

PREFACE

THE Second International Symposium on Geographic Information Systems (GIS)/Spatial Analyses in Fishery and Aquatic Sciences was held at the University of Sussex, Brighton, U.K., September 3-6, 2002. It was our second triennial global integrated conference on GIS/Spatial Analyses in Fishery and Aquatic Sciences. It stimulated tremendous interest world-wide, both pre- and post- Symposium, providing a strong incentive for documentation of the discussions by publication of the Proceedings. There were 144 participants from 31 countries and three international organizations.

After the Second Symposium quite a few international readers and symposium participants requested that a textbook-type of Proceedings should be published in future iterations. This is because the first publication became a highly-rated internationally due to the fact it was educational, informative and useful for beginners and experts in broader contexts.

Based on such requests, we changed the publication style completely to serve as a standard textbook on GIS based Spatial Analyses in Fishery and Aquatic Sciences. To achieve this purpose, we put out a call for the cover design, and received 21 attractive entries from which the current cover was selected. We also called for the logo designs for the Fishery-Aquatic GIS Research Group. We had 22 entries with the chosen logo used in this book. For more details on cover designs and logos refer to <http://www.esl.co.jp/Sympo/logo/design.htm>. It is with our great pleasure that we are able to provide you with a copy of this brand-new textbook.

EDITORIAL PROCESS

Preparation of these Proceedings has been a sizeable and time-consuming task, involving careful attention to the various processes that ensure a

publication of high quality. Each contribution was peer reviewed by two qualified and/or internationally renowned referees as listed in Table 1. Subsequently they were subject to fine-scale editorial reviews by two outstanding professional editors (Patricia J. Kailola and Chuck E. Hollingsworth) and then reviewed for consistency and overall content by me and the staff of the Fishery and Aquatic GIS Research Group. As a result we are confident that this textbook (Proceedings) we provide to you contains the standard and updated information on the GIS/Spatial Analyses in Fishery and Aquatic Sciences as well as reliable records the Symposium. Naturally, the Fishery/Aquatic GIS Research Group and I should be held responsible for any errors or omissions. In this connection, please inform us any errors or omissions that you found, so that we may provide the errata later if necessary.

CONTENTS

Contents of this book (Proceedings) are slightly different from those that restrict themselves to the presentation of original scientific research papers. This is due to the nature of GIS, i.e., we have included not only original scientific research papers, but also papers on GIS-related issues (reviews, concepts, computer systems, software development, etc.) that were also important topics in the Symposium. In addition, we include the papers under development as they might become potentially valuable contributions and references. After peer reviews of the 54 manuscripts submitted, we selected 46 papers and categorized them into four major parts as below:

- Part I : Keynote address by Tony Booth (1 paper);*
- Part II : Original articles (Marine) (22 papers);*
- Part III : Original articles (Freshwater and Aquaculture) (14 papers); and*
- Part IV : Information papers (software and research in progress) (9 papers).*

Most of these papers contain a few pages of GIS thematic color maps that provide quick and effective indications of recent products in GIS/Spatial Analyses in Fishery and Aquatic Sciences.

DIVERSITY

As the theme of the Second Symposium was the spatial numerical analyses, we have a number of pioneering papers on this theme including the key note paper. The range of the total of 46 papers is highly diverse, encompassing examples from small geographic areas (streams, reservoirs and watersheds in Bangladesh, Sri Lanka, USA and other countries) to large geographic areas (Mediterranean Sea, New Zealand waters, Indian Ocean, Chilean waters,

North Sea, and other waters). They also cover a broad range of species and life stages, from fresh water creatures to marine living resources such as kelp, shellfish, small pelagic fish, epibenthos, demersal fish and, further, to highly migratory species like squid and tuna).

Furthermore, the papers cover various methodologies for GIS and spatial analyses including simple mapping, multi-dimensional presentations, sophisticated overlay techniques, spatial numerical analyses, geostatistics and remote-sensing, as well as multi-species/ecosystem management and predictions.

USAGE

One of the uses for this textbook will be as a subject reference. Indices of key words in Appendix C (page 703-706) as well as list of the Contents will allow readers to carry out subject matter searches in their area of interest. Readers requiring more extensive information can make follow-up enquiries directly to authors using the author index in Appendix B (page 699-701) and the contact details from the first page of each paper. In addition, the Abstract Proceedings (a separate publication) will provide a summary of all 95 papers presented at the Symposium, providing readers with ideas for potential GIS and spatial analyses related works. Those who do not have the 'Abstract Proceedings' and wish to obtain it, please refer to the web site at <http://www.esl.co.jp/Sympo/index.htm>.

