Valuing recreational fishing
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ABARE report prepared for the Fisheries and Aquaculture Branch, Department of Primary Industries and Energy

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Summary

Recreational fishing is a significant and expanding activity in many fisheries. Recreational fishing pursuits produce evident benefits, but they may do so at the expense of commercial fisheries or some environmental values. Fisheries managers are faced with the task of allocating stocks of target fish between competing users. At the same time they must consider a range of noncatch values from conserving nontarget species and habitats, and from indirect uses and activities such as diving. While the output of commercial fisheries is sold in markets, there are few markets in which the value of recreational fishing is revealed. Market information is available for some segments of recreational fishing, such as charter boats and entry fees to some fisheries. However, such information on recreational fishing is usually limited. Generally, even less information is available on the value of various aspects of marine resource conservation.

Sustainable fisheries management is likely to involve strategies to maximise the net benefits from fish catch within a set of constraints. These constraints are designed to maintain the viability of target fish stocks and conserve other aspects of marine biology. In other words, conservation constraints exist as part of the normal framework of fisheries management. There is generally no need to seek information on the values protected by such constraints. Given the conservation constraints, management choices may be viewed as a two stage decision process — setting a total allowable catch and allocating the catch to competing users.

In fisheries where it is feasible to assign and enforce property rights to shares in the fish catch, an efficient allocation of the resource between uses and users can be provided by a market in those rights. In such cases there will be no need for managers to seek further information about the relative values of uses. In many fisheries such a simple solution is not likely to be achievable. Markets play a limited role in recreational fishing. However, it may be possible for managers to influence the level of catch and its allocation between sectors by imposing controls on commercial catch and by using such devices as regulation of recreational catch methods and seasons. In such cases, information about the value of recreational fishing may assist in making efficient management decisions.

In some fisheries, management choices may be further complicated by the existence of noncatch based recreational activities such as diving and
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snorkelling. The impact of the level of fish catch, and possibly the catch techniques used, on noncatch activities may then need to be considered in setting the allowable catch.

There are a number of nonmarket valuation techniques which could be used to value recreational fishing. These include travel cost, contingent valuation and choice modelling. In addition to these the benefit transfer method can be employed to estimate a value from other studies, if suitable ones are available. The latter method probably provides the lowest cost estimate of valuing recreational fishing but generally is not regarded as being as reliable as applying a nonmarket valuation technique.

Acquiring information is a costly exercise and so the cost of obtaining it should be weighed against the benefit of having that information — that is, against the chance of a better decision being made. The reliability of information improves with the rigour applied to (and hence cost of) collecting it. The same is true of nonmarket valuation where more reliable estimates can be achieved with the more expensive survey techniques (such as travel cost and contingent valuation methods) and with the degree of rigour with which the techniques are applied.

In addition to the question of cost, the choice of technique to employ to estimate a value of recreational fishing is influenced by the nature of the resource, its use and the magnitude of change being envisaged. For instance, as the travel cost method is based on surveying current recreational anglers this technique is limited to allocation decisions involving fish which are currently subject to recreational fishing. In other cases, to acquire information on the potential value of future recreational fishing a hypothetical method such as contingent valuation may be preferable.

The travel cost and contingent valuation methods have been the most commonly used techniques to estimate the value of recreational fishing. However, there are several difficulties involved in applying the techniques successfully, and the reliability of the estimates obtained has been questioned. While the travel cost method has the advantage of being based on associated market values the application of the technique hinges on critical assumptions. The degree of rigour with which the contingent valuation method is applied can strongly influence the estimated value, with several potential sources of bias needing careful treatment. This technique is most suited to well defined situations where the respondents already have some knowledge of the good to be valued.
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Several innovative techniques which use a combination of travel cost and contingent valuation methods have been recently developed. The hypothetical travel cost technique may give an indication of value under several different management strategies, which is not feasible with other techniques. Choice modelling is a relatively new development in nonmarket valuation and has the potential to overcome some of the biases evident in past contingent valuation studies. However, as this technique is relatively new it has been used in few applications.

While nonmarket valuation techniques may not yield accurate estimates of the value of recreational fishing they give an indication of the order of magnitude. This information can aid decisions about the allocation of the fish stock between commercial and recreational uses.

Lack of knowledge about other aspects of a fishery may limit the usefulness of nonmarket value estimates. In some fisheries little is known about fish populations and fish biology. That makes it difficult to set catch limits with any confidence that those limits will achieve conservation or economic objectives. Value estimates for either recreational or commercial fishing will be of little use in such fisheries.
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1. Introduction

Recreational fishing is one of Australia's most popular outdoor activities and provides the basis for a range of economic activity. Improvements in technology and increasing population mean that the level of resource use and potential conflicts between recreational and commercial users of the fish resource are likely to increase.

Growing pressure on fish stocks from recreational fishing means that managing the impacts of commercial fishing alone may not be sufficient to prevent fish stocks from becoming overexploited. Where both recreational and commercial sectors target the same fish stock, the use of the resource by both sectors needs to be considered in the management of the fishery. Media coverage of resource conflicts, such as those in the Zone E tuna and billfish fishery in the north of Australia and Port Phillip Bay in the south, has added to the tension between the commercial and recreational sectors. Good information about the values of different components of the catch will allow policy makers to make informed and defensible decisions about allocating the resource between the two sectors.

In some cases, it may be possible to use markets alone to maximise the social value of marine resources. If property rights could be well defined and enforced effectively across all users then it would be possible to set a total quota, assign shares of that quota to individuals or organisations, and allow a market for quota to develop for both commercial and recreational uses. However, markets are unlikely to provide a full resolution of competition for catch in all fisheries. As well, commercial and recreational fishers may impinge on other values derived from marine resources. So further information about the value of the catch to the different sectors and the impact of those sectors on other values may need to be sought to provide a basis for efficient management choices.

