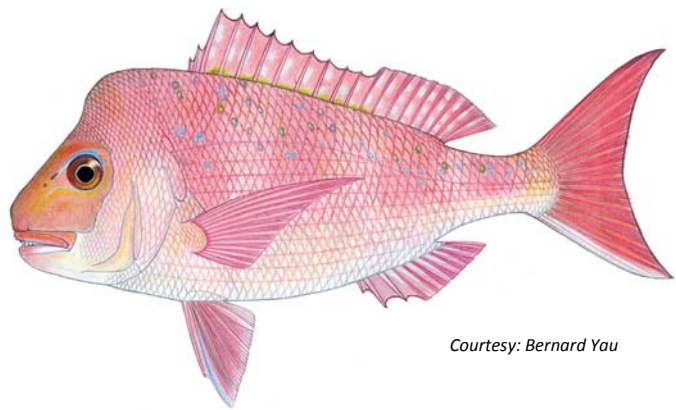


Size and age at sexual maturity of snapper *Pagrus auratus* in New South Wales 2008/09

by
John Stewart, Kevin Rowling, Anne-Marie Hegarty and Alexandra Nuttall



Courtesy: Bernard Yau

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NON-TECHNICAL SUMMARY

The length and age at sexual maturity of snapper, *Pagrus auratus*, was investigated during the 2008 spawning season at several locations along the NSW coast. Sexual maturity was estimated through macroscopic staging of ovaries and testes and calculation of the Gonadosomatic Index. The results showed no differences between the sizes and ages at sexual maturity between males and females. Overall, snapper matured at approximately 24.8 cm fork length (~ 29 cm total length) and at 2.5 years of age. However, significant latitudinal differences were detected with snapper from the northern group (Coffs Harbour) maturing at a significantly smaller size (21.8 cm fork length, ~ 26 cm total length) and age (1.7 years) than snapper from the southern group (Forster to Greenwell point) (27.3 cm fork length, ~ 32 cm total length and 3 years).

Comparison with research done during the early 1990s showed no change in either the size or age at maturity of snapper from the northern area. However, these sizes and ages were substantially smaller and younger than those estimated for snapper from Coffs Harbour during the mid 1980s. The 1980s study, when re-analysed, showed that 50% of snapper from Coffs Harbour matured at 5.8 years of age and the length at first maturity was 28 cm fork length. The age at 50% maturity of 5.8 years corresponds to a length of approximately 39 cm fork length. The length at sexual maturity for snapper was also estimated using an empirical equation that relates length at maturity to their asymptotic length. This equation resulted in an estimate of 42.3 cm fork length which is only slightly larger than the length at 50% maturity based on the age at 50% maturity during the mid 1980s.

These results suggest at sometime between the mid 1980s and the early 1990s snapper from Coffs Harbour northwards started to mature at smaller sizes and younger ages. This period was associated with a rapid decline in commercial landings and the change in when sexual maturity occurs may have been a response to exploitation. The results presented in this report suggest that spatial management based on reproductive characteristics of snapper in New South Wales could be considered, and that further work is needed to investigate the effects that an earlier onset of sexual maturity may have on the resilience of the snapper stock.

1. INTRODUCTION

Size and age at maturity are important factors when considering management strategies for commercially and recreationally harvested fish species. Both size and age at maturity influence population fitness through determining when during the life-history that reproduction occurs (Perrin and Rubin, 1990). Reduced size and age at maturity are the principal life history changes due to fishing pressure (Hart and Reynolds, 1999), with large, late-maturing fish being the most vulnerable to exploitation. In fish, the trade-off between reproduction and growth is potentially critical as female fecundity is a function of body size. Understanding the reproductive biology of exploited fish species is fundamental to assessing and managing sustainable fisheries. As an example, management to ensure sufficient spawning stock exists to replenish a population may be based on the sizes that fish mature. Minimum legal lengths are one management tool that may be used to achieve this.

Pagrus auratus, commonly referred to as snapper in the southern hemisphere, is distributed in the indo-pacific region from Japan and the Philippines to India and Indonesia, and New Zealand (Macdonald, 1982). In Australia, snapper are found in sub-tropical and temperate regions from Hinchinbrook Island in Queensland, throughout southern mainland Australian waters, to Barrow Island in Western Australia (Wakefield, 2006). Snapper are a predatory demersal fish, with juveniles inhabiting the mud banks and seagrass beds of shallow estuaries and adults being found in depths more than 200m on the continental shelf (Macdonald, 1982). Snapper are opportunistic feeders, occupying a broad feeding niche with low prey selectivity (Godfriaux, 1969). They are a long-lived species with Australian snapper exceeding 40 years of age and 120cm in length, while New Zealand animals reportedly live up to 60 years (Macdonald, 1982).

Several different stocks have been identified within the geographic distribution across western, southern and eastern Australia as well as New Zealand. Some genetic sub-structuring is thought to exist within the Western Australian and Southern Australian populations however east coast snapper populations most likely constitute a single stock (Ferrell and Sumpton, 1995). Further genetics research on eastern populations is required to definitively conclude that one single stock is present. The majority of snapper on the east coast are locally resident on a broad scale (Sumpton *et al.*, 2008), although a small proportion exhibit migratory behaviour (Sanders, 1974). Tagging studies support this conclusion, with adult snapper tagged in southern NSW being recaptured as far north as Byron Bay (Sanders, 1974). The small proportion of the adult population that undergoes extensive migration also facilitates genetic mixing (Sumpton *et al.*, 2003).

Like other fish of the family Sparidae, snapper display hermaphroditism; however they are classed as rudimentary hermaphrodites or 'late' gonochorists (Buxton and Garratt, 1990). Juveniles possess reproductive tissues of both sexes, with permanent male or female sexual dominance achieved at maturity (Brouwer and Griffiths, 2005). Vestigial remnants of the recessive sexual tissue remain after reaching maturity. Snapper are serial spawners, with individuals spawning repeatedly throughout a season (Wakefield, 2006). Spawning patterns of snapper vary across latitudinal locations (Macdonald, 1982) suggesting that temperature and day length may be a driving force in these patterns. Observations by Crossland (1977) suggest that gonad maturation and subsequent spawning activity occur at various locations within the distribution of snapper in Australia. The physiological requirements of snapper during reproduction are possibly a determining factor in their distribution and spawning timing. A minimum of 18°C surface water temperature is needed to induce spawning activity; coincidentally the maximum summer temperature of their southernmost distribution is 18°C (Cassie, 1956).

The fecundity of female snapper, like most fish, is linked to size (length/weight). Alterations in nutrition can either depress or enhance the fecundity or gamete production in female fishes (Hutchings, 1999). Therefore, the timing of sexual maturation is more closely linked to size rather than age. Snapper are considered to be a fecund species with no parental care. Studies (Kalmer,

2006) suggest that although females may mature at shorter lengths (depending on location), the number, size and quality of the eggs is far lower than that of the larger mature females from the same population.

The east coast snapper stock is in a depressed state. In NSW and Queensland snapper are listed as being growth-overfished and there is strong evidence that the stock has been over-exploited (Allen *et al.*, 2006). In NSW snapper are commercially and recreationally targeted due to their high value as a sports fish and their palatability on both the local and international market. The annual recreational harvest of snapper in NSW is thought to be between 180 and 250 t (Scandol *et al.*, 2008) and is similar to the commercial harvest. Almost all (97%) of commercially landed snapper in NSW are caught in the Ocean Trap & Line Fishery with the majority being caught in fish traps.

Snapper in NSW are managed through a minimum legal length of 30 cm total length (TL) and a recreational bag limit of 10 per person. The minimum legal length was increased from 28cm TL to 30cm TL in July 2001; however a planned further increase to 32cm has not occurred despite positive outcomes following the initial 2 cm increase (Gale *et al.*, 2007).

Little information exists regarding the sexual maturity of snapper in NSW, with far more research having been done in other Australian states. Size and age at maturity varies among states, with state-specific studies contributing towards legal size limits of snapper (Table 1).

Table 1. State-specific age and size at maturity estimates of snapper with minimum legal lengths.

Location	Age ₅₀ (years)	Fork Length ₅₀ (cm)	Minimum legal length (Total Length in cm)	References
NSW	2–5	22	30	Ferrell & Sumpton (1995)
Queensland	2–5	22–30	35	Ferrell & Sumpton (1995)
Victoria	3–4	Males – 27 Females – 25	27	McDonald (1982)
SA	Data unavailable	28	38	Primary Industries and Resources SA
WA (northern)	4	Males – 37.8 Females – 35.3	Carnarvon – 50	Wakefield (2006)
WA (southern)	5.6 – 7.0	Males – 58.5 Females – 56.6	Perth – 41 Wilson’s Inlet – 28	Wakefield (2006)

Snapper off the east coast are reported to spawn during winter/spring (Ferrell and Sumpton, 1995); however the peak times almost certainly vary with latitude. A previous study (Henry, unpublished report) revealed a 3 month spawning period at Coffs harbour from July to September, peaking during August.

Unfortunately, size at sexual maturity has not been well documented along the east coast of Australia. The most recent estimate is from snapper in Queensland (Ferrell and Sumpton, 1995) who did not sample fish during the spawning period specifically to estimate size at maturity. They reported that 50% of snapper were mature at 22cm FL (~25cm TL) and two years of age and that all fish were mature by 33cm FL and five years old (Fig. 1). Historical data (Fairbridge, 1943) (unseen but referenced in Macdonald, 1982) reports that first maturity of NSW snapper in the early

nineteen fourties was at 30cm length to caudal fork). Extensive (200 fish per month for 24 months) macroscopic gonad staging of snapper done during the 1980s from Coffs Harbour showed that maturity was first observed at age 4 (26 to 29.5 cm FL) and that all fish greater than 9 years old were mature (Henry, unpublished report).

Historically, commercial landings of snapper varied between approximately 600 and 800 tonnes p.a., however landings increased during the 1970s and early 1980s to peak at 950 tonnes in 1983. Since that time the commercial landings of snapper have declined markedly and have averaged around 250 t p.a. since 1998 (Fig. 2). Given the high exploitation of snapper during the previous century and the lack of current information on size or age at sexual maturity in NSW, this study aims to estimate the size and age at sexual maturity for snapper in NSW. In addition, unpublished data from the 1980s (Henry, unpublished report) is re-analysed to examine changes in the size/age at maturity since that time.

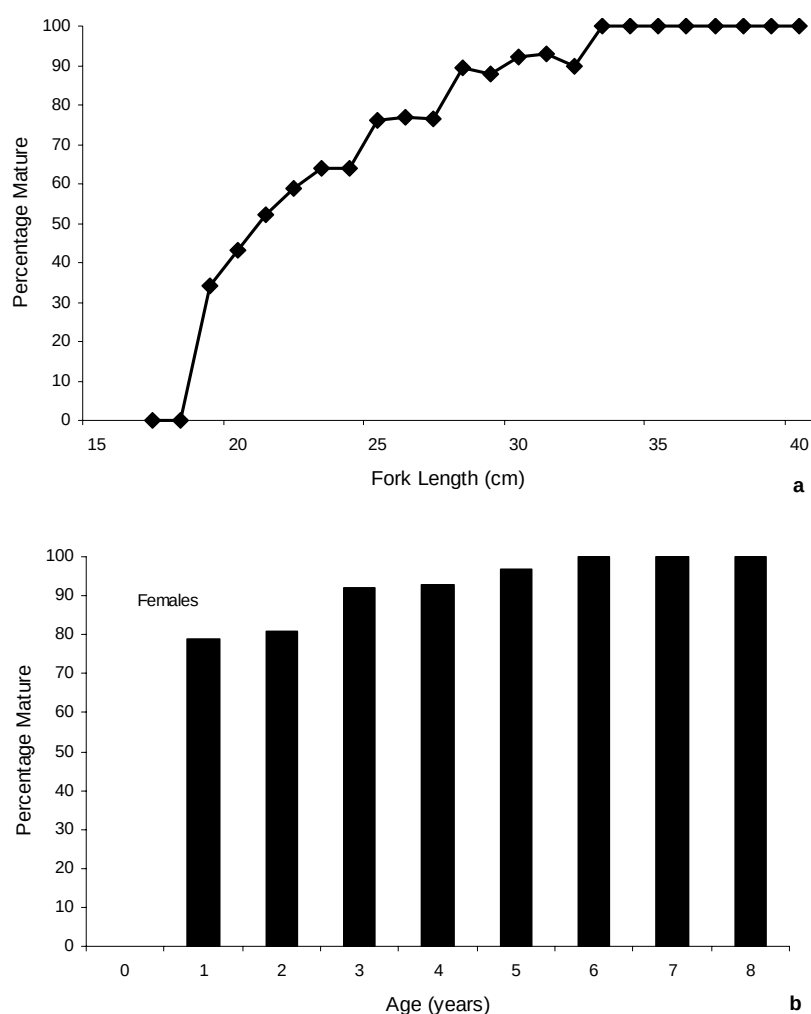


Figure 1. Size (a) and age (b) at maturity estimates for Queensland female snapper from Ferrell and Sumpton (1995).

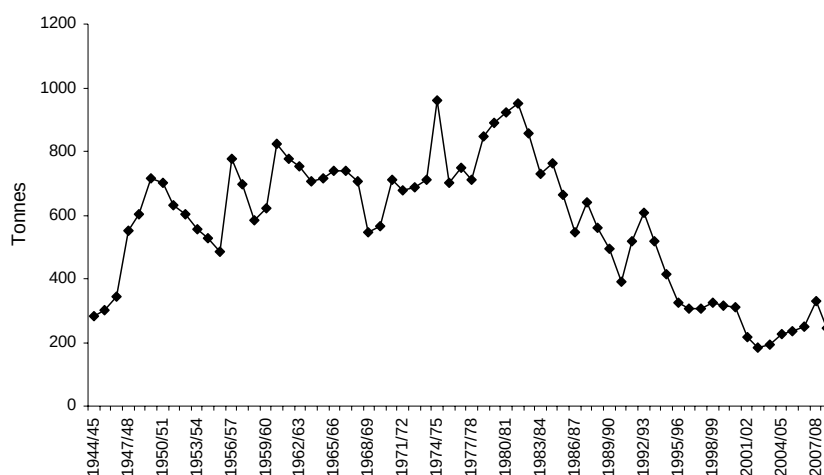


Figure 2. Historical commercial landings data for snapper in NSW.

2. MATERIALS AND METHODS

2008 sampling

Snapper were sampled between August and November 2008 to assess their sizes and ages at sexual maturity. Ports sampled were Coffs Harbour, Hastings River, Forster, Sydney and Greenwell Point. Most fish were sampled at fishermen's co-operatives or the Sydney Fish Markets; however snapper smaller than the minimum legal length of 30 cm TL were obtained by observers onboard commercial vessels.

Each fish had data on its length (FL), weight, sex, gonad weight and stage recorded and had its otoliths removed for age estimation. The gonadosomatic index (GSI) was calculated for each fish as gonad weight as a percentage of body weight. Gonads were assessed according to the staging schedule adopted from Brouwer and Griffiths (2005) for sparids (Table 1). To ensure consistency in macroscopic staging between researchers at different locations, photographs of representative samples were taken and sent to the Cronulla Fisheries Research Centre for checking.

Fish with stage 1 or 2 gonads were considered not capable of spawning during the 2008 reproductive season and were classed as immature.

Table 2. Macroscopic criteria used to stage snapper gonads.

Reproductive Stage	Males	Females
1. Immature	Testes thin, translucent, flattened	Ovary thin, translucent pink, oocytes not visible.
2. Developing/Resting	<u>Developing</u> : Testes obvious, larger than stage 1. <u>Resting</u> : May contain some residual fluid, judged to have spawned in previous season.	<u>Developing</u> : Ovary large, thick walled, but ova not visible. <u>Resting</u> : Judged to have spawned in previous season.
3. Maturing	Testes enlarged, opaque white.	Ovary enlarged, orange, oocytes clearly visible (some may contain hydrating eggs).
4. Running Ripe	Testes large, free flowing milt.	Ovary dominated by hydrated eggs, flow freely under pressure.
5. Spent	Testes flaccid, may contain blood or fluid, grey in colour, some residual sperm may be present.	Ovary dark orange/red, bloodshot, few hydrated eggs remain.

