Interdisciplinary Approaches in Fish Skeletal Biology

Schooling, mosaic by Charlsie Kelly (www.charlsiekelly.com)

Third Meeting
22-24 April 2013
Tavira, Portugal

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Fish Skeletal Biology

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Welcome from the organizers

Fish skeletal biology is concerned with the mechanisms involved in the evolution, development, adaptation and maintenance of the skeleton of the majority of the vertebrates. It takes advantage from the growing interest in teleosts as model organisms for developmental and biomedical research, such as zebrafish and medaka, but also from the increasing number of fish species used in aquaculture. As it is always the case in science, there is amazing progress and at the same time we are far from understanding all aspects of fish skeletal biology. Understanding the fish skeleton requires insights from disciplines such as Palaeontology, Evolutionary and Developmental Biology, Morphology, Physiology, Nutrition, Ichthyology, Biomechanics, Systematics, Biomineralisation, Genomics and Proteomics. There is clearly a demand for more interdisciplinary research. The 3rd international conference on *Interdisciplinary Approaches in Fish Skeletal Biology* is meant as a platform to establish just that kind of interdisciplinary research! It is organized as a conference with oral and poster presentations, but foremost it is a forum for discussions, for the exchange of ideas and hypotheses. The previous two conferences have been published in two volumes of the Journal of Applied Ichthyology, which provide a unique overview about the current status of fish skeletal research. We continue this series of conference proceedings and thus we offer again the possibility to all participants to publish their contributions as short articles. We thank all participants for coming to the 3rd conference on *Interdisciplinary Approaches in Fish Skeletal Biology* and welcome you all to Tavira. We also thank our sponsors for supporting this conference.

We wish you a fruitful and scientifically stimulating conference!

M. Leonor Cancela and **P. Eckhard Witten**

Scientific committee

Brian K. Hall
Ann Huysseune
Isabel Palmeirim
Jean-Yves Sire
Tom J. Hansen
Santosh P. Lall
Leonor Saúde
Christoph Winkler
Matthew P. Harris
Paula Mabee
Stefan Schulte-Merker

Local organizing committee

Vincent Laizé
Natércia Conceição
Paulo J. Gavaia
Ignacio Fernández
Evi Desender

Detailed programme

DAY 1: Monday April 22

09.20 **WELCOME BY THE ORGANISERS**

OPENING LECTURE
Chair: Ekker M

09.30 **Modularity in development and evolution of the head skeleton**
Kimmel CB

10.40 **Coffee break**

ORAL SESSION 1. EVOLUTION AND FUNCTION OF FISH SKELETAL TISSUES
Chair: Flik G

11.00 **Cartilage canals in the skeletons of sharks and rays: Morphology, homology and putative role in mineralization**
Dean MN, Blumer MJF, Adriaens D, Omelon S

11.25 **Retinoic acid-dependent enhanced osteoclastic activity as a major mediator of calvaria fragmentation in zebrafish**
Jeradi S, Hammerschmidt M

11.50 **Experimental evidence of the role of heterochronies in teleost evolution**
Kapitanova DV, Shkil FN

12.15 **Can acellular bone remodel?**
Atkins A, Habegger ML, Motta PJ, Kalish N, Dean M, Currey JD, Shahar R

12.40 **Lunch break**

ORAL SESSION 2. EVO-DEVO OF THE DENTITION AND THE PHARYNGEAL SKELETON
Chair: Gunter HM

14.00 **Regulation of tooth replacement in the zebrafish: The role of Wnt signaling**
Huysseune A, Dam Thi MT

14.25 **Aspects of tooth replacement in a basal actinopterygian, *Polypterus senegalus***
Vandenplas S, De Clercq A, Huysseune A

14.50 **Old, new and new-old concepts about the evolution of teeth**
Witten PE, Sire J-Y, Huysseune A

15.15 **Developmental genetic analysis of evolved head skeletal patterning in sticklebacks**
Miller CT, Glazer AM, Cleves PA, Ellis NA, Erickson PA

15.40 **Coffee break**

ORAL SESSION 3. DEVELOPMENT AND REGENERATION OF THE DERMAL SKELETON
Chair: Akimenko M-A

16.00 **Identification of osteogenic compounds using elasmoid scales of sp7:luciferase transgenic zebrafish**
Metz JR, De Vrieze E, Peeters BWMM, Flik G

