

COST Action FA1004 Conservation Physiology of Marine Fishes

Minutes of the 1st Conference on Conservation Physiology of Marine Fishes.

CIMAR, Porto, Portugal, 26 – 28 September 2011

The timetable of the meeting is shown in Annex 1.

The **objectives of this first meeting** were to

1. introduce the Action to all delegates
2. form the working groups
3. hold the first workshop for each group
4. make decisions about the next steps to take

The meeting started with a short introduction by David McKenzie (Action Chair), who described the reasons for establishing this COST Action, its overall objectives, how these would be achieved, and how the Action was structured. In particular, the Action comprises three Working Groups (WG1 Basic physiological knowledge; WG2 Integrating physiology into forecasting, and WG3 Conservation physiology and decision-making) each with specific objectives that are clearly described in the Memorandum of Understanding.

Each delegate presented themselves briefly, and explained their area of expertise and why they were interested in participating in the Action.

The **composition of the working groups** is shown in Annex 2, based upon expression of interest by each delegate.

Three workshops were held, starting with WG3, and working backwards to WG1. These workshops were chaired by the WG leaders, and each had about one half day of time for presentations and round-table discussion. The minutes of these three workshops are below, after the General Overview

General Overview (David McKenzie)

The conference went smoothly and the workshops were all very well-attended and discussion was open, lively and constructive.

A subject that arose in all of the workshops was the **question of scale**, which seems pertinent to try and summarise here. This issue was first raised in WG3 by Steve Cooke (see his scheme in the minutes for that WG), and then emerged again and again over the subsequent workshops. Thus, physiology can be used at various scales towards conservation objectives. At a local scale it can be directly applied to investigate specific questions related, for example, to pollution, bycatch, invasive species. At a wider scale, physiological data can be used in models of single species distributions and dynamics, such as those outlined in by Rebecca Holt, Myron Peck, Henk van der Veer and Adriaan Rijnsdorp in WG2, for example to inform fishery management. At an even broader geographic and biological scale, physiological data can be inputted into mechanistic niche models, as proposed by François Guilhaumon in WG2, to forecast effects of climate change on communities. As Steve Cooke describes in his scheme for WG3, this has very different implications in terms of how directly stakeholders are involved, the timescale involved (both for research effort and application of

the results), and where the research lies in terms of being “applied” (local) versus “basic” (forecasting impacts of climate change). Conservation physiology research at a local scale can, of course, provide case studies that can influence decision-making at a wider geographic scale, as Peter Pärt pointed out in his presentation in WG3.

The MoU describes review articles as deliverables for all WGs. During the conference, however, it became evident that the scope of the proposed subjects for each review, in particular in WG2, was too broad to be effectively addressed in a single article. One proposal that met with wide approval was to turn the topic of the review into a topic for a special issue of a suitable journal. The notion of scale, which is not addressed in the MoU, may provide an interesting means of structuring contributions to such special issues of journals.

General Decisions Taken

The following general decisions were taken by the Management Committee at the conference, following general discussion among all delegates:

- 1) The remainder of the budget for 2011/2012, which was not spent for the Porto meeting, will be spent for a workshop for WG2. **NB** the actual amount will be clear when delegates have been reimbursed for the Porto meeting
- 2) That a representative of the Action should attend the World Fisheries Congress in spring 2012, to contact policy makers in attendance. **NB** we have since learned that this *cannot be funded by COST*, unless the person(s) involved makes a presentation directly related to the Action.
- 3) That we will budget for a 2nd Conference on Conservation Physiology of Marine Fishes in Action year 2, as it was agreed that a single conference comprising sequential workshops for all WGs was the cheapest option because many delegates are members of more than one WG. The venues proposed were Barcelona or Croatia. The conference will be in early September 2012.

Note that decisions made within each WG are outlined in their specific minutes below.

The conference was ended at 15h00 on Wednesday 28th September 2011.

WG1 – Basic Physiological Knowledge

Workshop 28/09/2011

Chairs: Guy Claireaux and Rod Wilson

Work Group 1 workshop started with an introductory presentation by Guy Claireaux. This presentation highlighted the objectives of the group, as described in the Memorandum of Understanding, and raised some of the main issues to be addressed. These issues constituted the backbone of the discussion that followed.