The primary aim in publishing Proceedings would normally be to document and record details of presented papers. However, in this case, an additional aim is to provide a useful reference source for potential GIS users or beginners. This textbook illustrates the types of spatial analytical techniques which are available and effective for specific research topics using GIS, how different types of analytical techniques work using GIS, and the associated problems. Hence, potential GIS users and spatial analysts can avoid mistakes by selecting the best and most effective methods. In this way, the application of GIS/Spatial Analyses in Fishery and Aquatic Sciences will be greatly enhanced.

CURRENT SITUATION

Detailed review of the 95 papers presented in the Symposium, and consideration of other relevant recently published papers, suggests that the application of GIS/Spatial Analyses in Fishery and Aquatic Sciences might appropriately be categorized into four areas. These are:

- (a) *simple presentation of parameters;*
- (b) *ecological/ecosystem research or fisheries oceanography in marine science;*
- (c) *spatial numerical analyses and space-based stock assessments; and*
- (d) *Space-based management and predictions.*

The four categories are often interrelated and overlap. More than 90% of the applications in the First Symposium in 1999 were qualitative analyses (i.e., simple mapping and simple overlay in ecological research). However, in the Second Symposium this situation dramatically changed, i.e., more than 40% of the application turned to be last three categories which are more advanced applications in GIS and spatial analyses. This reflects the current situation. In other words, GIS has now morphed into powerful spatial analytical tools from the CAD-type simple drawing software as was in the past.

PROBLEMS AND IMPROVEMENTS

The primary reason for such change is that spatial analyses using GIS have been more easily achieved than in the past as user friendly GIS software applications for the Fishery and Aquatic Sciences have increased. The situation in the First GIS Symposium or before was different, i.e., the majority of the GIS software was the terrestrially based, which was rather inappropriate for tackling numerical and complicated spatial analyses for unique fishery and aquatic information that exhibit marked differences from land-based information.

In fact, in the First GIS Symposium, more than 95% of the papers presented at the Symposium used terrestrial-based GIS software. In these papers, a number of the authors who conducted qualitative analyses discussed difficulties associated with immediate extension to quantitative applications using the terrestrial-based GIS software. Several papers dealing with sophisticated and advanced numerical applications using terrestrial GIS software were presented but such elaboration was only feasible for skilled specialists.

In the Second Symposium, more than 40% of the papers used marine or aquatic specialized GIS software, which enables authors to do more advanced spatial analyses. However, the constraints associated with quantitative analyses, scope for the presentation of three- four- dimensional (3D-4D) information is also still limited in the currently available both terrestrial and aquatic-based GIS software.

Under such circumstances, there is still a need for more user-friendly GIS software developments for the fishery and aquatic sciences which are capable and effective for more quantitative spatial analyses and presentations of 3D-4D fishery and aquatic information. Development of such software is one of the most challenging areas in fishery and aquatic GIS application in the immediate future. This is still the same and continuous homework from the last Symposium.

There have been some developments which are documented in this book. Some terrestrial GIS software firms have been expanding their products' applicability to fishery and aquatic GIS information. In addition, a few marine-specific GIS software products have been developed and some were combined with GPS, VMS and electrical logbooks for fisheries management and also for fishers to detect good fishing grounds. Since these products have been recently developed, it may be anticipated that there will be more improvements in applications in the near future. As has been the case for terrestrial applications, progress in user-friendly software development can enable analyses to proceed without a requirement for the involvement of specialist GIS experts.

ENJOY THE GIS PRODUCTS...

Although we have pointed to several areas for future improvement in GIS applications in fishery and aquatic sciences, there is nonetheless value and enjoyment in the variety of GIS maps and figures presented in this textbook. There are 116 pages (16%) of color GIS products out of 732 (total) pages. These represent excellent 'home-made' (or we should say 'office-made') and elaborate representations, prepared by zealous authors. They illustrate the international proverb "Seeing is believing"- one GIS map can tell us everything, much more effectively than thousands of words. A map corresponds to an international 'common language' and communication tool, so that anyone (even children!) can readily understand the information presented. Maps enable some to overcome the frustration of an 'illiteracy syndrome' that difficult words otherwise impose and so allows greater access to information than the printed or spoken word. I now cease telling details about this book like avoid telling the story of the movie in advance; which may reduce your interests (appetites) or raise unrealistic expectations!

