THE ECOLOGY OF THE POLYTypIC
FRESHWATER TURTLE SPECIES, *Emydura macquarii macquarii*.

David Judge
Bachelor in Applied Science

Applied Ecology Research Group
Faculty of Applied Science
University of Canberra
ACT

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Abstract

An ecological study of *Emydura macquarii macquarii* in the south-east region of Australia was conducted between October 1995 and March 1998. *E. m. macquarii* is an abundant and widespread species of short-necked turtle that is highly variable in morphology and related life history attributes. No study in Australia had previously looked at geographic variation in biological traits in freshwater turtles, hence the level of variation in *E. m. macquarii* had been poorly documented. The principal aims of this study were to investigate the plasticity of life history traits across populations of *E. m. macquarii* and to speculate on possible causes. A more intensive study was also conducted on a rare and suspected declining population of *E. m. macquarii* in the Nepean River to determine whether relevant management and conservation measures were required.

The study involved comparing various life history attributes between five populations of *E. m. macquarii* (Brisbane River, Macleay River, Hunter River, Nepean River and Murray River). The populations were specifically chosen to account for the range of variation in body size within this subspecies. Body size (maximum size, size at maturity, growth rates), population structures (sex ratios, age and size structures), reproductive traits (clutch mass, clutch size, egg size, egg content, etc.) and other attributes were collected for each population. Patterns of life history traits, both within and among populations, were explored so that causes of variation could be sought.

**Geographic variation in Body Size and other Related Life History Traits**

Body size in *E. m. macquarii* differed markedly between populations. Females ranged in maximum sizes (carapace length) of 180 mm in the Macleay River to over 300 mm in the Murray River. *E. m. macquarii* was sexually dimorphic across all populations with females larger than males in all cases. Maximum body size was positively related to the size at which a turtle matures. The size at maturity in turn was positively related to juvenile growth rates. Age was a more important factor for males in terms of timing of maturity whereas in females it was body size. Morphological
variation was not only great between populations, but also within populations. Maximum body size was unrelated to latitude; hence it was inferred that habitat productivity had the most important influence on geographic variation in body size. Population structures also differed between populations. Sex ratios did not differ in the Brisbane, Macleay and Murray Rivers. However, a male bias was present in the Nepean River population and a female bias in the Hunter River. Juveniles were scarce in the Brisbane and Macleay Rivers but numerous in the Nepean and Hunter Rivers.

Geographic Variation in Reproduction

There was large variation in reproductive traits across populations of *E. m. macquarii*. Nesting season began as early as mid-September in the Brisbane River and as late as December in the Hunter River, and continued until early January. Populations in the Hunter and Murray Rivers are likely to produce only one clutch per season while populations from the Macleay and Nepean Rivers can produce two, and on some occasions, three clutches annually. The majority of females would appear to reproduce every year.

Clutch mass, clutch size, and egg size varied greatly both within and among populations. A large proportion of variation in reproductive traits was due to the effects of body size. *E. m. macquarii* from large-bodied populations such as in the Brisbane and Murray Rivers produced bigger eggs than small-bodied populations. Within a population, clutch mass, clutch size, and egg size were all correlated with body size, except the Nepean River. The variability of egg size was smaller in large-bodied populations where egg size was more constant.

Not all variation in reproductive traits was due to body size. Some of this variation was due to annual differences within a population. Reproductive traits within a population are relatively plastic, most likely a result of changing environmental conditions. Another source is the trade-off between egg size and clutch size. A negative relationship was found between egg size and clutch size (except the Brisbane River). Reproductive variation was also influenced by latitudinal effects. Turtles at lower
latitudes produces more clutches, relatively smaller clutch sizes, clutch mass and larger eggs than populations at higher latitudes. Annual reproductive output is greater in tropical populations because they can produce more clutches per year in an extended breeding season.

