# 6th World Recreational Fishing Conference

## Toward Resilient Recreational Fisheries

# Book of Abstracts


**August 01 – 04, 2011**

**Humboldt-Universität zu Berlin,**

**Berlin, Germany**

IGB
Leibniz-Institute of Freshwater Ecology and Inland Fisheries

HUMBOLDT-UNIVERSITÄT ZU BERLIN

DAV
German Anglers Association

Besatzfisch

museum für naturkunde
Leibniz-Institute for Research on Evolution and Biodiversity at the Humboldt University Berlin

# Welcome by Conference Chairman

As Chair of the Organizing Committee of the 6th WRFC in Berlin, Germany, I am delighted to welcome you in the German capital. I hope you will experience a stimulating scientific meeting.

The conference organizers – the **Inland Fisheries Management Laboratory** at the Faculity of Agriculture and Horticulture of **Humboldt-Universität zu Berlin**, the staff of the Department of Biology and Ecology of Fishes at the **Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB)** and the **German Anglers Association** – supported by an International Advisory Board and many sponsors have done their best to compile a programme that is novel and intellectually stimulating. We thank all for preparing high-quality abstracts, which provided the rich raw material on which the selection was based.

At the 6th WRFC, we continue the legacy of past WRFCs by presenting talks and posters that are of interest to a range of recreational fisheries stakeholders. What unfies us is a desire to better understand and manage our recreational fisheries. To that end, the conference theme "*Toward Resilient Recreational Fisheries*" emphasizes the need for a more interdisciplinary and adaptive approach to recreational fisheries science, management and development. The delegates attending the 6th WRFC in Berlin encompass the desired range, spanning fisheries scientists and managers, biologists, human dimension specialists, economists, outdoor recreation researchers, policy makers, NGO representatives and avid anglers. We can proudly present a record attendance of around 290 delegates from 33 countries who will be presenting 130 talks and 57 posters. I am very much looking forward to learning about the latest innovations in our field and discussing them during the various social events offered over the next four days.

In developing the WRFC's programme, and indeed the entire conference, I would like to express my sincere gratitude to all people – too many to be named here individually – for their hard work in the logistical preparations. This particularly applies to my colleagues of the International Scientific Advisory Board and all colleagues, students and assistants at IGB and the Humboldt-Universität zu Berlin. This conference is also a testament to your dedication and attention to detail. Thank you! I also want to thank all sponsors for their financial contributions that helped keep the registration costs moderate.

On behalf of my team and the co-organizers, I am delighted to welcome you to Berlin and the 6th WRFC in the summer of 2011.

Your sincerely,

Prof. Dr. Robert Arlinghaus (Chair of Organizing Committee)

# Welcome by German Anglers Association

On behalf of the German Anglers Association (Deutscher Anglerverband e.V., DAV) I would like to extend a warm welcome to all participants of the 6th World Recreational Fishing Conference (WRFC). I am looking forward to meeting people from all over the world in the German capital to share and increase knowledge about recreational fishing and its management.

Knowing the importance of recreational fishing science and the need to exchange scientific and managerial information at international conferences, we are proud to be part of the organizing team. The WRFC is a unique international platform for scientists, practitioners, and all other experts to discuss about the sustainable future of recreational fishing that needs all possible support. At this point I would like to express my gratitude to all the sponsors of the conference. With their sponsorship it was possible e.g. to keep the conference fees affordable, especially for students.

A tremendous line-up of high-class talks and poster presentations promises a very interesting basis to discuss all the ecological, economic, and social matters of recreational fishing. The scientific knowledge of our partners from the Leibniz-Institute of Freshwater Ecology and Inland Fisheries in Berlin and the Humboldt University of Berlin in cooperation with the world-renowned scientific advisory board guarantees for the consistently high standard of the WRFC.

Enjoy your stay in Berlin and the social events, especially the conference dinner in the famous dinosaur hall of the Museum of Natural History! We are sure that the offered excursions will help you discover a very interesting picture of Berlin, but also independent explorations of the multifaceted city will surely impress you.

I am very glad to meet you when the participants of the WRFC 2011 will share trends, tales and tools to improve the resiliency of recreational fishing!

Yours sincerely,

Günter Markstein
President of the German Anglers Association
(Deutscher Anglerverband e.V., DAV)

German Anglers Association

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# General Conference Information

## Registration

The registration office is located on the first floor directly in the foyer of the key lecture hall called Audimax at the Humboldt-Universität zu Berlin (Unter den Linden 6, 10099 Berlin, see Map 4). Note that the most direct way to the registration office is at the back of the main building via Dorotheenstraße (not via Unter den Linden). The closest public transport is the S and U-Bahn Station Friedrichstrasse. Registration will start on Sunday, July 31, at 6:00 pm. The registration office is subsequently open from Monday, August 01, to Thursday, August 04, from 8:00 am until 5:00 pm. You can approach the staff at the registration to ask for further information regarding social events and other issues. The telephone number for pertinent questions is provided below in the box.

## Wireless Internet Connection

Complementary wireless internet access is available in all areas of the university. For events or conferences the WiFi network "HU-Meeting" can be used. Every participant will get an individual password at the conference registration. For security reasons, you have to sign into a list. **Connecting:** Please connect your computer to the WiFi "HU-Meeting". The TCP/IP communication parameters are assigned automatically by DHCP (make sure your computer setting allows this). Please start a web browser and try to open a web site. Your browser will be redirected to the login page (*https://capportal-hwc1.cms.hu-berlin.de*). Please login with your account (wlanuserXXX = individual number) and password information provided to you at the registration office. **To log out:** Please open the web site (see above) and click on the button "LOGOUT".

## Speaker Check-In and Presentation Upload

There are two possibilities for presentation upload. On Sunday, July 31, during the Welcome Social in the registration area, or during the conference breaks, August 01-04, (coffee breaks, part of the lunch time) directly in the session rooms. Speakers should bring a copy of their presentation on a USB memory stick. We strongly encourage speakers who have not uploaded their presentation by Sunday, July 31, to do so at least one coffee break prior to the time their talk is scheduled. Please approach the student assistant in the session room where your talk takes place to facilitate the upload. After submitting your presentation, you will have the opportunity to view and test it once. You must ensure the style and format of your presentation is maintained before you leave the session room. Computer technicians will be available in each session room to help you deal with any compatibility issues. **Speakers will not be allowed to upload their presentations during the sessions, nor will the use of personal laptops be allowed.**

## Poster Reception & Session

Presenters should bring their poster directly to the conference registration, starting Sunday, July 31, at 6 pm. At the registration each participant will get an individual poster ID. Otherwise, please check the present abstract book for the poster list, which details the poster ID. Each poster presenter is then asked to display the poster individually in the poster session room on the boards where the ID is indicated. Poster display materials are provided in the poster session room. The poster session will take place in the Senatssaal in the Humboldt-Universität zu Berlin on Monday evening, August 01, from 5:30 pm to 9:00 pm (see Map 4).

Join us for a “flying dinner”, i.e., nice and tasty finger food and some beers. Posters must be taken down by 1:00 pm on Wednesday, August 03. Unless alternative arrangements are made in advance, posters that are not removed from the display boards by 2:00 pm on Wednesday will be discarded.

### Food & Drinks

Lunch will be served from 11:50 am to 1:30 pm daily at the canteen (Mensa) situated in the atrium of the Humboldt-Universität zu Berlin (for directions see Map 2). You will find the luncheon voucher inside your conference folder. Each participant gets one ticket per day, which entitles the holder to a salad, a cold drink, a dessert and a main course. Lunch anywhere else is at your own cost. Coffee breaks will take place directly in front of the registration area on the first floor of the main building (see Map 4). In your conference materials you will also find drink tickets (Getränke) for the Welcome Social on Sunday, July 31, and for the poster session on Monday, August 01. Please use these tickets during these social events. No drink tickets are needed for the conference dinner on Wednesday, August 03.

### Public Transportation

Berlin has an advanced public transport system. Therefore, public transport is the best way to move around in Berlin. There is absolutely no need to rent a car. You have a one-week ticket for the public transport system included with your name badge. **Please take care that you have it available on every trip.** The head organization for public transport is the BVG. On the BVG homepage you will find all the important information about timetables, lines and journey planners: **www.bvg.de**

### Security Advice

Smoking is not permitted anywhere inside the Humboldt-University or any other corresponding building. Smoking is permitted outside the main building. **Please also take care of your personal belongings** (laptops, purse etc.)**.** Petty theft is unfortunately very prevalent in the university complex, so please keep your valuables with you at all times or leave them in a secure place, e.g. hotel. **Neither the conference team nor the Humboldt-Universität zu Berlin will be liable for any theft or personal loss happening during the conference.**

## Contact Conference Team

For further information, please contact the conference team. The registration will be open from 8.00 am to 5.00 pm from Monday until Thursday. You can contact us during registration hours at:

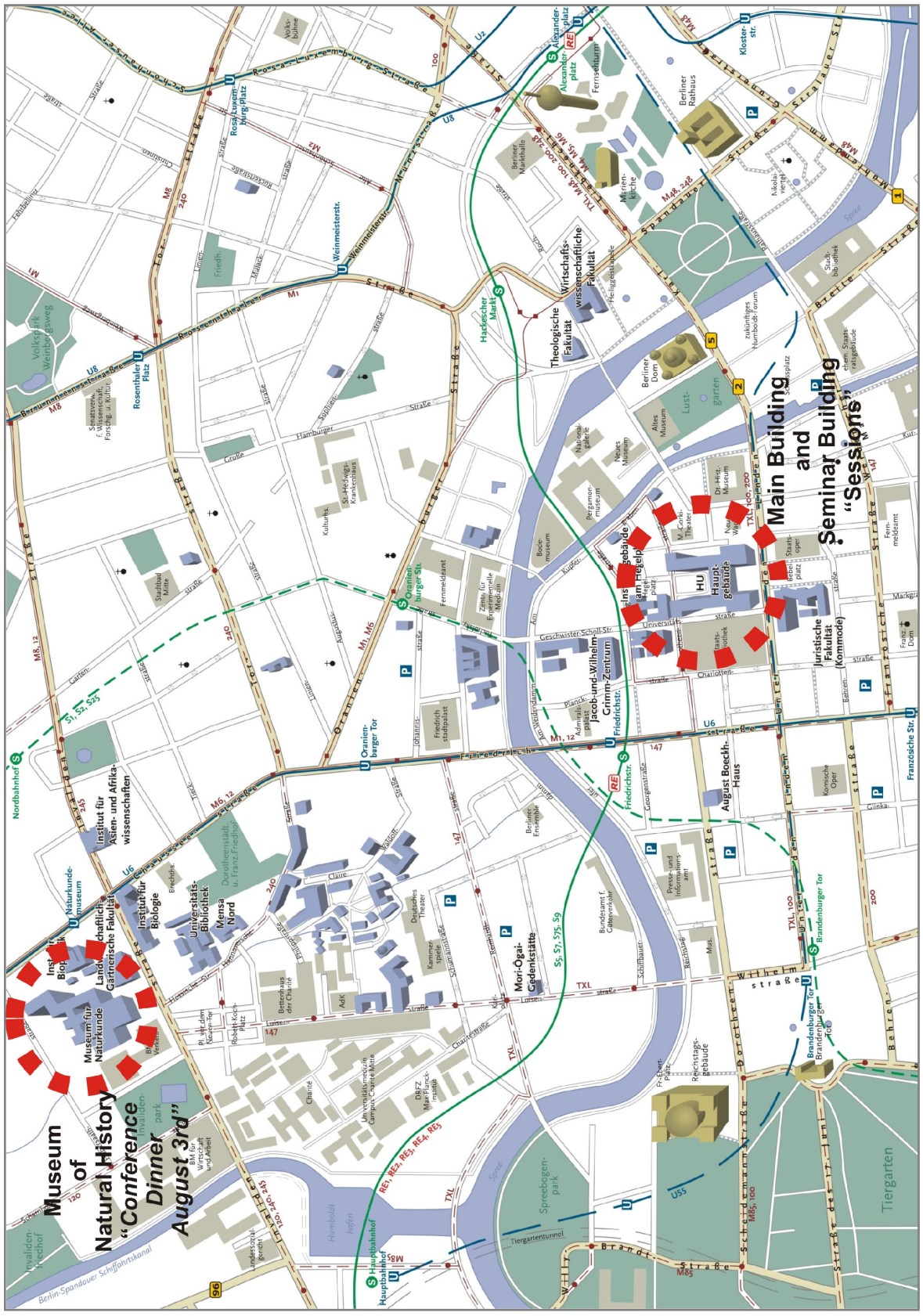
Tel.: +49 (0)30 2093 2535
Fax.: +49 (0)30 2093 2082
Email: wrfc@igb-berlin.de

(Note: This Email will only be irregularly checked during the conference times)

## Emergency telephone numbers

110 - Police
112 - Emergency services (fire and ambulance)

# City Map & Conference Location

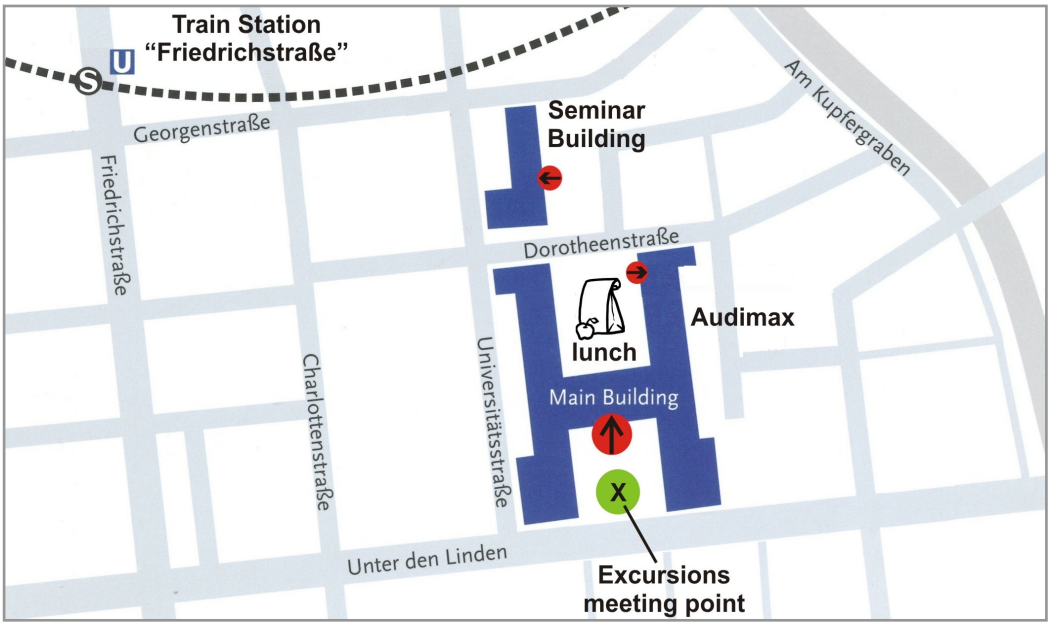



**Map 1: City Map and Conference Location**

# Conference Location

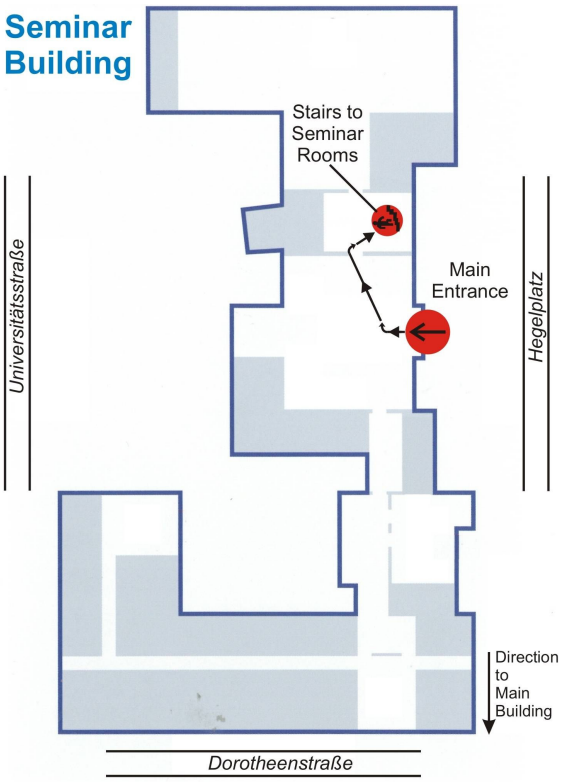
The main building of the Humboldt-Universität, where both the inaugural ceremony and the talk sessions will be held, is located squarely in the centre of Berlin, close to most of the major tourist attractions (see Map 1). The closest public transport is the S and U-Bahn Station Friedrichstrasse. The university is located at Unter den Linden 6, although the conference rooms are most easily accessed via Dorotheenstraße (at the back of the main university building).

A view towards the main building – conference rooms are located at the back of this building. The excursion meeting point is indicated here (in-between the book sellers).




**Map 2: Conference Location**

# Conference Location Main Building

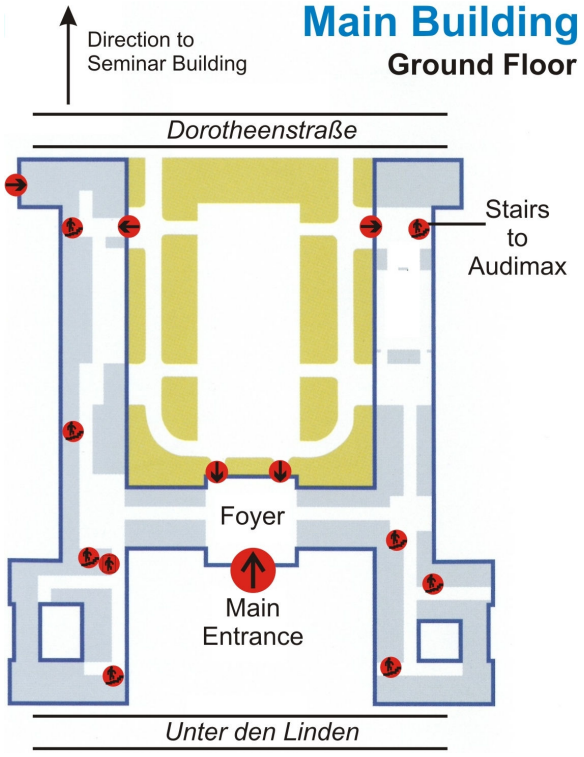


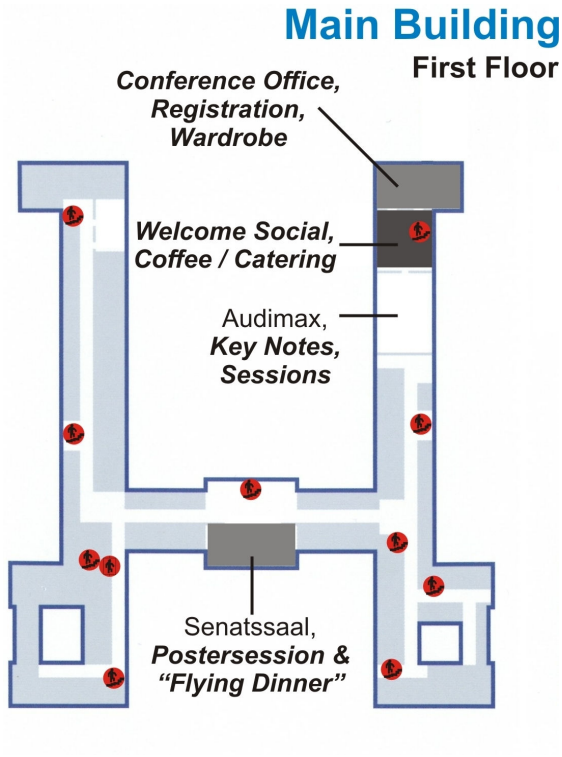

Sessions are held in the Audimax in the **Main Building** (Map 4) and the **Seminar Building** (Map 3) at very short distance from the main building at the Hegelplatz. **Poster session (Senatssaal)** and **Welcome Social (foyer of Audimax)** are also taking place in the main building on the first floor (Map 4). In front of the Audimax you will also find the **conference registration office**.

You can reach the **Seminar Building** from the main building by crossing Dorotheenstraße. All session rooms in the seminar building are located on the first floor. Simply go through the main entrance and then on the right side you will find the stairs to the seminar rooms. The rooms are numbered as follows:

**1.1001**
**1.1002**
**1.1003**

## Map 3: Seminar Building




## Map 4: Main Building – Ground Floor and First Floor

# Social Events

### Welcome Social – Sunday, July 31

The Welcome Social takes place on Sunday from 6:00 pm to 9:00 pm at the conference registration area in the main building of the Humboldt-Universität (see Map 4 / First Floor). On Sunday the main entrance to the university will not be open. Please use the Dorotheenstraße entrance.

### Poster Session & "Flying Dinner" – Monday, August 01

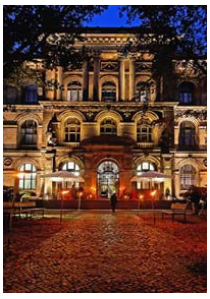
The Poster session will take place on Monday evening from 5:30 pm to 9:00 pm in the Senatssaal (see Map 4 / First Floor). There will be food available as a finger buffet – the "Flying Dinner". There will be poster judges and the best posters will be announced at the conference dinner on Wednesday, August 3.

### Berlin Nightlife – Tuesday, August 02 – the Free Evening

This evening is free for tourist activities. The city guarantees you a fascinating array of cultural options, operas, theaters, museum galleries, and a rich array of clubs, bars and restaurants. This gives you good reason to explore the city outside the congress sessions. If you require any special information about Berlin and its many possibilities, please don't hesitate to ask a member of the conference team. For further information please check: *www.berlin.de* or *www.berlinonline.de* and the last page of this abstract book.

### Conference Dinner – Wednesday evening, August 03

The conference dinner will be at 8:00 pm and takes place in the famous dinosaur hall (Sauriersaal) in the Berlin Museum of Natural History (Museum für Naturkunde, see Map 1). You will reach it easily by public transport (U-Bahn Station Naturkundemuseum). The dinner is included in the full registration fee. For all participants who have indicated their attendance during the registration process, the tour through the museum will start at 7:00 pm in the Museum of Natural History. There is no dress code!


Photos: Museum of Natural History

### After hour beers – the main conference pub!

We suggest one bar at walking distance to Humboldt-Universität, "Aufsturz" at Oranienburger Straße (cross the bridge over River Spree near Pergamon Museum and continue walking for five minutes until hitting the Oranienburger Straße, then turn left and after 50 m on the left) as a central meeting point for those that are still hungry for some beer after dinners or sessions. This bar offers a large selection of beers (over 100 different ones). Various other venues, including some clubs for dancing, are nearby at Oranienburger Straße and Hackescher Markt. On the last page we have listed additional locations, bars and clubs.

# Sightseeing Tours

## Tours and Sightseeing – Wednesday afternoon, August 03

The afternoon of August 03 is planned for excursions to explore the vibrant German capital, one of the prime urban tourist destinations of the world. The excursions will start around 2:00 pm and will end probably around 6:00 pm, depending on the trip you have registered for. Unregistered people principally cannot take part, but please check the registration office if there are still free places. We will meet at 1:00 pm (2:30 pm Tour German Bundestag) directly in front of the main building (see Map 2) and the conference team will guide you to the locations.

**Boat trip: Seeing Berlin from the Waterside of the River Spree**
The waterways are the arteries of Berlin, and Berlin was founded on fishing and fisheries. Enjoy a panoramic view along the shores of the Spree River and the Landwehrkanal. The tour takes you to some of the most interesting sites of Berlin such as: Historical City Center, East Harbour, Potsdam Square and Government Quarter. At the Charlottenburg Palace there will be a short break to enjoy the view of the beautiful castle. The tour starts at 2:00 pm at the landing stage Reichstagsufer directly in front of the S-Bahn Station Friedrichstraße (in case you prefer to go there directly), and will last for 4 hours.

**Walk along the "Wall": Feel the spirit of Berlin**
During the walk along the former Wall you can follow the tracks of history on foot. Discover what is left of the "Historic Mile" between Checkpoint Charlie and Potsdam Square. Hear about the construction of the Berlin Wall in 1961, its breathtaking fall in 1989 and about life in a divided city. The tour ends with a visit in the famous Museum “Haus am Checkpoint Charlie”, where in former times, spies and other “subjects” were exchanged between East and West. Through a small window in this house, escape helpers aided East German citizens in fleeing the DDR. The tour starts at 2:00 pm at the U-Bahn Station Stadtmitte on the station platform of the line U6 (if you decide to go there directly), and will last for around for 2 hours.


**German Bundestag: Get an idea of the German Governance**
The Bundestag is the heart of German democracy. Visitors are permitted to enter the impressive dome and enjoy a sensational view over the city. A guide will give you a glimpse behind the curtains of German Governance and its history. The tour starts at 3:30 pm and will last for one-and-a-half hours. The meeting point is the entrance “Nordeingang” of the Reichstag building, Paul-Löbe-Allee, 10557 Berlin, a short stroll from U-Bahn station Bundestag. Please be there at least 15 minutes before the tour starts. All participants have to present a valid identity document should they be asked. Please remember to switch off your mobile phone before you enter the building. In addition, all guests have to follow some rules which will be explained by the conference guide directly before the tour starts.

Photos: Wolfgang Scholvien

# Scientific Advisory Board of the 6th WRFC

**Prof. Dr. Robert Arlinghaus**

IGB & Humboldt-Universität,

Germany

Chair

**Prof. Dr. Ian Cowx**

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U.K.

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Carleton-University,
Canada

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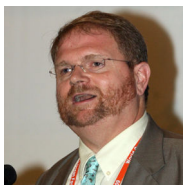
Huazhong Agricultural
University,
China

**Prof. Dr. Gene Wilde**

Texas Tech University,
USA

**Dr. Thomas Meinelt**

IGB and German Anglers
Association,
Germany



**Dr. Douglas Beard**

US Geological Survey,
USA

**Dr. Stephen Sutton**

James Cook University,
Australia

**Dr. Warren Potts**

Rhodes University,
South Africa

**Josep Alós**

Instituto Mediterráneo de
Estudios Avanzados,
Spain

**Alexander Schwab**

Author and philosopher,
Switzerland

**Jason Schratwieser**

International Game Fish
Association,
USA

# Local Organization Team of the 6th WRFC

**Prof. Dr. Robert Arlinghaus**

Scientist, IGB and Humboldt-Universität

**Dr. Maja Schlüter**

Postdoc, IGB

**Dr. Erik Eschbach**

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PhD student, IGB

**Thomas Klefoth**

PhD student, IGB

**Dr. Thomas Meinelt**

Scientist, IGB and German Anglers Association

**Philipp Freudenberg**

Executive director, German Anglers Association

**Leonore Oßwald**

Secretary, IGB

**Karena Kuntze**

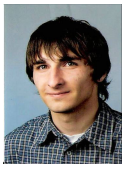
Technical assistant, IGB

**Jan Hallermann**

Scientific assistant, IGB

**Mara Beck**

Student assistant, IGB



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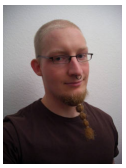
Student assistant, Humboldt-Universität



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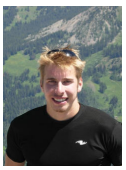
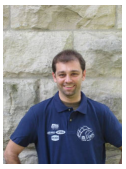
Student assistant, IGB



**Brandon Goeller**

Student, IGB



**Petr Zajicek**

Student, IGB

# Keynote Speakers

## John R. Post

**Recreational Fisheries: Resilient Fisheries or Prone to Collapse?**

John R. Post is a Professor of Ecology and Evolutionary Biology at University of Calgary, Calgary, Alberta, Canada. He received a Ph.D. from York University in Toronto in 1987 in fish ecology followed by a post-doctoral fellowship at University of Wisconsin and a term faculty position at University of British Columbia before being appointed to the Department of Biological Sciences at the University of Calgary in 1991. John's research spans fundamental fish population ecology, climate change biology, conservation biology, fish habitat requirements and harvest dynamics of freshwater fishes. John and his students use observations, experiments and models to understand ecological processes in size-structured fish populations, angler behaviour over landscapes, and efficacy of angling regulations to maintain viable fisheries. John and his students have published over 100 papers, book chapters and technical reports in fish ecology and fisheries.

## Brad Gentner

**An Economic Perspective on sustainable recreational fisheries.**

Brad Gentner completed the Ph.D. core at the University of Maryland, has a M.S. in Agricultural and Natural Resource Economics from Oregon State University, and a B.S. in Forestry from Northern Arizona University. He has over 16 years of experience in fisheries management. Before starting Gentner Consulting Group in 2007, he worked for the National Marine Fisheries Service (NMFS) as a Senior Research Economist in the Office of Science and Technology. While employed by NMFS, Brad Gentner ran the recreational economic data collection program designing and conducting expenditure surveys, demand surveys, and industry surveys to supply the data necessary to fulfill NMFS policy analysis mandates. He has published over 25 journal articles, book chapters, and technical reports on commercial and recreational fisheries in the United States, Europe and the South Pacific.

# Joint talk by Stephen Sutton and Len Hunt

## Stephen G. Sutton

**Human Dimensions of Recreational Fisheries: Challenges, Opportunities, and Emerging Research Needs**

Stephen Sutton is a Senior Research Fellow in the Fishing and Fisheries Research Centre at James Cook University in Townsville, Australia. He has received formal qualifications in both fisheries biology (Memorial University, Canada) and the human dimensions of recreational fisheries (Texas A&M University, USA). Since moving to Australia in 2002, he has been conducting human dimensions research on fisheries management and conservation issues in the Great Barrier Reef Marine Park and surrounding areas. His current lines of research include understanding drivers and trends in recreational fishing participation, improving the engagement of fishers in spatial zoning processes for marine protected areas, and understanding fisher's values and behaviours regarding threatened shark species.

## Len M. Hunt

**Human Dimensions of Recreational Fisheries: Challenges, Opportunities, and Emerging Research Needs**

Len M. Hunt is a Human Dimensions of Natural Resource Management Research Scientist with the Ontario Ministry of Natural Resources in Thunder Bay, Ontario, Canada. He holds a Ph.D. from the Geography and Environmental Studies program at Wiflrid Laurier University in Waterloo, Ontario. His PhD research focused on accounting for the complexity of spatial context within random utility models that predict the choices by anglers for fishing sites. He has developed a research program to understand how roads and road access affect primarily recreational anglers and resource-based tourism operations that cater to angling clientele. Other related research interests include development of social and ecological systems of recreational fishing, understanding and predicting choices by outdoor recreationists, understanding support by various publics for resource management decisions, and evaluating the effectiveness of ways to engage publics in resource management decision-making. Len has published over 50 papers, book chapters, and technical reports on the above (and other) research topics.

## Zeb S. Hogan

**The intersection of recreational fisheries and the world's freshwater megafishes: coexistence, conservation or extinction?**

Zeb Hogan has fifteen years experience studying and exploring the world's freshwater ecosystems. He is currently an assistant research professor at the University of Nevada-Reno, a National Geographic Emerging Explorer, and the United Nations Convention on Migratory Species Councilor for Fish. Zeb also hosts the National Geographic Television series "Monster Fish". Zeb received his Ph.D. in Ecology from the University of California, Davis in 2004. His research interests include migratory fish ecology, multi-species fisheries management, the population status of giant freshwater fish, endangered species issues and conservation genetics. Since 1996, Zeb has worked primarily in the lower Mekong River Basin. He has been studying the giant Mekong catfish (*Pangasianodon gigas*) and other large fish of the lower Mekong River, and has served as director of the Mekong Fish Conservation Project (MFCP). Through the MFCP and more recently through a new National Geographic-sponsored project "Megafishes", Zeb works to merge conservation science with conservation education and action. The project's outputs to date have included important contributions to understanding the migratory patterns and population structures of focal fish species; designation of the giant Mekong catfish as critically endangered on the IUCN Red List; awareness-raising through international media and local communications about the plight of endangered fish species; and the live release of numerous rare fish otherwise destined for fish markets. Zeb's recent articles include "Engaging Recreational Fishers in Management and Conservation: Global Case Studies" and "Size-biased extinction risk of the world's freshwater and marine fishes". Zeb's research has also been featured in Science (2007) and on the cover of Bioscience (2005) and American Scientist (2004).

# Conference Theme of the 6th WRFC

## Toward Resilient Recreational Fisheries

### *Challenges to be overcome*

In the past there have been at least three important barriers regarding the generation and application of new knowledge to improve the sustainable management of recreational fisheries: 1) general lack of data/research on recreational fisheries in many areas of the world and only local or regional problem solving, without appropriate communication of results across sectors, stakeholders and countries; 2) disciplinary thinking among those studying and attempting to solve issues of immediate relevance for recreational fisheries; and 3) pronounced external influences on the development and the quality of recreational fisheries often lying outside the control of fishery managers. To confront these and other challenges faced by global recreational fisheries, a radical shift in institutional design, research infrastructure, knowledge generation and application of new knowledge is needed that crosses and melds the boundaries between nature and culture, social and ecological science, and between science and management and policy making. This type of new knowledge generation is known as sustainability science and is also sometimes described as social-ecological research. It is particularly relevant for recreational fisheries, which are prime examples of coupled social-ecological systems.

### *Toward resilient recreational fisheries*

To sustainably develop the world's recreational fisheries, one needs interdisciplinary science and application of such knowledge to recreational fisheries coupled with efficient communication between all stakeholders. The goal of such science is to develop adaptive recreational fisheries management systems that remain flexible to accommodate change and new situations. One key term to describe such recreational fisheries is resiliency. One should bear in mind that a resilient system is characterized by its ability to cope with disturbance and change and to recognize after disturbances, while still delivering its original functions. In some situations a resilient system might be undesirable if it is "trapped" in an undesired state, but in many cases high resiliency is positive due to the ability of the system to adapt and still maintain its structure and function (e.g., provision of high-quality recreational fishing experiences to people) despite change and disturbances. Thus, the conference is aimed at providing a forum for discussion and further strengthening of interdisciplinary approaches to build resiliency of recreational fisheries as social-ecological systems. In this context, interdisciplinarity means addressing problems by means of at least two scientific disciplines, and in an ideal world it means integrating social and natural scientific approaches and thinking. Our conference is aimed at discussing the duality between how to achieve desired changes and avoiding undesired ones, attacking this challenge from a range of scientific disciplines and by interdisciplinary approaches.

### *Knowledge interfaces as interdisciplinary session topics*

In order to increase the ability of researchers and managers to understand different scientific approaches and appreciate potentially divergent perspectives, the program is developed was structured around key issues and topics that are relevant from a range of perspectives and disciplines. For example, harvest regulations have ecological, social, and economic dimensions. By structuring the programme around the emerging knowledge interfaces (i.e., interdisciplinary topics/issues) we aimed at providing salient reflection points to accommodate a range of disciplines, stakeholders and perspectives and "forcing" attendees to listen to each other's perspectives in the same session room.

# Sessions at the 6th WRFC at a glance

## Theme Sessions (T)

### Stock, stocking and the future of recreational fisheries (T1)

Stocking constitutes a dominant management tool in recreational fisheries. Papers in this session tackle issues relating to social reasons for stocking and its biological, social and economic impacts. Moreover, new forms of multi-attribute decision-making and risk analyses are presented.

### Change, adaptation and evolution in recreational fisheries (T2)

Papers in this session emphasize issues of change and adaptation in recreational fisheries, in particular how recreational fisheries as systems, and the fish populations that support recreational fisheries, adapt to change and various salient selection pressures such as those emerging from climate change, social value change and size-selective recreational fishing mortality.

### Space, place and recreational fisheries (T3)

Some argue that many recreational fisheries can only be managed on a large spatial scale, in which local fisheries are nested in a landscape of fisheries. At the same time, places matter emotionally to many fishers resulting in what psychologists call place attachment. This session tackles the interplay of local place and the larger spatial scales of recreational fisheries as moderated by (hopefully predictable, yet complex) movements of anglers in space and time.

## Contributed Sessions (C)

### Biological and social aspects of catch-and-release (C1)

Catch-and-release is widespread and a common by-product of all harvest regulations. The social dimension is important to secure success of the practice. At the same time, to improve catch-and-release practices, one needs to know which biological impacts can be expected as a consequence. This session will provide some novel insights.

### Angling tourism development: social, economic and biological challenges (C2)

Angling tourism constitutes an important global player, having particular social, economic and biological challenges. How to overcome some of these is the topic of this session.

### New methodological tools to survey and assess recreational fisheries (C3)

The toolbox to manage recreational fisheries increases as it accommodates social and biological methods and approaches. The latest methodological innovations will be presented in this section.

### Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives (C4)

Input versus output controls are intensively debated in the fisheries literature and among managers. Which tools are more effective and which regulatory policy mix is most likely to result in positive outcomes. This session tackles some answers to this timely problem.

**Social and biological factors affecting catch efficiencies by anglers (C5)**

In this session, research to understand variance in catch rate among anglers will be presented, in particular determinants of vulnerability of fish to angling gear.

**EFTTA/EAA Cormorant Session (C6)**

The cormorant conflict is well established in many areas of the world. Here, a range of papers is presented to answer some of the salient aspects. The session is co-organized by European Fish Tackle Trade Association (EFTTA) and the European Anglers Alliance (EAA).

**Biological impacts of recreational fisheries and their social and economic consequences (C7)**

Does recreational fisheries overfish stocks? And what are the consequences of biological impacts resulting from overexploitation or management measures such as stocking? Answers will be presented in this session.

**Creative methods for managing recreational fishing (C8)**

Managing recreational fisheries calls for innovative management and governance approaches. Some of the most innovative methods are presented.

**Understanding and solving conservation and other conflicts in recreational fisheries (C9)**

Conservation conflicts between nature conservation and fisheries interest can be pervasive and long-lasting. Ways toward solving or avoiding these conflicts will be presented in this session.

**Allocation of fisheries resources among competing demands (C10)**

The issue of allocation of fisheries among user groups such as commercial and recreational fisheries is paramount in many regions of the world. This session presents papers that help in solving allocation problems.

**Social, economic and biological aspects of a diversifying angler public (C11)**

The diversity of recreational fisheries is widely acknowledged, but little research has looked at all dimensions of angler type diversity. In this session, such a perspective is taken.

## Workshop

### Communication and Collaboration between Science and Management in Recreational Fisheries (Com Workshop)

On initiative by Michel Dedual from New Zealand, in this session the question of effective communication between recreational fisheries science and the management realm is tackled. What are the barriers and what are the bridges to effective collaboration and communication?

