

COST Action FA1004 Conservation Physiology of Marine Fishes

Minutes of the 3rd Conference on Conservation Physiology of Marine Fishes.

Hotel Real Marina, Olhão, Portugal, 28 – 30 October 2013

The timetable of the meeting is shown in Annex 1.

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

1. hold workshops for all working groups
2. encourage networking among members of the Action
3. discuss the budget plan and activities for Action year 3

The list of delegates attending this Olhão meeting is carried in Annex 2.

General Overview (David McKenzie)

The meeting started with a welcome by the local organiser and host Pedro Guerreiro (Centre of Marine Sciences, Faro Campus, University of Algarve, MC Member for Portugal). David McKenzie (CNRS Montpellier, Action Chair) then presented the general objectives for the three-day conference.

As with the previous conference, each day started with plenary lectures on aspects of conservation physiology. See programme in Annex 1 for details.

The workshops were held to take forward activities of the three Working Groups (WG1 Basic physiological knowledge; WG2 Integrating physiology into forecasting, and WG3 Conservation physiology and decision-making), in line with their specific objectives in the Memorandum of Understanding. The **composition of the working groups** can be found on the intranet section of the project website (<http://fish-conservation.nu/>), based upon expression of interest by each delegate at the 1st conference (CIMAR, Porto, Portugal, September 2011), and updated by the Action chair.

The **WG3 workshop** started the conference on Monday 28/10, and then was resumed and completed on Wednesday 30/10. The **WG1 workshop** comprised the late morning and afternoon of 28/10, the **WG2 workshop** occupied the full day of Tuesday 29/10. The WG leaders chaired these workshops. After a general overview of the meeting, details and minutes of the three WG workshops are provided.

Holding the conference in a hotel at which all delegates were accommodated provided extensive opportunities to network during the entire three-day event. In the evening of Monday, there was a poster session that was very lively and well attended. On the Tuesday evening we had a very convivial dinner attended by almost all delegates.

On Wednesday 30/10, after the WG3 workshop, there was a general discussion and **MC meeting**. This was chaired by David McKenzie, and involved a discussion around the 3rd year budget plan, and how best to proceed with the Action in general. The budget plan can be consulted on the intranet section of the website (see below). The COST initiative has moved from being run under the auspices of the European Science Foundation to the EU Horizon 2020 Framework, so some elements of the budget plan will only be financed after submission of a budget amendment, which should be in place before Christmas.

The Action Chair will confirm the completion and receipt of the budget amendment by the EU.

The main budget items for year 3 are scientific meetings and short-term scientific missions.

Meetings. The meetings detailed in the budget plan comprise this 3rd conference in Olhão, a WG1 workshop in spring 2014 on the state of the art in marine fish telemetry, and a WG2 workshop focussed on developing a review article on applications for physiological knowledge in ecological models, and the state of the art in this field (see the specific minutes below).

Short Term Scientific Missions. The COST will fund at least 12 STSMs for ESRs in year 3 of the Action. The deadline for submitting these, for year 3, is May 30th 2014, so that the STSM can be completed before August 31st 2014 (end of the Action year). Applications should be made through the online tool. They will be evaluated by the STSM coordinator (Gudrun de Boeck, Antwerp University, MC member for Belgium) and the STSM committee. Recipients of funding will be required to prepare a 150 word report of their STSM, plus a suitable photo, which to be put on the Action website.

Other matters. The *COST website* has an intranet area, password CONPHY2012 (case sensitive). In this area, delegates can find minutes of all meetings, COST updates, the annual budget plans, etc.. **We need photos for this website**, of marine fishes or dynamic researchers saving the world. Please email these to the COST website creator/manager, Michael Axelsson (michael.axelsson@bioenv.gu.se).

Remember also to visit and update our **Facebook interest group, Conservation Physiology of Marine Fishes**.

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

The conference was ended by David McKenzie at 14:00 on Wednesday 30th October, the remainder of that day was used for networking by delegates. Warm applause was given for the excellent job by the local organiser, Pedro Guerreiro, and his team.