16.25 **An amputation resets positional information to a proximal identity in the regenerating zebrafish caudal fin**
Azevedo AS, Sousa S, Jacinto A, Saúde L

16.50 **The cranial lateral line canal system as a module of the dermatocranium of bony fishes: Sensory adaptation via heterochrony**
Webb JF

17.15 **Evolution of a morphological innovation the pufferfish beak**
Smith MM, Johanson Z, Fraser GJ, Healy C, Britz R

18.00 **POSTER SESSION 1: EVO-DEVO OF THE SKELETON and SKELETAL MALFORMATIONS** (Wine tasting)

20.30 **Dinner**

Day 2. Tuesday April 23

ORAL SESSION 4. ESSENTIAL NUTRITIONAL FACTORS FOR SKELETAL DEVELOPMENT
Chair: Gisbert E

09.00 **Skeletal malformations in *Solea senegalensis* fed with diets using different *Artemia* enrichment products**
de Azevedo AM, Losada AP, Barreiro A, Barreiro JD, Ferreiro I, Riaza A, Vázquez S, Quiroga MI

09.25 **Bone development in Atlantic cod (*Gadus morhua*) larvae fed either natural zooplankton or industry standard enriched rotifers and *Artemia***
Lie KK, Sæle Ø, Hamre K, van der Meeren T, Moren M

09.50 **High dietary arachidonic acid levels affect the process of eye migration in pseudo-albino *Solea senegalensis* post-larvae**
Boglino A, Wishkerman A, Darias MJ, Estévez A, Andree KB, Gisbert E

10.15 **The effects of dietary P level on vertebral metabolism in rainbow trout (*Oncorhynchus mykiss*)**
Deschamps M-H, Bourdon B, Le Luyer J, Poirier Stewart N, Proulx E, Sire J-Y, Witten PE, Bureau DP, Vandenberg GW

10.40 **Coffee break**

ORAL SESSION 5. MOLECULES AND MOLECULAR DEVELOPMENT OF THE FISH SKELETON
Chair: Miller CT

11.00 **Molecular investigation of mechanical strain-induced phenotypic plasticity in an acellular bone**
Gunter HM, Fan S, Xiong F, Franchini P, Fruciano C, Meyer A

11.25 ***In vivo* imaging of osteoblast-osteoclast interaction during bone degeneration and repair in a medaka model for osteoporosis**
Büttner A, To TT, Yu TS, Renn J, Willems B, Sundaram S, Dasyani M, Vyas H, Witten PE, Huysseune A, Winkler C

11.50 **Understanding the genetic basis of skeletogenesis in fish using large scale genetic screens and high-throughput mapping**
Henke K, Boldt H, Harris MP

12.15 **Hox cluster: insights into fish temporal colinearity**
Monteiro AS, Gonçalves L, Freitas R, Palmeirim I, Casares F

12.40 **Lunch break**

ORAL SESSION 6. MECHANISMS OF SKELETAL MALFORMATIONS
Chair: Rosenthal H

14.00 **Skeletal malformations in Senegalese sole (*Solea senegalensis* Kaup, 1858): Gross morphology and radiolographic correlation**
Losada AP, de Azevedo AM, Barreiro A, Barreiro JD, Ferreiro I, Riaza A, Quiroga MI, Vázquez S

14.25 **Exploration of rainbow trout (*Oncorhynchus mykiss*) vertebrae transcriptome**
Le Luyer J, Deschamps M-H, Proulx E, Poirier Stewart N, Droit A, Robert C, Vandenberg GW

14.50 **Implementing a study on reared Siberian sturgeon *Acipenser baeri* axial deformities: First observations**
Leprévost A, Brunel O, Sire J-Y

15.15 **Radiological studies on vertebral deformities in triploid Atlantic salmon (*Salmo salar*)**
Fraser TWK, Hansen T, Fleming M, Sambraus F, Fjelldal PG

15.40 **Coffee break**

ORAL SESSION 7. FUNCTIONAL MORPHOLOGY IN AN EVOLUTIONARY CONTEXT
Chair: Webb JF

16.00 **A comparison of olfactory area skeleton in three species from Oxudercinae subfamily**
Kuciel MJ, Żuwała KD

16.25 **Increased tail flexibility in syngnathid fishes: From pipefish to seahorse**
Neutens C, Adriaens D, Christiaens J, De Kegel B, Dierick M, Boistel R, Van Hoorebeke L