Commercial fishing has well defined markets from which prices may be easily observed. Consequently it is not difficult to identify the direct benefits associated with commercial fishing. A large part of recreational fishing is not carried out through markets; however, there are markets for some recreational fishing, such as the charter boat industry, for which prices can be observed. Market substitutes may also be useful in helping to estimate a value. If further information is required, as may often be the case, nonmarket valuation has the potential to estimate a value for an activity such as recreational fishing.
2. Values and activities

The relationships between recreational fishing, commercial fishing and other activities which may be of economic value in a fishery are illustrated in figure A. In the diagram, potential economic values are categorised as direct use, indirect use and nonuse values. Direct use values are those derived from some activity within the fishery, mostly fishing but including diving and other viewing activities. Indirect use values are those derived from the use of the fish stock, or some other aspect of the fishery, by activities offsite. A fishery's capacity to absorb nutrient waste from shore based industries may produce an indirect use value. Nonuse values are values arising from knowledge that the fish stock is conserved and are realised offsite. A further important distinction is that between direct use values that are catch dependent and those that are not.

Recreational and commercial fishing provide use values. Realising most values from commercial and recreational fishing relies on the capture of fish. Since commercial fishing involves capturing fish for sale, it involves removing part of the fish stock from the fishery. Most recreational fishing also involves

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**A Factors affecting the economic value of the fish biomass**

<table>
<thead>
<tr>
<th>Recreational fishing</th>
<th>Other recreational use (nonextractive)</th>
<th>Commercial fishing</th>
<th>Marine ecology</th>
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<tr>
<td></td>
<td>Direct use</td>
<td>Indirect use</td>
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<td>Economic value of fish biomass</td>
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<td></td>
<td>Nonuse</td>
<td>Fish survival</td>
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<td></td>
<td>Existence</td>
<td>Option</td>
<td>Bequest</td>
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capturing fish and removing them from the fishery. Exceptions are the emerging 'catch and release' activities for some game and sport fish. Catch and release activities rely on fish being available for capture, but they do not generally involve significant reduction of the fish stock. Any removal of fish from the stock is largely the result of incidental kills.

Another set of use values is derived from a variety of scuba diving, snorkelling and other viewing activities. The values derived from these activities may depend on a number of factors including the number and diversity of fish seen and the overall quality of the underwater environment. Catching activities in the fishery could potentially reduce the value of diving and viewing experiences either by reducing the fish stock or by damaging nontarget animal or plant species (for example, damage to coral by anchors on the Great Barrier Reef).

Indirect use values of the fish resource arise from the function that the resource can play in providing or protecting other economic values. A species of fish may have an indirect value from its role in a marine ecosystem. For example, baitfish such as pilchards are relied on for food by predatory species.

A range of nonuse values may be derived from a fishery, all of them dependent on conservation of the fish stock or some other aspect of the fishery. The degree to which people derive nonuse values from fishery conservation is unclear. However, potential nonuse values include:

- existence values that individuals derive from knowing that the fish resource exists;
- bequest values that individuals place on providing future generations with access to the fish resource; and
- option values that individuals place on knowing the fish resource will be available to them for possible future use.

Marine environments involve complex interactions between a diversity of plant and animal species and some nonuse values may depend on the conservation of these broader aspects of a fishery.
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3. Management choices

Choosing the best management strategy for a fishery will be influenced by the extent to which property rights to access and catch can be developed and enforced. The choices are: regulating to facilitate the development of a market in access and use rights, prescriptive regulation, or some combination of the two. The greater the prospect for establishing and enforcing property rights, the less should be the need to rely on nonmarket value estimates. There may be a greater demand for nonmarket information in cases where property rights can be used to provide partial solutions only and where there is a role for more active management of fisheries.

Choosing the most efficient management strategies will also be affected by whether values that are not related to the fish catch are important in a fishery. Such values may include those arising from noncatch related recreational activities as well as those associated with conserving the fish stock or other aspects of the marine environment. In principle, all such values should be taken into account in deciding how to regulate commercial and recreational catch. In practice, an explicit and comprehensive assessment of all the values is often not possible because of a lack of quantitative information or a lack of even qualitative information about people's preferences for conservation of fish stocks and associated marine resources.

The management approach usually adopted in fisheries is to focus on regulating users within a framework of sustainability. It is plausible that a framework of sustainability may ensure the maintenance of the nonuse values associated with most fisheries, and this is in fact what Commonwealth fisheries policy pursues — maximising the net economic value of a fishery, subject to the assurance that the fishery activities are biologically sustainable (Commonwealth of Australia 1989).

For target species, management choices can be viewed as a two stage decision process. The first stage involves choosing the maximum level of catch by all users. The second stage involves allocating shares of the total catch between alternative uses. If noncatch activities are important and if their values are affected by catch levels, then both catch and noncatch activities will need to be taken into account when determining the total catch, as well when allocating catch between activities. For instance, in allocating the catch between activities, zoning arrangements — such as exclusion zones, where capture based activities are prohibited — may help maintain values associated with
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noncatch activities such as diving. Where the net benefit of the last fish caught or conserved needs to be assessed, the appropriate measure of value to consider is the marginal value of that last fish (Staniford and Siggins 1992; van Bueren, Lindner and McLeod 1996).

When making the first decision, most nonuse values for target species can probably be preserved as long as there is a sustainable fish population. Therefore, the marginal gain in nonuse value from greater conservation is likely to decline rapidly as more fish are conserved beyond a certain sustainable level. By the same token if the resource was exploited beyond this level, the marginal cost of use may increase rapidly in terms of loss of nonuse values.

If the point of sustainability was passed then the marginal cost of use would increase even further as a result of losses to all parts of economic value. It is therefore likely that there is some sustainable stock level at which the marginal cost of catch equals the marginal net value of catch.

Once a total catch has been established, the question that management has to answer is: How should the catch be allocated between recreational fishing and all other capture based use activities so that the net value of the catch is maximised? If it is possible to clearly define property rights to catch and to enforce them cost effectively, then no further information about the marginal value of fish to the different sectors would be required by managers. Maximising the net economic value of the total catch to society may be achievable by regulating to facilitate the development of a market in access and use rights, provided that problems of market power can be limited and that neither information costs, nor asymmetries in information available to different market participants are not too great.

In many fisheries, the complexities in establishing and effectively monitoring a system of property rights to catch among a number of different user groups may be costly or infeasible. Estimates of the marginal value of fish to each of the alternative activities may be useful in such fisheries, provided that there are practical means to influence the shares of catch for each activity.
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4. Incorporating recreational fishing into management decisions

Fisheries without noncatch activities

As argued above, a two stage decision framework is useful when all of the onsite values are derived from catch based commercial and recreational activities. Given that a target catch level has been decided in stage one, how should it be achieved?