Estimates of age were made from sectioned otoliths removed from all samples in this study. Each otolith was weighed with one of the pair being embedded in resin. Transverse sections of each otolith were taken through the core, with sections then mounted on glass microscope slides. Sections were viewed using a compound microscope with reflected light. Opaque zones were counted and measurements were then made from the core to each opaque zone and to the otolith edge (Fig. 3).

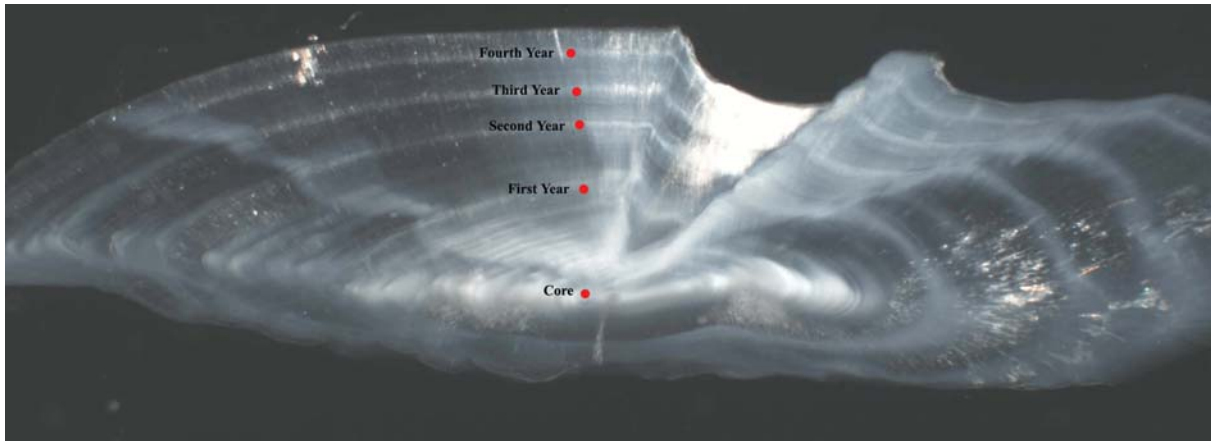


Figure 3. Sectioned otolith of a male snapper, 26.7 cm fork length from Sydney. It was 4 years old and had immature stage 2 testes.

Data Analyses

To examine latitudinal variation in size at maturity the data from the sampling locations of Greenwell Point, Sydney, Forster and Hastings River were pooled into a southern latitudinal group, while Coffs Harbour was considered as the northern latitudinal group.

A logistic regression model was used to test the effect of 4 variables on the binary variable ‘maturity’ (Y_i) of individual snapper (i.e., either mature or immature). These variables were: length, sex, age and latitude.

The models were:

$$\text{logit}(Y_i) = a + b \cdot \text{length}_i + c \cdot \text{latitude}_i + d \cdot \text{sex}_i + e_i$$

$$\text{logit}(Y_i) = a + b \cdot \text{age}_i + c \cdot \text{latitude}_i + d \cdot \text{sex}_i + e_i$$

where a to d are constants.

The model was calculated using the freeware statistical package “R” (R Development Core Team 2006). General linear models predicting maturity using the above variables were fitted within “R” using the `glm` (family = binomial) function.

The significance of each variable to the model was tested using the null hypothesis that they were significantly different from 0 using partial z-tests. Variables that were non-significant were removed and a reduced model refitted. The influence of each variable on the reduced model was assessed using the `drop1()` function within “R”. This function calculates an Akaike Information Criteria (AIC) value for the reduced model and for the model without each variable. Variables with the greatest corresponding AIC value influence the model the most. Data were pooled based on the results of the logistic regression analyses and a simple logistic curve was fitted to estimate the size and age at 50% maturity.

1980s sampling

Snapper were sampled for assessment of their reproductive biology during the mid 1980s from Coffs Harbour by NSW Fisheries (Henry, unpublished report). The sampling included macroscopic staging of 200 snapper each month from commercial landings for 24 months. The macroscopic staging schedule used was comparable to that used during 2008. In addition, the GSI was determined for each fish sampled through a 15 month period between January 1986 and March 1987. The raw data on macroscopic gonad staging were unavailable; however a summary table of maturity and age was available from the draft of a chapter on reproductive biology.

A logistic curve was fitted to this age and maturity data, as described above. The raw GSI data was available in MS Excel[®] spreadsheets.

Estimating size and age at maturity from empirical relationships

The onset of sexual maturity is related to fish size rather than age (Jobling, 2002) and we used the empirical relationship between length at first maturity and asymptotic length (L_{∞}) derived by Froese and Binohlan (2000) to estimate the size at maturity for snapper in eastern Australia. This empirical equation was determined using 467 pairs of size at maturity and L_{∞} , mostly for perciform fishes.

The empirical equation used to estimate the mean size at first maturity was:

$$\text{Log}_{10}L_m = 0.8979 * \text{Log}_{10}L_{\infty} - 0.0782$$

The parameters for growth we used were for snapper in Queensland (Sumpton, 2002) that are used in current stock assessments (Allen *et al.*, 2006) and were: $L_{\infty} = 79.2$ cm FL, $K = 0.082$ years⁻¹, $T_0 = -2.45$ years.

3. RESULTS

A total of 701 snapper were assessed for their reproductive condition: 326 from Coffs Harbour (134 males and 192 females); 7 from Hastings River (4 males and 3 females); 243 from Forster (3 juveniles, 99 males and 141 females); 74 from Sydney (41 males and 33 females), and; 51 from Greenwell point (5 juveniles, 22 males and 24 females).

Gonadosomatic indices

GSI values during the 2008 sampling of $> 1.5\%$ were associated with macroscopic stages of greater than 2 and were therefore classified as mature fish. These elevated GSI levels were first observed in fish from the northern group at 22 cm FL and in fish from the southern group at 24 cm (Fig. 4). There was a trend for GSI levels of $> 1.5\%$ to be observed in smaller fish from the north than in fish from the south.

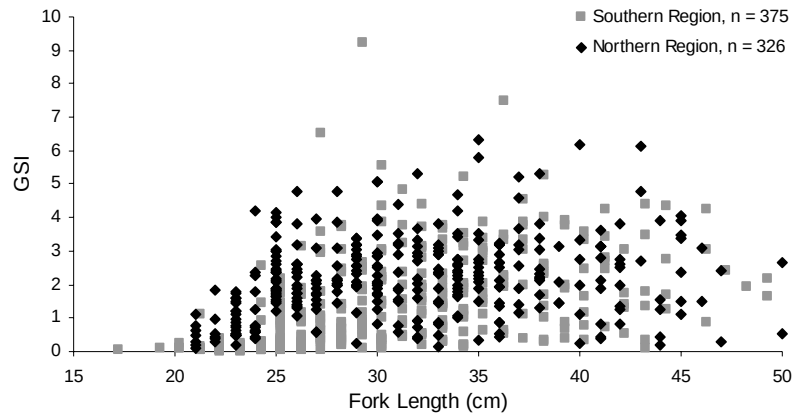


Figure 4. Gonadosomatic index data versus fish length (fork length cm) for the northern and southern latitudinal groups. Note that the lengths for the southern latitudinal group have been offset by 0.25 for clarity.

GSI values from fish sampled during 1986/87 from Coffs Harbour indicated that levels of $> 1.5\%$ were not observed in fish less than 28 cm FL.

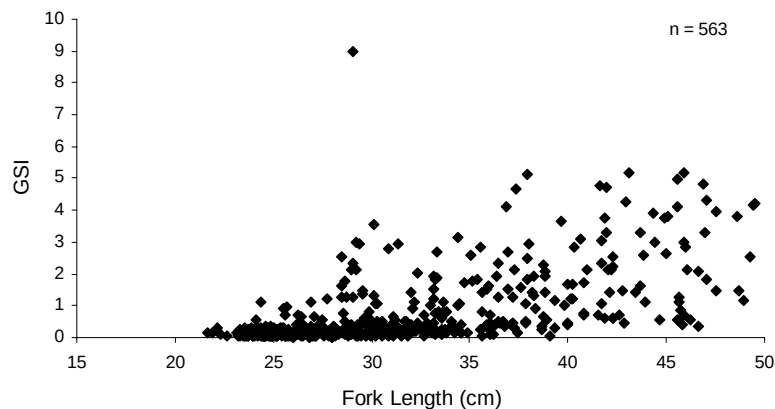


Figure 5. Gonadosomatic index data versus fish length (fork length cm) for snapper sampled from Coffs Harbour during 1986/87.

Macroscopic staging

Macroscopic stages were assigned to all snapper based on Table 2 and examples are provided in Figs. 6 and 7. The ages of 690 of these snapper were estimated from their sectioned otoliths.



Figure 6. Example of macroscopic gonad stages for male snapper.



Figure 7. Example of macroscopic gonad stages for female snapper.

Length

Snapper from both latitudinal groups were of similar sizes and ranged between 17 and 69 cm FL (Fig. 8). The proportion of snapper that were assessed as being mature in each 1 cm length class showed considerable variation (Fig. 9). There was a general pattern of an increasing proportion of mature snapper from all locations between approximately 21 and 34 cm FL; however many larger fish, especially from the northern group, were assessed as being immature. There was some evidence that a greater proportion of small fish (21 to 24 cm FL) from the northern group were mature than from the other regions. The data collected from the northern group had no length classes that were 100% immature (smallest length class 21 cm FL) and a general decline in the proportion of fish assessed as being mature beyond 30 cm FL.

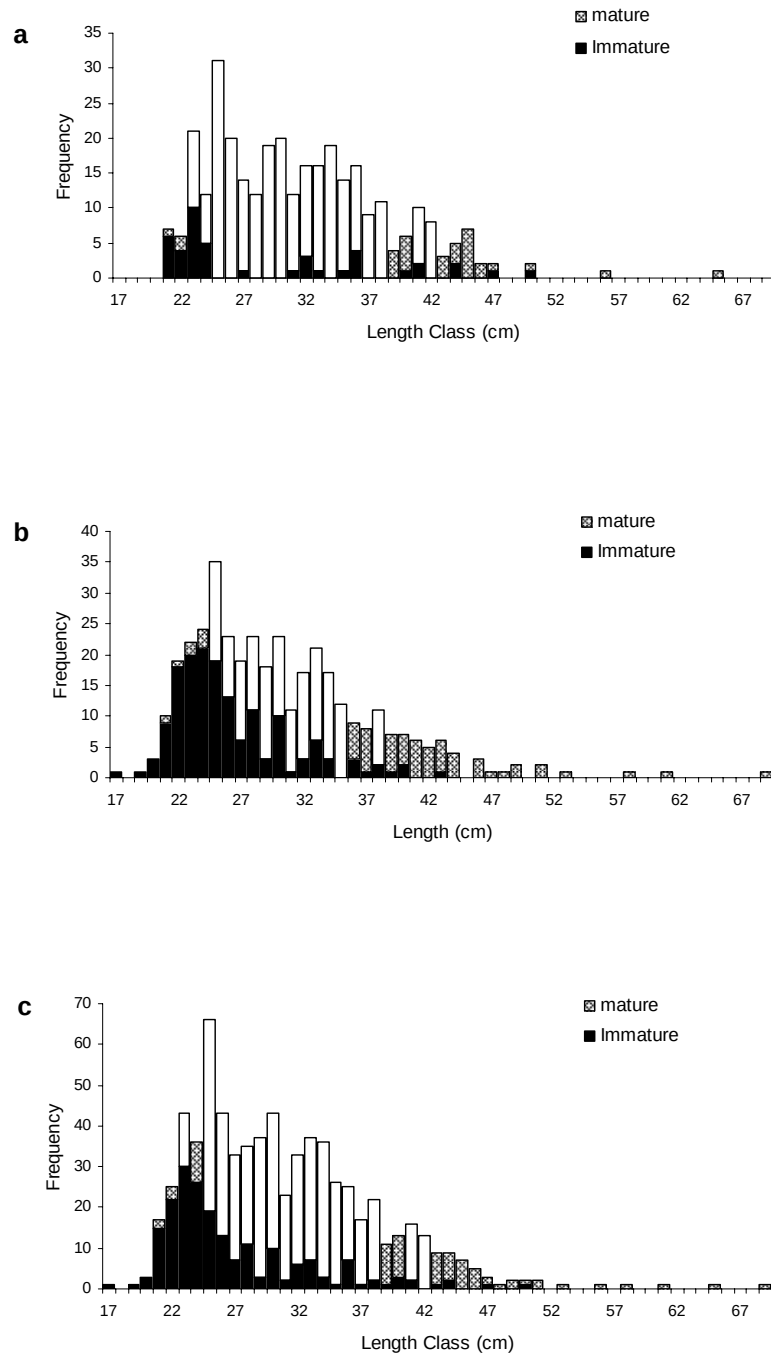


Figure 8. Snapper maturity frequencies in each 1 cm length class from different latitudinal groups: Coffs Harbour (a), Southern Region (b) and all locations combined (c).

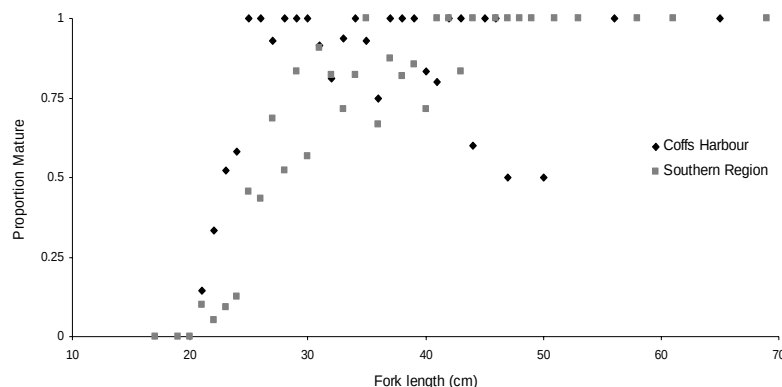


Figure 9. The proportion of snapper originally assessed as being mature in each 1 cm length class from each latitudinal group.

Age

Snapper from both latitudinal groups were of similar ages and ranged between 1 and 13 years old (Fig. 10). The proportion of snapper that were assessed as being mature in each year class increased with age, with some 1 year old fish being mature. The proportion of snapper aged 2 years that were mature was greater at Coffs Harbour (52%) than in the southern latitudinal group (19.5%).

Unfortunately, the distribution of the data from the northern latitudinal group precluded fitting logistic curves due to substantial proportions of larger and older fish being assessed as immature (see Figs. 8, 9 and 10). It has recently been demonstrated that determining maturity of snapper based only on the macroscopic appearance of the gonads is difficult and that histological analysis is the only way to definitely determine whether a fish is mature (Mackie *et al.*, 2009). Mackie *et al.* (2009) showed that for snapper in Western Australia it was difficult to distinguish macroscopically between mature fish that had finished spawning for the season (stage 5 or resting) from those that were immature (stage 2 or developing). Given this recent knowledge we believe that the larger fish assessed as being stage 2 (immature) in our study were probably mature fish that had finished spawning for the season. Therefore, to facilitate fitting logistic curves to the maturity versus length and age data we analysed the data by changing the maturity classification of large fish from immature to mature. After examining the distribution of the data and based on the assumption that the data should be roughly logistic in shape (symmetrical about the L50) we assumed that all snapper greater than 35 cm FL were mature (see Fig. 9). The 22 samples changed for the analysis (3.1% of fish) are highlighted in Appendix 1. Note that the original analyses were done on the unchanged data and the mean size and age at maturity were largely unaffected by changing the maturity score of 22 larger fish. The change did, however, allow us to fit maturity ogives to the data.

