economic value of
CHARTER AND
RECREATIONAL FISHING
in Australia’s eastern tuna and billfish fishery

Prepared for the Fisheries Resources Research Fund

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Walter Shafron and Ineke Redmond

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ABARE project 2867
Debate has recently increased on the issue of resource sharing in Australia’s Commonwealth fisheries and access to fish stocks by Australians other than commercial fishers. The Australian Government has stated that recreational fishing must be accounted for under Commonwealth fisheries management strategies.

ABARE was commissioned by the Fisheries Resources Research Fund to conduct an economic survey of the charter game fishing sector along the east coast of Australia. The objectives of the survey were to collect data for an economic valuation and profile of the sector. In addition a desktop study was undertaken to estimate the value of private recreational fishing in the fishery.

This report presents the economic values estimated for the charter and private recreational sectors, as well as previously estimated commercial fishing values for fishers operating in the eastern tuna and billfish fishery. An assessment of how these values could be used in the resource sharing process is also presented as is profile information from the charter fishing survey.

BRIAN S. FISHER
Executive Director
July 2004
acknowledgments

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The aim in this project was to examine the economic values associated with recreational and charter fishing in the eastern tuna and billfish fishery and how these values could be used in a resource allocation framework. Determining the economic values associated with the two recreational sectors — charter and private recreational — are made difficult because, unlike the value of commercial fishing interests whose outputs are sold in markets, the value of recreational fishing is often not revealed through markets. Some information is available in markets for the charter sector, but for the private recreational sector it is necessary to use nonmarket valuation methods.

ABARE has been conducting economic surveys of the commercial fishing sector since the early 1990s and for this report conducted a similar economic survey for the charter fishing sector of the fishery. For the private recreational sector, a benefit transfer study was conducted using data collected in a contingent valuation study for a similar fishery in Hawaii and cost data from numerous studies of game fishing tournaments conducted for the eastern tuna and billfish fishery.

The estimated economic values (net returns) for all three sectors are presented in this report. They show that net returns are relatively low under the prevailing management arrangements in each sector. In 2001-02, the net returns in the commercial, charter and private recreational sectors have been estimated at $3.5 million, negative $2.5 million and $4.9 million respectively.

It is important to note that these figures do not include values such as lifestyle benefits or any other values associated with going fishing, such as the value of spending a day on a luxurious boat or the value of seeing rare wildlife.

As a part of the economic survey of the charter sector, operators were asked about the impact that a number of factors would have on their charter fishing business in the next five years. In all three states, most charter operators were not particularly concerned about congestion between charter and commercial fishing operations. This suggests that while these sectors target the same stocks and that catches in the
commercial sector are likely to influence the catch and strike rate of the charter sector, the actual fishing grounds may not be the same. It may be the case that closing particular fishing grounds to commercial fishers for the exclusive use of charter and private recreational fishers would not have a significant impact on the charter and private recreational sectors (although specific individuals could be substantially affected).

As catch and release is increasing in popularity in the private and charter sectors, not all fish caught by these sectors are removed from the fishery. Catch and release activities rely on fish being available for capture, but they do not generally involve significant reduction of the fish stock if mortality of released fish is low. Estimates of the proportion of fish released as well as the mortality rate of released fish need to be considered in any resource sharing arrangements between the recreational and commercial sectors. This report provides estimates of the proportion of charter fishing catch that is released. On average in 2001-02, 97 per cent of billfish caught were released and 44 per cent of tuna were released.

To arrive at the allocation of resources between the sectors that maximises the net value of the catch to society a significant amount of information is required. In general a fish stock should be reallocated from the sector with the lower net marginal values to the sector with the higher net marginal values until the net marginal values are equal across both sectors. In addition, total removals from the fishery need to be controlled to the level that allows net benefits to be maximised. Collecting the data required to undertake such an analysis is likely to be prohibitively costly.

For the eastern tuna and billfish fishery, it is important to ensure that the current level of catch/effort in the fishery is not too high before significant funds are committed to determine the optimal allocation between sectors. Given that the management arrangements in all three sectors of the fishery currently rely heavily on limiting the number of licences and that a large body of latent effort exists in the fishery, any potential benefits from an improved allocation are likely be eroded through increased fishing effort. Until management regimes that effectively control effort in all the sectors are implemented, it is unlikely that significant expenditure to determine an optimal allocation could be justified.

Consequently, less expensive qualitative assessments may be useful in making comparisons between sectors. Information on the current total
net benefits of the charter and private recreational sectors have been calculated relatively easily and the required data were relatively inexpensive to collect. This information, along with other qualitative information such as the size of each sector and the major factors affecting net benefits, provides fishery managers and policy makers with data to help determine resource sharing arrangements between competing sectors in this fishery.

It is important to note that the estimates of current net returns in each sector presented in this report will be underestimates of maximum potential net returns. Given that tuna and billfish caught by all sectors in the fishery are thought to form part of the same stock (Caton 2003), overfishing in one sector would be likely to affect the stock available and hence the returns in the other sectors. Therefore, current net returns are at best only able to guide policy makers on the returns available under current management arrangements. If management arrangements that provide more effective control of catches and effort were implemented then net returns across the three sectors would be likely to increase.

This research has shown that while current net returns in the charter and private recreational sectors are relatively low, there were a little over 100 charter boats operating in the fishery in 2001-02 and an estimated 235,000 people days fished on private recreational boats. This compares with 132 longline boats (based on AFMA logbook data) in the commercial sector in 2000-01 (Galeano et al. 2003). With all three sectors being relatively large and appearing to have the potential to generate significant net returns, any resource sharing process needs to include all three sectors.
introduction

Australia’s present arrangements for Commonwealth fisheries were established in 1992 with the establishment of the Australian Fisheries Management Authority (AFMA). Management is administered through the Fisheries Management Act 1991 and the Fisheries Administration Act 1991. To date, Commonwealth fisheries have been managed for the commercial fishing sector only.

Recently, debate has increased on the issue of access to fish stocks by Australians other than commercial fishers. During 2001, the Australian Government made the following statement on recreational fishing in Commonwealth managed waters:

‘… recreational fishing must be an integral part of Commonwealth fisheries management and must be provided with rights and responsibilities.’
(Coolangatta Workshop Communiqué 2002)

The government then recommended that a workshop be held to:

‘… Identify how best to provide the appropriate management rights to the recreational sector as they apply to Commonwealth managed fisheries and how these rights are to be allocated.’

This workshop was held at Coolangatta in October 2002. Participants at the workshop discussed strategies for the development of resource sharing arrangements in Commonwealth managed fisheries. In addition in 2003 the Australian Government released Looking to the Future: A Review of Commonwealth Fisheries Policy (Commonwealth of Australia 2003). An outcome of this review was that:

‘The Commonwealth Government will develop and implement an agreed framework, in consultation with the states, the Northern Territory and stakeholders, for resource sharing and management between sectors that utilise Commonwealth-managed fisheries resources.’ (Commonwealth of Australia 2003 pp. 26)

The purpose in this report is to provide estimates of the economic value of charter and private recreational fishing that target tuna and billfish off the east coast of Australia that may help in the resource sharing process. This is in recognition that both commercial and recreational fishers target tuna and billfish off the east coast and that management of the resource needs to take into account these competing users. While the charter and recreational sectors will continue to be managed by the relevant state authorities, sound manage-
ment of the Commonwealth eastern tuna and billfish fishery will require that other users of the resource be adequately accounted for.

ABARE has conducted economic surveys of the commercial sector of the eastern tuna and billfish fishery since 1989-90. Some studies of the regional economic impact of particular recreational game fishing tournaments have been conducted, but there is little (if any) public information on the economic value of the entire charter and recreational fishing sectors of the eastern tuna and billfish fishery.
eastern tuna and billfish fishery – economic values

There are three sectors that operate in the waters off the east coast of Australia that target tuna and billfish species — the commercial sector, charter sector and private recreational sector. The purpose in this chapter is to present estimates of the economic value each of these three sectors.

Commercial sector

Management arrangements

The fishery extends to the limit of the 200 nautical mile Australian Fishing Zone from the tip of Cape York to the southernmost point of the Australian Fishing Zone to the South Australian – Victorian border (map 1). Under Offshore Constitutional Settlement agreements, the Australian Government manages the commercial sector. The relevant state authorities manage the charter and private recreational fishing sectors.

Commercial fishing operations take place throughout the entire area of the fishery. However, no tuna fishing is permitted inside the Great Barrier Reef Marine Park (GBRMP) without a permit from the GBRMP Authority. Major ports used by the fleet include Cairns, Mooloolaba, Coffs Harbour and Hobart.

The real gross value of production in the longline eastern tuna and billfish fishery in 2002-03 was $69.5 million (figure A). The principal commercial species are yellowfin tuna, bigeye tuna, albacore tuna and broadbill swordfish. However, many other species are caught as byproducts, such as striped marlin, pelagic sharks, longtail tuna, rudder fish, black oilfish, dolpinfish, rays bream, moonfish and wahoo. Incidental catches of blue and black marlin occur, but in recognition that
these species are a key target species of the recreational sectors they must be returned to the sea under a legislative amendment that came into effect in July 1998 (Caton 2003).