There is substantial evidence to suggest that setting up markets in individual transferable catch quota shares may provide an efficient solution in many purely commercial fisheries. In at least some cases, markets may offer the best resolution of competing recreational and commercial demand as well.

Developing a market in catch rights will be feasible only if it is possible to enforce those rights. In many recreational fisheries it may not be feasible to enforce individual catch rights, but it may be possible to limit recreational catch by using devices such as seasonal closures, daily bag limits and gear controls. As long as there are some practical measures that can be used to enforce the allocation of recreational and commercial catch rights, there is some potential use for information about the values of the two activities.

Cases 1–4 below illustrate the management options and relevance of non-market value estimates for some likely combinations of circumstances in commercial and recreational fisheries.

Case 1: Enforcing catch limits is feasible in both sectors

If enforcing catch limits is feasible, then setting a total quota and allowing a market in quota to develop for both recreational and commercial uses is likely to be optimal. Since an efficient allocation of rights will result from the market in quotas, there is no need for an estimate of the value of recreational fishing.

Ideally, quotas for both activities should be set on the basis of total fish kills. Landings are generally the only policy base for quotas. However, in both sectors, kills will exceed landings. As long as quotas are calculated on the basis of a realistic assessment of the relationship between fish kill and landings, there may be no significant management problem.
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Case 2: Enforcing catch limits is feasible in the commercial sector only, and the total recreational catch can be limited by restrictions on seasons, gear or other aspects of access

If shares of a total catch quota for the commercial and recreational sectors can be enforced, managers will have an interest in the relative value of the two activities. To be of use in making tradeoffs between the commercial and recreational allocation of the catch, value estimates for the recreational catch will need to be made at the margin. If season limits or limits on catch methods are used to control recreational catch, nonmarket value estimates may need to be obtained in a way which accounts for the likely impact of the controls.

Case 3: Enforcing catch limits is feasible in the commercial sector, but the recreational catch cannot be controlled

Open access for recreational users is likely to result in excessive recreational catch for a given fish availability. However, there may still be a role for assessing the relative values of recreational access and commercial use. The size of the commercial catch will influence the availability of fish to the recreational sector. Knowledge of the marginal value of the catch to the recreational sector may be useful in defining the optimal level of commercial catch. How and where the commercial activities take place may also influence recreational values.

Case 4: Enforcing catch limits is infeasible in both sectors

Many Australian commercial fisheries are managed by a combination of licences, gear controls and closed seasons. These controls limit the commercial catch to some extent. Recreational catches are generally not controlled in any effective way. In cases where there is no prospect of effectively controlling the catch, a valuation of either the commercial or recreational catch will be of limited use. Valuations may be useful where managers are considering adopting alternative strategies to control the total catch and the commercial and recreational shares of that catch. However, the valuations need to be specific to the alternative strategies being considered.

Fisheries where noncatch recreational activities are important

The logical sequence of arguments in cases 1–4 above can be extended to considering the tradeoffs between noncatch uses and catch dependent uses. Where noncatch uses have the potential to be significant, the impact of catch
on the value of those uses should be taken into account in deciding the total catch level.

The existence of significant "catch and release" activities in a fishery would make the choices and valuation problems considerably more complex than those outlined in the discussion of cases 1-4. Commercial fishing reduces the availability (catchability) of fish to the recreational sector. Catch and release recreational activities reduce fish availability to other sectors only to the extent of any unintentional fish deaths.

Management limitations
The discussion of cases 1-4 above is centred on catch of target species. In cases 1-3 it is also presumed that it makes sense to attempt to set and enforce a total allowable catch. In many fisheries, management choices may be constrained by issues of bycatch or other side effects or by a lack of knowledge about the fish stock.

Both recreational and commercial fishing may involve impacts on nontarget species. Some of the most obvious impacts arise from bycatch and modification of the sea floor by trawling operations. However, other forms of commercial and recreational fishing may have impacts on nontarget species. For example, bait collection by recreational fishers may denude the intertidal zone of some favoured bait species. In the decision framework outlined here, general environmental protection issues should be handled at the first stage — setting the total catch limits.

Knowledge of fish stocks and fish biology can vary greatly between fisheries. Establishing a total catch limit which is enforceable and which makes sense from both the biological and economic perspective requires information on both the biology and economics of the fishery. In some cases there will not be sufficient information to make catch quota setting meaningful. Seeking information on nonmarket values of recreational fishing in such cases is unlikely to be useful.
5. Estimating a value for recreational fishing

Market values and proxies

Prices paid for market goods and services, such as for charter boat fishing, can provide information which may be used in establishing a value for recreational fishing. Where market prices do exist, it may be possible to identify the proportion of the price that is associated with the use of the resource. For example, the price of charter services may reflect other factors apart from the value associated with fishing. It also needs to be kept in mind that most market information is available as average values for trips or other packages of services. Deriving an estimate of the value of an additional fish to the recreational sector from such information will not be simple, if possible at all.

The market segments for which prices exist may be used for the recreational fishery in question to identify key information gaps for which further information may be sought. For example, market prices for charter services may not cover all the options for recreational fishing for a particular species — such as pier, beach and rock fishing.

Sometimes it may be possible to use market information on substitutes if no direct market information is available. If further information is still required, nonmarket values associated with recreational fishing will need to be considered.

Nonmarket values

To be useful to a fisheries manager, a nonmarket value estimate needs to be specific to the particular management decision to be made. If the commercial or recreational use of a fishery involved the sacrifice of all or most nonuse values, then estimates of both use and nonuse values would be useful to the decision maker. However, as is argued above, the thrust of sustainable fisheries management is such that there is at least an intent to preserve most nonuse values. Therefore, monetary estimates of nonuse values are likely to be redundant, although there may still be a place for qualitative listings of values. For example, knowing that conservation of sea floor ecology is important will help to guide gear regulations or zoning in a trawl fishery.

In the context of the decision framework outlined in this report, the greatest potential use for nonmarket value estimates lies in resolving tradeoffs between
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commercial and recreational use activities. Mostly that will involve seeking estimates of the value of an additional fish as catch — or, in some cases, as part of the fish population for viewing.

The comparative ease with which it is possible to value the benefits that commercial fishing generates makes this the logical initial step in the decision process. This value is the value which would be forgone by reallocating the resource from commercial fishing to a competing use — that is, its ‘opportunity cost’. Given a measure of opportunity cost, it may be possible to make a resource allocation decision once the likely direction and volume of nonmarket effects have been considered. For example, if the marginal value of fish to the commercial sector was found to be low or negative and continued commercial fishing was likely to reduce the recreational catch, it would be rational to allocate less of the resource to the commercial sector without any further investigation.