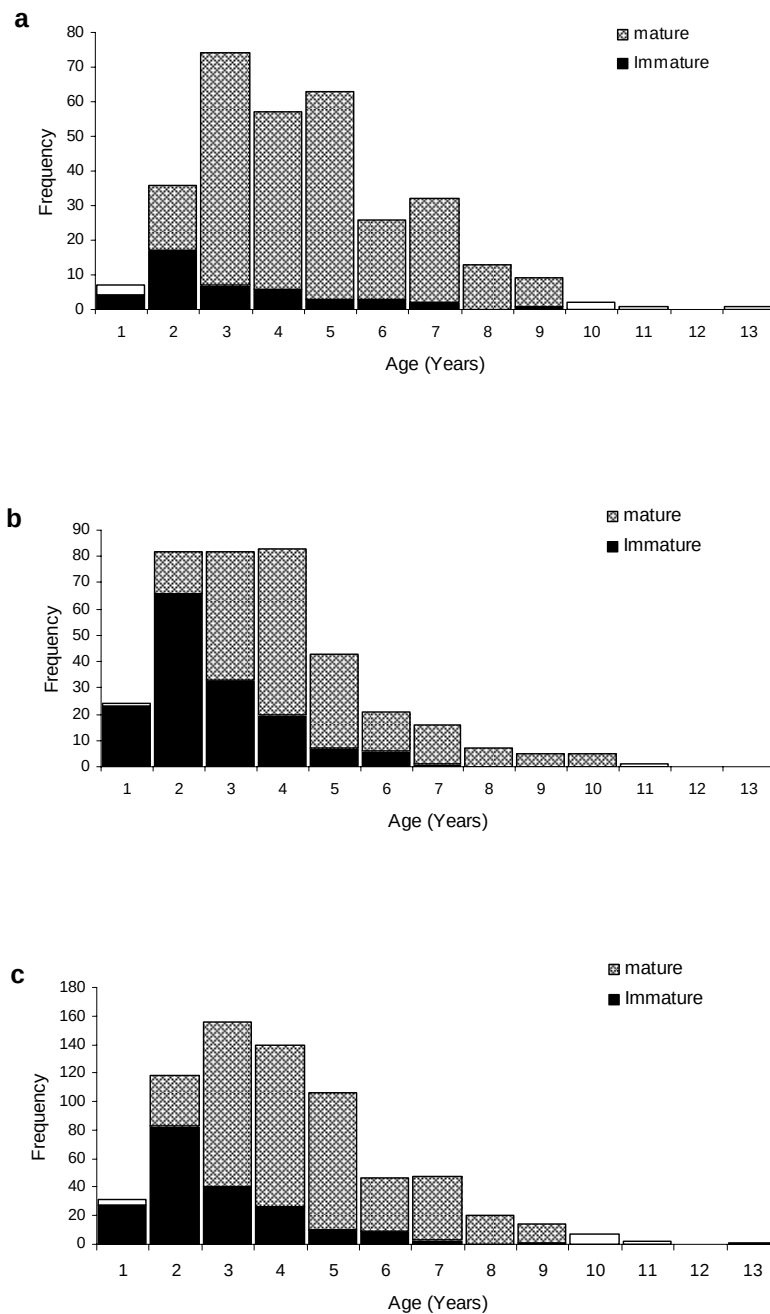


Figure 10. The proportion of snapper assessed as being mature in each year class from each latitudinal group: Coffs Harbour (a), Southern Region (b) and all locations combined (c).

Logistic regression models

Length

The initial full model using the variable length indicated that sex was a non-significant variable (Table 3).

Table 3. Parameter estimates for the full logistic regression model.

Variable	Value	SE	Z-value	P
Intercept	-8.21	0.95	-8.66	<0.001
Length	0.37	0.04	10.47	<0.001
Latitude	-2.25	0.27	-8.40	<0.001
Sex Juvenile*	-14.81	821.36	-0.02	0.99
Sex Male*	0.44	0.24	1.85	0.06

A reduced model was fitted without the variable sex. In the reduced model length and latitude were highly significant (Table 4) and the influence of each variable to the model was examined by comparison of the AIC values for the model without each variable. Length had the greatest influence on predicting maturity of snapper (Table 5).

Table 4. Parameter estimates for the reduced logistic regression model.

Variable	Value	SE	Z-value	P
Intercept	-7.97	0.91	-8.78	<0.001
Length	0.37	0.03	10.63	<0.001
Latitude	-2.24	0.26	-8.49	<0.001

Table 5. Influence of each variable on the reduced model.

	d.f.	deviance	AIC
Two variables		465.46	471.46
Length	1	707.93	711.93
Latitude	1	555.22	559.22

Age

The model fitting process was repeated for age instead of length. The age-based full model indicated that sex was a non-significant factor in predicting whether a fish was mature (Table 6).

Table 6. Parameter estimates for the full logistic regression model.

Variable	Value	SE	Z-value	P
Intercept	-2.11	0.41	-5.13	<0.001
Age	1.27	0.12	10.51	<0.001
Latitude	-1.77	0.26	-6.82	<0.001
Sex Juvenile	-14.98	797.19	-0.02	0.99
Sex Male*	0.30	0.23	1.29	0.20

A reduced model was therefore fitted without the factor sex. In the reduced model age and latitude were significant (Table 7) and the influence of each variable to the model was examined by comparison of the AIC values for the model without each variable. Age had the greatest influence on predicting maturity of snapper (Table 8).

Table 7. Parameter estimates for the reduced logistic regression model.

Variable	Value	SE	Z-value	P
Intercept	-1.99	0.39	-5.17	<0.001
Age	1.28	0.12	10.69	<0.001
Latitude	-1.79	0.26	-6.93	<0.001

Table 8. Influence of each variable on the reduced model.

	d.f.	deviance	AIC
Two variables		470.55	476.55
Age	1	699.18	703.18
Latitude	1	526.61	530.61

Maturity ogives

The variable latitude was a significant predictor of maturity of snapper in the logistic regression models incorporating both length and age. The raw data (Figs. 8 and 10) and the negative parameter values for the variable latitude (which compared the southern group against the northern group) indicated that snapper from the northern group were more likely to mature at earlier sizes and ages than those from the more southern group. Despite these significant differences we also pooled the data across latitude and sex to examine maturity across all samples. The resulting logistic curves indicated a size at 50% maturity of approximately 24.8 cm FL and an age at 50% maturity of 2.5 years for all snapper sampled (Figures 11 and 12).

The maturity ogives for each latitudinal group showed that 50% of snapper from the northern region were mature at 21.8 cm FL and 50% from the southern group were mature at 27.3 cm FL (Fig. 13). The ages at 50% maturity were 1.7 years and 3.0 years for the northern and southern groups respectively (Fig. 14).

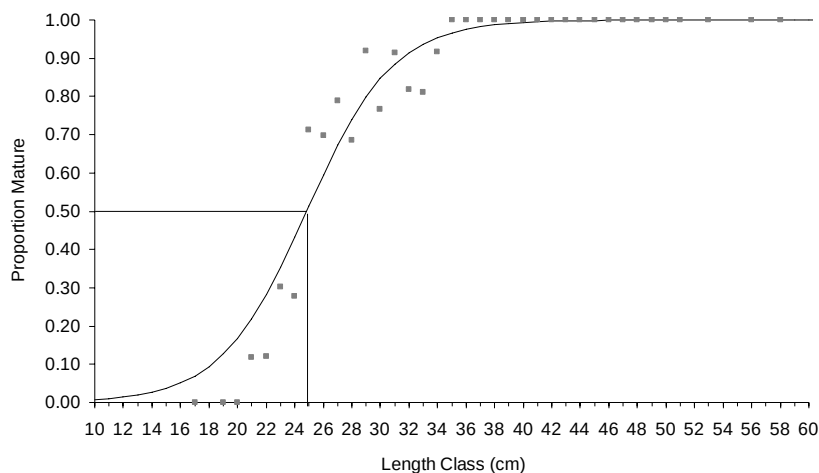


Figure 11. The proportion of snapper assessed as being mature in each 1 cm length class pooled for sex and region with all snapper greater than 35 cm FL assumed to be mature.

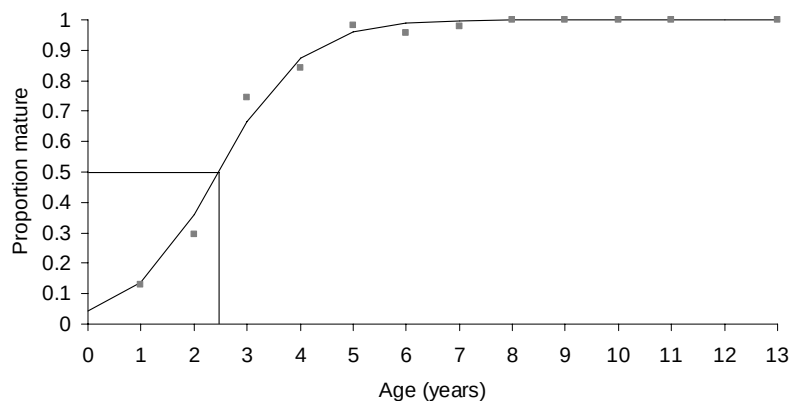


Figure 12. The proportion of snapper assessed as being mature in 1 year age classes pooled for sex and region with all snapper greater than 35 cm FL assumed to be mature.

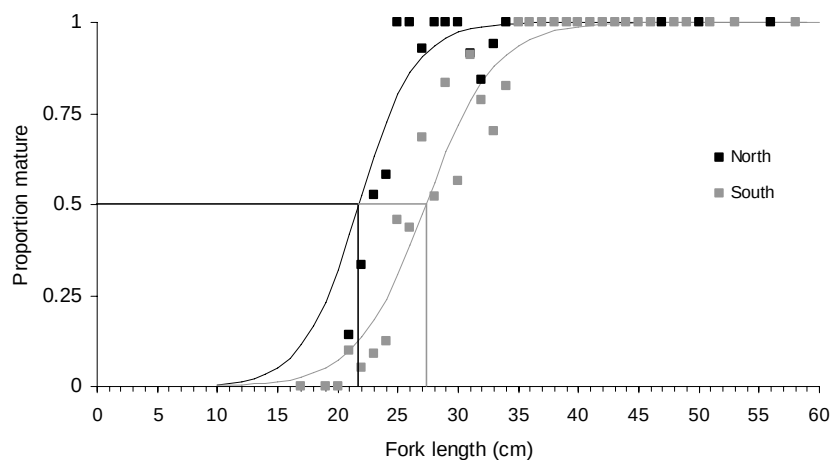


Figure 13. The proportion of snapper assessed as being mature in each 1 cm length class by region with all snapper greater than 35 cm FL assumed to be mature.

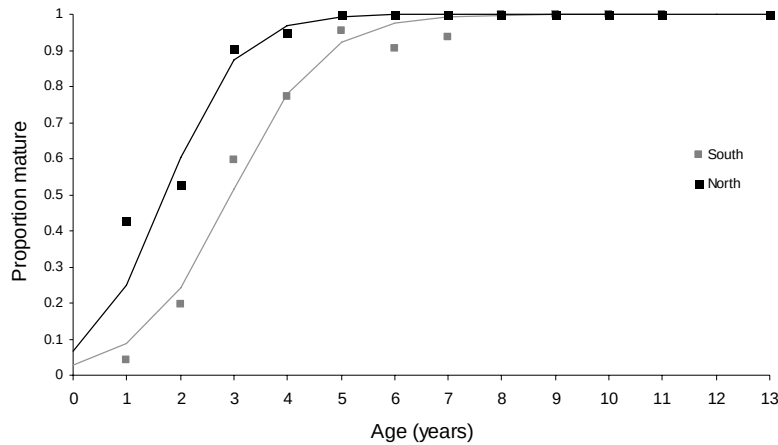


Figure 14. The proportion of snapper assessed as being mature in 1 year age classes by region with all snapper greater than 35 cm FL assumed to be mature.

1986 Sampling

The length data associated with ages from the 1986 sampling were unavailable; however the text of an unpublished chapter from this work states that the length at first maturity was around 4 years and 28 cm fork length. This length at first maturity corresponds well with the slightly elevated GSI levels at this size (Fig. 5). It is important to note that these are sizes and ages at first maturity and so are not directly comparable to the 2008 data above. However, the age at 50% maturity from the re-analysed data from 1986 was estimated to be 5.8 years (Fig. 15). This age corresponds to a length of 38.9 cm FL based on the growth parameters $L_{\infty} = 79.2$ cm FL, $K = 0.082$ years⁻¹, $T_0 = -2.45$ years.

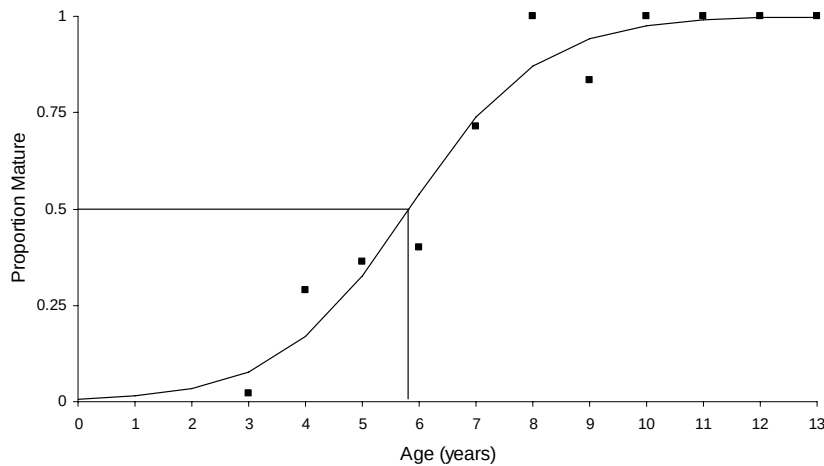


Figure 15. Age at maturity logistic curve for snapper sampled from Coffs Harbour during 1986/87. Source I&I NSW unpublished data.

Empirical relationship between length at maturity and L_{∞}

The estimate of mean length at first maturity using the empirical equation of Froese and Binohlan (2000) based on an L_{∞} of 79.2 cm FL was 42.3 cm FL, with standard errors of 31.6 to 56.7 cm.

4. DISCUSSION

The results from this study indicate that there are no differences in the sizes or ages at which male and female snapper mature. This finding is similar to observations on the closely related Australian sparid tarwhine *Rhabdosargus sarba* (Hughes *et al.*, 2008). Maturity is generally a function of size, rather than age (Jobling, 2002) and studies into the growth rates of snapper have shown no differences between sexes (Ferrell and Sumpton, 1995).

The finding that snapper from the northern group (Coffs Harbour) matured at significantly smaller sizes and ages than snapper from the southern group was unexpected and such latitudinal differences have not been proposed for east-coast snapper. The finding is also somewhat surprising given that the majority of samples from the southern group were collected from the port of Forster (243 of 375 fish) which is only approximately 200 km south of Coffs Harbour. However, we believe that such latitudinal variation is plausible given the available evidence of stock structure and movements. Adult snapper in Australia are believed to be fairly resident (Fowler *et al.*, 2005). Ferrell and Sumpton (1995) concluded that the available data relating to growth, movement, otolith readability and other factors indicated that most of the members of local (east-coast) populations did not migrate large distances as adults. Larval transport by the East Australian current, as well as large scale movements of a small proportion of the stock was believed to be responsible for the uniformity of genetic stock identity.

There are several explanations for the observed differences between latitudinal groups. One factor could have been that the subjective, macroscopic staging schedule was applied differently between researchers at different ports. However we do not believe this to have been the case for the following reasons: 1) the researcher at Coffs Harbour is very experienced and was in fact one of the researchers to have conducted the snapper maturity sampling during the 1980s; 2) photographs of selected macroscopic stages from Coffs Harbour demonstrated consistency in interpretation between researchers, and; 3) the GSI data, which is not subjective but a direct measure of gonad development, showed smaller fish from Coffs Harbour having more developed gonads than those from the south. The fact that the snapper spawning season gets later in the year with increasing latitude could perhaps have influenced our findings. However the majority of fish were sampled during August/September from Coffs Harbour and during September from Forster so it is unlikely that the majority of fish from either port were sampled at different stages through the spawning season.