Currently, the commercial fishery is managed by input controls including limited entry, zoning, boat and gear restrictions, and bycatch provisions. Some of the zoning restrictions include a maximum vessel size (32.67 metres) for fishing vessels operating within 50 nautical miles of the coast. Vessels fishing south of Sydney are required to hold a minimum of 500 kilograms of southern bluefin tuna quota to be able to fish for any tuna species. Longline fishing endorsements relate to specific regions of access, with a total of seven categories of endorsements issued. Despite these management controls there still exists a large amount of latent effort within the fishery (table 1).

In September 2002, AFMA released a draft management plan for public comment. While the proposal does not change the boundaries of the fishery, all zones, except the current zone E, will be removed. Zone E will be renamed the Coral Sea Zone and an additional permit will be required to fish in this zone.

 Tradable effort units are being proposed as the new primary management tool. These statutory fishing rights (SFRs) will be allocated to allow each operator a number of branchline clips per year. Each clip allows the fisher to set one hook. It is currently undecided as to how AFMA will monitor the number of hooks used by fishers. It is proposed that hook units will be fully transferable by lease or permanent sale. Minorline statutory fishing rights will also be introduced, defining the maximum number of lines that may be used at any one time in the fishery. Operators in the purse seine sector may be allocated a separate fishing permit pending the development of their own skipjack specific management plan.

### Economic returns

As an indicator of economic returns, ABARE has estimated the annual net returns to the eastern tuna and billfish fishery using survey data (table 2). For more detail on how these estimates were made, see Galeano, Gooday, Shafron and Levantis (2003) (for an explanation of the relationship between economic rent, net returns and profits see box 1).
Resource rent

The concept of economic rent arose in the early nineteenth century from the realisation that rent for land was not set by the owners of the land but rather by the potential profitability that users could reap from using the land (Barlowe 1958). Rent reflected surpluses after all other costs had been met, including the necessary return on capital to justify any investment. Economic rent therefore became the term to describe any earnings in an activity over and above that required to make the activity economically justifiable in the long term (Wessel 1967).

The term ‘resource rent’ is used to describe the part of the return from the use of a natural resource that stems from the scarcity of that resource. Rent to a resource is the return to ownership of the resource, net of all production costs other than the cost of acquiring the use of the resource itself. Production costs comprise direct operating costs such as fuel, labor (including the opportunity cost of a self employed fisher’s own labor), bait, overheads and the cost of capital invested in the boat and gear. The latter cost includes depreciation and the opportunity cost of equity capital employed in the fishery. The opportunity cost is equivalent to what the fisher’s investment could have earned in the next best alternative use.

Net returns and profits from commercial fishing

A starting point for measuring resource rent is an estimate of the apparent net return to a fishery’s resource — revenue from fishing less the social opportunity cost of capital and less other inputs used in fishing (including management inputs). Detailed financial input and output information is required for the calculation of reasonably accurate estimates of net return and of the value of fishing capital.

The accounts of businesses involved in a fishery are primary sources in deriving a measure of the apparent net return to the fishery resource. However, there are potentially important ways in which measures of profit to the businesses involved in a fishery may differ from the net return to the fishery resource. First, fishers often operate in more than one fishery and their accounts reflect those activities. Second, costs reported in the financial accounts of a business may vary from social opportunity costs, particularly for capital, management costs and owners’ or family labor. Interest payments and costs of purchasing and leasing quota and licences are costs that fishers incur. However, they also represent revenue to others — these transfers are not included in a measure of net return. Finally, in some fisheries the full costs of management may not be charged to operators. The relationship between total revenue, financial accounts of fishers’ costs and profit, and the social costs of fishing and net returns to the fishery resource are illustrated in the figure below.

As an indicator of resource rent, any measure of the net return to a fishery needs to be considered in the context of market conditions and the condition of the fishery. Of particular importance are the condition of the fish stock, capital capacity, prices of the fishery’s products and inputs and the management structure of the fishery. See Rose et al. (2000) for more detail.
Coinciding with the continued development of the billfish fishery off Mooloolaba in 1998-99, net returns rose to a little under $5 million. Since then, net returns have fallen and in 2000-01 were estimated at a little over $2.2 million.

The low (although not necessarily negative) net returns experienced prior to 1998-99 might have been expected given the management arrangements under which the fishery operated. The large body of latent effort that has existed in the fishery for a number of years implies that any above average profits are likely to be competed away relatively quickly through the activation of previously latent effort. It is possible that this has contributed to the lower net returns since 1998-99. Until a management arrangement is implemented that effectively constrains fishing effort, it is unlikely that the larger positive net returns, such as those estimated for 1998-99, can be sustained.

### Charter sector

#### Management arrangements

Management arrangements for this sector are in the form of licences and bag limits. Legal size, possession and bag limits for various fish species are imposed in New South Wales, Queensland and Tasmania. While the relevant authorities do not place limits on the total number of tuna and billfish caught in a given year, bag and size limits do apply in Tasmania.
and New South Wales (tables 3 and 4). The sale of fish taken by recreational anglers in these three states is prohibited.

Each of the state authorities impose some gear restrictions that apply to tuna and billfish game fishing. For example in New South Wales there is a restriction on the maximum number of lines per angler and number of hooks per line.

In New South Wales under the *Fisheries Management Act 1994*, recreational fishing licences are required for all marine fishing activities. In Tasmania a licence is required for all fishing other than line fishing in marine waters (*Living Marine Resource Management Act 1995*). Licences for private recreational fishers are not required in Queensland. In New South Wales charter operators can purchase annual block fishing licences so that clients do not have to purchase their own fishing licence.

In New South Wales, charter boat operators are required to possess and display a charter boat fishing licence. Charter operators in New South Wales and Queensland also require a waterways survey or logbook. Logbooks provide data to the managers on catch rates, fishing effort and the age and size composition of key target species.

### Economic survey of charter operators

Studies of the economic value of the charter fishing sector for the entire eastern tuna and billfish fishery are limited. There have been several regional studies such as Pepperell (1991, 1992, 2002) that aimed to determine the economic value of specific game fishing tournaments such as the ‘Bermagui Blue Water Classic Game Fishing Tournament’. These have been carried out with surveys of fishers on both charter and private recreational boats to determine expenditure per person.

The main problem with using these studies to form an estimate of the net benefits of recreational fishing in the fishery is that they were primarily designed to estimate the economic impact of tournaments in particular regions. They do not calculate the net benefits to the Australian community as a whole, rather they provide an indication of the expenditure in a region over the period of the tournament. The economic value of the charter sector
is not represented solely by expenditure on items such as fuel and bait. Rather it is the benefits of fishing less all the costs. While expenditure on goods and services associated with recreational fishing in regional economies create flow-on benefits to that region, if that expenditure were to cease because of a change in recreational fishing opportunities, it would be expected that a substantial proportion of that expenditure would occur elsewhere in the economy.

The economic survey of the charter sector carried out by ABARE used the same methodology as that used to survey the commercial sector. The aim of the charter sector survey was to calculate the net benefit (net returns) to the charter sector. Calculating net returns for this sector is relatively easy, as receipts are easily identified as the fees that charter operators charge to take people tuna and billfish fishing. The costs of fishing include fuel, bait, gear an so on, and the costs of capital equipment.

Between April 2003 and March 2004 ABARE conducted face to face and telephone interviews with charter fishing operators that targeted tuna and billfish in Queensland, New South Wales and Tasmania for the year 2001-02. In addition to collecting information to calculate net returns, information to profile the sector was also collected.

In Queensland, based on licensing information from the Queensland Department of Primary Industries (QDPI) and discussion with an industry representative, the population of charter boats that targeted tuna and billfish in 2001-02 was estimated at 46. This included Queensland boats that also operated in New South Wales at certain times of the year as well as in Queensland. Of these, seventeen were sampled.

Based on licensing information from New South Wales Fisheries and the billfish tagging database, the population of boats that targeted tuna and billfish in New South Wales in 2001-02 was estimated at 49. This also included an estimate of the New South Wales boats that fished for part of the year in Queensland waters. Of these, fourteen were sampled.

Based on information from the Sea Charter Boat Operators of Tasmania, the population of boats that targeted tuna and billfish in Tasmania in 2001-02 was estimated at sixteen. Of these, nine were sampled.

**Receipts**

Average per boat receipts and costs, by state, for 2001-02 for charter boats that targeted tuna and billfish are shown in table 5. It is important to note that these receipts and costs include those attributable to tuna and billfish fishing as well as other activities such as reef fishing, diving and sight seeing. Subsequent tables present receipts and costs attributable to tuna and billfish fishing only.

In New South Wales, average per boat charter income was estimated at just under $92 000 per boat in 2001-02, around half that of the boats in Queensland ($184 600 per boat) and three times more than the average for Tasmania ($30 700 per boat). Other boat income, which includes items such as the diesel fuel rebate and insurance claims, was estimated at
an average of around $6300, $10 500 and $10 600 per boat in the same year for New South Wales, Queensland and Tasmania respectively.

