

# Fisheries Long Term Monitoring Program

## Summary of Spanish mackerel (*Scomberomorus commerson*) survey results: 2004–05

October 2006





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(*Scomberomorus commerson*)  
survey results: 2004–05**

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## Acronyms

DPI&F	Department of Primary Industries and Fisheries, Queensland
FL	Fork length
JL	Jaw length
LTMP	Long Term Monitoring Program, DPI&F



## Summary

Spanish mackerel, *Scomberomorus commerson*, is an important commercial and recreational pelagic fish species. It has similar total landings for both of these sectors on the Queensland east coast. The majority of the commercial landings come from the Lucinda area, north of Townsville, whilst the bulk of recreational catch comes from south east Queensland (Bundaberg to the Gold Coast).

A preliminary stock assessment of the east coast Spanish mackerel fishery suggested that the exploitable biomass in 2002 had declined to approximately 44% of the estimated unfished biomass (Welch *et al.* 2002). The stock assessment recommended that fishing effort should not be increased above the 2002 level. Following the assessment, Hoyle (2002) conducted a management strategy evaluation of the east coast Spanish mackerel stock. The management strategy evaluation outlined alternative management arrangements. It proposed alternative monitoring and assessment methods to improve the resolution and utility of the information being collected.

Tobin and Mapleston (2004) identified that the biological characteristics of harvested Spanish mackerel on the east coast of Queensland varied between fishing sectors and coastal regions. They found that the landed catches from the recreational sector tended to be more diverse in size and age structure. Based on Tobin and Mapleston's findings and a management strategy evaluation of the fishery (Hoyle 2003), it was concluded that the Department of Primary Industries and Fisheries' Long Term Monitoring Program for Spanish mackerel, which commenced in 1999, was not representative of the entire Queensland fishery.

In 2004, the Long Term Monitoring Program was expanded to collect representative length, sex, and age information from both the recreational and commercial catch of Spanish mackerel from four regions along the Queensland east coast. The program also collected information on the spatial and temporal distributions of spawning. The monitoring strategy was designed from recommendations made by Sumpton and O'Neil (2004).

In the 2004–05 financial year, Spanish mackerel data were collected from Cairns to the New South Wales border from the commercial and recreational fishing sectors. These results for the Queensland east coast indicate:

- the majority of Spanish mackerel collected in 2004–05 were between 800 and 1100 mm fork length
- a higher proportion of the recreational catch was made up of relatively small (<800 mm fork length) and large (>1200 mm fork length) Spanish mackerel compared to the commercial catch. However, the sample sizes of fish collected in the recreational and commercial sectors were not equal.
- similar numbers of male and female Spanish mackerel were sampled during the 2004–05 season.
- the majority of female fish with ovaries in spawning condition were collected between September and December 2004
- the 3% of pre-mature fish caught by the commercial fishing sector is under the 5% reference point recommended by the Australian Government Department of the Environment and Heritage.

Future monitoring will focus on increasing the number of samples collected from the recreational sector across all regions.

The data summarised in this report are the results from the first year of a revised monitoring program for Spanish mackerel. This information provides biological data suitable for the stock assessment of Spanish mackerel.



## Long Term Monitoring Program background

The Department of Primary Industries and Fisheries (DPI&F), Queensland, manages the State's fish, mollusc and crustacean species and their habitats. As part of this commitment, DPI&F monitors the condition of, and trends in, fish populations and their associated habitats. This information is used to assess the effectiveness of fisheries management strategies and helps ensure that the fisheries remain ecologically sustainable. DPI&F also uses the information to demonstrate that Queensland's fisheries continue to comply with national sustainability guidelines, so that they may remain exempt from export restrictions under the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999*. DPI&F initiated a statewide Long Term Monitoring Program (LTMP) in 1999, in response to a need to collect enhanced data for the assessment of Queensland's fisheries resources. The LTMP is managed centrally by a steering committee with operational aspects of the program managed regionally from the Southern and Northern Fisheries Centres located at Deception Bay and Cairns respectively. The regional teams are responsible for organising and undertaking the collection of data to be used for monitoring key commercial and recreational species, and for preparing data summaries and preliminary resource assessments. A series of stock assessment workshops in 1998 identified the species to include in the LTMP.

The workshops used several criteria to evaluate suitability including:

- the need for stock assessment based on fishery independent data
- the suitability of existing datasets
- the existence of agreed indicators of resource status
- the practical capacity to collect suitable data.

Species currently monitored in the LTMP include saucer scallops, spanner crabs, stout whiting, mullet and tailor in southern Queensland, tiger and endeavour prawns and coral reef fish in northern Queensland. Species with statewide monitoring programs include mud crabs, barramundi, spotted and Spanish mackerel and freshwater fish. Various sampling methodologies are used to study each species. The incorporation of fishery independent techniques is preferred, with combinations of fishery dependent and independent techniques being used where appropriate. Data collected in the monitoring program are maintained in a central database in Brisbane. The primary aim of the LTMP is to collect data for resource assessment (ranging from analyses of trends in stock abundance indices to more complex, quantitative stock assessments) and management strategy evaluations. The greatest value of the growing datasets for each of the species and associated habitats is in the long time series generated by continued sampling, something that is usually required for accurate assessments but is rarely available. Stock assessment models have already been developed for saucer scallops, spanner crabs, stout whiting, mullet, tailor, barramundi, tiger and endeavour prawns, and spotted and Spanish mackerel. In some cases management strategy evaluations have also been carried out. The data collected in the LTMP have been integral to these activities.

