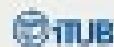




Lumpfish Habitat Development for use in Salmon Farming

Helen Conlon, Albert Imsland



Aquaculture and Salmon Farming

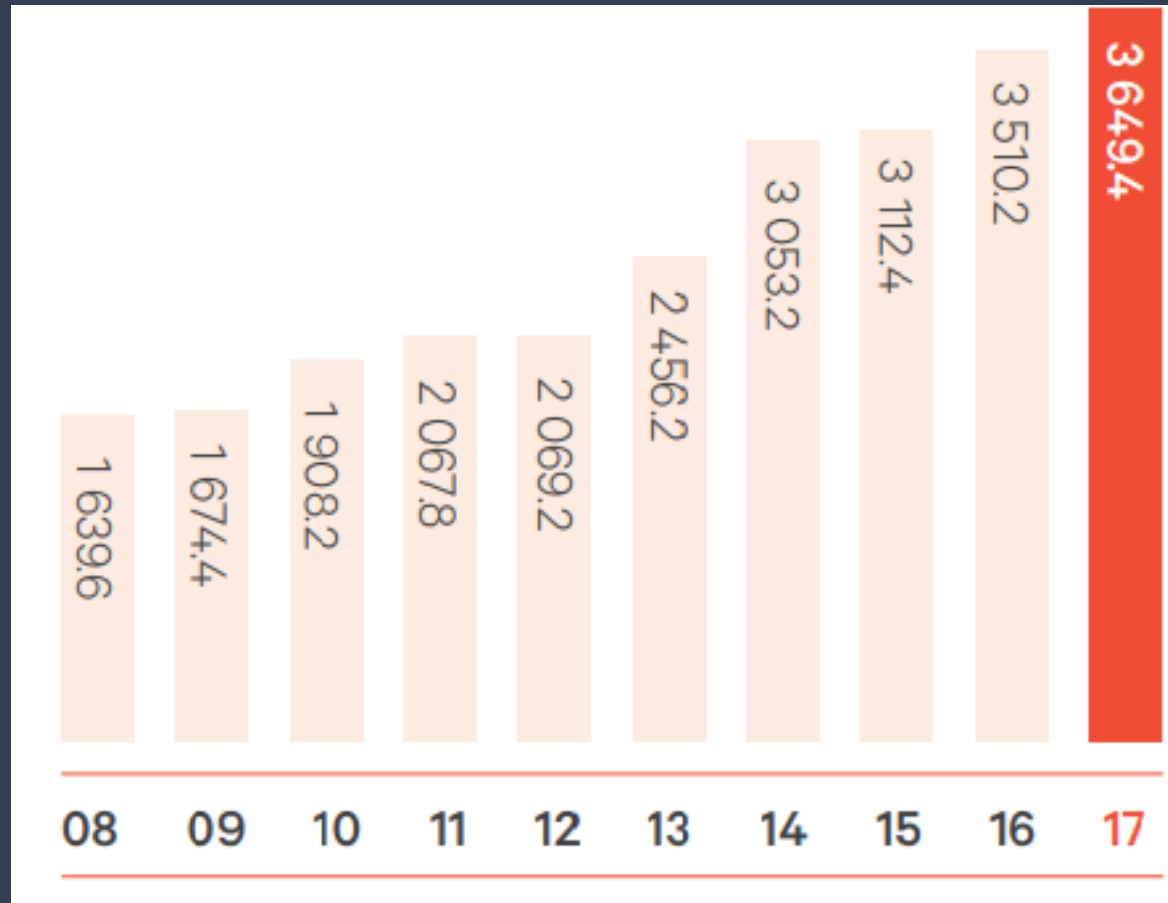


Figure 2. Mowi profit margin (eur million) in 2017. Taken from Mowi.com.

