BARRACADE

A FISH SURVEY IN CORROBOREE BILLABONG, MARY RIVER 2009

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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>1</td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>METHODS</td>
<td>1</td>
</tr>
<tr>
<td>Study site</td>
<td>1</td>
</tr>
<tr>
<td>Fish sampling</td>
<td>2</td>
</tr>
<tr>
<td>Calculating fish numbers</td>
<td>3</td>
</tr>
<tr>
<td>Barramundi weights</td>
<td>3</td>
</tr>
<tr>
<td>RESULTS AND DISCUSSION</td>
<td>3</td>
</tr>
<tr>
<td>Study site</td>
<td>3</td>
</tr>
<tr>
<td>Barramundi numbers</td>
<td>6</td>
</tr>
<tr>
<td>Barramundi size and age</td>
<td>7</td>
</tr>
<tr>
<td>Saratoga</td>
<td>8</td>
</tr>
<tr>
<td>Other fish</td>
<td>8</td>
</tr>
<tr>
<td>Fish health</td>
<td>9</td>
</tr>
<tr>
<td>SUMMARY</td>
<td>9</td>
</tr>
<tr>
<td>ACKNOWLEDGMENTS</td>
<td>9</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>10</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1. The location of Barracade 2009 adapted from Google Earth™ ........................................2
Figure 2. Water temperature (top) and dissolved oxygen (bottom) for four sites within the blocked-off area ........................................................................................................5
Figure 3. Estimated numbers of barramundi (± 95% confidence interval) and their estimated biomass (kg) for Barracade from 1989 to 2009 .............................................6
Figure 4. Size distribution of barramundi caught during Barracade 2009, with groupings corresponding to individuals of a) less than one year old, b) one to two years old, c) three years old ..........................................................................................................................7
Figure 5. Age distribution of barramundi that could be aged with confidence in Barracade 2009 ..........................................................................................................................7
Figure 6. Estimated numbers of saratoga (± 95% confidence interval) in blocked-off areas of Barracade from 1993 to 2009 ................................................................................8

LIST OF TABLES

Table 1. Numbers of barramundi and saratoga caught in each sampling period during Barracade 2009 .................................................................................................................3
Table 2. Water quality parameters in the blocked-off area at midday on 14 September 2009 ...............................................................................................................................4
Table 3. Prevalence of red spot in barramundi caught during Barracade 2009 ..................9
ABSTRACT

Important recreational and commercial fisheries are based on barramundi (*Lates calcarifer*) in the Northern Territory (NT), Australia. Barracade is an annual program that has been monitoring barramundi numbers, size, health and age at Corroboree Billabong in the Mary River system since 1987.

Using depletion methods, a fish survey was conducted in September 2009, which estimated that 1509 barramundi were present in a 660-m section of Corroboree Billabong. Both sizes and numbers of fish were above long-term averages, suggesting that barramundi stocks in Corroboree Billabong continue to be healthy. One-year-old fish dominated the catch (57%). A much smaller number of fish were less than one year old compared with the 2008 survey. The observed size distribution was typical of a year that follows a high recruitment of juvenile barramundi in the previous year.

INTRODUCTION

Barramundi inhabits the Indo-Pacific region and northern Australia. It is valued by recreational fishers for its large size (Coleman 1998), readiness to take artificial lures, fighting ability and eating qualities. These features have made it an iconic species on which depend substantial commercial and recreational fishing industries.

Barramundi stocks have been monitored in the NT using a range of methods, such as commercial fisher logbooks, on-board monitoring of commercial operations, recreational fishing surveys, mark and recapture experiments and depletion experiments. Barracade is an annual long-term (since 1987) fishery-independent depletion survey of barramundi abundance and population structure, which is conducted at Corroboree Billabong on the Mary River system.

For 23 years Barracade has been providing detailed information on abundance and age structure as well as annual measures of barramundi recruitment. Also, Barracade has been monitoring the long-term health of barramundi stocks in this area.

METHODS

The methods used in Barracade 2009 were similar to those in previous years (see de Lestang 2005, White and Grace 2007 and Grace 2008). The number of barramundi and saratoga was estimated by preventing the fish from entering or leaving a blocked-off section of the billabong, followed by heavily fishing the area. The number of fish originally present in the blocked-off section of the billabong was calculated by assessing how quickly the catch rates decreased over time.

STUDY SITE

A section of Corroboree Billabong (12°35’ S 131°40’ E) on the Mary River system (Figure 1) was isolated using two heavy-gauge, small-mesh block-off nets between 7 and 11 September 2009. The same section of the billabong was used in 2007 and 2008.
Water quality was measured on 14 September 2009 at four randomly-chosen sites within the blocked-off area, three days after the fish survey was completed. Dissolved oxygen, temperature, electro-conductivity, turbidity and pH were measured using a Hydrolab Quanto unit. Readings were taken at three levels: just below the surface, 1 m deep and just above the bottom.

