

ResearchOnline@JCU

This file is part of the following reference:

Bade, Terri Malcolm (1989) *Aspects of the biology of grunts (Teleostei : Haemulidae) from North Queensland waters*. PhD thesis, James Cook University.

Access to this file is available from:

<http://eprints.jcu.edu.au/24093/>

The author has certified to JCU that they have made a reasonable effort to gain permission and acknowledge the owner of any third party copyright material included in this document. If you believe that this is not the case, please contact ResearchOnline@jcu.edu.au and quote <http://eprints.jcu.edu.au/24093/>

ASPECTS OF THE BIOLOGY OF GRUNTS (TELEOSTEI : HAEMULIDAE)
FROM NORTH QUEENSLAND WATERS.

Thesis submitted by

Terri Malcolm BADE M.Sc., Dip.Ed. (Qld)

in June 1989.

*for the degree of Doctor of Philosophy in
the Zoology Department, School of Biological Sciences, at
James Cook University Of North Queensland.*

I, the undersigned, the author of this thesis, understand that the following restriction placed by me on access to this thesis will not extend beyond three years from the date on which the thesis is submitted to the University.

I wish to place restriction on access to this thesis as follows:

Access to be restricted to staff and students of James Cook University of North Queensland for a period of 2 years.

After this period has elapsed I understand that James Cook University of North Queensland will make it available for use within the University Library and, by microfilm or other photographic means, allow access to users in other approved libraries. All users consulting this thesis will have to sign the following statement:

"In consulting this thesis I agree not to copy or closely paraphrase it in whole or in part without the written consent of the author; and to make proper written acknowledgement for any assistance which I have obtained from it."

.....

... 1/6/89

ABSTRACT

Three species of haemulid fishes, *Pomadasys kaakan*, *P. argenteus*, and *P. maculatus*, were sampled from two sites, one inshore and one estuarine, in the Townsville region, northern Queensland. Aspects of their biology, with emphasis on feeding, reproduction, growth, and movements were studied.

It was found that all three species were primarily feeding on decapod crustaceans. However, bivalve molluscs and annelids were also important food items for these species at some times of the year.

All three species spawn over a prolonged breeding season, from about August to March, and individuals most probably spawn more than once during that period. There is a major spawning peak in spring (September - November) and a minor spawning peak in late summer/early autumn (February - March).

Two marks were laid down per year on the scales of individuals of *P. kaakan* and *P. argenteus*, corresponding with the times of the two peak spawning periods, but these are not spawning marks *per se*. The timing of mark formation suggests that it may be related to physiological changes or other events associated with reproductive development, and that one is a 'birthday' mark, laid down at the corresponding time of the year when the fish was spawned, and the second during the other peak spawning period. Individuals of *P. maculatus* larger than 100mm total length (TL) generally had a

high proportion of replacement scales, which were not useful for ageing purposes.

Individuals of each species grew rapidly over the first year, with those of *P. kaakan* and *P. argenteus* attaining average lengths of 157mm and 152mm respectively, and of *P. maculatus* an average length of 120mm. Early spawned fish grow larger than these values, due to a longer period of favourable growth conditions after being spawned, while late spawned fish grow slower and reach a smaller size. After the first year, individuals of *P. kaakan* continue to grow rapidly, approaching an estimated asymptotic length of 756mm, and a weight of 5.2kg, after 10+ years. *P. argenteus* may live to about 10 years old, but only reaches an estimated asymptotic length of 481mm and a weight of 1.6kg. Individuals of *P. maculatus* appear to be short lived, attaining approximately 60% of their growth in the first year and approaching their estimated asymptotic length of 203mm after 4 to 5 years. The weights of *P. maculatus* corresponding with the estimated asymptotic length are 143g for females and 127g for males.

Growth patterns determined from length frequency analysis, scale reading and tagging, were in close agreement, and von Bertalanffy growth equations were determined for each species.

Tagging of *P. kaakan* and *P. argenteus* indicated that most individuals of these fishes in the estuarine situation, at least up to 300mm TL, remained close to the tagging sites, with recoveries over periods as long as 517 days providing no evidence for extensive, or regular, movements.