**Operating costs**

Major cost items of charter boats include fuel, oil and grease, repairs and maintenance and labor costs. Together, these three items were estimated to account for 70–75 per cent of total cash costs across the three states in 2001-02.

Labor costs were split into two categories, those of paid labor such as employed skippers, crew and chefs, and those of owner and family labor cost. On many boats where owner or family labor is involved, the labor payments can be low or even nil. To more accurately reflect the true market value of the labor used in the fishing operation, operators were asked to estimate what it would cost to replace owner operator and family labor with paid crew and staff. The opportunity cost of owner and family labor is estimated to have accounted for 27 per cent of total operating costs in New South Wales, 16 per cent in Queensland and 31 per cent in Tasmania in 2001-02.

### Financial performance of charter fishing boats in the eastern tuna and billfish fishery, 2001-02 Average per boat

<table>
<thead>
<tr>
<th>Component</th>
<th>New South Wales</th>
<th>Queensland</th>
<th>Tasmania</th>
<th>All surveyed states</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total charter income</td>
<td>$91 982 (16)</td>
<td>$184 570 (12)</td>
<td>$30 682 (21)</td>
<td>$121 515 (9)</td>
</tr>
<tr>
<td>Other boat income</td>
<td>$6 253 (20)</td>
<td>$10 497 (17)</td>
<td>$10 559 (51)</td>
<td>$8 633 (14)</td>
</tr>
<tr>
<td><strong>Gross cash receipts</strong></td>
<td>$98 236 (16)</td>
<td>$195 067 (12)</td>
<td>$41 241 (20)</td>
<td>$130 148 (9)</td>
</tr>
<tr>
<td>Fuel, oil and grease</td>
<td>$17 628 (14)</td>
<td>$27 466 (13)</td>
<td>$7 423 (13)</td>
<td>$20 234 (9)</td>
</tr>
<tr>
<td>Repairs and maintenance</td>
<td>$11 911 (17)</td>
<td>$32 964 (32)</td>
<td>$6 296 (19)</td>
<td>$19 826 (22)</td>
</tr>
<tr>
<td><strong>Opportunity cost of family labor</strong></td>
<td>$22 244 (17)</td>
<td>$20 734 (20)</td>
<td>$12 963 (20)</td>
<td>$20 280 (12)</td>
</tr>
<tr>
<td>Employed labor</td>
<td>$11 376 (18)</td>
<td>$24 134 (17)</td>
<td>$3 467 (24)</td>
<td>$15 523 (12)</td>
</tr>
<tr>
<td>Insurance</td>
<td>$3 501 (13)</td>
<td>$10 310 (21)</td>
<td>$2 423 (17)</td>
<td>$6 168 (15)</td>
</tr>
<tr>
<td>Administration</td>
<td>$4 504 (20)</td>
<td>$5 618 (20)</td>
<td>$1 802 (20)</td>
<td>$4 576 (13)</td>
</tr>
<tr>
<td>Licences</td>
<td>$2 081 (14)</td>
<td>$7 406 (17)</td>
<td>$1 625 (16)</td>
<td>$4 222 (13)</td>
</tr>
<tr>
<td>Interest</td>
<td>$1 474 (40)</td>
<td>$2 215 (51)</td>
<td>$1 244 (35)</td>
<td>$1 748 (31)</td>
</tr>
<tr>
<td>Bait</td>
<td>$1 903 (33)</td>
<td>$2 472 (17)</td>
<td>$94 (30)</td>
<td>$1 878 (17)</td>
</tr>
<tr>
<td>Other costs</td>
<td>$7 068 (39)</td>
<td>$17 553 (26)</td>
<td>$5 134 (17)</td>
<td>$11 134 (20)</td>
</tr>
<tr>
<td><strong>Total operating costs</strong></td>
<td>$83 689 (14)</td>
<td>$150 873 (13)</td>
<td>$42 473 (12)</td>
<td>$105 589 (9)</td>
</tr>
<tr>
<td><strong>Boat cash income a</strong></td>
<td>$14 547 (56)</td>
<td>$44 194 (31)</td>
<td>$–1 232 (68)</td>
<td>$24 558 (28)</td>
</tr>
<tr>
<td>less depreciation</td>
<td>$15 522 (24)</td>
<td>$30 702 (19)</td>
<td>$9 852 (14)</td>
<td>$20 996 (14)</td>
</tr>
<tr>
<td><strong>Boat business profit b</strong></td>
<td>$–975 (746)</td>
<td>$13 492 (82)</td>
<td>$–11 085 (78)</td>
<td>$3 563 (161)</td>
</tr>
<tr>
<td>Profit at full equity</td>
<td>$499 (1 457)</td>
<td>$15 706 (70)</td>
<td>$–9 840 (89)</td>
<td>$5 311 (107)</td>
</tr>
<tr>
<td><strong>Capital value d</strong></td>
<td>$197 896 (13)</td>
<td>$492 721 (19)</td>
<td>$129 667 (11)</td>
<td>$310 240 (13)</td>
</tr>
<tr>
<td>Rate of return to capital e</td>
<td>%</td>
<td>0.3 (1 454)</td>
<td>3.2 (65)</td>
<td>–7.6 (88)</td>
</tr>
</tbody>
</table>

- a Gross cash receipts less total operating costs.
- b Boat cash income less depreciation.
- c Boat business profit plus interest, leasing and rent.
- d Boat and onshore equipment.
- e Profit at full equity divided by capital value.
Boat cash income and profits

Boat cash income is defined as total receipts minus operating costs. This was estimated at around $14,500 per boat in New South Wales and $44,200 in Queensland. However, in Tasmania it was estimated at negative $1,200 per boat.

Boat business profit is defined as boat cash income less capital depreciation costs. Queensland was the only state where boat business profit was estimated to be positive, at $13,500 per boat. In New South Wales and Tasmania, boat business profit was estimated at negative $975 and negative $11,100 respectively.

Profit at full equity is calculated by adding interest, leasing and rent payments to boat business profit. This is done because these payments represent profits that have accrued to other investors in the fishery. Profit at full equity provides a measure of the return that would have been earned by the business unit had the boat and other capital been fully owned by the operator. It was estimated at an average of around $500 in New South Wales, $15,700 per boat in Queensland and negative $9,800 in Tasmania in 2001-02.

It is important to note that the inclusion of any imputed value for family labor adds substantially to costs and therefore makes a significant difference to the estimates of profit at full equity and boat cash income.

The average capital value per boat of eastern tuna and billfish charter operations was estimated at approximately $197,900 in New South Wales, $492,700 in Queensland and $129,700 in Tasmania. This includes the value of the boat and any onshore capital such as vehicles and sheds associated with the charter business.

The rate of return to capital is the percentage annual return to the capital invested in the business (that is, profit at full equity divided by total capital). This was estimated to be only 0.3 per cent in New South Wales, 3.2 per cent in Queensland and negative 7.6 per cent in Tasmania.

Economic return to tuna and billfish charter fishing

The information presented in table 5 provides a financial profile of the boats that operate in the charter sector of the eastern tuna and billfish fishery. However, some of the receipts and the costs are attributable to reef fishing and other activities that this group of charter boats participate in. Consequently, as a part of the survey, interviewees were asked to estimate the proportion of their receipts and costs attributable to tuna and billfish operations. Tables 6 and 7 present the average per boat and total economic value of tuna and billfish charter fishing by only including receipts and costs attributable to that type of fishing. The economic indicators in tables 6 and 7 have been calculated in a manner consistent with the way in which ABARE calculates similar indicators in the commercial eastern tuna and billfish fishery.

Net returns are gross revenue less fishing costs. Fishing costs are broken up in tables 6 and 7 into three groups:
■ operating costs
■ depreciation costs and
■ opportunity cost of capital.

Operating costs are the day to day costs of running the business. These include items such as fuel, ice, insurance, administration and crew costs. Depreciation is the amount by which the value of capital falls in a year through wear and tear, and the opportunity cost of capital is an allowance for having the capital invested in the business. This is considered to be a cost because if the money were invested elsewhere a return on this capital would be expected. For example, if the money were invested in a term deposit at a bank, interest would be earned.

It is important to note that an estimated net return of around zero (such as in table 7) does not mean that charter businesses are not profitable. At this point, owners are receiving the appropriate return to capital and labor to justify their investment in the fishery. This return is in addition to covering all the day to day expenses of the business such as fuel, repairs and administration. Estimated net return of around zero means that the charter operators and hence the community are not getting a return from the use of the natural resource.

