Marine Policy 58 (2015) 108–115

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

# Cost benefit of fishery-independent surveys: Are they worth the money?

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ARTICLE INFO

*Article history:*
Received 18 February 2015
Received in revised form
20 April 2015
Accepted 27 April 2015

*Keywords:*
Fishery survey
Rock lobster fishery
Torres Strait
*Panulirus ornatus*
CPUE

ABSTRACT

Fishery-independent monitoring is invariably more costly than fishery-dependent monitoring but is justified on the basis of the value of the data for effective management, or is viewed as the only valid approach for setting Total Allowable Catches (TAC). However, the cost-benefit of fishery-independent monitoring is rarely explicitly assessed. Development of an integrated fishery model for the Torres Strait tropical rock lobster (TRL) *Panulirus ornatus* fishery provided the opportunity to assess the relative value of different combinations of fishery survey methods. Annual fishery-independent pre-season and mid-season surveys were compared with fishery-dependent data collection. All three methods are currently carried out or have been in place in the recent past. Typically, short-lived highly variable species such as TRL require both recruit and spawner biomass surveys. Using CPUE data only, and not carrying out either the pre-or mid season fishery independent surveys, resulted in lower and considerably less precise TAC estimates. When conducting both fishery-independent surveys a positive cost benefit ratio was realised if additional catch to the CPUE-based TAC estimate was greater than 14.8 t (around 2% of TAC). TAC estimates based on independent fishery surveys were up to 20% greater than the model-predicted estimates using CPUE data alone. Including both independent fishery surveys returned a positive net present value over a 20 year timeframe even when randomly varying biomass, accounting for increasing survey costs, lower gross margins, and lower lobster prices.


## 1. Introduction

Improved management of many of the world's wild-caught fisheries has led to more sustainable practices and stable catches [1], and further rebuilding of overfished stocks has the potential to dramatically increase net economic gains from global fisheries [2]. Overfishing is not a universal issue and many of the world's fisheries, including Australia's, are sustainably fished due to robust scientific advice and management of their target catch and ecosystem impact [3]. In these fisheries, it is important subsequently to maximize their economic viability [e.g. [4]. Effective stock monitoring and assessment are both key to this outcome. However, it is essential that monitoring and assessments are cost-effective; particularly given that many fisheries are pro-actively moving to quota management and cost-recovery management systems [5].

There are two major sources of data available to provide an index of relative (or absolute) abundance for fishery stock assessments: fishery-dependent data and fishery-independent data. Fishery-dependent data includes catch and effort information collected by the fishing industry itself. Fishery-independent data is based on independent surveys and abundance and distribution data are generally collected by fishery management agencies.

Fishery-dependent data are invariably cheaper to obtain given that the information can be captured in the process of fishing. The data can be provided by the fishers themselves through paper or electronic logbooks or by an observer onboard the fishing vessels during the fishing operation. An advantage of these data is that they usually encompass greater spatial and temporal coverage than possible by independent survey. However, the data may be insufficient for thorough stock assessment for many reasons including; hyper-stability [6], spatial variability of fishing effort [7], variable fishing power [8] or simply through erroneous data collection. Even after standardisation it is possible catch per unit effort (CPUE) may not reliably index stock abundance [9].

The advantages of fishery-independent data are often stated but the cost-benefit of the data is rarely explicitly assessed. However, Hoshino et al. [10] were able to assess the cost-benefit of scientific survey information under an adaptive management procedure developed for the Japanese common squid fishery. To achieve an indicative coefficient of variation (CV) of 0.1 for the CPUE estimate, they determined a within-season assessment would be worth doing if it

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http://dx.doi.org/10.1016/j.marpol.2015.04.016
0308-597X/

cost less than 1.28 billion yen per year. Fishery-independent data are invariably more expensive to attain per unit data coverage, if only because it involves employment of fisheries scientists to collect the data. Punt et al. [11], for example, showed the management-related benefits of fixed-station fishery-independent surveys for gummy shark, but did not estimate the cost-benefit ratio of this approach.

In a review of fisheries management, Caddy and Cochrane [12] highlighted the need for fishery monitoring systems that are both robust to inherent uncertainty and cost effective. Advancing this proposed need, Bentley and Stokes [13] developed a formal evaluation of alternative data collection regimes using a utility function to incorporate both costs and performance measures. They demonstrated the value of adaptive monitoring in a low-value, data-poor fishery in New Zealand. However, comparative estimates of assessment research to stock value are rare in the fisheries literature.

