



*AUSTRALIAN FISHERIES MANAGEMENT  
AUTHORITY*



# **The traditional fisheries catch of Torres Strait islanders Project Final Report, 1996-2001**

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This report contains the results of the Traditional Fisheries Catch of Torres Strait Islanders Project, 1996 - 2001. This research was carried out by the Australian Fisheries Management Authority (AFMA) and CSIRO between July 1996 and June 2001. The project was funded by AFMA and CSIRO. We would like to thank and acknowledge the efforts of the several fisheries observers that endeavored to carry out this difficult task during the duration of this project: Dirk Laifoo, Jillian Kennedy, Johanna Durante, Robert Ware and Peter Tapau. Thanks also to the communities of the Torres Strait Islands that were monitored over this period for their cooperation. The pilots and crews of customs aircraft and vessels also contributed greatly to the project by transporting observers.

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## **Executive summary**

In 1996, a joint AFMA/CSIRO project monitored the traditional marine catch of turtle and dugong in the Torres Strait Protected Zone (TSPZ). The project employed fisheries observers to collect information from 14 communities in the TSPZ using a frame survey method previously developed in Torres Strait by CSIRO. Five observers collected 733 days of catch data over four sample years during the project.

The annual catch of dugong was estimated at 241 (s.e. 92), 287 (s.e. 131), 692 (s.e. 150) and 619 (s.e. 134), and the annual catch of green turtles was estimated at 1896 (s.e. 445), 1097 (s.e. 340), 1507 (s.e. 358) and 1619 (s.e. 574) for the 1996, 1998, 1999 and 2000/01 sample years respectively. Although the lower catch estimates for dugong in 1996 and 1998 are considered as biased downwards, the catch estimates in 1999 and 2000/01 are more credible due to the higher level of observer competence and supervision by AFMA staff.

Most dugong were caught in the Western or Top Western regions of Torres Strait. The highest estimated catch of dugong in any one year was recorded at Mabiug Island, with an annual estimate of 238 dugong (s.e. 67.4) for the 2000/01 sampling period. However, the highest average annual catch for the sample period was Badu Island with 141 dugong/year.

Turtles were recorded across the entire Torres Strait region, however the highest catches of turtles were estimated for the central and western regions. The highest estimated catch of turtle in any one year was recorded at Warraber Island, with an annual estimate of 626 turtles (s.e. 562) for 2000/01. Warraber Island also had the highest average annual catch for the sample period with 315 turtle/year.

The recent dugong catch estimates are substantially lower than comparable catch data from the early 1990s. This could indicate a lower fishing effort, or a lower abundance and/or change in distribution of dugong in the Torres Strait fishing grounds.

The recent estimates of turtle catch was also showed a significant decline in annual catch rates since the early 1990s from about 2500 to about 1500 per year.

Apart from problems with low precision and bias in the catch estimates, the greatest limitation of the project catch data is that it does not account for dugong or turtles caught outside the Australian TSPZ, including the Thursday Island area, NPA and PNG side of the TSPZ. The catches in these areas are likely to be substantial.

Maintaining experienced fisheries observers was a major difficulty throughout the project, particularly in the initial years. Given the expense and difficulty in running the observer program, and the problems of precision, bias and coverage of the catch estimates, it was decided not to continue the observer program at the end of the 2000/01 sampling period.

There remains an urgent need to obtain accurate estimates of the dugong and turtle catch by Torres Strait islanders to assess the sustainability of the catch. This is especially important given that the current catch is most likely exceeding estimated sustainable harvest levels. The focus now is on establishing effective community based monitoring programs.

## INTRODUCTION

Sea based resources are extremely important to Torres Strait Islanders. They have one of the highest per capita seafood consumption rates in the world (Harris *et al.*, 1994). The most important resources are dugong, green turtle and a variety of finfish and shell fish with the relative importance of each group varying between island communities and at different times of the year. In addition, sea-based resources are also important in the commercial and artisanal fishing activities such as for lobster, mackerel, reef fish and pearl fisheries.

The assessment of the size of the catch and the changes that take place over time is important for the management of the traditional fisheries of the Protected Zone. One of the main purposes of the protected zone under the treaty was to protect the traditional way of life and livelihood of the Torres Strait Islanders, including their fishing activities.

The Torres Strait Protected Zone Joint Authority is responsible for managing the Torres Strait fisheries, including traditional fisheries, with the exception of recreational fishing. The Australian Fisheries Management Authority (AFMA) collect and process information by means of logbooks for some commercial fisheries managed under the *Torres Strait Fisheries Act 1984*. However, the traditional and island based fishing activities are not monitored through the use of logbooks because of the diverse and artisanal nature of the fishing activities.

The island based fishing activities are becoming increasingly important. Numerous freezers have been built over the last few years so that the inhabitants have an option of gainful employment instead of solely depending on the CDEP scheme. There is an increasing desire by the island communities to have greater control and benefit over the resources surrounding their islands.

The traditional resources of greatest importance to the Islanders and to AFMA are dugong and turtle. Both species are major cultural icons, sources of protein and both are listed under endangered species legislation.

From an environmental perspective, the Torres Strait dugong and turtle stocks are of both international and national significance. Dugong is listed in the International Union for the Conservation of Nature (IUCN) Red Data Book of Threatened species as vulnerable to extinction, dugongs are also listed in Appendix 1 of the Convention on the International Trade in Endangered Species (CITES). In Australia dugong are also protected under the Environment Protection and Biodiversity Conservation Act 1999, as marine species. Queensland considers dugong as a vulnerable species under its Queensland Nature Conservation Act.

Australian dugongs was also recently nominated to be considered as endangered under the Commonwealth Endangered Species Protection Act. On advice from the endangered Species Scientific Subcommittee, the Minister for the Environment decided that Australian dugong did not meet the criteria for either endangered or vulnerable, but recommended that the conservation status of dugong be kept under review. Reliable monitoring of the indigenous dugong catch is a fundamental aspect of assessing its status. The local catch is considered to be close to or greater than the sustainable yield of the stock and it is critically important that

accurate and precise information on catch rates is obtained so that the status of the stock can be reliably assessed.

In the case of turtle, six species are found in Torres Strait; the green, hawksbill, loggerhead, flatback, olive ridley and leatherback (which is rare). All species are on appendices 1 and 11 of CITES, the IUCN Red Book lists the leatherback, green, loggerhead and olive ridley as endangered and the hawksbill as critically endangered. From an Australian perspective, all sea turtles are protected in Commonwealth waters/territory by the Environment Protection and Biodiversity Conservation Act. Under this act the loggerhead turtle and the olive ridley turtle are listed as endangered and the green, leatherback and hawksbill are declared vulnerable.

Australia, like most other countries, allows harvesting of turtles by indigenous peoples for traditional use. The draft Recovery Plan for Marine Turtles in Australia highlights unsustainable harvest levels of turtles by indigenous Australian as a potential threat and has identified monitoring of their catch and increased awareness of turtle conservation issues in indigenous communities as priority action areas.

Islander dugong and turtle catch cannot be monitored through the use of traditional logbooks because of the diverse and artisanal nature of the fishing activities. Therefore, catch estimates have to be carried out by direct observation. In 1991, CSIRO, funded by AFMA, began a project to estimate the traditional catch in the Torres Strait Protected Zone (TSPZ) using a frame survey and roving observers (Harris *et al.*, 1994). This provided the first reliable estimates of dugong and turtle catches for the TSPZ.

## **Current project (1996-2001)**

Following the catch surveys in 1991- 1993 (Harris *et al.*, 1994), the responsibility for monitoring traditional fisheries catch was transferred to AFMA. CSIRO helped AFMA set up and operate the catch sampling using the frame survey method previously developed in the Torres Strait by CSIRO (Dews *et al.*, 1993) and provide training to Torres Strait islanders recruited and managed by AFMA. The catch monitoring would primarily estimate the catch of dugong and turtle although information on the catch of other marine animals would also be collected.

Following the completion of that project in mid 1996 (Harris *et al.*, 1997), a new project, managed by AFMA but in close partnership with CSIRO, was started to continue the work of training fisheries observers, monitoring their progress and collecting and analysing fisheries data. Catch information was collected from 14 communities in the Torres Strait (Fig. 1), using the sampling technique developed by CSIRO (Dews *et al.*, 1993). The project was nominally for five years (to 2000/01) with annual reviews. The AFMA component of the project was to manage and conduct the data collection and the CSIRO component of the research was to help train the observers and analyse the data.

## Objectives

The overall objective of the project was to monitor the traditional catch, with emphasis on dugong and turtle, of the Australian side of the Torres Strait Protected Zone (TSPZ), with Torres Strait islander participation, and to analyse the results to produce information relevant to the management of those fisheries within the TSPZ.

Due to concerns over data quality, in 1999 it was decided that the observer's primary focus of their monitoring activities would be on the catch of dugong and turtle only. This decision was made in order that the monitors were not distracted by documenting catches of other marine species and the possibility arising that they missed catches of dugong and turtle whilst they were on the islands.

The specific objectives of the project were to:

1. Recruit and train suitable fisheries observers to be proficient in the survey method.
2. Collect data on fishing activities and catch of dugong and turtle from all communities on the Australian side of the Torres Strait Protected Zone (TSPZ).
3. Annually, analyse the results of the catch surveys and report the estimates of catch to TSFSAC, TSRA/ICC/MaSTERS, and the Islander Communities.