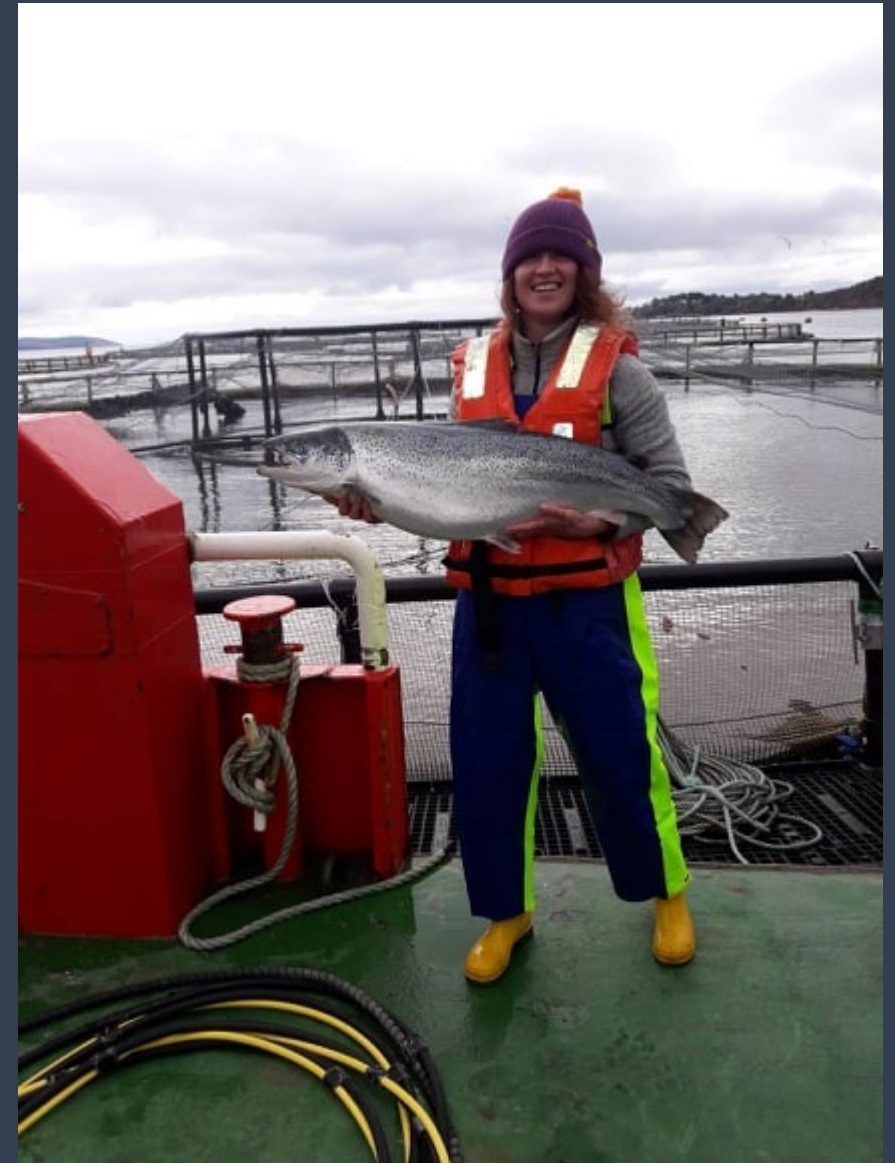


Figure 3. Harvest size salmon from Scottish salmon farm. Image Credit: Warren Harvey

Issues in Salmon Farming

High stocking densities = increased spread of disease and parasites

Sea Lice (*Lepeoptheirus salmonis*)

- US\$436m to the Norwegian salmon industry
- Eradication methods include chemicals, hydrolicer, thermolicer, lice skirts, lasers, **cleanerfish**



Use of Cleanerfish

Can be very effective.....



Wrasse
(*Labridae*)



Lumpfish (*Cyclopterus
lumpus*)



Figure 4. Treatments and total lice levels, excluding caligus, from the Mowi fish farm in Scotland. 'With Cleanerfish' indicates the salmon cycle where cleanerfish were used, in comparison to the previous cycle where they were not. Adapted from Mowi data source.