General Decisions Taken by the MC

The following general decisions regarding the **budget for Year 4** were taken by the Management Committee at the conference, following general discussion among all delegates:

- 1) We will budget for a **4th Conference on Conservation Physiology of Marine Fishes** in Action year 4. Once again, this is because a single conference comprising sequential workshops for all WGs is the cheapest option when so many delegates are members of more than one WG. The venues proposed were Salonica (Host Basile Michaelidis, University of Salonica and MC Greece) or Montpellier (Host David McKenzie). The conference will be in autumn 2014, the exact date will be based on a doodle poll among MC members.
- 2) We will budget for a **final high-profile meeting**, to disseminate the COST Action results as widely as possible. This meeting will provisionally be held in September 2015 (this requires an extension of the Action) at an ICES Conference (European venue TBA), so that resource managers and policy makers will be in attendance. The proceedings of this meeting will be published as a special issue of the Journal *Conservation Physiology* (online, Society for Experimental Biology & Oxford University Press, see below). This SI will comprise a combination of perspective/recommendation papers, authoritative reviews and research articles.

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

WG3 Conservation physiology and decision-making

Workshop on a traits-based approach to conservation physiology

28/10 & 30/10/13

Chair: Julian Metcalfe (CEFAS Lowestoft)

On Monday 28/10, Julian Metcalfe opened this workshop by introducing the idea of using physiological knowledge to develop a “trait-based approach” to evaluate the relative sensitivity of marine fishes to environmental stressors. This in order to provide decision-makers with a tool that can be used to predict the relative sensitivity of any particular marine fish species to climate change based on knowledge of its physiology, ecology and behaviour.

Julian identified that, while the full development of a trait-based sensitivity index for marine fish was probably beyond the scope and resources of the COST Action, there probably *was* scope within the Action to support a workshop (or similar) that would provide a process for incorporating physiological knowledge (i.e. by using outputs from WG1) into such a sensitivity index. Julian also identified that, as he understood it, the process of developing sensitivity indices provided scope for involving policy advisors as they were more fully aware of the types and nature of the output required and therefore helpful in designing the structure of such an index

The workshop was then set in motion with a lecture by Silvana Birchenough (CEFAS Lowestoft), who is developing a trait-based approach to assess and predict the relative sensitivity of marine benthic communities to acidification. The process involves assembling a group of cross-discipline researchers who can use existing data and expert opinion to construct a trait-based index of sensitivity to environmental stressors. The index is then tested against existing community level data from field experiments and observational studies at sites where benthic species are exposed to different pH and temperature regimes. Finally, the sensitivity index would be used to construct simple models of species extinctions and predict the likely impact of climate change on biodiversity and community function.

Given that this trait-based method was relatively unfamiliar to most of the COST Action delegates, Julian, Richard Corner (Longline Environmental) and Steven Cooke (Carleton University) asked each delegate to think of up to three perceived opportunities and up to three perceived challenges of this approach for applying physiological knowledge to marine fishes, in preparation for the second part of the workshop where the meeting would consider in more detail how the COST Action might support an exercise that could provide a method for incorporating physiological knowledge into a climate change sensitivity index.

On Wednesday 30/10, the workshop reconvened with a lecture by Steve Cooke, about the significance of scale (biological, spatial, temporal, allometric, phylogenetic) in conservation physiology, and how this influenced the scale at which policy makers would be involved (local, regional, national, European). Steve also provided an overview of the new journal *Conservation Physiology*, of which he is the editor. The journal has already received 50 submissions, but relatively few are on marine fishes so far. We are grateful to the Society for Experimental Biology for funding Steve’s attendance at the conference.

Julian, Richard and Silvana then returned to the subject of a trait-based approach for evaluating the relative sensitivity of marine fishes to environmental stressors that had been introduced on the first day of the meeting. Having previously been asked to consider 3 opportunities and 3 challenges associated with the approach in the context of the COST Action, delegates outlined these anonymously by posting notes on a board. The notes were then categorised by Steve Cooke and Richard Corner. The categories were not pre-defined and developed spontaneously at the time based solely on the comments and ideas posted. Opportunities and challenges were summarised by Richard and Steve, respectively. The outcome of this exercise will be taken forward in planning a workshop to be organised as part of the COST action that would develop a framework for using trait-based approaches for fish that concentrates on physiology, ecology and behaviour. This approach will help translate different sources of information and understanding in a simplified manner to inform and support climate change predictions for decision makers. The outputs from the workshop will be presented to the 4th COST Action Conference to be held in October 2014 and will be prepared as a manuscript for the COST Action Special Issue of Conservation Physiology.

Julian Metcalfe then asked for all members of nations present to identify a person that would contact national representatives involved in decision-making (ministries, government agencies, advisory bodies). A list was developed and these people will contact Julian with relevant information, towards organisation of a future workshop or the final high-profile meeting.