The assessments and evaluations have, in turn, allowed options for improvements to the management of Queensland's fisheries resources to be considered. Enhancements to ongoing monitoring have also been identified, particularly to address the increasing demand for high quality data for dynamic fish population models. Through the ongoing process of collecting and analysing LTMP data and incorporating these data into regular assessments and refining monitoring protocols as required, DPI&F is enhancing its capacity to ensure that Queensland's fisheries resources are managed on a sustainable basis.

## Introduction

The Spanish mackerel (*Scomberomorus commerson*) is an epipelagic continental shelf species. Its distribution spans the northern Australian coastline, south to approximately 30°S latitude, on the east and west coasts. Their habitat extends from the edge of the continental slope to inshore coastal waters, often of low salinity and high turbidity (Munro 1943).

Several genetic stocks of Spanish mackerel are thought to occur in Queensland waters (Buckworth *et al.* In Prep). The fish on the Queensland east, and New South Wales coasts are part of an east coast stock. In the Gulf of Carpentaria, the genetic structure consists of several sub-stocks whose distributions are largely unknown. Those in the Torres Strait are thought to represent a separate genetic stock to the Gulf of Carpentaria and Australian east coast stock.

Spanish mackerel is an important commercial and recreational fish species with similar total landings from the Queensland east coast. In 2004–05 the commercial catch was estimated to be 326 tonnes (DPI&F 2006a). In 2002, the recreational harvest was estimated to be 425 tonnes (DPI&F 2006a). The majority of the commercial landings come from the Lucinda area, north of Townsville, whilst the bulk of recreational catch comes from south east Queensland (Bundaberg to the Gold Coast).

The DPI&F Fisheries Long Term Monitoring Program (LTMP) began collecting information in 1999 from the commercial fishery offshore from Lucinda, North Queensland (DPI&F 2005). The objective of the program was to develop a time-series of data to monitor population trends within the resource in that region as representative of the fishery.

In 2002, a preliminary stock assessment of the east coast Spanish mackerel fishery identified the risk of overfishing to be high (Welch *et al.* 2002). The stock assessment model indicated that the exploitable biomass in 2002 had declined to approximately 44% of the estimated unfished biomass. Welch *et al.* conducted sensitivity analyses of the model and found the stock estimates potentially ranged between 22% and 61% of the initial unfished biomass. The stock assessment recommended that fishing effort should not be increased above the 2002 levels.

Following the 2002 stock assessment, Hoyle (2003) conducted a management strategy evaluation of the east coast Spanish mackerel stock. The management strategy evaluation outlined alternative management arrangements, and proposed alternative monitoring and assessment methods to improve the resolution and scale of the information being collected.

In response to the 2002 stock assessment and recommendations from the 2003 management strategy evaluation, the Department of Primary Industries and Fisheries Queensland (DPI&F) restructured the management of the east coast Spanish mackerel fishery. The new management arrangements included: limited participation and a total allowable catch within the commercial sector; and a reduction in the bag limit from ten to three fish for the recreational sector. The main objective of the restructure was to cap the level of commercial and recreational fishing effort.

Tobin and Mapleston (2004) identified that the biological characteristics of harvested Spanish mackerel on the east coast of Queensland varied between fishing sectors and coastal regions. They found that landed catches from the recreational sector tended to be more diverse in size and age structure. Based on Tobin and Mapleston's findings and the management strategy evaluation, (Hoyle 2003) it was concluded that the LTMP sampling for Spanish mackerel was not representative of the entire Queensland fishery. Sumpton and O'Neil (2004) also made recommendations to monitor the fishery, particularly in relation to appropriate sample sizes and weighting of sampling effort.

In 2004, the LTMP was expanded to collect representative length, sex, and age information from both the recreational and commercial catch of Spanish mackerel, from a number of regions along the Queensland east coast. The program was also expanded to collect information on the spatial and temporal distributions of spawning.

The program provides data in a suitable format for stock assessment analysis and assists in measuring the performance of the relevant Fisheries arrangements.

## Objectives

The objectives of the LTMP for Spanish mackerel are to develop time-series datasets for the Queensland east coast containing:

- length, sex, and age structure of commercial and recreational catches
- spatial and temporal distributions of spawning.

The program provides length, sex, and age structures, and growth for use in Spanish mackerel stock assessment.

This report presents a summary of the DPI&F LTMP data collected during the 2004–05 financial year. Fish ageing information is not presented in this report, and will be presented in future summaries when data become available.

## Methods

The Spanish mackerel sampling strategy is fishery dependent. Representative length, sex, and age information was collected from both the recreational and commercial fishing sectors. Detailed protocols for the collection of this information are documented in the DPI&F Fisheries LTMP Sampling Protocol for Spanish mackerel (2004 onwards) (DPI&F 2006b).

## Sites

Commercial and recreational catches of Spanish mackerel were sampled within each of four regions between Cairns and the Queensland–New South Wales border ( Figure 1). The four regions were: Townsville, Mackay, Rockhampton and South East Queensland.