Eggs that were incubated at warmer temperatures hatched faster and produced smaller hatchlings. Incubation temperatures above 30°C increased egg mortality and hatchling deformities, suggesting this is above the optimum developmental temperature for *E. m. macquarii*. Hatchling size was positively related to egg size, hence hatchling sizes was on average larger in the Murray and Brisbane rivers. However, population differences remained in hatchling size after adjustments were made for egg size. For example, hatchlings from the Hunter River were smaller than those from the Macleay River despite the egg size being the same. These differences were most likely due to the shorter incubation periods of hatchlings from the Hunter River.

Nepean River

The Nepean River population of *E. m. macquarii* is at the southern coastal limit of its range. This is a locally rare population, which is believed to be declining. This study aimed at determining the distribution, abundance, and population dynamics to assess whether any conservation management actions were required. *E. m. macquarii* in the Nepean River was mainly concentrated between Penrith and Nortons Basin, although even here it was found at a very low density (10.6 – 12.1 per hectare). The largest male caught was 227 mm while the largest female was 260.4 mm. Males generally mature between 140 – 150 mm in carapace length and at four or five years of age. Females mature at 185 – 195 mm and at six to seven years of age.

Compared with other populations of *E. macquarii*, Nepean River turtles grow rapidly, mature quickly, are dominated by juveniles, have a male bias and have a high reproductive output. Far from being a population on the decline, the life history traits suggest a population that is young and expanding. There are considered to be two possible scenarios as to why the Nepean River population is at such a low density when
it appears to be thriving. The first scenario is that the distribution of the population on the edge of its range may mean that a small and fluctuating population size may be a natural feature due to sub-optimal environmental conditions. A second scenario is that the population in the Nepean River has only recently become established from dumped pet turtles.
Table of Contents

Statement of Originality ii
Copyright iii
Acknowledgments iv
Abstract v
Table of Contents ix
List of Tables xiii
List of Figures xvi

CHAPTER 1

GENERAL INTRODUCTION 1
1.1 Introduction 1
1.2 Geographic variation in Australian turtles 3
1.3 Scope and aims of this thesis 6

CHAPTER 2

STUDY ANIMAL, STUDY SITES AND GENERAL METHODS 7
2.1 Study animal – *Emydura macquarii macquarii* 7
2.2 The study areas 12
   2.2.1 Brisbane River 12
   2.2.2 Macleay River 15
   2.2.3 Hunter River 15
   2.2.4 Nepean River 16
   2.2.5 Murray River 17
2.3 General methods 17
   2.3.1 Sex and Maturity Status 18
   2.3.2 Growth Rates and Size-At-Age 20
   2.3.3 Clutch Size and Clutch Frequency 21
CHAPTER 3

THE SYDNEY SHORT-NECKED TURTLE (EMYDURA MACQUARI MACQUARI)

3.1 Introduction
3.2 Materials and methods
3.3 Results
3.4 Discussion

CHAPTER 4

GEOGRAPHIC VARIATION IN BODY SIZE AND RELATED TRAITS OF EMYDURA MACQUARI

4.1 Introduction
4.2 Materials and methods
4.3 Results
4.4 Discussion

4.3.1 Body size
4.3.2 Age and size at maturity
4.3.3 Population structure
4.3.4 Growth
4.3.6 Reproduction
4.3.7 Movements and dispersal
4.3.8 Other turtle species
4.4.1 Body size
4.4.2 Population structure
4.4.3 Summary
CHAPTER 5

GEOGRAPHIC VARIATION IN REPRODUCTION

5.1 Introduction
5.2 Materials and methods
   5.2.1 Analysis
5.3 Results
   5.3.1 Date of reproduction and clutch frequency
   5.3.2 Comparison of clutch size, clutch mass and egg size between rivers
   5.3.3 Comparison in reproductive traits between years
   5.3.4 Egg shape
   5.3.5 Relationship of reproductive parameters with body size
   5.3.6 Relationship of clutch mass to clutch size, egg width and egg length
   5.3.7 Trade-off between reproductive traits and clutch size
   5.3.8 Egg component analysis
   5.3.9 Hatchling results
   5.3.10 Incubation regime
       No. Eggs
   5.3.11 Summary
5.4 Discussion
   5.4.1 Effect of body size on reproduction
   5.4.2 Other factors influencing reproductive variability
   5.4.3 Egg shape
   5.4.4 Egg components
   5.4.5 Hatchlings
   5.4.6 Summary