An overriding issue was the complexity of physiological data, and how this can be accounted for in models (WG2).

The notion of variability was the first to be tackled by the group. In recent years, intra- and inter-population variability has become an emerging issue for the community of physiologists. Nowadays, it is generally accepted that the understanding of species responses to environmental stressors requires that within and among population variation be measured and monitored. Through the discussion it was considered that the notion of variability was not fully incorporated in the population-level modelling, although no technical difficulty objectively prevented this integration. However, the discussion also highlighted differences in perception about what variability exactly is, why it is important and how it should be interpreted. This was viewed as an issue that will require further discussion via a specifically dedicated session.

The next point discussed concerned the link between lab populations and wild populations and whether the variability in a lab population was representative of that *in natura*. Experimental approaches generally maintain investigated populations under constant conditions which may not be adequate to investigate and demonstrate the ecological/evolutionary relevance of variability. In this regard, cage studies or studies comparing fish populations along an environmental gradient were believed to be interesting approaches to study the complexity of environmental constraints on fish as well as the importance of understanding the scales (time and space) at which the various interactions occur.

The time dimension of individual and population responses to environmental stressors was evoked in more detail, the idea of annual, lunar and circadian cycle influencing how fishes respond to their environment. This is a difficult challenge, in particular for the modellers, since very little data is currently available. This is also a challenge for the physiologists who need guidance in order to design proper experiments.

During introductory presentation and early discussion, emphasis was put on including more mechanistic physiology into models. However, it was pointed out that conservation physiology does not just imply inputting physiological data into ecological models, it has many other facets. It is possible to use physiological understanding directly to respond to societally-relevant issues, especially with resource managers at a local scale. For instance, most day-to-day fisheries managers deal with habitat alteration for which physiological tools can provide the info needed quickly and within the timescale of the funding available to resolve the problem (without modelling).

This recognition that not all the WG1 activities need to aim at providing modelling links was completed with the suggestion that only focusing on climate change was improper and that

other environmental issues, such as contaminants for instance, were relevant to the activities of WG1.

Another critical point in the discussion concerned the usefulness of physiological biomarkers. It was recognised that biomarkers are difficult to use and can be too context-dependant to allow comparison between studies or species. Moreover, typical indicators of “stress” such as glucose, cortisol etc, are too sensitive to sampling effects to be useful under field conditions. Also, biomarkers are very often indicators of cellular or sub-cellular effects whose consequences at higher orders of biological organisation are difficult to predict and validate. There are very few studies that examine effects of a stressor at all levels (cellular, organismal, populations). One exception was mentioned which is that of endocrine disrupting chemicals (EDCs) which cause gene expression changes, VTG induction, fertilisation, fecundity and population effects. Another example was that of the FP-5 CityFish project, which provided an example of using whole animal performance traits (routine metabolic rate and swimming performance) as biomarkers of sub-lethal toxicity of polluted urban rivers. Because these integrated traits have intuitive ecological relevance, such approaches can provide insight into potential links to population level performance and processes. One key element to the success of a biomarker approach is the possibility of using rapid screening procedures. This would allow the assessment of intra and inter-population variability (e.g. the use of maximal cortisol response, that has been widely applied on birds).

Elements of discussion also concerned the impact of the fisheries upon population-level performances, as well as the use of biotelemetry to investigate what fish actually do in nature, in particular directly to explore whether there are trade-offs in habitat choice, whereby a non-optimal habitat in terms of tolerance ranges is occupied for other reasons, such as prey availability or predator avoidance.

In order to begin the process of collecting and collating physiological data, and to identify gaps in knowledge, a matrix was constructed to identify major subject areas to consider for a literature survey, and to identify persons to undertake this. It was agreed that the focus should be on European species. The deadline for this was set at Dec 2011.