WG1 – Basic Physiological Knowledge

Workshop on Biomarkers in Conservation Physiology (28/10/2013)

Guy Claireaux (University of Bretagne Occidentale) & Rod Wilson (University of Exeter)

Work Group 1 workshop started with an introductory lecture by Guy Claireaux about the use of biomarkers in marine fish conservation physiology research. This presentation reviewed how biomarkers are used in biomedical research, and highlighted how a similar approach in environmental sciences would provide a framework for strategic thinking about linking the fields of aquatic toxicology, physiology, ecology and conservation.

The delegates then identified **five major environmental stressors**, namely global warming, hypoxic events, ocean acidification, noise pollution and fisheries bycatch. Five groups were formed and half a day was dedicated to discussing what biomarkers might be used to evaluate the impact of these stressors, or to predict the relative sensitivity of marine fish species. After 2h of discussion, all delegates reconvened and each group provided a short presentation on how biomarkers could be used for their stressor.

Temperature (spokesperson Gudrun de Boeck). The necessity of bring into line the time frames of biomarker response with that of the event under scrutiny was particularly highlighted together with a better understanding of how the effect of environmental stressors cascade through biological organisation scale.

Hypoxia (spokesperson Rod Wilson). This working group highlighted the fact that although conceptually and mechanically well understood, in practice evaluating the impact of environmental hypoxia upon fish species' ecology and evolution remains a difficult issue. It is believe that an important first step would be the constitution of a data base gathering key information about fish species' oxygen requirement and susceptibility to reduced oxygen availability.

Acidification (spokesperson Richard Corner). The most important point that emerged from this group is the need for considering early life stage and therefore to design and validate biomarkers capable of providing key information about the physiology and behaviour of fish embryos and larvae.

Noise pollution (spokesperson Myron Peck, University of Hamburg). Experiments can be easily planned to address this broad issue. The importance of distinguishing the types of noise (on a continuum from not detectable, chronic but allowing habituation, to acute and damaging) and behavioural and physiological responses of various life stages was highlighted.

Accidental bycatch (spokesperson Steve Cooke) Due to the reformed CFP, this is an important policy item. The following management needs were identified:

Characterizing the relative sensitivity of different species relative to gear types, environmental conditions and handling procedure;

Predict mortality (and sublethal fitness impact) of discarded fish;

Identify strategies for reducing stress, injury, mortality and improving welfare

Important concepts were also identified:

- Impossible to capture fish without causing some level of stress and injury (reality check);
- Recognize that injury and stress are difficult to uncouple, and are indeed related;
- Recognize that it is difficult to generalize across species and gear types;
- Recognize potential impacts for fish that escape prior to capture;
- Recognize need to combine field and experimental approaches and include ecological relevance;
- Recognize the need for biomarkers that are “user friendly” and reliable
- Recognize that impacts likely vary seasonally and ontogenetically

A general framework of thought was constructed from the various contributions and is summarized below

The issue	Time frame	Org. level to consider	Process to target	Potential biomarker	Link with org. level below	Link with org. level above
Ocean Acidification	Multi generation	Population	Natural selection	Variance in traits	Traits of environ ^{tal} adapt.	Resilience
Noise	Year	Population	Distribution Elements of pop. dynamics		Percep. of cues Sensory syst.	Recruitment Pop dynamics
Discard	Day-Week	Species	Survival	Mech ^{tic} -based Empirical	Physiology Behavior	Sensitivity index
Hypoxia	Hour to OW/Eutroph.	Individual to Population	Metabolism	P _{crit}	Mitochondria ATP production	Behavior Growth
Temperature	Hour to OW	Individual to Population	Perf. traits to Elements of pop. dynamics	Mech ^{tic} -based to Variance in traits	Energetics	Resilience

The workshop concluded with two announcements:

- i) **Special Issue on Metabolic Rate in Fishes : Methods and Ecological Significance.**
This SI will be published by the Journal of Fish Biology in 2015, with Guest Editors Denis Chabot (DFO Mont Joli), Guy Claireaux and David McKenzie. It will comprise invited reviews in two main areas: (1) measuring various elements of metabolic rate in fishes, including larvae, with the objective of establishing standard methods and definitions, and (2) how such measurements can be used in conservation physiology. It will also accept research articles on fish respiratory metabolism, in particular if these have a conservation perspective.
- ii) **Workshop on telemetry for conservation physiology of marine fishes.** A hands-on workshop will be held in Brest, France, over 5 days from 12/5/14 to 16/5/14. The workshop is organised by Guy Claireaux, Michael Axelsson (University of Gothenburg) and Julian Metcalfe (CEFAS), see Annex 3 for details. The Action will fund up to 16 attendees, with priority given to ESRs. Please contact one of the organisers if you, or an ESR in your lab, wish to attend.

