

A NOTE RELATED TO THE IMPACT OF DIFFERENT AGES-AT-RECRUITMENT FOR THE WESTERN NORTH PACIFIC BRYDE'S WHALES

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ABSTRACT

It was proposed during the First Intersessional Workshop for the western North Pacific Bryde's whales that the associated *Implementation Simulation Trials* be based on an age-at-recruitment of five years (corresponding to the legal minimum size limit for previous coastal whaling operations) rather than nine years (corresponding to the legal minimum size limit for previous pelagic whaling operations). This paper explores the implications of an age-at-recruitment of five rather than nine years, in terms of its impact on Maximum Sustainable Yield, *MSY*. *MSY* is higher for an age-at-recruitment of five years for all choices for *MSYR* between 0.005 and 0.06 and *M* between 0.05 and 0.15yr⁻¹.

KEYWORDS: BRYDE'S WHALES, *IMPLEMENTATION*, *MSY*, WESTERN NORTH PACIFIC

INTRODUCTION

The First Intersessional Workshop for the western North Pacific Bryde's whales (IWC, 2005) developed *Implementation Simulation Trials* for this population of whales. Among specifications needed for *Implementation Simulation Trials* are the selection patterns for past and future whaling operations. In relation to past whaling operations, a 35ft (10.7m) legal minimum size limit applied to coastal whaling and a 40ft (12m) limit to pelagic operations. These limits correspond to ages of five and nine years respectively (Ohsumi, 1977). During the First Intersessional Workshop, Japan advised that it did not intend to impose any whale-length related restrictions on future catches of Bryde's whales and, accordingly, IWC (2005) agreed that trials should assume that the age at recruitment that applied to past coastal whaling (in contrast to the higher age corresponding to past pelagic operations) would apply in future. However, IWC (2005) considered it prudent to check whether restrictions similar to those imposed on past pelagic whaling operations might offer benefits to the resource compared to those imposed on past coastal whaling, by comparing *MSY*'s based on ages at recruitment corresponding to the two earlier forms of operation. This paper conducts the requested comparison.

METHODS

The comparison between the alternative selectivity patterns is based on the ratio, χ , of the *MSY* possible for an age-at-recruitment of five years to that possible for an age-at-recruitment of nine years for a range of values for the biological parameters of a whale population (e.g. *MSYR*, natural mortality, age-at-maturity). The algorithm used to calculate χ is:

- A. Specify the population components used when defining *MSYL* and implementing density-dependence (set to the mature female component of the population because this specification has formed the basis for previous *Implementation Simulation Trials*).
- B. Specify the population component used when defining *MSYR*. This has been set to the exploitable component of the population, although this is largely inconsequential because the value of χ is calculated for a range of values for *MSYR*.
- C. Specify the values for the age-at-maturity, the rate of natural mortality, and *MSYL*.
- D. Specify the *MSY* rate for the reference selection pattern (i.e. uniform selectivity harvesting from age nine) and calculate the values for the resilience parameter and the degree of compensation (*A* and *z*) for the reference selection pattern (see Punt (1999) for details).
- E. Calculate the *MSY* for the reference selection pattern when carrying capacity (in terms of mature female component of the population) is 10,000, *MSY_{ref}*.
- F. Calculate the *MSY* for the alternative selection pattern (uniform selectivity harvesting from age five) when carrying capacity is 10,000, *MSY_{alt}*.
- G. Calculate $\chi = \text{MSY}_{\text{alt}} / \text{MSY}_{\text{ref}}$.

The age-at-maturity is set to 6 years, corresponding to an age-at-first-parturition of 7 years (Punt, 2005), and MSYL is set to 0.6. There is considerable uncertainty regarding the rate of natural mortality, M , (IWC, 2005) so values in the range 0.05yr^{-1} to 0.15yr^{-1} are considered. Similarly, MSYR for the western North Pacific Bryde's whales is unknown so values in the range 0.005-0.06 are considered.

METHODS AND DISCUSSION

Figure 1 plots χ (expressed as a percentage) against MSYR and M for an age-at-maturity of six years. The value of χ is lowest for the lowest values for MSYR and M and *vice versa*. The value of χ is larger if the age-at-maturity is actually larger than six (Figure 2). Irrespective of this, χ is never less than 1 (i.e. MSY for the lower age-at-recruitment is always greater than that for the higher age-at-recruitment; see Table 1 for the range of values for χ in Figures 1 and 2).

