

Summary note: 3rd sea lice multination workshop Edinburgh

The 3rd sea lice multination workshop (3rd SLM) took place in Edinburgh 16th and 17th November 2011. This workshop was being held following the Scottish sea lice symposium.

The 3rd SLM focus was to “follow up” discussion from the 2nd SLM in Aberdeen. An overall agreement from the 2nd workshop was the need for implementation of aquatic integrated pest management. Discussions in Aberdeen were initiated with the question “How do we get there?”, and the working groups were asked to outline a roadmap consisting of requisite R&D and best practises activities.

As a summary from the 2nd SLM Aberdeen the following table outlines the suggested main knowledge gaps and research priority not identified in granted R&D projects/activities at that time:

WGs	Main prioritized knowledge gaps
1	Knowledge on spatial distribution, geographic variability and density of sea louse for development of a IPM decision support system Knowledge on farmed - wild interactions related to sea louse populations
2	Knowledge needed on wrasse populations and effects of fishing for sustainable capture Knowledge on health and welfare both in the wild and intensively cultured cleanerfishes
3	Knowledge on sea louse modulation of virulence. Study on variations of virulence as response to more resistant fish and as response to different control measurements
4	Knowledge on optimum use of medicines related to selection of the most appropriate treatment, treatment delivery methods and robust technology under different environmental conditions
5	Knowledge and standardisation for development on international “meta data” to ensure effective analysis within regions and potential comparisons across regions, related to field counts, pen-side bioassays (single dose) and laboratory data (classical bioassays).
6*	Development and validation of different novel non-medical technologies for sea louse control

*Not discussed in the Aberdeen workshop

	Working groups	Scientific/Industrial coordinators
1	Structural measures and dispersion modelling	K. Boxaspen/S. Murray
2	Farming and use of wrasse	AB. Skiftesvik/PG Kvenseth
3	Biological measures and molecular knowledge building	F. Nilsen
4	Resistance challenges and use of medication	TE. Horsberg/G.Ritchie
5	Surveillance (farmed and wild fish)	C. Revie
6	Novel technologies	D. Jackson

In the 3rd SLM Edinburgh the pinpoints for discussion in wgs 1, 2, 3 and 5 were:

- review Aberdeen discussions
- update/status R&D activities
- pinpoint new R&D projects for discussion

Working groups discussions in working group 6 were not facilitated and the thematic “resistance” in wg 4 was included in working group 5. The discussion in working group 4 “use of medication” was facilitated as a SOP and best practice workshop.

Each working group was asked to present summaries from the discussions and following are an overview from the wg discussion:

Working group 1: Structural measures and dispersion modeling

Attendees: Deirdra Williams, George Gettingby (day 1), Dave Cockerill (day 1), Randi Grøntvedt (day 1), Sandy Murray, Nabeil Salama, Jose Miguel Burgos, Paul Negård (day 1), Lars Asplin, Hulda Bysheim (day 1) and Karin K. Boxaspen.

Discussions in working group 1 were this time mainly focused on general discussions related to on-going projects and activities in oceanography and hydrodynamic modeling. One main goal was posted:

- Linking population models with hydrodynamic models - to create a decision support system for management and testing of questions.

During the discussion several topics were mentioned on the road towards a decision support system:

- Validation of models
 - Sentinel cages, predicted vs measured
- What will we use the models for?
 - Long term model run - prediction of sea lice infections inclusive wild fish lice burden
 - To recognize patterns/hot spots
 - Prediction of carrying capacity for a region?
 - Management:
 - Planning and coordination of treatment regime, management areas, fallowing time, localization of farms
- Bottlenecks:
 - Better usage of registered sea lice data
 - Assess (validating) models, both hydrodynamics and sea lice dispersion
 - Transfer “model densities” to real life -
 - Scenario testing - “weather and climate”
 - Need for more knowledge related to sea lice biology/behavior

During day 2, scientific discussions and comparison of hydrodynamic model system and results in Norway, Canada and Chile were carried out.