CHAPTER 6

SYNOPSIS

6.1 Models to explain variability
   6.1.1 Conclusions
6.2 Nepean River population
6.2.1 Management considerations 133
6.3 Further research 134

REFERENCES 137

APPENDIX A 162
APPENDIX B 163
APPENDIX C 164
List of Tables

Chapter 2

Table 2.1. Location and climate of the Brisbane, Macleay, Hunter, Nepean and Murray River study sites. .................................................................14

Chapter 3

Table 3.1. The number of times each turtle was recaptured..........................31
Table 3.2. Jolly-Seber parameter estimates for the total population, adults and juveniles at Norton's Basin.................................................................31
Table 3.3. Comparison of adult sex ratios between seasons at the Nepean River.................................................................34
Table 3.4. Number of adults and juveniles caught in each season....................34
Table 3.6. Von Bertalanffy growth parameters for male and female Emydura macquarii macquarii from the Nepean River.................................................................39
Table 3.7. Dates in which female Emydura macquarii macquarii from the Nepean River were gravid .................................................................41
Table 3.8. Summary of reproductive results of Emydura macquarii macquarii from the Nepean River .................................................................42
Table 3.9. Incubation period of eggs incubated at temperatures of 26°C, 28°C, and 30°C.................................................................42
Table 3.10. Summary of the number of recaptured individuals for each sex that were caught in the same location that they were initially captured as well as those that were not.................................................................44
Table 3.11. Comparison of the two von Bertalanffy parameters - asymptotic body size (a1) and intrinsic rate of growth (r) – and age at maturity between species of turtles.................................................................48

Chapter 4

Table 4.1. Population parameters for Emydura macquarii from the Macleay, Hunter, Nepean, Brisbane, and Murray rivers.................................................................57
Table 4.2. Comparison of adult sex ratios between rivers.................................................................60
Table 4.3. Comparison of adult sex ratios between field trips in the Hunter River.................................................................60
Table 4.4. Comparison of adult sex ratios between years at the Nepean River.................................................................60
Table 4.5. Comparison of adult growth rates of *Emydura macquarii macquarii* from the Macleay, Murray, Nepean, and Hunter Rivers. ..........................................................65

Table 4.6. The proportion of adults with annual growth rates greater than 1.0 mm for *Emydura macquarii macquarii* from the Macleay, Murray, Hunter and Nepean Rivers. ..........................................................65

Table 4.7. Comparison of the size (carapace length mm) at each age group of Murray River populations of *E. macquarii* from Chessman (1978) and this study. ..........................................................66

Table 4.8. Von Bertalanffy growth parameters for female *E. macquarii*. ..........................................................67

Table 4.9. Von Bertalanffy growth parameters for male *E. macquarii*. ..........................................................70

Table 4.10. Comparison of life-history traits from other populations of *Emydura macquarii*. ....................71

**Chapter 5**

Table 5.1. Comparison of the commencement of the breeding season among populations of *Emydura macquarii macquarii*. ..........................................................85

Table 5.2. Reproductive traits of *Emydura macquarii* from the Macleay, Hunter, Nepean, Brisbane, and Murray Rivers. ..........................................................87

Table 5.3. Results from a paired t-test analysis testing differences in reproductive traits between 1995 and 1996 for *Emydura macquarii* from the Murray River. ..........................................................90

Table 5.4. Results from a paired t-test analysis testing differences in reproductive traits between 1995 and 1996 for *Emydura macquarii* from the Macleay River. ..........................................................90

Table 5.5. Relationships of reproductive traits with female body weight for the Macleay, Hunter, Nepean, Brisbane and Murray Rivers. ..........................................................92

