Seasonal migrations and thermal histories of large ovigerous lobsters (*Homarus americanus*): Do movements maximize degree days for egg development?

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BACKGROUND –

- Adult lobsters in different parts of the species' range have been documented to undergo seasonal movements or long range migrations to meet the physiological requirements of:

  Molting, Mating, Egg Extrusion, Embryonic Development

- It has also been hypothesised that ovigerous (egg bearing) lobsters undertake seasonal inshore/offshore migrations to maximise the degree-days experienced by their embryos

- Only one study has measured both the migration (horizontal distance) and temperatures experienced by naturally brooding lobster (Cowan *et al*. 2007), but did not measure depth, and water temperatures in different areas.

(Q1) What is a Degree Day?
(Q2) How Would an Inshore/Offshore Migration affect Degree Days?

Cooper and Uzmann 1971, 1980; Campbell and Duggan 1980; Forgarty *et al.* 1980; Ennis 1984; Campbell 1986, 1990, 1992; Pezzack *et al.* 1992; Lawton and Lavalli 1995; Comeau and Savoie 2002; Wahle *et al.* 2004; Cowan *et al.* 2007

BACKGROUND –

(Q1) What is a Degree Day?

- Below 3.4°C -> No Egg Development Occurs
- If the water is 4.4°C for one day -> One Degree Day
- If the water is 13.4°C for one day -> 10 Degree Days Accumulated
- If the water is 23.4°C for one day -> 20 Degree Days Accumulated!
- Campbell (1986) estimated1832 degree days are needed

- So if the ovigerous female lobster stayed in 4.4°C water year round -> 1832 days needed for an egg to hatch into a larvae (5 years)
- 13.4°C Year Round -> 183.2 days to hatch (~6 months)
- 23.4°C Year Round -> 91.6 days to hatch (~3 months)

BACKGROUND –

(Q2) How Would an Inshore/Offshore Migration affect Degree Days?

It would enable the lobster to stay in the warmest water available, year round

Shallow Inshore Sites – Warm water in Summer, very cold in winter

Deep Offshore Sites – Constant cool water year round

So by being shallow in the summer, and deep in the winter a lobster could maximize the number of degree days experienced, and thus its eggs would mature fastest