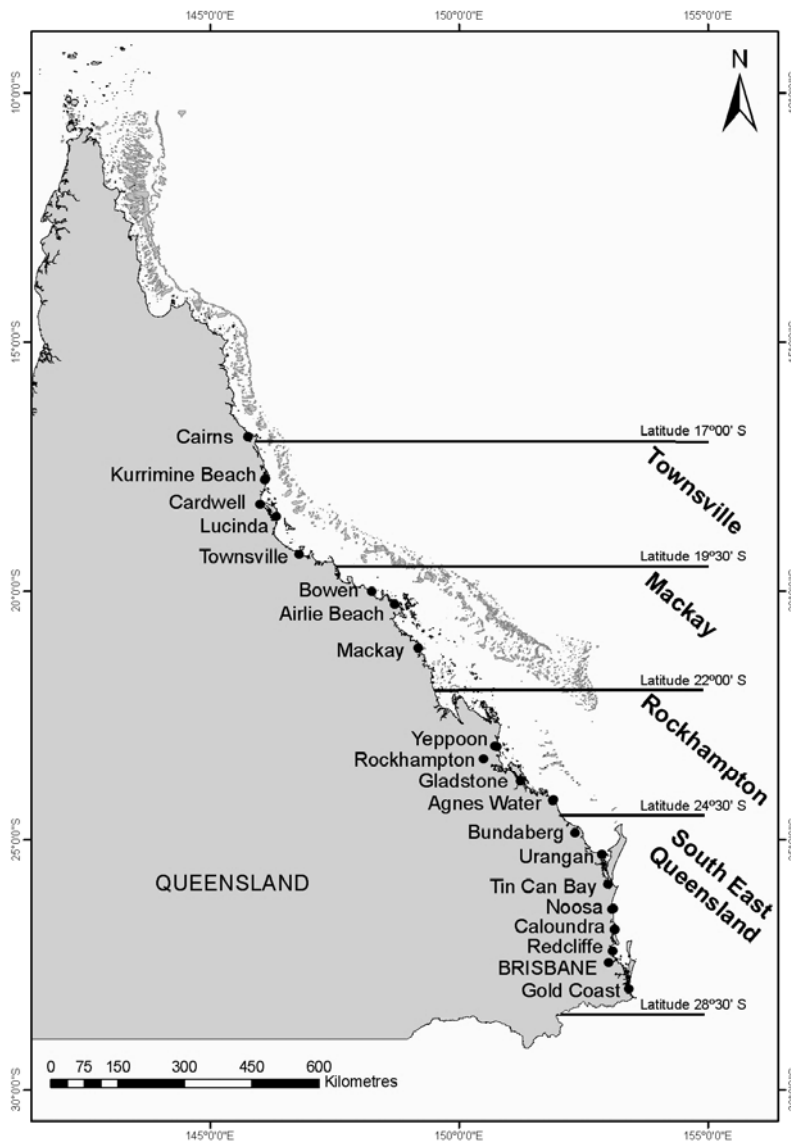


Figure 1. Sampling regions and major sampling locations for the Spanish mackerel monitoring program.

## Times

The sampling periods for Spanish mackerel were aligned with financial years (1 July 2004 to 30 June 2005). Sampling occurred all year round, with most samples collected during peak fishing periods in each region as these corresponded to times of highest availability (Table 1). Data presented in this report includes information collected during the 2004–05 financial year.

**Table 1. Peak sampling months for Spanish mackerel in different regions during 2004–05.**

Region	July	August	September	October	November	December	January	February	March	April	May	June
Townsville												
Mackay												
Rockhampton												
South East Queensland												

## Data collection

The target number of fish to be measured from each sector in each region (Table 2) was set at the start of the 2004–05 sampling season, based on the estimated size (weight) of historical catches (DPI&F 2006b).

**Table 2. Target numbers of Spanish mackerel to be measured from each sector in each region during the 2004–2005 sampling period. Target numbers of catches to be sampled are shown in parentheses.**

Region	Recreational	Commercial
Townsville	277 (55)	787 (157)
Mackay	61 (12)	61 (12)
Rockhampton	152 (30)	200 (40)
South East Qld	728 (146)	133 (27)
Total	1219 (244)	1181 (236)

The fork lengths (FL) of Spanish mackerel were measured to the nearest 10 mm. Where FL data could not be collected, the upper jaw length was measured (to the nearest 1 mm). The upper jaw length was converted to FL using an empirical relationship between the two measurements (Figure 4).

Sex was determined as male or female by macroscopic examination of the gonads. Ovaries were macroscopically assessed using the McPherson (1993) staging system.

Where possible, otoliths (sagittae) were removed, washed, dried, and stored. Fish age was estimated by examining whole otoliths as per LTMP Ageing Protocols (DPI&F In Prep.). Results from ageing the samples collected during 2004–05 are not yet complete, and these data will be incorporated into future summaries.



### **Data summaries and analysis**

The reproductive staging data (based on the McPherson [1993] staging system) was grouped to simplify the reproductive stages of Spanish mackerel presented in this report (Table 3). Grouping the reproductive stages in this manner improves the accuracy of interpretation of this information.

