A summary of jellyfish and aquaculture interactions:

where to next?

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Jellyfish attack destroys salmon

A jellyfish invasion has wiped out Northern Ireland's only salmon farm, killing more than 100,000 fish.

A Northern Salmon spokesman said last week's attack could cost more than £1m.

Billions of small jellyfish, known as Mauve Stingers, flooded into the cages about a mile into the Irish Sea, off Glenarm Bay and Cushendun.

The density of jellyfish stopped workers from reaching cages

Open Enlarge Image

The jellyfish covered an area of up to 10 square miles and a depth of 35 feet. Rescuers tried to reach the cages but the density of fish made it impossible.

Managing director John Russell said he had never seen

A tale of two projects…

GilPat (2008-2011)

GilPat

Marine Institute
Foras na Mara

SeaChange
Casadh na Taoide

EcoJel (2008-2012)

A collaborative effort



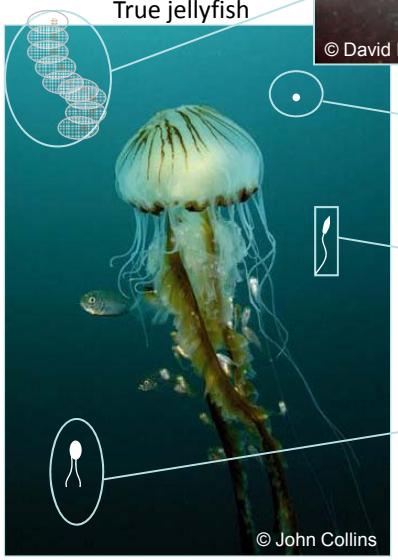




What are jellyfish?

Salps and co.

True jellyfish

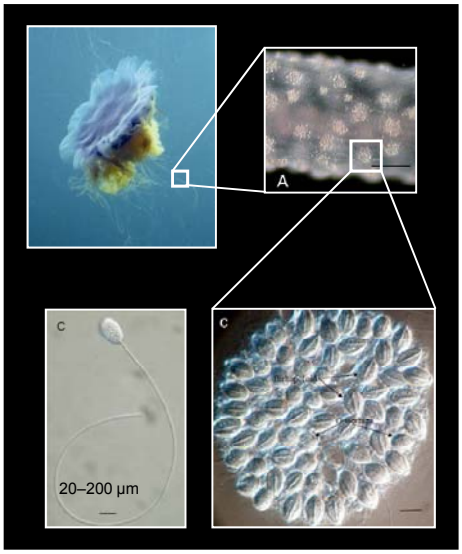


Little jellyfish

Comb jelly

Siphonophores

A defining characteristic of harmful sp. – the stinging capsules



How do jellyfish impact with aquaculture?

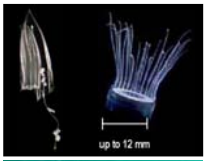
- There are two types:

Those that cause catastrophic fish kills

Those that are capable of causing background levels of mortality

Jellyfish that cause 'catastrophic fish kills'

- There are four species that have caused major fish kills in the past
  - The mauve stinger (*Pelagia noctiluca*)
  - *Muggiaea atlanticum* (siphonophore)
  - *Apolemia uvaria* (siphonophore)
  - *Solmaris corona*




Fish farm
© Nigel Motyer
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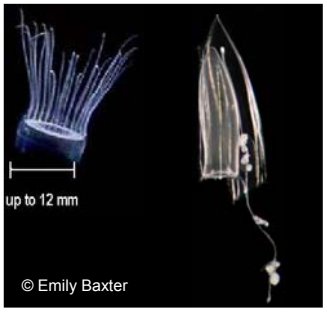
Other catastrophic fish kills…