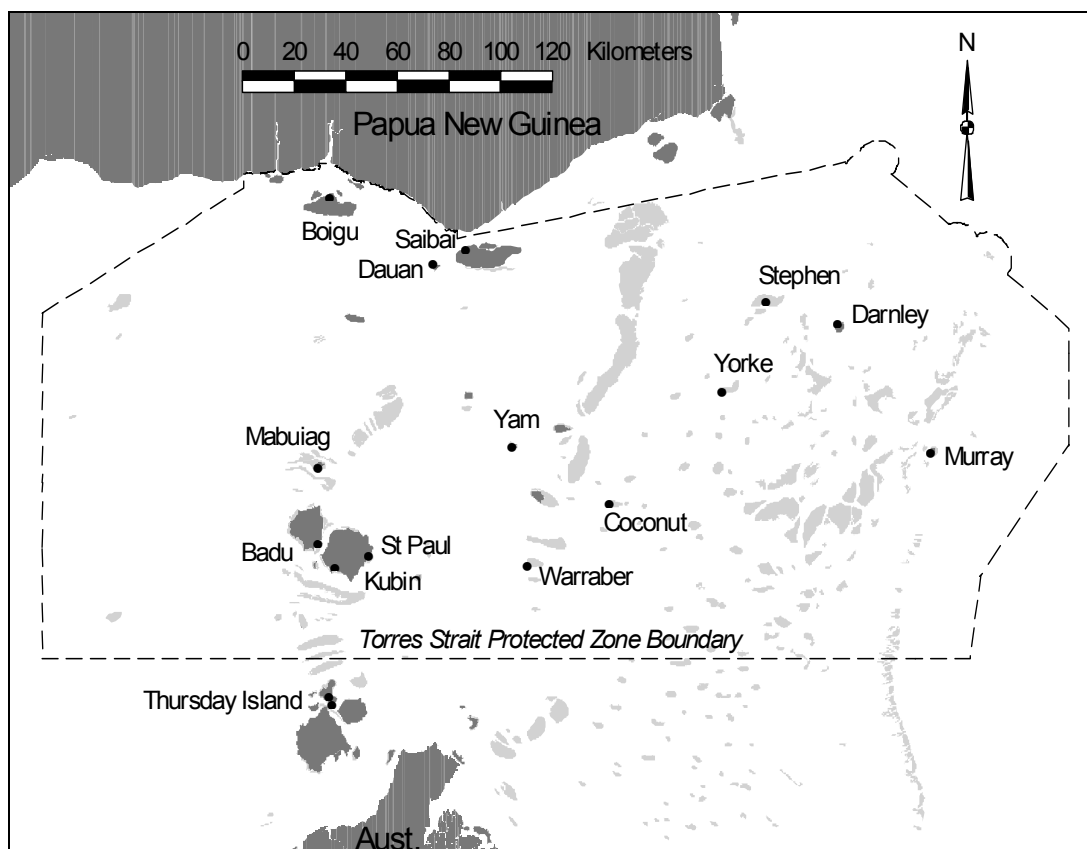


Figure 1. The Torres Strait Protected Zone with the locations of islands surveyed for traditional catch by fisheries observers.

## METHODS

CSIRO developed a method for assessing the traditional catches that are landed on the islands in the Torres Strait Protected zone (Harris *et al.*, 1994; Dews *et al.*, 1993). The method is based on a systematic monitoring of the different islands for periods of 3-7 days at a time per island, spread throughout the year. Over those periods, the information on the fishing activities (method, catch, composition, effort, location, boats, fishers, weather, tide) are collected and used to estimate the catch, effort and participation for the year. The precision and reliability of these estimates depend on the total number of days with information, the seasonal coverage, the islands visited relative to their importance, and the thoroughness of the fisheries observer. The method was adapted so that Torres Strait Islander observers could be trained to monitor the traditional and island fisheries.

The observers were members of AFMA staff based on Thursday Island. Generally, sampling periods lasted about one year, with each individual observer collecting about 120 days observer data. Although the project had only one observer initially, in December 1997, AFMA's Research and Environment Committee approved a proposed doubling of sampling effort for the next two years, with most of the extra effort to be targeted towards the dugong hunting islands of Mabuiag, Badu and Boigu Islands. This was in response to concerns about the low precision of the catch estimates. An analysis of predicted precision versus sampling effort showed that a doubling of the sampling effort would probably result in a 26% to 36% reduction in the size of the 95% confidence intervals of the mean estimate (Fig. 2).

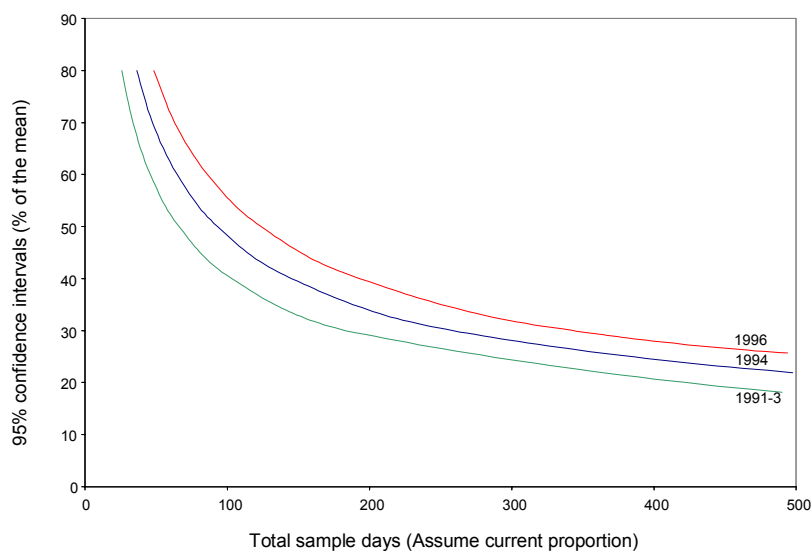


Figure 2. Predicted precision of the estimate of annual dugong catch, as a function of total sample days and assuming the same proportion of time spent at each island, for the 1991-93, 1994 and 1996 sample years.

There were three phases to the project (establishment, operation, assessment) that were repeated in entirety each year depending on the availability of funding for the AFMA observer — if the observer was retained from year-to-year, then the establishment phase was

simplified. All phases involved close cooperation between the AFMA office on Thursday Island and the CSIRO researchers. The activities involved in the various stages are summarised below.

### ***Phase I. Establishment:***

Procedures for data collection, storage and checking were established. Prospective fisheries observers were selected by advertising the position and selecting the most appropriate applicant. Local knowledge of Torres Strait Island communities and customs was a key prerequisite for the observer position.

The fisheries observers were trained in the procedures to be used in the project. This was usually carried out on Thursday Island and on one or more of the sample islands. AFMA and CSIRO endeavored to carry out regular training sessions for new observers throughout the project. Normally, several training sessions were conducted throughout the year, either during dedicated training trips or opportunistically by CSIRO staff in Thursday Island while carrying out other projects.

During the training sessions, the observers were given an outline of the project objectives and trained in the overall methods including data collection methods, data entry and the principals of the project database. Special emphasis was placed on transferring an understanding of the problem of bias and data integrity. AFMA staff endeavored to maintain close contact with the monitoring officers throughout their contracts in order to ensure methods were consistent and that the overall sampling strategy was sufficient. This was especially successful after the appointment of a dedicated project officer, Mr Douglas Jacobs, to the AFMA TI office in 2000. This entailed feedback sessions on the return to the AFMA office after each outer island monitoring trip to check if there were any problems, and also by the monitoring officers ringing the AFMA office regularly during their trips to ensure everything was going as planned. Close links were also maintained with CSIRO staff to further ensure the project achieved its overall objectives. The number of monitoring days conducted on each island was also checked after each trip to see that sufficient monitoring was done on each island. Subsequent trips were then planned to ensure that the monitoring officers visited islands to ensure sufficient effort was given to each to fit into the overall monitoring plan.

### ***Phase II. Operation***

The fisheries observer roved the island communities within a simple, flexible sampling scheme recording the marine catch on each island for multiple periods of 2 to 6 days. More time was spent sampling 5 primary communities (found to land more catch in previous surveys; Harris *et al.*, 1994) than 9 secondary communities (Appendix 1).

The observer's itinerary was faxed to staff at CSIRO in Cleveland on a regular basis. Suggestions were relayed back via AFMA in Thursday Island regarding future sampling strategies to comply with the monitoring technique

Scheduling of observer activities was structured to maintain overall sampling requirements. A general quarterly schedule was set up that allowed for alterations provided they did not affect cross-checking requirements. To ensure successful collection of information, the fisheries observers were provided with direction and follow-up training as required. Dugongs and

turtles were the primary target species for monitoring, but other species and approximate location of catch will be monitored whenever practical (this ceased at the beginning of the 2000 observer period). The data was entered into a MS Access database on laptops or in the office and transferred to the AFMA computer system. The data was checked for errors and inconsistencies that may have arose during collection as well as during data entry. The data was analysed to provide estimates of total annual catch by species; however, as the information collected was unlike logbook information it required relatively sophisticated analysis and interpretation. The resulting estimates of annual catch were provided to AFMA in written reports for management of the traditional fishery.

The methods for the survey, especially the database and datasheets, were modified during the project, especially after the arrival of Mr Jacobs in the AFMA TI office. The modifications were made primarily to reduce confusion for the observers and make the data collection and data entry as straightforward as possible. The modifications included matching the datasheets and database as closely as possible. With the more concentrated focus on dugong and turtle catches only, checklists were outlined to ensure that as far as possible all catches of these species were recorded whilst monitors were on each island (Appendix 2). These checklists were designed to ensure consistency in methodology between the two monitoring officers, and also over the period of their contracts.

### *Phase III. Assessment, optimisation.*

The monitoring method was assessed annually for statistical performance (design) and information quality. The details of the monitoring method were modified through time to re-optimize the data collection, without compromising consistency, in response to changing circumstances in Torres Strait.

A major workshop was held in early 1999 to review the effectiveness of the observer program and make recommendations to improve the methodology (Appendix 3). Many improvements in the project methods were formulated during the workshop. These improvements were completed and implemented in the early stages of the terms of the two new monitoring officers in 2000, therefore the quality of data collected by these officers would have benefited from these improvements.

## **Data analysis**

At the completion of each observers' one-year term, the data was entered into a database and verified, and forwarded to CSIRO. The data was subject to further extensive verification and validation by CSIRO staff, which improved the accuracy of the dataset markedly. All data used in the analysis was checked against the original observer data sheets to ensure data quality.

The information used in the analysis were records of catch for all days that were adequately sampled. This number is sometimes less than records of visits to the communities because days when the observer travelled from one island community to another may not be considered as adequately sampled. Catch records from all islands in the TSPZ were used. After islander observers entered and verified the data, the catch data was put into a stratified

sampling analysis that defines the islands as strata and calculates the mean and variance of the mean (s.e.) using stratified analysis techniques (Appendix 4).