WG 2 Interactions between Physiologists and Ecologists
Workshop on the Dynamic Energy Budget 29/10/2013
Christian Jørgensen (University of Bergen) & Myron Peck (University of Hamburg)

(Adriaan Rijnsdorp, IMARES Wageningen, is co-chair but was unable to attend)

Plenary lectures

This workshop started with two introductory lectures. Jaap van der Meer (Royal Netherlands Institute for Sea Research, Texel, and Free University of Amsterdam) is one of the main developers of the Dynamic Energy Budget (DEB) modelling approach. He gave a detailed overview over the general modelling philosophy of DEB, the main assumptions, and implications and possible applications. Lorna Teal (IMARES Wageningen) then presented specific applications of DEB modelling that were relevant for conservation physiology of marine fishes. In the second presentation, a coupled model approach predicted preferred habitat for growth by using spatially explicit fields of temperature and benthic food availability from another model (ERSEM) as input to a physiologically detailed DEB model for flatfishes (plaice and sole). In this way, the DEB framework was able to predict the seasonal movements of different life stages in the North Sea at present, and how these might change with predicted future warming, based upon the areas with the best combination of temperature and prey availability for growth.

Group discussions

After the presentations, the delegates were split into 5 groups, each of which discussed an element of the DEB. These were:

- i) Quantification of physiological parameters as input to DEB;
- ii) Modelled versus observed growth in fish;
- iii) DEB's assumptions on resource allocation;
- iv) Metabolism and aerobic scope in DEB; and
- v) Linking DEB with behaviour.

The discussions raised many interesting points. A positive observation from experimental physiologists was the better articulation of i) what models are capable of, and ii) the strengths and weaknesses of the approach. This indicates that WG2 is fulfilling its mission of promoting dialogue between experimentalists and modellers.

Next steps: A writing workshop in 2014

The perspective from the WG2 discussions in Olhão will be taken further at a writing workshop to be held in Haarlem, the Netherlands, in the first week of February 2014. At this workshop, the plenary speakers and a group of willing writers spanning from experimentalists to modellers will discuss and write a review-type paper relating DEB to conservation physiology. The workshop is organised by the WG leaders with Lorna Teal as local host.

Annex 1

COST Action FA1004 3rd Conference on Conservation Physiology of Marine Fishes



Real Marina Hotel, Olhão, Portugal

October 28, 29, 30, 2013

Local organiser: Pedro Guerrero, Centre of Marine Sciences, University of Algarve, Faro.

GENERAL INFORMATION

Delegates have received extensive information about venue, travel, etc. We expect up to 50 delegates at the meeting, 45 from afar, 5 local (University of Algarve). It promises to be a lively meeting.

Venue: Hotel Real Marina, Olhão. Delegates have already booked at this hotel or made their own arrangements. The conference will take place in a meeting room at the hotel. Coffee breaks will be served outside the room, there is a bar nearby in case delegates want to buy a drink during the poster session

Posters: These informal sessions are an important part of the conference, to promote networking and reveal opportunities for collaboration.

There will place to set up posters outside the conference hall. These should be in portrait format. They can be set up at any time; poster sessions proper will be at 18h30 on Monday 28 and Tuesday 29 October.

Please advise Pedro Guerrero by **Tuesday October 22nd 2013** if you will be bringing a poster. Presentations by early stage researchers are particularly welcome.

Meeting structure. The 3rd Conference will comprise three full days, the detailed programme is overleaf. The following main activities will take place:

- **Plenary lectures** Each day will start with 30-min lectures by COST participants or invited experts from COST countries.
- **WG1 workshop on Biomarkers** This will take place after the lectures on day 1 (see below). The primary objective of this WG is to identify and discuss physiological biomarkers of stress and impaired ecological performance, which can be used as indicators of population health and resilience. We take the term biomarker in the broadest sense. The informal and participative workshop will comprise an introductory talk about how biomarkers might be applied in conservation physiology (NOT ecotoxicology biomarkers, although these can be included if relevant). Delegates will then split into 8 groups to discuss potential biomarkers and propose a research project to apply these. No matter how speculative, we just want ideas. Each group will then identify a spokesperson to describe, in 3 slides, the project.
- **WG2 workshop on the Dynamic Energy Budget** This workshop will take place after dedicated introductory lectures on day 2. The DEB is a widely-applied model for estimating various elements of the bioenergetics of organisms, including their growth rates. It is currently being used by a number of COST participants to predict responses

of fishes to climate change. The bases for its parameterisation have historically proven rather difficult to grasp for ecophysiologicalists. This workshop will aim to improve understanding, and uptake, of this modelling approach by fish ecophysiologicalists. It will be structured into discussion groups after a general roundtable.