# Daily Program of the 6th WRFC

| Sunday, July 31, 2011 | |
|---|---|
| **Time** | **Audimax** |
| 6:00 - 9:00 **pm** | Registration and Welcome Reception (Food & Drinks) |

| Monday, August 01, 2011 | | | |
|---|---|---|---|
| **Time** | **Audimax** | | |
| 8:00 - 9:00 **am** | Registration and Morning Coffee | | |
| 9:00 - 9:15 | Robert Arlinghaus: Conference Inauguration | | |
| 9:15 - 9:30 | Welcome Address by the German Federal Ministry for Food, Agriculture and Consumer Protection (State Secretary Dr. Kloos) | | |
| 9:30 - 9:40 | Welcome Address by Conference Organizers (IGB and DAV) | | |
| 9:40 - 9:45 | Robert Arlinghaus: Introduction of Key Note speaker | | |
| 9:45 - 10:45 | Key Note **John Post**: Recreational fisheries: Resilient fisheries or prone to collapse? | | |
| 10:45 - 11:10 | Coffee Break in Registration Area | | |
| | **Audimax** | **Seminar Building Room 1.101** | **Seminar Building Room 1.102** |
| 11:10 - 11:30 | **Stock, stocking and the future of recreational fisheries**<br><br>Chair: Maja Schlüter<br><br>**Cowx**:<br>Stocking in recreational fisheries: using a risk framework to ensure the good and avoid the bad and ugly. | **Biological and social aspects of catch-and-release**<br><br>Chair: Steven Cooke<br><br>**Danylchuk et al.**:<br>Effects of catch-and-release angling on the physiology and behavior of juvenile lemon shark (*Negaprion bevirostris*) in the Bahamas. | **Angling tourism development: social, economic and biological challenges**<br><br>Chair: Robert Burns<br><br>**Greiner & Franklin**:<br>Managing angling tourism in northern Australia. |
| 11:30 - 11:50 | **Hühn & Arlinghaus**:<br>Determinants of successful stocking in European freshwater fishes of importance to recreational fisheries: A review. | **de Faria et al.**:<br>Effects of recreational fishing on sharks in the Great Barrier Reef Marine Park. | **Morales-Nin & Grau**:<br>Challenges in recreational fisheries assessment and management in a Mediterranean Island. |
| 11:50 - 12:10 | **Boukal et al.**:<br>Stock-catch analyses of carp recreational fisheries in Czech reservoirs. | **McGrath**:<br>The fate of mulloway (*Argyrosomus japonicus*) after ingesting conventional and modified stainless- and carbon-steel hooks. | **Ferter et al.**:<br>The management of the Norwegian marine tourist fishery and its implications on angler behaviour and coastal economies. |

| | Audimax | Seminar Building Room 1.101 | Seminar Building Room 1.102 |
|---|---|---|---|
| 12:10 - 12:30 | **Adamek et al.**: Rates of return and feeding habits of farmed rainbow trout after their release into angling grounds. | **Suski et al.**: Impacts of dissolved oxygen on the behavior and physiology of bonefish: implications for live-release angling tournaments. | **Borch et al.**: Economic impact of marine fishing tourism in Norway. |
| 12:30 - 2:00 **pm** | Lunch in Canteen (Mensa) | | |
| 2:00 - 2:20 | **Stock, stocking and the future of recreational fisheries (continued)**<br><br>Chair: Robert Arlinghaus<br><br>**van Poorten et al.**: Social-ecological interactions, panaceas and the future of wild fish. | **Biological and social aspects of catch-and-release (continued)**<br><br>Chair: Steven Cooke<br><br>**Cline et al.**: Growth response to catch-and-release angling in wild largemouth bass (*Micropterus salmoides*). | **Angling tourism development: social, economic and biological challenges (continued)**<br><br>Chair: Wolfgang Haider<br><br>**Brown**: Assynt Angling Research: The challenges of developing angling tourism. |
| 2:20 - 2:40 | **Schlüter et al.**: Management objectives drive optimal stocking strategies – a modeling approach. | **Landsman et al.**: Evaluation of the physiology, behaviour, and survival of adult muskellunge (*Esox masquinongy*) captured and released by specialized anglers. | **Burns & Graefe**: Anglers and tourists: User group variation in the Columbia River Gorge, USA. |
| 2:40 - 3:00 | **Varkey et al.**: Bayesian Belief Network model for rainbow trout stocking optimization in British Columbia, Canada. | **Stålhammar et al.**: Short-term effects of catch-and release angling on pike (*Esox lucius*) behaviour. | **Nelson et al.**: Identifying a balance between commercial and recreational fisheries: The Costa Rica experience. |
| 3:00 - 3:20 | **Meraner & Gadolfi**: When choosing the wrong one: genetic consequences of salmonid hatchery programs based on non-genetic selection parameters. | **Hall et al.**: Sublethal effects of angling and release on two Australian native freshwater fish. | **Graefe et al.**: A model of fishing satisfaction among Pine Creek anglers. |
| 3:20 - 3:50 | Coffee Break in Registration Area | | |

| | Audimax | Seminar Building Room 1.101 | Seminar Building Room 1.102 |
|---|---|---|---|
| 3:50 - 4:10 | **Stock, stocking and the future of recreational fisheries (continued)**<br><br>Chair: Maja Schlüter<br><br>**Johnson**:<br>Illegal stocking: socioeconomic, ecological, and human health implications. | **Biological and social aspects of catch-and-release (continued)**<br><br>Chair: Cory Suski<br><br>**Cooke et al.**:<br>Biological and human dimensions perspectives on catch-and-release of sockeye salmon during freshwater migration to spawning grounds. | **New methodological tools to survey and assess recreational fisheries**<br><br>Chair: Jeremy Lyle<br><br>**Moilanen & Ahvonen**:<br>Recreational fishing surveys in Finland. |
| 4:10 - 4:30 | **Zagars & Roze**:<br>Introduction of arctic char (*Salvelinus alpinus*) and lavaret (*Coregonus lavaretus*) and its impact on the recreational fisheries in lake Kals, Latvia. | **Kagervall et al.**:<br>Acceptance of catch & release fishing in Sweden: results from a survey-based study of attitudes and norms. | **Mugerza et al.**:<br>Characterization of the impact of Cantabrian Sea recreational, boating and fishing. |
| 4:30 - 4:50 | **Hilsberg et al.**:<br>Institutional diversity governing fish stocking in German inland recreational fisheries under a private fishing rights framework. | **Olaussen**:<br>Catch and release: Economics trumps biology trumps ethics? | **Sipponen**:<br>The EIFAC Methodologies for assessing socio-economic benefits of European inland recreational fisheries. |
| 4:50 - 5:10 | **Ochwada-Doyle et al.**:<br>Replenishing recreational fisheries through stock enhancement; ecological considerations for *Penaeus plebejus*. | **Arlinghaus & Riepe**:<br>Do shifts in wildlife value orientations affect the moral acceptability of recreational fishing in post-industrialized societies? | **Ueberschär et al.**:<br>Mobile applications for the angling community. |
| | **Senatssaal** | | |
| 5:30 - 9:00 | Poster exhibition, finger buffet and drinks<br>(end of poster exhibition: Wednesday, August 3, noon) | | |

| Tuesday, August 02, 2011 | | | |
|---|---|---|---|
| **Time** | **Audimax** | | |
| 8:00 - 9:00 **am** | Morning Coffee in Registration Area | | |
| 9:00 - 9:05 | Robert Arlinghaus: Introduction of Key Note speaker | | |
| 9:05 - 10:05 | Key Note **Brad Gentner**: Linking angler behaviour and incentives to achieve sustainability. | | |
| 10:05 - 10:30 | Coffee Break in Registration Area | | |
| | **Audimax** | **Seminar Building Room 1.101** | **Seminar Building Room 1.102** |
| 10:30 - 10:50 | **Change, adaptation and evolution in recreational fisheries**<br><br>Chair: Phil Hickley<br><br>**Beard et al.**:<br>What do we know about how climate will impact recreational fisheries and what are the next steps for adaptation planning. | **Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives**<br><br>Chair: Gene Wilde<br><br>**Veiga et al.**:<br>Attitudes and perceptions of recreational shore anglers towards the implementation of saltwater fishing regulations: a case study in the south of Portugal. | **New methodological tools to survey and assess recreational fisheries**<br><br>Chair: Matti Sipponen<br><br>**van Voorhees et al.**:<br>Evaluation of a new design and estimation approach for the access point angler intercept survey in the U.S.. |
| 10:50 - 11:10 | **Kaczkowski et al.**:<br>Recreational fishery pressure – is it river flow dependent factor? | **Giménez et al.**:<br>Maritime recreational fisheries in the new communitarian fisheries framework. | **Wagner et al.**:<br>The role of variance components and survey design in detecting trends in recreational fisheries monitoring data. |
| 11:10 - 11:30 | **Wilde & Pope**:<br>Use of Google insights for search in fisheries. | **Beardmore et al.**:<br>Fish for eel (*Anguilla anguilla*) or not – Predicting fishing effort responses and harvest outcomes to altered recreational eel angling regulation. | **Lyle et al.**:<br>RecSurvey: an integrated analytical approach to the estimation of recreational catch and effort based on a telephone-diary survey method. |
| 11:30 - 11:50 | **Potts et al.**:<br>Transboundary climate induced distributional changes in an important recreational fish species – consequences and adaptation. | **Claussen et al.**:<br>Impacts of Angling and environmental changes on the reproductive success and recruitment of Bass. | **Zischke et al.**:<br>Tagging fishers, not fish: Capture-recapture methods for estimating population size of specialized recreational fisheries. |
| 11:50 - 1:30 **pm** | Lunch in Canteen (Mensa) | | |

| | Audimax | Seminar Building Room 1.101 | Seminar Building Room 1.102 |
|---|---|---|---|
| 1:30 - 1:50 | **Change, adaptation and evolution in recreational fisheries (continued)**<br><br>Chair: Ian Cowx<br><br>**Colman et al.**:<br>What is the economical and social value of fishing in the inner Oslo fjord and how does ecology and cultural change interact? | **Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives (continued)**<br><br>Chair: Gene Wilde<br><br>**Fenichel**:<br>An economic model for regulating the human predator in recreational fisheries. | **New methodological tools to survey and assess recreational fisheries (continued)**<br><br>Chair: David van Voorhees<br><br>**Axford et al.**:<br>Long-term changes in angling catches in a once polluted river. |
| 1:50 - 2:10 | **Dedual**:<br>Retaining angler's trust when fishing is mediocre. | **Stoeven**:<br>A micro-foundation for the response of recreational fishing effort to fish abundance. | **Ciesla & Wolos**:<br>The role of recreational fisheries in fluvial cyprinids protection, research development and aquaculture diversification in Poland. |
| 2:10 - 2:30 | **Hegen**:<br>Driving forces in the evolution of the Texas marine recreational fisheries and their management. | **Vainikka & Hyvärinen**:<br>Ecologically and evolutionarily sustainable fishing of the pikeperch, *Sander lucioperca.* | **Kelly**:<br>Satellite based tools for improving recreational fishing. |
| 2:30 - 2:50 | **Hertig**:<br>Almost 70 years of fish catch records: Environment-induced changes in the fisheries of Canton Zurich. | **van Poorten et al.**:<br>Evaluating the efficacy and consistency of management regulations in US marine recreational fisheries. | **Kleiven et al.**:<br>Finding the unreported recreational catch in the Norwegian lobster (*Homarus gammarus*) fishery. |
| 2:50 - 3:20 | Coffee Break in Registration Area | | |
| 3:20 - 3:40 | **Change, adaptation and evolution in recreational fisheries (continued)**<br><br>Chair: Ian Cowx<br><br>**Hickley**:<br>Access and opportunity; the importance of stakeholder contribution to recreational fishery resilience. | **Social and biological factors affecting catch efficiencies by anglers**<br><br>Chair: Josep Alós<br><br>**Klefoth et al.**:<br>The phenotypic and genotypic basis of individual vulnerability to angling. | **New methodological tools to survey and assess recreational fisheries (continued)**<br><br>Chair: Mike Allen<br><br>**de Graaf et al.**:<br>Current status of the recreational fisheries in the Netherlands: results of an online screening and diary survey on participation, catches, effort, expenditure and motivation of marine and freshwater recreational fishermen. |

| | Audimax | Seminar Building Room 1.101 | Seminar Building Room 1.102 |
|---|---|---|---|
| 3:40 - 4:00 | **Change, adaptation and evolution in recreational fisheries (continued)**<br><br>Chair: Ian Cowx<br><br>**McLoone & Caffrey**: Managing recreational fisheries on Ireland's navigable waterways in changing legislative, environmental and fiscal climates. | **Social and biological factors affecting catch efficiencies by anglers (continued)**<br><br>Chair: Josep Alós<br><br>**Palmer & Alós**: Fish mobility and vulnerability to angling of marine sedentary fish: a simulation experiment. | **New methodological tools to survey and assess recreational fisheries (continued)**<br><br>Chair: Mike Allen<br><br>**Laakkonen**: Internet-based fishing diary improves fisheries management. |
| 4:00 - 4:20 | **Hertig**: The struggle of Swiss anglers with the new animal protecion law: A juristic overkill? | **Pieterek et al.**: Impacts of domestication on vulnerability to angling of carp (*Cyprinus carpio*): the role of behavior, food preferences and learning. | **Kerns et al.**: Assessing catch and harvest components of a recreational fishery across a broad spatial range for freshwater systems. |
| 4:20 - 4:40 | **Kennelly & Turnell**: Recreational fishing, management and research in New South Wales, Australia. | **Tsuboi et al.**: The effects of recreational fishing on body size and age structure, and vulnerability to fishing on salmonid populations in Japanese streams. | **Hakaste**: Network analysis improves the management of change. |
| 4:40 - 5:00 | **Vítek et al.**: Do anglers reflect the dynamic trends in recreational fisheries? A case study of the Czech Republic. | **Zajicek et al.**: Juvenile growth and adult behavior determine angling vulnerability of pike (*Esox lucius*) in their natural environment. | **Phillips**: Electronic monitoring in the Gulf of Mexico Charter/For-Hire Fleet: Using technology to improve data collection. |
| 5:00 - open end | Let Berlin absorb you. For suggestions on dinner and meeting places see abstract book and information spread during the conference. | | |

| Wednesday, August 03, 2011 | | | | |
|---|---|---|---|---|
| **Time** | **Audimax** | | | |
| 8:00 - 9:00 **am** | Morning Coffee in Registration Area | | | |
| 9:00 - 9:05 | Robert Arlinghaus: Introduction of Key Note speaker | | | |
| 9:05 - 10:05 | Key Note **Stephen Sutton & Len Hunt**: Human dimensions of recreational fisheries: Challenges, opportunities, and emerging research needs. | | | |
| 10:05 - 10:30 | Coffee Break in Registration Area | | | |
| | **Audimax** | **Seminar Building Room 1.101** | **Seminar Building Room 1.102** | **Seminar Building Room 1.103** |
| 10:30 - 10:50 | **Change, adaptation and evolution in recreational fisheries (continued)**<br><br>Chair:<br>Douglas Beard<br><br>**Alós et al.**:<br>Is angling a stochastic process for life-history traits? An empirical assessment for marine coastal fisheries. | **Social and biological factors affecting catch efficiencies by anglers (continued)**<br><br>Chair:<br>Thomas Klefoth<br><br>**Heermann et al.**:<br>Where did the perch go? Decreasing resources determine angling success. | **EFTTA/EAA Cormorant Session**<br><br>Chair:<br>Jan Kappel<br><br>**Kohl**:<br>Cormorant populations in Europe: sizes and trends. | **Communication and collaboration between science and management in recreational fisheries**<br><br>Chair:<br>Michel Dedual<br><br>10:30 - 10:35<br>**Dedual**:<br>Introduction and workshop overview. |
| 10:50 - 11:10 | **Sutter et al.**:<br>Angling reduces fitness in a recreationally exploited fish. | **Cabanellas-Reboredo & Alós**:<br>How environment affects catch rates in the recreational squid jigging fishery. | **Jepsen & Bregnballe**:<br>Reconciling the conflict between cormorants and anglers. | 10:35 - 10:50<br>**Riedl et al.**:<br>Options and pitfalls of research communication in fisheries science: lessons learned from a salmonid conservation project. |
| 11:10 - 11:30 | **Skov et al.**:<br>60 years of perch (*Perca fluviatilis*) and pike (*Esox lucius*) population dynamics in relation to commercial fishing, cormorants and temperature change as revealed by angler diaries. | **Arregui et al.**:<br>Variables affecting recapture rates of tagged tuna in North East Atlantic tagging programmes. Perspective from recreational fishery. | **Heinimaa**:<br>EIFAAC and Cormorant management in Europe. | 10:50 - 11:05<br>**Gordoa**:<br>Communication Network: The basis of the problem and its options.<br><br>11:05 - 11:20<br>**Sagué Pla**:<br>Scientists and recreational fishermen: The missing ring. |

| | Audimax | Seminar Building Room 1.101 | Seminar Building Room 1.102 | Seminar Building Room 1.103 |
|---|---|---|---|---|
| 11:30 - 11:50 | **Fenichel et al.**: Managing ecological thresholds in coupled environmental-human systems. | **Wilson et al.**: Capture technique and fish personality: angling targets timid bluegill sunfish, *L. macrochirus.* | **Hanfland & Laggerbauer**: Decline of grayling in Bavaria and their relation to cormorants. | 11:20 - 11:35 **Hames**: Science and recreational fishery management: How can we improve the collaboration? |
| 11:50 - 1:00 **pm** | Lunch in Canteen (Mensa) and end of poster exhibition | | | 11:35 - 11:50 **Kennelly** Science-based collaboration between recreational fishing management and science in New South Wales, Australia. |
| | | | | 11:50 - 12:05 **Clarke**: Model of not-for-profit co-management of recreational fisheries in British Columbia. |
| | | | | 12:05 - 12:30 Final discussion and wrap-up |
| | | | | Lunch in Canteen (Mensa) and end of poster exhibition |
| 1:00 - 5:00 | Excursions:<br>Boat trip: at 1:00 **pm** in front of the main building (see Map 2)<br>Walk along the "Wall": at 1:00 **pm** in front of the main building (see Map 2)<br>German Bundestag: at 2:30 **pm** in front of the main building (see Map 2) | | | |
| 7:00 - 10:00 | Conference dinner at the Museum of Natural History, dinner starts at 8:00 **pm** | | | |

| Thursday, August 04, 2011 | | | |
|---|---|---|---|
| **Time** | **Audimax** | | |
| 8:00 - 9:00 **am** | Morning Coffee in Registration Area | | |
| 9:00 - 9:05 | Robert Arlinghaus: Introduction of Key Note speaker | | |
| 9:05 - 10:05 | Key Note **Zeb Hogan**: The intersection of recreational fisheries and the world's freshwater megafish: coexistence, conservation or extinction? | | |
| 10:05 - 10:30 | Coffee Break in Registration Area | | |
| | **Audimax** | **Seminar Building Room 1.101** | **Seminar Building Room 1.102** |
| 10:30 - 10:50 | **Space, place and recreational fisheries**<br><br>Chair: Kevin Pope<br><br>**Hunt et al.**:<br>The effects of regional angling effort, angler behavior, and harvesting efficiency on landscape patterns of overfishing. | **Understanding and solving conservation and other conflicts in recreational fisheries**<br><br>Chair: Phil Hickley<br><br>**McPhee**:<br>No-take marine reserves and recreational fishing in Australia: Are we getting it right and can we do it better? | **Allocation of fisheries resources among competing demands**<br><br>Chair: Brad Gentner<br><br>**Crowe et al.**:<br>Evolution and implementation of allocation arrangements for recreational and commercial fishing sectors in Western Australia. |
| 10:50 - 11:10 | **Taylor et al.**:<br>Implications of social networks for sustaining resilient recreational fisheries. | **Tubino et al.**:<br>Spatial patterns of coastal recreational fisheries in metropolitan Rio de Janeiro, Brazil. | **Gislason**:<br>Recreational & commercial fisheries allocation with market transfers - The case of pacific halibut in Canada. |
| 11:10 - 11:30 | **Ward et al.**:<br>Recreational angler characteristics and management implications in a multi-stock, spatially structured fishery. | **Norman**:<br>Fish for the future: A human dimensions assessment of the resiliency of the recreational Red Snapper fishery along the Texas coast. | **Gerdeaux**:<br>Contrasting recreational and commercial fishing in Lake Annecy: differences in effects on the fishery. |
| 11:30 - 11:50 | **Martin & Pope**:<br>Maintaining resilience of regional fisheries through angler management. | **Smith et al.**:<br>Managing angler conflict in coastal recreational fisheries: perceptions and attitudes of limited impact fishing areas in shallow water flats. | **Strehlow & Schultz**:<br>Recreational cod fishery in the German Baltic Sea, 2004-2009. |
| 11:50 - 1:30 **pm** | Lunch in Canteen (Mensa) | | |

| | Audimax | Seminar Building Room 1.101 | Seminar Building Room 1.102 |
|---|---|---|---|
| 1:30 - 1:50 | **Space, place and recreational fisheries (continued)**<br><br>Chair: Kevin Pope<br><br>**Kadagi**: Globalization of recreational marine fisheries in Kenya: trends, opportunities and challenges. | **Understanding and solving conservation and other conflicts in recreational fisheries (continued)**<br><br>Chair: Phil Hickley<br><br>**Djohari**: Re-imagining the role of the fishery: angling intervention work with excluded young people. | **Allocation of fisheries resources among competing demands (continued)**<br><br>Chair: Brad Gentner<br><br>**Moyle et al.**: Recreational fishing property and access rights – A necessity of resilient recreational fisheries. |
| 1:50 - 2:10 | **Space, place and recreational fisheries (continued)**<br><br>Chair: Kevin Pope<br><br>**March & Palmer:** Spatial monitoring of recreational fisheries: a geostatistical approach. | **Social, economic and biological aspects of a diversifying angler public**<br><br>Chair: Stephen Sutton<br><br>**Haider et al.**: Comparing general and species-specific angler motivations in Mecklenburg-Vorpommern, Germany. | **Creative methods for managing recreational fishing**<br><br>Chair: Christian Skov<br><br>**Erzini & Veiga**: How size selective are hooks and are minimum hook sizes useful for management of saltwater recreational fisheries? |
| 2:10 - 2:30 | **Harrison et al.**: Managing for sustainability in a fishery of high significance for recreational and commercial fishers. | **Dankel et al.**: What do Lake Lipno stakeholders want? Analysis of stakeholder groups and preferences based on interviews for a Czech reservoir resource. | **Gaden et al.**: Restoring Atlantic Salmon to Lake Ontario: An unprecedented, stakeholder-driven effort to bring back one of the Great Lakes' most prized species. |
| 2:30 - 2:50 | **Rowland et al.**: Wilderness conservation areas - A concept developed and supported by recreational fishers to protect ecological and social values associated with wilderness. | **Stolk**: Catching communities: The positive social impact of recreational angling in England and Scotland. | **Irwin et al.**: Structured decision making and recreational fisheries management. |
| 2:50 - 3:20 | Coffee Break in Registration Area | | |

| | Audimax | Seminar Building Room 1.101 | Seminar Building Room 1.102 |
|---|---|---|---|
| 3:20 - 3:40 | **Biological impacts of recreational fisheries and their social and economic consequences**<br><br>Chair: Cory Suski<br><br>**Allen et al**.:<br>Is recruitment overfishing common in freshwater recreational fisheries? | **Social, economic and biological aspects of a diversifying angler public (continued)**<br><br>Chair: Stephen Sutton<br><br>**Freire et al.**:<br>Recreational fishery in Brazil. | **Creative methods for managing recreational fishing (continued)**<br><br>Chair: Christian Skov<br><br>**Aarts**:<br>Sustainable fisheries and social acceptation of recreational fisheries through a new license system and improved enforcement. |
| 3:40 - 4:00 | **Haugen et al.**:<br>Spatial variation in movements and mortality for Atlantic Cod in the inner Oslo fjord. | **Pope et al.**:<br>Angler choice of terminal tackle and water depth. | **Peterson**:<br>Innovative approaches to rebuilding angler participation. |
| 4:00 - 4:20 | **Font Payeras & Lloret**:<br>Biological and socioeconomic implications of recreational fishing for the management of coastal resources in a Mediterranean marine protected area. | **O'Bryant**:<br>Teach a child to fish. | **Jackson et al.**:<br>Assessing the effectiveness of quota-tags to manage recreational catches of snapper (*Pagrus auratus*) in the Freycinet Estuary, Shark Bay, Western Australia. |
| 4:20 - 4:40 | **Pita & Freire**:<br>Competitive spearfishing in Galicia (NW Spain): impacts on target fish communities. | **Staugler & Adams**:<br>Angler based research tournament: links general public and a strong science mission. | **Prokop & Moyle.**:<br>Maximum Experiential Yield - a new MEY and other new ways of managing recreational fisheries. |
| 4:40 - 5:00 | **Jacobsen et al.**:<br>Disturbance by human activities on fish individual behaviour in a small lake. | **Li et al.**:<br>Towards improved communication of scientific information to recreational fisheries stakeholders. | **Alonso et al.**:<br>Application of population dynamics models to meet multiple-use objectives in recreational fisheries management. Case study: brown trout (*Salmo trutta*) angling in La Rioja (north of Spain). |
| 5:00 | **End of Conference (Departure)** | | |

# Posters presented at the 6th WRFC

**To be held during the Poster Session, Monday, August 1, 5:30 – 9:00 pm, Senatssaal at Humboldt-Universität zu Berlin.**

**Posters will be displayed from Monday, August 1, 5:30 pm to Wednesday, August 3, noon.**

**Presenters are kindly asked to attach their posters on the pin board where the abstract's individual ID provided below will be displayed (e.g., T1.13).**

## *T1 Stock, stocking and the future of recreational fisheries*

T1.13. IDA AHLBECK, PER B. HOLLILAND. **Rearing environment affects important life skills in pikeperch (*Sander lucioperca*).**

T1.14. GERARD CARMONA-CATOT, PETER B. MOYLE, RACHEL E. SIMMONS. **Long-term captive breeding does not necessarily prevent reestablishment.**

T1.15. THERESA GODIN, TIM YESAKI, KANJI TSUMURA, ADRIAN CLARKE. **Development of sterile and all-female kokanee *Oncorhynchus nerka* for recreational fisheries in British Columbia.**

T1.16. PAVEL JURAJDA, SETH WHITE, MICHAL JANÁČ, GABRIELA KONEČNÁ. **The effects of fish stocking on the evaluation of ecological quality of rivers.**

T1.17. ANDREW MCFALL, ROBERT ARLINGHAUS. **Are more specialized anglers really less supportive of fish stocking?**

T1.18. THILO PAGEL, JOHANNA HILSBERG, ROBERT ARLINGHAUS. **Dimension of fish stocking in the German recreational fisheries sector.**

T1.19. DAVID STRAUS. **The US Drug Approval Process: Disease treatments may be necessary for better stocking success.**

## *T2 Change, adaptation and evolution in recreational fisheries*

T2.19. ADAM BROWN, NATALIE DJOHARI, PAUL STOLK. **Change in fisheries – the importance of angling social research.**

T2.20. IGNASI A. CATALÁN, JOSEP ALÓS, ITZIAR ÁLVAREZ, ANTONI JORDI, GOTZON BASTERRETXEA. **Enhanced self-recruitment in a highly exploited sedentary marine fish population: how plausible is fishing-induced evolution?**

T2.21. JEFFERSON DEWEBER, TYLER WAGNER. **Climate and land use change impacts on brook trout populations and associated recreational fishing opportunities.**

T2.22. NELLY KADAGI. **Change, adaptation and evolution in recreational fisheries: the case of sport fishing in Kenya's marine waters.**

T2.23. CHAD LUNOW. **Collaborative influence on bioregional planning in Australia.**

T2.24. SILVA UUSI-HEIKKILÄ, ANNA KUPARINEN, CHRISTIAN WOLTER, THOMAS MEINELT, JON SLATE, ROBERT ARLINGHAUS. **Adaptive changes in size-selectively exploited zebrafish (*Danio rerio*) populations.**

## *T3 Space, place and recreational fisheries*

T3.9. FAITH OCHWADA-DOYLE, JAMES MCLEOD, GEOFFREY BARRETT, CHARLES GRAY. **Spatial variation in the characteristics of recreational fisheries: understanding the effects of management changes.**
T3.10. FRANK PROKOP. **How far have recreational fishers come - how far to go?**

## *C1 Biological and social aspects of catch-and-release*

C1.14. GUSTAV HELLSTROM, ANDERS KAGERVALL. **Attitudes of Swedish anglers towards releasing fish.**

## *C2 Angling tourism development: social, economic and biological challenges*

C2.9. FEDERICO CARDONA-PONS. **Socioeconomics of recreational fisheries in a Mediterranean touristic island: The case of Mallorca.**
C2.11. RUSSELL NELSON, ROB SOUTHWICK. **Factors that motivate destination choice by international anglers.**

C2.12. DAVID PHILIPP, JEFFREY KOPPELMAN, AARON ADAMS, AARON SHULTZ, PRESCOTT SMITH, ANDY SMITH, JASON FRANKLIN, GREG VINCENT. **Integrating science, angling, and politics to conserve flats fishing in the Bahamas.**

## *C3 New methodological tools to survey and assess recreational fisheries*

C3.18. DAVID BOUKAL, MARTIN JANKOVSKY, JAN KUBECKA. **Tracing angler behaviour and exploitation pressure from individual logbook data.**

C3.20. SABRINA COLELLA, FORTUNATA DONATO, NANDO CINGOLANI, ALBERTO SANTOJANNI. **Monitoring of recreational fisheries in Italian seas: biological and social aspects.**

C3.21. ROMY GREINER, ANDRIA HANDLEY, LEE HOCKSENG. **A methodological approach to estimating the total economic value of recreational fishing for the Northern Territory, Australia.**

C3.23. DUSTIN MARTIN, POPE KEVIN. **Can we predict angler effort on a regional scale from online fishing forum activity?**

C3.24. MIKKO OLIN, ANNA KUPARINEN, JUSSI ALHO, JONI TIAINEN, HANNU LEHTONEN, JUKKA RUUHIJÄRVI. **Changes in pike populations after 3 years size selective fishing monitored via mark-recapture.**

C3.25. PABLO PITA, DIANA FERNÁNDEZ-MÁRQUEZ, JUAN FREIRE. **Near collapse of a coastal rocky reef fish community in the northeast Atlantic Ocean.**

C3.26. ORIOL RIBALTA, ANA GORDOA. **Tag and recapture study carried out in the Ebro river delta by the Catalan Association for Responsible Fishing: Summary of preliminary results.**

C3.27. NIKICA ŠPREM, TOMISLAV TREER, DANIEL MATULIĆ, MARINA PIRIA, TEA TOMLJANOVIĆ, IVICA ANIČIĆ, ROMAN SAFNER, HRVOJE NOVOSEL. **Monitoring of freshwater fish stock in Croatia according to the anglers' data.**

C3.29. MARC SIMON WELTERSBACH, HARRY V. STREHLOW. **Comparison of sea-based recreational and commercial cod catches in the German Baltic Sea**.

C3.30. GARY JACKSON, CLAIRE SMALLWOOD, KENNETH POLLOCK, BRENT WISE, NORMAN HALL, DAN GAUGHAN. **A new complementary survey approach for estimating shore-based recreational fishing catch and effort.**

## *C4 Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives*

C4.9. FIONA JOHNSTON, ROBERT ARLINGHAUS, ULF DIECKMANN. **Fish life history, angler behaviour, and optimal management of recreational fisheries.**
C4.10. JON OLAF OLAUSSEN, YAJIE LIU, ANDERS SKONHOFT. **Optimal harvest pattern under sea lice attacks. What size of salmon to harvest?**

C4.11. STEPHEN SUTTON. **Recreational fishers' beliefs about the impacts of fishing and the necessity of recreational fishing regulations in Queensland, Australia.**

## *C5 Social and biological factors affecting catch efficiencies by anglers*

C5.10. SEAN LANDSMAN, STEVEN COOKE. **Linking muskellunge (*Esox masquinongy*) catch rates and activity with lunar cycles.**

## *C6 EFTTA/EAA Cormorant Session*

C6.5. FRANZ KOHL. **Theoretical model for quantifying 'Foraging Site Attractivity' as function of distance, expected hunting success and perceived security, plus implications for site-specific probability of Cormorant caused damages.**

C6.6. FRANZ KOHL. **A simplified population model to predict the effects of different management scenarios (egg oiling + shooting) on size development of a cormorant colony.**

C6.7. THOMAS BREGNBALLE, BRUNO BROUGHTON[1], DAVID CARSS, IAN RUSSEL. **'Cormorants in Europe': A new European Commission funded project**

## *C7 Biological impacts of recreational fisheries and their social and economic consequences*

C7.6. ANDREW KAUS, DIETRICH BORCHARDT. **Current research investigating a developing recreational fishery in the Kharaa River catchment, Mongolia.**

C7.7. ORIOL RIBALTA, POL LIBORI. **Comparative study between the recreational fishing against commercial fishing in Catalonia, species, total catch and relationships.**

## *C8 Creative methods for managing recreational fishing*

C8.10. EZEQUIEL DA SILVA. **Recent sport fishing developments in Brazil.**

C8.11. JEAN-MARTIN FIERZ. **Recreational fisheries in Switzerland and the fishery advisory office (FIBER).**

C8.12. BRYAN FLUECH, JOY HAZELL, MITTS MRAVIC. **Utilization of marine fisheries regulations workshops to expand fisheries outreach efforts in Southwest Florida.**

C8.13. TAYLOR HUNT, JOHN DOUGLAS, PAUL BROWN, KHAGESWOR GIRI. **Predicting coldwater fish habitat using water levels in reservoirs: benefits to anglers and managers.**

C8.14. LARA KRAMER. **How one organization uses $22 to educate 100,000 new anglers.**

C8.15. DARYL MCPHEE, RENAE TOBIN. **Co-management in recreational fisheries: Can it work?**

C8.16. ONNO TERLOUW. **Sportfishing in Dutch society: developing the social, economic and ecological benefits of Angling in the Netherlands from 2006-2010, future improvements and constraints. Strategies used, results, and critical factors involved.**

C8.17. HERKI TUUS, KUNNAR KLAAS. **Paper-free leisure fishery benefits in Estonia.**

C8.18. PETER WALSH, R. CAPLICE, JOE M. CAFFREY. **Community - the foundation for sustainability in fishery management.**

C8.19. MICHELE PALMER, DOUG DEMKO, JIM INMAN, MAX BOYD. **Recreational fisheries management and recovery of native fish species in the Sacramento-San Joaquin Delta, California.**

C8.20. PAULO CHAVES, DIEGO ZANLORENZI. **Use of fish aggregating device for recreational fishing in Guaratuba Bay, Brazil.**

C8.21. JONATHAN E COLMAN, THROND O HAUGEN, LEE HANKINSON. **Are anglers catching bigger sea bass in Norway compared to the rest of Europe?**

C8.22. SEAN TRACEY, KLAAS HARTMANN, JEREMY LYLE, JAYSON SEMMENS. **Using acoustic telemetry to understand the behaviour and habitat utilisation of key recreational fish in southeast Australia.**

## *C11 Social, economic and biological aspects of a diversifying angler public*

C11.10. BERNARDO ROXO COUTO, RAFAEL DE ALMEIDA TUBINO, CASSIANO MONTEIRO-NETO, PEDRO VIEIRA ESTEVES, MAGDA FERNANDES DE ANDRADE-TUBINO. **Recreational fisheries within the Guapimirim environmental protection area, Guanabara Bay, Rio de Janeiro, Brazil.**

C11.11. KELVEN LOPES, ELIZANGELA GALHARDO. **Description of catches and socioeconomic profile of recreational fishermen in São Caetano de Odivelas, state of Pará, Brazil.**

C11.15. NINA MOSTEGL, WOLFGANG HAIDER, LEN HUNT, BEN BEARDMORE. **Where is the catch? A closer look at the human dimensions in the fishing surveys of British Columbia from 1985 to 2005.**

C11.12. EILA SEPPÄNEN, PÄIVI ESKELINEN, PEKKA SALMI. **Reasons for Finnish recreational fishers' low willingness to pay the fisheries management fee.**
C11.13. JIANZHONG SHEN, PINGHUA HE, WEIMING WANG. **Regard or disregard? Challenges facing development and management of recreational fishing in the open public waters in the People's Republic of China.**

## ***Other***

O.1. ANDREW BARBOUR, AARON ADAMS. **Watershed degradation reduces nursery habitat function.**

O.4. FATIMA VAHIDI, REZVAN MOOSAVI, SEYED MOHAMADREZA FATEMI, SHAHLA JAMILI. **Estimation of potential primary production & fish yield potential by using Bramick Model.**

# Abstracts presented at the 6th WRFC

## Abstracts presented at the 6th WRFC

### The presenter's name is underlined.

**Oral** C8.5 in *Creative methods for managing recreational fishing*

August, 04, 3:20 – 3:40 pm, Seminar Building - Room 1.102

**Sustainable fisheries and social acceptation of recreational fisheries through a new license system and improved enforcement**

*TOINE AARTS*[1]

[1] Sportvisserij Nederland

In the Netherlands the license system changed when the fisheries law 1963 changed in 2007. At that time 550.000 people were buying the governmental license of which about 350.000 were a member of an angling club. Since 2007 The Royal Dutch Angling Association Sportvisserij Nederland is promoting membership and distributing the VISpas. In 2007 Sportvisserij Nederland set up a policy concerning simplifying the rules, building a large network of inspectors all through the organization, countrywide and educating volunteers and policemen in fisheries law and rules. The purpose of this policy is to regulate recreational fisheries in a way that it is socially accepted and sustainable by limiting the number of fish to be taken. But also to show that the angling association clearly takes it's own responsibility to regulate itself in changing society. In three years a central internet system was built where inspectors can enter their activities and results when violation of the rules is noticed. 139 volunteering, so called BOA's, where instructed and governmentally licensed. In four years a growth of 40% in memberships was noticed. In 2008 12,6% of the persons inspected got a penalty, in 2010 11,5% got a penalty. The presentation will show the main goals of the policy, the way this is implemented through the country, how it contributes to social acceptance and sustainable fisheries and detailed results of enforcements and growth in membership will be shown.

**Oral** T1.4 in *Stock, stocking and the future of recreational fisheries*

August, 01, 12:10 – 12:30 pm, Audimax

## Rates of return and feeding habits of farmed rainbow trout after their release into angling grounds

*ZDENEK ADAMEK*[1], ROMAN BLASZCZOK[2], PETR CTRNACT[2]

[1] Department of Fish Ecology, Institute of Vertebrate Zoology
[2] Faculty of Fisheries and Protection of Waters, University of South Bohemia

The rates of return and diet composition of farmed rainbow trout stocked for angling purposes were evaluated in non-salmonid and salmonid angling grounds in 2007 and 2008. Rainbow trout in an angling ground are usually subject to heavy angling pressure immediately after their release. In a non-salmonid angling ground, their rates of return ranged between 43.38 and 50.87% in 2008 and 2007, respectively. The vast majority of these fish have been caught within the first two-three days after release. Afterwards, their catches were rather sporadic. In a salmonid angling ground, the rates of return amounted to 36.75 and 64.86% in 2007 and 2008, respectively. Despite obvious peaks in catching rates following fish release, the time span of catches was considerably prolonged compared to non-salmonid angling grounds. Rainbow trout diet after release differed significantly between the angling grounds – in the ground based on non-salmonid management, it consisted mainly of baiting items (bread, maize, maggots etc.), whilst in salmonid angling ground (where the application of natural baits is prohibited), rainbow trout, despite their farmed origin, ingested natural food items since the beginning. First, it consisted mostly of items of low (or zero) nutritional value (like wood debris, buds, alder-tree catkins etc.) but with increasing proportion of benthic and terrestrial drifting organisms in the time process.

**Poster** T1.13 *Stock, stocking and the future of recreational fisheries*

## Rearing environment affect important life skills in pikeperch (*Sander lucioperca*)

*IDA AHLBECK*[1], PER B. HOLLILAND[1]

[1] Systems ecology, Stockholm University

The effect of rearing environment on the behaviour of young-of-the-year pikeperch (*Sander lucioperca*) bred at three different production facilities was investigated. Two groups were reared in semi natural ponds and one group in indoor tanks. Explorative behaviour, foraging behaviour and anti-predator behaviour were studied in aquarium experiments. There were no significant differences between pond and tank reared fish in reluctance to explore its new environment, but pond reared fish spent significantly more time in plant refuge. Pond reared fish were significantly faster to start foraging on a live prey (*Neomysis integer*) that they had not encountered before. Pond reared fish were also significantly more active in their anti-predator response than tank reared fish. The rearing environment obviously influences the development of important life skills. These differences may impact the success rate when stocking young-of-the-year pikeperch to natural waters.

**Oral** C7.1 in *Biological impacts of recreational fisheries and their social and economic consequences*

August, 04, 3:20 – 3:40 pm, Audimax

**Is recruitment overfishing common in freshwater recreational fisheries?**

*MIKE ALLEN*[1], ROBERT ARLINGHAUS, MIKE HANSEN

[1] Fisheries and Aquatic Science Program, University of Florida

Sustainability of fish populations is a common goal of recreational-fisheries management, but specific management objectives often differ between freshwater and marine fisheries. Preventing recruitment overfishing is the primary management goal for recreational fisheries in marine systems, which probably arises from high profile fisheries collapses (e.g., Atlantic cod, *Gadus morhua*). Conversely, freshwater fisheries management agencies across the world, and especially in North America, tend employ strategies aimed at increasing angling effort such as increasing angler access and fish stocking programs. Such strategies could heighten the likelihood of recruitment overfishing, which in turn may occur as a widespread, rather than a localized phenomenon, in recreational fisheries ("invisible collapse"). We found empirical support that fish mortality rates for many recreational fishing mortality rates put stocks at risk of recruitment overfishing, similar to the marine fisheries. We then developed a simple population model to show that preventing recruitment overfishing generally improves long term angler catch, yield, and abundance of trophy fish. We conclude that management of freshwater recreational fisheries should consider, rather than downplay, the potential for recruitment overfishing to threaten fishing quality. Fishery managers should employ assessment methods to diagnose recruitment overfishing in freshwater systems, and initiate management actions to prevent it.

**Oral** C8.9 in *Creative methods for managing recreational fishing*

August, 04, 4:40 – 5 pm, Seminar Building - Room 1.102

**Application of population dynamics models to meet multiple-use objectives in recreational fisheries management. Case study: brown trout (*Salmo trutta*) angling in La Rioja (north of Spain)**

*CARLOS ALONSO*[1], JAVIER GORTÁZAR[2], DIEGO GARCÍA DE JALÓN[1]

[1] Laboratory of Zoology, Department of Forest Engineering, Polytechnic University of Madrid
[2] Ecohidráulica, SL

Recreational fisheries management programs usually have to define the form and quantify the intensity of the yield that can be obtained from a stock in order to achieve previously defined objectives of ecological, economic or social nature. For this purpose the following methodological procedure has been designed and applied in a brown trout angling management plan in La Rioja (north of Spain): (1) identification of the populations inhabiting the project area; (2) determination of anthropogenic pressures and multiple-use constraints; (3) modelling of the population dynamics; (4) definition of objectives of the management plan; (5) simulation of the response of the population to management measures; and (6) error estimation. The dynamics of the largest four populations in the project area have been represented by means of a theta-logistic model to which a population viability threshold effect and an adjustable stochastic variation component have been added. In these models the concept of *resilience* has been defined by two factors: *resistance* (function of the difference between population viability threshold and its carrying capacity) and *recovery ability* (function of the intrinsic population growth rate). By estimating the resilience of a given population we have been able to determine the Total Allowable Catch (TAC) that meets the requirements of multiple-use river management with a known confidence interval and a previously specified significance level.

