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## Aquatic Asset Critical Links to Flow – Information Summary

Emydura macquarii (Murray River Turtle)

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Qld Department of Natural Resources and Mines, 120 Meiers Road, Indooroopilly Qld 4068

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Prepared By:	Sharon Marshall
Work Unit:	Aquatic Ecosystem Health
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## ***Emydura macquarii* (Murray River Turtle)**

### **Status:**

Rare or insufficiently known in commonwealth territories (including Ashmore reef, Australian Antarctic Territory, Christmas Island, Cocos Island, Heard Island, McDonald Island, Jervis Bay Territory and Norfolk Island). Common elsewhere. (Stanger et al., 1998).

### **General distribution:**

Murray-Darling drainage, traverses four states and the Australian Capital Territory (Cann, 1998). Murray River turtles are found near headwaters at many locations west of the Great Dividing Range (Cann, 1998). Throughout its known distribution, from the Balonne, which runs into the Condamine before connecting to the Darling River and in many other reaches running north to meet the Murray, these turtles display morphological variations (Cann, 1998). A polytypic species or species complex with distinctive populations also in Cooper creek and Fraser Island (Georges, 1993). *E. macquarii* has been recorded in the Condamine Balonne system (NR&M unpublished data) (APPENDIX 2).

### **Moonie distribution:**

Moonie River included in species distribution map (Cann, 1998).

### **Habitat:**

*E. macquarii* occurs primarily in rivers and water bodies associated with rivers such as backwaters, oxbows, anabranches and deep, permanent waterholes on the floodplains (Greer, 2003; Young, 2001; Chessman, 1988). This species appears to avoid shallow water. In one study it was not recorded from water less than 2 m deep (Chessman, 1988). Its abundance is positively correlated with water depth, transparency, persistence and flow rate and negatively correlated with distance from the river, thus it prefers large, deep, clear, flowing, stable water bodies in the Murray (Chessman, 1988). Along the Murray River, there are countless lagoons and lakes with *E. macquarii* populations present. Some of these waterbodies are under continuous pressure (from a combination of man's demand, little annual rainfall and extended droughts) and rely on rare floodwaters for any relief (Cann, 1998).

Meathrel et al. (2002) concluded habitat and dietary overlaps existed between *C. longicollis*, *C. expansa* and *E. macquarii*, suggesting strong

competition for resources in large, permanent billabongs. All species preferred the more complex habitats in which to forage and during times of flood, all turtles appeared to become opportunistic and consumed any food items available.

### **Reproduction:**

Turtles are slow growing and typically do not reach sexual maturity until about 15 years of age (Georges et al., 2003: Conf. 3). Courtship and mating in captivity is known to occur from March to April (Cann, 1998).

### **Nesting:**

Nesting occurs between mid- and late spring to early summer (late October – mid December). Females generally lay two or three clutches of eggs in a season, each clutch consisting of about 10 – 15 eggs, and taking six weeks to four months to hatch (Young, 2001). Chessman (1978) considers that this species has the potential to lay 84 eggs in a season. Incubation period at Patho (Victoria) was recorded at 78 days (Cann, 1998). Incubation period appears to increase with decreasing temperatures (Greer, 2003). Thompson (1983b) showed that temperatures did not influence the ratio of males to females and recorded incubation period of 48 days at 30°C.

Rainfall appears to be a critical determinant of nesting behaviour for *E. macquarii* (Bowen et al., unpublished). Rain may soften the ground and make nest excavation easier and thus faster, minimising the time that turtles spend on land and are exposed to predators. The species is said to nest in soils ranging from light sand to heavy clay, but ‘more frequently’ in lighter soils (Greer, 2003). Nest sites are usually in the open and from 2 – 40 m from the water (Greer, 2003). The same areas seem to be used for nesting by the population year after year (Greer, 2003). Nests are flask shaped and approximately 150 – 200 mm deep (Greer, 2003). The female, on completing her laying makes an earthen plug to cover her nest (Cann, 1998).

### **Feeding:**

*E. macquarii* eat both plants and animals (omnivore) (Greer, 2003). Plant matter includes green algae, blue-green algae, diatoms, fungi and macrophyte shoots and leaves. Animal food consists mainly of invertebrates (eg. crustaceans, molluscs) and also fish (kidszoo website). Diet changes with size. Small turtles tend to eat more microorganisms and the substrate on which they grow (Greer, 2003).

## Threats:

Approved recovery plan for the Bellinger River Emydura (*Emydura macquarii*), which is a sub-species of the *Emydura macquarii* lists a potential threat may be reduced stream flow through extraction of water (NPWS, 2001).