<u>Subject area</u>	Physiology	Behaviour	Ecology
Temperature	Peck/Axelsson	Killen/Sanchez	Milazzo/Azzuro Ruzafa
Hypoxia	Chabot/McKenzie	Domenici/Lefrançois	Chabot
Salinity	J Wilson	J Wilson	Ruzafa
Ocean Acidification	Pörtner	McCormick	Peck/Pörtner
Contaminants	DeBoeck/Claireaux	Sloman/Cooke	Ruzafa/Azzuro

Other specific future activities of the WG-1 were discussed:

- Seven Short Term Scientific Missions (STSMs) – Need to be decided and money allocated by May 2012 (2500 Euros per month). Priority will be given to travel/education of early career scientists but it is suggested it could also fund travel of a PDRA or PhD from within the labs of the Matrix task managers to visit other PIs to pick brains, facilitate knowledge transfer and collate data. Also the possibility was raised of funding visits to do experiments in

another's lab that aimed to fill identified gaps in the matrix. **Deadline for applications is 15 Nov.**

- Training course in Copenhagen in Jan 2012 on collecting physiological data (15-17 students – can include 10 COST students) – 9-10 days of theory and practicals largely on Respirometry. **Apply to John Steffensen and David McKenzie by email by 15 Nov.**
 - The possibility of organizing workshops at upcoming conferences in particular to meet decision makers and stake holders (World Fisheries Congress, SEB, IUPS) was discussed.
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WG 2 Interactions between Physiologists and Ecologists

Workshop 27/09/2011

Chair: Adriaan Rijnsdorp

The Workshop started with a number of presentations illustrating how physiology can be integrated in ecological modelling of population dynamics and distribution.

Presentations

Rebecca Holt (University of Bergen, Norway) – *Conservation Physiology and Theoretical Ecology* - presented a number of examples illustrating how modellers think. Central in these examples was life history theory predicting that behaviour is aimed at maximising individual fitness. As a consequence, there will be a trade-off between behaviour maximising the gain in energy and behaviour minimising mortality risk. This view has implication for how we can link physiology to ecology as it predicts that animals may prefer habitats that are sub-optimal from a physiological point of view if, for example, there is a higher predation risk in the optimal habitat. For the integration of physiology into life history theory, she made a plea not to think of the organism in isolation, with defined strict limits, thermal windows etc, but to have curves and not thresholds or optimal temperatures to find ecological and evolutionarily acceptable temperature ranges. It is better to think in this broader context, and theoretical models have the capacity do this, demonstrating how a range of tolerated performance varies with ecological parameters.

Myron Peck (University of Hamburg, Germany) – *Linking physics and physiology to management of marine fish* - presented examples of how bioenergetic models of fish eggs and larvae can be coupled to biophysical models of the ocean describing both the physical parameters as well as the dynamics of primary production and the zooplankton. Examples were provided of the types of measurements needed to parameterize current models. The talk also included a summary of recent attempts to utilize biophysical models (many of which contain physiological parameters) in marine spatial management (linking with working group 3).

Henk van der Veer (Netherlands Institute for Sea Research, Netherlands) – *Dynamic Energy Budget and its application* - presented the Dynamic Energy Budget (DEB) model of Kooijman which offers a generic model of the bioenergetics of organisms. He showed how these Dynamic Energy Budget studies are applied to analyse and forecast physiological performance of organisms and reconstruct growth conditions. By combining information on tolerance limits to environmental factors, particularly water temperature, and growth energetics by means of DEBs, insight can be obtained about the physiological plasticity of a species. This will provide a sound foundation for analyses of ecosystem functioning and

response to environmental variability such as climate change. The model is becoming increasingly popular to apply in ecological studies to understanding the response of organisms to changes in their environment due to for instance climate change.

Adriaan Rijnsdorp (IMARES, Netherlands) – *Modelling the spatial distribution and migrations of North Sea flatfish*. An example of the application of the DEB approach was presented to study the ontogenetic and seasonal migrations in North Sea plaice. Based on the weekly output of a spatially explicit Ecosystem model of the North Sea (ERSEM), the habitat quality was estimated in terms of growth rate for different size classes. Both the observed ontogenetic change in distribution as well as the seasonal migrations of the adult fish was related to the changes in habitat quality. The 1st results of a model that attempted to capture the spatial dynamics were presented. This model used a genetic algorithm to estimate optimal migration routes.