16.50 **Thyroidal divergence as a basis for evolutionary changes in fish skeleton: Example from cyprinid genus *Ballerus***
Levin BA, Levina MA, Bolotovskiy AA

17.15 **Osteological differentiation of Atlantic salmon (*Salmo salar* L.) from the Northwest Russia rivers**
Yurtseva A, Lajus D, Artamonova V, Makhrov A

18.00 **POSTER SESSION 2: TEETH, SCALES AND FIN RAYS and MOLECULAR PATHWAYS** (Beer probing)

20.30 **Dinner**

Day 3. Wednesday April 24

ORAL SESSION 8. SKELETAL STRENGTH AND BIOMINERALISATION
Chair: Dean MN

09.00 **Restriction of biomineralization during zebrafish embryogenesis**
Apschner A, Logister I, Spoorendonk K, Schulte-Merker S

09.25 **Zebrafish caudal skeleton: Insights into vertebral mineralization and fusion events**
Bensimon-Brito A, Cancela ML, Cardeira J, Dionísio G, Huysseune A, Witten PE

09.50 **Identification and characterization of a new neural brain-to-bone pathway regulating bone mass accrual**
Torres-Nuñez E, Ceinos RM, Suarez-Bregua P, Figueras A, Prober D, Cerdá-Reverter JM, Guerreiro PM, Cardoso J, Canário AVM, Power DM, Du SJ, Cañestro C, Rotllant J

10.15 **The role of zinc in bone development: too much of a good thing?**
Mackay E, Schulte-Merker S

10.40 **Coffee break**

GENERAL DISCUSSION
Chairs: Hall BK, Schulte-Merker S

11.00 **Questions that drive fish skeletal research**
All participants

12.40 **Lunch break**

20.30 **Farewell barbecue**

Poster Session 1 (Monday April 22)

Improved phosphorus utilization in Atlantic salmon (*Salmo salar* L.) by acid hydrolysis of bone minerals in fish meal
Albrektsen S, Thorsen K, Bæverfjord G, Nygård H

Late appearance of ossification in the burbot (*Lota lota*) larvae
Appelbaum S, Gospic D, Jencic V, Kuzir S, Gjurcevic E

Spinal organization and deformities in cultured Senegalese sole (*Solea senegalensis*) at early stages of development
de Azevedo AM, Losada AP, Ferreiro I, Riaza A, Vázquez S, Quiroga MI

Vertebral counts in salmonids: The effect of ploidy, temperature and hybridization
Fleming MS, Hansen T, Skulstad OF, Fjelldal PG

Osteology of the axial skeleton of the bay snook *Petenia splendida* (Cichlidae)
Gisbert E, Alvarez-González CA

Fluctuating asymmetry of roach *Rutilus rutilus* and bleak *Alburnus alburnus* bones from area of the Chernobyl disaster
Lajus D, Yurtseva A, Arshavsky D

Squamation process and pattern in *Ballerus ballerus* at normal conditions and at manipulation of thyroidal status
Levina MA, Levin BA

Phosphatase activities in Atlantic salmon (*Salmo salar*) vertebral bone and scales: our findings from the past years
Lock E-J, Fjelldal PG, Ørnsrud R, Albrektsen S, Hansen T, Waagbø R

BMP2, 4 and 16: A new evolutionary perspective
Marques CL, Fernández I, Rosa J, Viegas MN, Cancela ML, Laizé V

Evaluation of skeletal deformities in the meagre reared under different nutritional conditions
Martins G, Pousão-Ferreira P, Gavaia PJ

The variation of somite and vertebral numbers in the spine of the zebrafish (*Danio rerio*)
Nguyen THT, Huysseune A, Witten PE

An interdisciplinary approach to the problem of temperature and vertebrae number in osteichthyans: The chick embryo perspective
Pais de Azevedo T, Witten PE, Huysseune A, Palmeirim I

Comparison of vertebral abnormalities diagnosis between X-rays and histology observations in juvenile rainbow trout fed with a low-phosphorus diet (*Oncorhynchus mykiss*)
Poirier Stewart N, Deschamps M-H, Huysseune A, Witten PE, Le Luyer J, Proulx E, Bureau D, Vandenberg GW

Dietary phosphorus in fresh and seawater – impacts on rapid growing farmed Atlantic salmon
Sambraus F, Breck O, Albrektsen S, Witten PE, Fontanillas R, Fjelldal PG

