

Centro de Ciências do Mar do Algarve
Algarve Centre of Marine Sciences
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Publications List

Division Aquaculture and Biotechnology

Books, edited books, chapters of books

- Dias, E. L **Cancela, L.** Fonseca, P. Beja, T Dentinho (coord.). Gestão de Recursos Marinhos: Teses em Gestão e Conservação da Natureza. Editora Principia, 2006 (ISBN 972-8818-60-2)
- Mancera, JM and **J Fuentes.** 2006. Osmoregulatory action of hypophyseal hormones in Teleosts. In: Fish Endocrinology: Volume 2: B. G. Kapoor, G. Zaccane & M. Reinecke Editors Science Publishers, Inc. Enfield (NH). USA; Plymouth, U.K. & Oxford & IBH Publishing Co. Pvt. Ltd., ISBN 1-57808-415-6, pp 393-419
- Rønnestad, I., **Conceição, L.E.C.**, 2005. Aspects of protein and amino acids digestion and utilization by marine fish larvae. In: Physiological and Ecological Adaptations to Feeding in Vertebrates (J. Matthias Starck and Tobias Wang, eds.), Science Publishers: Enfield, New Hampshire, USA, pp. 389 - 416.

Articles in international refereed journals (listed in SCI)

- Abbink, W., Bevelander, G. S., Hang, X. M., Lu, W. Q., Guerreiro, P. M., Spanings, T., Canario, A. V. M. & Flik, G. 2006 PTHrP regulation and calcium balance in sea bream (*Sparus auratus* L.) under calcium constraint. *Journal of Experimental Biology* 209, 3550-3557.
- Almansa, E., Domingues, P., Sykes, A., Tejera, N., Lorenzo, A. & Andrade, J. P. 2006 The effects of feeding with shrimp or fish fry on growth and mantle lipid composition of juvenile and adult cuttlefish (*Sepia officinalis*). *Aquaculture* 256, 403-413.
- Alves Martins, D., Gomes, E., Rema, P., Dias, J., Ozório, R.O.A. & Valente, L.M.P. 2006. Growth, digestibility and nutrient utilization of rainbow trout (*Oncorhynchus mykiss*) and European sea bass (*Dicentrarchus labrax*) juveniles fed different dietary soybean oil levels. *Aquaculture International* 14, 285-295.
- Alves, D. M., Cristo, M., Sendao, J. & Borges, T. C. 2006 Diet of the cuttlefish *Sepia officinalis* (Cephalopoda : Sepiidae) off the south coast of Portugal (eastern Algarve). *Journal of the Marine Biological Association of the United Kingdom* 86, 429-436.
- Beirao, J., Robles, V., Herraes, M. P., Sarasquete, C., Dinis, M. T. & Cabrita, E. 2006 Cryoprotectant microinjection toxicity and chilling sensitivity in gilthead seabream (*Sparus aurata*) embryos. *Aquaculture* 261, 897-903.
- Bevelander, G. S., Hang, X., Abbink, W., Spanings, T., Canario, A. V. M. & Flik, G. 2006 PTHrP potentiating estradiol-induced vitellogenesis in sea bream (*Sparus auratus*, L.). *General and Comparative Endocrinology* 149, 159-165.
- Braga, D., Laize, V., Tiago, D. M. & Cancela, M. L. 2006 Enhanced DNA transfer into fish bone cells using polyethylenimine. *Molecular Biotechnology* 34, 51-54.
- Breda, S, Reva, I., Lapinski, L., Frija, L.M.T., Cristiano, M.L.S., & Fausto, R., 2006 Photochemical Ring-opening and Intramolecular Hydrogen Shift Reactions in Sulfur Analogues of γ -Pyrone. *Journal of Physical Chemistry A*, 110 (20), 6415-
- Cabrita, E., Robles, V., Wallace, J. C., Sarasquete, M. C. & Herraes, M. P. 2006 Preliminary studies on the cryopreservation of gilthead seabream (*Sparus aurata*) embryos. *Aquaculture* 251, 245-255.
- Cabrita, E., Soares, F. & Dinis, M. T. 2006 Characterization of Senegalese sole, *Solea senegalensis*, male broodstock in terms of sperm production and quality. *Aquaculture* 261, 967-975.
- Calado, R. & Chapman, P. M. 2006 Aquarium species: Deadly invaders. *Marine Pollution Bulletin* 52, 599-601.
- Calado, R. 2006 Marine ornamental species from European waters: a valuable overlooked resource or a future threat for the conservation of marine ecosystems? *Scientia Marina* 70, 389-398.
- Calado, R., Nogueira, N. & dos Santos, A. 2006 Extended parental care in a hermit crab of the genus *Calcinus* (Anomura : Diogenidae). *Journal of the Marine Biological Association of the United Kingdom* 86, 121-123.
- Calado, R., Vitorino, A. & Dinis, M.T. 2006. Bopyrid isopods do not castrate the simultaneous hermaphroditic shrimp *Lysmata amboinensis* (Decapoda: Hippolytidae). *Diseases of Aquatic Organisms*. 73, 73-76.

- Campinho, M. A., Sweeney, G. E. & Power, D. M. 2006 Regulation of troponin T expression during muscle development in sea bream *Sparus auratus* Linnaeus: the potential role of thyroid hormones. *Journal of Experimental Biology* 209, 4751-4767.
- Canario, A. V. M., Rotllant, J., Fuentes, J., Guerreiro, P. M., Teodosio, H. R., Power, D. M. & Clark, M. S. 2006 Novel bioactive parathyroid hormone and related peptides in teleost fish. *Febs Letters* 580, 291-299.
- Cardoso JCR, Pinto VC, Vieira FA, [Clark MS](#), [Power DM](#) (2006) [Evolution of secretin family GPCR members in the metazoa](#). *BMC Evolutionary Biology* 6: Art. No. 108
- [Cardoso JCR](#), [Vieira F](#), [Clark MS](#) and [Power DM](#) (2006) Putative ancestral receptor genes of vertebrate family 2 GPCR in the invertebrate genome of the nematode *Caenorhabditis elegans*. *Journal of Experimental Zoology A-Comparative Experimental Biology* 305A (2): 115
- Delgado, J. B. O., Ruane, N. M., Pousao-Ferreira, P., Dinis, M. T. & Sarasquete, C. 2006 Thyroid gland development in Senegalese sole (*Solea senegalensis* Kaup 1858) during early life stages: A histochemical and immunohistochemical approach. *Aquaculture* 260, 346-356.
- Domingues, P. M., Bettencourt, V. & Guerra, A. 2006 Growth of *Sepia officinalis* in captivity and in nature. *Vie Et Milieu-Life and Environment* 56, 109-120.
- Einarsdottir, I. E., Silva, N., Power, D. M., Smaradottir, H. & Bjornsson, B. T. 2006 Thyroid and pituitary gland development from hatching through metamorphosis of a teleost flatfish, the Atlantic halibut. *Anatomy and Embryology* 211, 47-60.
- Franch, R., Louro, B., Tsalavouta, M., Chatziplis, D., Tsigenopoulos, C. S., Sarropoulou, E., Antonello, J., Magoulas, A., Mylonas, C. C., Babbucci, M., Patarnello, T., Power, D. M., Kotoulas, G. & Bargelloni, L. 2006 A genetic linkage map of the hermaphrodite teleost fish *Sparus aurata* L. *Genetics* 174, 851-861.
- Fuentes, J., Figueiredo, J., Power, D. M. & Canario, A. V. M. 2006 Parathyroid hormone-related protein regulates intestinal calcium transport in sea bream (*Sparus auratus*). *American Journal of Physiology-Regulatory Integrative and Comparative Physiology* 291, R1499-R1506.
- Garcia-Lopez, A., Anguis, V., Couto, E., Canario, A. V. M., Canavate, J. P., Sarasquete, C. & Martinez-Rodriguez, G. 2006 Non-invasive assessment of reproductive status and cycle of sex steroid levels in a captive wild broodstock of Senegalese sole *Solea senegalensis* (Kaup). *Aquaculture* 254, 583-593.
- Garcia-Lopez, A., Fernandez-Pasquier, V., Couto, E., Canario, A. V. M., Sarasquete, C. & Martinez-Rodriguez, G. 2006 Testicular development and plasma sex steroid levels in cultured male Senegalese sole *Solea senegalensis* Kaup. *General and Comparative Endocrinology* 147, 343-351.
- Gavaia, P. J., Simes, D. C., Ortiz-Delgado, J. B., Viegas, C. S. B., Pinto, J. P., Kelsh, R. N., Sarasquete, M. C. & Cancela, M. L. 2006 Osteocalcin and matrix Gla protein in zebrafish (*Danio rerio*) and Senegal sole (*Solea senegalensis*): Comparative gene and protein expression during larval development through adulthood. *Gene Expression Patterns* 6, 637-652.
- Gomez-Zavaglia, A, Reva, I., Frija, L.M.T., Cristiano, M.L.S., & Fausto, R., 2006 Infrared spectrum and UV-induced photochemistry of matrix-isolated 5-methoxy-1-phenyl-1H-tetrazole. *Journal of Photochemistry and Photobiology A: Chemistry*, 180, 175-183.
- Gomez-Zavaglia, A, Reva, I., Frija, L.M.T., Cristiano, M.L.S., & Fausto, R., 2006 Photochemistry of 1-phenyl-tetrazolone isolated in solid argon. *Journal of Photochemistry and Photobiology A: Chemistry*, 179, 243-255.
- Gomez-Zavaglia, A, Reva, I., Frija, L.M.T., Cristiano, M.L.S., & Fausto, R., 2006 Molecular structure, vibrational spectra and photochemistry of 5-mercapto-1-methyltetrazole in solid argon. *Journal of Molecular Structure*, 786, 182-192.
- Guerreiro, P. M., Canario, A. V. M., Power, D. M. & Renfro, J. L. 2006 Parathyroid hormone (PTH)-related protein stimulates Pi secretion across fish proximal tubule cells. *Journal of Experimental Zoology Part a-Comparative Experimental Biology* 305A, 130-130.
- Guerreiro, P. M., Rotllant, J., Fuentes, J., Power, D. M. & Canario, A. V. M. 2006 Cortisol and parathyroid hormone-related peptide are reciprocally modulated by negative feedback. *General and Comparative Endocrinology* 148, 227-235.
- Guilgur, L. G., Moncaut, N. P., Canario, A. V. M. & Somoza, G. M. 2006 Evolution of GnRH ligands and receptors in gnathostomata. *Comparative Biochemistry and Physiology a-Molecular & Integrative Physiology* 144, 272-283.
- Hubert, F., Pellaud, M. & Gamito, S. 2006 Environmental effects of marine fish pond culture in the Ria Formosa (Southern Portugal). *Hydrobiologia* 555, 289-297.
- Huertas, M., Scott, A. P., Hubbard, P. C., Canario, A. V. M. & Cerda, J. 2006 Sexually mature European eels (*Anguilla anguilla* L.) stimulate gonadal development of neighbouring males: Possible involvement of chemical communication. *General and Comparative Endocrinology* 147, 304-313.

- Khmelniskii, I.V., Frija, L.M.T. & Cristiano, M.L.S 2006 Mechanistic investigations into the photochemistry of 4-allyltetrazolones in solution; a new approach to the synthesis of 3,4-dihydro-pyrimidinones. *Journal of Organic Chemistry*, 71 (9), 3583-3591.
- Laize, V., Viegas, C. S. B., Price, P. A. & Cancela, M. L. 2006 Identification of an osteocalcin isoform in fish with a large acidic prodomain. *Journal of Biological Chemistry* 281, 15037-15043.
- Makridis, P., Costa, R. A. & Dinis, M. T. 2006 Microbial conditions and antimicrobial activity in cultures of two microalgae species, *Tetraselmis chuii* and *Chlorella minutissima*, and effect on bacterial load of enriched *Artemia metanauplii*. *Aquaculture* 255, 76-81.
- Modig, C., Modesto, T., Canario, A., Cerda, J., von Hofsten, J. & Olsson, P. E. 2006 Molecular characterization and expression pattern of zona pellucida proteins in gilthead seabream (*Sparus aurata*). *Biology of Reproduction* 75, 717-725.
- Moncaut, N. M., Somoza, G. M., Power, D. M. & Canario, A. V. M. 2006 Co-localization of GnRH ligands and their receptors in the European sea bass, *Dicentrarchus labrax*. *Journal of Experimental Zoology Part a-Comparative Experimental Biology* 305A, 157-157.
- Morais, S., Caballero, M. J., Conceicao, L. E. C., Izquierdo, M. S. & Dinis, M. T. 2006 Dietary neutral lipid level and source in Senegalese sole (*Solea senegalensis*) larvae: Effect on growth, lipid metabolism and digestive capacity. *Comparative Biochemistry and Physiology B-Biochemistry & Molecular Biology* 144, 57-69.
- Morais, S., Torten, M., Nixon, O., Lutzky, S., Conceicao, L. E. C., Dinis, M. T., Tandler, A. & Koven, W. 2006 Food intake and absorption are affected by dietary lipid level and lipid source in seabream (*Sparus aurata* L.) larvae. *Journal of Experimental Marine Biology and Ecology* 331, 51-63.
- Morgado, I. M., Sauer-Eriksson, E. & Power, D. M. 2006 Thyroid hormone binding by recombinant sea bream transthyretin: The role of the N-terminal region. *Journal of Experimental Zoology Part a-Comparative Experimental Biology* 305A, 158-158.
- O'Neill, P., Verissimo, E., Ward, S.A., Davies, J., Bachi, M.D., Korshin, E.E., Araújo, N., Pugh, M., Cristiano, M.L.S. & Stocks, P. 2006 Diels-Alder/Thiol-olefin co-oxidation approach to the antimalarial 2,3-dioxabicyclo [3.3.1] nonane pharmacophore. *Bioorganic and Medicinal Chemistry Letters*, 16 (11), 2991-2995.
- Ortiz-Delgado, J. B., Simes, D. C., Viegas, C. S. B., Schaff, B. J., Sarasquete, C. & Cancela, M. L. 2006 Cloning of matrix Gla protein in a marine cartilaginous fish, *Prionace glauca*: preferential protein accumulation in skeletal and vascular systems. *Histochemistry and Cell Biology* 126, 89-101.
- Pinto, P. I. S., Passos, A. L., Martins, R. S., Power, D. M. & Canario, A. V. M. 2006 Characterization of estrogen receptor beta b in sea bream (*Sparus auratus*): Phylogeny, ligand-binding, and comparative analysis of expression. *General and Comparative Endocrinology* 145, 197-207.
- Pinto, P. I. S., Teodosio, H. R., Galay-Burgos, M., Power, D. M., Sweeney, G. E. & Canario, A. V. M. 2006 Identification of estrogen-responsive genes in the testis of sea bream (*Sparus auratus*) using suppression subtractive hybridization. *Molecular Reproduction and Development* 73, 318-329.
- Pinto, P.I.S., Teodosio, H.R., Condeça, J.B., Singh, P.B., Power, D.M. & Canário, A.V.M. 2006 ICI has agonistic effects in fish. *Reproductive Biology and Endocrinology* 4, 67.
- Rafael, M.S., Laizé, V., Cancela, M.L. 2006 Identification of *Sparus aurata* bone morphogenetic protein 2: Molecular cloning, gene expression and *in silico* analysis of protein conserved features in vertebrates. *Bone* 39, 1373-1381.
- Ramos, S., Manuel, M., Tiago, T., Duarte, R., Martins, J., Gutierrez-Merino, C., Moura, J. J. G. & Aureliano, M. 2006 Decavanadate interactions with actin: Inhibition of G-actin polymerization and stabilization of decameric vanadate. *Journal of Inorganic Biochemistry* 100, 1734-1743.
- Rhyne, A. L., Fujita, Y. & Calado, R. 2006 Larval development and first crab of *Mithraculus sculptus* (Decapoda : Brachyura : Majoidea : Mithracidae) described from laboratory-reared material. *Journal of the Marine Biological Association of the United Kingdom* 86, 1133-1147.
- Robles, V., Cabrita, E., Anel, L., Herráez, M. P. 2006 Microinjection of the antifreeze protein type III (AFPIII) in turbot embryos: toxicity and protein distribution. *Aquaculture* 261, 1299-1306.
- Rodrigues, P. M., Macedo, A. L., Goodfellow, B. J., Moura, I. & Moura, J. J. G. 2006 *Desulfovibrio gigas* ferredoxin II: redox structural modulation of the [3Fe-4S] cluster. *Journal of Biological Inorganic Chemistry* 11, 307-315.
- Rotllant, J., Guerreiro, P. M., Redruello, B., Fernandes, H., Apolonia, L., Anjos, L., Canario, A. V. M. & Power, D. M. 2006 Ligand binding and signalling pathways of PTH receptors in sea bream (*Sparus auratus*) enterocytes. *Cell and Tissue Research* 323, 333-341.
- Rotllant, J., Ruane, N. M., Dinis, M. T., Canario, A. V. M. & Power, D. M. 2006 Intra-adrenal interactions in fish: Catecholamine stimulated cortisol release in sea bass (*Dicentrarchus labrax* L.). *Comparative Biochemistry and Physiology a-Molecular & Integrative Physiology* 143, 375-381.

- Saavedra, M., Conceicao, L. E. C., Pousao-Ferreira, P. & Dinis, M. T. 2006 Amino acid profiles of *Diplodus sargus* (L., 1758) larvae: Implications for feed formulation. *Aquaculture* 261, 587-593.
- Saele, O., **Silva, N.** & Pittman, K. 2006 Post-embryonic remodelling of neurocranial elements: a comparative study of normal versus abnormal eye migration in a flatfish, the Atlantic halibut. *Journal of Anatomy* 209, 31-41.
- Senger F, Priat C, Hitte C, Sarropoulou E, Franch R, Geisler R, Bargelloni L, Power DM and Galibert F, (2006). The first radiation hybrid map of a perch-like fish: the gilthead seabream (*Sparus aurata* L). *Genomics*. 87, 793-800.
- Silva, P. A. S. & Cruzeiro, L. 2006 Dynamics of a nonconserving Davydov monomer. *Physical Review E* 74, -021920.
- Simões, B., Conceição, N., Viegas, C. S. B., Pinto, J. P., Gavaia, P. J., Hurst, L. D., Kelsh, R. N. & Cancela, M. L. 2006 Identification of a promoter element within the zebrafish *colXα1* gene responsive to Runx2 isoforms *Osf2/Cbfa1* and *til-1* but not to *pebp2αA2*. *Calcified Tissue International* 79, 230-244.
- Soares, S. S., Martins, H. & Aureliano, M. 2006 Vanadium distribution following decavanadate administration. *Archives of Environmental Contamination and Toxicology* 50, 60-64.
- Tiago, T., Ramos, S., Aureliano, M. & Gutierrez-Merino, C. 2006 Peroxynitrite induces F-actin depolymerization and blockade of myosin ARPase stimulation. *Biochemical and Biophysical Research Communications* 342, 44-49.
- Tiago, T., Simao, S., Aureliano, M., Martin-Romero, F. J. & Gutierrez-Merino, C. 2006 Inhibition of skeletal muscle S1-myosin ATPase by peroxynitrite. *Biochemistry* 45, 3794-3804.
- van der Ven, L. T. M., van den Brandhof, E. J., Vos, J. H., Power, D. M. & Wester, P. W. 2006 Effects of the antithyroid agent propylthiouracil in a partial life cycle assay with zebrafish. *Environmental Science & Technology* 40, 74-81.

Articles in other refereed journals (national and international)

- Araújo, N. 2006 The Drug-Hybrid Approach to Antimalarial Chemotherapy. *Drugs of the Future*, 31 (A), 36-37.

Papers in refereed conference proceedings and published abstracts

- Costa, M.C., Gadjia, K., Natu, S., Paiva, A.P.,** 2006. Iron(III) removal from chloride solutions by solvent extraction. Third International Symposium on Iron Control in Hydrometallurgy. J.E. Dutrizac and P.A. Riveros (Eds). Conference of Metallurgists. Canadian Metallurgical Society, Montreal, Canada. 465-477
- Laizé, V., Gavaia, P.J., Viegas, C.S.B., Cancela, M.L. (2006) Whole-genome sequence analysis: Evidences for new osteocalcin isoforms in fish and tetrapods. ASBMR 28th Annual Meeting, September 15-19, Philadelphia, USA. In: *Journal of bone and Mineral Research* 21:S338.

Conferences papers (not in proceedings)

- Araújo, N., 2006. *The Drug-Hybrid Approach to Antimalarial Chemotherapy*, XIXth International Symposium on Medicinal Chemistry, Istanbul, August 29-September-2. Oral communication.
- Araújo, N., Cabral, L., Cristiano, M.L.S., O'Neill, P., 2006. *DNA-Directed Endoperoxides; a New Approach to Antimalarials*, Medicinal Chemistry for the 21st Century, Lisboa, October 13-14. Poster
- Araújo, N., Verissimo, E., Cristiano, M.L.S. & O'Neill, P., 2006. *Fighting Back Malaria...* Medicinal Chemistry for the 21st Century, Lisboa, October 13-14. Oral communication.
- Ascenso, R.M.T., Afonso, R.M., Leite, R.B., Cancela, M.L. (2006) Identification of differentially expressed target genes involved in perkinsus-host interaction: comparison of two alternative SSH methods. Genomic Perspectives to Host Pathogen Interactions, September 7-10, Hinxton, UK.
- Ascenso, R.M.T., Leite, R.B., Afonso, R.M., Cancela, M.L. (2006) Does *Perkinsus olseni* expresses pathogenic factors? XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Ascenso, R.M.T., Leite, R.B., Afonso, R.M., Cancela, M.L. (2006) Does *Perkinsus olseni* expresses pathogenic factors? XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Barata, E.N., Hubbard, P.C., Almeida, O., Miranda, A., Frade, P., Canário, A.V.M. (2006). The urine of male Mozambique tilapia signal social status. VIIth International Congress on the Biology of Fish, July 18 – 22, St. John's, Newfoundland, Canada.
- Barata, E.N., Serrano, R.M., Hubbard, P.C., Canário, A.V.M. (2006). 11-ketotestosterone mediates anal and testicular gland differentiation and pheromone production in the peacock blenny, *Salaria pavo* (Risso). 23rd Conference of European Comparative Endocrinologists, 29 August – 2 September, Manchester, UK.

- Barbosa, V., Cancela, M.L., Herráez, M.P., Martínez, Ascenso, R.M.T., Afonso, R.M., Leite, R.B., Cancela, M.L. (2006) Identification of differentially expressed target genes involved in perkinsus-host interaction: comparison of two alternative SSH methods. Genomic Perspectives to Host Pathogen Interactions, September 7-10, Hinxton, UK.
- Barbosa, V., Cancela, M.L., Herráez, M.P., Martínez, S., Robles, V. (2006) AFP I increases chilling resistance at 0°C in sea bream (*Sparus aurata*) microinjected embryos. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Beirão, J., Cabrita, E., Robles, V., Dinis, M.T., Sarasquete, M.C., Herráez, M.P., 2005. Microinjection of cryoprotectants into seabream embryos. Cryo 2005, 42nd Meeting of the society for cryobiology, Minneapolis, USA, July 24-27, 2005.
- Beirão, J., **Cabrita, E.**, Robles, V., **Dinis, M.T.**, Sarasquete, M.C., Herráez, M.P., 2005. Microinjection of cryoprotectants into seabream embryos. Cryo 2005, 42nd Meeting of the society for cryobiology, Minneapolis, USA, July 24-27, 2005.
- Brito, A., Gavaia, P., Cancela, M.L. (2006) Regeneration in zebrafish (*Danio rerio*) fins: pattern of expression of mineralization-related Gla proteins. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Brito, A., Gavaia, P., Cancela, M.L. (2006) Regeneration in zebrafish (*Danio rerio*) fins: pattern of expression of mineralization-related Gla proteins. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Brito, A., Leite, R., Cancela, M.L. (2006) Cloning of HIF prolyl hydroxylase transcripts: identification of an alternative splicing mechanism in *Perkinsus olseni*. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Brito, A., Leite, R., Cancela, M.L. (2006) Cloning of HIF prolyl hydroxylase transcripts: identification of an alternative splicing mechanism in *Perkinsus olseni*. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Cabrita, E., Paramo, S., Anel, L. Herraez, MP. Motility of cryopreserved seabream spermatozoa: effect of channel blockers. 10th International Symposium on Spermatology, 17-22th Septiembre, Madrid.
- Cabrita, E., Robles, V., Sarasquete, C., Soares, F., Dinis, M.T., Herráez, M.P. 2005. Sperm quality evaluation in fish. 05 Fish and Shellfish Larviculture Symposium European Aquaculture Society, Special Publication No 36. Belgium.
- Cabrita, E., Soares, F. & Dinis, M.T. Characteristics of sole *Solea senegalensis* sperm during the spermiation period. Aqua2006, 8-13 de Maio 2006, Florença, Itália.
- Cavaco, S.I., Marques, S.M.P., Simes, D.C., Cancela, M.L. (2006) Constitutive expression of *Sparus aurata* osteocalcin in a chondrocytic-like (VSA13) and osteoblastic-like cell line (VSA16). XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Cavaco, S.I., Marques, S.M.P., Simes, D.C., Cancela, M.L. (2006) Constitutive expression of *Sparus aurata* osteocalcin in a chondrocytic-like (VSA13) and osteoblastic-like cell line (VSA16). XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Coelho, N.C., Pombinho, A.R., Laizé, V., Cancela, M.L. (2006) Characterization of lipoprotein lipase gene expression in teleost fish *Sparus aurata*: Molecular evolution and functional implications XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Coelho, N.C., Pombinho, A.R., Laizé, V., Cancela, M.L. (2006) Characterization of lipoprotein lipase gene expression in teleost fish *Sparus aurata*: Molecular evolution and functional implications XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Conceição, L.E.C., Aragão, C. (2006). Amino acid metabolism and requirements in fish larvae; are they different from juveniles? Book of abstracts of the *Aqua 2006*, May 9-13, Firenze, Italy.
- Conceição, L.E.C., Morais, S. & Rønnestad, I. 2006 Tracer studies in fish larvae. Book of abstracts of the XII International Symposium on Fish Nutrition & Feeding, 28 May- 1 June, Biarritz, France.
- Conceição, L.E.C., Pinto, W., Costas, B., Bruwiere, S. & Aragão, C. 2006 Stressful husbandry conditions and amino acids requirements in Senegalese sole. COST 867 Workshop on Welfare of fish in European Aquaculture, 9-11 October, Arcachon, France.
- Conceição, N., Cancela, M.L. (2006) The importance of fish stem cells to study the regulation of Gla proteins during early development. MGE Exploratory Workshop in Stem Cells in Marine Organisms, November 27-28, Palermo, Italy.
- Conceição, N., Cancela, M.L. (2006) The importance of fish stem cells to study the regulation of Gla proteins during early development. MGE Exploratory Workshop in Stem Cells in Marine Organisms, November 27-28, Palermo, Italy.
- Conceição, N., Fidalgo, J., Simões, B., Cancela, M.L. (2006) Regulation of the *Xenopus laevis* MGP promoters by transcription Factors: NF-AT and Runx2. Workshop Mineralised Tissue Formation, Regeneration and Repair, November 16-17, Lisboa, Portugal.

- Conceição, N., Fidalgo, J., Simões, B., Cancela, M.L. (2006) Regulation of the *Xenopus laevis* MGP promoters by transcription Factors: NF-AT and Runx2. Workshop Mineralised Tissue Formation, Regeneration and Repair, November 16-17, Lisboa, Portugal.
- Conceição, N., Silva, A., Simões, B., Belo, J.A., Cancela, M.L. (2006) Mapping of the *cis*-regulatory elements in the XIMGP promoters by cell culture experiments and microinjection of *Xenopus laevis* embryos using deletion mutant constructs. 4th Meeting of the CIMAR, October 20-21, Peniche, Portugal.
- Conceição, N., Silva, A., Simões, B., Belo, J.A., Cancela, M.L. (2006) Mapping of the *cis*-regulatory elements in the XIMGP promoters by cell culture experiments and microinjection of *Xenopus laevis* embryos using deletion mutant constructs. 4th Meeting of the CIMAR, October 20-21, Peniche, Portugal.
- Conceição, N., Simões, B., Cancela, M.L. (2006) Runx2 regulates transcription of *Xenopus laevis* matrix Gla protein (XIMGP) gene in the A6 cell line. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Conceição, N., Simões, B., Cancela, M.L. (2006) Runx2 regulates transcription of *Xenopus laevis* matrix Gla protein (XIMGP) gene in the A6 cell line. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Costas, B., Pinto, W., Corte-Real, J., Aragão, C. & Conceição, L.E.C. 2006 Evaluation of stressful husbandry conditions Senegalese sole. COST 867 Workshop on Welfare of fish in European Aquaculture, 9-11 October, Arcachon, France.
- Cristiano, M.L.S.C., Araújo, N., Pena, P., Frija, L., 2006. *Reductive Cleavage of Heteroaromatic Naphthyl Ethers: Structural Effects on Reactivity*, IUPAC International Conference on Physical Organic Chemistry, ICPOC 18, Warsaw, August 19-25. Oral communication.
- Cristiano, M.L.S.C., Frija, L M.T., Coelho, D.V., N., Khmelinskii, I.V., 2006. *Photochemistry of Allylic Derivatives of Tetrazole and Benzisothiazole*, Transmediterranean Colloquium on Heterocyclic Chemistry, Aveiro, SC8., June 23-27. Oral communication.
- Cruzeiro, L. 2006. The VES hypothesis and protein folding and function, invited talk at the workshop on "Protein Science", CFTC, Lisbon, 8th November.
- Cruzeiro, L. 2006. The VES hypothesis and protein misfolding diseases, IV Meeting of CIMAR- L.A., Peniche, 20-21 October.
- Cruzeiro, L. 2006. The VES hypothesis and prion diseases. invited talk at the CECAM Workshop on "Protein folding and misfolding: Bringing theory close to experiment and vice versa", Lyon, France, 19-22 September.
- Dias, J. Dietary trace elements and stress response in farmed fish. COST 867 Workshop on Welfare of Fish in European Aquaculture, 9-11 October, Arcachon, France.
- Dias, J., Rueda-Jasso, R., Conceição, L. & Dinis, M.T. Effect of dietary non-protein energy levels on muscle lipids and oxidative status in Senegalese sole (*Solea senegalensis*) juveniles. COST 925 Workshop on Growth and Development "Environmental and genetic regulation of prenatal events and its importance for postnatal growth performance and meat quality", September 21-22, Antalya, Turkey.
- Dias, P.J., Leite, R.B., Cancela, M.L. (2006) Some aspects of perkinsiosis explored through the experimental infection of the apparently resistant Pacific oyster *Crassostrea gigas*. AQUA 2006, May 9-13, Florence, Italy
- Dias, P.J., Leite, R.B., Cancela, M.L. (2006) Some aspects of perkinsiosis explored through the experimental infection of the apparently resistant Pacific oyster *Crassostrea gigas*. AQUA 2006, May 9-13, Florence, Italy
- Engrola, S., Conceição, L. E. C. & Dinis, M.T. 2006 Effect of stocking density and food intake in protein metabolism of Senegalese sole post - larvae. Book of abstracts of the XII International Symposium on Fish Nutrition & Feeding, 28 May- 1 June, Biarritz, France.
- Frija, L M.T., Reva, I. D., Gómez-Zavaglia, A., Cristiano, M.L.S.C., Fausto, R., 2006. *Matrix-isolated 5-Ethoxy-1-Phenyl-Tetrazole: Photochemistry and Vibrational Spectra*, Transmediterranean Colloquium on Heterocyclic Chemistry, Aveiro, PP23., June 23-27. Poster
- Fuentes J., Silva, A., P.M. Guerreiro, Haond, C., Silva, N., Power, D.M., Canario, A.V.M. 2006. Calcium balance in sturgeon (*Acipenser naccarii*): involvement of PTHrP. 23rd Conference of European Comparative Endocrinologists, 29 August – 2 September University of Manchester, Manchester, UK
- Gomes, H.L., Afonso, R., Leite, R.B., Stallinga, P., Cancela, M.L. (2006) Interaction between biological cells monitored by microelectrode impedance techniques. 11th International Meeting on Chemical Sensors, July 16-19, Brescia, Italy.
- Gomes, H.L., Afonso, R., Leite, R.B., Stallinga, P., Cancela, M.L. (2006) Impedance based bio-chip to monitor interactions between cells. 5th Brazilian Materials Research Society Meeting, October 8-12, Florianópolis, Brazil.

- Gomes, H.L., Afonso, R., Leite, R.B., Stallinga, P., Cancela, M.L. (2006) Interaction between biological cells monitored by microelectrode impedance techniques. 11th International Meeting on Chemical Sensors, July 16-19, Brescia, Italy.
- Gomes, H.L., Afonso, R., Leite, R.B., Stallinga, P., Cancela, M.L. (2006) Impedance based bio-chip to monitor interactions between cells. 5th Brazilian Materials Research Society Meeting, October 8-12, Florianópolis, Brazil.
- Gricar, B.L.A., Barata, E.N., Hubbard, P.C., Plenderleith, M., van Oosterhout, C. Breithaupt, T. (2006). Social context modulates olfactory potency in two closely related species of Lake Malawi cichlids, *P. emmiltos* and *P. fainzilberi*. 23rd Conference of European Comparative Endocrinologists, 29 August – 2 September, Manchester, UK
- Hubbard, P.C., Haond, C., Canário, A.V.M. (2006). Olfactory sensitivity to calcium and sodium is mediated by different mechanisms in the goldfish. VIIth International Congress on the Biology of Fish, July 18 – 22, St. John's, Newfoundland, Canada.
- Huertas, M. Cerdà, J., Canário, A.V.M., Hubbard, P.C. (2006). A role for bile acids in inter-specific communication in teleosts? . VIIth International Congress on the Biology of Fish, July 18 – 22, St. John's, Newfoundland, Canada.
- Jesus, C., Martins, M. Duarte, J. C., **Costa**, M. C. 2006. A sulfate-reducing bacteria process for the decontamination of acid mine drainage, 45th Conference of Metallurgists, COM 2006, Canadian Metallurgical Society, 1-4 October, Montreal, Canada (Poster).
- Jesus, C., Martins, M., **Costa**, M.C. 2006. Studies on a combined chemical and biological process for the treatment of acid mine drainage. 6th European Symposium on Biochemical Engineering Science, ESBES 6, 27-30 August, Salzburg, Austria. 231p (Poster).
- Kolmakov, N., Hubbard, P.C., Canário, A.V.M. (2006). Phylogenetic and sequence analysis of goldfish, *Carassius auratus*, olfactory receptor cDNAs. 23rd Conference of European Comparative Endocrinologists, 29 August – 2 September, Manchester, UK.
- Lacuisse, M., Rocha, R., Conceição, L.E.C., Makridis, P., Dinis, M.T., 2005. Influence of different microalgae species on size and growth of *Brachionus plicatilis*. World Aquaculture Symposium, May 9-13, Bali, Indonésia.167p.
- Laizé, V., Viegas, C.S.B., Gavaia, P.J., Cancela, M.L. (2006) Evidences for new osteocalcin isoforms in fish and tetrapods. First meeting of the European Society for Evolutionary Development Biology, August 16-19, Prague, Czech Republic.
- Laizé, V., Viegas, C.S.B., Gavaia, P.J., Cancela, M.L. (2006) Evidences for new osteocalcin isoforms in fish and tetrapods. First meeting of the European Society for Evolutionary Development Biology, August 16-19, Prague, Czech Republic.
- Leite, R. Cordero, D., Kube, M., Klages, S., Peña, J.B., Reinhardt, R., Cancela, M.L., Saavedra, C. (2006) Complementary genomic approaches to study clam (*Ruditapes* sp.) biology and culture adaptations to environmental conditions and parasitosis. Marine Genomics International Congress, October 28/November 1, Sorrento, Italy.
- Leite, R. Cordero, D., Kube, M., Klages, S., Peña, J.B., Reinhardt, R., Cancela, M.L., Saavedra, C. (2006) Complementary genomic approaches to study clam (*Ruditapes* sp.) biology and culture adaptations to environmental conditions and parasitosis. Marine Genomics International Congress, October 28/November 1, Sorrento, Italy.
- Leite, R.B., Afonso, R., Ascenso, R., Simão, M., Cancela, M.L. (2006) Effect of *Perkinsus* infection on expression of *Ruditapes decussatus* biomarkers genes in response to environmental pollutants. Marine Genomics International Congress, October 28/November 1, Sorrento, Italy.
- Leite, R.B., Afonso, R., Ascenso, R., Simão, M., Cancela, M.L. (2006) Effect of *Perkinsus* infection on expression of *Ruditapes decussatus* biomarkers genes in response to environmental pollutants. Marine Genomics International Congress, October 28/November 1, Sorrento, Italy.
- Leite, R.B., Afonso, R., Cancela, M.L. (2006) Characterization of purine metabolism in the protozoan parasite *Perkinsus olseni*: identification of genes involved in these pathways and potential therapeutic targets. Cell Organelles of Protozoan Parasites:From Basic Science to Drug Targets. June 5-7, Prague, Czech Republic.
- Leite, R.B., Afonso, R., Cancela, M.L. (2006) Characterization of purine metabolism in the protozoan parasite *Perkinsus olseni*: identification of genes involved in these pathways and potential therapeutic targets. Cell Organelles of Protozoan Parasites:From Basic Science to Drug Targets. June 5-7, Prague, Czech Republic.
- Leite, R.B., Afonso, R., Cancela, M.L. (2006) Effect on genetic expression of DHFR-TS gene in *Perkinsus* sp. exposed to anti-folates drugs. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.

- Leite, R.B., Afonso, R., Cancela, M.L. (2006) Effect on genetic expression of DHFR-TS gene in *Perkinsus* sp. exposed to anti-folates drugs. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Lopes, M.R., Laizé, V., Cancela, M.L. (2006) Characterization of tissue non-specific alkaline phosphatase expression in fish: Molecular evolution and functional implications. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Lopes, M.R., Laizé, V., Cancela, M.L. (2006) Characterization of tissue non-specific alkaline phosphatase expression in fish: Molecular evolution and functional implications. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Louro, B.E.P., Silva, N., Canário, A.V.M. Power, D.M. (2006) Gilthead sea bream *Sparus auratus* thyroid stimulating hormone β subunit gene expression and characterization. 23rd Conference of European Comparative Endocrinologists, 29 August – 2 September, Manchester, UK.
- Marques, S.M., Simes, D.C., Cavaco, S.I., Cancela, M.L. (2006) Constitutive expression of *Sparus aurata* osteocalcin in a chondrocytic-like (VSA13) and osteoblastic-like cell line (VSA16): effect on mineralization rate and levels of gene expression of *Sparus aurata* genes important for calcification. 4th Meeting of the CIMAR, October 20-21, Peniche, Portugal.
- Marques, S.M., Simes, D.C., Cavaco, S.I., Cancela, M.L. (2006) Constitutive expression of *Sparus aurata* osteocalcin in a chondrocytic-like (VSA13) and osteoblastic-like cell line (VSA16): effect on mineralization rate and levels of gene expression of *Sparus aurata* genes important for calcification. 4th Meeting of the CIMAR, October 20-21, Peniche, Portugal.
- Marques, S.M., Simes, D.C., Cavaco, S.I., Cancela, M.L. (2006) Development of *Sparus aurata* cell lines constitutively expressing osteocalcin: effect on mineralization related gene expression. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Marques, S.M., Simes, D.C., Cavaco, S.I., Cancela, M.L. (2006) Development of *Sparus aurata* cell lines constitutively expressing osteocalcin: effect on mineralization related gene expression. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Martínez-Páramo, S, Robles, V., Anel, L., dePaz, P., Herráez, M.P. 2005. Cell viability after vitrification of zebrafish embryos. 9th Annual Conference of ESDAR. Murcia, 1-3 September.
- Martinez-Pastor, F., Cabrita, E., Soares, F. & Dinis, M.T. Definition and changing patterns of *Solea senegalensis* Spermatozoa after activation. International Symposium on spermatology, Madrid.
- Ozório, R.O.A., Conceição, L.E.C., Andrade, C., Timóteo, V.M.F.A. & Valente, L.M.P. 2006 Restricting feeding reduces body fat in Blackspot seabream (*Pagellus bogaraveo*). Book of abstracts of the XII International Symposium on Fish Nutrition & Feeding, 28 May- 1 June, Biarritz, France.
- Pérez-Cerezales, S. Martínez-Páramo, S., Cabrita, E., Anel, L., Martínez-Pastor, F. & Herráez, M.P. Chromatin stability during short and long-term storage of sex reversed rainbow trout sperm. Aqua2006, 8-13 de Mayo, Florencia, Itália
- Picanço, C., Brito, C., Carvalho, I. (2006) Occurrence and conservation of cetaceans in S. Tomé and Príncipe archipelago (Gulf of Guinea). 1st European Congress of Conservation Biology, August 22-26, Eger, Hungary.
- Picanço, C., Brito, C., Carvalho, I. (2006) Occurrence and conservation of cetaceans in S. Tomé and Príncipe archipelago (Gulf of Guinea). 1st European Congress of Conservation Biology, August 22-26, Eger, Hungary.
- Picanço, C., Carvalho, I., Brito, I. (2006) Occurrence of cetaceans in S. Tomé and Príncipe archipelago and its relation with environmental variables. 20th Conference of the European Cetacean Society, April 2-7, Gdynia, Poland
- Picanço, C., Carvalho, I., Brito, I. (2006) Occurrence of cetaceans in S. Tomé and Príncipe archipelago and its relation with environmental variables. 20th Conference of the European Cetacean Society, April 2-7, Gdynia, Poland
- Pinto, W., Aragão, C., Dinis, M.T. & Conceição, L.E.C. 2006 Growth and stress condition in Senegalese sole juveniles chronically exposed to exogenous ammonia. Book of abstracts of the Aqua 2006, May 9-13, Firenze, Italy, 36p.
- Pombinho, A.R., Coelho, N.C., Laizé, V., Planas, J.V., Cancela, M.L. (2006) FICEL, a pilot study to assess gene function in a high-throughput manner during adipocytic transdifferentiation and mineralization of fish bone-derived cell lines. Marine Genomics International Congress, October 28/November 1, Sorrento, Italy.
- Pombinho, A.R., Coelho, N.C., Laizé, V., Planas, J.V., Cancela, M.L. (2006) FICEL, a pilot study to assess gene function in a high-throughput manner during adipocytic transdifferentiation and mineralization of fish bone-derived cell lines. Marine Genomics International Congress, October 28/November 1, Sorrento, Italy.

- Rafael, M.S., Laizé, V., Schüle, R., Cancela, M.L. (2006) Role of four and a half LIM domains 2 (FHL2) in fish bone biology. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Rafael, M.S., Laizé, V., Schüle, R., Cancela, M.L. (2006) Role of four and a half LIM domains 2 (FHL2) in fish bone biology. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Ribeiro, L., Aragão C., Conceição, L.E.C., Fyhn, H.J. & Dinis, M.T., 2006 Implications of different amino acid profiles in fish larval growth. XII International Symposium on Fish Nutrition and Feeding in Fish. 28 May - 1 June 2006, Biarritz, France. Page 213.
- Ribeiro, L., Kamisaka, Y., Kurokawa, T., Dinis, M.T. & Rønnestad, I., 2006 Ontogeny of cholecystokinin-immunoreactive cells in the digestive tract of *Sparus aurata* and *Solea senegalensis* larvae – preliminary results. XII International Symposium on Fish Nutrition and Feeding in Fish 28 May - 1 June 2006, Biarritz, France. Page 209.
- Ribeiro, L., Rocha, R., Falcão, M., Couto, A. & Dinis, M. T., 2006 Influence of different microalgae on water quality during *Sparus aurata* larval development. AQUA 06 - European and World Aquaculture Society, 9 to 13 May, Firenze, Italy.
- Roberto, V., Cancela, M.L., Gavaia P. (2006) Gla proteins in skeletal deformed fish. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Roberto, V., Cancela, M.L., Gavaia P. (2006) Gla proteins in skeletal deformed fish. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Roberto, V., Gavaia, P., Cancela, M.L. (2006) Vertebral deformities and local accumulation of Gla proteins in *Sparus aurata*. AQUA 2006, May 9-13, Florence, Italy.
- Roberto, V., Gavaia, P., Cancela, M.L. (2006) Vertebral deformities and local accumulation of Gla proteins in *Sparus aurata*. AQUA 2006, May 9-13, Florence, Italy.
- Robles, V., Herráez, M.P., Barbosa, V., Martínez-Páramo, S., Cancela, M.L. (2006) Cryopreservation as a tool for germplasm banking in fish. MGE Exploratory Workshop in Stem Cells in Marine Organisms, November 27-28, Palermo, Italy.
- Robles, V., Herráez, M.P., Barbosa, V., Martínez-Páramo, S., Cancela, M.L. (2006) Cryopreservation as a tool for germplasm banking in fish. MGE Exploratory Workshop in Stem Cells in Marine Organisms, November 27-28, Palermo, Italy.
- Robles, V., Sussman, R., Cancela, M.L. (2006) Lipid based transfection in zebrafish (*Danio rerio*) embryos. AQUA 2006, May 9-13, Florence, Italy.
- Robles, V., Sussman, R., Cancela, M.L. (2006) Lipid based transfection in zebrafish (*Danio rerio*) embryos. AQUA 2006, May 9-13, Florence, Italy.
- Saavedra, M., Conceição, L.E.C., Pousão-Ferreira, P. & Dinis, M.T. 2006 Effect of tryptophan and arginine supplementation in the amino acid metabolism of *diplodus sargus* larvae. Book of abstracts of the Aqua 2006, May 9-13, Firenze, Italy, 820p.
- Saavedra, M., Pousão-Ferreira, P., Conceição, L.E.C., Dinis, M.T. (2005). Evaluation of amino acids requirements of *Diplodus sargus* (L.,1758): Comparison between larval and diet profiles. Book of abstracts of the X Congreso Nacional de Acuicultura, October 17-14, Gandía (Valência, Espanha).
- Serrano, R.M, Barata, E.N., Hubbard, P.C., Guerreiro, P. Birkett, M.A., Pickett, J.A., Lopes, O., Araújo, J. Canário A.V.M. (2006). The anal gland of male blenny *Salaria pavo*: structure and function. VIIth International Congress on the Biology of Fish, July 18 – 22, St. John's, Newfoundland, Canada.
- Silva, J.M.G., Conceição, L.E.C., Espe, M. & Valente, L.M.P. 2006 Lysine requirements in diets for juveniles Senegalese sole (*Solea senegalensis*). Book of abstracts of the XII International Symposium on Fish Nutrition & Feeding, 28 May- 1 June, Biarritz, France.
- Silva, N., Campinho, M.A., Power, D.M. (2006) Comparative analysis of fTNT genes in sea bream (*Sparus auratus*) and Atlantic halibut (*Hippoglossus hippoglossus*). European Association for Animal Production, 21st-22nd September, Belek, Antalya, Turkey
- Simão, M., Leite, R.B., Afonso, R., Joaquim, S., Matias, D., Cancela, M.L. (2006) Evaluation of oxidative stress levels and antioxidants mRNA expression within a variable range of temperatures in clam *Ruditapes decussatus*. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Simão, M., Leite, R.B., Afonso, R., Joaquim, S., Matias, D., Cancela, M.L. (2006) Evaluation of oxidative stress levels and antioxidants mRNA expression within a variable range of temperatures in clam *Ruditapes decussatus*. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Simões, B., Silva, A., Conceição, N., Vitorino, M., Belo, J., Cancela, M.L. (2006) Spatial-temporal pattern of expression and regulation of matrix Gla protein (MGP) during early development in *Xenopus laevis*. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Simões, B., Silva, A., Conceição, N., Vitorino, M., Belo, J., Cancela, M.L. (2006) Spatial-temporal pattern of expression and regulation of matrix Gla protein (MGP) during early development in *Xenopus laevis*. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.