Total tuna and billfish charter receipts across the three states in 2001-02 were estimated to be around $9.67 million. Of the three cost categories described above, operating costs

### Economic value of tuna and billfish charter fishing in the eastern tuna and billfish fishery, 2001-02 – average per boat

<table>
<thead>
<tr>
<th></th>
<th>New South Wales</th>
<th>Queensland</th>
<th>Tasmania</th>
<th>All surveyed states</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Tuna and billfish fishing receipts</td>
<td>41 665 (23)</td>
<td>157 458 (16)</td>
<td>24 369 (26)</td>
<td>87 158 (13)</td>
</tr>
<tr>
<td>Operating costs</td>
<td>32 544 (24)</td>
<td>93 556 (15)</td>
<td>26 299 (15)</td>
<td>56 928 (12)</td>
</tr>
<tr>
<td>Depreciation</td>
<td>6 900 (26)</td>
<td>28 160 (22)</td>
<td>7 407 (17)</td>
<td>15 784 (17)</td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>6 555 (22)</td>
<td>31 683 (22)</td>
<td>6 616 (13)</td>
<td>16 977 (18)</td>
</tr>
<tr>
<td>Net return</td>
<td>–4 334 (58)</td>
<td>4 059 (275)</td>
<td>–15 952 (28)</td>
<td>–2 531 (189)</td>
</tr>
<tr>
<td>Capital value</td>
<td>93 642 (22)</td>
<td>452 609 (22)</td>
<td>94 511 (13)</td>
<td>242 529 (18)</td>
</tr>
</tbody>
</table>

*Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.*

### Economic value of tuna and billfish charter fishing in the eastern tuna and billfish fishery, 2001-02 – total for fishery

<table>
<thead>
<tr>
<th></th>
<th>New South Wales</th>
<th>Queensland</th>
<th>Tasmania</th>
<th>All surveyed states</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S’000</td>
<td>S’000</td>
<td>S’000</td>
<td>S’000</td>
</tr>
<tr>
<td>Tuna and billfish fishing receipts</td>
<td>2 041 (23)</td>
<td>7 243 (16)</td>
<td>390 (26)</td>
<td>9 674 (13)</td>
</tr>
<tr>
<td>Operating costs</td>
<td>1 595 (24)</td>
<td>4 304 (15)</td>
<td>421 (15)</td>
<td>6 319 (12)</td>
</tr>
<tr>
<td>Depreciation</td>
<td>1 295 (26)</td>
<td>1 395 (22)</td>
<td>119 (17)</td>
<td>1 752 (17)</td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>321 (22)</td>
<td>1 457 (22)</td>
<td>106 (13)</td>
<td>1 884 (18)</td>
</tr>
<tr>
<td>Net return</td>
<td>–212 (58)</td>
<td>187 (275)</td>
<td>–255 (28)</td>
<td>–281 (189)</td>
</tr>
<tr>
<td>Capital value</td>
<td>4 588 (22)</td>
<td>20 820 (22)</td>
<td>1 512 (13)</td>
<td>26 921 (18)</td>
</tr>
</tbody>
</table>

*Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.*
accounted for the majority, at around $6.3 million or 63.5 per cent of total costs. The opportunity cost of capital accounted for about $1.9 million or 18.9 per cent of total costs, with depreciation accounting for the remainder at around $1.8 million. As a result, the estimated net return across the three states were estimated to be negative $280 900. Of the three states, only Queensland had an estimated positive net return, at $186 700, compared with New South Wales and Tasmania where net returns were estimated to be under negative $200 000 in each state.

While the estimated net returns here are relatively low, there are over 100 charter boats in the fishery. With this many boats and given the amount of money that some clients are willing to pay for a tuna and billfish trip, it is possible that the charter sector has the potential to generate significant net returns.

There may be several reasons why the estimated net returns are low. First, they do not include any possible lifestyle benefits. Lifestyle benefits are where owners derive satisfaction from fishing or taking people fishing. In this case they are willing to accept a lower level of profit to participate in the activity — especially where charter fishing is not the primary source of income. The net returns estimated would tend to underestimate actual net returns in this case.

Also, the estimated net returns for boats in the charter sector displayed some variation, particularly in Queensland. In this state there were a number of sampled boats that were making significant net returns. In general the primary business activity of these operators was charter fishing. There was another group of sampled boats whose primary business activity was something other than charter fishing. In general this group of boats made low or even negative net returns in 2001-02.

However, the price that people pay for charter services is likely to include, at least to some extent, the value of other factors apart from that associated with fishing (for example, spending a day on a luxurious boat). If this were the case then the net return estimates would be overestimates of the returns from fishing.

Other information about the charter sector

In conjunction with the economic survey of the charter sector, information was collected to form a profile of charter fishing in the eastern tuna and billfish fishery. This included information on the catch, percentage of catch released, number of fishing days, skipper experience, peak periods, origin of passengers and factors likely to have an impact on charter fishing operations in the next five years.

Charter fishing boats when targeting tuna and billfish were estimated to have caught an average per boat of 38 billfish, 112 tuna and 47 other fish in 2001-02 (table 8). Nearly all billfish were released, around 44 per cent of tuna released and 28 per cent of other fish released. Other fish caught on the game fishing trips included shark species and dolphin fish (mahi mahi). It does not include fish caught while reef or deepsea fishing.
The average charter boat across the three states was estimated to have spent about sixty days fishing for tuna and billfish in 2001-02, of which about seven days were spent in organised tournaments (table 9). Neither of these figures includes days fished while reef or deepsea fishing.

While tuna and billfish fishing can be carried out at all times of the year, there was a distinct peak period of five months in each state. The peak five months in Queensland occurs between August and December, when fishers primarily target large marlin. Fishers in New South Wales and Tasmania identified the peak five months to be between January and May and February and June respectively. The predominant species caught in New South Wales was marlin and yellowfin tuna, and southern bluefin tuna in Tasmania.

Charter operators were asked what proportion of their clientele was from overseas. Of the three states, Queensland was estimated to be the state that had a significant proportion of their clientele from overseas, with 76 per cent of operations having greater than 50 per cent of their clients from overseas. If these visitors came from overseas for the sole purpose of going tuna and billfish fishing off north Queensland and expenditure were to cease in response to a change in recreational fishing opportunities, it is likely that these tourists would go fishing elsewhere, such as in Hawaii. If this is the case then this change in recreational fishing opportunities may involve a significant cost to the Australian community. If on the other hand these tourists would come to Australia regardless of recreational fishing opportunities, it is possible that they would spend an equivalent amount of money on other recreational activities. Similarly for domestic fishers, if recreational fishing opportunities changed, then the majority of their expenditure would likely be switched to other recreational activities.

### Table 8
Number of billfish, tuna and other fish caught and released by the charter sector, 2001-02  
Average per boat

<table>
<thead>
<tr>
<th></th>
<th>Billfish catch</th>
<th>Billfish release</th>
<th>Tuna catch</th>
<th>Tuna release</th>
<th>Other catch</th>
<th>Other release</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>no.</td>
<td>no.</td>
<td>no.</td>
<td>no.</td>
<td>no.</td>
<td>no.</td>
</tr>
<tr>
<td>New South Wales</td>
<td>32.0 (22)</td>
<td>29.7 (24)</td>
<td>18.4 (26)</td>
<td>14.2 (32)</td>
<td>29.2 (38)</td>
<td>14.8 (43)</td>
</tr>
<tr>
<td>Queensland</td>
<td>58.1 (21)</td>
<td>57.9 (21)</td>
<td>52.5 (27)</td>
<td>28.1 (44)</td>
<td>78.6 (25)</td>
<td>14.1 (53)</td>
</tr>
<tr>
<td>Tasmania</td>
<td>0.7 (55)</td>
<td>0.6 (66)</td>
<td>566.9 (14)</td>
<td>218.4 (19)</td>
<td>8.3 (18)</td>
<td>1.1 (47)</td>
</tr>
<tr>
<td>Total</td>
<td>38.3 (16)</td>
<td>37.2 (16)</td>
<td>111.6 (12)</td>
<td>49.4 (16)</td>
<td>46.6 (21)</td>
<td>12.5 (33)</td>
</tr>
</tbody>
</table>

Note: Figures in parentheses are relative standard errors. A guide to interpreting these is included in appendix A.

### Table 9
Number of days fished and competition days in the charter sector, 2001-02  
Average per boat

<table>
<thead>
<tr>
<th></th>
<th>New South Wales</th>
<th>Queensland</th>
<th>Tasmania</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>days</td>
<td>days</td>
<td>days</td>
<td>days</td>
</tr>
<tr>
<td>Tuna and billfish</td>
<td>43 (21)</td>
<td>83 (15)</td>
<td>50 (18)</td>
<td>60 (11)</td>
</tr>
<tr>
<td>Competitions</td>
<td>5 (17)</td>
<td>9 (23)</td>
<td>4 (23)</td>
<td>7 (14)</td>
</tr>
</tbody>
</table>
Charter operators were asked about the impact that the following factors were expected to have on their business in the next five years:

- commercial fishing operations in the eastern tuna and billfish fishery, through catch/strike rate
- commercial fishing operations in other fisheries
- commercial fishing operations in the eastern tuna and billfish fishery, through congestion and overcrowding
- war
- terrorism
- exchange rate expectations
- change in management regime in the fishery
- competition from other charter operators.

