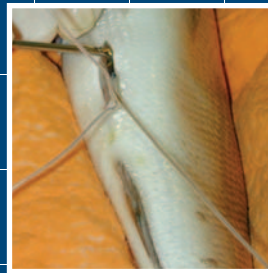


AQUATIC TELEMETRY

ADVANCES AND APPLICATIONS



AQUATIC TELEMETRY

ADVANCES AND APPLICATIONS

Proceedings of the
Fifth Conference on Fish Telemetry held in Europe
Ustica, Italy, 9–13 June 2003

Edited by

Maria Teresa Spedicato and **Giuseppe Lembo**

COISPA Tecnologia & Ricerca
Stazione Sperimentale per lo Studio delle Risorse del Mare
Bari, Torre a Mare, Italy

and

Gerd Marmulla

Fishery Resources Division
FAO Fisheries Department
Rome, Italy

COISPA TECNOLOGIA & RICERCA
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, 2005

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations and COISPA Tecnologia & Ricerca concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Mentioning of specific manufacturers and trade companies, their products or brand names does not imply any endorsement by the Food and Agriculture Organization of the United Nations or COISPA Tecnologia & Ricerca. The views expressed herein are those of the authors and do not necessarily represent those of the Food and Agriculture Organization of the United Nations or COISPA Tecnologia & Ricerca. The scientific papers have been reproduced as submitted by the authors.

ISBN 92-5-105301-4

All rights reserved. Reproduction and dissemination of material in this information product for educational or other non-commercial purposes are authorized without any prior written permission from the copyright holders provided the source is fully acknowledged. Reproduction of material in this information product for resale or other commercial purposes is prohibited without written permission of the copyright holders. Applications for such permission should be addressed to:

Chief
Publishing Management Service
Information Division
FAO
Viale delle Terme di Caracalla, 00100 Rome, Italy
or by e-mail to:
copyright@fao.org

Preparation of this publication

This co-publication by FAO and COISPA is a compilation of 29 selected papers presented at the Fifth Conference on Fish Telemetry held in Europe which COISPA organized in Ustica, Italy, in 2003 to bring together researchers and fisheries biologists involved in telemetry and biotelemetry studies in marine and freshwater ecosystems. In line with its attempts to make the use of the aquatic resources more sustainable, the FAO Fisheries Department decided to publish these Proceedings to put emphasis on telemetry as a useful tool for gathering biological information to serve as a basis for management decisions.

The submitted papers examined and selected for publication by the Scientific Committee of the Conference and peer-reviewed by independent referees. Thus, this publication complies with the high international scientific standards. The document was compiled and technically edited by Maria Teresa Spedicato and Giuseppe Lembo, COISPA, in cooperation with Gerd Marmulla, FAO. The desktop processing was done by Linopuglia (Bari, Italy).

The views expressed in this publication are those of the authors and do not necessarily represent those of the Food and Agriculture Organization of the United Nations or COISPA.

Acknowledgements

We express our gratitude to the Italian Association of Marine Biology (S.I.B.M.), the Italian Ministry of the Environment and the Italian Ministry of Agriculture and Forestry Policy that provided support for the organization of the Conference. We also like to thank all the attendees for participating in, and contributing to, the Conference as well as all those who assisted in the Conference arrangements. We wish likewise to thank the members of the Secretariat, the Scientific and Organizing Committees and the referees for helping to improve the manuscripts.

Spedicato, M.T.; Lembo, G.; Marmulla, G. (eds.)

Aquatic telemetry: advances and applications. Proceedings of the Fifth Conference on Fish Telemetry held in Europe. Ustica, Italy, 9-13 June 2003.

Rome, FAO/COISPA. 2005. 295p.

Abstract

This volume includes 29 peer-reviewed papers presented at the Fifth Conference on Fish Telemetry held in Europe (Ustica, Italy, 9-13 June 2003). The papers cover a wide range of topics on the application of aquatic telemetry in the field of human impact, fishery management and aquaculture. Evaluations of the barriers' effects on the migrations of both juvenile and adult fish are presented and discussed. New results on migratory patterns and habitat utilization are reported, elucidating behavioural ecology of several freshwater and marine species. Advances in methodology and new technology are also described and examined.