It should be noted that the method is primarily concerned with producing catch estimates for the entire TSPZ. Estimates for each Island will have a high uncertainty, as reflected by their relatively high s.e. values. For example, in 2000/01, the communities of Kubin, St.Pauls and Stephens communities had no catches of dugong or turtle recorded in the monitoring period. It is undoubted that these communities caught turtles during the year, and for Kubin and St.Pauls small numbers of dugong would also be caught. However, this is compensated in part by the relatively high estimate of dugong catch for Coconut Island, not a traditional dugong catching Island.

## RESULTS

### Observers

In December 1995, AFMA recruited Dirk Laifoo as a fisheries observer to collect catch information for one year. During 1996, he collected information from all islands using the frame survey method previously developed in the Torres Strait by CSIRO (Dews *et al.*, 1993). Mr Laifoo ceased duties in January 1997.

The project had difficulties in recruiting and retraining fisheries observers for 1997. In June 1997, AFMA recruited a new fisheries observer to collect catch information for one year. Unfortunately, after one month the observer resigned. After another unsuccessful attempt to recruit a suitable observer in November 1997, a new fisheries observer, Jillian Kennedy, was recruited in January 1998. At about that time it was decided to increase the observer effort to two observers. After some delay caused by the difficulty in recruiting a new observer, a second fisheries observer, Ms Johanna Dorante, commenced full time observer duties in June 1998.

In January 1999, there was a change in project management, with Mr Tony Kingston replacing Mr Mick Bishop as AFMA Manager, Torres Strait Fisheries, with Mr Kingston assuming overall project responsibility.

Ms Jillian Kennedy and Ms Johanna Dorante completed their one-year contracts in January and May of 1999 respectively. Ms Kennedy accepted a second one-year contract commencing January 1999, but advised AFMA that she will not be seeking a third contract upon the expiry of the current contract in January 2000. Ms Dorante accepted a two-month extension to her contract for the period June-August, but declined the offer of a further contract at the completion of the two-month extension in early August.

One of the monitoring officers was seriously assaulted while on a monitoring trip in April 1999. The assault was not directly related to the officer's monitoring activity, but it nonetheless prompted an internal AFMA review of the occupational health and safety issues associated with the project. That review, undertaken by AFMA Thursday Island staff, decided that the project could continue in its present structure, subject to several new

operational procedures being implemented, mainly concerning accommodation arrangements on the islands.

On the 17 April 2000 AFMA employed two new monitoring officers, Robert Ware and Peter Tapau. Both observers successfully carried out catch monitoring over the next year in accordance with the initial sampling plan, except for a 3 months period of leave for Mr. Tapau for personal reasons. In an effort to improve the training and supervision of the data monitors, and assist in rigorous and timely verification of the data, Douglas Jacobs, a former CSIRO scientist that joined AFMA in early 2000, was assigned to the project. The benefits of a consistent contact in the Thursday Island office with the monitoring officers were clearly evident, and Mr. Jacobs presence ensured that the monitoring officers were well supervised and motivated. It also had the benefit of regular data checking for problems on an ongoing basis, rather than waiting until the end of the project. The new observers continued monitoring until 30 June 2001 when the project ended.

## Monitoring effort

### January 1996 – December 1996

The sampling effort in 1996 complied well with the sampling strategy (Table 1). Sampling effort was well spread throughout the year, and the ratio of primary Island to secondary Islands sampling effort (57% effort on primary Islands) was close to the suggested sampling strategy of 59% effort on primary Islands. The total number of days sampled in 1996 was slightly higher than in 1994 (138 days in 1996, 124 days in 1994—excluding the detailed daily records gathered in the observers absence on Murray Island in 1994).

Table 1. Monitoring effort, by community, by month, for the observer during 1996.

Community	1996												Totals
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Badu	3	0	0	0	0	0	0	6	0	0	4	0	13
Boigu	0	2	0	0	0	0	0	6	0	3	3	4	18
Coconut	0	0	0	4	0	4	0	0	0	0	0	4	12
Darnley	0	4	0	0	0	5	0	0	0	0	0	0	9
Dauan	0	0	0	3	0	0	0	0	0	0	0	0	3
Kubin	0	0	0	4	0	0	0	3	0	0	0	0	7
Mabuiag	0	0	0	7	0	0	5	0	0	0	4	0	16
Murray	0	5	0	0	0	6	0	0	0	0	5	0	16
Saibai	0	0	0	4	0	0	1	3	0	0	0	0	8
St Pauls	0	0	0	3	0	0	0	5	0	0	0	0	8
Stephens	0	3	0	0	0	0	0	0	0	0	0	0	3
Warraber	0	0	5	0	0	0	0	0	0	0	0	0	5
Yam	0	0	0	0	0	0	6	0	0	0	0	0	6
Yorke	4	0	0	0	0	0	6	0	0	0	1	3	14
Days/month	7	14	5	25	0	15	18	23	0	3	17	11	138

## January 1998 - December 1998

A total of 175 full monitoring days (excluding transit days) were completed by the two observers in 1998. As envisaged, monitoring effort was concentrated on the main dugong islands (Badu, Boigu, Mabuiag, and to a lesser extent, Dauan and Saibai; 57% of effort) (Table 2).

Table 2: Monitoring effort, by community, by month, for the two observers during 1998.

Community	1998												Totals
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Badu	0	2	0	0	0	0	5	3	4	4	1	1	20
Boigu	0	0	0	0	3	2	0	0	9	0	3	0	17
Coconut	0	0	3	0	0	0	0	0	0	0	0	2	5
Darnley	2	0	0	0	2	0	0	2	0	0	0	0	6
Dauan	0	0	0	0	5	0	3	3	0	0	4	3	18
Kubin	0	2	0	0	0	0	2	3	0	0	0	4	11
Mabuiag	0	3	1	0	0	3	4	6	6	2	3	0	28
Murray	0	0	0	2	0	0	0	4	0	0	5	0	11
Saibai	0	2	0	0	0	0	3	5	0	3	0	3	16
St Pauls	0	3	0	0	0	1	2	3	0	0	3	0	12
Stephens	0	0	0	5	0	0	0	1	0	0	0	0	6
Warraber	0	0	3	0	0	0	2	1	0	0	0	0	6
Yam	0	1	3	0	0	0	0	0	0	3	0	0	7
Yorke	0	2	0	0	2	1	0	4	0	0	0	3	12
Days/month	2	15	10	7	12	7	21	35	19	12	19	16	175

This level of monitoring activity is consistent with the target of 120 full monitoring days per observer per year, noting that Ms Dorante only commenced duties in June 1998.

## January 1999 - December 1999

The 1999 monitoring schedule was severely disrupted by a serious incident involving one of the monitoring officers while on-duty on one of the islands in April. Given this disruption, the target coverage of 240 days planned for 1999 was not achieved. The 1999 coverage resulted in a coverage of 170 monitoring days (Table 3).

Again, most of the monitoring effort was concentrated on the main dugong hunting islands (Badu, Boigu and Mabuiag; 52% of total effort).

Table 3. Monitoring effort, by community, by month, for the two observers during 1999.

Community	1999												Totals
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Badu	1	10	5	5	0	6	5	5	0	0	7	0	44
Boigu	5	6	0	2	2	0	2	2	0	5	0	0	24
Coconut	0	3	0	1	1	0	0	0	0	0	0	0	5
Darnley	0	0	0	0	0	0	0	0	4	0	0	0	4
Dauan	0	0	0	0	5	0	0	2	0	0	0	0	7
Hammond/NPA	0	0	0	0	0	0	0	2	1	0	0	0	3
Kubin	5	4	0	0	2	0	0	0	0	0	0	0	11
Mabuiag	2	1	4	2	3	9	0	0	0	0	0	0	21
Murray	0	0	4	0	0	0	0	0	3	0	2	0	9
Saibai	0	2	0	0	0	0	0	1	1	2	0	0	6
St Pauls	0	5	0	4	0	0	0	2	0	0	0	0	11
Stephens	0	0	2	0	0	0	0	0	2	0	0	0	4
Warraber	0	3	0	0	2	1	0	0	0	0	0	0	6
Yam	0	3	0	1	0	1	0	0	0	0	0	0	5
Yorke	0	0	4	0	0	0	0	0	6	0	0	0	10
Days/month	13	37	19	15	15	17	7	14	17	7	9	0	170

### May 2000 – June 2001

A total of 250 full monitoring days were completed by the two observers in 2000/01 (Table 4). Monitoring effort was again concentrated on the main dugong hunting islands of Badu, Boigu and Mabuiag Islands (53% of total effort), with effort on other islands spread according to their ranking as primary or secondary islands. The monitoring effort for each island followed very closely the effort regime that was planned at the beginning of the employment of the two monitoring officers (Appendix 1). The only impact on the initial monitoring plan was that one monitoring officer, Mr Tapau, required 3 months leave at the end of 2000 due to personal reasons. Apart from this 3 month absence, the level of monitoring activity exceeded the target of at least 120 full monitoring days per observer per year.

The sampling effort throughout the monitoring period was spread relatively evenly amongst the months of the year to ensure a constant monitoring presence throughout the year (Table 4). However, as noted above, the effort in November and December 2000, and January 2001 was lower because of the leave of absence of Mr. Tapau.

Table 4: Monitoring effort, by community, by month, for the two observers during 2000-2001.