THIRD SYMPOSIUM

We will soon circulate an announcement for the 'Third International Symposium on GIS/Spatial Analyses in Fishery and Aquatic Sciences', to be

held at the Shanghai Fisheries University (China) in August, 2005. In the three years since the Second Symposium, I have no doubt that tremendous progress on GIS/Spatial Analyses in Fishery and Aquatic Sciences will have been accomplished. Hence, we encourage all of you to participate in the Third Symposium, to present updates on research on spatial analyses with GIS and on other relevant progress (such as software, computer systems, education and reviews).

ACKNOWLEDGMENTS

We express our sincere appreciation to authors and co-authors for their cooperation and contributions. In the course of finalization of this text over the last two years, we bothered them many times in relation to peer reviews and editorial matters. Sometimes we pushed very hard to ensure that deadlines were met. Contributors come from many areas of the world, and speak different languages. During the two years since the Symposium some have changed jobs, some have married and some have retired. Despite this, all were very patient and met our demanding requirements. We sincerely thank the 75 referees/reviewers (listed on the next three pages) from 17 countries and two international organizations, and express our special appreciation to the two professional editors, Patricia J. Kailola (Australia) and Chuck E. Hollingworth (UK). Without the dedicated peer reviews and patient editorial work the Proceedings could not have been produced. At last, special thanks should be towards my two skillful assistants, Ms Yukiko Shiba and Ms Miyako Tanaka for their endless efforts to make this book publishable! Thank you for all, once again.

Finally, we hope to see you all at the Third International Symposium in Shanghai, China in August 2005.

*Tom Nishida
Editor-in-Chief
December, 2004
Shizuoka, Japan*

Table 1. List of (76) Referees and Reviewers

Note (1): Listed in alphabetical order of last names with titles omitted.

(2): Country with () means the location of the HQs of the International Organization.

<i>Name</i>	<i>Agency</i>	<i>Country</i>
[A]		
<i>Abery, Nigel</i>	<i>Deakin University</i>	<i>Australia</i>
<i>Ahmed, Munir</i>	<i>Technological Assistance for Rural Advancement</i>	<i>Bangladesh</i>
<i>Aguilar-Manjarrez, José</i>	<i>FAO of the United Nations</i>	<i>(Italy)</i>
<i>Caton, Albert</i>	<i>BRS, Dept. of Agriculture, Fisheries and Forestry</i>	<i>Australia</i>
<i>Amarasinghe, Upali</i>	<i>University of Kelaniya</i>	<i>Sri Lanka</i>
<i>August, Frank</i>	<i>Fisheries Inmarsat (Inc.)</i>	<i>UK</i>
[B]		
<i>Barratt, David</i>	<i>BRS, Dept. of Agriculture, Fisheries and Forestry</i>	<i>Australia</i>
<i>Barroso1, Fonseca</i>	<i>University of Espírito Santo (UFES)</i>	<i>Brazil</i>
<i>Bonetti, Jarbas</i>	<i>Universidade Federal de Santa Catarina</i>	<i>Brazil</i>
<i>Booth, Anthony</i>	<i>Rhodes University</i>	<i>South Africa</i>
[C]		
<i>Caddy, John</i>	<i>FAO (retired)</i>	<i>Italy</i>
<i>Carocci, Fabio</i>	<i>FAO of the United Nations</i>	<i>(Italy)</i>
<i>Chen, Din-Geng</i>	<i>International Pacific Halibut Commission</i>	<i>(USA)</i>
<i>Cunningham, Kenneth</i>	<i>Division of Wildlife, State of Ohio</i>	<i>USA</i>
[D]		
<i>de Graaf, Gertjan</i>	<i>NEFISCO Foundation</i>	<i>Netherlands</i>
<i>De Silva, Sena</i>	<i>Deakin University</i>	<i>Australia</i>
[E]		
<i>Eastwood, Paul</i>	<i>CEFAS, Lowestoft Laboratory</i>	<i>UK</i>
[F]		
<i>Fisher, William</i>	<i>Oklahoma State University</i>	<i>USA</i>
<i>Flitcroft, Rebecca</i>	<i>US Forest Service</i>	<i>USA</i>
<i>Fluharty, David</i>	<i>University of Washington</i>	<i>USA</i>

[G]

<i>Ganjidoust, Hossein</i>	<i>Tarbiat Modarres University</i>	<i>Iran</i>
<i>Gardner, Beth</i>	<i>Cornell University</i>	<i>USA</i>
<i>Garrison, Lance</i>	<i>National Marine Fisheries Service, NOAA</i>	<i>USA</i>
<i>Garofalo, Germana</i>	<i>IRMA - Consiglio Nazionale delle Ricerche(CNR)</i>	<i>Italy</i>
<i>Gimona, Alessandro</i>	<i>FRS, Marine Laboratory Aberdeen</i>	<i>UK</i>