Foreword

Freshwater and marine resources, especially fish, have long provided a valuable source of food for mankind. However, heavy fishing pressure and the environmental impacts associated with the fast growing human population are increasing the stress on the aquatic resources and this calls for the strict application of management regulations. To protect biodiversity and assure the sustainability of the resources for the future, sound and responsible management is today more important than ever before. Ideally, current regulations are to be based on various criteria including the biology of the species concerned, as outlined in the FAO Code of Conduct for Responsible Fisheries and the related Technical Guidelines.

Telemetry, i.e. the remote measurement of biological variables, is a viable tool to obtain, in a limited time, information on the biology and the behaviour of the animals, one of the important preconditions for management decisions. The use of this technology in the aquatic environment has seen a rapid increase in the last two decades, as evidenced by the growing number of studies being undertaken.

The Fifth Conference on Fish Telemetry held in Europe, organized by COISPA Tecnologia & Ricerca in June 2003, brought together researchers and fisheries biologists involved in telemetry and biotelemetry studies on marine and freshwater ecosystems. The central theme of the conference was the interdisciplinary approach to provide the scientific basis for the conservation and rational management of natural resources. With the present book, FAO and COISPA are now publishing the Proceedings of a conference that was of particular relevance to all those involved in the field of fish ecology, aquaculture and fisheries management.

In an attempt to make the use of resources more sustainable, FAO is promoting the idea of using telemetry to study characteristics of fish, with a view to increase benefits for fisheries and aquaculture while maintaining a balance between exploitation and conservation. As part of its work under the Major Programme on Fisheries, the FAO Fisheries Department is active in raising the awareness of managers and scientists regarding the potential use of telemetry for supporting the management decision process¹. In this context, the FAO Fish Telemetry Web site², which was launched on the occasion of the Fifth Fish Telemetry Conference, provides access to technology to help foster sustainability, addresses key management issues, and promotes information and technology exchange between managers and researchers in fisheries and aquaculture. FAO also co-financed a pilot workshop on the application of biotelemetry to fish studies for the management of inland fisheries in West Africa and is planning to provide inputs to training courses in future. Furthermore, a manual on telemetry is in preparation.

We trust that the compilation of excellent papers in these Proceedings, intended to serve as a showcase for the latest developments in aquatic telemetry and to give technical guidance to managers, will help provide concrete answers to questions in relation to fisheries management.

Serge M. Garcia
Director, Fishery Resources Division
FAO Fisheries Department

¹ <http://www.fao.org/english/newsroom/news/2003/19343-en.html>

² <http://www.agsci.ubc.ca/gbi/FAO%20Fish%20Telemetry/>

CONTENTS

	page
Scientific Committee, Organizing Committee, Secretariat, Editorial Board, Sponsors, Commercial Exhibitors	x
List of participants	xi
Introduction <i>M.T. Spedicato, G. Lembo and G. Marmulla</i>	xiii
HUMAN IMPACT, FISHERY MANAGEMENT AND AQUACULTURE	1
Using electromyogram telemetry to study the spawning migration of sea lamprey (<i>Petromyzon marinus</i> L.) <i>P. R. Almeida, B. R. Quintella, A. Koed and N. O. Andrade</i>	3
Radio-tracking: a useful tool for the Aulne Atlantic salmon rehabilitation program <i>O. Croze</i>	13
3-dimensional positioning of salmon in commercial sea cages: assessment of a tool for monitoring behaviour <i>K. F. Cubitt, S. Churchill, D. Rowsell, D. A. Scruton, R. S. McKinley</i>	25
Effect of hydropeaking on migrations and home range of adult Barbel (<i>Barbus bar-</i> <i>bus</i>) in the river Meuse <i>A. De Vocht and E. Baras</i>	35
Linking individual migratory behaviour of Atlantic salmon to their genetic origin <i>N. Jepsen, E. E. Nielsen and M. Deacon</i>	45
The use of radio telemetry for optimizing fish pass design <i>M. Larinier, M. Chanseau, F. Bau, O. Croze</i>	53
Factors affecting adult Pacific lamprey passage rates at hydropower dams: using “time to event” analysis of radiotelemetry data <i>M. L. Moser, R. W. Zabel, B. J. Burke, L. C. Stuehrenberg, T. C. Bjornn</i>	61
No-take zones: does behaviour matter? <i>R. F. G. Ormond and M. A. Gore</i>	71