They were asked to use the following scale to rate to what extent they thought that each of these factors were likely to impact on their business in the next five years:

1. Not at all
2. To a small extent
3. To a moderate extent
4. To a reasonable extent
5. To a large extent.

In New South Wales, charter operators identified commercial fishing operators in the eastern tuna and billfish fishery as likely to have a large impact on their businesses (figure B). However, the same charter boat operators were not as concerned about overcrowding and congestion between commercial and charter boats. This suggests that while these sectors target the same stocks and that catches in the commercial sector are likely to influence the catch and strike rate of the charter sector, the actual fishing grounds may not be the same. It may be the case that closing particular fishing grounds to commercial fishers for the exclusive use of charter and private recreational fishers would not have a significant impact on the charter and private recreational sectors. However, "gentlemen’s" agreements do currently exist between some commercial operators and charter operators in some specific locations whereby commercial operators have agreed not to set gear on or near known charter fishing locations. An example of this is between commercial longliners and charter boats off Bermagui during the striped marlin season (Bill Edwards, Queensland game fishing industry, personal communication, June 2004).

New South Wales charter operators also identified commercial fishing in fisheries other than the eastern tuna and billfish fishery as likely to have a significant impact on charter businesses. Operators were concerned primarily about activities in bait fisheries that influenced the stock of tuna and billfish available to be caught. There are also "gentlemen’s" agreements between commercial longliners and charter boats where commercial fishers
Impacts on charter fishing in New South Wales

Impacts on charter fishing in Queensland

Impacts on charter fishing in Tasmania
have agreed not to take baitfish in the few days prior to major recreational fishing tournaments (for example, the Port Stephens Tournament in February and March each year) (Bill Edwards, Queensland game fishing industry, personal communication, June 2004).

In addition, New South Wales based charter operators identified a change in management regime as likely to have a large impact on their charter boat businesses in the next five years. In particular they were concerned about more charter fishing licences being issued as well as the development and implementation of resource sharing between commercial and recreational fishing activities.

While some operators identified war, terrorism and exchange rate expectations as likely to have a large or moderate impact on their business, the majority (between 75 per cent and 85 per cent) believed that these will have no or only a small impact on their businesses. This is probably because the majority of charter fishing clients in New South Wales were domestic clients.

In Queensland, around 75 per cent of respondents said that a change in the management regime in the fishery is likely to have a large impact on their business in the next five years (figure C). In particular, many fishers were concerned about how marine protected areas would limit their access to common tuna and billfish fishing grounds and how management of the Great Barrier Reef in general might affect their business.

Exchange rate expectations, war and terrorism were expected to have a larger impact on charter fishing businesses in Queensland compared to New South Wales. This might be expected given that a significant proportion of operators’ clients were overseas visitors.

Commercial fishing operations in fisheries other than the eastern tuna and billfish fishery were thought likely to have a larger impact on charter boat businesses than commercial fishing operations in the eastern tuna and billfish fishery. Also, around 75 per cent of respondents said that overcrowding between the commercial and charter sectors were likely to have no impact at all on their businesses in the next five years. Like New South Wales, “gentlemen’s” agreements do exist between some commercial operators and charter operators in some specific locations whereby commercial operators have agreed not to fish in known charter fishing locations.

In Tasmania, there was considerable concern about the impact of a change in the management regime of the fishery (figure D). Specifically they were concerned about the allocation of southern bluefin tuna (the primary game species) between the recreational and commercial sectors.

In addition charter operators were concerned about the impact that commercial fishing in the eastern tuna and billfish fishery and other fisheries such as the bait fisheries would have on the stock available for the charter sector to target. Like New South Wales, charter operators said that overcrowding between commercial and charter boats was not likely to affect their businesses. This suggests that while the two sectors fish the same stock, they do not fish in the same locations.
Also similar to New South Wales, the majority of clients are domestic clients, so that exchange rate expectations, war and terrorism were indicated to have little if any impact on their businesses in the next five years.

**Private recreational sector**

For this study the private recreational sector of the eastern tuna and billfish fishery includes fishers who use a private (either owned or leased) boat to fish the Commonwealth waters for tuna and billfish species. The licensing and bag limits that apply to fishers on charter boats also apply to the private recreational sector. The primary species targeted are the same for the charter and commercial sectors, namely billfish, tuna, sharks and dolphinfish. It is assumed that all recreational fishing is undertaken for enjoyment purposes only, with no selling of landed catch. The majority of private game fishers are male 30–49 years of age (Pepperell 2002).

Valuation of goods and services is usually through the use of a market price for the good or service in question. However, sometimes goods or services do not have a market price. Recreational fishing falls into this category. With no market price available, a variety of nonmarket based methods can be used to impute a market value (see appendix B for a description of these methods). Benefit transfer of market values and economic cost data are used in this report to value the private recreational sector. This was chosen because of funding limitations and the availability of relevant data.

There are no studies available on the economic benefits and costs of private recreational game fishing in Australia. Studies such as Coopers and Lybrand Consultants (1996) and Driml (1994) analyse the willingness to pay and expenditure data on the regional area of interest (Cairns and the GBRWHA respectively), yet the population considered is all recreational fishers, not just game fishers. In 2000-01, Commonwealth and state agencies carried out the National Recreational Fishing Survey (Henry and Lyle 2003). This survey used diary entries to estimate the number of recreational fishers in each state. Data collected include catch levels, fishing mode and location, recreational vessel ownership, and expenditure data at a state level. Unfortunately only a small number of households reported tuna and billfish catch off the east coast of Australia. Consequently it is not possible to use catch and expenditure data from the National Recreational Fishing Survey in this analysis.

For this reason, an estimate of the economic benefit derived from private recreational game fishing was transferred from a study of the Hawaii small boat fishery (McConnell and Haab 2001). This study provided an estimate of the value of private recreational game fishing using a contingent valuation survey. The willingness of fishers to pay for a day of game fishing in the Hawaii small boat fishery was estimated at US$75 a day per fisher (in 2000-01 dollars).

In order to use this estimate in a calculation of the net benefit of the private recreational sector in the eastern tuna and billfish fishery it is important that the two recreational fisheries have similar characteristics. These characteristics include the population of fishers, the motivation for fishing, the catch rates of the two fisheries, and the type of fish caught.
The population of fishers and motivation for fishing is assumed to be similar for both fisheries. The population of both the eastern tuna and billfish fishery and the Hawaii survey excludes commercial and charter boat operators. Fishers in both fisheries are predominantly males aged between 35 and 64 years of age (McConnell and Haab 2001; Pepperell 2002). In both fisheries, eating the fish motivates many of the participants, but many fish for the enjoyment only and release their catch. Further demographic information such as the average income of the participants is unavailable for comparison. Target species of the two fisheries are similar, with tuna and billfish the primary species. Data on recreational catch rates for both fisheries are unavailable to compare.

While no studies on the economic costs of private recreational game fishing exist, there are studies that include private expenditure from fishing trips. Pepperell (1991, 1992, 2002) conducted regional expenditure studies on populations of recreational game fishers participating in tuna and billfish tournaments in different regions of the eastern tuna and billfish fishery. While these studies contain no data on the benefits derived by this population of fishers, cost data have been collected.

Data on the number of fishing events and recreational fishing vessels from the National Recreational Fishing Survey along with cost data from Pepperell (1994, 2002) can be used to estimate the total costs per day of private recreational game fishing in the eastern tuna and billfish fishery. These costs are similar to those in the other two sectors and include items such as fuel, bait, gear etc.

In a survey conducted by Pepperell (1994) it was estimated that around 230 000 private recreational game fishing days were taken in the eastern tuna and billfish fishery from the mainland states. This represented 54 per cent of private offshore events for Queensland, New South Wales and Victoria, as calculated in the National Recreational Fishing Survey. As fishing days in Tasmania were not included in Pepperell’s estimate, 54 per cent of the National Recreational Fishing Survey offshore events in Tasmania were added. The total number of private recreational game fishing days in the eastern tuna and billfish was therefore estimated at 235 000.

The costs per fishing day are shown in table 10. Data on fuel, bait, tackle and food costs are estimated from Pepperell (2002). The value of game fishing vessels was approximated from the National Recreational Fishing Survey. While not exact, it is assumed these costs are indicative of the costs of recreational game fishing off the east coast of Australia.

The total cost of fishing per day is estimated as:

\[ TCF_d = FC_d + RC_d + DC_d + OC_d \]

where \( TCF_d \) = total cost of fishing per day

\( FC_d \) = fishing costs per day (boat fuel + tackle + bait + food consumed on board vessel)

\( RC_d \) = repairs and maintenance costs per day
\[ DC_d = \text{depreciation cost of capital per day} \]

\[ OC_d = \text{opportunity cost of capital per day.} \]

Net returns per day to the private recreational game fishing sector are:

\[ NR_d = TBF_d - TCF_d \]

where \( NR_d = \text{net return} \)

\[ TBF_d = \text{total benefit from fishing.} \]

These valuations are estimated by the same method used for the commercial and charter sectors of this study.

