Direct and indirect evidence for massive differences in jellyfish biomass between the Pacific and Atlantic: implications for fisheries bycatch?

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Introduction

Historical jellyfish data:
  Incidental observations and bycatch
  Few specific long-term datasets

Jellyfish blooms are attracting widespread attention
Public interaction – many sightings
  *But are blooms actually anything new?*

Few reviews of long-term quantitative data
Current projects collating data and assessing qualitative data
Part 1 – Gelatinous biomass assessment

Sampling method?

Numerical data more widely available
*but assessment of size absent*

Biomass allows assessment of predation potential and prey availability
*but one individual or many?*

*Ideally both would be recorded simultaneously*
Biomass trends

Global database estimated from the epipelagic.

Low sample sizes excluded

Exponential decrease with depth. $r^2 = 0.543$, $p < 0.001$

Highest biomass: enclosed lakes

Lowest biomass: mid ocean

Species composition

Proportional composition of taxa biomass

Species composition of groupings not consistent with depth. e.g. Semaeostomes

Life-history dictates depth of observations

Ctenophores predominantly *Mnemiopsis*.

n = 11, 13, 14, 6, 8, 6 study sites

Location of Biomass estimates

Lilley et al. (2011)
Marine Biology 158: 2429-2436.

58 data sets/sites
Notable gaps
  e.g. central oceanic

Additional data may be available if mined from the sources of overview databases.
Part 2 – Applying biomass estimates at an ocean basin scale and their effects on predators.

Known predators of gelatinous zooplankton

Up to 200kg / day
Leatherback turtles: An indicator of gelatinous blooms?

- Endangered species
- Wide distribution, independent populations
- Deep diver
- Feeding migrations
- Bi-/Tri-annual nesting

Migrations studied through satellite tracking
Atlantic vs Pacific
An applied case

Tracking study
(Bailey et al. 2012)
Migration differences

Behaviours as a proxy for foraging

What is the evidence for a difference between the Atlantic and Pacific?
Atlantic vs Pacific
Population differences

Nesting interval – Pacific > Atlantic
Clutch Size - Pacific < Atlantic
Body size - Pacific < Atlantic

Reduced resource availability for Pacific leatherbacks

Result:
Current decline in Pacific population size

Generic issues:
Predation/culling/bycatch
Changes in beach condition/Temp
Poor foraging?
Reduced survival

Kraer & Van Essen-Fishman (ian.umces.edu/imagelibrary/)
Atlantic vs Pacific
Jellyfish Biomass

Is there a difference between Atlantic & Pacific gelatinous biomass?

Open water sites only (n=16/ocean)

Samples within top 200m

Few truly oceanic samples, typically coastal or continental shelf
Atlantic vs Pacific
Jellyfish Biomass

Median Biomass – Atlantic > Pacific

Open water sites
Median biomass
Atlantic 20:1g Pacific

N=16 per ocean
Atlantic vs Pacific
Jellyfish Biomass

Median Biomass – Atlantic > Pacific
Maximum Biomass – Atlantic > Pacific

Open water sites
Most productive site (mean biomass)
Atlantic 15:1g Pacific

Best sample biomass
Atlantic 219:1g Pacific

N=16 per ocean
Atlantic vs Pacific
Jellyfish Biomass

Median Biomass – Atlantic > Pacific
Maximum Biomass – Atlantic > Pacific

Biomass caveats:
Spatial variability
Energy density
Coastal research emphasis

Does turtle behaviour overlap with prey availability?
Atlantic vs Pacific
Turtle behaviour

Percentage frequency graph of daily distance travelled

Can identify:
1) Foraging
2) Migration
3) Compare rate of travel between individuals or locations

Bimodal frequency between travelling and foraging
Atlantic vs Pacific

*Turtle behaviour*

**A** Atlantic Travel Speed

Bimodal frequency between travelling and foraging

**B** Pacific Travel Speed

Unimodal frequency in the Pacific – More migration, less foraging
Atlantic vs Pacific

Turtle behaviour

Atlantic Dives

Dives peak around the productive gyre region

Gyre deeper

Shallow dives

No peak in diving behaviour

= less gelatinous prey?

Or out of reach?

Pacific Dives

South Pacific Gyre

Nutricline

Deeper dives

Gyre deeper

Shallow dives

No peak in diving behaviour

= less gelatinous prey?

Or out of reach?
Atlantic vs Pacific
Turtle behaviour

The exception:
• Coastal migration path
• Data similar to Atlantic individuals
  • Larger female
  • Larger clutch sizes
  • Productive upwelling region
  • More productive for turtles?

Highest recorded East Pacific jellyfish biomass

East Pacific coastal frequency of travel speeds n = 1
Atlantic vs Pacific

Conclusions

Biomass estimates would support hypothesis of a reduced food resource in the Pacific

Broadscale evidence for prey trends (Brotz et al 2012)
- SE Pacific – gelatinous decline
- Atlantic – stable/increasing

Foraging response?

Turtles may no longer forage in best jellyfish regions because of bycatch
(Mismatch productivity & foraging locations)

_Turtle behaviour may be useful as an indicator of productive regions for gelatinous biomass_
One last thought

What role do smaller gelatinous species, such as these small 4g Linuche, play in the diet of turtle species?

(Fossette et al 2012, Biology Letters 8:351-4.)

Questions? – lilley@obs-vlfr.fr
Poster S7-7 / S7-8

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