**Table 3. Grouping of the Spanish mackerel reproductive staging data based on the macroscopic staging system by McPherson (1993).**

<b>Reproductive stage grouping</b>	<b>McPherson (1993) reproductive staging classification</b>
Virgin	Virgin (Stage 1)
Resting	Resting (Stage 2)
Developing	Early (Stage 3) and Late (Stage 4) developing
Mature	Mature (Stage 5)
Post spawning	Postovulatory (Stage 6)
Spawning	Ripe (Stage 7) & Running ripe (Stage 8)
Spent	Spent (Stage 9)

### **Data limitations**

The data presented in this report have limitations due to the collection methods employed. When interpreting data in this report the following provisions must be applied:

- size of the Spanish mackerel recorded during surveys may be a direct result of the selectivity of the fishing gear used in the recreational and commercial fishery. Gear selectivity may influence the catchability of the fish
- *Fisheries Regulation 1995* applies a minimum legal size of 750 mm total length to Spanish mackerel. This restriction constrains the size and age of Spanish mackerel collected by the LTMP from the Queensland east coast Spanish mackerel fishery
- the catchability of Spanish mackerel varies depending on the season, fishing techniques, and gear used by fishers
- the spatial pattern of Spanish mackerel spawning was not reported in this summary due to the incomplete series of reproductive data collected within each region.

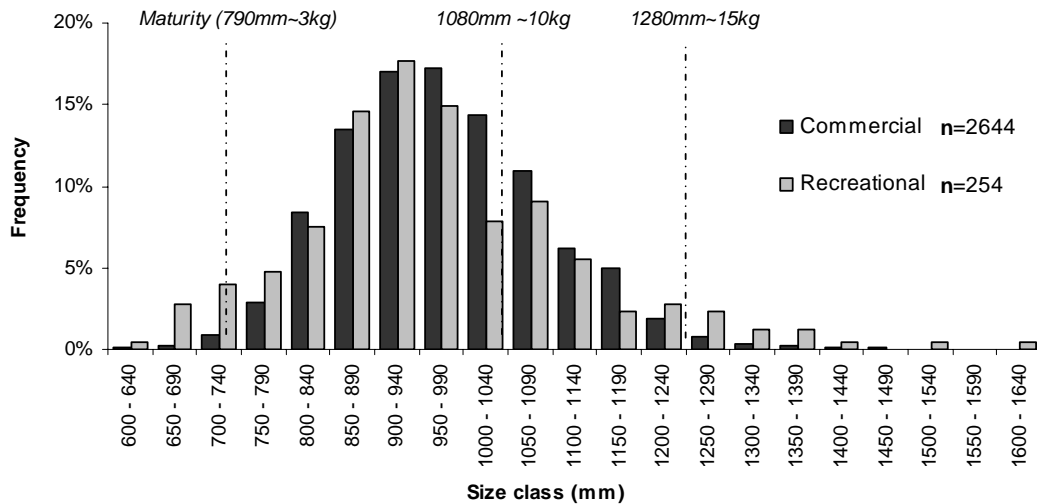
## Results

### Length frequency

Eighty-one percent of the 2898 fish measured from both commercial and recreational fisheries were between 800 and 1100 mm FL (Figure 2). Most of these fish were sampled from the commercial fishery (Table 4). The size distribution of the commercial and recreational catch within this size range was similar. However, outside of these size classes, the recreational sector recorded higher proportions of Spanish mackerel than the commercial fishery. The sample sizes of fish collected in the commercial and recreational fisheries were not equal.

The length distribution of the recreational catch was representative of the large number of Spanish mackerel collected from the southern regions (South East Queensland and Rockhampton) and therefore may show bias (Table 4).

Only 3% of the Spanish mackerel measured from the commercial fishery were of a pre-mature size of less than 790 mm FL (approximately 880 mm total length) (Figure 2).