CONTENTS

	<u>Page</u>
ABSTRACT.....	iii
CONTENTS.....	v
FIGURES.....	ix
TABLES.....	xv
PLATES.....	xvi
DECLARATION.....	xvii
ACKNOWLEDGEMENTS.....	xviii
<u>CHAPTER 1. INTRODUCTION</u>	
1.1 GENERAL INTRODUCTION.....	1
1.2 TAXONOMY.....	5
<u>CHAPTER 2. SAMPLING SITES AND GENERAL METHODS.....</u>	11
<u>CHAPTER 3. GENERAL RESULTS.....</u>	18
<u>CHAPTER 4. FOOD AND FEEDING</u>	
4.1 INTRODUCTION.....	22
4.2 METHODS.....	24
4.3 RESULTS.....	25
4.4 DISCUSSION.....	31
<u>CHAPTER 5. REPRODUCTION</u>	
5.1 INTRODUCTION.....	38

CONTENTS (Cont'd) - REPRODUCTION

	<u>Page</u>
5.2 METHODS.....	41
5.3 RESULTS	
5.3.1 Sex Ratio.....	44
5.3.2 Length at Maturity.....	46
5.3.3 Spawning.....	48
(a) Gonad Condition.....	48
(b) Larvae.....	54
(c) Rearing.....	56
5.3.4 Fecundity.....	56
5.4 DISCUSSION.....	63

CHAPTER 6. TAGGING AND MOVEMENT

6.1 INTRODUCTION.....	73
6.2 METHODS.....	76
6.3 RESULTS.....	79
6.4 DISCUSSION.....	90

CHAPTER 7. GROWTH

7.1 INTRODUCTION.....	97
7.2 METHODS.....	101
7.3 RESULTS AND DATA INTERPRETATION.....	105
7.3.1 <i>P. kaakan</i> - Barramundi Ck	
(a) Length Frequency.....	106
(b) Scale Reading.....	114

CONTENTS (Cont'd) - GROWTH - RESULTS AND DATA INTERPRETATION

	Page
(c) Tagging.....	122
7.3.2 <i>P. kaakan</i> - Cleveland Bay	
(a) Length Frequency.....	128
(b) Scale Reading.....	132
(c) Tagging.....	135
7.3.3 <i>P. argenteus</i> - Barramundi Ck	
(a) Length Frequency.....	135
(b) Scale Reading.....	143
(c) Tagging.....	149
7.3.4 <i>P. argenteus</i> - Cleveland Bay	
(a) Length Frequency.....	154
(b) Scale Reading.....	159
7.3.5 <i>P. maculatus</i> - Cleveland Bay	
(a) Length Frequency.....	161
(b) Scale Reading.....	167
7.3.6 Determination of Asymptotic Lengths by Walford Plots.....	170
7.3.7 von Bertalanffy Growth Equations	
(a) <i>P. kaakan</i>	172
(b) <i>P. argenteus</i>	175
(c) <i>P. maculatus</i>	177
7.3.8 Length - Weight Relationships.....	178
(a) <i>P. kaakan</i>	180
(b) <i>P. argenteus</i>	180

CONTENTS (Cont'd) - GROWTH - Length - Weight Relationships

	<u>Page</u>
(c) <i>P. maculatus</i>	181
7.3.9 Length - Length Relationships.....	181
(a) <i>P. kaakan</i>	181
(b) <i>P. argenteus</i>	182
(c) <i>P. maculatus</i>	182
 7.4 DISCUSSION	
7.4.1 <i>P. kaakan</i>	182
7.4.2 <i>P. argenteus</i>	187
7.4.3 <i>P. maculatus</i>	189
7.4.4 General.....	193
 CHAPTER 8. CONCLUDING COMMENTS AND RECOMMENDATIONS.....	202
 REFERENCES.....	207
 APPENDIX 1. TAG RECOVERY DATA.....	221
Table A1. <i>P. kaakan</i>	222
Table A2. <i>P. argenteus</i>	227

FIGURES

	<u>Page</u>
Fig. 1. Map showing the relationship of the study sites, (a) Cleveland Bay and (b) Barramundi Creek, to Townsville.....	12
Fig. 2. Map of the Barramundi Creek (site b) sampling area, showing tagging and recapture sites.....	13
Fig. 3. Temperature of near surface water for Cleveland Bay over 24 months (1981 and 1982).....	19
Fig. 4. Salinity of near surface water for Cleveland Bay over 24 months (1981 and 1982).....	19
Fig. 5. Temperature of near surface water for Barramundi Creek over 24 months (1984 and 1985).....	20
Fig. 6. Salinity of near surface water for Barramundi Creek over 24 months (1984 and 1985).....	20
Fig. 7. Percent of mature fish in each size group, for <i>P. kaakan</i> and <i>P. argenteus</i> from Cleveland Bay and Barramundi Creek and for <i>P. maculatus</i> from Cleveland Bay.....	47
Fig. 8. Percent of monthly samples of female <i>P. kaakan</i> from Cleveland Bay and Barramundi Creek, with a gonad condition stage (GS) greater than 0.....	50
Fig. 9. Number of fish in monthly samples of female <i>P. argenteus</i> from Cleveland Bay and Barramundi Creek, with a gonad condition stage (GS) greater than 0.....	52