Francois Guilhaumon (University of Evora, Portugal) – *Bioclimatic envelope modelling* – Basic concepts of Bioclimatic envelope modelling (BEM) were presented along with the classical work-flow used for BEM calibration and subsequent forecasting. Specific steps of the BEM work-flow where physiological inputs can enhance BEM efficiency were highlighted and discussed. Among those steps, the most critical are those related with evaluation of the fundamental ecology of the species. This is where physiology can help to improve BEM, so as to take into account, for example, problems of non analogous climates when forecasting.

Discussion

The objectives formulated for the WG2 in the Memorandum of Understanding were presented. There was general agreement that the objectives are well formulated although the objective to *Foster interactions between physiologists and ecologists* needs to be considered more broadly. The objective to *Evaluate potential effects of environmental change on fish assemblage composition and structure using MPAs as “natural laboratories”* raised some discussion as it was thought to be difficult to design experiments. On the other hand, they exclude certain anthropogenic impacts which may help to disentangle the effects of climate change or pollution from the effect of fishing.

The deliverables specified in the MoU were presented and the question was raised whether we are happy with them or need to rephrase them.

- Literature reviews (minimum of 3): (1) Fish growth and population dynamics; (2) Species distributions; (3) Multi-species interactions and ecosystem dynamics
- Report identifying gaps in scientific knowledge and future research needs
- ≥ 10 STSMs
- Joint research proposals
- Technical workshop on approaches to incorporate physiological models into forecasting climate change on fishes
- Training course for young scientist on developing ecological models to implement these approaches

The 1st point in the discussion was whether we would position our work in the context of climate change. There was general support, however, for broadening the scope and include multiple stressors such as pollution, noise and invasive species, which would offer a link to WG3 because of its relevance for the Marine Strategy Framework Directive. There was some discussion on including the effect of fishing, but it was felt that this should not be a focus area but may be included as a factor that interacts with the key stressors studied.

Reviews.

Rijnsdorp proposed to organise a workshop dedicated to each of the review topics, by inviting the relevant expertise. He explained that the WG-coordinators are responsible for managing the process to make sure that the reviews are written, but not to write the reviews themselves. For each review, one or a few volunteers are needed who are interested to take up the challenge and use the opportunity offered by the COST-project. Additional reviews may be included as well and people are encouraged to send in their suggestions to the WG-coordinators and MC.

It was noted that there is a lot of overlap between the reviews.

(1) Fish Growth and Population Dynamics

In the discussion many comments were given but no clear delineation of a possible approach emerged. The main comments made were:

- Although growth is an important trait, it is not necessarily the only trait to include in the modelling and it may be safer to come up with traits and currencies.
- Although stressors affect the physiology of a fish on different levels of organisation, it is not directly obvious how the effects on the cellular level for instance can be translated in an effect on the organism.
- The review needs to formulate questions for persuasive essays, for instance advocating for greater inclusion of physiology in ecological modelling to improve predictive power of the ecological models.
- Don't forget the conservation perspective
- If we want to go from physiology to population dynamics, we need to focus on the processes at the level of the individual. The implications for distribution will follow as a logical consequence.

(2) Species distributions

Two approaches are available: climate envelope and mechanistic models; as illustrated by the presentations

The climate envelope approach presented by François Guilhaumon will be a good starting point. François suggests that we need to figure out the main physiological factors that constrain distribution of fishes in space. This has been done for terrestrial ecosystems but not for marine. Can we establish what can be done? Can modelling tools for land be transposed to sea? If not, what to do? Then, some examples and comparisons?

It was agreed that this review should focus on the effect of stressors on the distribution of species but should not focus specifically on the effects of species interaction, such as competition and invasive species, as this is the topic of the 3rd review.

François Guilhaumon is prepared to take the lead in this review.

Other comments made:

- either of the reviews could consider effects of fisheries on removal of fast-growers, and also interpretation of pop dynamics – effects on range size due to changes in this.
- Relevance of scale: what do we know about how to preserve populations, then species, then biodiversity, then functional diversity.

- Physiologists have to define variables affecting growth, ecologists to define what influences population dynamics to construct links. Compare different species, or same species in different environments. Compare physiological and ecological elements, to see if it reveals patterns.
- Identify tools we want to use to explain distributions – what are we trying to explain? What are the drivers? This may reveal how physiology is an explanatory variable.
- Invasives can be included to study how their physiology allows them to invade for instance due to climate change.
- Four different levels of integration – individual – population – species – communities.