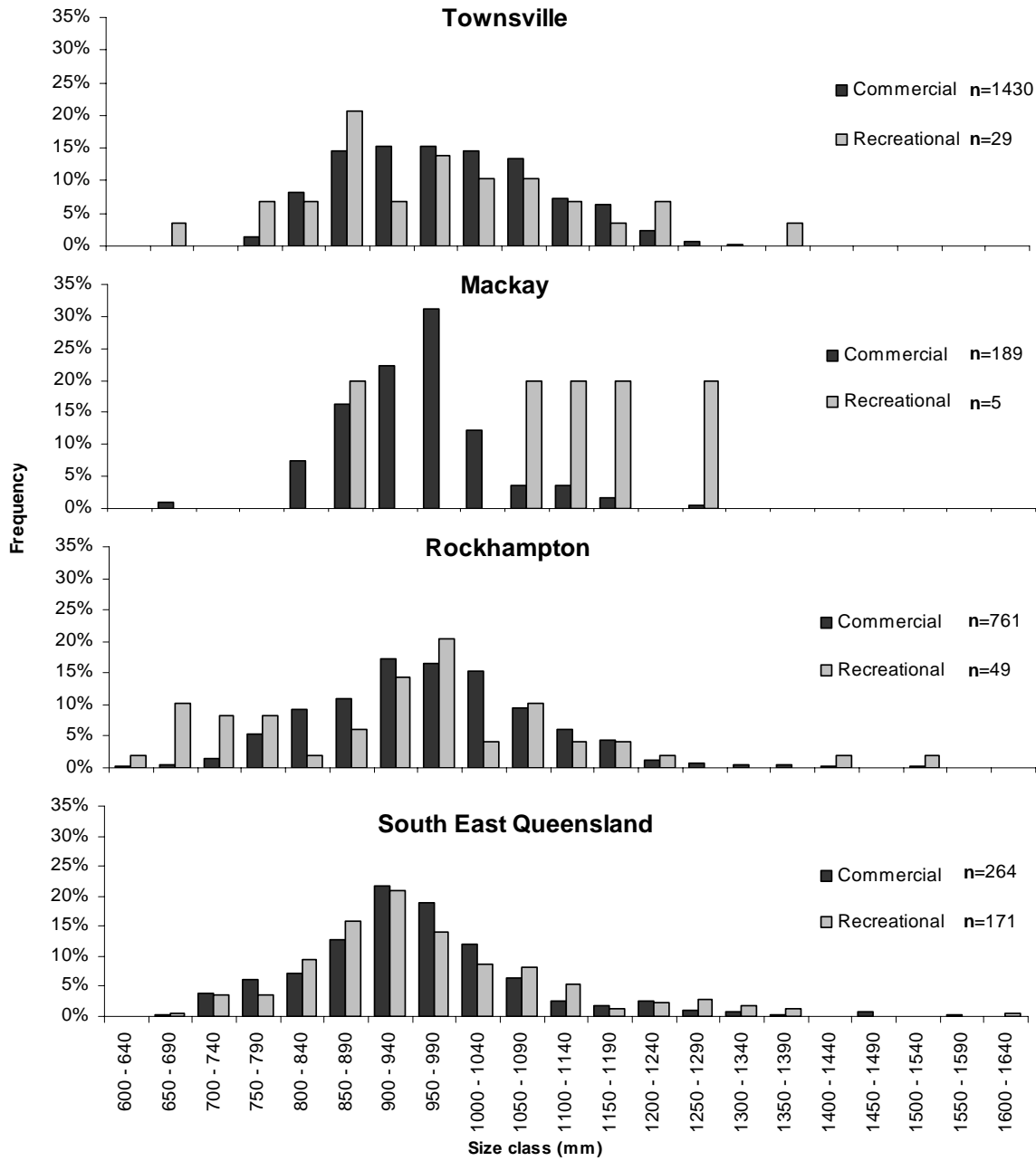
**Figure 2. Length frequency distribution of Queensland east coast Spanish mackerel collected from commercial and recreational catches in all regions during the 2004–05 sampling season (n=number sampled). The minimum length at maturity for females and length approximations for 3kg, 10 kg, and 15 kg Spanish mackerel are provided.**

**Table 4. Numbers of Spanish mackerel measured from each sector in each region during the 2004–2005 sampling period. Numbers of sampled catches are shown in parentheses.**

<i>Region</i>	<i>Recreational</i>	<i>Commercial</i>
Townsville	29 (15)	1430 (117)
Mackay	5 (4)	189 (18)
Rockhampton	49 (15)	761 (94)
South East Qld	171 (81)	264 (53)
<b>Total</b>	<b>254(115)</b>	<b>2644 (282)</b>

The greatest numbers of recreationally caught Spanish mackerel were collected within the southern regions: South East Queensland, and Rockhampton (Table 4). The commercial and recreational length frequency distributions were relatively similar in the South East Queensland region (Figure 3). The size distribution of fish from the recreational sector in Rockhampton showed higher proportions in size classes of less than 800 mm FL compared to all other regions.

The size frequency distributions of commercially caught fish in Rockhampton and South East Queensland were similar. Fish sampled from the commercial sector in the Townsville region had a broad length frequency distribution, with a large proportion (73%) measured between 850 and 1099 mm FL (Figure 3).



**Figure 3. Length frequency distributions of Queensland east coast Spanish mackerel collected from commercial and recreational catches during the 2004–05 sampling season for each region sampled.**

## Fork length and upper jaw relationship

There is a strong relationship between fork length (FL) and upper jaw length (JL) ( $R^2 = 0.8974$ ) (Figure 4). The equation for the relationship was used to convert Spanish mackerel jaw lengths into fork lengths, when fork length could not be measured.

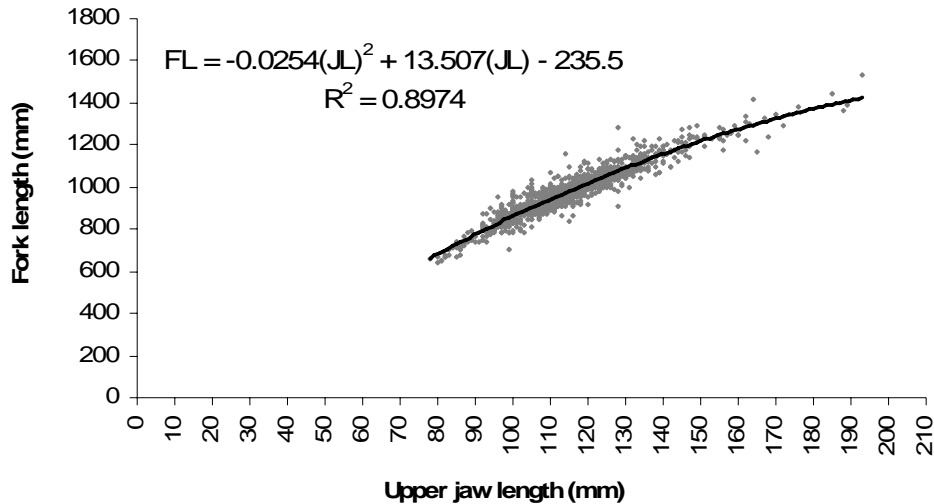


Figure 4. Relationship between fork length and upper jaw length of Queensland east coast Spanish mackerel.