**Oral** T2.15 in *Change, adaptation and evolution in recreational fisheries*

August, 03, 10:30 – 10:50 am, Audimax

## Is angling a stochastic process for life-history traits? An empirical assessment for marine coastal fisheries

*JOSEP ALÓS*[1], ROBERT ARLINGHAUS[2], MIQUEL PALMER[1], LUCIE BUTTAY[1], ALEX ALONSO-FERNÁNDEZ[3]

[1] Instituto Mediterráneo de Estudios Avanzados, IMEDEA (CSIC-UIB)
[2] Department of Biology and Ecology of Fishes, Leibniz-Institute of Freshwater Ecology and Inland Fisheries Müggelseedamm 310, 12587 Berlin, Germany and Inland Fisheries Management Laboratory, Faculty of Agriculture and Horticulture, Humboldt-Universität zu Berlin, Germany
[3] Instituto de Investigaciones Marinas, IIM (CSIC) C/ Eduardo Cabello 6, 36208, Vigo, Pontevedra, Spain

Larger and older fish individuals within a population tend to experience a larger mortality probability than smaller and younger individuals. This implies that fishing selects against life-history traits correlating with body size, such as growth capacity, reproductive investment and timing of maturation. It is currently unkown whether individuals vulnerable to fishing gear differ systematically from the average individual in terms of growth capacity and reproductive investment. Here, we present results that supports that angling does not constitute a stochastic process for targeting life-history traits in a marine sedentary fish populations. Individuals from a wild population of S*erranus scriba* were sampled using two different gears to obtain a random sample regarding life-history traits (beam trawl) and a hook-and-line-sample (angling). We fitted individual back-calculated size-at-age data to life-history models to obtain the parameters maximum size (*Lmax*) and reproduction investment (*g*). In line with expectations we found that individuals vulnerable to angling exhibited larger maximum sizes and lower values for reproductive investments, collectively indicating faster growing individuals in terms of somatic growth. Thus, our study suggests that systematic removal of vulnerable fish will exert selection pressures for increasing reproductive investment and smaller maximum sizes, which will penalize the average growth rate of individuals in the population.

**Oral** C1.12 in *Biological and social aspects of catch-and-release*

August, 01, 4:50 – 5:10 pm, Seminar Building - Room 1.101

**Do shifts in wildlife value orientations affect the moral acceptability of recreational fishing in post-industrialized societies?**

*ROBERT ARLINGHAUS*[1], CARSTEN RIEPE[1]

[1] Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany

The objective of this study was to test a cognitive hierarchy model composed of wildlife value orientations affecting attitudes towards animals, which in turn were hypothesized to explain specific attitudes related to the morality of recreational fishing and behavioural intentions to support a ban on recreational fishing. Data originated from N = 1,043 randomly selected individuals in Germany aged 14+ years (face-to-face interviews, response rate 72%). At the lowest level of the cognitive hierarchy, behavioural intention to support a ban on angling was explained by the perceived moral acceptability of recreational fishing in general and by the attitude towards catch-and-release angling in particular, a practice that may be perceived as “playing with food for no good reason”. Both of these attitudes were influenced by the attitude towards animal rights, which in turn was driven by domination and mutualistic wildlife value orientations. Signs of relationships were as expected. However, contrary to expectations, anthropomorphism had only negligible influence on other constructs in the model. It is concluded that if mutualistic wildlife value orientations emphasizing the individuality of animals and questioning their use for human pleasure do indeed continue to grow, an increase in critical opinions held by the general public in Germany towards particular forms of human-animal interaction such as recreational fishing will be likely.

**Oral** C5.8 in *Social and biological factors affecting catch efficiencies by anglers*

August, 03, 11:10 – 11:30 am, Seminar Building - Room 1.101

## Variables affecting recapture rates of tagged tuna in North East Atlantic tagging programmes. Perspective from recreational fishery

*IGOR ARREGUI*[1], RONAN COSGROVE[2], *IKER ZUDAIRE*[1], NICOLAS GOÑI[1], HARITZ ARRIZABALAGA[1]

[1] Marine Research Division, AZTI-Tecnalia
[2] BIM (Irish Sea Fisheries Board)

AZTI-Tecnalia has developped an important cooperation with recreative tuna fishers operating in the Bay of Biscay. The main activity within this cooperation is the tagging of albacore (*Thunnus alalunga*) and bluefin tuna (*T. thynnus*), with both conventional (partly implanted by recreational fishers) and electronic tags. The observed recovery rates were analysed using GAMs. Recovery rates appear significantly higher for bluefin tuna. No significant difference in recovery rates is observed between fish tagged by recreational fishers and those tagged by scientists. Trolling gear (vs. baitboat), fish size from 59 to 75 cm FL, experience of taggers and conventional tags (vs. archival tags) yielded significantly higher recovery rates. Length-dependency of recovery rate is more likely related to a length-dependent mortality than to migration patterns. Direct effects of tagging technique (fishing gear, handling or hooking) on survival at release may be actually the main cause of the variability of recovery rates. These results can help maximizing archival tag recaptures of both species in the Bay of Biscay and can contribute to tag-depletion model analyses by preventing biases due to the tagging process itself. Recommendations from this study include the incorporation of double conventional tagging in trolling technique. In general, a careful hooking, fish manipulation and fish selection in recreational tagging are expected to have higher recapture rates and are recommended.

**Oral** C3.9 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 1:30 – 1:50 pm, Seminar Building - Room 1.102

**Long-term changes in angling catches in a once polluted river**

*STEPHEN AXFORD*[1], TERRY LANGFORD[2], DAVID SANDERSON, TOM WORTHINGTON

[1] Institute of Fisheries Management
[2] University of Southampton

The composition of angling catches in the River Trent has changed greatly as this river has recovered from thermal and organic pollution. The responses of the fish community are examined as well as the responses of anglers to the changed fish communities. The pros and cons associated with using angling catches for monitoring fish stock changes are discussed.

**Poster** O.1 in *Other*

## Watershed degradation reduces nursery habitat function

*ANDREW BARBOUR*[1], AARON ADAMS[2]

[1] Fisheries and Aquatic Sciences, University of Florida
[2] Mote Marine Laboratory

Overfishing has traditionally been blamed for declines of fish stocks, but increasing attention is being paid to the influence of habitat alteration. For many tropical fishes, coastal mangrove creeks function as nursery habitats essential for replenishing exploited populations. To determine the effect of coastal development on nursery habitat function, we studied three tidal mangrove creeks that were impacted by different levels of watershed degradation in Charlotte Harbor, FL USA. We used PIT tags to mark 1,444 juvenile common snook, *Centropomus undecimalis*, over two years, and recaptured >83% of fish with an array of 11 autonomous PIT tag antennae to estimate survival. This survival data allowed us to examine how habitat degradation influenced the ability of juvenile snook to resist the effects of a disturbance. In January 2010, an extended low-pressure system caused water temperatures to drop below the thermal lethal minimum of *C. undecimalis*. Habitat degradation influenced survival, with lowest impacts in the least degraded habitats: when compared to previous years, there was a 5% reduction in apparent survival in the natural creek; a 20% reduction in one degraded creek; and a 50% reduction in the most degraded creek. We suggest that degradation of coastal habitats reduces the functional quality of nursery habitats and reduces the ability of juvenile fishes to resist natural disturbances, thereby reducing the number of recruits available to replenish adult populations.

**Oral** T2.1 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 10:30 – 10:50 am, Audimax

## What do we know about how climate will impact recreational fisheries and what are the next steps for adaptation planning

*T. DOUGLAS BEARD*[1], ELDA VARELA-ACEVEDO[2], WILLIAM TAYLOR[3]

[1] National Climate Change and Wildlife Science Center, USGS
[2] National Climate Change and Wildlife Science Center
[3] Michigan State University

Changes in climate will impact the distribution and populations of fish in the United States. Management agencies, tasked with developing plans that integrate adaptation of fish to changes in climate are in need of a systematic, scientific approach to understanding changes in recreational fisheries. Unfortunately scientific projections of future changes in recreational fisheries as a result of climate change is still in its "infancy" and broad-scale understanding of how climate driven impacts will affect recreational fisheries are largely unknown. Downscaling of climate information to a more effective management scale, can allow fisheries managers to make informed projections about possible changes in fisheries distributions and populations. Development of techniques that link changes in fish populations and distribution with changes in angler interest will be a key next step in providing fisheries managers with the necessary science based tools for making decisions. Effective management of recreational fisheries, in the future, will be dependent on incorporation of science-based projections into recreational fisheries adaptation management plans.

**Oral** C4.3 in *Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives*

August, 02, 11:10 – 11:30 am, Seminar Building - Room 1.101

## Fish for eel (*Anguilla anguilla*) or not – Predicting fishing effort responses and harvest outcomes to altered recreational eel angling regulation

BEN BEARDMORE[1], *MALTE DOROW*[2], WOLFGANG HAIDER[1], ROBERT ARLINGHAUS[3]

[1] School of Resource and Environmental Management, Simon Fraser University
[2] Institute for Fisheries, State Research Center for Agriculture and Fisheries MV
[3] Department of Biology and Ecology of Fishes, Leibniz Insitute of Freshwater Ecology and Inland Fisheries

Understanding how anglers would change their fishing effort in response to regulations is important conserving threatened fisheries resources such as the European eel (*Anguilla anguilla*). A discrete choice experiment was applied to predict the allocation of recreational eel angling days versus potential substitute fishing opportunities in Northern Germany as a function of eel angling regulations, catch attributes and hypothetical eel fishing costs. The resulting allocation model accurately predicts current eel angling allocation patterns. Further, it was found that the allocation of eel angling effort is largely resilient to changes in individual eel angling regulations, including daily bag limits, daily rod limit and temporal fishery closures. The observed inelastic effort response to the most commonly discussed policy interventions suggests that managers cannot expect to substantially reduce eel angling effort using moderate management interventions. However, under a strict regulation set up (two week closure per month, daily bag limit of 1 eel, 60 cm or larger, 1 rod per angler) the eel angling effort can be expected to be reduced by about 42 % relative to current conditions. Under such a strict regulation set up the eel landings by anglers would be reduced by 73%. At the same time such an intense policy intervention substantially reduces angler welfare while the effect on the future eel recruitment is unknown.

**Oral** C2.4 in *Angling tourism development: social, economic and biological challenges*

August, 01, 12:10 – 12:30 pm, Seminar Building - Room 1.102

## Economic impact of marine fishing tourism in Norway

*TRUDE BORCH*[1], FRANK OLSEN[2], MIKKO MOILANEN[2]

[1] Nofima
[2] Norut

In Norway marine fishing tourism is a rapidly developing activity and there are sustainability issues to be dealt with. The long Norwegian coastline with a fairly open access to salt-water recreational fishing, the lack of a license system and a registry of fishing tourism enterprises makes it is challenging to identify tourists and enterprises for survey purposes. This article presents the results from an economic impact study attempting to overcome these challenges through combining supply-side data on capacity and guest nights with demand-side data on daily expenditures collected from tourists via European tour operators. There is a wide variety of accommodation facilities and rental boats on offer to tourists visiting Norway. This study focus on the professional establishments, providing services to tourists who purchase a specialized fishing holiday package including accommodation, boat rental and facilities for rinsing and freezing fish catch. The study identified 434 enterprises as belonging to this Industrialized Fishing Tourism sector (IFT sector), providing 14 968 beds and 2369 rental boats to tourists. The paper describes the structure of the IFT sector, the nationality, travel mode, travel group and expenditure pattern of marine fishing tourists visiting Norway and it presents the total economic impact of the IFT sector in four different coastal regions in Norway (direct, indirect and induced effects).

**Poster** C3.18 in *New methodological tools to survey and assess recreational fisheries*

## Tracing angler behaviour and exploitation pressure from individual logbook data

*DAVID BOUKAL*[1], MARTIN JANKOVSKY[2], JAN KUBECKA[3]

[1] Laboratory of Theoretical Ecology, Biology Centre AS CR, CZ
[2] Faculty of Science, Charles University in Prague, CZ
[3] Fish Ecology Unit, Biology Centre AS CR, CZ

Recreational fisheries in the Czech Republic are underpinned by a meticulous recording scheme. Anglers in the Czech Republic are obliged to record fishing trips and catches at a daily resolution in locally administered logbooks and submit their annual records to the authorities of the Czech Angler's Union, which extract selected data. The amount of detail stored in Czech Angler's Union records has increased over time from basic summary statistics to separate records of individual-level annual catches, but the data have been little explored so far. Here we use data from several years and reservoirs to show that the individual-level annual catches can be used to separate anglers into groups with different impact on local fish stocks. There were more generalist anglers who caught 2-3 species from the set of 2-3 most commonly caught fish at a given reservoir, as opposed to specialist anglers who caught only one. Generalists also had higher catches and effort but lower CPUE than the specialists. The results indicate that generalist anglers with a low degree of specialisation and high effort may contribute to long-term pair wise correlations in species catches, observed at some of the reservoirs. Finally, data with daily resolution collected in a recent pilot project can reveal fine detail in temporal variation in fishing pressure and angling success, and yield additional insights into the behaviour of anglers.

**Oral** T1.3 in *Stock, stocking and the future of recreational fisheries*

August, 01, 11:50 am – 12:10 pm, Audimax

## Stock-catch analyses of carp recreational fisheries in Czech reservoirs

*DAVID BOUKAL*[1], MARTIN JANKOVSKY[2], JAN KUBECKA[3], MIKKO HEINO[4]

[1] Laboratory of Theoretical Ecology, Biology Centre AS CR, CZ
[2] Faculty of Science, Charles University in Prague, CZ
[3] Fish Ecology Unit, Biology Centre AS CR, CZ
[4] Institute of Marine Research, Norway

Many recreational fisheries are actively managed by regular stocking. Ratio between caught and stocked fish is an important indicator for fisheries managers, who strive for high return rates of stocked fish. Here we propose relatively simple time series analyses to examine the dependence of reported anglers' catches on stocking, using 16-52 year long time series on common carp (*Cyprinus carpio* L.) from 14 Czech reservoirs. Carp is the backbone of Czech recreational fisheries and accounts for a large proportion of catches at most reservoirs. We show that regression models based on generalized least squares can simultaneously estimate the long-term return ratio and likely mean survival times of stocked carp. Moreover, the models can identify the (lack of) impact of major environmental and societal events, such as major floods in the year 2002 and the fall of the Communist regime in 1989, on recreational fisheries. These analyses shed more light on the performance of current stocking practices at individual reservoirs.

**Oral** C2.5 in *Angling tourism development: social, economic and biological challenges*

August, 01, 2 – 2:20 pm, Seminar Building - Room 1.102

## Assynt angling research: The challenges of developing angling tourism

*ADAM BROWN*[1]

[1] Director, Substance

This paper is based on a three year study of angling in Assynt, Sutherland in North West Scotland (www.assynt.anglingresearch.org.uk). Assynt has an extensive and unique wild brown trout fishery as well as salmon and sea trout and sea fishing. It has long been the focus for angling tourism dating at least to the early 19th century (Hicks 1855) and embodies a number of different forms of land and angling ownership – from community charitable trust to more traditional single landowner (MacAskill 1999). In 2008/09 it was the focus for an angling tourism initiative and local organisations have sought to promote angling tourism as a route to both fishery and wider community social and economic development. Based on extensive empirical evidence generated through quantitative and qualitative surveys, semi-structured interviews and 'action research' approaches, the paper explores: i) the challenges entailed in undertaking angling tourism research in a remote, rural community. ii) the dichotomy between angling tourists, often fearful of change and increased numbers to a unique resource, and local organisations aware of significant capacity and with a desire to develop income. iii) Evidence about the experience of visiting anglers and from an economic impact study of angling tourism in the area. iv) Piloting of a unique online digital mapping and comment tool as a way of assisting ongoing information provision and information gathering to inform visitors and local fisheries alike.

**Poster** C6.7 in *EFTTA/EAA Cormorant Session*

## ‘Cormorants in Europe’: A new European Commission funded project

THOMAS BREGNBALLE, ***BRUNO BROUGHTON***[1], DAVID CARSS, IAN RUSSEL

[1] CORMAN & EFTTA

Cormorants and cormorant-fisheries issues are still very much part of the European Commissions agenda. We describe the EC’s new initiative to organise pan-European counts of cormorants and establish a platform on the internet where knowledge about cormorant populations and cormorant-fisheries issues can be disseminated to stakeholders and other persons with an interest in the issue. The project will run from 2011 to 2013. The platform will be available from the summer of 2011. Facilities and new material will be added regularly during the project period. The planned facilities include a database of literature, information about cormorant populations, help desk functions, and recommendations for best practices through access to a Cormorant Management Toolbox developed during the INTERCAFE COST Action project. A count of ‘all’ cormorant colonies in Europe and adjacent states will take place in 2012. This count will be followed by a pan-European census of wintering birds in January 2013. The counts are organised with Wetlands International IUCN/SSC Cormorant Research Group as a partner. The success of the counts will to a large extent depend on the willingness of volounteers to participate in the project. Selected stakeholders are connected to the project through a Stakeholders’ Liaison Group.

**Poster** T2.19 in *Change, adaptation and evolution in recreational fisheries*

## Change in fisheries – the importance of angling social research

*ADAM BROWN*[1], NATALIE DJOHARI[1], PAUL STOLK[1]

[1] Substance

This position paper will provide an overview of the need for our understanding of change in fisheries to encompass research about angling's social benefits. An extensive 3 year research programme in the UK, *The Social and Community Benefits of Angling* (www.anglingresearch.org.uk), has sought to start to bridge the 'evidence gap' in angling about its social and community value. The paper will: i) Outline why recreational angling needs to demonstrate its *social* value, in order to properly inform and promote the sustainable development of fisheries. Although there have been increasing calls for the 'social dimension' to complement natural sciences (Environment Agency 2004; Whightman et al 2007; EIFAC 2010) and an increasing interest from researchers (Oughton 2009) angling has a significant evidence gap compared to other activities and sports (Brown 2010). Addressing this will provide dividends for fisheries and angling bodies from policymakers, funders and potential anglers.ii) Provide an overview of evidence from the research about the scope of social and community benefits angling can deliver, including health and well being, environmental improvement, young people's development and tourism. This is based on hundreds of interviews, survey data and online data collection.iii) Outline a framework for ongoing work, highlighting key emerging issues and the potential use of online tools and new technologies that have been piloted during our research.

**Oral** C2.6 in *Angling tourism development: social, economic and biological challenges*

August, 01, 2:20 – 2:40 pm, Seminar Building - Room 1.102

## Anglers and tourists: User group variation in the Columbia River Gorge, USA

*ROBERT BURNS*[1], ALAN GRAEFE[2]

[1] Forestry and Natural Resources, West Virginia University
[2] Penn State

The Columbia River Gorge (CRG) is a 23 mile long linear gorge lying between 500 foot tall cliffs, with the Columbia River and numerous waterfalls/trailheads dominating the landscape. Two popular primary activities in the Gorge are fishing and tourist activities (picnicking, viewing scenery, driving for pleasure, etc.). Although a substantial degree of effort has been placed on understanding the satisfaction levels of CRG recreationists, little emphasis has been placed on segmenting these user groups to develop a socio-economic and satisfaction typology. To better understand CRG users, on-site surveys (n=741) were conducted to develop a comparison of anglers versus tourists. The anglers showed significantly lower satisfaction levels than the tourists across all nine quality service indicators (5-point Likert scale) and the global measure (mean=6.57 vs. 8.76). Anglers were more likely to be repeat visitors (89% vs. 11%), more racially/ethnically diverse (80% White vs. 93% White), less likely to visit in all four seasons (15% vs. 30%), more likely to visit alone (40% vs. 7%), and more likely to visit longer (mean=5.9 vs. 1.7 hours). These differences, spread across not only socio-demographic characteristics, but across satisfaction indicators suggests a differing management approach may be necessary to better meet the needs of both groups. Targeting these segments may result in a more satisfied constituency and potentially in a greater economic impact through return visits.

**Oral** C5.7 in *Social and biological factors affecting catch efficiencies by anglers*

August, 03, 10:50 – 11:10 am, Seminar Building - Room 1.101

**How environment affects catch rates in the recreational squid jigging fishery**

*MIGUEL CABANELLAS-REBOREDO*[1], JOSEP ALÓS[1]

[1] Ecology and Marine Resources Department, IMEDEA (UIB-CSIC)

How catch rates are influenced by the environment (e.g. moon phase) is a key topic when coping with ecological traits and fisheries management of exploited stocks by angling. However, these kinds of studies are still very scarce and limited to some freshwater and big game fish species. The objective of this study was to disentangle the effects of the environment factors on the angling of the most important species targeted by the anglers in the Mediterranean Sea, the European squid *Loligo vulgaris*. We present the results of two-year based study where a number of experimental angling sessions were carried out to estimate the independence of catch rates and different environmental explanatory variables in the recreational squid jigging fishery. Variables considered in the study were moon phase, water temperature, hour of catch (regarding sunset), angling pressure, as well as variables regarding weather (wave, speed wind intensity and direction, rain intensity or cloud cover). Variance portioning showed how temporal variables explain large percentages of variability resulting in catch rates patterns at different time scales (i.e. within day (i.e. sunset), season and year). This study provides essential information to optimize the sampling efforts when attempting to asses squid stock. Moreover, this study reveals the keys for the anglers select the most productive periods, through the year and within day, to obtain the best efficient CPUE of this important cephalopod species.

**Poster** C2.9 in *Angling tourism development: social, economic and biological challenges*

## Socioeconomics of recreational fisheries in a Mediterranean touristic island: The case of Mallorca

*FEDERICO CARDONA-PONS*[1]

[1] Instituto Mediterráneo de Estudios Avanzados, IMEDEA (CSIC-UIB)

The number of recreational fishers was 34,014 people in Mallorca in 2009 while the number of tourists was 8,718,788. Taking these figures into account it was developed a socio-economic study to better understand who went fishing and how much do they spent. Three different surveys were carried out. The first one was focused on the local recreational fishers; profile, opinion about different management measures applied, and expenditures were considered. The second one was focused on the tourists to know the percentage of both, visitors who had been fishing during their holidays and those who had not been fishing despite being a recreational fisher at their home place, visited Mallorca. The third was focused on the nautical tourists, letting a good understanding about the relation between boating and recreational fishing. Local fishers who answered the survey were divided into different management groups to enable the extrapolation of the data, and an economic impact analysis using input-output models was performed. It was estimated the 2.35% of the tourist population practiced recreational fishing in the Island while the percentage of potential recreational fishers was estimated at 9.25%. The 20% of boaters practiced recreational fishing. The results offered a wide vision about facts and figures of the recreational fishing activity on the island of Mallorca. Methodologies used, data treatment and analysis, and a summary of the main results of this study will be shown at the presentation.

**Poster** T1.14 in *Stock, stocking and the future of recreational fisheries*

## Long-term captive breeding does not necessarily prevent reestablishment

*GERARD CARMONA-CATOT*[1], PETER B. MOYLE[2], RACHEL E. SIMMONS[2]

[1] University of California, Davis & University of Girona, Spain
[2] University of California, Davis

Captive breeding of animals is often cited as an important tool in conservation, especially for fishes, but there are few reports of long-term (< 50 years) success of captive breeding programs, even in salmonid fishes. Here we describe the captive breeding program for Eagle Lake rainbow trout (ELRT), *Oncorhynchus mykiss aquilarum*, which is endemic to the Eagle Lake watershed of northeastern California, USA. The population in Eagle Lake has been dependent on captive breeding for more than 60 years and supports a trophy fishery in the lake. Nevertheless, the basic life history, ecological, and genetic traits of the subspecies still seem to be mostly intact. Although management has apparently minimized negative effects of hatchery rearing, re-establishing a wild population would ensure the maintenance of its distinctive life history and its value for future use as a hatchery fish. An important factor that makes re-establishment possible is that the habitat in Eagle Lake is still intact and that Pine Creek, its major spawning stream, is recovering as habitat. The ELRT story shows that long-term captive breeding of migratory salmonid fishes does not necessarily prevent re-establishment of wild populations, provided effort is made to counter effects of hatchery selection and that natural habitats are restored for reintroduction. Long-term success, however, ultimately depends eliminating hatchery influence on the single wild-spawning population.

**Poster** T2.20 in *Change, adaptation and evolution in recreational fisheries*

## Enhanced self-recruitment in a highly exploited sedentary marine fish population: how plausible is fishing-induced evolution?

IGNASI A. CATALÁN[1], *JOSEP ALÓS*[1], ITZIAR ÁLVAREZ[1], ANTONI JORDI[1], GOTZON BASTERRETXEA[1]

[1] Instituto Mediterráneo de Estudios Avanzados, IMEDEA (CSIC-UIB)

Size-dependent fish mortality can drive the optimal strategy in opposite directions. Given the high heritability of some life-history traits (such as growth or reproduction investment) evolutionary responses in sedentary fish populations could modify optimal strategies. For open of marine populations with significant early life-stage dispersal and heterogeneous fishing effort this factor is controversial. We estimate fish larval dispersal (10 years forced with real data) along the Southern shelf of Mallorca Island. Results show how relatively small areas in enclosed bays present low dispersal trough pelagic stages and a high degree of self-recruitment. When these areas were overlapped on the spatial recreational fishing effort layers, results showed how the most important recreational fishing area coincides with the main areas of high self-recruitment. The biological properties of the exploited species are characterized by a high turnover, including first-year maturation, fast growth, short life-span and short home-ranges in their adult phases. The high-selective properties of the fishery (including minimum legal sizes) coupled to the high degree of harvest since seventies might have positively selected for a “be smaller” optimal life history strategy. Considering this biology outpoints and the data from the larval and eggs connectivity, we speculate on the plausible evolutionary response over time.

**Poster** C8.20 in *Creative methods for managing recreational fishing*

## Use of fish aggregating device for recreational fishing in Guaratuba Bay, Brazil

*PAULO CHAVES*[1], DIEGO ZANLORENZI[1]

[1] Parana, Universidade Federal do Parana

The "*cevas*", used for fattening fish, help the community to support recreational fisheries. They are rectangles of 10-18m$^2$, delimited in their corns by bamboo-sticks. Along 12 months of surveys in the tributaries of the Guaratuba Bay (25$^o$52'S; 48$^o$39'W), 49 *cevas* were registered placed close to the river margins, depths 3-6m. Small-scale fishers that inhabit this region, the "guides", self-considered owners of these *cevas*, feed them by submerging permeable bags with bread, wheat, maize and fish's food. Recreational fishers coming from cities distant up to 200Km are conduced to *cevas* in small boats. Anglers use several types of bait, mainly animal viscera. A total of 226 of them was interviewed and informed to practice it once or twice a month, mainly in winter. For 80% of them, sportiveness is the most important attribute of fishing in *cevas*, while for 20% their main attractive is the high number and type of fish caught. Mullets and marine catfish are the target groups, but 25 or more species are caught. Fish are note marketed, so guides invest in *cevas* exclusively aiming to have incomes provided by recreational fishers. For 48% of these last, the number of *cevas* could be increased, but for 16% the number of boats is excessive, troubling the activity. In catch composition adult individuals predominate, and litterature data show that at least 40% of species use this estuarine zone for breeding. The resilience of this modality of fisheries in this region will also be discussed.

**Oral** C3.10 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 1:50 – 2:10 pm, Seminar Building - Room 1.102

## The role of recreational fisheries in fluvial cyprinids protection, research development and aquaculture diversification in Poland

*MIROSLAW CIESLA*[1], ARKADIUSZ WOLOS[2]

[1] Department of Ichthyobiology and Fisheries, Warsaw Univesity of Life Sciences - SGGW
[2] Inland Fisheries Institute in Olsztyn

As far as recreational fisheries in Poland is moving more to “C&R” model, total amount of fish consumption from angling could be estimated on 30.000 – 40.000 tons per year, comparing with 35.000 tons from traditional aquaculture and 2.900 tons from inland fisheries in lakes, dam reservoirs and rivers. For very long time the most important species for angling were two cyprinids (roach and bream), pikeperch, pike, common carp, brown trout and grayling. However, investigations started on a large scale in 90ties of XX century showed that the most endangered species were fluvial cyprinids (ide, chub, barbel, nase, asp and vimba bream), highly influenced by anglers overexploitation. All of them were critically endangered (CE) or endangered (EN) species. In 1990 Polish Anglers Association, the largest fishery user of open waters, started long-term project on fluvial cyprinids restoration. The number of centers, involved in research and production, increased from 2 in 1989 to more than 150 in 2010. Production of the fish for restocking increased from 20.000 juveniles and 50 kg fingerlings in 1990 up to approx. 14.000.000 juveniles and 80.000 kg fingerlings in 2009. The paper presents the role the recreational fisheries could play in sustainable riverine ecosystems exploitation and eco-development. Present status of fluvial cyprinids in selected mountain, sub-mountain and lowland rivers is also presented based on the results of obligatory registration of anglers’ catches.

**Oral-WS** Com.6 in *Workshop: Communication and Collaboration between Science and Management in Recreational Fisheries*

August, 03, 11:50 am – 12:05 pm, Seminar Building - Room 1.103

## Model of not-for-profit co-management of recreational fisheries in British Columbia

*ADRIAN CLARKE*[1]

[1] Science, Freshwater Fisheries Society of BC

The Freshwater Fisheries Society of British Columbia (FFSBC) is a non-profit organization who works in partnership with the provincial government to deliver the fish stocking program as well as providing conservation fish culture services that support steelhead and sturgeon recovery programs. Our not for profit status allows us to enter into formalized research partnerships with Academic experts in the fields of ecology, physiology, Fisheries Management, and Human Dimensions. These partnerships are jointly supported by FFSBC and the Natural Sciences and Engineering Research Council of Canada and have greatly increased our capacity to take a multi-disciplinary approach to recreational fisheries management.

**Oral** C4.4 in *Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives*

August, 02, 11:30 – 11:50 am, Seminar Building - Room 1.101

## Impacts of angling and environmental changes on the reproductive success and recruitment of bass

JULIE CLAUSSEN[1], *DAVID PHILIPP*[1], BRANDON BARTHEL[2], JAMES LUDDEN[3], JANA SVEC[4]

[1] Natural History Survey, University of Illinois
[2] Florida Fish and Wildlife Conservation Commission
[3] College of DuPage
[4] Moraine Valley College

Our research group has monitored the reproductive activity and angling activity of largemouth and smallmouth bass in several water bodies in Ontario since 1990. Specifically, snorkelers have located all nests formed during each year's spawning season, quantifying the mating success for each male (numbers of eggs laid) and the success or failure of the brood (reaching the independent fry stage), thereby allowing the quantification each year of lake-wide reproductive success (number of successful offspring produced). Our data demonstrate that in Ontario, there is a direct, positive relationship between lake wide reproductive success and the size of the year class produced (i.e., the relative number of 1+ juveniles the next year). Individual characteristics of each male (e.g., size, age, duration of parental care provided) together with the level of angling that occurs on nesting bass allowed us to assess the factors important for nest success or failure. The long-term nature of this study has allowed us to assess the long-term impacts that angling for nesting bass can have on the reproductive success and recruitment of bass, as well as the impacts of environmental and climatic changes.

**Oral** C1.5 in *Biological and social aspects of catch-and-release*

August, 01, 2 – 2:20 pm, Seminar Building - Room 1.101

## Growth response to catch-and-release angling in wild largemouth bass (*Micropterus salmoides*)

*TIMOTHY CLINE*[1], JAMES KITCHELL[1], BRIAN WEIDEL[2], JAMES HODGSON[3]

[1] Center for Limnology, University of Wisconsin-Madison
[2] Great Lakes Science Center, United States Geological Survey
[3] Department of Biology, St. Norbert College

Catch-and-release angling is gaining popularity worldwide due to angler conservation practices, sport fishing tournaments, and management restrictions. To be an effective management tool, mortality and sublethal effects of catch-and-release angling must be nominal. Black bass (*Micropterus* spp.) are the most sought after sport fish in North America. Angling related mortality is well documented in these species but the sublethal effects have not been evaluated in a natural setting, which more adequately captures scales of stress and variability than laboratory studies. We used a 27-year mark-recapture study of over 1,200 individuals to assess the effects of catch-and-release angling on the growth of largemouth bass (*Micropterus salmoides*). Recapture intervals range from 1 to 98 days after being angled. Mean growth rates of fish recaptured less than 13 days after being angled were significantly reduced ($p < 0.001$). However, 20 days after being angled mean growth rates were not significantly different from population-wide growth rate ($p=0.852$). Due to the observed compensatory feeding and growth, catch-and-release angling has little impact on seasonal growth patterns of largemouth bass and therefore should have limited adverse effects on growth dependent ecological functions.

**Poster** C3.20 in *New methodological tools to survey and assess recreational fisheries*

**Monitoring of recreational fisheries in Italian seas: biological and social aspects**

*SABRINA COLELLA*[1], FORTUNATA DONATO[1], NANDO CINGOLANI[1], ALBERTO SANTOJANNI[1]

[1] O.U. of Ancona, CNR -Marine Science Institute

The present study describes the quantitative (e. g. numbers of recreational fishermen and vessels), and various social aspects (e.g. profile of recreational fishermen) of the recreational fishermen who practice the activity at the sea and by vessels; the survey was carried out during 1998. In Italy, the lack of licensing system, made impossible to evaluate the exact number of recreational fishermen; using an indirect approach (data provided by Ministry of Transport and Navigation related of number of pleasure boats below 7.5 m) about 1500000 recreational fishermen were been estimated. The majority of vessels were between 4 and 6 m in length and had an engine power lower than 100 HP. The most popular recreational fishing gears were rod, tuna fishing line and handline (bolentino), and bogue (*Boops boops*) was the most fished specie. The average annual number of fishing days of a fisherman was between 20 and 60, and the average annual catch was 167 kg per recreational fishermen vessel. At national level, the total production of the recreational fishermen was about 24000 tons which was equal to 10% of the total fisheries production. Regarding the status of recreational fisherman our data collection showed that the typical recreational fisherman was a male, from 30 to 50 years old, employed, and graduated as level of education. No conflicts seemed to exist among recreational fishermen, but between recreational fishermen and those who fish illegally.

**Oral** T2.5 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 1:30 – 1:50 pm, Audimax

## What is the economical and social value of fishing in the inner Oslo fjord and how does ecology and cultural change interact?

*JONATHAN E. COLMAN*[1], THROND O. HAUGEN[2], JEANETTE THIMAMONTRI[2]

[1] Department of Biology, University of Oslo
[2] Department of Ecology and Natural Resource Management, Norwegian University of Life Sciences

Norwegian fjord ecology varies and will continue to change according to climate, ocean currents, natural dynamics and culture. Norwegian culture drives the estimate that half the population are recreational anglers. Culture also changes, especially with globalization and a growing diversity of new countrymen. Little information exists on the economical or social value of recreational angling in Norway. In 2003, we began interviewing anglers near Oslo about their angling activities, motivation for fishing, and local knowledge of fish populations, target species and catch data. Over an 8 year period, we recorded interesting changes in anglers' responses. We aim to test and compare the fishing characteristics of recreational versus commercial fishing for the inner Oslo fjord within a holistic ecological and socioeconomic framework. Commercial and recreational catch information from the inner Oslo fjord will be synthesized for economical value and catch details. Will changes in fish populations and the increase or decrease of certain species alter an anglers' motivation for fishing and/or their target species? Will this in turn influence an angler's behaviour, time expenditure and ecological imprint? Likewise, human and cultural changes in the Oslo community directly influence the recreational and commercial target species and total catch for both industries. How might fish availability and perceived population size interact with target species and actual catches?

**Poster** C8.21 in *Creative methods for managing recreational fishing*

## Are anglers catching bigger sea bass in Norway compared to the rest of Europe?

*JONATHAN E COLMAN*[1], THROND O HAUGEN[2], LEE HANKINSON[3]

[1] Department of Biology, University of Oslo
[2] Department of Ecology and Natural Resource Management, Norwegian University of Life Sciences
[3] Det Norske Veritas (DNV)

Anglers have been catching European sea bass (Dicentrarchus labrax) in Norwegian coastal waters since the late 1980s, and their distribution stretches to Vest fjord on the north coast. 50% of marine fish species in the North Sea have shifted their distribution according to increase in sea temperature of 1.05°C from 1977 to 2001, and sea temperatures in the North Sea are predicted to increase. Warmer sea temperatures are a major driving force for an increasing population size and distribution of sea bass in Norway. Has this also influenced individual growth rates and size? To investigate the age structure and growth pattern for sea bass caught in Norway, a total of 349 fish were examined from the 2004 to 2009 using scale samples collected and submitted by anglers. In regards to the general latitudinal trend of sea bass growth within European waters, the Norwegian population is an anomaly, as the growth rate estimates from this study confirm that Norwegian sea bass on average grow at a faster rate and mature earlier than UK sea bass mean growth and maturation rates. Sea bass individuals of the ages 4 years and higher are the most important age classes of the species due to the onset and continuance of reproductive capabilities which maintain stock levels. This is the first study of its kind for European sea bass within Norwegian waters and contributes to the growing biological knowledge needed for proper management and research of this species.

**Oral** C1.9 in *Biological and social aspects of catch-and-release*

August, 01, 3:50 – 4:10 pm, Seminar Building - Room 1.102

## Biological and human dimensions perspectives on catch-and-release of Sockeye Salmon during freshwater migration to spawning grounds

*STEVEN COOKE*[1], SCOTT HINCH[2], TONY FARRELL[2], MURRAY RUDD[3], VIVIAN NGUYEN[4], MIKE DONALDSON[2], DAVID PATTERSON[5], MARIKA GALE[2], KENDRA ROBINSON[2], TIM CLARK[2]

[1] Biology, Carleton University
[2] UBC
[3] York University, UK
[4] Carleton University
[5] DFO - Pacific Region

Sockeye salmon are captured by anglers in the lower Fraser River of British Columbia en route to natal spawning grounds. Many fish are released but their fate is unknown. Moreover, little is known about whether there is a need to use recovery gears to facilitate recovery of exhausted fish. Management agencies are also unsure of the heterogeneity of the angling community and their perspectives on different aspects of catch-and-release. Our team has used an inter-disciplinary approach that involves studies of both the natural and social sciences. From a biological perspective we have used biotelemetry studies to evaluate the fate of fish after release including after use of holding pens and fish bags intended to facilitate recovery. Parallel physiological sampling and evaluation of reflexes has provided additional insight into fish condition post-angling. Bank-side social science surveys were conducted and latent class modelling was used to identify different types of anglers. Anglers provided information on questions related to their perspectives on catch-and-release and strategies for maximizing survival of released fish. By combining biological and social science we have been able to provide fisheries managers with novel and comprehensive knowledge that has the potential to ensure the sustainability of the fishery.

**Poster** C11.10 in *Social, economic and biological aspects of a diversifying angler public*

## Recreational fisheries within the Guapimirim environmental protection area, Guanabara Bay, Rio de Janeiro, Brazil

*BERNARDO ROXO COUTO*[1], RAFAEL DE ALMEIDA TUBINO[1], CASSIANO MONTEIRO-NETO[2], PEDRO VIEIRA ESTEVES[3], MAGDA FERNANDES DE ANDRADE-TUBINO[4]

[1] Universidade Gama Filho
[2] Universidade Federal Fluminense
[3] Laboratório Nacional de Ciência da Computação
[4] Universidade Federal do Rio Janeiro/Universidade Veiga de Almeida

Recreational fisheries within protected areas are of great concern to environmental managers. Nevertheless, information about the activity is scarce or inexistent. We characterized the recreational fisheries in the Guapimirim Environmental Protection Area, inner Guanabara Bay, RJ, Brazil, looking at: a) fisher's socio-cultural profile, and b) catch species composition, production, productivity and costs. Information was obtained through direct monitoring of the fisheries and interviews with practitioners. We interviewed 39 recreational fishers (mean age = 54.8 years), from which 50% had a middle to high school degree at the most. About 76% of them owned a boat and 19% did not know how to swim. Most fishers (71%) went fishing between one to five times per month. Average fishing experience in the region was 25.1 years. The average cost per fishing trip was US$ 60.00. Sixty five percent of the fishers were licensed for recreational fishing, but only 26% were affiliated with fishing associations, and 11% participated in tournaments. About half of the fishers recognized they were fishing within a protected area, and most (79%) knew about minimum legal capture sizes for the local species. We recorded ten fish species in catches within the studied period. The snook (Centropomidae) was the most abundant and frequent species prized by fishers. The total return rate of 49.0% was associated with the capture of less appreciated (Ariidae) or small sized fishes. The CPUE was 0.1 kg/hour.