FIGURES - Cont'd

	<u>Page</u>
Fig. 10. Percent of monthly samples of female <i>P. maculatus</i> from Cleveland Bay, with a gonad condition stage (GS) greater than 0.....	53
Fig. 11. Distribution of different ova sizes within selected ovaries from three species of <i>Pomadasy</i> s.....	59
Fig. 12. Growth in length of tagged <i>P. kaakan</i> from Barramundi Creek, less than 300mm TL at release and free between 28 days and 100 days.....	85
Fig. 13. Growth in length of tagged <i>P. argenteus</i> from Barramundi Creek, less than 300mm TL at release and free between 28 days and 100 days.....	86
Fig. 14. Mean growth per day for recaptured tagged <i>P. kaakan</i> from Barramundi Creek.....	88
Fig. 15. Mean growth per day for recaptured tagged <i>P. argenteus</i> from Barramundi Creek.....	89
Fig. 16. Length frequency histograms of <i>P. kaakan</i> caught from Barramundi Creek each month in 1982, with tag recovery data superimposed.....	107
Fig. 17. Length frequency histograms of <i>P. kaakan</i> caught from Barramundi Creek each month in 1983, with tag recovery data superimposed.....	108
Fig. 18. Length frequency histograms of <i>P. kaakan</i> caught from Barramundi Creek each month in 1984, with tag recovery data superimposed.....	109

FIGURES - Cont'd

	<u>Page</u>
Fig. 19. Likely separation of year classes for <i>P. kaakan</i> from Barramundi Creek.....	113
Fig. 20. Back-calculated lengths at mark formation on the scales of 593 <i>P. kaakan</i> from Barramundi Creek.....	116
Fig. 21. Back-calculated lengths at mark formation for the first four marks on the scales of <i>P. kaakan</i> from Barramundi Creek, with males and females figured separately.....	117
Fig. 22. Proportion of scales, from each monthly sample of <i>P. kaakan</i> , with a mark close to the edge corresponding with less than 10mm in back-calculated length since mark formation.....	118
Fig. 23. Average growth per month and number of recaptures for tagged <i>P. kaakan</i> , less than 300mm in length at release and free for 28-100 days, from Barramundi Creek.....	127
Fig. 24. Length frequency histograms of <i>P. kaakan</i> trawled from Cleveland Bay each month in 1981, and collected by small mesh beach seine from Pallarenda in 1984.....	129
Fig. 25. Length frequency histograms of <i>P. kaakan</i> trawled from Cleveland Bay each month in 1982, and collected by small mesh beach seine from Pallarenda in 1985.....	130

FIGURES - Cont'd

	<u>Page</u>
Fig. 26. Likely separation of year classes for <i>P. kaakan</i> from Cleveland Bay.....	131
Fig. 27. Back-calculated lengths at mark formation on the scales of 477 <i>P. kaakan</i> from Cleveland Bay.....	133
Fig. 28. Length frequency histograms of <i>P. argenteus</i> caught from Barramundi Creek each month in 1982, with tag recovery data superimposed.....	136
Fig. 29. Length frequency histograms of <i>P. argenteus</i> caught from Barramundi Creek each month in 1983, with tag recovery data superimposed.....	137
Fig. 30. Length frequency histograms of <i>P. argenteus</i> caught from Barramundi Creek each month in 1984, with tag recovery data superimposed.....	138
Fig. 31. Likely separation of year classes for <i>P. argenteus</i> from Barramundi Creek.....	140
Fig. 32. Back-calculated lengths at mark formation on the scales of 351 <i>P. argenteus</i> from Barramundi Creek.....	144
Fig. 33. Back-calculated lengths at mark formation for the first four marks on the scales of <i>P. argenteus</i> from Barramundi Creek, with males and females figured separately.....	145

FIGURES - Cont'd

	<u>Page</u>
Fig. 34. Proportion of scales, from each monthly sample of <i>P. argenteus</i> , with a mark close to the edge corresponding with less than 10mm in back-calculated length since mark formation.....	147
Fig. 35. Average growth per month and number of recaptures for tagged <i>P. argenteus</i> , less than 300mm in length at release and free for 28-100 days, from Barramundi Creek.....	151
Fig. 36. Length frequency histograms of <i>P. argenteus</i> trawled from Cleveland Bay each month in 1981, and collected by small mesh beach seine from Pallarenda in 1984.....	155
Fig. 37. Length frequency histograms of <i>P. argenteus</i> trawled from Cleveland Bay each month in 1982, and collected by small mesh beach seine from Pallarenda in 1985.....	156
Fig. 38. Likely separation of year classes for <i>P. argenteus</i> from Cleveland Bay.....	157
Fig. 39. Back-calculated lengths at mark formation on the scales of 275 <i>P. argenteus</i> from Cleveland Bay.....	160
Fig. 40. Length frequency histograms of <i>P. maculatus</i> trawled from Cleveland Bay each month in 1981, and collected by small mesh beach seine from Pallarenda in 1984.....	162