The opportunity cost approach may be useful only if there is a large difference between the market net benefit and nonmarket values because it gives only a threshold with which to compare a list of qualitative values. Nevertheless, estimating the opportunity cost is a necessary part of any attempt to make an optimal tradeoff between use values. The relevant measure of opportunity cost is the net value of an additional fish to the commercial sector — or the change in net value between any two discrete management options being considered.

An alternative to the opportunity cost approach is to estimate the cost of replacing a good or service provided by the natural resource. For example, the costs of establishing, operating and maintaining a recreational trout farm could represent the replacement cost for a natural trout fishery. However, it is usually not possible to fully replicate the habitat. Consequently, only a minimum replacement cost of the recreational fishery could usually be derived. This estimate may not reflect the value society ascribes to that service. All it provides is what it would cost if replaced. Notwithstanding that, if no alternative valuation is feasible, such information can assist decision makers. Several direct means of estimating nonmarket values are discussed in section 6.

When should nonmarket values be quantified?

Although it may appear desirable to have perfect information for resource use decisions, gathering and analysing information is costly and deferring decisions until new information becomes available may also involve a cost. So it may not be optimal to measure all the costs and benefits of alternative uses accurately. For example, the cost of gathering information on recreational
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fishing in a fishery with little recreational activity may be large relative to the

Information should be gathered to the point where the expected benefit from
generating additional information equals the cost of obtaining that information.
Additional information will produce benefits if it reduces the probability of
making a wrong decision. So the expected net benefit from new information
depends on how much it reduces the chance of making a wrong decision, the
cost of a wrong decision and the cost of acquiring the information.

Survey based techniques such as travel cost and contingent valuation tend to
be more expensive and time consuming than other nonmarket techniques.
There are a number of potential errors which can arise in conducting surveys
and in applying nonmarket valuation techniques which can reduce the benefits
that will be obtained from gathering the additional information. The
probability of making a wrong decision will only be reduced if the new
information is sufficiently reliable.

Reliability of estimates
While several techniques have the potential to yield quantitative estimates of
nonmarket values, the reliability of the estimates and the feasibility of obtain-
ing them varies according to:

- the effort directed to the valuation process,
- how easily the good can be defined,
- familiarity with the good, and
- comparability with market goods.

The level of effort and expense will usually affect the reliability of estimates
obtained from a nonmarket valuation technique. With survey techniques such
as travel cost and contingent valuation, greater statistical reliability (or reduced
sampling error) of the estimate will necessitate more thorough survey
procedures and larger, more expensive, surveys. Nonsampling or measurement
errors of survey estimates are reduced by better questionnaire design through
the use of focus groups or pilot surveys to determine the appropriate framing
of the information as well as the description of the good itself. The cost of
contingent valuation studies varies with: survey design; the degree of
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pretesting; the size and form of the survey; training of interviewers; and the form of the valuation question itself. The degree of error or loss of data quality is likely to become greater the less are the resources expended on the survey (Flatley and Bennett 1995). The judgment on how far to pursue reliability depends on the comparison of the cost of reducing the errors in the estimates with the benefit to the decision process from better information.

Estimating nonmarket values is often made difficult by the complexity of the impacts of the proposed policy changes or by the unavailability of appropriate information. For example, it may be difficult to describe the impact of proposed changes to access regulations in a fishery simply and accurately. Providing better information may require both time and expense.

Apart from the difficulty in defining the good, it is important to recognize that valuing a good that is unfamiliar to individuals presents conceptual difficulties. The purchase of an unfamiliar good involves many uncertainties, a majority of which may be overcome with further information. This situation applies even to market goods where there may be several attributes of the good and a large array of choices to compare the different characteristics. Lack of appropriate information may limit people's ability to assign economic values to unfamiliar goods. Before purchasing a good in the market individuals will acquire information on that good and its substitutes. The amount of information sought will vary with the benefit that the information provides in assisting the individual decide on the value of the good. Rarely, if ever, will complete information be sought about a good before the market transaction is completed. The amount and type of information about a good and its substitutes available to individuals will affect the values that they assign to that good. This has implications for contingent valuation where individuals in the sample are presented with information on the good to be valued. If this information includes substantial new information for those sampled, the survey may no longer be representative of the population.

For nonmarket goods there are further problems in estimating values using contingent valuation because people may have difficulty expressing their value for it in monetary terms as they are not normally required to pay money directly for these goods. This difficulty is likely to increase the more remote the good is from marketed private goods. The chance that estimated values reflect society's true value — that is, the reliability of the estimate — is likely to decrease along with the ability of people to express a value for the good. This is less problematic for an activity such as recreational fishing, where some markets do exist, than for nonuse values. When it appears worthwhile to determine an estimate of a nonmarket value the next question is which technique is most suitable.
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6. Techniques for valuing recreational fishing

The aim in this section is not to provide a comprehensive guide to valuation techniques but rather to give an overview of the techniques which may be used to provide information about the value of recreational fishing. DEST, DoF and RAC (1995) and Bateman and Turner (1993), among others, have completed a summary of the techniques which can be used to value environmental resources.

The major recognised valuation techniques are the travel cost method and contingent valuation. In recent years the methodology of nonmarket valuation has been further advanced through the development of techniques which use a combination of these methods and the development of more complex behavioural models such as choice modelling. Once a decision has been made to pursue information about the value of recreational fishing the first source of information investigated should be any applicable market data.

Market information

If there is market information associated with recreational fishing then this should be identified and considered. For example, charter fees, entry fees or licences to a fishery may provide an indication of the value of recreational fishing. However, this type of market information is reasonably limited and will not always be able to provide a complete value. For example, charter services may not cover options associated with shore based recreational fishing. As well, fees and licences generally cover a package of services. It may not always be easy, or even possible, to derive a reliable estimate of the marginal value of fish from these market data.

Proxy goods or market substitutes

It may be possible to value recreational fishing by using the value of a proxy or substitute. If a close substitute is available then it can provide an inexpensive way of obtaining a value. The use of proxy goods stands or falls on the availability of a close substitute and the availability of a value for that substitute. Examples of proxy goods which may be useful for the valuation of recreational fishing are fees charged for access to alternative recreational fishing areas such as piers and jetties or fish farms and charter boat fishing in substitute fisheries. For this method to be used successfully, it is necessary that the relationship between the proxy and recreational fishing is carefully defined.

