Increasing Industrial Resource Efficiency in European Mariculture

The IDREEM Newsletter

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25 percent size increase for oysters at Italian pilot IMTA site

Crassostrea gigas on the left and Ostrea edulis on the right. These two specimens were juveniles from the batch deployed on 27 June 2013.

In Italy, AQUA s.r.l. is carrying out IMTA operations with the support of the University of Genova. In June 2013 , 2100 oysters were deployed at the AQUA farm site as part of the IMTA experimental trials. Two species, *Ostrea edulis* and *Crassostrea gigas*, were chosen each making up half of the total number of oysters deployed.

Oysters in lantern cages at AQUA s.r.l.

Previous studies indicate that oysters grow better in IMTA systems than in monoculture. Oysters are filter feeders, and this experiment aimed at testing oyster growth and mortality when exposed to the particulate matter falling off AQUA's sea bream and sea bass cages. These oysters were arranged in three lantern cages with a setup that also allowed testing for the effect of depth on growth and mortality.

After 5 months in November 2013 the oysters had grown and had to be reallocated in a larger number of lantern nets (from the initial three to five). During these operations, the shell height and total weight of 400 individuals (100 for each combination of species and depth treatment) were measured, and mortality was assessed, as well. Furthermore, 10 individuals for each treatment were sampled and subsequently dissected for a finer scale measurement of the body components.

Results

Compared to time of deployment, both *O. edulis* and *C. gigas* increased both in size and weight to a comparable amount. Size increased by about 25% in both species at both depths, going from ≈ 60 mm shell length in July to ≈ 75–80 mm shell length in November in both species.

Differently, average whole wet weight (including shell) increased at a higher rate in *O. edulis*compared to *C. gigas*, and weight increase was larger at higher depth. Between July and November *O. edulis* went from ≈ 20 g/individual to ≈ 60 g/individual at the deeper treatment and to ≈ 50 g/individual at the shallower treatment. *C. gigas*, during the same time frame, only increased from ≈ 15 g/individual to ≈35–40 g/individual at both depth treatments.

Conversely to its growth rate, ***O. edulis* showed higher mortality** compared to *C. gigas* both at lower and higher depths (≈5% Vs. ≈1% respectively at different depths), nevertheless mortality percentages in *Ostrea edulis* are still very low.

Dissection results showed a similar weight of the soft body parts of *O. edulis* and *C. gigas*(Figure 6 upper half), despite the lower total wet weight of the latter. This finding is reflected in the higher percentage of total body weight due to the soft body parts in *C. gigas.*

The IDREEM Newsletter

No. 3 – April 2014

What's next

The oysters at AQUA are now in five lantern nets. This gives them more room for further growth to reach a potentially marketable size. Other measurements of size and weight will be carried out in the next few months to keep monitoring the oysters' performances under Integrated Multitrophic Aquaculture (IMTA) conditions under sea bass and sea bream cages. If growth in both size and weight is successful, AQUA will need to get the high quality of the seawater around its farms site certified, in order to get a permit to a potential commercialization of oysters.

Written by Danilo Pecorino – DISTAV, University of Genova, Italy

IDREEM session at Aquaculture Europe 2014

A dedicated IDREEM session on the theme **"Beyond Monoculture"** will feature at this year's Aquaculture Europe conference in San Sebastian, Spain on Wednesday, 15 October. Chaired by Professor Kenny Black of SAMS – the Scottish Association of Marine Science , the morning session will showcase the project's first two years of designing and implementing Integrated Multi-trophic Aquaculture (IMTA) systems.

Project consortium members will speak on the role of Life Cycle Assessment in aquaculture, environmental monitoring programmes to support IMTA, and case studies detailing IMTA production at several project sites. Other talks may introduce newly-developed modelling tools for maximising the benefits of IMTA for producers, and policy and regulatory frameworks that could impact IMTA potential. An afternoon session on IMTA, chaired by Dr Thierry Chopin of the University of New Brunswick, is open to abstracts from the wider IMTA community.