Telemetry studies of the passage route and entrainment of downstream migrating wild Atlantic salmon (<i>Salmo salar</i>) smolts at two hydroelectric installations on the Exploits River, Newfoundland, Canada <i>D. A. Scruton, C. J. Pennell, M. J. Robertson, K. D. Clarke, W. Eddy and R. S. McKinley</i>	91
Insight into the homing behaviour of the dusky grouper (<i>Epinephelus marginatus</i> Lowe, 1834) around the island of Ustica, Italy <i>M. T. Spedicato, P. Carbonara, G. Lembo</i>	103
Upstream migration of Atlantic salmon in three regulated rivers <i>E. B. Thorstad, P. Fiske, K. Aarestrup, N. A. Hvidsten, K. Hårsaker, T. G. Heggerget and F. Økland</i>	111
MIGRATORY PATTERNS, HABITAT UTILIZATION AND BEHAVIOURAL ECOLOGY	123
Mekong giant catfish tracking project (MCTP): preliminary results in 2002 <i>N. Arai, H. Mitamura, Y. Mitsunaga and T. Viputhanumas</i>	125
Movements of juvenile and adult spider crab (<i>Maja squinado</i>) in the Ría da Coruña (N-W Spain) <i>C. Bernárdez, E. González-Gurriarán, B. García-Calvo, A. Corgos and J. Freire</i>	133
Landlocked Atlantic salmon: movements to sea by a putative freshwater life history form <i>J. Carr, F. Whoriskey and D. Courtemanche</i>	141
Spatial segregation of three anadromous salmonids in a northern Labrador (Canada) river during the spawning and over wintering periods <i>K. D. Clarke, C. J. Pennell, D. G. Reddin and D. A. Scruton</i>	151
Movements and migrations of North Atlantic Bluefin tuna tagged with pop-up satellite tags <i>G. De Metrio, G. P. Arnold, J. M. de la Serna, P. Megalofonou, G. Sylos Labini, M. Deflorio, A. Buckley, J. L. Cort, C. Yannopoulos, M. Pappalepore</i>	161
Juvenile sturgeon (<i>Acipenser sturio</i>) habitat utilization in the Gironde estuary as determined by acoustic telemetry <i>M. Lepage, C. Taverny, S. Piefort, P. Dumont, E. Rochard and L. Brosse</i>	169
Spatial behaviour of pike <i>Esox lucius</i> L. in the river Frome, UK <i>J. E. G. Masters, K. H. Hodder, W. R. C. Beaumont, R. E. Gozlan, A. C. Pinder, R. E. Kenward, J. S. Welton</i>	179