- >100000 farmed salmon in Norway caused by the siphonophore *Muggiaea atlantica* (Fosså et al. 2003)
- This species was also a suspected causative agent of over 1000000 salmon killed off northwest Ireland in 2003 (Cronin et al. 2004)
- The siphonophore *Apolemia uvaria*, the oceanic hydromedusa *Solmaris corona* and the neritic hydromedusa *Phialella quadrata* have also been previously implicated in fish kill events (Bruno & Ellis 1985, Båmstedt et al. 1998)

Characteristics of jellyfish that cause catastrophic fish kills

- Most are **oceanic or shelf species** (i.e. they need to be carried into an aquaculture site)
- Some of them can **multiple very rapidly** (10 days)
- Can occur in **very high densities** e.g. 100s – 1000s individuals m^{-3}
- Can occur in enormous aggregations 10s – 100s km^{-2} spatial extent



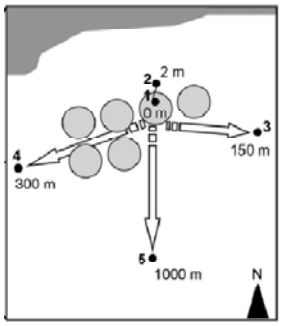
Jellyfish that cause 'background levels' of mortalities

- Between 2003 and 2006 Irish farms suffered an average of 12% mortality due to gill disorders (Rodger & Mitchell 2005)
- Gill disorders may be multi-factorial with 1□ damage caused by jellyfish and then 2□ infection by bacteria or parasite
- All of the jellies that cause 'catastrophic fish kills' (in low densities) plus many other species may cause background level of mortalities e.g.
  - The common jellyfish (*Aurelia aurita*)
  - The Lion's Mane (*Cyanea capillata)*
  - *Phialella quadrata* (a little jellyfish)

Baxter et al (2011) Aquacult Environ Interact

What evidence do we have for background levels of impact?

- Zooplankton samples collected every 2 weeks for 2 years at two sites (southern and western)
- Fish mortalities recorded and fish samples taken for examination of gills disorders



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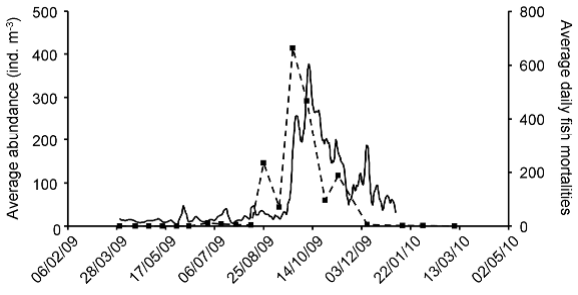
Results

- Daily fish mortality correlated with the abundance of harmful jellyfish species
- Densities as low as ~450 jellyfish m-3 were associated with gross gill pathologies



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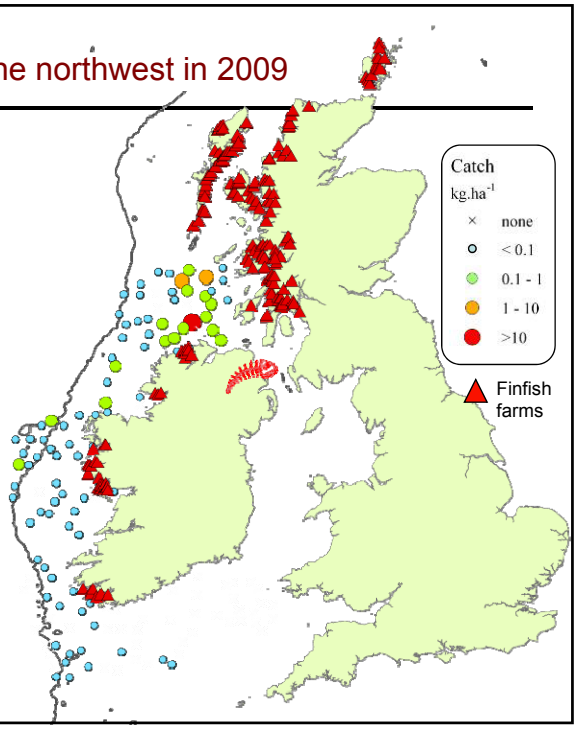
Characteristics of jellyfish that cause 'background levels'

- No unifying characteristics but some generalisations can be made:
  - Occur in lower densities
  - Many are local species (home grown)
  - Hydrographic factors or behaviour may led to local aggregations
  - Some are very large/visible (e.g. *Aurelia*)
  - Others very small (*Phialella*)

So what are the real threats?