The willingness to pay estimate from the Hawaii small boat fishery is converted to 2003-04 Australian dollars, and is equal to $151 a day per fisher. Subtracting the appropriate costs from the willingness to pay value gives a rough estimate of the average net returns per person per day to private recreational game fishing in the eastern tuna and billfish fishery of $25.32 in New South Wales, $19.33 in Queensland and $20.22 in Tasmania (table 10). Multiplying the net return per person per day by the number of fishing days estimates a total net return of $4.9 million for the fishery.

While this estimate relies on data from an overseas fishery and cost data from only a limited number of recreation fishers, it is still likely to provide an indication of the importance of the private recreational sector. It shows that the private recreational sector is likely to be

**Fishing days, capital value, cost of fishing per day, by state**

<table>
<thead>
<tr>
<th>Fishing days</th>
<th>New South Wales</th>
<th>Queensland</th>
<th>Tasmania</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>no.</td>
<td>59 582</td>
<td>170 418</td>
<td>5 367</td>
<td></td>
</tr>
<tr>
<td>Boat value</td>
<td>$'000</td>
<td>2 639</td>
<td>13 648</td>
<td>467</td>
</tr>
<tr>
<td>Fishing costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– boat fuel</td>
<td>$/day</td>
<td>93.34</td>
<td>93.34</td>
<td>93.34</td>
</tr>
<tr>
<td>– tackle</td>
<td>$/day</td>
<td>6.48</td>
<td>6.48</td>
<td>6.48</td>
</tr>
<tr>
<td>– bait</td>
<td>$/day</td>
<td>3.87</td>
<td>3.87</td>
<td>3.87</td>
</tr>
<tr>
<td>– food</td>
<td>$/day</td>
<td>15.19</td>
<td>15.19</td>
<td>15.19</td>
</tr>
<tr>
<td>– total</td>
<td>$/day</td>
<td>118.88</td>
<td>118.88</td>
<td>118.88</td>
</tr>
<tr>
<td>Other costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>– repairs and maintenance</td>
<td>$/day</td>
<td>2.70</td>
<td>5.25</td>
<td>4.32</td>
</tr>
<tr>
<td>– depreciation of capital</td>
<td>$/day</td>
<td>1.04</td>
<td>1.97</td>
<td>1.53</td>
</tr>
<tr>
<td>– opportunity cost of capital</td>
<td>$/day</td>
<td>3.10</td>
<td>5.61</td>
<td>6.09</td>
</tr>
<tr>
<td>Estimated benefit</td>
<td>$/day</td>
<td>151</td>
<td>151</td>
<td>151</td>
</tr>
<tr>
<td>Net return</td>
<td>$/day</td>
<td>25.32</td>
<td>19.33</td>
<td>20.22</td>
</tr>
<tr>
<td>Total net return</td>
<td>$'000</td>
<td>1 509</td>
<td>3 294</td>
<td>108</td>
</tr>
</tbody>
</table>
significant and has the potential to generate substantial net benefits from the fishery. In addition, this estimate may also be used as a guide to value changes made to the sector, such as the loss to society from prohibiting private recreational fishing in the eastern tuna and billfish fishery. This loss would need to be set against any gains made in other sectors that resulted from this change.

**Sensitivity analysis**

Assumptions about the number of days fished and the costs and benefits of recreational fishing affect the estimate of total net returns from recreational fishing significantly. While the best data available have been used in constructing the total net return estimate, it is useful to examine the impact of alternative assumptions. Changes in the number of recreational fishing days will have the same proportional impact on the net return estimate — a 10 per cent fall (rise) in days fished will result in a 10 per cent fall (rise) in the net returns estimate. Changes in the estimates of daily costs and benefits will result in more than proportional changes in the net returns estimate. A 10 per cent decrease (rise) in the costs of fishing (including repairs and maintenance, depreciation and the opportunity cost of capital) results in a 68 per cent rise (fall) in the total net returns estimate. A 10 per cent decrease (rise) in the benefits from recreational fishing results in a 78 per cent fall (rise) in the total net return estimate.
economic efficiency and resource sharing in the eastern tuna and billfish fishery

Commonwealth objectives

For Commonwealth fisheries, the Australian Government holds title to the resource on behalf of the Australian community. In setting up the arrangements under which Commonwealth fisheries are currently managed it was recognised that the government has a role to play in preventing market failures that occur in the unmanaged exploitation of common property resources and maximising the net value of the resource to the Australian community (Commonwealth of Australia 1989).

As the Commonwealth’s managing body, the Australian Fisheries Management Authority (AFMA) has its role outlined by legislated objectives in the *Fisheries Management Act 1991* and *Fisheries Administration Act 1991*. These objectives include:

- providing efficient and cost effective fisheries management;
- maximising economic efficiency of fisheries resources;
- accountability to the fishing industry and the broader community;
- achievement of government cost recovery targets; and
- ensuring that the exploitation of fisheries resources and the carrying on of related activities are conducted in a manner consistent with the principles of ecological sustainable development (AFMA 2003).

Maximising economic efficiency

The economic issues associated with fishery management are well documented. A simplified Gordon–Shaefer analysis is used to illustrate the fundamental economic concepts associated with fisheries management (see Cunningham, Dunn and Whitmarsh 1985 for an overview of this type of analysis).

A diagrammatic representation of the total operating costs and total revenue from a fishery is shown in figure E. Fishing costs are assumed to be a linear function of fishing effort and include operating costs associated with fishing, an allowance for depreciation and normal returns to capital.
The total revenue curve is derived from a yield curve (relating the catch quantity to fishing effort). Initially as effort increases, total catch and revenue increase. There will be a point (E₂ in figure E) where additional effort will not increase catch or revenue any further. This is the point of biological maximum sustainable yield (MSY). Beyond this point, additional effort leads to a reduction in catch and revenue.

Where there is open access to a fishery, fishing effort will expand until the point E₀ in figure E is reached. At this point there are no economic returns gained from the fishery.

Point E₃ represents the optimal level of fishing effort for the fishery. At this point the difference between total revenue and total costs is at its greatest. It is clear that this level of effort is less than that associated with open access (E₀) and MSY (E₂) equilibriums. AFMA's economic efficiency objective provides fishery managers with the goal of implementing management arrangements that limit harvests and fishing effort to levels consistent with maximising net returns (E₃ in figure E). If harvests are restricted to levels consistent with maximum economic yield it is clear that the management regime would also ensure sustainability of target stocks.

It is important to note that fisheries can be managed in an ecologically sustainable manner yet produce no net economic benefits. Management regimes, through controlling the total level of harvest (by whatever means) and contributing to the incentive structure within which fishers operate, will determine whether the net value of the fish resources to the community is maximised — that is, whether the fishery is economically efficient.

The analysis above only considers the commercial fishing sector. However, in the eastern tuna and billfish fishery there are competing noncommercial sectors that also derive benefits from the fishery resource. To maximise the net value from the entire fishery resource it follows that the total net benefit derived from the combined use of the commercial and noncommercial sectors should be maximised.

**Resource sharing**

The sustainable and efficient management of a fishery requires that all significant fishing be incorporated into an effective management strategy (Chapman, Blias and Gooday 2001). Currently the management of the recreational sector is carried out by state authorities, but not formally incorporated with management of commercial fishing sectors. However, recreational catches are substantial in a number of Commonwealth fisheries (Pepperell 2001). In particular, the Commonwealth managed tuna fisheries have been identified by fisheries managers as lacking sound analysis of the impact of recreational fishing (AFMA 2000).
Management of a fishery where different sectors target the same stock can be seen as a two stage process (Schuele, Rose and Treadwell 1997). First, a total catch level has to be set that ensures the long term sustainability of the fishery resources and, second, that catch has to be allocated between competing users.

Before allocating resources between sectors, it is important to ensure that the current level of catch/effort in the fishery is not too high. In fisheries where there is no effective cap on the level of effort, it is likely that the level of effort is too high. This situation should be addressed before there is any allocation of resources between sectors. If not addressed, any potential benefits from an improved allocation are likely to be eroded by increased effort.

The economically optimal allocation of catch between competing users in a fishery is one that maximises the net value to society of the catch. In general the fish stock should be reallocated from the sector with the lower net marginal fish values to the sector with the higher net marginal values until the net marginal values are equal across both sectors (Blamey 2002; Holland 2002). It may be the case that the efficient allocation of catch between sectors is one where the fishery becomes exclusively a recreational or a commercial fishery. For example, where the net marginal benefits of fish allocated to the commercial sector are higher than the net marginal benefits of fish allocated to the recreational sector at all catch levels, then the ideal allocation of catch will exclude any allotment to recreational fishers. Similarly, where the net marginal benefits of fish allocated to the recreational sector exceed the net marginal benefits of fish allocated to the commercial sector at all catch levels, the resources are best managed solely as a recreational fishery.

Determining this optimal allocation is made difficult for fishery managers because, unlike the value of commercial or charter fishing sectors whose output is sold in markets, the economic value of the private recreational sector is often not revealed through markets.