- Soares, F., Cabrita, E., Aragão, C. & Dinis, M.T. Does feeding polychaets affects reproduction in captive Senegalese sole?. XII International Symposium on Fish Nutrition and Feeding, May 28 – June 1, Biarritz, France.
- Tiago, D.M., Laizé, V., Aureliano, M., Cancela, M.L. (2006) Vanadate oligomers affect fish mineralization *in vitro*. EUROBIC8, July 1-6, Aveiro, Portugal.
- Tiago, D.M., Laizé, V., Aureliano, M., Cancela, M.L. (2006) Vanadate oligomers induce proliferation and prevent mineralization of a fish bone-derived cell line. 232nd ACS Meeting & Exposition, September 10-14, San Francisco, USA.
- Robles, V. (2006) AFP I increases chilling resistance at 0°C in sea bream (*Sparus aurata*) microinjected embryos. XV Congresso Nacional de Bioquímica, December 8-10, Aveiro, Portugal.
- Tiago, D.M., Laizé, V., Aureliano, M., Cancela, M.L. (2006) Vanadate oligomers affect fish mineralization *in vitro*. EUROBIC8, July 1-6, Aveiro, Portugal.
- Tiago, D.M., Laizé, V., Aureliano, M., Cancela, M.L. (2006) Vanadate oligomers induce proliferation and prevent mineralization of a fish bone-derived cell line. 232nd ACS Meeting & Exposition, September 10-14, San Francisco, USA.
- Velez, Z. Hubbard, P.C., Barata, E.N., Canário, A.V.M. (2006). Olfactory sensitivity to conspecific-related stimuli in the Senegalese sole (*Solea senegalensis*). VIIth International Congress on the Biology of Fish, July 18 – 22, St. John's, Newfoundland, Canada.
- Velez, Z., Barata, E.N., Hubbard, P.C., Canário, A.V.M. (2006). Differential detection of conspecific-derived odorants by the two olfactory epithelia in the Senegalese sole. 23rd Conference of European Comparative Endocrinologists, 29 August – 2 September, Manchester, UK.
- Velez, Z., Hubbard, P.C., Barata, E.N., Hardege, J.D., Bubblitz, R. Canário, A.V.M. (2006). Olfactory sensitivity to food-related odorants in the Senegalese sole (*Solea senegalensis*). VIIth International Congress on the Biology of Fish, July 18 – 22, St. John's, Newfoundland, Canada.
- Vieira, F. Cardoso, J.C.R., Power, D.M. (2006) The evolution of VIP and PACAP peptides in teleosts. 23rd Conference of European Comparative Endocrinologists, 29 August – 2 September, Manchester, UK.
- Vielma, J., Verlhac, V. & Dias, J. Efficacy of phytase on plant protein feedstuffs in rainbow trout: a digestibility study. XII International Symposium of Fish Nutrition and Feeding, May 28 – June 1, Biarritz, France.

Project and consultancy final reports

- Björnsson, B. Th., Einarsdóttir, I.E., Sweeney, G.E., Pittman, K., Smáradóttir, H., Power, D.M. 2006. Q5RS-2002-01192 (ARRDE) Arrested development: The molecular and endocrine basis of flatfish metamorphosis. Final Report
- Koutoulas, G., Power, D.M. et al., 2006. Q5RS-2001-01797 (BRIDGE-MAP) Bridging genomes: an integrated genomic approach toward genetic improvement of aquacultured fish species. Final report
- Laizé, V. 2006. POCTI/BCI/48748/2002 (SaMGP) Efeito do cálcio extracelular na expressão da MGP. Final report.

Prizes and Honours

- Calado, R. 2006. Prize Günther E. Maul awarded by the Conselho Regional da Madeira da Ordem dos Biólogos to the paper entitled "A new species of the deep-sea genus *Bresilia* (Crustacea: Decapoda: Bresiliidae) discovered from a swallow-water cave in Madeira. Journal of the Marine Biological Association of the United Kingdom. 84 (2004): 191-199."
- Robles, Vanesa (2006) "2006 Notorious Evaluation" award for the best review of the Scientific Journal CIT, Editor: Dr. José O. Valderrama.
- Robles, Vanesa (2006) Award for the Best PhD in the area of Biology, University of León, Spain.

Division of Living Resources

Patents

Books, edited books, chapters of books

- Coelho, R. Tradução da versão Portuguesa do Livro: Séret, B. 2006. Guide d'identification des principales espèces de requins et de raies de l'Atlantique oriental tropical, à l'usage des enquêteurs et biologistes des pêches. IUCN and FIBA. 75 pp.

- Teixeira, S.B., Fernandes, J., Gaspar, P., Gamito, T. Gonçalves, J., Bentes, L., Ribeiro, J., Lino P. 2006. Percurso subaquático da Praia da Marinha. Comissão de Coordenação e Desenvolvimento Regional do Algarve, Faro, 30p.
- Xavier, J. C. & Croxall, J. P. (2005). Sexual differences in foraging behaviour and food choice: a case study of wandering albatrosses. In Kruckstuhl, K. & Neuhaus, P. Sexual Segregation in Vertebrates. Cambridge University Press: 74-91

Articles in international refereed journals (listed in SCI)

- Abecasis, D.; Bentes, L.; Ribeiro, J.; Machado, D.; Oliveira, F.; Veiga, P.; Gonçalves, J.M.S. & Erzini, K. (2006) First record of the Mediterranean parrotfish, *Sparisoma cretense* in Ria Formosa (south Portugal). JMBA2 - Biodiversity records.
- Abecasis, D.; Costa, A.R.; Pereira, J.G. & Pinho, M.R. (2006) Age and growth of bluemouth, *Helicolenus dactylopterus* (Delaroche, 1809) from the Azores. *Fisheries Research*, 79 (1-2): 148-154.
- Alberto, F., Arnaud-Haond, S., Duarte, C. M. & Serrao, E. A. 2006 Genetic diversity of a clonal angiosperm near its range limit: the case of *Cymodocea nodosa* at the Canary Islands. *Marine Ecology-Progress Series* 309, 117-129.
- Alexandre, A., Cabaco, S., Santos, R. & Serrao, E. A. 2006 Timing and success of reproductive stages in the seagrass *Zostera noltii*. *Aquatic Botany* 85, 219-223.
- Almansa, E., **Domingues, P., Sykes, A.,** Tejera, N., Lorenzo, A. & **Andrade, J. P.** 2006 The effects of feeding with shrimp or fish fry on growth and mantle lipid composition of juvenile and adult cuttlefish (*Sepia officinalis*). *Aquaculture* 256, 403-413.
- Arnaud-Haond, S., Teixeira, S., Massa, S. I., Billot, C., Saenger, P., Coupland, G., Duarte, C. M. & Serrao, E. A. 2006 Genetic structure at range edge: low diversity and high inbreeding in Southeast Asian mangrove (*Avicennia marina*) populations. *Molecular Ecology* 15, 3515-3525.
- Beldade, R., Borges, R. and Gonçalves, E.J. 2006. Depth distribution of very nearshore temperate fish larval assemblages at close proximity to the rocky substrate. *Journal of Plankton Research*, 28: 1003-1013.
- Beldade, R., Erzini, K. & Goncalves, E. J. 2006 Composition and temporal dynamics of a temperate rocky cryptobenthic fish assemblage. *Journal of the Marine Biological Association of the United Kingdom* 86, 1221-1228.
- Carmona, R. & Santos, R. 2006 Is there an ecophysiological explanation for the gametophyte-tetrasporophyte ratio in *Gelidium sesquipedale* (rhodophyta)? *Journal of Phycology* 42, 259-269.
- Carvalho, S., Moura, A. & Sprung, M. 2006 Ecological implications of removing seagrass beds (*Zostera noltii*) for bivalve aquaculture in southern Portugal. *Cahiers De Biologie Marine* 47, 321-329.
- Catry, T., Ramos, J. A., Martins, J., Peste, F., Trigo, S., Paiva, V. H., Almeida, A., Luis, A., Palma, J. & Andrade, P. J. 2006 Intercolony and annual differences in the diet and feeding ecology of little tern adults and chicks in Portugal. *Condor* 108, 366-376.
- Chicharo, L. & Chicharo, M. A. 2006 Applying the ecohydrology approach to the Guadiana estuary and coastal areas: Lessons learned from dam impacted ecosystems. *Estuarine Coastal and Shelf Science* 70, 1-2.
- Chicharo, L., Chicharo, M. A. & Ben-Hamadou, R. 2006 Use of a hydrotechnical infrastructure (Alqueva Dam) to regulate planktonic assemblages in the Guadiana estuary: Basis for sustainable water and ecosystem services management. *Estuarine Coastal and Shelf Science* 70, 3-18.
- Chicharo, M. A., Chicharo, L. & Morais, P. 2006 Inter-annual differences of ichthyofauna structure of the Guadiana estuary and adjacent coastal area (SE Portugal/SW Spain): Before and after Alqueva dam construction. *Estuarine Coastal and Shelf Science* 70, 39-51.
- Coelho, R. & Erzini, K. 2006 On the occurrence of the arrowhead dogfish, *Deania profundorum* (Chondrichthyes : Squalidae) off southern Portugal, with a missing gill slit. *Cybium* 30, 93-96.
- Coelho, R. & Erzini, K. 2006 Reproductive aspects of the undulate ray, *Raja undulata*, from the south coast of Portugal. *Fisheries Research* 81, 80-85.
- Coyer, J. A., Hoarau, G., Pearson, G. A., Serrao, E. A., Stam, W. T. & Olsen, J. L. 2006 Convergent adaptation to a marginal habitat by homoploid hybrids and polyploid ecads in the seaweed genus *Fucus*. *Biology Letters* 2, 405-408.
- Craig, M. T., P. Bartsch, **P. Wirtz**, and P. C. Heemstra. 2006. Redescription and validation of *Alphestes* as an ampho-Atlantic grouper species (Perciformes: Serranidae). *Cybium* 30(4):327-331.
- Domingues, P. M., Bettencourt, V. & Guerra, A. 2006 Growth of *Sepia officinalis* in captivity and in nature. *Vie Et Milieu-Life and Environment* 56, 109-120

- Engel, C. R., Daguin, C. & Serrao, E. A. 2006 When is a hybrid a hybrid? A counter-reply to Wallace et al. *Molecular Ecology* 15, 3481-3482.
- Erzini, K., Goncalves, J. M. S., Bentes, L., Moutopoulos, D. K., Casal, J. A. H., Soriguer, M. C., Puente, E., Errazkin, L. A. & Stergiou, K. I. 2006 Size selectivity of trammel nets in southern European small-scale fisheries. *Fisheries Research* 79, 183-201.
- Erzini, K., Salgado, M. & Castro, M. 2006 Dynamics of black spot sea bream (*Pagellus bogaraveo*) mean length: evaluating the influence of life history parameters, recruitment, size selectivity and exploitation rates. *Journal of Applied Ichthyology* 22, 183-188.
- Faria, A., Morais, P. & Chicharo, M. A. 2006 Ichthyoplankton dynamics in the Guadiana estuary and adjacent coastal area, South-East Portugal. *Estuarine Coastal and Shelf Science* 70, 85-97.
- Figueroa, F. L., Santos, R., Conde-Alvarez, R., Mata, L., Pinchetti, J. L. G., Matos, J., Huovinen, P., Schuenhoff, A. & Silva, J. 2006 The use of chlorophyll fluorescence for monitoring photosynthetic condition of two tank-cultivated red macroalgae using fishpond effluents. *Botanica Marina* 49, 275-282.
- Fordham, S., Fowler, S.L., Coelho, R., Goldman, K.J. & Francis, M. 2006. *Squalus acanthias*. In: IUCN Red List of Threatened Species. www.iucnredlist.org.
- Fritz, U., Barata, M., Busack, S. D., Fritzsche, G. & Castilho, R. 2006 Impact of mountain chains, sea straits and peripheral populations on genetic and taxonomic structure of a freshwater turtle, *Mauremys leprosa* (Reptilia, Testudines, Geoemydidae). *Zoologica Scripta* 35, 97-108.
- Galhardo, A. C., Serafim, P. & Castro, M. 2006 Aspects of the biology and fishery of the European spiny lobster (*Palinurus elephas*) from the SouthWest coast of Portugal. *Journal of Crustacean Biology* 26, 601-609.
- Gallucci, V. F., Taylor, I. G. & Erzini, K. 2006 Conservation and management of exploited shark populations based on reproductive value. *Canadian Journal of Fisheries and Aquatic Sciences* 63, 931-942.
- Hernández, I., Pérez-Pastor, A., Vergara, J.J., Martínez-Aragón, J.F., Fernández-Engo, M.A., Pérez-Lloréns J.L. (2006). Studies on the biofiltration capacity of *Gracilariopsis longissima*: From microscale to macroscale. *Aquaculture*. 252: 43-53.
- Hernández-García E, Rozenfeld AF, Eguíluz VM, Arnaud-Haond S, Duarte CM (2006). Clone size distributions in networks of genetic similarity. *Physica D* 224:166-173
- Korn, M., Marrone, F., Perez-Bote, J. L., Machado, M., Cristo, M., da Fonseca, L. C. & Hundsdoerfer, A. K. 2006 Sister species within the *Triops cancriformis* lineage (Crustacea, Notostraca). *Zoologica Scripta* 35, 301-322.
- Machas, R., Santos, R. & Peterson, B. 2006 Elemental and stable isotope composition of *Zostera noltii* (Horneman) leaves during the early phases of decay in a temperate mesotidal lagoon. *Estuarine Coastal and Shelf Science* 66, 21-29.
- Magoulas, A., Castilho, R., Caetano, S., Marcato, S. & Patarnello, T. 2006 Mitochondrial DNA reveals a mosaic pattern of phylogeographical structure in Atlantic and Mediterranean populations of anchovy (*Engraulis encrasicolus*). *Molecular Phylogenetics and Evolution* 39, 734-746.
- Malaquias, M. A. E., Bentes, L., Erzini, K. & Borges, T. C. 2006 Molluscan diversity caught by trawling fisheries: a case study in southern Portugal. *Fisheries Management and Ecology* 13, 39-45.
- Malta E-j, Brun FG, Vergara JJ, Hernández I and Pérez-Lloréns JL (2006). Recovery of *Cymodocea nodosa* (Ucria) Ascherson photosynthesis after a four-month dark period. *Scientia Marina* 70: 413-422
- Martinez, P., Gonzalez, E. G., Castilho, R. & Zardoya, R. 2006 Genetic diversity and historical demography of Atlantic bigeye tuna (*Thunnus obesus*). *Molecular Phylogenetics and Evolution* 39, 404-416.
- Mata, L., Silva, J., Schuenhoff, A. & Santos, R. 2006 The effects of light and temperature on the photosynthesis of the *Asparagopsis armata* tetrasporophyte (*Falkenbergia rufolanosa*), cultivated in tanks. *Aquaculture* 252, 12-19.
- McKindsey, C. W., Thetmeyer, H., Landry, T. & Silvert, W. 2006 Review of recent carrying capacity models for bivalve culture and recommendations for research and management. *Aquaculture* 261, 451-462.
- Melo, P. C., Teodosio, J., Reis, J., Duarte, A., Costa, J. C. & Fonseca, I. P. 2006 *Cryptosporidium* spp. In freshwater bivalves in Portugal. *Journal of Eukaryotic Microbiology* 53, S28-S29.
- Monteiro, P., Bentes, L., Coelho, R., Correia, C., Goncalves, J. M. S., Lino, P. G., Ribeiro, J. & Erzini, K. 2006 Age and growth, mortality, reproduction and relative yield per recruit of the bogue, *Boops boops* Linne, 1758 (Sparidae), from the Algarve (south of Portugal) longline fishery. *Journal of Applied Ichthyology* 22, 345-352.
- Moustakas, A., W. Silvert and A. Dimitromanolakis. 2006. A spatially explicit learning model of migratory fish and fishers for evaluating closed areas. *Ecological Modelling* 192: 245-258.
- Neiva, J., Coelho, R. & Erzini, K. 2006 Feeding habits of the velvet belly lanternshark *Etmopterus spinax* (Chondrichthyes : Etmopteridae) off the Algarve, southern Portugal. *Journal of the Marine Biological Association of the United Kingdom* 86, 835-841.

- Olim, S. & Borges, T. C. 2006 Weight-length relationships for eight species of the family Triglidae discarded on the south coast of Portugal. *Journal of Applied Ichthyology* 22, 257-259.
- Paiva, V. H., Ramos, J. A., Catry, T., Pedro, P., Medeiros, R., Palma, J., 2006. Influence of environmental factors and energetic value of food on Little Tern *Sterna albifrons* chick growth and food delivery: Chick diet and early growth parameters differed between birds breeding on natural (sandy beaches) and alternative (salinas) habitats. *Bird Study* 53(1), 1-11.
- Paiva, V. H., Ramos, J. A., Machado, D., Penha-Lopes, G., Bouslama, M. F., Dias, N. & Nielsen, S. 2006 Importance of marine prey to growth of estuarine tern chicks: evidence from an energetic balance model. *Ardea* 94, 241-255.
- Palma, L., Beja, P., Pais, M. & Da Fonseca, L. C. 2006 Why do raptors take domestic prey? The case of Bonelli's eagles and pigeons. *Journal of Applied Ecology* 43, 1075-1086.
- Pearson, G. A. & Serrao, E. A. 2006 Revisiting synchronous gamete release by furoid algae in the intertidal zone: fertilization success and beyond? *Integrative and Comparative Biology* 46, 587-597.
- Pearson, G., Lago-Leston, A., Valente, M. & Serrao, E. 2006 Simple and rapid RNA extraction from freeze-dried tissue of brown algae and seagrasses. *European Journal of Phycology* 41, 97-104.
- Ribeiro, J., Bentes, L., Coelho, R., Goncalves, J. M. S., Lino, P. G., Monteiro, P. & Erzini, K. 2006 Seasonal, tidal and diurnal changes in fish assemblages in the Ria Formosa lagoon (Portugal). *Estuarine Coastal and Shelf Science* 67, 461-474.
- Sa, R., Bexiga, C., Veiga, P., Vieira, L. & Erzini, K. 2006 Feeding ecology and trophic relationships of fish species in the lower Guadiana River Estuary and Castro Marim e Vila Real de Santo Antonio Salt Marsh. *Estuarine Coastal and Shelf Science* 70, 19-26.
- Santos, R. 2006 Special issue opening comments: Seaweed-based integrated mariculture. *Aquaculture* 252, 1-2.
- Schuenhoff, A., Mata, L. & Santos, R. 2006 The tetrasporophyte of *Asparagopsis armata* as a novel seaweed biofilter. *Aquaculture* 252, 3-11.
- Stergiou, K. I., Moutopoulos, D. K., Soriguer, M. C., Puente, E., Lino, P. G., Zabala, C., Monteiro, P., Errazkin, L. A. & Erzini, K. 2006 Trammel net catch species composition, catch rates and métiers in southern European waters: A multivariate approach. *Fisheries Research* 79, 170-182.
- Stobberup, K. A. & Erzini, K. 2006 Assessing mackerel scad, *Decapterus macarellus*, in Cape Verde: Using a Bayesian approach to biomass dynamic modelling in a data-limited situation. *Fisheries Research* 82, 194-203.
- Sykes, A. V., Domingues, P. M. & Andrade, J. P. 2006 Effects of using live grass shrimp (*Palaemonetes varians*) as the only source of food for the culture of cuttlefish, *Sepia officinalis* (Linnaeus, 1758). *Aquaculture International* 14, 551-568.
- Sykes, A. V., Domingues, P. M., Correia, M. & Andrade, J. P. 2006 Cuttlefish culture - State of the art and future trends. *Vie Et Milieu-Life and Environment* 56, 129-137.
- Varela-Alvarez, E., Andreakis, N., Lago-Leston, A., Pearson, G. A. & Serrao, E. A. 2006 Genomic DNA isolation from green and brown algae (Cauleriales and Fucales) for microsatellite library construction. *Journal of Phycology* 42, 741-745.
- Vasconcelos, P., Cúrdia, J., Gaspar, M.B., Castro, M. 2006 The shell of *Hexaplex (Trunculariopsis) trunculus* (Gastropoda: Muricidae) as a mobile hard substratum for polychaetes (Annelida: Polychaeta) in the Ria Formosa (Algarve coast - southern Portugal). *Hydrobiologia* 575: 161-172.
- Vasconcelos, P., Gaspar, M. B. & Castro, M. 2006 Development of indices for nonsacrificial sexing of imposex-affected *Hexaplex (Trunculariopsis) Trunculus* (Gastropoda : Muricidae). *Journal of Molluscan Studies* 72, 285-294.
- Vasconcelos, P., Gaspar, M. B. & Castro, M. 2006 Imposex in *Hexaplex (Trunculariopsis) trunculus* (Gastropoda : Muricidae) from the Ria Formosa lagoon (Algarve coast - southern Portugal). *Marine Pollution Bulletin* 52, 337-341.
- Vasconcelos, P., Gaspar, M. B., Pereira, A. M. & Castro, M. 2006 Growth rate estimation of *Hexaplex (Trunculariopsis) trunculus* (Gastropoda : Muricidae) based on mark/recapture experiments in the Ria Formosa lagoon (Algarve coast, southern Portugal). *Journal of Shellfish Research* 25, 249-256.
- Veiga, P., Vieira, L., Bexiga, C., Sa, R. & Erzini, K. 2006 Structure and temporal variations of fish assemblages of the Castro Marim salt marsh, southern Portugal. *Estuarine Coastal and Shelf Science* 70, 27-38.
- Vieira, G. T., Xavier, J. C., Neves, M. (2005). I workshop Portugal and the Antarctic and the preparation for the Portuguese activities in the International Polar Year 2007-08, *Finisterra*, 80: 105-111
- Wirtz, P. Eight gastropods new for the marine fauna of Madeira. *Arquipélago Life and Marine Sciences* 22A, 77-79
- Wirtz, P. Let sleeping fish lie. *Global Marine Environment* 3, 27.
- Wirtz, P. Steinkorallen des Ostatlantik: Azoren, Madeira. *Kanaren DATZ* 2006/2, 22-26

- Wirtz, P. Steinkorallen des Ostatlantik: Kapverden, São Tomé e Príncipe. *DATZ* 2006/3, 38-42
- Wirtz, P., Araujo, R. & Southward, A. J. 2006 Cirripedia of Madeira. *Helgoland Marine Research* 60, 207-212.
- Wirtz, P., R. Araújo, A. Southward (2006): Cirripedia of Madeira. *Helgoland Marine Research* 60/3, 207-212.
- Wolanski, E., Chicharo, L., Chicharo, M. A. & Morais, P. 2006 An ecohydrology model of the Guadiana Estuary (South Portugal). *Estuarine Coastal and Shelf Science* 70, 132-143.
- Xavier, J. C., Croxall, J. P. and Cresswell, K. A. (2005). Boluses: a simple, cost-effective diet method to assess the cephalopod prey of albatrosses? *Auk* 122: 1182-1190
- Xavier, J. C., Tarling, G. A. & Croxall, J. P. 2006 Determining prey distribution patterns from stomach-contents of satellite-tracked high-predators of the Southern Ocean. *Ecography* 29, 260-272.
- Xavier, J. C., Tarling, G. A. and Croxall, J. P. (2006). Determining large scale distribution of pelagic cephalopods, fish and crustaceans in the South Atlantic from wandering albatross (*Diomedea exulans*) foraging data. *Ecography* 29 (2): 260-272

Articles in other refereed journals (national and international)

- Barracosa, H e Meira Cartea, P. (2006) “Los Equipamientos para la educación ambiental em Portugal: una aproximación diagnostica” in “Carpeta Informativa do Centro Nacional de Educación Ambiental.

Papers in refereed conference proceedings and published abstracts

- Barracosa, H e Meira Cartea, P. (2006) “Do estudio diagnóstico dos equipamentos para a Educação Ambiental en Portugal á proposta dunha Carta de Qualidade: un deseño mixto de investigación cualitativo-cuantitativo” in Actas do II Seminário Compostela de Investigação em Educação Ambiental e para a Sustentabilidade, Santiago de Compostela.
- Barracosa, H, Meira Cartea, P. e Santos, R. (2006) “Percurso de investigação na definição de critérios de qualidade em Equipamentos para a Educação Ambiental em Portugal” in Actas do V Congresso Ibero Americano de Educação Ambiental, Joinville, Santa Catarina, Brasil
- Barracosa, H, Rio, D., REpEA Algarve e Santos, R. (2006) “Construindo a Qualidade: REpEA - Rede Portuguesa de Equipamentos para a Educação Ambiental” in Actas do V Congresso Ibero Americano de Educação Ambiental, Joinville, Santa Catarina, Brasil
- Erzini, K. 2006. Future of fisheries: prospects for economic diversification in fishery-dependent areas. pp. 18-24, *In: Uma Visão Marítima Europeia, Conferência das Regiões Periféricas Marítimas da Europa, Celula de Prospectiva das Periferias Marítimas da Europa. Encontros do Porto, 8-9 de Dezembro 2005.* 122 pp.
- Ribeiro, J. and Erzini, K. 2006. Ecologia e Dinâmica da Ictiofauna da Ria Formosa. Actas do 1º Seminário sobre Sistemas Lagunares Costeiros, Vila Nova de Santo André, 2004. ICN, pp. 77-86.
- Rio, D., Barracosa, H (2006) Contributo para a Educação Ambiental e Participação Pública no Parque Natural do Sudoeste Alentejano e Costa Vicentina in Actas do V Congresso Ibero Americano de Educação Ambiental, Joinville, Santa Catarina, Brasil.

Conferences papers (not in proceedings)

- Afonso, C.M.L.; Monteiro, P.; Almeida, C.; Bentes, L.; Oliveira, F.; Coelho, R.; Veiga, P.; Abecasis, D.; Ribeiro J.; Machado, D. & Gonçalves, J.M.S. 2006. Gastropod biodiversity in submerged soft and rocky bottoms from the Algarve, South Portugal. Simpósio Ibérico de Estudios de Biología Marina, 12-15 Setembro 2006, Barcelona – Espanha.
- Almeida, C., Oliveira, F., Afonso, C., Veiga, P., Monteiro, P., Bentes, L., Coelho, R., Gonçalves, J.M.S. 2006. Diversity and distribution of hermit crabs on soft bottom sediment from South Portugal. Simpósio Ibérico de Estudios de Biología Marina, 12-15 Setembro 2006, Barcelona – Espanha.
- Barracosa, H (2006). Construindo a Qualidade: Equipamentos para a Educação Ambiental em Portugal. II Seminário Nacional Equipamentos para a Educação Ambiental: qualidade e inovação, Universidade do Algarve, January, 2006
- Barracosa, H, Rio, D. e REpEA Algarve (2006). Proposta de recomendações para uma futura Carta de Qualidade em Portugal. II Seminário Nacional Equipamentos para a Educação Ambiental: qualidade e inovação Universidade do Algarve, January, 2006
- Barracosa, H (2006). Recomendações para a Carta de Qualidade em Equipamentos para a Educação Ambiental em Portugal. VII Jornadas sobre Conservação da Natureza: Conservação da Natureza e Educação Ambiental, Ilhavo, March, 2006.

- Barracosa, H, (2006) "Definição de critérios de qualidade em Equipamentos para a Educação Ambiental em Portugal" , Mostra de Projectos de Educação para o Desenvolvimento sustentável, Fórum Exponor, May, 2006.
- Barracosa, H, (2006) "Equipamentos para a Educação Ambiental em Portugal: caracterização de uma realidade emergente e reptos. Encontro de Educação Ambiental, Projecto REIA MAC (Interreg IIIB Açores-Madeira-Canárias), Santana (Madeira) September, 2006.
- Barracosa, H, (2006). Turismo e Educação: o potencial dos Equipamentos para a Educação Ambiental em Portugal". Seminário Turismo Educacional e Educação Ambiental, Caldas da Rainha , December, 2006.
- Barracosa, H, Meira Cartea, P. and Santos, R. (2006)"Percursos de investigação na definição de critérios de qualidade em Equipamentos para a Educação Ambiental em Portugal" , V Congresso Ibero Americano de Educação Ambiental, Joinville, Brasil, April 2006.
- Barracosa, H, Rio, D. e REpEA Algarve Proposta de recomendações para uma futura Carta de Qualidade em Portugal. II Seminário Nacional Equipamentos para a Educação Ambiental: qualidade e inovação, Faro, January 19 to 21, 2006.
- Barracosa, H. & Rio, D. "REpEA: Rede Portuguesa de Equipamentos para a Educação Ambiental" II Seminário Nacional de Equipamentos para a Educação Ambiental em Portugal: Qualidade e Inovação, Faro January 19 to 21, 2006
- Barracosa, H., Rio, D & Santos, R. "Seminários de Equipamentos para a Educação Ambiental: uma experiência de participação". II Seminário Nacional de Equipamentos para a Educação Ambiental em Portugal: Qualidade e Inovação, January 19 to 21, 2006
- Barracosa, H., Rio, D & Santos, R. E grupo dos EqEA's Algarve "Educação Ambiental mais a Sul: uma experiência de cooperação no Algarve". II Seminário Nacional de Equipamentos para a Educação Ambiental em Portugal: Qualidade e Inovação, January 19 to 21, 2006
- Barracosa, H, (2006). Recursos Educativos para o Desenvolvimento Sustentável em Portugal. Seminário Protecção do Litoral: Educação para o Desenvolvimento Sustentável, Ovar, November, 2006.
- Billard E, Serrao EA, Valero M, Pearson GA (2006). Polymorphism of chloroplast intergenic sequences between and within species of *Fucus*. *Marine Genomics Europe Annual Meeting, Oct 28-31 2006, Sorrento, Italy*
- Borges, R.; R. Ben-Hamadou; M.A. Chícharo; P. Ré; E.J. Gonçalves. Horizontal patterns of distribution of nearshore larval fish assemblages at the Arrábida Marine Park (Portugal). 30th Larval Fish Conference, Lake Placid, 11-14 September 2006.
- Coelho, R. & Erzini, K. 2006. Size distributions, maturity distributions and sex ratios of four deep water shark species caught by longline and trawl in southern Portugal. "41st European Marine Biological Symposium", 4 a 7 de Setembro, Cork, Irlanda.
- Faria, A.; R. Borges; E.J. Gonçalves. School composition of very-nearshore larval assemblages occurring at the bottom at a temperate rocky shore. 30th Larval Fish Conference. Lake Placid, 11-14 September 2006.
- Faustino C, Pearson G, Serrão E (2006). Ecologia reprodutiva de espécies com sistemas de reprodução contrastantes: o caso de algas fucóides intertidais. *2º Congresso Ibérico de Ecologia*. 18-21 Jul 2006, Lisboa.
- Fernandez-Carvalho., J., Bentes, L., Coelho, R., Erzini, K. & Gonçalves, J.M.S. 2006. Mobile fauna behaviour in the presence of an underwater sledged video. "41st European Marine Biological Symposium", 4 a 7 de Setembro, Cork, Irlanda.
- Gonçalves, J.M.S., L. Bentes, P. Monteiro, R. Coelho, J. Ribeiro, P.G. Lino and K. Erzini. 2006. "Discarding practices in a coastal trammel net fishery". ICES 2006 Annual Science Conference, em Maastricht, Holanda, 18-23 Setembro de 2006.
- Gonçalves, J.M.S., P. Veiga, D. Machado, F. Oliveira, L. Bentes, P. Monteiro, R. Coelho, M. Ruano, J. Ribeiro & Karim Erzini. 2006 "Variação espaço-temporal de grupos funcionais de peixes no estuário do rio Arade". 2º Congresso Ibérico de Ecologia., Universidade do Lisboa a 18-21 de Julho.
- Hazin, H. and K. Erzini. 2006. Essential fish habitat and spatial prediction of swordfish (*Xiphias gladius*) catches in the south Atlantic. ICCAT, SCRS/2006/128. Borges, R.; R. Ben-Hamadou; M.A. Chícharo; P.Ré; E.J. Gonçalves. Temporal dynamics of very-nearshore larval fish assemblages at a temperate rocky shore. 30th Larval Fish Conference. Lake Placid, 11-14 September 2006.
- Hazin, H.G., Hazin, F., Travassos, P., Carvalho, F.C. and K. Erzini. 2006. Fishing strategy and target species of the Brazilian tuna longline fishery, from 1978 to 2005, inferred from cluster analysis. ICCAT, SCRS/2006/126.
- Hazin, H.G., Hazin, F., Travassos, P., Carvalho, F.C. and K. Erzini. 2006. Standardization of swordfish CPUE series caught by Brazilian longliners in the Atlantic Ocean, by GLM, using the targeting strategy inferred by cluster analysis. ICCAT, SCRS/2006/127.

- Hernández I, Pérez-Pastor A, Pérez Lloréns JL, Brun FG, Vergara JJ (2006). Large scale biofiltration by *Ulva rotundata* in a fish farm at San Fernando (Cádiz, Southern Spain). *Aqua* 2006. Annual Meeting of the European Aquaculture Society. Florencia (Italia).
- Leitão J C, Leitão P C, Coelho H, Santos R, Silva S e Bercibar E. Massas de água fortemente modificadas: a zona costeira de Sines. Workshop Avaliação do Impacto Ecológico e/ou Químico das Pressões Antropogénicas nas Águas Costeiras e de Transição. Redondo-Gómez S, Mateos-Naranjo E, Silva J, Santos R, Figueroa ME (2006) Effect of prolonged flooding on the invader *Spartina densiflora* Brong. (Poaceae). NEOBIOTA. From Ecology to Conservation, 4th European Conference on Biological Invasions, Vienna, Austria.
- Procaccini G, Arnaud-Haond S, Migliaccio M, Diaz-Almela E, Teixeira S, Alberto F, Duarte CM, Serrão E (2006). Vicariance patterns in the Mediterranean Sea: East-West cleavage and low dispersal in the endemic seagrass *Posidonia oceanica*. *Mediterranean Seagrass Workshop*. May 29-June 3, 2006, Marsascala, Malta.
- Rio, D.; Barracosa, H.; ; “Contributo para a Educação Ambiental e Participação Pública no PNSACV”, II Seminário Nacional de Equipamentos para a Educação Ambiental em Portugal: Qualidade e Inovação, Faro, January 19 to 21, 2006
- Rio, D.; Barracosa, H.; “Educação Ambiental e Participação Pública no Parque Natural do Sudoeste Alentejano e Costa Vicentina - Portugal”, V Congresso Ibero-Americano de Educação Ambiental, Joinville, Santa Catarina, Brasil, April 5 to 8, 2006.
- Rozenfeld AF, S Arnaud-Haond, E Hernández-García, VM Eguíluz, MA Matías, E Serrão, CM Duarte (2006). Genetic similarity networks in clonal plant populations. *FisEs2006, XIV Reunión de Física Estadística* (Spanish Meeting of Statistical Physics). 14-16 Sept 2006, Granada, Spain.
- Santos R, Alexandre A, Cabaço S and Cunha, A. Impacts of physical and nutrient disturbances on the seagrass *Zostera noltii*. *Mediterranean Seagrass Workshop*, Malta.
- Santos R. Avaliação do impacte ecológico das pressões antropogénicas na vegetação de sistemas costeiros. Workshop Avaliação do Impacto Ecológico e/ou Químico das Pressões Antropogénicas nas Águas Costeiras e de Transição. Oral communication.
- Santos R. Contributos para a implementação de Áreas Marinhas Protegidas (AMPs). Reunión Internacional de Expertos en Reservas e Áreas Mariñas Protexidas, CEIDA, Santa Cruz, Spain. Invited speaker
- Schuenhoff A, Mata L, Santos R. A direct comparison of two successful seaweed biofilters *Asparagopsis armata* and *Ulva rigida*. *AQUA* 2006, Maio 9-13, 2006, Firenze, Italy
- Serra I, S Arnaud-Haond, S Calvo, G Di Maida, CM Duarte, A Innocenti, M Migliaccio, M Pirrotta, EA Serrão, A Tomasello, G Procaccini (2006) Genetic variability of *Posidonia oceanica* (L.) Delile in a Mediterranean transition zone. *Marine Genomics Europe Annual Meeting*, Oct 28-31 2006, Sorrento, Italy
- Serrão E, Vliet M, Hansen G, Maggs C, Pearson G (2006). Molecular characterization of the “*cottonii*” form of *Fucus* in the northeastern Pacific versus the Atlantic. *60th Meeting of the Phycological Society of America*, 7-12 July 2006, Juneau, Alaska, USA.
- Silva J, Calleja ML, Duarte CM, Santos R (2006) Submerged versus air-exposed intertidal macrophyte productivity: from plant to community. *Mediterranean Seagrass Workshop*, Marsascala, Malta.
- Stigter T, Dill A C, Malta E and Santos R. Quantificação da descarga de nutrientes de azoto e fósforo para a Ria Formosa por escoamento superficial. V Congresso Ibérico sobre Gestão e Planeamento da Água, 4-8 de Dezembro de 2006, Universidade do Algarve
- Xavier, J. C. & Vieira, G. T. (2006). Portugal and the International Polar Year 2007-08: the key role of researchers in promoting science to a wider audience. At “I meeting of communication of science”, Institute Gulbenkian of science, Lisbon, 3 June.
- Xavier, J. C. (2006). “Portuguese Scientific Strategy for the International Polar Year”. II workshop Portugal and the Polar regions, Oceanarium of Lisbon, 8 May, Portugal.
- Xavier, J. C. (2006). Biological sciences. III workshop Portugal and the Polar regions, University of Lisbon, 29 November, Portugal.
- Xavier, J. C. (2006). Biology and diversity: relevance of trophic interactions in the Antarctic marine ecosystem.” Annual meeting of CIMAR Associate Laboratory, Peniche Portugal, 20-21 October
- Xavier, J. C. and Borges, T. C. (2006). Cephalopods caught by non-cephalopod target fisheries: does it produce damaging effects on the structure of the cephalopod populations? “Cephalopods life-cycles: biology, management and conservation”, Cephalopod International Advisory Council (CIAC) conference, 2-10 February, 2006.
- Xavier, J. C. and Cherel, Y. (2006). Cephalopod beak guide for the Southern Ocean. Workshop Southern Ocean Cephalopods, in “Cephalopods life-cycles: biology, management and conservation”, Cephalopod International Advisory Council (CIAC) conference, 2-10 February, 2006.
- Xavier, J. C., Croxall, J. P. and C. Nigmatullin (2006). Predator-prey interactions in the Southern Ocean: identification of growth and post-spawning periods of Antarctic squids using albatross diets.

- "Cephalopods life-cycles: biology, management and conservation", Cephalopod International Advisory Council (CIAC) conference, 2-10 February, 2006.
- Xavier, J. C., Kresswell, K. A., Mendes, D., Cristo, M. and Borges, T. C. (2006). A statistical method to estimate the optimal number of stomach samples to assess the diet of cephalopods. "Cephalopods life-cycles: biology, management and conservation", Cephalopod International Advisory Council (CIAC) conference, 2-10 February, 2006.
- Xavier, J.C. and G.T. Vieira (2006). Portugal and the International Polar Year. XVII Encontro Nacional de Educação Ambiental - Miranda do Douro. 5 - 8 October.
- Xavier, J.C. and G.T. Vieira (2006). Portugal and the International Polar Year. 3º Congresso de Geomorfologia " Dinâmicas Geomorfológicas, Metodologia, Aplicação. Funchal, 12 a 14 de Outubro
- Xavier, J.C. and G.T. Vieira (2006). Portugal and the International Polar Year. II Jornadas de Ambiente e Moinhos Mira, - organização AAMARG - Associação dos Amigos dos Moinhos e Ambiente da Região da Gândara, 14 October.
- Xavier, J.C. and G.T. Vieira (2006). Portugal and the International Polar Year. Etwinning School Partnerships in Europe, Professional development workshop - Grup E - Projects in EE, 19- 20 de October.
- Xavier, J.C. and G.T. Vieira (2006). Portugal and the International Polar Year. Acção de Formação - Circulo de Estudos - "Projecto Rios" - Coimbra Escola Sec D. Duarte/ Centro de Formação Ágora, 7 – 21 October.

Project and consultancy final reports

- Gonçalves, J.M.S.; Machado, D.; Veiga, P.; Bentes, L.; Monteiro, P.; Ribeiro, J.; Coelho, R.; Afonso, C.; Almeida, C.; Ruano, M.; Oliveira, F.; Corado, M.; Abecasis, D. and Erzini, K. 2006. Recrutamento de Espécies Piscícolas de Interesse Comercial no Estuário do Rio Arade/Recruitment of Fish Species of Commercial Interest in the Arade River Estuary. Final report, DGPA (MARE P.O. Pesca: 22-05-01-FDR-00017), Universidade do Algarve, CCMAR, Faro, 162 pp. + Anexos.
- Santos R, Cabaço S (2006) Caracterização de base das comunidades vegetais das zonas de descarga das ETARs de Almagem, Faro noroeste, da companheira (Rio Arade) e do estuário do Guadiana. Contract with Hidrotec / Águas do Algarve to monitor the macrophyte communities of Algarve coastal systems, 32pp.

Prizes and Honours

- Luis Chicharo received an Honorary award for his support in establishing the European regional Centre for Ecohydrology (ERCE) under the auspices of UNESCO in Lodz, Poland (31 de Maio de 2006), during the Opening Ceremony.

Thesis supervised by members of the research unit

Division of Aquaculture and Biotechnology

Theses PhD

Completed

- Campinho, Marco. The molecular and endocrine basis of finfish embryo development and metamorphosis. (Supervisors: Deborah M. Power and Dr Glen Sweeney (University of Cardiff, UK). Completion expected 2007
- Estêvão, Dulce. Endocrine regulation of extracellular matrix proteins in calcified tissue in teleost fish. University of Algarve (Supervisor: Deborah M. Power) Examination January 2006
- Mira, Sara Maria. Population genetics of an endangered species, the Bonelli's eagle (*Hieraaetus fasciatus*). (Supervisors: Leonor Cancela and Pedro Beja in Portugal; Paula Dias from CNRS in France).
- Morais, Sofia (2006). Digestive physiology and food intake in marine fish larvae with respect to dietary neutral lipids. Universidade do Algarve (Supervisors: Maria Teresa Dinis, Luis E.C. Conceição and Ivar Rønnestad, from University of Bergen, Norway).
- Pinto, Patricia Isabel Silvestre (2006) Diversidade, expressão e mecanismo de acção do receptor de estrogénio na dourada, *Sparus aurata*. University of Algarve (supervisors Adelino V.M. Canário and Dr Glen Sweeney, University of Cardiff, UK).

Ongoing

- Andrade, Fábila Karina. Desenvolvimento de estruturas à base de celulose bacteriana para culturas de condrócitos (Supervisors: FM Gama, L Domingues and ML Cancela). Completion expected in 2009.
- Anjos, L.G. The biochemical and biological characteristics of PTH and PTHrP in fish. (Supervisor: Deborah M. Power). Completion expected 2010.
- Ascenso, Rita Margarida Teixeira: "Identification of *P. Atlanticus* genes differentially expressed in response to parasite-host interaction and development of an in vivo infestation system". (Supervisor: Leonor Cancela). Completion expected in 2007.
- Borges, Gisela. Endothelium dysfunction in microvascular diseases. (Supervisor: Josefina Coucelo). Completion expected in 20076.
- Campinho, Marco. The molecular and endocrine basis of finfish embryo development and metamorphosis. (Supervisors: Deborah M. Power and Dr Glen Sweeney (University of Cardiff, UK). Completion expected 2006
- Carvalho, Inês. Abundance, site fidelity and population structure of humpbacks whales (*Megaptera novaeangliae*) in S. Tomé e Príncipe. University of Algarve (Supervisors: Howard Rosenbaum from the American Museum of Natural History and the Wildlife Conservation Society, NY, USA, and M. Leonor Cancela). Completion expected in 2008.
- Carvalho, Suzana. Papel das Comunidades de Macrofauna Bentónica na Gestão de Tanques para Piscicultura (supervisors Maria Teresa Dinis and Luis Fonseca). Completion expected in 20052007.
- Coesel, Sacha. Isolation and characterization of regulatory and biosynthetic genes involved in carotenogenesis in the microalga *Dunaliella salina*. (supervisors João Varela and Chris Bowler). Completion expected in 20076.
- Fagundes, Teresa Ecologia comportamental do blenídeo *Salaria pavo* na Ria Formosa: tácticas alternativas de reprodução e inversão de papéis sexuais (Supervisors Rui Oliveira and Adelino Canário). Completion expected in 20076
- Frade, Pedro Alexandre. Chemical identification and function of pheromones in the reproduction of tilapia, *Oreochromis mossambicus* (Pisces: Cichlidae). Universidade do Algarve (supervisors Eduardo N. Barata, Adelino V.M. Canário and Peter C. Hubbard). (Fellowship temporarily suspended).
- Gavaia, Paulo J. "Functional analysis of osteocalcin (Bone Gla protein, BGP) from bony fish during skeletal development. Universidade do Algarve (Supervisors: Leonor Cancela and Carmen Sarasquete, CSIC Cadiz, Espanha). Completion expected in 2005.
- Henriques, Nuno. Regulation of the gene expression associated with the carotenoid biosynthesis in the microalga *Dunaliella salina*. University of Algarve (Supervisors: M. Leonor Cancela and João Varela). Completion expected in 2006.

