



Association of Scottish Shellfish Growers

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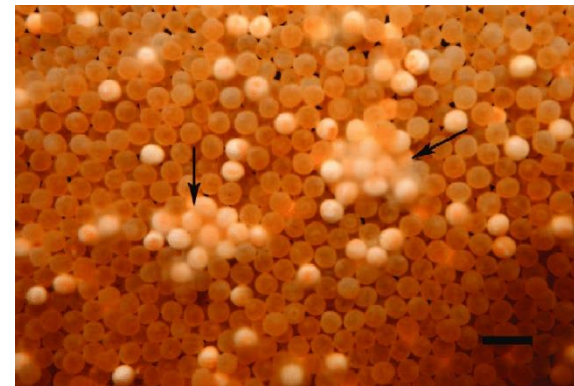
Probing the marine microbiome with
metagenomics.

Health, Disease and Aquatic Microbiomes

Healthy microbiomes



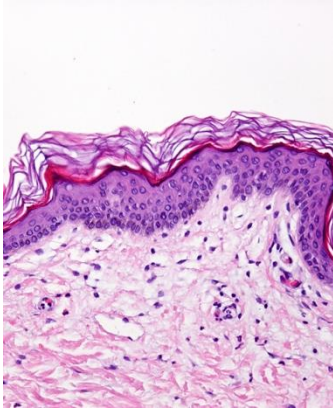
Dysfunctional microbiomes



A History of Microbiome Monitoring



Visual observation
600 million BC



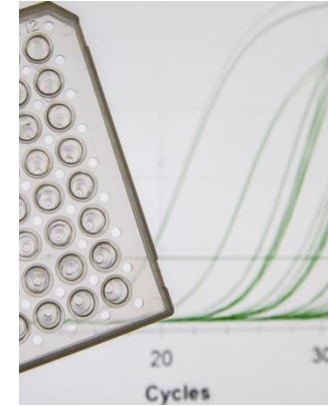
Histology
17th century



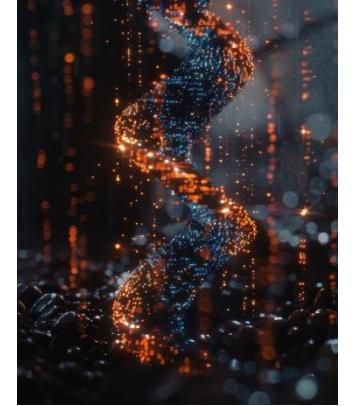
Culture
19th century



Water chemistry
19th century



Polymerase
Chain
Reaction
(PCR)
20th century



Metagenomics
21st century

Limitations of Targeted Detection

Aquatic livestock live alongside an unseen world of microbes, yet the most commonly used pathogen detection methods target one pathogen at a time.