- The major threats to 'a single farm' are from:
  - *The Mauve stinger (Pelagia)*
  - *Muggiaea*
  - *Apolemia*
  - *Solmaris*
- All are **oceanic/shelf species with late seasonal arrival** usually
- Northern/western coast seems to be more affected by *Pelagia*

The mauve stinger off the northwest in 2009



So what are the real threats?

- *Muggiaea* appears to be more widespread appearing first in southern waters and then later further up the coast
- *Apolemia* and *Solmaris* we know very little about
- The above species in lower densities and other 'local species' (little jellyfish, moon) can cause background mortalities that add up on a national level

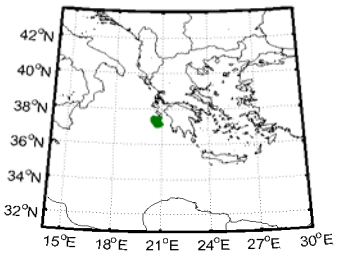
So where to next?

- Problem… what to you do when you know a hurricane is heading straight for your house?

- *You leave, or batten down the hatches…*

Development of an early warning system

- It would help if we knew when a jellyfish bloom is going to occur and how they move



How can the aquaculture industry 'batten down the hatches'?

- Deployment of finer meshes and aeration….

- We to conduct large scale trails for several weeks or more when jellyfish abundance is high

How can the aquaculture industry 'batten down the hatches'?

- Bubble curtains…

- Design and field trials (several weeks) of such a system are required to assess the effectiveness of this technology and to investigate the operating parameters such as operating depth, pressure and air flow rates
- If it works, we need to develop low cost methods for running the bubble curtains (renewable energy)

How can the aquaculture industry 'batten down the hatches'?

- Forcing salmon lower in the water…

- We need to understand the vertical distribution of jellyfish

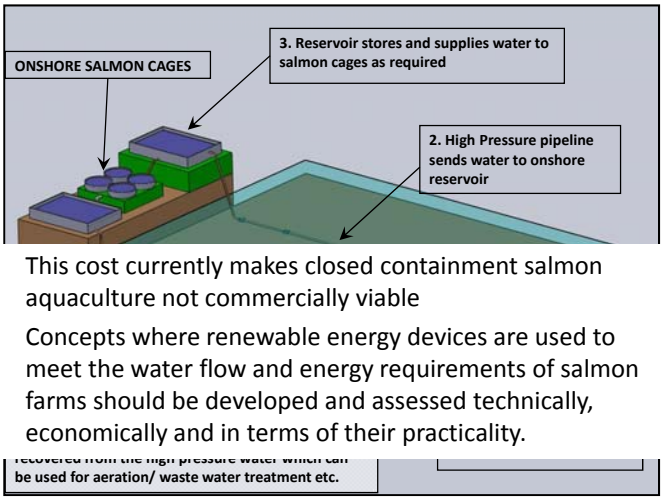
How can the aquaculture industry 'batten down the hatches'?

- Moving aquaculture cages offshore

- We need more data on jellyfish distribution and abundance
- More information is needed on the movements of water

How can the aquaculture industry 'batten down the hatches'?

- Moving aquaculture onshore (closed containment systems)



  - This cost currently makes closed containment salmon aquaculture not commercially viable
  - Concepts where renewable energy devices are used to meet the water flow and energy requirements of salmon farms should be developed and assessed technically, economically and in terms of their practicality.

The future?

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