A field study on occurrence of vertebral deformities in Atlantic salmon (*Salmo salar* L.) from two rivers in Western Norway
Sambraus F, Fjelldal PG, Hansen T, Solberg M, Glover KA

Bony skull development in barbs (*Barbus sensu lato*; Cyprinidae; Teleostei) with different ploidy level
Shkil FN, Smirnov SV

An exploratory study of using histological methods for bone staining in gilthead seabream (*Sparus aurata*) for detection of osteological pathologies
Thuong NP, De Wolf T, Witten PE, Huysseune A, Sorgeloos P, Adriaens D

Poster Session 2 (Tuesday April 23)

Use of reporter lines to visualize bone and cartilage phenotypes in the zebrafish *mef2ca*^{b1086} mutant line
Adrião A, Gavaia PJ, Conceição N, Cancela ML

Imaging soft tissues during tooth development and replacement in the zebrafish (*Danio rerio*)
Bruneel B, Mushegyan V, Sharir A, Klein O, Huysseune A

Inducing a transient diabetic phenotype in zebrafish: can this model be used to study insulin related changes in bone metabolism?
Carvalho FR, Cardeira J, Simão M, Gavaia PJ, Cancela ML

Exogenous thiaminase expression as a method for the biological confinement of fish
Ekker M, Saxena V, Byers E, Boratynska S, Devlin R

Transcriptional regulation of the zebrafish *Gla-rich protein 2* (*grp2*) gene
Fazenda C, Conceição N, Cancela ML

ZFB1 cell line, an *in vitro* tool to unveil mineralogenic and skeletogenic roles of vitamin K in zebrafish
Fernández I, Parameswaran V, Cancela ML, Laizé V, Gavaia PJ

Scale regeneration in sp7:nlsGFP transgenic zebrafish
Flik G, De Vrieze E, Metz JR

Vitamin K antagonist warfarin affects *Danio rerio* skeletal development and arterial calcification
Gavaia PJ, Santos A, Cancela ML, Fernández I

The *dlx5a/dlx6a* genes play essential role in the early zebrafish development of median skeletal fin and pectoral structures
Heude E, Shaikho S, Ekker M

Zebrafish tooth development and replacement in the absence of the transcription factor *osterix*
Huysseune A, Kague E, Soenens M, Witten PE, Fisher S

Fish systems to assess osteotoxicity of environmental pollutants
Laizé V, Gavaia PJ, Viegas MN, Caria J, Luis N, Cancela ML

Evolution and regulation of *actinodin* genes
Moses D, Zhang J, Lalonde R, Cornell N, Bleeker H, Akimenko M-A

Multipotency of blastema cells isolated from regenerating caudal fin of *Sparus aurata*
Parameswaran V, Laizé V, Cardeira J, Gavaia PJ, Cancela ML

Tg(*sox4bΔC*:HSE:GFP) zebrafish to analyze Sox4 function for bone formation *in vivo*
Renn J, Aceto J, Muller M

Molecular cloning, gene characterization and expression analysis of zebrafish miR-223
Roberto VP, Tiago DM, Gautvik K, Cancela ML

Transcriptional and post-transcriptional regulation of a fish cartilage-specific S100 protein
Rosa JT, Cancela ML, Laizé V

Can zebrafish be a valid model to study Paget's disease of bone?
Silva IAL, Conceição N, Cancela ML