Long range seasonal movements of northern pike (<i>Esox lucius</i> L.) in the barbel zone of the River Ourthe (River Meuse basin, Belgium) <i>M. Ovidio and J. C. Philippart</i>	191
Preliminary results from an exploratory translocation study at the Natural Marine Reserve of Miramare (Trieste, Italy) <i>M. Picciulin, M. Umani, M. Costantini, M. Spoto and E. A. Ferrero</i>	203
Habitat use by roach (<i>Rutilus rutilus</i> L.) and perch (<i>Perca fluviatilis</i> L.) in response to the presence of cormorants (<i>Phalacrocorax carbo</i> L.) and artificial refuges <i>I. C. Russell, D. Goldsmith, A. C. Cook, D. Parrott, J. Allcock and J. Barry</i>	211
METHODOLOGY AND NEW TECHNOLOGY	223
Influence of the light-dark cycle in the diel activity rhythms of sea lamprey's ammocoetes <i>P. R. Almeida, C. Paulo-Martins, N. O. Andrade, B. R. Quintella</i>	225
Activity patterns in pike (<i>Esox lucius</i>), as determined by motion-sensing telemetry <i>W. R. C. Beaumont, K. H. Hodder, J. E. G. Masters, L. J. Scott and J. S. Welton</i>	231
Estimation of positioning error from an array of automated omnidirectional receivers in an artificial reef area <i>V. M. Giacalone, G. D'Anna, G. Garofalo, K. Collins, F. Badalamenti</i>	245
A brief discussion on the 2% tag/body mass rule of thumb <i>N. Jepsen, C. Schreck, S. Clements and E. B. Thorstad</i>	255
A new pass-through PIT tag detection system for marine use <i>T. Jørgensen, J. T. Øvredal and I. Huse</i>	261
Effects of surgically-implanted transmitters on survival and feeding behavior of adult English sole <i>M. L. Moser, M. S. Myers, B. J. Burke, S. M. O'Neill</i>	269
Comparison of acoustic and PIT tagged juvenile Chinook, Steelhead and Sockeye Salmon (<i>Oncorhynchus</i> , spp.) passing dams on the Columbia River, USA <i>T. W. Steig, J. R. Skalski and B. H. Ransom</i>	275
Behavioural effects of surgically implanting transponders in European eel, <i>Anguilla anguilla</i> <i>H. V. Winter, H. M. Jansen, B. Adam and U. Schwevers</i>	287

SCIENTIFIC COMMITTEE

Marie-Laure Bégout Anras
C.R.E.M.A., France

Etienne Baras
University of Liège, Belgium

Ian Fleming
Oregon State University, United States of America

Niels Jepsen
Danish Institute for Fisheries Research, Denmark

Giuseppe Lembo
COISPA Tecnologia & Ricerca, Italy

R. Scott McKinley
University of British Columbia, Canada

Andrew Moore
CEFAS Lowestoft Laboratory, United Kingdom

Maria Teresa Spedicato
COISPA Tecnologia & Ricerca, Italy

Eva Thorstad
NINA, Norway

ORGANIZING COMMITTEE

Pierluigi Carbonara
COISPA Tecnologia & Ricerca, Italy

Giovanni D'Anna
C.N.R. Mazara del Vallo, Italy

Gregorio De Metrio
University of Bari, Italy

Giuseppe Lembo
COISPA Tecnologia & Ricerca, Italy

Attilio Licciardi
Major of Ustica, Italy

Gerd Marmulla
FAO, Rome, Italy

Antonio Mazzola
University of Palermo, Italy

Giulio Relini
President of S.I.B.M., University of Genova, Italy

Maria Teresa Spedicato
COISPA Tecnologia & Ricerca, Italy

SECRETARIAT

COISPA Tecnologia & Ricerca
Stazione Sperimentale per lo Studio
delle Risorse del Mare
Via Dei Trulli n° 18/20
70045 BARI – Torre a Mare, Italy

CONFERENCE SPONSORS AND PARTNERS

COISPA Tecnologia & Ricerca, Italy
FAO, Rome, Italy
Italian Association of Marine Biology (S.I.B.M.), Italy
Lega Pesca, Italy
Ministry of the Environment, Rome, Italy
Ministry of Agriculture and Forestry Policy, Rome, Italy
Municipality of Ustica, Italy
Planeta, Italy

COMMERCIAL EXHIBITORS

Biotrack Ltd., United Kingdom
Hydroacoustic Technology, Inc., United States
of America
LOTEK Wireless Inc., Canada
SONOTRONICS, United States of America
Star-Oddi, Iceland
VEMCO Ltd., Canada