Cleanerfish Husbandry

Artificial habitats

- Provide shelter
- Improving health
- High cost
- Manual labour

Natural Habitats

- Currently being trialled
- Reduced costs
- Not as reliable



Figure 5. Examples of fake kelp used in salmon farming. Top left: close up of fake kelp with lumpfish attached, highlight by red square. Top right: fake kelp and barrels air drying. Bottom right: fake kelp example. Bottom left: real kelp line. Top image credit:Helen Conlon. Bottom image credit: Daniel Moller.

Material Selection



Figure 6. Plastic waste products at Highland Waste Services, Inverness. Taken by Helen Conlon on 5.6.18.
can you sub lable a-d?



Figure 7. Initially selected recycled materials for material preference trial. Top left: salmon feed pipes. Top right: salmon farm circle walkway section. Bottom middle: Salmon farm square cage section. Bottom left: Square salmon cage walkway section. Image credit: Helen Conlon.

Material Hatchery Trials



Figure 8. Three of the four materials used in preference trials. Left to right: cut feed pipes, walkway, and flat sheet of plastic. Image credits: Helen Conlon.



Figure 9. Material preference trial underway at Otter Ferry lumpfish hatchery. Image credit: Helen Conlon

Material Trial Results

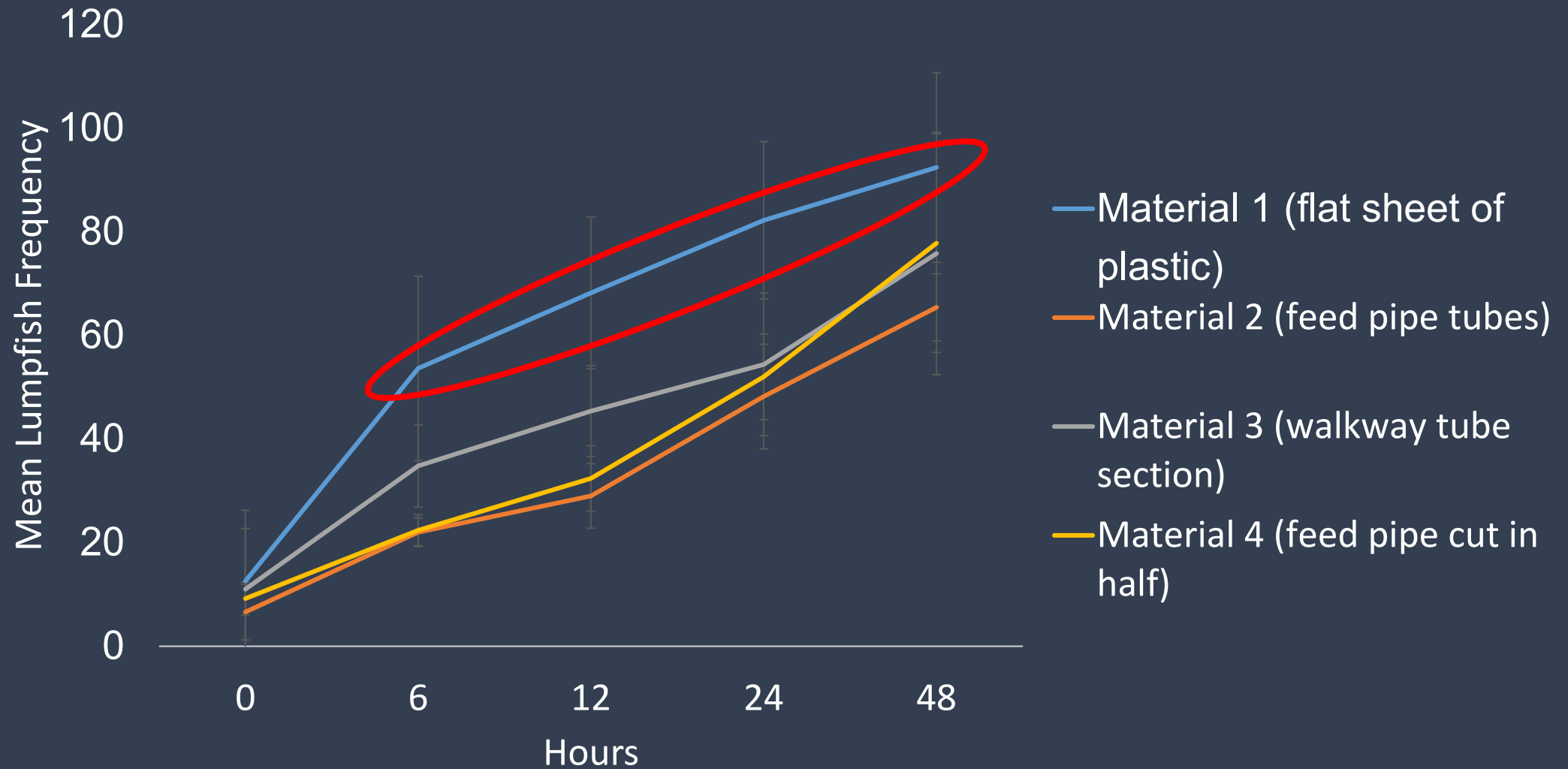


Figure 10. Mean (\pm SE) lumpfish found at five different time points across 48 hours on four different materials in the Otter Ferry hatchery trials.

Colour Hatchery Trials



Figure 11. Left: colour preference trial at Otter Ferry Hatchery. Right: black and white plastic sheets in colour preference trial. Image credit: Helen Conlon.