Community	2000								2001						Totals
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
Badu	10	5	0	2	5	1	0	4	0	6	2	2	0	7	44
Boigu	5	1	0	7	0	5	6	0	0	7	0	7	8	0	46
Coconut	3	0	0	4	0	0	0	0	0	0	2	0	1	0	10
Darnley	0	3	0	0	0	0	0	0	0	0	3	1	0	0	7
Dauan	0	4	0	5	0	0	0	0	0	0	0	2	0	0	11
Kubin	3	2	0	0	2	0	0	0	0	2	0	0	0	0	9
Mabuiag	0	5	6	11	0	3	1	6	0	6	0	1	0	4	43
Murray	0	0	5	0	0	3	0	0	0	4	0	4	4	0	20
Saibai	0	2	0	0	0	0	0	0	0	1	2	0	3	0	8
St Pauls	0	5	0	0	3	0	0	0	0	2	0	0	1	0	11
Stephens	0	2	0	0	0	0	0	0	0	2	0	3	0	0	7
Warraber	0	0	2	0	2	1	0	0	0	0	2	0	0	0	7
Yam	0	0	4	0	0	3	0	0	0	0	1	0	3	0	11
Yorke	0	3	0	0	0	4	0	0	0	2	2	0	0	5	16
Days/month	20	32	17	29	12	20	8	10	0	32	14	20	20	16	250

## Catch estimates

### December 1995 – December 1996

The estimate for dugong and turtle caught in the TSPZ between January 1996 and December 1996 was 241 (s.e. 92.0) and 1896 (s.e. 445.3) respectively (Table 5). The catch estimate for dugong was significantly smaller than both the 1994 catch estimate of 860 dugong (s.e. 241) (Harris *et al.*, 1997) ( $P < 0.02$ ), and the 1991-92 catch estimate of 1010 dugong (s.e. 240) (Harris *et al.*, 1994) ( $P < 0.01$ ). The catch estimate for turtle was also lower than previous estimates in 1994 (2600 turtles, s.e. 378) (Harris *et al.*, 1997) and 1991-92 (2410 turtles, s.e. 250) (Harris *et al.*, 1994) but was not significantly different to either previous catch estimate.

Dugong were sampled by the observer only on Badu, Boigu and Mabuiag islands. No dugong were seen while the observer was on Murray, Yorke, or any of the secondary Islands. Only 8 dugong were seen during the 45 days spent on the primary dugong hunting islands of Badu, Boigu and Mabuiag (0.18 dugong per day). This contrasts with 28 dugong seen at the same islands over 49 days in 1994 (0.57 dugong per day), and 80 dugong seen at the same islands over 79 days in 1991-2 (1.01 dugong per day). The 95% confidence limits (CL) of the mean was  $\pm 184$  dugong, meaning that, based on the data, there is a less than 2.5% chance of the catch being greater than 425 dugong for the year, for the communities sampled.

While the overall catch of turtles in the TSPZ was not significantly different from previous estimates, the turtle catch of the 5 primary islands in 1996 of 792 turtles (s.e. 200.8) was

significantly less than the 1994 catch of 1594 (s.e. 218) ( $P < 0.01$ ). The drop in catch was mainly caused by lower recorded catches at Murray and Yorke Islands.

Table 5. The catches of dugong and turtle and mean estimates of annual catch and their standard errors for 1996.

Island	Survey							Annual			
	Days	Dugong			Turtle			Dugong		Turtle	
	No.	No.	No./d	SE	No.	No./d	SE	No.	SE	No.	SE
<b>Primary Communities</b>											
Badu	13	2	0.15	0.10	14	1.08	0.43	56	38.0	393	157.3
Boigu	16	3	0.19	0.14	8	0.50	0.22	69	49.6	183	81.8
Mabuaig	16	3	0.19	0.14	6	0.38	0.20	69	49.6	137	73.7
Murray	17	0			3	0.18	0.18	0		64	64.2
Yorke	14	0			2	0.14	0.10	0		52	35.4
Dugong (3 sites)	45	8	0.18	0.07				195	79.9		
Turtle (5 sites)	76	8	0.11	0.04	33	0.43	0.11			792	200.8
<b>Secondary Communities</b>											
Coconut	11	0			0	0.00		0		0	
Darnley	8	0			2	0.25	0.16	0		81	59.9
Dauan	3	0			0	0.00		0		0	
Kubin	7	0			1	0.14	0.14	0		52	52.2
Saibai	8	1	0.13	0.13	5	0.63	0.63	46	45.6	228	228.1
St pauls	7	0			3	0.43	0.30	0		137	108.4
Stephens	3	0			1	0.33	0.33	0		122	121.5
Warraber	5	0			2	0.40	0.40	0		146	146.0
Yam	6	0			5	0.83	0.83	0		304	304.0
Turtle (7 sites)	44	0			19	0.43	0.16	0		1104	401.1
<b>Total estimated catch (with stratification)</b>								<b>241</b>	<b>92.0</b>	<b>1896</b>	<b>445.3</b>

The analysis of the catch data collected between January 1996 and December 1996 raised serious questions about the precision of the catch estimate, and potential biases in the sampling method. The low precision of the estimate resulted in a recommendation for increased sampling effort, to two observers.

### January 1998 - December 1998

The estimate for dugong and turtle caught in the TSPZ between January 1998 and December 1998 was 256 (s.e. 136) and 1097 (s.e. 340) respectively (Table 6). When 324 days of reliable catch data from Mabuaig Island collected by Donna Kwan (JCU) is included in the analysis, the estimate for dugong in the TSPZ was increased to 287 (s.e. 140).

The estimates for dugong and turtle catches in 1998 were very low compared with previous estimates. The results for Biogu Island were particularly low. Given some of the difficulties in verifying the data collected through the datasheets, and after identifying some deficiencies in the methodology used by the observers in 1998, it was decided that the dataset also probably underestimates the real catch markedly. Another indication that the observer

estimate underestimates the real catch was the comparison with comprehensive reliable catch data from Mabuiag Island collected by Donna Kwan for 1998 (Kwan, 2002); her estimate, 0.4 dugong/day was far greater than the observer estimate of 0.14 dugong/day.

Table 6. The catches of dugong and turtle and mean estimates of annual catch and their standard errors for 1998.

Island	Survey							Annual			
	Days	Dugong			Turtle			Dugong		Turtle	
	No.	No.	No./d	SE	No.	No./d	SE	No.	SE	No.	SE
<b>Primary Communities</b>											
Badu	23	4	0.17	0.17	2	0.09	0.06	63.5	61.4	31.7	21.2
Boigu	18	0			1	0.06	0.05			20.3	19.8
Mabuaig	29	4	0.14	0.12	0			50.3	22.8		
Murray	13	0			0						
Yorke	8	0			6	0.75	0.61			273.8	223.7
<b>Secondary Communities</b>											
Coconut	4	0			0						
Darnley	8	0			4	0.5	0.37			182.5	136.4
Dauan	17	0			3	0.18	0.09			64.4	34.0
Kubin	12	0			0						
Saibai	18	1	0.06	0.05	1	0.06	0.05	20.3	19.8	20.3	19.8
St pauls	14	0			3	0.21	0.11			78.2	40.7
Stephens	5	0			0						
Warraber	7	0			7	1	0.57			365.0	208.7
Yam	6	2	0.33	0.33	1	0.17	0.17	121.7	120.7	60.8	60.3
<b>Total estimated catch (with stratification)</b>								<b>256</b>	<b>136.2</b>	<b>1097</b>	<b>340.0</b>

## January 1999 - December 1999

The estimate for dugong and turtle caught in the TSPZ between January 1999 and December 1999 was 692 (s.e. 150) and 1507 (s.e. 358) respectively (Table 7).

The precision of the final estimates was quite good given the disrupted observer program that year. The high level of observer expertise and increased supervision by AFMA and CSIRO staff increased the credibility of the estimate. Encouragingly, the observer estimates for Mabuiag Island, 0.5 dugong/day, more closely matched a comprehensive catch estimate for 1999 collected by Donna Kwan (Kwan, 2002) of 0.47 dugong/day. However, there were still some indications that the estimate probably underestimates the actual catch in the protected zone. The extensive observer training done during June 1999 still unearthed some deficiencies in the methodology used by the observers, and an estimate of the number of dugong caught on Badu Island during an observer visit in February 1999 (30 dugong caught; data from Islander interviews carried out by observer), was not reflected in the observer catch records (12 dugong seen).

Once again however, the catch in the TSPZ appears to be lower than historical yearly catch values although in this case, the difference is not statistically significant. This result may

indicate lower catch rates caused by changes in abundance and/or distribution of dugong in Torres Strait, or lower fishing effort.

Table 7. The catches of dugong and turtle and mean estimates of annual catch and their standard errors for 1999.

Island	Survey							Annual			
	Days	Dugong			Turtle			Dugong		Turtle	
	No.	No.	No./d	SE	No.	No./d	SE	No.	SE	No.	SE
<b>Primary Communities</b>											
Badu	64	35	0.55	2.57	31	0.48	2.98	200	66.41	177	71.6
Boigu	20	7	0.35	0.56	9	0.45	0.79	128	59.13	164	70.4
Mabuaig	18	9	0.50	0.85		0.00	0.00	183	77.47	0	0.0
Murray	7		0.00	0.00	3	0.43	1.29	0	0.00	156	154.9
Yorke	7		0.00	0.00	2	0.29	0.24	0	0.00	104	66.7
<b>Secondary Communities</b>											
Coconut	5		0.00	0.00		0.00	0.00	0	0.00	0	0.0
Darnley	4		0.00	0.00		0.00	0.00	0	0.00	0	0.0
Dauan	8	4	0.50	0.57	2	0.25	0.21	183	96.48	91	59.1
Kubin	11		0.00	0.00	3	0.27	0.42	0	0.00	100	70.1
Saibai	5		0.00	0.00		0.00	0.00	0	0.00	0	0.0
St pauls	8		0.00	0.00	5	0.63	0.84	0	0.00	228	116.9
Stephens	4		0.00	0.00	4	1.00	2.00	0	0.00	365	256.7
Warraber	6		0.00	0.00	2	0.33	0.27	0	0.00	122	76.3
Yam	3		0.00	0.00		0.00	0.00	0	0.00	0	0.0
<b>Total estimated catch (with stratification)</b>								<b>692</b>	<b>149.8</b>	<b>1507</b>	<b>357.6</b>

### May 2000 – June 2001

The estimated annual catch of dugong and turtle in the TSPZ between May 2000 and June 2001 was 619 (s.e. 134) and 1631 (s.e. 574) respectively (Table 8).

The final estimates of annual catch were very similar to the 1999 estimates for both dugong and turtles. Given the high level of competence of the observers, and the higher level of support from the AFMA office in TI, we attach some credibility to these estimates. However, it must be noted that the turtle catch estimate probably has some additional uncertainty. This is partly due to the 3 months leave taken by one observer (Mr Tapau). Even though the observer monitored one of the primary dugong hunting islands (Boigu Island), his main focus was the Eastern and Central islands where there are high catches of turtles.