The deadline for abstracts for Aquaculture Europe 2014 is 1 May. Essential information can be found in the event brochure on the European Aquaculture Society website (www.easonline.org). The conference programme will be forthcoming.

IMTA explained: interview to Keri Wallace and Adam Hughes of SAMS

What is Integrated Multi-trophic Aquaculture and why should we adopt it? What is the state of the art of research and demonstration in this field? How is IMTA related to developments in seaweeds farming?
Find the answers and more in this introductory article by Keri Wallace and Adam Hughes featured in World Fishing and Aquaculture Magazine.

The IDREEM Newsletter

No. 3 – April 2014

Policy and regulatory implications for the development of IMTA in Europe

Policy and legislation are likely to have an impact on the development of innovative and sustainable aquaculture practices such as integrated multi-trophic aquaculture (IMTA). To investigate the flexibility for the adoption of IMTA within the current management and control frameworks of the six European countries involved in the IDREEM project, a study was undertaken to identify opportunities for, and challenges and barriers to, IMTA development.

In the study by Karen Alexander and Tavis Potts of SAMS, EU, national and regional level policy and regulations were identified and combined with a desktop study of existing literature in order to define the existing procedures for planning and operating aquaculture in each of the countries (Scotland, Ireland, Norway, Italy, Cyprus, and Israel). A comparison between countries highlighted differences and similarities in governance frameworks and enabled 4 key questions to be answered:

- What are the implications of existing policy and institutions for deployment of IMTA?
- Are any conditions within the planning regime affected by the deployment of IMTA?
- Are any conditions within operational requirements affected by the deployment of IMTA?
- Is there a need for change in the governance framework to accommodate IMTA?

A key finding of this study was that the move from species mono-culture to bi-culture, and potentially to poly-culture, raises additional legal considerations and questions, particularly as the regulatory frameworks largely differ (or are non-existent) for different species both in isolation and in combination (particularly between finfish, shellfish and seaweed).

The analysis also highlighted that there may be a need for a change to some aspects of the legal regimes of the IDREEM project partner countries in order to accommodate IMTA, and that these changes may also be relevant worldwide. A number of policy recommendations by which to address these issues were offered.

A publication detailing the full results of this study is forthcoming.

Written by Karen Alexander – Researcher in Marine Social Science, Scottish Association of Marine Science.

The IDREEM Newsletter

No. 3 – April 2014

New Bellona Foundation report: IMTA is the future of aquaculture

IMTA model with mussels and kelp cultivated together with farmed fish. Image: Bellona.no

"*Integrated Multi-Trophic Aquaculture can combat a number of the problems in today's fish farming industry and is a sustainable system which marks a new approach to aquaculture. IMTA represents the future of aquaculture and its potential is enormous*".

These are the main conclusions of the new report **Traditional and Integrated Aquaculture**, published in late 2013 by the Bellona Foundation and written by Annelise Leonczek.

Integrating species like in ecosystems

IMTA is a polyculture system where several species from different trophic levels (levels in the food chain) are cultivated together. Each species has different functions in the ecosystem that can benefit another species. The term "Integrated" refers to synergistic cultivation, using water-born nutrient and energy transfer. "Multi-Trophic" means that the various species occupy different trophic levels.

With IMTA, several species are located together in a way that creates an ecosystem, so that waste from one species becomes a resource for another. In Nordic countries such as Norway there is considerable potential for mussels, algae (e.g. seaweeds) and invertebrates (lobsters, sea urchins, sea cucumbers, etc.) grown in proximity of fish farming sites (i.e. salmon cages).