**Oral** T1.1 in *Stock, stocking and the future of recreational fisheries*

August, 01, 11:10 – 11:30 am, Audimax

## Stocking in recreational fisheries: using a risk framework to ensure the good and avoid the bad and ugly

*IAN COWX*[1]

[1] International Fisheries Institute, Univesrity of Hull

The stocking, transfer or introduction of fish species is a practice frequently used in the belief they will improve the quantity or quality of catches and have long-term beneficial effects on fish stocks. This paper examines the impact of stock enhancement programmes on wild fisheries and analyses the importance of restocking to freshwater fisheries. Most stock enhancement activities, either deliberate or accidental, have had negative effects on indigenous fish communities and other fauna through predation, competition, loss of genetic integrity, reduction of biodiversity, introduction of pathogens and change in ecosystem dynamics. There is, however, a paucity of information about the efficacy of stock enhancement activities both from the production and economic perspectives and a mechanism to account for the risk of detrimental impact in any programme. This paper examines the application of risk assessment in the decision framework for approval of stock enhancement activities.

**Oral** C10.1 in *Allocation of fisheries resources among competing demands*

August, 04, 10:30 – 10:50 am, Seminar Building - Room 1.102

## Evolution and implementation of allocation arrangements for recreational and commercial fishing sectors in Western Australia

*FIONA CROWE*[1], IAN LONGSON[1], LINDSAY JOLL

[1] Aquatic Management, Department of Fisheries

This paper examines why Western Australia's Integrated Fisheries Management (IFM) policy was adopted, how it has evolved, its achievements to date and future directions. IFM is aimed at addressing how fish resources can best be sustainably shared between competing recreational, commercial and customary users. The policy was adopted in 2004 and amended in 2009. It involves: setting the total allowable (ecologically sustainable) harvest level of each resource; allocation of explicit catch shares for commercial, recreational and customary sectors using the independent Integrated Fisheries Allocation Advisory Committee; continual monitoring of each sector's catch; managing each sector within its allocated catch share; and developing reallocation mechanisms to transfer catch shares between sectors. The Western Rock Lobster and Metropolitan Roe's Abalone resources were formally allocated in 2009 using the Allocation Committee process. The recreational sector was allocated 5% of the Western Rock Lobster resource and the commercial sector 95%, amid serious fishery recruitment problems. The tightly managed recreational sector was allocated 40 tonnes of the Metropolitan Roe's Abalone resource and the commercial sector was allocated 36 tonnes. An IFM allocation for the multi-species West Coast Demersal Scalefish resource is nearing completion. A reallocation workshop was held in February 2011 to examine ways to transfer fish resources between the sectors.

**Oral** C11.3 in *Social, economic and biological aspects of a diversifying angler public*

August, 04, 2:10 – 2:30 pm, Seminar Building - Room 1.101

## What do Lake Lipno stakeholders want? Analysis of stakeholder groups and preferences based on interviews for a Czech reservoir resource

DOROTHY DANKEL[1], *DAVID BOUKAL*[2], MARTIN JANKOVSKY[3], MIKKO HEINO[4]

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[2] Laboratory of Theoretical Ecology, Biology Centre AS CR, CZ
[3] Faculty of Science, Charles University in Prague, CZ
[4] Institute of Marine Research, Norway

The man-made Lake Lipno is the largest freshwater body in the Czech Republic (47 $km^2$). The reservoir provides various services that include recreational fishing, boating, swimming, flood protection, and production of hydroelectricity. However, it is difficult to propose adequate management of the lake's resources given the lack of explicit data on stakeholder groups and coalitions in countryside areas such as around Lake Lipno. Local stakeholders could be a priori categorized as recreational fishermen, tourists, locals and local property owners, river authorities and power plant representatives. These categories should differ in their perspective on the services provided by the reservoir. To understand the variation within and among the stakeholder categories, we designed a questionnaire which we carried out face-to-face with individual stakeholders in the summer and fall 2010 (*n*=273). Each individual provided his/her own identification with one of the main stakeholder categories and answered questions related to the main services. The data shows that individual stakeholder preferences vary greatly, making their classification less straightforward. We use cluster analysis to group the stakeholders, discuss how much detail is required to define main stakeholder groups, and relate the results to the a priori defined categories. These results can be used to identify possible management strategies that maximize stakeholder satisfaction for Lake Lipno.

**Oral** C1.1 in *Biological and social aspects of catch-and-release*

August, 01, 11:10 – 11:30 am, Seminar Building - Room 1.101

## Effects of catch-and-release angling on the physiology and behaviour of juvenile lemon shark (*Negaprion bevirostris*) in The Bahamas

*ANDY DANYLCHUK*[1], STEVE COOKE[2], JOHN MANDELMAN[3], CORY SUSKI[4]

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[2] Environmental Sciences and Biology, Carleton University
[3] Edgerton Research Laboratory, New England Aquarium
[4] Department of Natural Resources and Environmental Sciences, University of Illinois

Targeting sharks with hook and line angling is becoming more prevalent within the recreational angling community. Sharks are also landed as bycatch when anglers target other marine fishes. In either case, catch-and-release is often advocated as a conservation tool to help protect these apex predators, however, little research has been conducted to quantify the effects of catch-and-release angling on sharks. Juvenile lemon sharks (*Negaprion bevirostris*) are vulnerable targets of recreation anglers that frequent shallow tropical flats. As such, we measured the physical impacts, physiological response, and post-release behaviour and mortality of juvenile lemon sharks caught from the coastal of Eleuthera, The Bahamas. A total of 32 sharks ranging from 530-875 mm (TL) were caught and released using spinning rods, dead bait, and circle hooks (5/0). Following release, each shark was tracked for 20 min using a visual float. Hooking in the tongue was most prominent (59%), following by corner jaw (31%), face/eye (6%), and gut (3%). Two sharks (6.25%) hooked in the tongue died prior to release. Two sharks (6.25%) died post-release, both when water temperature was at or near 35°C. Of the physiological parameters measured, only blood lactate (0.3-6.31 mmol/L) and potassium (6.02-9.81 mmol/L) correlated positively with fight time. Results indicate that hooking injuries and environmental conditions contribute to the overall stress of catch-and-release angling for juvenile lemon sharks.

**Poster** C8.10 in *Creative methods for managing recreational fishing*

## Recent sport fishing developments in Brazil

*EZEQUIEL DA SILVA*[1]

[1] Faculty of Education, State University of Campinas

Presents the recent developments of sport fishing in Brazil, focusing on the works of Federal Government and associations. The main difficulties shall be pointed out, especially in the area of support of research. The presentation will take into account the efforts made by the website Pescarte along 11 years of studies, congregation of fishermen, surveys, etc published by the Virtual Magazine Pescarte - http://www.kaluapesca.com.br/pescarte /revista.asp with 97 issues on the Internet since the year 2000.

**Oral** T2.6 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 1:50 – 2:10 pm, Audimax

## Retaining angler's trust when fishing is mediocre

*MICHEL DEDUAL*[1]

[1] Taupo-nui-a-Tia Area, Department of Conservation

Since the introduction of trout at the end of the nineteenth century, New Zealand and visiting anglers have generally been spoiled by having access to exceptional recreational salmonids fishing. However, for the last four years the self sustaining Taupo trout fishery in central North Island has been passing through a depression. This is reflected by the decreasing quantity and quality of the fish caught. Historically fishery managers have used diverse very-mission oriented measures to address any slump in fish quality. Nowadays, a multidisciplinary approach is used to identify the main reasons behind the fishery decline. The most salient results indicate that Lake Taupo is going through a series of physical and ecological changes that are profound and largely beyond control. Our most pressing task as managers is to explain the situation to anglers while still retaining their trust. This is paramount for the successful management of the fishery. While science can estimate some impacts of individual factors on the Taupo fishery, simultaneous changes in several environmental factors in the lake generate considerable uncertainty. This presents a great conundrum for managers who should not only anticipate change, but also recognize that ecosystems are in constant transformation. The challenge for the Taupo Fishery managers is to confidently assess if these changes are only short term events or if the fishery is moving toward a new equilibrium.

**Oral** C1.2 in *Biological and social aspects of catch-and-release*

August, 01, 11:30 – 11:50 am, Seminar Building - Room 1.101

**Effects of recreational fishing on sharks in the Great Barrier Reef Marine Park**

*FERNANDA DE FARIA*[1], STEPHEN SUTTON[1], COLIN SIMPFENDORFER[1], RENAE TOBIN[1], CYNTHIA AWRUCH[1]

[1] Fishing and Fisheries Research Centre, James Cook University

Recreational fishing is a major activity in the Great Barrier Reef (GBR), yet very little is known about recreational fishers' catch in this region. Recent studies in the GBR have raised concerns regarding possible declines in shark populations and the Great Barrier Reef Marine Park Authority has highlighted the importance of understanding the impacts of fisheries on elasmobranchs. This study aimed to engage the recreational fishing community in research to understand the species composition of the recreational catch of sharks and to measure indicators of stress in caught-and-released individuals. There has been excellent participation from the GBR charter fleet, fishing clubs and individual recreational fishers, indicting a high level of interest among recreational fishers in shark conservation in the GBR. Results showed that recreational fishers do not catch a large number of sharks and most of those that are caught are released. The use of blood lactate as an indicator of stress measured against different play times, air exposure times and species suggests that post release survival of sharks in the GBR is high. Results will provide recommendations to fishers and managers about how physiological effects of catch and release can be reduced by improving handling and release practices.

**Oral** C3.13 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 3:20 – 3:40 pm, Seminar Building - Room 1.102

**Current status of the recreational fisheries in the Netherlands: results of an online screening and diary survey on participation, catches, effort, expenditure and motivation of marine and freshwater recreational fishermen**

*MARTIN DE GRAAF*[1], TESSA VAN DER HAMMEN[1], TOINE AARTS[2]

[1] IMARES
[2] Sportvisserij Nederland

Recently the EU installed regulations, which obliges Member States to estimate recreational catches of several fish species. Late 2009, the Netherlands implemented a Recreational Fisheries Programme, a collaboration between Sportvisserij Nederland, the main stakeholder representing the recreational fishermen and IMARES Wageningen UR, the main fish and fisheries research institute in the Netherlands.An online Screening Survey was conducted in December 2009 (55.000 households) to identify fishing households, profile fishing households and select participants (2000) for a follow-up, 12-month Diary Survey. Participants were asked to maintain a logbook and record per fishing trip detailed information on the fishing location, gear, catches (species, size), ratio kept-retained, reason released, motivation, satisfaction and expenditure. Participants were approached on a monthly and requested to transfer the data recorded in their logbooks to online questionnaires. We will present an overview of the current status of the recreational fisheries in the Netherlands with specific attention to cod *Gadus morhua* and European eel *Anguilla anguilla*. The two stage survey design is in line with the recommendations of the 2010 ICES Planning Groups on Recreational Fisheries Surveys. Furthermore, we will discuss the strengths and weakness of the current (online) design in comparison with telephone diary surveys.

**Poster** T2.21 in *Change, adaptation and evolution in recreational fisheries*

## Climate and land use change impacts on brook trout populations and associated recreational fishing opportunities

*JEFFERSON DEWEBER*[1], TYLER WAGNER[2]

[1] Pennsylvania Cooperative Fish and Wildlife Research Unit, Pennsylvania State University
[2] United States Geological Survey, Pennsylvania Cooperative Fish and Wildlife Research Unit, Pennsylvania State University

Throughout its native range in the Eastern U.S., the brook trout *Salvelinus fontinalis* is a culturally, ecologically, and recreationally important species that is sensitive to warming stream temperatures and habitat degradation. Brook trout have been extirpated throughout much of this region due to a number of human activities and land cover alterations, and are physiologically limited to streams with suitably cold temperatures. In this assessment, we offer predictions of the impacts of projected future land use and climate changes on the condition of stream habitat to support self-sustaining brook trout populations throughout the next century. Habitat suitability will be determined by analyzing relationships between brook trout occurrence data compiled from agencies throughout the study region, continuous stream temperature records and a number of other datasets representing both current and future atmospheric (i.e. air temperature), landscape (i.e. road density) and stream habitat conditions. We will then classify each stream reach as suitable, marginal, and unsuitable under present conditions and future scenarios of land use and climate change. It is expected that warming air temperatures and increases in human land use will result in predicted losses of suitable habitat. We discuss the predicted impacts and the associated impacts on brook trout recreational fisheries, both of which could be substantial, and discuss some potential mitigation strategies.

**Oral** C11.1 in *Social, economic and biological aspects of a diversifying angler public*

August, 04, 1:30 – 1:50 pm, Seminar Building - Room 1.101

## Re-imagining the role of the fishery: angling intervention work with excluded young people

*NATALIE DJOHARI*[1]

[1] Research, Substance

The role of angling as a diversionary activity for young people has long been recognised, but in recent years angling has undergone a quiet revolution, developing into an effective, intervention tool to engage a wide range of socially excluded young people. The result is a growing professional sector that applies angling to transform anti-social behaviour, improve health and wellbeing, encourage civic engagement and re-inspire young people to engage with education and achieve qualifications. This transformation in angling practice is challenging fisheries to incorporate youth intervention work and as a result, deliver added benefit for the communities that sustain them. Drawing on two years of ethnographic research as part of the *Social and Community Benefits of Angling Research Project,* this paper illustrates the growing role of fisheries is social intervention. It is based on 466 interviews and discussions with fishery owners, clients, young people and local residents, and over 400 hours of observational site visits across the UK. It will reflect specifically on examples from UK charity Get Hooked On Fishing and the fisheries they both manage and deliver from. The popular community support of these projects suggests that where a fishery generates wider value for the community, there is opportunity not only for new business developments but also the potential for increased resilience, buffered by a wider community that recognises the value of its local fishery.

**Oral** C8.2 in *Creative methods for managing recreational fishing*

August, 04, 1:50 – 2:10 pm, Seminar Building - Room 1.102

**How size selective are hooks and are minimum hook sizes useful for management of saltwater recreational fisheries?**

*KARIM ERZINI*[1], PEDRO VEIGA

[1] CCMAR, CCMAR, Universidade do Algarve

Hook size selectivity has been studied extensively in recent years, and minimum hook sizes are stipulated for some saltwater recreational fisheries. However, there is no clear consensus on the form of the size selectivity curve of hooks, and different authors have fitted a range of models, including uni-modal (e.g. normal) and asymptotic (e.g. logistic) selectivity models. Few studies have evaluated the effectiveness of minimum hook size regulations in saltwater recreational fisheries. Here we review hook size selectivity studies, with particular emphasis on species commonly caught by recreational anglers in the NE Atlantic and Mediterranean. Based on analysis of catch distributions of hooks of different sizes, we conclude that logistic-type size selectivity is characteristic for the small-sized hooks used to catch sea breams (Sparidae), wrasses (Labridae) and other relatively small species caught by recreational shore- and boat-based anglers in this region. Thus, for a given hook size and species, selectivity increases with fish size up to a size above which all individuals are fully selected, with no decrease in selectivity for the largest sizes. Experimental fishing trials with fish populations of known size structure confirms these findings. We evaluate the implications and effectiveness of logistic size selectivity for minimum hook size regulations, with examples from the SW coast of Portugal, where a minimum hook size regulation is in force.

**Oral** T2.18 in *Change, adaptation and evolution in recreational fisheries*

August, 03, 11:30 – 11:50 am, Audimax

## Managing ecological thresholds in coupled environmental-human systems

*ELI FENICHEL*[1], RICHARD HORAN[2], KEVIN DRURY[3], DAVID LODGE[4]

[1] School of Life Sciences, Arizona State University
[2] Michigan State University
[3] Bethel College
[4] Notre Dame

Many kinds of ecosystems appear subject to regime shifts—abrupt changes from one state to another after crossing a threshold or 'tipping point.' These thresholds, and their respective stability landscapes, are determined as part of a coupled socioeconomic-ecological system (SES). In particular, SES stability landscapes depend on human feedback responses to ecological variables, and on the human institutions that condition these responses. Changes in institutions can therefore alter the SES stability landscape. Using several model scenarios rooted in well-documented smallmouth bass – invasive crayfish interactions, we illustrate that SES stability landscapes are movable. When no human feedbacks are considered, the modeled system has two basins of attraction. We then incorporate human feedbacks, which depend on the institutional setting. We define strong institutions as those that provide resource managers with the authority and resources to regulate both fish and crayfish harvests, and weak institutions as those that restrict managers' abilities to manage important SES relations. The key finding is that weak institutions can lead to undesirable states of the world, whereas strong institutions that account for human feedback responses create the possibility for desirable states of the world and can cause undesirable states to cease to exist as possibilities.

**Oral** C4.5 in *Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives*

August, 02, 1:30 – 1:50 pm, Seminar Building - Room 1.101

## An economic model for regulating the human predator in recreational fisheries

*ELI FENICHEL*[1]

[1] School of Life Sciences, Arizona State University

Recreational fisheries can be a major source of fish mortality. Increasingly, there is interest in managing and rationalizing recreational fisheries. Yet, most models in recreational fisheries science and economics model total catch, escapement, or fishing mortality rate. Rarely are the regulations, angler wellbeing, and angler behavior explicitly linked to fish mortality. This makes it difficult to evaluate the impact of regulations on stocks or anglers. We fill this gap in the literature by developing a bioeconomic model that merges fishery regulation, individual angler behavior, and fish population dynamics. We show that technical fishing regulations (i.e., effort controls such as bag or gear limits) have two effects on fish mortality: a technical effect and an angler behavioral effect. The technical effect affects anglers' abilities to catch fish. An angler behavioral effect emerges because the regulations change the tradeoffs that anglers face between fishing and other activities. Alternatively, fee based management only generates an angler behavioral effect. This single behavioral effect means that fee based approaches may more precisely control overfishing. We show that a fee based approach results in greater fishing value for anglers per unit of fish mortality. The paper also clearly illustrates the importance of modeling individual fisher behavior and the difficulty in linking common recreational fishing policies to outcomes for fish stocks and anglers.

**Oral** C2.3 in *Angling tourism development: social, economic and biological challenges*

August, 01, 11:50 am – 12:10 pm, Seminar Building - Room 1.102

**The management of the Norwegian marine tourist fishery and its implications on angler behavior and coastal economies**

*KENO FERTER*[1], JON HELGE VØLSTAD[1], TRUDE BORCH[2]

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Recreational fishing as tourism is an important part of the Norwegian travel industry and may contribute significantly to the fishing mortality of selected target species such as Norwegian coastal cod (*Gadus morhua*) stock, which may presently be overfished. The research and management of Norway`s coastal tourist fishery has undergone several changes over the past years. For many years gear regulation was the only management tool to constrain catches in this fishery. However, a growth in the industry followed by conflicts between commercial fisheries and the fishing tourism industry led to the introduction of an export limit for marine fish caught by tourists in 2006. This was followed by the implementation of minimum length regulations in 2010 for selected species. A probability based self-sampling survey of the formal Norwegian marine tourist fishery concluded that 3,300 tons of fish were landed in this sector in 2009. By doing on-site interviews in Northern and Southern Norway in 2010 we found that a significant proportion of the catch is released, with release rates of more than 60 % of the total catch for cod, saithe and haddock in Northern Norway. We applied the catch estimates for 2009 and our new findings about the practice of catch and release, as a basis to discuss the effects of the current management on angler behavior and coastal economies in Norway, and to outline how additional or different management tools could be beneficial to the coastal fish stocks and coastal economies.

**Poster** C8.11 in *Creative methods for managing recreational fishing*

## Recreational fisheries in Switzerland and the fishery advisory office (FIBER)

*JEAN-MARTIN FIERZ*[1]

[1] Fish Ecology, Eawag

Switzerland is renowned for its water-rich landscapes harbouring many rivers and lakes. In total, around four percent of the surface is covered by 1500 lakes along with more than 65,300 km of streams flowing through the country. It is thus no surprise that more than 100,000 people devote their spare time to recreational fishing. Anglers primarily fish Brown Trout from the rivers and streams. In the lakes, anglers harvest around 300 tonnes made up of a variety of fish species (average total catch per angler: 4 trouts and 3 kg lake fish/year). At the federal level, anglers are organised by the Swiss Anglers Federation, which consists of Canton associations and fishing clubs. However, in Switzerland, flood protection measures and hydropower plants threaten the streams and their fish. Out of 55 original native species, 8 are extinct and 33 are endangered. The management of fisheries is the responsibility of Canton institutes. The legislative entity for fishery matters is the Swiss Federal Office for the Environment (FOEN). Fish research is carried out at Eawag and at several universities. A peculiarity of Switzerland is the existence of a fishery advisory office (FIBER), which is financed by the FOEN and Eawag. Its main responsibility is to support fishermen in taking decisions, informing anglers about the findings of the latest scientific research regarding fish ecology and fisheries-related inland waters management. The office produces newsletters and holds seminars.

**Poster** C8.12 in *Creative methods for managing recreational fishing*

## Utilization of marine fisheries regulations workshops to expand fisheries outreach efforts in Southwest Florida

*BRYAN FLUECH*[1], *JOY HAZELL*[1], MITTS MRAVIC[2]

[1] Florida Sea Grant College Program, University of Florida Extension Service
[2] Florida Fish and Wildlife Conservation Commission Law Enforcement

In response to increased fishing pressure, fisheries managers often have to modify fishing regulations to protect and conserve marine fish stocks. Management is diminished, however, if the information does not reach anglers in a meaningful manner. Often the rules can be confusing to anglers, if they are aware of them at all, and if not followed, can be detrimental to local fisheries. Despite existing robust and successful fisheries outreach programs, it's not feasible for Florida Sea Grant (FSG) extension agents to reach out to every angler in their region. Collaboration with local partners who can assist with outreach efforts is essential to the sustained success of FSG's programs as well as to the conservation of the regions' fisheries. Since 2010 FSG Extension Agents in Southwest Florida have partnered with Florida Fish and Wildlife Conservation Commission law enforcement officers to host an annual marine fisheries regulations workshop. The workshops are intended for park rangers, resource managers, informal educators, and industry representatives who routinely interact with anglers at locations such as boat ramps, marinas, parks, or on the water. Given the proper information and resources, they serve as a valuable partner in expanding the knowledge base of anglers in the region. This proposal will provide an overview of the need and rational of the workshops, discuss presented content, and share workshop impacts and evaluation data.

**Oral** C7.3 in *Biological impacts of recreational fisheries and their social and economic consequences*

August, 04, 4 – 4:20 pm, Audimax

**Biological and socioeconomic implications of recreational fishing for the management of coastal resources in a Mediterranean marine protected area**

*TONI FONT PAYERAS*[1], JOSEP LLORET[2]

[1] Deparment of Environmental Sciences, University of Girona
[2] University of Girona

In the Mediterranean Sea, recreational fishing is particularly important, representing more than 10% of total fisheries production in the area. However, few studies have focused on these fisheries. This study reviews the socioeconomic characteristics and the biological impacts of the recreational fisheries in a Mediterranean marine protected area. We collected information on the different recreational fishing methods in the Cap de Creus Natural Park from 2006 to 2009. On-site surveys were carried out to interview fisherman. Altogether, a total of 58 species were caught. The total estimated annual catch by recreational fishers comes to a total of 42 tons which is close to the 50 tons caught by commercial artisanal fishing in the same area. The average vulnerability values for catches are higher than the world average (48). A minimum of 43% of the baits used by the shore anglers were live, non-native species (mostly polychaetes). Recreational fishers spent between 500 and €800. The willingness of most anglers to pay a fee for fishing (up to €60) in the MPA supports the socioeconomic importance of this activity. Overall, results highlight the socioeconomic benefits from this leisure activity, the impact of recreational fishing on coastal fish communities and the increasing environmental risks arising from the use of exotic marine baits, which constitute a potential vector of introduction of non-native species in the Mediterranean.

**Oral** C11.5 in *Social, economic and biological aspects of a diversifying angler public*

August, 04, 3:20 – 3:40 pm, Seminar Building - Room 1.101

## Recreational fishery in Brazil

*KÁTIA M. F. FREIRE*[1], MICHEL L. MACHADO[2], DANIEL CREPALDI[3]

[1] Universidade Federal de Sergipe, Núcleo de Engenharia de Pesca, Sergipe-Brazil
[2] Ministério da Pesca e Aqüicultura, Coordenação Geral de Registro e Licenças de Pesca Amadora, Brasília-DF-Brazil
[3] Superintendência do Ibama em Minas Gerais, Núcleo de Ecossistemas Aquáticos, Minas Gerais-Brazil

Recreational fishery in Brazil has developed in the last two decades, but the scientific work to support it is still scarce. Currently, the Ministry of Fisheries and Aquaculture is responsible for its management. A federal license is required to fish nationwide, but additional permits can be charged in inland waters by local authorities. In 2010, about 220,000 federal licenses were sold, but the actual number of anglers is unknown (may be higher than 6 million). Total caught and economic value are also unknown. In some areas, recreational catches can surpass commercial catches. Recreational fishing activities occur in marine and fresh waters, from boats or not, and include spearfishing. However, there is no effort to quantify the relative importance of each sector. Competitive fishing is also important, but there is no record of the total number of events or their total catch. They are organized by fishing clubs, private businesses, and governmental institutions. A preliminary study indicated that at least 170 fishing clubs are active. Recreational fishing ranges from a very high profitable activity (release-oriented) to an almost subsistence-level activity (consumption-oriented). Some difficulties detected: lack of official statistics, conflict with commercial fisheries, lack of basic infra-structure, litter production by anglers, illegal fishing activities, changing quotas, and lack of governmental support. Much effort is still required to develop this activity in Brazil.

**Oral** C8.3 in *Creative methods for managing recreational fishing*

August, 04, 2:10 – 2:30 pm, Seminar Building - Room 1.102

**Restoring Atlantic Salmon to Lake Ontario: An unprecedented, stakeholder-driven effort to bring back one of the Great Lakes' most prized species**

*MARC GADEN*[1], TERRY QUINNEY[2], CHRIS GODDARD[1], CHRIS ROBINSON[2], JOHN DETTMERS[1]

[1] Great Lakes Fishery Commission
[2] Ontario Federation of Anglers and Hunters

Few species are more acclaimed than the Atlantic salmon (*Salmo salar*). By the late 1800s, due to massive habitat alteration and over-exploitation in a subsistence fishery, the species saw large-scale collapse in most areas where it occurred, including Lake Ontario, the extremity of its Great Lakes range. With reforestation, recent water quality improvements, and careful management by the Province of Ontario and the State of New York, conditions are now right to restore self-sustaining populations. Uniquely, the Ontario Federation of Anglers and Hunters—the province's largest non-governmental conservation organization—has assumed a leadership role in restoring Atlantic salmon, given the federation member's deep affection for this species and their desire to see it return to the Great Lakes. The federation conducts its work in cooperation with the Ontario Ministry of Natural Resources and other agencies. The restoration involves stocking, habitat and water quality enhancement, assessment, research, and outreach. In this case, the anglers themselves have leveraged millions of dollars from donors, mobilized thousands of volunteers, facilitated public and private hatchery upgrades, and restored habitat. To maintain interest and aid assessment, the project provides new angling opportunities while recovery occurs. This presentation will discuss the importance of Atlantic salmon and the role of the federation in creating a major, unique public-private partnership for restoration.

**Key Note** K2.1 in *Key Note*

August, 02, 9:05 – 10:05 am, Audimax

## Linking angler behaviour and incentives to achieve sustainability

*BRAD GENTNER*[1]

[1] Gentner Consulting Group, Inc.

Marine recreational fishing is at a crossroads in the United States. Several issues have recreational anglers optimistic and concerned about the direction of future fisheries management. In response to overfishing and rampant commercial overcapacity, the US strengthened its fishery management laws to end overfishing by 2011 and take more precaution in establishing total allowable catches (TACs). The end to overfishing and the rebuilding of overfished stocks has meant draconian regulations and sometimes very short seasons with the worst yet to come under the more cautious TACs. To get away from tight bag limits and short seasons, recreational anglers want managers to reallocate fish using economic criteria. With the National Oceanic and Atmospheric Administration Catch Share Policy, the agency has required that allocation be examined using economic criteria; a first for the agency. As a result, the fishery management councils have begun to move forward with re-allocation. The recreational sector is not guaranteed to end up with more fish, however. Political constipation, data limitations and lack of consistent allocation guidelines may stymie reallocation that could improve the sustainability and economic vitality of coastal communities. At the allocation extreme of creating recreational only fisheries, regulations may still be very stringent. Increasing coastal populations and improving fishing quality, may act to increase harvests that are unsustainable.

**Oral** C10.3 in *Allocation of fisheries resources among competing demands*

August, 04, 11:10 – 11:30 am, Seminar Building - Room 1.102

## Contrasting recreational and commercial fishing in Lake Annecy: differences in effects on the fishery

*DANIEL GERDEAUX*[1]

[1] INRA

A long term monitoring of both recreational and commercial fisheries in Lake Annecy (France) is analyzed to study the differences in effects mainly on the whitefish (*Coregonus lavaretus* L.) population. Lake Annecy commercial and recreational fishermen are providing daily obligatory fish catch data since 1986. For the last 20 years, 20 volunteer anglers from Lake Annecy are also providing additional data regarding their own fish catch. A persistent conflict between recreational and commercial fishermen is exacerbated last years. The effect of commercial fishery is agreed.The crucial point is the demonstration of the effect of recreational fishing. More than 70% of whitefish caught are released. 12% of the whitefish in the commercial fishery show injuries due to hooking. The condition of these fish is low. Mortality rate associated with hooking is difficult to estimate and probably highly variable in accordance with water temperature, depth of catch and handling. Recreational fishermen refuse to take this mortality into account. This conflict retards progress towards generating sustainable fishery.

**Oral** C4.2 in *Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives*

August, 02, 10:50 – 11:10 am, Seminar Building - Room 1.101

**Maritime recreational fisheries in the new Communitarian Fisheries Framework**

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European Union has exclusive oversight in the regulation of marine fisheries, using the Common Fisheries Policy (CFP) and associated Council regulations. Member States have no regulatory capacity in management and conservation of marine resources, their action is solely limited to applying Community law and can not develop their own resource policy. The CFP, a basic framework that aims to anticipate the conflicts that may arise in respect to fisheries, has never recognized the Marine Recreational Fisheries (MRF). In this sense, due to the global growth of MRF, particularly in European waters, it is necessary that the CFP provides a role for recreational fishing in the exploitation of fisheries resources. MRF create a significant economic value to local communities and provide an important source of employment. Establishing a common legal framework for recreational fisheries at the level of EU and Mediterranean countries can begin to solve potential conflicts between users. Along with the CFP, other EU policies should interact with the MRF as it is the EU Maritime Policy that seeks sustainable development of coastal regions. The tourism and recreational activities should be a meaningful component of the Maritime Policy instrument and be included in the ecosystem approach of the EU Marine Strategy. Only by doing so can we have sustainable and resilient recreational fisheries in the Mediterranean basin.

**Oral** C10.2 in *Allocation of fisheries resources among competing demands*

August, 04, 10:50 – 11:10 am, Seminar Building - Room 1.102

## Recreational & commercial fisheries allocation with market transfers - The case of Pacific Halibut in Canada

*GORDON GISLASON*[1]

[1] GSGislason & Associates Ltd.

The recreational vs commercial allocation for Pacific halibut in Canada was set under federal government policy at 12 % recreational and 88 % commercial in late 2003. The policy also allowed for market-based adjustments in allocation between sectors. This paper outlines the evolution to the formal allocation policy, the performance of the policy including the market transfer mechanism, and current challenges. In particular, the recreational sector has been impeded by its inability : 1) to to develop a legal entity to enact allocation purchases and / or sales, and 2) to have licence fees earmarked to pay for such purchases and to pay for stronger catch monitoring. The great promise of the allocation policy has not been realized. The Canadian experience offers several lessons learned for other jurisdictions.

**Poster** T1.15 in *Stock, stocking and the future of recreational fisheries*

## Development of sterile and all-female kokanee *Oncorhynchus nerka* for recreational fisheries in British Columbia

THERESA GODIN[1], TIM YESAKI[1], KANJI TSUMURA, *ADRIAN CLARKE*[1]

[1] Science, Freshwater Fisheries Society of BC

In an attempt to provide kokanee salmon recreational fisheries while minimizing the risks associated with stocking reproductive fish (introgression), the Freshwater Fisheries Society of BC has been developing sterile (3n) and all-female sterile (AF3n) kokanee stocks. Sterile males still develop secondary sex characteristics and exhibit false spawning behavior by age 2 so the next step we took was the development of a mono-sex sterile kokanee (AF3n). Initial trials were undertaken to masculinize genetically female kokanee, the first step in producing all-female fish. Three replicates of mixed sex eggs/alevins were immersed in one of four concentrations of α-methyltestosterone. All experimental groups showed 100% sex reversal. Some mature males from each experimental group were crossed with wild females in an attempt to produce all-female kokanee families, verifying the existence of and the viability of XX males in the experimental groups. Preliminary effort investigations have demonstrated an unprecedented response to kokanee salmon by anglers in British Columbia. The kokanee salmon fishery appears to be providing both winter (ice) and summer fishing opportunities for families that are mainly harvest-oriented. Overall, sterile kokanee are an exciting new product that will help to reduce the downtrend in license sales while limiting any negative impacts on wild stocks of fish in British Columbia.

**Oral-WS** Com.2 in *Workshop: Communication and Collaboration between Science and Management in Recreational Fisheries*

August, 03, 10:50 – 11:05 am, Seminar Building - Room 1.103

## Communication Network: The basis of the problem and its options

*ANA GORDOA*[1]

[1] Marine ecology, CEAB- CSIC

Beginning with the unquestionable statement “the management of fisheries, no matter recreational or commercial, relies on scientific input”. The scientific input, is based on research that depends on allocated budget, availability of basic information (e.g. catch reports, fleet size, anglers population, etc.) and a good communication network with fishermen. The main obstacle to achieve this rests on the fact that fishermen associate science with policy and control measures and that whatever the scientific input is it will sooner or later restrict their activity.

**Oral** C2.8 in *Angling tourism development: social, economic and biological challenges*

August, 01, 3 – 3:20 pm, Seminar Building - Room 1.102

## A model of fishing satisfaction among Pine Creek anglers

*ALAN GRAEFE*[1], HARRY ZINN[1], ANDREW PURRINGTON[1]

[1] Recreation, Park & Tourism Management, Penn State University

This paper reports a satisfaction model for anglers on Pine Creek in central Pennsylvania, USA. Anglers surveyed in 2008 were asked to evaluate their most recent fishing trip. Responses were grouped into major themes based on a series of factor and reliability analyses. Six items were used to create an overall satisfaction index (α=.85). Items related to the catch and the setting and natural environment were treated as separate aspects of the angling experience. Items focused on angler reactions to facilities, services and information in the area formed a customer service index (α=.62). Two questions addressed the potential impacts of crowding and conflicts with other people (α=72). A total of 53% of the variance in overall angler satisfaction was accounted for by six predictor variables. Satisfaction with the number of fish caught was the strongest predictor, followed by satisfaction with the type of fish caught. Other significant predictors included the perceived customer service quality in the area and the perceived condition of the environment. Those placing more value on the opportunity to be outdoors reported higher satisfaction, while those who were bothered by too many people or the behavior of other people reported lower satisfaction. Results support the multiple satisfaction approach to recreational fisheries management and shed light on the relationship between the consumptive and non-consumptive elements of the fishing experience.

**Poster** C3.21 in *New methodological tools to survey and assess recreational fisheries*

## A methodological approach to estimating the total economic value of recreational fishing for the Northern Territory, Australia

*ROMY GREINER*[1], ANDRIA HANDLEY[2], LEE HOCKSENG[2]

[1] Charles Darwin University
[2] Northern Territory Government

Fisheries managers in Australia have long recognised the necessity for 'appropriate' social and economic data about recreational (including charter). However, comparatively little remains known about the recreational sector, particularly in the geographically vast fisheries of Northern Australia. The key reason is the absence of a clear data collection framework and methodology, geared at addressing issues peculiar to the region, including: remoteness, very sparse population, extensive and diverse fishing zones, and absence of requirement of recreational fishing licences and boat registrations. Obtaining a 'holistic' value of recreational fishing is thought to be critical to articulate the social wellbeing generated by this fisheries sector and give it the appropriate consideration during processes to allocate resources between sectors. A project is underway to (1) estimate of the total economic value (TEV) of recreational fishing and its components, and (2) illustrate the social distributions of values and benefits.This paper outlines key conceptual and methodological challenges of estimating TEV of recreational fisheries across an entire state in northern Australia, and the proposed solutions. The valuation needs to account for diversity of recreational fishing sectors, fishing locations and platforms, platforms and anglers. The paper discusses matters of data to be collected; sampling frame and strategies and data analytical methods.

**Oral** C2.1 in *Angling tourism development: social, economic and biological challenges*

August, 01, 11:10 – 11:30 am, Seminar Building - Room 1.102

## Managing angling tourism in northern Australia

*ROMY GREINER*[1], DONALD FRANKLIN[1]

[1] Charles Darwin University

The coastlines and river systems of northern Australia are intensely contested by a predominantly tourism-based recreational fishing sector. The results of a face-to-face survey of 427 recreational fishing parties at a prominent angling destination are analysed using multivariate analysis and post-hoc comparisons. The relationships between socio-demographic and attitudinal attributes, angler behaviour and stated responses to potential policy instruments are explored. An integrated assessment is provided of the potential for different policy instruments to (i) moderate the impact of the recreational sector on the fishery and (ii) facilitate a diversification of the regional tourism product away from recreational fishing.

**Oral** C11.2 in *Social, economic and biological aspects of a diversifying angler public*

August, 04, 1:50 – 2:10 pm, Seminar Building - Room 1.101

## Comparing general and species-specific angler motivations in Mecklenburg-Vorpommern, Germany

*WOLFGANG HAIDER*[1], BEN BEARDMORE[1], MALTE DOROW[2], ROBERT ARLINGHAUS[3]

[1] School of Resource and Envtl Mgt, Simon Fraser University
[2] IGB, Berlin
[3] IGB, Berlin

General assessments of angler motivations have frequently found non-catch motives to be more important to anglers than catch motives. In a personalized mail survey to former diary respondents, we collected general and species-location angler motivations of ten catch and non-catch motives. In agreement with earlier findings respondents placed greater emphasis on non-catch motives than on catch motives in the absence of context in the angler motivation assessment. In the species-specific context, however, catch motives were frequently cited as the most important fishing motive by anglers. Five distinct angler types based on motivational similarity were identified, namely trophy anglers, non-trophy challenge-oriented anglers, nature-oriented anglers, consumption-oriented anglers and social anglers. Angler types did not differ substantially in demographics and general angler behaviour, but differed strongly in targeted fishing effort, travel distance and catch and harvesting behaviour as well as the centrality-to-fishing as a lifestyle. Trophy anglers and non-trophy challenge oriented anglers were found to exhibit a higher centrality-to-fishing score, indicating that committed anglers are primarily catch-driven and thus more catch-oriented than previously assumed.

**Oral** C3.16 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 4:20 – 4:40 pm, Seminar Building - Room 1.102

**Network analysis improves the management of change**

*TAPIO HAKASTE*[1]

[1] Department of Fisheries and Game, Ministry of Agriculture and Forestry

Review of the networks in fisheries organisations gives a new angle to the cooperation between different actors involved. Networks are self-organising and non-hierarchical systems, where individual actors operate through their own frame of reference. The network culture may enable or inhibit the participation of individual actors. Analysis of the properties of the network and bottlenecks in the network operations, gives useful insight to the development possibilities of the network. Better understanding of the network culture helps to update the management strategy. Fishing regions in Finland were examined from the network point of view. Many possess the characteristics of a network. The perceptions of various actors have been managed successfully in questions related to fishing licence policy or the general acceptance of the organisation itself.The networks appeared to be strongly closed. In most cases these networks allow participation within the framework of water area owners. Outside this framework it is much harder to get an influential position. The social connections inside the network are based on strong social ties. Decisions are mostly based on consensus, and new ideas are adopted slowly. Professionals in the fisheries advisory organisations have an important role as well. Their work may either reinforce existing networks by adding professional knowledge suitable for the frames of reference, or weaken them if the advisory organisation acts as an alternative forum.