Table 8. The catches of dugong and turtle and mean estimates of annual catch and their standard errors for 2000/01.

Island	Survey							Annual			
	Days	Dugong			Turtle			Dugong		Turtle	
	No.	No.	No./d	SE	No.	No./d	SE	No.	SE	No.	SE
Primary Communities											
Badu	44	20	0.45	0.18	21	0.48	0.15	166	65.32	174	53.9
Boigu	46	11	0.24	0.07	5	0.11	0.05	87	26.38	40	19.1
Mabuaig	43	28	0.65	0.18	8	0.19	0.06	238	67.38	68	23.5
Murray	20		0.00	0.00	5	0.25	0.10	0	0.00	91	35.3
Yorke	16		0.00	0.00	5	0.31	0.15	0	0.00	114	53.7
Secondary Communities											
Coconut	10	1	0.10	0.10	3	0.30	0.21	37	36.00	110	76.8
Darnley	7		0.00	0.00	1	0.14	0.14	0	0.00	52	51.6
Dauan	11		0.00	0.00	1	0.09	0.09	0	0.00	33	32.7
Kubin	9		0.00	0.00		0.00	0.00	0	0.00	0	0.0
Saibai	8	2	0.25	0.25	2	0.25	0.16	91	90.24	91	59.1
St pauls	11		0.00	0.00		0.00	0.00	0	0.00	0	0.0
Stephens	7		0.00	0.00		0.00	0.00	0	0.00	0	0.0
Warraber	7		0.00	0.00	12	1.71	1.54	0	0.00	626	561.8
Yam	11		0.00	0.00	7	0.64	0.27	0	0.00	232	100.2
<b>Total estimated catch (with stratification)</b>								<b>618.6</b>	<b>134.2</b>	<b>1631.2</b>	<b>574.2</b>

## Size frequency data

The size of 73 dugong in the catch were recorded during the project (1996 – 2001). Lengths were standardised to centimetres and fluke lengths converted to total lengths (Harris *et al.*, 1994; Dews *et al.*, 1993). The average length of dugong in the catch was 204.8 cm ( $n = 73$ ) and ranged from 70 cm to 280 cm (Fig. 3). This wide size range represents a wide age range as dugongs over 300 cm long are rare (Nishiwaki and Marsh, 1985). The average length of females 113.9 cm ( $n = 40$ ) was substantially smaller than males at 193.1 cm ( $n = 30$ ) (Fig. 3).

The size frequency distribution of the dugong measured by the observers shows four distinct modes for both sexes; 80 cm, 130 cm, 230 cm and 270 cm for females, and 70 cm, 150 cm, 200 cm, and 250 cm for males. This is similar to the size frequency of catches in the early 1990s, apart from the small numbers of very small dugong (70 cm – 100 cm) seen in the recent catch (Harris *et al.*, 1994; Harris *et al.*, 1997).

Based on the dugong that were identified to sex by the observers, the sex ratio of the catch was biased towards females by 1.3:1, which was significantly less biased than recorded dugong catches in 1990 to 1992 (2.0:1,  $P < 0.01$ ) (Harris *et al.*, 1997).

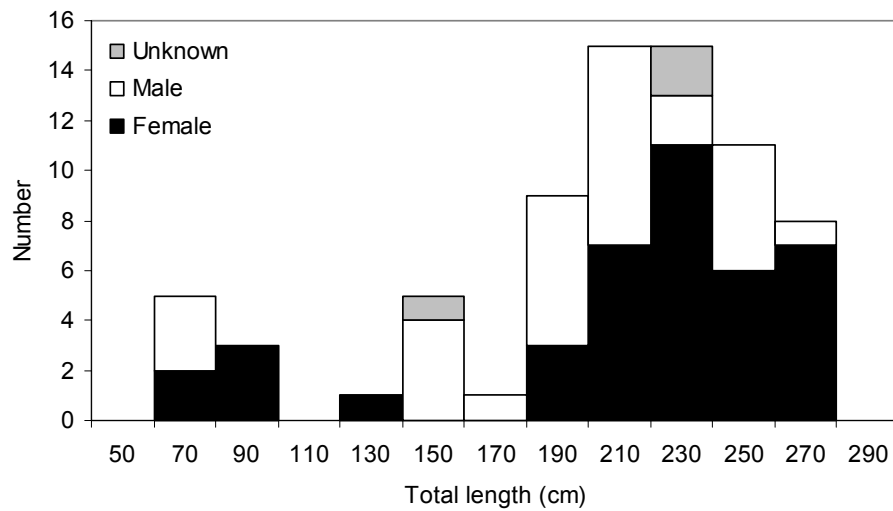


Figure 3. Size frequency of the recorded measurements of dugong size in the catch in the TSPZ 1996 – 2001 (n = 73).

The sizes of 146 turtles in the catch were recorded by the observers during the project (1996 – 2001). The average curved carapace length (CCL) for turtles measured from the catch was 95.1 cm (n = 146) and ranged from 37 cm to 145 cm (Fig. 4). This range represents the full range of sizes in the Torres Strait turtle population - Small turtles recruit into Torres Strait from their 'lost years' at around 40 cm CCL (Limpus, *pers. comm.*) and the largest verified record of a green turtle is 135 cm from the Ascension islands (Marquez, 1990). The average length of females was 96.1 cm (n = 100) and the average length of males was 100.1 cm (n = 12) (Fig. 4).

The size frequency distribution of the turtles measured by the observers shows a small mode at 45 cm CCL, and a large mode at about 100 cm CCL, which is similar to that found during surveys in 1991-92 and in 1994 (Harris *et al.*, 1994; 1997), although the proportion of turtles less than 60 cm CCL was substantially greater in 1991-93 (~25 % of catch) than recent catches (~5 % of catch) (Harris *et al.*, 1994).

Based on the turtles that were identified to sex by the observers, the sex ratio of the catch was heavily biased towards females by 8.3:1.

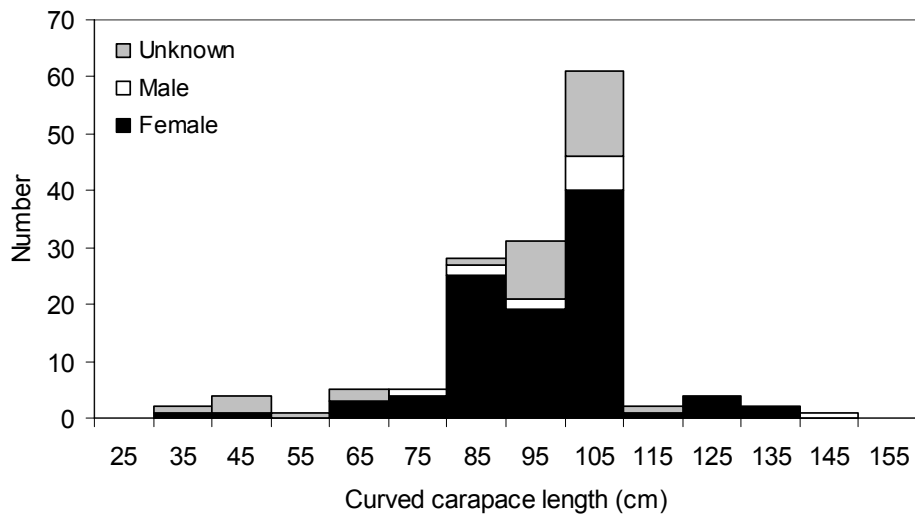


Fig. 4. Size frequency of the recorded measurements of turtle size in the catch in the TSPZ 1996 – 2001 (n = 146). Curved carapace length (CCL).

## DISCUSSION

Estimates of the annual catches of dugong during the project (1996 - 2001) ranged between 241 and 692 per year (Table 9). The majority of dugong were caught in the Western or Top Western regions of Torres Strait (Fig. 5). The highest estimated catch of dugong in any one year was recorded at Mabiug Island, with an annual estimate of 238 dugong (s.e. 67.4) for the 2000/01 sampling period. However, the highest average annual catch for the sample period was Badu Island with 141 dugong/year.

Estimates of the annual catch of turtles during the project (1996 - 2001) ranged from 1097 to 1896 (Table 9). Turtles were caught across the entire Torres Strait region, however the highest catches of turtles were estimated for the central and western regions (Fig 6). The highest estimated catch of turtle in any one year was recorded at Warraber Island, with an annual estimate of 626 turtles (s.e. 562) for 2000/01. Warraber Island also had the highest average annual catch for the sample period with 315 turtle/year.