Predation is a major factor driving nest site selection for *E. macquarii*. Females prefer to nest in areas where offspring survival is greatest (ie. not too close to shore due to flooding, not too far from shore due to increased predation during traverse across land), but when the risk of direct predation (on the female) is increased, they trade off minimising nest predation with survival by locating their nests closer to shore. Females consistently nest 10 – 15 m closer to shore in high-risk areas. The Murray population of *E. macquarii* contains a large number of old individuals. Juvenile recruitment is low, due to predation (Thompson, 1983a).

Little annual rainfall, regular droughts (many extended), and chemical run-off from pastoral demand have changed much of the turtles habitat (Cann, 1998).

## Valued attributes:

### Hydraulic requirements:

#### **CRITICAL LINK 1**

##### ***Flood frequency may influence available habitat***

Extreme low flows could potentially affect Murray River turtle abundance, since they have a preference for deep, permanent water bodies

Information level: Poor

#### **CRITICAL LINK 2**

***Nesting cue:*** Rainfall

***Nesting season:*** Nesting occurs between mid- and late Spring to early summer (late October – mid December).

***Nesting sites:*** Nests are usually 2 – 40 m from the water.

In high-risk areas i.e predators abundant, flow must be minimal during nesting season (late Oct – mid Dec) because females will nest closer to shore, thus increasing chances of offspring mortality due to flood.

***Nesting substrate:*** light sands

***Incubation period:*** six weeks to four months

Information level: Poor

### **CRITICAL LINK 3**

***Floods during nesting/hatching season may influence offspring survival.***

Flood events can be linked to offspring survival. If offspring mortality is a function of distance from shore (or elevation), the curve would be broadly U-shaped because offspring mortality generally increases closer to shore due to flooding (Milton et al. 1994, Standing et al. 1999), nest predation and inappropriate nesting substrates. If nests are too far from the shore, direct predation on the female increases as does offspring mortality because they spend more time traversing over land to water.

### **CRITICAL LINK 4**

***Waterhole persistence and turtle populations***

CRC for Freshwater Ecology Dryland River Refugia project. Georges and Guarino (2002. conf. 2) working hypothesis: Waterholes that dry too frequently (every 2 – 5 years) will have no turtles at all. Waterholes drying every 15 – 25 years are unlikely to develop self-sustaining populations, and must rely on immigration during times of flood. Waterholes drying every 25 – 50 years will have time for some breeding, but insufficient time for mature populations to establish. Only permanent waterholes could have well established populations dominated by large adult turtles, with low growth rates and low rates of recruitment. Relatively few waterholes function as long-term refugial sites for turtles.

### **CRITICAL LINK 5**

***Changes in floodplain connectivity could have a marked effect on the flows to waterholes consequently causing a change in resource availability, on which the turtle populations depend upon for reproduction and growth.***

White (2002 Conf. 4) investigated the population dynamics of *Em. macquarii* to determine the traits that enable this species to survive in the ‘boom’ and ‘bust’ ecology of dryland rivers. The study focuses on the Cooper Creek turtle (*Em. macquarii sp.*), a sub species of *Emydura macquarii*. Major findings from this project revealed that *Emydura macquarii* complex from the Cooper Creek has life history traits that enable its persistence in the harsh ‘boom’ and ‘bust’ environment. Survival is enhanced through biological features including a large body size, delaying sexual maturity and indeterminate growth, combined with the turtles ability to seek out refuge in the permanent waterholes during the ‘bust’ periods.

The research demonstrated that permanent waterholes are consistently dominated by adults, have a high density of turtles, and a low growth

coefficient. Semi-permanent waterholes on the other hand are predominated by juveniles, turtles are in low density and exhibit a high growth coefficient (White, 2002)

A trade-off exists during a drought between permanent and semi-permanent waterholes. High turtle density causes competition for decreasing resources in the permanent waterholes, resulting in turtles exhibiting a type of shutdown mode, where energy is no longer being directed into reproduction and growth. On the other hand, semi-permanent waterholes are exhibiting a boom time during the drought period. Due to low turtle density there is less competition for resources allowing turtles to direct energy into reproduction and growth. However, the semi-permanent waterhole may dry up before the next flood therefore decreasing the turtles survival in the waterhole, compared to the permanent waterholes where survival is enhanced (White, 2002).

#### **CRITICAL LINK 6**

***Flood timing is important. Floods prior to the breeding season are necessary to ensure ample supply of food for the breeding females.***

To ensure successful breeding, females need ample of food to build up their fat reserves before breeding. While flooding does provide ample food, flooding is not known to be necessary for successful breeding, and once the eggs are laid flooding may actually destroy them (Young, 2001).