- Kolmakov, Nikolai. Pheromone olfactory receptors in fish: isolation and functional characterization. (supervisors: Adelino Canário, Peter Hubbard and João Coimbra). Completion expected in 2007.
- Leite, Ricardo Mário Bastos. Characterization of metabolic pathways in the protozoan parasite *Perkinsus atlanticus/olseni*: Identification of potential targets for therapeutic drugs. University of Algarve (Supervisors: M. Leonor Cancela). Completion expected in 2008.
- Louro, Bruno, E.P. An integrated approach to genetic selection of the aquaculture species dourada (*Sparus auratus*). University of the Algarve (Supervisors: Deborah M. Power and Giorgos Koutoulas, HCMR, Crete, Greece. Completion expected in 2010.
- Martins, Rute Sofia. Dax-1, a sex determination gene in fish? Universidade do Porto (supervisors: Adelino Canário and João Coimbra). Completion expected in 2007.
- Mesquita, Sandra Maria Sengo. Isolamento e caracterização de cianofagos de *Microcystis* sp. Implicação no desenvolvimento de um método de diagnóstico molecular associado á detecção da produção/libertação de microcistinas. University of Algarve (Supervisors: Rachel Noble from the Insitute of Marine Sciences, University of North Caroline, Chapel Hill, USA, and M. Leonor Cancela) Completion expected in 2008.
- Morgado, Isabel. (2002) Transthyretin: its role in the transporte of thyroid hormone in fish and the influence of endocrine disruptors. (Supervisor: Deborah M Power). Completion expected 20076.
- Pais, Miguel Caldeira. Seleção e utilização do habitat pela população não reprodutora de Aguiá de Bonelli (*Hieraaetus fasciatus*) no Sul de Portugal. (Supervisors: M. Leonor Cancela and Pedro Beja (Erena]) Completion expected in 20076.
- Rafael, Marta Isabel da Silva. Role of the transcriptional regulator FHL2 in bone formation: Identification of fish bone-specific target genes and regulatory mechanisms. University of Algarve (Supervisors: M. Leonor Cancela and Vincent Laizé, and Roland Schüle from the University of Freiburg, Germany) Completion expected in 2008.
- Ramos, Alexandra. Isolation and characterization of the lycopene cyclase gene involved in the carotenoid biosynthetic pathway in the microalga *Dunaliella salina*. (supervisors João Varela and Bertram Brenig). Completion expected in 2007.
- Ribeiro, Ana Rita. Iodine nutrition in larval marine fish; uptake, metabolism and effect on development (Supervisors: Mari Moren, Laura Ribeiro and Maria Teresa Dinis). Completion expected in 2009.
- Saavedra, Margarida. Requisitos em aminoácidos de larvas e pós-larvas de sargo (*Diplodus* spp.): efeitos na performance e na qualidade. Universidade do Algarve (Supervisors Maria Teresa Dinis, Luis E.C. Conceição and Dr Pedro Pousão- Ferreira). Completion expected in 2008.
- Serafim, Maria Paula. Universidade do Algarve (supervisor Margarida Castro). Completion expected in 2006.
- Serrano, Rui Manuel. Pheromones in the reproduction of *Salaria pavo* and *S. fluviatilis* (Pisces: Blenniidae): a comparative study. Universidade do Évora (supervisors Eduardo N. Barata, Adelino V.M. Canário and Peter C. Hubbard). Completion expected in 2007.
- Silva, Joana. Effectiveness of alternative protein sources in meeting the true amino acid requirements of Senegalese sole. (Supervisors Luisa Valente, Luis E.C. Conceição and Marit Espe). Completion expected in 2009.
- Silva, P.A.S. Estados vibracionais excitados e o funcionamento das proteínas. University of Algarve (supervisor: L.eonor Cruzeiro). Completion expected in 20076.
- Soares, Sandra Sofia Ganchas. Stresse oxidativo no músculo cardíaco induzido por iões metálicos. (supervisors: Josefina Coucelo, Manuel Aureliano Alves e Carlos Gutierrez-Merino). Completion expected in 20076.
- Teodósio, Rita. Fish parathyroid hormone-like proteins: in search for functions. Universidade do Porto (supervisors: Adelino Canário, Deborah Power and João Coimbra). Completion expected in 2009.
- Tiago, Daniel António Martins: Role of IGF1 and IGF2 in the mineralization mechanisms using fish bone derived cell lines. (Supervisors M.L. Cancela and V. Laizé from CCMAR, MA Alves from FCT-UALG) To be completed in 2007.
- Vasconcelos, Paulo. Universidade do Algarve (supervisor Miguel Gaspar, IPIMAR and Margarida Castro. Completion expected in 2005.
- Viegas, Carla Alexandra São Bento. Molecular cloning and regulation of the genes encoding matrix and bone Gla proteins from sturgeon, an archaic teleost fish. Studies towards understanding the evolution of their molecular mechanisms of action. University of Algarve (Supervisors: M. Leonor Cancela and Dina Simes). Completion expected in 2008.
- Vieira, A.S. Evolution of the extracellular matrix in deuterostomes and the Influence of calcitropic hormones. University of the Algarve (Supervisor: Deborah M Power) Completion expected in 2009.

Theses Master of Science

Completed

- Bruwiere, Stijn (2006) The effects of amino acid supplementation on stress response and performance of juvenile sole (*Solea senegalensis*). European Masters of Aquaculture and Fisheries, Ghent University (Supervisors: Luís Conceição and Cláudia Aragão).
- Canoza, Beatriz (2006) Effects of copper in plasma, gills, liver and muscle of seabream (*Sparus aurata*, Linnaeus 1758) juveniles. European Masters of Aquaculture and Fisheries, University of Algarve (Supervisors: Florbela Soares and Rui Cabral e Silva).
- Costas, Benjamin (2006) Effect of high densities on growth, stress response and plasma amino acid levels in Senegalese sole (*Solea senegalensis*, Kaup 1858). European Masters of Aquaculture and Fisheries, University of Algarve (Supervisors: Luís Conceição and Cláudia Aragão).
- Roberto, Vânia (May 2006) Gla protein localization and histological characterization of bone structures in relevant aquaculture fish. International Masters in Aquaculture, University of Algarve (Supervisors: ML Cancela and PJ Gavaia).

Ongoing

- Afonso, Ricardo. Estudos sobre aproveitamento biotecnológico da quitina produzida por organismos marinhos. Master in Biotechnology, University of Algarve (Supervisors: ML Cancela from the University of Algarve and M Gama from the University of Minho)
- Barbosa, Vera. Effect of antifreeze proteins (AFP) on teleost embryo cryoresistance (Supervisors: ML Cancela and V Robles)
- Cepo, Susana Isabel Coelho dos Santos. Contributo para a implementação de um sistema de gestão integrado de recolha e valorização de óleos alimentares usados. MSc in Gestão e Conservação da Natureza, University of Algarve (Supervisors: Raul Costa, António Portugal and M. Leonor Cancela). Completion expected in 20076
- Costas, Benjamim. "The effects of stressfull conditions on amino acids metabolism of Senegalese sole (*Solea senegalensis*, Kaup 1858)". Universidade do Algarve (Supervisors: Luís Conceição and Cláudia Aragão). Completion in 2006.
- Rainha, Rita. Determinação de possível correlação entre polimorfismos morfológico e genético em dourada *Sparus aurata* (Supervisors: ML Cancela and S Mira)
- Roberto, Vania. Characterization of the skeletal development of *Pagrus auriga* and *Scophthalmus maximus* through histological methods. International Masters in Aquaculture, University of Algarve (Supervisors: M. Leonor Cancela and Paulo J. Gavaia). Completion in 2006.
- Santos, Erika Silva. Potencial de utilização do *Cistus ladanifer* L. na vegetalização de áreas mineiras. MSc in Gestão e Conservação da Natureza, University of Algarve (Supervisors: M^a Manuela Abreu, Cristina Nabais and M. Leonor Cancela). Completion expected in 20076.
- Silva, Conceição. Desenvolvimento de ferramentas interactivas para divulgação das aplicações da biotecnologia ambiental em biorremediação. MSc in Biotechnology, University of Algarve (Supervisors: Carlos Rocha and M. Leonor Cancela). Completion expected in 20076,

Graduation Honours thesis (Estágio de licenciatura)

Completed

- Carneiro, João Tiago Estêvão Tomé. Contribuição para a optimização de uma metodologia de detecção de cistos de *Cryptosporidium spp* em amostras de águas (Supervisores: ML Cancela and R Leite)
- Corte-Real, Joana (2006) Efeito das condições de stress no crescimento do linguado Senegalês (*Solea Senegalensis*). (Supervisors: Luís Conceição and Cláudia Aragão).
- Jesus, Cláudia (2006) Chemical and biological treatment of acid mine drainage (Supervisor: M. Clara Costa).
- Márcio Alexandre Filipe. Resposta molecular da amêijoia *Ruditapes decussatus* à infecção do parasita *Perkinsus olseni*, e a sua interdependência com a dinâmica biogeoquímica do Ferro em sedimentos inter-mareais (Supervisors: ML Cancela from CCMAR and C Rocha from CIMA).
- Vitorino, António (2006) Avaliação do efeito de diferentes dietas de maturação na produção e qualidade larvar do camarão ornamental *Lysmata amboinensis* (Decapoda: Hippolytidae) (Supervisors: R. Calado and Gonçalo Calado from U. Lusófona).

Ongoing

- Castro, Cecília. Synthesis of N,N'-tetrasubstituted malonamides and their application to the extraction of metals by solvent extraction (Supervisors: M. Clara Costa and Ana Rosa Costa).
- Dionísio, G. Alimentação larvar de camarões ornamentais do género *LySMata* (Supervisors: R. Calado and M, T. Dinis)
- Fazenda, Cindy. Regulação do(s) promotor(es) distal e/ou proximal do gene MGP de *Xenopus laevis* (Supervisors: ML Cancela and N Conceição)
- Fernandes, Alberto J. D. A influência de diferentes estímulos na capacidade digestiva de larvas de Linguado (*Solea senegalensis*). (Supervisors: Laura Ribeiro and Gonçalo Calado from U. Lusófona).
- Lopes, Rui. Cloning and characterization of *Sparus aurata* tissue-non-specific alkaline phosphatase and role in tissue mineralization (Supervisors: M. Leonor Cancela and Vincent Laizé)
- Oliveira, Daniel. Caracterização de proteínas soluveis do nacre da ostra *C. Gigas*. Estudo do efeito destas proteínas na mineralização óssea (Supervisor: D. Simes)
- Pinto, Bruno. The role of matrix Gla protein during *in vitro* biomineralization: Phosphorylation as a key mechanism for protein function (Supervisors: M. Leonor Cancela e Dina Simes)
- Raikundalia, Shikha. Creation of a zebrafish transgenic line for the antifreeze protein type I (AFP I) (Supervisors: ML Cancela and V Robles)
- Rosa, Joana. Cloning and characterization of *Sparus aurata* sniffer-like protein and role in tissue mineralization (Supervisors: ML Cancela and V Laizé)
- Silva, Patrícia. Estudo da variação individual do crescimento, e consumo de alimento do linguado (*Solea senegalensis*) cultivado em isolamento ou em grupos (Supervisors: Luís Conceição, Catarina Martins e Sofia Engrola).
- Silva, Tomé. Análise do Proteoma do esqueleto do sargo (*Diplodus spp.*) (Supervisor: P Rodrigues)
- Viegas, Michael. Regulação da transcrição do gene matrix Gla protein (MGP) pelo factor de transcrição NF-AT em células derivadas de vértebra de *Xenopus laevis* (Supervisors: ML Cancela and N Conceição)

Division of Living Resources

Theses PhD

Completed

- Alberto, Filipe. Dispersal, sex and clonality in the marine environment: population genetic structure of the seagrass *Cymodocea nodosa* on Mediterranean and Atlantic coasts.. Univ. Algarve (supervisor E. Serrão and C. Duarte, CSIC, Spain). Sept 2005.
- Beldade, Manuel Ricardo do Ó de Oliveira. Patterns of recruitment and stability in rocky coast cryptic fish communities. (Supervisors: Karim Erzini and Emanuel Gonçalves, ISPA).
- Borges, Rita. Composition, Temporal and Spatial Patterns of Very nearshore Larval Fish Assemblages at the Arrábida Marine Park. PhD. Universidade do Algarve. (supervisor: Emanuel Gonçalves and M. Alexandra Chicharo).
- Hazin, Humberto Gomes. Influence of oceanographic parameters on the population dynamics of swordfish, *Xiphias gladius* (Linnaeus, 1758), caught in the Atlantic ocean. (supervisor: Karim Erzini)
- Stobberup, Kim Araujo. 2005. Study of community structure, trophic interactions and exploitation pattern in the Cape Verde coastal ecosystem. PhD. Dissertation, Universidade do Algarve. (supervisor: Karim Erzini).

Ongoing

- Alexandre, Ana. Metabolismo do azoto na angiospérmica marinha *Zostera noltii* (Hornem.) na Ria Formosa Universidade do Algarve. (supervisor Rui Santos, CCMar)
- Bartilotti, Cátia Alexandra Vieira: "Processos bio-ecológicos dos estádios larvares de crustáceos decápodes na região adjacente à Ria de Aveiro: morfologia e ecologia larvar". (Supervisor A. Dos Santos and M. Castro). Completion expected in 2009.
- Beldade, Manuel Ricardo do Ó de Oliveira. Patterns of recruitment and stability in rocky coast cryptic fish communities. (Supervisors: Karim Erzini and Emanuel Gonçalves, ISPA). Completion expected in 2007.
- Berecibar, Estibaliz. "Global related changes in the Portuguese marine flora". Universidade do Algarve (Supervisor: Rui Santos, CCMar).
- Billard, Emmanuelle. Evolution of reproductive strategies in four closely related brown seaweeds, *Fucus spiralis*, *F. vesiculosus*, *F. ceranoides* and *F. serratus*. Univ. Algarve and Univ. Paris VI, France. (Supervisors: Ester Serrão and Myriam Valero, CNRS, France). Completion expected in 2007.

- Blomqvist, Inês de Melo Fernandes da Silva. Acoustic communication and social dynamics of a stable group of bottlenose dolphins (*Tursiops truncatus*) in human care. (supervisors: Karim Erzini and Mats Amudin, Linköping University, Sweden. Defense scheduled for February 17, 2006.
- Borges, R. "Processo de retenção do ictioplâncton na costa da Arrábida (supervisors: Emanuel Gonçalves-ISPAA, Alexandra Chicharo Universidade do Algarve) - Completion expected in 2007.
- Cabaço, Susana. "Population dynamics of *Zostera noltii* along a nutrient gradient". Universidade do Algarve (supervisors: Rui Santos, CCMar and Carlos Duarte, Universidade das Ilhas Baleares).
- Candeias, A. "The Processes Of Feeding In The Physiological Energetics Of Coastal Meroplankton" (Supervisor Alexandra Chicharo em co-orientação com Doutor Andrew Bruce Yule - School Of Ocean Sciences, University of Wales).
- Coelho, Rui Pedro Andrade. Biology, spatio-temporal dynamics and conservation and management of deep water sharks. (supervisor: Karim Erzini) Completion expected in 2007.
- Costa, M.E. By-catch e rejeições da pesca comercial de arrasto na costa Sul de Portugal. Universidade do Algarve (supervisor Teresa Cerveira Borges)
- Díaz-Almela, Elena. "Population dynamics and reproductive ecology of *Posidonia oceanica* (Delile)". Univ. Illas Ballears, Spain (Supervisors: Ester Serrão and Carlos Duarte, CSIC, Espanha). Completion expected in 2007.
- Esteves, Eduardo Bruno Oliveira. Recrutamento e condição larvar de savelha, *Alosa fallax fallax*, nos rios Mira e Guadiana. (Supervisor: J. Pedro Andrade).
- Fonseca, Paulo Jorge Menano Ribeiro da. Selectivity of trawl and gill nets on the Portuguese continental coast. (supervisor: Karim Erzini) Completion expected in 2007.
- Garrido, S. Ecologia Alimentar Da Sardinha (*Sardina Pilchardus*) Ao Largo Da Costa Continental Portuguesa Universidade do Algarve (supervisors: Maria Alexandra Chicharo (CCMar) Carl van der Lingen (MCM – África do Sul), Emilia Cunha (IPIMAR)
- Godinho, Cecile. "The impact of anti-fouling paints on seagrass populations of *Zostera noltii* (Hornem., 1832) in the Ria Formosa Lagoon". Universidade do Algarve (supervisors: Rui Santos, CCMar and Maria João Bebianno).
- Hazin, Humberto Gomes. Influence of oceanographic parameters on the population dynamics of swordfish, *Xiphias gladius* (Linnaeus, 1758), caught in the Atlantic ocean. (supervisor: Karim Erzini) Completion expected in 2006.
- Lago-Leston, Asuncion. The Molecular Basis for Differential Stress-Tolerance in Co-Existing, Ecologically Similar Algal Species, Univ. Algarve (supervisor G. Pearson, and E. Serrão). Completion expected in 20086.
- Leitão, Francisco Miguel de Sousa. Contribution of the artificial reefs of the Algarve coast to the trophic ecology of Sparidae. (Supervisors: Karim Erzini and Miguel Neves dos Santos, IPIMAR CRIP-Sul). Completion expected in 2007.
- Lino, Pedro Gil. Potential of restocking with cultivated fish on the south coast of the Algarve. (Supervisors: Karim Erzini, CCMAR and Miguel Neves dos Santos, IPIMAR, Olhão).
- Machás, Raquel. "The role of *Zostera noltii* on the food web of Ria Formosa", Universidade do Algarve (supervisor: Rui Santos, CCMar and Bruce Peterson, Marine Biological Laboratory, Wood's Hole, USA).
- Marçalo, Ana Luisa Barreto. Evaluation of stress in the sardine (*Sardina pilchardus*) during seining. (Supervisors: Karim Erzini, CCMAR and Yorgos Stratoudakis, IPIMAR, Lisboa). Completion expected in 2007.
- Mata, Leonardo - "Estudo da fisiologia de *Falkenbergia rufolanosa* para a optimização da produção e valorização da biomassa cultivada com os efluentes de uma piscicultura." Universidade do Algarve (Supervisor: Rui Santos).
- Morais, P. - "*Engraulis encrasicolus* (Linnaeus, 1758) population dynamics in the Guadiana estuary and adjacent coastal area" (Supervisores Alexandra Chicharo e Luis Chicharo).
- Moschino, V. - "Impact of fishing activity on the morphology, physiology and biochemistry of the bivalves *Chamelea gallina* and *Tapes philippinarum* from coastal and lagoon areas of the Northern Adriatic Sea (Italy)" (Supervisor Luis Chicharo em co-orientação com a Dra. Maria Gabriella Marin da Universidade de Padova (Itália).
- Olim, Sónia. Estudo bio-económico das capturas acessórias e rejeições no arrasto de crustáceos na costa do Algarve. Universidade do Algarve (Supervisors: Teresa Cerveira Borges & Francesc Maynou, CSIC, Barcelona). Completion expected in 2010.
- Oliveira, M. Sustainable underwater ecotourism: biological, ecological and socio-economic bases in Portugal (Central Algarve) and Cabo Verde (Ilha de Santiago). (Supervisors U Algarve: K. Erzini and J.M.S. Gonçalves) Completion expected in 2010.
- Pais, MC. Use and selection of habitats by non-breeding Bonelli's eagles in southern Portugal. (supervisors Pedro Beja and Leonor Cancela). Completion expected in 2007.

- Ribeiro, Joaquim. Ecology and dynamics of ichthyofauna of the Ria Formosa. (supervisor: Karim Erzini) Completion expected in 2007.
- Santana, J. - "Comparação bioeconómica das pescas no rio Tocains Amazônia-Brasil", (Supervisor Luis Chícharo em co-orientação com o Doutor Miguel Petreire da Universidade de Pernambuco (Brasil).
- Schuenhoff, Andreas - "The application of *Asparagopsis-Falkenbergia* as a commercially viable biofilter for water re-use". Universidade do Algarve (Supervisors: Rui Santos, CCMar and James Mui, Universidade de Stirling).
- Serafim, Maria Paula. Universidade do Algarve (supervisor Margarida Castro). Completion expected in 2008.
- Sykes, António Vilhena - "Hatchery Technologies and Nutritional Contents of Cuttlefish (*Sepia officinalis*) spawners, eggs, hatchlings and live prey associated" (Supervisor: José Pedro Andrade, CCMar). Completion in 2007
- Teodósio, J. "Dinâmica populacional e caracterização do estado fisiológico e bioquímico da ameijoia asiática *Corbicula fluminea* na bacia hidrográfica do rio Guadiana". (Supervisores Alexandra Chícharo e Luis Chícharo).
- Van de Vliet MS. Population structure of amphibians inhabiting Mediterranean temporary ponds. Univ. Algarve. Supervisors: E. Serrão, P. Beja (ERENA), N. Ferrand (CIBIO). Completion expected in: 2010
- Vasconcelos, Paulo da Conceição Silva (supervisors Miguel Gaspar (IPIMAR) and Margarida Castro). Completion expected in 2007.
- Veiga, P. Sport fishing in the south and southwest of Portugal: biological and socio-economic aspects and management perspectives. (Supervisors: K. Erzini and J.M.S. Gonçalves) Completion expected in 2010.
- Vieira, Vasco. Modelo ecológico da Ria formosa, , Universidade do Algarve. (supervisor Rui Santos, CCMar and Ramiro Neves, Instituto Superior Técnico, Universidade de Lisboa)

Theses Master of Science

Completed

Ongoing

- Antunes, Marisa. "Utilization of satellite tracking to assess feeding strategies of seabirds: the case study of Cory's shearwaters during their breeding period at Azores Islands". (Supervisors: J. C. Xavier, T. C. Borges and M. Carvalho (Univ. Azores). Completion expected in 2008.
- Araújo, João. Análise de capturas de aparelho de anzol em função de variáveis ambientais e de pesca. Completion expected in 2007. (Supervisors: Karim Erzini and Jorge Gonçalves).
- Bentes, L. Luís Bentes. Identificação e caracterização de habitats essenciais para peixes na Costa Algarvia. Completion expected in 2007 (Supervisors: Karim Erzini and Jorge Gonçalves)
- Brito, Joana Rodrigues Lisboa. "Conservation of Cory's shearwaters *Calonectris diomedea* populations of the Azores Islands: evaluation of sexual dimorphism, diet and reproductive strategies". (Supervisors: J. C. Xavier, T. C. Borges and M. Carvalho (Univ. Azores). Completion expected in 2008.
- Carvalho, Joana Fernandez. Aplicação de técnicas de vídeo subaquático na caracterização de biocenoses marinhas. (Supervisors: Jorge Gonçalves and Karim Erzini). Completion expected in 2007.
- Conduto, Telma. Utilização de indicadores para a avaliação do impacto de diferentes artes de pesca. Mestrado em Aquacultura e Pescas. (Supervisor: Karim Erzini) Completion expected in 2006/2007.
- Correia, Marta. Biologia alimentar de *Galeus melastomus* e *Galeus atlanticus* (Chondrichthyes: Scyliorhinidae) na costa sul de Portugal. (Supervisors: Karim Erzini, Rui Coelho and José Xavier) Completion expected in 2007.
- Correia, Miguel. Feeding requirements in early stages of cuttlefish *Sepia officinalis* (Linnaeus, 1758) life cycle. (Supervisors J. Pedro Andrade, Henrique Cabral). Completion expected in 2007.
- Costa, Joana Ferreira "Portugal, um Consumidor Consciente" (Supervisor: M. Castro) Completion expected in 2007.
- Ferreira, Ana Margarida Marques. "A Pesca da Enguia-Europeia, *Anguilla anguilla* no Rio Tejo: Contributos para a Gestão Sustentável" (Supervisor: M. Castro) Completion expected in 2007.
- Fragoso B. Assessment of biofouling pressure in an oyster aquaculture longline. Mestrado em Biologia Marinha. Universidade do Algarve. Supervisors: E. Serrão, J. Icely (Sagremarisco). Completion expected in 2007
- Frutuoso Ana Luísa Diversidade de macrofungos em sobreirais serranos do sul de Portugal: sua relação com a gestão florestal. Mestrado em Gestão e Conservação da Natureza. Universidade do Algarve. Supervisors: E. Serrão, M. Honrubia (Univ. Murcia), P. Beja (ERENA). Completion expected in 2007.

- Jesus, Ana Cristina Martins de Jesus "Community-based management of a MPA/coastal area in the Yucatán península" (Supervisors: Júlia Fraga, M. Castro) Completion expected in 2007.
- Leocádio, Ana Maria. "Pesca de crustáceos com armadilhas" (Supervisor: M. Castro) Completion expected in 2007.
- Machado, Daniel Miranda. Distribution patterns of flatfishes in 3 marine habitats: Coastal area, Coastal lagoon and Estuary. Mestrado em Ecologia, Faculdade de Ciências e Tecnologia da Universidade de Coimbra.(Supervisor: Jorge Gonçalves e Miguel Pardal) Completion expected in 2006.
- Mendes, Marina Tamagnini. "Effects of sexual dimorphism of juveniles on reproductive success of the Cory's shearwaters *Calonectris diomedea borealis* at Azores Islands (Faial, Pico and São Jorge)". (Supervisors: J.C. Xavier, T.C. Borges and M.Carvalho (Univ. Azores). Completion expected in 2008.
- Miodonski, J. Caracterização da ictiofauna de poças de maré na costa sul de Portugal. (Supervisors: Jorge Gonçalves, Cláudia Faria, Karim Erzini). Completion expected in 2007
- Monteiro, Carla. Reproductive Ecology of *Sargassum muticum* (Yendo) Fensholt in Viana do Castelo (Northern Portugal). Mestrado em Biologia e Ecologia do Litoral Marinho. Universidade de Évora. (supervisor Rui Santos and Aschwin Engelen, CCMar)Completion expected in 2007.
- Nhanca, Florentino José Lopes. Avaliação das capturas na ZEE da Guiné-Bissau e desenvolvimento de um plano de amostragem e monitorização. Mestrado em Gestão e Conservação da Natureza (Supervisor: Karim Erzini) Completion expected in 2006.
- Paulo, Diogo. The compared photosynthetic performances of the invasive *Sargassum muticum* and the native seagrasses of southern Portugal. MSc in Biologia Marinha (supervisors Rui Santos, João Silva and Aschwin Engelen, CCMar). Completion expected in 2007.
- Piló, David Indicadores de eutrofização em comunidades bentónicas na Ria Formosa (Supervisors Luis Chícharo e Alexandra Chícharo). Completion expected 2007.
- Pires, Francisco. Levantamento taxonómico e distribuição de esponjas (Filo Porífera) na costa do Algarve. (Supervisors: Jorge Gonçalves, Luís Fonseca, Carlos Afonso). Completion expected in 2007.
- Rosa, Ana. Guia de Campo das algas do intertidal da Praia da Vigia. Mestrado de Biologia e Geologia para o Ensino, Universidade do Algarve (supervisor Rui Santos and João Silva, CCMar) Completion expected in 2007.
- Tania Pedro. Padrões de Crescimento em Otólitos de Larvas de *Pomatoschistus pictus* (Pisces, Gobiidae) (Supervisors Emanuel Gonçalves e Alexandra Chícharo). Completion expected 2007.
- Vale, Neusa (University Lisbon) "Feeding ecology of the conger eel *Conger conger* off Algarve waters: implications on conservation". (Supervisors: J. C. Xavier and C. Assis (Univ. Lisbon). Completion expected in 2008.
- Vieira, Cátia. "Predator-prey interactions between sharks *Etmopterus pusillus* and their prey South of Portugal (Algarve)". (Supervisors: J. C. Xavier, T. C. Borges, R. Coelho and M.E. Costa). Completion expected in 2008.
- Vieira, P. Levantamento taxonómico e distribuição de gorgónias (Anthozoa: Gorgonacea) na costa do Algarve. (Supervisors: Jorge Gonçalves, Luís Fonseca, Carlos Afonso). Completion expected in 2007.
- Xavier, B. Indicadores de eutrofização em comunidades bentónicas na Ria Formosa (Supervisors Luis Chícharo e Alexandra Chícharo)

Graduation Honours thesis (Estágio de licenciatura)

Completed

- Assis, Jorge Manuel Ferreira. "Rapid Assessment Protocol em Sistema de Informação Geográfica para proposta de uma área marinha protegida, no Arco Sul de Gran Canaria". Marine Biology and Fisheries (supervisors: Ricardo H. Tabraune and M. Castro).
- Pereira, Maria do Rosário Gonçalves. "Socio-Economic Assessment of Vellapatti and Inigonagar villages, Tuticorin, Tamil Nadu, Índia". Marine Biology and Fisheries (supervisors: Vineeta Hoon and M. Castro).
- Pereira, José Nuno David e Silva Gomes. "Contribuições para a Biologia e Ecologia de Golfinhos de Risso (*Grampus griseus*) no Arquiélago dos Açores". Marine Biology and Fisheries (supervisors: José Azevedo and M. Castro).

Ongoing

- Assis, Jorge. Caracterização Espacial e Ecológica do Sítio de Interesse Comunitário “Franja de Mogan” da Ilha de Gran Canária (Espanha) para proposta a AMP (Área Marinha Protegida). (Supervisors: Margarida Castro e Jorge Gonçalves). Completion expected in 2007.
- Carvalho, Joana Fernandez. Aplicação de técnicas de vídeo subaquático na caracterização de biocenoses marinhas. (Supervisors: Jorge Gonçalves and Karim Erzini). Completion expected in 2007.
- Guerra, Luís. Modelação da Produção Primária Bentónica no Ormonde (supervisors Rui Santos, CCMar; Henrique Coelho, Hidromod)
- Guimarães, Maria Helena Mapeamento por SIG das populações de *Zostera noltii* da Ria Formosa. (Supervisors: Rui Santos and Alexandra Cunha). Completion expected in 2007
- Machado, Susana. Origem e modo de reprodução da alga *Fucus vesiculosus* na Ria Formosa, inferidos por genotipagem com microsatélites. Licenciatura em Bioquímica, Universidade do Algarve. Completion expected in 2007.
- Mendonça, Ana (Univ. Porto). "Feeding ecology of blue sharks off Azores" (Supervisors: J. C. Xavier and Nuno Queiroz (Univ. Porto)). Completion expected in 2007.
- Mendonça, Ana Sofia (Univ. Algarve). "Predator-prey interactions between Cory's shearwaters *Calonectris diomedea* and their prey at the Azores" (Supervisors: J. C. Xavier, T. C. Borges and Maria Carvalho (Univ. Azores)). Completion expected in 2007.
- Pedro, P. Padrões de Crescimento em Otólitos de Larvas de *Pomatoschistus pictus* (Pisces, Gobiidae) Licenciatura em Biologia Marinha e Pescas, Universidade do Algarve. (Supervisors: Maria Alexandra Chicharo e Emanuel Gonçalves ISPA)
- Pires, Francisco. Levantamento taxonómico e distribuição de esponjas (Filo Porífera) na costa do Algarve. (Supervisors: Jorge Gonçalves, Luís Fonseca, Carlos Afonso). Completion expected in 2007.
- Possante, André. Algas do intertidal da ilha de São Vicente, Cabo Verde. Estágio de licenciatura em Biologia Marinha e Pescas, Universidade do Algarve (supervisors Rui Santos and João Silva, CCMar) Completion expected in 2007.
- Vieira, P. Levantamento taxonómico e distribuição de gorgónias (Anthozoa: Gorgonacea) na costa do Algarve. (Supervisors: Jorge Gonçalves, Luís Fonseca, Carlos Afonso). Completion expected in 2007.

Description of the Research activities

Division of Aquaculture and Biotechnology

Group: Molecular Biology - EDGE

Research team

Leader: M. Leonor Cancela

Researchers and post docs: Vincent Laizé, Pedro Rodrigues, Natércia Conceição, Dina Simes, Vanesa Robles, Paulo Gavaia

PhD students: Sara Mira, Daniel Tiago, Rita Ascenso, Marta Rafael, Carla Viegas, Ricardo Leite, Inês Carvalho, Sandra Mesquita

MSc students: Vania Roberto, Ricardo Afonso

Technicians/ research assistants: Marta Valente, Cátia Marques, Brigitte Simões, Sofia Cavaco, Nelson Coelho, Susana Pereira, Odete Cordeiro, Anabela Brito, Márcio Simão

Undergraduate students: João Carneiro, Bruno Pinto, Rui Lopes, Rita Rainha, Joana Rosa, Mickael Viegas, Cindy Fazenda, Vera Barbosa, Shikha Raikundalia, Daniel Oliveira, Tomé Silva, Paulo Dias

Research activity

The Molecular Biology - EDGE group is currently involved in studies related to:

The identification of molecular determinants of extracellular matrix calcification. Research focus is primarily on understanding molecular pathways of tissue mineralization and its regulation in adult life and during development, using teleost and cartilaginous fish and amphibians as model organisms; additional goals include studies on (1) the molecular adaptations of mechanisms that control extracellular matrix mineralization, (2) the evolution of mineralization-related gene structure and protein function, (3) the effect of environmental factors on tissue formation, mineralization and regeneration, and (4) the mechanisms of mineralization in mollusc bivalves.

Developmental expression of mineralization-related genes. Effect on embryo patterning.

Research aims at analysis of expression of genes encoding Gla-containing and mineralization-related proteins during early development. An integrated approach is being used, combining *in vivo* and *in vitro* work, through knock down, over-expression and forced expression. Analysis is focusing on correlations between transcript localization, embryonic patterning and regulation of gene expression.

The biology of clam (*R. decussatus*) infection by the parasite *Perkinsus olseni* and development of new drug therapies. Research focus on *in vivo* and *in vitro* analysis of parasite-host interactions. Additional goals include molecular characterization of specific parasite genes involved in host infection, identification of parasite metabolic pathways in an effort to develop new drug therapies, and identification of clam marker genes responsive to environmental iron stress.

Population conservation studies. Research has focused on population genetic studies of endangered or special interest species such as the Bonelli's eagle *Hieraaetus fasciatus* and the European otter *Lutra lutra*, through development of suitable molecular markers, genotyping and analysis of population structures.

Dietary amino acids and skeletal development in white bream (*Diplodus spp.*)(In collaboration with the aquaculture group). The central objective of this study is to evaluate the possibility of minimizing the skeletal deformity problems commonly found when *Diplodus spp.* are cultured, through the use of amino acid supplements or increasing the quantity of available dietary nitrogen. It is intended to verify how the expression of key proteins involved in skeletal development are affected using 2D-electrophoresis, in order to better understand the mechanisms involved in skeletal development. Members of this group are responsible for proteomics and genomics approaches of this project.

Summary of activities and progress during 2006 and Plans for 2007

1. Molecular determinants of extracellular matrix calcification

Achieved in 2006:

Major results included: **1)** Studies on the comparison of sites of mineralization-related gene expression and protein accumulation (e.g. osteocalcin, matrix Gla protein, bone morphogenetic protein-2, osteopontin, osteonectin, alkaline phosphatase, collagen) in adult teleost fish and during larval development; **2)** Functional analysis of selected mineralization-related gene promoters in amphibians and fish (e.g. osteocalcin, bone morphogenetic protein-2, matrix Gla protein); **3)** Elucidation of molecular evolution of bone metabolism and matrix Gla proteins; **4)** Identification of new genes and signal transduction pathways involved in the mechanisms of regulation of tissue mineralization; **5)** Continuous effort on development and characterization of bone- and cartilage-derived cell lines from fish (freshwater & marine) and amphibian; **6)** Studies on environmental factors affecting bone biology; **7)** Collection of deep-sea fish living close to Atlantic hydrothermal vents to study bone-related mechanisms of adaptation to high hydrostatic pressure; **8)** Strong inhibition of *in vitro* mineralization by vanadates in mineralogenic cells, **9)** Development of new methods for introduction of nucleic acids in fish embryos and application to cryopreservation.

Plan for 2007:

Major goals include: **1)** integrated multidisciplinary approaches (in particular high-throughput approaches) for *in vivo* and *in vitro* functional analysis of bone- and cartilage-related genes through techniques of overexpression and RNA interference; **2)** Evolutionary studies on specific gene function to understand mineralization in vertebrates; **3)** Effect of environmental parameters (estrogenic/anti-estrogenic chemicals, heavy metals, etc.) on bone biology; **4)** Development of cell lines from fish with different types of calcified tissues: agnathes (lamprey), cartilaginous fish (shark), marine and freshwater teleost fish (seabream, solea and zebrafish); **5)** Development of transgenic zebrafish lines expressing OC-, MGP-, BMP2-GFP fusion proteins and a line expressing antifreeze proteins; **6)** Identification of polymorphisms in specific genes related to environmental adaptations

and in populations at risk of developing specific phenotypes; 7) Identification of mineralization-related proteins from mollusc bivalves; 8) Characterization of deep-sea fish bone architecture.

2. Developmental expression of mineralization-related genes. Effect on embryo patterning.

Achieved in 2006:

Major results included (1) Construction of large set of MGP/ColX/OC promoter constructions essential for functional analysis of corresponding promoters and identification of responsive elements involved in their transcriptional regulation. (2) Identification of spatial/temporal expression of MGP/ColX gene transcripts driven by distal or proximal promoters. (3) Identification of various regulatory nuclear factors involved in the regulation of MGP/ColX/Oc gene transcription (i.e. Retinoic acid receptor, Runx2). (4) Purification of MGP protein from *Xenopus* suitable for antibody development.

Plan for 2007:

Major goals include (1) Work towards completing characterization of our recently developed *Xenopus* X1 cell line. (2) Confirm effect of nuclear factors on MGP/colX gene expression through binding by cotransfection and co-microinjection of wild type and mutant factors with the responsive DNA binding elements from target promoters. (3) unravel the functional relevance of these transcripts and access the phenotype of in vivo /in vitro loss of function mutants using morpholino oligos, and in vitro gain of function mutants. (4) Develop specific antibodies for *Xenopus* MGP and other target proteins.

3. Studies on the biology of clam (*R. decussatus*) infection by the parasite *Perkinsus olseni* and development of new drug therapies

Achieved in 2006:

Major results included: 1) Effects on environmental factors on the infection of Portuguese clam by *Perkinsus*; 2) Identification of structural components of *Perkinsus*; 3) Identification of genes involved in possible drug target pathways; 4) *in vitro* screening of various drugs for therapy of perkinsiosis using as model system a clonal culture of *P. atlanticus*; 5) Identification of regulatory mechanisms for purine salvage and shikimate pathways in *Perkinsus*; 6) Development of subtractive cDNA libraries focussing on identification of genes involved in host-parasite interactions; 7) Effect of sediment iron levels on clam infection; 8) Cloning and expression analysis of iron stress marker genes from clam.

Plan for 2007:

Major goals include: 1) Studies towards the identification of metabolites produced *in vitro* by *Perkinsus* cell lines with biotechnological applications; 2) Identification and expression studies of genes involved in host-parasite interaction through an integrated genome/proteome approach; 3) Identification of environmental parameters capable of modulating parasite growth *in vivo* and *in vitro*; 4) Gene expression analysis of environment stress-responsible genes from *P. Atlanticus*; 5) Development of a transfection method for *P. atlanticus* cells; 6) Search for new therapeutic agents capable of modulating in vivo clam infection.

4. Population conservation studies for the Bonelli's eagle, *Hieraetus fasciatus*, and the European otter *Lutra lutra*.

Achieved in 2006:

For the Bonelli's eagle: 1) genotyping Iberian peninsula population (250 samples) and 2) comparison and analysing population structure from the different locations.

Plan for 2007:

1) Analysis of museum collections (including New York Science Museum and UK Museums) to pursue comparison of Bonelli's eagle population from Southern Portugal with those from populations found in different parts of the world. 2) Extend our offer of external services for sex determination in birds. 3) Return to work on population genetics and paternity of crustaceans (*Nephrops norvegicus*) in collaboration with other researchers from CCMAR and IPIMAR. 4) Work on the phylogeny of several branquipedes in collaboration with other CCMAR researchers.

5. Dietary amino acids and skeletal development in white bream (*Diplodus spp.*)

Achieved in 2006:

The fish used in this study were previously fed since the larval state with diets containing exact quantities of protein hydrolysates in order to verify to what extent skeletal deformities can be reduced through improvement of the quantity of available nitrogen in the diet of larval *Diplodus spp.* The effect of a diet well balanced in the different indispensable amino acids (tank 1 – control tank), or supplemented with amino acids involved in skeletal formation (tank 2 – control diet with tryptophan supplements and tank 3 – control diet with lysine supplements), on performance and skeletal deformities of larval *Diplodus spp.* was studied. All the fish used in this study were grown at the IPIMAR (Olhão, Algarve). The expression of selected skeletal proteins was analyzed in normal and deformed fish obtained from the different dietary conditions. The standard method for proteome analysis combines protein separation by high-resolution two-dimensional gel electrophoresis (2DE), which consists of an isoelectric focusing step in an immobilized pH-gradient gel followed by SDS-PAGE, with MALDI-TOF-MS identification of selected spots. Qualitative and quantitative analysis is dependent on specific software (PDQuest), which enables detection, matching and quantification of the protein spots.

Plan for 2007:

The skeletal proteome allowed the identification of modulated protein clusters in skeletal tissue in response to dietary stimuli. The identification and sequencing (ongoing work in 2007) of selected spots representing differentially expressed proteins in normal and deformed fish in the same dietary condition and between different conditions will allow a better understood of the mechanisms through which dietary nitrogen influences skeleton formation. Corresponding genes will be cloned and expression analysed in the various dietary conditions.

Group: Comparative and Molecular Endocrinology - CME

Research team

Leaders: Adelino V. M. Canário and Deborah Power

Visiting scientist: Karin Pittman

Principal investigators and Post-docs: Eduardo N. P. Barata, Juan Fuentes, Ana Lúcia S.de Passos, Peter C. Hubbard, Ana Freitas, Laurence Deloffre, Begoña Redruelo, Pedro Miguel Guerreiro, Teresa Modesto, João Carlos Cardoso, Cristophe Haond, Lília Brinca, Dulce Estevão, Patrícia Pinto, Mar Huertas, Vanessa Schein.

PhD students: Isabel Morgado, Rui Manuel Lanceiro Serrano, Zélia Cristina Pereira Velez, Helena Rita Teodósio, Nikolai Kolmakov, Liliana Isabel Tomé dos Anjos.

Technicians/ research assistants: Nádia Silva, Elsa Couto, Bruno Louro, Olinda Gomes de Almeida, Adriana Silva.

Undergraduate students: Rita Isabel G. Soares, Vânia F. Martins, Aurore Coppieters.

Summary of activities and progress during 2006

The main topics of the group are the molecular mechanisms underlying hormone action and the physiological response of the whole animal. The processes that are the focus of attention are growth and development (with particular emphasis on cartilage, bone and muscle metabolism), reproduction and chemical communication (with emphasis on sex determination and pheromones), endocrine disruption, calcium regulation focussing on hypercalcaemic and hypocalcaemic hormones, and the stress response to normal physiological challenges (with emphasis on ion regulation). An integrated systems approach is being taken and genomics, molecular biology, proteomics, biochemistry, cell biology and whole animal physiology are deployed in order to give an overview of hormone function. The approach encompasses studies of gene regulation, gene expression, tissue specific proteome and changes in response to hormones, post-translational and post-secretory processing, receptor binding, signal transduction and finally the response at a cellular and whole animal level.

Calcitropic hormones

The work carried out in this area has progressed on several different fronts which include, molecular, biochemical, and physiological approaches. The target species being studied have been extended to take advantage of the diversity of fishes and also their divergent life strategies. A key question with regards to calcium homeostasis is to establish the role of internal deposits and external sources of calcium on this process.

Molecular studies using *in silico* analysis of the genome of model organisms has led to the identification of a new family of genes in teleosts, the PTH/PTHrP family. All the PTH/PTHrP-like genes are expressed but there appears to be a differential expression of the different forms. The biological activity of the N-terminal "calcitropic" regions of the protein product encoded by the genes, also reveals significant differences in activity and raises exciting new possibilities about the role of this gene family in fish. A number of biochemical assays have been developed and used to study the action of the N-terminal region of PTHrP on a number of different tissues. Receptor type, affinity (ligand binding, secondary messenger activation) and tissue responsiveness (gene targets and gene expression) have all been studied in a number of different tissue.

In keeping with the work plan proposed for 2006 much effort has been put into developing new tools for the study and characterisation of endocrine calcitropic actions (of PTHrP and other factor) across different fish species. The piscine model systems to study calcium balance in fish have been extended a step further and initial characterisation of calcium balance and the potential role of PTHrP in sturgeon have been performed *in vivo*.

In addition, the potential interaction of PTHrP with other endocrine system in the scenario calcium regulation in fish has been of interest. Thus, stanniocalcin has received particular attention, as it is the main truly hypocalcemic factor in fish. At present a partial mRNA sequence of the sea bream stanniocalcin has been obtained and the sea bream stanniocalcin purified from the Corpuscles of Stanniuous to undertake further functional studies in *in vivo* and *in vitro* models during 2007.

During the previous year we presented evidence of the importance of the intestine as a target for the calcitropic actions of PTHrP in the sea bream. Together with the intestine the gill and the kidney are the calcium handling organs. Kidney function has been studied in response to PTHrP in a variety of species (i.e. tilapia, sea bream, goldfish and flounder) and model systems, *in vitro*, *in situ* and *in vivo* and we have some good leads for the functional action of PTHrP at the level of the kidney. At the gill level, we have developed a good model to study PTHrP actions in the sea bream and the opercular membrane will complement to studies initiated with the euryhaline killifish (*Fundulus heteroclitus*) during the previous year.

In addition to the actions on calcium exchange and balance, we have initiated an extensive characterisation of ion exchange mechanisms in the gill and intestinal models of killifish and sea bream that may be targets of PTHrP. So far we have good indication that the actions of PTHrP may be more extensive than just calcium exchange and the control of acid-base balance and the control of epithelial chloride secretion may be targets of PTHrP.

Associated with the cell biology and physiological studies advances in molecular methodologies have been taken to establish routine recombinant protein production and purification in order to pursue biochemical studies but also functional studies using homologous hormones. This approach has also encompassed the development of proteomics in relation to skeletal tissue which has involved installation of hardware and establishment of contacts with experts in the area.

