

Lobster Sustainability Measures in Newfoundland: Are They Effective?

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BACKGROUND: WHY DO WE CARE?

- Many rural Newfoundland communities depend on the American lobster (*Homarus americanus*) fishery as an important source of income; the well-being of these communities depends on this fishery.
- Lack of scientific data on lobster stock¹ sparked the FFAW and fish harvesters to collect data, contribute to the assessment of the stock, and actively participate in conservation initiatives.
- The conservation initiatives undertaken include locally supported closed areas [i.e., marine protected areas (MPAs)]; voluntary v-notching of berried females; and the adoption of a maximum size limit in 4 Lobster Fishing Areas (i.e., a slot fishery).
- To establish the science basis for these initiatives we used an established concept in population biology called "reproductive value" to evaluate their effectiveness.
- Reproductive value uses current and expected future mortality and fecundity (egg production) of lobsters in different life stages to calculate the value of the individual to the population.
- Reproductive value allows us to compare the value of an individual to its population with its value as a commodity.



RESEARCH GOALS

- (1) Calculate the reproductive value of lobsters in Newfoundland at each age and size throughout a lobster's life and calculate the ratio of reproductive value to landed value;
- (2) Identify if differences exist in lobster fecundity at size and growth in locations from Newfoundland down to the southern end of the lobster's range (Virginia, USA);
- (3) Identify the effects of voluntary v-notching, a slot fishery, and closed areas on size and reproductive value;
- (4) Estimate the spatial scale at which small closed areas increase reproductive value of lobster populations; and
- (5) Promote stewardship on the basis of science.

RESULTS

Table 1. Effects of conservation initiatives on lobster sizes, egg production, and reproductive values.

Conservation measure	Lobster size	Egg production	Reproductive value	EFFECTIVE MEASURE?
Closed areas	Increased	Increased	Increased (64.9%)	Yes (locally only)
Slot fishery	Increased	Increased	Increased (16.8%)	Yes
Modified slot fishery*	No increase, fishing removes jumbos	—	Increased (8.7%) No change No change	No
V-notching	Increased	Increased	Increased (18.3%)	Yes

*A slot fishery where lobsters <82.5 mm and in a window, e.g., between 100 and 129 mm, are protected from harvest.

RESULTS cont'd.

Goal 1: Reproductive Value

- The ratio of reproductive value relative to dollar value increased from age 7 onward; e.g., at age 7 it is 78 while at age 29 it is 1775. The future reproductive value at age 29 was roughly 120 times more than at age 7.²
- As lobsters get older, value in terms of current and future egg production and sustaining future populations increases at a greater rate compared with dollar value. The tradeoff for fishermen to release large lobsters is positive for the sustainability of the fishery.

Goal 2: Egg Production and Growth Rates

- Formula developed to estimate the number of eggs on lobsters based on female size throughout its entire geographic range.³
 - Females in northerly latitudes carry fewer eggs than lobsters in more southern regions.
 - Model developed to estimate growth rates of lobsters based on latitude.⁴
 - Growth rates decrease with increasing latitude and depend on temperature.
- Value of results:** Reduces cost of research; allows evaluation of conservation measures without capturing large numbers of lobsters to estimate egg production and growth rates.

Goal 3: Effectiveness of V-notching, Slot Fishing, and Closed Areas

- V-notching increased lobster size and egg production;⁵ reproductive value increased by 18.3%.

Value of result: V-notched lobsters accounted for 6.8% of the catch but 42% of the estimated egg production.