- ***WG3 workshop on making conservation physiology relevant to decision-makers.*** This workshop will focus on whether the COST Action can devise a trait-based approach to predict the relative sensitivity of a species of marine fish to climate change, based solely on knowledge of its physiology, ecology and behaviour. The workshop will start with two lectures on Monday (see programme overleaf) and then there will be a round-table workshop on Wednesday morning, animated by an invited expert from a consultancy firm, Longline, specialised in making conservation biology research comprehensible for non-scientists. There will also be a lecture by Steve Cooke (Carleton and Society for Experimental Biology) about making conservation research relevant to policy, and the significance of scale. He will also provide information about the new journal Conservation Physiology (SEB, OUP).
- ***Summing up and MC meeting*** This will be for the last hour of day 3, to progress with COST business. In particular, information will be provided of the next activities planned, and suggestions for STSM subjects.
- ***Networking for research collaboration and STSMs*** The final afternoon will be available for people to finalise networking, in particular to focus on possible STSMs etc.

PROGRAMME

Monday 28 October

09:15 Welcome (Pedro Guerrero; David McKenzie)

09:30 *An introduction to the WG3 workshop : Can a traits-based approach make conservation physiology of marine fishes relevant to policy makers ?* by Julian Metcalfe (Cefas Lowestoft)

10:00 *A traits-based approach to predict responses of marine biota to climate change* by Silvana Birchenough (Cefas Lowestoft)

10:30 Refreshment Break

11:00 WG1 Workshop on Biomarkers (Chair: Guy Claireaux)

12:30 Lunch

13:30 WG1 Workshop (cont.)

16:00 Refreshment Break

16:30 WG1 Workshop: Synthesis of progress

18:00 End of day

18:30 Poster Session

Tuesday 29 October

09:30 *The Dynamic Energy Budget : an Introduction* by Jap van der Meer (NIOZ)

10:00 *Applications of the DEB to predict responses of flatfish to climate change* by Lorna Teal (IMARES)

10:30 Refreshment Break

11:00 WG2 Workshop on the Dynamic Energy Budget (Chair: Christian Jørgensen, Myron Peck)

12:30 Lunch

14:00 WG2 Workshop (cont.)

16:00 Refreshment Break

16:30 WG2 Workshop: Synthesis of progress

17:30 End of day

18:30 Poster Session

Wednesday 30 October

09:30 *Conservation physiology and policy : a question of scale ?* by Steve Cooke (Carleton University and Society for Experimental Biology)

10:00 WG3 Meeting (Chair: Julian Metcalfe)

10:30 Refreshment Break

11:00 WG3 Meeting (Chair: Julian Metcalfe)

12:00 COST Action Business (Chair: David McKenzie)

13:00 Lunch

14:30 Networking, STSM discussions

17:00 End of conference

Annex 2

Attendance list

Family Name	First Name	Affiliation	email
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Annex 3

Telemetry for Conservation Physiology of Marine Fish: A hands-on workshop organised as part of the COST Action FA1004.

5th-9th May 2014, Ifremer, Brittany Centre, Brest, France

It remains a central problem to relate how marine fishes perform in laboratory experiments with knowledge of the habitats they choose, the conditions they experience and trade-offs that are involved in their natural environment. There are immense technical difficulties in following the movements of fish in the vast underwater realm, let alone in estimating how this relates to their physiological state and whether they choose habitats that optimise their fitness.

Telemetry, using electronic devices attached to or implanted into the animal, is a key technology helping to resolve this problem by allowing scientists to gather information on the physiology, movements and behaviour of wild fish whilst responding to, and coping with, the variety of challenges they continually face in their natural environment. Telemetry technology is developing rapidly and there are now many different types of device incorporating both environmental and physiological sensors that are beginning to provide new understanding of how animals function in their environment.