Single target
assays



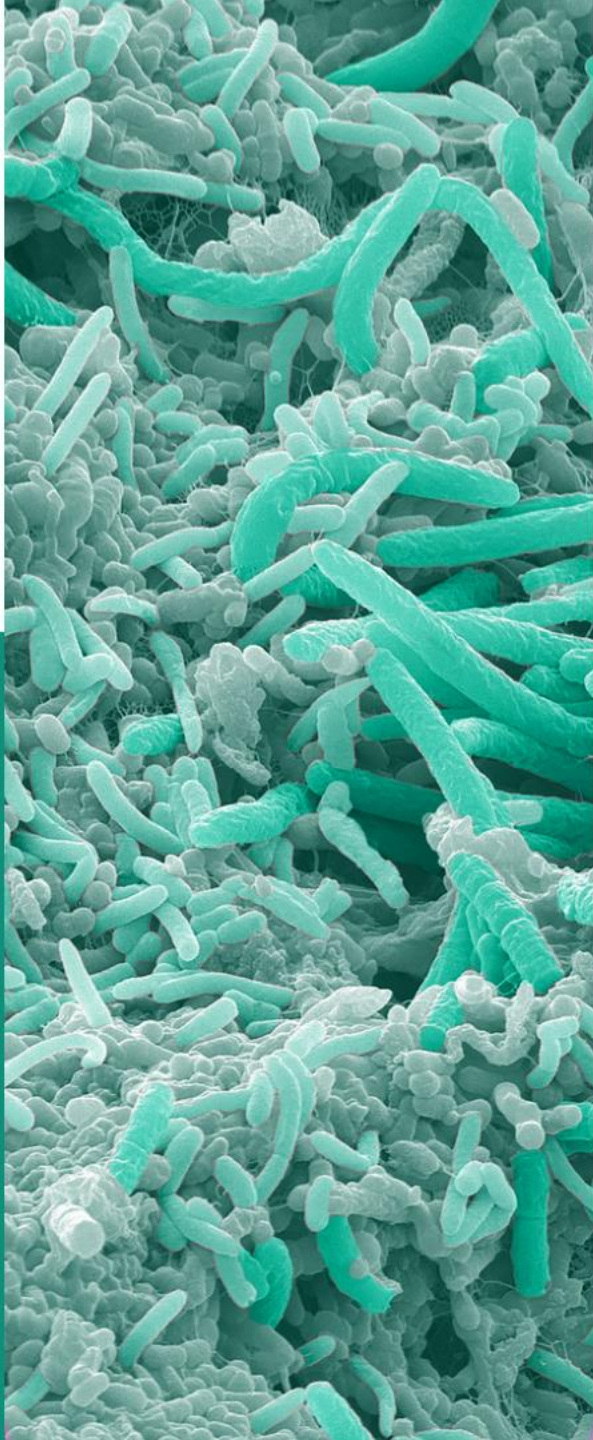
Prior knowledge
required



Linear cost
scaling



Undetected
novel variants



One Sample, Every Microbe with Total Microbiome Analysis

Using metagenomics we sequence every DNA molecule in a single water sample. This provides you with a complete overview of the microbiome living alongside your livestock.

- ▶ Enhanced pathogen detection
- ▶ Increased sample size
- ▶ Reduced cost per pathogen detected
- ▶ Observe beneficial microbiomes

How it Works

Durable and efficient, our water sampling equipment and process has been designed specifically for aquaculture.



Marine-grade equipment (SAE 316)



4 litres of water processed per minute



Up to 2 samples processed at a time



Pre-paid, next day delivery to our lab

Total Microbiome Analysis Powered by Metagenomics

From sample extraction, to data interpretation, every step of the process is handled by Esorex Biologics.