## Sex ratio

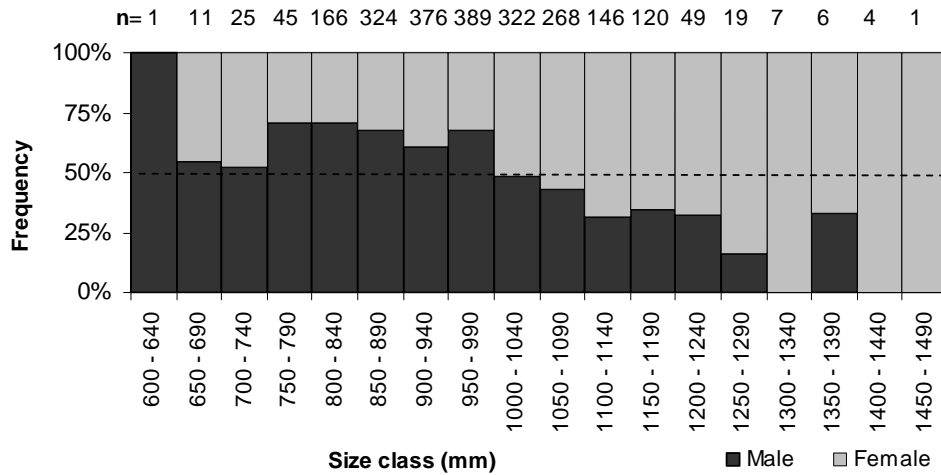
Of the 2306 Spanish mackerel that were sexed during surveys, 55% were male and 45% were female. A total of 631 fish were of unknown sex (Table 5). This often occurred when commercially caught fish were sold as whole fish, and macroscopic examination of the gonads was not possible.

Table 5. Observed number of males and females, and number of fish with undetermined sex of Queensland east coast Spanish mackerel for each region and sector.

<i>Region</i>	<i>Sector</i>	<i>Number of observed male</i>	<i>Number of observed female</i>	<i>Number of sex unknown</i>
Townsville	Commercial	798	641	26
Townsville	Recreational	16	12	1
Mackay	Commercial	145	44	2
Mackay	Recreational	2	3	
Rockhampton	Commercial	209	221	331
Rockhampton	Recreational	19	26	4
South East Queensland	Commercial	15	4	245
South East Queensland	Recreational	72	79	22
<b>Total</b>		1276	1030	631

### Size class summary

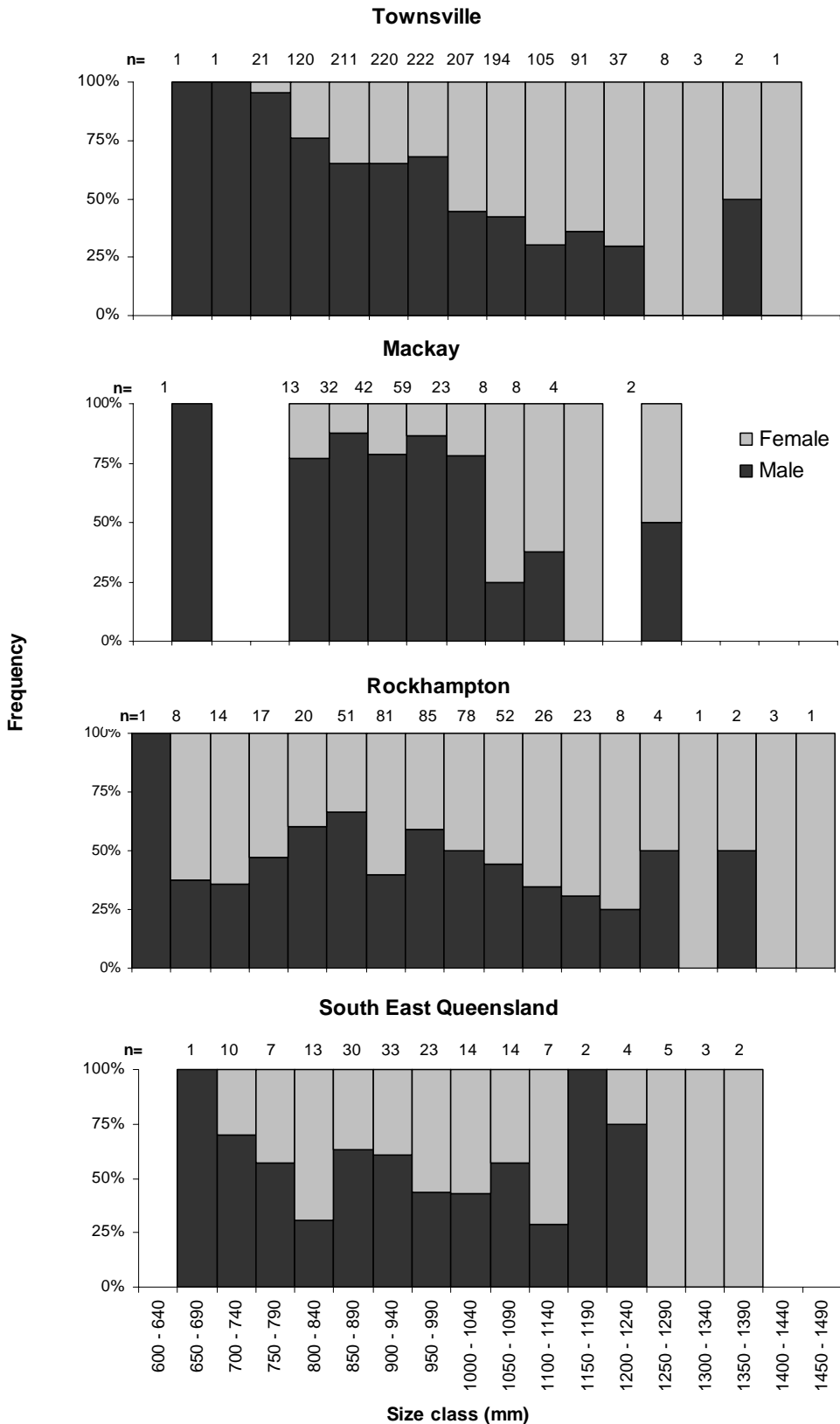
The total male to female sex ratio varied over the eighteen 50 mm FL size classes (Figure 5). The observed trend in the data suggests female Spanish mackerel occur more frequently in the larger size classes, above 1000 mm FL.