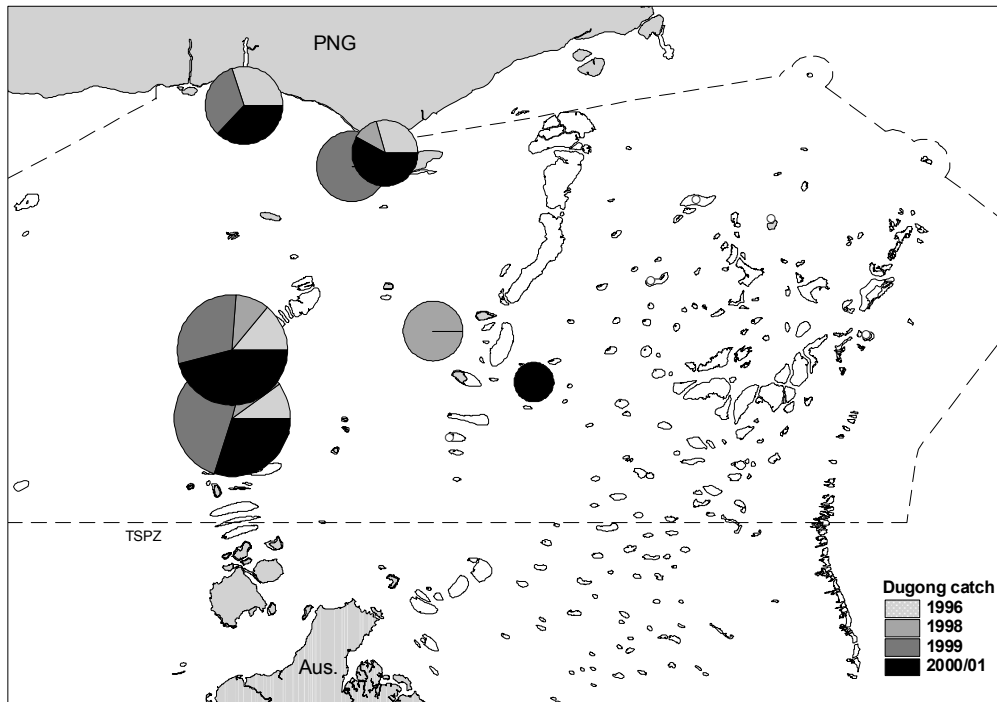


Figure 5. Map of Torres Strait showing the annual catch estimates for dugong for the Island communities of the TSPZ for the period 1996 to 2001. The area of the pie diagram is proportional to the average annual catch estimate for the sample period (range: zero (several Islands) to 141 dugong/yr (Badu Island))

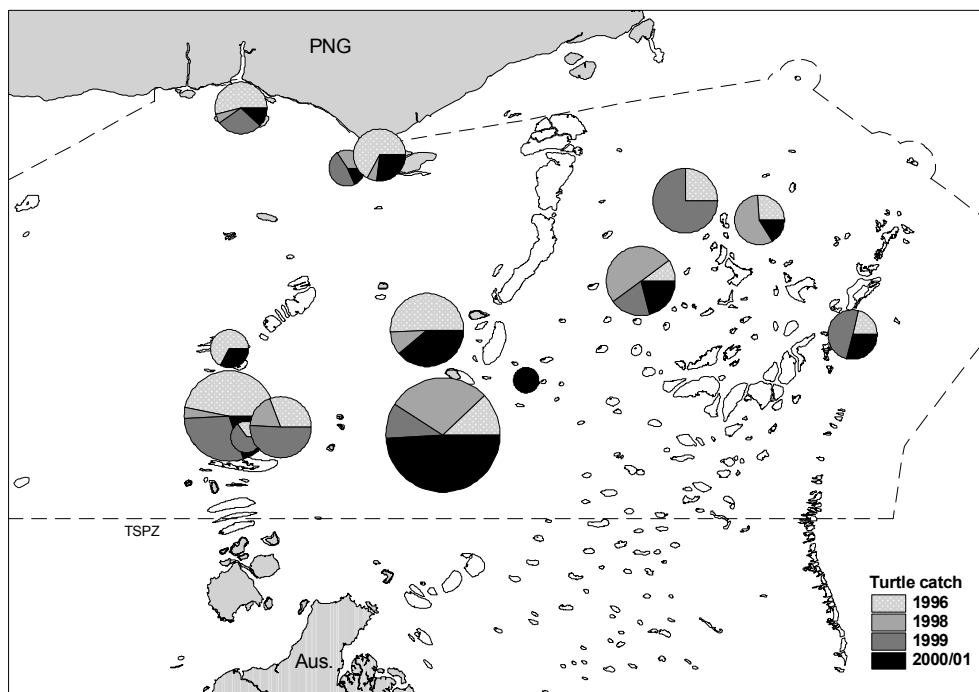


Figure 6. Map of Torres Strait showing the annual catch estimates for turtle for the Island communities of the TSPZ for the period 1996 to 2001. The area of the pie diagram is proportional to the average annual catch estimate for the sample period (range: 27.4 turtle/yr (Coconut Island) to 315 turtle/yr (Warraber Island)).

Table 9. Estimates of the yearly catch of dugong and turtle caught in the TSPZ obtained by catch sampling on TSPZ Islands. Estimates from 1991 onwards are from the AFMA/CSIRO traditional fishing project.

Sample period	Dugong catch (per year)		Turtle catch (per year)	
	mean	s.e.	mean	s.e.
1976/78 <sup>1</sup>	243	-	2100	-
1983-86 <sup>2</sup>	110-130	-	~4000	-
1991/92 <sup>3</sup>	1010	240	2410	250
1991-93 <sup>4</sup>	1226	204	2504	358
1994 <sup>5</sup>	860	241	2600	378
1996 <sup>6</sup>	241	92	1896	445
1998 <sup>7</sup>	287	131	1097	340
1999	692	150	1507	358
2000/01	619	134	1619	574

<sup>1</sup> Nietschmann (1985). No confidence limits supplied.

<sup>2</sup> Johannes and MacFarlane (1991). No confidence limits supplied.

<sup>3</sup> Harris *et al.* (1992).

<sup>4</sup> Harris *et al.* (1994). Combined data for the period June 1991 to May 1993 (considered as biased upwards (Harris *et al.*, 1997)).

<sup>5</sup> Harris *et al.* (1997).

<sup>6</sup> Rejected by TSFSAC because of low precision and potential bias.

<sup>7</sup> Considered to be biased downwards. (Note. 1998 estimate includes 324 days of catch monitoring data for Mabuia Island collected by Donna Kwan).

Note: Other estimates of the annual turtle catch in the TSPZ are 2500 (Kowarsky 1978), 4150 (Parmenter 1980) and 4000 (Limpus 1981). However, it is not known how the estimates were calculated and no confidence limits are supplied.

Although the lower estimates in 1996 and 1998 are considered as biased downwards, the two higher estimates in 1999 and 2000/01 are more credible due to the higher level of observer competence and increased supervision by AFMA and CSIRO staff. These later estimates also compare well with independent reliable catch data for Mabuia Island at least (Kwan, 2002). She recorded daily catch rates of 0.4 to 0.47 dugong per day over an extended period in 1998 and 1999 (Kwan, 2002), compared to 0.5 and 0.65 dugong per day recorded by the monitors in 1999 and 2000/01 respectively.

In the case of dugong, even the more reliable estimates from 1999 and 2000/01 are substantially lower than comparable catch data from the early 1990s (though the difference is not statistically significant in this case) (Table 9). While there may still be some downward bias in the recent catch estimates, this could also indicate a lower fishing effort, or a lower abundance and/or change in distribution of dugong in the Torres Strait fishing grounds. While some fishermen expressed concerns about the abundance of dugong during the project, dugong abundance was temporally and spatially very patchy with large numbers occasionally being found adjacent to Island communities.

The recent estimates of turtles catch was also lower than estimates from the early 1990s, and had dropped from about 2500 to 1500 per year, a significant decline ( $P < 0.01$ ) in annual catch rates.

The project experienced many problems since 1996, ranging from low precision and bias in the catch estimate, problems in recruiting suitable local observers, and disruptions owing to a serious assault on one of the observers (this assault was not related to the observer performing actual monitoring duties). Maintaining experienced fisheries observers was a major difficulty throughout the project, particularly in the initial years. These factors resulted in considerable downtime in the project, where there was little or no monitoring activity.

While the lack of precision of the catch estimate was address somewhat be the increase in sampling effort in 1998, an even greater concern for the observer data was the problem of bias. Bias is where there was a consistent under or over-reporting (usually under) of catches during the observer sampling. This type of data error is more insidious than a lack of precision because it can lead to inaccurate and misleading conclusions rather than unsure ones. Also, there is almost no way of assessing bias from the dataset. Some possible sources of bias identified during the project included; fishers behavior being modified when an observer is on an island (may cause under or over-reporting); the observer timing his/her visits for when he/she expects catches to be made (causes over-reporting); and the observer missing catches of dugong or turtles when they are observing on an island (causes under-reporting). These issues were addressed to some extent during the project. However, the possible effects of bias causing factors needed to be constantly revisited throughout the project.

Probably the greatest limitation of the project catch data however, is that the catch does not account for dugong or turtles caught outside the TSPZ. This is likely to be substantial with over 100 dugong estimated caught for Bamaga alone in 1997 (AFMA, unpublished data), and a substantial catch from the large communities adjacent to Thursday Island.

The 1999 workshop was held to address some of the identified problems of the project, including the personnel issues, which resulted in a number of positive steps being taken to improve catch monitoring program.

While the project had many problems, it also had some other benefits besides being a source of independent catch data. This included the excellent extension work the observers were able to provide for Island Communities. Generally, the attitude of Torres Strait Islanders was extremely positive to the project goals.

In any case, given the expense and difficulty in running the observer program, and the problems of precision, bias and coverage of the catch estimates it produced, it was decided not to continue with the observer program at the end of the 2000/01 sampling period.

AFMA also ran a school based catch monitoring project for dugong and turtles from 1990 to 1999. This involved school children on the various communities recording dugong and turtle catches, usually on purpose made calendars, and forwarding the information to a liaison officer in AFMA on Thursday Island. While this project fulfilled an excellent educational and extension role, analysis of the catch data showed that it had limited utility for calculating reliable catch estimates (Harris *et al.*, 1997, AFMA/CSIRO, unpublished data).

There remains an urgent need to obtain accurate estimates of the dugong and turtle catch by Torres Strait islanders to assess the sustainability of the catch. This is especially important given that the current catch is most likely exceeding sustainable levels. (Marsh, 1998). The focus now is on establishing effective community based monitoring programs.

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## APPENDIX 1. Proposed Sampling Scheme for Monitoring Officers.

Example from 2000/01 sampling period, with amended days taking into account logistical considerations.

At least 120 full observer days throughout the year								
Plus-travelling days, days at the TI office and days off								
	Robert	%/island	days	amended days	Peter	%/island	days	amended days
	Badu	40%	48	44	Boigu	40%	48	43
	Mabuiag	40%	48	43	Murray	15%	18	16
					Yorke	15%	18	16
	Yam	6%	7	9				
	St.Pauls	6%	7	9	Dauan	6%	7	9
	Kubin	6%	7	9	Saibai	6%	7	9
	Warraber	5%	6	9	Stephen	5%	6	9
					Darnley	5%	6	9
					Coconut	5%	6	9
	Total	103%	123	123	Total	97%	116	120
Islands with 5 or 6% effort- 3 trips x 3days=9 days								
Islands with 15 % effort- 3 trips x 5 days, or 5 trips x 3 days, or 3 trips x 4 days + 1 trip x 3 days								
Badu-6 trips x 7 days or 7 trips x 6 days + 2 extra days in somewhere								
Mabuiag-6 trips x 7 days or 7 trips x 6 days + 1 extra day in somewhere								
Boigu-6 trips x 7 days or 7 trips x 6 days + 1 extra day in somewhere								

## **APPENDIX 2. Checklists for monitoring officers to ensure consistent methodology**

Datasheets to be filled out are Daily activity sheets, site activity (completed 3 times daily morning, midday and afternoon), Fishing activity (concentrating on dugong and turtle), vessel surveys – of active vessels towards the end of an island visit and complete vessel survey 1-2 times a year.

