Project 4.5: Oceanic migration of the threatened American eel to spawning grounds in the Sargasso Sea

PI: Julian Dodson and Martin Castonguay
R.A.: Mélanie Béguer-Pon
Master student: José Benchetrit
Collaborators: Shiliang Shan, Kyoko Ohashi, Jinyu Sheng, Keith Thompson, Guy Verreault, David Stanley
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The American eel: a threatened enigmatic species

Panmictic population

Endangered (IUCN red list)
Threatened in Canada (COSEWIC, 2012)

Complex life cycle

Spawning migration largely unknown

Escapement rate
Exact location
Migration routes
Environmental conditions/cues
Vertical behaviour
Swimming speed
Multiple approaches to reveal the migration pattern

Field tracking
  - Passive acoustic tracking
  - Pop-up Satellite Archival Tags
  - Simulation using particle-tracking models

St. Lawrence system
Sargasso Sea
Many partners and collaborators

- Ministère des Forêts, de la Faune et des Parcs (Quebec) (D. Hatin, G. Verreault, M. Legault, Y. Mailhot)
- AECOM (V. Tremblay)
- Ontario Power Generation (D. Stanley)
- Lucia Abellan
- Dept of Oceanography, Dalhousie University
  K. Ohashi, S. Shan, K. Thompson and J. Sheng
Acoustic tracking in the St. Lawrence system

604 eels tagged (2010-2014)

328 eels detected
154,925 detections

Migratory pattern in the St Lawrence River and Estuary (2010-2011)
• Unidirectional and downstream movements but with pauses
• High individual variability
• Route: southern part of SLR-E
• Nocturnal ebb tide transport

Escapement from the Gulf (2011-2014)
• Low rate (11.3%)
• Takes 13 to 67 days
• Route: Laurentian Channel
• Predation: 2 cases – a lot more possible
• DVM (Temp sensors)
• Stocked and Transported eels can find their way out

Béguer-Pon et al, 2014. CJFAS; Béguer-Pon et al, In prep
Tracking using PSAT: increasing success over the years

Sargasso Sea N=5!

<table>
<thead>
<tr>
<th>Release Locations</th>
<th>Total Tracking Duration (days)</th>
<th>Max tracking distance (Km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2012</td>
<td>50</td>
<td>50</td>
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<td>2014</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>2015</td>
<td>200</td>
<td>200</td>
</tr>
</tbody>
</table>

Translocated eels (Larger)
First direct evidence of eels migrating to the Sargasso Sea

- Particular areas
- Similar trajectories
- Little effect of currents
- True navigation?

Vertical behaviour documented
Large Media coverage of our findings

Direct observations of American eels migrating across the continental shelf to the Sargasso Sea

Eel Migration Mapped for the First Time

Canadian eel tracked on 2,400-kilometre migration to Sargasso Sea

L’anguille d’Amérique livre ses secrets
Simulating the migration

⇒ 2 individual-based models coupled with ocean circulation model

In the St. Lawrence Estuary and Gulf (Dalcoast)

Which behaviours allowed v-eels to reproduce the migration pattern observed by telemetry experiments?

⇒ Active swimming and complex orientation strategies must be employed

⇒ Selective tidal stream transport sufficient in SLE (but active)

⇒ Orientation based on salinity gradient or depth not sufficient

⇒ Tool for evaluating the potential effect of climate change on the duration of migration

Béguer-Pon et al, 2016. MEPS
Simulating the migration

In the North Atlantic Ocean (NEMO)

Exploring the role of the physical marine environment in silver eel migrations
(European and American eel)

2 swimming-directed behaviours simulated

→ Minimum swimming speeds assessed
→ Effects of ocean currents for swimming speed <0.8 m/s
→ Energy would not be a limiting factor; affected by range of DVM

Béguer-Pon et al, 2016. ICES Journal of Marine Science
Tracking eels: a review of telemetry studies

6 co-authors

- K. Aarestrup
- K. Tsukamoto
- D. Jellyman

- American eel: 25.6%
- European eel: 46.2%
- Longfinned eel: 10.3%

- 81 References
- Acoustic (51%), Radio (28%), Satellite (16%)
- Freshwaters/Brackish/Marine Waters
- Direct Management component: 43%
- Small eels (males) neglected
- Little use of tags equipped with sensors
- Satellite tracking challenging

*Béguer-Pon et al, In prep.*
Project 4.5. List of publications


In preparation


- Béguer-Pon, M., Stanley, D., Threader, R., Verreault, G., Castonguay, M., Dodson, J. (In prep) Leaving the St. Lawrence system : can stocked or transported silver eels make it?
Ongoing collaboration with

Tag-it-Yourself (TiY) project

Objective:
Collecting more accurate and diverse information from electronic tags

⇒ Development of a new generation of affordable electronic tags which will transfer data through a nano-satellite

Meeting scheduled Mid-July (Sète & Montpellier, France)

In collaboration with:
- the Institut d'Electronique du Sud (IES, Montpellier)
- Laboratoire d'Informatique, Robotique et Micro-électronique de Montpellier (LIRMM)
Thank you for your attention