(3) Multispecies interactions and ecosystem dynamics

This review is truly innovative. The discussion was a true brainstorm without a clear idea how to continue. This deliverable will be worked on in the latest phase of the COST project and will build on the results of the other two deliverables.

- It is suggested that we could use case studies here to explore the implications of different types of physiology (endotherms, ectotherms) on their ecological response and implications for the ecosystem dynamics. So we have to go beyond subtle differences between temperature tolerance of interacting species.
- Incorporating physiology into Ecopath and Ecosym may be an option to tackle this challenge.
- People have constructed food webs and put physiology in at nodes, to then see how physiology would then influence the web? Hans Pörtner was involved.
- Distinguishing ecological functions may be important. Can we predict which roles might be lost? Use guild system to define functions? To categorise fish functions?
- Distinguish between fundamental versus realised niche. Differences – biotic interactions?

Report on gaps on knowledge

Gaps in knowledge will emerge quite naturally from the reviews and the interactions at the workshops.

10 STSMs provide focus for these (subject areas), perhaps focussed on deliverables?

There is support for the idea to focus at least part of the STSMs to the specific question dealt with in the review.

Technical workshop/training course

Myron Peck volunteers to organise this in collaboration with the University of Bergen.

There was a lively discussion on using case studies to integrate physiology and ecology. These case studies can be species specific (cod, herring, flatfish), focussed on functional relationships (wide-ranging species vs localised species with similar ecological roles) or areas (Baltic Sea)

Points raised in the discussion:

- focus workshops and STSMs on deliverables.
- link to fisheries management, and to WG3

- reviews articles should explore how individual variation can be incorporated into models. Are there techniques out there or not, to translate individual variation in physiology to fitness.
- prepared a scheme of relation of individual growth to population dynamics. Mortality is linked to k in equation of growth rate..? where are the various species in these curves ? cold versus warm, etc
- starting point for hypothesis, selecting key species for case studies.

Conclusions

A Workshop will be organised in early 2012 to develop a concrete workplan for the activities of WG2, in particular the preparations for review 1 and the 1st call for STSMs. The MC voted to use the remainder of the budget from the Porto meeting to fund this WG2 workshop in early 2012. The amount available will become evident when the delegates from Porto have been reimbursed.

The possibility of extending the concept of the reviews to a collection of such papers in a special issue of a journal emerged as a possible way forward, since the scope of the reviews, as currently considered, is probably too broad for a single article.

WG3 Conservation physiology and decision-making

Workshop 26/09/2011

Chair: Julian Metcalfe

Julian Metcalfe (JM) opened the WG3 session with a presentation describing the aims, objectives and deliverables for the WG, identifying that a key function would be to facilitate the flow of understanding between physiologists, modellers, policy advisors and policy makers.

JM said that while, at this stage, he wasn't entirely clear how to achieve all these objectives in detail, he was confident they were achievable and that it should be possible to recognise success when it happens.

JM expressed the view that there was a need to keep open minds and to leave "scientific baggage at the door"; the aim was not about getting "pet" research projects funded.

The key objectives of WG3 were to achieve effective communication between scientists, stakeholders and policy-makers, enabling research to be incorporated into decision support tools and to provide scientists with better understanding of legal and policy frameworks of fisheries and resource management so that conservation research meets societal needs

JM highlighted the need to identify:

1. The relevant important policy drivers such as the Marine Strategy Framework Directive, OSPA etc.,
2. Who are the key policy/decision makers and how/where/from whom they currently get their advice,
3. How to interact with others to understand needs and drivers and how to feed knowledge and understanding to the relevant fora

Peter Pärt (PP) followed with a short presentation on the current priorities in the marine area at the European Environment Agency, drawing attention to the State of the

Environment in Europe Reports and specifically recent reports on marine issues (e.g. Impacts of Europe's changing climate – 2008 indicator-based assessment)

PP identified the audience of these reports. Policymakers included the European Commission, European Parliament, European Council – Environment, Member State governments and the general public such as News and media, NGOs, interested citizens