**Oral** C1.8 in *Biological and social aspects of catch-and-release*

August, 01, 3 – 3:20 pm, Seminar Building - Room 1.101

**Sublethal effects of angling and release on two Australian native freshwater fish**

*KARINA HALL*[1], MATT BROADHURST[1], PAUL BUTCHER[1], STUART ROWLAND[2]

[1] Fisheries Conservation Technology Unit, Industry and Investment New South Wales
[2] Grafton Aquaculture Centre, Industry and Investment New South Wales

Over four million Australian native freshwater fish are angled and released each year (≈ 45% of the total catch). Although immediate and short-term (<5 days) post-release mortalities have been quantified (0–43%) and attributed to a few severe factors (e.g. barotrauma and deep hooking), less is known about potential sublethal or long-term effects. Through a series of manipulative experiments, we assessed the effects of angling on the health, somatic condition and gonadal development of golden perch (*Maquaria ambigua*) and Australian bass (*M. novemaculeata*). Both species developed a number of sublethal symptoms of barotrauma in response to rapid retrieval from >10 m, including ruptured swim bladders and compressed or displaced organs, that could adversely affect health and reproduction in the long-term. Deep hooking caused delayed mortality in *M. novemaculeata*, mainly because of minimal hook shedding and feeding. Our results also suggested that the severity and timing of angling in relation to the stage of gonadal development could influence the reproduction of both species after release. Further investigation and mitigation of long-term and sublethal effects will not only benefit the sustainability of stocks, but help address the increasing social awareness of animal welfare and ethical concerns associated with releasing fish in recreational fisheries.

**Oral-WS** Com.4 in *Workshop: Communication and Collaboration between Science and Management in Recreational Fisheries*

August, 03, 11:20 – 11:35 am, Seminar Building - Room 1.103

**Science and recreational fishery management: How can we improve the collaboration?**

*FERN HAMES*[1]

[1] Arthur Rylah Institute for Environmental Research, Department of Sustainability & Environment

The Native Fish Strategy (NFS) provides direction for the rehabilitation of severely degraded native fish populations of the Murray-Darling Basin, south-eastern Australia. The NFS defines key threats for native fishes, supports targeted research, identifies actions and disseminates knowledge to support rehabilitation of native fish populations. A key component of the NFS is engagement of communities and stakeholders. Engagement with recreational fishers has involved actions ranging from on-ground action to support habitat (such as re-vegetation), participation in research *via* activities such as angler diaries, through to representation in advisory forums and effective lobbying and advocacy for habitat, flows and fish passage.

**Oral** C6.4 in *EFTTA/EAA Cormorant Session*

August, 03, 11:30 – 11:50 am, Seminar Building - Room 1.102

## Decline of graylings in Bavaria, their relation to cormorant population dynamics, and possibilities for recreational fishing

*SEBASTIAN HANFLAND*[1], BERNHARD LAGGERBAUER[1]

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In the past 30 years, autochthonous fish in rivers of Bavaria underwent a dramatic decline, particularly in hyporithral waters where graylings (*Thymallus thymallus*) are the lead fish. Sewage or hydropower plants, stream regulation or overfishing are often suspected causes. Here, we show that these factors do not explain the dwindling fish populations. Some rivers have good grayling populations and fishing despite profound structural deficits, low water quality and manipulated flow. By contrast, rivers in better condition have collapsed grayling populations in spite of their protection from fishing. Grayling decline clearly correlates with the presence of cormorants (*Phalacrocorax carbo*). In urban areas, absence of cormorants allows for fair grayling populations although other parameters are suboptimal. On the other hand, frequent or occasional but intense fishing by cormorants reduced graylings even in waters of high natural quality. Cormorant countings in Europe indicate an exponential 25fold increase since 1967. Most birds colonize coasts, but many migrate inland in winter and further intensify their raids to streams when still waters freeze over. One study revealed that graylings benefit from chasing off cormorants and mergansers non-lethally, but this shifts predation to other areas. Local shooting of cormorants is also not effective if inland winter migration is not limited. We propose a Europe-wide reduction of cormorants to the non-endangered population status of 1994.

**Oral** T3.7 in *Space, place and recreational fisheries*

August, 04, 2:10 – 2:30 pm, Seminar Building - Room 1.101

## Managing for sustainability in a fishery of high significance for recreational and commercial fishers

NATHAN HARRISON[1], BRENT WISE[2], CLINTON SYERS[1], BRETT MOLONY[2], *HEATHER BRAYFORD*[1]

[1] Aquatic Management, Department of Fisheries
[2] Research Division, Department of Fisheries

In order to address overfishing of key demersal scalefish species off Western Australia a combination of different management strategies, supported by effective education, compliance and research monitoring programs, were required. A critical overarching sustainability requirement, and of considerable political sensitivity, was to reduce catch of a suite of popular species by 50%; this applied to both the commercial and recreational sectors. Recreational management arrangements developed through extensive consultation with stakeholders are aimed at not only reducing recreational catches by 50%, but also maintaining the social amenity value of the recreational fishing experience. The agreed management strategy included introduction of a fishing-from-boat licence and a carefully selected 2-month seasonal closure to reduce effort. Commercial management similarly involved extensive consultation to reduce effort from a fleet of approximately 250 to a more efficient fleet of 30 vessels with unitized individual effort allocations. This presentation will explore the issues associated with balancing the impacts of various fisheries management strategies against their impacts on the recreational fishing experience.

**Oral** C7.2 in *Biological impacts of recreational fisheries and their social and economic consequences*

August, 04, 3:40 – 4 pm, Audimax

## Spatial variation in movements and mortality for Atlantic Cod in the inner Oslo fjord

THROND O. HAUGEN[1], SONDRE SKI[1], HANS ERIK KARLSEN[2], JONATHAN E COLMAN[2]

[1] Department of Ecology and Natural Resource Management, Norwegian University of Life Sciences
[2] Department of Biology, University of Oslo

With an estimated half a million anglers, the inner Oslo fjord supports the largest concentration of recreational anglers in Norway, as well as a limited commercial fishing fleet. Commercial catches of licensed fish are partially recorded, while bi-catch and fish mortality of non-targeted fish associated with commercial fishing is non-existent for all species. The affect of recreational fishing on fish mortality, movement patterns and population recruitment is unknown, yet vital for optimal management and an understanding of anglings' ecological imprint. Human harvest influences the behaviour, movements and demography of many fish species. Atlantic cod (*Gadus morhua*) are likely the most important commercial and recreational fish in the inner Oslo fjord, but we know nothing about the numbers of cod being caught by anglers or the effect the angler or commercial harvest has on the cod population. Knowledge on the influence of commercial and recreational fishing on coastal cod population's survival, movement patterns and local recruitment is pertinent. Using tagging and recapture data, tagged and sampled according to a robust Huggins design, we investigated the movement patterns, mortality and demographical characteristics of cod in the inner Oslo fjord. To provide a basis for future management, we investigated local movement patterns, population size and structure and age and sex specific natural versus harvest mortality.

**Oral** C5.6 in *Social and biological factors affecting catch efficiencies by anglers*

August, 03, 10:30 – 10:50 am, Seminar Building - Room 1.101

## Where did the perch go? Decreasing resources determine angling success

*LISA HEERMANN*[1], MARTINA HEYNEN[1], JOST BORCHERDING[1]

[1] Department of General Ecology & Limnology, Ecological Field Station Grietherbusch, University of Cologne

Eurasian perch (*Perca fluviatilis*) as one of the most common fish species in gravel pit lakes along the Lower River Rhine frequently is a target species of anglers. Particularly for larger individuals of perch the angling success is known to be highly variable within one season, a phenomenon that was scientifically documented by standardised angling effort. Stomach content analyses and the documentation of sex ratios gave further insight into possible reasons for fluctuating numbers of perch angled. Catch rates which dramatically increased in late summer were caused by altered structures of the food web. Stomach content analyses revealed that with a decreasing zooplankton resource inter-cohort cannibalism of perch became more and more pronounced. However in late summer, the dynamics of the two main food resources of larger perch (zooplankton and young-of the-year perch) and a decrease of both caused hunger in bigger individuals. The lack of food was not only reflected in rising catch rates but also in a decrease in perch's condition and increasing numbers of empty stomachs. In September more than 95% of angled perch were females, whereas for the rest of the season the sex ratio of perch caught was about 50% males and 50% females. This suggests that perch were affected sex-dependently by the shortage of food resources, which might be due to sex-dependent differences in metabolism, growth rates, age of maturation and energy invested into gonads.

**Oral** T2.7 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 2:10 – 2:30 pm, Audimax

## Driving forces in the evolution of the Texas marine recreational fisheries and their management

*ED HEGEN*[1]

[1] Coastal Fisheries Division, Texas Parks and Wildlife Department

Texas' coastal geography supports diverse marine habitats and species of commercial and recreational interest. Recreational fisheries, beginning as low impact sport fishermen obtaining family meals, have gained notoriety from high profile fishermen like Teddy Roosevelt and tarpon, and have evolved to high monetary stakes national professional tournaments. What once were independent weekend anglers now belong to highly organized, informed board-scope conservation groups. Historically, authority for fisheries management regulations has involved multiple entities including: Texas Legislature, the fisheries management commission, cities, counties, and other governmental jurisdictions. Currently it is governed by the Legislature, Texas Parks and Wildlife Department, and the federal fisheries management council with jurisdiction in federal waters of Gulf of Mexico. The regulation process has evolved from simple unquestioned law making to now include public education and participation. Regulations have evolved from means, manners, and methods of catching fish to license restrictions and user allocation. The science of management has evolved from life history and ecology studies to genetic identification of parental stock for hatchery reared fishes. Single species management has moved to ecosystem management. Increasingly sophisticated models, statistical tests and technology are being utilized to study the aquatic and human environments for recreational fisheries management.

**Oral** C6.3 in *EFTTA/EAA Cormorant Session*

August, 03, 11:10 – 11:30 am, Seminar Building - Room 1.102

## EIFAAC and Cormorant management in Europe

*PETRI HEINIMAA*[1]

[1] Fisheries Research, Finnish Game and Fisheries Research Institute

European Inland Fisheries and Aquaculture Advisory Commission (EIFAAC) has for a long time been concerned over the impacts of the increasing European Cormorant population on aquaculture and the fish stocks of inland waters. EIFAAC has acknowledged that interactions between humans and Cormorants are not only a local or national issue but also a concern of pan-European dimension. In 2008 EIFAC made at its 25th Session a resolution that there is a need for a pan-European management plan for Cormorant populations. Also many other forums have come to a conclusion that there should be actions to limit the European Cormorant populations into a reasonable level. To achieve this goal there should be coherent management plans for Cormorant populations in each country and especially in the major reproducing areas for example in the Baltic Sea region.

**Poster** C1.14 in *Biological and social aspects of catch-and-release*

## Attitudes of Swedish anglers towards releasing fish

*GUSTAV HELLSTROM*[1], ANDERS KAGERVALL[1]

[1] Department of Wildlife, Fish, and Environmental Studies, Swedish University of Agricultural Sciences

Although implementation of Catch and Release fisheries is increasing in Scandinavia, little is known about how the anglers perceive such a development. We present results of a 2011 survey investigating attitudes towards releasing fish among members of the Swedish Association of Anglers. Attitudes varied between angler profiles, based on preferred fishing method and species preferences. The motifs and intentions behind releasing a fish, as well as the circumstances in which the release occurred, were important determinants to whether or not the action was considered ethically and biologically justified. We discuss the results from a management perspective and give suggestions for when C&R may or may not be an appropriate management strategy.

**Oral** T2.11 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 4 – 4:20 pm, Audimax

## The struggle of Swiss anglers with the new animal protection law: A juristic overkill?

*ANDREAS HERTIG*

Fish and Game Service, Baudirektion Kanton Zürich

Since 2009 Switzerland has one oft he strongest animal protection laws. Because the new federal animal protection law includes all vertebrates, fish are juristically set on the same level with dogs or cattle. Fishing is affected by many new rules such as prohibition of catch and release practice, banning of barbed hooks, introduction of compulsory fishing courses for holders of longtime fishing licences (how to keep fish alive, correct killing techniques and so on) but not for holders of short-time fishing licences (e.g. one day permits). Many exceptions of certain rules – e.g. allowance of barbed hooks under special conditions/techniques – lead to confusion among fishermen and make law enforcement difficult for fishing authorities. The presentation will show examples of experience from practical fishing as well as upcoming problems for fishery management in Switzerland in the context of the new law. A general discussion is needed about how far animal protection rules make sense in fishing.

**Oral** T2.8 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 2:30 – 2:50 pm, Audimax

## Almost 70 years of fish catch records: Environment-induced changes in the fisheries of Canton Zurich, Switzerland

*ANDREAS HERTIG*[1]

[1] Fish and Game Service, Baudirektion Kanton Zürich

The fishing rights in the waters of Canton Zurich, Switzerland, are state owned. For all waters catch records are available since 1942. Fish catch in the running waters (790 km) showed massive changes over time: while stable before, the general catch dropped from around 70‘000 to 30‘000 fish/year during the period 1985 to 2010. The catch of the preferred and stocked trout and grayling but also of the less preferred nase, barbel and roach decreased while perch (preferred) and chub (less sought) catches didn’t show similar changes. The reason for the changes is seen in environmental changes, specially in the decrease of nutrients in the water due to the prohibition of phosphate and the installation of WWTP as well as the increase of micropollutants. The lake fisheries did also undergo changes: the catch of whitefish (coregonids) did almost explode after phosphate reduction in the two smaller lakes Greifensee and Pfäffikersee (8.4 and 3.3 $km^2$) and showed a significant increase in Lake Zürichsee (60 $km^2$). The overall catch (150 to 270 tons/year, gillnet-fishing included) showed no reduction but a significant change in the composition of fish species with a decrease of cyprinids and an increase of whitefish. Catch of pike remained rather stable over the whole period. The anglers reacted quickly to the increase of the planctivorous whitefish stocks by introducing the Swiss fishing technique called «hegene » to these lakes, a special rig with five nymphs fished with sensitive rods.

**Oral** T2.9 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 3:20 – 3:40 pm, Audimax

## Access and opportunity; the importance of stakeholder contribution to recreational fishery resilience

*PHIL HICKLEY*[1]

[1] Fisheries Technical Services, Environment Agency

The sustainability of freshwater recreational fisheries depends on the provision and maintenance of access and opportunity. In addition to ecological fisheries management, the human dimension components of motivation, constraints and participation require consideration. The Environment Agency is the responsible authority for inland fisheries but the recent UK Government concept of Big Society implies an increasing importance of the third sector stakeholder community for fishery surveillance, promotion and management. The recreational fisheries sector is described in terms of economic value, angler preferences, participation, and marketing. The ecological and social management requirements for the sector are outlined and the potential for switching certain facets from Government agency to stakeholder contribution and activity is discussed.

**Oral** T1.11 in *Stock, stocking and the future of recreational fisheries*

August, 01, 4:30 – 4:50 pm, Audimax

## Institutional diversity governing fish stocking in German inland recreational fisheries under a private fishing rights framework

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[3] Humboldt-Universität zu Berlin, Faculty of Agriculture and Horticulture, Department of Agricultural Economics
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The institutional framework affecting fish stocking strongly impacts how decisions about this popular recreational-fisheries management tool are taken. No research on the formal and informal institutions governing fish stocking under private fishing rights regimes is available. Focusing on Germany as a case, we analysed the legal framework governing freshwater fish stocking in each of the 16 German states using document analyses and short interviews with managers of recreational fisheries associations and managers of angling clubs. We find that international agreements and directives, the national nature protection act as well as 16 different state-specific inland fisheries laws provide general guidance of relevance for local fish stocking decision making by angling clubs and associations in Germany. Interestingly, the 16 fisheries laws differ in the level of details and the provisions on fish stocking in each of the German states. Most strikingly, local fisheries owners are bound to follow management plans controlled by authorities in some states, while local self-management of stocking with limited external input is common in other German states. Overall, we find that despite the common framework of private fishing rights in Germany, the institutional framework governing fish stocking decision making highly varies across Germany. This situation provides both challenges and opportunities concerning the development of fish stocking policies in Germany.

**Key Note** K4.1 in *Key Note*

August, 04, 9:05 – 10:05 am, Audimax

**The intersection of recreational fisheries and the world's freshwater megafish: coexistence, conservation or extinction?**

*ZEB HOGAN*[1]

[1] University of Nevada, Reno

Recreational fishing for large-bodied freshwater fish, also known as megafish, is growing in popularity. Opportunities for recreational anglers to catch these giant fish now exist in almost every area where they occur. Yet the impact of recreational fishing on many megafish species has not been well studied, despite the fact that several megafish species are listed as threatened. This presentation examines the role of recreational fishing for megafish in the context of conservation and sustainable use. Which species are popular with anglers? Does recreational fishing for large-bodied fish threaten their survival? What are some the direct and indirect impacts of megafish fishing? And finally, where are the success stories – can recreational fishing actually help protect vulnerable megafish? Case studies, including the white sturgeon (Acipenser transmontanus), Mississippi paddlefish (Polyodon spathula), alligator gar (Atractosteus spatula), lake sturgeon (Acipenser fulvescens), European catfish (Silurus glanis), Mekong giant catfish (Pangasianodon gigas), and giant Eurasian trout (Hucho taimen) show that the issues surrounding recreational angling of large-bodied fish are as varied as the species themselves. Growing movements to fish for large-bodied invasives (such as European catfish in Spain) and exotics in fishing ponds (such as arapaima in Thailand) demonstrate the complexities of evaluating the effects of recreational angling for megafish.

**Oral** T1.2 in *Stock, stocking and the future of recreational fisheries*

August, 01, 11:30 – 11:50 am, Audimax

## Determinants of successful stocking in European freshwater fishes of importance to recreational fisheries: A review

*DANIEL HÜHN*[1], ROBERT ARLINGHAUS[1]

[1] Biology and Ecology of Fishes, Leibniz-Institute of Freshwater Ecology and Inland Fisheries

Stocking is one of the most widespread means of management of fish species in freshwater recreational fisheries. We examined available literature with regard to major determinants of successful stocking measures for the most important European freshwater fish species. We identified that a small set of key factors affected the success probability of stocking events, namely degree of natural recruitment in the recipient water body, size of stocked fish, genetic background of stocked seeds and stocking intensity. We then analysed the literature for evidence of these factors in explaining stocking experiments in six key freshwater species, i.e., brown trout (*Salmo trutto*), grayling (*Thymallus thymallus*), pike (*Esox lucius*), zander (*Sander lucioperca*), carp (*Cyrinus carpio*), and eel (*Anguilla anguilla*). We found that the available evidence is incomplete across species, with much more research conducted on salmonids compared to non-salmonids. Generally, however, we found evidence that the probability of stocking success sharpely increases across species with the degree of habitat degradation and the size of stocked species. Size of fish, however, also increases the cost of stocking, but we found no study on the cost-benefits of stocking practices in Europe in the species examined. We found lower consistency in the reported findings on the importance of local adaptation for stocking success, and even less controlled studies were conducted on stocking density. We conclude that some basic generalizations about stocking success factors may be possible across species, but much more studies are needed to facilitate quantitative meta-analyses that provide the next step to complement our qualitative review.

**Oral** T3.1 in *Space, place and recreational fisheries*

August, 04, 10:30 – 10:50 am, Audimax

## The effects of regional angling effort, angler behaviour, and harvesting efficiency on landscape patterns of overfishing

*LEN HUNT*[1], ROBERT ARLINGHAUS[2], NIGEL LESTER[3], ROB KUSHNERIUK[1]

[1] Centre for Northern Forest Ecosystem Research, Ontario Ministry of Natural Resources
[2] Department of Biology and Ecology of Fishes, Leibniz Institute of Freshwater Ecology and Inland Fisheries and Inland Fisheries Management Laboratory, Department for Crop and Animal Sciences, Faculty of Agriculture and Horticulture, Humboldt-Universität zu Berlin, Germany
[3] Aquatic Research and Devlopment Section, Ontario Ministry of Natural Resources

We used a coupled social-ecological model to study the landscape-scale patterns emerging from a mobile population of anglers exploiting a spatially structured walleye (*Sander vitreus*) fishery. We systematically examined how variations in angler behaviours (i.e., relative importance of walleye catch rate in guiding fishing site choices), harvesting efficiency (as implied by varying degrees of inverse density-dependent catchability of walleye), and angler population size affected the depletion of walleye stocks across 157 lakes located near Thunder Bay (Ontario, Canada). We found support for the hypothesis of sequential collapses of walleye stocks in inverse proportionality of travel cost from the urban residence of anglers. We found little support for the hypotheses of systematic overexploitation of the most productive stocks and homogenized catch-related qualities among lakes sharing similar access costs to anglers. Our study also illustrates that understanding landscape overfishing dynamics involves a careful appreciation of angler population size and how it interacts with the attributes that drive angler behaviors and depensatory mechanisms such as inverse density-dependent catchability. Only when one considers and understands these ingredients can reasonably predictable patterns of overfishing in the landscape be derived.

**Poster** C8.13 in *Creative methods for managing recreational fishing*

## Predicting coldwater fish habitat using water levels in reservoirs: benefits to anglers and managers

*TAYLOR HUNT*[1], JOHN DOUGLAS[1], PAUL BROWN[1], KHAGESWOR GIRI[1]

[1] Fisheries Victoria, Department of Primary Industries Victoria

Temperate reservoirs worldwide are often stocked with fish species for the purposes of recreational fishing. But the stratification of temperate reservoirs can cause a 'habitat squeeze' for some coldwater fish species such as brown (*Salmo trutta*) and rainbow (*Oncorhynchus mykiss*) trout, challenging their survival and making them more difficult for anglers to catch. The objectives of this study were to: 1) explore the differences in brown trout (*Salmo trutta*) habitat squeeze between two large reservoirs in south-eastern Australia, Lake Hume and Lake Dartmouth; 2) determine the most likely locations of trout during reservoir stratification and 3), develop models to predict the quantity of trout habitat based on water levels. We developed GIS models for both reservoirs and found that Lake Hume had a significantly lower volume of habitat in summer and a greater habitat squeeze than Lake Dartmouth. We provided information to recreational anglers regarding the most likely location of trout on a month-by-month basis in the reservoirs. We created habitat models that demonstrate a strong relationship between water levels and trout habitat. The results of this study will be of use to managers in understanding the factors contributing to a habitat squeeze, informing anglers where to effectively target fish and optimising trout stocking based on the quantity of suitable habitat.

**Oral** C8.4 in *Creative methods for managing recreational fishing*

August, 04, 2:30 – 2:50 pm, Seminar Building - Room 1.102

## Structured decision making and recreational fisheries management

*BRIAN IRWIN*[1], MICHAEL WILBERG[2], MICHAEL JONES[1], JAMES BENCE[1]

[1] Quantitative Fisheries Center, Department of Fisheries and Wildlife, Michigan State University
[2] Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science

Recreational fisheries managers routinely contend with multiple objectives and multiple uncertainties, which pose real challenges to decision making. We suggest that structuring partnership-based policy evaluations using formal decision-making frameworks can improve recreational fisheries management. Critical steps include: diagnosing the issue, specifying management objectives and corresponding performance measures, identifying critical uncertainties, and evaluating predicted policy outcomes. Such approaches (e.g., Management Strategy Evaluation) are becoming more commonly applied to harvest management of marine commercial fisheries, but remain uncommon for recreational fisheries or inland waters. We describe how a structured decision-making process can be based upon collaborative development of a quantitative forecasting model, and we refer to illustrative examples primarily from the Laurentian Great Lakes. An iterative, interactive modeling process provides opportunities for more transparent decision making, including identifying realistic expectations for fishery productivity and management and acceptable levels of risk to the resource. Although tradeoffs among metrics commonly used to assess recreational fishery performance can sometimes be anticipated, we suggest that formal decision-making processes offer tremendous value by elucidating tradeoff characteristics and identifying whether decisions are likely to be sensitive or robust to key uncertainties.

**Poster** C3.30 in *New methodological tools to survey and assess recreational fisheries*

## A new complementary survey approach for estimating shore-based recreational fishing catch and effort

*GARY JACKSON*[1], CLAIRE SMALLWOOD[1], KENNETH POLLOCK[1], BRENT WISE[1], NORMAN HALL[1], DAN GAUGHAN[1]

[1] Western Australian Department of Fisheries, Western Australian Fisheries and Marine Research Laboratories

Information on shore-based recreational fishing is essential for the sustainable management of nearshore fish stocks. However, obtaining estimates of catch and effort can be complex and expensive due to the diffuse spatio-temporal scales over which this form of recreational fishing is typically conducted. A recent study in the Perth metropolitan area of Western Australia tested a new complementary design that incorporated maximum count aerial surveys, roving creel surveys and remote cameras. Cameras ascertained fishing patterns over the 24-hr day, and highlighted an afternoon peak in activity, while aerial surveys revealed a heterogeneous spatial distribution in fishing. Roving creel surveys yielded 1,194 interviews with shore-based fishers. Total fishing effort was estimated at 196,430 fisher hours (SE± 8,662) and the total retained catch was 327,414 fish (SE± 33,107) with Australian herring the dominant species. Aerial surveys were able to rapidly collect data on the spatial distribution of fishing while roving creel surveys were the only method from which catch rates could be calculated. This study improves our understanding of the exploitation of nearshore fish stocks by shore-based recreational fishing in the Perth metropolitan area. The complementary survey approach has broader potential to provide robust estimates of recreational shore-based fishing activity elsewhere.

**Oral** C8.7 in *Creative methods for managing recreational fishing*

August, 04, 4 – 4:20 pm, Seminar Building - Room 1.102

## Assessing the effectiveness of quota-tags to manage recreational catches of snapper (*Pagrus auratus*) in the Freycinet Estuary, Shark Bay, Western Australia

*GARY JACKSON*[1], EVA LAI[1], TIM GREEN[1]

[1] Western Australian Department of Fisheries, Western Australian Fisheries and Marine Research Laboratories

Separate stocks of snapper (*Pagrus auratus*) in the Eastern Gulf, Denham Sound and Freycinet Estuary areas of Shark Bay, Western Australia, have been a major attraction for recreational boat fishers since the 1970s at least. Following research that showed all three stocks were depleted, stricter management was progressively introduced between 1998-2002 that included increases in minimum length and introduction of a maximum length, reductions in daily bag limits, and various temporal and spatial closures. In 2003, a Total Allowable Catch (TAC) was set for each stock for the first time and different combinations of measures implemented to manage catches to the respective TACs. These included a novel quota-tag system in the Freycinet Estuary, to limit the snapper catch to only 5 tonnes per year. The most recent assessment indicates that the Freycinet Estuary spawning stock has now rebuilt to the management target, seven years on from the introduction of TAC-based management. The success of quota-tags in limiting catches to below the TAC each year has significantly assisted in this stock recovery. This paper will present a brief assessment of the quota-tags in terms of ability to limit recreational catches, levels of compliance, acceptance by recreational fishers and administrative cost. Such information may be useful to recreational fisheries managers elsewhere where quota-tags may have potential application with similar finfish fisheries.

**Oral** C7.5 in *Biological impacts of recreational fisheries and their social and economic consequences*

August, 04, 4:40 – 5 pm, Audimax

**Disturbance by human activities on fish individual behaviour in a small lake**

*LENE JACOBSEN*[1], HENRIK BAKTOFT[1], SØREN BERG[1], NIELS JEPSEN[1], CHRISTIAN SKOV[1], KIM AARESTRUP[1]

[1] National Institutes of Aquatic Sciences (DTU-Aqua), Technical University of Denmark

Many freshwater lakes are subjected to human recreational activity, e.g. angling and boating. Disturbances by these activities will inevitably influence the freshwater habitat, either temporarily or more persistently. Fish might be affected in various ways, potentially leading to suboptimal behaviour. The effect of recreational activities on three fish species were explored by high resolution tracking using an automatic acoustic telemetry system (Lotek MAP_600). Twenty-two roach (17-24cm), 24 perch (16-30cm) and 24 pike (48-100cm) were equipped with acoustic transmitters with sub-minute burst rates. Scheduled human disturbances were performed, following a protocol of 4 hours activity in the lake every third day for 32 days, with no activity in the lake in between. Activity were either 1) boating with a small motor (petrol) driven dinghy in short sequences around the lake, changing position every 15 min, simulating boating in connection with angling activity or 2) same boating protocol combined with 15 min of angling using two rods with artificial lures. The three fish species showed variable responses to the disturbances. Roach activity levels were considerably higher during the four hours of disturbance compared to days with no disturbance. Perch reacted less and more inconsistently, whereas pike did not show any clear response to disturbance. There was no difference between boating and boating + angling, indicating that boating was the primary source of disturbance.

**Oral** C6.2 in *EFTTA/EAA Cormorant Session*

August, 03, 10:50 – 11:10 am, Seminar Building - Room 1.102

## Reconciling the conflict between cormorants and anglers

*NIELS JEPSEN*[1], THOMAS BREGNBALLE[2]

[1] Freshwater, DTU Aqua
[2] NERI, Aarhus University

Reconciling the conflict between cormorants and anglers *Quantification of predation effects* Niels Jepsen & Thomas Bregnballe The conflict between conservation of fish stocks and fisheries can be complicated by a third party. This seems to be the case in some areas where high numbers of cormorants can keep fish stocks at a very low level, thus hampering recruitment. In such a situation the task for managers is to protect the fish from both fishing and predation. In Europe, the conflict between cormorants (*Phalacrocorax carbo sinensis*) and anglers go back a long time, but despite much focus and many studies, the scientific documentation of significant impact of cormorants on fish stocks is very limited. This lack of documentation complicates management of the conflict because the discussions between user groups are based more on feelings than facts. In this paper we will provide a summary of the types of documentation of the magnitude and effects of cormorant predation, we have produced through many years of research. The various methods used will be briefly discussed and the process of turning scientific evidence into changes in attitudes and management will be described.

**Oral** T1.9 in *Stock, stocking and the future of recreational fisheries*

August, 01, 3:50 – 4:10 pm, Audimax

## Illegal stocking: socioeconomic, ecological, and human health implications

*BRETT JOHNSON*[1]

[1] Fish, Wildlife and Conservation Biology, Colorado State University

Illegal stocking is frustrating for fishery managers, particularly when it conflicts with management goals and jeopardizes recreational fishery sustainability. The practice may also interfere with conservation of sensitive species. In some cases illegal stocking has even altered contaminant uptake and potential exposure of anglers and their families to environmental toxins. Illegal stocking of nonnative recreational fishes is a common practice in the Colorado River Basin (CRB), USA, with more than 50 unauthorized populations of cool- and warmwater fish. These fish have increased management costs by necessitating the stocking of larger trout to avoid predation by introduced piscivores, and are degrading kokanee fisheries valued at millions of dollars. Dispersal of introduced fish into native fish habitat is a key factor limiting recovery of endangered fishes in the CRB. When piscivores were introduced into some Colorado reservoirs managed for panfish and salmonids, availability of the latter decreased while mercury concentration of the former rose beyond levels safe for human consumption. Apparently, some people are unaware that their efforts to establish new recreational fish populations can be contrary to their own goals and personal well-being. Because most introductions are difficult to remedy, fishery professionals should strive to educate anglers that illegal stocking can be counterproductive, sometimes with significant economic and human health implications.

**Poster** C4.9 in *Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives*

## Fish life history, angler behaviour, and optimal management of recreational fisheries

*FIONA JOHNSTON*[1], ROBERT ARLINGHAUS[1], ULF DIECKMANN[2]

[1] Department of Biology and Ecology of Fishes, Leibniz-Institute of Freshwater Ecology and Inland Fisheries
[2] Evolution and Ecology Program, International Institute for Applied Systems Analysis

Some recreational fisheries are not managed sustainably. This might be because angler behaviour and diversity are often not considered in fisheries-management models. But the interplay among fish populations, anglers, and management actions will influence the impact recreational fishing has. We use a bioeconomic model to examine how accounting for diverse angler behaviour (i.e., generic, consumptive, or trophy angler types), and fish life-history (LHT) diversity alter predictions about optimal angling regulations that maximize aggregated angler utility. Five freshwater species were described – *Perca fluviatilis*, *Salmo trutta*, *Sander lucioperca*, *Esox lucius*, and *Salvelinus confluentus*. We report four main results. (1) Accounting for dynamic angler behaviour altered predictions about optimal license number and minimum-size limit. (2) LHT was important for determining fish populations' vulnerability to overfishing, but angler type influenced the magnitude of declines. Thus, both LHT and angler type were important for determining optimal regulations. (3) Angler types were systematically attracted to particular LHTs (e.g., consumptive anglers preferred perch). (4) Despite differences in socially optimal regulations, these regulations resulted in biological sustainability, in all but one case. Our results highlight the importance of jointly considering fish diversity, angler diversity, and management when deriving sustainable management strategies for recreational fisheries.

**Poster** T1.16 in *Stock, stocking and the future of recreational fisheries*

## The effects of fish stocking on the evaluation of ecological quality of rivers

*PAVEL JURAJDA*[1], SETH WHITE[2], MICHAL JANÁČ[1], GABRIELA KONEČNÁ[1]

[1] Department of Fish Ecology, Institute of Vertebrate Biology Academy of Sciences CR
[2] Department of Fish Science, Columbia River Inter-Tribal Fish Commission, USA

The EU's WFD makes good use of riverine biota - including fish - as ecological indicators of river health. However, it is important to examine when our indicators fail to serve the purpose for which they were originally intended: to reliably describe the quality of the environment. We argue that in the Czech Republic the use of adult fish as ecological indicators often fails to fulfil these purposes especially when fish are stocked in natural waters. The ecological quality of running waters sensu WFD is usually assessed on the basis of the adult fish assemblage (≥1 year old). However, the CR has regular and widespread enhancement stocking of more than one third of fish species (mainly native) present in running waters. An alternative strategy is young-of-the-year (YOY) fish monitoring to assess river ecological quality. Indices based on YOY monitoring have the ability to provide a sensitive response to water quality and habitat structure regardless of the effect of stocking. We compare results from YOY and adult samples with including information about stocked species in order to determine the relative importance of stocking to the adult fish assemblage composition and stocking-based bias in estimated ecological quality of the river. Stocking influenced the ecological status of rivers (expressed as EFI+ index) and we conclude that YOY sampling is often a more logical and practical approach to water quality monitoring under specific conditions.

**Oral** T2.2 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 10:50 – 11:10 am, Audimax

**Recreational fishery pressure – is it river flow dependent factor?**

*ZBIGNIEW KACZKOWSKI*[1], PIOTR FRANKIEWICZ[2], MACIEJ ZALEWSKI[2]

[1] Department of Applied Ecology, University of Lodz
[2] Department of Applied Ecology, University of Lodz, International Institute of Polish Academy of Sciences EUROPEAN REGIONAL CENTRE FOR ECOHYDROLOGY under the auspices of UNESCO

Observed climate instability significantly affects the hydrological regime of rivers, especially through more frequent and more prolonged appearance of low flow conditions due to precipitation-related runoff decrease in summer. Comparative evaluation of fishing pressure during lowered discharges revealed as high as 60-percent increase in total fishing effectiveness with a stable number of anglers. Some differences in fishing statistics between low and high water conditions have been observed between rheophilic and limnophilic species. Survey was conducted in lowland Grabia river, in Central Poland, dominated by a few eurytopic coarse fish species (roach *Rutillus rutillus*, dace *Leuciscus leuciscus*, perch *Perca fluviatilis*, pike *Esox lucius*, ide *Leuciscus idus*) which were also the main target species for anglers. New compensatory measures, like fishery free refugee area, should be considered if climate change scenarios forecasting flow alterations become true.

**Poster** T2.22 in *Change, adaptation and evolution in recreational fisheries*

## Change, adaptation and evolution in recreational fisheries: the case of sport fishing in Kenya's marine waters

*NELLY KADAGI*[1]

[1] African Billfish Foundation

Compared to other places around the world, there are inadequate data concerning the trends in change, adaptation and evolution in recreational marine fisheries in Kenya. However, recreational marine fishing is increasing in significance. This presentation provides perspectives into the various changes in social, biological and economic aspects of sport fishing particularly in marine waters based on the information received from local anglers who have taken this sport over the years and the data collected by the African Billfish Foundation. This section reviews environmental changes, political changes and also changes in fisheries management strategies among others that affect recreational marine fisheries. The paper also explores the different ways that recreational marine fishing has managed to cope up with the changing status of this fishery. In addition, the evolutionary aspects of this fishery in terms of biological, cultural and management are also discussed. As a conclusion, the paper also presents the different ways that have been employed by the recreational fishing fraternity in addressing the challenges resulting from change and evolution and the goals towards resilient recreational fisheries in Kenya.

**Oral** T3.5 in *Space, place and recreational fisheries*

August, 04, 1:30 - 1:50 pm, Audimax

## Globalization of recreational marine fisheries in Kenya: Trends, opportunities and challenges

*NELLY KADAGI*[1]

[1] African Billfish Foundation

Despite its less recognition and often ignored role in the nation's economy, recreational fishing particularly in marine waters continues to play a big part in the Kenyan economy, conservation sector and social well-being. With a coastline of about 640 kilometres, Kenya is known to have some of the best sport fishing areas that attract anglers from all over the world who have a variety of choice for species such as billfish, Wahoo and Dorado among others. This paper explores the trends in which recreational marine fishing in Kenya has emerged basing on globalization in terms of fishing tools and equipment, as well as the stakeholders. In this section, the changes in the perception of stakeholders in regards to recreational marine fishing over time and utilization of the present globalization of ecological thought are also dealt with. This paper also offers perspectives in the opportunities that have resulted from globalization by giving a case- study of African Billfish Foundation's findings in the tagging and recoveries programme that has been on-going for over ten years. Highlights to the challenges that have resulted from globalization have also been discussed in-depth with emphasis on the social, economic and biological aspects. As a conclusion, the paper also presents the different ways that have been employed by the recreational fishing fraternity in addressing the challenges faced and the goals towards resilient recreational fisheries in Kenya.

**Oral** C1.10 in *Biological and social aspects of catch-and-release*

August, 01, 4:10 – 4:30 pm, Seminar Building - Room 1.101

**Acceptance of catch & release fishing in Sweden: results from a survey-based study of attitudes and norms**

*ANDERS KAGERVALL*[1], GUSTAV HELLSTRÖM[1], GÖRAN ERICSSON[1], THOMAS HEBERLEIN[1]

[1] Department of Wildlife, Fish and Environmental Studies, Swedish University of Agricultural Sciences

In Sweden, there is an increased implementation of a recreational fisheries in where all, or the majority, of the caught fish are released. Although several case-studies suggest such fisheries become more biologically sustainable, there are ethical and cultural/institutional aspects attached to management policies promoting the release of fish. Knowledge about how catch & release fishing is perceived among fisherman and the general public is still sparse. Implementation and promotion of management actions that have low acceptance by stakeholder groups and local communities, may risk being ignored and/or result in conflict. Based on a 2011 survey targeting a national selection of recreational fishermen and the general public in Sweden, we present geographical, social and gender-based variation in attitude towards C&R. Variation in C&R behavior within the angler community, depending on factors such as angler specialization, angler experience, preferred fishing method and species preferences is also discussed. Our aim is to understand the underlying determinants of attitudes toward C&R as well as the norms that control behavior and to use such information to identify contexts where C&R fisheries will be a suitable management strategy, as well as identify situations where other methods may be more appropriate.

**Poster** C7.6 in *Biological impacts of recreational fisheries and their social and economic consequences*

## Current research investigating a developing recreational fishery in the Kharaa River catchment, Mongolia

*ANDREW KAUS*[1], DIETRICH BORCHARDT[1]

[1] Department Aquatic Ecosystem Analysis and Management, Helmholtz Centre for Environmental Research GmbH - UFZ

Mongolians have traditionally not been fishermen; however with recent economic growth in the country this activity has increased in popularity and is now considered to be the greatest threat to the native fish species. The Kharaa River, 300km north of Ulaanbaatar, is one catchment that experiences high fishing pressure from local nomadic people and middle and upper class city dwellers throughout the year but particularly during the spring and summer months. The current research aims to quantify the recreational fishery's total catch and effort and to identify significant spawning, rearing, feeding and overwintering locations of the three target species *Brachymystax lenok, Thymallus arcticus* and *Hucho taimen.* Specific projects underway involve otolith and fin ray chemistry, acoustic telemetry tagging and genetics studies as well as total angler counts and fisher interviews. At the conclusion of the research we will provide scientifically sound species and catchment specific fisheries management recommendations to the responsible Mongolian authorities to conserve and promote species recovery and sustainability of fish stocks in the Kharaa River catchment for the future.

**Oral** C3.11 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 2:10 – 2:30 pm, Seminar Building - Room 1.102

## Satellite based tools for improving recreational fishing

*MICHAEL KELLY*[1]

[1] Sustainable Marine Resources, CLS America

CLS America, together with partners at the University of Miami, and the Central American Billfish Association have developed new technologies for real-time recreational fishing data collection and analysis. In pilot projects that have been ongoing for 2 years, the value of real-time data and its correlation with physical oceanographic features is already yielding important results.