[H]

<i>Hamano, Akira</i>	<i>National Fisheries University</i>	<i>Japan</i>
<i>Hand, Claudia</i>	<i>Fisheries and Oceans Canada</i>	<i>Canada</i>
<i>Hassan, Musse</i>	<i>University Putra Malaysia</i>	<i>Malaysia</i>
<i>Hendrickson, Lisa</i>	<i>National Marine Fisheries Service, NOAA</i>	<i>USA</i>

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<i>Iida, Kohji</i>	<i>Hokkaido University</i>	<i>Japan</i>
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[J]

<i>Jeness, Jeff</i>	<i>Jeness Enterprises</i>	<i>USA</i>
<i>Jensen, Olaf</i>	<i>University of Maryland</i>	<i>USA</i>

[K]

<i>Kaiser, Horst</i>	<i>Rhodes University</i>	<i>South Africa</i>
<i>Kapantagakis, Argyris</i>	<i>Institute of Marine Biology of Crete</i>	<i>Greece</i>
<i>Kapetsky, James</i>	<i>C-FAST, Inc., (FAO retired)</i>	<i>USA</i>
<i>Kar, Devashish</i>	<i>Assam (Central) University</i>	<i>India</i>
<i>Kemp, Zarine</i>	<i>University of Kent</i>	<i>UK</i>
<i>Khodadadi, A.</i>	<i>Tarbiat Modares University</i>	<i>Iran</i>
<i>Kiefer, Dale</i>	<i>University of Southern California</i>	<i>USA</i>
<i>Kiyofuji, Hidetada</i>	<i>Hokkaido University</i>	<i>Japan</i>
<i>Komatsu, Teruhisa</i>	<i>University of Tokyo</i>	<i>Japan</i>

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<i>Larcombe, James</i>	<i>BRS, Dept. of Agriculture, Fisheries and Forestry</i>	<i>Australia</i>
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<i>Leickly, Richard</i>	<i>International Pacific Halibut Commission</i>	<i>(USA)</i>
<i>Leverette, Tanya</i>	<i>Dalhousie University</i>	<i>Canada</i>
<i>Levi, Dino</i>	<i>IRMA - Consiglio Nazionale delle Ricerche(CNR)</i>	<i>Italy</i>
<i>Lucas, Anne</i>	<i>University of Bergen</i>	<i>Norway</i>
<i>Lyne, Vincent</i>	<i>CSIRO/Marine Research</i>	<i>Australia</i>

[M]

<i>Maher, Bob</i>	<i>Centre for Geographic Sciences</i>	<i>Canada</i>
<i>Martin, Felix</i>	<i>FAO of the United Nations</i>	<i>(Italy)</i>

<i>Mauritzen, Mette</i>	<i>Institute of Marine Research</i>	<i>Norway</i>
<i>Meaden, Geoff</i>	<i>Canterbury Christ Church University College</i>	<i>UK</i>
<i>Miyashita, Kazushi</i>	<i>Hokkaido University</i>	<i>Japan</i>
<i>Murfitt, Ian</i>	<i>Fisheries and Oceans Canada</i>	<i>Canada</i>

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<i>Porter, Michael</i>	<i>US Bureau of Reclamation</i>	<i>USA</i>
<i>Power, Mary</i>	<i>University of California Berkeley</i>	<i>USA</i>

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<i>Rahel, Frank</i>	<i>University of Wyoming</i>	<i>USA</i>
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<i>Srivastava, Sanjeev</i>	<i>Australian National University</i>	<i>Australia</i>
<i>Stensholt, Boonchai</i>	<i>Institute of Marine Research</i>	<i>Norway</i>
<i>Sullivan, Patrick</i>	<i>Cornell University</i>	<i>USA</i>
<i>Swartzman, Gordie</i>	<i>University of Washington</i>	<i>USA</i>

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<i>Taconet, Marc</i>	<i>FAO of the United Nations</i>	<i>(Italy)</i>
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<i>Taylor, Richard</i>	<i>Seascallop Working Group</i>	<i>USA</i>
<i>Tokai, Tadashi</i>	<i>Tokyo University of Marine Science and Technology</i>	<i>Japan</i>

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<i>Wood, Brent</i>	<i>National Institute of Water and Atmospheric Research</i>	<i>New Zealand</i>