PP went on to identify up-coming issues in the marine area e.g. Update 2012 of the 2008 Climate change adaptation report (the chapter on the Marine environment) which included:

- Case studies on consequences of increased temperature on marine life
- Case studies on effects of acidification on marine life.
- Case study on factors affecting the cod population in Kattegatt (potential for input on cod physiology and capacity to adapt to environmental changes identified)
- Report on coastal zones and coastal management (potential for input on pollution effects in the coastal zone)
- Case studies from the Mediterranean environment
- Effects of temperature
- Effects of changed weather conditions – more summer storms, less winter storms – consequences for vertical mixing and nutrient flows
- Pollution effects

PP identified that all these EEA reports are available in PDF format at: www.eea.europa.eu under the heading: **Environmental topics**, Sub-headings: “**climate change**”, “**water**” or “**fisheries**”

João Coimbra then gave a presentation on the importance of physiology in the conservation and management of marine fishes, drawing on examples from his own research area of pressure effects on fish endocrinology.

During subsequent discussion Steven Cooke suggested a conceptual framework for thinking about issues related to scale in conservation physiology (table overleaf). It was noted that for almost all of these there is a gradient between “Type A” and “Type B” rather than two distinct categories.

In concluding discussions it was agreed that WG3 should:

1. consider drafting case study “stories” on particular issues, presented in an accessible way for policy makers/advisors and stakeholders that explain how physiology can contribute to mitigate contemporary environmental issues. PP to advise on issues that might be suitable and to provide example(s);
2. explore the possibility and value of holding a workshop on the Marine Strategy Framework Directive (MSFD) and its relevance as a policy driver. It was noted that Eugene Nixon leads on MSFD in ICES;
3. consider proposing an ICES session on Conservation Physiology at the 2013 ICES ASC (**NB.** this is probably an objective for the COST Action as a whole rather than for WG3 alone);
4. explore the possibilities for engaging with policy advisors and others at the 6th World Fisheries Congress (due to be held in Edinburgh 7-12 May, 2012);
5. develop a list NGO/Stakeholder/advisory structures (e.g. Regional Advisory Councils) for each country and across Europe so the Action can identify with whom it should be building a dialogue;

6. consider the need for a “100 questions exercise”* to enhance fisheries and aquatic conservation, policy, management and research;
7. seek further details on the ICES Advisory Plan for 2012 onwards;
8. identify other policy drivers (OSPAR etc.) that are relevant to conservation physiology;
9. explore potential for future conservation physiology studies under EU FP7 and elsewhere.

SCALE/ISSUE	“Type A”	“Type B”
Geographic/spatial scale	Local/Regional (e.g., an estuary)	National/International (e.g., the North Sea)
Specificity of Question	Quite specific – e.g., a point-source disturbance/pollutant, a bycatch issue with a specific fishery	General – Broad-scale environmental change phenomena
Decision Makers	State/Provincial/Regional/Sometimes national – several people, often fisheries managers make decisions on a local level	Regional Fisheries Management Organizations and Bodies – Multinational (e.g., UN COFI, EIFAC, ICES) – high-level politicians
Time Scale (for making decisions and the issues)	Short-term	Long-term
Potential for application of conservation physiology knowledge	Direct – specific studies can inform a specific issue	Indirect – Information incorporated into models and decision support tools
Level of Stakeholder Engagement by Researcher	Lots	Less
Information on which decisions are based	Potentially 1 or 2 papers/studies	Burden of proof – large body of knowledge needed
Research timescale in terms of making significant advances towards solving a problem	Grant/Thesis duration	Career(s)
Basic/Applied Gradient	Applied	Basic – with eventual application

1st Conference on the Conservation Physiology of Marine Fishes

CIMAR, Porto, Portugal, September 26 – 28, 2011

Programme

MONDAY September 26

- 9:15 Welcome (Jonathan Wilson)
- 9:20 Introduction to the COST Action (David McKenzie/Paolo Domenici)
- 9:40 Workshop WG3 Conservation physiology and decision-making (introduced and chaired by Julian Metcalfe)
In this workshop, speakers with a role in policy-making will have an opportunity to present their views on making research more relevant to decision-making.
- 10:30 *Coffee*
- 11:00 WG3 Round Table Discussion
- 13:00 *Lunch*
- 15:00 Delegates Introductions (Chair David McKenzie)
- 16:00 *Coffee*
- 16:30 Delegates Intros (Chair Paolo Domenici)
- 18:00 *End of day*