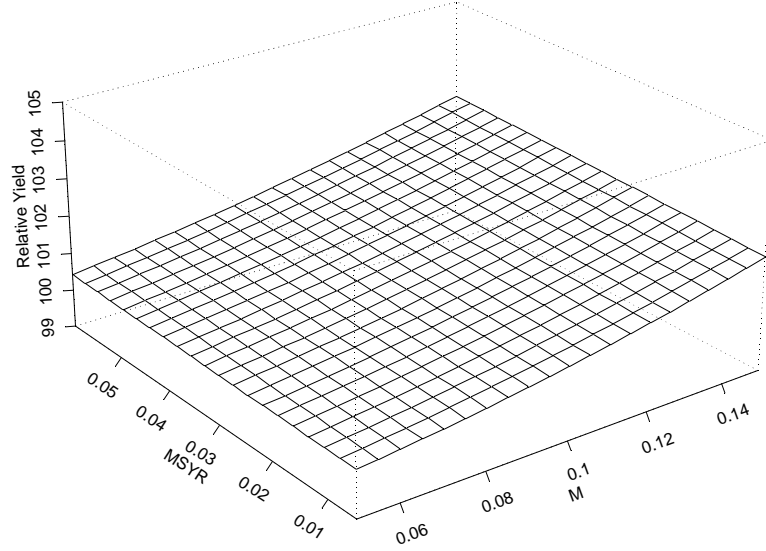


Figure 1. χ against MSYR and M for an age-at-maturity of six years.

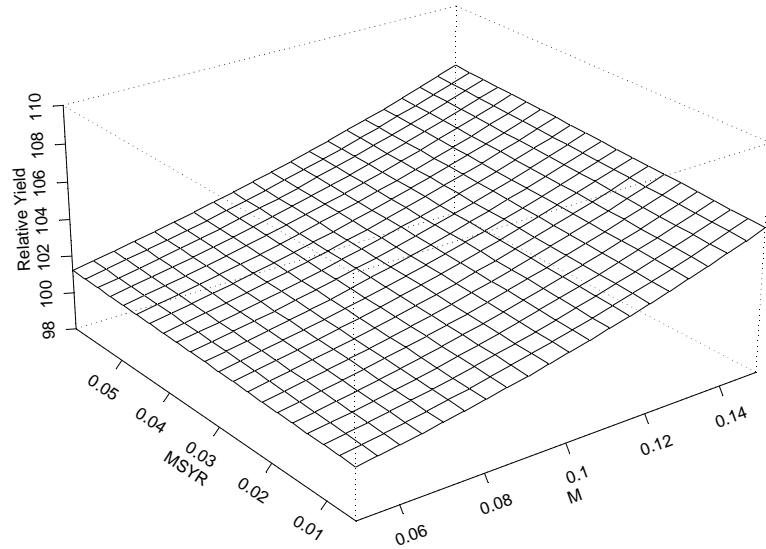


Figure 2. χ against MSYR and M for an age-at-maturity of seven years.

It is intuitive that the yield will be larger for a lower age-at-recruitment because yield is expressed in numbers (rather than weight) so that a reduction in the age-at-maturity leads to some of the animals that would have died

due to natural causes being harvested. The “yield-per-recruit effect” that reducing the age-at-recruitment may lead to a lower yield because the average mass of the catch drops even though the catch in numbers increases therefore does not apply in this case. As a result, the yield is always higher for a lower age-at-recruitment, irrespective of the level of depletion (see Figure 3; parameter values chosen to illustrative differences).

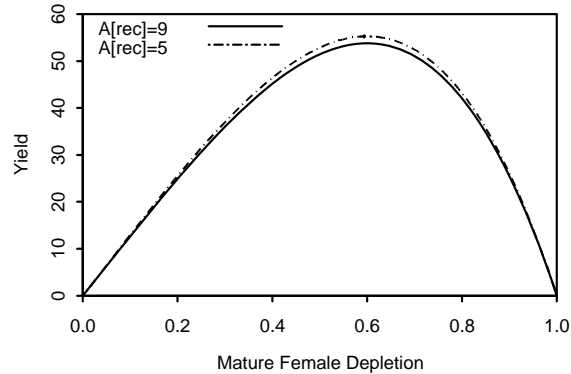


Figure 3. Yield versus mature female depletion when the age-at-maturity is seven years, $M=0.1\text{yr}^{-1}$, and $\text{MSYR}=0.04$.

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Table 1. Range of values for χ (expressed as a percentage) for different values for the age-at-maturity.

Age-at-maturity	Range
6	100.257 – 102.342
7	100.750 – 106.625