A second hypothesis for the observed latitudinal differences is that they reflect the real sizes and ages at sexual maturity in the population. Such latitudinal variation for snapper has been shown in Western Australia, with snapper from the north of the state maturing on average between 35 and 38cm FL, whereas in the south of the state, snapper matured between 56 and 59cm FL (Wakefield, 2006). In addition, a recent study by Sumpton *et al.* (2008), using spatial variation in allele frequency of east-coast snapper, reported a weak genetic discontinuity in the stock around Forster. If such a stock discontinuity does in fact exist around this part of the coast it is plausible that differences in life-history characteristics, including the timing of onset of maturity, could exist for snapper.

A third hypothesis for the observed latitudinal differences in sizes and ages at maturity relates to the plasticity of sparid life-histories and the ability to mature at smaller sizes and younger ages when under excessive fishing pressure. The majority of the NSW commercial snapper catch has historically been taken from Coffs Harbour northwards supporting the notion that the snapper stock in this part of the coast has been fished more heavily than that in the south. In fact, Ferrell and Sumpton (1995) reported that the one-degree area of latitude around Coffs Harbour traditionally has had the highest landings of snapper of any comparable region in NSW. Roughly 60% of the entire commercial catch was taken in the northern third of the state.

The comparison in estimated sizes and ages at maturity of snapper during the 2008 sampling with those from earlier studies suggests that, at least in the north of the state, they have changed considerably through time. Our estimate of 50% of snapper from the northern group being mature at approximately 22 cm FL and 1.7 years of age compared well with the work done by Ferrell and Sumpton during the early 1990s. Whilst they sampled snapper throughout the year in Queensland waters and reported that maturity was highly variable, the estimated size at 50% maturity was also at 22 cm FL and close to 2 years of age. This comparison suggests that the size and ages at which east-coast snapper mature in the northern part of their range has not changed since the early 1990s. However the data we were able to retrieve from an unpublished study that was done during the mid 1980s at Coffs Harbour (Henry, unpublished report) suggests that historically snapper matured at larger sizes and later in life than today. Analysis of the unpublished 1980s GSI data showed that the smallest snapper to be mature were in the 28 cm FL class. The 28 cm FL class was also reported to be the smallest mature in the unpublished text of that study. Re-analysis of the maturity versus age data indicated an age at 50% maturity of 5.8 years that corresponds to an approximate length of 39 cm FL. These data suggest therefore that sometime between the mid 1980s and the early 1990s that snapper started to mature at roughly 6 cm smaller and 4 years earlier. It was during this period that commercial landings of snapper declined at an unprecedented rate and may have been related to a decline in the stock.

It is difficult to directly compare results from 2008, the early 1990s and the mid 1980s without a complete understanding of the methods and sampling regimes used. However, the methods described by each study appear to have been very similar. Additional support for a decline in average size at maturity comes from the unseen report of Fairbridge (1943) who reported the length at first maturity to be in the order of 30 cm FL, very similar to the results from the mid 1980s. The empirical relationship of Froese and Binohlan (2000) used to estimate size at maturity from asymptotic length is likely to describe the length at maturity for a population that has not altered its life-history characteristics to compensate for excessive fishing pressure. Clearly, the results from this empirical equation will relate directly to the estimate of L_{∞} being used and we acknowledge that the estimate of 79.2 cm FL is based on fish from Queensland. However, we believe that this estimate is reasonable because a preliminary growth curve using > 13,000 size-at-age estimates for snapper from NSW resulted in a very similar estimate of L_{∞} (I&I NSW unpublished data). The empirical estimate of 42.3 cm FL (standard errors 31.6 to 56.7 cm FL) may therefore reflect the virgin population length at maturity and is very similar to the estimated length at 50% maturity based on the age at 50% maturity during the mid 1980s.

Implications for management

The finding that snapper in NSW mature, on average, at around 25 cm FL (approximately 29 cm total length – TL) means that a large proportion of juveniles are being protected from harvest by the minimum legal length (MLL) of 30 cm TL. However, the finding that snapper south from Coffs Harbour matured at significantly larger sizes and older ages than those in the north may have implications for management of the stock. Currently there is no specific spatial management of snapper in NSW; however the results presented here suggest that spatial management should be considered. In particular, if protection of juveniles is an objective of setting minimum legal lengths (MLLs) then any MLL in the southern areas of the state would need to be greater than 27.2 cm FL (approximately 32 cm TL).

Conclusions

This study has highlighted the difficulty in using a macroscopic staging schedule to accurately determine whether a snapper is sexually mature, particularly once spawning has ceased. We suggest that future studies incorporate microscopic examination of histological sections of gonads to validate whether fish were mature. The evidence of significant latitudinal differences in sizes and ages at sexual maturity should be further investigated using these improved assessment methods. In

addition, the peak spawning periods, and how they vary with latitude, require better description prior to designing future studies to investigate latitudinal variation in maturity. Finally, the evidence that the sizes and ages at sexual maturity may have declined markedly since the mid 1980s requires further investigation. Specifically, the effect on total egg production (numbers and quality of eggs) that such plasticity in life-history characteristics may have on the health and resilience of the snapper stock should be modelled.

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6. APPENDIX

Sampling and biological data for all snapper sampled during 2008. Note that fish that had their maturity stage changed from immature to mature are shaded.

Sample Date	Location	Sex	Length	Body Weight	Gonad Weight	Gonad Stage	Age	maturity	GSI
6/10/2008	COFFS HARBOUR	Male	21.9	251	0.2	1	2	imm	0.0796813
6/10/2008	COFFS HARBOUR	Male	21.3	216	0.4	1	1	imm	0.1851852
1/09/2008	COFFS HARBOUR	Female	47.9	2080	6	2	6	imm	0.2884615
10/09/2008	COFFS HARBOUR	Male	41.1	1569	6.5	2	7	imm	0.4142766
10/09/2008	COFFS HARBOUR	Female	50.1	2620	14.5	2	7	imm	0.5534351
10/09/2008	COFFS HARBOUR	Female	44.9	2040	4.4	2	5	imm	0.2156863
12/09/2008	COFFS HARBOUR	Female	27.4	446	2.6	2	3	imm	0.5829596
21/09/2008	COFFS HARBOUR	Female	41.2	1446	5.4	2	6	imm	0.373444
21/09/2008	COFFS HARBOUR	Female	36.2	1128	5.8	2	6	imm	0.5141844
21/09/2008	COFFS HARBOUR	Male	44.5	1760	7.6	2	9	imm	0.4318182
30/09/2008	COFFS HARBOUR	Male	36.6	953	8.4	2	5	imm	0.8814271
30/09/2008	COFFS HARBOUR	Female	32.4	763	2.9	2	3	imm	0.3800786
1/10/2008	COFFS HARBOUR	Male	33.1	723	1.2	2	3	imm	0.1659751
1/10/2008	COFFS HARBOUR	Female	36.9	1070	4.6	2	4	imm	0.4299065
1/10/2008	COFFS HARBOUR	Male	40.8	1387	3.4	2	5	imm	0.2451334
1/10/2008	COFFS HARBOUR	Female	35.9	1014	3.3	2	4	imm	0.3254438
6/10/2008	COFFS HARBOUR	Male	22	250	1	2	2	imm	0.4
6/10/2008	COFFS HARBOUR	Female	23.6	281	1.3	2	2	imm	0.4626335
6/10/2008	COFFS HARBOUR	Female	21.3	218	1.1	2	2	imm	0.5045872
6/10/2008	COFFS HARBOUR	Female	22.7	276	1.2	2	2	imm	0.4347826
6/10/2008	COFFS HARBOUR	Female	21.6	260	0.8	2	2	imm	0.3076923
6/10/2008	COFFS HARBOUR	Male	22.7	291	1.5	2	2	imm	0.5154639
6/10/2008	COFFS HARBOUR	Male	23.7	310	1.7	2	2	imm	0.5483871
6/10/2008	COFFS HARBOUR	Female	24.1	346	1.3	2	3	imm	0.3757225
6/10/2008	COFFS HARBOUR	Female	24.2	308	2.4	2	4	imm	0.7792208
6/10/2008	COFFS HARBOUR	Male	24.6	345	1.5	2	2	imm	0.4347826
3/10/2008	COFFS HARBOUR	Male	22.2	258	0.7	2	2	imm	0.2713178
3/10/2008	COFFS HARBOUR	Male	23	307	2.2	2	2	imm	0.7166124
3/10/2008	COFFS HARBOUR	Male	23.5	299	1.4	2	1	imm	0.4682274
3/10/2008	COFFS HARBOUR	Female	24	316	1.8	2	1	imm	0.5696203
3/10/2008	COFFS HARBOUR	Male	24.2	321	1.9	2	3	imm	0.5919003
3/10/2008	COFFS HARBOUR	Male	23.9	293	1.4	2	2	imm	0.4778157
3/10/2008	COFFS HARBOUR	Male	23.7	323	0.7	2	2	imm	0.2167183
3/10/2008	COFFS HARBOUR	Female	23	294	1.6	2	3	imm	0.5442177
3/10/2008	COFFS HARBOUR	Male	23.8	307	2.6	2	2	imm	0.8469055
3/10/2008	COFFS HARBOUR	Male	23.5	294	2.3	2	3	imm	0.7823129
3/10/2008	COFFS HARBOUR	Female	21.8	229	1.4	2	2	imm	0.6113537
3/10/2008	COFFS HARBOUR	Male	21.7	243	1.9	2	1	imm	0.781893
3/10/2008	COFFS HARBOUR	Female	23.1	293	1.4	2	2	imm	0.4778157
22/08/2008	COFFS HARBOUR	Female	32.2	790	5.7	2.3	4	imm	0.721519
26/08/2008	COFFS HARBOUR	Female	36.1	926	8.2	2.3	4	imm	0.8855292
21/09/2008	COFFS HARBOUR	Female	31.9	727	4.2	2.3	2	imm	0.5777166
1/10/2008	COFFS HARBOUR	Female	32.6	755	6.8	2.3	4	imm	0.9006623
15/08/2008	COFFS HARBOUR	Male	26.9	471	12.2	3	4	mature	2.5902335
15/08/2008	COFFS HARBOUR	Male	26.2	429	11.2	3	3	mature	2.6107226
15/08/2008	COFFS HARBOUR	Female	26.8	464	9.3	3	3	mature	2.0043103
15/08/2008	COFFS HARBOUR	Male	26.2	445	9.8	3	3	mature	2.2022472
15/08/2008	COFFS HARBOUR	Female	25.9	416	11.2	3	3	mature	2.6923077
15/08/2008	COFFS HARBOUR	Female	30.7	672	23.5	3	5	mature	3.4970238
15/08/2008	COFFS HARBOUR	Female	26.5	452	10.8	3	4	mature	2.3893805
15/08/2008	COFFS HARBOUR	Male	24.7	367	8.6	3	3	mature	2.3433243
15/08/2008	COFFS HARBOUR	Female	26.2	411	7.2	3	3	mature	1.7518248
15/08/2008	COFFS HARBOUR	Female	27	486	15.1	3	4	mature	3.1069959
15/08/2008	COFFS HARBOUR	Female	27.3	486	2.9	3	3	mature	0.5967078
15/08/2008	COFFS HARBOUR	Female	26.2	471	11.2	3	3	mature	2.3779193
15/08/2008	COFFS HARBOUR	Female	32	840	22.7	3	5	mature	2.702381
15/08/2008	COFFS HARBOUR	Male	26.8	467	17.9	3	3	mature	3.8329764
15/08/2008	COFFS HARBOUR	Male	30.5	666	19.5	3	3	mature	2.9279279
15/08/2008	COFFS HARBOUR	Female	28.1	505	10.8	3	4	mature	2.1386139
15/08/2008	COFFS HARBOUR	Female	32.3	780	22.4	3	7	mature	2.8717949
15/08/2008	COFFS HARBOUR	Male	33.7	933	23.2	3	6	mature	2.4866024

Sample Date	Location	Sex	Length	Body Weight	Gonad Weight	Gonad Stage	Age	maturity	GSI
15/08/2008	COFFS HARBOUR	Male	33.1	849	26.3	3	5	mature	3.0977621
15/08/2008	COFFS HARBOUR	Male	35.3	1062	22.2	3	5	mature	2.0903955
15/08/2008	COFFS HARBOUR	Male	34.7	948	40	3	7	mature	4.2194093
15/08/2008	COFFS HARBOUR	Female	31.6	837	29.6	3	6	mature	3.5364397
15/08/2008	COFFS HARBOUR	Female	34.3	867	22.4	3	4	mature	2.5836217
15/08/2008	COFFS HARBOUR	Female	30.5	676	10	3	4	mature	1.4792899
15/08/2008	COFFS HARBOUR	Male	31	792	18.9	3	5	mature	2.3863636
15/08/2008	COFFS HARBOUR	Male	35.8	1064	25.1	3	4	mature	2.3590226
15/08/2008	COFFS HARBOUR	Male	33.6	920	35.3	3	5	mature	3.8369565
15/08/2008	COFFS HARBOUR	Female	38.5	1355	41.5	3	7	mature	3.0627306
15/08/2008	COFFS HARBOUR	Male	37.2	1156	29.6	3	5	mature	2.5605536
15/08/2008	COFFS HARBOUR	Female	31.9	741	14.1	3	4	mature	1.902834
15/08/2008	COFFS HARBOUR	Male	29	541	14.8	3	3	mature	2.7356747
15/08/2008	COFFS HARBOUR	Female	26.7	477	22.7	3	5	mature	4.7589099
15/08/2008	COFFS HARBOUR	Male	26.3	425	11	3	3	mature	2.5882353
15/08/2008	COFFS HARBOUR	Male	27.7	501	9.4	3	4	mature	1.8762475
15/08/2008	COFFS HARBOUR	Female	25.9	414	12.7	3	3	mature	3.0676329
15/08/2008	COFFS HARBOUR	Male	28.3	555	14.1	3	2	mature	2.5405405
15/08/2008	COFFS HARBOUR	Male	29.8	563	1.4	3	4	mature	0.2486679
15/08/2008	COFFS HARBOUR	Female	29.6	607	17.2	3	4	mature	2.8336079
15/08/2008	COFFS HARBOUR	Female	27.3	545	9.3	3	3	mature	1.706422
15/08/2008	COFFS HARBOUR	Male	31.3	728	11.1	3	3	mature	1.5247253
15/08/2008	COFFS HARBOUR	Male	30.4	645	13	3	4	mature	2.0155039
15/08/2008	COFFS HARBOUR	Male	25.8	466	5.6	3	4	mature	1.2017167
15/08/2008	COFFS HARBOUR	Female	30.4	679	19.3	3	4	mature	2.8424153
15/08/2008	COFFS HARBOUR	Male	24.9	368	6.5	3	2	mature	1.7663043
15/08/2008	COFFS HARBOUR	Male	25.5	395	11.9	3	4	mature	3.0126582
15/08/2008	COFFS HARBOUR	Male	32.4	842	27.9	3	3	mature	3.3135392
15/08/2008	COFFS HARBOUR	Male	29.8	616	20.9	3	3	mature	3.3928571
15/08/2008	COFFS HARBOUR	Female	29.1	580	18.6	3	3	mature	3.2068966
15/08/2008	COFFS HARBOUR	Female	27.1	502	10.7	3	3	mature	2.1314741
15/08/2008	COFFS HARBOUR	Female	27.3	474	10.1	3	4	mature	2.1308017
15/08/2008	COFFS HARBOUR	Male	25.2	394	16.3	3	3	mature	4.1370558
15/08/2008	COFFS HARBOUR	Male	25.4	410	7.5	3	4	mature	1.8292683
15/08/2008	COFFS HARBOUR	Female	30.1	642	12.1	3	3	mature	1.8847352
15/08/2008	COFFS HARBOUR	Female	25	393	7.3	3	3	mature	1.8575064
15/08/2008	COFFS HARBOUR	Male	29.2	590	13.6	3	3	mature	2.3050847
15/08/2008	COFFS HARBOUR	Female	29.1	562	18.9	3	4	mature	3.3629893
15/08/2008	COFFS HARBOUR	Female	30.1	668	19	3	3	mature	2.8443114
15/08/2008	COFFS HARBOUR	Female	25.7	390	9.2	3	3	mature	2.3589744
15/08/2008	COFFS HARBOUR	Female	25.3	427	16.6	3	3	mature	3.8875878
22/08/2008	COFFS HARBOUR	Male	33.9	989	18.5	3	5	mature	1.8705763
22/08/2008	COFFS HARBOUR	Female	29.4	626	15.9	3	5	mature	2.5399361
22/08/2008	COFFS HARBOUR	Female	28.5	541	10.8	3	4	mature	1.9963031
22/08/2008	COFFS HARBOUR	Female	32.3	839	26.5	3	5	mature	3.1585221
22/08/2008	COFFS HARBOUR	Male	34.7	951	26.2	3	4	mature	2.7549947
22/08/2008	COFFS HARBOUR	Female	25.8	373	6.6	3	4	mature	1.769437
22/08/2008	COFFS HARBOUR	Female	25.5	342	5.8	3	3	mature	1.6959064
22/08/2008	COFFS HARBOUR	Female	28.3	554	17	3	6	mature	3.0685921
22/08/2008	COFFS HARBOUR	Female	28.2	566	12.1	3	3	mature	2.1378092
22/08/2008	COFFS HARBOUR	Female	28.3	487	9.6	3	2	mature	1.9712526
22/08/2008	COFFS HARBOUR	Female	25.3	386	8.1	3	4	mature	2.0984456
22/08/2008	COFFS HARBOUR	Female	41.1	1587	57.2	3	8	mature	3.6042848
22/08/2008	COFFS HARBOUR	Male	42.7	1787	44.5	3	8	mature	2.4902071
22/08/2008	COFFS HARBOUR	Female	42.9	1828	47.7	3	9	mature	2.6094092
22/08/2008	COFFS HARBOUR	Female	40.6	1460	15.9	3	5	mature	1.0890411
22/08/2008	COFFS HARBOUR	Male	45.2	2020	68.2	3	9	mature	3.3762376
22/08/2008	COFFS HARBOUR	Female	41.6	1551	48.9	3	9	mature	3.1528046
22/08/2008	COFFS HARBOUR	Female	56.7	3820	67.3	3	9	mature	1.7617801
22/08/2008	COFFS HARBOUR	Female	50.5	2640	69.7	3	7	mature	2.6401515
22/08/2008	COFFS HARBOUR	Female	37.8	1031	14.3	3	6	mature	1.3870029
22/08/2008	COFFS HARBOUR	Female	34.3	990	23.6	3	6	mature	2.3838384
22/08/2008	COFFS HARBOUR	Female	41.7	1663	46.7	3	7	mature	2.808178
22/08/2008	COFFS HARBOUR	Male	31.7	707	22.8	3	4	mature	3.2248939
22/08/2008	COFFS HARBOUR	Female	34.3	1006	23	3	4	mature	2.2862823
22/08/2008	COFFS HARBOUR	Female	25.6	436	6.3	3	2	mature	1.4449541
22/08/2008	COFFS HARBOUR	Female	25.6	437	6.8	3	2	mature	1.5560641
22/08/2008	COFFS HARBOUR	Male	34.5	921	32.5	3		mature	3.5287731