EDITORIAL BOARD

M. T. Spedicato
COISPA Tecnologia & Ricerca, Italy

G. Lembo
COISPA Tecnologia & Ricerca, Italy

G. Marmulla
FAO, Rome, Italy

List of participants

Aarestrup Kim – Denmark
 Agostiano Angela – Italy
 Alfredsen Jo Arve – Norway
 Almeida Pedro Raposo – Portugal
 Andrade Nuno Oliveira – Portugal
 Arai Nobuaki – Japan
 Arnold Geoffrey – United Kingdom
 Bacchi Bianca – United Kingdom
 Batten Sonia – Canada
 Beaumont William – United Kingdom
 Bégout Anras Marie-Laure – France
 Bendall Barry – United Kingdom
 Bergstedt Roger – United States of America
 Bernardez Cristina – Spain
 Bjørnsen Jan E. – Norway
 Buysse David – Belgium
 Campbell Robert – United States of America
 Carbonara Pierluigi – Italy
 Carr Jonathan – Canada
 Cassio Luigi – Italy
 Clements Shaun – United States of America
 Cowley Paul – South Africa
 Croze Olivier – France
 Cubitt K. Fiona – Canada
 Dalla Valle Zanone – Italy
 D’Anna Giovanni – Italy
 Deflorio Michele – Italy
 De Metrio Gregorio – Italy
 De Vocht Alain – Belgium
 Dedual Michel – New Zealand
 Egli Daniel – New Zealand
 Fiske Peder – Norway
 Floen Svein – Norway
 Focardi Silvano – Italy
 Frangez Christian – Austria
 Fredrich Frank – Germany
 Furdal Arne – Norway
 Geeraerts Caroline – Belgium
 Giacalone Vincenzo – Italy
 Gore Mauvis – United Kingdom
 Hunter Kristopher – Canada
 Hyvarinen Pekka – Finland
 Jadot Catherine – Belgium
 Jang Min-Ho – United Kingdom
 Jansen Henrice Maria – Netherlands
 Jepsen Niels – Denmark
 Johnstone Alastair – United Kingdom
 Jørgensen Terje – Norway
 Karplus Ilan – Israel
 Knudsen Frank Reier – Norway
 Koed Anders – Denmark
 Lacroix Gilles – Canada
 Latvala Jyrki – Finland
 Lembo Giuseppe – Italy
 Lepage Mario – France
 Løkkeborg Svein – Norway
 Lucas Martyn – United Kingdom
 Marmulla Gerd – FAO
 Masters Jerome – United Kingdom
 McKenzie Tessa – United Kingdom
 McKinley Scott – Canada
 McKinnon Greg – Canada
 Mitamura Hiromichi – Japan
 Mitsunaga Yasushi – Japan
 Moore Andrew – United Kingdom
 Moser Mary – United States of America
 Næsje Tor – Norway
 Nykänen Mari – Finland
 Økland Finn – Norway
 Ormond Rupert – United Kingdom
 Östergren Johan – Sweden
 Ovidio Michael – Belgium
 Øvredal Jan Tore – Norway
 Picciulin Marta – Italy
 Quintella Bernardo Ruiivo – Portugal
 Reid Andy – United Kingdom
 Renzi Monia – Italy
 Righton David – United Kingdom
 Rikardsen Audun – Norway
 Roussel Jean-Marc – France
 Roux Francois – South Africa
 Russell Ian – United Kingdom
 Schreck Carl – United States of America
 Scruton David – Canada
 Sigurgeirsson Baldur – Iceland
 Sisak Mitchell – Canada
 Skov Cristian – Denmark
 Spedicato Maria Teresa – Italy
 Steig Tracey – United States of America
 Stoodley Keith – Canada
 Svendsen Jon Christian – Denmark
 Tanaka Hideji – Japan
 Thorne Alastair – United Kingdom
 Thorstad Eva – Norway
 Ueda Hiroshi – Japan
 Uglem Ingebrigt – Norway
 Ulvestad Bente – Norway
 Unfer Günther – Austria
 Vanden Elzen John – Canada
 Vikebo Eivind – Norway
 Webber Dale – Canada
 Welch David – Canada
 Westerberg Håkan – Sweden
 Winter Hendrik V. – Netherlands
 Zion Boaz – Israel