**Figure 5. Percentage of total observed male and female Queensland east coast Spanish mackerel within each 50 mm fork length class. Data are pooled across sector and region, and sample sizes are given above each bar.**

### Size class and region

The observed size class and sex ratio of Spanish mackerel varied between regions (Figure 6). In all regions sampled, the larger size classes (>1000 mm FL) contained higher proportions of female Spanish mackerel. The variation between regions may be explained by low numbers of fish caught ( $n < 30$ ) in the smaller size classes.

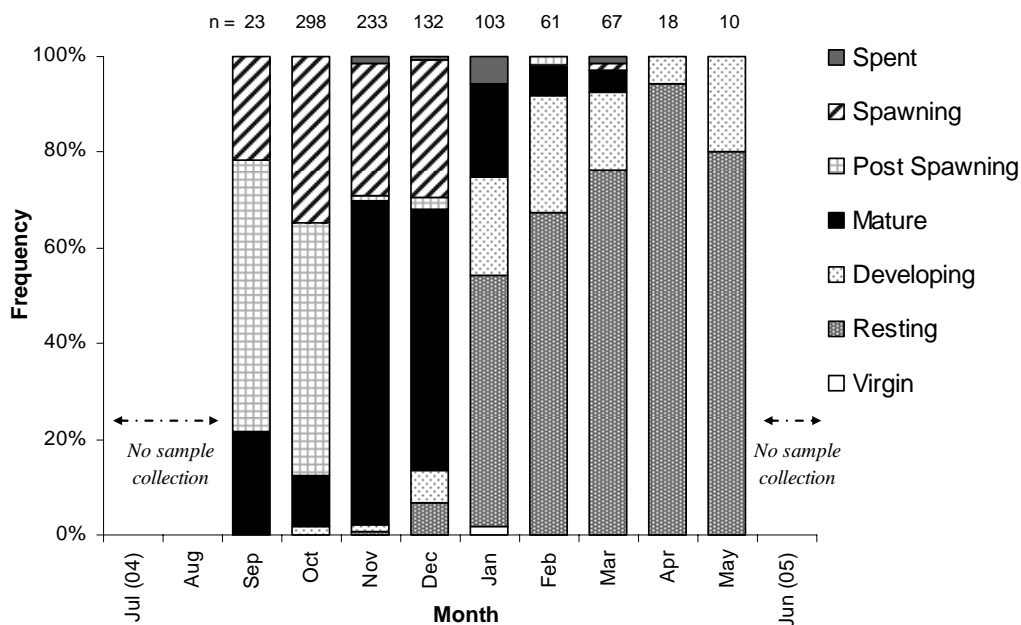


**Figure 6. Percentage of male and female Spanish mackerel within each 50 mm fork length size class for each region sampled from the Queensland east coast. Data are pooled across sector, and sample sizes are given above each column.**

## Reproduction

A total of 945 female Spanish mackerel ovaries were macroscopically staged. No samples were collected in July or August 2004, or June 2005. The majority of females were reproductively inactive between January and May (Figure 7). In January 2005 two gonads were staged as virgin. Very few ovaries were assessed as spent. No hydrated running ripe ovaries (Stage 8) were recorded during the 2004–05 sampling season.

During sampling, the reproductive period for Spanish mackerel extended from September to December 2004, with a very small proportion of reproductively active ovaries (spawning and post-spawning) sampled in February and March 2005 (Figure 7). The highest proportion of reproductively active ovaries was recorded in October (88%). Spawning was still evident in November and December and mature ovaries were observed in the greatest proportions in these months. A small number of the ovaries at this time showed no activity.