FIGURES - Cont'd

	<u>Page</u>
Fig. 41. Length frequency histograms of <i>P. maculatus</i> trawled from Cleveland Bay each month in 1982, and collected by small mesh beach seine from Pallarenda in 1985.....	163
Fig. 42. Likely separation of year classes for <i>P. maculatus</i> from Cleveland Bay.....	165
Fig. 43. Back-calculated lengths, at the time of scale replacement and of mark formation, for 76 <i>P. maculatus</i> from Cleveland Bay.....	168
Fig. 44. Walford Plot of length at age (t + 1) against length at age (t), for <i>P. kaakan</i> , <i>P. argenteus</i> , and <i>P. maculatus</i>	171
Fig. 45. von Bertalanffy growth curve for <i>P. kaakan</i> from Barramundi Creek.....	174
Fig. 46. von Bertalanffy growth curve for <i>P. argenteus</i> from Barramundi Creek.....	176
Fig. 47. von Bertalanffy growth curve for <i>P. maculatus</i> from Cleveland Bay.....	179

TABLES

	<u>Page</u>
<u>Table 1(a).</u> Gut contents of <i>Pomadasys kaakan</i> and <i>P. argenteus</i> (larger than 150mm TL) from two sites and <i>P. maculatus</i> (larger than 100mm TL) from one site.....	26
<u>Table 1(b).</u> Gut contents of <i>Pomadasys kaakan</i> and <i>P. argenteus</i> between 50mm TL and 100mm TL and <i>P. maculatus</i> between 25mm TL and 75mm TL from Cleveland Bay.....	27
<u>Table 2.</u> Percentage of males and females of <i>P. kaakan</i> , <i>P. argenteus</i> , and <i>P. maculatus</i> in samples from Cleveland Bay and Barramundi Creek.....	45
<u>Table 3.</u> Estimated fecundities of <i>P. kaakan</i> , <i>P. argenteus</i> , and <i>P. maculatus</i> for a range of lengths.....	57
<u>Table 4.</u> Number of fish tagged, recovery rate and known loss rate for <i>Pomadasys</i> tagged at Barramundi Creek.....	80
<u>Table 5.</u> Freedom time distribution of recaptured tagged <i>P. kaakan</i> and <i>P. argenteus</i> from Barramundi Creek.....	83

PLATES

	<u>Page</u>
<u>Plate 1.</u> <i>Pomadasys kaakan</i> (198mm TL).....	6
<u>Plate 2.</u> <i>Pomadasys argenteus</i> (203mm TL).....	6
<u>Plate 3.</u> <i>Pomadasys maculatus</i> (160mm TL).....	7
<u>Plate 4.</u> <i>Pomadasys trifasciatus</i> (120mm TL).....	7
<u>Plate 5.</u> Typical habitat at Barramundi Creek, site (b).....	16
<u>Plate 6.</u> <i>Pomadasys</i> larva (3.0mm TL) collected off Saunders Beach, just north of Townsville.....	55
<u>Plate 7.</u> Transverse section of a mature (Gonad Stage 3) ovary from <i>P. kaakan</i>	60
<u>Plate 8.</u> Transverse section of a mature (Gonad Stage 3) ovary from <i>P. argenteus</i>	60
<u>Plate 9.</u> Transverse section of a mature (Gonad Stage 3) ovary from <i>P. maculatus</i>	61
<u>Plate 10.</u> Floy FD-68BC anchor tag and modified one-piece 'clothes' tag in place on a recaptured <i>P. kaakan</i>	77
<u>Plate 11.</u> Scale of a 200mm TL <i>P. argenteus</i> , showing two marks.....	103
<u>Plate 12.</u> Magnification of a mark on the scale of <i>P. argenteus</i>	103
<u>Plate 13.</u> Replacement scale of a 160mm TL <i>P. maculatus</i>	104

DECLARATION

I declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

T. M. BADE.

1 June, 1989.

ACKNOWLEDGEMENTS

I wish to express thanks to my supervisor, A/Prof. Norm Milward, for his assistance with the field work involved in this study, for his guidance and suggestions during the study, and for his constructive criticism of drafts of this thesis.

I also wish to thank Mr. Dave Duncan, Mr. John Barnett, and the crew of the R.V. "James Kirby", for their helpfulness and interest during the sampling in Cleveland Bay.