#### **CRITICAL LINK 7**

***Low flows may concentrate turtle populations, therefore increase competition.***

An example is given by Cann (1998) at the Fitzroy drainage system in Queensland. A stretch of water, normally running slowly had ceased to flow and was exceptionally low. Consequently, the turtles were greatly concentrated. Food was obviously in short supply. Following a downpour, at least 50 turtle heads were estimated, facing the bank from about 25 cm away.

#### **Other relevant information on hydraulic requirements:**

Changes in flow pattern of the Murray River as a result of river regulation have probably been an advantage to *E. macquarii*. The elimination of minor floods and droughts, and increased summer flow have probably reduced the average amount of ephemeral water habitat (detrimental to *C. longicollis*) while maintaining a more stable permanent water habitat during the summer when the turtles are active (preferred habitat for *E. macquarii*) (Chessman, 1988).

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## APPENDIX 1

Assigning confidence to asset critical link information:

Two confidence rating systems exist: one for rating individual data sources (table 1) and another for rating the overall critical link document (table 2). Each statement from a source added to the critical link document must be referenced with the source details plus a confidence rating based on the values in the table below. Use all table columns that are relevant to the type of information. For encyclopaedias and atlases, the information quality may be unknown. For many references the information quality or specificity may be unknown, and thus cannot be accounted for, or some categories may not be relevant to the information being cited. To derive the citation score, add the scores for each category together then divide by the number of categories used. Record this final number as part of the citation reference within the asset critical link document [e.g. Bletch, P. & Lurgg, E. (1953) C= 3]

For example: a journal article based on single-season observations from multiple wetlands in the Victorian Murray-Darling Basin states that “*the spotted weevil-duck requires a minimum wetland inundation of 3 months after complete drying for successful recruitment to occur*”.

Source = journal article = 5

Quality = single season, multiple sites & records = 4

Specificity = Quantitative data = 4

Relevance = non-plan region of basin = 3

Source Ranking =  $16/4 = 4$

**Table 1:** Assigning a confidence level to a specific reference or statement

Information Source		Information quality		Information specificity		Locational Relevance	
Journal or book (peer reviewed)	5	Multiple sites, multiple records, multiple seasons/occasions (all 3)	5	Quantitative data with experimentally-derived values	5	Data specific to locations within the plan area	5
Conference presentation or report (peer reviewed)	4	Single site, single record <i>or</i> single season/occasion (2 of 3 multiple)	4	Quantitative data with observationally-derived values	4	Data specific to the overall plan area	4
Report or discussion paper (non-reviewed)	3	Single site, single record <i>and</i> single season/occasion (1 or 0 multiple)	3	Qualitative data or relationships based on direct observation, no values provided.	3	Data relevant to the greater basin, province or ecosystem type.	3
Unpublished data	2	<i>Quantitative</i> expert opinion	2	Extrapolation from information on related taxa (including sub-species).	2	Data relevant to a broad regional spread (e.g. state, arid zone, east coast).	2
Opinion, personal communication	1	<i>Qualitative</i> expert opinion	1	Anecdotal evidence, unsupported opinion.	1	Data generalised to continental or greater scale	1
<b>Source ranking:</b>							

When compilation of the asset critical link document is complete, the author must give an overall confidence score for all the information contained in the document. This is a more objective process, related to the source-ranking categories in table 1, with the author selecting the appropriate score from the options in table 2. The given score should approximate the mean of the individual citation confidence ratings. This score must be recorded in the designated text box in the asset critical link template.

**Table 2:** Developing an overall confidence score for the critical link document:

<i>Confidence Score</i>	<b>Classification</b>
5	Good data quality and well referenced information from multiple incidences with specific details directly relevant to the plan area.
4	Good data quality, detailed information, but lacking in good locational specificity.
3	Moderate to good quality data with gaps in completeness or comprehensiveness; lacking locational specificity.
2	Poor to moderate quality data with major knowledge gaps.
1	Paucity of data – no relevant information.

## APPENDIX 2

Turtle catch data from Qld Condamine Balonne system (NR&M unpublished data).

Site Name	Latitude (S) Degree	Longitude (E) Degree
Balonne River at Kurray	28°11'35.3"	148°31'46.9"
Balonne River nr Brookdale	28°17'20.2"	148°25'05.9"
Culgoa River at Whyenbah	28°25'52.9"	148°16'09.9"
Condamine River at Chinchilla Weir Pondage	26°47'47.4"	150°40'39.2"
Condamine River at Leslie Reserve	28°10'09.9"	151°55'14.9"
Condamine River at Sunnyside	27°02'59"	149°55'23.3"
Condamine River at Cotswold	27°05'08"	149°47'13.7"
Condamine River at Yarramalong	27°50'05"	151°26'57"
Condamine River at Talgai Tailwater	28°00'08.4"	151°45'52.1"