The tropical rock lobster (TRL) fishery in Torres Strait, Australia (Fig. 1) provides valuable income for the indigenous inhabitants and a small fleet of non-indigenous fishers [14]. Fishery-independent surveys of the population have been conducted annually since 1989 [15] to inform managers of relative stock abundance. The average annual ratio of the cost of stock monitoring and assessment research to gross value of the fishery catch is relatively high at ~2.5%, due primarily to its local importance to the indigenous inhabitants. More recently, commercial catch and effort statistics have been provided through compulsory logbooks. The age-structured fishery stock assessment model [16] fits to both CPUE data and fishery-independent data to determine stock status and total allowable catch (TAC). The development of the integrated model to estimate a TAC was done in response to a directive from the Australian government to move management of the TRL fishery from input controls to a quota managed system (QMS), and the fishery is currently in a transition period.

The cost of management-related research for this fishery could be greatly reduced by discontinuing the fishery-independent surveys but the outcomes of this change are unknown. However, it was possible to predict these outcomes using different data source inputs to the integrated model.

Generally, the aim of a fishery independent survey is to help reduce uncertainty in stock assessment results which will thus increase allowable harvest and revenues to the fishery [17]. The success of a survey achieving this relies on: risk adverse managers who set harvest levels to some fraction of the nominal target; the fraction has to be based on uncertainty in stock assessment results (with lower fractions and lower catches at higher levels of uncertainty); no direct linkage between recruitment and harvest (harvest this year has no effect on harvest next year); and the foregone catch has no value to the fishery as catch in another fishery.

In this paper, we use a simple net benefit approach to retrospectively assess the question of whether predicted increased revenues of assessments based on fishery-independent information offset the cost of the survey. A sensitivity analysis of the cost-benefit ratio of fishery-independent monitoring under different catch assumptions can be used to assist management of this small-scale but locally important fishery.

## 2. Methods

### 2.1. Fishery-independent data

Annual surveys of the TRL population in Torres Strait were instigated in 1990 following a broad-scale survey of lobster distribution and abundance in 1989 [15] involving 542 randomly-allocated stations. The annual stock surveys were conducted mid-year (June) and involved divers sampling a sub-set of the stations sampled in the benchmark 1989 survey. The design and implementation of the surveys changed over time due to funding and logistical constraints and Ye et al. [18] constructed consistent abundance indices using GLM standardisation of the historical data.

The annual surveys provided relative abundance indices for two lobster age-classes; sub-legal recruiting lobsters aged about 1.5 years (1+) and legal lobsters aged about 2.5 years (2+). Lobsters settle in Torres Strait around June each year following a ~6 month larval phase [19]. They live among the coral reefs for about 2 years. The 2+ lobster population emigrates to breed between mid-August and late-September each year [20]. The 2+ lobster population that migrates does so on the bottom of deep waters in the Torres Strait and effectively becomes unavailable for fishing during migration as trawling along the migration route is

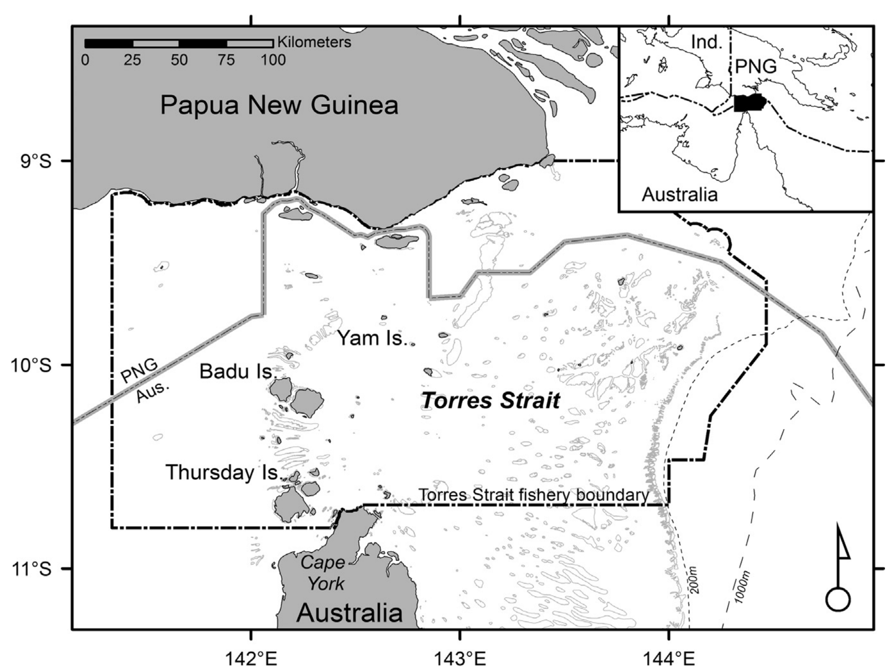


**Fig. 1.** Map of Torres Strait showing the international boundary of Australia and Papua New Guinea and the boundary of the tropical rock lobster (TRL) fishery.