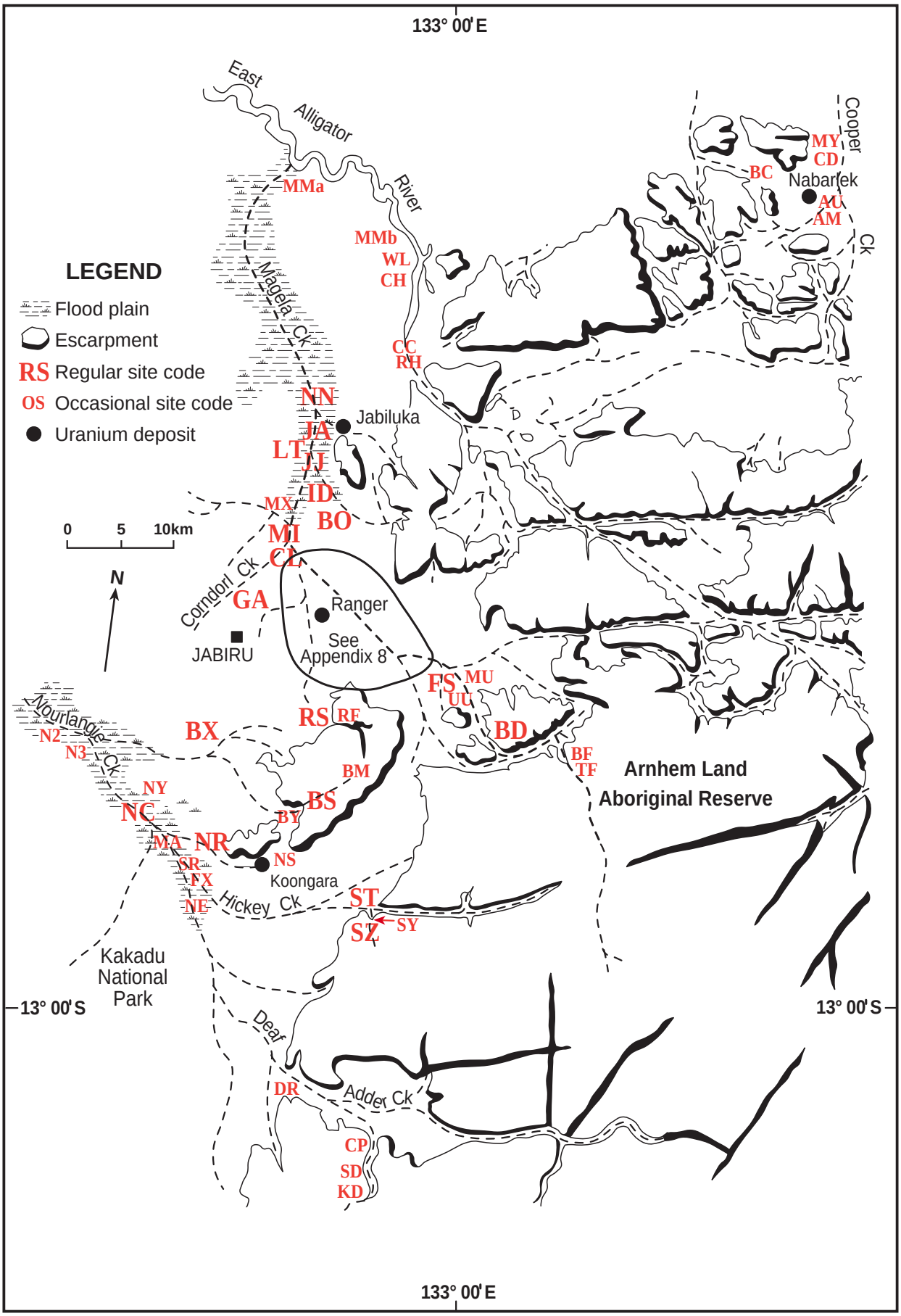
Mid-wet season feeding activity had peaked, and then decreased slightly by the Late-wet–Early-dry season. An examination of variations in body condition indicated that most species obtained their best condition from the Mid-wet to the Mid-dry season, with a peak in the Late-wet–Early-dry season.

A key finding from the study is the crucial importance of lowland backflow billabongs to the ecology of the majority of the freshwater fish fauna.

The detailed information presented in this report constitutes a major contribution to the autecological knowledge of the freshwater fish fauna of the Alligator Rivers Region. Because many of the species have a wide distribution, the information will be valuable to researchers across Australia, especially those working in the Timor Sea, Gulf of Carpentaria and north-east coast drainage divisions, and within Papua New Guinea and Irian Jaya. Insights gained into the processes 'driving' the ecology of this tropical riverine fish fauna also have world-wide application. Importantly, the information arising from the present study will have considerable application when assessing the nature and magnitude of impacts arising from a range of freshwater-associated developments, and particularly those in the mining arena.




**Map 1** Major catchments and zones examined in the Alligator Rivers Region




**Map 2** Location of regular and occasional sampling sites. Sites JD and TW are further south than the coverage of this map. Sites CA, C1, C2, C3, C4, DA, GD, GL, GN, GU, IF, II, IM, LC, MD, MG, MJ, RO, RT, TD and ZZ are shown in appendix 8.