**Oral** T2.12 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 4:20 – 4:40 pm, Audimax

## Recreational fishing, management and research in New South Wales, Australia

*STEVE KENNELLY*[1], PETER TURNELL[1]

[1] Fisheries and Ecosystems Research, Industry and Investment NSW

New South Wales has Australia's largest recreational fisheries, involving over 1 million people and valued at over $500 million. All recreational fishers (except aboriginal people, pensioners and children under 18 years) are required to pay a licence fee (for 3 days - $6, 1 month - $12, 1 year -$30 and 3 years - $75) which generates over $13 million per year, which is spent on enhancement, education, compliance, habitat restoration and research programs. Key programs include: Freshwater stocking of native and introduced species; Artificial reef and FAD programs; 350 Fishcare Volunteers who teach anglers about fishing rules and responsible fishing techniques; Fishing clinics and education programs for school children, people from culturally diverse backgrounds and special needs groups; Fish habitat restoration projects, including the building of fishways and re-snagging rivers. All programs are underpinned by extensive research before, during and after to ensure that all work is scientifically based. Key research projects include biological studies of recreationally important species, creel surveys and interviews of anglers, acoustic tagging, assessing impacts of FADs and artificial reefs, and maximising the survival of fish released by anglers. This paper provides an example of a very large, sophisticated and diverse recreational fishery that is managed at world's best practice standards, made possible by the significant input of quite modest individual licence fees.

**Oral-WS** Com.5 in *Workshop: Communication and Collaboration between Science and Management in Recreational Fisheries*

August, 03, 11:35 – 11:50 am, Seminar Building - Room 1.103

## Science-based collaboration between recreational fishing management and science in New South Wales, Australia

*STEVE KENNELLY*[1]

[1] Fisheries and Ecosystems Research, Industry and Investment NSW

New South Wales has Australia's largest recreational fisheries, involving over 1 million people and valued at over $500 million. All recreational fishers (except aboriginal people, pensioners and children under 18 years) are required to pay a licence fee (for 3 days - $6, 1 month - $12, 1 year -$30 and 3 years - $75) which generates over $13 million per year, which is spent on enhancement, education, compliance, habitat restoration and research programs.
All programs are underpinned by extensive research before, during and after to ensure that all work is scientifically based. At key steps of the process, scientists and fisheries managers liaise and together discuss ways to design projects and implement the findings. This is an example of a very large, sophisticated and diverse recreational fishery that is managed at very high standards, made possible by the significant input of solid science and quite modest individual licence fees.

**Oral** C3.15 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 4 – 4:20 pm, Seminar Building - Room 1.102

## Assessing catch and harvest components of a recreational fishery across a broad spatial range for freshwater systems

*JANICE KERNS*[1], MIKE ALLEN[1], JASON DOTSON[2], DAN GWINN[1]

[1] Fisheries and Aquatic Sciences, University of Florida
[2] Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission

Freshwater fisheries are composed of diverse angler groups including those who prefer to harvest fish, release fish, and those who seek trophy fish. Fisheries managers typically obtain directed fishing mortality estimates within a single lake or river section, and then extrapolate to other systems when setting harvest regulations. Thus, there is a need to identify regional trends in fishing mortality and catch and release fishing for informed use of regionally applied regulations. We implemented a cost-effective method for assessing catch and harvest for a recreational fishery across a broad spatial region. We employed a passive tag reward study within a broad management regulation area for largemouth bass in central Florida. A total of 501 fish were tagged, of which, 250 were tagged with high reward tags ($200) and 251 were tagged with low reward tags ($5). From the 82 tags that were returned the overall proportion of fish caught by anglers was 0.26 (SD = 0.04) with an estimated directed fishing mortality rate of 0.07 (SD = 0.02). Methods we used could provide critical information needed to identify management strategies (e.g., harvest or effort restrictions) to improve recreational fisheries management across broad spatial scales. Our study design will not provide mortality estimates for any specific lake due to a low number of tagged fish per lake, but it will provide overall regional fishing mortality rate, and thus, is useful for regionally applied regulations.

**Oral** C5.1 in *Social and biological factors affecting catch efficiencies by anglers*

August, 02, 3:20 – 3:40 pm, Seminar Building - Room 1.101

## The phenotypic and genotypic basis of individual vulnerability to angling

*THOMAS KLEFOTH*[1], CHRISTIAN SKOV[2], ROBERT ARLINGHAUS[1]

[1] Fish Biology and Ecology, Leibniz-Institute of Freshwater Ecology and Inland Fisheries
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Vulnerability to angling has been shown to have a heritable basis, but much less is known about the phenotypic expressions determining the probability of being captured. We used two genotypes of common-garden reared carp (*Cyprinus carpio*) with differences in their degree of domestication to test for a phenotypic and genotypic basis of vulnerability to passive angling gear using baited hooks. Measurements of individual morphology, relative body fat content and boldness-related traits were conducted within the laboratory and in ponds to determine phenotypic traits correlating with vulnerability to angling. Vulnerability was then tested in a standardized and replicated angling experiment in ponds. PCA`s of phenotypic measurements revealed a morphological factor , a laboratory-based boldness factor, and a third factor describing high feeding activities in ponds. Subsequent nested logistic regressions revealed significant positive correlations of vulnerability and 1. the domesticated genotype, 2. body size and 3. feeding activities in ponds. In addition, bold fish (as measured in the laboratory) tended to be more vulnerable than their shy counterparts. Using two genotypes of common-garden reared carp our study showed morphological, physiological and behavioural determinants of angling vulnerability confirming the genetic basis of vulnerability to angling and suggesting the potential for fisheries-induced evolutionary changes of suites of traits.

**Oral** C3.12 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 2:30 – 2:50 pm, Seminar Building - Room 1.102

## Finding the unreported recreational catch in the Norwegian lobster (*Homarus gammarus*) fishery

*ALF RING KLEIVEN*[1], ESBEN MOLAND OLSEN[1], JON HELGE VØLSTAD[1]

[1] Institute of Marine Research, Norway

Recreational fishing for coastal marine species can be significant, but is often challenging to estimate. Here we present a case study where a probability-based strip transect survey is used to estimate effort in the Norwegian fishery for European lobster (*Homarus gammarus*). In 2008, we conducted a strip transect sampling survey throughout the lobster fishing season along southern Norway to estimate the number of deployed lobster traps over time. The survey covered a surface area of 471 $km^2$ of the coast with depths ≤ 40 meters. Surface buoys marking lobster traps were counted along strip transects placed representatively in the survey area in 5 different weeks from start to end of the lobstering season. CPUE data was obtained independently from volunteer catch diaries, phone interviews and questionnaires. We estimated that recreational catch account for 65 % of the total catch in the study area. Moreover, only a small proportion (23 %) of the commercial lobster landings are sold through the legal market and documented. In total, the estimated catch of lobster is found to be nearly 14 times higher than the officially reported landings. Our study highlights the need for appropriate data collection of catch in coastal areas and is a warning sign to management authorities of the consequences of ignoring the potential impact of recreational fisheries.

**Poster** C6.6 in *EFTTA/EAA Cormorant Session*

## A simplified population model to predict the effects of different management scenarios (egg oiling + shooting) on size development of a cormorant colony

*FRANZ KOHL*[1]

[1] EAA (European Anglers Alliance)

Management of cormorant population by controlling reproduction success in breeding colonies has been proposed as the most promising method for reducing cormorant predation pressure on fish stocks to a bearable level. However, this approach has been criticized from two different angles: Either that it would not work because 'compensatory mortality' would easily balance the induced losses. Or that it would require so 'excessive shooting' that it would be socially unacceptable. Population modelling, based on the the currently best estimates for breeding success and age dependent mortalities, was used to predict the development of an exemplary cormorant colony with an assumed starting size of 1.000 breeding pairs. A large number of scenarios with a varying mix of egg sterilization and selective shooting were tested. Stabilization was achieved with 20% egg sterilization (without shooting). When 20% egg sterilization was combined with selective shooting of 5% of adults before nest building, the model predicted a gradual reduction from 1.000 to 548 pairs within twenty years.Despite some simplifying assumptions (e. g. assuming a 'closed system' without potential immigration) the modelling results clearly demonstrate that significant population control is achievable by a proper combination of non-lethal and low-level lethal measures. However, a time frame from ten to twenty years must be foreseen.

**Poster** C6.5 in *EFTTA/EAA Cormorant Session*

## Theoretical model for quantifying 'Foraging Site Attractivity' as function of distance, expected hunting success and perceived security, plus implications for site-specific probability of Cormorant caused damages

*FRANZ KOHL*[1]

[1] EAA (European Anglers Alliance)

Cormorants, as any predator, aim at getting their desired food with minimum energy expenditure and maximum security feeling. As flying and swimming/diving require a certain multiple of Existence Metabolism, daily energy expenditure of a bird can be calculated as a function of body weight, flying distance and hunting success (= gram fish caught per minute). Starting from this the model constructs a “Foraging Site Attractivity Index”, which varies between 100 under optimal conditions and approaches zero at high distance, low hunting success and high risk. Implications for assessing damage probability at specific sites are shortly discussed.

**Oral** C6.1 in *EFTTA/EAA Cormorant Session*

August, 03, 10:30 – 10:50 am, Seminar Building - Room 1.102

## Cormorant populations in Europe: sizes and trends

*FRANZ KOHL*[1]

[1] EAA (European Anglers Alliance)

Data on Cormorant Breeding Population exist for many individual countries in Europe. However, there is no actual publication which provides a satisfactory pan-European overview. Publications from BirdLife (for 1998 -2002) and Wetlands International (for 2006) provide important overall figures. But the Wetlands International leaflet only published highly aggregated figures, not the counting results per country. And neither of the two enables an insight into population trends - which is indispensible for any rational discussion on cormorants. This EAA-documentation provides a comprehensive data-set with the number of Cormorant Breeding Pairs, covering the period from 1970 to 2006/2009. Based on these data on breeding population we have also tried an estimate of the Total Cormorant Population (including juveniles / non-breeders). More details see http://www.eaa-europe.eu/index.php?id=157

**Poster** C8.14 in *Creative methods for managing recreational fishing*

## How one organization uses $22 to educate 100,000 new anglers

*LARA KRAMER*[1]

[1] Fish Florida

Florida is the fishing capital of the *world*. From a 2006 national survey, the U.S. Fish and Wildlife Service estimated 2.8 million anglers fishing in Florida. Amazingly, .5 million anglers were not included in that count. While those anglers did not yet need a fishing license, nor could they buy their own tackle, they were resource users. They were Florida's 6 to 15 year old children and our future scientists, fishery managers and voters. While 88% of Florida's children, ages 6 to 15, are not anglers, they *are* future caretakers of our environment. What would recreational fisheries be like if these children understood basic fisheries science and management? What if all Florida's children learned ethical angling? I will discuss what one small organization is doing to create thousands of new and educated anglers and how scientists, fishermen, managers and others are working together to create fishing education best practices. Fish Florida is a non-profit organization with a mission to promote awareness and protection of marine fisheries and coastal habitats. Through classes, clinics and other means, Floridians, particularly children, learn about recreational fisheries and practice responsible angling. In the last six years, with one employee, Fish Florida has spent $2 million in support of fishing education programs - donating 90,000 rods, reels and tackle kits to over 500 kids' fishing clinics, $500,000 for 99 grants and $60,000 for 18 scholarships. All made possible by $22.

**Oral** C3.14 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 3:40 – 4 pm, Seminar Building - Room 1.102

**Internet-based fishing diary improves fisheries management**

*MIKA LAAKKONEN*[1]

[1] Natural heritage services, Metsähallitus, Finland

Fisheries management requires knowledge of fish stocks and catches. Metsähallitus administers state-owned water areas in Finland. The total area of these waters is approximately 3.4 million hectares. Metsähallitus sells annually about 70 000 fishing permits including sport, net and commercial fishing. In the beginning of year 2008 Metsähallitus started to collect feedback from fisherman, who can give information of their catches easily by internet. The data is collected and then analyzed with the help of a planning and monitoring system. In 2011 Metsähallitus improved this feedback system by publishing a free internet-based fishing diary for every fisherman. In the diary fisherman can save all their fishing data, including fishing places, catches, pictures, stories, weather etc. and analyze their own fishing statistics. They can also see the data reported by other fisherman and, for example, search where the best fishing places are. It is possible to use the diary also with a mobile phone. Metsähallitus analyzes the fishing data that concerns state-owned areas and uses that data in fisheries management. The planning and monitoring system can be used to calculate catch per unit efforts (CPUEs). We believe that this new diary will motivate fishermen to give more feedback about their fishing than they did before. By giving feedback and updating their diary, fishermen take actively part in fisheries management, help to protect fish stocks and thus also their fishing opportunities in the future.

**Oral** C1.6 in *Biological and social aspects of catch-and-release*

August, 01, 2:20 – 2:40 pm, Seminar Building - Room 1.101

## Evaluation of the physiology, behaviour, and survival of adult muskellunge (*Esox masquinongy*) captured and released by specialized anglers

*SEAN LANDSMAN*[1], HEDRIK WACHELKA[2], CORY SUSKI[3], STEVEN COOKE[1]

[1] Department of Biology, Carleton University
[2] Muskies Canada Inc.
[3] Natural Resources and Environmental Sciences, University of Illinois

Little is known about the muskellunge, *Esox masquinongy*, despite its popularity as a sport fish for many Canadian and U.S. anglers. Over the last 50 years, organizations such as Muskies Inc. and Muskies Canada have created major paradigm shifts in muskellunge angling from catch-and-kill to catch-and-release (C&R). Today, release rates approach 100% for specialized anglers. One topic that has been neglected by the research community is evaluating the biological consequences of C&R on adult muskellunge, particularly in light of such high release rates. We conducted a study aimed at revealing the physiological disturbances, behavioural consequences, and mortality rates of muskellunge subjected to C&R by specialized anglers. In total, 30 muskellunge were affixed with small external radio transmitters to monitor behaviour and survival after release. To assess physiological disturbance, non-lethal blood samples were taken from each tagged muskellunge plus an additional group of untagged muskellunge. We compared two types of handling practices: normal procedures used by specialized anglers and an alternative gentler procedure. Differences in physiology were minimal following angling and handling, as was post-release behaviour. All 30 tagged muskellunge survived the C&R event, indicating current handling procedures may be most appropriate for anglers to employ and fisheries managers to encourage.

**Poster** C5.10 in *Social and biological factors affecting catch efficiencies by anglers*

## Linking muskellunge (*Esox masquinongy*) catch rates and activity with lunar cycles

*SEAN LANDSMAN*[1], STEVEN COOKE[1]

[1] Department of Biology, Carleton University

Much research has been devoted to understanding the effects of lunar cycle on marine fishes, particularly with respect to reproduction. However, the effects of lunar cycle on freshwater fish activity and catch rates are poorly understood. Nevertheless, many angling publications produce solunar calendars predicting the best angling times to occur during the new and full moon periods. Our objective was to evaluate the effect of lunar cycles on catch rates and activity of muskellunge (*Esox masquinongy*). Catch rates were compiled using angler diaries and activity was quantified using acoustic transmitters fitted with acceleration sensors. Results indicate an influence of lunar cycle on catch rates and activity, which has important implications for the validity of solunar calendars, predator foraging behaviours, allocation of angler effort, and angling-based stock assessments.

**Oral** C11.9 in *Social, economic and biological aspects of a diversifying angler public*

August, 04, 4:40 – 5 pm, Seminar Building - Room 1.101

## Towards improved communication of scientific information to recreational fisheries stakeholders

*OWEN LI*[1], STEPHEN SUTTON[1], LIZ TYNAN[2]

[1] Fishing and Fisheries Research Centre, James Cook University
[2] Graduate Research School, James Cook University

Our understanding of how fisheries science outcomes are communicated among recreational fisheries stakeholders is not as advanced as our understanding of the fisheries system. Previous models for the communication of fisheries science between recreational fishers have proven inadequate. This presentation explores the potential for using the concept of informal learning and the variables that influence it to investigate how recreational fishers uptake fisheries science outcomes. The hypothetical theoretical model presented is based around the cognitive, affective and conative dimensions of a fisher's attitude towards scientific information, and includes other variables identified in informal learning and public understanding of science literature. The other variables include scientific literacy, power in fisheries management and also the source and delivery of the information. A survey of recreational fishers Australia provides evidence to support the use of the cognitive, conative and affective dimensions, scientific literacy, and source and delivery of the information in modelling recreational fishers' informal learning of fisheries science outcomes. Results of this preliminary survey are being used to refine the theoretical model and guide further investigation into the communication of scientific information in a recreational fisheries context.

**Poster** C11.11 in *Social, economic and biological aspects of a diversifying angler public*

## Description of catches and socioeconomic profile of recreational fishermen in São Caetano de Odivelas, state of Pará, Brazil

*KELVEN LOPES*[1], ELIZANGELA GALHARDO[1]

[1] Ministry of Aquaculture and Fisheries / Institute for Sustainable Development Mamirauá

The São Caetano de Odivelas estuary is located in the state of Pará, Brazil, where recreational fishing is intensely practiced. However, no records on this fishing activity, hindering the proper of fishing administration. The aim of the present study was to describe the fish caught and the socioeconomic profile of recreational fishermen. From January to December 2008, 146 amateur sport fishermen were interviewed. The majority were males, with a mean age of 45 years and a mean monthly household income of US$ 1.610,37. Most 58% had a greater degree of schooling (complete high school), 42% had professional occupations, 92% resided in the state of Pará and 51% visited the fishing area once a month. The Fishing occurred throughout the year, always practiced during the waning and crescent quarter moon. Catches were performed exclusively with boats, with a mean fuel expenditure of 19.3 liters per day. The rod-and-reel was the most often employed gear. Natural bait was deployed most often, with a predominance of sardines *Anchovia* sp. 77%. The catch was composed of 11 species distributed among six families, the most important of which was *Cynoscion acoupa* 36%. A total of 71% of the amateur fishermen declared that they did not spontaneously perform catch-and-release and only released species that were not fit for consumption. Sixty-nine percent of the fishermen used local fishing guides.

**Poster** T2.23 in *Change, adaptation and evolution in recreational fisheries*

## Collaborative influence on bioregional planning in Australia

*CHAD LUNOW*[1]

[1] Spearfishing commission, Australian Underwater Federation, Queensland, Recfish Australia, FRDC

Australia's Federal Department of Sustainability, Environment, Water, Population and Communities is responsible for managing our marine resources under the *Environment Protection and Biodiversity Conservation Act 1999,* which aims to protect marine biodiversity and the sustainable use of our marine resources by our marine-based industries. A national system of five large, multi-purpose marine reserves are being implemented by SEWPaC, who must undertake public consultation and find balance among competing ideals. The voluntary Australian Underwater Federation is engaging in bioregional planning through submission to Government despite competing interests from well funded preservationist groups lobbying to close entire bioregions. AUF is seeking recognition of recreational fishing interests in Marine Park planning through co-operation with national and state marine resource user groups, businesses and political parties. Co-operation, support and effective use of our collective skills will generate a greater voice for the aspiration and needs of our $4 billion industry. Through education and open communication, groups with apparently competing interests may find their aspirations more aligned than misaligned. In 2011, these multidisciplinary relationships, aspirations and conflicts will play out to define the world's largest national system of marine parks. The AUF intends to influence these plans to assure the sustainable use and custodianship of Australia's marine resources.

**Oral** C3.7 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 11:10 – 11:30 am, Seminar Building - Room 1.102

## RecSurvey: an integrated analytical approach to the estimation of recreational catch and effort based on a telephone-diary survey method

*JEREMY LYLE*[1], SIMON WOTHERSPOON[2], KATHRYN STARK[3], SEAN TRACEY[1]

[1] Institute of Marine and Antarctic Studies, University of Tasmania
[2] School of Mathematics and Physics, University of Tasmania
[3] University of Tasmania

The provision of reliable information about recreational catch and effort represents a significant challenge, both methodologically and in terms of cost. This is especially so where the spatial scales over which fisheries operate are large. Recognising the need for cost-effective approaches to provide recreational data, we have developed an off-site approach that has been applied to estimate fishing activities at state and national scales in Australia. The design involves three key components: (i) selection of a sample of fishers; (ii) a diary phase to collect fishing information; and (iii) follow-up of non-intending fishers to account for unexpected fishing. The primary contact method is by telephone, with intending fishers identified initially through a general population screening survey. Respondents are then invited to use a simple diary to record fishing data and are contacted frequently by survey interviewers who are responsible for recording the data. This approach results in substantial reporting detail, with diary response rates of >90%. To analyse the complex data, we have developed an analytical package (*RecSurvey*) in *R*. The package provides for non-response adjustment, calibration against benchmark data, and the capability to account for the dynamic nature of fishing participation, i.e. persons entering and exiting the fishery. Using examples from recent state-wide surveys we demonstrate the sensitivity of catch and effort estimates to the different adjustments.

**Oral** T3.6 in *Space, place and recreational fisheries*

August, 04, 1:50 – 2:10 pm, Audimax

## Spatial monitoring of recreational fisheries: a geostatistical approach

*DAVID MARCH*[1], MIQUEL PALMER[1]

[1] IMEDEA, Spain

Spatial patterns of recreational fisheries constitute a key point when considering management actions and marine spatial planning. Spatial monitoring of fishing effort allows the identification of hot spots in order to evaluate recreational fishing impact. Moreover, information regarding the spatial distribution of target species and environmental parameters provide additional information that can be integrated in quantitative models. This work summarizes different approaches for modelling the spatial distribution of recreational fishing effort and main targeted species. We used small-scale fishing effort data from monitoring programs conducted at Palma Bay (Balearic Islands, NW Mediterranean) since 2005. In addition, we used moorings and boat-license data to determine an accessibility index from ports and ramps. Finally, we also incorporated spatial information derived from map-based interviews. Geographic Information Systems (GIS) were used to explore, manage and visualize spatial data. On the other hand, different geostatistical approaches were applied to develop spatially explicit models of recreational fishing effort. The combination of GIS and geostatistics has been demonstrated as a useful tool for the Palma Bay case study. Results obtained from this work could be incorporated into management tool that would address the decision-making under spatial explicit scenarios.

**Oral** T3.4 in *Space, place and recreational fisheries*

August, 04, 11:30 – 11:50 am, Audimax

## Maintaining resilience of regional fisheries through angler management

*DUSTIN MARTIN*[1], POPE KEVIN[2]

[1] Nebraska Cooperative Fish and Wildlife Research Unit, University of Nebraska-Lincoln
[2] U.S. Geological Survey—Nebraska Cooperative Fish and Wildlife Research Unit, and School of Natural Resources, University of Nebraska, Lincoln

Human impacts on ecosystem services have increased interest in building resilience, the ability of a system to maintain structure and function while absorbing disturbance, into management plans at multiple spatial scales (i.e., lake, watershed and region). Resilience of a regional fishery, the network of individual waterbodies in a region from which anglers choose to fish, is greatly influenced by angler behaviors such as waterbody choice, effort, and harvest. In this study, we discuss implications of unequal distribution of angler waterbody choice to resilience of a regional fishery. We used an access-point creel survey and a return-mail survey to examine potential substitute sites within a regional fishery of 19 rural and urban reservoirs in southeastern Nebraska, U.S.A. Anglers identified type of fish and water quality as important factors influencing their site selection. However, nearly half (44%) of anglers surveyed at the largest urban reservoir reported no suitable substitute site. In contrast, approximately 38% of anglers at rural reservoirs reported they would substitute their effort at a nearby reservoir with a similar fish community. This directional substitution may reduce resilience of regional fisheries to social disturbances such as reservoir closures. Given this possible reduction in resilience, we recommend building a diversity of fishing opportunities within the context of a regional fishery using an “angler-first” management strategy in which anglers are lured to or from particular waterbodies.

**Poster** C3.23 in *New methodological tools to survey and assess recreational fisheries*

## Can we predict angler effort on a regional scale from online fishing forum activity?

*DUSTIN MARTIN*[1], POPE KEVIN[2]

[1] Nebraska Cooperative Fish and Wildlife Research Unit, and School of Natural Resources, University of Nebraska-Lincoln
[2] U.S. Geological Survey—Nebraska Cooperative Fish and Wildlife Research Unit, and School of Natural Resources, University of Nebraska, Lincoln

The increasing popularity of online social networks (e.g., fishing forums) among anglers may serve as an additional tool for assessing fishing pressure at a regional scale. Anglers use these social networks as a means to communicate and investigate fishing conditions at water bodies within a region. We examined the relationship between number of posts to a regional social network about a specific reservoir and observed fishing effort for 19 water bodies in southeastern Nebraska during 2009 and 2010. The strong correlation between total number of posts and total fishing effort indicates that a social network may serve as an index of fishing effort across a region. This approach provides a simple and cost-effective method to compare effort distribution across water bodies within a region. However, potential limitations to this method exist; the proportion of anglers using a reservoir that post to the social network likely varies spatially and temporally. We recommend the use of this method only for short-term, regional assessments of angler use.

**Poster** T1.17 in *Stock, stocking and the future of recreational fisheries*

## Are more specialized anglers really less supportive of fish stocking?

*ANDREW MCFALL*[1], ROBERT ARLINGHAUS[1]

[1] Department IV - Biology and Ecology of Fishes, Leibniz Institute Of Freshwater Ecology and Inland Fisheries

Recreation specialisation theory suggests that the greater the degree of specialisation in an angler, the less likely the angler would be supportive of fish stocking as a method to maintain stocks for recreational angling. The mechanistic reason behind this prediction is thought to be related to the greater preferences of more specialized anglers for more natural fisheries. This hypothesis has been developed for trout fisheries, and it is not clear whether it also holds for other recreational fisheries. We surveyed anglers and angling-club heads in Lower Saxony Germany using a mail-survey. We assessed angler specialisation using a multi-dimensional index and a self-classification procedure, and we also measured the respondent's attitudes, norms, and beliefs toward fish stocking. Analyses of attitudes and norms toward stocking suggested that fish stocking was viewed to be a necessary management tool by anglers of all specialisation levels, and there were few differences among anglers and angling club heads. Similarly, beliefs about stocking impacts on wild stocks were consistent across angler specialization levels. Our results show that depending on the fishing culture and fishery, even highly specialized anglers may be strong supporters of fish stocking programs. This will affect stocking decision-making by angling clubs because more specialized anglers are more likely to become angling club heads and engage in stocking management in Germany.

**Oral** C1.3 in *Biological and social aspects of catch-and-release*

August, 01, 11:50 am – 12:10 pm, Seminar Building - Room 1.101

## The fate of mulloway (*Argyrosomus japonicus*) after ingesting conventional and modified stainless- and carbon-steel hooks

*SHANE MCGRATH*[1]

[1] Southern Cross University, Australia

Previous research on angled-and-released mulloway (*Argyrosomus japonicus*) identified a significant positive relationship between the depth of hooking and mortality. This result warranted further investigation and subsequently led to two experiments to quantify: (1) the effects of wire material and modifications to hooks on their breakage and ejection after ingestion; and (2) the absorption of metals by fish during the oxidation of ingested nickel-plated hooks. Experiment one involved six treatment groups comprising fish that were allowed to ingest conventional or modified J-hooks made from three materials (stainless steel and nickel-plated and red-lacquer carbon steel). Hook-ingested fish were placed into the tanks in pairs and monitored for up to 61 days. The total mortality among angled fish was 35% (no controls died). Of the survivors, 28% ejected their hooks. In experiment two, 25 treatment fish were allowed to ingest nickel-plated hooks and were monitored along with 25 controls for 42 days for hook ejection and mortality. Treatment fish that ejected their hooks were euthanized (along with control fish) before being removed from their tanks and had blood and tissue samples taken, which were assessed for the concentrations of metals. The results from these experiments showed, due to increased oxidation, nickel-plated hooks were ejected at a greater rate than the remaining two hook types; however, they resulted in elevated levels of nickel in fish and increased mortalities.

**Oral** T2.10 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 3:40 – 4 pm, Audimax

## Managing recreational fisheries on Ireland's navigable waterways in changing legislative, environmental and fiscal climates

*PAUL MCLOONE*[1], JOE CAFFREY[1]

[1] Inland Fisheries Ireland

Inland Fisheries Ireland (previously the Central and Regional Fisheries Boards) have managed recreational fisheries, and the habitats that support these fisheries, on a number of navigable waterways in Ireland since 1990. The core principals underpinning the original program recognised that good water quality, allied with the rational management of instream and riparian vegetation were essential in sustaining healthy fish populations, whilst also recognising the needs of the various recreational stakeholder groups utilising these waterways. These core principles remain, however, national and European legislation - notably the Water Framework Directive - now provide rigid structures around which any management regimes are based. While navigable watercourses in Ireland support relatively stable environments, changes in floral and faunal (including fish) communities have been noted. Furthermore, Irish society has undergone tremendous societal and financial change in recent years. We seek to discuss how management of these important recreational resources can adapt to the challenges outlined.

**Oral** C9.1 in *Understanding and solving conservation and other conflicts in recreational fisheries*

August, 04, 10:30 – 10:50 am, Seminar Building - Room 1.101

## No-take marine reserves and recreational fishing in Australia: Are we getting it right and can we do it better?

*DARYL MCPHEE*[1]

[1] Institute of Sustainable Development and Architecture, Bond University

No take Marine Reserves have been implemented and continue to be implemented for biodiversity protection in Commonwealth and state waters in Australia. In part, these marine reserves are "sold" by advocates and government environment agencies implicitly or explicitly on the basis of benefits to fisheries, a claim that is frequently challenged by recreational fishers. For a fisheries benefit to occur, spillover of eggs/larvae or adult fish from no-take areas to areas remaining open to fishing needs to occur and be off a magnitude sufficient to offset lost access. In this paper, the spillover effect is investigated to determine the key factors that influence it, with the aim of critically evaluating the concept with respect to recreational fishing. Potential inequities between recreational fishing sub-groups from marine reserve declaration are explained, and the importance of these inequities in explaining conflict is discussed. It is argued that a more flexible approach to the implementation of no-take marine reserves be considered that allows for optimising community benefits and responding more adaptively to changing circumstances, including those associated with climate change.

**Poster** C8.15 in *Creative methods for managing recreational fishing*

## Co-management in recreational fisheries: Can it work?

*DARYL MCPHEE*[1], RENAE TOBIN[2]

[1] Institute of Sustainable Development and Architecture, Bond University
[2] Fishing and Fisheries Research Centre, School of Earth and Environmental Sciences, James Cook University

Co-management is an emerged paradigm for fisheries management with the principal focus being management of commercial fisheries and artisanal fisheries in developing countries. Its application in fisheries has been driven by a widespread recognition that traditional top-down western approaches to fisheries management have frequently failed leading to negative environmental, economic and social impacts. In particular, legislative approaches may compromise the adaptability of fishers and hence reduce the resilience against changing circumstances (both natural and anthropogenic). The open access nature of recreational fisheries presents a particular challenge for developing co-management arrangements. However, given the importance of recreational fisheries in inshore areas in Australia, the need to include recreational fisheries in such arrangements is paramount. In this paper case studies of developing co-management arrangements at a regional level are presented. Reasons for potential successes and failure are discussed and the utility of approaches and alternative possible approaches are also described. The need to define and clarify recreational fishing property rights for advancing co-management is highlighted.

**Plenary Talk** in *Other*

August, 01, 9:30 – 9:40 am, Audimax

## The German Anglers Association (DAV): A national non-profit association along with sciences toward sustainable angling

*THOMAS MEINELT*[1], PHILIPP FREUDENBERG[1], GÜNTER MARKSTEIN[1], WERNER STEFFENS[1]

[1] German Anglers Association (DAV)

The German Anglers Association (DAV), founded in 1954, is one of the two large umbrella recreational fishing organizations aiming to foster the angling hobby as a natural-based leisure activity providing benefits not only to anglers, but also to the public and the environment. It is representing the anglers' interests in national and international politics. The DAV member alliances, in each of the 16 federal states of Germany, incorporate ~ 3 500 local fishing clubs with more than 170 000 people in total. Fisheries rights in Germany are commonly in private hands, for the most part angler organizations. Fisheries management of more than 60 000 ha of angling waters in the DAV is practiced mainly in responsibility of the regional associations. This requires close cooperation with fisheries science. Provided by fisheries institutes, scientific knowledge is often based on data gathered from angler organizations. Since 1995 fisheries scientists are members of the presidium of the DAV. Beginning in 2004, supra-regional scientific projects are financially supported by DAV. This was one important step for the establishment of the first cooperation between DAV and angling science at the Humboldt-Universität zu Berlin (HU) and the Institute of Freshwater Ecology and Inland Fisheries (IGB). This new link between IGB, HU, and DAV resulted in several study projects and sequentially in the collective application for the 6th World Recreational Fishing Conference.

**Oral** T1.8 in *Stock, stocking and the future of recreational fisheries*

August, 01, 3 – 3:20 pm, Audimax

## When choosing the wrong one: Genetic consequences of salmonid hatchery programs based on non-genetic selection parameters

*ANDREAS MERANER*[1], ANDREA GANDOLFI[1]

[1] Department of Biodiversity and Molecular Ecology, Conservation Genetics Group, IASMA - Research and Innovation Centre, E. Mach Foundation

Captive breeding programs are widely used to counteract the decline of fish populations in the wild, therefore enhancing natural resources of recreational angling. In this context there is general agreement that such hatchery stocks have to be established respecting genetic diversity at a micro geographic scale and, consequently, operating at the level of evolutionary significant units. That is, at least when foreign strains are potentially present in the wild, captive breeding programs have to comprise genetic fingerprinting of wild spawners founding hatchery strains. In contrast to this scientific awareness most captive breeding programs in the Northern Adriatic region, harboring highly endangered endemic salmonid species, still exclusively depend on morphological selection parameters. Here we provide multi locus genotypic data of both Marble trout and Adriatic grayling captive breeding strains managed by local angler associations for wild stock enhancement. Individual assignment tests of wild brood stocks and simulated subsequent hatchery generations indicate introgression of foreign alleles into native stocks in both empirical case studies. By analyzing simulated genotypes of subsequent hatchery generations we found that introgression was critically depending on parameters such as 'immigration rate', gender of non-native fish and, finally, the number of subsequent hatchery generations.

**Oral** C3.1 in *New methodological tools to survey and assess recreational fisheries*

August, 01, 3:50 – 4:10 pm, Seminar Building - Room 1.102

## Recreational Fishing Surveys in Finland

*PENTTI MOILANEN*[1], *ANSSI AHVONEN*

[1] Statistics, Finnish Game and Fisheries Research Institute

Recreational fishing is a very common hobby in Finland. 34% of the population, which means 1.8 million people, go fishing at least once a year. The total catch amounts to some 33 million kg. Recreational fishing is a very multiform phenomenon in Finland, because of many possibilities for fishing. There are close to 30 000 lakes larger than 4 hectares in Finland, many rivers, large coastal waters and an excellent archipelago in south-western Finland for recreational fishing. Also fishing license system is multiform including landowner's license system, licenses for right to fish with spinning rod in any county regardless of the landowners and also everyman's right for ice fishing and to fish with rod and line. The data for recreational fishing statistics are collected every other year by postal questionnaire using a sample drawn from the population register maintained by the Population Register Centre. The sample comprises about 6000 household-dwelling units. The sample design is stratified sampling. For the estimation, a weighting factor is formed for each statistical unit. The weighting factor is formed from the inverses of the inclusion probability and response probability of the sampling unit and from the calibration weight. The bias caused by non-response has been corrected using the homogeneous response group model. The non-response rate has been about 35%. The results of non-response analysis are described closer in the paper.

**Oral** C2.2 in *Angling tourism development: social, economic and biological challenges*

August, 01, 11:30 – 11:50 am, Seminar Building - Room 1.102

## Challenges in recreational fisheries assessment and management in a Mediterranean Island

*BEATRIZ MORALES-NIN*[1], ANTONI MARIA GRAU[2]

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While the impacts of fishing on fish populations and demersal and pelagic marine ecosystems are well documented for commercial fishing, the impacts of artisanal and recreational fishing -as well as their relationships- on the coastal ecosystem have received little attention. Nevertheless, the interest on recreational fishing as a leisure activity is growing rapidly, creating a potential conflict between this open access type of fishing and the regulated artisanal fishing. On the other hand, this intense fishing activity may have multiple effects over the exploited species and the coastal ecosystem. In Mallorca Island (W Mediterranean) more than 10% of the population fish for recreation, while an unknown portion of tourists fish occasionally. In this contribution we revise the challenges into the monitoring and evaluation of this disperse and diverse activity considering the socio-economic study of the recreational anglers, the fishing activity (habits, effort, catches and generated mortality) and its effects on the main exploited species (demography and biological changes). The aim is to establish the foundations for the sustainable and adaptive management of coastal resources, which are deeply affected by anthropogenic activities. An adaptive management of the ecosystem is necessary to avoid the collapse of the populations and maintain the resiliency of the coastal ecosystems, the health of the fish stocks and the quality of the fisheries.

**Poster** C11.15 in *Social, economic and biological aspects of a diversifying angler public*

## Where is the catch? A closer look at the human dimensions in the fishing surveys of British Columbia from 1985 to 2005

NINA MOSTEGL[1], *WOLFGANG HAIDER*[1], LEN HUNT[2], BEN BEARDMORE[1]

[1] School of Resource and Envtl Mgt, Simon Fraser University
[2] Ontario Ministry of Natural Resources

Many jurisdictions collect information from recreational anglers periodically. So does British Columbia in conjunction with the federal government of Canada in angler surveys every 5 years. The last five BC surveys, and especially the last three, contain highly comparable data about angling motivation and satisfaction in addition to the standard catch related information. We analysed the motivation responses longitudinally in one single component / cluster analysis, leading to five motivational clusters that are comparable over time. Secondly we observed significant variation in the satisfaction ratings over time, and therefore calibrated a tobit model that specifies satisfaction as a function of the year the survey was taken (earlier years are more negative), the age (negative) and residency (BC residents are more positive) of respondents, fishing expertise (more is more negative), days fished annually (positive), catch variables (positive), and motivation components (nature, catch motivation, social are all positive; eating is negative).In summary, these results show that meaningful HD information can be collected in these regular agency wide surveys, and it can be analysed longitudinally as long as the comparability of the data is ensured.

**Oral** C8.1 in *Creative methods for managing recreational fishing*

August, 04, 1:30 – 1:50 pm, Seminar Building - Room 1.102

## Recreational fishing property and access rights – A necessity of resilient recreational fisheries

KANE MOYLE[1], IAN STAGLES[1], *FRANK PROKOP*[1], ANDREW ROWLAND[1]

[1] Recfishwest, Australia

Without a clearly defined formal access right the recreational sector has to frequently negotiate and consult with a myriad of agencies in order to ensure it is not continually disenfranchised. With the introduction of more defined resource sharing arrangements under Integrated Fisheries Management in Western Australia the imbalance in the quality and integrity of access rights for the recreational sector have begun to be addressed. This is an important step towards gaining wider recreational sector support for entering into resource sharing initiatives. A collective recreational property right for the sector could be determined as part of a specific resource management strategy as a proportional allocation against the fishery TAC. The collective right held on behalf of the recreational sector could then create the environment for future inter-sectoral resource trading. With explicit government assurance of continued access with clear legal access rights increased recreational stewardship and conservation can bear a measurable reward for the sector. The Department of Fisheries of Western Australia are in the process of rewriting their Fisheries Resources Management Act. Recfishwest, the peak recreational fishing body of W.A., will share its experiences in advocating and developing sectoral equity in relation to access arrangements and how they can be legislated accordingly.

**Oral** C3.2 in *New methodological tools to survey and assess recreational fisheries*

August, 01, 4:10 – 4:30 pm, Seminar Building - Room 1.102

**Characterization of the impact of Cantabrian Sea recreational, boating and fishing**

*ESTANIS MUGERZA*[1], LUCIA ZARAUZ[1], RAUL PRELLEZO[1], JON RUIZ GONDRA[1], RUBEN ROA[1], IÑAKI ARTETXE[1], JESUS MARTINEZ[1], IÑIGO ONAINDIA[1], LUIS ARREGI[1]

[1] AZTI-Tecnalia, Spain

In recent years recreational boating and fishing has become an important sector of coastal regions of Spain for which the Basque Country is not an exception. Nevertheless not attempts have been made to measure the sector size and its impacts in economic, biological and social terms. A true biological, economic and social portrait of recreational boating and fishing in the Basque Country begins with an accurate count of boats in the region. We have use several sources such as official records and statistics, direct observations and satellite pictures (Google Earth) to create the census of recreational boats along the coast of the Basque Country. Catches, expenses and effort have been categorized and analyzed by a survey in which more than 5% of the population has been contacted. Using the survey and the census and by a statistical methodology based on a multiplicative model of descriptors, every single data category (catches, investments, expenses,) has been raised to its population. Finally, comprehensive economic and social impacts of boater and recreational fisheries spending on the Basque Country regional economy were estimated by applying the spending to an input-output (I-O) model of the regional economy.