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(DEST, DoF and RAC 1995). Use of data for prices of many proxy goods may entail similar difficulty in deriving marginal values as that described for market information on recreational services.

**Benefit transfer method**

The benefit transfer method is a way of adapting estimates of previously conducted studies to construct values for resources in a different location (Smith 1993). If this method can be implemented successfully it can reduce the costs of a nonmarket valuation. The benefit transfer method can be applied either in terms of transferring the benefits per trip or by transferring the underlying relationships from one study or several studies in one location to a new study in a new location. Loomis (1992) has found the second approach to be more robust as it allows the characteristics of the new site to be considered.

Read Sturgess and Associates (1992) used Sinden (1990) estimates of benefits per trip for the Ovens and King Rivers to derive benefit values for recreation in several other Victorian rivers. The general situation and the variables that were used were very similar to the Sinden study. In situations such as this, the accuracy of the net benefit estimates depends on the accuracy and validity of the original study and the similarity of every aspect of the two situations. There is some evidence that benefit transfer in recreational fisheries may be quite unreliable. Downing and Ozuna (1996) found transfer of underlying relationships for Texas coast fisheries to be unreliable both over time within a fishery and between fisheries within a year.

**Travel cost method**

The travel cost method is based on the premise that the quantity of the good (recreational fishing) consumed depends on the cost of travel that is undertaken to obtain it (see Ward and Loomis 1986 for a review of the method). The data requirements for this valuation technique are the cost of travel to the location and the quantity of fish that is taken per unit of time. The data are obtained through a survey of recreational anglers visiting the site. The method rests on two necessary assumptions. First, the cost of travel constrains the use of the fish resource like a price — assuming that fishing is the only value which is reflected in the cost of travel. Second, anglers living in one area would exhibit the same type of behaviour if they lived in a different area.

Travel cost method survey data are used to derive a demand curve for fishing days based on the regression of the number of visits an individual makes to a fishing site over a period of time against the travel cost incurred by the individual angler and other explanatory variables such as the quality of the site,
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level of income, employment status and the value of fishing gear owned by the respondent (van Bueren, Lindner and McLeod 1996).

There are several factors which make a satisfactory application of the method problematic. In terms of the individual angler's recreational experience, the influence of time cost and congestion are difficult to determine. The presence of multiple purpose trips, multiple sites and substitute sites can bias the results if not incorporated adequately into the model (Durden and Shogren 1988). There has been considerable debate over how to incorporate the effect of substitute sites into the estimation process (see Cichetti and Smith 1976; Hof and King 1982; Ward 1983). Also, the functional form of the model can affect the results. Huppert (1989) estimated five demand equations using the method and found that the estimated values varied substantially (up to 300 per cent), depending on the empirical specification.

Smith, Desvouges and McGivney (1983) have shown that the opportunity cost of time may have a significant impact on the demand for a good such as recreational fishing. Bockstael, Strand and Hanemann (1987) used the example of anglers in southern California to demonstrate one way of incorporating time costs into the travel cost method. They divided the sample of anglers into those who had a flexible relationship between work and leisure and those who had set work commitments to explain the value of anglers' time.

Congestion will also influence the amount that the angler will pay in terms of cost of travel to get to the location. As with time cost, congestion is a difficult variable to incorporate into the travel cost method because the influence on demand may vary considerably from one angler to the next (Krutilla and Fisher 1975). The application of the method to a particular fishery should attempt to explain, as far as it is cost effective, the influence of such factors as congestion and time cost on each individual angler's demand for recreational fishing. This could be achieved by eliciting information on these factors from surveyed anglers and incorporating them into the model.

The angler may also pursue other activities such as photography and swimming during the course of a trip. If there are multiple activities on a trip, fishing is not the only one which the angler has bought by travelling to the site. So it may be difficult to isolate what the angler has paid for recreational fishing alone in terms of the cost of travel to the location.

If an angler visits multiple sites it is possible to use a multisite travel cost method to estimate net benefit values. If a number of anglers visit each site then the multisite method estimates average values of net benefit for those anglers who visit each site. The variations that exist in the catch rates across
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1 Travel cost valuations of recreational fishing

<table>
<thead>
<tr>
<th>Study</th>
<th>Nature of recreational fishing</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>van Bueren, Lindner and McLeod (1996)</td>
<td>Western Australian salmon fishery</td>
<td>$3.41 million</td>
</tr>
<tr>
<td>Donnelly, Sorg-Swanson, Loomis and Nelson (1990)</td>
<td>Idaho steelhead salmon fishery</td>
<td>Visitor day US$14.29 and average trip US$27.87</td>
</tr>
<tr>
<td>Sorg and Loomis (1986)</td>
<td>Idaho cold water and warm water fisheries</td>
<td>Visitor day US$42.93, trip US$25.55 for cold water; US$42.18 day and US$26.36 for warm water</td>
</tr>
<tr>
<td>Huppert (1989)</td>
<td>Central Californian chinook salmon and striped bass fishery</td>
<td>Values US$61 to US$296 for half to double catch, depending on equation specification</td>
</tr>
</tbody>
</table>

The sites are often used to value the marginal benefits that would result from an incremental improvement in the catch rate (van Bueren, Lindner and McLeod 1996). Loomis (1988) and Samples and Bishop (1985) also estimated marginal values of fish using multisite surveys. However, in general, deriving marginal values using the travel cost method is more problematic than it is with other nonmarket valuation techniques such as contingent valuation. The travel cost method may be used more successfully to estimate average values in a situation where the decision is one of exclusion of a particular activity or where an appropriate entry charge needs to be calculated.

The travel cost method is a commonly used technique to estimate the value of recreational fishing, with several studies summarised in table 1. It is unlikely that the method will be suited to estimating values for all recreational fishing as at least several violations of the assumptions are likely.

Contingent valuation method

In using contingent valuation a hypothetical market is created in order to elicit the individual angler's willingness to pay for a day of fishing or an improvement in the quality of fishing (van Bueren, Lindner and McLeod 1996). The parameters of the market such as the size of the area, species that can be caught and the method of payment are described before valuation is sought from the
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angler. Contingent valuation survey techniques are based fundamentally on the question of how much an individual is willing to pay for a particular level of recreational fishing. The use of a realistic payment vehicle to convince anglers that payment will occur is a crucial part of conducting contingent valuation.

