Effects of bottom temperature on growth of Snow Crab: A comparison between the Newfoundland-Labrador Shelf and the southern Gulf of St. Lawrence

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Outline

• Background; snow crab life history

• Effects of bottom temperature on size-at terminal molt, by sex

• Effects of bottom temperature on male molting frequency (skip molting)

• Conclusions:
  What is the overall effect of variation in the thermal regime on snow crab populations?
Male, Female

Snow Crab Life Cycle

40 mm
70 mm
95 mm
135 mm

Earliest sexual maturation
Both Sexes

Fishery
Combination small claw and spermatophores is **adolescent** (also called ‘morphometrically immature’ or ‘small-clawed’).

Combination large claw and spermatophores is **adult** (also called ‘morphometrically mature’ or ‘large-clawed’).
Shell condition

New-shelled  Older-shelled
NL Shelf
Div. LNOPs spring
Div. 2J3KLNO fall

nGSL
Div. 4T
I. Effect of temperature on size-at-terminal molt
Recently-molted new-shelled males
(adult on top, adolescent below)
Sample sizes

NL Females

NL Males

sGSL Females

sGSL Males
Size-at-terminal molt

NL Females

NL Males

sGSL Females

sGSL Males
Mean size and Size-at-50% maturity

**NL Females**
- Mean CW
- CW at 50% Maturity

\[ y = 2.6954x + 42.437 \]
\[ R^2 = 0.7381 \]

\[ y = 2.118x + 42.824 \]
\[ R^2 = 0.6736 \]

**NL Males**
- Mean CW (Adults)
- CW at 50% Maturity

\[ y = 3.5237x + 84.5 \]
\[ R^2 = 0.7841 \]

\[ y = 2.5361x + 81.131 \]
\[ R^2 = 0.6653 \]

**sGSL Females**
- Mean CW (Mature)
- CW at 50% Maturity

\[ y = 1.0619x + 52.747 \]
\[ R^2 = 0.8064 \]

\[ y = 1.7177x + 47.989 \]
\[ R^2 = 0.8866 \]

**sGSL Males**
- Mean CW (Mature)
- CW at 50% Maturity

\[ y = -0.476x + 93.22 \]
\[ R^2 = 0.1174 \]

\[ y = -0.3817x + 95.775 \]
\[ R^2 = 0.0548 \]
Conclusions (Size-at-terminal molt)

• Temperature has a greater effect on females than males (despite smaller ‘available’ size range) because:
  - the energetic cost of the terminal molt is much higher for females.
  - females are not as migratory as males and so are better conditioned by temperature.
• Temperature effect is clearer at NL than sGSL because:
  - Males at NL, with sharper bathymetry and larger areas of extreme temperatures, are better conditioned by all temperatures than those at sGSL. Temperature-related ontogenetic migrations are likely more pronounced at NL than at sGSL.
II. Effect of temperature on molting frequency (incidence of ‘skip molting’)
Molting frequency (percentage skip-molting)
Conclusions (Molting frequency)

- Frequency of molting decreases with size and increases with temperature (highest incidence of skip molting at largest sizes and lowest temperatures)
Recruitment to the fishery

Hatching

\[ \downarrow \]

Pelagic larvae

\[ \downarrow \]

Settlement

\[ \downarrow \]

\begin{itemize}
  \item Cold Regime during early benthic life
  \item Positive effect on early survival (Marcello et al. this meeting)
\end{itemize}

\[ \downarrow \]

\begin{itemize}
  \item Cold Regime throughout remainder of pre-recruit life
  \item Negative effect through small size-at-terminal molt (this study)
  \item Negative effect through low molting frequency (this study)
\end{itemize}

Recruitment to the fishery

Conclusion

Schematic of effects of thermal regime on snow crab population dynamics and recruitment
Recruitment to the fishery

Hatching

Pelagic larvae

Settlement

Cold Regime during early benthic life

Positive effect on early survival (Marcello et al. this meeting)

Cold Regime throughout remainder of pre-recruit life

Negative effect through small size-at-terminal molt (this study)

Negative effect through low molting frequency (this study)

Recruitment to the fishery

Negative effect through delayed embryonic development

Negative effect through reduced fecundity