Hormonal control of development and growth of fish eggs and larvae

In the context of this research domain a thesis was completed (Marco. A. Campinho) and the final report of an EU research project (ARRDE) was finalised. In the context of this work it has been demonstrated that in the flatfish, Atlantic halibut, THs are important for metamorphosis, and that there is a co-ordinated expression of deiodinases and thyroid receptors (TR) during this process which is concomitant with major organ and tissue transformations. Moreover, even though round fish do not appear to suffer such a radical modification during the larval/juvenile transformation THs also appear to regulate the process. Through the use of functional genomics, linking quantitative and qualitative gene expression assessment with location and tissue content of transcribed proteins, a comprehensive picture of an extremely delicate developmental process of a number of

different organ and tissue systems has been established. It has been clear from *in vivo* studies that slight disturbances during development, such as handling, hormone or blocker treatments, can have profound consequences on metamorphosis. The progress made this year in understanding metamorphosis has been crucial in underlining the links between Health and Welfare and also the Environment in determining the progression of development/metamorphosis.

Sea bream genome mapping

This year saw the consolidation and completion of the pioneering EU project Bridgemap (Greek, Italian, French collaboration) in which the CME group were involved, a genomic toolbox has been generated for sea bream which includes several genomic libraries for development of microsatellites, cDNA libraries for EST sequencing and oligo design, a BAC library with 6x coverage. Moreover, high quality genetic linkage and Radiation Hybrid (RH) mapping panel was produced. These tools have been applied to produce a linkage map with 200 microsatellite markers and a RH map with about 1000 genes and microsatellite markers. A genomic panel was produced of parents and F1 and a geographic genomic panel is being generated with representatives from key geographic locations, Mediterranean, Aegen and Atlantic (Morrocan, Portugeuse and French). This year has largely been dedicated to completing outstanding practical work and finalising data analysis.

Molecular evolution of hormones and receptors

Family 2 GPCRs is one of the major hormone and neuropeptide receptor families present in vertebrate genomes, although relatively little is known about their evolution in metazoan. Moreover, the study of receptor and ligand interactions and how such systems evolved represents an challenging model system particularly when considered in the context of the numerous duplicate genes found in teleosts.

a) Evolution of family 2 GPCRs in metazoans

Family 2 GPCRs members have now been identified in the protostome genomes of the nematodes *C. elegans* and *C. briggsae* and the arthropods fruit-fly *D. melanogaster* and mosquito *A. gambiae* and in the early deuterostome *C. intestinalis* suggesting they are of ancient origin and have evolved through duplication events. Sequence comparisons and phylogenetic analysis demonstrated that gene environment is conserved between protostomes and deuterostomes receptors and that the protostome receptors are more like the CRF and CAL/CGRP deuterostome members. Evolution of family 2 GPCRs in deuterostomes is characterised by acquisition of new family members with new functions.

b) Duplication and functional divergence of teleost family 2 GPCRs members

This year saw investment in the area of functional analysis, the equipment and set-up for such analysis was obtained and installed. Initial studies have been carried out with duplicate sea bream PACAP receptors and suggest they have been maintained through both neo-functionalization and sub-functionalisation.

c) Teleost ligands are their receptors

In order to better understand the evolution of family 2 GPCRs, studies were initiated to identify and study their ligands. VIP, PACAP and GHRH genes have been identified in vertebrates and studies initiated in protostomes. Currently models to explain ligand-receptor co-evolution are under consideration.

Control of sexual determination and differentiation

Fish have a variety of sex determining mechanisms, including environmental sex determination. DAX1 (*NR0B1*), a member of the nuclear receptors super family, has been shown to be involved in the genetic sex determination and in gonadal differentiation in several vertebrate species. We have now cloned and characterized DAX1, DAX2 and the related Small Heteroprotein. Current studies investigate interaction between these proteins and other putative sex differentiation genes. A new methodologies for subtractive hybridization has been developed and is being used to identify sex specific genes.

Fish Chemical Senses: identification of active compounds and modes of action

The two main questions that we have been addressing are 'what do fish smell?' and 'why?'. Olfaction is important in many aspects of fish biology; chemical communication (pheromones), food location/identification and environmental monitoring are the three main facets that are currently under investigation. The main focus of our activity has been the identity and biological roles of reproductive pheromones in three species; the Mozambique tilapia (*Oreochromis mosambicus*), the peacock blenny (*Salaria pavo*) and the eel (*Anguilla anguilla*). These three species are both phylogenetically diverse and different in terms of reproductive strategy. It is becoming increasingly clear that the identities and biological roles of reproductive pheromones reflect this diversity. The Senegalese sole (*Solea senegalensis*) presents a 'natural experiment' in that the two olfactory epithelia are in contact with two different bodies of water; the lower nostril samples interstitial water whilst the upper samples open water. We now have good evidence for functional asymmetry between the two epithelia. This may allow a better understanding of the functional organisation of the olfactory system; the upper side seems to be specialised for detection of conspecific-derived stimuli and so is likely to be involved in chemical communication whilst the lower side seems more adapted for food identification. Finally, olfactory sensitivity to the 'unconventional' odorants calcium and sodium has been studied. In the goldfish at least, these two ions seem to be detected differentially. Future work will investigate the exact cellular detection mechanisms and the possible input of this olfactory information on iono-osmoregulatory pathways.

Plan for 2007

Calcitropic hormones

Physiological and molecular studies will be carried on as they are complementary tools to elucidate the role of PTH-like molecules in reproduction, skeletal development, calcium balance and immune response in sea bream and other teleosts. Studies to determine the potential interaction of the PTH/PTHrP family of peptides with stanniocalcin in sea bream will be performed. The model systems will include 1) bioelectrical characterisation of epithelia responsive to PTHrP and stanniocalcin 2) identification of the common ion transporting systems common to the PTH/PTHrP family and stanniocalcin 3) identify the role the PTH/PTHrP family of peptides in fish kidney function.

Recombinant proteins will be generated for PTH/PTHrP gene family members and will be purified and 1) used to generate antisera in order to carry out tissue and cellular localisation studies but also to generate radioimmunoassay, 2) for bioassays *in vivo* and *in vitro*, and 3) carry out biochemical characterisation of PTH/PTHrP (post-translational and post-secretory) and how it influences skeletal tissue turnover.

Hormonal control of development and growth of fish eggs and larvae

Studies will continue to 1) relate the major morphological transformations of round and flat fish to genes and proteins (in particular endocrine factors) during metamorphosis, using external morphology and internal morphology (whole mount and sections) and relating this to fitness and survival; 2. Apply molecular and biochemical markers of key physiological systems, nervous system, digestive system, musculo-skeletal system, immune system and endocrine system in round fish and flat fish and relate it to TH axis; 3. Experiments to establish the effect of absence of excess of hormone on metamorphosis and larval/juvenile transition and relate this to potential endocrine disruptors; 4. endocrine disruption of the TH axis (TRH and TSH, THs, binding proteins, thyroid hormone receptors, and deiodinases).

Molecular evolution of hormones and receptors

Emphasis will be given to investigate how ligand-receptor pairs evolve using *in silico* approaches but also using *in vitro* and *in vivo* assays in order to understand binding and activation kinetics and also biological functions. Emphasis will be placed on receptors and ligands belonging to family 2 GPCRs which are involved in calcium balance (eg. calcitonin). Studies of auxiliary proteins in

receptors activation and inactivation will be initiated. Emphasis in 2007 will be given on the development of functional assays using cell culture and model organisms..

Bioprospecting

It was not possible to initiate bioprospecting studie in 2006 as planned as a consequence of other commitments. This year it is expected that bioprospecting using family 2 GPCRs as a trap will be carried out in order to identify compounds from less complex organisms which are active in more complex organisms. A number of different technologies and collaborations will be established in 2007 in order to start developing this area.

Sea bream genome mapping

Studies will be continued in the context of the results obtained from BRIDGEMAP/Aquafirst this will entail: 1. Implementation of genotyping and phenotype analysis in a commercial aquaculture company in order to identify stress QTL, linkage analysis will be carried out. 2. Physiological studies will be initiated in the context of a European project to establish the heretability of stress. 3. Candidate genes will be identified for traits of interest using a comparative approach. 4. Linkage analysis will be conducted with candidate genes to establish their weight in QTL.

Control of sexual determination and differentiation

A number of testis and ovary specific genes have been isolated and their expression profile during early development and gametogenesis stages will be studies.

Fish Chemical Senses: identification of active compounds and modes of action

In addition to continuing the work initiated in 2006, the role of olfactory sensitivity to bile acids in fish will be studied. This phenomenon is widespread amongst teleosts but its biological significance is poorly understood. However, we have recently shown that the bile acid contents of the bile fluid of eels depends on both sex and state of sexual maturity; future work will establish whether bile acids play a pheromonal role in reproduction in teleosts. Also, we hope to use molecular techniques to probe for differential gene expression in the two epithelia of the sole. This will allow a more detailed examination of the functional asymmetry. We will focus on the sites of synthesis and endocrine regulation of the putative male pheromone in the tilapia and its role in male-male interactions (such as the establishment if hierarchies) as well as its reproductive role(s).

Group: Biophysics

Leader - Leonor Cruzeiro

PhD Student - Paulo Silva

Summary of activities and progress during 2006

Proteins are the machines of life and the problems of how they acquire their three dimensional structure (the protein folding problem) and, of how they perform their functions once they have folded, are fundamental problems in all living beings. The main scientific research of the Biophysics group is based on the assumption that those two processes involve the storing and propagation of energy in the form of vibrational excited states (VES), something that we have started to designate as the VES hypothesis. The vibrational excited state we are thinking about is the amide I vibration, a well-known normal mode of the peptide groups, which consists essentially of the stretching of the carbonyl groups. We apply the Davydov/Scott model to describe the storing and interaction of the amide I with the conformational degrees of freedom of the protein. While most of the work in the literature has been done on simplified one-dimensional models, our recent research has included the extension of the Davydov/Scott model to real proteins. This has allowed the calculation of the relative amount of energy that a protein can extract from the neighbouring water molecules, showing that prions can absorb more energy than normal proteins, something that can explain their greater structural instability.

In 2006 the research work concentrated on obtaining a better parametrization for the interactions of the vibrational excitations of the water molecules with one another and with the protein carbonyl groups. For that, numerically calculated absorption lineshapes for bulk water were compared with experimentally measured values and two physical parameters, essential to deal with the bending mode of water molecules, namely, its transition dipole moment and a nonlinear parameter of the extended Davydov/Scott Hamiltonian, were estimated. Such a parametrization is necessary for the application of the extended Davydov/Scott Hamiltonian to different proteins, as is proposed in the research work for 2007.

Another topic or research in 2006 was related to protein function and involved the development of models capable of describing protein conformational changes. Here the hypothesis is that conformational changes take place when the energy stored in the form of VES is released to the conformational degrees of freedom of the protein. The Davydov/Scott model, per se, is not able to describe such a process, because it does not allow that release. Paulo Silva, a PhD student, is working on non-conservative Davydov/Scott models and looking for physical mechanisms by which VES, which are essentially localized, can lead to the more global transformations that characterize conformational changes. His recent studies suggest that one way that can happen is via a resonance between the VES induced vibrations and the natural vibrations of the protein backbone.

Plan for 2007

In 2007 the research on proteins will include three main lines. One is related to the protein folding problem and consists of a study of the dynamical and thermodynamical stability of different structures that, according to the classical all-atom potentials, a given amino acid sequence can assume. This line of research challenges the idea that protein structure is essentially determined by its sequence. The second line of research consists of applying the Davydov/Scott model, extended to include the bending mode of water molecules (using the physical parameters estimated previously), to the calculation of the absorption spectra of alpha-helices, beta-sheets and random coil structures in proteins. The third line of research is to apply the VES hypothesis to misfolding diseases, in particular to Huntington's disease. This disease is caused by the extension of Glutamine sequences in the protein huntingtin and studies have related the onset of disease to poly-glutamine tracts greater than 36. In this line of research the absorption of vibrational excitations from water will be calculated from proteins with poly-glutamine tracts of different sizes, above and below 36.

Finally, a fourth line of research is concerned with the application of nonlinear physical models to the problem of High T_c superconductivity. This work is in collaboration with Prof. Chris Eilbeck, of Heriot-Watt University, Edinburgh, UK and will be performed by a contract researcher, within a project funded by FCT.

Group: Synthesis and Organic Reactivity

Leader – Maria de Lurdes Cristiano

Post-Doctoral Researcher - Nuna Araújo

PhD Students - Edite Veríssimo, Luís Frija, David Gago

MSc students - Daniela Coelho, Emanuel Morgado, Rui Almeida

Summary of activities and progress during 2006

The research activities in the group were concentrated in two major topics:

Organic reactivity. Within this topic we aim at the development of new synthetic methods, applicable to the preparation of bioactive compounds and to the modification of natural products. Synthesis and structural elucidation of bioactive compounds were carried out, followed by reactivity studies and mechanistic investigations, in catalysed and non-catalysed reactions. These include: (i) reductive cleavage of carbon-oxygen bonds catalysed by transition metals, (ii) sigmatropic

isomerisations in allyl vinyl ethers, (iii) photochemistry of bioactive derivatives of the heterocycles tetrazole and benzisothiazole, (iv) thermolysis and photolysis of carbamates.

Medicinal Chemistry. Design and synthesis of potential antimalarial and antineoplastic agents. Within this field of research we aim at the development of synthetic routes to different DNA-directed endoperoxides, combining a DNA binding moiety with known antimalarials, which can also act as potential antiproliferative agents in various cancer cell lines. The rationale is based on the ability of Fe(II) to selectively cleave the peroxide bridge of peroxide-type drugs, generating radicalar species capable of damaging key biomolecules. Thus, the compounds produced should be capable of simultaneous selective oxidative damage to a complimentary strand of DNA and liberation of a protein inhibitor, in a combination chemotherapy-like approach.

Plan for 2007

We envisage to strenghten research in the design and synthesis of DNA-directed endoperoxides. The rationale for drug design and proposed synthetic approaches will make use of synthetic strategies developed within the group. Structure/reactivity/activity correlations will be investigated.

Group: Celular and Inorganic Biochemistry

Leader – Manuel Aureliano Alves
Post-Doctoral Researcher - Teresa Tiago, PhD

Summary of activities and progress during 2006:

- 1) *Interaction of vanadate with myosin/actin*
- 2) *Insulin-mimetic vanadate complexes effects on calcium pump*
- 3) *Cellular responses induced by vanadate*

Vanadium is one of the important transition elements in biology. In aqueous solution vanadium (V) occurs in a number of oxometalates called vanadates. At neutral pH and through the range of concentrations most frequently employed in biochemical studies, the predominant vanadate species are the monomer (H_2VO_4^-), dimmer ($\text{H}_3\text{V}_2\text{O}_7^-$) and tetramer ($\text{V}_4\text{O}_{12}^{4-}$). These species reach chemical equilibrium on a millisecond time scale making difficult the identification of the oligomers responsible for the effects promoted in biological systems. ^{51}V NMR spectroscopy studies have proved to be highly informative in systems of biological relevance. The rapid exchange between vanadate oligomers and the changes in the ^{51}V NMR signal line-widths at different conditions makes this spectroscopy a sensitive tool to examine interactions between proteins and vanadate species. However, the disappearance of one of the vanadate species resonance upon binding to protein is dictated by the total population of free exchanging oxovanadates and would result whether this or another vanadate species were bound to the protein. The research of the group was divided in three main sections:

1) Myosin is a highly specialised protein involved in the process of muscle contraction, which along with actin, converts the chemical energy of ATP hydrolysis to mechanical work. Although the actomyosin ATPase activity has been described to be about 90% inhibited by V_1 , it was suggested that this inhibition might be due in part to the presence of polymeric vanadate ions. In fact, it has been suggested that V_4 interacts with myosin, being responsible for the vanadate-induced photolytic cleavage of myosin subfragment-1 (S1). There are also some indications that decameric vanadate ($\text{V}_{10}\text{O}_{28}^{6-}$), a large polymeric anion formed under mildly acidic conditions, interacts to S1 as well as to affect the actomyosin ATPase activity although little is known about its putative binding sites. In order to gain a deeper knowledge of decavanadate-myosin interactions, the ^{51}V NMR approach was applied to S1, taking advantage of the fact that contrarily to the labile oxovanadates, V_{10} is sufficiently long-lived that the broadening of NMR signals can be attributed exclusively to protein binding.

^{51}V NMR spectra of 5 mM decavanadate solution (containing 148 μM V_1 and 485 μM V_{10} species) were obtained at several conditions and the relative order of line broadening upon protein addition (reflecting the interaction of vanadate species with myosin S1) was analyzed. To study a possible competition between polymeric vanadate species and V_{10} we have also used a 2 mM metavanadate solution mixed to 5 mM decavanadate solution, containing in total 760 μM V_1 , 146 μM V_2 , 268 μM V_4 and 487 μM V_{10} . The relative order of line broadening of ^{51}V NMR signals was $V_{10} \gg V_4 > V_1$ whereas no significant changes were observed for V_1 . The large effect of KCl on the broadening of V_{10} signal indicates that electrostatic interactions play a major role in V_{10} binding to S1. Moreover, this binding is non-competitive with respect to nucleotides (ATP or ADP) or actin but the binding of V_4 to S1 is largely affected in the presence of V_{10} . This suggests that either V_4 species competes to the same V_{10} binding sites (although with much lower affinity), or V_{10} binding is causing localized structural changes, which promotes dissociation of V_4 . These observations help to explain why decavanadate solutions inhibit actomyosin ATPase activity to a much higher extent than metavanadate solutions (Tiago et al, 2006a e 2006b).

2) Sarcoplasmic reticulum (SR) Ca^{2+} -ATPase is a transmembrane transport system, which accumulates Ca^{2+} at expense of ATP splitting during the process of muscle relaxation. ATP is used in a process involving the transfer of the phosphoryl group to the Ca^{2+} -ATPase with subsequent breakdown of the phosphorylated enzyme. The mechanism by which the Ca^{2+} pumping is associated with ATP hydrolysis is not fully understood in clear molecular terms and is usually summarized by a cycle of sequential reaction steps with two major states of the enzyme, E1 and E2, with high and low affinity for Ca^{2+} and ATP, respectively. Initially it was thought that vanadate affected this Ca^{2+} pump in the same way as other P-type ATPases, but recent studies show the existence of Ca^{2+} ATPases with different sensitivities to vanadate. It was demonstrated that some of the interactions, e.g. decameric species, disrupt the energetic coupling and the enzyme turnover. Other interactions of vanadium, e.g. monomeric species, may be without effect or even improve the coupling of Ca^{2+} pumping (Ramos et al, 2006). It was also observed that insulinomimetic vanadium compounds affects SR calcium pump.

3) Oxidative stress studies induced by cadmium, zinc, selenium, copper and vanadium are also almost limited to hepatic and renal injury studies. On other hand, the contribution of vanadate oligomers to vanadium toxicity is usually not considered. The different responses obtained on *in vivo* and *in vitro* studies proves that *in vivo* metals metabolism is very complex and great care must be taken on extrapolation from *in vitro* conditions. Recently, it was demonstrated that decameric vanadate species are responsible for a strong increase on lipid peroxidation and a decrease in cytosolic catalase activity thus contributing to oxidative stress responses upon vanadate intoxication. Furthermore, acute exposure studies suggest a different *in vivo* metabolic pattern for decameric vanadate species, pointing out the importance of vanadate speciation on the evaluation of vanadium toxicity (Soares et al, 2006). Moreover, reactive oxygen species also affect the proteins involved in muscle contraction and regulation.

Group: Bioremediation

Research team

Leader – M. Clara Costa

research assistant: Mónica Martins

Undergraduate students: Cláudia Jesus, , Cecília Castro, Karolina Gadga (Sócrates/Erasmus)

1. Bioremediation technologies

Summary of activities and progress during 2006

The central aim of this research group is to contribute to the development of sustainable bioremediation technologies for the decontamination of acid mine waters. With that purpose fundamental and applied

research aiming the optimization of the bioremediation processes is being undertaken as following described.

This research line is under strong development with the start of the project "ECOTEC – Eco-technologies based on the use of sulphate-reducing bacteria and their application for the treatment of acid mine drainage". Within the framework of the ECOTEC project, natural anaerobic environmental samples, such as sludge, sediments and soils previously collected from selected sites, were utilised in batch screening tests to choose suitable sulphate-reducing bacteria (SRB) to be used as inoculum sources. The most probable number technique (MPN), together with other tests such as lactate (as carbon source) consumption and sulphate reduction, allowed the selection of several sludge samples from water treatment plants as the best SRB inoculum sources. Those samples were subsequently tested in terms of their resistance to metals such as iron, copper and zinc, since those are the high concentrated elements in the acidic waters from the sulphide mine sites to be treated. The results obtained demonstrated that, contrarily to what happened with other samples, the presence of those metals did not affect the reduction of sulphates by SRB contained in the sludge sample of the water treatment plant of Montenegro (Faro). In addition, the metals were very satisfactorily removed as metal sulphides after a period of 20 days.

Considering that sulphate reduction by SRB requires an energy-rich carbon source as the electron donor, the choice of carbon substrates has an important effect on the economics of the process and therefore, the most cost-effective carbon source is required. Thus, batch test were performed in order to select several compounds (lactate, ethanol, lactose) or preferentially organic wastes (easily obtained at null cost from local winery and cheese industries) as efficient carbon sources. The results showed that the carbon source has a great influence on sulphate reduction, and thus on metals reduction. While lactate is utilised by all SBR samples, ethanol is only efficient when sludge samples from water treatment samples are involved. On the other hand, the use of lactose was never efficient. These studies also demonstrated that the pH of the medium is a determinant parameter when wine wastes or cheese whey were utilised as carbon sources. In fact, unless the medium was previously neutralised, there was no sulphate reduction in the presence of those wastes, although the consumption of ethanol and cheese whey was observed together with a pH decrease. These results can be due to the wastes complexity, or to the pH decrease that can be eventually caused by the presence of other than sulphate reduction bacteria (that also use the same carbon sources) promoting selective growth conditions.

Several solid materials, such as coarse sand, mineral wastes, cereal straw and glass spheres were previously tested as solid supports of fixed bed type percolation columns as bioreactors. Those studies allowed the selection of coarse sand and neutralising mineral wastes as the materials for the column matrices. Moreover, they were determinant in the identification of key parameters of the bioremediation process and on the optimization of the columns design. As a result two bioremediation systems, based on solid and on liquid columns are being evaluated. The best performing inoculum was used for feeding continuous solid and liquid column bioreactors.

Plan for 2007

Additional studies will be undertaken to clarify the role of bacteria populations and pH on the use of wastes from winery and cheese industries as carbon sources for SRB. Those studies will contribute to confirm the viability of using such wastes in the bioremediation processes under development.

Microbial and genetic identification of selected bacterial populations will be done, as well as kinetic studies.

The efficiency limits of the bioremediation systems in terms of temperature, sulphates and metals concentrations and hydraulic retention time will be investigated.

Besides the solid and liquid bioremediation systems, the viability and performance of a third system with recirculation will be evaluated.

The metal precipitates generated during the bioremediation process will be characterised by electron microscopy techniques.

During 2007 it is planned to start the studies for the development of a technology for uranium removal from mine flood waters, based on the use of sulphate-reducing bacteria. That investigation will be performed in the framework of Mónica Martins PhD.

Samples from uranium contaminated mine sites will be collected (e.g. Urgeiriça mine, Portugal) and chemically characterised. Thereafter, batch screening tests will allow the selection of suitable SRB from the environmental samples, with resistance to metals and with ability to enzymatically reduced uranium(VI), to uranium(IV), which can be precipitated as UO_2 . The effect of different carbon sources (organic compounds or wastes) on the efficiency of uranium(VI) reduction will be evaluated, considering their economical importance for the overall bioremediation process. It is also aimed to examine the effect of several heavy metals, sulphates, nitrates and organic compounds in the SRB capacity for uranium(VI) reduction, since those substances are usually present in the effluents to be treated. The kinetic behaviour of the best and more

resistant SRB cultures will be investigated. Bacteria that present better performances will be subsequently used to inoculate a column bioreactor.

In order to control the system under development it is important to characterise the SRB community involved on the different phases of the process. This characterisation aims to ensure the stability of the system and towards a better knowledge of the physiology of the microbial population, to contribute for its optimisation. Thus, the SRB population selected will be identified by molecular methods, such as 16S rDNA sequencing. The SRB community profile will be followed by Denaturing Gradient Gel Electrophoresis (DGGE).

At the same time similar studies will be carried out for chromium(VI), which can also be reduced to chromium(III), less toxic, by SRB action.

Summary of activities and progress during 2006

2. Solvent extraction of metals

The extraction of iron(III) from chloride solutions has been investigated using *N,N'*-tetrasubstituted malonamides, such as *N,N'*-dimethyl-*N,N'*-diphenylhexylmalonamide (DMDPHHMA), *N,N'*-dimethyl-*N,N'*-dipenyldodecylmalonamide (DMDPHDDMA), *N,N'*-dimethyl-*N,N'*-dicyclohexylmalonamide (DMDCHMA) and *N,N'*-dimethyl-*N,N'*-dihexylmalonamide (DMDHMA). The main aim of this work was to investigate whether there is a relation between the chemical structure of malonamides and their iron(III) extraction behavior, and particularly to try to understand the dependence of the metal extraction mechanism on the structural characteristics of the malonamides. The introduction of an alkyl chain on the central carbon atom of *N,N'*-dimethyl-*N,N'*-diphenyl skeleton malonamides increases the affinity of the organic derivatives for iron(III) at lower concentrated hydrochloric acid concentrations: the longer the alkyl chain is, the lower acidity of half extraction of iron(III) is. A similar effect has been observed both for DMDCHMA and DMDHMA when *N,N'*-dimethyl-*N,N'*-diphenylmalonamide (DMDPHMA) is taken as a reference. The collected equilibrium and spectroscopic results point out that either the presence of a central alkyl chain on *N,N'*-dimethyl-*N,N'*-diphenyl skeleton malonamides or the replacement of the *N,N'*-diphenyl groups by dicyclohexyl- or di-*n*-hexyl ones, likely determines iron(III) extraction through a solvation mechanism.

Plan for 2007

The synthesis of new diamide molecules (*N,N'*-succinamides) able to be used in the solvent extraction of metals. The main objective is to extend the solvent extraction studies that have been performed until now in view of Fe(III) extraction, to the extraction of rare metals, such as Pd and Pt, considering the increase application of those metals and their economical relevance.

Group: Aquaculture

Research team

Leader: Maria Teresa Dinis

CIMAR-LA Researchers: Luis Conceição, Jorge Dias

Post-docs: Florbela Soares, Laura Ribeiro, Cláudia Aragão, Ricardo Calado, Elsa Cabrita

PhD students: Ana Rita Ribeiro, Sara Silva, José Beirão, Joana Silva, Margarida Saavedra

Undergraduate students: Alberto Fernandes, Gisela Dionísio, Patrícia Silva

Research assistants: Sofia Engrola, Wilson Pinto, François Hubert, Benjamin Costas.

Aquaculture technicians: Helena Damásio Luís, Helena Teixeira

Summary of activities and progress during 2006

The main goal of the group is to contribute to the sustainable development of the aquaculture industry, through basic and applied research aiming at optimisation of rearing techniques and identification of bottlenecks in the cultivation of new fish species. Ongoing projects involve nutrition, digestive physiology, stress physiology in particular during the early stages of marine fish, broodstock management, as well as the development and optimisation of production systems and feeding regimes for fish. One of the key areas of

work in recent years is the optimisation of the farming techniques of Senegalese sole, *Solea senegalensis*. Several advances in broodstock management, spawning in captivity, and husbandry in larval and post-larvae rearing have been accomplished, and research continues on these issues. Recently, the group started similar work with dusky grouper (*Epinephelus marginatus*), where the main objective is to establish the zootechnical basis for reproduction and juveniles production using mesocosms systems. The Aquaculture research group members are also involved in research projects studying: (1) nutritional requirements, in particular amino acids, of fish larvae and juveniles and the basis for the understanding of the relation between nutrition, metabolism, stress and abnormalities; (2) ontogeny of larval digestive functionality and control, in relation to feeding plans and weaning; (3) identification of the effects of “green water” technique on larvae performance, feeding, nutrition, and microbial ecology; and (4) culture of marine ornamental shrimps. The main progress accomplished in 2006 was:

The effect of green water on larval development

The use of microalgae in larval rearing tanks is a common procedure in marine aquaculture. The aim of this project was to analyse the influence of different microalgae species during two marine fish species development, *Solea senegalensis* and *Sparus aurata*. The microalgae studied were *Tetraselmis chuii*, *Isochrysis galbana* and *Nannochloropsis gaditana* as microalgae paste - Phytobloom[®]. Significant higher growth and survival rates were observed when using green water technique, with microalgae *T. chuii* treatments inducing better fish larvae performances when compared with other microalgae. Nevertheless, the results obtained when using Phytobloom were also positive, indicating that this product is a good substitute of fresh microalgae to be used as green water technique. Live food nutritional quality, fish larvae digestive and metabolic enzymes activity were not altered by the green water technique. Nevertheless, some improvements were observed on fish larvae feeding behaviour, in water quality improvement as well as a positive probiotic effect when using the green water technique. Seabream larvae exhibited a higher dependence of microalgae at early life stages than Senegalese sole larvae, which might be related with the type of prey used at that period, respectively rotifers and *Artemia* nauplii.

Understanding the regulation of the digestive function on marine fish larvae

The use of microdiets from mouth opening will be one of the most important achievements in marine aquaculture. Although marine fish larvae do ingest microdiets and exhibit digestive capacity after hatching, growth and survival rates are still lower when compared with fish larvae fed live food. The aim of this project is to understand fish larval digestive regulation. Samples for immunohistochemical analysis were collected during Senegalese sole development for cholecystokinin (CCK), vaso intestinal peptide (VIP) and gastrin immunoreactive cells analysis. The presence of CCK and VIP were observed at mouth opening (2 days after hatching - dah). CCK immunoreactive cells were located in the intestinal epithelium all along the intestine, and their number increased with larval development. No CCK cells were observed in stomach neither in posterior intestine. VIP signal was identified in submucosa at 2 dah; since this component only exists in nerves it can be assumed that at this age Senegalese sole already presented an innervated digestive tract that can be regulated with neurotransmitters. No significant differences were observed on digestive enzymes activity after submitting fish larvae to different stimuli (physical, chemical and visual) at different stages of development. However, it was possible to notice that the use of physical and chemical stimuli simultaneously induce a higher average activity of some digestive enzymes at early life stages of development, whereas chemical stimuli was more important during later stages of development. The introduction of microdiet at early life stages, induced significant differences in digestive enzymes activity of Senegalese sole larvae aged 15 days after hatching, specially when *Artemia* nauplii was substituted more than 80 % by microdiet. The determination of cholecystokinin content in fish larvae using radioimmuno assay was realized at CCMAR facilities, becoming possible through a cooperation with Dr. Carlos Rojas Garcia.

Physiological importance and metabolism of aromatic and sulphur amino acids during fish ontogeny

The major fate of amino acids (AA) is towards protein synthesis, but some AA are involved in the synthesis of other compounds of physiological importance. Among them, sulphur and aromatic AA seem to have a special importance during the fish ontogenesis. The main objective of this study is to acquire a better knowledge on the physiological importance and metabolism of these AA during the early life stages of fish, focusing especially on taurine and tyrosine. The free amino acid levels along the endogenous feeding period of Senegalese sole (*Solea senegalensis*) and toadfish (*Halobatrachus didactylus*) were monitored. This allowed a comparison between species with pelagic (sole) and demersal (toadfish) eggs. In sole the amino profile was essentially dominated by leucine, lysine, and alanine during the egg period, while taurine dominates the amino acid pool after hatching. On the other hand, in toadfish the amino acid profile was clearly dominated by taurine during the whole endogenous period. Some tube-feeding experiments were also done, in order to analyse the metabolism of aromatic amino acids during the metamorphosis in Senegalese sole. Tyrosine retention is much higher during the period around metamorphosis than afterwards, suggesting a possible increase of its requirement during this period.

Stressful husbandry conditions and dietary amino acid requirements in sole

Stressful conditions are known to cause growth suppression in cultured fish, either by impacts on appetite reduction, a stimulated catabolism, or a combination of both. As growth is essentially protein deposition, stressful husbandry conditions are expected to affect amino acid requirements. The effects of selected stressful husbandry conditions on growth and amino acid metabolism were assessed in juvenile Senegalese sole. Results show that both high stocking densities and air exposure induce stress in Senegalese sole juveniles, as cortisol levels were significantly increased. Depending on the stress situation tested, plasma glucose and osmolality were also significantly affected. However, in both stressful conditions tested neither growth or food consumption was affected. Furthermore, plasma amino acid concentrations indicate that their requirements in stressed fish were altered, which probably reflects a higher demand for energy production, a higher rate of protein synthesis or the synthesis of proteins or other specific important metabolites related to stress response. Therefore, the effect of amino acid supplementation on fish performance under stress conditions was assessed, in order to verify to what extent the negative effects of stressful husbandry conditions on amino acid metabolism can be minimized through dietary amino acid supplementation. A possible beneficial effect of amino acid supplementation was found in sole juveniles after a chronic ammonia exposure followed by drastic changes in water temperature. However, no clear effect of dietary amino acid supplementation was found in fish exposed to crowding stress situations.

Dietary amino acids and skeletal development in white bream

The central objective of this study is to evaluate the possibility of minimizing the skeletal deformity problems commonly found when *Diplodus* spp. are cultured, through the use of amino acid supplements or increasing the quantity of available dietary nitrogen. The efficiency of dietary supplementation of tryptophan, methionine and arginine was tested in larval *Diplodus sargus* in order to find its effect on metabolism of these amino acids. Tube-feeding of ¹⁴C-Amino acids combined with crystalline amino acids was used to assess supplementation efficiency. Results showed low absorption levels for tryptophan (70%) as well arginine (80%) and similar absorption for methionine (90%) when compared with the average of all amino acids. Supplementation of all three amino acids seemed to be viable but it did not lead to higher retention meaning these amino acids are probably not in deficiency in *Diplodus sargus* larvae. Next, three experimental diets were tested: a balanced diet supplemented with lysine, a balanced diet supplemented with tryptophan and, as control, a balanced diet. Trials were performed with larvae from 1 to 25 DAH. Results showed a similar survival and growth rate in all treatments. No significant differences were found for ammonia excretion, percentage of deformities or enzymatic activity. Still, prevalence of some deformities changes between treatments. The expression of selected skeletal proteins was analyzed in normal and deformed fish obtained from the different dietary conditions (see further

details in the molecular biology group section). The skeletal proteome allowed the identification of modulated protein clusters in skeletal tissue in response to dietary stimuli.

Broodstock management

Identify the effect of using worms in the broodstock feeding on reproduction success and quality of eggs and larvae of sole. It seems that feeding Senegalese sole with polychaets during the spawning season has a positive effect on the females, since it increases the number of spawns and the quantity of eggs produced. However, the major part of the eggs was unfertilized which suggests other type of problems related with the males. Therefore, feedings polychaets seem beneficial to enhance reproduction in Senegalese sole, but problems with the male reproduction deserve a careful attention to achieve good fertilization rates.

Senegalese sole males produce low quantities of milt being a problem when a large number of eggs must be fertilized. Moreover, some males do not produce sperm during female spawning period being necessary a previous selection of males based on sperm characteristics. Sperm production and motility using computer assay sperm analysis was studied in two populations, one maintain in contact with females and the other isolated. Both sperm volume and motility characteristics were not affected by isolation detecting similar sperm production in both types of males. The percentage of spermatozoa motil as well as sperm velocity and movement pattern were not affected by this separation. The hormonal levels (testosterone, 11-Ketotestosterone and estrogens) in this two groups are being studied. The quality of sperm in senegales sole was also studied in terms of resistance to osmotic shock in contact with several motility activation solutions. In these conditions, several subpopulation were identified in the same ejaculate, meaning that sperm samples have different resistance in the fertilizing medium. This study offered an interpretation of the subpopulation patterns and the differences between activating treatments based in studies on osmotic stress. The analyses demonstrated the existence of a heterogeneous sperm population in all samples. Activation of sperm with an osmolarity of 800mOsm/Kg produced higher percentage of spermatozoa with progressive motility and higher values of VCL and VSL (linear and curvilinear velocity). In conclusion, CASA and subpopulation analysis would allow a better understanding of the physiology of *Solea senegalensis* spermatozoa. The effect of broodstock feeding regimes (mussel or polichaete) were also investigated in the phospholip and cholesterol content on the composition of spermatozoa plasma membranes.

Attempt to increase reproducibility of hormonal induction of spawning in dusky grouper using GnRH α slow-releasing devices, and induction of precocious males using hormonal treatment. Cryopreseervation of grouper semen will also be attempted. The dusky grouper broodstock is being kept in collaboration with IPIMAR/CripSul, at their EPPO facility, was monitored through canulation in spring-summer 2006, and hormonal induction of spawning in grouper using GnRH α slow-releasing devices was attempted following promising results from 2005. Six females, three males and two immature fish were studied. All sex-reversed fish (one female and two immature) were successfully reversed into functional males (100% success). One female was natural reversed into male changing the sex-ratio to 6 males:5 females. Collected sperm of both years range from 30 μ l to 300 μ l and cell concentration varies between 3 to 6.5 x10⁹ spermatozoa/ml. Duration of sperm motility was 35 min and decreased in cryopreserved sperm. Males produced sperm within 24 h after Lucrin Depot injection. A total of 8 spawns were obtained in 2006. Relative fecundity was 114.7. The frequency of ovulations was 1.6 per female, with a maximum of 3 spawns. However, only 13% of eggs were fertilized, and no hatching occurred. Too high water temperature (due to natural conditions) with subsequent overrippingening, was identified as the cause for the poor fertilization and hatching rates.

Zootechnical improvements in the larval rearing of new species for Aquaculture

A study was conducted in the optimization of the larval rearing conditions and feeding regimes of sole (*Solea senegalensis*). In order to determine the impact of feeding regime on weaning performance by sole, three feeding regimes were studied, using different relative proportions of Artemia and dry feed. Feeding regime had an impact on growth, digestive enzyme activity and survival at the end of the pelagic phase. Apparently co-feeding of Artemia with a moderate amount of a dry feed produces the best results

Marine ornamental shrimps culture

The annual trade of marine ornamental species is currently estimated in over one billion euros. The majority of traded specimens is collected in the coral reefs of Southeast Asia, namely the Philippines and Indonesia, the Red Sea and the Caribbean. Among the 500 species of invertebrate organisms (excluding corals) that are generally collected for trade, 15% are ornamental shrimp of the genus *Lysmata* (approximately 1,5 million individuals/year). This intense collecting effort certainly influences the reef community, although the negative impacts of removing these organisms from the reef (some ornamental shrimps are fish cleaners) are still largely unknown. The commercial scale production of these organisms in captivity will certainly lighten the pressure on the wild stocks of *Lysmata* and can also become an important economic activity due to their high market value ((€ 20-40 per specimen). We have tested the suitability of different maturation diets for *Lysmata* species and verified that the most suitable diets are those having a wide variety of frozen ingredients from marine origin, and that there is no significant benefit on supplementing maturation diets with squid or enriched *Artemia* biomass. Fatty acid analyses of larvae spawned in captivity revealed that experimental diets do not mimic the essential fatty acid profiles of embryos spawned in the wild, namely on their docosahexaenoic acid (DHA, 22:6n-3) content. Concerning ornamental shrimps larviculture, we verified that prey capture ability of newly hatched larvae of different *Lysmata* species is not similar, that not all species display facultative primary lecithotrophy and that photoperiod manipulation does not increase feeding rates for most species.

Plan for 2007

The research during 2007 will continue to focus on various aspects of fish nutritional and digestive physiology, but also on broodstock management and aspects of larval and juvenile rearing of sole (*Solea senegalensis*), seabream (*Sparus aurata*) and grouper (*Epinephelus marginatus*).

Understanding the regulation of the digestive function on marine fish larvae

The importance of different stimulus on seabream larvae digestive activity will be further studied. Cholecystokinin (CCK) levels of fish larvae fed different regimes will be evaluated. Moreover, the importance of CCK on fish larvae assimilation will also be evaluated.

Physiological importance and metabolism of aromatic and sulphur amino acids during fish ontogeny

The importance and metabolism of aromatic and sulphur amino acids during fish ontogeny will be further analysed. Experiments involving dietary taurine and tyrosine supplementation will be carried out using gilthead seabream (*Sparus aurata*) and Senegalese sole (*Solea senegalensis*) larvae. The effects of this supplementation on growth, metamorphosis, and amino acid metabolism will be assessed, using growth trials and tracer studies.

Dietary amino acids and skeletal development in white bream

Graded levels of protein hydrolysates will be supplied in the diet in order to verify to what extent skeletal deformities can be reduced through improvement of the quantity of available nitrogen in the diet of larval *Diplodus* spp. Proteomics work will also follow on the identification and sequencing of selected spots representing differentially expressed proteins in normal and deformed fish in the same dietary condition and between different conditions (experiments from 2006 and 2007) will allow a better understanding of the mechanisms through which dietary nitrogen influences skeleton formation.

Stressful husbandry conditions and dietary amino acid requirements in sole

The relation between stressful conditions and amino acid requirements on sole juveniles will be further studied. The effect of amino acid supplementation on performance under stress conditions will further be characterised. It will be verified to what extent the negative effects of stressful husbandry conditions on amino acid metabolism and retention can be minimized through

supplementation of the diets with individual amino acids, using plasma free amino acid levels, intermediary metabolic enzyme activities, and proteome expression as indicators.

Nutritional and stress effects on fish proteome expression

Work will be performed on the effect of dietary nitrogen on fish proteome expression. White bream will be used as model. Two-dimension gel electrophoresis will be followed by proteome comparison and identification of differentially expressed proteins,

Broodstock management

Sperm quality will continue to be studied in the senegalese sole males. The research will be focus on the identification of spermatid subpopulations based on certain characteristics (sperm motility, viability, resistance to osmotic shock, plasma membrane composition, ATP levels and cell maturation). Moreover, other aspects related to broodstock management and gamete quality will also analysed:

- a) Identify the effect of stress in the broodstock and quality of eggs and larvae of sole.
- b) Study the effect of stress on sole sperm quality
- d) Determine the influence of stress on sole male and female gamete quality and reproduction
- e) Attempt to increase reproducibility of hormonal induction of spawning in sole

Zootechnical aspects of larval and juvenile rearing

- a) Improve the success and reproducibility of grouper (*Epinephelus marginatus*) larval rearing in mesocosms systems.
- b) Determine if Vitamin K plays a role in setting sole larval and juvenile quality, namely in terms of skeletal deformations.

Marine ornamental shrimps culture

Our goals are to improve and develop new commercial scale larviculture techniques of marine ornamental shrimps of the genus *Lysmata*, namely *L. amboinensis* and *L. debelius*. We plan to 1) study biochemical and enzymatic aspects of larval shrimp nutrition; 2) quantify ontogenic changes during larval development on feeding ability; and 3) ascertain the role of microorganisms (pathogenic and probiotic) in culture tanks. Future results will allow a better understanding of the nutritional and microbiological requirements of ornamental shrimps.

Nutritional modulation of flesh quality, health status of farmed fish

The role of nutrition and feeding strategies as tools to modulate the quality and health status of farmed fish will be a new research axis within the team (funding pending). Our research aim is to promote a fish production with low environmental impact and high-quality fish products. Activities are foreseen on:

- a) the development of low-pollution diets for on-growing juvenile Senegalese sole and gilthead seabream
- b) the effect of dietary protein sources and vegetable oils on flesh quality of fish
- b) the dietary modulation of the immune status of farmed fish

Division of Living Resources

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Summary of activities and progress during 2006

Main objectives:

Our study themes focus on understanding patterns and processes mediating reproductive ecology and dispersal, and abiotic stress responses, of marine organisms, at ecological and evolutionary time scales. The approaches to study reproductive ecology include studying spawning synchrony, fertilization success, selfing and outcrossing rates, direct dispersal and gene flow levels and scales of divergence within and between populations as well as species (hybridization, speciation) and biogeographic processes over long time scales inferred from current patterns in genetic structure. We are also studying stress-driven ecological and adaptive evolution in populations along environmental stress gradients (local adaptation) by combining information from quantitative selective traits and gene polymorphism data with neutral genetic markers. Approaches include also genome wide variation in stress-responsive gene expression between species by means of microarrays of desiccation-responsive cDNAs. To achieve these objectives we have to devote significant effort into methodological objectives that include development of various types of molecular methods and markers, and software.

Achieved in 2006:

Networks of clonal organisms

Clonal organisms present a particular challenge in population genetics because some of the hypotheses and concepts underlying classical population genetics models are irreconcilable with clonality. We developed new tools for studying the genetic structure of clonal populations of the marine angiosperm *Posidonia oceanica* using microsatellite data, based on examination of the frequency distribution of the genetic distance among ramets, termed the spectrum of genetic diversity (GDS), and of networks built on the basis of pairwise genetic distances among genets. Clonal growth and outcrossing appear as dominant processes, whereas selfing and somatic mutations appear to be marginal, and the contribution of immigration seems to play a small role in adding genetic diversity to populations. The properties and topology of networks based on genetic distances showed a "small-world" topology, characterized by a high degree of connectivity among nodes, and a substantial amount of substructure, revealing organization in sub-families of closely related individuals. The combination of GDS and network tools helped dissecting the influence of various evolutionary processes in shaping the intra-population genetic structure of these clonal organisms.

Genetic structure at distributional range limits

Biogeographic theory predicts that for clonal species on island habitats near the edge of distribution there might be a lower contribution of sexual (versus clonal) reproduction, and populations are likely to have lower diversity and higher differentiation. We addressed these hypotheses by studying the genetic structure, using microsatellite markers, of ten prairies of *Cymodocea nodosa* located in the main four islands of the Canary archipelago and comparing these with two sites from the Iberian coast. A novel standardization method was developed in order to compare genetic variation statistics in clonal organisms. High genotypic richness, comparable

with the values from the Iberian sites, revealed effective sexual reproduction of *C. nodosa* on these islands. In contrast, lower *allelic diversity* suggests a founder effect during the colonization of the archipelago, and similar allelic composition across all islands indicates colonization from a single source. Wind and surface current patterns as well as distance to the mainland explain lower allelic diversity and higher similarity of northwestern sites on different islands. All populations were differentiated from each other and there was no correlation between genetic and geographic distances. This non equilibrium migration-mutation system is therefore influenced mostly by the diversifying effects of genetic drift and less by the homogenizing effects of gene flow.