**Figure 7. Macroscopic stages of Queensland east coast Spanish mackerel ovaries. Data are pooled across sector and region, and sample sizes are given above each column. Samples were not collected during July and August 2004, or June 2005.**



## Discussion

### Length frequency

The trend in the grouped 2004–05 length frequency data shows a higher proportion of the recreational sample was made up of relatively small (<800 mm FL) and large (>1200mm FL) Spanish mackerel compared with the commercial sample. Tobin and Mapleston (2004) also found a similar trend in the recreational length distribution on the Queensland east coast. They suggested a small percentage of recreational fishers were selectively targeting the very large Spanish mackerel (>15 kg). In some regions, anecdotal reports have suggested that commercial fishers will avoid areas or schools of Spanish mackerel considered small (but greater than legal minimum size of 750 mm total length) due to poor economic returns of the saleable product. These anecdotal reports may explain the slighter proportions of smaller (<800 mm FL) commercially caught Spanish mackerel. In future years the Spanish mackerel program aims to be able to monitor this trend from larger samples of Spanish mackerel provided by recreational fishers.

The expansion of the sampling strategy for the Spanish mackerel LTMP was implemented in August 2004. Collection of northern recreational data was minimal in the first season due to fishery seasonality and the large amount of time required to establish extensive networks. In 2005–06, the monitoring program developed a number of recreational contacts including individuals; tackle shops; fishing competitions; and charter operators which should increase data collection from this sector.

The reasons for the length frequency distribution of commercially caught Spanish mackerel in the Townsville region differing from the Southern regions are unknown. Possible explanations may include: differences in fishing gear and technique; different fishing grounds; seasonality; and fish behaviour. As the 2004–05 period is the first year sampling has been conducted in the southern regions, very little can be concluded at this stage.

The Australian Government Department of the Environment and Heritage in a recent assessment of the east coast Spanish mackerel fishery, under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*, has recommended that DPI&F monitors the size composition of the retained commercial catch of Spanish mackerel (DEH 2004). DPI&F has agreed to conduct a review of the fishery appropriate to the magnitude of the change if the proportion of the catch of pre-mature fish increases above 5% of the total allowable catch. If necessary, DPI&F may introduce additional management arrangements to address these sustainability issues. McPherson (1993) estimated the minimum length at maturity and spawning of female Spanish mackerel in Queensland east coast waters was 790 mm FL (approximately 880 mm total length). In the 2004–05 season the pre-mature proportion of the sampled commercial catch (fish less than 790 mm FL) was 3%, below the reference point of 5%.

### Sex ratio

Mackie (2003) observed a relationship between size class and sex ratio for Spanish mackerel captured in Western Australia. The dominance of female fish in size classes greater than 1000 mm FL was the same between the Western Australia and Queensland east coast stocks. Female fish dominated the harvest in the Western Australian fishery. In comparison, the Queensland east coast harvested approximately equal numbers of male and female fish. The difference may be due to the larger legal minimum size limit (900 mm total length) in Western Australia compared to (750 mm total length) Queensland.

The relationship between size class and sex ratio has been documented in other mackerel species (spotted and grey mackerel) on the Queensland east coast (Cameron and Begg 2002; Staunton–Smith *et al.* 2005). Biological characteristics including differential growth in length and longevity between the sexes are likely factors that may explain the trend in the sex ratio observed for Spanish mackerel.

## Reproduction

The period of spawning activities for Queensland east coast Spanish mackerel from September to December is comparable to that documented in Western Australia (Mackie 2003) and in previous studies on the Queensland east coast (McPherson 1993). McPherson (1993) obtained samples from an area between Lizard Island and Townsville in Queensland. No spawning fish were collected in September however he did observe a reproductive peak from October to early December. The current monitoring program does not collect samples as far north as Lizard Island but it did also observe high proportions of spawning ovaries in October. The absence of spawning fish in September from McPherson's observations may indicate variability in the period of spawning activities between years.

The reason for the absence of female fish in imminent spawning condition (stage 8) from the 2004–05 year sample is largely unknown. McPherson (1993) showed spawning occurred in the late afternoon and suggested these fish may be isolated from the main fishing grounds or exhibit non-feeding behaviour immediately prior to spawning and hence be unavailable to the fishery.

## Conclusions

The Long Term Monitoring Program expanded its monitoring of Spanish mackerel in August 2004. In the financial year 2004–05 Spanish mackerel data were collected from Cairns to the New South Wales border for both the commercial and recreational sectors. The results from the first year of the expanded monitoring program indicate:

- the majority of Spanish mackerel caught were between 800 and 1100 mm fork length
- a higher proportion of the recreational catch was made up of relatively small (<800 mm fork length) and large (>1200 mm fork length) Spanish mackerel compared to the commercial catch
- similar numbers of male and female Spanish mackerel were caught
- the majority of spawning occurred between September and December
- the 3% of pre-mature fish caught by the commercial fishing sector is below the 5% reference point recommended by the Australian Government Department of the Environment and Heritage as sustainable.

Future monitoring will focus on collecting a greater number of samples from the recreational sector in the northern regions than was collected during 2004–05.

Ageing data will be presented in a future report. The age structure data together with a longer time series of length and sex data will provide a more accurate description of the biological characteristics of the fish harvested in the Queensland east coast fishery. This will contribute to greater certainty in the results of future stock assessments.

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