Annex 1 Conference Timetable

TUESDAY September 27

- 9:00 Delegates Intros (Chair David McKenzie)
- 10:10 Summing up of delegates intros (David McKenzie, Paolo Domenici)
- 10:30 *Coffee*
- 11:00 Workshop WG2 Integrating physiology into forecasting (introduced and chaired by Adriaan Rindsorp)
- 11:20 WG 2 Round Table Discussion
- 13:00 *Lunch*
- 15:00 WG 2 Round Table Discussion
- 16:00 *Coffee*
- 16:30 WG 2 Round Table Discussion
- 18:00 *End of day*
- WEDNESDAY September 28***
- 9:00 Workshop WG1 Basic Physiological Knowledge (introduced and chaired by Guy Claireaux and Rod Wilson)
- 9:20 WG 1 Round Table Discussion
- 10:30 *Coffee*
- 11:00 WG 1 Round Table Discussion
- 13:00 *Lunch*
- 14:30 WG 1 Round Table Discussion
- 16:00 *End of conference*

Annex 2. Composition of Working Groups

Family Name	First Name	Affiliation	Country	Action Role	MC Role	WG1	WG2	WG3	email
Axelsson	Michael	Göteborgs University	Sweden	MC	STSM referee	1			m.alexsson@zooi.ru.se
Azzurro	Ernesto	ICM CSIC	Spain	MC	STSM referee	1	1		azzurro@icm.csic.es
Branco	Paolo	ISA UTL	Portugal	ECS			1		pibranco@isa.utl.pt
Chabot	Denis	DFO	Canada	Expert		1	1		denis.chabot@dfp-npo.gc.ca
Chairaux	Guy	U. Bretagne Occidentale	France	MC	WG1 leader	1	1	1	Guy.Chairaux@univ-brest.fr
Cooke	Steven	Carleton University	Canada	Expert		1	1	1	Steven.Cooke@carleton.ca
Costa	Silvia	ISPA	Portugal	ECS		1			scostai@ispa.pt
Darnaudé	Audrey	University of Montpellier	France	MCsub			1		audrey.darnaudede@univ-montp2.fr
DeBoeck	Gudrun	University of Antwerp	Belgium	MC			1		gudrun.deboeck@ua.ac.be
Domenici	Paolo	CNR	Italy	MC	Vice-Chair	1	1	1	paolo.domenici@cnr.it
Grigorjov	Panos	Hellenic Center for Marine Research	Greece	ECS		1			panos.grigorjov@hcmr.gr
Gronkjaer	Peter	University of Aarhus	Denmark	MCsub		1	1		peter.gronkjaer@biology.au.dk
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Killen	Shaun	University of Glasgow	UK	ECS		1	1	1	Shaun.Killen@glasgow.ac.uk
Kulczykowska	Ewa	IOPAN	Poland	MC	Finance Rap	1			ekulczykowska@iopan.gda.pl
Lefrançois	Christel	University of La Rochelle	France	MCsub		1	1	1	ChristelLefrancois@univ-lr.fr
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Metcalfe	Julian	CEFRAS	UK	MC	WG3 leader	1	1	1	julian.metcalfe@cefas.co.uk
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Nilsson	Goran E.	University of Oslo	Norway	MC	STSM referee	1	1	1	g.nilsson@mbv.uio.no
Peck	Myron	University of Hamburg	Germany	MC		1	1	1	myron.peck@uni-hamburg.de
Perez-Ruata	Angel	University of Murcia	Spain	MC	STSM referee	1	1	1	angelpr@um.es
Rijnsdorp	Adriaan	Wageningen University	Netherlands	MC	WG2 leader	1	1	1	Adriaan.Rijnsdorp@wur.nl
Sanchez	F. Javier	University of Murcia	Spain	MCsub		1			javisan@um.es
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