![Barracade block-off net](image)

**Figure 1.** The location of Barracade 2009 adapted from Google Earth™

The area of the blocked-off section of the billabong was estimated by multiplying the average channel width by the distance between the two block-off nets. Channel width within the section was measured at five sites using a Leupold RX-1 rangefinder. The length of the section was estimated by tracking a path with a GPS while travelling along the centre of the billabong. Water depth was measured at 20 sites, which were chosen in a stratified random manner.

**FISH SAMPLING**

Fish were sampled inside the blocked-off area using six gill nets, each with a different stretched mesh size ranging from 75 mm (3-inch) to 200 mm (8-inch). Four sampling periods were conducted when nets were randomly set among six locations within the blocked-off area. The experiment was conducted between 7 and 11 September 2009.

Each gill net was randomly set at one of six locations within the blocked-off area for 14 hours. After 24 hours, the nets were moved to other locations. To reduce interactions with crocodiles, all gill nets were brought ashore at 8 p.m. They were then redeployed at 6 a.m. the following morning.
All the barramundi and saratoga caught were measured for total length. The fish were placed in tubs of oxygenated water and then released outside the block-off nets. Barramundi fish were not tagged in 2009 due to concerns that tagging at that time of year substantially increased mortality, which would affect tag/recapture information. Also, scales were not collected for ageing as in previous years. Instead, a selection of all size classes of barramundi present was retained for age/length validation based on otolith aging.

The severity of fungal lesions was scored on each fish (0-3) (White and Grace 2007).

Table 1. Numbers of barramundi and saratoga caught in each sampling period during Barracade 2009

<table>
<thead>
<tr>
<th>Sampling period</th>
<th>Net times</th>
<th>Barramundi</th>
<th>Saratoga</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4 p.m. 7 Sept – 4 p.m. 8 Sept</td>
<td>148</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4 p.m. 8 Sept – 4 p.m. 9 Sept</td>
<td>115</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>4 p.m. 9 Sept – 4 p.m. 10 Sept</td>
<td>142</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>4 p.m. 10 Sept – 4 p.m. 11 Sept</td>
<td>98</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>503</td>
<td>11</td>
</tr>
</tbody>
</table>

**CALCULATING FISH NUMBERS**

The number of barramundi and saratoga in the blocked-off section of the billabong was estimated from fish captured in each sampling period (Table 1). This was achieved by using a maximum likelihood estimator (Zippin 1956) to calculate how many fish would have been caught if the survey continued until no fish were left in the blocked-off area. These estimations assume that no fish entered the blocked-off area and none died from natural causes within that area.

**BARRAMUNDI WEIGHTS**

Barramundi weights were calculated using the equation:

\[ \text{Weight} = 0.0000106 \times \text{total length}^{3.02} \]

where total length is in cm and weight is in kg (Reynolds 1978).

**RESULTS AND DISCUSSION**

**STUDY SITE**

The 660-m section of Corroboree Billabong examined had an average width of 37 m (range 30 – 57 m) giving an area estimate of 24 600 m². The blocked-off area had an average depth of 1.7 m (range 0.1 – 3.0 m). Lilies, mainly lotus (Nelumbo nucifera) covered an estimated 31% of the study area.
Dissolved oxygen levels were suitable for fish survival and were typical for Corroboree Billabong in the dry season (e.g. Grace et al. 2007). The water was stratified (layered) with temperature, dissolved oxygen and pH all highest near the surface and lower towards the bottom (Table 2, Figure 2) as Powell and Townsend (1997) found in other billabongs on the Mary River system.

**Table 2.** Water quality parameters in the blocked-off area at midday on 14 September 2009. Numbers are averages of nine readings ± standard error of mean (sem).

<table>
<thead>
<tr>
<th>Water quality parameter</th>
<th>Average ± sem</th>
</tr>
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<tbody>
<tr>
<td>Dissolved oxygen (mg/L)</td>
<td>3.67 ± 0.4</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>27.9 ± 0.3</td>
</tr>
<tr>
<td>Electro-conductivity (S/cm)</td>
<td>0.08 ± 0.0003</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>80.7 ± 5</td>
</tr>
<tr>
<td>pH</td>
<td>7.3 ± 0.06</td>
</tr>
</tbody>
</table>
Importantly, the water was less turbid, or muddy, in 2009 than it was in 2008 (82 nephelometric turbidity units (NTU) compared with 118 NTU), and higher than previously reported for the Mary River system (Schultz et al. 2002; Powel and Townsend 1997). An increase in the number of boats using the billabong and erosion as a result of fire and grazing was suggested as a possible factor for the higher turbidity in 2008. However, boating traffic in the billabong would have remained similar if not increased during 2009, suggesting that other factors also influenced the turbidity of water in that area.