Integrated aquaculture can help reduce the spread of lice, disease and reduce organic waste from farmed fish. Image: Bellona.no

One example has mussels and kelp being cultivated together with farmed fish. The mussels live on organic particles (e.g. plankton,fish waste, organic particles from fish feed) in the water, while kelp absorbs dissolved nutrients such as nitrogen and phosphorus (from sources such as fish faeces). Research has shown that mussels grow faster when they are cultivated alongside fish farming sites. They filter the water and have proven helpful in reducing the spread of salmon lice and infectious diseases. At the same time, nutrients released from fish farms are ideally suited for kelp growth. It has been documented that kelp can remove between 30% and 100% of the dissolved nitrogen produced by the fish. Algae are good sources of protein and omega 3, as well as being highly suitable as an ingredient in fish feed and a promising feedstock for bioenergy production.

The IDREEM Newsletter

No. 3 – April 2014

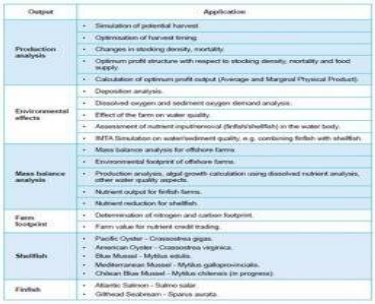
The multiple benefits of diversifying seafood production

The system leads to better use of sites and facilities, greater diversity of production – which brings higher profit from multiple products instead of one and more jobs. "A *transition from monoculture to IMTA will increase profitability*" states the report, "*it will be more viable to convert existing aquaculture than to start from scratch. In this respect, we should look at countries that have come far such as Canada, the USA and China*".

The report also addresses the challenges to face in order to achieve this transition on large scale, and highlights that research, development and industrial demonstration are essential at this stage. "*The normal linear approach starts with research, then come political decisions and finally there is investment*. *New technologies and systems need to be developed, and here there is no other option but trial and error. The focus should be on the overall potential*". The report concludes that "*collaboration between industry, business, research and politicians is necessary in order to ensure effective development of sustainable aquaculture. Such a partnership should be established simultaneously for both pilot projects and industrialization"*.

Tackling these challenges is the scope of the IDREEM project. Since 2012 research organizations are partnering with SMEs across North and South Europe, with a transversal approach to demonstrate the environmental and economic feasibility of different IMTA models at nine pilot sites, as well as to address policy and normative barriers to the adoption of integrated aquaculture systems.

Computer models simulate aquaculture sites in IDREEM project



The use of computer models plays an integral part in the development of aquaculture, whether it is to understand and model growth, to evaluate overall carrying capacity, or to improve selection of aquaculture sites. Within the IDREEM project, evaluation of the potential for IMTA will in large part be established through modelling.

The FARM model is an established means of evaluating the growth and economic potential and environmental consequences of shellfish production. Through this project, further integration of fish, shellfish and macroalgal aquaculture has taken place in FARM, to evaluate multiple species IMTA potential across Northern and Southern Europe. Underlying the FARM model management tool, which evaluates population outcomes, are a series of console-based models (called WinFish, WinShell and WinFrond) for each of the culture groups, which evaluate growth and environmental inputs and outputs from selected individual fish, shellfish and algae, which have in turn developed been tested using a visual platform.

What FARM allows is the ability to allow culture groups on any one farm site to have one of three status conditions in a model run: Live | On | Off. Only one species can be |Live| at any one time, but with another group or groups switched |On| it means the environmental and biogeochemical interactions of these other species can be assessed, in how they affect the |Live| species growth and economic performance. So we can assess what the outputs will be for any given species, or combination of species, before any fish have been put in the sea.

Work is ongoing, and detailed assessment and validation is taking place which will allow farmers to simulate the best combination of species for their specific environmental conditions, whether they are based in the Mediterranean or in Northern Europe.

Written By Richard Corner, Longline Environment Ltd.

Events

April 9-11, 2014, Naples - Italy
Offshore Mariculture

May 19-20, 2014, Bremen - Germany
European Maritime Day

May 28-29, 2014 – Aviemore, Scotland UK
Aquaculture UK

June 22, 2014 – June 27, 2014, Sydney - Australia
5th Congress of the International Society for Applied Phycology 2014

October 14-17, 2014, San Sebastian - Spain
Aquaculture Europe 2014

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