Working group 2: Farming and use of cleaner fish

Attendees: Hulda Bysheim, Norwegian Food Safety Authority, Gunvor Øye, SINTEF Fisheries and Aquaculture, Richard Prickett, RSP Services, Derek Robertson, University of Sterling, Jamie Smith, Scottish Salmon Producers Organisation, Ole Torrissen, Institute of Marine Research, Ingejerd Opstad, Institute of Marine Research, Anne Berit Skiftesvik, Institute of Marine Research, Per Gunnar Kvenseth, Villa Organic AS, Norway, Regin Arge, Fiskaaling, Faroe Island, Keng Pee Ang, Cooke Aquaculture Inc, Canada, Harald Sveier, Lerøy Seafood Group ASA, Norway, Jim Treasurer, Ardtoe Marine Laboratory, Clive Talbot, North Atlantic Fisheries College and Reidun Bjelland, Institute of Marine Research.

Since 2nd SLM in Aberdeen, new R&D projects related to farming and use of cleaner fish has been initiated and granted both in Norway and Scotland. In addition, activities on other fish species like lumpsucker and cunner to work as cleaner fish are recognized. The 3rd SLM workshop discussions in the wg 2 were mainly used for discussion and identification of synergies and links between current projects. The discussions were related to the cleanerfish species: ballan wrasse (*Labrus bergylta*), goldsinny (*Ctenolabrus rupestris*), lumpsucker (*Cyclopterus lumpus*) and cunner (*Tautoglabrus adspersus*).

Pinpoints from topics and bottlenecks discussed:

- Broodstock (sexdifferentiation, stripping, fecundity, diet, spawning, photomanipulation and spawning substrate)
- Eggs and larvae (transferring, light, rotifer, artemia, clay, tankdesign)
- Juveniles (weaning time, diet, feeding regime, deformities, light, balling, hides, stocking densities)
- On growing (production time, diet, temperature, feeding regime, cost of production)
- Use in cages (behavior, escapees, mortality)

The working group focused on information between the different countries and research groups. Creation of a list of all participants with keynotes on experience, interests and ongoing and planned projects will be a desirable tool to ensure ongoing cooperation.

Working group 3: Biological measures and molecular knowledge building (Attendees not noted)

Like wg2, several R&D activities related to wg3 thematic have been granted since the 2nd SLM in Aberdeen. In Norway, the Sea lice research Centre (a center for research based innovation (SFI)) with main focus on development of new methods for lice control has been granted for eight years. An introduction of the Sea lice research Centre was given in plenary. In this centre, development of new methods

for sea lice control based on molecular biology will include research for: new medicine, high throughput resistance diagnostics, feed additives, immune control (specific or unspecific) and novel lice control methods.

Moreover, in Scotland, a new four years project is granted by the Technology Strategy board, for development of novel sea lice vaccine.

In addition to the two newly granted projects related to sea lice molecular biology, vaccine development and sea lice control, the salmon louse genome has been sequenced since the last SLM workshop, which gives a new era for molecular research.

To utilize the knowledge base and establish best synergy between the ongoing projects several initiatives were discussed:

- Challenge models (*L. salmonis*).
 - Write a summary paper “state of the art in sea lice experiments”
 - Initiate collaboration projects for validation of different existing systems
- Salmon louse genome
 - Need for increased effort on salmon louse genome annotation
 - Sequence of a free-living copepod for comparative purposes for enhancing use of sea lice genome
 - Create a joint project Norway/Scotland etc.?
- Development of new tools:
 - Transgenic lice
 - Artificial feeding system for lice
 - Sea lice signature kit (i.e. a set of genes/proteins that describes an infection)
 - Cell culture/skin model
 - Cryopreservation of salmon louse eggs/embryos
- Breeding: there is a need to understand the difference between “resistant and susceptible” salmon families. Fish with particular properties towards lice susceptibility can be very useful tools in sea lice research.
- Cooperation:
 - Establish web pages for sharing of tools and techniques on sea lice
 - Facilitate mobility of people between labs/research groups.
Establishment of mobility grants?

Working group 4: Use of medication - SOP and best practice workshop

During the 3rd SLM in Edinburg the working group 4 discussions were facilitated as a best practice workshop. Each medicine supplier was asked to present the best use of their product and describe this onto a one-page SOP.

During the discussion several issues were raised by delegates:

- Harmonisation of licensing; a proposal was put forward that there should be a single EU license for each product. Allied to this was the need for a debate in Scotland to look at discharge consents and move to a bay area management approach rather than a single site to ensure best practice in the use of medicines which was often precluded because of the current regulatory regime in Scotland.
- The concept of bringing in experts from other areas of pest management was again endorsed as a good idea that should be followed up.
- The need for a project to assess treatment efficacy together with sensitivity testing was discussed. This topic was also being looked at by WG 5.
- The desirability of a generic code of best practice to guide lice management and treatment was put forward. But this was tempered by the fact that there is little consensus on the best management strategy. This may reflect knowledge gaps in biology of lice in terms of population dynamics and gene flow etc.