A distinct advantage that contingent valuation has over the travel cost method is that it can be used to estimate marginal values for recreational fishing directly. Contingent valuation can be used to simulate outcomes from potential policy actions and, consequently, to estimate values that people place on a good beyond the existing situation.

The hypothetical nature of contingent valuation and the difficulties associated with eliciting a true response result in a number of biases and problems which must be considered when designing the survey form and when analysing the results (see Mitchell and Carson 1989).

Starting point bias

One approach to eliciting anglers' willingness to pay is for the interviewer to use a close ended framework where an initial bidding value is given to the angler. There is some evidence that starting points can influence the willingness to pay bid, as shown in a study by Boyle, Bishop and Walsh (1985).

Strategic bias

If anglers believe that their response may affect the outcome they may behave strategically by deliberately understating or overstating their willingness to pay in an attempt to achieve the outcome which they perceive as being optimal. The potential for strategic bias can be gauged through an initial attitude survey and by formulating some a priori expectations based on any current information that may be available.

Information bias

Some anglers may have knowledge of recreational fishing in an area beyond the information described in the hypothetical market. In all markets, consumers possess different levels of information. When designing the survey it should be remembered that if too much information is provided then some anglers with less prior knowledge of the fishery will find it difficult to consider all the relevant detail when making their willingness to pay bid.
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Instrument bias

If anglers do not believe that payment will be required there is no compulsion to provide accurate responses. In a study by Cronin (cited in Cummings, Brookshire and Schultze 1986) it was found that the choice of payments instrument used in the hypothetical market influenced the willingness to pay bid. Respondents who were asked to pay through a local tax gave a lower willingness to pay bid than those who were asked to make a bid based on the understanding that the money to pay for the improvement in water quality would come from the federal government.

Unless such biases can be limited, there may be situations where contingent valuation cannot be applied. Conducting an attitude survey or coordinating focus groups before a contingent valuation survey is undertaken can indicate to the researcher sources of potential bias and whether or not contingent valuation can be applied successfully. A focus group is a small group of people where directed discussion and an interchange of ideas can take place, thus revealing people's views and thought processes about a topic, and the relevant characteristics or attributes that people use in forming choices and opinions (Rolfe and Bennett 1996). Through the use of a focus group, researchers can gauge such factors as the knowledge that people have about an issue, how emotive people are about an issue and the credibility of payment methods. In addition, focus groups are helpful in determining the extent of the description of the good needed to avoid misperception about the nature and scope of the good. This information can help the researcher to identify which explanatory factors should be included in the model, how much information is required to be presented to respondents and how to minimise bias.

There have been very few studies using contingent valuation to value recreational fishing which have had sufficient funding for a comprehensive testing and development of questionnaires through the use of focus groups. Many of the problems in these studies may be linked to inadequate funding rather than an underlying problem with contingent valuation. Several studies using contingent valuation to estimate monetary values for recreational fishing are summarised in table 2.

An important aspect of contingent valuation is that respondents may factor nonuse and indirect values into their bid for recreational fishing when the researcher is only interested in the use value. If anglers do include other values in their willingness to pay bids there may be an overestimation of the value for recreational fishing. With the travel cost method, the use value only is estimated. Therefore, it could be argued that a comparison of contingent valuation with travel cost method estimates would indicate the presence of
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Contingent valuations of recreational fishing

<table>
<thead>
<tr>
<th>Study</th>
<th>Nature of recreational fishing</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>van Bueren, Lindner and McLeod (1996)</td>
<td>Western Australian salmon fishery</td>
<td>$1.87 million total; an extra salmon was worth $5.55</td>
</tr>
<tr>
<td>Staniford and Siggins (1992)</td>
<td>Coffin Bay fishery, with king George whiting accounting for 54 per cent of the catch</td>
<td>$1.67 for an extra kilogram of fish</td>
</tr>
<tr>
<td>Huppert (1989)</td>
<td>Central Californian chinook salmon and striped bass fishery</td>
<td>Values estimated for double and half the catch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US$12.78 and US$9.81 respectively for double catch</td>
</tr>
<tr>
<td></td>
<td>Idaho steelhead fishery</td>
<td>Visitor day US$20.29 and trip US$31.45</td>
</tr>
<tr>
<td></td>
<td>Idaho steelhead fishery</td>
<td>US$9.91 for double catch</td>
</tr>
</tbody>
</table>

Other values in the contingent valuation estimate. However, an actual use value is estimated using the travel cost method, whereas a potential use value is estimated using the contingent valuation method. In making a willingness to pay bid people may be looking to their future use of the fisheries resource as being part of the value which they currently obtain. This potential use value could also be less than the actual use value where anglers believe it likely that some negative impacts on the resource will occur.

The debate over the validity of contingent valuation has been extensive (see Bateman and Turner 1993). If the angler understands the parameters of the market and truthfully answers the willingness to pay question then contingent valuation provides an estimate of benefit, which has the potential to reflect the benefit that the angler obtains from the hypothetical recreational fishing market. Bennett (1992) points out that researchers need to be very careful in selecting the issues and circumstances where contingent valuation is applied. Contingent valuation is likely to be most successful with goods that are well understood, clearly defined and confined to local areas. In the context of this
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report, contingent valuation is more likely to provide useful estimates of recreational fishing values than conservation values.

The quality of answers that people give to a willingness to pay question will partly reflect the level and quality of information provided by the researcher and the anglers' perceptions of that information. Carson and Mitchell (1993) argue that there is a need to draw a clear distinction between a willingness to pay question and a contingent valuation response. They point out that asking respondents for their willingness to pay for a common access good does not ensure that a valid contingent valuation response will be obtained. For this to occur respondents must:

- clearly understand the nature and characteristics of the good for which they are asked to give a response;

- find the relationship between the elements presented in the contingent valuation scenario and the provision of the good believable; and

- respond to and answer the contingent valuation questions in a deliberate and honest manner.

Combining revealed and expressed preferences

Innovative techniques recently developed in the literature include two methods which combine contingent valuation and the travel cost method in an attempt to overcome the problems in applying each of these techniques separately.