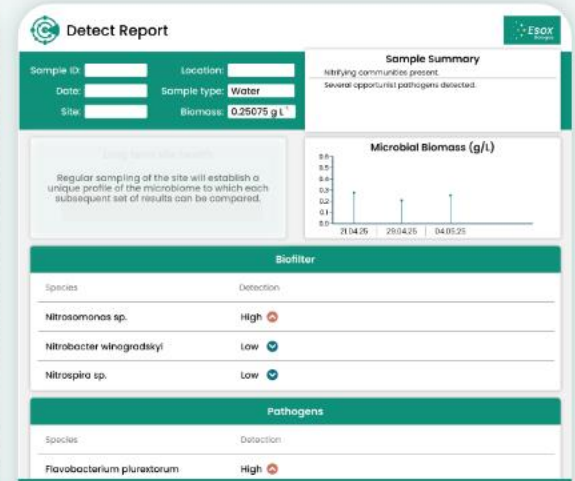
DNA extraction of
microbial communities



Metagenomic
sequencing



Bioinformatics analysis



Microbiome reports



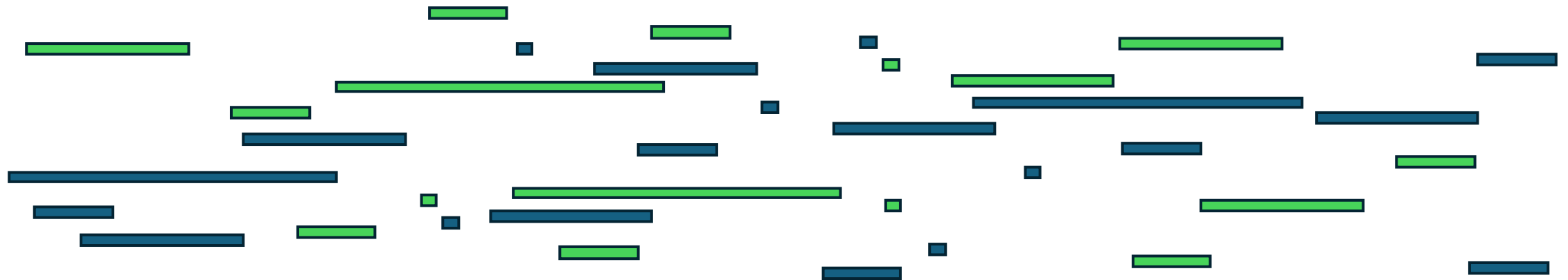
Reference genome



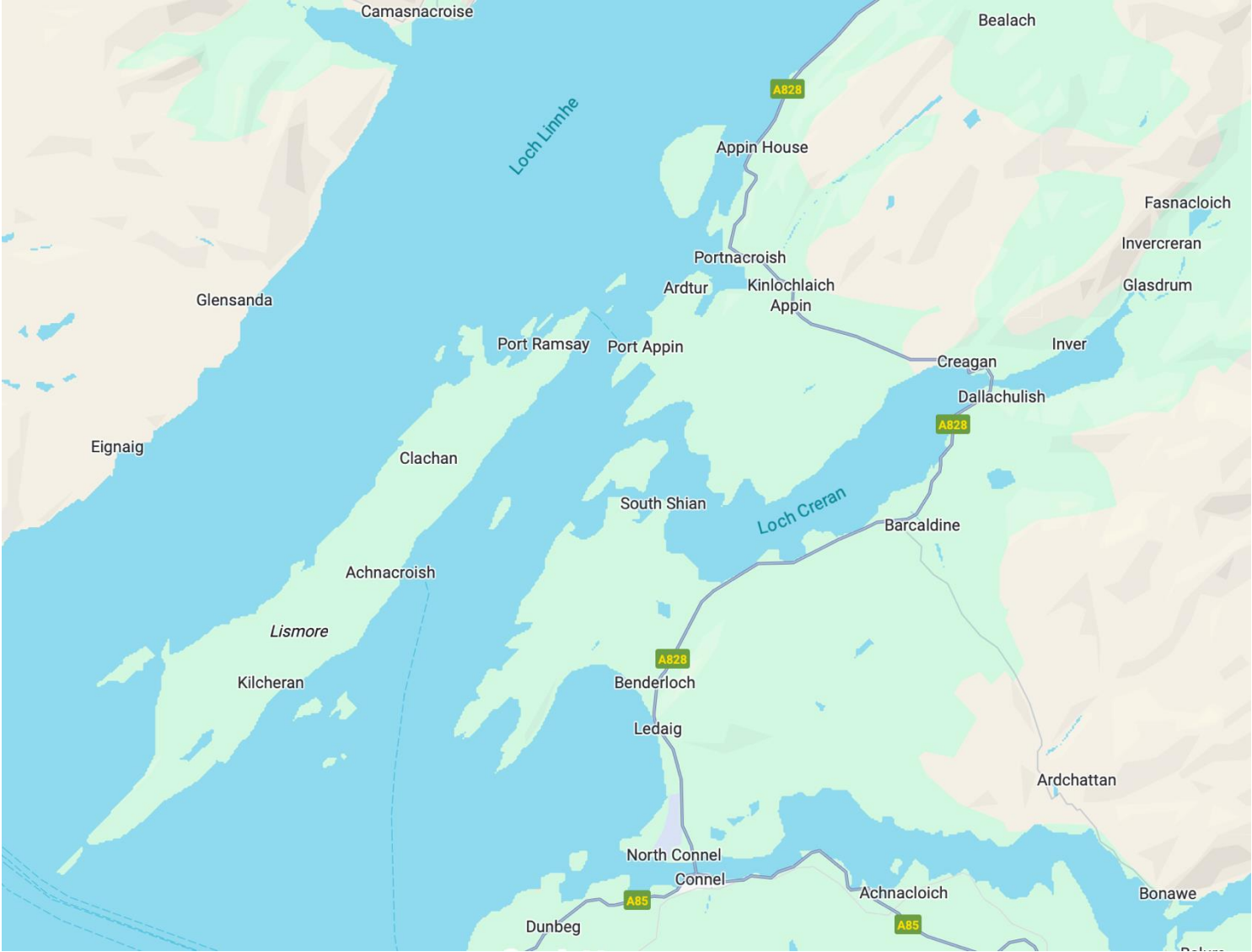
Sequenced DNA



Reference genome



Sequenced DNA







Species of Interest

Pathogens

Aashiwo catenella	Not Detected
Akashiwo sanguinea	Not Detected
Alexandrium catenella	Not Detected
Asterionellopsis glacialis	Not Detected
Ceratium fuses	Not Detected
Chaetoceros debilis	Not Detected
Gonyaulax spinifera	Not Detected
Lingulodinium poyedrum	Not Detected
Procentrum cordatum	Not Detected
Procentrum lima	Not Detected
Proceratium reticulatum	Not Detected
Vibrio aestuarianus	Detected
Vibrio splendidus	Detected

Plankton Species (Detected)