In addition, as commercial fishing operations involve capturing fish for sale, such operations involve removing part of the fish stock from the fishery. While recreational fishing also involves capturing fish, ‘catch and release’ is increasing in popularity, so not all fish caught by the recreational sectors are removed from the fishery. Catch and release activities rely on fish being available for capture, but they do not generally involve significant reduction of the fish stock if mortality of released fish is low. This makes the allocation decision more complex. Estimates of the proportion of fish released as well as the mortality rate of released fish need to be considered in any allocation of fish between the recreational and commercial sectors.

Also, it is important that valuations are calculated in the same way when comparing valuations between sectors. For example, the total or marginal value of commercial fishing cannot be compared with the gross value of expenditure from the recreational sectors.

The decision to incorporate a recreational sector into the management of a commercial fishery is justified only when the benefits to society from integrated management exceed the costs associated with achieving it. The benefits from incorporating the recreational sector into commercial fisheries management are only likely to exceed the costs when both sectors have an impact on the same stock and the catch in either sector is significant enough to have an impact on the other sector’s catch.
Data requirements for allocations

Collecting data on the net marginal value of fish to competing sectors is only required when market based solutions are not feasible. A market based solution is where a market for the fisheries resource is created in the form of individual transferable quotas. If quota can be traded between sectors, there is no need to conduct valuations, as quota will be bought by those that value it the most. Operators would only retain quota if it yielded them benefits in excess of its market value.

In cases where market solutions are not feasible — for example, if it is too expensive to monitor and enforce the recreational sectors catches — collecting information on the net marginal benefits of fish to each sector may help in the allocation decision. Calculating the net marginal value of each fish to each sector is difficult, as information is required on the marginal benefit of each fish and the marginal catching costs of each fish for all sectors (table 11).

Collecting information such as that outlined in table 11 for the eastern tuna and billfish fishery would enable the calculation of the marginal net benefits of each fish to each sector across all catch allocations. These marginal net benefits can be plotted in a simplified graph (the two curved lines in figure F). Point $A^*$ in figure F is the optimal allocation between sectors. At this point, the marginal net benefits of the last fish to each sector are equal and the entire resource has been allocated between the two sectors.

ABARE survey data could be used to estimate the marginal net benefits of allocated fish to the commercial sector. However, for the charter and private recreational sectors collecting the data in table 11 would be difficult and very costly. Collecting such information would only be justified if the costs of collection were less than the benefits that would result from its use.

Data requirements for optimal allocation

<table>
<thead>
<tr>
<th>Data on benefits</th>
<th>Data on costs</th>
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<tbody>
<tr>
<td>Commercial sector</td>
<td>Price of fish in the market</td>
</tr>
<tr>
<td>Charter sector</td>
<td>Charter fees</td>
</tr>
<tr>
<td>Private recreational sector</td>
<td>Nonmarket valuation of willingness to pay for each fish or fishing trip a</td>
</tr>
</tbody>
</table>

A A discussion of the various nonmarket valuation techniques is given in appendix A.
Even if an optimal allocation could be identified, the benefits from such an allocation would only be captured if fishery managers have adequate control over the total catch/effort in all sectors. If they do not, then any benefits would likely be dissipated through increased effort. If the large degree of latent effort that currently exists in the commercial sector of the eastern tuna and billfish fishery is not addressed, any benefits from collecting information to determine the optimal allocation to each sector would be quickly eroded. This, combined with the large expected costs in collecting the necessary information, makes it is unlikely that collecting the information would be justified. Until a management regime that effectively controls effort in the commercial sector is implemented, it is unlikely that significant expenditure to determine an optimal allocation could be justified.

Consequently, less expensive qualitative assessments such as those presented in this report may be useful in making comparisons between sectors. Information on the current total net benefits of the charter and private recreational sectors have been calculated relatively easily and were much less expensive to collect than the data described in table 11. This information, along with other qualitative information such as the size of each sector and the major factors affecting net benefits, provide fishery managers and policy makers with data to help determine resource sharing arrangements between competing sectors in this fishery.
survey methods and definitions

Collecting survey data

Commercial sector
ABARE commercial fishery surveys are designed and samples selected on the basis of information supplied by the Australian Fisheries Management Authority (AFMA). This information includes data on the size of the catch, fishing effort and boat characteristics.

Because it is not possible to survey all the boats in a fishery, a sample of boats is selected based on their ‘representativeness’. Where possible, boats are classified into subgroups based either on the fishing method used (longline boats, purse seine boats, trawlers and so on) or on the size of operations (typically small, medium and large producers). A number of representative boats from each subgroup is then targeted for the survey.

The owners of the sample boats are contacted by ABARE and face to face interviews are conducted. Interviewers ask for information on the physical and financial details of the fishing business. In a number of instances, the skipper of the boat may also be interviewed. In general, information is collected for the preceding two financial years. Major Commonwealth fisheries are surveyed every two years.

Charter sector
Less information was available for the charter fishing sector. Complete and up to date name and address lists were difficult to find. However, based on the information available a population of charter boats was defined. The information collected in the face to face and phone interviews was similar to that in the commercial fishing surveys.

Net returns
The net return to the fishery is defined as:

\[ \sum_{i=1}^{n} R_i - \sum_{i=1}^{n} p_i[OC_i + (d_i + r)K_i] - M \]

where

- \( R_i \) = total cash receipts attributable to the fishery, excluding any receipts from leasing or sales of licences or quota for boat \( i \);
\[ p_i = \text{proportion of total fishing receipts attributable to the fishery for boat } i; \]

\[ OC_i = \text{total cash costs less interest paid on debt less expenditure on leasing or purchase of licences or quota for boat } i; \]

\[ K_i = \text{value of capital associated with boat } i \text{ (depreciated replacement value);} \]

\[ d_i = \text{depreciation rate for boat } i \text{ (depreciation less capital appreciation associated with boat } i \text{ divided by } K_i); \]

\[ r = \text{real interest rate (assumed at 7 per cent for calculations in this report);} \]

\[ M = \text{costs of managing the fishery;} \]

\[ n = \text{number of boats operating in the fishery.} \]

**Sample weighting**

**Commercial sector**

The estimates presented in this report are calculated by appropriately weighting the data collected from each sample boat and then using these weighted data to calculate estimates for the population. Sample weights are calculated such that the weights summed represent the target population, and the sum of the weighted catch of the sample equals the logbook totals supplied by AFMA. Technical details of the method of weighting used are given in Bardsley and Chambers (1984).

**Charter sector**

Sample weights were also calculated for the charter survey but as benchmark variables such as catch were not available, a simpler method of weight calculation was employed. Weights were calculated using a factor, where the factor was simply the number in the population in each state divided by the number of sampled boats in that state. For more details of this method see Cochran (1977).

**Reliability of estimates**

Only a portion of the estimated population was sampled. Estimates derived from these boats are likely to be different from those that would have been obtained if information had been collected from a census of all boats. How closely the survey results represent the population is influenced by the number of boats in the sample, the variability of boats in the population and most importantly the design of the survey and the estimation procedures used.

To give a guide to the reliability of the survey estimates, measures of sampling variation have been calculated. These measures, expressed as percentages of the survey estimates and termed ‘relative standard errors’, are given next to each estimate in parentheses. In general, the smaller the relative standard error, the more reliable the estimate.
Use of relative standard errors

These relative standard errors can be used to calculate ‘confidence intervals’ for the survey estimate. First, calculate the standard error by multiplying the relative standard error by the survey estimate and dividing by 100. For example, if average total cash receipts are estimated to be $100 000 with a relative standard error of 6 per cent, the standard error for this estimate is $6000.

There is roughly a two in three chance that the ‘census value’ (the value that would have been obtained if all boats in the target population had been surveyed) is within one standard error of the survey estimate. There is roughly a nineteen in twenty chance that the census value is within two standard errors of the survey estimates. Thus, in this example, there is approximately a two in three chance that the census value is between $94 000 and $106 000, and approximately a nineteen in twenty chance that the census value is between $88 000 and $112 000.

Nonsampling errors

The values obtained in a survey are affected by errors other than those related directly to the sampling procedure. For example, it may not be possible to obtain information from certain types of boats, respondents may provide inaccurate information or respondents may differ from nonrespondents in a variable being surveyed.

ABARE’s experience in conducting surveys has resulted in procedures aimed at minimising nonsampling errors. However, when drawing inferences from estimates derived from sample surveys, users should bear in mind that both sampling and nonsampling errors can occur.
Valuation of goods and services is dependent on the use of a market price for the good or service in question. However, sometimes goods or services, such as recreational fishing, do not have a market price. With no market price available there is a variety of nonmarket based methods available to determine their value.

Nonmarket based tools are divided into two groups — those that use revealed preferences and prices, and those that elicit preferences. The travel cost, hedonic travel cost and random utility methods fall into the former, and the contingent valuation, conjoint and discrete choice methods into the latter.