Layman, Boyce and Criddle (1996) developed a two stage method of incorporating contingent valuation into the travel cost method and applied this technique to the Gulkana River chinook salmon fishery in Alaska. The first stage is to estimate the value of recreational fishing through an application of the travel cost method from information gathered about the cost and number of trips where the park is in its present state. From this point a number of hypothetical management scenarios are presented and the respondents are then asked to estimate the number of trips they would undertake under the circumstances in each separate management scenario. This technique has the potential to measure the marginal value of recreational fishing under different management options, provided the hypothetical management scenarios are easily understood by the respondents. The combination of the techniques has the potential to overcome the problem that the travel cost method by itself has in estimating marginal values.
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Another method for combining travel cost and contingent valuation data has been proposed by Cameron (1992). Information about the cost of travel is limited in that it can only reveal preferences for current users of the nonmarket good. Despite the fact that contingent valuation is based on hypothetical markets it can still derive important information about the nature of preferences outside the range of current users (Cameron 1992). Cameron proposes that responses to the contingent valuation survey could be combined with travel cost data on actual market behaviour to jointly estimate the demand function. Although this approach could be applied to value recreational fishing, Cameron states that the application of this technique would be well suited to matching the expressed preference of nonusers to the revealed preferences of users in order to establish values for nonuse demand.

Conjoint analysis

Conjoint analysis values all aspects of a recreational trip as components of a price function (Mackenzie 1992). For recreational fishing, components such as equipment expenditure become part of the price function for recreational fishing.

Conjoint analysis first requires the good to be disaggregated into its various components. A good may be disaggregated into \( n \) different attributes such as number of fish caught and time spent fishing. Once the good has been disaggregated into attributes it is then possible to put these attributes into \( m \) different bundles. At least one attribute should have a value attached. Subsequently, there are \( n \) by \( m \) possibilities in terms of describing the good. The survey is designed to elicit the preference ranking of the angler across the bundles. From the survey rankings it is possible to calculate willingness to pay for various attributes such as the number of fish caught and the time spent fishing.

There are several major disadvantages with the technique and its application. There is the potential for bias resulting from information overload as the conjoint analysis survey requires anglers to take up and assess a large quantity of information. The technique requires stringent theoretical and statistical conditions to be met, which makes the technique both complex in its application as well as making it expensive to undertake owing to a necessarily large sample.

Another technique which is based on the concept of disaggregation of the good, and which overcomes some of the disadvantages of conjoint analysis is choice modelling.
Choice modelling

The title choice modelling describes the technique well in that it attempts to model how people make choices. From the choices that people make it is possible to establish what people are prepared to pay so that these choices are available to them. Choice modelling incorporates the strength of using expressed preferences while avoiding the potential pitfalls which have made the use of contingent valuation so controversial for the valuation of environmental goods. It is important to note that the incorrect application of contingent valuation may have added to the mistrust of the technique.

There are three stages involved in choice modelling. The first stage involves identifying the main attributes of what is to be valued and the levels at which these attributes are to be varied. The second stage involves estimating the relevant form of the utility function, selecting the attributes and levels to be incorporated into the different scenarios and then conducting the survey. The final stage is to statistically analyse the results of the survey.

Choice modelling as a technique is complex in both its underlying methodology and in the statistical techniques which it uses. The first stage of choice modelling involves working out attributes and this is usually done through a series of focus groups. If through these focus groups it is found that people have a very good knowledge of the good then contingent valuation could be suitable. Rolfe and Bennett (1996) valued rainforests in Vanuatu using the choice modelling approach and through a series of focus groups they found that Australians had some knowledge of the issues confronting the preservation of rainforests in Vanuatu. They felt that this knowledge would not have been sufficient for a contingent valuation study to be effective as the respondents would have been required to take up too much information.

Attributes for a recreational fishing situation could, for example, include the quality of the fishing environment, the quality of the experience in terms of the amount of congestion and the number of fish captured. The combination of attributes and the levels at which they are presented could be based on hypothetical management scenarios. For statistical ease there are usually six attributes and these can be further split into two levels (Rolfe and Bennett 1996). With six attributes and two levels it is possible to generate sixty-four possible scenarios.

The relevant form of the utility function is arrived at through an iterative process. Once the relevant form has been specified it is then possible to present the respondents with the different attribute combinations across two or more levels (Rolfe and Bennett 1996). A disadvantage of the iterative process is that
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an error in the specification will be compounded; therefore, eliciting the correct attributes from the focus group is vital to the success of this approach.

The angler is able to make a choice based on the attributes and levels that are presented where the focus is on the choice of situation and not the choice of a price as is the case with contingent valuation. The effect on the price which the angler associates with a scenario is gauged where only a single attribute is varied. For example, the number of fish caught could be varied while holding the levels of the other attributes constant to get an estimate of what the angler is willing to pay for an additional fish (marginal value).

Another strength of choice modelling is that the utility which an individual expresses for a good can be disaggregated. This means that it is possible to estimate what an angler’s demand for recreational fishing is without including the value that the angler might place on such factors as the need for conservation in coming to a decision about which scenario would maximise his/her welfare.

While this technique offers some potential for the valuation of recreational fishing, as yet there have been few applications. As it is more extensively applied, choice modelling will require further development and refinement.
7. Approaching decisions on the use of fisheries

Decision framework
A stylised framework for choices about nonmarket valuation when setting a total allowable catch is feasible is illustrated in figure B. Once a maximum allowable catch has been decided the next question is: how should it be allocated to maximise the net benefit of the catch to society. If it is feasible to enforce property rights to catch fish for all users, if efficient markets can be established and if non-capture uses are not significant then no further investigation of the use values is necessary. If a market solution is not feasible, or would provide a partial solution only, it may be useful to seek nonmarket information on recreational fishing values.

B Decision framework when setting a total allowable catch is feasible

- Total allowable catch – if sustainable, this preserves nonuse values
- Is an efficient quota market feasible?
  - No
  - Would markets give enough information?
    - No
    - Would nonmarkets valuation give reliable results?
      - Yes
      - Is the cost of information less than the benefit?
        - Yes
        - Estimate the nonmarket value of recreational fishing
        - No
        - Choose policy option on the basis of existing information
      - No
    - No
  - Yes
    - Choose policy option on the basis of existing information
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Where there are significant noncatch activities in a fishery, these need to be considered at the stage of setting total allowable catch or setting alternative regulatory controls. In some such cases it may be useful to seek nonmarket valuation of both catch dependent recreational fishing activities and noncatch activities at the first stage.