Table 5.6 Summary of stepwise multiple regression analysis for the dependent variable clutch mass. ....93

Table 5.7 Partial Correlation matrix of total clutch mass, egg length, egg width, egg mass and hatchling mass correlated with clutch size. Female carapace length and body weight held constant. ..........95

Table 5.8. Means ± standard errors for wet and dry weights of egg yolks and egg shells for the Macleay, Hunter, Nepean, Brisbane and Murray Rivers. ..........................................................98

Table 5.9. Proportion of lipids and protein in egg dry mass (g) from the Macleay, Hunter, Nepean, Brisbane and Murray Rivers. ..........................................................99
Table 5.10. Means ± standard errors for eggshell dry mass, eggshell percentage ash and eggshell ash expressed as the percentage of total egg dry mass for *Emydura macquarii* from the Macleay, Hunter, Nepean, Brisbane and Murray Rivers.  

Table 5.11. Size of *Emydura macquarii* hatchlings reared at 26°C and 28°C from the Macleay, Hunter, Nepean, Brisbane, and Murray Rivers.  

Table 5.12. Relationships of reproductive traits with hatchling weights for the Macleay, Hunter, Nepean, Brisbane and Murray Rivers.  

Table 5.13. Comparison of incubation periods (days) of eggs incubated at 26°C, 27°C, 28°C, 30°C and 32°C between *Emydura macquarii* from the Brisbane, Hunter, Macleay, Nepean and Murray rivers.  

Table 5.14. Comparison of hatchling deformities and the number of eggs that failed to hatch between incubation temperatures.  

Table 5.15. Comparison of the average reproductive potential between populations of *Emydura macquarii* *macquarii* as well as two populations of *Emydura macquarii krefftii* from Fraser Island and North Queensland.  

Table 5.16. Comparison of the proportion of lipids, water, eggshell, eggshell ash and energy content of eggs between *Emydura macquarii* *macquarii* and various other turtle species from North America.
List of Figures

Chapter 2

Figure 2.1. Distribution of the two subspecies of *Emydura macquarii* in Australia.................................9

Figure 2.2. Location of the drainages for populations of *Emydura macquarii macquarii* that were studied in this project..............................................................13

Figure 2.4. The marking system used in this study. ......................................................................................19

Chapter 3

Figure 3.1. Nortons Basin study site. ...........................................................................................................26

Figure 3.2. Nepean River drainage showing the location of the Nortons Basin site, as well as other locations that were surveyed for *Emydura macquarii macquarii*. ..............................................29

Figure 3.3. Size distribution of *Emydura macquarii macquarii* in the Nepean River. Data represent all individuals caught during the study period from 1995-1997 and over the study area between Penrith and Nortons Basin. ..................................................................................................................35

Figure 3.5. Average size for each age class of *Emydura macquarii macquarii* from the Nepean River. .37

Figure 3.5. Von Bertalanffy growth curves for male and female *Emydura macquarii macquarii* from the Nepean River..............................................................................................................39

Figure 3.6. Relationship of clutch size, clutch mass, egg weight, egg length, and egg width with maternal body weight. ........................................................................................................43

Chapter 4

Figure 4.1. Comparison of age distribution between the Nepean, Murray, Macleay, and Hunter rivers...61

Figure 4.2. Comparison of the size distribution between the Hunter, Murray, Brisbane, Macleay, and Nepean rivers..............................................................................................................63

Figure 4.3. Comparison of the average body size for each age group (0-7 years) between the Macleay, Hunter, Nepean and Murray Rivers.........................................................................................i

Figure 4.4. Comparison of Von Bertalanffy growth curves between the Murray, Nepean, Hunter, and Macleay rivers. ..................................................................................................................i
Chapter 5

Figure 5.1. Comparison of egg components (wet mass) between the Macleay, Hunter, Nepean, Brisbane and Murray Rivers. .................................................................................................................96