Colour Trial Results

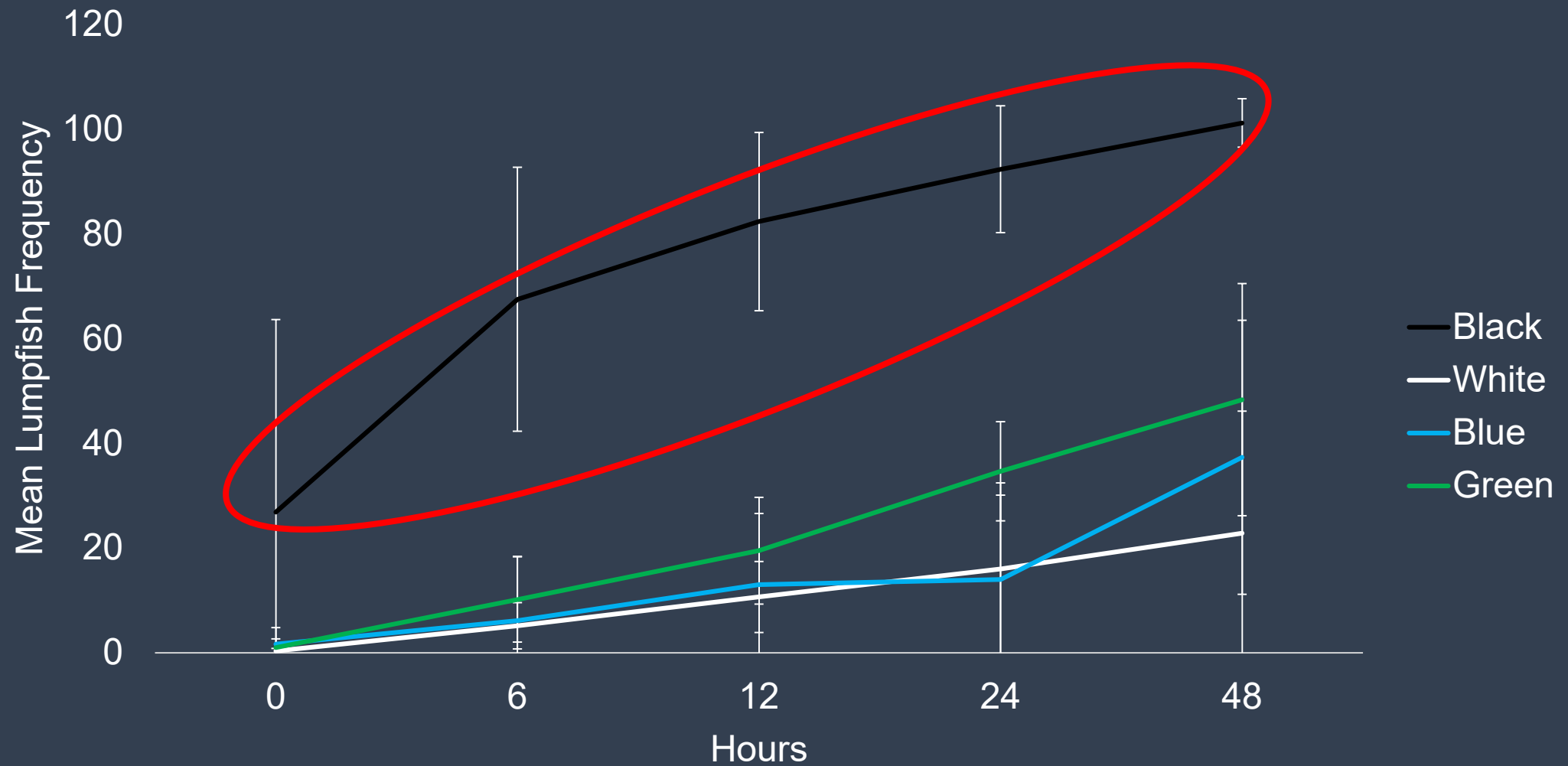


Figure 12. Mean (\pm SE) lumpfish found at five different time points across 48 hours on four different materials in the Otter Ferry hatchery trials.



Aquacultural Engineering

Volume 87, November 2019, 102015



Money for nothing: The possible use of recycled fish farm material as habitat for lumpfish

Albert K.D. Imsland ^{a, b}  , Helen Conlon ^c

 [Show more](#)

<https://doi.org/10.1016/j.aquaeng.2019.102015>

[Get rights and content](#)

Final Design Development

- A folding design was developed
- Recycled walkway and flat sheet of plastic were incorporated