**Poster** C2.11 in *Angling tourism development: social, economic and biological challenges*

## Factors that motivate destination choice by international anglers

*RUSSELL NELSON*[1], *ROB SOUTHWICK*[2]

[1] Nelson Resurces Consulting, Inc.
[2] Southwick and Associates

For nations with quality sportfishing opportunities, international anglers represent a major potential source of economic development. Recent investigations by The Billfish Foundation into anglers' motivations and decision-making processes provide a basis for understanding what motivates angling tourists to pick a destination. U.S. anglers were surveyed to determine the percentage who fish internationally, where they preferred to fish, and the factors motivating their decisions. It is estimated that 10.3 million Americans have fished outside the United States at least once in the past five years. The top reason for selecting a destination is the quality of the fishing, but considering the many high quality fisheries to choose from, other reasons also affect their decisions. Factors such as "relative peace and quiet," "safety and security," "price," "amenities" and more were rated. The species targeted by international anglers were also ranked, representing fisheries around the world. Conservation and fishery management issues can also impact anglers' decisions. This paper will share the results of these investigations and discuss the implications for fisheries conservation and ecotourism development.

**Oral** C2.7 in *Angling tourism development: social, economic and biological challenges*

August, 01, 2:40 – 3 pm, Seminar Building - Room 1.102

## Identifying a balance between commercial and recreational fisheries: The Costa Rica experience

RUSSELL NELSON[1], *CHACON MARLON YONG*[2], *SOUTHWICK ROB*[3], *NANNE HERBERT*[4]

[1] Nelson Resources Consulting, Inc.
[2] University of Costa Rica
[3] Southwick Associates
[4] The Billfish Foundation

Tourism is Costa Rica's top industry, with sportfishing one of its primary components. The Billfish Foundation partnered with the University of Costa Rica to measure the economic contributions of various fisheries to the national economy. By demonstrating the relative economic returns from recreational and commercial harvests, new policies and regulations could be developed to sustainably manage Costa Rica's rich fisheries resources. This comprehensive study estimated focused on the expenditures and economic impacts from marlin, sailfish, yellowfin tuna, wahoo and dorado fisheries of commercial and recreational sectors. Results provided estimates of both sectors contributions to gross domestic product, tax revenues and jobs. Also estimated was key economic measure of gross capital formation. By comparing returns using standardized economic techniques, Costa Rica is now able to develop fisheries management policies that sustain and enhance all its fisheries and tourism resources for the benefit of Costa Rica's citizens.

**Oral** C9.3 in *Understanding and solving conservation and other conflicts in recreational fisheries*

August, 04, 11:10 – 11:30 am, Seminar Building - Room 1.101

## Fish for the future: A human dimensions assessment of the rresiliency of the recreational Red Snapper fishery along the Texas coast

*SARAH NORMAN*[1]

[1] Marine Resources Management, Texas A&M University at Galveston

In 1988, the red snapper fishery in the Gulf of Mexico (GOM) was declared severely overfished. Changes in recreational regulations have since included a reduction in the daily bag limit from 7 to 2, and a shift from a year-round season to one lasting 53 days. Despite NOAA's recommendations that the Gulf States match these regulations, Texas has enforced a 4 bag limit and no seasonal restrictions. In 2009 alone, the total recreational catch exceeded the allocated quota by 1.7 million pounds, suggesting a social resistance to the regulations. Thus, the lack of consistency between state and federal regulations and the drastic changes in management schemes have limited the ability for the fishery to evolve sustainably. This study provides an innovative assessment that measures fishers' understanding of the resiliency of the fishery. Over 140 interviews of recreational red snapper fishers at charter and head boat docks were conducted along the Texas coast. Interview results will: 1) target gaps in angler understanding of state versus federal regulations; 2) identify what scientific information anglers understand about the red snapper stock in the GOM; 3) quantify the resistance to current management and stock assessment practices; and 4) assess recreational red snapper anglers' demographics through GIS. Results will be imperative for managers to expand their multi-disciplinary approach to include social analysis for the successful evolution of recreational fisheries management.

**Oral** C11.7 in *Social, economic and biological aspects of a diversifying angler public*

August, 04, 4:00 – 4:20 pm, Seminar Building - Room 1.101

## Teach a child to fish

*ROBERT O'BRYANT*[1]

[1] Mahogany Youth Corporation, Florida

Fishing is a multimillion dollar industry. It is not being promoted in the ethnic community as a way to make a living. The fact that there are fishing related industries and occupations is not taught. The opportunities i.e. to be apprenticed in boat building, or tackle manufacturing are missing. The perception is that it's a "good ol boy' industry. It's time we open up to more people in all areas of the industry. What is the solution to creating more diversity in the fishing industry? Education and promotion. Our program called "Teach a Child to Fish" teaches youth to fish in our community in clubs, the parks, and in the school systems. It incorporates curriculum from the "Hooked on Fishing Not on Drugs", my 20+ years experience as a drug counselor and Florida Fish wildlife materials. Fishing is a motivator. Youth learn life skills that help them practice and model positive behaviour. Our specially developed program keeps the youth engaged. Graduates from our program take an oath to stay off drugs and out of gangs and explore careers in fishing. Past graduates include professional athletes, business owners, high school, college graduates, navy, army service men, and more. We can develop stronger citizens that will make a difference in their communities. This is a grassroots effort to make change happen in the fishing industry. So if you can see the vision and have an interest in investing in this untapped resource please let me know. See our website at WWW.MAHOGANYYOUTH.COM

**Poster** T3.9 in *Space, place and recreational fisheries*

## Spatial variation in the characteristics of recreational fisheries; understanding the effects of management changes

*FAITH OCHWADA-DOYLE*[1], JAMES MCLEOD, GEOFFREY BARRETT, CHARLES GRAY

[1] Cronulla Fisheries Research Centre, Industry & Investment, NSW

Recreational fishing is one of the most popular aquatic pastimes in Australia with a population participation rate of around twenty percent. Management of the fisheries resources in New South Wales has recently resulted in major reallocation in the catch of many exploited species due to the introduction of Recreational Only Fishing Areas (i.e. areas closed to commercial fishing). Moreover, artificial reefs have been deployed in some of these estuaries to further enhance recreational fishing opportunities. Understanding the long-term effects of such management changes on recreational fisheries resources requires knowledge of large and fine scale spatial differences as well as temporal changes in the effort and catch of recreational anglers. Here, we describe the design of surveys of recreational anglers aimed at quantifying spatial and temporal changes in recreational catch and effort within three estuaries that have become Recreational Only Fishing Areas. We use on-site interviews (creel surveys) of anglers and complementary roving counts of fishing effort to determine differences in catch and effort among: (1) different zones and habitats (including artificial reefs) within estuaries, (2) the different estuaries, and (3) shore and boat-based anglers. These surveys are also repeated through time to determine temporal changes in the quality of recreational fisheries. These data will be used to model and further assess the effects of management changes on recreational anglers.

**Oral** T1.12 in *Stock, stocking and the future of recreational fisheries*

August, 01, 4:50 – 5:10 pm, Audimax

## Replenishing recreational fisheries through stock enhancement; ecological considerations for *Penaeus plebejus*

*FAITH OCHWADA-DOYLE*[1], IAIN SUTHERS[2], CHARLES GRAY[1], NEIL LONERAGAN[3], MATTHEW TAYLOR[2]

[1] Cronulla Fisheries Research Centre, Industry & Investment, NSW
[2] Evolution & Ecology Research Centre, School of Biological, Earth and Environmental Science, University of New South Wales
[3] Centre for Fish, Fisheries & Aquatic System Research, School of Biological Sciences and Biotechnology, Murdoch University

Like many other penaeid species, *Penaeus plebejus* Hess represents a significant recreational fishery through out its distribution in eastern Australia. This species spawns offshore and relies on estuarine habitats for early development, but is often recruitment limited in intermittently opened estuaries. Stock enhancement has consequently been proposed as a means of addressing the lack of larval recruitment in such estuaries and thus supplementing recreational harvests. However, this management tool has rarely been successful when applied to penaeids and other species and this is primarily due to a poor understanding of the ecological processes that limit the survival of released animals and the potential ecological consequences of stocking on resident populations. Using *P. plebejus* as a test species, we showcase a series of experimental studies used to assess these unknowns. The presentation focuses on data comparing stocked and wild *P. plebejus* in terms of their capacity to successfully avoid predators and compete for resources. As well as identifying optimal release strategies, the studies and data presented here allow the ecological risks of enhancement to be compared with its projected benefits. This is a critical step in assessing the practicality of stock enhancement as a management tool aimed at supplementing recreational fisheries.

**Oral** C1.11 in *Biological and social aspects of catch-and-release*

August, 01, 4:30 – 4:50 pm, Seminar Building - Room 1.101

**Catch and release: Economics trumps biology trumps ethics?**

*JON OLAF OLAUSSEN*[1]

[1] Trondheim Business School

Catch and release is a potential powerful tool in the management of recreational fisheries. In some nations, catch and release have been implemented as an essential part of the management, while in others catch and release is forbidden. When it comes to bioeconomic models, catch and release introduce an important distinction between economic and biological effects of harvest. The same angling experience can be sold many times as long as the catch is released. However, advocates of catch and release bans argue that catch and release is synonymous to animal cruelty. The paper compares the economic surplus and optimal stock size with and without catch and release in an Atlantic salmon recreational fishery. Hence, we calculate the economic and biological "cost of ethics".

**Poster** C4.10 in *Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives*

## Optimal harvest pattern under sea lice attacks. What size of salmon to harvest?

*JON OLAF OLAUSSEN*[1], YAJIE LIU[2], ANDERS SKONHOFT[3]

[1] Trondheim Business School
[2] Centre for Economic Research at NTNU
[3] Department of Economics, Norwegian University of Science and Technology

Recently, increased sea lice densities caused by salmon farming have received increasing attention in Norway. The paper presents a bioeconomic model for wild Atlantic salmon and explores to what extent the optimal harvest pattern is affected by sea lice induced mortality. Because salmon lice attacks the post smolt salmon only, while the harvest value is related to the mature, spawning fish, an age structured population is required. The costs are analyzed by calculating the reduced harvesting value of the mature salmon due to various sea lice attack scenarios. We compare the situation where the harvest activity is assumed *not* to be influenced by sea lice induced reduced survival of the salmon with the case where the manager maximizes the sustainable value taking sea lice induced mortality into account.

**Poster** C3.24 in *New methodological tools to survey and assess recreational fisheries*

## Changes in pike populations after 3 years size selective fishing monitored via mark-recapture

*MIKKO OLIN*[1], ANNA KUPARINEN[2], JUSSI ALHO[2], JONI TIAINEN[1], HANNU LEHTONEN[1], JUKKA RUUHIJÄRVI[3]

[1] Department of Environmental Sciences, University of Helsinki
[2] Ecological Genetics Research Unit, Department of Biosciences, University of Helsinki
[3] Evo Research Station, Finnish Game and Fisheries Research Institute

Pike is a popular species in recreational fisheries, and population estimates are critically needed to design fishing regulations. This is difficult for sedentary pike whose catch rate is often not related to population size. To advance ecologically sustainable management of piscivores, SUSFISH project (2005-2014, www.helsinki.fi/keskala) was started. As a part of this project, we estimated pike population parameters in four lakes based on experimental mark-recapture fishing (CMR) by angling, fyke nets and wire traps before and during size selective (min. length limit 40 or harvestable slot-length limit 40-65 cm) pike removal. Population sizes were estimated both by hierarchical Bayesian model and traditional Petersen's estimates. The Bayesian model also provided estimates for natural mortality (*M*), capture probabilities (*pi*) and amount of unobserved individuals. The ranges in estimated population sizes were 8.5-33.8 and 7.3-51.7 ind. $ha^{-1}$ according to Bayesian and Petersen's methods, respectively. Recaptures were rather evenly distributed and *pi*'s similar (0.118-0.231) among the gears. Despite intensive fishing with multiple gears, the Bayesian model estimated that 34.7-69.7% of individuals remained unobserved. Size selective pike removal rapidly changed the size structure of populations but harvestable slot-length limit retain biomass and big pike. Our results suggest that reliable estimates of pike populations by CMR demand a multi-gear procedure and a modeling approach.

**Poster** T1.18 in *Stock, stocking and the future of recreational fisheries*

## Dimension of fish stocking in the German recreational fisheries sector

*THILO PAGEL*[1], JOHANNA HILSBERG[1], ROBERT ARLINGHAUS[1]

[1] Department of Ecology and Biology of Fishes, Leibniz-Istitute of Freshwater Ecology and Inland Fisheries

Fish stocking represents one of the most preferred management strategies of angling clubs in Germany to sustain degraded fisheries, to fulfil their stewardship obligation and to care for the aquatic environment. Until now, however, the total amount of fish stocked for recreational purposes was totally unknown. Furthermore, no single study has investigated the extent of fish stocking in relation to the characteristics of the clubs. Investigating these influencing factors, however, is the first step in developing a good understanding of fish stocking as a tool in modern recreational fisheries management. Therefore, a nationwide questionnaire survey was conducted in cooperation with a private research institute with 2.000 randomly selected angling clubs. The response rate achieved was 50%, allowing representation of more than 1.000 individual clubs. We found that stocking density and total amount of fish stocked differed markedly between the clubs. Furthermore, the empirical findings in this study provide us with a context with sufficient variation to be able to derive insights into the impact of a range of hypothesized drivers of fish stocking. In addition to tenure regimes, we found that a number of ecological, social, institutional, and economic variables explain variance in the extent of fish stocked within the clubs. Such large-N, comparative studies are essential if we are to derive more complex and nuanced frameworks that help to plan better policies for the management of natural resources.

**Poster** C8.19 in *Creative methods for managing recreational fishing*

## Recreational fisheries management and recovery of native fish species in the Sacramento-San Joaquin Delta, California

*MICHELE PALMER*[1], DOUG DEMKO[1], JIM INMAN[1], MAX BOYD[1]

[1] FISHBIO, California, USA

Fisheries managers intentionally introduced and have extensively managed many non-native fish, including predators, to provide sportfishing opportunities in the Sacramento-San Joaquin Delta (Delta), California. However, predation by non-native sportfish is recognized as one of the current primary factors contributing to the decline of native species in the region. Despite the recognized biological impacts of these recreational fisheries, predator eradication is not a popular option because angling represents a valuable economic resource and public leisure activity. Predator suppression programs using recreational fishing as a tool to achieve reduced predation rates have been employed elsewhere (e.g., monetary bounties for Northern pikeminnow, and campaigns to catch and eat the Indo-Pacific lionfish and the Chesapeake Ray). These programs have inspired a cost-effective management alternative for California whereby fishing regulations have been modified to allow anglers to catch and keep higher numbers of targeted predators. The biological and economic implications of this program on the local and regional level will be presented.

**Oral** C5.2 in *Social and biological factors affecting catch efficiencies by anglers*

August, 02, 3:40 – 4 pm, Seminar Building - Room 1.101

## Fish mobility and vulnerability to angling of marine sedentary fish: A simulation experiment

*MIQUEL PALMER*[1], JOSEP ALOS[1]

[1] Ecology and Marine Resources, IMEDEA, Spain

Recreational fishing is not a random process. Larger and older fish may experience larger mortality rate than smaller fish because the enforcement of management tools (e.g. minimum legal sizes) or by the gear selectivity itself (e.g. hook selectivity). Theoretical expectation and empirical evidences suggest that angling could select not only for life-history traits such as growth and reproduction investment but also for behaviour-related traits. Specifically, movement characteristics could affect the probability of being fished. Differences in the rate a specific fish explores its home range will result in different degree of boldness or shyness. Fish that are more active and mobile would expend more effort looking for food resources (bold personality). Therefore, more food resources would be available to them. In consequence, they would display higher growth rate. The trade-off is that they may be more vulnerable because higher mobility implies larger chance of encountering a fishing gear in comparison with other fish with reduced mobility. Here we show the results of a simulation experiment that consists in releasing a large number of fish in a realistic scenario. Fishing effort in this scenario is spatially heterogeneous and emulates the observed pattern at the Palma Bay (Mallorca, Spain). Fish movement characteristics are also based in empirical data. Overall, the results obtained suggest that angling can select against more active fish (i.e. fish that grow faster).

**Oral** C8.6 in *Creative methods for managing recreational fishing*

August, 04, 3:40 – 4 pm, Seminar Building - Room 1.102

## Innovative approaches to rebuilding angler participation

*DONALD PETERSON*[1]

[1] Freshwater Fisheries Society of BC

In 2003, the Canadian Province of British Columbia embarked on an innovative approach to freshwater fisheries management that is unique in the world. The new private non-profit society, the Freshwater Fisheries Society of BC (FFSBC), was given responsibility for the delivery of a number of key fisheries services including fish stocking programs and the promotion and development of sport fishing. The Society is funded under a user-pay model and receives about 50% of freshwater fishing license revenue to fund its operations. With funding dependent on angler participation and fishery performance the FFSBC has become highly motivated to reverse a long term decline in angling participation by residents of the province. Working closely with a number of government and non-profit partners the FFSBC has introduced a number of new programs including "Learn to Fish" and "Fishing in the City" that are aimed at attracting youth and reactivating lapsed and occasional adult anglers. Over its short, 8 year history, the FFSBC model has proven to be an innovative and cost-effective model that that is contributing to the rebuilding of the sport fishing sector in British Columbia that will be of interest to other jurisdictions.

**Poster** C2.12 in *Angling tourism development: social, economic and biological challenges*

## Integrating science, angling, and politics to conserve flats fishing in the Bahamas

*DAVID PHILIPP*[1], JEFFREY KOPPELMAN[2], AARON ADAMS[3], AARON SHULTZ[4], PRESCOTT SMITH[5], ANDY SMITH[5], JASON FRANKLIN[5], GREG VINCENT[5]

[1] Natural History Survey, University of Illinois
[2] Missouri Department of Conservation
[3] Bonefish and Tarpon Trust
[4] Cape Eleuthera Institute
[5] Bahamas Guides Association

The flats ecosystem in The Bahamas supports a fishery for bonefish, tarpon, and permit that generates over $140 million to the Bahamian economy each year. Little is known, however, about how much these species depend on the flats habitat or how alterations to mangroves, sea grass beds, and tidal creeks could impact this fishery. Critical biological information on these target species is just now being supplied via recent research efforts. Using that information to help shape an effective coastal zone management policy, however, is an ongoing challenge. To address that challenge, the community of flats fishing guides from throughout the Bahamas has come together to organize the Bahamas Guides Association (BGA). With the support of an advisory committee made up of outside scientists, the BGA is addressing an array of environmental threats to the flats (e.g., commercial and private development, limestone mining, pollution, and global climate change) by working to change environmental standards and legal practices. They are also working with anglers to improve fish handling practices and with local Bahamians to stop the practice of netting and spearing these fish for commercial sale. All of these efforts involve initiating a novel education and outreach campaign that translates fisheries science and flats conservation for the Bahamian people, including governmental officials. This unique partnership serves as a model for sharing conservation responsibility among stakeholders.

**Oral** C3.17 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 4:40 – 5 pm, Seminar Building - Room 1.102

## Electronic monitoring in the Gulf of Mexico Charter/For-Hire Fleet: Using technology to improve data collection

*TODD PHILLIPS*[1]

[1] Ocean Conservancy

Enhanced monitoring in the for-hire fleet in the US is a necessary component of recreational fishery data improvements, as recognized in the Natural Research Council's Review of Recreational Fisheries Survey Methods. Currently, much of the US for-hire fleet is sampled by telephone survey for effort and voluntary dockside angler creel interviews for catch, and statistics derived from those methods are neither timely, nor precise. At-sea observers, commonly employed in commercial fisheries, are used to sample only a small percentage of for-hire trips in the US because of cost and vessel size limitations. Logbooks are used by many sampling programs to derive catch and effort statistics, but those data suffer from small sample sizes, lack of consistent regulation, and lack of validation. Electronic Monitoring (EM), a rapidly-evolving technology deployed in many commercial fisheries, presents a means to advance data collection in the for-hire sector. EM can provide data capture on vessels too small to carry observers, decreased cost to sampling programs over time, and validation of self-reported data. We explore the potential use for EM in the for-hire fleet in such areas as logbook submission, bycatch observation, and effort estimation. Specifically, we investigate the use of closed circuit video cameras for validating catch and discard reporting, the use of vessel monitoring systems for validation of spatial data, and use of electronic logbooks to accurately capture effort.

**Oral** C5.3 in *Social and biological factors affecting catch efficiencies by anglers*

August, 02, 4 – 4:20 pm, Seminar Building - Room 1.101

## Impacts of domestication on vulnerability to angling of carp (*Cyprinus carpio*): the role of behaviour, food preferences and learning

*TONIO PIETEREK*[1], THOMAS KLEFOTH[2], ROBERT ARLINGHAUS[2]

[1] Inland Fisheries Management Laboratory, Humboldt-Universität zu Berlin
[2] Leibniz-Institute of Freshwater Ecology and Inland Fisheries

Domesticated fish used for stocking can phenotypically differ from their wild conspecifics, which might affect differential vulnerability to angling gear. We used two common-garden reared genotypes of carp (*Cyprinus carpio*) differing in their degree of domestication (scaled and mirror carp) to test for their differences in vulnerability to angling. We also conducted a laboratory experiment to investigate the effects of domestication on feeding behavior and food preferences to explain differences in vulnerability. In addition, the role of learned hook-avoidance on catchability of the fish was tested. Standardized angling experiments revealed approximately twice as many captures of highly domesticated mirror carp compared to scaled carp, but those differences were only present during the first days of angling. Furthermore, capture events decreased and time until first capture increased over time, whereas time until first bite remained constant, indicating learned hook avoidance of the fish. A potential explanation for higher catchability of mirror carp might be based on initially higher and more rapid feeding activities compared to scaled carp, as found in our accompanying laboratory experiments. No differences between the two types of carp were observed in their food preferences when tested in a two way choice feeding trial. Our results show that domestication influences behavior and catchability of carp and highlights the importance of learned hook avoidance on vulnerability of this species.

**Oral** C7.4 in *Biological impacts of recreational fisheries and their social and economic consequences*

August, 04, 4:20 – 4:40 pm, Audimax

## Competitive spear fishing in Galicia (NW Spain): impacts on target fish communities

*PABLO PITA*[1], JUAN FREIRE[1]

[1] Animal Biology, Vegetal Biology and Ecology, Marine Resources and Fisheries Research Group of A Coruña University

Spear fishing is the oldest fishing method but currently generates intense debate. The works on their impacts are few and contradictory: some authors consider it sustainable, while others reported important concerns. The lack of specific information has not prevented the imposition of severe restrictions in Galicia. Hence, in the management of this fishery, social and political issues determine the decision-making. Around 4000 spear fishers operate annually in Galicia, 13% of them participate in competitions. We studied one archive that contains the records of all the competitions in Galicia since 1953 and we stated that the total catches (94.68 t in 54 years) represent only 4% of the annual commercial landings for the same species. Although the overall effect of the competitions is not large, the short-term effect could be locally relevant. To answer this, we measured the rate of change in the CPUE of competitions in the same area to analyze its relationship with time between them. We also monitored the densities of fish species targeted by spearers during a period of 4 years to analyze how they vary after competitions. We found that CPUE don't decrease in the last competitions. But we found that the fish density increased after competitions and that densities of some species were inversely related to the size of the catch. In our opinion, the variations observed in the CPUE and in the densities were dependent on natural variations and not on the impact of the competitions.

**Poster** C3.25 in *New methodological tools to survey and assess recreational fisheries*

**Near collapse of a coastal rocky reef fish community in the northeast Atlantic Ocean**

*PABLO PITA*[1], DIANA FERNÁNDEZ-MÁRQUEZ[1], JUAN FREIRE[1]

[1] Animal Biology, Vegetal Biology and Ecology, Marine Resources and Fisheries Research Group of A Coruña University

For years now the estimates of the consequences of overfishing for marine ecosystems have differed greatly within the scientific community. The use of commercial catch statistics to estimate tendencies has been much criticised, but alternative information sources with long time series are rare. Here we employ the historic archive (1953-2007) of the recreational spear fishery in Galicia (NW Spain), which contains the records of the 864 spear fishing championships, to estimate long-term changes in coastal ecosystems. This archive does not share the problems common to other fishery registers and the information is extremely reliable: the divers are competing and are interested in their catches being registered, and the fishing effort has been carried out at the same sites and on the same species. However, due to the improvements in fishing technologies and methods, we can expect that the divers' efficiency has increased over time. Using generalized additive regression models we estimated over the last 50 years decreases of around 83% in the abundances and 36% in the average body size of coastal rocky reef fish. In addition, the relative catch frequency has decreased for the most valuable commercial species. Commercial overfishing has brought these ecosystems so close to the brink of collapse that it is imperative to implement measures that ensure their recovery.

**Oral** C11.6 in *Social, economic and biological aspects of a diversifying angler public*

August, 04, 3:40 – 4 pm, Seminar Building - Room 1.101

## Angler choice of terminal tackle and water depth

*KEVIN POPE*[1], DUSTIN MARTIN[1], GENE WIDLE[2]

[1] Nebraska Cooperative Fish and Wildlife Research Unit, University of Nebraska
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Recreational angling is an influential factor structuring fish populations, especially in inland systems. Angler choice of terminal tackle and water-depth target are important variables for understanding capture efficiency and size selectivity of sport fishes. Further, these choices establish bounds on processes such as growth suppression and mortality associated with catch-and-release events. Unfortunately, only antidotal information exists about these choices. We interviewed anglers at the conclusion of their fishing day on two Nebraska, USA reservoirs from April 2009 through December 2010. We asked each angling party questions to categorize (a) what type of terminal tackle they used and (b) what depth of water they fished to capture a majority of their fish for that day. We will summarize anglers' choice of gear and water depth by season and angler group.

**Key Note** K1.1 in *Key Note*

August, 01, 9:45 – 10:45 am, Audimax

**Recreational fisheries: Resilient fisheries or prone to collapse?**

*JOHN POST*[1]

[1] Biological Sciences, University of Calgary

Recreational fisheries are often distributed in lake districts and are connected by a mobile angler community. Decisions of where and how much to fish are determined by travel time and costs, amenities, crowding and the fishing quality. At this landscape scale, the resiliency of an individual fishery is dependent on its spatial context. Fisheries distant from population centres maintain high quality whereas those near population centres are prone to collapse. Assessments of the sustainability of fisheries near population centres requires an understanding the dynamics of populations at low density. This understanding is fundamental in designing effective management strategies for assessing resilience to collapse. Identifying and quantifying low density processes in nature is challenging due to sparse and variable data typical of low density populations. Two key processes in involve the compensatory ability of populations to offset harvest and the density-dependent behaviour of harvesters. I show that these processes are strongly non-linear, leading to important deviations from predictions made by classical harvest dynamics models. The interactive dynamics of these competing processes lead to higher minimum density thresholds for persistence and to enhanced risk of population collapse. The precautionary principle suggests that these nonlinear processes be incorporated into future assessments of harvest strategies and conservation thresholds to avoid fishery collapse.

**Oral** T2.4 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 11:30 – 11:50 am, Audimax

## Transboundary climate induced distributional changes in an important recreational fish species – consequences and adaptation

*WARREN POTTS*[1], ROMINA HENRIQUES[2], WARWICK SAUER[1], CARMEN SANTOS[3], PAUL SHAW[2]

[1] Rhodes University
[2] Royal Holloway University of London
[3] University of Agostinho Neto

A molecular technique was used to distinguish between the morphologically similar Sciaenids, *Argyrosomus coronus* and *Argyrosomus inodorus* in the recreational shore fisheries of Angola and Namibia and compared with a similar study conducted in Namibia in 1995. The ratio of *A. inodorus*: *A. coronus* in the Namibian central and northern area changed from 9: 1 in 1995 to 4: 6 in 2009. This result suggests that the rapid decline in the relative abundance (69% *cpue*) of *A. coronus* in the southern Angolan recreational fishery between 2005 and 2009 may be attributed to a southward distributional shift and not solely to a recent increase in fishing pressure. A 0.8˚C decadal increase in sea temperature in this region is thought to be the main driver of the distributional change as *A. coronus* are sensitive to temperatures above 20˚C. The distributional shift will result is decreased catches in southern Angola while Namibian recreational fisheries could experience better catches, particularly since *A. coronus* attains a larger maximum size (77kg) than *A. inodorus* (36 kg). However, the larger size at sexual maturity of *A. coronus* may result in the overexploitation of this species under Namibia's current management regulations. A revision of the current stock assessment procedures, a reassessment of the current management regulations and a revision of the value of Namibia's marine protected area network under the altered species distribution regime is required.

**Poster** T3.10 in *Space, place and recreational fisheries*

## How far have recreational fishers come - how far to go?

*FRANK PROKOP*[1]

[1] Recfishwest, Australia

Recreational fisheries are a significant component of the total fishing mortality, which must be managed. It generates significant economic activity, with the attribution of economic benefit hotly debated.
In Australia, nearly 1/3 of the adult population fishes at least once a year and the tackle industry alone is worth $1 billion Australian dollars. The impacts of recreational fishing are being increasingly studied, appropriately, as part of overall stock management. The benefits of recreational fishing, from an economic, social and well being perspective are frequently cryptic, ignored or attributed to wider tourism activities.
Recreational fishing has made enormous inroads from an intergenerational attitudinal perspective, but recreational and commercial fishing are being increasingly vilified in the press and wider community.
The evolution of recreational fisheries management in Australia is presented and critiqued. The ongoing changes which are required to allow this activity to continue without compromising sustainability and with support from the wider community will be presented.

**Oral** C8.8 in *Creative methods for managing recreational fishing*

August, 04, 4:20 – 4:40 pm, Seminar Building - Room 1.102

## Maximum Experiential Yield - a new MEY and other new ways of managing recreational fisheries

*FRANK PROKOP*[1], KANE MOYLE[1]

[1] Recfishwest, Australia

Management of recreational fisheries where multiple sectors have access or where there is a range of harvest expectations is extremely difficult and frequently controversial. Allocation decisions across sectors or within the recreational sector rely on historical methods which are not necessarily capable of recognising ongoing social changes within the recreational fishery. Measures such as maximum economic yield, catch per unit effort, and even maximum sustainable yield do not recognise the vastly different experiential drivers which are becoming more common in the recreational sector. As more fishers move from a commodity motivated recreational fishing driver to one based on experiential motivated fishing, new measures and assessments are required. New tools are needed to provide recreational resource management strategies which are increasingly conservative; allow a reasonable take of fish, a quality experience and rewards the recreational sector for pro-active and conservative management. The author will draw on examples from 20 years as a fisheries manager and advocate for recreational fishing around Australia and propose a number of new management protocols for the next 20 years.

**Poster** C7.7 in *Biological impacts of recreational fisheries and their social and economic consequences*

## Comparative study between the recreational fishing against commercial fishing in Catalonia, Species, total catch and relationships

*ORIOL RIBALTA*[1], POL LIBORI[1]

[1] Pesca Recreativa Responsable, Spain

Real comparison between these two sectors in one of the most developed areas of the Mediterranean. In an overfished area, with the largest recreational fishing fleet, only stopped because the crisis. And the commercial fishing has been in decline for twenty years. Study reveals that area of conflict between recreational fishing and the respective kinds of commercial fishing such as trawling, purse seine and artisanal fisheries. So the real impact on fish stocks and sectors compared to the main species of endangered situation.

**Poster** C3.26 in *New methodological tools to survey and assess recreational fisheries*

## Tag and recapture study carried out in the Ebro river delta by the Catalan Association for Responsible Fishing: Summary of preliminary results

*ORIOL RIBALTA*[1], ANA GORDOA[2]

[1] Asociació Catalana per a una Pesca Responsable, Spain
[2] Marine ecology, CEAB- CSIC, Spain

Fishing and tourism are one of the major functions of the coastal zone influenced by the Ebro river, the second largest river in the North western Mediterranean region, favouring the development of recreational fishing during the last decade. *The Catalan* Association *for* Responsible Recreational Fishing, sensitive of this development, has presented management plans as well as a research tagging project to increase the knowledge of the main target species of recreational marine fisheries in this area: European seabass, Leerfish and Bluefish. *The* tag and recapture study began in 2007 and since then 896 fishes have been tagged with a recapture percentage varying from 8 to 3% between species. The preliminary results on the spatial and temporal patterns of each species as well as their recapture time and location are presented.

**Oral-WS** Com.1 in *Workshop: Communication and Collaboration between Science and Management in Recreational Fisheries*

August, 03, 10:35 – 10:50 am, Seminar Building - Room 1.103

## Options and pitfalls of research communication in fisheries science: lessons learned from a salmonid conservation project

*ANDREAS RIEDL*[1], ANDREAS MERANER

[1] President, Landesfischereiverband Südtirol

The identification of successful ways of research communication from science to public is a major endeavor in recreational fisheries, given its intrinsic applied nature. Successful pathways but also dead ends of outcome communication were identified in the context of marble trout conservation. Factors perceived to influence the success of outcome communication and application were the complexity of the research theme and hence the level of details transmitted from scientists to anglers. On the other hand, bidirectionality of the communication process was hindered by an only marginal direct angler response, therefore impeding to tailor research objectives *a priori* to angler's expectations.

**Oral** T3.8 in *Space, place and recreational fisheries*

August, 04, 2:30 – 2:50 pm, Audimax

**Wilderness Conservation Areas - A concept developed and supported by recreational fishers to protect ecological and social values associated with wilderness**

*ANDREW ROWLAND*[1], KANE MOYLE[1], FRANK PROKOP[1], MARK PAGANO[1]

[1] Recfishwest, Australia

Changing expectation of recreational fishers in Western Australia has lead to the development of new spatial management concepts for recreational fishing. Buoyed by recent marine conservation planning activities in remote locations of W.A., the recreational fishing sector has development a complimentary zoning concept called "Wilderness Conservation Areas". Wilderness Conservation Areas (WCAs) focus on the preservation of the ecological and social values associated with marine, estuarine or riverine areas. This zoning aims to protect the pristine natural condition of an area while still retaining recreational amenity values by allowing for a low level of recreational fishing. It is our view that WCAs can become an important management tool in the suite of marine conservation measures. WCAs are Marine Protected Areas that can offer an extensive level of protection. The proponents of WCAs do not see them as a replacement for Strict Nature Reserves rather this zoning presents a balancing tool that aims to meet conservation objectives while maintaining recreational fishing values in a given area. The W.A. government has recently acknowledged the potential of WCAs as a tool which can offer effective marine conservation outcomes while reducing conflicts among stakeholder groups with often competing objectives. We report here on the development this concept, its operational aspects, the community benefits, and the processes involved in gaining government acceptance.

**Oral-WS** Com.3 in *Workshop: Communication and Collaboration between Science and Management in Recreational Fisheries*

August, 03, 11:05 – 11:20 am, Seminar Building - Room 1.103

## Scientists and recreational fishermen: The missing ring

*OSCAR SAGUÉ PLA*[1]

[1] International representative, Federacion Española de Actividades Subacuáticas (FEDAS)

Recreational fisheries are developing at high speed and fishermen are getting more and more specialized, helped with new fishing techniques and gear. Understanding them requires almost becoming part of them. Moreover, potential information that recreational fishermen hold about targeted species and coastal environments where they develop their activity is lost due to a lack of communication between them and scientists. Mistrust is the reason (due to a too often happened linkage between science/managers/restrictive measures) and underwater fishing is the paradigm. New approaches between sectors need to be built in order to get the most of it. Some examples will be provided.

**Oral** T1.6 in *Stock, stocking and the future of recreational fisheries*

August, 01, 2:20 – 2:40 pm, Audimax

## Management objectives drive optimal stocking strategies – a modelling approach

*MAJA SCHLÜTER*[1], FIONA JOHNSTON[1], MIKE ALLEN[2], ROBERT ARLINGHAUS[1]

[1] Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin
[2] School of Forest Resources and Conservation, Institute of Food and Agricultural Sciences, The University of Florida

Stocking fish into wild populations, to maintain or enhance fish stocks and angler satisfaction, is common in recreational fisheries. Development of sustainable stocking strategies, however, is challenging. Natural variation in fish abundance and interactions between wild and stocked fish can have unexpected consequences for stocking outcomes, as do uncertain responses of anglers to stocking measures or harvest limits. Particularly the latter is often ignored in stocking decisions and models. We developed a bio-economic model of a stock-enhanced recreational fishery of northern pike (*Esox Lucius*). It incorporates dynamic angler behaviour that was informed by empirical surveys. We defined management objectives ranging from "angler-pleasing" to "conservation-oriented" and investigated stocking of different sized fish. We found that in high quality habitats which support naturally reproducing pike stocks, the objectives of both angler-pleasing and conservation-oriented strategies can best be achieved at intermediate minimum-size limits without stocking. By contrast, in low quality habitats with limited natural recruitment, stocking and minimum-size limit adjustments are needed to maximize angler-oriented management objectives. Here benefits increase with increasing size-at-release. This contradicts the common perception that stocking small fish is superior to larger fish. The results show that optimal stocking policies can vary considerably depending on the management objective and the natural productivity of the fishery.

**Poster** C11.12 in *Social, economic and biological aspects of a diversifying angler public*

## Reasons for Finnish recreational fishers' low willingness to pay the fisheries management fee

*EILA SEPPÄNEN*[1], PÄIVI ESKELINEN[1], PEKKA SALMI[1]

[1] Economics and society, Finnish Game and Fisheries Research Institute

Most fishers between 18 and 64 years of age are obliged to pay the fisheries management fee to the Finnish state. The collected funds, about € 5.5 million annually, are reallocated to fisheries organizations, water owners and their associations and fisheries enhancement projects. This user-based funding system constitutes a substantial and firm basic funding of the central fisheries organizations and the Fisheries Regions, which spread information to the public, engage the youth to the hobby and provide fishing opportunities and services. Despite these benefits a substantial amount of the Finnish recreational fishers do not pay the fisheries management fee, which hampers funding of the multi-level management system and application of the 'users pay principle'. Our paper studies reasons behind this free-riding phenomenon. Is the lack of commitment due, for instance, to shortage of information? The recreational fishers consist of highly diversified subgroups whose motivations for buying – or not buying - fishing licenses vary. Thus different fisher classifications shall be used in our analysis. The main material has been collected in a large national postal survey, which inquired recreational fishers about their main barriers against paying the fisheries management fee and other fishing licenses. Secondly, we use material collected in a project, which studied the impacts of the fisheries management fee system.

**Poster** C11.13 in *Social, economic and biological aspects of a diversifying angler public*

## Regard or disregard? Challenges facing development and management of recreational fishing in the open public waters in the People's Republic of China

*JIANZHONG SHEN*[1], PINGHUA HE[2], WEIMING WANG[3]

[1] College of Fisheries, Huazhong Agricultura University
[2] College of Economy and Management, Huazhong Agricultural University
[3] College of Fisheries, Huazhong Agricultual University

Recreational fishing has developed as one of important recreational activities in China. But the angling is mainly fee fishing in the private or collectively-operated ponds or small lakes. No real license fishing like the developed countries exists in the open public waters in P. R. China for problems in management and fishery resources. So, two situations occur: forbidding or disregarding angling in the open public waters. Faced with the existence of angling in the open public waters and potential growing demand because it's more challenging and exciting, more and more attentions should be paid to the development and management of angling in the open public waters in order to increase the economic benefits while protecting the fisheries resources. Firstly, rules and regulations specific for management of angling in the open public waters, such as the limitation to fish species, size, quantity, season and grounds and gears of fishing should be defined and instituted to for its sustainable development. Surveys on fishing gears, species, size and quantity and evaluations of effects of anglings on the fishery resources should be carried out. Secondly, the potential market scales, the motivation and demand should be observed and evaluated for its healthy development. Thirdly, effects of angling on fisheries resources should be evaluated and corresponding measures for enhancement and conservation of the fisheries resources be forwarded and put into practice.

**Oral** C3.3 in *New methodological tools to survey and assess recreational fisheries*

August, 01, 4:30 – 4:50 pm, Seminar Building - Room 1.102

## The EIFAC Methodologies for assessing socio-economic benefits of European inland recreational fisheries

*MATTI SIPPONEN*[1]

[1] Centre for Economic Development, Transport and the Environment for Central Finland

Upon request by the European Inland Fisheries Advisory Commission (EIFAC), an EIFAC Working Party consisting of economists and other social scientists created guidelines for assessing socio-economic benefits of European inland recreational fisheries (published as EIFAC Occasional Paper no 46). The report provides guidelines on how social and economic benefits of inland recreational fishing can be described, assessed and measured. To help users select appropriate methodologies, it reviews and provides descriptions of the most commonly used concepts and methods to assess social and economic benefits and costs associated with recreational fisheries. Due to institutional aspects and management traditions, these guidelines are confined to Europe and emphasis is on inland fisheries. Fishery authorities and managers, when exercising their powers, need to consider the wider socio-economic consequences of their actions on a local, regional, national and sometimes transboundary scale. They should also be aware of the preferences and values of the current and, importantly, the potential recreational anglers in order to better manage existing and planned fisheries. In order to preserve fishery resources, economic valuation techniques in damage assessment are expected to be forthcoming also within the EU. The document is mainly targeted to policy managers and fisheries authorities - to people who commission or manage valuation studies and need to understand more about valuation or human dimension methods and underlying principles.