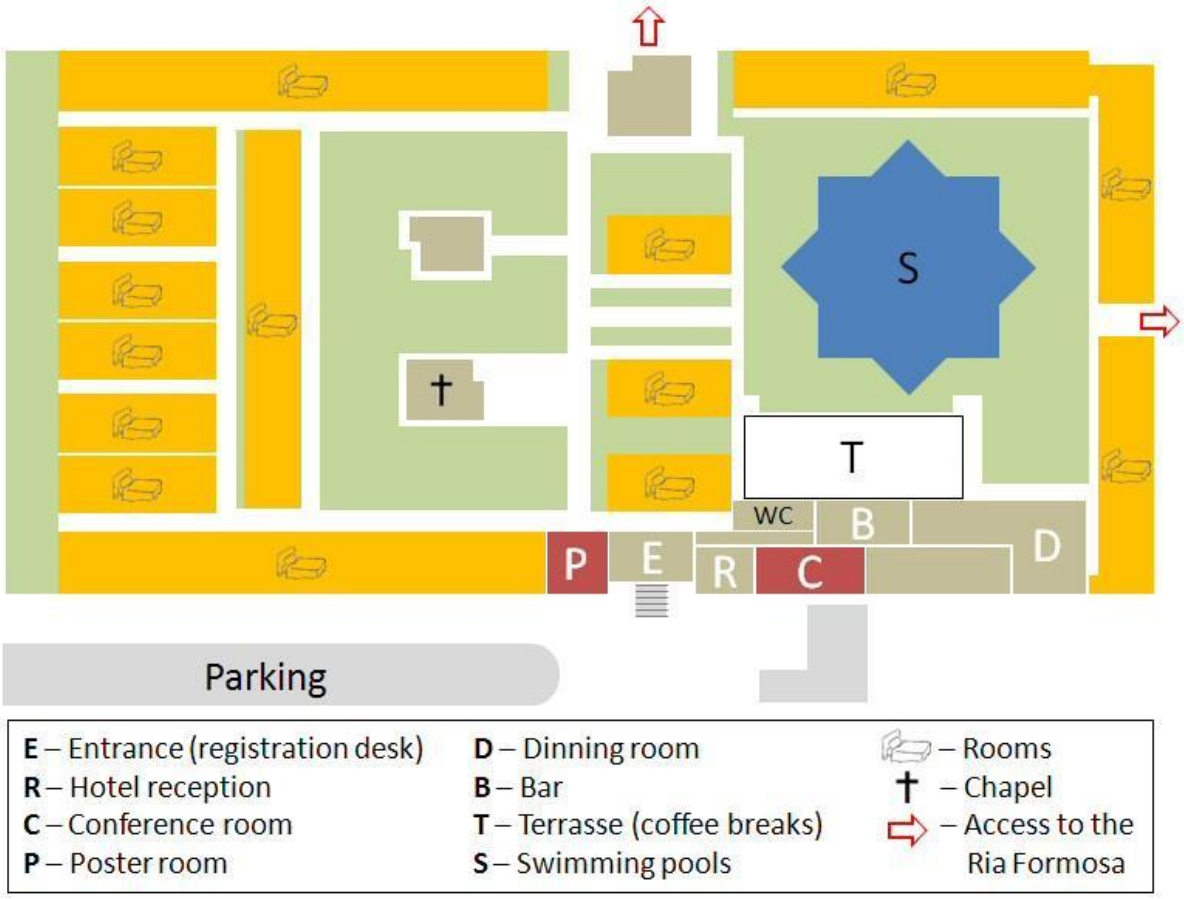
Molecular characterization of CBFβ gene and identification of new transcription variants: Implications for function
Simões B, Conceição N, Cancela ML

Note

Abstracts are listed in alphabetical order according to the last name of the first author.

Programme overview

	Sunday 21.04.2013	Monday 22.04.2013	Tuesday 23.04.2013	Wednesday 24.04.2013
09:00		**Welcome**	**ORAL SESSION 4** Essential nutritional factors for skeletal development	**ORAL SESSION 8** Skeletal strength and biomineralisation
09:30		**Opening lecture**		
10:40		**Coffee break**	**Coffee break**	**Coffee break**
11:00		**ORAL SESSION 1** Evolution and function of fish skeletal tissues	**ORAL SESSION 5** Molecules and molecular development of fish skeleton	**General discussion** Questions that drive fish skeletal research
12:40		**Lunch**	**Lunch**	**Lunch**
14:00		**ORAL SESSION 2** Evo-devo of the dentition & the pharyngeal skeleton	**ORAL SESSION 6** Mechanisms of skeletal malformations	Note: April 25 is an holiday in Portugal
15:40		**Coffee break**	**Coffee break**	
16:00	Registration & Welcome drink (18:00)	**ORAL SESSION 3** Development & regeneration of the dermal skeleton	**ORAL SESSION 7** Functional morphology in an evolutionary context	
18:00		**POSTER SESSION 1** (& wine tasting)	**POSTER SESSION 2** (& beer probing)	
20:30		**Dinner**	**Dinner**	**Farewell barbecue** (20:00)



E – Entrance (registration desk)
R – Hotel reception
C – Conference room
P – Poster room
D – Dinning room
B – Bar
T – Terrasse (coffee breaks)
S – Swimming pools
– Rooms
– Chapel
– Access to the Ria Formosa

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