Two important things to remember are to ensure to make a record of when there is no activity, so at least there is some record that observing was done, even though there was no activity.

The systematic process is outlined as follows:

- Daily recording and activities -including 3 times daily site activity
- Island recording and activities – includes all days spent on an island
- Trip recording and activities – includes all days on all islands per observer trip, and also includes before a trip, during the trip, and follow-up after the trip
- Yearly – all the above feed into this.

### **Site Activity**

Site Activity datasheet records ID, Island, Date, Activity Period, Time, Departing, Arriving Dinghies, Origin of the dinghy, Number of persons and comments. Recording of site activity is done by dividing the island (usually the beach) into sections for recording the data. This way the observer can divide the beach up into manageable sections to record activities. These sections could be more easily monitored for possible activities that the observer may have missed as vessel numbers are recorded for each of the 3 recording times, and any changes in these counts may signify that a vessel has gone or come back, or just moved to a different section of the island. The observer can then follow this up to ascertain whether any dugong or turtle hunting activity has occurred. These sections would be used again in subsequent visits enabling changes between visits to be recorded.

In this form it was also decided to record all vessels in each section but also to record the number of vessels with outboard motors separately as these vessels may be more likely to be used if an islander decides to go hunting. Vessels that were in close proximity to the waterfront, and that could be quickly and easily used were identified as “active” vessels, and

were recorded on this datasheet. Also the dropdown list actually describing the type of vessel was to be edited down to vessel types that the observer was likely to see.

### **Lists of Descriptions for categories on Datasheets**

#### **Vessel Descriptors**

#### **To reduce confusion of the observer new vessel descriptors were defined.**

- ANCHORED- beyond low water mark eg. Badu channel- can not be accessed unless by another vessel.
- MOORED- anchored or tied (jetty, ramp, sea wall or beach)- access from jetty, ramp, sea wall or beach- intertidal- between low water and high water marks.
- ON BEACH- Between the high water mark and yard (community).
- YARD- within the communities and in yards.
- TRAILERED- vessel on trailer.

#### **Record Quality – how certain are you of the catch**

1. Catch seen, counted and measured.
2. Catch seen and counted – not measured.
3. Catch known but not seen or no other evidence (shell, plastron or guts).
4. Catch recorded later in the day after activity or next day.
5. Hunted but catch not known
6. Animals caught when observer not on island (told by people they were caught).

#### **Process Stage – did you see the animal or other evidence**

- **WA** – Whole Animal
- **BU** – Butchered Animal
- **T** – Tail (Dugong)
- **SH** – Shell (Turtle)
- **PL** – Plastron (Turtle chest plate)
- **M** – Meat (either animal)

#### **Destination – what is the animal to be used for**

1. Own and family use.
2. Friends and relatives.
3. Used for feasting, cultural ceremony other community gathering.
4. Sent to another island.

5. Sold.
6. None of the above – use comments box to describe destination of meat.

**CHAR** – Confidence Hunting All Recorded

To be filled in with Yes – sure recorded all hunting activity whilst on island, or No – unsure whether all hunting activity record. If answer is no, need to provide a reason in the comments section.

**HW – LW** – High Water/Tide – Low Water/Tide

Need to record what time of day it is high tide and low tide – to the nearest half an hour.

**HR00-06, HR06-1000, HR1000-1400, HR1400-1800, HR1800-2400**

The above categories on the daily activities/conditions datasheet refer to different periods in the day. The amount of time spent monitoring during these periods of the day should be recorded in the spaces on the datasheet. An example might be monitoring was done from 0700 in the morning until 0900 therefore 2 is put in the space ie the observer spent 2 hours monitoring during that time period on that day. For each time period the monitoring officer records how much time was spent monitoring.

**Checklists for the observer (may be added to)**

**Daily Checklist**

Things to be done during a day on an island/community.

1. Ensure to record all Dugong/Turtle catch/hunting activity.
2. Do daily site activity recording- Morning, Midday, Afternoon – in observer identified sections of the island.
3. Do daily weather report.
4. Record “other” fishing activities.
5. Transfer data from datasheets onto database (ASAP- if possible straight after recorded, or on the same day the data recorded – whilst fresh in observers mind) once entered datasheets to be stamped as such and filed.

**Island Checklist**

**Things to be done while on an individual island/community.**

1. Record all dugong/turtle catch/activity.
2. Do “active” vessel survey (in sections).

3. When arriving on an island, if possible interview fishermen/people to find out info about recent fishing activities.
4. Record all data collected on the island from datasheet to database, and stamp and file when entered.

### **After Trip Checklist**

Things to be done after a trip on return to TI.

1. Make sure trip data is entered into database.
2. Crosscheck database ensuring records are complete and correct.
3. Debrief – do a rundown of trip and data collected, each observer to do after each trip and after a few trips have a joint debrief with Douglas and Tony.
4. Ensure trip datasheets are filed correctly at the end of every trip.

### **Yearly Checklist**

Things to be done on a yearly basis.

1. Full Vessel Survey- included all active vessels as well as all other vessels- twice yearly, midyear and towards end of year.
2. Quarterly Data Management- Observer to check database thoroughly, give to supervisor and then forward to CSIRO.

## **APPENDIX 3. Workshop on dugong and turtle catch monitoring. Thursday Island, 27-27 July 1999.**

### **Catch Analysis and Evaluation of Catch Monitoring of Dugong and Turtle in Torres Strait**

#### **Introduction**

The catch rate of dugongs and turtles is a key management issue in the Torres Strait region. There have been various attempts to monitor the dugong and turtle catch in the Australian sector in Torres Strait (Table 1). Catches of dugong and turtle in the Australian sector of Torres Strait are currently being monitored by AFMA using two independent methods. Catches of dugong and turtle are recorded by schools on a continuous basis with days when no recording occurs being noted. In addition, catches of dugong and turtle are monitored using a catch frame survey with roving fisheries observers. In 1998, catch statistics for dugong were also collected on a continuous basis for Mabuiag Island by the Dugong Life History Parameters Project.

The Schools Dugong and Turtle Program has been conducted by AFMA since 1990. Although the main emphasis is to provide effective education to future dugong hunters of the need for sustainable use, conservation and knowledge of the biology of dugongs, this program also collects catch statistics of dugongs and turtles. The schools dugong catch monitoring program has recently been extended beyond the Protected Zone including communities on the Inner Islands and the Northern Peninsula Area (NPA).

Since 1993 AFMA has continued Traditional Fisheries Monitoring Program developed by CSIRO. In 1998, two fisheries monitoring officers were employed to rove island communities recording the marine catch on islands for multiple periods of 2-10 days. More time is spent sampling five primary communities (Boigu, Mabuiag, Badu, Yorke and Murray) which includes the three major dugong hunting communities of Boigu, Mabuiag and Badu.

For government agencies such as AFMA charged with the responsibility of finding effective strategies to address the critical issue of managing the rate of use of wildlife where its consumptive use threatens to lead to over-exploitation, obtaining reliable information on level of indigenous harvest is no easy task. Moreover, the geographic remoteness and isolation of Torres Strait Island communities also present significant constraints to undertaking catch monitoring of dugong and turtle in the region.

Table 1. Methods used to record annual dugong catches from various Torres Strait communities

Area	Method	Date	Estimated annual dugong catch	Reference
Mabuiag Is		1973	24	Bertram and Bertram 1973
	continuous	1976-77	109	Nietschmann 1989
	limited cont.	mid 1980s	75	Johannes and MacFarlane 1991
	survey	1994	274 (se 156)	Harris <i>et. al.</i> 1997
	continuous	1998	155	D. Kwan pers. observ.
Badu Is	survey	1994	107 (se 68)	Harris <i>et. al.</i> 1997
Boigu Is	survey	1994	256 (se 119)	Harris <i>et. al.</i> 1997
TSPZ <sup>1</sup>	continuous	1976-77	750	Nietschmann 1984
	limited cont.	mid 1980s	110	Johannes and MacFarlane 1991
	school	1991-92	579	Harris and Nona 1997
	school (corr.)	1991-92	954	Harris and Nona 1997
	survey	1991-92	1010 (se 240)	Harris 1992
	survey (corr.)	1991-92	1095 (se 193)	Harris and Nona 1997
	survey	1991-93	1226 (se 204)	Harris <i>et. al.</i> 1994
	survey	1994	860 (se 241)	Harris <i>et. al.</i> 1997
	survey	1996	241 (se 92)	Skewes <i>et al.</i> 1997
Bamaga	survey	1997	116	M. Bishop pers.comm
Daru, PNG	continuous	1976-77 <sup>2</sup>	74-120	Hudson 1986
	continuous	1978-83 <sup>2</sup>	463	Hudson 1986

<sup>1</sup> Includes Mabuiag, Badu and Boigu Island communities

<sup>2</sup> Catch statistics recorded during period when dugong meat was legally sold in the Daru market.

### **Workshop Aims**

The major aims of the workshop will be:

- 1) Clarify objectives of the catch monitoring project
- 2) Critically examine the catch records collected from the Schools and Traditional Fisheries monitoring program and their statistical treatment to determine their usefulness in providing indications of the catch of dugong and turtle in the TSPZ and in Torres Strait in general. Identify all possible biases associated with each catch recording method in order to assist in: (1) making recommendations to improve data quality, and (2) more accurately interpret catch analysis results.
- 3) Use the 1998 catch statistics for the dugong fishery in Torres Strait including catch records from (a) the Schools, (b) Traditional Fisheries monitoring programs, and (c) the Dugong Life History Project to evaluate the effectiveness AFMA's monitoring programs to provide reliable catch statistics in Torres Strait.
- 4) Consider possibilities for validating catch statistics from the Schools and Traditional Fisheries monitoring programs with comparative catch statistics (eg from the Dugong Life History Parameters Project for Mabuiag Island in 1998).
- 5) Consider current monitoring programs w.r.t. logistics, personnel, OHS.