Sample Date	Location	Sex	Length	Body Weight	Gonad Weight	Gonad Stage	Age	maturity	GSI
22/08/2008	COFFS HARBOUR	Male	35.1	946	25	3		mature	2.6427061
22/08/2008	COFFS HARBOUR	Male	36.2	1109	16.3	3	4	mature	1.4697926
22/08/2008	COFFS HARBOUR	Male	35.2	958	18.2	3	3	mature	1.8997912
22/08/2008	COFFS HARBOUR	Male	38.1	1190	15.4	3	4	mature	1.2941176
22/08/2008	COFFS HARBOUR	Female	38.1	1199	26.9	3	8	mature	2.2435363
22/08/2008	COFFS HARBOUR	Male	42.4	1565	59.7	3	7	mature	3.8146965
22/08/2008	COFFS HARBOUR	Male	37.4	1086	32.8	3	6	mature	3.0202578
22/08/2008	COFFS HARBOUR	Female	38.5	1297	49.2	3	7	mature	3.7933693
22/08/2008	COFFS HARBOUR	Male	37.3	1093	12.6	3	5	mature	1.1527905
22/08/2008	COFFS HARBOUR	Female	34.1	876	41.1	3	6	mature	4.6917808
22/08/2008	COFFS HARBOUR	Female	33.5	868	20.4	3	5	mature	2.3502304
26/08/2008	COFFS HARBOUR	Male	40.7	1352	26.6	3	7	mature	1.9674556
26/08/2008	COFFS HARBOUR	Female	34.6	985	21.2	3	6	mature	2.1522843
26/08/2008	COFFS HARBOUR	Male	42.6	1592	43.8	3	7	mature	2.7512563
26/08/2008	COFFS HARBOUR	Female	36.4	1112	29.4	3	5	mature	2.6438849
26/08/2008	COFFS HARBOUR	Female	32.3	802	16.4	3	3	mature	2.0448878
26/08/2008	COFFS HARBOUR	Female	33.7	930	21.6	3	4	mature	2.3225806
26/08/2008	COFFS HARBOUR	Male	36.3	1008	13.4	3	5	mature	1.3293651
26/08/2008	COFFS HARBOUR	Female	35.3	945	33.2	3	4	mature	3.5132275
26/08/2008	COFFS HARBOUR	Female	37.8	1388	44.1	3	5	mature	3.1772334
26/08/2008	COFFS HARBOUR	Female	32.3	783	28.8	3	5	mature	3.6781609
26/08/2008	COFFS HARBOUR	Male	38.3	1278	27.6	3	7	mature	2.1596244
26/08/2008	COFFS HARBOUR	Male	36.6	1122	32.6	3	7	mature	2.9055258
26/08/2008	COFFS HARBOUR	Female	38.1	1330	70.8	3	9	mature	5.3233083
26/08/2008	COFFS HARBOUR	Female	34.8	910	25.1	3	7	mature	2.7582418
26/08/2008	COFFS HARBOUR	Female	35.5	1052	34.9	3	4	mature	3.3174905
26/08/2008	COFFS HARBOUR	Female	42.8	1574	19.4	3	5	mature	1.2325286
26/08/2008	COFFS HARBOUR	Female	35.8	1092	23.5	3	6	mature	2.1520147
26/08/2008	COFFS HARBOUR	Female	38.8	1350	45.7	3	7	mature	3.3851852
26/08/2008	COFFS HARBOUR	Female	33.6	872	7.2	3	5	mature	0.8256881
26/08/2008	COFFS HARBOUR	Female	35.4	989	24.9	3	5	mature	2.5176946
26/08/2008	COFFS HARBOUR	Male	38.2	1215	28.2	3	3	mature	2.3209877
26/08/2008	COFFS HARBOUR	Female	39.1	1227	38.4	3	7	mature	3.1295844
26/08/2008	COFFS HARBOUR	Female	36	1130	36.2	3	5	mature	3.2035398
27/08/2008	COFFS HARBOUR	Male	39.5	1299	19.1	3	8	mature	1.4703618
27/08/2008	COFFS HARBOUR	Female	36.8	1127	28.4	3	8	mature	2.5199645
27/08/2008	COFFS HARBOUR	Female	36.5	1155	37.5	3	7	mature	3.2467532
27/08/2008	COFFS HARBOUR	Female	42.1	1558	30.8	3	8	mature	1.9768935
27/08/2008	COFFS HARBOUR	Female	39.4	1329	19.3	3	5	mature	1.4522197
27/08/2008	COFFS HARBOUR	Male	43.1	1660	101.7	3	7	mature	6.126506
27/08/2008	COFFS HARBOUR	Female	45.3	2140	83.3	3	8	mature	3.8925234
27/08/2008	COFFS HARBOUR	Male	42.4	1800	15	3	5	mature	0.8333333
27/08/2008	COFFS HARBOUR	Male	46.6	2200	33.1	3	7	mature	1.5045455
27/08/2008	COFFS HARBOUR	Male	44.7	2120	26.3	3	9	mature	1.240566
27/08/2008	COFFS HARBOUR	Male	45.3	2220	53	3	7	mature	2.3873874
27/08/2008	COFFS HARBOUR	Female	65.2	5100	193.2	3	10	mature	3.7882353
27/08/2008	COFFS HARBOUR	Male	36.7	1200	23.4	3		mature	1.95
27/08/2008	COFFS HARBOUR	Female	37.6	1211	44.2	3		mature	3.6498761
1/09/2008	COFFS HARBOUR	Male	42.9	1655	22.2	3	7	mature	1.3413897
1/09/2008	COFFS HARBOUR	Male	45.6	2000	22.3	3	5	mature	1.115
1/09/2008	COFFS HARBOUR	Male	41.7	1591	50.1	3	7	mature	3.1489629
1/09/2008	COFFS HARBOUR	Female	40.9	1520	50.9	3	7	mature	3.3486842
1/09/2008	COFFS HARBOUR	Female	41.7	1740	14.2	3	5	mature	0.816092
1/09/2008	COFFS HARBOUR	Female	45.9	1960	79.3	3	8	mature	4.0459184
1/09/2008	COFFS HARBOUR	Female	43.8	1780	85	3	10	mature	4.7752809
1/09/2008	COFFS HARBOUR	Female	38.8	1137	23.9	3	7	mature	2.1020229
1/09/2008	COFFS HARBOUR	Male	40.1	1450	89.5	3	5	mature	6.1724138
10/09/2008	COFFS HARBOUR	Male	30.2	720	9.2	3	5	mature	1.2777778
10/09/2008	COFFS HARBOUR	Female	30.1	607	5	3	5	mature	0.8237232
10/09/2008	COFFS HARBOUR	Male	27.6	536	6.7	3	2	mature	1.25
10/09/2008	COFFS HARBOUR	Female	26.2	453	5.9	3	4	mature	1.3024283
10/09/2008	COFFS HARBOUR	Male	26.2	407	6.5	3	3	mature	1.5970516
10/09/2008	COFFS HARBOUR	Male	25.6	427	7.1	3	2	mature	1.6627635
10/09/2008	COFFS HARBOUR	Male	25.4	422	10.1	3	3	mature	2.3933649
10/09/2008	COFFS HARBOUR	Female	25.1	392	7.4	3	3	mature	1.8877551
10/09/2008	COFFS HARBOUR	Male	29.8	610	12.1	3	5	mature	1.9836066
10/09/2008	COFFS HARBOUR	Male	26	401	7.5	3	4	mature	1.8703242
10/09/2008	COFFS HARBOUR	Female	26.2	437	13.9	3	3	mature	3.180778

Sample Date	Location	Sex	Length	Body Weight	Gonad Weight	Gonad Stage	Age	maturity	GSI
10/09/2008	COFFS HARBOUR	Male	26.3	409	5.8	3	3	mature	1.4180929
10/09/2008	COFFS HARBOUR	Female	34.8	896	17.9	3	5	mature	1.9977679
10/09/2008	COFFS HARBOUR	Female	26.1	404	5.4	3	3	mature	1.3366337
10/09/2008	COFFS HARBOUR	Male	25.2	387	6.4	3	3	mature	1.6537468
10/09/2008	COFFS HARBOUR	Male	26.5	444	7.8	3	3	mature	1.7567568
10/09/2008	COFFS HARBOUR	Male	45.9	1940	29	3	7	mature	1.4948454
10/09/2008	COFFS HARBOUR	Female	25.6	420	10.4	3	5	mature	2.4761905
10/09/2008	COFFS HARBOUR	Male	25.5	375	8.8	3	2	mature	2.3466667
10/09/2008	COFFS HARBOUR	Male	29.2	593	18.9	3	4	mature	3.1871838
10/09/2008	COFFS HARBOUR	Female	28.1	509	11.1	3	2	mature	2.1807466
10/09/2008	COFFS HARBOUR	Male	28.1	507	10.4	3	3	mature	2.0512821
10/09/2008	COFFS HARBOUR	Female	29.5	624	16.1	3	5	mature	2.5801282
10/09/2008	COFFS HARBOUR	Female	27	478	7.4	3	4	mature	1.5481172
10/09/2008	COFFS HARBOUR	Male	26.1	433	6.5	3	3	mature	1.5011547
10/09/2008	COFFS HARBOUR	Male	25.4	373	11.1	3	2	mature	2.9758713
10/09/2008	COFFS HARBOUR	Female	25.9	420	11	3	3	mature	2.6190476
10/09/2008	COFFS HARBOUR	Male	29.3	596	7	3	3	mature	1.1744966
10/09/2008	COFFS HARBOUR	Male	25.2	375	8.1	3	3	mature	2.16
10/09/2008	COFFS HARBOUR	Female	27.1	472	8.2	3	3	mature	1.7372881
10/09/2008	COFFS HARBOUR	Male	27.4	500	19.7	3	3	mature	3.94
10/09/2008	COFFS HARBOUR	Female	27.8	474	10.8	3	3	mature	2.278481
10/09/2008	COFFS HARBOUR	Female	26.2	407	4.4	3	3	mature	1.0810811
10/09/2008	COFFS HARBOUR	Male	28.1	482	6.9	3	3	mature	1.4315353
10/09/2008	COFFS HARBOUR	Female	30.9	695	12.2	3	5	mature	1.7553957
10/09/2008	COFFS HARBOUR	Female	47.8	2220	53.8	3	8	mature	2.4234234
10/09/2008	COFFS HARBOUR	Female	29.2	601	12.6	3	5	mature	2.0965058
10/09/2008	COFFS HARBOUR	Female	27.4	426	8.7	3	2	mature	2.0422535
10/09/2008	COFFS HARBOUR	Female	25.7	380	5.6	3	3	mature	1.4736842
10/09/2008	COFFS HARBOUR	Female	25.3	387	7.2	3	3	mature	1.8604651
12/09/2008	COFFS HARBOUR	Male	33.6	905	27	3	5	mature	2.9834254
12/09/2008	COFFS HARBOUR	Male	30.9	662	26.1	3	5	mature	3.9425982
12/09/2008	COFFS HARBOUR	Female	35.3	1000	22.9	3	6	mature	2.29
12/09/2008	COFFS HARBOUR	Female	26.2	411	10.1	3	4	mature	2.4574209
12/09/2008	COFFS HARBOUR	Male	30.3	663	13.1	3	5	mature	1.9758673
12/09/2008	COFFS HARBOUR	Male	34.3	1035	17.2	3	5	mature	1.6618357
12/09/2008	COFFS HARBOUR	Female	34.2	1057	27.6	3	6	mature	2.6111637
12/09/2008	COFFS HARBOUR	Female	29.5	547	10.7	3	5	mature	1.9561243
12/09/2008	COFFS HARBOUR	Female	30.3	675	17.4	3	7	mature	2.5777778
12/09/2008	COFFS HARBOUR	Male	25	392	6.9	3		mature	1.7602041
21/09/2008	COFFS HARBOUR	Male	33.7	888	13.5	3	5	mature	1.5202703
21/09/2008	COFFS HARBOUR	Male	30.1	673	14	3	7	mature	2.0802377
21/09/2008	COFFS HARBOUR	Female	29.8	641	15.5	3	5	mature	2.4180967
21/09/2008	COFFS HARBOUR	Male	30.5	650	11	3	7	mature	1.6923077
21/09/2008	COFFS HARBOUR	Male	31.5	780	22.5	3	5	mature	2.8846154
21/09/2008	COFFS HARBOUR	Male	43.9	1740	46.9	3	8	mature	2.6954023
21/09/2008	COFFS HARBOUR	Female	44.1	1680	65.7	3	9	mature	3.9107143
21/09/2008	COFFS HARBOUR	Female	29.8	633	19.3	3	5	mature	3.0489731
21/09/2008	COFFS HARBOUR	Female	30.3	590	14.8	3	4	mature	2.5084746
30/09/2008	COFFS HARBOUR	Male	36.1	1021	32.8	3	6	mature	3.2125367
30/09/2008	COFFS HARBOUR	Female	34.8	994	34.2	3	5	mature	3.4406439
30/09/2008	COFFS HARBOUR	Female	31.9	671	10	3	5	mature	1.490313
30/09/2008	COFFS HARBOUR	Male	39.6	1317	27.1	3	6	mature	2.0577069
30/09/2008	COFFS HARBOUR	Male	41.6	1592	29.9	3	5	mature	1.8781407
30/09/2008	COFFS HARBOUR	Female	30.6	730	16.7	3	3	mature	2.2876712
30/09/2008	COFFS HARBOUR	Female	31.3	735	5.8	3	3	mature	0.7891156
30/09/2008	COFFS HARBOUR	Female	31.7	740	13.7	3	5	mature	1.8513514
30/09/2008	COFFS HARBOUR	Male	34.2	993	23.8	3	5	mature	2.3967774
30/09/2008	COFFS HARBOUR	Female	34.3	976	18.5	3	6	mature	1.8954918
1/10/2008	COFFS HARBOUR	Male	32.1	774	3.2	3	4	mature	0.4134367
1/10/2008	COFFS HARBOUR	Male	32.4	708	13	3	1	mature	1.8361582
1/10/2008	COFFS HARBOUR	Female	32.6	679	14.6	3	3	mature	2.1502209
1/10/2008	COFFS HARBOUR	Female	45.6	1920	67	3	8	mature	3.4895833
1/10/2008	COFFS HARBOUR	Male	32.1	774	22.8	3	4	mature	2.9457364
1/10/2008	COFFS HARBOUR	Female	34	905	9.7	3	5	mature	1.0718232
1/10/2008	COFFS HARBOUR	Male	40.2	1256	34.7	3	5	mature	2.7627389
1/10/2008	COFFS HARBOUR	Male	32.9	718	6.7	3	7	mature	0.9331476
1/10/2008	COFFS HARBOUR	Male	33.1	810	6.9	3	5	mature	0.8518519
1/10/2008	COFFS HARBOUR	Male	38.6	1268	21.4	3	5	mature	1.6876972