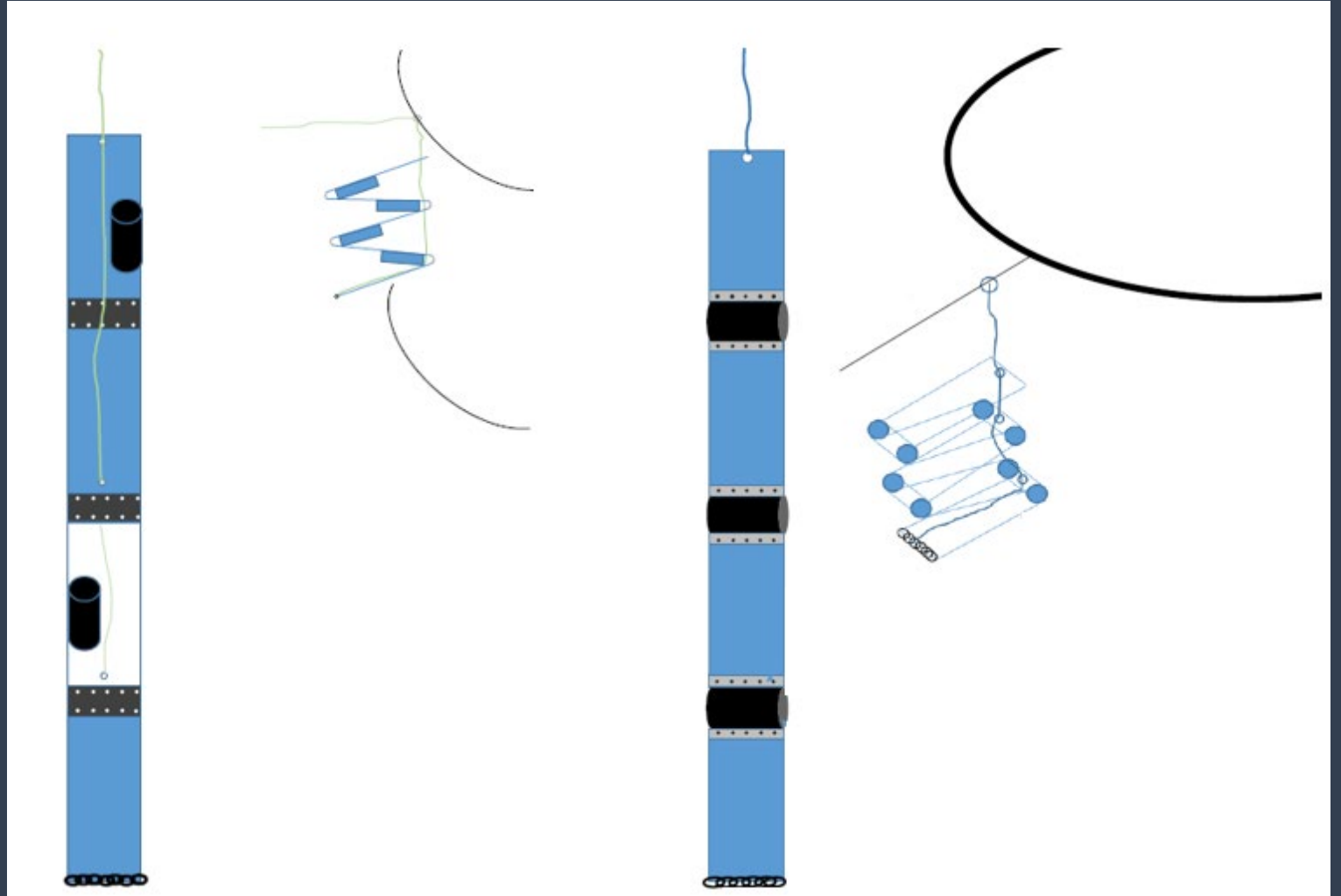


Figure 13. Initial hide design proposals. Left: prototype 1. Right: Prototype 2.

Final Design Development



Figure 31. Lumpfish habitat development. Bottom left: plaining plastic strips off recycled walkways. Top rleft: Folded habitat. Bottom right: stretched out habitat. Image credit:Helen Conlon.

Final Design Development



Final Design GoPro Footage

- 30 seconds



GoPro Footage Analysis

- General upward trend
- 5125 lumpfish in cage
- 0.2% of lumpfish utilised section of habitat