Bathycoccus prasinos	Detected
Discostella pseudostelligera	Detected
Ostreococcus sp. 'lucimarinus'	Detected
Picochlorum sp. BH-2019	Detected
Pseudo-nitzschia multiseriis	Detected
Pycnococcus provasolii	Detected
Seminavis robusta	Detected

Candidate species

Match Name	Relative Abundance (%)	Reference Length (Mb)	Coverage Breadth (%)	Average Depth (X)	Microbe Wiki
Pseudoalteromonas sp. EB27	9.62	4.53	77.8	1.8	More info
Vibrio splendidus LMG 19031 ASM2434761v1	8.87	5.88	64.5	1.3	More info
Pseudoalteromonas carrageenovora IAM 12662 ATCC43555T	3.15	4.58	38.6	0.6	More info
Cobetia amphilecti NRIC 0815 ASM3001041v1	2.78	4.17	39.7	0.6	More info
Bathycoccus prasinos	1.80	15.00	9.3	0.1	More info
Paraglaciecola mesophila KMM 241	1.60	5.06	21.6	0.3	More info
Pseudoalteromonas aliena SW19	1.42	4.49	21.2	0.3	More info
Skeletonema dohrnii	1.14	45.90	2.0	0.0	More info

On this page

Report summary

Sample report

Sample results

Explanation

Candidate species

Species of interest

Appendix

Nitrosomonas

Classification: Genus

Concern (Mucosal Swabs): Orange

Concern (Water): Green

Concern (RAS): Green

Type: Gram-negative, Burkholderiales

Habitat environment: Marine

Freshwater

Soil

Impact to aquaculture: Positive impact on aquaculture playing a crucial role in ammonia catabolism and nitrogen cycling in recirculating systems.

Example Species: *Nitrosomonas marina*

Nitrogen Metabolism: Nitrification (Ammonia Oxidation)

Summary

The genus *Nitrosomonas* includes ammonia-oxidizing bacteria vital for nitrification in aquatic environments, with species such as *Nitrosomonas europaea* contributing to water quality in aquaculture by converting toxic ammonia to nitrites. While beneficial for fish health, some research indicates potential

On this page

[Nitrosomonas](#)

[Summary](#)

[Details](#)

[References](#)

Details

The genus *Nitrosomonas* encompasses ammonia-oxidizing bacteria that play a critical role in the nitrification process, commonly inhabiting environments such as soils, freshwater, and marine systems Brown et al. (2012). Species like *Nitrosomonas europaea* and *Nitrosomonas marina* are known to thrive in both aquaculture biofilters and natural aquatic ecosystems, where they contribute to maintaining water quality by converting ammonia, a toxic byproduct of fish metabolism, into less harmful nitrites (Quirós et al., 2023; Dhanasiri et al., 2011). This process is particularly relevant in aquaculture systems, as efficient nitrification helps prevent ammonia toxicity in fish, ensuring healthier cultivation conditions (Dhanasiri et al., 2011; Bollmann et al., 2002). While *Nitrosomonas* species are primarily beneficial in aquaculture, their potential pathogenicity remains a topic of ongoing research, with findings indicating that certain viral phages can infect multiple *Nitrosomonas* species, which may affect their density and function (Quirós et al., 2023). Therefore, understanding the ecology of *Nitrosomonas* is vital for optimizing aquaculture practices and enhancing fish health.

References

Bollmann, A., Bär-Gilissen, M., & Laanbroek, H. (2002). Growth at low ammonium concentrations and starvation response as potential factors involved in niche differentiation among ammonia-oxidizing bacteria. *Applied and Environmental Microbiology*, 68(10), 4751-4757.
<https://doi.org/10.1128/aem.68.10.4751-4757.2002>