Sample Date	Location	Sex	Length	Body Weight	Gonad Weight	Gonad Stage	Age	maturity	GSI
1/10/2008	COFFS HARBOUR	Female	33.1	771	11.3	3	4	mature	1.4656291
1/10/2008	COFFS HARBOUR	Female	36.5	1089	21.1	3	6	mature	1.9375574
1/10/2008	COFFS HARBOUR	Male	33.4	874	4.4	3	4	mature	0.5034325
1/10/2008	COFFS HARBOUR	Male	34.6	836	15	3	4	mature	1.7942584
1/10/2008	COFFS HARBOUR	Female	41	1427	30.2	3	11	mature	2.116328
6/10/2008	COFFS HARBOUR	Female	22.7	292	2.8	3	1	mature	0.9589041
6/10/2008	COFFS HARBOUR	Male	23.2	293	5.2	3	2	mature	1.774744
6/10/2008	COFFS HARBOUR	Female	23.5	305	4.5	3	3	mature	1.4754098
6/10/2008	COFFS HARBOUR	Male	23.2	312	3.8	3	3	mature	1.2179487
6/10/2008	COFFS HARBOUR	Female	23	276	3.1	3	3	mature	1.1231884
3/10/2008	COFFS HARBOUR	Male	23.9	321	3.9	3	4	mature	1.2149533
3/10/2008	COFFS HARBOUR	Male	24.7	370	2.3	3	3	mature	0.6216216
3/10/2008	COFFS HARBOUR	Male	23.6	324	3.1	3	3	mature	0.9567901
3/10/2008	COFFS HARBOUR	Female	24.1	354	8	3	3	mature	2.259887
3/10/2008	COFFS HARBOUR	Female	23.8	325	5.6	3	4	mature	1.7230769
3/10/2008	COFFS HARBOUR	Female	23.8	316	5	3	2	mature	1.5822785
3/10/2008	COFFS HARBOUR	Male	23	304	1.9	3	1	mature	0.625
3/10/2008	COFFS HARBOUR	Male	21.1	238	2.6	3	3	mature	1.092437
3/10/2008	COFFS HARBOUR	Male	24	323	4.1	3	2	mature	1.2693498
3/10/2008	COFFS HARBOUR	Male	24.6	376	2.8	3	3	mature	0.7446809
15/08/2008	COFFS HARBOUR	Female	31.3	756	33.4	3.4	3	mature	4.4179894
15/08/2008	COFFS HARBOUR	Female	30.1	636	32.2	3.4	5	mature	5.0628931
15/08/2008	COFFS HARBOUR	Female	29.5	640	18.5	3.4	4	mature	2.890625
15/08/2008	COFFS HARBOUR	Female	37.6	1127	51.5	3.4	5	mature	4.5696539
15/08/2008	COFFS HARBOUR	Female	36.7	1071	28.4	3.4	5	mature	2.6517274
15/08/2008	COFFS HARBOUR	Female	28.3	610	29.1	3.4	4	mature	4.7704918
15/08/2008	COFFS HARBOUR	Female	30.9	753	38.1	3.4	5	mature	5.059761
10/09/2008	COFFS HARBOUR	Female	25.5	380	8	3.4	2	mature	2.1052632
10/09/2008	COFFS HARBOUR	Female	37.4	1152	21.5	3.4	8	mature	1.8663194
10/09/2008	COFFS HARBOUR	Female	29.7	635	12.6	3.4	4	mature	1.984252
21/09/2008	COFFS HARBOUR	Female	46.3	2520	77.5	3.4	13	mature	3.0753968
21/09/2008	COFFS HARBOUR	Female	31.7	714	22.9	3.4	5	mature	3.2072829
21/09/2008	COFFS HARBOUR	Female	35.7	1026	28.2	3.4	7	mature	2.748538
21/09/2008	COFFS HARBOUR	Female	33.5	869	27.5	3.4	7	mature	3.164557
21/09/2008	COFFS HARBOUR	Female	33.6	845	24.3	3.4	6	mature	2.8757396
21/09/2008	COFFS HARBOUR	Female	33.2	914	26.4	3.4	8	mature	2.8884026
30/09/2008	COFFS HARBOUR	Female	30.3	662	26	3.4	4	mature	3.9274924
1/10/2008	COFFS HARBOUR	Male	38.1	1194	29.2	3.4	6	mature	2.4455611
3/10/2008	COFFS HARBOUR	Female	23.7	330	5.2	3.4	5	mature	1.5757576
3/10/2008	COFFS HARBOUR	Female	22.1	244	4.5	3.4	2	mature	1.8442623
3/10/2008	COFFS HARBOUR	Female	23.7	333	4.9	3.4	3	mature	1.4714715
15/08/2008	COFFS HARBOUR	Female	37.9	1182	61.7	4	6	mature	5.2199662
27/08/2008	COFFS HARBOUR	Male	44.8	2060	31.7	4	7	mature	1.538835
10/09/2008	COFFS HARBOUR	Female	25.2	355	12.1	4	3	mature	3.4084507
12/09/2008	COFFS HARBOUR	Female	28.3	555	21.4	4	3	mature	3.8558559
12/09/2008	COFFS HARBOUR	Female	25.9	439	17.5	4	4	mature	3.9863326
12/09/2008	COFFS HARBOUR	Female	25.5	427	12.1	4	2	mature	2.8337237
12/09/2008	COFFS HARBOUR	Female	25.3	379	14.7	4	2	mature	3.878628
12/09/2008	COFFS HARBOUR	Female	35.2	1060	67.2	4	6	mature	6.3396226
21/09/2008	COFFS HARBOUR	Female	29.7	582	18.5	4	6	mature	3.1786942
21/09/2008	COFFS HARBOUR	Female	32.1	821	43.5	4	9	mature	5.2984166
30/09/2008	COFFS HARBOUR	Female	35.7	1031	59.7	4	6	mature	5.7904947
3/10/2008	COFFS HARBOUR	Female	24.1	346	14.5	4	3	mature	4.1907514
10/09/2008	COFFS HARBOUR	Female	28.1	514	9.2	4.5	4	mature	1.7898833
12/09/2008	COFFS HARBOUR	Female	36.9	1095	23.5	4.5	5	mature	2.1461187
12/09/2008	COFFS HARBOUR	Female	27.1	455	6.4	4.5	2	mature	1.4065934
21/09/2008	COFFS HARBOUR	Female	41.8	1502	46.9	4.5	4	mature	3.1225033
12/09/2008	COFFS HARBOUR	Female	32.5	773	12.5	5	4	mature	1.6170763
30/09/2008	COFFS HARBOUR	Female	35.2	937	14	5	6	mature	1.4941302
1/10/2008	COFFS HARBOUR	Female	34.9	947	16.1	5	4	mature	1.7001056
30/09/2008	COFFS HARBOUR	Male	34.1	911	9.2	5.2	6	mature	1.0098793
2/10/2008	CROWDY HEAD	Male	26.8	514	0.6	2	3	imm	0.1167315
2/10/2008	CROWDY HEAD	Male	26.1	392	0.9	2	3	imm	0.2295918
2/10/2008	CROWDY HEAD	Male	27.9	577	0.4	2	4	imm	0.0693241
2/10/2008	CROWDY HEAD	Male	25.6	421	0.6	2	3	imm	0.1425178
2/10/2008	CROWDY HEAD	Female	29.9	645	4.2	3	4	mature	0.6511628
2/10/2008	CROWDY HEAD	Female	25.3	366	3.9	3	3	mature	1.0655738
2/10/2008	CROWDY HEAD	Male	31.4	678	8.6	3	4	mature	1.2684366

Sample Date	Location	Sex	Length	Body Weight	Gonad Weight	Gonad Stage	Age	maturity	GSI
2/10/2008	CROWDY HEAD	Male	26.1	411	4.7	3	4	mature	1.1435523
2/10/2008	CROWDY HEAD	Male	24.8	426	6.1	3	3	mature	1.4319249
2/10/2008	CROWDY HEAD	Female	27.3	499	8.9	3	6	mature	1.7835671
2/10/2008	CROWDY HEAD	Male	25	365	5.3	3	4	mature	1.4520548
2/10/2008	CROWDY HEAD	Male	29.2	616	11.2	3	3	mature	1.8181818
2/10/2008	CROWDY HEAD	Male	25	407	3.3	3	3	mature	0.8108108
2/10/2008	CROWDY HEAD	Female	24	332	8.5	4	2	mature	2.560241
2/10/2008	CROWDY HEAD	Male	31.2	697	22.7	4	6	mature	3.2568149
15/10/2008	FORSTER	Male	22.3	261	0.1	1	3	imm	0.0383142
15/10/2008	FORSTER	Male	24.2	364	0.1	1	2	imm	0.0274725
15/10/2008	FORSTER	Male	21.9	268	0.1	1	2	imm	0.0373134
15/10/2008	FORSTER	Juvenile	17.3	147	0.1	1	1	imm	0.0680272
15/10/2008	FORSTER	Male	21.9	231	0.1	1	1	imm	0.04329
9/10/2008	FORSTER	Male	24.7	374	0.13	1	2	imm	0.0347594
9/10/2008	FORSTER	Male	22.8	328	0.1	1	3	imm	0.0304878
9/10/2008	FORSTER	Female	20.2	222	0.18	1		imm	0.0810811
9/10/2008	FORSTER	Juvenile	24.2	340	0.4	1	2	imm	0.1176471
9/10/2008	FORSTER	Female	23.1	331	0.08	1	2	imm	0.0241692
9/10/2008	FORSTER	Male	23.1	338	0.08	1	2	imm	0.0236686
18/11/2008	FORSTER	Male	22.9	303	0.2	1	2	imm	0.0660066
18/11/2008	FORSTER	Male	23.1	321	0.1	1	2	imm	0.0311526
18/11/2008	FORSTER	Male	24.7	355	0.1	1	3	imm	0.028169
18/11/2008	FORSTER	Juvenile	21.2	246	0.1	1	1	imm	0.0406504
15/10/2008	FORSTER	Female	22.1	284	0.6	2	1	imm	0.2112676
15/10/2008	FORSTER	Female	22	271	0.4	2	2	imm	0.1476015
15/10/2008	FORSTER	Female	25.8	414	1.1	2	2	imm	0.2657005
15/10/2008	FORSTER	Female	21.6	241	0.3	2	1	imm	0.1244813
15/10/2008	FORSTER	Male	23.6	317	0.3	2	2	imm	0.0946372
15/10/2008	FORSTER	Male	21.5	239	0.1	2	1	imm	0.041841
15/10/2008	FORSTER	Male	20.6	241	0.2	2		imm	0.0829876
15/10/2008	FORSTER	Female	22.2	283	0.5	2	2	imm	0.1766784
15/10/2008	FORSTER	Female	24.5	365	1	2	2	imm	0.2739726
15/10/2008	FORSTER	Female	20.5	217	0.5	2	1	imm	0.2304147
15/10/2008	FORSTER	Female	24.3	366	1	2	2	imm	0.273224
15/10/2008	FORSTER	Female	22.7	306	0.6	2	2	imm	0.1960784
15/10/2008	FORSTER	Male	22.7	271	0.1	2	2	imm	0.0369004
15/10/2008	FORSTER	Female	23.7	350	0.7	2	2	imm	0.2
15/10/2008	FORSTER	Female	22.5	275	0.9	2	2	imm	0.3272727
9/10/2008	FORSTER	Male	24.8	369	0.1	2	2	imm	0.0271003
9/10/2008	FORSTER	Female	24.9	355	0.6	2	2	imm	0.1690141
9/10/2008	FORSTER	Female	19.9	183	0.2	2	1	imm	0.1092896
9/10/2008	FORSTER	Male	24.2	370	0.1	2	3	imm	0.027027
9/10/2008	FORSTER	Male	23.6	341	0.1	2	1	imm	0.0293255
9/10/2008	FORSTER	Female	21.7	196	0.2	2	2	imm	0.1020408
9/10/2008	FORSTER	Female	23.3	328	0.4	2	3	imm	0.1219512
9/10/2008	FORSTER	Female	22.5	260	0.3	2	2	imm	0.1153846
9/10/2008	FORSTER	Female	22.4	267	0.6	2	2	imm	0.2247191
9/10/2008	FORSTER	Male	23	300	0.1	2	2	imm	0.0333333
9/10/2008	FORSTER	Female	24.3	351	0.9	2	2	imm	0.2564103
18/11/2008	FORSTER	Female	21.7	256	0.3	2	1	imm	0.1171875
15/10/2008	FORSTER	Male	25.6	372	6.4	3	2	mature	1.7204301
15/10/2008	FORSTER	Male	25	383	0.9	3	2	mature	0.2349869
9/10/2008	FORSTER	Female	21.8	242	2.7	3	2	mature	1.1157025
18/11/2008	FORSTER	Male	23.4	337	0.3	3	2	mature	0.0890208
18/11/2008	FORSTER	Male	23.5	308	0.6	3	2	mature	0.1948052
18/11/2008	FORSTER	Male	22.1	309	1.2	3	1	mature	0.3883495
9/10/2008	FORSTER	Unknow	22.3	267			2	imm	0
13/08/2008	GREENWELL POINT	Male	24.3	312	0.62	1	2	imm	0.1987179
13/08/2008	GREENWELL POINT	Female	24.6	378	0.7	1	2	imm	0.1851852
13/08/2008	GREENWELL POINT	Female	25.7	410	0.85	1	2	imm	0.2073171
13/08/2008	GREENWELL POINT	Female	26.7	404	0.8	1	2	imm	0.1980198
13/08/2008	GREENWELL POINT	Male	23.8	336	0.5	1	2	imm	0.1488095
13/08/2008	GREENWELL POINT	Female	26.3	429	0.7	1	3	imm	0.1631702
13/08/2008	GREENWELL POINT	Male	22.8	295	0.1	1	1	imm	0.0338983
13/08/2008	GREENWELL POINT	Male	26.5	412	0.4	1	2	imm	0.0970874
13/08/2008	GREENWELL POINT	Female	25.3	409	0.9	1	2	imm	0.2200489
13/08/2008	GREENWELL POINT	Female	22.8	312	0.5	1	2	imm	0.1602564
13/08/2008	GREENWELL POINT	Female	21.7	256	0.2	1	1	imm	0.078125