**Revealed preference valuation methods**

Revealed preference methods use data from events to construct values. The use of revealed rather than stated preferences is believed by many to be more accurate and will limit many of the biases associated with elicited values such as strategic, starting point and information biases. Each of the methods is discussed below in more detail.

**Travel cost method**

The travel cost method uses revealed travel costs to determine the value that users place on recreational activities or sites. This method can be useful for evaluating the demand for recreational fishing in some instances. However, the likely violation of the founding assumptions and the method’s inability to capture the total value that an individual places on an activity may render it less useful for valuing private recreational game fishing in the eastern tuna and billfish fishery.

The travel cost method is based on the theory that the amount of recreational fishing consumed is dependent on the cost of travel to undertake the activity. This assumes that the cost of traveling to a site is an important component of the full cost of a visit and that for any given site, the cost will vary across any sample of visitors (Freeman 1993). An extensive list of studies using the method can also be found in Smith and Kaoru (1990). For a more comprehensive description of the methodology see Ward and Loomis (1986) and Freeman (1993).

Limitations of the travel cost model include large variations in demand estimates based on the statistical specification of the model (Huppert 1989), influences of congestion (see Krutilla and Fisher 1975), the differences between individuals cost perceptions and actual
costs (Randall 1994; Common, Bull and Stoeckl 1997), and the question of the division of costs between multiple car occupants (Common, Bull and Stoeckl 1997).

**Hedonic travel cost modeling**

Hedonic pricing methods were originally used in the valuation of environmental goods based on property prices. Brown and Mendelsohn (1984) extended the framework for use as a tool for valuation of recreational sites; however, few studies have been carried out since. This method may be considered useful in the valuation of marginal changes to a site; however, the inability of this methodology to determine the total value that a user places on a site limits its use for valuing private recreational game fishing in the eastern tuna and billfish fishery.

Like the travel cost method, the cost of travel to each site is used as a proxy market. The utility gained by each consumer is assumed to be dependent on the characteristics of the recreational sites. Various approaches have been used to measure the characteristics, including average values across people and trips (Brown and Mendelsohn 1984; Englin and Medelsohn 1991), treating each individual’s visit to a site as a separate observation (Bocksteal, Hanemann and Kling 1985), or aggregating the characteristics across trips to all sites (Smith and Kaoru 1987).

The method is most useful in valuing the effect of small policy changes on a recreational site. As Mendelsohn (1985) notes, as long as the change makes no perceptible impact on the price gradient, the hedonic price function is a valuable tool. Benefits also include the valuation of the attributes of the site, rather than the site as a whole (Brown and Mendelsohn 1984).

Limitations of the method include the opportunity cost of time and associated limitations of the travel cost method (including multiple destination and multiple purpose trips), equation specification, the assumption that willingness to pay equals the travel cost and the tradeoff between omitted variable bias and coefficient significance.

**Random utility modeling**

In answer to many of the limitations of the travel cost method, such as the lack of consideration of alternatives, the random utility model has gained increasing popularity in the literature. The main limitation precluding the use of this model for our purposes is its data intensive nature.

By taking into account alternative options, the random utility model estimates the probability of a representative consumer visiting a chosen site and the expected value derived from that site based on its attributes. The alternatives make up a choice ‘set’ and sites are defined by a set of attributes. Choice of a site is based on the probability of it returning a greater level of utility, and therefore the choice is assumed to reveal preferences for those characteristics (Hanemann 1984). For recreational fishing studies, attributes usually include such things as species availability, catch rates, water quality and trip costs. For the original
formulation of the method, see McFadden (1978), and Bockstael, Strand and Haneman (1987) for an early application to recreational fishing.

The major limitation of a random utility model for valuing recreational fishing is its inability to directly estimate the demand of consumers for the activity, based only on single trip analysis and assuming individuals’ choices are independent across trip occasions (Adamowicz 1994; van Bueren 1998; Parsons 2001).

The method, while currently the most favored method for choice analysis, is still surrounded by debate on correct choice set size, functional forms, and the number of models to be used. Direct estimation of demand is also lacking. The method has proved useful, however, both in itself and as an extension to the more traditional methods such as the travel cost method as well as the more recently explored stated preference methods (Parsons 2001). However, the inclusion of a random utility model in other methodologies often does not eliminate the limitations of the original model and will also include its own limitations (Parsons 2001).

**Elicited preference valuation methods**

These methods are based on the perceived behavior of the respondents and are typically used when there is no available market in which to trade the good or service in question.

**Contingent valuation model**

Contingent valuation models use survey information to elicit preferences from individual respondents on their willingness to pay for public goods or services.

The method is based on three steps. First is the description of the good in question, such as recreational fishing, and a description of the payment vehicle. Second is the willingness to pay questions. Third, information is gathered on characteristics of the respondents that is used to model the estimates of willingness to pay (Mitchell and Carson 1989). For a more complete overview of the methodology, see Freeman (1993), Mitchell and Carson (1989) and Mitchell (2002).

The way in which a question is framed will have an effect on the willingness to pay response. Point bids can lead to estimates that are higher or lower than the true value (commonly known as starting point bias). Open ended questions or payment card methods seem least likely to give reasonable and consistent answers (Cameron et al. 2002). Wheeler and Damania (2001) found the use of a nominated single bid with a binary ‘take it or leave it’ (referendum) choice for the willingness to pay for a fishing trip to be most consistent.

Other biases that can result from the use of contingent valuation surveys include strategic bias and information bias. Strategic bias will arise if respondents believe that their response will have an effect on the outcome of the survey. It is assumed that strategic bias is more likely when valuing public goods, because of their nature and respondents’ perceptions of the probability of having to pay for them (Wheeler and Damania 2001). To deal with this likely problem, Kealy and Turner (1993) use the discrete elicitation format.
Thus the contingent valuation method has substantial benefits in its use by eliciting values for goods not otherwise observable. The use of the methodology is largely reliant on the nature of the good being valued and a comprehensive and well designed survey and a relatively high knowledge from the respondents of the good or service being valued. Although many biases can be obtained with these methods, many of these if not solvable, can at least be tested for.

Conjoint analysis and discrete choice modeling
Conjoint analysis and discrete choice modeling (at times these names refer to the same thing) are an extended version of the contingent valuation and random utility models. Like contingent valuation method surveys the undertaking of conjoint analysis requires substantial funding that is currently unavailable for this project.

Conjoint analysis surveys require the respondents to make choices between different scenarios presented. The respondent either ranks, rates or chooses the most preferred option (Hanley, Maurato and Wright 2001). It is the attributes of the scenario that provide the valuation of the good or service.

The valuing of individual attributes is a strength of conjoint analysis as the respondent’s expressed utility from a good or service can be disaggregated into the utility gained from the relevant attributes. Ranking of attributes also means that less information is required to be known by the respondents.

Limitations of the model derive from the complexity of choices made available to the respondents. The information burden is thought to lead to errors (Mackenzie 1992, 1993; Hanley, Wright and Koop 2000). Consistency of preferences can be checked for and inconsistent responses removed (Foster and Mourato 2002). Misspecification of the utility model is also a limitation of this methodology as the misspecification will flow through and be compounded in the rest of the model (Schuele, Rose and Treadwell 1997).

Conjoint analysis can be useful in valuing the relevant attributes associated with recreational fishing activities. Focus groups can be used to identify the relevant attributes, and surveys undertaken to indicate consumer preferences.

Other valuation methods
Other nonmarket valuation methods include the production function method, the replacement cost technique and the benefit transfer method. The production function is where demand for a site has to do with the demand for that site in the household production function. See Freeman (1993) for further details of the former two methods. A synopsis of the benefit transfer method is given below.

Benefit transfer method
Benefit transfer is the process of transferring existing nonmarket estimates from a study site to a new site. As this study has available survey data collected from the target site, as well
as data collected from a similar overseas site, the benefit transfer methodology was chosen for use in this study.

Using benefit transfer avoids the costs associated with the collection of primary data required for a nonmarket estimate. However there exists a tradeoff between the increased potential error and variability of benefit transfer against the reduction in time and money constraints. A benefit transfer will only be as accurate as the original benefit estimates (Brookshire and Neill 1992). For an overview see Desvouges, Naughton and Parsons (1992) and Brookshire and Neill (1992).

In general, benefit transfer requires a high degree of statistical similarity between the study and policy sites in both the characteristics of the population and the nonmarket commodity being valued. Potential bias can be introduced if the study and policy site do not have identical characteristics (Brouwer 2000).

The benefit transfer technique has been heavily criticised over several limitations. The first of which is the unlikelihood of finding similar study and policy sites. Related to this is the potential source of error in benefit transfer based on the reliance on the accuracy of the primary research. This is particularly relevant when the primary research was not specifically conducted for the purposes of benefit transfer (Bouwer 2000).

In view of the criticisms surrounding the benefit transfer technique its use should be confined to well defined conditions that specify the compatibility of study and policy sites. This compatibility and hence the reliability of the nonmarket value estimated for the policy site, is also dependent on the method of benefit transfer chosen.


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