Identified bottlenecks for control of sea lice:

- The need to define IPM in a wider context than treatments alone with a view to reducing dependence on treatments. The example of antibiotic use in the industry was cited. The goal to be using husbandry and other practice to minimise the lice challenge and deploy treatments strategically.
- A project to advice on the best approach will require a multidisciplinary team to include vets, engineers, farmers etc.
- Rotation strategies are not currently being evaluated for efficacy and there is a need to do this in order to select the most appropriate strategy for each situation.
- A much better understanding of delivery methods and their strengths and weaknesses is required both for topical and in feed treatments.

From these pinpoints it was concluded with two main areas requiring specific action:

1. An inter-disciplinary team on technology and processes for delivery of active ingredients.
2. A review on the effectiveness of product rotation strategies

Working group 5: Surveillance (wild and farmed fish)

Attendees: Kristin Ottesen, Chris Wallace, Hulda Bysheim, John McHenry, Kari Helgesen, Eirik Wilkinson, Iain Berrill, Alicia Gallardo, Branny Montecinos, George Gettinby, Bill Roy, Sigmund Sevattal, Daniel Jimenez, Peter Andreas Heuch, Randi Grøntvedt and Crawford Revie.

The topics resistance and surveillance (bioassays) were included in the wg 5 discussions. In opposite, focus on wild fish surveillance was scarce during the 3rd SLM discussions due to lack of delegates with "wild fish" background.

The main topics of discussion were:

- Routine counting
 - Different protocols and legislation for routine counting in different countries
- Treatment efficacy
 - What is efficacy and can it be defined (90% efficacy? 100% efficacy? Less?)
 - How should efficacy be reported?
 - What is perfect degree day post-treatment lice count for each medicine?
- Convenient sampling - representative? Random?
- Sharing and access of data and information
 - A summary was made on the different countries system to collect and share data
- Bioassays
 - Fixed (single) dose bioassay
 - Classical (EC50) bioassays
 - F1 and Copepodid bioassays

During the discussion several main research questions and related activities were posted:

- Sea lice population
 - General need of knowledge
- Methods for estimating and reporting treatment efficacy:
 - What are the best protocols to report treatment efficacy?
 - Monitoring vs. efficacy? Can a single counting protocol cover both?
 - Combination of model/simulation and empirical data from farms
 - Review current practice on how efficacy is tested/understood/legislated?
- Fixed (single) dose bioassays farmed based:
 - How to gain trust in approach?
 - Needs standardization against classical laboratory bioassays

- Classical (EC50) bioassay:
 - Share and agree protocol
 - Look into variation/consistencies/temporal differences
 - Globally- look at sensitivity data
- F1 and Copepodid Bioassay
 - How should we collect lice/eggs from the farms?
 - Explore different testing methods - i.e. EC50 vs. other methods
 - Use lab models to relate EC50 to treatment efficacy
 - Benchmark field bioassay to Laboratory copepodid and F1 studies?
- Sharing and access of data and information
 - Need framework to specify what questions need to be ask
 - Focus on demonstrating where info can be used practically,
 - Intermediate position = having access to data but not always use it for publishing
 - May firstly look at sharing EC50 data then promote this as a way of how other data sharing could be used.
 - Types of data to share include bioassay and treatment efficacy
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Some final remarks

During the 3rd sea lice multination Edinburgh, several useful working group discussions resulted in sharing of knowledge and pinpointing of important research questions and activities towards an aquatic integrated pest management.

Many research questions and tasks can be outlined in a roadmap towards aquatic IPM. However, funding and an internationally concerted action is needed to create a true development of integrated control system taking into account all measures available to control sea lice.

The conference "Sealice 2012" in Bergen will bring about an overview on important new results from sea lice research worldwide.

From this and together with members of the sea lice multination platform an outline of ongoing research projects related to *L. Salmonis* should be made.

Due to positive responses from delegated at the 3rd SLM in Edinburgh, the sea lice multination steering committee will continue to facilitate the 4th sea lice multination workshop during 2013.

Thanks to all of you and especially the working groups coordinators: Karin K. Boxaspen, Anne Berit Skiftesvik, Frank Nilsen, Gordon Ritchie, David Jackson and Crawford Revie.

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Randi Nygaard Grøntvedt