Sample Date	Location	Sex	Length	Body Weight	Gonad Weight	Gonad Stage	Age	maturity	GSI
13/08/2008	GREENWELL POINT	Male	25.1	390	0.1	1	2	imm	0.025641
13/08/2008	GREENWELL POINT	Male	24.6	350	0.1	1	1	imm	0.0285714
13/08/2008	GREENWELL POINT	Male	26.4	426	0.3	1	2	imm	0.0704225
13/08/2008	GREENWELL POINT	Female	23.8	344	0.4	1	2	imm	0.1162791
13/08/2008	GREENWELL POINT	Male	24.6	355	0.1	1	2	imm	0.028169
13/08/2008	GREENWELL POINT	Male	23.9	328	0.2	1	1	imm	0.0609756
13/08/2008	GREENWELL POINT	Male	21.6	272	0.1	1	1	imm	0.0367647
13/08/2008	GREENWELL POINT	Unknow	24.9	368	0.1	1	3	imm	0.0271739
13/08/2008	GREENWELL POINT	Male	24.5	376	0.1	1	2	imm	0.0265957
13/08/2008	GREENWELL POINT	Male	24.3	373	0.2	1	2	imm	0.0536193
13/08/2008	GREENWELL POINT	Female	23.2	296	0.2	1	1	imm	0.0675676
13/08/2008	GREENWELL POINT	Male	24.9	403	0.1	1	2	imm	0.0248139
13/08/2008	GREENWELL POINT	Female	22.8	321	0.6	1	3	imm	0.1869159
13/08/2008	GREENWELL POINT	Female	22.9	286	0.5	1	2	imm	0.1748252
13/08/2008	GREENWELL POINT	Unknow	23.3	305	0.1	1	1	imm	0.0327869
13/08/2008	GREENWELL POINT	Unknow	25.5	398	0.1	1	2	imm	0.0251256
13/08/2008	GREENWELL POINT	Male	25.3	386	0.4	1	2	imm	0.1036269
13/08/2008	GREENWELL POINT	Unknow	23.2	315	0.1	1	1	imm	0.031746
13/08/2008	GREENWELL POINT	Female	27.2	482	1.3	1	2	imm	0.2697095
13/08/2008	GREENWELL POINT	Male	22.3	263	0.1	1	1	imm	0.0380228
13/08/2008	GREENWELL POINT	Female	23.2	292	0.2	1	1	imm	0.0684932
13/08/2008	GREENWELL POINT	Male	24.7	353	0.2	1	2	imm	0.0566572
13/08/2008	GREENWELL POINT	Male	23	287	0.1	1	2	imm	0.0348432
13/08/2008	GREENWELL POINT	Unknow	23.7	298	0.1	1	1	imm	0.033557
13/08/2008	GREENWELL POINT	Male	22.2	285	0.1	1	1	imm	0.0350877
13/08/2008	GREENWELL POINT	Female	22.9	297	0.6	1	2	imm	0.2020202
13/08/2008	GREENWELL POINT	Female	28.4	566	3.1	1.2	3	imm	0.5477032
13/08/2008	GREENWELL POINT	Male	23.5	343	0.5	1.2	3	imm	0.1457726
13/08/2008	GREENWELL POINT	Male	25.8	429	0.6	1.2	3	imm	0.1398601
13/08/2008	GREENWELL POINT	Female	24.6	367	1.1	1.2	2	imm	0.2997275
13/08/2008	GREENWELL POINT	Female	26.4	454	0.5	1.2	2	imm	0.1101322
13/08/2008	GREENWELL POINT	Female	23.9	333	0.8	1.2	2	imm	0.2402402
13/08/2008	GREENWELL POINT	Female	23.5	314	0.5	1.2	1	imm	0.1592357
13/08/2008	GREENWELL POINT	Male	25.4	395	0.5	1.2	2	imm	0.1265823
13/08/2008	GREENWELL POINT	Female	25.2	409	0.9	1.2	2	imm	0.2200489
13/08/2008	GREENWELL POINT	Female	27.9	489	3.14	2	4	imm	0.6421268
13/08/2008	GREENWELL POINT	Male	29.3	580	0.7	2	3	imm	0.1206897
13/08/2008	GREENWELL POINT	Female	28.7	553	2	2	3	imm	0.3616637
13/08/2008	GREENWELL POINT	Female	28.8	499	2.3	2	3	imm	0.4609218
13/08/2008	GREENWELL POINT	Female	30.7	659	15.6	3	3	mature	2.3672231
9/09/2008	HASTINGS RIVER	Female	44.4	1956	85.2	3	7	mature	4.3558282
9/09/2008	HASTINGS RIVER	Male	32	689	13.1	3	5	mature	1.9013062
9/09/2008	HASTINGS RIVER	Female	33.9	847	11.4	3	5	mature	1.3459268
9/09/2008	HASTINGS RIVER	Male	32.5	818	15.5	3	5	mature	1.8948655
9/09/2008	HASTINGS RIVER	Female	42.5	1647	50.5	3	10	mature	3.0661809
9/09/2008	HASTINGS RIVER	Male	32.7	774	28.8	3	4	mature	3.7209302
9/09/2008	HASTINGS RIVER	Male	42.5	1563	27.3	4		mature	1.7466411
2/09/2008	TERRIGAL	Male	30	631	0.6	1	3	imm	0.0950872
2/09/2008	TERRIGAL	Male	25.5	382	0.2	1	2	imm	0.052356
28/08/2008	TERRIGAL	Male	28.4	457	0.9	1	3	imm	0.1969365
2/09/2008	TERRIGAL	Female	30.1	658	2.7	2	4	imm	0.4103343
2/09/2008	TERRIGAL	Male	30.3	641	0.9	2	4	imm	0.1404056
2/09/2008	TERRIGAL	Male	26.7	462	1.1	2	4	imm	0.2380952
2/09/2008	TERRIGAL	Female	28.3	513	2.2	2	3	imm	0.4288499
2/09/2008	TERRIGAL	Female	28.9	510	3.4	2	4	imm	0.6666667
2/09/2008	TERRIGAL	Female	32.7	813	3.8	2	4	imm	0.4674047
2/09/2008	TERRIGAL	Male	26.5	454	0.2	2	3	imm	0.0440529
2/09/2008	TERRIGAL	Female	31.2	698	3.1	2	4	imm	0.4441261
2/09/2008	TERRIGAL	Male	32.6	803	4.2	2	4	imm	0.5230386
2/09/2008	TERRIGAL	Male	30.5	610	0.9	2	2	imm	0.147541
2/09/2008	TERRIGAL	Male	30.7	753	1.5	2	4	imm	0.1992032
2/09/2008	TERRIGAL	Female	33	802	2.8	2	4	imm	0.3491272
2/09/2008	TERRIGAL	Female	33.2	927	2.5	2	3	imm	0.2696872
2/09/2008	TERRIGAL	Male	26.3	444	0.3	2	3	imm	0.0675676
2/09/2008	TERRIGAL	Female	27.6	457	1.6	2	4	imm	0.3501094
28/08/2008	TERRIGAL	Female	29.9	652	5.1	2	4	imm	0.7822086
28/08/2008	TERRIGAL	Female	28.6	566	3.7	2	3	imm	0.6537102
28/08/2008	TERRIGAL	Female	28.2	607	2.6	2	3	imm	0.4283361

Sample Date	Location	Sex	Length	Body Weight	Gonad Weight	Gonad Stage	Age	maturity	GSI
28/08/2008	TERRIGAL	Female	33.7	904	7.1	2	2	imm	0.7853982
2/09/2008	TERRIGAL	Male	24.8	373	3.5	3	2	mature	0.9383378
2/09/2008	TERRIGAL	Male	25.6	398	3	3	2	mature	0.7537688
2/09/2008	TERRIGAL	Male	31	677	3.3	3	3	mature	0.4874446
2/09/2008	TERRIGAL	Male	31.5	709	11.1	3	4	mature	1.5655853
2/09/2008	TERRIGAL	Male	28	543	7.5	3	3	mature	1.3812155
2/09/2008	TERRIGAL	Male	27.9	529	15.6	3	3	mature	2.9489603
2/09/2008	TERRIGAL	Female	29.1	646	16.3	3	4	mature	2.5232198
2/09/2008	TERRIGAL	Female	30.5	756	22.6	3	4	mature	2.989418
2/09/2008	TERRIGAL	Female	25.5	445	5.8	3	3	mature	1.3033708
2/09/2008	TERRIGAL	Female	27.4	515	18.3	3	3	mature	3.5533981
2/09/2008	TERRIGAL	Female	29.1	532	6.2	3	3	mature	1.1654135
2/09/2008	TERRIGAL	Male	34.1	891	9.6	3	6	mature	1.0774411
2/09/2008	TERRIGAL	Female	34.2	842	26.4	3	4	mature	3.1353919
2/09/2008	TERRIGAL	Female	32.9	782	21.9	3	4	mature	2.8005115
2/09/2008	TERRIGAL	Male	26.9	449	4	3	2	mature	0.8908686
2/09/2008	TERRIGAL	Female	35.7	1158	38.9	3	7	mature	3.3592401
2/09/2008	TERRIGAL	Male	29.6	550	14.5	3	4	mature	2.6363636
2/09/2008	TERRIGAL	Female	35.9	1069	6.9	3	5	mature	0.645463
2/09/2008	TERRIGAL	Male	27.2	538	7.6	3	4	mature	1.4126394
2/09/2008	TERRIGAL	Male	29.1	510	4.1	3	4	mature	0.8039216
2/09/2008	TERRIGAL	Male	28.3	580	13.6	3	3	mature	2.3448276
2/09/2008	TERRIGAL	Male	26.1	440	13.9	3	3	mature	3.1590909
2/09/2008	TERRIGAL	Female	26.1	434	3.9	3	3	mature	0.8986175
2/09/2008	TERRIGAL	Female	29.5	629	15.1	3	4	mature	2.4006359
2/09/2008	TERRIGAL	Female	27.7	483	14.6	3	3	mature	3.0227743
2/09/2008	TERRIGAL	Male	26.4	443	4	3	4	mature	0.9029345
2/09/2008	TERRIGAL	Male	29.2	561	10.3	3	3	mature	1.8360071
2/09/2008	TERRIGAL	Female	25.7	415	5.5	3	2	mature	1.3253012
9/09/2008	TERRIGAL	Female	41	1397	59.2	3	7	mature	4.2376521
9/09/2008	TERRIGAL	Female	36.8	1179	41	3	5	mature	3.4775233
9/09/2008	TERRIGAL	Male	36.9	1228	92.1	3	5	mature	7.5
28/08/2008	TERRIGAL	Female	32	807	25.2	3	3	mature	3.1226766
28/08/2008	TERRIGAL	Male	30.2	685	14.6	3	4	mature	2.1313869
28/08/2008	TERRIGAL	Male	29.1	656	5.8	3	4	mature	0.8841463
28/08/2008	TERRIGAL	Female	35.5	965	37.5	3	5	mature	3.8860104
28/08/2008	TERRIGAL	Female	34.1	803	28.4	3	3	mature	3.5367372
28/08/2008	TERRIGAL	Male	32.6	799	12.8	3	4	mature	1.6020025
28/08/2008	TERRIGAL	Female	32.9	851	26.3	3	4	mature	3.0904818
2/09/2008	TERRIGAL	Male	28.6	574	17.5	4	3	mature	3.0487805
2/09/2008	TERRIGAL	Male	31.3	700	5.7	4	3	mature	0.8142857
2/09/2008	TERRIGAL	Male	37.4	1327	40.4	4	7	mature	3.0444612
2/09/2008	TERRIGAL	Male	31	709	34.4	4	4	mature	4.8519041
2/09/2008	TERRIGAL	Male	30.8	712	30.8	4	4	mature	4.3258427
2/09/2008	TERRIGAL	Male	28	512	19.1	4	3	mature	3.7304688
2/09/2008	TERRIGAL	Male	33.3	943	35.7	4	4	mature	3.78579
2/09/2008	TERRIGAL	Male	30.3	675	37.4	4	4	mature	5.5407407
2/09/2008	TERRIGAL	Male	26.1	400	6.7	4	2	mature	1.675
9/09/2008	TERRIGAL	Female	32	797	35	4	3	mature	4.391468
9/09/2008	TERRIGAL	Male	43.1	1572	28	4	7	mature	1.7811705
9/09/2008	TERRIGAL	Male	37.8	1183	23.3	4	5	mature	1.9695689
2/09/2008	TERRIGAL	Male	34	839	1.8	5	3	mature	0.2145411
9/09/2008	TERRIGAL	Female	42.7	1530	7.8	5	4	mature	0.5098039
8/09/2008	WALLIS LAKE	Male	25.8	410	0.7	1	3	imm	0.1707317
8/09/2008	WALLIS LAKE	Female	26.2	375	1	1	2	imm	0.2666667
10/09/2008	WALLIS LAKE	Female	28.2	475	1.1	1	2	imm	0.2315789
10/09/2008	WALLIS LAKE	Female	25.7	395	1.2	1	3	imm	0.3037975
10/09/2008	WALLIS LAKE	Female	30.8	665	2.4	1	3	imm	0.3609023
10/09/2008	WALLIS LAKE	Female	25.8	440	0.6	1	2	imm	0.1363636
11/09/2008	WALLIS LAKE	Female	26.5	425	1.9	1	2	imm	0.4470588
11/09/2008	WALLIS LAKE	Female	25.1	390	1.2	1	2	imm	0.3076923
12/09/2008	WALLIS LAKE	Female	33.6	850	2.3	1	4	imm	0.2705882
17/09/2008	WALLIS LAKE	Female	24.8	375	0.8	1	2	imm	0.2133333
18/09/2008	WALLIS LAKE	Male	34.1	885	1.8	1	5	imm	0.2033898
30/09/2008	WALLIS LAKE	Female	32.1	705	1.5	1	3	imm	0.212766
1/10/2008	WALLIS LAKE	Male	34.5	940	1.4	1	6	imm	0.1489362
3/09/2008	WALLIS LAKE	Female	25.2	380	1.1	1.2	2	imm	0.2894737
3/09/2008	WALLIS LAKE	Male	26.5	365	0.9	2	2	imm	0.2465753