MAIN RESEARCH QUESTION

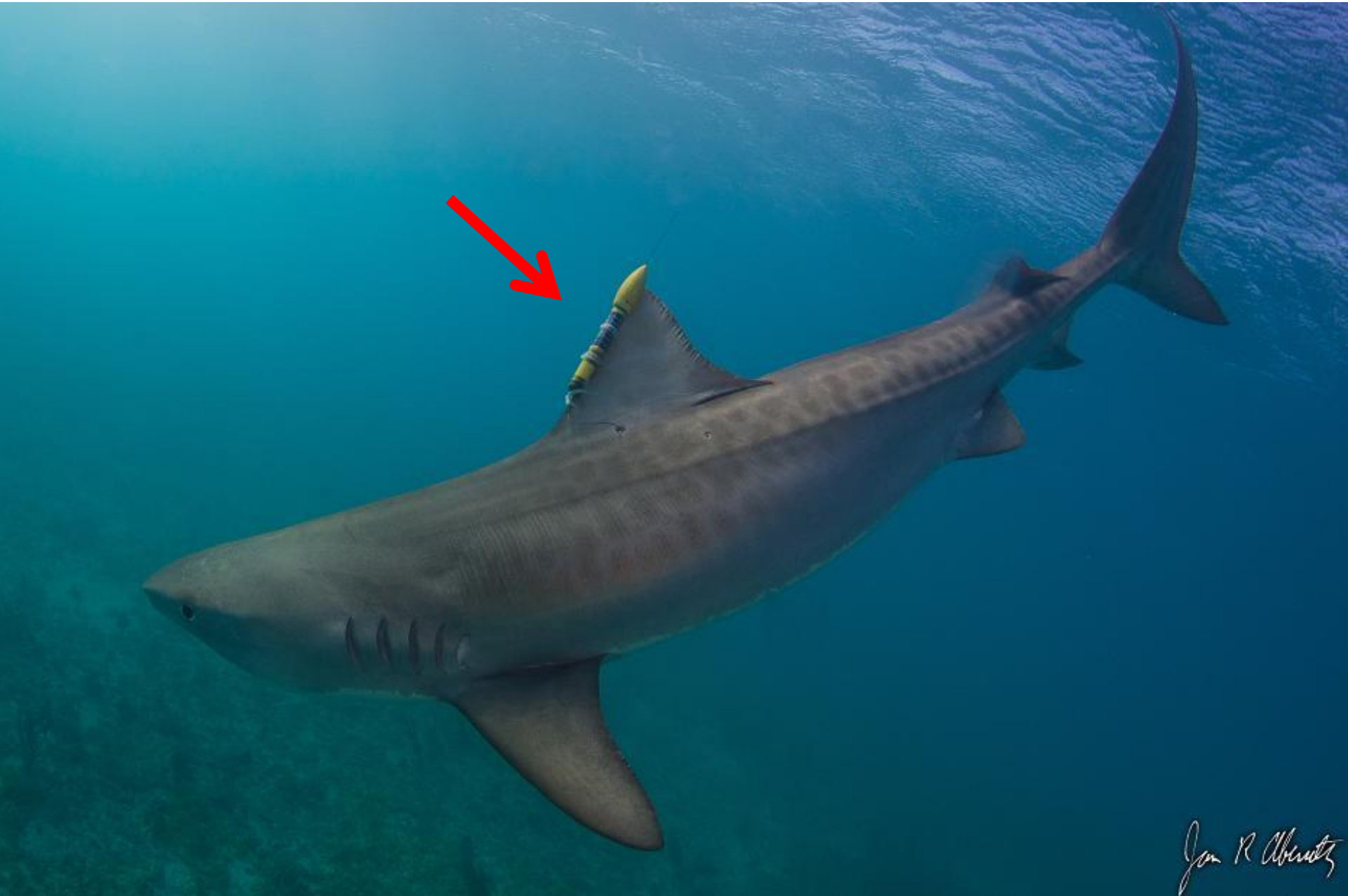
Do ovigerous American Lobsters, tagged in the shallow waters of Grand Manan, make a seasonal migration which enables them to stay in the warmest waters available year round, thus maximizing the degree days for egg development?

ADDITIONALLY:

What does the seasonal migration of these lobsters look like?

- Date/water temp at beginning of migration?
- Route of migration?
- Location/ depth/ temperature of overwintering area?
- Date/ water temp at beginning of return journey?
- Do all lobsters return to the cove they were tagged in?
  - If not where do they go?

METHODS



METHODS

- Pop-up Satellite Archival Tag
  - Desert Star Systems
  - Depth and Temp every minute!
  - Daily estimate of location
  - User set time and date of pop off
  - Works on ARGOS Satellite System (worldwide)
  - Reasonable price (for a PSAT Tag) only $2250 each!

- Have been used on many marine mammals, sharks, pelagic fish, turtles etc.
- This will be the first use on an invertebrate
- I'm very excited!

This project is funded by an ALSF Grant awarded to Bryan Morse, as well as an NSERC Discovery grant awarded to Dr. Remy Rochette

METHODS

- Early September 2013 – 10 very large 180 mm CL+ ovigerous lobsters
- Flagg Cove, Grand Manan, NB
- Track seasonal migration to depths of 200m (600ft)
- Place 20 – 40 temperature loggers in area, to create a spatial model of the temperatures the lobsters could experience in different areas (location of loggers to be determined in collaboration with DFO SABS)
- In June 2014 Tags will pop off the 10 animals and transmit data

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We can then compare the migration route of the 10 lobsters to the temperature spatial model to see how optimal the migration was for embryo development

We can also learn a lot about the migration of these 10 animals, including where they went, how long it took to get there and how many of the 10 returned to Flagg Cove the next summer and much much more!

QUESTIONS?

Is anyone here from Grand Manan?
Do you want to help? (we can chat later)