Adaptive population divergence

We are using EST (Expressed Sequence Tags) to study population genetic structure that may reflect adaptive responses to local conditions of abiotic stress. Loci under diversifying selection can be identified by their elevated level of divergence and those under stabilising selection by their reduced divergence relative to expected distribution of allele frequency divergence levels in the absence of selection. We obtained EST databases for stress-tolerant and stress-susceptible *Fucus* species. A total of ca. 8000 sequences, with ca. 3800 unigenes were obtained from algae exposed to heat (*F. serratus*) or desiccation (*F. vesiculosus*) stresses. The sequences for each species/stress were assembled into clusters (contigs), *Single Nucleotide Polymorphism (SNP)* were identified and PCR primers were designed to amplify genes from both assemblies for which the gene's annotation suggested a role in stress response on the basis of its function and for which most or all of the coding sequence was available. For EST contigs without reliable annotation, or those for which annotations indicated that the coding sequence was incomplete, we are using Rapid Amplification of cDNA Ends (RACE) in order to obtain full length cDNA sequences. For RNA derived from heat stressed and desiccated algae of both species, we synthesised full-length cDNA using SMART (Switching Mechanism At 5' end of RNA Transcript) technology.. Three software routines were developed to incorporate into a strategy for the analysis of sequences obtained by RT-PCR, including Bayesian analysis of selection intensities implemented by the "mkprf" software and analysis with the standard software for calculating McDonald-Kreitman tables, "DnaSP", and to facilitate inference of haplotypes using the program "PHASE".

Microarray analysis of stress-responsive gene expression over environmental gradients.

A cDNA screening microarray was developed by spotting 5280 independent clones (16,416 spots) from suppression subtractive hybridization (SSH) libraries for *F. vesiculosus* undergoing and recovering from desiccation stress. The hybridization experiments aimed at understanding 1) What are the comparative patterns of gene expression between three congeneric species (*Fucus vesiculosus*, *F. serratus* and *F. spiralis*) at a common location (Viana do Castelo), and 2) How do population-specific patterns of gene expression vary across habitat in the Baltic Sea region? Populations were chosen from the central Baltic (non-tidal, low salinity) and the Skagerak (marine intertidal), and within the Baltic, the common morph of *F. vesiculosus* versus a dwarf form (now called *F. radicans*), because all these populations show physiological differences in stress tolerance. The data have been normalised and initial comparisons of responses between populations/species are currently underway.

Plan for 2007

Metapopulation Structures and Marine Protected Areas

Forests of the giant kelp *Macrocystis pyrifera* sustain one of the most diverse, productive, and dynamic ecosystems on Earth. In collaboration with MSI-UCSB (USA) we will combine data from a long term ecologic monitoring program (LTER-SBC) and spatially referenced (GIS) kelp demography data in a landscape genetics study of giant kelp. We will develop molecular markers for *Macrocystis pyrifera* and will estimate genetic connectivity among populations, effective population size via genetic and demographic approaches; analyse the mating system and genetic structure in relation to metapopulation properties like patch (i) age; (ii) size and (iii) isolation; and infer the effects of putative marine geographic barriers as generators of genetic structure across space. This information will be used in the establishment the first managed network of marine protected areas (MPAs) for the state of California, USA.

Likewise, for European kelp species, as part of a French (ANR) project, we will study population connectivity and ecological aspects towards conservation of these key marine ecosystems.

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Summary of activities and progress during 2006

1. METABOLISM OF COASTAL SYSTEMS

This research line received a strong impulse in 2006 with the start of the project "Carbon uptake by Ria Formosa intertidal communities", POCI/MAR/58172/2004, which aims to quantify the carbon uptake patterns of the main intertidal communities of Ria Formosa coastal lagoon, both when plants are submerged and air-exposed. A prototype system for underwater measurements of CO₂ uptake by plant communities was developed and tested. The experimental approach was to use incubation chambers fitted to the sediment, and to route the water through a degasifying column, from where a low-volume air-circuit was linked to a non-dispersive infrared gas analyser (IRGA) that measures CO₂ concentrations. This methodology was also adapted to deeper underwater operation (> 6m) enabling carbon uptake measurements in submerged communities, under natural conditions on the Mediterranean *Posidonia oceanica* meadows, in the context of a bilateral cooperation with IMEDEA. Plant responses to over-saturating irradiances and desiccation stress were also evaluated, both through direct field assessments of photosynthetic efficiency, using the modulated chlorophyll fluorescence method, and also by quantifying the daily patterns in the activity of key enzymes of the antioxidant system, such as ascorbate peroxidase (APx), monodehydroascorbate reductase (MDHAR), dehydroascorbate reductase (DHAR), catalase (Cat), superoxide dismutase (SOD) and glutathione reductase (GR).

The development of an ecological model of the Ria Formosa lagoon started in collaboration with the Instituto Superior Técnico, University of Lisbon. An ecological module is being integrated in the hydrological model MOHID, developed in that institute. The ecological model integrates the benthic processes, particularly those related to the marine plants, with the planktonic and transport processes. It will be a powerful tool to assess the whole metabolism and C and N budgets of the ecosystem and to simulate the anthropogenic impacts in the Ria Formosa lagoon.

2. HUMAN IMPACTS ON COASTAL SYSTEMS

This research line focuses on the effects of the human-related disturbances on the seagrasses and salt marshes of the most important coastal systems of southern Portugal. Our aim is to contribute with sound scientific inputs to the conservation and management of these systems.

A major threat to the coastal ecosystems results from the increasing nutrient load with anthropogenic origin. Eutrophication of coastal systems such as Ria Formosa lagoon can lead to drastic qualitative changes of the ecosystem where the key seagrass species are substituted by opportunistic green algae. Episodes of green algae blooms occur within Ria Formosa in winter and

along the coastal beaches during summer. Two projects were initiated in 2005 that address the research being carried out on this item. The project "CLONMACMORPH" is financed by the European Commission (Marie Curie European Reintegration Grant to Erik-jan Malta) started in April 2005 and focuses on the effects of increased nutrient load on the architecture of clonal marine macrophytes and seagrasses and its consequence for the competition with ephemeral green macroalgae. In this project the group cooperates with the University of Cádiz (Spain). One paper was published (Malta et al. 2005) which provides proof for the clonal behaviour of the green macroalga *Caulerpa prolifera* in response to nitrogen limitation. Furthermore a monitoring program has been set-up, with the voluntary help of third parties operating along the beaches of the Ria Formosa (salvavidas, firemen, concessionarios, general public) to monitor the occurrence of green algal blooms. It appears that the peak of these bloom occurs in May and June. Other elements of the monitoring program includes the analyses of abiotical variables (climate, nutrient concentrations in the algae and in the water). This approach is taken further in the project "Green macroalgal blooms in Ria Formosa and adjacent coastal beaches", financed by the FCT (POCI/MAR/58427/2004). This project, started in December 2005 and involves a cooperation with the geohydrology group of the IMAR. An aerial survey and field visits revealed that first green algae activity started by the end of December. Nutrients and freshwater might trigger algal proliferation. Although we are awaiting the results of the analyses of water samples, it is already clear that the streams and rivers discharging in the Ria Formosa form an important nutrient source to the system. One single, small stream, was estimated to be responsible for a daily input of 25 kg of dissolved nitrogen, even when rainfall was absent. A geophysical survey indicated the presence groundwater inflow in the lagoon, a source which is difficult to characterize but probably very important in terms of nutrient input.

One other project that has started in 2005 was the characterization of the impact of the urban wastewater treatment works (ETARs) in the key macrophyte communities of three coastal systems, the estuary of Arade, the Ria Formosa lagoon and the estuary of Guadiana. The aim of the project was to assess the base line situation of macrophyte communities under the influence of the ETARs and to develop vegetation indexes for monitoring the effect if urban effluents on the system.

3. ECONOMIC VALORIZATION OF SEaweEDS

During this year, the research on the economic valorisation of seaweeds focused mainly on the pursuit of some of the objectives proposed on the project "Cultivation and halogen compounds yields of Bonnemaisioniaceae red seaweeds", POCTI/MAR/56956/2004. This project aims the study of the ecophysiological controls of biomass and halogen production of several Bonnemaisioniales species. The photosynthetic mechanisms of inorganic carbon acquisition by the species were studied in order to understand if the species is limited by carbon under mass outdoor cultivation conditions. We revealed in this research that these seaweeds cultivated in fish farm effluents benefit not only from a rich source of ammonia but also from an important and free source of DIC for their photosynthesis. If supplied at relatively high turnover rates (~100 vol. d⁻¹), fish farms effluents provide enough carbon to maximize the photosynthesis and growth even for species with low affinity for HCO₃⁻, avoiding the artificial and costly supply of inorganic carbon to seaweed cultures.

The project submitted and financed by Agência de Inovação to install a seaweed-based biofiltration system at Zoomarine a marine theme park of Algarve, was signed during this year. The cultivation system is now in the final phase of construction. This will allow us to determine the feasibility of seaweeds to biofiltrate the water in recirculation cultivation systems, where nitrates are the most abundant nutrient.

4. EFFECTS OF GLOBAL CHANGE ON THE PORTUGUESE MARINE FLORA

The Portuguese continental coast has been recognized as particularly relevant in biogeographical terms (Lusitania Province), as it represents a boundary between the southern warmer communities

and the northern colder communities, and hence has a high biodiversity. We are assessing the long-term changes in the benthic marine flora by comparing the marine flora of the 23 sites along the Portuguese coast that were described by Ardré in the 1960's with the present situation. The relationships of the patterns of change, particularly the changes in the distribution limits and the origin of the new introduced species, with the water temperature increase will be assessed. The analysis of the samples that was done during 2006 revealed about 56 new species for the Portuguese flora, which will be the subject of publications during the following years.

In the nationally funded project, "The invasive theory of the pest seaweed *Sargassum muticum* in Southern Portugal", POCI/MAR/55377/2004 we investigated this year the food preference of local herbivores comparing among local seaweeds and the invader *Sargassum muticum*. Some herbivores showed a specific preference for a single or a few local seaweed(s), whereas others exhibited no specific preference. *S. muticum* was the least or among the least preferred food options. However, the grazing choice of herbivores in most cases did not result in a significant competitive advantage of the invader *S. muticum* over local seaweeds, like the most important invasive theory, the enemy release hypothesis, predicts. The same theory also predicts that local herbivores will avoid using new invaders as habitat leading to the hypothesis that *S. muticum* should have less abundant and diverse associated fauna. In addition, interactions between seaweed species and their associated fauna are of great interest for marine invasions, because herbivores might strongly influence the biotic resistance of systems and invasions might cause shifts in native fauna. We assessed the effect of a non-indigenous seaweed species on the composition and diversity of the associated fauna of native species. We investigated two different intertidal systems (the West and South Atlantic coasts of Portugal) each with two replicate locations using the brown seaweed *Sargassum muticum* as a non-indigenous model species. The first system consists of two locations with pools dominated by the native *Cystoseira humilis* or *S. muticum*. In the second system we studied the fauna of seven native seaweed species and *S. muticum* in two mixed seaweed communities. Within both systems biodiversity of *S. muticum* fauna was either among the lowest or highest depending on location. Species richness of taxonomic components were similar, but in general abundances were lower in *S. muticum*. Multidimensional (MDS) and SIMPER analysis of both systems and the comparison of the *C. humilis* and *S. muticum* fauna across systems revealed a strong spatial structure: fauna composition and biodiversity differed between systems and between locations within systems. The associated fauna composition of *S. muticum* is different from the fauna of almost all native seaweeds. Thus, invasive species like *S. muticum* can affect associated fauna composition, diversity and abundances, however, effects cannot easily be generalised due to spatial variation.

Field studies were conducted to assess the role of meso-herbivores on the survival of seaweeds and the competition between micro-recruits of *S. muticum* and its local competitor *Cystoseira humilis*. Data are to be analysed.

We started an awareness programme on invasive seaweeds in which we used the discovery of *Sargassum muticum* in the National Park Ria Formosa as a starting point to get media attention. We performed an example harvesting exercise which was covered by the most important television stations and newspapers.

We hosted an ESF exploratory workshop on *Sargassum muticum* invasions on European shores from 8-12 November, 2006. The aim of this workshop was to assemble researchers that are working in various disciplines of marine sciences and that have an interest in *Sargassum muticum* invasions, in order to update and integrate all knowledge on *S. muticum*, to identify data gaps, to improve management strategies and to stimulate future collaborative research. During the workshop it has become clear that the current state of knowledge on *Sargassum muticum* invasions needs to be reviewed and that the species should be used as one of the model species to address marine invasion research questions. There was general agreement among the participants that 1) most studies have been performed on a scale too small, but that some of these could be used for meta-analysis studies, 2) although there is a huge amount of literature available there are still data gaps that need to be addressed, 3) there is a need and much room for fruitful collaborations which enable tests of invasive theories on large scales. All participants are currently working on a joint review of *Sargassum muticum* invasions on two continents.

During 2006 we continued the development of micro-satellite markers for *Sargassum muticum* and obtained samples from the entire distribution of the species. Currently, we have almost 1000 samples from 28 populations worldwide.

5. ENVIRONMENTAL EDUCATION

This research line focuses on the characterization of the Portuguese Environmental Education Centres (EEC), which correspond to all the initiatives, including appropriate installations and specialised educational teams that offer environmental education programmes and activities. The research aims to evaluate how established are the EECs in Portugal as well as the limitations and problems encountered in their educational action. This line of research is unique in our country where the environmental education area is still little developed.

Based upon questionnaire responses from 103 of the 126 Portugal environmental education centres, interviews and focus group methodologies we described these centres in terms of the infrastructures and installations, the human resources and the environmental educational program offered, the employment opportunities (internships and volunteer positions), funding sources, problems faced etc. A qualitative approach was conducted to determinate quality criteria for such facilities. These were selected through numerous group interviews that were conducted in several regions of Portugal. The results of this participatory approach will be presented in January 2006 on the "II Seminário Nacional Equipamentos para a Educação Ambiental: Qualidade e Inovação" held at the University of Algarve.

Plan for 2007

1. METABOLISM OF COASTAL SYSTEMS

The basic plan for 2007 is to continue the long-term sampling program of CO₂ uptake measurements, which is based on three monthly full-day campaigns. Along with this sampling program, specific field campaigns will be design to address particular questions regarding the plants' responses to the over-saturating irradiances and the desiccation stress experienced during low tide. As well, the ecophysiological constraints of intertidal photosynthesis, namely those related to the metabolic pathways of carbon acquisition by the dominant intertidal seagrass *Zostera noltii* will be investigated during this year. Preliminary sampling for daily changes in intracellular malate and/or aspartate will be conducted. The photosynthetic dependence of Ci concentration and irradiance will be established through P-I and Ci-I curves. The Ci compensation point and the importance of malate decarboxylation will be assessed. The ability of *Zostera noltii* to use bicarbonate as Ci source will also be investigated, by measuring the activities of the internal and external carbonic anhydrase enzyme.

A second campaign in the Balearic Islands is also planned for 2007, for assessment of the net community metabolism of the seagrass *Posidonia oceanica* at different depths.

2. HUMAN IMPACTS ON COASTAL SYSTEMS

The CLONMACMORPH project ended on 1 April 2006, while the FCT project faced its first full year of execution. We plan to continue the work focusing on three levels: a system level, a community level and an organism level. An annual nitrogen budget of the whole lagoon will be assessed by monthly monitoring the discharges of the rivers and streams and the oceanic exchange through the two most important inlets (Armona inlet and Faro channel). Other sources and sinks, such as groundwater inflow and the role of the sediments will also be addressed. Occurrence of green algal blooms will be assessed by aerial surveys combined with ground truthing in which samples will be taken for biomass determination and tissue nutrient composition. The specific ecophysiological characteristics of the dominant algal species will be studies in experiments, focusing on bloom initiation and die-off and the processes which trigger these. The origin of the blooms will be studied

with the help of molecular tools (comparison of ITS ribosomal DNA sequences, population identification using microsatellites).

3. ECONOMIC VALORIZATION OF SEAWEEDS

Concerning the study of the ecophysiological controls of biomass and halogen production of the seaweed *Falkenbergia rufolanosa*, this year will focus on the determinants of the halogenated compounds metabolism, responsible for the biological activity against pathogens. This research will be conducted in cooperation with the “Fundação da Faculdade de Ciências de Lisboa” and the “Instituto Nacional de Engenharia e Tecnologia Industrial”.

Concerning the biofiltration of recirculating water in a marine theme park, we will infer the effects of seaweed biofiltration on the water quality and animal health and welfare. The expected results will allow:

1. To reduce the water replacement and associated financial investment
2. To improve the water quality and the welfare of the exhibition animals
3. To decrease the potential environmental impact through effluent release
4. To increase the park's attractiveness to visitors by exposing the biofiltration system
5. To raise the good public image of the company
6. To produce valuable seaweed biomass that has a potential use within the aquatic park, for example as food for marine herbivores, for exposition within the aquaria or as fertilizer for the park ornamental plants.

4. EFFECTS OF GLOBAL CHANGE ON THE PORTUGUESE MARINE FLORA

The analysis of the 23 sites along the Portuguese coast that were described by Ardré in the 1960's will continue. We expect to reveal biogeographic zones along the Portuguese coast based on the multivariate analysis on the quantitative data on the abundance of the prominent seaweed species of the locations sampled. Manuscripts will be submitted on the new additions to the marine flora of the continental coast of Portugal.

On what respects the research of the invasive seaweed, *Sargassum muticum*, the following goals are planned:

- To finalize the testing of *Sargassum muticum* micro-satellites for their genetic resolution and cross amplification on other *Sargassum* species.
- To obtain more *Sargassum muticum* samples from locations all over the world and start genotyping them.
- To perform several feeding experiments and analysis of anti-herbivore compounds in native and invasive seaweed species.
- To submit papers on: (1) Can marine herbivores influence the competition between local and invading seaweeds? (2) Are life history traits the ecological basis of invasiveness? (3) Differences in associated fauna between native seaweeds and the invading brown seaweed *Sargassum muticum*.

The investigation on the alien saltmarsh species *Spartina densiflora* in Ria Formosa lagoon, in cooperation with the University of Seville, will continue. The development of this research line will depend on the available funding. The available micro-satellite markers for the genus *Spartina* will be tested to develop a molecular tool to assess the invasive ecology of the species.

An awareness program of the users and local entities of the Ria Formosa lagoon will be developed to reveal the potential negative impacts of the two recent invaders, *Sargassum muticum* and *Spartina densiflora*.

5. ENVIRONMENTAL EDUCATION

We will promote and organize the “II Seminário Nacional equipamentos para a Educação Ambiental. Qualidade e Inovação”, at the University of Algarve in January. This seminar is essential to discuss and establish the quality criteria with the national environmental education stakeholders based on a participatory approach. We will conclude and submit to Instituto do Ambiente, a final proposal of Quality Criteria to Environmental Education Centres in Portugal. That proposal will regulate the activities of the EEC’s in Portugal and will establish, for the first time, the rules that may regulate the activities of these centres. A publication on the Directory of Nature Centers, Outdoor Study Areas and Environmental Education Centers in Portugal will be compiled from survey responses and published during 2006. This will constitute a guide to established outdoor and environmental education centers in Portugal. Organized by region, approximately 100 entries will be included.

We also plan to finish the analysis of the significant life experiences (SLEs) study. This will address the life factors that influence the development of environmental knowledge and concern to the environment. We plan to publish the results of this long term study (8 years of data) in 2006.

Group: Ecohidrologia e Recursos de Estuários e Zonas Costeiras - *ECORECURSOS*

Research team

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PhD students: Pedro Morais, Joaquim Teodósio, Vanessa Moschino, Susana Sarrido

MSc students: Tania Pedro, David Piló, Carmen Mateus

Summary of activities and progress during 2006

Modelling the Use of a hydrotechnical infrastructure to regulate planktonic assemblages in estuaries

This study was developed in the Guadiana estuary area and it is based on the fact as phyto-zooplankton coupling in these systems is an important regulator of processes in the estuarine trophic web, changes in the dominant groups can have consequences on water quality, especially on the occurrence of toxic plankton blooms. A generic model to illustrate the major dynamic properties of phytoplankton succession under bottom-up and top-down control was developed using MATLAB 6.5 Software. The model consists of three nutrient compartments (Nitrogen “N”, Phosphate “P” and Silica “Si”), two phytoplankton compartments (Diatoms “D” and Cyanobacteria “CB”) and a grazer compartment “H”. Nutrient inputs are conditioned by flow discharge. Both phytoplankton groups assimilate N and P, Silica is taken up only by diatoms. Nutrient assimilation is conditioned by light limitation “LL” modelled as a sinusoidal function. Herbivore grazing concerns both phytoplankton groups, but preferentially upon diatoms. The Nitrogen compartment is regenerated by Herbivore releases. All biological state variables are affected by mortality, which eliminates the relative biomass from the system. Biological parameters were derived mainly from field experiments conducted at the Guadiana estuary. Modelling simulations indicate that a day discharge of 50 m³.s⁻¹, every week during critical periods, such as Summer/Autumn, could be enough to avoid cyanobacteria blooms. Since freshwater “pulses” can be managed by operating the freshwater release from hydrotechnical structures, understanding the relationships between the periodicity and magnitude of inflow pulse events and the estuarine ecosystem structure and healthy functioning is a crucial step towards the development of management modelling tools.

UNESCO Ecohydrology demonstration projects: Guadiana demosite *Sustainable estuarine zone management for control of eutrophication, toxic blooms, invasive species and conservation of biodiversity.* Construction of the Alqueva Dam across the upper Guadiana River has affected nutrient ratios and sediment loads transported to the estuary with eventual consequences in eutrophication, decreased biodiversity and marshland degradation. These

processes can be mitigated by developing guidelines for optimizing pulse patterns of water discharge from the reservoir. The implementation of the demonstration site in the Guadiana estuary represents an excellent opportunity to showcase the possibilities that ecohydrology can offer to mitigate and restore estuary and coastal functions. This is true even when these areas are affected by a number of issues, including dam construction. Since worldwide several estuaries are suffering similar impacts, the Guadiana demonstration project site will constitute a study case and a microcosm experiment for other systems. By controlling algal blooms through pulses of freshwater inflow, the project hopes to enhance the diversity of phytoplankton species and associated nutrient loads. Because phytoplankton responds more quickly to physiochemical conditions than zooplankton, the freshwater pulses should allow the phytoplankton to grow more rapidly and become more edible – thereby stimulating zooplankton growth. This will prevent the excessive presence of phytoplankton blooms. In the lower estuary, salinity is close to that of the sea, and the vegetation is dominated by salt marshes. The use of these areas for agriculture, aquaculture or urbanization has resulted in their degradation: restoring them would be beneficial for estuarine water quality. Over the last year, activities in the Guadiana River demonstration site have focused on creating links with local authorities and the developing models of the ecohydrology of the Guadiana system. During 2006 a special issue in the scientific journal *Estuarine and Coastal Shelf Science* has been published Volume 70, Issues 1-2, Pages 1-334 (October 2006) Applying the Ecohydrology approach to the Guadiana estuary and coastal areas: lessons learned from dam impacted ecosystems, edited by Luis Chícharo and M. Alexandra Chícharo.

Characterising the impact of Waste Water Treatment Plant on benthic ecosystem in the Ria Formosa coastal lagoon. The effects of effluents from waste water discharge on the benthic assemblages of Ria Formosa lagoon, were analysed in the Western area of Faro. Results allowed a characterization of the spatial and temporal variability of the impact on the benthic assemblages and indicated that the structuring factor affecting the benthos is the freshwater discharge and the content of organic matter in the sediment. However, the tidal water circulation in the area allows a fast “absorption” of the ETAR effluent discharge.

Assessing the nutritional condition of fish larvae in marine protected areas. Besides previous studies, that have show that coastal systems are important nurseries areas for juveniles, especially the salt-marshes areas, for many commercially important fish species, several issues are still not understood. They are: Is the nutritional condition of fish larvae higher inside these systems compared with the same species captured in coastal zone? Is this due to higher food availability or to higher predation inside the systems that remove weak larvae quickly or to absence or retention strategies? Are there, from typical fish species, some more sensitive to inanition then others? Are larval species from benthonic eggs more resistant to adverse environmental condition than that from pelagic egg? An in depth investigation of the nutritional condition of larval phase of the fishes inside the Ria Formosa and the Guadiana estuary can help to find the answers to the above questions, through the use of nucleic acids derived indices, such as RNA/DNA, RNA residuals and DNA per mg of larva dry weight. Those indices have been used successfully in several larval fish species in different phase of its development to access their nutritional condition. The results were obtained through sampling of this larval species inside the Ria Formosa, inside the Guadiana estuary and in adjacent coastal areas through the participation of Guadiria team, in the oceanographic cruise (CIMA-IHP). Light trap was use to capture the fish larvae, in order to minimize the physiologic stress cause by net tow and to increase the size of fish larvae caught by the traditional ichthyoplanktonic gears.

The results of the present study showed that the species *Engralius encrasicolus*, *Atherina* sp., *Sardina pilchardus*, *Diplodus* sp. *Pomatochistus* sp captured inside protected areas were predominately in good condition (RNA/DNA > 1). This helped in the support of an important theory in fish larval recruitment study, the Bakun or “triad” hypothesis : (1) nutrient enrichment (2) concentration of larval food distributions, and (3) local retention of eggs and larvae, three elements as factors underlying favorable fish larval fish survival.

Sex effect on RNA/DNA ratios in marine organisms. The aim of this study was to quantify differences in RNA/DNA ratios between male and female fishes (*Pomatoschistus microps*), crustaceans (*Crangon crangon*), and bivalves (*Ruditapes decussatus*). RNA/DNA ratios were

greater in females than in males, especially because of a greater content of RNA per unit dry weight in females. Sexual dimorphism and physiological and behavioural differences between males and females may explain these results. RNA/DNA ratios of adult organisms should be interpreted with caution because the effect of sex on nucleic acid concentrations may bias results if the sex ratio in the sample from which the results were derived is not representative of the population.

Plans for 2007

Developing UNESCO Ecohydrology demonstration projects: Guadiana demosite *Sustainable estuarine zone management for control of eutrophication, toxic blooms, invasive species and conservation of biodiversity.* During 2007 we will continue to develop the Guadiana demonstration Ecohydrology project. Our aims include the development of Ecohydrologic solutions for controlling eutrophication in coastal water bodies. For achieving these aims scientific projects will be developed as well as dissemination activities.

Modelling bivalve filter-feeding capacity of remove microalgae blooms. This study will be developed based on the fact that phyto-bivalve coupling is an important regulator of processes in the estuarine trophic web, changes in the dominant phytoplanktonic groups can have consequences on water quality, especially on the occurrence of toxic plankton blooms. A generic model to illustrate the major dynamic properties of phytoplankton succession under bottom-up and top-down control will be developed using MATLAB 6.5 Software. Biological parameters will be derived mainly from field experiments conducted at the Guadiana estuary, with the alien species *Corbicula fluminea*, and native unioids. Understanding the relationships between the filter-feeding capacity, ammonia excretion and estuarine ecosystem structure and healthy functioning is a crucial step towards the development of management modelling tools.

Fatty acid (FA) ratios as nutritional condition index and trophic marker in marine fish larvae. Assessment of nutritional condition of larval fish has been, and continues to be, a major focus of research in recruitment studies. FAs for successful development of marine larval fish has long been known and the dietary essential fatty acids are: docosahexaenoic acid (DHA) 22:6n-3, eicosapentaenoic acid (EPA) 20:5n-3, and arachidonic acid (ARA) 20:4n-6. The composition of fatty acids (FA) and specific ratios (EPA/DHA, EPA/ARA) in larval fish has also been proposed as an indicator of quality and quantity of ingested food. There are recent evidences that the FA ratios are also related to the RNA/DNA ratios. The use of FA composition as an index of nutritional status in larval fish is motivated by absolute and relative amounts of FAs are expected to contain information about past growth history, the FA composition may also reflect variation in the quantity of non-essential relative to essential FAs which are thought to be preferentially conserved during starvation requirement of essential. The major advance of FA is based on the information that can give about fish larvae diet, which is usually difficult to assess by traditional methods, eg, gut content, because gut are usually empty. In 2007 we intend to run several analyses in fish larvae captured in the Ria Formosa and Guadiana estuary in order to investigate major food items of the diet.

Development of integrated Ecotechnological solutions to restore and improve Aquatic ecosystems functions and sustains related Services. Restoring and sustaining good ecological status of these ecosystems (Water Framework Directive 2000/60/EC) is the baseline for sustainability of biodiversity (Habitats Directive 92/43/EEC) and economical and social important uses and services in the areas. The traditional approach to improve water and ecosystem qualities considers the reduction of threats to sustainable levels. However, reduction of all point and mostly diffuse pollution sources threats is virtually impossible, at the basin scale, due to their spatial dispersion, and also does not enable the restoration of already impacted ecosystems. Therefore, measures to enhance the retention capacity of ecosystems – ecotechnologies - should be used in addition, or as a supplement, to threat reductions. These ecotechnologies are based on a profound knowledge of the ecosystems functioning and will address identified environmental problems in both areas: mercury contamination, eutrophication, toxic algal blooms or xenobiotics compounds associated with the discharge of waste water. With this study we propose to develop, test and integrate different ecotechnology solutions: 1) creation of sedimentation zones using macrophytes

to reduce nutrients loads entering or deposited in the ecosystem; 2) implementation of floating "bio-plates" - anchored floating structures – to reduce locally pollutants concentrations; 3) creation of high density bivalves areas for control of phytoplankton density, 4) creation of planktivorous fish free-areas for increase zooplankton top-down control on phytoplankton and 5) develop a phytoremediation system for sediments contaminated with pollutants. By applying these ecotechnologies, in an integrative way, we aim to increase the capacity of the ecosystems to support, absorb and reverse negative impacts and to upgrade ecosystem services. Because these ecotechnologies are based on the intrinsic ecosystems properties, the solutions to be designed will be sustainable and adaptable to different threats and stress levels. Moreover, we aim to perform a preliminary evaluation of the energy gains associated with the use of vegetation from the ecotechnologies solutions for bioenergy production (Renewable Energy Directive 2001/77/EC). The development of a modeling tool to support decisions about the best solutions to address specific water degradation problems- including the energy and economic components- enable testing scenarios under dynamic realities: further development of anthropogenic activities or climatic change stress. The ecotechnologies solutions to be tested are ecologically sustainable (ensuring long term resilience of aquatic ecosystems), economically viable (based on low cost technologies) and also aim to provide social and economic benefits (sustainable ecosystem uses and services and bioenergy production). Therefore, with this project we aim to develop ecologically sound solutions to solve aquatic ecosystems degradation by transforming ecosystem threats into socio-economic benefits.

Group: Fisheries Biology and Hydrobiology

Research team

Leader: José Pedro Andrade
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MSc student: Miguel Correia

Summary of activities and progress during 2006

Cuttlefish culture: Cephalopod's potential for commercial aquaculture has been increasing in the past few years. Cuttlefish, *Sepia officinalis* has been cultured in laboratory for many years. This species possesses several characteristics that make it highly suitable for large scale culture. In order to obtain high survival rates and optimal growth in early stages of cuttlefish life cycle, adequate feeding must be provided. Several live diets were tested on cuttlefish hatchlings, with *Paramysis nouvelli* and *Palaemonetes varians* promoting the highest growth rates. Previous investigations concerning the use of live diets as food source for cuttlefish were mostly qualitative and little data is available concerning food ration and growth/ration relations. Research done focused to study the influence of food availability on growth and survival of newly-born cuttlefish fed with two different live diets. This information is essential to promote optimal growth in critical phases of cuttlefish life cycle, thus obtaining better fitted specimens and so contributing to the success of cuttlefish culture. Also we studied the influence of prey stocking on growth and survival of juvenile cuttlefish. Up to now no artificial diet was ever recorded to be used on hatchlings and, therefore, tests must be made to determine the viability of live prey culture to sustain production, especially for the early stages of cuttlefish. The results obtained in this study are important to determine the viability of stocking large quantities of prey, when feeding cuttlefish, thus reducing the production costs when rearing this species at a commercial level.

Furthermore, during 2006, research was focused on the nutrition of cuttlefish.

A set of 4 experiments were conducted focused on the following themes:

a) on the lipid requirements of hatchlings and their lipidic metabolism at the first days after hatching:

- b) on the effect of bottom areas on the reproduction stage of the species;
- c) on the effects of tank colours on growth and survival of cuttlefish hatchlings and juveniles;
- d) on the effects of thermal transformed grass shrimp supplied as prey to cuttlefish juveniles: growth, mortality and nutritional characterization.

Additional research comprised the collection of samples of the first reported hatchling diseases both by photography and histology.

Also, a project on the cuttlefish population characterization through genetics that will allow a better management of the species in both aquaculture and fisheries was submitted to FCT under de acronym SEPIAGEN (PTDC/MAR/70839/2006).

Crustacean research: Throughout 2006, this work group developed investigation on the production of live diets for aquaculture, namely, the shrimp species *Palaemonetes varians* e *Palaemon elegans*, and the candidate species for aquaculture, caramote shrimp, *Penaeus kerathurus*. Research on these species focused on the inclusion of attractants in diets, alternative use of plant sources, namely, wheat gluten and soybean meal and dietary requirements on amino acids (lysine, methionine and arginine).

Plan for 2007

Cuttlefish culture

During 2007, the research on the nutrition and the establishment of the best nursery technology of cuttlefish will carry on. This year, due to the constraints of project approval, will be a year were mainly the results of the last year will continue to be published. Also, it will be used to determine new strategies to overcome the bottlenecks already found and identified in terms of nutrition and culture technology.

Crustacean research

During 2007, it is planed to continue the research on these species carried out during 2006, in issues like; induced spawning outside breeding season, optimal tank characteristics and rearing density for maximum larval growth and survival, protein utilisation and diets digestibility with different protein sources and effect of nutrient leaching on growth performance.

Group: Coastal Fisheries Research

Research Team

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MSc Resercher Pedro Monteiro.

PhD student: Joaquim Ribeiro, Rui Coelho, Humberto Hazin.

MSc students: Luis Bentes, Daniel Machado, João Araújo, David Abecasis, Joana Carvalho, Pedro Vieira, Joana Miodonski, Marta Correia, Francisco Pires.

Technicians: Carlos Afonso, Pedro Veiga, Frederico Oliveira, Cheila Almeida.

Summary of activities and progress during 2006

Gestpesca II (INTERREG III) project: During 2006, the CFRG was responsible for the preparation of a publication (catalogue) on commercial species of common interest in the Algarve and Gulf of Cádiz within the framework of the project "Scientific bases for the management of fisheries resources of common interest" (GESTPESCA-INTERREG III). This catalogue will be published in 2007 and is based in part on unpublished and published data and parameters resulting from previous projects of the CFRG. An INTERREG project continuing the work carried out within the

framework of the GESTPESCA I and II projects was submitted and approved (PROMOPESCA) The CFRG will continue telemetry studies in relation to the artificial reefs of the Algarve.

Telemetry project (POCI/BIA-BDE/61949/2004): Within the framework of the FCT funded project “Sea bream spatio-temporal dynamics and habitat use in the Ria Formosa lagoon”, 2440 fish of several species were tagged with external T-tags (Floy) in the Ria Formosa lagoon. A total of 83 (3.4%) fish have been recaptured to date. Posters for informing fishermen and offering rewards were distributed in fishing tackle and bait shops as well as other locations such as cafes and bars frequented by commercial and sport fishermen. Press releases were also disseminated in order to inform the general public and fishermen in particular. Six fish were implanted with acoustic tags and released in the ria Formosa lagoon: 3 *Sparus aurata*, 1 *Sarpa salpa*, 1 *Diplodus vulgaris* and 1 *Diplodus sargus*. A total of 10 field trips were carried out in order to catch fish of the right size for the telemetry studies. To date, approximately half a million detections have been recorded from the hydrophones deployed along the channels of the western part of the Ria Formosa. Particularly noteworthy are the data obtained for one gilthead seabream over a period of 10 days. A total of 4 trips were made to recover, download data from the hydrophones and redeploy the hydrophones. One *Diplodus vulgaris* was monitored over a period of 24 hours with a VR100 receiver and VH165 omnidirectional hydrophone and VH110 directional hydrophone from the semi-rigid boat acquired with project funds.

Sport fishing project (POCI/MAR/58157/2004): In 2006, a FCT funded project on sport fishing was initiated (POCI/MAR/58157/2004 - *O declínio dos recursos pesqueiros - a culpa é dos pescadores não profissionais?* (“The decline of fisheries resources – is it the fault of non-professional (recreational) fishermen?”)) The objective of this project is to quantify sport fishing effort, catches and to obtain socio-economic data on this activity. Questionnaire surveys were developed and a stratified sampling strategy developed for the creel surveys. In 2006, 12 aerial surveys were carried out using a small chartered aircraft. A total of 3684 fishermen were counted during the course of these aerial surveys, with 1684 on the south coast and 2030 on the west coast. A total of 48 daily creel surveys were carried out, with 710 interviews of individual fishermen. Creel surveys were carried out on 8 days per month (4 week days and 4 weekend days). During this first year of the project, 1000 logbooks were printed and to date, several hundred have been distributed to volunteer anglers. All the tasks have been successfully carried out.

Monitoring programmes: Studies of the Ria Formosa fish community continued with the annual monitoring program. A series of locations were sampled with a beach seine in the Spring/Summer of 2006. This continued the time series of sampling initiated in 2000 and considered of great importance for evaluating possible changes resulting from climatic or human-induced changes. The importance of lagoon and estuarine systems as nurseries and essential habitat for fish was also studied in the Arade river, where a monitoring programme was also initiated.

Population dynamics: Work on different aspects of the fisheries biology and population dynamics of a number of species was carried out, with emphasis on age and growth, reproductive biology and feeding ecology of several deep water shark species and species of sea breams (Sparidae). The biology and ecology of non-commercial species such as pipefishes were also studied.

Modelling and stock assessment: A PhD thesis on the spatial and temporal distribution of swordfish longline catches in the south Atlantic as a function of environmental variables was completed in 2006. Work is also continuing on the evaluation of indicators for evaluating the effects of fishing and for comparing the relative impacts of different gears. A collaborative project on gear selectivity and fisheries management funded by FCT (GRICES) involving the CFRG (co-ordinator) and IPIMAR in Portugal and the Tunisian National Fisheries Institute was started in 2006. One researcher from each country visited the other international partner. Possibilities for collaboration, such as joint data analysis, were discussed. Follow-up meetings will take place in 2007.

Essential fish habitat: Studies on the identification of essential fish habitat were carried out, based on data from experimental fishing trials and data characterising the bottom type and associated fauna and flora off the Algarve coast. These data are being analysed with GAMs and GLMs and mapped with GIS. A Masters thesis (Aquaculture and Fisheries) was carried out using data from a project on hook selectivity. The catch rates were analysed by GAM and GLM as a function of a variety of variables such as bottom type, depth, temperature, and lunar phase.

Estuarine ichthyofauna: During 2006, monitorization of the ichthyofauna of the Arade estuary was carried out and a scientific dissemination programme was initiated which included participations in scientific congresses and seminars, organizing exhibitions, producing booklets and the preparation of a book and several scientific papers.

Sublittoral communities mapping: The second stage of RENSUB project was accomplished with the epibenthic communities mapping of the seafloor from the Central Algarve (Ancão-Galé). The biological characterization was made at a 1:25000 scale based on 162 visual census transects and 107 experimental trawls and it included density maps, several biodiversity, vulnerability and ecological sensibility indexes that will be useful for coastal management purposes. Several methodological experimental studies concerning the *Quadrat Method*, using still underwater photography and the *Transect Method*, using video sledge techniques, were carried out. New biotope classification based on multivariate analysis was achieved and from the approximately 1040 species identified so far, 4 are most probably new records for the Iberian Peninsula and 25 for the continental Portuguese coast.

Plan for 2007

The main focus of the CFRG group in 2007 will be on: 1) the evaluation and monitoring of ichthyofauna and fisheries in the Arrábida Marine Park, 2) telemetry studies both within the Ria Formosa and in the vicinity of the Algarve artificial reefs, 3) the assessment of recreational fishing activity in the south and southwest coast of Portugal, and 4) Marine Biotope mapping, sensibility/vulnerability analysis, biodiversity studies including biological impact assessment of coastal dredging. Secondary objectives include the monitoring ichthyofauna of the Ria Formosa and the Arade estuary. studies on fisheries biology and population deep water sharks.

The CFRG will also collaborate with colleagues with expertise in Molecular Biology techniques to prepare a data base that can be used to resolve species identity problems. This will be a service that can be provided to sport fishing associations, for example. It is also foreseen that with global climate change, there will be an increasing need for species identification as more and more warm water species appear in Algarve waters.

INTERREG Projects: GESTPESCA II and PROMOPESCA: The GESTPESCA II project was granted an extension to March 2007, while a continuation of the GESTPESCA projects, PROMOPESCA, was approved and will continue the work in 2007. Specific telemetry experiments will be carried out in 2007. Hydrophones will be deployed around artificial reefs and adjacent natural reefs. Wild sea breams (*Diplodus sargus*) will be caught with longlines on the artificial reefs and tagged with pingers. They will be released on the artificial reefs, together with IPIMAR reared sea breams of approximately the same size. Their daily movements will be recorded using hydrophones and receivers. The network of receivers around the reefs will record data on a long-term basis while a hydrophone on board a research vessel will be used periodically to study short-term movements. The objective of the study is to evaluate differences in behavior and movement patterns between wild and cultured sea breams. In addition to the telemetry studies, the CFRG will contribute to the publication of a catalogue of commercial species of the Algarve and Gulf of Cadiz and will participate in several workshops and other activities for technology transfer and training.

Ria Formosa telemetry project: For this project FCT project approved in 2005, more fish (approximately 2500) will be caught and tagged with external Floy T-tags in the Ria Formosa lagoon in order to study habitat use and movements. In the spring of 2007, fish will be tagged with small pingers and their movements monitored by active telemetry from a boat over 24 hour periods, while long-term movements will be tracked using a number of receivers attached to navigation buoys throughout the Ria and in the adjacent coastal waters. It is expected that at least 20 fish of several species will be tagged with pingers and tracked.

Sport fishing project: Field work will continue until July 2007. Creel surveys will continue to be carried out along the coast from the Guadiana estuary to Sines, with 8 days a month devoted to questionnaire surveys aimed at quantifying the fishing effort, the catches and the socio-economic characterisation of recreational anglers. Aerial surveys are also being carried out on a monthly

basis (once during the week and once on the week end). These low level flights allow the quantification of angler fishing effort along the whole coast. After the one year sampling period, data will be analysed and the final report prepared. As a complement to this study of shore-based angling, a Masters thesis will also be carried out in 2007. The student will focus on sport fishing competition in the south of Portugal. Data on catches, sizes and effort will be obtained in approximately 20 competitions between March and July 2007. Data from competitions held in the past will be obtained from sport fishing clubs and organisations. This will be analysed for trends in species composition and sizes.

Monitoring of ichthyofauna: Studies of the Ria Formosa and Arade fish communities will continue with the annual monitoring programmes. In the case of the Ria Formosa, a series of locations will be sampled with a beach seine in the Spring of 2007. This will continue the time series of sampling initiated in 2000 and considered of great importance for evaluating possible changes resulting from climatic or human-induced changes. The importance of estuarine systems as nurseries and essential habitat for fish will also be studied in the Arade river. Here, a variety of sampling gears will be used to study the fish community along a salinity gradient and over tidal, daily and seasonal bases.

The CFRG will also have a monitoring role in the BIOMARES Life project. Here, the ichthyofauna and the landings will be monitored within the Arrábida marine park.

Population dynamics, modelling and stock assessment: Work on the population dynamics and stock assessment of sea breams and of deep water sharks will continue. In the latter case, age structured Leslie models will be developed and life table constructed. A new approach based on Fisher's reproductive value will be applied to evaluate the state of the populations and their vulnerability to exploitation. Work on essential fish habitat and indicators for fisheries management and for comparing the impacts of different fishing gear, taking place within the framework of this research will be finished.

Sublittoral communities mapping: The third stage of RENSUB project will begin with the epibenthic communities mapping of the seafloor from the Central Algarve (Galé-Arade estuary). The biological characterization will be made at a 1:25000 scale and it will include density maps, several biodiversity, vulnerability and ecological sensibility indexes. The sampling procedure will be based on three main methods: underwater visual census for ichthyofauna and macrofauna on rocky bottoms; quadrat method for algae; beam trawl and video transects for sandy bottoms. All this information **will** be analysed through geostatistics **and** GAM **analysis** and integrated in Geographic Information Systems in order to produce maps **that can be used** for coastal management purposes.

Group: Biodiversity and Biology in Fisheries (BIOPESCAS)

Research team

Leader: Teresa Cerveira Borges

Post Doc: José Xavier

PhD students: Maria Esmeralda Costa, Sónia Olim, João Sendão, Manuel António Malaquias

Technicians/ research assistants:

MSc students: Cátia Vieira, Marina Mendes, Marisa Antunes, Neusa Vale, Joana Lisboa, Marta Correia (with CFR Group).

Undergraduate students: Ana Sofia Mendonça, Ana Mendonça.

Summary of activities and progress during 2006

Science, Education and Marine Archaeology Programme in Portugal (SEMAPP): A group of 17 students, together with 2 researchers/teachers from the University of Connecticut (UCONN) and one technician from the Ocean Technology Foundation (OTF) came to work in the Ria Formosa, Olhão. During this visit 2 presentations were given.

Biodiversity in fisheries off the South coast of Portugal (Algarve):

Main purposes:

The research focus on the faunistic diversity encounter in fisheries, to study the possible effects of fisheries on the biodiversity off the south coast of Portugal (Algarve). Main objectives are: 1) Identification of all species caught by the most important fishing gears; 2) Compilation of all information on the biology, ecology, fisheries and socio-economic importance of each of these species; 3) Production of a book with all the information; 4) A reference collection of all species existent in the fisheries, to be available to all community (academic, schools, etc.).

During the fishing activity, beside the target commercial species, other species are also captured, the so-called by-catch. Species by-catch can also be commercial, but most have a low or null commercial value, and therefore are discarded to the sea.