Choice of valuation technique

If it is worthwhile to pursue a valuation of recreational fishing the researcher should then focus on matching a technique to the characteristics of the situation while considering the cost of gathering the information against the benefits expected to be generated from it. Given the relative ease of acquiring market information, all possible sources of market information should be investigated. The choice of an appropriate technique is crucial in deriving useful estimates (table 3).

A major advantage of the benefit transfer method is that the cost of information is quite low; however, this is potentially the least reliable technique. The success of this technique for providing a low cost estimate of value depends on the existence and quality of other studies of recreational fishing with similar characteristics. The transfer of benefits should be made such that the unique characteristics of the new situation are taken into account as far as is possible.

The theoretical requirements of conjoint analysis are often not able to be satisfied. Both the theoretical and statistical requirements make this technique very expensive to undertake. The costs associated with applying conjoint analysis would usually not be proportionate to the benefits that the information would generate.

The nonmarket valuation techniques which hold the most potential for valuing recreational fishing are the travel cost, contingent valuation, hybrid techniques such as the hypothetical travel cost method and possibly choice modelling, with further development and application of the technique.

The travel cost method estimates the actual use value and not the potential use value. The potential value of the resource could change depending on changes to the resource. If there are to be no major changes to variables which determine the value for recreational fishing then the travel cost method can estimate an actual value which is equivalent to the potential value. Further development of the travel cost method should focus on addressing the restrictive underlying assumptions of the technique and the fact that marginal values are difficult to estimate. An important point for further investigation is the incorporation of the cost of time into the estimation procedure.
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### Techniques for valuing recreational fishing

<table>
<thead>
<tr>
<th>Technique</th>
<th>Estimated value</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market information</td>
<td>Uses prices for market segments of recreational fishing</td>
<td>Proportion of the price dependent on fishing must be identified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Market information is limited</td>
</tr>
<tr>
<td>Proxy good (market substitute)</td>
<td>Based on a proxy or substitute</td>
<td>Application depends on the existence of a proxy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Care required in definition of link with proxy</td>
</tr>
<tr>
<td>Benefit transfer</td>
<td>Transfer of relationship or values from one study to another</td>
<td>Questionable reliability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transfer of underlying relationship more reliable than transfer of values</td>
</tr>
<tr>
<td>Travel cost</td>
<td>Cost of travel used as a surrogate for recreational fishing</td>
<td>Results sensitive to assumptions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More suited to estimating average rather than marginal values</td>
</tr>
<tr>
<td>Contingent valuation</td>
<td>Based on anglers' responses to choices in hypothetical market for recreational fishing</td>
<td>Potential biases, problem of scoping</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Most applicable to situations where resource is well understood</td>
</tr>
<tr>
<td>Combining travel cost and contingent valuation</td>
<td>Level of use in hypothetical scenarios used with travel cost method value</td>
<td>Hypothetical scenarios must be easily understood by the respondent</td>
</tr>
<tr>
<td></td>
<td>Joint estimation of demand by travel cost method and contingent valuation</td>
<td>Application more suited to establishing nonuse values</td>
</tr>
<tr>
<td>Conjoint analysis</td>
<td>Uses anglers' preference ranking of attributes of recreational fishing</td>
<td>Large sample required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stringent theoretical and statistical conditions</td>
</tr>
<tr>
<td>Choice modelling</td>
<td>Uses anglers' choices of attributes varied in different scenarios</td>
<td>Complex statistical process</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New technique with few applications</td>
</tr>
</tbody>
</table>

Expressed preference techniques such as contingent valuation and choice modelling can measure the potential value of recreational fishing. The biggest problem with contingent valuation is the range of biases to which the estimates may be subject. The effectiveness of contingent valuation is strongly influenced by the degree of rigour used in applying the technique. An important advantage of choice modelling is that it represents a technique which is
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rigorous in its underlying methodology and therefore in the manner in which it should be applied. Although choice modelling is still being developed the technique is potentially useful.

Accuracy and application of estimates

Convincing policy makers of the importance of nonmarket values is a task made more difficult by the inconsistent results which the current techniques have delivered. In the United States there is legislation in place which stipulates how contingent valuation is to be undertaken. This has greatly improved the consistency and therefore the acceptability of contingent valuation in that country; however, it has tended to preclude further development of the technique there.

A general problem which needs to be addressed in estimating the variation in the demand for recreational fishing is the lack of explanatory power exhibited by the studies which have been undertaken. Of the studies reviewed all had models which could only explain less than 30 per cent of the variation in the recreational value. This, in part, reflects the fact that the studies mostly use cross-sectional data with sometimes quite small samples; however, it may also indicate that the demand for recreational fishing is influenced by factors which have not been considered in such studies. Choice modelling could help to resolve this issue in that it bases its survey and analysis on what anglers say influences their choices about recreational fishing.

While it is difficult to judge the reliability of estimates of nonmarket values, some Australian studies of recreational fishing have yielded results which accord with expectations. Van Bueren, Lindner and McLeod (1996) showed that the value of an additional Australian salmon allocated to the recreational sector would be worth $5.55, whereas this same fish was worth less than a dollar to the commercial sector. Although the authors did express some concerns about the robustness of this estimate the result is consistent with expectations. Australian salmon is a low value commercial species which is mostly processed into pet food. The fish is a very popular recreational species with excellent sportfishing qualities as well as being a good table fish if eaten fresh. Based on the nonmarket estimate of value there would be scope for allocating additional fish from the commercial to the recreational sector.

Staniford and Siggins (1992) showed that the value of allocating an additional kilogram of fish to the recreational sector in Coffin Bay was worth $1.67, with king george whiting making up over half of the recreational catch. King george whiting is an excellent sport fish as well as a highly prized table fish with a high commercial value. Using the same catch percentages as for the rec-
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Recreational sector, Staniford and Siggins calculated a net commercial marginal value of $3.86 a kilogram. In the case of Coffin Bay there may be scope for allocating more fish to the commercial sector.

For fisheries resources to be allocated in such a way that conditions of equity and efficiency are met, managers need to make informed decisions based on the best available information. Nonmarket information should be assessed together with any available market information. Currently, given the problems with nonmarket valuations, the techniques should be viewed as able to indicate the order of magnitude, rather than a definitive single estimate, of the value for recreational fishing.
References


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