**Figure 2.** Water temperature (top) and dissolved oxygen (bottom) for four sites within the blocked-off area
**Barramundi Numbers**

During the 2009 survey, 503 barramundi were caught (Table 1). Based on the depletion survey, it is estimated that there were 1509 (±79) barramundi in the blocked-off area in 2009. If this was the case, approximately 33% of all the barramundi in the area were caught. The block-off nets were not damaged by crocodiles at all during the sampling period. Thus, it can be assumed that no barramundi moved in or out of the blocked-off area.

This estimate of 1509 barramundi is the third highest number recorded in the history of Barracade and is well above the average for the previous 21 years (827 fish). However, barramundi numbers in this system have been characterised by large inter-annual variation (Figure 3).

The average weight was calculated to be 2.35 kg, giving a total biomass of 3546 kg of barramundi in the blocked-off area, which was the second highest recorded in the history of Barracade (Figure 3).

Using these figures, the freshwater section of the lower catchment of the Mary River (north of the Arnhem Highway) contained roughly 160 000 barramundi in 2009, assuming there is 70 km of suitable barramundi habitat in this area.

![Figure 3. Estimated numbers of barramundi (± 95% confidence interval) and their estimated biomass (kg) for Barracade from 1989 to 2009](image)

**Note:** Population numbers could not be estimated during 2002-2004 as depletion was not achieved during those years
**BARRAMUNDI SIZE AND AGE**

The patterns of barramundi sizes reflect fish ages. A large proportion (57%) of the barramundi caught were between one and two years old (40-50 cm total length) while only 2.6% were less than one year old (<40 cm total length) (Figures 4 and 5). The observed age structure in 2009 contrasted substantially from that in 2008 where one to two year-olds comprised 28% and fish less than one year old accounted for 46% of all barramundi caught.

During the 2009 survey, 42% of the fish caught were of legal length (i.e. 55 cm or above).

**Figure 4.** Size distribution of barramundi caught during Barracade 2009, with groupings corresponding to individuals of a) less than one year old, b) one to two years old, c) three years old

**Figure 5.** Age distribution of barramundi that could be aged with confidence in Barracade 2009
**SARATOGA**

Eleven saratoga were caught in 2009 (Table 2), giving an estimate of 14 saratoga in the blocked-off area (Figure 6). This is below the long-term average of 35 fish.

The number of saratoga at Corroboree Billabong has varied greatly between years, which is thought to be related to the amount of water lilies present. However, 36 saratoga were recorded in Barracade 2007 and only 9% lily cover compared with eight saratoga and 24% lily cover recorded in 2008. In 2009, the lily cover was estimated at over 30% and there was no significant increase in the number of saratoga present. Consequently, the relationship between saratoga and lilies is clearly not as straightforward as was first thought.

The lengths of saratoga caught in 2009 ranged from 34 to 63 cm, with an average of 52 cm, which is slightly shorter than the average length of 55 cm recorded in 2008.

![Figure 6. Estimated numbers of saratoga (± 95% confidence interval) in blocked-off areas of Barracade from 1993 to 2009](image)

**OTHER FISH**

After barramundi, bony bream were the most commonly fish caught during Barracade 2009. Despite there being concerns of increases in catfish numbers in the billabong, only five were observed in nets during 2009, similar to the three observed in 2008.
FISH HEALTH

Ninety two barramundi (18%) were infected with the fungal disease red spot (*Aphanomyces invadans*) (Table 3). This infection rate is below the long-term average of 27%, which is not surprising given that smaller individuals are more likely to have red spot lesions compared with larger individuals (Grace 2008) and the average size of barramundi in 2009 was above the long-term average.

**Table 3.** Prevalence of red spot in barramundi caught during Barracade 2009

<table>
<thead>
<tr>
<th>Severity of red spot</th>
<th>Proportion of all barramundi caught (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No lesions</td>
<td>84</td>
</tr>
<tr>
<td>One lesion</td>
<td>8</td>
</tr>
<tr>
<td>Two to three lesions</td>
<td>7</td>
</tr>
<tr>
<td>More than three lesions</td>
<td>1</td>
</tr>
</tbody>
</table>

SUMMARY

The results of Barracade 2009 indicate that the barramundi resource in Corroboree Billabong remains healthy. The number and average size of barramundi were substantially larger than historical averages. While there were fewer juvenile barramundi caught than expected, the substantial numbers of larger barramundi probably restricted the numbers of recruits through increased/elevated competition and/or predation.

Barracade has generated a long-term dataset of fish sizes, abundance and health. Data from the 21 years of Barracade is currently being examined to further determine how rainfall and flooding affect barramundi growth and recruitment. This will provide an interesting contrast to work done on barramundi in a very different environment in central Queensland (Robins et al. 2006).

Future work needs to concentrate on expanding the current fishery-independent monitoring program to other sites within the Mary River and into other river systems within the NT.

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REFERENCES