Recent studies show that of the more than 900 species captured by the main fishing gears acting off the Algarve (trawls, purse seine and trammel nets), 69% are always discarded, 27% are frequently discarded, and only 4% are occasionally discarded. After several years to study discards and its problems, we were able to perceive not only the biological richness of our waters but also that most species were completely ignored. Therefore, the idea of a book on biodiversity in fisheries was born, to divulge not only the commercial species, but also all the ones completely unknown from the public. In reality, the knowledge of the species existent in Portuguese waters is dispersed and little or nothing at all divulged. The publications about the species diversity at the Algarve region are scarce, and the few existents are mostly species with commercial interest.

The main objective of this book is, not only to make known the existent biologic diversity, but also to open new commercial opportunities, like new species in the Portuguese market or even new markets. Moreover, with the disclosure of the biologic richness of the region, it is expected that the public will become more aware of the fact that "although not everything can be eaten, everything is important". This is due to the fact that many of the species that are discarded at sea, mostly dead, can be preferential prey to present commercial species, being, therefore, important elements of the marine trophic chains and for the ecologic balance of the oceans.

Due to the diversity of species, it was considered indispensable to have a group of specialists to identify and characterise the species found. Therefore, each taxonomic group presented is described by specialists.

Achieved in 2006:

During 2006, more than 900 species were identified and 300 were photographed. Some species were identified for the first time for Portuguese waters, and a new species was found. Red coral was captured alive for the first time for many years. The compilation of information on the biology and ecology of around 300 species, together with a photograph of each species, was arranged in identification cards, in Portuguese and English. The selection of the species was based on the abundance, management and conservation needs, or commercial potential. All species identification cards were arranged and sent to the graphic designer. The layout of the book was decided, and its publication is expected for 2007.

The collection of species for the reference collection had to stop due to lack of space. However, several species are still in freezers waiting for a solution.

A new dwarf skate species was discovered off the south coast of Portugal by the PhD student M. E. Costa, during two previous research projects (DISCALG & BYDISCARD). In order to taxonomically identify the new dwarf skate species discovered, Dr. Matthias F.W. Stehmann, from the ICHTHYS (Ichthyological Research Laboratory and Consultant, Hamburg, Germany) was contacted, and was able to include the specimens captured in the genus *Neoraja*, although, without any mature males (only male & female juveniles; and 1 adolescent female), it was not possible to describe to species level. More recently (2005/2006), more 17 new *Neoraja* specimens were collected during the scientific project BIOFISH, of which 2 mature males and 2 mature females, making finally possible the description to species level, showing a new European species (n. sp.) of dwarf skate worldwide. The new species name has been chosen but, until the publication of the paper it cannot be revealed.

Predator-prey interactions in European waters: The research tested fundamental hypotheses, particularly in Macronesia (area that includes mid-Atlantic Azores and Madeira Islands) and

Portugal, and will provide essential data to assess contrasting trophic marine systems. This is the first study of this kind in the region.

Predator-prey interactions in the Antarctic: Data started to be collected for the multi-disciplinary investigation that will be part of the contribution of Portugal to the International Polar Year (IPY), focusing on predator-prey interactions in a changing environment, using novel technologies to marine ecology.

Fisheries biology and population dynamics of cephalopods:

Main purposes:

The cephalopods are one of the most important group of species for Portugal, due to not only to the high commercial value, but also to the trophic chain position that they occupy. The main example is the common octopus (*Octopus vulgaris*), which is one of the most relevant species for the fishery sector in Portugal, representing an average of 6 % of the total of the fishing products landed, and 11 % of the total value commercialised, being the Algarve the most important region of the country. The main purpose of this research line is to study not only the fisheries biology of commercial cephalopods, but also to focus on studies on the biology of non-commercial species. An example is the sepiolids, a group of small species with no commercial value but great importance to the trophic ecology of the oceans.

Achieved in 2006:

Cephalopod specimens collected from different research projects of different research CCMAR groups have been kept. Biological sampling has been performed to collect morphologic and biological parameters, for taxonomy and biology studies, with special relevance on growth, reproduction and feeding ecology.

Fisheries by-catch and discards:

Main purposes:

During the fishing activity, beside the target commercial species, other species are also captured, the so-called by-catch. Species by-catch can also be commercial, but most have a low or null commercial value, and therefore are discarded to the sea. The main reasons for discarding are economical restrictions (low or null commercial value for species with no immediate market), and technical restrictions (fishing gear selectivity). Other less frequent reasons are the legal/administrative restrictions (minimum landing sizes, quotas). Studies from fisheries by-catch and discards in Algarve show that the number of species discarded is much higher than the species commercialized, therefore, not only most species are unknown to the general public but also their biology and ecology are poorly known or completely unknown. This constitutes not only a real problem for the management and maintenance of the biodiversity and ecologic balance, but also a substantial lost of prime-material, with negative economic consequences. Therefore, studies on socio-bio-economic aspects of the fisheries by-catch and discards in south Portugal are undergoing, manly on trawls, the fishing gear with highest diversity of species due to the low selectivity.

Achieved in 2006:

Biological aspects – species, quantities and species biological parameters – and socio-economic aspects started to be collected from the commercial fishing trawl fleet. Old data has also been compiled for future comparisons.

Studies on population dynamics, biology and ecology of a number of non-commercial species (around 30) has been carried out, with emphasis on growth, reproductive biology and feeding ecology.

Two papers have been published, one on length/weight relationships of Triglidae fish, and another on the impact of fishing on gastropod species.

Plan for 2007

In late spring (June), another visit is expected from a new group of students and teachers/researchers from UCONN, probably to work in Ria Formosa, Olhão, and Boca do Rio, Budens, in SEMAPP.

After the finishing of the uniformisation of text and necessary corrections, all species identification cards will be sent to the publishing to be printed (BIOFISH). The distribution of the book is expected in March/April.

The publication of the paper in an international journal about the new dwarf skate species is expected to be in March/April 2007. Two international known taxonomists (Dr. M. Stehmann & Dr. Bernard Serét) and two biologists (M.E. Costa & Jorge Baro) are involved in this paper.

Concerning the studies on predator-prey interactions in European waters, work will focus on a wide range of aspects of food webs ecology: 1) Characterisation of the cephalopod-predator interactions in South Portugal, Azores and Madeira, 2) Evaluation of trends of cephalopod landings in Portugal and in Northeastern European waters, and 3) Test hypotheses related to feeding and foraging ecology of key predators.

Concerning the Antarctic studies, the research will focus on predator-prey interactions between top predators and cephalopods in relation to climate change in Antarctic waters through the analysis of the diet of albatrosses, possibly king penguins, and collection of biological data of Antarctic squid.

Biological sampling and data analysis on cephalopod species will continue. Two or three publications are expected.

Biological sampling on by-catch and discards will continue, also starting with compilation of socio-economic information of the fishery sector. Two trips are planned for data analysis and in the bilateral cooperation GRICES/CSIC: one trip to Spain of S. Olim, and one trip to Portugal of F. Maynou.

A new cooperation will start in 2007 between research groups of the Universidade Federal do Reconcavo da Bahia (UFRB), Brazil, and CCMAR. Based on that a preliminary survey on the fisheries in Bahia de Todos os Santos, Brazil, will be done. The tasks will mainly be 1) compilation of existent fishery data (statistical); 2) compilation of all small scale fishing gears used; 3) compilation of all faunistic species captured by each fishing gear; 4) the socio-economic situation of the fisheries in that area. A final report with all preliminary data will be distributed to several official institutions.

Group: Biodiversity and Conservation (BioCon)

Research team

Researchers: Rita Castilho, Margarida Castro, Margarida Cristo and Margarida Machado.

PhD students: Regina Cunha and Paula Serafim.

Other colaboraros: Dora Jesus (M. Sc.), Gonçalo Silva (BTI).

Honors thesis students: Miguel Soares

Summary of activities and progress during 2005

Molecular Evolution, Phylogeny/Molecular systematics and Phylogeography

Genetic screening of *Pyrrhula pyrrhula*, an Azorean endemic endangered avian species was completed.

Paper on the molecular and morphological validation of two catshark species accepted by Journal of Fish Biology.

Work on the population historical demography of two sand smelt species started with collaborators from ISPA, Lisbon.

Submission to Ecology of the paper "Are current genetic models of glacial refugia adequate fot North Atlantic Marine Organisms?", a paper drafted at the Workshop on Marine Biodiversity and Ecosystem Stability, in the framework of the Network of Excellence MARBEF, Marine Biodiversity and Ecosystem Function. Tavira, March 15-19, 2005 (Organized by the team MAREE).

Ecology and Fisheries of Decapods

Continuation of work in progress related with the reproductive biology of *Nephrops norvegicus* involving mechanisms of sperm competition and mating systems (in collaboration with the "Molecular Biology of Marine Organisms". This work is being complemented with histology studies

to understand male reproductive patterns (spermatophore formation) and contribution of males to the population reproduction (timing of fertility of male of different size classes with female matting season).

Modelling of fecundity aspects of the Norway lobster relevant to management based on egg and larvae estimates.

Selectivity experiments associated with using traps to catch bottom decapods. Two gears considered if high environmental impact were targeted, bottom trawl and tangling nets, and different types of traps to catch decapod species targeted by those gears were built. The objective is to undertake studies of compared catchability.

Large branchipods in temporary ponds

Continuation of the inventory of species present in ponds from the Central and South of Portugal and studies related with the biology and population dynamics of the most important species. Study of ecological aspects modelling species distribution.

Colaboration on the study of sister species within the Triops genera in Europe.(University of Dresden)

Study of Large Branchiopods in the Iberian Peninsula in collaboration with several Universities in Spain.

Publication/acceptance/submission of papers from last year research activities on:

;

Population structure of anchovy (*Engraulis encrasicolus*) in the Mediterranean and the Atlantic: revealing strong unexpected subdivision (one paper);

Population genetics of *Scomber scombrus* and *Scomber japonicus* in the Mediterranean and the adjacent Atlantic Ocean (one paper accepted);

“Replaying the tape: replicated evolutionary patterns in Cape Verde Conus” (one paper submitted).

Morphological and mitochondrial DNA divergence validates blackmouth, *Galeus melastomus*, and Atlantic sawtail catsharks, *G. atlanticus*, as separate species (one paper accepted).

Biology of the conch *Hexaplex trunculus* (3 papers published- main researcher developed at IPIMAR, Olhão)

Biology of the green lobster *Palunirus regius* (1 paper accepted– main research developed at ISECMAR, Cabo Verde)

Biology of the European lobster *Panulirus elephas* (1 paper published)

Diet of the cuttlefish *Sepia officinalis* (Cephalopoda : Sepiidae) off the south coast of Portugal (eastern Algarve) (one paper).

Sister species within the Triops cancriformis lineage (Crustacea, Notostraca) (one paper)

Distribution of Large Branchiopods from temporary ponds in Portugal) (one paper submitted)

Organization of a “Workshop on Scientific Writing” lectured by W.Stewart Grant, University of Anchorage, Alaska, USA.

New projects:

Comparison of population genetic signatures of sand-smelts (*Atherina presbyter* and *A.boyeri*). Plurianual FCT.

Larvar recruitment mechanisms and stock identification in lobsters - POCTI/BIA-BDE/ 59426/2004 “LOBASSESS - Norway lobster stocks in Portugal. Basis for assessment using information on larval production and ecology”.

Survival of Norway lobsters passing through the mesh of the codend - PDCT/MAR/59366/2004 “Survival of Norway lobster (*Nephrops norvegicus*) escaping through the codend of trawling nets or by-catch reducing devices”.

Visitor's:

W.Stewart Grant (Anchorage University, USA) spent 2 weeks at CCMAR, lecturing on a workshop (see above) and presenting a seminar on “Biogeographic Evidence for Selection on mitochondrial DNA in North Pacific Walleye Pollock *Theragra chalcogramma*”.

Plan for 2007

Molecular Evolution, Phylogeny/Molecular systematics and Phylogeography

Completion of work with two deep-water species (*Hoplostethus atlanticus* and *Aphanopus carbo*) and submission of manuscripts.

Submission of a manuscript resulting from collaboration with the Eco-Ethology Unit from ISPA, Lisbon on sand-smelts (*Atherina presbyter* and *A. boyeri*).

Re-submission of the manuscript "Replaying the tape: replicated evolutionary patterns in Cape Verde Conus".

Completion of the genetic screening of the European Conger eel (*Conger conger*) and draft of the manuscript.

Ecology and Fisheries of Decapods

Continuation of work in progress related with the reproductive biology of *Nephrops norvegicus* (in collaboration with the "Molecular Biology of Marine Organisms").

Compared selectivity of traps with tangling and trawling nets for capturing spiny lobster, Norway lobster and deep water shrimp.

Advances in the collection of data for modeling larval recruitment processes in lobsters.

Re-submission of the manuscript "Diet of the Norway Lobster (*Nephrops norvegicus*) off the South coast of Portugal"

Large branchipods in temporary ponds

Continuation of the inventory of species present in ponds from Portugal and studies related with the biology and population dynamics of the most important species.

Continuation of ecological studies in temporary ponds in Portugal and Spain (ongoing collaboration with Spanish colleagues .

Genetic screening of *Cyzicus grubei* from Portugal, Spain and Marroc (in collaboration with the "Molecular Biology of Marine Organisms" group

Submission of a manuscript resulting from the ecological characterization of the prospected ponds in Portugal

Submission of manuscript resulting from collaboration with Spanish colleagues regarding the establishment of ecological quality indexes for temporary ponds for management purposes.

Externally funded Projects

Division of Aquaculture and Biotechnology

New and ongoing beyond 2006

Title: "Mecanismos da sensibilidade olfactiva aos catiões não orgânicos em teleósteos" (Mechanisms of olfactory sensitivity to inorganic cations in teleosts)

Summary: Without exception, teleosts are able to maintain extracellular concentrations of physiologically important ions, such as calcium and sodium, at levels dramatically different from those of the environment. Much work has focussed on the mechanisms responsible for maintaining this differential; however, little is known about how the environmental concentrations of these ions are sensed. This is particularly important for those species that habitually encounter rapidly changing concentrations of these ions such as estuarine or migratory fish. We have recently shown that a range of different teleosts have high olfactory sensitivity to calcium and, to a lesser extent, sodium. The aim of the proposed project is to establish whether teleosts have distinct olfactory receptor mechanisms for both calcium and sodium, rather than a single 'salinity' receptor mechanism. To do this we will investigate the effects of changes in environmental ions to the olfactory sensitivity to sodium and calcium in three model species; the marine gilthead seabream (*Sparus auratus*), the estuarine bass (*Dicentrarchus labrax*) and the freshwater goldfish (*Carassius auratus*). Although all three species can tolerate some change in salinity, only the bass is truly euryhaline. Furthermore, we will investigate the long-term effects of salinity changes on the olfactory sensitivity to sodium and calcium. This is important to understand whether this olfactory sensitivity is primarily linked to internal ionic homeostasis, or to inform the fish where exactly, in a fluctuating environment, it is. Lastly, we will begin to investigate where, within the CNS, this primary sensory information is relayed. This will be done by a combination of activity-dependent neuronal labelling and immunocytochemistry for the early response element c-fos. We expect that primary sensory input concerning food-related odorants to be processed differently from that concerning levels of inorganic cations. However, do calcium sensitive neurones project to different areas of the olfactory bulb from those sensitive to changes in sodium? Once these questions are answered, future studies can be directed as to how these ions are detected (at a cellular and molecular level) and exactly what use the fish makes of this sensory information.

Objectives: To assess how changes in concentration of one cation may influence the olfactory sensitivity to others in marine, estuarine and freshwater teleosts.

To assess how long-term adaptation to altered salinities may influence olfactory structure and sensitivity to cations in marine, estuarine and freshwater teleosts.

To determine the types of cells responsible for olfactory sensitivity to Ca^{2+} and Na^{+} and to where in the olfactory bulbs this information is relayed.

Reference and funding entity: POCI/BIA-BCM/55467/2004 (FCT)

Duration: 1st January 2005 - 31st December 2007 (3 years)

Research team: P.C. Hubbard (PI), C. Haond, E.N. Barata and A.V.M. Canário

Total budget: 45000 euro

Title: "Comunicação química na tilápia Moçambicana, *Oreochromis mossambicus*." (Chemical communication in the Mozambique tilapia, *Oreochromis mossambicus*.)

Summary: Chemical communication is believed to play diverse and important roles in the biology of fishes. However, the number of species that have been studied in detail remains very low. Given their distinctive reproductive strategies and complex social behaviour, the cichlids have received surprisingly little attention in this respect. Over the past three years, our laboratory has made significant inroads into the understanding of chemical communication in the Mozambique tilapia, an African mouth-brooding cichlid. It is clear that this fish uses chemical signals both during reproduction and in the maintenance of social hierarchies. Thus the aim of the proposed project is

to extend and embellish these initial findings, particularly with regard to the chemical cues that the females release, and answer some of the questions raised by previous research in both our and other laboratories. Firstly, the identification of putative pheromones released by pre-ovulatory females will be carried out in conjunction with IACR-Rothamsted (United Kingdom). We already know that pre-ovulatory females smell different from post-ovulatory to males, and that males behave differently towards them, depending on this olfactory cue. Our aim is to establish what these cues may be, and their likely source and routes of release. Once the likely site of pheromone synthesis is established - the ovaries - we can assess the endocrine factors responsible for the regulation of pheromone production in vitro. This may also prove to be a convenient way to collect relatively large amounts of pheromones for identification. Thirdly, the effects of the putative pheromones on male physiology and behaviour will be investigated; we already have good evidence that female pheromones induce an increase in the urination rate of males as part of their courtship 'display' (male urine is a potent odorant to females). Lastly, we will begin to investigate how this pheromonal information is processed by the CNS using a combination of neuronal activity-dependent labelling and immunocytochemistry for the early response element c-fos; to where in the olfactory bulbs (and possibly beyond) this information is relayed. In the future, this will allow us to define how the pheromonal message is translated into the appropriate behavioural and physiological responses. This species has a number of advantages for this type of study; the social behaviour is well-described, males and females are easily recognisable and are reproductively active throughout the year. It is also a resilient fish and amenable to the type of experimental manipulations outlined in this study. As such, it is an ideal introductory model for young scientists to learn how to formulate, and test, hypotheses. We think that the proposed project will establish the Mozambique tilapia as the model species for studies in chemical communication in cichlids and provide an important addition to the studies of this phenomenon in teleosts as a whole.

Objectives: To identify chemicals released to the environment by pre-ovulatory females that are detected by males.

To identify the source and routes of release of these chemicals.

To investigate the effects of endocrine factors that govern the rate of synthesis of these putative pheromonal compounds by the ovaries (and/or other tissues) in vitro.

To identify the biological effects of these chemicals on male behaviour and physiology.

To trace the neural pathways of olfactory receptor neurones for these chemicals to the olfactory bulb.

Reference and funding entity: POCI/BIA-BDE/55463/2004 (FCT)

Duration: 1st June 2005 to 31st May 2008 (3 years)

Research team: Peter Hubbard (PI), Eduardo Barata, Christophe Haond, Adelino Canário, Olinda Almeida (BIC),.

Total budget: 82500 euro

Title: Diferenciação sexual do robalo (*Dicentrarchus labrax*): identificação de genes com expressão dimórfica de sexo e efeito ambiente

Summary and Objectives: Seabass, *Dicentrarchus labrax*, is a gonochoristic marine fish with a high market value. In farming conditions males grow 20-30% slower than females. Hatchery stocks often yield over 90% males, with an important loss of revenue. Gonadal differentiation occurs only 11 months post-hatching and coincides with a period of maximum sensitivity to the action of exogenous steroids. Rearing temperature has a strong influence on sex ratio in particular during the first two months after hatching. Steroid hormones (androgens and estrogens) are the ultimate mediators of phenotypic sex and temperature strongly influences aromatase activity required for ovary differentiation. Other genes in the sex differentiation cascade may also be influenced by temperature, some of which interact directly with steroidogenic P450 enzymes.

The main objectives of the project are to: 1) Identify and characterize sex specific genes or genes that are differentially expressed in males and females 2) Determine the expression profile in early development of identified genes and how their expression is modified by temperature.

Reference and funding entity: POCTI/CVT/47124/2002

Duration: April 2005-March 2009

Research team: Adelino Canário, Laurence Deloffre, Rute Martins

Total budget: 50,000 euros

URL:

Title: "ECOTEC - Ecotecnologias baseadas no uso de bactérias sulfato-redutoras e sua aplicação ao tratamento de águas ácidas de mina" ("ECOTEC – Eco-technologies based on the use of sulphate-reducing bacteria and their application for the treatment of acid mine drainage").

Summary and Objectives: It is possible to grow bacteria consortia based on SRB's adapted to low pH, to high amounts of sulphates and to the presence of heavy metals, thus, adapted to similar conditions to those found in the acid mine drainage (AMD) waters, which are presently a serious problem in Portugal and also all over the World. With this project it is aimed to develop a simple, efficient and economically attractive technology, based on the capabilities of SRB's and on the utilization of natural and locally available substrates, which also needed to be subjected to treatment. Such will be a sustainable, integrated and low cost technology that can be designated as eco-technology. In this case, these eco-technologies use the ability of SRB's to utilise sulphate as electron acceptor. The sulphide generated in the presence of metals leads to the formation of very insoluble metal sulphides and therefore, both metals and sulphates can be eliminated simultaneously. In addition to the generation of sulphide, the generation of CO₂ and carbonates, allows the neutralization of the AMD, which have usually pH values close to 2. Besides the economical and environmental advantages presented by these eco-technologies, they are also mentioned in the literature as the only ones able to reduce sulphates concentration to values below 1500 mg/L. The process to develop will be based on the design of natural systems, modulated as fixed-bed column bioreactors, where the natural phenomena of depuration are simulated. Several carbon, electron and energy sources, easily and locally available at cost zero or even at negative cost (e.g. effluents from local winery and cheese industries) will be tested for bacterial growth. The ecology and physiology of those systems will be studied as a function of the substrate utilised. The study of the ecosystems established in those eco-reactors has the objective of isolating and characterise bacterial populations particularly resistant to the presence of high metal contents and thus, very useful to the treatment of AMD (or soils) highly contaminated. With this eco-technology it is expected to develop a process able to neutralise the AMD acidity, to reduce their sulphate content and to eliminate the heavy metals, in order to obtain an effluent with concentration values below to those admitted for the discharge of residual water, or even lower to those allowed for irrigation waters. The isolation of new SRB with metal tolerant genes and thus, highly specific is previewed.

Reference and funding entity: POCI/AMB/58512/2004 (FCT)

Duration: 1st October 2005 - 31st September 2008 (3 years)

Research team: Maria Clara Costa (PI) and Mónica Martins (CCMAR), Leonor Faleiro (FERN/CBME), Raúl Barros (FERN) and members from INETI/UME.

Total budget: 74880 euros

Title: Molecular and cellular basis of teleost fin regeneration

Summary and Objectives: Inducing regeneration of damaged tissue is currently a major focus of biomedical research. Outstanding questions include: How can the adult tissue be reprogrammed during regeneration? How is organ morphogenesis and patterning achieved during regeneration? The overall objective of this project is to determine the timing and morphology of the different stages of teleost caudal fin regeneration after ablation as well as the dissection and control of the pivotal genes responsible for each stage. As model organism we will use the zebrafish (*Danio rerio*) due to the readily available molecular tools and approaches necessary to conduct complex research from a genetic point of view.

Reference and funding entity: FCT POCTI/MAR/61091/2004

Duration: 2006-2008

Research team: Begoña Redruello, Adelino Canário, Deborah Power

Total budget: 83 963 euro.

URL:

Title: Physiology of PTHrP in fish, relevance to calcium balance of an unique hypercalcemic factor

Summary and Objectives: The objective of this project is to determine the specific roles of PTHrP in fish tissues responsible for calcium handling. The specific objectives are 1. Set up a radioimmunoassay for PTHrP measurement of circulating plasma levels across species with different osmoregulatory pattern 2. Identify the relative importance of calcium sources for the whole body calcium budget i.e. environmental vs. dietary. 3. Investigate the "ex vivo"/"in situ" specific role of PTHrP and its truncated forms in calcium transport in isolated tissues and cells i.e. gill epithelia,

intestinal preparations, "in situ" kidney preparations 4. Analyse the cellular action of PTHrP in calcium transport and expose the mechanisms sensitive/insensitive to PTHrP.

Reference and funding entity: POCTI/CVT/48946/2002 (FCT)

Duration: 01/01/2005-31/12/2007

Research team: Juan Fuentes Diaz, Pedro Miguel Guerreiro, Deborah M. Power

Total budget: 50.000 euro

Title: Identification and function of crypt-type olfactory receptor neurons (CORN) in marine fish.

Summary and Objectives: The aim of the project is to study the crypt-type olfactory receptor neurons (CORNs) in the olfactory epithelium of marine fish. The first objective is to perform a comparative structural study of the olfactory epithelium of marine fish using histology, immunohistochemistry and electron microscopy. The originality of the study will be the use of the immunolocalization of the Na⁺,K⁺-ATPase as a tool for the visualization of the CORNs. The second objective of the study will be to investigate the function of the CORNs by applying the agmatine staining procedure that labels activated neurons. The sea bass and the seabream will be the principal models.

Reference and funding entity: FCT; POCI/BIA-BCM/60554/2004

Duration: 2005-2008.

Research team: Scientist in charge Christophe Haond; Adelino Canario; Peter Hubbard (CCMAR); Alexandre Lobo Cunha (Instituto de Ciências Biomédicas Abel Salazar, Universidade do Porto).

Total budget: 50 000€

Title: Stanniocalcin in sea bream: interaction with hypercalcemic factors in calcium balance

Summary and Objectives:

The endocrine control of calcium availability to the body fluids in higher vertebrates is well studied and primarily controlled by the interplay of the parathyroid hormone and calcitonin. In contrast, the endocrine control of calcium balance in lower vertebrates remains little understood. Endocrine factors with species-specific actions like cortisol, prolactin, estradiol or vitamin D have been suggested to actively participate in calcium metabolism in fish. We aim at characterise the putative interplay between PTHrP and stanniocalcin (STC), in short term calcium balance, and to establish their relative importance in calcium regulation in fish. We also propose to establish the relationship between short term and long term endocrine regulation of calcium balance in fish. The overall aim of the proposal is to establish the physiological role of the most important short term calcium regulating hormones in fish, STC and PTHrP and to establish the feed-back mechanisms by which calcium homeostasis is maintained.

Reference and funding entity: POCI/CVT/55683/2004 (FCT)

Duration: 1/06/2005-31/12/2007.

Research team: Juan Fuentes Díaz, Lilia Brinca, Adelino Canário, Pedro Miguel Guerreiro, Deborah Power

Total budget: 74.820 Euro

Title: Aquafirst- Combined genetic and functional genomic approaches for stress and disease resistance marker assisted selection in fish and shellfish

Summary and Objectives: The overall aim of this project is to identify genes associated with stress and disease resistance in oyster, trout, sea bream, and sea bass in order to provide a physiological and genetic basis for marker-assisted selection.

These studies will be carried out for fish using stress and pathogen challenges directly relevant to aquaculture and for oyster using environmental conditions that are known to lead to significant summer mortalities. In Part 1 of the project the genes involved in the functional response to stress or pathogen exposure will be identified. This will be carried out in the four species by (i) constructing relevant EST collections using SSH cDNA libraries which will be spotted on microarrays, followed by (ii) analysis of gene expression profiles in various tissues of animals exposed to stressors or pathogens. This analysis will be also carried out in families that are

divergent for stress response or disease resistance (fish) or for summer survival (oyster). In order to investigate relationship between potential candidate genes and QTL for these traits, Part 2 of the project will identify Single Nucleotide Polymorphisms (SNP) in these candidate genes in oyster and trout. This polymorphism will be analysed both in the EST sequences and in the promoter region. In Part 3 of the project QTL analysis will be used to identify genes that are associated with stress specific traits and disease resistance traits using previously characterized SNP and also microsatellites markers. We will also carry out mapping of these genes in linkage and gene maps. Part 4 is devoted to outline operational genetic protocols incorporating identified QTL and traditional breeding approaches in oyster, sea bream and sea bass. This knowledge will be transferred to the industry through organisation of workshops gathering scientists and RTD performers.

Reference and funding entity: sixth framework programme - contract n° 513692

Duration: 1/11/2004 – 31/08/2008

Research team: Adelino Canário, Deborah Power, Pedro Guerreiro.

Total budget: 3,799,954 EUR Euro; **Funding for CCMAR:** 63 493 Euro

URL: <http://lotus5.vitamib.com/hnb/aquafirst/aquafirst.nsf/Web/>

Title: Marine Genomics Europe - Implementation of high-throughput genomic approaches to investigate the functioning of marine ecosystems and the biology of marine organisms

Summary and Objectives: The overall aim of this project is to set up and develop a European Network of Excellence, referred to as "Marine Genomics", for the implementation of high-throughput genomic approaches in the biology of marine organisms. "Marine Genomics" will promote, develop, and spread throughout the European Union a broad range of genomic approaches, to investigate a wide range of questions related to the functioning of marine ecosystems and to the biology of marine organisms. With this aim in view, we propose to group and network experts in genomics, proteomics, and bioinformatics from several Centres of Excellence in genomics in Europe with marine biologists who can make use of high-throughput genomics data. This will involve the dedication and the development of common research infrastructures, both in genomics and in marine biology. Joining together these distinct scientific communities will establish Europe's lead in marine genomics.

The J.E.R. of "Marine Genomics" is broken down into Comparative, Functional and Environmental Genomics, three sections which structure more traditional streamlines, leading to various microbial, algal, evolution development and diversity, and fish and shellfish nodes. This research can be applied to the management of marine resources (prediction of global changes in marine populations, conservation of biodiversity, fisheries management and improvement of aquacultured species) and to gene mining for health and biotechnology.

The Integration activities of Marine Genomics are based on the following strategies: i) jointly develop enabling technologies; ii) sharing existing technical platforms iii) collectively gaining access to major Genomic centres; iv) regrouping under a common Bioinformatics Centre; and v), create and develop a Knowledge and Communication System, a permanent web-based interface for communications within and outside the network.

Spreading activities will include workshops and courses implemented by a Training & Education Council. Marine Genomics will also develop complementary dissemination strategies, targeting public, private and institutional communities with the purpose of enhancing the integration of marine biologists in the ERA.

Reference and funding entity: NoE sixth framework programme - contract n° 505403

Duration: 1/3/2004 – 28/02/2008

Research team: Adelino Canário, M. Leonor Cancela, Ester Serrão, Gareth Pearson, Deborah Power, Vincent Laizé, João Cardoso e outros.

Total budget: 10,000,000 EUR Euro; **Funding for CCMAR:** >100 000 euro

URL: <http://www.marine-genomics-europe>

Title: "Functional genomics using marine fish cell lines - **FICEL**"

Summary and Objectives: FICEL is a pilot project to develop high throughput molecular tools towards the identification of gene function in fish. The main objective of FICEL project is to develop

molecular tools towards the identification of gene function in fish. Genome sequence analysis initiated during the first phase of Marine Genomics Europe NoE must be complemented/ followed by functional genomics to assign a function to specific genes based upon experimental rather than *in silico* only evidences. These functional studies need: (1) *in vitro* cellular models from various tissues to answer specific questions on gene function and regulation, (2) *in vivo* systems suitable to verify the functional significance of selected genes, and (3) tools for large scale analysis of gene function. *In vitro* studies on specific gene function and regulation will be done through the use of gilthead seabream [*Sparus aurata*] cell lines already available (bone, branchial arch and fin) or developed within the scope of this work package (hepatocyte and adipocyte). Embryos from Atlantic killifish [*Fundulus heteroclitus*] will be used for *in vivo* studies. Large scale analysis of gene function will be done using tissue-specific shRNA libraries to silence gene expression in both *S. aurata* cell lines and *F. heteroclitus* embryos.

Funding agency: Marine Genomics Europe NoE GOCE-CT-2004-505403

Duration: 03/2005 - 03/2008

Research team: ML Cancela (coordinator), V laizé, J Cerdà, E Lubzens, JV Planas, A Canário

Budget: 271,450 euros

Title: "Chemical Communication in the Tilapia, *Oreochromis mossambicus*"

Summary and Objectives: Chemical communication is believed to play diverse and important roles in the biology of fishes. However, the number of species that have been studied in detail remains very low. Given their distinctive reproductive strategies and complex social behaviour, the cichlids have received surprisingly little attention in this respect. Over the past three years, our laboratory has made significant inroads into the understanding of chemical communication in the Mozambique tilapia, an African mouth-brooding cichlid. It is clear that this fish uses chemical signals both during reproduction and in the maintenance of social hierarchies. Thus the aim of the proposed project is to extend and embellish these initial findings, particularly with regard to the chemical cues that the females release, and answer some of the questions raised by previous research in both our and other laboratories. Firstly, the identification of putative pheromones released by pre-ovulatory females will be carried out in conjunction with IACR-Rothamsted (United Kingdom). We already know that pre-ovulatory females smell different from post-ovulatory to males, and that males behave differently towards them, depending on this olfactory cue. Our aim is to establish what these cues may be, and their likely source and routes of release. Once the likely site of pheromone synthesis is established - the ovaries - we can assess the endocrine factors responsible for the regulation of pheromone production *in vitro*. This may also prove to be a convenient way to collect relatively large amounts of pheromones for identification. Thirdly, the effects of the putative pheromones on male physiology and behaviour will be investigated; we already have good evidence that female pheromones induce an increase in the urination rate of males as part of their courtship 'display' (male urine is a potent odorant to females). Lastly, we will begin to investigate how this pheromonal information is processed by the CNS using a combination of neuronal activity-dependent labelling and immunocytochemistry for the early response element *c-fos*; to where in the olfactory bulbs (and possibly beyond) this information is relayed. In the future, this will allow us to define how the pheromonal message is translated into the appropriate behavioural and physiological responses. This species has a number of advantages for this type of study; the social behaviour is well-described, males and females are easily recognisable and are reproductively active throughout the year. It is also a resilient fish and amenable to the type of experimental manipulations outlined in this study. As such, it is an ideal introductory model for young scientists to learn how to formulate, and test, hypotheses. We think that the proposed project will establish the Mozambique tilapia as the model species for studies in chemical communication in

cichlids and provide an important addition to the studies of this phenomenon in teleosts as a whole.

Reference and funding entity: POCTI/BIA-BDE/55463/2004, FCT

Duration: 1/06/2005 – 31/05/2008

Research team: Peter C. Hubbard (Coordinator), Eduardo N. Barata, Adelino V.M. Canário, Christophe Haond.

Total budget: 91 620 Euro; **Funding for CCMAR:** 91 620 Euro

Title: “Mechanisms of olfactory sensitivity to inorganic cations in teleosts”

Summary and Objectives: Without exception, teleosts are able to maintain extracellular concentrations of physiologically important ions, such as calcium and sodium, at levels dramatically different from those of the environment. Much work has focussed on the mechanisms responsible for maintaining this differential; however, little is known about how the environmental concentrations of these ions is sensed. This is particularly important for those species that habitually encounter rapidly changing concentrations of these ions such as estuarine or migratory fish. We have recently shown that a range of different teleosts have high olfactory sensitivity to calcium and, to a lesser extent, sodium. The aim of the proposed project is to establish whether teleosts have distinct olfactory receptor mechanisms for both calcium and sodium, rather than a single 'salinity' receptor mechanism. To do this we will investigate the effects of changes in environmental ions to the olfactory sensitivity to sodium and calcium in three model species; the marine gilthead seabream (*Sparus auratus*), the estuarine bass (*Dicentrarchus labrax*) and the freshwater goldfish (*Carassius auratus*). Although all three species can tolerate some change in salinity, only the bass is truly euryhaline. Furthermore, we will investigate the long-term effects of salinity changes on the olfactory sensitivity to sodium and calcium. This is important to understand whether this olfactory sensitivity is primarily linked to internal ionic homeostasis, or to inform the fish where exactly, in a fluctuating environment, it is. Lastly, we will begin to investigate where, within the CNS, this primary sensory information is relayed. This will be done by a combination of activity-dependent neuronal labelling and immunocytochemistry for the early response element *c-fos*. We expect that primary sensory input concerning food-related odorants to be processed differently from that concerning levels of inorganic cations. However, do calcium sensitive neurones project to different areas of the olfactory bulb from those sensitive to changes in sodium? Once these questions are answered, future studies can be directed as to how these ions are detected (at a cellular and molecular level) and exactly what use the fish makes of this sensory information.

Reference and funding entity: POCTI/BIA-BCM/55467/2004, FCT

Duration: 1/01/2005 – 31/12/2007

Research team: Peter C. Hubbard (Coordinator), Eduardo N. Barata, Adelino V.M. Canário, Christophe Haond.

Total budget: 45 000 Euro; **Funding for CCMAR:** 45 000 Euro

Title: Characterization of folate and purine metabolism in the protozoan parasite *Perkinsus atlanticus*: Identification of genes involved in these pathways and potential therapeutic targets -

PTarget

Summary and Objectives: The major objectives are the identification of genes/pathways that are known to differ between protozoan parasites and their hosts such as folate and purine metabolism whose pathways appear to vary significantly between parasites and their hosts and therefore offer excellent opportunities for chemotherapeutic exploitation.

Reference and funding entity: POCTI/CVT/57982/2004, FCT

Duration: 06/2005 - 2008

Research team: R. Leite, R. Afonso, R. Ascenso, A. Brito, M.L. Cancela (coordinator)

Total budget: 84,552 euros

Title: Spatial-temporal pattern of expression and regulation of matrix Gla protein (MGP) during early development in *X. laevis* - **GLARE**

Summary and Objectives: *Xenopus laevis* will be used as model system to investigate the function of matrix Gla protein (MGP) in early vertebrate development building upon our results in this model system. (1) By injecting either distal (IA) or proximal (IB) promoter constructs of xMGP gene in fertilized eggs and detecting lacZ and GFP activity after midblastula transition we expect to clearly identify where and when each promoter is functional during early development. (2) Using the one hybrid screen technology, the already available promoter deletion mutants and our recently developed *Xenopus* X1 cell line we expect to identify and clone the regulatory nuclear factors involved in the regulation of MGP gene transcription after MBT and confirm binding by cotransfection and co-microinjection of wild type and mutant factors with the responsive DNA binding elements from MGP promoter. (3) Through maternal versus zygotic knockdown of the xMGP messengers using morpholino oligos we expect to unravel the functional relevance of these two transcripts and access the phenotype of xMGP loss of function.

Reference and funding entity: POCTI/BIA-BCM/58677/2004, FCT

Duration: 04/2005 - 2008

Research team: N. Conceição (Coordinator), M. L. Cancela, D. Simes, A.C. Silva and J. Belo

Participant institutions: CCMAR/UALG and CBME/UALG

Total budget: 90,000 euros

Title: MGP functional role regarding local regulation of extracellular matrix mineralization: Identification of the structural motifs responsible for its function - **Sparusprot**

Summary and Objectives: The major objectives are to determine which MGP protein domains and/or aminoacids are essential for the maintenance of its physiological function as an inhibitor of mineralization, using MGP point and deletion mutants which will be transfected into a homologous cell system capable of mineralization and recently developed and characterized in our laboratory.

Reference and funding entity: POCI/MAR/57921/2004, FCT

Duration: 09/2005 - 02/2008

Research team: D. Simes (coordinator), S. Marques, M.L. Cancela, V. Laizé, S. Cavaco.

Participant institutions: CCMAR/UALG

Total budget: 86,270 euros

Title: Identification and characterization of *C. gigas* nacre proteins inducing bone mineralization

Summary and Objectives: The main objective of this project is to identify and to characterize the water soluble matrix proteins involved in mollusc mineralization and to test their activity on vertebrate and invertebrate cells.

Reference and funding entity: F-47/06 Actions intégrées Luso-Francaises

Duration: 2005-2006

Research team: M.L. Cancela (coordinator), D. Simes, S. Cavaco, C. Delsert

Participant institutions: CCMAR/UALG - CRBM/Univ Montpellier II

Total budget: 2,000 euros

Title: "Efeito dos factores ambientais na infecção originada por *Perkinsus atlanticus* nas populações da amêijoia *Ruditapes decussatus* – **Ambiperk**"

Summary and Objectives: The major objectives are to investigate the importance of the environmental factors on the infection of the Portuguese clam *Ruditapes decussatus* by *Perkinsus atlanticus* and the effect of this infection on the reproduction of the clam populations.

Reference and funding entity: FEDER - MARE - Programa para o Desenvolvimento Sustentável do Sector da Pesca Fundação para a Ciência e Tecnologia, 22-05-01-FDR-00020

Duration: 07/2004 - 06/2007

Research team: R. Leite, R.Afonso, P.Dias, D. Matias, S. Joaquim, M.L. Cancela (coordinator),

Total budget: 191313 euros

Title: "Effects of xenobiotics in skeleton development and fin regeneration in fish - **XENOFISH**"

Summary and Objectives: A great number of chemicals in the environment can interfere with hormonal and other signaling pathways. These contaminants can enter in the aquatic environment and are known to bioaccumulate and biomagnify in the food chain. A potential target of xenobiotic compounds is the signaling pathway of AhR. The AhR functions as a ligand-activated transcription factor that controls the expression of several genes. Activation of gene transcription by transformed AhR complexes occurs through interaction with xenobiotic-responsive sequences (XRE) located in the promoter region of xenobiotic-responsive genes. Interaction of the xenobiotic-AhR-ARNT complex with one or more XREs, appears to initiate gene transcription (i.e., cytochrome P4501A1). Fish are among the most sensitive vertebrates to xenobiotic compounds. The hypersensitivity of fish embryos and larvae to xenobiotic compounds suggests that they may modulate the expression of genes involved in signal transduction and cell proliferation or differentiation. Exposure to xenoestrogens during fish embryonic and larval development leads to yolk sac edema, craniofacial malformation, cardiovascular dysfunction, growth retardation and mortality. Fin regeneration is a complex process involving multiple stages, which include mesenchymal cell differentiation as well as cellular differentiation and proliferation, most of these stages occurring in the first 4 days of fin regeneration. It could be possible that under xenobiotic exposure, the up regulation of the AhR pathway in the fin may lead to increased cell cycle arrest and inhibition of regeneration of the caudal fin. Because the physiological/molecular mechanisms implicated in bone and cartilage formation/ regeneration are not clearly understood, we propose the use of eggs, larvae and juveniles of *Danio rerio* and *Sparus aurata* for freshwater and saltwater respectively, as model organisms in order to study the effects of xenobiotics on skeleton development and fin regeneration. The major objectives of the present study are i) to identify the effects of the exposure to two model xenobiotic compounds, known to have either an antiestrogenic (3-methyl cholantrene (3-MC)) or estrogenic (lindane (LIN)) effect, in fish bone mineralization and development of abnormalities; ii) identification of possible correlations with altered expression of two marker proteins for bone and cartilage, osteocalcin and matrix Gla protein; and iii) effects of xenobiotic exposure on tissue regeneration after partial caudal fin amputation. For that purpose, *Danio rerio* and *Sparus aurata* eggs, larvae and juveniles will be used as model organisms.

Funding entity: Fundação para a Ciência e Tecnologia, POCI/MAR/60883/2004

Duration: Jan 2006 - Dec 2008

Research team: CCMAR: Paulo Gavaia, Leonor Cancela, Anabelo Brito

Total budget: 80,200 euros

Title: Identification of Sex Pheromones from the Anal Gland of Male Blennies, *Salaria pavo* and *S. fluviatilis* (Pisces: Blenniidae)

Summary and Objectives: *Salaria pavo* is small bottom living fish in the littoral zone of the Mediterranean and adjacent Atlantic coast. The closely related freshwater species, *S. fluviatilis*, inhabits rivers and lakes in the vicinity of the Mediterranean. In both species, the mating system is promiscuous. Males occupy holes or crevices in rocks where females come to spawn and the males subsequently guard the eggs. These are a good model fish species to investigate specialization in sex pheromone production. The males develop anal glands from the epidermis of the first two rays of the anal fin concurrent with development of the gonads. The research team has previously shown that the anal gland of *S. pavo* is a source of substances that attract pre-ovulatory females and promotes male reproductive success. This suggests that male blennies are "active signallers" in contrast with known pheromone systems in teleosts, where receivers are "chemical spies" detecting gonadal steroids or prostaglandins passively excreted by females into the water via the urine or gills.

The proposed work aims to identify the chemical structures of sex pheromones in both species. The marine origin of *S. fluviatilis* is well established and, as with *S. pavo*, it is plausible that the anal gland has a pheromonal function in female attraction. If so, one would expect the pheromonal components of the two species to have similar or closely related chemical structures. In addition,

the inclusion of *S. fluviatilis* in the project will simplify the chemical identification, since recording of electro-olfactograms (EOG) is technically easier in freshwater, and can be combined with chromatographic separation of anal gland-produced substances.

The research will involve: 1) testing a pheromonal function for the anal gland of males *S. fluviatilis* in female attraction, through behavioural assays in the laboratory; 2) evaluation of the specificity of pheromonal action through test of the behavioural activity of substances from the anal gland of male *S. fluviatilis* and the marine fish, *S. pavo*, on females of the other species; 3) solid phase extraction of substances released by the anal gland of both species, fractionation of extracts by vacuum distillation and chromatographic techniques, and evaluation of biological activity of each fraction through behavioural assays and EOG recordings; 4) chemical identification of active substances, and synthesis of putative pheromones; 5) confirmation of biological activity of synthesised chemicals.

This research project will likely provide empirical evidence to fill a gap in the current leading hypothesis on the evolution of fish sex pheromones. Known pheromonal systems in teleosts indicate that males are “chemical spies” of information excreted by females. Evidence of true chemical communication is lacking, where senders should have evolved a specialization in the way they produce and release a signal. The results will also add to the knowledge on *S. pavo* biology, grounding management strategies of the populations in the nature park of Ria Formosa (Algarve).

Reference and funding entity: POCTI/BSE/45843/2002, FCT

Duration: 1/02/2004 – 31/01/2007

Research team: Eduardo N. Barata (Coordinator), Peter C. Hubbard, Adelino V.M. Canário.