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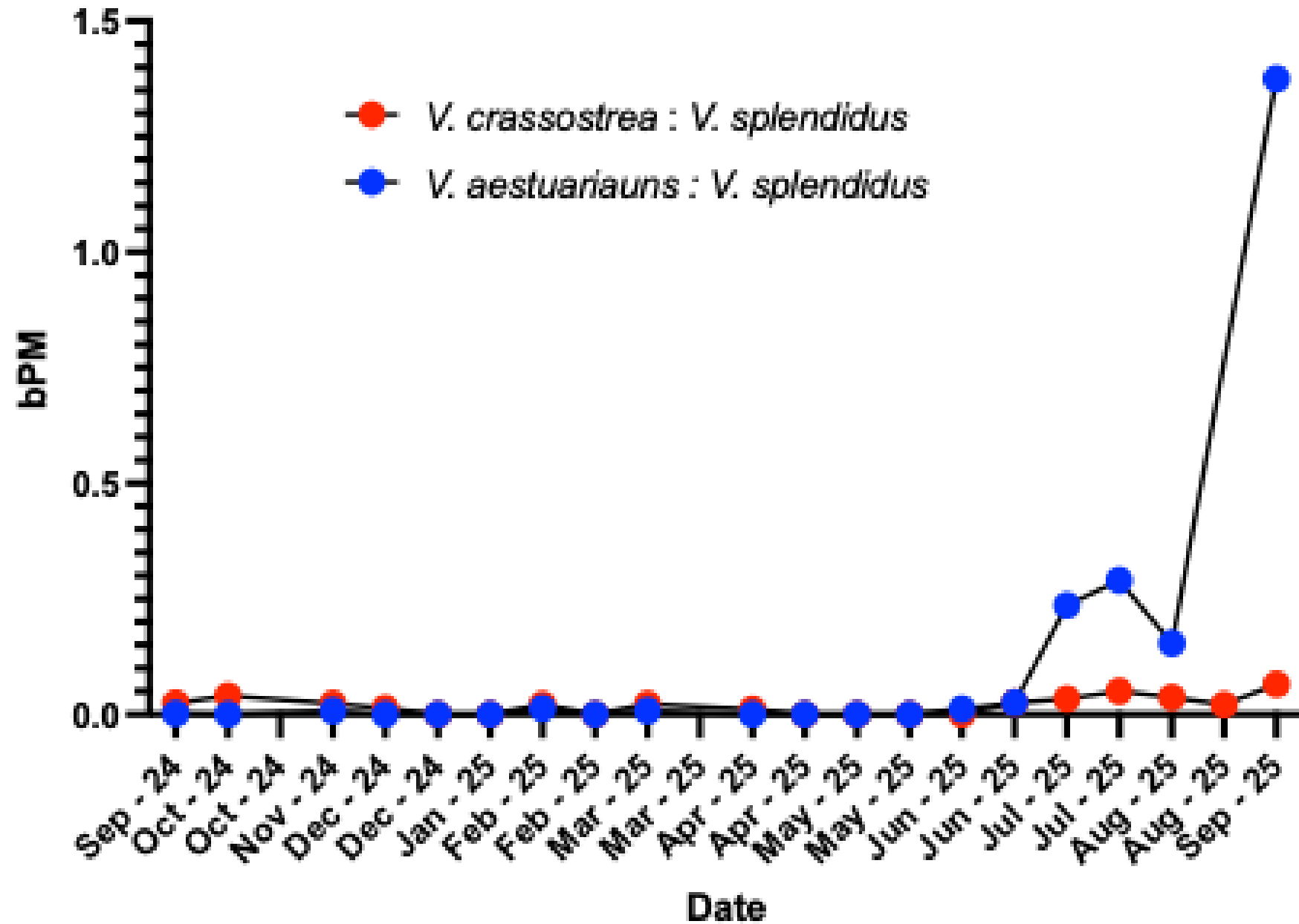
Nitrosomonas

Summary

[Details](#)

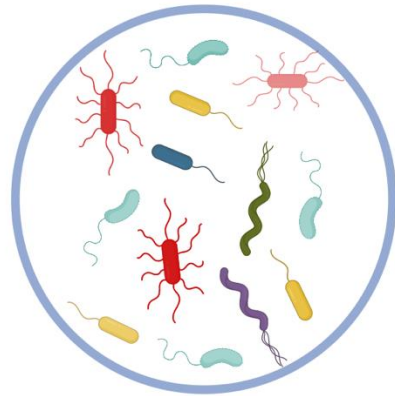
References

Site 2



Metagenome Assembled Genomes (MAGs)

Complex microbial community



Sp. 1
Sp. 2
Sp. 3
Sp. 4
Sp. 5

DNA extraction



Metagenomic
DNA sequencing



Metagenome assembled
genomes (MAGs)

Taxonomy

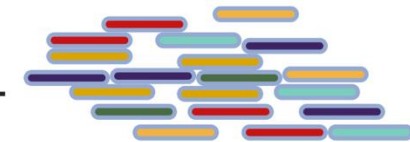
Assembled contigs

Contig
assembly

Clean reads

QC

Raw sequencing reads



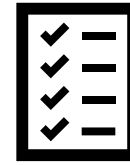
Supporting Aquaculture with Genomics



Vaccine and Probiotic
Development



**Genomic
database**



Pathogen Detection



Risk Management



Water Quality Monitoring



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