Sample Date	Location	Sex	Length	Body Weight	Gonad Weight	Gonad Stage	Age	maturity	GSI
3/09/2008	WALLIS LAKE	Female	28.1	505	1.4	2	3	imm	0.2772277
3/09/2008	WALLIS LAKE	Male	27.6	470	2.4	2	4	imm	0.5106383
8/09/2008	WALLIS LAKE	Female	29.5	505	2.8	2	4	imm	0.5544554
10/09/2008	WALLIS LAKE	Female	39.6	1445	5.9	2	6	imm	0.4083045
10/09/2008	WALLIS LAKE	Female	25.5	355	1	2	2	imm	0.2816901
11/09/2008	WALLIS LAKE	Female	27.6	505	1.9	2	3	imm	0.3762376
11/09/2008	WALLIS LAKE	Female	30.5	630	3	2	3	imm	0.4761905
11/09/2008	WALLIS LAKE	Female	30.4	685	2.5	2	7	imm	0.3649635
12/09/2008	WALLIS LAKE	Female	33.6	825	5.7	2	6	imm	0.6909091
12/09/2008	WALLIS LAKE	Female	33.2	790	5.6	2	4	imm	0.7088608
12/09/2008	WALLIS LAKE	Female	36.8	1180	22.9	2	6	imm	1.940678
17/09/2008	WALLIS LAKE	Female	38	1170	3.2	2	5	imm	0.2735043
17/09/2008	WALLIS LAKE	Female	36.4	965	6	2	6	imm	0.6217617
18/09/2008	WALLIS LAKE	Female	25.3	360	1.2	2	2	imm	0.3333333
18/09/2008	WALLIS LAKE	Female	36.8	1210	6.2	2	5	imm	0.5123967
18/09/2008	WALLIS LAKE	Female	25.4	330	1.8	2	2	imm	0.5454545
22/09/2008	WALLIS LAKE	Male	40.5	1175	4.2	2	5	imm	0.3574468
30/09/2008	WALLIS LAKE	Female	38.6	1105	3.7	2	4	imm	0.3348416
30/09/2008	WALLIS LAKE	Female	30.4	600	2.2	2	3	imm	0.3666667
1/10/2008	WALLIS LAKE	Female	43.5	1815	6.5	2	6	imm	0.3581267
1/10/2008	WALLIS LAKE	Female	40.5	1500	11.6	2	5	imm	0.7733333
1/10/2008	WALLIS LAKE	Female	34.2	555	3.1	2	5	imm	0.5585586
1/10/2008	WALLIS LAKE	Female	37.7	1260	5.1	2	5	imm	0.4047619
3/09/2008	WALLIS LAKE	Female	28.3	565	1.2	2.3	4	imm	0.2123894
8/09/2008	WALLIS LAKE	Male	30.1	535	1.8	2.3	4	imm	0.3364486
3/09/2008	WALLIS LAKE	Male	30.1	655	9.3	3	3	mature	1.4198473
3/09/2008	WALLIS LAKE	Male	28.9	585	8.1	3	5	mature	1.3846154
3/09/2008	WALLIS LAKE	Male	27.3	455	3.8	3	4	mature	0.8351648
3/09/2008	WALLIS LAKE	Female	28.5	565	7.2	3	4	mature	1.2743363
3/09/2008	WALLIS LAKE	Female	28.7	540	3.6	3	3	mature	0.6666667
3/09/2008	WALLIS LAKE	Male	30.1	595	13.2	3	3	mature	2.2184874
3/09/2008	WALLIS LAKE	Male	30.6	615	6.1	3	3	mature	0.9918699
3/09/2008	WALLIS LAKE	Female	27.3	485	3	3	3	mature	0.6185567
3/09/2008	WALLIS LAKE	Female	31.4	660	13	3	4	mature	1.969697
3/09/2008	WALLIS LAKE	Female	26.3	340	1.7	3	2	mature	0.5
3/09/2008	WALLIS LAKE	Female	33.7	745	17.4	3	3	mature	2.3355705
3/09/2008	WALLIS LAKE	Male	33.6	875	12.2	3	4	mature	1.3942857
3/09/2008	WALLIS LAKE	Male	28.2	565	2.3	3	2	mature	0.4070796
3/09/2008	WALLIS LAKE	Male	27.1	460	4.5	3	2	mature	0.9782609
8/09/2008	WALLIS LAKE	Female	27.3	450	3.4	3	3	mature	0.7555556
8/09/2008	WALLIS LAKE	Male	28.1	475	3.8	3	4	mature	0.8
8/09/2008	WALLIS LAKE	Female	26.4	465	4.5	3	4	mature	0.9677419
8/09/2008	WALLIS LAKE	Female	34.2	820	15.5	3	4	mature	1.8902439
8/09/2008	WALLIS LAKE	Male	35.8	875	26	3	5	mature	2.9714286
8/09/2008	WALLIS LAKE	Male	28.7	505	4.5	3	3	mature	0.8910891
8/09/2008	WALLIS LAKE	Female	27.2	400	26.1	3	6	mature	6.525
8/09/2008	WALLIS LAKE	Male	31.3	710	6.4	3	4	mature	0.9014085
8/09/2008	WALLIS LAKE	Male	25.3	360	5.3	3	3	mature	1.4722222
8/09/2008	WALLIS LAKE	Male	27.7	430	4.5	3	4	mature	1.0465116
10/09/2008	WALLIS LAKE	Male	32	655	7.3	3	5	mature	1.1145038
10/09/2008	WALLIS LAKE	Male	32.2	730	8.9	3	4	mature	1.2191781
10/09/2008	WALLIS LAKE	Female	26.9	415	3.9	3	3	mature	0.939759
10/09/2008	WALLIS LAKE	Female	31.6	700	26.4	3	3	mature	3.7714286
10/09/2008	WALLIS LAKE	Female	29.8	590	11.4	3	4	mature	1.9322034
10/09/2008	WALLIS LAKE	Male	25.9	395	3.6	3	3	mature	0.9113924
10/09/2008	WALLIS LAKE	Female	33.1	860	14	3	5	mature	1.627907
10/09/2008	WALLIS LAKE	Female	30.1	635	13.6	3	4	mature	2.1417323
10/09/2008	WALLIS LAKE	Female	34.8	925	16.3	3	5	mature	1.7621622
10/09/2008	WALLIS LAKE	Female	39.1	955	18.7	3	6	mature	1.9581152
10/09/2008	WALLIS LAKE	Female	33.3	880	12.4	3	5	mature	1.4090909
10/09/2008	WALLIS LAKE	Female	38.2	1140	45.5	3	5	mature	3.9912281
10/09/2008	WALLIS LAKE	Female	30.2	620	18.8	3	4	mature	3.0322581
11/09/2008	WALLIS LAKE	Female	27.1	445	8	3	3	mature	1.7977528
11/09/2008	WALLIS LAKE	Male	29.2	550	8.3	3	3	mature	1.5090909
11/09/2008	WALLIS LAKE	Male	33.5	880	11.3	3	5	mature	1.2840909
11/09/2008	WALLIS LAKE	Female	36.1	985	32.9	3	5	mature	3.3401015
11/09/2008	WALLIS LAKE	Male	32.4	700	13.9	3	5	mature	1.9857143
11/09/2008	WALLIS LAKE	Male	29.9	655	5.3	3	4	mature	0.8091603

Sample Date	Location	Sex	Length	Body Weight	Gonad Weight	Gonad Stage	Age	maturity	GSI
11/09/2008	WALLIS LAKE	Female	39	1215	45.9	3	4	mature	3.7777778
11/09/2008	WALLIS LAKE	Male	29.2	595	54.8	3	4	mature	9.210084
11/09/2008	WALLIS LAKE	Male	38.7	1145	27.3	3	5	mature	2.3842795
11/09/2008	WALLIS LAKE	Male	28.6	535	13.1	3	3	mature	2.4485981
11/09/2008	WALLIS LAKE	Male	37	1040	11.6	3	7	mature	1.1153846
12/09/2008	WALLIS LAKE	Male	38.6	1260	16.8	3	6	mature	1.3333333
12/09/2008	WALLIS LAKE	Female	32.7	770	17.7	3	4	mature	2.2987013
12/09/2008	WALLIS LAKE	Male	43.1	1675	22.9	3	8	mature	1.3671642
12/09/2008	WALLIS LAKE	Female	36.2	995	20.4	3	7	mature	2.0502513
12/09/2008	WALLIS LAKE	Female	35.1	910	24.7	3	6	mature	2.7142857
12/09/2008	WALLIS LAKE	Male	35	945	13.8	3	8	mature	1.4603175
12/09/2008	WALLIS LAKE	Female	34.6	835	9.9	3	4	mature	1.1856287
12/09/2008	WALLIS LAKE	Male	39.2	1305	11.2	3	6	mature	0.8582375
15/09/2008	WALLIS LAKE	Female	31.8	595	14.2	3	3	mature	2.3865546
15/09/2008	WALLIS LAKE	Male	41.5	1300	9.6	3	4	mature	0.7384615
15/09/2008	WALLIS LAKE	Female	37.5	1120	37.2	3	4	mature	3.3214286
15/09/2008	WALLIS LAKE	Female	43.8	1720	59.7	3	6	mature	3.4709302
15/09/2008	WALLIS LAKE	Male	44.8	1885	32	3	6	mature	1.6976127
15/09/2008	WALLIS LAKE	Female	34.6	815	10.1	3	5	mature	1.2392638
15/09/2008	WALLIS LAKE	Male	41.2	1650	44.6	3	9	mature	2.7030303
3/09/2008	WALLIS LAKE	Female	49.1	2100	34.3	3	8	mature	1.6333333
12/09/2008	WALLIS LAKE	Female	46.6	2070	62.7	3	7	mature	3.0289855
12/09/2008	WALLIS LAKE	Female	58.1	3850	164.3	3		mature	4.2675325
17/09/2008	WALLIS LAKE	Female	38	1245	21.2	3	6	mature	1.7028112
17/09/2008	WALLIS LAKE	Female	33.5	820	7.7	3	4	mature	0.9390244
17/09/2008	WALLIS LAKE	Female	34.1	765	15.2	3	4	mature	1.9869281
17/09/2008	WALLIS LAKE	Male	43.4	1545	67.6	3	5	mature	4.3754045
17/09/2008	WALLIS LAKE	Female	35.8	1025	31.7	3	4	mature	3.0926829
17/09/2008	WALLIS LAKE	Male	25.8	400	1.6	3	3	mature	0.4
17/09/2008	WALLIS LAKE	Female	51.6	2775	93.5	3	10	mature	3.3693694
17/09/2008	WALLIS LAKE	Male	47.2	2170	52.2	3	11	mature	2.40553
17/09/2008	WALLIS LAKE	Female	49.8	2405	51.8	3	9	mature	2.1538462
17/09/2008	WALLIS LAKE	Female	53.3	2685	73.4	3	10	mature	2.7337058
18/09/2008	WALLIS LAKE	Female	38.6	1275	32.4	3		mature	2.5411765
18/09/2008	WALLIS LAKE	Female	41.2	1445	40.6	3	5	mature	2.8096886
18/09/2008	WALLIS LAKE	Male	33.6	860	14.8	3	4	mature	1.7209302
18/09/2008	WALLIS LAKE	Male	36	885	20.3	3	5	mature	2.2937853
18/09/2008	WALLIS LAKE	Male	35.2	880	15.2	3	5	mature	1.7272727
18/09/2008	WALLIS LAKE	Male	35.2	955	14.6	3	5	mature	1.5287958
18/09/2008	WALLIS LAKE	Male	42.1	1695	23.5	3	5	mature	1.3864307
18/09/2008	WALLIS LAKE	Female	35.5	915	18.5	3	6	mature	2.0218579
18/09/2008	WALLIS LAKE	Female	34.4	1005	10.2	3	6	mature	1.0149254
18/09/2008	WALLIS LAKE	Female	25.3	375	4.9	3	3	mature	1.3066667
18/09/2008	WALLIS LAKE	Female	25.9	410	5.4	3	3	mature	1.3170732
18/09/2008	WALLIS LAKE	Female	46.2	1975	84.2	3	10	mature	4.2632911
22/09/2008	WALLIS LAKE	Male	33.2	850	28.3	3	7	mature	3.3294118
22/09/2008	WALLIS LAKE	Female	69.9	5620	144	3	9	mature	2.5622776
22/09/2008	WALLIS LAKE	Male	46.2	2060	17.5	3	8	mature	0.8495146
22/09/2008	WALLIS LAKE	Male	37.8	1015	39.3	3	4	mature	3.8719212
22/09/2008	WALLIS LAKE	Female	44.2	1540	19.1	3	8	mature	1.2402597
22/09/2008	WALLIS LAKE	Male	35.3	965	28.5	3	5	mature	2.9533679
22/09/2008	WALLIS LAKE	Male	33.9	855	31.4	3	4	mature	3.6725146
22/09/2008	WALLIS LAKE	Male	48.5	1970	37.8	3	8	mature	1.9187817
22/09/2008	WALLIS LAKE	Female	42.3	1555	20.2	3	5	mature	1.2990354
30/09/2008	WALLIS LAKE	Male	51.2	2595	32.9	3	9	mature	1.2678227
30/09/2008	WALLIS LAKE	Female	38.8	1235	28.8	3	10	mature	2.3319838
30/09/2008	WALLIS LAKE	Male	34.5	830	22.6	3	4	mature	2.7228916
30/09/2008	WALLIS LAKE	Male	33.6	805	17.2	3	5	mature	2.136646
30/09/2008	WALLIS LAKE	Female	33.9	845	15.8	3	5	mature	1.8698225
1/10/2008	WALLIS LAKE	Male	38.1	1130	11.7	3	5	mature	1.0353982
1/10/2008	WALLIS LAKE	Male	39.2	1345	8.9	3	7	mature	0.66171
1/10/2008	WALLIS LAKE	Female	40.4	1365	16.1	3	6	mature	1.1794872
1/10/2008	WALLIS LAKE	Female	40	1350	22.2	3	5	mature	1.6444444
1/10/2008	WALLIS LAKE	Male	40.3	1390	34.5	3	9	mature	2.4820144
1/10/2008	WALLIS LAKE	Female	61.2	4300	142.5	3	8	mature	3.3139535
3/09/2008	WALLIS LAKE	Female	30.2	620	13.7	3.4	3	mature	2.2096774
3/09/2008	WALLIS LAKE	Female	39.5	1340	25	3.4	5	mature	1.8656716
8/09/2008	WALLIS LAKE	Male	30.5	620	24.1	3.4	4	mature	3.8870968

Sample Date	Location	Sex	Length	Body Weight	Gonad Weight	Gonad Stage	Age	maturity	GSI
8/09/2008	WALLIS LAKE	Female	30.3	650	9.7	3.4	3	mature	1.4923077
3/09/2008	WALLIS LAKE	Female	37	1185	44.7	4	7	mature	3.7721519
3/09/2008	WALLIS LAKE	Female	44.1	1795	49	4	3	mature	2.729805
8/09/2008	WALLIS LAKE	Female	33.1	760	11.1	4	4	mature	1.4605263
8/09/2008	WALLIS LAKE	Female	32.4	730	3.9	4	4	mature	0.5342466
8/09/2008	WALLIS LAKE	Female	32.7	740	11.1	4	4	mature	1.5
8/09/2008	WALLIS LAKE	Female	39.7	1190	46.4	4	4	mature	3.8991597
8/09/2008	WALLIS LAKE	Female	29.7	590	5.4	4	5	mature	0.9152542
8/09/2008	WALLIS LAKE	Male	25.9	415	8.3	4	2	mature	2
10/09/2008	WALLIS LAKE	Female	41.7	1385	47.7	4	7	mature	3.4440433
10/09/2008	WALLIS LAKE	Female	28	505	19.1	4	3	mature	3.7821782
11/09/2008	WALLIS LAKE	Female	25.9	410	9	4	2	mature	2.195122
11/09/2008	WALLIS LAKE	Female	41.8	1715	42.4	4	4	mature	2.4723032
12/09/2008	WALLIS LAKE	Female	33.1	945	28.9	4	4	mature	3.0582011
12/09/2008	WALLIS LAKE	Female	34.3	1005	20.4	4	5	mature	2.0298507
15/09/2008	WALLIS LAKE	Female	38.3	1265	66.5	4	7	mature	5.256917
15/09/2008	WALLIS LAKE	Female	34.4	775	24.9	4	4	mature	3.2129032
17/09/2008	WALLIS LAKE	Male	37.2	1000	45.6	4	6	mature	4.56
17/09/2008	WALLIS LAKE	Female	40.1	1345	48.1	4	7	mature	3.5762082
17/09/2008	WALLIS LAKE	Female	38.3	1165	30.3	4	4	mature	2.6008584
18/09/2008	WALLIS LAKE	Female	40.5	1350	45.2	4	7	mature	3.3481481
18/09/2008	WALLIS LAKE	Female	34.7	685	35.9	4		mature	5.2408759
1/10/2008	WALLIS LAKE	Male	36.4	980	21.9	4	4	mature	2.2346939
8/09/2008	WALLIS LAKE	Female	27.5	435	4.4	4.5	3	mature	1.0114943
8/09/2008	WALLIS LAKE	Male	43.1	1540	1.5	5	5	mature	0.0974026
8/09/2008	WALLIS LAKE	Male	25.9	395	5.4	5	3	mature	1.3670886
10/09/2008	WALLIS LAKE	Female	26.1	395	7.5	5	3	mature	1.8987342
10/09/2008	WALLIS LAKE	Female	35.1	990	10.9	5	4	mature	1.1010101
11/09/2008	WALLIS LAKE	Female	29.1	575	2.8	5	4	mature	0.4869565

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