Total budget: 59.706 Euro; **Funding for CCMAR:** 59.706 Euro

Title: “Minimization of the effects of stress in senegal sole through amino acid supplementation - **STRESSAA**”

Summary and Objectives: Stressful conditions are known to cause growth suppression in cultured fish, either by impacts on appetite reduction, a stimulated catabolism, or a combination of both. As growth is essentially protein deposition, its optimisation depends on the understanding of protein and amino acid (AA) metabolism. The relative balance of the different metabolic pathways involved in AA metabolism is affected by the physiological condition of the animal. Thereby, stressful husbandry conditions do affect AA requirements. The central objective of this study is to contribute to a better understanding of the metabolic processes impinging on amino acid requirements of animals when they are exposed to stress situations. Post-larval and juvenile Senegal sole (*Solea senegalensis*) will be used as model species, because it is a species resistant to stress in terms of survival and also because it is a species of importance to the Portuguese marine aquaculture industry. It is intended to verify to what extent the amino acid metabolism of fish change when fish are under stress situations, and also whether the metabolic and growth depression effects of stress can be reduced by AA supplementation. The project will involve a first part where the effects of selected stressful husbandry conditions on growth and AA metabolism will be assessed in post-larvae and juvenile sole. This will involve the study of AA metabolism through different angles and methodologies: AA utilisation will be studied using tracer studies for individual AA, nitrogen balances and plasma free AA levels; food consumption will be determined using ¹⁴C as tracer for post-larvae and feed with glass beads plus x-rays for juvenile fish; stress condition will be ascertained by measuring plasma levels of cortisol, lactate and glucose; and the relative activity of the different intermediary metabolism pathways will be assessed through the determination of the activities of different enzymes. The second part of the project will verify to what extent the negative effects of stressful husbandry conditions on amino acid metabolism and retention can be minimized through supplementation of the diets with individual amino acids. Post-larvae and juvenile fish will be reared under selected acute and chronic stressful conditions based on the results of the first part of the project. Diets will be supplemented with individual key AA depending also on the results of the first part of the project. The same methodologies as before will be used to evaluate the results. Ultimately, this project expects to contribute to: 1) clarify the relation between stressful husbandry conditions and AA metabolism; 2) understand to what extent stress can affect animal growth and AA requirements; and 3) ascertain whether stress effects on growth and susceptibility to disease can be minimized through AA supplementation.

Reference and funding entity: Fundação para a Ciência e Tecnologia, POCTI/CVT/49324/2002

Duration: Fev 2005- Mai 2007

Research team: Luis Conceição, Cláudia Aragão, Maria Teresa Dinis.

Total budget: 50,000 Euro; **Funding for CCMAR:** 50,000 Euro

Title: “Understanding the regulation of the digestive function on marine fish larvae - **DIGFISH**”

Summary and Objectives: Scarce information exists concerning the digestive function of marine fish larvae. However, understanding the digestive function of fish larvae and the mechanisms they use to regulate this function at different stages of development is extremely important. This information will allow to stimulate food intake, to adequate diet composition to a specific stage of development and related them with food assimilation rates. Therefore, the knowledge of these mechanisms will contribute to enable marine fish larvae fed with microdiets to achieve growth and survival rates identical to live food.

To achieve this goal it is important to study the ontogeny of the neuro-endocrine system associated to marine fish larvae digestive tract, which in resemblance with other larval systems is poorly developed at first feeding although functionally adapted to this stage of development. According to existing bibliography, different periods can be identified on the neuro-endocrine system ontogeny, reflecting developmental differences in the regulation mechanisms of larval digestive function. The immunohistochemical methods are essential in this type of studies, since they allow the identification and location of nervous fibres and neuropeptides, although the latter only at a semi-quantitative level.

Some studies reported the importance of visual and chemical stimuli on the increase of food intake, either with live food or microdiets. Although an increase in pancreatic enzymes was reported, no relation was established with the regulation of the digestive function. The small dimensions of fish larvae difficult the use of standard methodologies for this kind of studies. The use of a new methodology will allow the quantification of cholecystokinin (CCK) secretion on individual larvae. With this method the influence of different stimuli on digestive function will be assessed, especially the pancreatic function that is essential during the larval stages of marine fishes. In parallel, the use of labelled food, based in another new methodology, will allow to quantify the effect of different stimuli on food ingestion and assimilation by fish larvae that will allow the evaluation of digestive function efficiency at different stages of development.

Reference and funding entity: Fundação para a Ciência e Tecnologia, POCTI/CVT/58790/2004

Duration: 2005- 2008

Research team: CCMAR: Laura Ribeiro, Maria Teresa Dinis, Deborah Power, Cláudia Aragão.

Total budget: 73056 Euros

Title: “Physiological importance and metabolism of aromatic and sulphur AA during fish ontogeny - **SULFAAR**”

Summary and Objectives: The major fate of amino acids (AA) is towards protein synthesis, but studies showed that the determination of the AA requirements should consider not only the AA profile of the proteins being synthesised, but also which AA are used for energy or for other metabolic purposes. Some AA are involved in the synthesis of other compounds of physiological importance, therefore a better understanding of its physiological role and metabolism deserves special attention. Among them, sulphur and aromatic AA may seem to have a special importance during the fish ontogenesis. The main objective of this study is to acquire a better knowledge on the physiological importance and metabolism of these AA during the early life stages of fish, focusing especially on taurine and tyrosine. Several questions regarding these AA need to be clarified and intend to be study within this project. Three model species will be used in this project: toadfish, which is a marine species with demersal eggs, seabream, and sole, which are marine species with pelagic eggs. Furthermore, sole and seabream are species with or without a marked metamorphosis, respectively. The first part of this project intends to analyse the aromatic and sulphur AA metabolism along development and to compare this metabolism in species with demersal and pelagic eggs. This will involve the analysis of the free AA profile in eggs and larvae of the three model species. In this first part, the larvae will also be tube-fed with radio-labelled precursors of taurine and tyrosine and is intended to verify if the pathways for the biosynthesis of

these AA are available in young fish stages. The second part of this project intends to better understand the effects of dietary taurine or tyrosine supplementation in growth, metamorphosis, and AA metabolism of fish larvae. This will be done by conciliating traditional studies on AA metabolism, involving the rearing of the species and the analysis of several parameters, with more recent techniques, such as the tube-feeding of radio-labelled AA, in order to analyse differences in AA utilisation. Larvae will be reared according to standard procedures and using diets supplemented or not with taurine or tyrosine. The first trials will analyse the effects of taurine supplementation on growth performance of the three model species. The second trials will analyse the effects of tyrosine supplementation on metamorphosis of fish species with and without a marked metamorphosis process, using sole and seabream as model species. For both experimental trials, the effects of AA supplementation on AA utilisation will be analysed. Fish receiving or not a dietary taurine or tyrosine supplementation will be tube-fed ³⁵S- or ¹⁴C-labelled AA and the fate of this AA will be followed in the fish. This project will ultimately result in a better understanding of the AA requirements during fish ontogenesis, which will have an impact in the aquaculture industry.

Reference and funding entity: Fundação para a Ciência e Tecnologia, POCTI/CVT/60176/2004

Duration: Jul 2005 - Jul 2008

Research team: CCMAR: Cláudia Aragão, Laura Ribeiro, Luís Conceição, Maria Teresa Dinis.

Total budget: 91,500 Euro; **Funding for CCMAR:** 91,500 Euro

Title: "Dietary amino acids and skeletal development in white bream (*Diplodus spp.*) - SAARGO"

Summary and Objectives: Although high larval survival rates are commonly observed in aquaculture production of white sea bream (*Diplodus spp.*), skeleton deformities are one of the main constraints. Diets with poor protein content and amino acid deficiencies have been related to development of skeletal deformities. The central objective of this study is to evaluate the possibility of minimizing the skeletal deformity problems commonly found when *Diplodus spp.* are cultured, through the use of amino acid supplements or increasing the quantity of available dietary nitrogen. It is also intended to verify how the expression of key proteins involved in skeletal development are affected, in order to better understand the mechanisms involved in skeletal development. Graded levels of protein hydrolysates will be supplied in the diet in order to verify to what extent skeletal deformities can be reduced through improvement of the quantity of available nitrogen in the diet of larval *Diplodus spp.* The efficiency of supplementation of a diet with different indispensable amino acids on larval *Diplodus spp.* will be determined. The effect of a diet well balanced in the different indispensable amino acids, or supplemented with amino acids involved in skeletal formation, on performance and skeletal deformities of larval *Diplodus spp.* will also be studied. In addition, the expression of selected skeletal proteins will be analyzed in normal and deformed fish obtained from the different dietary treatments. It is expected that the study of the skeletal proteome will allow to identify modulated protein clusters in skeletal tissue in response to dietary stimuli. The mechanisms through which dietary nitrogen influences skeleton formation should then be better understood.

Reference and funding entity: Fundação para a Ciência e Tecnologia, POCI/MAR/61623/2004

Duration: Nov 2005 - Oct 2008

Research team: CCMAR: Luis Conceição, Paulo Gavaia, Dina Simes, Pedro Rodrigues; IPIMAR: Pedro Pousão Ferreira, Margarida Saavedra.

Total budget: 86373 Euro; **Funding for CCMAR:** 55404 Euro

Title: "Algarve-Andalucía cooperation for promotion of the marine aquaculture resources in the South-Atlantic coast - PROMAR"

Summary and Objectives: To establish an inter-regional scientific and technical cooperation on rearing of new aquaculture species in order to promote marine aquaculture, through:

- Improvement of broodstock of new aquaculture species of common interest
- Improvement of experimental pilot aquaculture facilities

- To improve the rearing techniques of new aquaculture species such as fish, bivalves, gastropods and cephalopods of common interest.
- To establish a monitoring programme of the most common pathologies of farmed species
- Evaluate the genetic diversification of broodstock and identify genetic markers for the main aquaculture fish species.

Reference and funding entity: Programme **INTERREG IIIA, SP5.P117/03**

Duration: Jan 2006 - Dec 2007

Research team: CCMAR: Maria Teresa Dinis, Luis Conceição, Florbela Soares, Laura Ribeiro, Cláudia Aragão, Sofia Engrola, Leonor Cancela, Paulo Gavaia, Sara Mira; IPIMAR: Pedro Pousão Ferreira, Margarida Saavedra; Junta da Andalucía

Total budget: 995000 Euro; **Funding for CCMAR:** 150000 Euro

Completed in 2006

Title: “Optimização da reprodução do linguado (*Solea senegalensis*)- **REPROSOL**”

Summary and Objectives: The investigation of new species for aquaculture, such as the sole (*Solea senegalensis*) could offers potential development for many coastal regions along the Mediterranean belt (Dinis et al, 1999). However the mass production of this species has not yet been achieved. One of the major problems in the culture of this species is the control of reproduction in captivity and the production of regular high quality spawns. It is well known that environmental factors such as temperature and photoperiod as well as nutrition, play an important role in fish reproduction. However, little is known about how those factors can be controlled and evaluated, in order to produce high quality gametes in sole fish. Egg quality is a specific requirement for the production of healthy larvae. The aim of the present project is evaluate the parameters (zootecnical and feeding plan) that can control reproduction in sole maintained in captivity. Several sperm and egg parameters (biochemical and physiological) will be determined and analysed for correlations with fertility and hatching rates.

It is proposed to achieve these objectives:

- a. Parameters optimization on the broodstock reproduction
- b. The importance of controlled husbandry conditions on the maturation and emission of gametes, as well as in the production of high quality spawns.
- c. Characterize the influence of husbandry conditions, such as temperature, photoperiod and nutrition on gametes and egg quality.
- d. Effect of the hormonal induction in the broodstock reproduction
- e. Identification and characterization of the feeding plan for sole
- f. Characterize and identify quality in gametes and spawns

Reference and funding entity: MARE- 22-05-01-FDR-00026

Duration: 2004 - 2006

Research team: CCMAR: Florbela Soares, Maria Teresa Dinis, Elsa Cabrita.

Total budget: 224.507 Euro

Title: “The underlying mechanisms of the effect of microalgae on the early life stages of fishes – **MICROALGAE**”

Summary and Objectives: The beneficial role of microlagae on the development of marine fish larval is widely reported, however the mechanisms are still poorly understood. This project aims to understand a bit further how microlage affect marine fish larvae early stages. Two species of microalgae (*Tetraselmis chui* and *Isocrhysis galbana*), a commercial microalgae concentrate (Fitobloom®, Necton) and clear water, will be used as treatments. Sea bream and sole were the marine fish species used in this study since they are commonly used for aquaculture in the southern Europe. This project intends to analyse: 1) the effect of microalgae on larval ontogeny, growth and survival, biochemical composition and larval condition; 2) the effect of microalgae on the activity of digestive enzymes and some key enzymes of intermediary metabolism; 3) the effect of microalgae on food intake; and 4) the effect of microalgae on the modulation of the intestinal

microflora. The project expects to increase the knowledge on the effect of microalgae on fish larval development, which will contribute to obtain higher quality aquaculture products.

Reference and funding entity: Fundação para a Ciência e Tecnologia, POCTI/BSE/37378/2001

Duration: Out 2002- Feb 2006

Research team: CCMAR: Maria Teresa Dinis, Laura Ribeiro, Luis Conceição, Pavlos Makridis, Rui Rocha, Pedro Cação, João Sendão; ICETA: Emídio Gomes.

Total budget: 67,000 Euro; **Funding for CCMAR:** 59518.02 Euro

Title: “Nutritional requirements and feeding of blackspot seabream (*Pagellus bogaraveo*), a new species for aquaculture – **GORAZ**”

Summary and Objectives: In order to ensure a sustainable growth of the Portuguese mariculture, it is necessary to diversify the offer of cultivated species to avoid market saturation, competition among producers and to increase the efficacy of production facilities, namely hatcheries. The marine teleost, blackspot seabream (*Pagellus bogaraveo*), has a high market price and is considered as a strong candidate species for intensive aquaculture in Atlantic coasts. Up to now, studies with blackspot seabream under captivity are extremely scarce and have dealt mainly with the control of reproduction, larvae and juveniles cultivation techniques. To our knowledge, blackspot seabream has been fed with diets developed for other marine fish, namely gilthead seabream, and no available literature data exists on the specific nutritional requirements of this species. Therefore, the overall objective of this project is to contribute towards a better knowledge of the nutritional requirements and feeding strategies of the larvae and juveniles of blackspot seabream. Concerning the larvae, studies will cover: 1) optimisation of feeding strategies with live preys; 2) evaluation of precocious feeding strategies with micro-particulate diets; 3) optimisation of the dietary composition of micro-particulate feeds (i.e. dietary lipid, protein and energy level and source, adequate dietary PUFA level and DHA/EPA ratio). Regarding the juveniles, studies will evaluate: 1) the dietary protein requirements; 2) the relative potential of proteins, fats and carbohydrates as energy donors; 3) the optimal dietary DP/DE ratio. Given the economic importance and ecological implications of man-made feeds and feeding in aquaculture, the development of nutritionally balanced and environmental friendly diets is of utmost importance for a future establishment of blackspot seabream as a consolidated species in intensive aquaculture.

Reference and funding entity: Fundação para a Ciência e Tecnologia, POCTI 39239/2001.

Duration: Out 2002 – Mar 2006

Research team: CCMAR: Maria Teresa Dinis, Luis Conceição, Florbela Soares, Laura Ribeiro; CIIMAR: Emidio Gomes, Paulo Rema, Luisa Valente; DAM-SRP da Madeira: Carlos Andrade, Nuno Gouveia

Total budget: 100.000 Euros **Funding for CCMAR:** 15.081 Euros

Title: Skeletal development, alterations and malformations during larval ontogeny of species with interest for aquaculture. Molecular, cellular and biochemical approaches - **SPARUGENES**

Objectives: To perform an integrated study to evaluate the onset of skeletogenesis and development of skeletal structures during larval ontogeny of commercially important species in the southern Peninsula and Mediterranean area (Senegal sole, *Solea senegalensis*; Gilthead sea bream, *Sparus aurata*; white sea bream, *Diplodus sargo* and *hurta*, *Pagrus auriga*). Expression of specific genes and accumulation of these proteins will be compared between standard rearing conditions (live food and/or equilibrated diets) and by supplying microencapsulated diets, deficient or enriched in essential micronutrients.

Reference and funding entity: Spanish funding agency CICYT

Duration: 12/2003-11/2006

Research team: Coordinator: Carmen Sarasquete CSIC/Cadiz: Participants from UALG-CCMAR, M. Leonor Cancela, P. Gavaia, JB Ortiz-Delgado, Carla Viegas

Total budget: 150.000 Euro;

Title: “Mineralization processes in marine and fresh water teleosts: function of Gla proteins (Matrix Gla and osteocalcin) – **FishDev**”

Summary and Objectives: The main objectives are to investigate the mineralization processes during development and the involvement of BGP and MGP in these processes using zebra fish and solea as fresh water and marine model organisms.

Reference and funding entity: POCTI/CVT/42098/2002 - FCT

Duration: 06/2003-2006

Research team: Coordinator: L. Cancela. Participants: P, Gavaia, D.Simes, Susana domingues, MT Dinis (consultant)

Total budget: 65.000 Euro

Title: “Effect of extracellular calcium on MGP gene expression – **SaMGP**”

Summary and Objectives: The major objectives are to investigate the function of matrix Gla protein (MGP) in the regulation of the extracellular matrix mineralization and in cell differentiation through 1) characterization of the extracellular calcium effect on the regulation of MGP gene expression by identifying calcium sending mechanisms, transcription regulatory elements and signal transduction pathways; and 2) evaluate the effect of altered MGP levels on ECM mineralization and specific gene expression.

Reference and funding entity: Fundação para a Ciência e Tecnologia, POCTI/BCI/48748/2002

Duration: 03/2003 - 02/2006

Research team: V. Laizé (coordinator), M.L. Cancela, N. Conceição, A.R. Pombinho, D. Simes, S.M.P. Marques, V. Fonseca, D. Tiago

Total budget: 99.620 euros

Title: “ARRESTED DEVELOPMENT: The molecular and Endocrine Basis of Flatfish”

Reference and funding entity: Q5RS-CT-2002-01192

Summary and Objectives: Flatfish species form a major focus of the diversification of European marine aquaculture industry. However, production has been severely hampered by biological problems in larval rearing. The objectives of this project are to determine the biological bases for abnormalities arising during metamorphosis of a model cultured marine flatfish, the Atlantic halibut. This will be achieved by comparing normally and abnormally metamorphosing larvae in terms of differential gene expression, endocrine regulation, and biochemical and morphological transformations. This will help establish improved, cost-effective rearing techniques for the production of marine flatfish juveniles, ultimately strengthening European aquaculture of marine flatfish species, an important emerging industry in many rural, coastal areas.

Duration: 1/10/2002 – 31/03/2006

Research team: D. M. Power

Total budget: Euro; **Funding for CCMAR:** 217 536 Euro

Division of Living Resources

New and Ongoing beyond 2007

Title: Adaptive population divergence and comparative population structure in the brown algal genus *Fucus* (ADAPT)

Summary and Objectives: The project will investigate adaptive evolution of abiotic stress tolerance within and between species of the intertidal brown algal genus *Fucus*. The genus contains several closely related and broadly distributed species differing in stress tolerance and vertical distribution on the shore. Three approaches will be taken to study this question. First, available molecular biology tools and resources (abiotic stress-related EST collections from

subtractive libraries, full length cDNA libraries, EST sequence databases, as well as technical platform access and bioinformatic support) will be directed towards the generation of a gene polymorphism database for selectively relevant genes responding to abiotic stress in 3 species of *Fucus*. these data will be used to test the neutral theory of evolution for genes involved in abiotic stress responses. Any polymorphic loci found will be used to compare patterns of genetic structure at neutral versus selected loci. Secondly, genome wide variation in stress-responsive gene expression between species occurring in sympatry, and between isolated populations across species ranges, will be studied by the use of microarrays of desiccation-responsive cDNAs. These will be hybridized with mRNA from stressed versus control populations acclimated under common conditions in laboratory culture, and analysed with gene clustering tools. Thirdly we will compare patterns of population genetic structure using molecular markers (FST) with analogous estimates of quantitative trait variation (QST) in a common garden experimental design. Zygotes for half-sib or full-sib families will be produced by in vitro fertilization and outplanted in suitable field sites. Juvenile/young adult stages will be subjected to desiccation and thermal stress tolerance assays by rapid chlorophyll fluorescence screening. Estimated QST values will be compared with FST for neutral markers (microsatellites) and FST candidate stress-related genes if sufficiently polymorphic loci are available.

Reference and funding entity: FCT - (POCI/MAR/61105/2004)

Duration: Feb 2006 – Feb 2009

Research team: Gareth Pearson (coord.), Ester Serrão, Asuncion Lago

Total budget: 86400 Euro; Funding for CCMAR: 86400 Euro

Title: Ecology and evolution of mating systems in fucoid algae (MATING)

Summary and Objectives: Mating system evolution in marine algae is poorly understood despite their high variability. In the genus *Fucus* the character dioecy/hermaphroditism has undergone multiple switches and hybridization is possible between taxa with contrasting mating systems, making it an excellent model for this project, to study evolution of mating systems at both macro- and micro-evolutionary scales. In this project, phylogenetic analyses in parallel with comparative population biology in these hybridizing taxa, will be applied to provide insight into the factors that influence the evolutionary pathway between different reproductive systems. Specific aims are: - phylogenetic reconstruction of the evolutionary history of mating systems in the genus *Fucus* in order to test the hypothesis that hermaphroditism is the ancestral state and to assess whether shifts in mating system are correlated with different ecological pressures. –understanding the role of mating system in speciation over microevolutionary time scales, by using ecological and population genetics approaches to i) determine the frequency, success rate, and orientation of hybridization between hermaphroditic/dioecious species, and ii) evaluate the variability in sexual phenotype by comparing resource allocation patterns and reproductive success in parental species and their hybrids.

Reference and funding entity: FCT - (POCI/MAR/57499/2004)

Duration: Jan 2006 – Jan 2009

Research team: Ester Serrão (coord.), Gareth Pearson, Emanuelle Billard, João Neiva

Total budget: 89100 Euro; **Funding for CCMAR:** 89100 Euro

Title: Neutral and non-neutral genes: population diversity and stability (DIVSTAB)

Summary and Objectives: Evolutionary ecology studies in general, and conservation genetics studies in particular, are mostly based on the use of neutral markers to trace population history, estimate effective population size and study the pattern of gene flow. Theoretical models predict that low genetic diversity reduces the chances to persist and/or adapt to the variety of future environmental changes. yet, empirical or experimental evidences are lacking to establish a formal relationship between the levels of genetic diversity at neutral markers and at potentially adaptive genes. A major challenge in population genetics today, particularly in conservation genetics, is to understand whether or not the level of genetic variability at neutral markers is a good indicator of the level of variability of the entire genome, including polymorphic genes potentially submitted to natural selection. In this study we propose to isolate genes implicated in the response to different kinds of stress in *Zostera noltii* and *Fucus vesiculosus* in order to study the implication of

adaptation in the evolution of polymorphism and in demographic responses to natural populations. Experimental plots will be set up, exhibiting contrasted levels of genotypic diversity for neutral genes. These plots will be submitted to a combination of light and temperature stress and followed for demographic indicators, and the relationship between genetic diversity and demographic resistance to high stress will be tested for. Polymorphic non-neutral genes implicated in stress responses will be selected in *Zostera noltii* and *Fucus vesiculosus* by screening cDNA libraries. Polymorphic genes isolated will then be screened on the plots at the end of stress experiments, in order to test for the existence of a relationship between genetic variability at genes putatively involved in response to environmental stress and 1) genetic variability at neutral loci – microsatellites, as well as 2) resistance to stress as estimated during the experiments. By clarifying the relationship between neutral/non-neutral genetic diversity and population resistance to perturbation, this project will contribute with crucial scientific knowledge for evolutionary ecology and conservation genetics.

Reference and funding entity: FCT - (POCI/MAR/60179/2004)

Duration: Feb 2006 – Feb 2009

Research team: Sophie Arnaud (coord.), Gareth Pearson, Ester Serrão, Sónia Massa, Tânia Aires, Onno Diekmann

Total budget: 82800 Euro; **Funding for CCMAR:** 82800 Euro

Title: “**SAGRES** – Environmental impact of fixed fishing gears in the SW coast of Portugal. Conciliating fisheries and conservation of the marine ecosystem.”

Summary and Objectives: 1.- Compared selectivity of traps and fixed nets targeting spiny lobsters. 2- Propose management measures for the spiny lobster fishery in the SW coast of Portugal.

Reference and funding entity: POCTI/CTA/549248/2002

Duration: 2007-2008.

Research team: Margarida Castro, Dora Jesus, Ana Maria Leocádio.

Total budget: 50 000 **Funding for CCMAR:** 50 000.

Web site:

Title: “**SURVIVE** – Survival of Norway lobster (*Nephrops norvegicus*) escaping through the codend of trawling nets or by-catch reducing devices

Survival of Norway lobsters passing through the mesh of the codend. Norway lobster stocks in Portugal. Basis for assessment using information on larval production and ecology”

Summary and Objectives: 1.- Estimate abundance and propose management options based on the understanding of larval recruitment processes.

2- To investigate larval exchanges among the different adult populations along the Portuguese coast.

Reference and funding entity: PDCT/MAR/59366/2004

Duration: 2007-2008

Research team: Margarida Castro (coordinator of the CCMAR participation).

Total budget: 93 357 **Funding for CCMAR:** 60 720.

Web site:

Title: Decreasing fisheries resources: are non-professional fishermen to blame?

Summary and Objectives: The main objective of the proposed study is to quantify the impact of rod and line sport fishing in the south and south-west coast of Portugal, from Sines on the west coast to the mouth of the Guadiana river on the border with Spain. This will be done by: 1) quantifying the number of fishermen and mapping the distribution of their fishing effort over the year and area, 2) characterising and quantifying the sport fishing catches over a one year period and 3) evaluating the impact of sport fishing by comparison with the landings of professional small-scale fisheries in this area. A secondary objective is to characterize the sport fishermen from the demographic and socio-economic perspective through questionnaire surveys and to evaluate the economic importance of sport fishing at the regional scale by obtaining data on costs and

expenditures associated with the sport fishing activity. The study will provide valuable information that can be used to provide guidelines for sustainable management and conservation of inshore fisheries.

Reference and funding entity: FCT - (POCI/MAR/58157/2004)

Duration: Nov 2005- Oct 2007

Research team: Karim Erzini, Jorge Gonçalves, Pedro Veiga, David Abecasis, Luís Bentes, Pedro Monteiro

Total budget: 72500 Euro; Funding for CCMAR: 72500 Euro

Title: Sea bream spatio-temporal dynamics and habitat use in the Ria Formosa lagoon

Summary and Objectives: The main objective of this project is to study habitat use within the Ria Formosa lagoon. We will be using tagging studies (telemetry and external T-tags) to obtain information on sea bream movements within the lagoon. We will be able to answer questions such as: how important are the sea grass beds for sea breams? do sea breams use the small creeks and the areas that are flooded at high tide? are there daily migratory patterns? The information obtained will be useful for conservation and management plans for the Ria Formosa lagoon, which is a protected area of international importance.

Reference and funding entity: FCT - (POCTI/BIA-BDE/61949/2004)

Duration: Apr 2005- Mar 2007

Research team: Karim Erzini, Jorge Gonçalves, Pedro Veiga, David Abecasis, Luís Bentes, Pedro Monteiro

Total budget: 86,500 Euro; **Funding for CCMAR:** 86,500 Euro

Title: “LOBASSESS – Norway lobster stocks in Portugal. Basis for assessment using information on larval production and ecology”

Summary and Objectives: 1.- Estimate abundance and propose management options based on the understanding of larval recruitment processes.

2- To investigate larval exchanges among the different adult populations along the Portuguese coast.

Reference and funding entity: POCTI/BIA-BDE/59426/2004

Duration: 2005-2006

Research team: Margarida Castro (coordinator of the U. Algarve participation), Sara Mira.

Total budget: 89 946 **Funding for CCMAR:** 9 300.

Web site:

Title: “Impacto ambiental de artes de pesca fixas na costa sudoeste de Portugal. Conciliar a pesca e a conservação do ecossistema marinho”

Summary and Objectives: 1.- Compared selectivity of traps and fixed nets targeting spiny lobsters. 2- To propose management measures for the spiny lobster fishery in the SW coast of Portugal.

Reference and funding entity: POCTI/CTA/549248/2002

Duration: 2006-2008.

Research team: Margarida Castro, Dora Jesus + bolseiro.

Total budget: 50 000 **Funding for CCMAR:** 50 000.

Web site:

Title: “The molecular basis for differential stress-tolerance in sympatric, ecologically similar algal species – STRESSREG”

Summary and Objectives:

In order to address the poorly-understood role of physical stress in driving evolution in marine ecosystems, furoid algae with contrasting stress-tolerances will be used as models to investigate the molecular basis of their evolutionary divergence with respect to desiccation-stress responses. The models are three sympatric species of the genus *Fucus* (*F. serratus*, *F. vesiculosus*, and *F. spiralis*) with distinct vertical distributions in the intertidal zone, correlated with distinct physiological

tolerances to desiccation stress. The recent evolution of the genus suggests that small molecular changes, in genes or regulatory regions, may account for differences in stress-tolerance.

This project will compare homologous desiccation-responsive genes from the 3 species, and their cis-regulatory regions. Results from current work in isolating desiccation- and rehydration-specific transcripts using suppression subtractive hybridization will be used to 1) Screen cDNA libraries for 3 species to obtain full sequences of homologous genes; 2) Screen for species-specific variations in gene expression in response to desiccation using Northern analysis. Candidate genes will be selected for further analysis. Since important species differences may lie at the level of gene regulation, promoter regions will be sequenced, either using a PCR-based strategy, or by screening genomic libraries. Online tools and sequence comparisons will be used to search for conserved DNA-binding elements and species variations. Major novel scientific advances: 1) Understanding the role of physical stress in driving molecular evolution in marine ecosystems, 2) Identify which evolutionary changes at the molecular level are responsible for divergence in stress-resistance in closely-related species, 3) Improve the limited knowledge of stress-responsive genes and regulatory pathways in non-green photosynthetic organisms. In summary, the project will provide insight into the evolution of stress-responsive genes in sympatric species in marine environments.

Reference and funding entity: FCT (POCTI / BSE / 48317 / 2002)

Duration: Apr 2004-Mar2007

Research team: G. Pearson (coordinator), E Serrão, A. Lago-Leston

Total budget: 105490 Euro **Funding for CCMAR:** 105490 Euro

Title: Conservation of marine prairies: causes of regression and effects on ecosystem function

Summary and Objectives:

The goal of the proposed research is to assess the causes of the decline of seagrass meadows, the development of early warning techniques to detect stress to seagrass meadows and the evaluation of the health of seagrass meadows and their functions. Finally, the project aims at the design of strategies for the effective conservation of seagrass meadows in the Mediterranean, Caribbean and Gulf of Mexico. The project will provide the scientific basis necessary to propose a conservation plan for the sustainable management of the meadows in protected areas.

Reference and funding entity: Fundación BBVA, Spain.

Duration: 1/09/2005 - 31/08/2008

Research team: list of PI's: IMEDEA, CSIC-UIB (Carlos M. Duarte, coordinator), CEAB, CSIC (Esperança Gacia, ecology), IVIA Valencia (Ester Marco, bacterial infections), CCMAR, Portugal (Ester Serrao, genetic markers), ICML, Univ. Aut. Mexico (Susana Enriquez, physiology), IDO, Cuba (Mercedes Cano, biodiversity), CIEC, Cuba (Adán Zúñiga, coastal dynamics), Dauphin Island, U. Alabama (DISL), USA (Just Cebrián, competition eutrofication).

Total budget: 170 000 Euro; **Funding for CCMAR:** CCMAR does not receive a fixed amount, but will receive reimbursement for travel costs and for expenses associated to the field and laboratory work, as needed.

Title: Genetic diversity and differentiation in the seagrass species *Zostera noltii* and *Cymodocea nodosa* across the Atlantic-Mediterranean divide.

Summary and objectives:

The southern Atlantic and Mediterranean coasts of the Iberian Peninsula are biogeographic transition zones where many marine species encounter their distribution limits. The Atlantic-Mediterranean junction is an important region because it may function as a barrier to gene flow affecting population structure and connectivity. Only few studies have addressed questions related to this putative biogeographic barrier to gene flow and none of these involved seagrasses. Two possible explanations for maintaining genetic discontinuities are the sea surface currents associated with the Strait of Gibraltar and the existence of a hydrogeographic surface water boundary between Almeria and Oran, the Almeria-Oran ocean front. Two seagrass species,

Zostera noltii and *Cymodocea nodosa* are dominant in this region often growing in the same locations though in different habitats. In the proposed project intra-specific phylogenetic relationships, genetic diversity, genetic structure and connectivity will be studied between populations of two important seagrass species with different life-histories, *Zostera noltii* and *Cymodocea nodosa*, along the Southern Iberian coast across the Strait of Gibraltar. Intra specific phylogenetic relationships will be studied using ITS rDNA and matK cpDNA sequences. Genetic diversity, population genetic structure and gene flow will be investigated using high resolution microsatellite markers specifically designed for the *Z. noltii* and *C. nodosa*.

The proposed project will lead to the following novel scientific contributions:

- 1) The importance of the Atlantic/Mediterranean divide as a biogeographic barrier to gene flow.
- 2) Understanding of population dynamics as to where are sources or sinks for gene flow. This information will be of great importance for conservation and restoration of seagrass meadows and their habitat.

Reference and funding entity : POCI/MAR/60044/2004, FCT

Duration of the project : 01/11/2005 – 31/10/2008

Research team : O. Diekmann (coordinator), F. Alberto, E. Serrao, S. Arnaud-Haond

Total budget : 41400€ **Funding for CCMAR:** 41400€

Title: Genetic Networks and Evolution: from individuals to populations

Summary and objectives:

A network is a system composed of several interacting nodes related among them by links. A variety of networks have been defined in physics, all exhibiting specific properties as to the pattern of dominance of certain nodes or the resistance to perturbations of the whole system. During the last decades, the principles of networks have been shown to apply to a wide variety of biological phenomena, from ecosystems to food webs, or gene expression. In this project, we apply network analysis to the structure of the genetic relationship between different levels of organization, from individuals to populations, in clonal marine plants and algae with contrasting life spans and life histories: *Posidonia oceanica* (high longevity), *Cymodocea nodosa* (younger but stable meadows), and *Caulerpa prolifera* (short life-span, colonizing species). At the intra population level, a network organization will help to describe and analyze the genetic relationship, and genealogy, between individuals. This task will have a particular importance and will be specifically developed to deal with those populations of clonal organisms in which some clones are susceptible to being highly dominant, both in terms of space occupation and in terms of contribution to the next generation. At the inter population level, it will provide a description of the metapopulation systems in terms of migration links, or preferential colonization pathways between populations. This will allow to test for the possible existence of some migration pathways or dominant populations acting as "central nodes" relaying gene flow, and then for the possible consequences of local extinctions. Such information are essential to understand population dynamics, and the impact of population fragmentation or local extinctions on a metapopulation system. Finally, this project will allow to explore the network properties of metapopulation systems and will open new prospects as for the possible applications of network analysis in population genetics.

Reference and funding entity : POCI/MAR/57342/2004, FCT

Duration of the project : 1 Jul 2005 – 31 Jun 2007

Research team : S Arnaud (coordinator), E. Serrao, F. Alberto, E. Varela (with the teams of E. Hernandez and C. Duarte, from CSIC, IMEDEA)

Total budget : 45000 € **Funding for CCMAR:** 45000 €

Title: Population dynamics, geographical distribution and genetic diversity of macroalgal species at their southern distributional limits (LIMITS)

Summary and objectives:

The Portuguese coast constitutes the southernmost distribution limit of nearly 40 species of macroalgae. Populations living at their southern distribution limits experience adverse environmental conditions that, magnified by climatic changes, may lead to changes in population dynamics and geographical distribution of these species. These populations, isolated near their limits of distribution can become genetically differentiated as a consequence of limited interpopulational gene flow and local adaptation to their environment. This project aims at understanding whether southern limit populations on the Portuguese coast have diverged from central range populations, particularly aiming at answering the following questions: 1: are growth, reproductive rate and population dynamics different at the southern limits? 2: is intra-population genetic diversity lower and are populations more differentiated at this distributional limit? 3: have these species undertaken changes in their southern distributional limits in the last 40 years? 4: what is the capacity of resistance and recovery of these populations to environmental disturbance? In order to address these questions the current distributional limits of the nearly 40 species with southern distribution limits in the Portuguese coast will be established and compared with the data available in previous studies. To address the other questions 4 species of brown algae will be selected (*Fucus serratus*, *Ascophyllum nodosum*, *Pelvetia canaliculata* e *Himantalia elongata*) as study models. These species have different distributional heights in the intertidal zone (2 in the midlittoral zone and 2 in the low littoral zone) thus representing different conditions of environmental stress. In conclusion, the objective of this project is to understand whether these populations are adapted to the higher stress conditions that they have to face at their distributional limits and in case the marginal populations should disappear what is the uniqueness of the genetical heritage that will be lost.

Reference and funding entity : POCI/MAR/56149/2004, FCT

Duration of the project : 1 Sept 2005-31 Aug 2008

Research team : I. Sousa-Pinto (coordinator, CIIMAR), R. Araújo (CIIMAR), E. Serrão, G. Pearson, F. Alberto

Total budget : 54000 € **Funding for CCMAR**: 25020 €

“Recrutamento de Espécies Piscícolas de Interesse Comercial no Estuário do Rio Arade” (DGPA – MARE P.O. Pescas: 22-05-01-FDR-00017). Jorge Gonçalves.

Title: “**LOBASSESS** – Norway lobster stocks in Portugal. Basis for assessment using information on larval production and ecology”

Summary and Objectives: 1) Estimate abundance and propose management options based on the understanding of larval recruitment processes. 2) To investigate larval exchanges among the different adult populations along the Portuguese coast.

Reference and funding entity: POCTI/BIA-BDE/59426/2004

Duration: 2005-2007

Research team: Margarida Castro (coordinator of the CCMAR participation), Sara Mira.

Total budget: 89 946 € **Funding for CCMAR**: 9 300 €

Web site: <http://ipimar-iniap.ipimar.pt/divulgacao/LobAssess/index.html>

Title “Biodiversity in fisheries off the South coast of Portugal (Algarve) (BIOFISH)” (Ref: 22-05-01-FEDER-00031)

Summary and Objectives: The main objective of this project is the compilation, characterization and photographic registration of all faunal species caught by commercial fisheries off the south coast of Portugal (Algarve), not only known commercial species, but also non-commercial species, which are generally discarded due to their inexistent commercial value in Portugal. All species caught by the most important fishing gears (trawl, purse seine, trammel net, longline, etc) will be identified, photographed, and all biological, ecological and fisheries information as well as their socio-economic importance, will be compiled. The result will be the production of a book with all species caught by fishing gears used off the coast of Algarve, to divulge in the fishing community (fishermen, researchers, managers) and public in general. A reference collection will also be created, open to all community.

Duration: 2005-2007

Funded by: Programme MARE, DGPA

Research team: Teresa Cerveira Borges (coordinator), Sónia Olim, Paulo Morais, Luís Fonseca, Margarida Cristo, Margarida Machado, Jeff Wallace, João Sendão, José Xavier, António Malaquias, Carlos Afonso, Esmeralda Costa, João Gomes, David Francisco (photographer).

Total budget: 246 052 €

Funding for CCMAR: 246 052 €

Title: “Global related changes in the Portuguese marine flora over a long time scale”

Summary and Objectives: The main aim of this proposal is to describe the long-term changes in the benthic marine flora of the continental coast of Portugal by comparing the actual situation with the only available description of the Portuguese marine flora, which was done in the 1960’s by André (1970, 1971).

Reference and funding entity: POCTI/BSE/48918/2002

Duration: 2003-2007

Research team: R Santos, E. Barecibar, J. Silva

Total budget: 92 000 Euro **Funding for CCMAR:** 92 000 Euro

Title: “Carbon uptake by Ria Formosa intertidal communities”

Summary and Objectives: This proposal aims to quantify the carbon uptake of the main intertidal communities of Ria Formosa coastal lagoon, both when submerged and when air-exposed. Specific objectives are:

- To establish innovative and reliable methods for field assessment of intertidal communities’ carbon uptake, namely the seagrass *Zostera noltii* and the cordgrass *Spartina maritima*.
- To determine the short-term variability of the carbon uptake, as conditioned by the combined rhythms of circadian light and tidal cycles.
- To determine the seasonal variation of the carbon uptake.
- To evaluate the intrinsic mechanisms determining the community carbon uptake by investigating the photosynthetic responses of the main species to changes in light, temperature and water stress during tidal cycles.
- To assess the effects of increased CO₂ on the carbon uptake, both at the community and the species level, in a global change scenario.
- To obtain a comprehensive set of data for the up-scaling (modelling) of the carbon uptake to the whole-system level.

Reference and funding entity: POCI/MAR/58172/2004

Duration: 2005-2008

Research team: J. Silva (coordinator), R. Santos, I. Barrote, R. Carmona

Total budget: 72 013 Euro **Funding for CCMAR:** 72 013 Euro

Title: “Improvement of the cost effectiveness of marine land-based aquaculture facilities through use of Constructed Wetlands with *Salicornia* as an environmentally friendly biofilter and a valuable by-product”

Summary and Objectives: One of the main economic problems for SMEs operating land-based facilities is the cost of water treatment. The cost of this single item, approximately 0.5 Euro per kg feed consumed by the fish can mean the difference between a profit-making enterprise and failure. Developing a cost-effective biofilter which will remove the nutrients from the water and convert these nutrients into valuable products, has the potential to solve both economic and environmental constraints.

Protein is the most expensive component of fishmeal and the main source of nitrogenous pollution in aquaculture. In conventional mariculture, fish or shrimps assimilate only part of their diets; the rest is excreted into the water, mainly as dissolved inorganic or solid organic compounds. These effluents may damage coastal ecosystems. According to international (EU) and national regulations, fish effluents must be treated before being discharged back to the sea.

We propose the use of constructed wetlands (CW) planted with halophytes, which would take in the nutrient-rich wastewater and convert it into valuable plant biomass. The CW will be evaluated in three prototypes, in cold, temperate and warm water conditions that are representative of systems that may be applied in the prevailing climates of most European countries.

CW is efficient in clearing water of nutrients and suspended solids, some materials being purified through incorporation into the plants and others attaching to the substrate or being broken down by bacteria living therein. CW has the benefit of being low cost, simple to operate, and can be given an aesthetically pleasing appearance to attract tourism.

Salicornia is a succulent halophyte, which flourishes best in intertidal areas flooded by brackish and seawater and collects nutrients and salts. These plants have commercial value as a health food and are potential candidates for the health, beauty and nutraceutical industries. The *Salicornia* market is presently based mostly on amateur gathering of branches from wild plants, which limits the market supply because most natural wetlands are protected areas where harvesting is limited or forbidden. Quality and quantity of the halophytes are inconstant and change throughout the year and the product is not clean or uniform, which is a disadvantage for commercial processing. Conversion of 'expensive' nitrogen from fishpond effluents into a valuable commodity as a raw product or source of extract for the beauty and nutraceutical industries will diversify the fish farm products and will increase the profitability of land-based facilities. The main objective of the project is the improvement of the cost-effectiveness of marine land-based facilities through use of Constructed Wetlands with *Salicornia* as an environmentally friendly biofilter and a valuable by-product for the health food, nutraceutical and beauty industries

Reference and funding entity: EU CONTRACT No COOP-CT-2006 – 032167 Co-operative

Research Projects

Duration: 2006-2008

Research team: R. Santos (coordinator), J. Silva

Total budget: 1 422 543Euro **Funding for CCMAR:** 129 500 Euro

Title: "The invasive theory of the pest seaweed *Sargassum muticum* in Southern Portugal"

Summary and Objectives: The main aim of this proposal is to use the brown seaweed *Sargassum muticum* to test general invasive theories like the enemy release hypothesis that states that invaders have an advantage over local competitors because they are not considered as a food and habitat source by local animals.

Reference and funding entity: POCTI/MAR/55377/2004

Duration: 2005-2008

Research team: A. Engelen, R. Santos, E. Serrão, L. Gouveia, T. Cruz, J. Castro

Total budget: 85 500 Euro **Funding for CCMAR:** 85 500 Euro

Title: "Green macroalgal blooms in Ria Formosa and adjacent coastal beaches"

Summary and Objectives: The Ria Formosa is a large lagoon in southern Portugal. Every winter, an ulvoid macroalgal bloom occurs within the lagoon whereas a summer bloom occurs along the beaches outside the lagoon. Expected increases in nitrogen loads from urban sewages and agriculture runoff may drive drastic increases in macroalgal blooms, which may disrupt the lagoon ecosystem and be a serious threat to summer tourism. This proposal aims to identify the species-specific nitrogen metabolism of the blooms both within and outside the lagoon and to relate them with the nitrogen mass balance between the lagoon and the adjacent terrestrial and coastal zones. A model of the macroalgal blooms in the lagoon as influenced by extrinsic (nutrient loads, weather) and intrinsic variables (algal nutrient uptake rates, mortality rates) will be developed.

Reference and funding entity: POCI/MAR/58427/2004

Duration: 2005-2008

Research team: E. Malta, A. Alexandre, R. Santos, J. Silva (CCMAR), T. Stigter, A. Carvalho (IMAR)

Total budget: 73 800 Euro **Funding for CCMAR:** 57 537 Euro

Title: “Microben2. Ecological responses of microbenthos to accumulation of nitrophilic macroalgae on intertidal sediments: Senescence and early diagenesis”

Summary and Objectives: The proliferation and accumulation of macroalgae blooms on the sediment is a characteristic signal of eutrophication in coastal areas. These blooms have been shown to affect other ecosystem compartments (flora, fauna, microbenthos, etc.), compromising several ecosystems functions and services. The general objective of this proposal is to evaluate the microbenthos response when the macroalgae biomass undergoes senescence and decomposition in the following four aspects: 1) Net community metabolism 2) Structure of microbenthic community and of meio-and macrofauna 3) Mass exchange at the sediment-water interface 4) Effects on the early diagenesis of organic matter and the fate of carbon in the upper layer of the sediment, due to the interaction between the inorganic components of the sediment with the degradation products of the organic matter and microbial activity. These processes will be studied at microscale and nanoscale in terms of geochemical, mineralogical and textural changes. Additionally it is intended to study the eutrophication history of the last 150 years of the Bay of Cádiz by means of well known indicators and comparable system as the Ria Formosa in Portugal.