- 6) Consider any other alternatives to AFMA's monitoring programs that provide reliable catch statistics for dugong and turtles in the Australian sector of Torres Strait.
- 7) Investigate interactions between the revised catch monitoring programs and the development of a proposed community based management strategies (MaSTERS) in Torres Strait
- 8) Make recommendations that will provide feasible long term options which improve AFMA's monitoring programs ability to provide reliable catch statistics for dugong in the Australian sector of Torres Strait. Including recommendations to improve catch monitoring methodology in NPA and Inner Island area. (Schools and/or Frame Survey or other?)
- 9) Determine how catch statistics will be reported to: (a) AFMA/CSIRO; (b) TSFSAC; (c) ICC/TSRA and (d) Communities.

## **PROGRAM**

**Monday 26<sup>th</sup> July 1999**

**9.00am – 1.00pm (Morning tea 11.00am)**

**1.00 – 5.00pm (Afternoon tea 3.30pm)**

**Tuesday 27<sup>th</sup> July 1999**

**9.00am – 1.00pm (Morning tea 11.00am)**

**2.00-5.00pm (Afternoon tea 3.30pm)**

**Outcomes of a Workshop on dugong and turtle catch monitoring.  
Thursday Island, 27-27 July 1999.**

Attendees: Tony Kingston (AFMA), Nancy Mosby (AFMA), Jillian Kennedy (AFMA), Donna Kwan (JCU), Douglas Jacobs (CSIRO), Tim Skewes (CSIRO)

**AFMA/CSIRO Catch Monitoring Project**

Overall objective restated as “To obtain yearly estimate of dugong and turtle catch in Australian waters of Torres Strait to feed into stock assessments and management plans”.

Observer program priorities (in order of importance).

1. Dugong and turtle catch.
2. Dinghy based fishing activity and their primary fishing objective.
3. Vessel survey:
  - a. Total vessel survey once or twice a year (active and inactive).
  - b. Number of active vessels once a sample trip.
    1. Other (non-dugong or turtle) catch from active vessels. Why is this not 4-6?
    2. Other shore based fishing activity and catch.
    3. Extension education work; in conjunction with school program and proposed community monitoring program to be piloted in Mabuiag Island.

**Project Issues**

Precision

- Currently low (especially with 120 d/year effort).
- A product of coverage (the number of observer days, efficiency of the stratification) and natural variability (high for dugong and moderate for turtles)
- For dugong, s.e.~30% of the mean with 120 d/year sampling. Probably ~17% with double that.
- Lots of zeros in the daily data makes it problematic to deal with.
- Stratification of sampling effort needs to be spatially appropriate ie by island. Current split is probably OK but could be reanalysed using catch and variability by island.
- Keep new observer percentages calculated for two observers no matter what effort is available.
- Tony outlined plans for getting observer effort up to 240 days. Observer sample design split into (with approximate sampling effort as a percentage):
  - 3 primary dugong islands (Mabuiag, Badu, Boigu; 19% each)
  - 2 primary (Murray, Yorke; 6% each)
  - 9 secondary (2.5% each)
  - outside TSPZ (10%)
- Useful to construct new power (precision) curves for number of observer effort days. Need to take into account finite correction factor and new stratified effort design. Also detecting change power curves could be built.

Bias

- Observer efficiency.
  - observer (training, morale, better data sheets, continuity)
  - logistics (sampling methodology, ERE, time of day, location, variation by island)
- Also caused by behavioral change by fishermen caused by observer presence.
  - mitigated by communication and trust building.
- Distribution of sampling effort temporally. Sampling effort needs to be spread evenly through out the year.

Analysis technique

- Use patterns in the data (Charis) to produce higher precision catch estimates.
- Looking at absolute numbers of dugong caught per year versus change in catch through time. Leads to different designs with the latter having less effort and using repeated measures techniques.

OHS aspects

Being addressed. Safety of observers during sampling is a high priority. Probably no significant change to operation at this time.

#### Getting data from outside the TSPZ

##### 1. Thursday Island and Hammond Island.

- Extract catch records from recognized dugong hunters by interviews.
- Beefed up school data program. TI high school should be encouraged to include dugong in the curriculum. Hammond Island catches mainly from the Sacred Hearts School.
- Include Hammond Island in the observer program. Will only get Hammond Island and not TI or the MPA. Same level of primary school.

##### 2. NPA

- Put on hold. Priority to TI.
- Beefed up school data program.
- Observer program probably not achievable there. Data could be extracted by interviews with:
  - AQIS observer at Bamaga (Sailor & Bonn)
  - ranger at Injinoo (Li Fu).
- Tony to progress and get in touch with contacts.

#### Other issues

##### 1. Travel days.

- Use the data from the days that the observer arrives on the AM and feels that all of the catch has been seen.

##### 2. Data integrity

- More regular data exchange and updates both at AFMA and with CSIRO.
- Tony/observers to check data after every trip. Contact between CSIRO and the observers after every trip to discuss data issues.
- Progressive data update to CSIRO quarterly.
- Need to have a streamlined data-sheet to database entry procedures. Update all datasheets to make easier to fill out
- Retraining of datasheet filling and database entry procedures.

##### 3. Observer visit lengths

- Keep visits to islands from 3-7 days.

##### 4. Current data analysis

- CSIRO will analyse the 1998 data ASAP.
  - Douglas and observers to check and verify data
  - Donna will send down catch data for Mabuiag Island for 1998 (for use with suitable acknowledgement)
  - Charis, Douglas and Tim use data to produce catch estimates for 1998.

#### School program

Project has a dual monitoring and education role. Project does an excellent job in education school age children, with flow-on effects into the broader community.

Project produces catch of dugong and turtle per day by island straight averages. Data good at comparing islands, and for looking at temporal changes in catch. Has some limitations in providing reliable annual catch estimates.

Nancy presented the 1998 data. Best coverage yet. Meeting stressed importance of extension visits and communication in the success of the schools program.

#### **Data issues**

##### Precision

- Currently unable to calculate variance therefore precision not known. Need daily records (now getting daily records).
- Coverage on some islands is low or non-existent. Coverage is heavily dependant on extension visits by Nancy and teachers interest.

#### Bias

- Historically, catch estimates from the school program have been low compared to observer program (this bias is the worst kind in terms of sustainable catch levels). Need to determine if it is still significant and why.
- Data generally not recorded during holidays, esp. Dec, Jan, Feb, or weekends? Could use cyclic trends to correct for this (Charis). Can also stratify if dates of catches are known and some catch data exists for each day type (ie weekends).
- Not all islands sample each year therefore the catch for that island unknown. Greater extension work may help in getting wider coverage.
- Multiple reporting of catches could also be a problem. Could be addressed by naming hunters.

#### Interaction between school and observer program

- Record school data overlapping with the observers is very useful to supplement the observer data and increase coverage.
- Compare school data to observer data ie ERE feedback.
- Target school data collection to get higher quality results over shorter time periods.

#### Alternative program

Tony and Donna outlined a possible source of dugong and turtle catch data from locally based islander observers. Funding provided by AFMA would enable catch recording and collection of dugong heads (as currently occurs under the Dugong Life History Parameters Project) by a community member. The community observer would be employed for a couple of hours per day, 5 days per week. While this proposal was seen as very positive, some risks were also identified. It was decided to use Mabuiag to set up a pilot. There is potential for data obtained from a community catch monitoring program to be useful as another independent source of catch statistics. The Mabuiag Island monitoring program would provide a valuable contribution to AFMA's monitoring and research program for traditional fisheries ie life history project, the observer program and school program.

A broader island based observer scheme could also feed into community based management being developed by ICC?TSRA and supported by AFMA ?

It was recognized as important to keep the data collection of the island observer independent from the AFMA observer and the schools program. This would allow comparison of the catch data collected by the three sources. The Island observer would also be able to collect samples to input into the dugong life history program.

A project proposal for submission to TSFSAC has been prepared to be presented to TSFSAC.

#### Other business

The meeting recommend that a dugong and turtle monitoring workshop be held once a year.

Donna and Douglas and observers to produce a general observer dugong research article for the Torres News. – By 27/8/99 (for next edition of Torres News)? OK, Douglas?

Donna will send her catch data for Mabuiag for 1998 to CSIRO in the next two weeks for input into the calculation of catch estimates for 1998. – Done!

## APPENDIX 4. Calculation of stratified mean and variance estimates

Stratified sampling techniques. In stratified sampling the total number of possible fishing days for the TSPZ of  $N$  units is divided into Island fishing days of  $N_1, N_2, N_3, \dots, N_L$  units respectively. If each Island is relatively homogenous, a more precise estimate of any stratum mean can be obtained in that stratum. These estimates can then be combined to give a precise estimate for the whole TSPZ. The notation of terms used for stratified sampling follows below:

$N$	total number of possible fishing days in the TSPZ;
$N_h$	total number of possible fishing days for each Island $h$ ;
$n_h$	actual number of samples taken in Island $h$ ;
$y_{hi}$	value obtained from $i$ th fishing day on Island $h$ ;
$W_h = \frac{N_h}{N}$	Island $h$ weight;
$f_h = \frac{n_h}{N_h}$	sampling fraction in Island $h$ ;
$\bar{y}_h = \frac{\sum_{i=1}^{n_h} y_{hi}}{n_h}$	Island $h$ mean;
$\bar{y}_{st} = \sum_{h=1}^L W_h \bar{y}_h$	stratified mean over all TSPZ;
$s_h^2$	sample estimate of Island $h$ variance;
$v(\bar{y}_{st}) = \sum_{h=1}^L \left( \frac{W_h^2 s_h^2}{n_h} \right) - \sum_{h=1}^L \left( \frac{W_h s_h^2}{N} \right)$	estimated TSPZ variance.