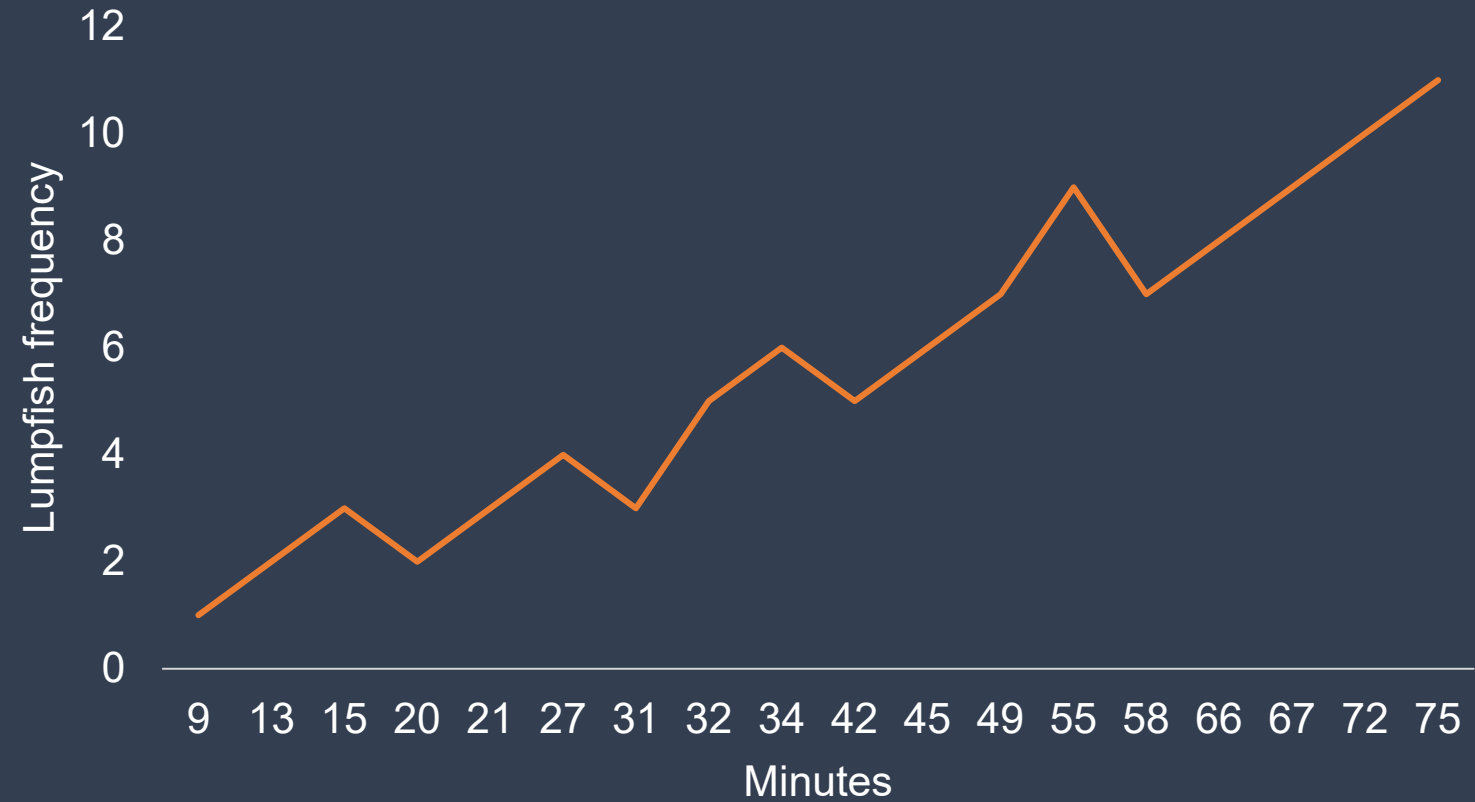


Figure 37. Number of lumpfish seen on the GoPro footage of the section of the end lumpfish habitat, across 75 minutes.

£1500



£336

Main Conclusions

- Non recycled and recycled materials used
- Significant preference for thin sheet of plastic and colour black
- Manual labour was reduced due to folding design
- Cost per hide was significantly reduced
- Limited GoPro footage, but showing promising trend
- Adding plastic to the marine environment, is using real kelp the future??



Can your industry upcycle?



Acknowledgements

I would like to thank **James Symth, Iainy Johnson**, and all staff at BDNC for allowing me to trial my habitat at their salmon farm. **Duane Coetzer and Ronnie Hawkins** for support from Mowi throughout the process. All staff at **Otter Ferry hatchery** for assisting me with my trial and the entertainment while I was waiting in between trial checks! Staff at **Highland Waste Services** for being extremely helpful and letting me take materials away for the project. **Neil and Monica Conlon** for assisting with the development of the end hide, and **Professor Albert Imsland** for the continued support on the project.

(as well as **Marnik Van Cauter** for keeping me sane throughout the process)



Cheers for listening!!