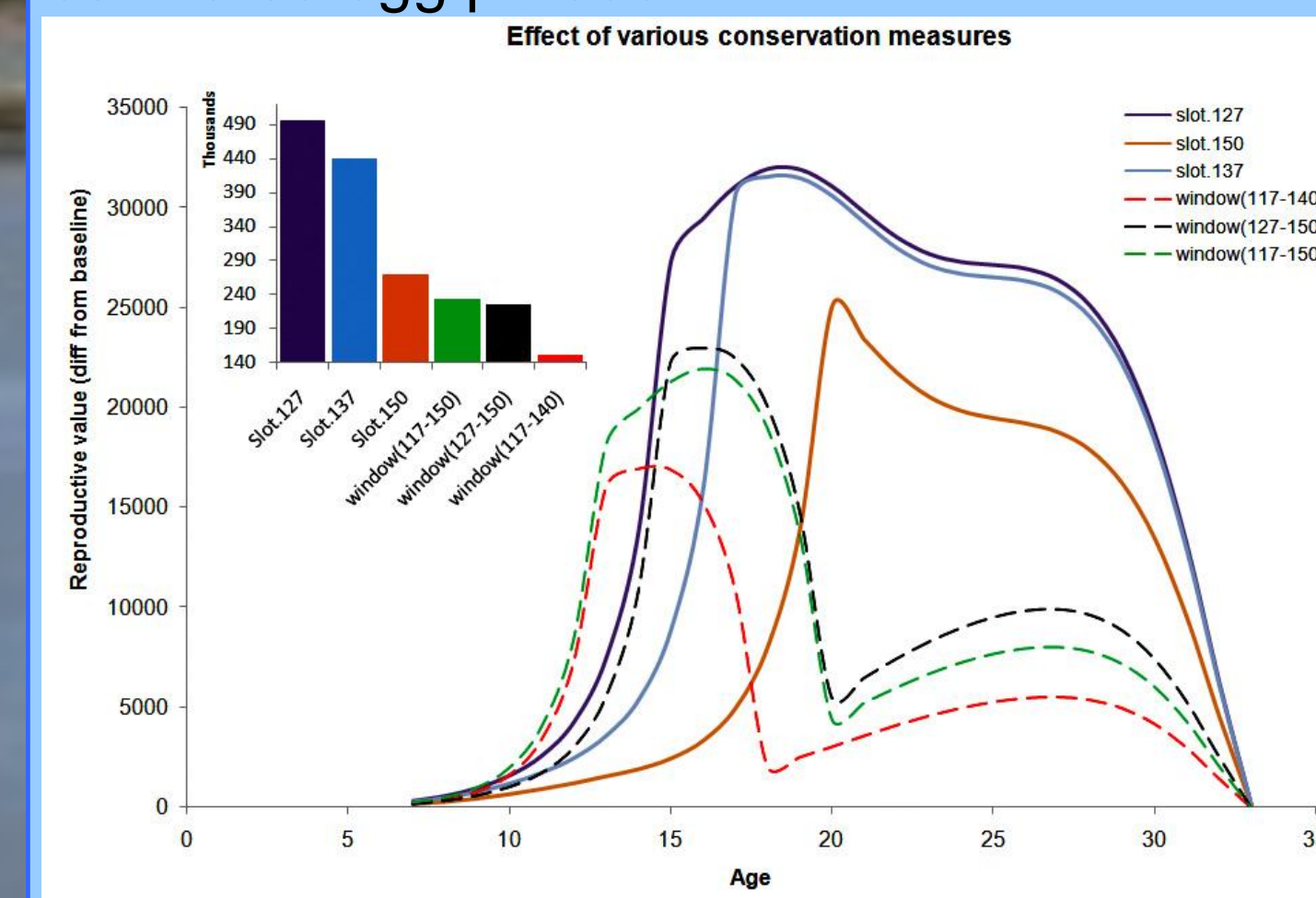


Figure 1. Effects of slot fishing and modified slot fishing on reproductive value.

- The slot fishery, protecting lobsters with carapace lengths <82.5 mm and >127 mm, increases current and future egg production by 16.8%.
- Harvesting of lobsters >127 mm reduces this percent.
- Modified slot fishing with a wide window was less effective with an average increase of 8.7% in current and future egg production.
- Narrower windows are not effective.²
- Closed areas increased egg production/female compared with adjacent areas because of larger lobster sizes (Duck and Round Island) over a 12-year period.⁶
- Analyzing closed areas for a 1-year period showed inconsistent results; 2 closed areas had larger females and males within closure (Gander Bay and Summerford), 2 had larger males only (Round and Duck Island) and 2 had no size differences (Shoal Point and Trout River).⁷
- Local effect of closed areas on reproductive value was greater than the other conservation measures (Table 1).

Goal 4: Large-scale effects of closed areas

- We calculated the large-scale effects of closed areas on reproductive value (RV) as follows:²

$$\text{Eq. [1]} \quad \text{RV}_{\text{total}}(\text{MPA})/\text{RV}_{\text{total}}(\text{no MPA}) = 1 + (1.65 \times 1.2 - 1) \times \% \text{MPA}$$

where % MPA = Area of MPA / (Area of MPA + Surrounding Area)

- Small protected areas at Eastport increased reproductive value in a large area (Bonavista Bay) by a factor of 1.07 (see report for details).

Value of result: Small protected areas have little effect on reproductive value at a larger scale; however, they are potentially important as refuges.

Goal 5: Promoting Stewardship: Following up on Fishermen's Questions

Why do scientists get licenses to catch egg-bearing lobsters for research and we have to release them back into the water? Noninvasive sampling technique created to estimate egg numbers on lobsters without removing all of the eggs.⁸

Value of result: Stock assessments on egg production can be done while still respecting the conservation measures to protect egg-bearing females.

Do large females reproduce less frequently? Percent of females with eggs increases with increasing size.

CONCLUSIONS

- V-notching and slot fishing (protecting sizes <82.5 mm and >127 mm) significantly increase reproductive value (current and future egg production).
- The effect of closed areas on reproductive value depends on the size of the closure.
- Although all three measures are shown to increase current and future egg production, a combination of v-notching, slot fishing, and closures would be more effective than any one measure.
- Sustainable management of lobster fisheries needs to take into account the ratio of reproductive value relative to dollar value.
- A detailed plain language report is available from www.curra.ca or contact Kate Wilke at kmwilke@mun.ca for more information.



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