Reference and funding entity: CTM2006-04015/MAR, Ministerio de Educación y Ciencia, Espanha

Duration: 2007-2010

Research team: A. Corzo, J. García, E. Morris, E. García (Dept. de Biología, Universidad de Cádiz, Espanha), J. Guevara (Ayuntamiento de Málaga, Espanha), P. Mata, J. Martínez, A. Sánchez (Dept. de Cristalografía y Mineralogía, Universidad de Cádiz, Espanha), E. Malta, R. Santos (CCMAR)

Total budget: 107 690 Euro **Funding for CCMAR:** Not specified. Travel expenses and costs of analyses of the CCMAR will be paid for by the University of Cádiz from this project.

Title: Estado de conservación de los fondos de maerl en el Atlantico de la peninsula Iberica

Summary and Objectives: The aim of this project is the improvement of the maerl community knowledge in the Atlantic Iberian Peninsula (Galicia and southern Portugal) to study the high floristic diversity of this subtidal community and assess the conservation status in these protected areas, as well as to determine the vulnerability of the main maerl-forming species. The project will provide a valuable and accurate data of the Atlantic maerl populations in order to compare with the current information from the rest of European ones. It is closely related to the ongoing research and conservation/legislation efforts on the biodiversity of the European coasts since the data obtained from the project will be useful in the Habitats Directive of Natura.

The project encompasses the following targets: a) the floristic characterization of the maerl-forming algae and their associated epiflora, as well as their latitudinal variations from North to South; b) the study of the seasonal variability of the associated epiflora and its relationship with the environmental factors like temperature and light; c) assessment of the conservation status of the maerl beds and search for the main threats derived from human activities like eutrophication, reduction of water quality, sedimentation, smothering and invasions of alien species; and d) adjustment and development of a new methodology to assess in situ the productivity of subtidal communities using infrared gas analysis (IRGA) by an improved prototype apparatus with the ability to measure CO₂. **Reference and funding entity:** CGL2006-03576/BOS, Ministerio de Educación y Ciencia, Espanha

Duration: 3 years

Research team: Universidade de La Coruña, Espanha: Javier Cremades Ugarte, Viviana Peña Freire, Oscar Freire Gago, Sergio Baamonde López, Pilar Díaz Tapia, Verónica Lagos González, María del Carmen López Rodríguez

Universidad Complutense, Madrid: Tomás Gallardo García

CCMAR: Rui Santos, Estíbaliz Berecibar Zugasti

Total budget: 124630 Euro; **Funding for CCMAR:** Not specified. Travel expenses and costs of analyses of the CCMAR will be paid for by the University of La Coruña from this project.

Title: Assessment of the production and harvest impact of the seaweed *Sphaerococcus coronopifolius* in the adjacent coastal zone of the Sines power plant.

Summary and Objectives: 1. Assessment of the impact of harvesting the seaweed *Sphaerococcus coronopifolius* on the population structure, recovery and reproduction. This species is a nuisance for the Sines power plant as it accumulates on the water filters of the cooling system to a point that the power plant must be shut down.

2. Development of a production model for the species to integrate in a hydrodynamic model to preview the release and transport of seaweeds to the power plant.

Reference and funding entity: Hidromod/EDP

Duration: 2006-2008

Research team: CCMAR – R Santos, J Silva, Rita Costa

Total budget: n.a. **Funding for CCMAR:** 100 000 Euro

Title: “Cultivation and halogen compounds yield of Bonnemaisoniaceae red seaweeds”

Summary and Objectives: The aim of this proposal is to investigate the effects of different cultivation conditions on the productivity of different species of the algae family Bonnemaisoniaceae as well as on the yield of secondary metabolites, which may be marketed for a wide range of applications in cosmetics, preservatives and antifouling, so that its commercial cultivation can be optimized.

Reference and funding entity: POCI/MAR/56956/2004

Duration: 2005-2008

Research team: CCMAR - R Santos. L. Mata, I. Figueiredo; INETI – H. Gaspar, M. Humanes

Total budget: 99 153 Euro **Funding for CCMAR:** 99 153 Euro

Title: “Filtralgaes – Cultivo de macroalgas para biofiltração de água salgada de um parque oceanográfico de entretenimento educativo”

Summary and Objectives: O objectivo do projecto é testar a biofiltração de nutrientes da água salgada de um parque oceanográfico de entretenimento educativo, usando algas. O efeito da biofiltração por algas será monitorizado tendo em conta a qualidade da água e a saúde e bem-estar dos animais de exposição. Os resultados esperados do projecto permitirão:

1. Reduzir o investimento associado à substituição periódica da água dos tanques de exposição e aquários

2. Melhorar a qualidade da água dos aquários e a saúde dos seus habitantes

3. Reduzir o potencial impacto ambiental resultante da libertação da água com elevada concentração de nutrientes no meio

4. Diversificar os atractivos do parque expondo o sistema de biofiltração ao público

5. Incrementar a boa imagem pública da empresa

6. Produzir biomassa de algas comercializável ou com uso potencial na própria empresa como, por exemplo, para a alimentação de animais herbívoros marinhos, para a decoração dos aquários ou para a elaboração de fertilizantes naturais à base de algas para as plantas ornamentais dos jardins da empresa.

Reference and funding entity: Agência de Inovação

Duration: 2006-2008

Research team: CCMAR - R Santos. L. Mata, A. Schuenhoff; **Mundo Aquático** – E. Vicente, M. Bragança, B. Nascimento, P. Barroso

Total budget: 119 832 Euro **Funding for CCMAR:** 12 803 Euro

Title: “Recruitment of Fish Species of Commercial Interest in the Arade River Estuary”

Summary and Objectives: Knowledge concerning estuarine fish communities is particularly important for the sustainable management and exploitation of our natural resources. Given that the estuary of the Arade river is one of the largest in the south of Portugal, there is a pressing need to better understand the ichthyofauna and how the different fish species use the estuary. Information concerning the type of recruitment, migrations and habitat use (spawning, shelter and feeding),

especially with regards to juveniles of commercially important species, is of primary importance for coastal fishing activity and the conservation of these resources. On the other hand the existence of protected or threatened species and habitats should be evaluated in a way that sustainability can be ensured by means of appropriate measures. The dissemination of this knowledge is urgent given the utility for the public in general and for the various public and private economic entities involved. It is not enough to merely know it is also necessary to inform so that a sustainable relationship between man and the natural resources can be established and perpetuated. The objectives of this project are twofold: 1- The characterisation of the structure of the fish community and the distribution of the different species in the estuary of the Arade river, with particular emphasis on the juvenile stages of commercial and threatened species and the interactions between their distribution and abundance and estuarine environmental parameters. 2 - The dissemination of scientific knowledge to the public in general, to public and private entities and to the scientific community.

Reference and funding entity: MARE Programme - P.O. Pescas (Cód. 22-05-01-FDR-00017)

Duration: 2003-2006

Research team: CCMAR: Jorge M.S. Gonçalves, Pedro Veiga, Daniel Machado, Luis Bentes, Pedro Monteiro, Rui Coelho and Karim Erzini

Total budget: 139170 Euro; **Funding for CCMAR:** 139170 Euro

Web site: <http://www.ualg.pt/fcma/cfrg/>

Title: "Condição nutricional das larvas de peixes nas principais áreas marinhas protegidas do sul de Portugal (Ria Formosa e Estuário do Guadiana)" **GUADIRIA**

Summary and Objectives

In the south of Portugal there are two important and contrasted marine protected areas: the Ria Formosa and the Guadiana estuary. The Ria Formosa is a tidal coastal lagoon, with low depth and high rate of water exchange with the sea, and the Guadiana river has is a medium estuarine area, with an irregular hydrological regime, with severe droughts and floods, and its under increasing pressure for exploitation of water resources, being the construction of Alqueva dam the most recent example. Both systems are highly productive and provide ideal conditions for initial phases of fish's life cycle.

Besides previous studies, that have show that these coastal systems are important nurseries areas for juveniles, especially the salt-marshes areas, for many commercially important fish species, several issues are still not understood. They are: Is the nutritional condition of fish larvae higher inside these systems compared with the same species captured in coastal zone? Is this due to higher food availability or to higher predation inside the systems that remove weak larvae quickly or to absence or retention strategies? Are there, from typical fish species, some more sensitive to inanition than others? Are larval species from benthonic eggs more resistant to adverse environmental condition than that from pelagic egg? Our main objective will be an in depth investigation of the nutritional condition of larval phase of the fishes inside the Ria Formosa and the Guadiana estuary. Specific objections are the answers to the above questions, through the use of nucleic acids derived indices, such as RNA/DNA, RNA residuals and DNA per mg of larva dry weight. Those indices have been used successfully in several larval fish species in different phase of its development to access their nutritional condition. This project will tstudy the relative importance of ontogenic (benthonic or pelagic eggs) or ecohydrologic factors (currents, winds, food availability) in the nutritional condition of fish larvae in the selected systems. It will be selected fish species residents in these systems such as Gobidae with benthonic eggs and larvae from planktonic eggs, usually temporary species, such as Soleidae or Sparidae for the Ria Formosa, and *Engraulis encrasicolus* for the Guadiana estuary. The sampling of this larval species will be done inside the Ria Formosa and the Guadiana estuary and in both adjacent coastal areas. Light trap will be use to capture the fish larvae, in order to minimize the physiologic stress cause by net tow and to increase the size of fish larvae caught by the traditional ichthyoplanktonic gears. The results of the present study obtained in different marine protected coastal areas, will help in the support or refute an important hypothesis in larval ecology and recruitment field, "the member vagrant or retention hypothesis", that link high larval condition (and future recruitment) with successful strategies of retention during the larval stage in adequate areas.

Reference and funding entity: POCTI/BIA-BDE/59200/2004 , FCT

Duration: 2005-2007

Research team: CCMAR: Maria Alexandra Chícharo, Luis Chícharo, Ana Faria, Ana Amaral, Pedro Morais

Total budget: 42620 Euro Euro; **Funding for CCMAR:** 42620 Euro

Web site: <http://www.ualg.pt/fcma/>

Title: "Study of the life history of the European conger eel (*Conger conger*) as revealed by DNA analysis and chemistry - elemental and isotopic composition - of fish otoliths." **CONGRO.**

Summary and Objectives: The European conger (*Conger conger*) is a marine fish common in the NE Atlantic and Mediterranean. Several spawning locations have been suggested for the conger eel, even though the only known spawning ground for this species is in the Mediterranean Sea. The age of some larvae and water current systems suggests however, that conger might spawn also near the Azores. Moreover, a preliminary study provided some evidence for the existence of significant genetic differentiation among local populations, suggesting that the conger eel does not comprise a single panmictic population. Further information on the geographical distribution and age of this species is still necessary in order to determine the actual spawning grounds of this population and its migration pathways to the European and North African coasts. In an attempt to provide better understanding the conger eel life cycle, we propose a three-year multidisciplinary approach project which includes both otolith chemistry and genetic analyses. The age of some individuals will be accessed as well, using otoliths and vertebrae. A multiple site sampling program - Portugal, Azores, Madeira and Mediterranean - will provide the biological study material. A mtDNA sequence of the control region will be examined with the purpose of elucidate the genetic background of the population structure. Furthermore, the knowledge about the reproductive biology of conger eel, although limited, suggests that males and females have different pre-migratory behaviours. Some studies have show, that it is not easy to determine the stock structure of marine fish based solely on genetic markers, since they have an original low genetic flow differentiation, a high degree of gene flow as a results of active larval periods allowing widespread dispersal in currents and long-lived migratory adults, a large population size reducing the importance of genetic drift in producing genetic differences between populations and the convergent mutations often erase the effects of genetic drift. Otolith chemistry studies may be a potential supplement for genetic markers when studying the stock structure of marine fishes. Multivariate spatial/temporal analyses of some trace elements and stable isotope ratios from fish otoliths provides unique information about habitat, water temperature and salinity, migration routes, changes in sexual maturity and dietary shifts. Some otolith trace elements will be measured either by ICPMS and PIXE. Two isotope ratios ($^{18}\text{O}/^{16}\text{O}$ and $^{13}\text{C}/^{12}\text{C}$) will be also analysed in the otolith core region, which corresponds to the starting time of a fish's life history. Our goal is to detect a natural chemical marker, which could permit to distinguish between different stocks or nursery grounds and also tracks the migration of individuals.

The two major goals of the project are:

1. Verify whether the trace elements composition and isotopic signatures of otoliths can be used as a natural tag to identify the nursery origin of adult fish and to track the movement of juveniles into spawning areas. Therefore, we will: a) determine the otolith trace elements which can act as fingerprints of the fish origin and stock; b) scan the isotope ratios of $^{18}\text{O}/^{16}\text{O}$ and $^{13}\text{C}/^{12}\text{C}$, in order to evaluate its suitability as also a fingerprint; c) examine the variation in otolith trace elements at both large and small spatial scales; and d) evaluate the temporal variation in elemental signatures.
2. Test the existence of more than one spawning site for conger by molecular means. Therefore, we will: a) assert the genetic structure of populations over a wide geographical area by performing hierarchical gene diversity analysis; b) establish the temporal stability of the genetic structure of populations over a period of two consecutive years; c) estimate levels of migration among populations; and d) estimate the effective population size.

Reference and funding entity: POCI/MAR/58837/2004, FCT

Duration: 2005-2008

Research team: CCMAR: Rita Castilho, Gonçalo Silva

Total budget: 73800 Euro; **Funding for CCMAR:** 30528 Euro

Web site: <http://www.biocongroup.org>

Completed in 2006

International and Inter-Institutional Cooperations

Division of Aquaculture and Biotechnology

Title: "Development of a seabream pre-adipocyte cell line and its application to the study of adipocyte differentiation and functional regulation"

Summary and Objectives: The main objective of this proposal is to study the physiological basis of adipocyte differentiation in fish. In fish, contrary to the situation in mammals, the cellular and molecular mechanisms which govern the process of differentiation of adipocytes are largely unknown. In addition, the nature or origin of precursor cells which are recruited to differentiate into mature adipocytes in fish adipose tissue is not known. In order to identify factors which are responsible for the acquisition of an adipocytic phenotype in fish cells, an in vitro cell culture system will be developed and validated. For this purpose, we propose to use a seabream (*Sparus aurata*) pre-osteoblast cell line which can acquire a pre-adipocytic phenotype and determine the factors and culture conditions required for its differentiation into mature adipocytes. Therefore, a stable pre-adipocyte cell culture system will be established and will be used to study changes in gene expression associated with acquisition of an adipocytic phenotype as well as the regulation of lipid metabolism.

Reference and funding entity: Conselho de Reitores das Universidades Portuguesas, AI-E-104/05

Duration: 2005-2006

Research team: M.L. Cancela (coordinator), V. Laizé, A.R. Pombinho

Total budget: 2.500 euros

Title: Application of sperm quality parameters in *Solea senegalensis*: analysis of fresh and cryopreserved sperm.

Summary and Objectives: The aim of the present project is to develop a simple and reliable test or group of tests to assay sperm quality during the spawning period as well as develop a cryopreservation protocol for Senegalese sole

Reference and funding entity: Conselho de Reitores das Universidades Portuguesas, AI-E/07

Duration: 2006-2007

Research team: Elsa Cabrita (coordinator), Florbela Soares, Maria Teresa Dinis

Total budget: 2.500 euros

New instruments for the detection of immunosuppression in aquaculture. Acção integrada Luso-Espanhola E-135/2004 com Lluís Tort (Univ. Autònoma de Barcelona). Adelino V.M. Canário, Rita Teodósio

Identification of attractants related to preys of sole, *Solea senegalensis*. Acções Integradas Luso-Britânicas nº B-71/2004 com Joerg Hardge (Universidade de Hull, Reino Unido). Eduardo Barata, Zélia Velez.

Project Marine aquaculture in Vietnam, funded by NUFU (Norway) having as partners the Fisheries University (Nha Trang, Vietnam), NTNU (Trondheim, Norway) and CCMAR (Maria Teresa Dinis, Luís Conceição).

MARBEF-Marine Biodiversity and Ecosystem Function – EU Network of Excellence. Participation in the projects: - *GBIRM-Genetic Biodiversity*, - *MARPACE-Marine Propagation Along the Coasts of Europe*, - *BIOFUSE –Effects of biodiversity on the functioning and stability of marine ecosystems-European scale comparisons*.

Division of Living Resources

- Research Coordination Network funded by N.S.F., USA. The CORONA Project: Historical Ecology of the trans-Atlantic Marine Biota. 2002-2006. Coordinator: C. Cunningham, Duke University, USA. CCMAR participants: E. Serrão, G. Pearson.
- Bilateral cooperation CRUP/Univ. Pierre et Marie Curie. "Evolution of reproductive systems in four species of Fucus." 2004/2005. (E. Serrão, M. Valero, Station Biologique de Roscoff, France).
- Bilateral cooperation PESSOA- GRICES/CNRS. "Evolution of reproductive systems in algae" 2004/2005. (E. Serrão, M. Valero, Station Biologique de Roscoff, France).
- Bilateral cooperation GRICES/CSIC. "Clonal structure of populations of marine macrophytes". 2004/2005. (E. Serrão, C. Duarte, IMEDEA, CSIC, Spain)
- Ocean Tracking Network (OTN): an International cooperation (Canada, E.U.A., Austrália, Morocco, Argentina, New Zealand etc. – see <http://www.oceantrackingnetwork.org/>) for the preparation of a proposal for the global deployment of hydrophones in key locations (e.g. the Strait of Gibraltar) that will be used to study movements of fish, mammals and reptiles. CCMAR participants: Karim Erzini and T.C. Borges.
- CoastTrack Network: a European initiative based on the OTN. Karim Erzini attended several meetings and is involved in the preparation of a proposal to be submitted to the 7th Framework Programme.
- International cooperation, Commission Sous-Regionale des Pêches (Africa Ocidental) (CSRP) (2004-2007): Participation in Workshops to train African scientists (Morocco, Mauritania, Senegal, Gambia, Cape Verde, Guiné-Bissau and Guiné-Conacri) in the biology, conservation and management of elasmobranch fishes. CCMAR participant: Rui Coelho.
- Bilateral cooperation CRUP/Museu Nacional de Ciencias Naturales, Madrid, Spain. 2006. Participant: Rita Castilho (BioCon).
- Bilateral cooperation GRICES/CSIC. "Volatile organic carbon emissions by marine vegetation" 2006/2008. (R. Santos, J. Silva, C. Duarte, IMEDEA, Islas Baleares, CSIC, Spain).
- Bilateral cooperation CRUP/MCT. "Determinación del índice ^{13}C y su relación con la actividad anhidrasa carbónica en productores primarios de la costa sur de la Península Ibérica" 2004/2006 (R. Santos, J. Silva, J. Mercado, Instituto Español de Oceanografía, Málaga)
- Bilateral cooperation "Selectivity studies in Portugal and Tunisia" (2006-2007): Scientific and Technological Cooperation between CCMAR, IPIMAR and the Tunisian National Fisheries Institute. Funding through GRICES (Portugal) and the Ministry of Science and Development (Tunisia). e o Ministério da Investigação Científica e do Desenvolvimento de Competências da Tunísia. Coordinator: Karim Erzini.
- Bilateral cooperation, Instituto Espanhol de Oceanografia (IEO): Participation in the MEDITS (International Trawl Survey in the Mediterranean) cruise of an invited CCMAR scientist, specialist in Elasmobranch fishes (Rui Coelho).
- Research Programme Science, Education and Marine Archaeology in Portugal Programme (SEMAPP), with University of Connecticut (UCONN), Ocean Technology Foundation (OTF), and other Portuguese institutions (Hydrographic Institute, Portuguese Fisheries Institute, etc.). Since 2000. Funded by American and Portuguese official and private institutions (Zoomarine, Luso-American Foundation, etc.). Coordinators: Prof. Richard Cooper, Teresa Cerveira Borges (Portuguese coordinator).
- Bilateral cooperation CPqN, Universidade Federal do Recôncavo da Bahia, Brasil/Portugal. "Fisheries on Bahia de Todos-os-Santos and Rio Paraguaçu, Brasil". Participants: Teresa Cerveira Borges (CCMAR) and Clovis Matheus Pereira (UFRB).
- Bilateral cooperation GRICES/CSIC 2006-2007. "By-catch and discards from crustacean trawl off the south coast of Portugal". (S. Olim, CCMAR, Fransc Mainou, Instituto de Ciencias Marinas, CSIC, Barcelona).

Seminars given by CCMAR members in other institutions

- Castro, M.C. 2006 "O sector das pescas. Ameaças e oportunidades (The fisheries sector, menaces and opportunities)", EXPOMAR, Olhão, March 2.
- Castro, M.C. 2006 "A Lagosta da costa SW (The lobster of the SW coast)". Seminar "Certification of fishing products from 'Costa Vicentina e Sudoeste Alentejano', Aljezur, July 5.
- Castro, M.C. 2006 "Gestão integrada da zona costeira. Unir esforços para a sustentabilidade - a pesca (Integrated coastal management. Uniting efforts towards sustainability – fisheries)" Debate of the Green Book of the future EU maritime policy, Faro, December 4.

- Abecasis, D. & Gonçalves, J.M.S. "Expedições ao Gorringe". Lusoexpedição 2006 - Atlântico Norte, a bordo do N.T.M. "Creoula", 3 Junho 2006.
- Cancela, M.L. (March 2006) "CSI: Verdade ou Ficção?", Biblioteca Municipal de Faro, Portugal.
- Cancela, M.L. (May 2006) "Vitamin K-dependent proteins and tissue mineralization in fish" at the Instituto Gulbenkian de Ciência, Oeiras, Portugal.
- Cancela, M.L. (July 2006) "Gla proteins and tissue mineralization: what can we learn from fish?", Instituto de Patologia e Imunologia Molecular da Universidade do Porto IPATIMUP, Porto, Portugal.
- Cancela, M.L. (September 2006) "Evolution of bone-related Gla proteins: implications for tissue mineralization" at the Center of Marine Biotechnology, University of Maryland Biotechnology Institute, Baltimore, USA.
- Cancela, M.L. (November 2006) "Non-mammalian model systems to unveil the role of matrix Gla protein in tissue mineralization" at the Instituto Gulbenkian de Ciência, Oeiras, Portugal.
- Chicharo, L. 2006- . 1- Ecohydrology as new tool for sustainable management of estuaries and coastal water: lessons learned and the options. 2- Key parameters for estuaries monitoring. 3- Guadiana demosite a study case for ecohydrological solutions Expert Meeting in Astrakan (Russia) on Ecohydrology as new tool for sustainable management of estuaries and coastal water: lessons learned and the options for implementation in the Vouga Delta. Invitation from UNESCO Moscow Regional office and Astrakan Biosphere Reserve
- Chicharo, M. A., Chicharo, L. and Morais, P. (2006) Inter-annual differences of ichthyofauna structure of the Guadiana estuary and adjacent coastal area (SE Portugal/SW Spain): before and after Alqueva dam construction. 4th Meeting of UNESCO Working Group on Ecohydrology of Estuaries and Coastal Areas - WG – Tulcea Danubio , Romania, 5-8 October 2006
- Chicharo, L. Chicharo, M. A, Ben-Hamadou, R. (2006). Use of a hydrotechnical infrastructure (Alqueva Dam) to regulate planktonic assemblages in the Guadiana estuary: basis for sustainable water and ecosystem services management 4th Meeting of UNESCO Working Group on Ecohydrology of Estuaries and Coastal Areas - WG – Tulcea Danubio , Romania, 5-8 October 2006
- Chicharo, MA. Ligando a Biologia e a Hidrologia.O Estuário do Guadiana como zona de Demonstração do programa de Ecohidrologia da UNESCO" 20-21 October 2006. Fórum Guadiana 2006 IV SIPRES_ Simpósio Interdisciplinar sobre Processos Estuarinos Castro Marim (invited communication)
- Chicharo L. Impacte da construção da barragem do Alqueva no ecossistema do estuário e nas pescas da zona costeira: necessidade de uma gestão ecocidrológica 4-8 December 2006 V Congresso Ibérico sobre Gestão e Planeamento da Água Faro (invited communication).
- Erzini, K. "Management of recreational sea fishing in Portugal". Primer Congreso Mediterráneo de Pesca Marítima de Recreio, Palma de Mallorca, Espanha, 20-23 de Setembro de 2006 (Invited speaker).
- Gavaia, P.J. (September 2006) "Expression of Gla Proteins During Fish Skeletal Development" at the Center of Marine Biotechnology, University of Maryland Biotechnology Institute, Baltimore, USA.
- Gavaia, P.J., Cancela, M.L. (November 2006) Perspectivas en citogenética y biología molecular: Biotecnologías en acuicultura. XI Curso de Avances en Acuicultura y Calidad Ambiental. Instituto de Ciências Marinas de Andalucía –CSIC, Cadiz, Spain.
- Gonçalves, J.M.S., Bentes, L., Coelho, R., Machado, D., Monteiro, P., Ribeiro, J., Oliveira, F., Almeida, C. and K. Erzini. "Sistemas lagunares versus espécies de peixes marinhas ameaçadas". 2º Seminário sobre Sistemas lagunares costeiros, ICN, Vila Nova de Santo André, 2 a 4 de Junho de 2006.
- Gonçalves, J.M.S., P. Monteiro, J. Ribeiro, C. Afonso, R. Coelho, C. Almeida, P. Veiga, D. Machado, M. Machado, F. Oliveira & L. Bentes 2006. Palestra "Algarve subaquático". EXPOSUB PORTUGAL 2006 "1º Salão Português de Actividades Subaquáticas". Fórum Mergulho, Fundação de Oeiras em 6 a 9 de Abril de 2006.
- Leite, R. (September 2006) "Evolution of Biochemical Pathways: Implications for Therapeutic Strategies to Control *Perkinsus* Dissemination" at the Center of Marine Biotechnology, University of Maryland Biotechnology Institute, Baltimore, USA.
- Soares, F., Cabrita, E., Dinis.M.T. Characterisation of sole, *Solea senegalensis*, broodstock quality at the facilities of the University of Algarve. Workshop "The cultivation of soles", 22-23 Março, El Toruño, Cadiz, Espanha.
- Calado, R. (May 2006) Life support systems for marine organisms keeping in captivity. Universidade Lusófona
- Conceição, L. (2006) Flujos de nutrientes en larvas de peces: aplicación de técnicas de modelización y de marcadores isotópicos. Instituto de Ciencias Marinas de Andalucía (CSIC), Puerto Real, Cadiz, Spain.
- Ribeiro, J., Monteiro, C.C., Monteiro, P., Bentes, L., Coelho, R., Gonçalves, J.M.S., Lino, P.G. and K. Erzini. "Alterações a longo prazo na comunidade de peixes da ria Formosa (Algarve): uma comparação baseada em dois estudos realizados com 20 anos de diferença". 2º Seminário sobre Sistemas lagunares costeiros, ICM, Vila Nova de Santo André, 2 a 4 de Junho de 2006.

Dissemination of scientific culture

- Borges, T. C. 2006. "Impacto do arrasto no ambiente". Interview by the electronic magazine *eciencia* (September 2006)
- Borges, T. C. 2006. "Biodiversity in fisheries off the south coast of Portugal". Talk presented to the group of guest students from the University of Connecticut, USA (19 June 2006).
- Borges, T. C. 2006. "Biodiversidade e curiosidades do mar". Universidade Sénior de Loulé. (21 June 2006).
- Borges, T. C. & Gonçalves, J.M.S. (coordinators). 2006. Photograph Exhibition "Mar Imenso, Mar Intenso" organized by CCMAR and Lusotur, for the International Day of the Sea – Marina Vila Moura (15 to 18 December 2006).
- Borges, T. C. & Gonçalves, J.M.S. (coordinators). 2005. Photograph Exhibition "Mar Imenso, Mar Intenso" organized by CCMAR for the International Day of the Sea – Main Library of UALG (15 to 30 November).
- Borges, T. C., et al. (2006). "Biodiversity and the impact of Fisheries" in the RTP 2 television programme of scientific dissemination "Magazine 2010". (27 July 2006).
- Borges, T. C., Olim, S., Sendão, J. & Conde, A. (2006). "Octopus Fishery" in the RTP 2 television programme of scientific dissemination "Magazine 2010". (22 June 2006)
- Cabrita, E. A reprodução em linguado. Comunicação oral nas Jornadas de Aquacultura 2006, 5 de Dezembro 2006, na Universidade do Algarve, Faro.
- Castro, M.C. 2006 "A biodiversidade marinha e a exploração dos recursos (Marine biodiversity and exploitation of resources)" Seminar cycle of DGM/INETI, Linbon, June 21.
- Castro, M.C. 2006 "As responsabilidades da PCP no colapso dos recursos a nível regional e mundial (the responsibility of the CFP in the collapse of resources at the regional and world level)" CCMAR seminar, Faro, October 18.
- . Ascenso, R.M.T., Leite, R.B., Afonso, R.M., Cancela, M.L., (May 2006) Molecular characterization of *Perkinsus olseni* response to its host *Ruditapes decussatus*. Seminários de Mar e Ambiente 2006, FCMA, Universidade do Algarve, Portugal.
- Cancela, M.L. (May 17, 2006) "A Biologia Molecular e a Biotecnologia Aplicada - Terapia Gênica" na Escola Secundária Pinheiro e Rosa, Faro, Portugal.
- Cancela, M.L. (2006) "A Biologia Molecular e a Biotecnologia Aplicada - Terapia Gênica" na Escola Secundária João de Deus, Faro, Portugal.
- Costa, M. E. Interviews on the new dwarf skate species by television (SIC and TVI channels), radio (TFI), national newspaper (Correio da Manhã, Diário de Notícias), local newspapers (Barlavento, Região Sul), University of the Algarve Magazine (UALGzine) and Portuguese news agency (Agência Lusa). Several science & technology, radio, television and University Internet Sites also reported and divulged the discovery through the internet (November and December 2006).
- Gavaia, P. (November 21, 2006) "Novas técnicas de diagnóstico: que impacto no nosso dia a dia?" na Escola Secundária Poeta António Aleixo no âmbito da semana da ciência e tecnologia, Portimão, Portugal.
- Leite, R. (2006) Efeito de factores ambientais na infecção originada por *Perkinsus* na amêijoia: Resultados preliminares de 18 meses do Projecto Ambiperk. Expomar, March 3, Olhão, Portugal.
- Rafael, M.S., Laizé, V., Schüle, R., Cancela, M.L. (May 2006) Role of FHL2 in fish bone biology. Seminários de Mar e Ambiente 2006, FCMA, Universidade do Algarve, Portugal.
- Rafael, M (November 24, 2006) "Novas técnicas de diagnóstico: que impacto no nosso dia a dia?" na Escola Secundária João de Deus no âmbito da semana da ciência e tecnologia, Faro, Portugal.
- Tiago, D.M. (November 9, 2006) "A Biologia Molecular e a Biotecnologia Aplicada - Terapia Gênica" na Escola Pinheiro e Rosa no âmbito da semana da ciência e tecnologia, Faro, Portugal.
- Sadat, M. Domingues, R., Chicharo, M., Chicharo, L. 2006. Roteiro Ecológico da Ria Formosa, Vol. V, Unicelulares, Edição Universidade do Algarve/CIMA, 89 p.
- Chicharo, L. Impacto da construção da barragem de alqueva na sustentabilidade das pescas da zona costeira. Março 2006. Expomar Olhão.
- Chicharo, L. 2006. Impacto da barragem do Alqueva no ecossistema do estuário do guadiana e nas pescas da zona costeira. Fevereiro 2006. Associação de Professores Católicos Portugueses. Lagos
- Chicharo, L. 2006. Impacto da barragem do Alqueva no ecossistema do estuário do guadiana. Março 2006. Semana aberta da Universidade do Algarve - Colegio Internacional de Vilamoura.
- Chicharo, Luis, Maria Chicharo, Radhouane Ben Hamadou, Pedro Morais (2006) Sustainable estuarine zone management for control of toxic blooms, invasive species and conserving biodiversity. Guadiana Demosite, Portugal. Globec international newsletter Vol 12, no1: 57-58
- Chicharo, Maria, Chicharo, Luis, Ana Faria, Pedro Morais (2006) Development of new methods for sampling and evaluation nutritional of marine fish larvae in estuarine and coastal areas. Globec international newsletter Vol 12, no1: 59-60

- Chicharo, MA. O que comem as larvas de sardinha? Orientação de estágio integrado no programa Ocupação Científica de Jovens nas férias, promovido pela Agência Ciência Viva, dos alunos do ensino secundário (escola secundária de Rio Maior) Carmen Dionísio e Mónica Mateus, no Centro de Ciências do Mar do Algarve (CCMAR), de 4 a 14 de Julho de 2006.
- Chicharo, MA. Estão as conchas a dissolver-se no mar. Consequências das alterações globais. Palestra apresentada nas escolas: Escola Secundária Poeta António Aleixo (Portimão) e Escola EB 23 Dr. Alberto Iria (Olhão), promovido pela Agência Ciência Viva e pelo Centro de Ciências do Mar do Algarve, entre 20 e 25 de Novembro de 2006
- Abecasis, D., L. Bentes, J.M.S. Gonçalves. 2006. Participation in the scientific photography contest "Laboratório de imagens, a ciência em fotografia", with underwater photographs taken within the framework of the RENSUB I & II projects. Photographs by David Abecasis were included among the finalists and were exhibited in the Centro Cultural de Belém in February 2006. This event was promoted by the Associação Viver. .
- Abecasis, D., Bentes, L. Gonçalves, J.M.S., K. Erzini. 2006. "Utilização espaço-temporal de habitats pelos esporádeos na Ria Formosa". Festival do mar - Vila do Bispo, 2006.
- Abecasis, D., Gonçalves, J.M.S. Participation in the Lusoexpedição 2006 "Submerged islands of the Atlantic". Scientific dives were undertaken to study the ichthyofauna of the Gorringe bank, in collaboration with Universidade Lusofona. <http://eventos.ulusofona.pt/Lusoexpedicao/apoios.html>. This expedition was widely disseminated by radio, national press and in two documentaries produced for television "Os Cumes Atlânticos do Gorringe", RTP Bombordo.
- Bentes, L., Abecasis, D., J.M.S. Gonçalves. 2006 Participation in the scientific photography exhibition in the Fundação Caloute Gulbenkian (December 2006) in association with the "Laboratório de imagens, a ciência em fotografia", with selected underwater photographs taken within the framework of the RENSUB I & II projects, taken by Luís Bentes.
- Cardigos, F. & Abecasis, D, 2006. "Missão ao Gorringe". Mundo Submerso 109, Julho 2006.
- Cunha, A., & Coelho, R. 2006. Banco d' Arguin (Mauritânia): um mundo (ainda) por descobrir. CCMAR seminar series: "Quem somos e o que fazemos". 3 de Abril, Universidade do Algarve.
- Erzini, K. 2006. O Estado dos Recursos Pesqueiros e o Futuro das Actividades Haliêuticas. Comemorações do dia do mar, Faro.
- Erzini, K. 2006. Biologia e pesca do robalo (*Dicentrarchus labrax*) no Algarve. Seminário "Certificação dos produtos da pesca da Costa Vicentina e Sudoeste Alentejano". Aljezur.
- Erzini, K. 2006. Biologia e pesca do sargo (*Diplodus sargus*) no Algarve Seminário "Certificação dos produtos da pesca da Costa Vicentina e Sudoeste Alentejano". Aljezur.....
- Gonçalves, J.M.S. 2006. "Case study: Recruitment of commercially important species in the Arade estuary" CCMAR seminar series: "Quem somos e o que fazemos", March 20, Faro..
- Gonçalves, J.M.S., D. Machado, P. Veiga, L. Bentes, P. Monteiro, J. Ribeiro, R. Coelho, C. Afonso, C. Almeida, M. Ruano, F. Oliveira, M. Corado, D. Abecasis & K. Erzini. 2006. *Estuário do Rio Arade-Recrutamento de Espécies Piscícolas de Interesse Comercial*. Folheto de divulgação Nº9 Centro de Ciências do Mar (CCMAR), Universidade do Algarve.
- Gonçalves, J.M.S., L. Bentes, P. Monteiro, P. Veiga, D. Machado, F. Oliveira, J. Ribeiro, R. Coelho & Karim Erzini. 2006. Participação na exposição de fotografia "Mar Imenso, Mar Intenso", com fotografias subaquáticas tiradas no âmbito do projecto RENSUB I nos seguintes eventos:
- Comemorações do dia Nacional do Mar, Marina de Vilamoura, Clube Náutico, de 16 Novembro a 31 de Dezembro 2006.
 - Conferência "Mar Algarvio, um oceano de oportunidades" CCDR Algarve, Portimão 26 Maio 2006.
 - EXPOMAR, Olhão, 1-5 Março 2006.
- Gonçalves, J.M.S., L. Bentes, P. Monteiro, P. Veiga, D. Machado, F. Oliveira, J. Ribeiro, R. Coelho & Karim Erzini. 2006. Photographs provided to the Camara Municipal of Lagoa for posters to inform beach visitors about the local marine biodiversity.
- Gonçalves, J.M.S., Bentes, L., Ribeiro, J., Lino P.G. 2006. Roteiro subaquático da Praia da Marinha. Comissão de Coordenação e Desenvolvimento Regional do Algarve.
- Silva, J. 2006. "O aumento de CO2 e as plantas da Ria Formosa". Semana da Ciência e Tecnologia – Programa "Os cientistas vão à escola" CCVIVA-CCMAR.
- Santos R 2006. Sustentabilidade da exploração dos recursos marinhos: bivalves na Ria Formosa. Dia do Mar, CCMAR, Biblioteca de Faro.
- Santos R 2006. Mortalidade da ameijoas na Ria Formosa, IPIMAR, March 2006.
- Soares, F. Orientação de um estágio de formação Profissional integrado no curso de técnico de Aquacultura do Forpescas, da aluna Vânia David, no Centro de Ciências do Mar do Algarve (CCMAR), de 6 de Março a 9 de Maio de 2006.

- Soares, F. Orientação de estágio integrado no programa Ocupação Científica de Jovens nas férias, promovido pela Agência Ciência Viva, dos alunos do ensino secundário Marta Filipa Pedro da Silva e Vítor Hugo de Oliveira Silva, com o tema "Cultivo de Peixes Marinhos", no Centro de Ciências do Mar do Algarve (CCMAR), de 3 a 14 de Julho de 2006.
- Soares, F. Captura, adaptação e manutenção de reprodutores de linguado em cativeiro. Comunicação oral nas Jornadas de Aquacultura 2006, 5 de Dezembro 2006, na Universidade do Algarve, Faro.
- Veiga, P., Bentes, L., Gonçalves, J.M.S., Erzini. 2006. "Pesca recreativa na costa sul de Portugal". Festival do mar - Vila do Bispo, 2006.
- Xavier, J. C. (2006). Aquecimento global e degelo. Interview in the magazine e.Ciência, n 117: 10-14 regarding global warming and climate change in polar regions. December.
- Xavier, J.C. (2006). Radio interview to national radio RDP Antena 3, regarding the International Polar Year. December.
- Xavier, J.C. (2006). Radio interview to national radio RDP Antena 1, regarding marine ecology research. July.
- Xavier, J. C. (2006). Television interview for the program "Magazine 2010", on national TV RTP2. June.
- Xavier, J. C. (2006). Newspaper interview for the national newspaper "Semanário". July.
- Xavier, J. C. (2006). Éden. Article in VEGA Magazine (Adventure and Sea; 8 pages) regarding work in the Antarctic. March issue.
- Xavier, J. C., Vieira, G. T. and Canário, A. (2006). Antarctica: a question of a treaty? Público (National Portuguese newspaper), 22 Jan.

Visiting scientists

- Carlos Duarte, IMEDEA, CSIC, Spain. Host: team MAREE
- Tim Sherman, University of Southern Alabama, USA. (Sabbatical). Host: team MAREE
- Einar Hjørleifsson, Icelandic Fisheries Institute (host: CFRG)
- Helena Fortunato, Smithsonian Tropical Research Institute (STRI), Panamá. June 2006. (host: BIOPECAS team)
- Jesus Mercado, Spanish Oceanographic Institute (host: group ALGAE)
- Kevin McBride, University of Connecticut, June 2006 (host: BIOPECAS team)
- Maja Godwska – Universidade de Lotz (Polonia) (Dezembro 2006) (host team: Ecoresources)
- Marouene Bdioui, Tunisian National Fisheries Institute (host: CFRG)
- Matthias F.W. Stehmann, Ichthyological Research Laboratory and Consultant, Hamburg, Germany (ICHTHYS), September 2006 (host: BIOPECAS team)
- Paulo Travassos, Lab. Ecologia Marinha – LEMAR, Depto. de Pesca e Aquicultura – UFRPE, Brasil (host: CFRG)
- Pilar Olivar Maria Pilar Olivar, Científico Titular del Instituto de Ciencias del Mar (CSIC) (Abril 2006) (host team: Ecoresources)
- Richard A. Cooper, University of Connecticut. June 2006 (host: BIOPECAS team)
- Ron O'Dor, University of Dalhousy, Canada, and Census of Marine Life, Washington, DC., July 2006 (host: BIOPECAS team, and CFR team).
- Felipe Martinez-Pastor, University of Albacete, Spain (guest of Elsa Cabrita)
- Susana Redondo Gomez, Universidad de Sevilla (host: group ALGAE)
- W.S.Grant, University of Anchorage, USA. (Host: Rita Castilho, BioCon).
- Witten, P.E. from AKVAFORSK, Inst Aquaculture Res, N-6600 Sunndalsora, Norway (host: team EDGE)
- Zardoya, R. Museo Nacional de Ciencias Naturales, Madrid, Spain. (Host: Rita Castilho, BioCon)

Organization of Conferences, Workshops, Courses

- W.S. Stewart. Workshop on Scientific Writing (December 11-15, 2006). CCMAR, University of Algarve. Organization BioCon.
- Bentes, L., Gonçalves, J.M.S., K. Erzini Organization of seminar on "Seabed Classification Products" by Chris Elliott of QTC- Quester Tangent Corporation, Universidade do Algarve, January 27, 2006.
- 1st Task forces on Ecohydrology (TF's) in the University of Algarve, between 7 and 10 June 2006 (Local organization by Luis Chicharo and Alexandra Chicharo)
- 4th Meeting of UNESCO Working Group on Ecohydrology of Estuaries and Coastal Areas - WG – Tulcea Danubio, Romania, 5-8 October 2006 (Scientific organization and Co-Chairman by Luis Chicharo)
- Fórum Guadiana 2006 Castro Marim. 20-21 October 2006 (M. Alexandra Chicharo Membro da comissão científica)

- _IV SIPRES - Simpósio Interdisciplinar sobre Processos Estuarinos Castro Marim. 20-21 October 2006. (M. Alexandra Chicharo Membro da comissão científica)
- 5º Simpósio sobre a Margem Ibérica Atlântica”, Aveiro (Setembro 2006), (Luis Chicharo Membro da Comissão Científica).
- LARVAR 06 - Workshop in Fish Larval Research, 9th January 2006, Centre of Marine Sciences (CCMAR), Faro, Portugal (Organizers: Maria Teresa Dinis, Luís Conceição and Karin Pittman, from University of Bergen, Norway).
- Jornadas de Aquacultura 2006, 5th December 2006, University of Algarve, Faro, Portugal (Organisazers: Florbela Soares and Elsa Cabrita).
- 3rd Workshop on the Cultivation of Soles. 22 – 23 March 2006, CIFPA El Toruño, Cádiz, Spain. (Organizers: Bari Howell, Pedro Cañavate, Richard Prickett and Luis Conceição).
- R. Santos, A. Engelen (November 2006) ESF LESC Exploratory Workshop. Invasion of European Shores by *Sargassum muticum*: Research Integration towards the Future, Tavira.
- IV Encontro Regional de Educação Ambiental, scientific council, Loulé, November 2006.
- V Congresso Ibero Americano de Educação Ambiental, Working Group coordination, Joinville, Santa Catarina, Brasil, April 2006
- V Congresso Ibero Americano de Educação Ambiental, scientific council, Joinville, Santa Catarina, Brasil, April 2006
- II Seminário Nacional “Equipamentos para a Educação Ambiental: qualidade e inovação” Faro, Universidade do Algarve, January 2006.
- VI Seminário Participativo Equipamentos para a Educação Ambiental do Algarve Centro Ambiental da Pena, May 2006
- Workshops of Integration4waterSpecific Support Action in April and June (Luis Chicharo- Moderator)

Participation in scientific and advisory committees

- Borges, T. C. (2000-2006). Council member of the Cephalopod International Advisory Council (CIAC).
- Cancela, M.L. (June 2006) Federation of European Biochemical Societies (FEBS): Scientific Council. Istanbul, Turkey.
- Cancela, M.L. (May 2006) Fundação para a Ciência e Tecnologia, Evaluation of PhD fellowships (Biological Sciences), Lisbon, Portugal.
- Chicharo, L. 2006 Member of International Scientific Advisory Board of ERCE Ecohydrology under UNESCO IHP Programme by appointment of the UNESCO Intergovernmental Bureau
- Chicharo, L. 2006. Chairman (elected) of the a UNESCO Global Task Force of the Ecohydrology programme on Coastal Zones .
- Conceição, L.. Management committee member for Portugal on COST action 867 “Welfare of fish in European aquaculture”.
- Chicharo, L. 2006. Co-chairman of the UNESCO “European Working Group on Ecohydrology as a tool for restoration and management of the coastal zone”,
- Coelho, R. Participation in the Shark Specialist Group (IUCN / SSG) (<http://www.iucn.org/>).
- Erzini, K. Participation in the Ocean Tracking Network (<http://www.oceantrackingnetwork.org/>)
- Erzini, K. Participation in the Scientific Advisory Board of the CoastTrack network..
- Gonçalves, J.M.S. Participation in the PLANET - Portuguese Lagoons Network.
- Xavier, J. C. (2006). Elected council member of the Cephalopod International Advisory Council (CIAC) (February 2006).
- Xavier, J. C. (2006). Member of the Geographic Society of Lisbon (SGL)
- Xavier, J. C. (2006). Member of the International Polar Year Education & Outreach Sub-Committee.
- Xavier, J. C. (2006). Member of the International Youth Steering Committee for the IPY.
- Xavier, J. C. (2006). Member of the NSERC (Natural Sciences and Engineering Research Council of Canada)
- Xavier, J. C. (2006). Member of the Portuguese Committee for the International Polar Year (IPY).
- Xavier, J. C. (2006). Member of the Scientific Committee for Antarctic Research (SCAR) group “Capacity Building, Education and Training Group (CBET)”.
- Xavier, J. C. (2006). Portuguese Coordinator of LATITUDE60! (Portuguese Educational program for the International Polar year).