The aim of this workshop is to provide early and mid-career fish physiologists and ecologists, who have little or no experience of telemetry, a comprehensive view of the different technologies available and their current and potential applications in a marine fish context. Presentations and demonstrations will be given by internationally renowned experts and from leading device and system manufacturers. It is intended that participants should see how telemetry can enhance their research and, through dedicated hands-on training using acoustic, archival, and satellite telemetry systems, provide them with the knowledge and skills needed to start using telemetry to develop their research as it relates to marine fish ecology and conservation.

Workshop Plan.

The workshop will start at 09:00 on Monday 5th May and run until 17:00 on Friday 9th May.

Participants should travel to Brest during the weekend prior to the start so that we can start promptly on Monday morning. The session after lunch on Friday will largely be dedicated to discussion groups, so there will be scope for people to travel home on Friday afternoon if necessary.

Morning sessions will consist of two themed presentations while the afternoon sessions will involve practical, hands-on activities involving devices, systems and data. Where live fish are used, demonstrations will be given by suitably authorised people, but there will be scope for participants to practice surgical attachment and implantation techniques on cadavers.

Outline plan

Presentations

1. **Introductory presentation (JDM/MA):** Why use telemetry? What questions can it solve? What are the limitations? How can it link laboratory-based physiology to the ecology of animals in the wild? Telemetry in the lab, mesocosm and field.
2. **Animal deployment of devices (MA/JDM):** external and internal, fish surgery and welfare, EU law and animal use in science. (need to think where this should come in the overall programme)
3. **Acoustic methods in detail (MH/Vemco)**(simple tracking and monitoring (presence/absence), 2D and 3D positioning, coded tags etc), environmental and physiological telemetry (temperature, heart rate etc.). Devices, systems and manufacturers, Vemco, Lotek.
4. **Archival methods in detail (JDM/Wildlife)** (sensors: depth temperature, salinity, geomagnetism, acceleration, blood flow, blood pressure, ECG, muscle myograms, PO₂, etc.). Devices, systems and manufacturers, Star-Oddie, CTL, Wildlife Computers, Little Leonardo, Endogear Inc.
5. **Geoposition (DS/ Wildlife)** (GPS, Argos, dead reckoning, light-based, tidal-based, using other environmental data to refine geoposition estimates.
6. **Data recovery (JDM/ Wildlife)** physical recover of archival tags through fisheries, passive recovery of flotsam tags, Argos data transmission, PSATS and SPOT devices.
7. **Data presentation** analysis and interpretation: from simple measurements to complex biology interaction/integration telemetry vs physiology: improving the interpretation and reconstruction of migration routes.
8. **Advanced data handling and manipulation:** Beyond Excel: (IGOR, R, etc.), Integration with other environmental data sources: World Ocean Atlas, ARGO data, SWifs etc.
9. **Accelerometry and animal state** (Rory Wilson)
10. **Telemetry and conservation** (Scott Hinch), field energy budgets, intra- and inter specific interactions.

Afternoon demonstrations/practical session, this would be hands on: with either live data gathering and/or pre gathered data sets. (If there's a lot of, we might run two sessions in parallel on some afternoons, possibly with the scope to move between them)

Day A. Implantation and attachment methods (demonstrations with live fish that will be used later in the workshop, also use cadavers for participants.)

Day B. Acoustics, tracking equipment, monitoring presence/absence with VR2, 2 & 3D positioning with VRAP, acoustic telemetry tags. Acoustic tag specific data analysis and presentation.

Day C. Archival tags, logging regimes, data analysis

Day D. Accelerometry. Logging regimes, advanced data handling, visualisation and analysis.

Day E. General/group discussions

People and companies (these are mostly just suggestions at the moment)

Michael Axelsson, (laboratory- and mesocosm-based telemetry, physiology sensors, ECG blood flow etc.)

Guy Claireaux, (acoustic telemetry)

Julian Metcalfe, Archival tags (Archival tags: from simple measurements to complex behaviour),

David Sims (spatial movement, track reconstruction, environmental data integration)

Rory Wilson (application of telemetry to understanding animal state)

Serena Wright (advanced data manipulation, visualisation and analysis with particular reference to accelerometry)

Carl Meyer (novel and future potential, feeding behaviour in sharks)

Michelle Heupel (Acoustic tracking in marine coastal systems)

Steve Cooke or Scott Hinch (telemetry and conservation applications)

Wildlife Computers (PSAT and SPOT technologies)

Vemco (Acoustic, VR2, VRAP technologies)

Endogear (radio and archival biotelemetry technologies)