**Oral** T2.17 in *Change, adaptation and evolution in recreational fisheries*

August, 03, 11:10 – 11:30 am, Audimax

## 60 years of perch (*Perca fluvitilis*) and pike (*Esox lucius*) population dynamics in relation to commercial fishing, cormorants and temperature change as revealed by angler diaries

*CHRISTIAN SKOV*[1], TEUNIS JANSEN[1], ROBERT ARLINGHAUS[2]

[1] DTU Aqua, Section for Inland Fisheries Ecology, Technical University of Denmark
[2] Department of Biology and Ecology of Fishes, Leibniz-Institute of Freshwater Ecology and Inland Fisheries

In order to perform lake-specific fisheries management, managers benefit from keeping track of population dynamics of the focal species. This requires standardised monitoring of the fish population, which is often very costly. A less costly approach would be to derive information on catch, size distribution and effort using angler diaries. This approach may generate useful information if a high quality of data entries can be guaranteed, which might be the case in avid angler groups that co-exploit a fishery over long periods of time. Here we use diary data of more than sixty years from a Danish lake (17.3 $km^2$) to study trends in the populations (abundance, mean size and maximum size) of Eurasian perch (*Perca fluviatilis*) and pike (*Esox lucius*). Overall we conclude that strong inferences about population trends can be derived from angler diary data if such data are reliably recorded over long periods of time. Further we present the main conclusions from the study, which allowed us to explore population dynamics in relation to 1) Catch of commercial fishermen differing by fishing strategies, 2) ban of commercial fishing and a concurrent establishment of a cormorant colony, 3) the growing importance of catch-and-release among pike-anglers during the period and 4) the role of interannual variation in recruitment success estimated by temperature fluctuations.

**Oral** C9.4 in *Understanding and solving conservation and other conflicts in recreational fisheries*

August, 04, 11:30 – 11:50 am, Seminar Building - Room 1.101

## Managing angler conflict in coastal recreational fisheries: Perceptions and attitudes of limited impact fishing areas in shallow water flats

*WILLIAM SMITH*[1], GERARD KYLE[1], STEPHEN SUTTON[2]

[1] Recreation, Park & Tourism Sciences, Texas A&M University
[2] Fishing and Fisheries Research Centre, James Cook University

Texas has over 1.1 million licensed saltwater anglers that have access to approximately 1.5 million acres of open water bays and estuaries. Technological advances in both fishing equipment and information, as well as targeted marketing, have facilitated complete access to Texas inshore waters and exposed once secluded shallow water flats to an influx of new users. The resulting explosion in the popularity of shallow water fishing among anglers has lead to increases in habitat damage from boating, prompted angler conflict and enabled the adoption of unethical fishing techniques by some anglers. These growing issues are problematic for fisheries agencies from both an ecological and sociological perspective.

Angler alliances have coalesced around different fishing styles and resource managers are faced with mitigating these issues while providing a variety of fishing opportunities to a diversity of anglers. Some angler groups have suggested the creation of limited impact fishing areas (LIFA) to reduce conflict and prevent habitat damage. This investigation surveyed Texas' 1000 licensed recreational inshore fishing guides to understand their perceptions and attitudes regarding the creation of these fishing areas. Due to their on water experience, fishing acumen, representation of general angler fishing styles and social standing among anglers as opinion leaders, this group is uniquely positioned to provide insight on the utility of adopting LIFAs as a management option.

**Poster** C3.27 in *New methodological tools to survey and assess recreational fisheries*

## Monitoring of freshwater fish stock in Croatia according to the anglers' data

NIKICA ŠPREM[1], TOMISLAV TREER[1], DANIEL MATULIĆ[1], *MARINA PIRIA*[1], TEA TOMLJANOVIĆ[1], IVICA ANIČIĆ[1], ROMAN SAFNER[1], HRVOJE NOVOSEL[1]

[1] Dept. of fisheries beekeeping and spec. zoology, Faculty of Agriculture

One of the reliable evaluations on the current state of the freshwater fish communities is based on the catch of the anglers. The aim of this study was to provide an overview of the monitoring of freshwater fish community in Croatia by anglers' data over the six year period (2004-2009). The current quantity of fish species in Croatian freshwaters is evaluated by catch per unit effort (CPUE). The evaluated CPUE parameter was highest in 2006 (18.42 kg/per angler), and lowest in 2009 (15.43 kg/per angler). During the study period the number of anglers oscillated minimally. The yearly average number of anglers was 36,612 while the yearly average of total catch was approximately 618.656 kg. The results on the total anglers' catch correlates with the increasing number of anglers proves there is no overfishing. The most common fish species caught by the anglers were common carp (*Cyprinus carpio*), Prussian carp (*Carassius gibelio*) and grass carp (*Ctenopharyngodon idella*). The results on the variability coefficient (CV) of catfish (*Silurus glanis*) and common carp were only 5.84% and 7.06% respectively, showing a steady catch over the years. On the contrary CV for asp (*Aspius aspius*) was 79.69% because, in 2007 due to some unknown reasons, the catch was exceptionally high. Therefore, for better and easier freshwater management it is necessary to develop an accurate fish stock monitoring method. Precise collection of reliable data on the anglers' catch may be one of them.

**Oral** C1.7 in *Biological and social aspects of catch-and-release*

August, 01, 2:40 – 3 pm, Seminar Building - Room 1.101

## Short-term effects of catch-and release angling on pike (*Esox lucius*) behaviour

*MARTIN STÅLHAMMAR*[1], RASMUS LINDERFALK[1], CHRISTER BRÖNMARK[1], ROBERT ARLINGHAUS[2], P. ANDERS NILSSON[1]

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[2] Department of Biology and Ecology of Fishes, Leibniz-Institute of Freshwater Ecology and Inland Fisheries

Catch-and-release (C&R) angling, where fish are returned to the water after being caught, bears the potential to minimise negative impacts on targeted fish populations. However, the effects of being caught and released on individuals' behaviour are not fully evaluated. We here investigate the short-term behavioural changes in foraging behaviours of pike (*Esox lucius*) individuals caught and release in two different social contexts: when alone or in a group. Pike generally increased the time to become interested in prey after being exposed to C&R. However, they attack prey relatively sooner when released into groups of conspecifics. This suggests that pike recover and return to normal foraging behaviour sooner after C&R when other similar sized pike are present. Which is contradiction to predictions from pike agonistic behaviours. Moreover, pike released into conspecific groups showed as frequent agonistic behaviours as other group members. We conclude that the short-term effects on foraging behaviour of pike have only minor impacts on individual behaviour at this time scale, but acknowledge that C&R can potentially have effects at the population and community levels as a result of altered pike predation pressure.

**Oral** C11.8 in *Social, economic and biological aspects of a diversifying angler public*

August, 04, 4:20 – 4:40 pm, Seminar Building - Room 1.101

## Angler based research tournament links general public and a strong science mission

*ELIZABETH STAUGLER*[1], CHARLES ADAMS[1]

[1] Florida Sea Grant, University of Florida

"Kids Cup", an annual research-based catch-and-release tournament was developed to allow youth and adult stakeholders to participate in research and encourage resource accountability and awareness. Research components included a tagging study and an economic impact study of tournament expenditures. An angler awareness survey, conducted via participating bait and tackle shops, gauged community awareness of project. Key to Kids Cup was a buy in from participants and community stakeholders who assisted with data collection and tagging procedures. All findings were relayed to anglers and community stakeholders via print media and a project website. IMPLAN analysis concluded total regional impacts from tournament to be $37,670 in economic output and $20,490 in value added. Angler awareness surveys concluded 54% of respondents were aware of Kids Cup, 31% followed the project through outreach venues and 67% had seen a project flyer (n=171). Data collected from the tagging study has provided important information on release site fidelity and dispersal with respect to capture origins, and habitat-specific preferences. The Kids Cup project enthused the fishing public about science by allowing community and youth stakeholders to play a role in the research, thus enhancing ownership and interest in the environment and in conservation.

**Oral** C4.6 in *Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives*

August, 02, 1:50 – 2:10 pm, Seminar Building - Room 1.101

## A micro-foundation for the response of recreational fishing effort to fish abundance

*MAX THILO STOEVEN*[1]

[1] Department of Economics, University of Kiel

This paper explains the response of recreational fishing effort to changes in fish abundance using a microeconomic utility maximization approach. Recreational fishing effort and catch are modeled as imperfect complements. The effect of the preferences for catch and the elasticity of substitution between catch and effort on the shape of the effort response are analyzed. The preferences for catch have a stock-dependent effect on actual catches: At low stock sizes, lower preferences for catch lead to increased catches. The model predicts that increasing technical efficiency in recreational fisheries leads to a reduced fish stock that is masked by unaltered fishermen behavior.

**Oral** C11.4 in *Social, economic and biological aspects of a diversifying angler public*

August, 04, 2:30 – 2:50 pm, Seminar Building - Room 1.101

## Catching communities: The positive social impact of recreational angling in England and Scotland

*PAUL STOLK*[1]

[1] Social and Community Benefits of Angling, Substance

It is widely accepted that participation in recreational fishing generates a range of social, economic and ecological benefits to society. However, rigorous social science-based investigation of the precise nature and value of such benefits is lacking. This paper aims to further develop understanding of the benefits of all forms of recreational angling participation by reviewing findings from a UK-based research project running from 2009 to 2011. Analysing a mix of qualitative and quantitative data – including a questionnaire survey of more than 2,400 anglers, semi-structured interviews with over 100 anglers or angling stakeholders, and a series of on-site observations – this paper investigates the ways that individuals and communities in England and Scotland accrue benefit from recreational fishing participation. In addition to identifying the direct psychological and physiological benefits experienced by anglers, the wider social and ecological benefits that recreational angling confers on English and Scottish society are also explored. Particular attention is directed to the positive activities and outcomes associated with formal and informal groups of recreational anglers, as well as community initiatives that offer recreational angling participation as way of achieving specific health and well-being outcomes.

**Poster** T1.19 in *Stock, stocking and the future of recreational fisheries*

## The US Drug Approval Process: Disease treatments may be necessary for better stocking success

*DAVID STRAUS*[1]

[1] U. S. Department of Agriculture, Agriculture Research Service, Harry K Dupree - Stuttgart National Aquaculture Research Center Stuttgart, Arkansas USA

When stocking streams and lakes for recreational fishing, the fish must be disease-free. A current challenge is the control of fish diseases with the limited number of approved drugs available in various countries. There are very few therapeutants available in the US and fewer in Germany. Some disease treatments that were widely available in the past are not used anymore because of human safety concerns or negative environmental impacts. In the US, there is a defined process to gain approval for New Animal Drugs by the US Food and Drug Administration/Center for Veterinary Medicine (FDA/CVM). Data must be developed and submitted for these major technical sessions: 1) Effectiveness, 2) Target Animal Safety, 3) Human Food Safety, 4) Environmental Safety, and 5) Chemistry, Manufacturing and Controls. There are also minor technical sections that must be addressed: 1) Labeling and 2) All Other Information. Once all Technical Sections are accepted by FDA/CVM, the drug sponsor can submit a New Animal Drug Application. The application is reviewed to determine if the drug is safe and effective when used as stated on the label. If all data is acceptable, the drug is approved.

**Oral** C10.4 in *Allocation of fisheries resources among competing demands*

August, 04, 11:30 – 11:50 am, Seminar Building - Room 1.102

**Recreational cod fishery in the German Baltic Sea, 2004-2009**

*HARRY STREHLOW*[1], NORBERT SCHULTZ[1]

[1] Johann Heinrich von Thünen-Institute - Institute of Baltic Sea Fisheries

Next to the commercial fishery the recreational fishery plays an important role concerning the removal of biomass from fish stocks. In this study we present the recreational cod catches in the German Baltic Sea (SD 22 + 24) between the years 2004 and 2009. Fishing effort was estimated using a stratified mail survey and annual sales of fishing licenses. Catch per unit effort was estimated by stratified random sampling of access-points. Length distributions of cod catches were acquired by sampling of recreational cod catches from charter boats and data from community fishing events. The total cod biomass estimates removed by the recreational fishery have been fluctuating between 1907 t in 2007 and 2766 t in 2005 using recorded effort data from diaries. Using effort data based on recalled information from anglers total catches were estimated between 2940 t in 2007 and 4482 t in 2005. Annual recreational fishery cod catches have a significant share of the total landings, varying between 26% respectively 84% of the German commercial cod catches in SD 22 – 24. The majority of recreational fishery cod catches are from boat and charter vessels.

**Oral** C1.4 in *Biological and social aspects of catch-and-release*

August, 01. 12:10 – 12:30 pm, Seminar Building - Room 1.101

## Impacts of dissolved oxygen on the behaviour and physiology of bonefish: implications for live-release angling tournaments

*CORY SUSKI*[1], AARON SHULTZ[1], KAREN MURCHIE[2], CHRISTINE GRIFFITH[1], STEVEN COOKE[2], ANDY DANYLCHUK[3], TONY GOLDBERG[4]

[1] University of Illinois
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[3] University of Massachusetts
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Angling tournaments for bonefish often retain fish in livewells. During livewell confinement, oxygen concentrations may fall due to elevated fish biomass, coupled with low exchange of water. Some anglers use oxygen infusion systems, potentially exposing fish to water that is supersaturated with oxygen. Because physiological disturbances related to angling can influence the probability of predation in bonefish, livewell conditions that maximize recovery without imparting negative consequences need to be defined. The objective of this study was to assess the behavior, physiological response and metabolic rates of bonefish recovered in hypoxic, normoxic, or hyperoxic seawater after a simulated angling event. Behavioral experiments consisted of placing bonefish in one of three dissolved oxygen concentrations and monitoring gill ventilation. For blood sampling and metabolic rates, bonefish were exercised and then recovered in different dissolved oxygen concentrations, replicating different livewell holding conditions. Both hypoxic and hyperoxic conditions caused bonefish to experience behavioral and physiological disturbances, compared to fish in the normoxic treatment. Bonefish used more energy when recovered in hyperoxic seawater and fish in the hypoxic treatment were unable remove lactate. Results indicate that anglers and tournament organizers should recover angled bonefish in normoxic seawater.

**Oral** T2.16 in *Change, adaptation and evolution in recreational fisheries*

August, 03, 10:50 – 11:10 am, Audimax

## Angling reduces fitness in a recreationally exploited fish

*DAVID A. H. SUTTER*[1], CORY D. SUSKI[1], DAVID P. PHILIPP[2], THOMAS KLEFOTH[4], PETRA KERSTEN[5], STEVEN J. COOKE[3], DAVID H. WAHL[2], ROBERT ARLINGHAUS[4]

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Few empirical studies have evaluated the consequences of angling-induced selection (AIS) on fitness in fish. The present study examines potential impacts of AIS on behaviour and reproductive success using two lines of largemouth bass (LMB) selected for high (HVF) and low vulnerability to angling (LVF). LMB is a suitable model species for the study of behavioural mechanisms leading to AIS and the impacts of such evolution on fitness. The extended parental care provided by male LMB make them highly vulnerable to fishing when guarding eggs and fry. Even without harvest AIS can occur because during catch-and-release nest predation can reduce male fitness. We tested the hypothesis that reproductive output is a result of known behavioural differences between HVF and LVF influencing reproductive success. To this end four HVF and LVF male were stocked in common garden into six ponds together with seven unselected females and allowed to reproduce. For all nest guarding males, along with behavioural observations, the vulnerability to angling was assessed. While guarding eggs male HVF were found to stay longer times on nests and more vulnerable to fishing lures. Parentage assignment using microsatellite markers of 1200 subsampled juvenile LMB revealed that fall recruitment was highest for large HVF males. The present study showed that reproductive success of LMB is likely dependent upon behavioural but also physiological characteristics which can be altered by AIS and reduce species fitness.

**Key Note** K3.1 in *Key Note*

August, 03, 9:05 – 10:05 am, Audimax

## Human Dimensions of Recreational Fisheries: Challenges, Opportunities, and Emerging Research Needs

*STEPHEN SUTTON*[1]

[1] Fishing and Fisheries Research Centre, James Cook University

The study of human dimensions has been part of recreational fisheries science and management for many years. However, until recently human dimensions research has been largely isolated from the natural sciences and often relegated to provide only descriptive profiles of fishers and their fishing activity. More recently, fisheries managers and biologists have come to realize the importance of understanding and predicting angling behaviours to better assess the consequences of fisheries management policies on biological and social outcomes. This increasing interest in interdisciplinary research is most obvious in the development and application of models that couple social and ecological systems. These models explicitly recognize that fisheries involve systems of people and fish with feedbacks within and between these systems that are critical for predicting outcomes from fisheries management. The human dimensions field still faces a number of criticisms and challenges that constrain its ability to contribute to the management of sustainable recreational fisheries. In this talk, we use a coupled social-ecological system framework to discuss the utility and value of research into the human dimensions of recreational fisheries and to address some of the criticisms and challenges faced by human dimensions research. In particular, we discuss challenges related to: 1) the acceptance of human dimensions research by non social scientists; 2) the importance of clarifying the goals of fisheries management from both biological and social perspectives; 3) the importance of understanding antecedents that influence the behaviours of different anglers; and 4) the importance of integrating human dimensions and natural science within fisheries management frameworks. We then consider the future of human dimensions research and outline what we see as both short and long-term research needs and emerging research topics.

**Poster** C4.11 in *Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives*

## Recreational fishers' beliefs about the impacts of fishing and the necessity of recreational fishing regulations in Queensland, Australia

*STEPHEN SUTTON*[1]

[1] Fishing and Fisheries Research Centre, James Cook University

It is increasingly recognized that recreational fishing can have serious impacts on fish populations. In Australia, this recognition has led to increasingly tighter regulations on recreational fishing activity. Such tightening of regulations is often met with opposition from members of the recreational fishing community. We used a statewide survey of recreational fishers in Queensland to investigate fishers' beliefs about the impacts of recreational fishing on fish populations, and their beliefs about the effects of reducing/limiting recreational catch on fisheries sustainability. Approximately 30% of fishers strongly believed that recreational fishing can have negative impacts on fish populations. Approximately 66% of fishers strongly believed that recreational fishing regulations are necessary for protecting against overfishing. There were positive relationships between beliefs about the necessity of fishing regulations and fishers' level of support for regulations used to manage recreational fisheries in Queensland. Committed fishers, and those who placed higher importance on the catch-related aspects of the fishing experience were less likely to believe in the necessity of recreational fishing regulations. Results suggest that a better understanding of recreational fishers' beliefs regarding fishing impacts, the necessity of regulations, and the variables that influence these beliefs, can help understand and influence fishers' responses to regulation change.

**Oral** T3.2 in *Space, place and recreational fisheries*

August, 04, 10:50 – 11:10 am, Audimax

## Implications of social networks for sustaining resilient recreational fisheries

*WILLIAM TAYLOR*[1], KATRINA MUELLER[2], KEN FRANK[3], MARIA GIMENEZ[4], KELSEY SCHLEE[1], GRAHAM NORM[5]

[1] Fisheries and Wildlife, Michigan State University
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[5] Center for European, Russian and Eurasian Studies, Michigan State University

Fish provide countless essential goods and ecosystem services. When fisheries accessibility is limited to users dependent upon local resources to meet their needs and those of the local community, they have incentive to utilize their social network to co-manage the commons and promote their resiliency. Globalization has accelerated the ability of humans to access and extract distant resources and grow beyond local carrying capacities. Fish become vulnerable when increasing demands from outsiders outpaces the rate at which management institutions and local social networks can respond. Recreational fisheries, like commercial fisheries, are vulnerable to "the tragedy of the commons." Anglers seeking high quality recreational experiences in distant places may have little incentive to help prevent localized overharvest or degradation. Likewise, communities may experience tension between competing for outsiders and preserving local resources. While management protections may be in place broadly, localized disruptions may occur if network mechanisms are not in place to provide added protection. We discuss the importance of social networks for resilient recreational fisheries in the context of identity and sense of place by exploring how the behaviors of anglers are influenced by others and how the interaction between locals and non-local recreational anglers are influenced by community dynamics in select areas of North America and the Mediterranean region.

**Poster** C8.16 in *Creative methods for managing recreational fishing*

## Sportfishing in Dutch society: developing the social, economic and ecological benefits of Angling in the Netherlands from 2006-2010, future improvements and constraints. Strategies used, results, and critical factors involved

*ONNO TERLOUW*[1]

[1] Communication, Sportvisserij Nederland

In 2006 the semi- governmental organization OVB (Organization for the improvement Dutch inland fisheries) merged with the NVVS (Dutch Anglers Association) to become Sportvisserij Nederland (Sportfishing Netherlands Association). One of the mayor goals the new Association set itself for the coming five years was to become a strong and healthy organization which is recognized and respected as a representant of one of the three biggest outdoor activities in the Netherlands. This wide goal incorporated the following six targets: -increasing its memberships by her affiliated angling clubs with 25 % to 455.000 members; -wide media attention in all the national media types to increase popularity of angling and its benefits; -getting angling seen as an accepted family activity; -angling is completely sustainable and has strong ecological benefits; -active partnership with water bodies, nature-organizations and other parties; -political active, trusted and worthy. In the presentation the strategies used to reach these 6 targets in the period 2006-2010, the results and critical factors involved are presented. In conclusion a brief look into the future about upcoming chances and threats for Angling in Dutch Society are presented.

**Poster** C8.22 in *Creative methods for managing recreational fishing*

## Using acoustic telemetry to understand the behaviour and habitat utilisation of key recreational fish in southeast Australia

*SEAN TRACEY*[1], KLAAS HARTMANN[1], JEREMY LYLE[1], JAYSON SEMMENS[1]

[1] Institute of Marine and Antarctic Studies, University of Tasmania

Recreational fishing in Tasmania, Australia is a popular past-time for approximately 30% of the state's population. The highest participation rates occur in the southern statistical division, which includes the Derwent Estuary, a populous area around the state's capital Hobart. In this study we investigate the movement and habitat utilisation of three of the most targeted scalefish species in this estuarine system, *Platycephalus bassensis*, *Salmo trutta* and *Acanthopagrus butcheri*. We did this using a 78 site array of Vemco VR2 receivers and incorporating the data into a state-space model. Each of the study species are uniquely different in their morphology and this was reflected in the way each species utilised their shared environment. Sand flathead tagged in the mid-estuary were highly sedentary with 80% of individuals demonstrating a strong affinity to a narrow home range. The degree of movement of brown trout was mixed, some individuals utilised the mid-estuary widely, while others displayed resident behaviour. Black bream displayed the highest movement rate, with all individuals utilising the mid and upper estuary widely throughout the year. These results further our knowledge of the behaviour of these key recreational scalefish species in a highly fished area, providing information not only for continued sustainable management but also an insight into the ecology and behaviour of popular target species to recreational anglers.

**Oral** C5.4 in *Social and biological factors affecting catch efficiencies by anglers*

August, 02, 4:20 – 4:40 pm, Seminar Building - Room 1.101

**The effects of recreational fishing on body size and age structure, and vulnerability to fishing on salmonid populations in Japanese streams**

*JUN-ICHI TSUBOI*[1], KENTARO MORITA[2], SHINSUKE ENDOU[3]

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[3] Prifoods Co. LTD.

Almost all fishing is non-random. Especially in the case of recreational fishing, anglers make an effort to catch trophy fish. In this study, we studied how a population persists under high fishing pressure, via comparing the body size and age structure, and vulnerability to fishing between high and low fishing-pressure streams (HP-stream vs LP-stream) on masu salmon (*Oncorhynchus masou*). We conducted fishing experiments twice (Aug 2008 & June 2009) in two mountain streams, Fuji River basin. These streams apparently differs fishing pressure, depends on accessibility, although fishing regulations are same (i.e., size limits and open seasons). Toiwa Stream has forest road along with current (HP-stream), whereas Itajiki Stream locates more than 5km far from car stop (LP-stream). We caught masu salmon by bait fishing, and then caught un-hooked individuals by electrofisher in two depletion passes. For fish caught by bait fishing and electrofishing in 1st pass, we measured fork length and aged (otolith analysis). CPUE of bait fishing in HP-stream was much lower than that in LP-stream, even though masu salmon densities were similar. Vulnerability to fishing in HP-stream was independent with body size, whereas larger fish were more vulnerable in LP-stream. Body size and age distributions in HP-stream were smaller and younger than those in LP-stream. We conclude that a masu salmon population persists by smaller, younger, and hardly catchable individuals under high fishing pressure.

**Oral** C9.2 in *Understanding and solving conservation and other conflicts in recreational fisheries*

August, 04, 10:50 – 11:10 am, Seminar Building - Room 1.102

## Spatial patterns of coastal recreational fisheries in metropolitan Rio de Janeiro, Brazil

*RAFAEL DE ALMEIDA TUBINO*[1], PEDRO VIEIRA ESTEVES[2], BERNARDO ROXO COUTO[3], MAGDA ANDRADE-TUBINO[4], CASSIANO MONTEIRO-NETO[5]

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[3] Universidade Gama Filho
[4] Universidade Federal do Rio de Janeiro/Universidade Veiga de Almeida
[5] Universidade Federal Fluminense

Metropolitan Rio de Janeiro comprises 17 municipalities around the Guanabara Bay and a population of approximately 11 million people. A variety of coastal habitats including ocean beaches, the bay itself, islands and coastal lagoons allow the practice of recreational fishing year round. Nevertheless, we still know very little about this activity, despite of its social, economic and environmental importance. From 2004 to 2011 we monitored the recreational fisheries in nine different locations along the coast to elaborate a species list and to identify patterns of spatial similarity of the catches. A total of 1253 fisheries were followed, and 1698 specimens recorded, belonging to 47 species or categories. Most common species belonged to the families Haemulidae, Gerreidae, Sciaenidae and Centropomidae. The discard rate varied from 8.0 to 53.9% between sites. Numerical classification generated three distinct locality groups: a) marine open water sites including rock outcrops and surf zone habitats; b) estuarine waters within the Guanabara Bay sites; c) riverine low salinity sites of the Guapimirim drainage. None of the species were captured in all localities and 49% of them occurred exclusively in one of the locations alone. These results suggested a correlation between the catch composition and species habitat preferences. Recreational fishers focused their fishing pressure on different species populations following the transition between low salinity to coastal marine waters.

**Poster** C8.17 in *Creative methods for managing recreational fishing*

## Paper-free leisure fishery benefits in Estonia

*HERKI TUUS*[1], KUNNAR KLAAS[1]

[1] Fisheries Department, Ministry of the Environment of Estonia

Organisation and control of hobby fishery in all waters of Estonia, with population of 1.3 million, are managed centrally by the governmental institutions. For easier purchase of licenses for hobby fishery several innovative approaches have been introduced during the period from the Soviet rule up to Republic of Estonia. New solutions applied to improve an access to the hobby fishery have been an effective tool to increase substantially the number of hobby fishermen in Estonia. The last quantitative jump in number of fishermen was connected to the introduction of payment by mobile phone. The use of unified license purchasing system (includes mobile phone, internet and retail) gives an excellent opportunity for Estonia to enforce a paper-free hobby fishery, as on-site control of the validity of fishing right bases only on identity document. In addition to the increase of the legally fishing hobby fishermen innovative solutions guarantee a high quality real-time statistics of the characteristics of the recreational fisheries sector (age and sex composition of the license owners, temporal and spatial dimension etc). The reliable statistics create a basis for scientific approach which leads to reasonable management decisions.

**Oral** C3.4 in *New methodological tools to survey and assess recreational fisheries*

August, 01, 4:50 – 5:10 pm, Seminar Building - Room 1.102

## Mobile applications for the angling community

*BERND UEBERSCHÄR*[1], WIDURA SCHWITTEK[2], STEFAN EICKER[2], MOHAMED BOURIMI[3], JULIAN DAX[3], MARCEL HEUPEL[3]

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[2] University Duisburg-Essen, Germany
[3] University of Siegen, Germany

Recreational anglers explore most water bodies and coastal areas, even the unproductive and those inaccessible to commercial fisheries, to an extent that is unattainable by scientific projects. They spend tremendous effort of time, energy and money to "investigate" fish communities, particularly in freshwaters. There is no doubt that the recreational angler community can provide a wealth of data which have, however, hardly been used for monitoring, management and biodiversity conservation acts. In order to encourage angler to communicate their catch data online, FishBase, the global information system about fish, has established the FishWatcher facility years ago. The FishWatcher is a place, where angler and fish watcher (e.g. diver) can upload their catch data and observations which then may be used anonymously to improve e.g. species biodiversity maps. Since it was required to use a webbrowser to upload observations, this has obviously hampered a more frequent usage by the angling community. In order to facilitate the upload of catch data and observations straight from the fishingspot, we have developed mobile angler applications for the iPhone and a client for Android-Smartphones. These applications provide online community functionalities and allow the angler to upload his catch data to the FishWatcher. The presentation will demonstrate the usefulness of the features of both applications for angler and will demonstrate how to upload observations to the FishWatcher.

**Poster** T2.24 in *Change, adaptation and evolution in recreational fisheries*

## Adaptive changes in size-selectively exploited zebrafish (*Danio rerio*) populations

*SILVA UUSI-HEIKKILÄ*[1], ANNA KUPARINEN[2], CHRISTIAN WOLTER[1], THOMAS MEINELT[1], JON SLATE[3], ROBERT ARLINGHAUS[1]

[1] Leibniz-Institute of Freshwater Ecology and Inland Fisheries
[2] Ecological Genetics Research Unit, Department of Biosciences, University of Helsinki
[3] Department of Animal and Plant Sciences, University of Sheffield

Pronounced size-selectivity together with substantial mortality rates suggest the potential for fisheries-induced evolutionary changes in average growth rate and productivity in exploited stocks. We subjected experimentally wild zebrafish populations for size-selective mortality over five generations in order to understand how various phenotypic traits change over time under substantial selection pressure. Fish were harvested according to body length and three selection regimes were established: selection for large body size, random body size and small body size. After five generations of selection, fish selected for small body size were significantly smaller than fish selected for large or random body size. Despite the fact that body size of the spawners differed significantly between the large and small size selected fish, there were no differences in reproductive output between the groups. In addition to phenotypic changes, genetic changes were studied by using non-neutral markers (SNPs) to detect signs of possible evolutionary changes in response to the experimental selection. In doing so, we aim at contributing to fundamental understanding of the evolution of adaptive traits due to size-selective mortality.

**Poster** O.4 in *Other*

## Estimation of potential primary production & fish yield potential by using Bramick Model

*FATIMA VAHIDI*[1], REZVAN MOOSAVI[1], SEYED MOHAMADREZA FATEMI[1], SHAHLA JAMILI[1]

[1] Department of Marine Biology, Science and Research, Islamic Department of Marine Biology, Science and Research, Islamic Azad University, Tehran

In this present study fishes fauna were identificated by using identification keys. Fish specimens were caught by hand net and transported to local laboratory alive. We found three species, Chalcalbarnus chalcoides Guldenstaedt, 1662, Leuciscus cephalus Linnaeus, 1758 and Esox lucius Linnaeus, 1758 respectively of the population. Also In this present study the Bramick Model was used to estimate potential primary production & fish yield potential. This model is based on stratification & maximum TP which is recorded in spring. The annual results of our studies show that the Lake Valasht is a holomictic & monomictic lake. The station period, starts on April which the water temperature is going up 19.5 ± 0.35C°. When the surface water temperature is going down on October, 14.5±0.2C°, water turnover, completes. The thermocline gradient is between 4-8 m. In different months, its thickness would be different. The thermocline is at the depth of 4-6 m in spring, however it is deeper in summer (6-8m). By increasing the depth, the amount of oxygen goes down. Its minimum is 1.5 mg/lit (19.5 depth) in August. Based on data from the lake bathymetry map of Valasht Lake the average of hypolimnion is %57.2 in Valash lake in spring & summer. So this lake has a strong stratification (0>Hd). The maximum of total TP is 80 µgr.$l^{-1}$on April. By using the Bramick model, the lake has a potential of primary productivity as 241.2 gC/m2.a. The fish yield potential of the lake is estimated as 19.28 kg/ha.a.

**Oral** C4.7 in *Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives*

August, 02, 2:10 – 2:30 pm, Seminar Building - Room 1.101

## Ecologically and evolutionarily sustainable fishing of the pikeperch *Sander lucioperca*

*ANSSI VAINIKKA*[1], PEKKA HYVÄRINEN[2]

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[2] Finnish Game and Fisheries Research Institute

Due to the multitude of participants and a diverse range of used fishing gear freshwater fisheries are often managed using minimum size limits (MSL) rather than effort regulations. However, selective harvesting of large fish may raise problems by inducing adaptations to selective fishing. We examined the ecological and evolutionary impacts of varying fishing efforts under varying MSLs, with and without stockings, in an age-, size-, and maturity-structured evolutionary model which was parameterized for Lake Oulujärvi pikeperch, *Sander lucioperca*. We found that at the current level of harvesting ($F$=0.7) and stockings (430 000 year$^{-1}$), the nation-wide MSL of 370 mm maximizes theoretical biomass yield in a deterministic model but does not prevent severe recruitment overfishing under further increased fishing pressures or stochasticity in recruitment success. The recently imposed, local MSL of 450 mm better ensures stable yields even in the absence of stockings that appear inefficient when natural recruitment is successful and growth is density-dependent. Further increase of MSL to 500 mm would reduce the risk of recruitment overfishing but also reduce yield especially if there is discard mortality for undersized fish. Evolutionarily stable size at maturation decreases under strong fishing mortality, but increased MSLs reduce the magnitude of this undesired effect. Our results support the intentions to increase MSLs in order to improve the sustainability of recreational fisheries.

**Oral** C4.8 in *Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives*

August, 02, 2:30 – 2:50 pm, Seminar Building - Room 1.101

## Evaluating the efficacy and consistency of management regulations in US marine recreational fisheries

*BRETT VAN POORTEN*[1], SEAN COX[1], ANDREW COOPER[1]

[1] School of Resource and Environmental Management, Simon Fraser University

Recreational fishing regulations are designed to ensure fisheries sustainability by limiting harvest, yet there have been few examinations of the efficacy of different regulations across fisheries. Despite the complexity of the biological systems being managed, we use simple regulations to either limit the effectiveness of anglers or directly limit harvest. However, regulations act not only on an individual angler by limiting catch or harvest, but also on the perception of the fishery, so that changes that reduce per-angler harvest may increase attractiveness of the fishery, leading to an increase in total harvest due to increased fishing effort. There are various studies demonstrating contrasting views on the efficacy of different regulations in different contexts, but few meta-analyses designed to critically examine how well various regulations work across species and under what conditions they fail. We examine catch and effort from marine recreational fisheries across the coastal United States to identify fisheries that have performed well over time under different regulations. Additionally, we identify situations and fisheries that are best suited to different regulations or combinations thereof. Through an examination of multiple fisheries in various social, biological and management contexts, future regulations may be chosen based on their probability of success, helping to promote long-term sustainability in fisheries and fish populations.

**Oral** T1.5 in *Stock, stocking and the future of recreational fisheries*

August, 01, 2 – 2:20 pm, Audimax

## Social-ecological interactions, panaceas and the future of wild fish

*BRETT VAN POORTEN*[1], ROBERT ARLINGHAUS[2], KATRIN DAEDLOW[2], SUSANNE HAERTEL-BORER[3]

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[3] EAWAG Swiss Federal Institute of Aquatic Science and Technology

A common emergent property of social-ecological interactions is the development of panaceas. To highlight key mechanisms and outcomes of the emergence of a management panacea we present an empirically informed model of a coupled social-ecological system of recreational fisheries. We find regular fish stocking develops as a panacea when management decisions are affected by harvest-dependent angler satisfaction that itself is decided based on past fishing success which is largely dictated by stochastic natural recruitment. While stocking generally preserves the renewable natural resource, it facilitates the replacement of wild by stocking-descended fish. This is particularly likely when stocking reasonably fit individuals and/or when natural productivity is low so that wild fish are outcompeted. The panacea's social benefits involve a dampening of natural population fluctuations, which generates stability in the provision of salient cultural ecosystem services (e.g., angler well-being). The potential for stocking-based panacea formation is particularly likely under user-based management regimes where users lobby for using technical fixes (e.g. stocking) to counter declining natural resources. The result is an ecosystem providing stable cultural ecosystem services, while being comprised of an altered species community, which risks the provision of other ecosystem services. We argue that distributing management authority among multiple levels may help solve the issue.

**Oral** C3.5 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 10:30 – 10:50 am, Seminar Building - Room 1.102

## Evaluation of a new design and estimation approach for the Access Point Angler Intercept Survey in the U.S.

*DAVID VAN VOORHEES*[1], HAN-LIN LAI[1], F. JAY BREIDT[2], JEAN OPSOMER[2], PATRICIA ZIELINSKI[1], KELLY FITZPATRICK[3]

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The U.S. NOAA Fisheries Service has been conducting the Access Point Angler Intercept Survey (APAIS) to estimate characteristics of recreational catch in U.S. coastal waters. The APAIS is a stratified, multi-stage sample that is used to collect data on catch by species and to estimate the mean catch per angler fishing day. Estimates from the APAIS have relied on unweighted averages that did not reflect the complex sampling design. Estimates produced from the APAIS have also used some data that were not obtained through a probability sample. New estimation procedures have recently been developed for the APAIS and these methods have been applied to revise catch estimates based on 2003-2010 APAIS data. In addition a new sampling design was developed and tested in a pilot study conducted in North Carolina from January to December 2010. The pilot study implemented a number of improvements, including construction of a new sampling frame of fishing sites suitable for applying formal sampling methods, a new constrained sampling approach that explicitly accounts for interviewer scheduling, a redesign of the interview protocols, and improvements in the estimation methods to account for the complex sampling design. We discuss some of the lessons learned in implementing the new sampling, data collection, and estimation methods.

**Oral** T1.7 in *Stock, stocking and the future of recreational fisheries*

August 01, 2:40 – 3 pm, Audimax

## Bayesian Belief Network model for rainbow trout stocking optimization in British Columbia, Canada

DIVYA VARKEY[1], PAUL ASKEY[2], ERIC PARKINSON[2], *ADRIAN CLARKE*[1]

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[2] Ministry of Environment

British Columbia has approximately 900 small stocked lakes currently managed on an individual lake basis. We present an analysis "toolkit" that will inform stocked lakes management. The toolkit is built using a Bayesian Belief Network (BBN) model which works within a decision making framework to combine both information and associated uncertainty from multiple sources. The multiple sources of information are modeled as nodes in the model and each node in the BBN is associated with a set of probability tables. The size and structure of the probability tables is determined by the flow of information within the network. The BBN model integrates stocking information on density and size of stocked fish, fisheries models of fish growth and survival, models of angler effort trade-off with fish size, lake productivity and release mortality. The model predicts the expected angler effort and expected catch or kill per angler day. These results are subsequently integrated with the cost of the stocking program and the revenue from angling effort to calculate the utility of different stocking management options. The model aids decision making on stocking rates and sizes based on available information about the different influences on the system. Managers will be able to use the "toolkit" to click through choices of fry or yearling stocking rates and check the impact various choices have on fishing effort. Overall, this is a significant step towards improving the small lake fishery management in British Columbia, Canada.

**Oral** C4.1 in *Harvest regulations and effort controls in recreational fisheries: social, economic and ecological perspectives*

August, 02, 10:30 – 10:50 am, Seminar Building - Room 1.101

## Attitudes and perceptions of recreational shore anglers towards the implementation of saltwater fishing regulations: a case study in the south of Portugal

*PEDRO VEIGA*[1], CRISTINA PITA[2], LAURA LEITE[1], JOAQUIM RIBEIRO[1], JORGE M.S. GONÇALVES[1], KARIM ERZINI[1]

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Recreational saltwater fishing in Portugal was for a long time an open-access activity, without restrictions of any kind. Specific restrictions and limitations to control the recreational harvest have only been implemented in 2006, and were highly criticized by the angler community both by being highly restrictive and lacking of scientific support. The present study aimed to obtain socio-economic data on the recreational shore anglers and analyze attitudes and perceptions towards the existence of saltwater regulations and the newly implemented restrictions in Portugal. Roving creel surveys were conducted along the south and south-west coasts of Portugal, during pre and post regulation period (2006-2007), to interview the anglers while fishing (i.e. face to face interviews). Logit models were fitted to identify and estimate which characteristics most influence anglers' perceptions and attitudes towards recreational fishing regulations. The majority of the interviewed anglers was aware and agreed with the existence of recreational fishing regulations. However, most were against the recreational fishing regulations currently in place. Logit models revealed that education, income and awareness of decrease in the overall size of the fish, influence positively anglers regarding the existence of recreational fishing regulations. The findings from this study will contribute to inform decision-makers about anglers' potential behaviour towards the new and future regulations.

**Oral** T2.13 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 4:40 – 5 pm, Audimax

## Do anglers reflect the dynamic trends in recreational fisheries? A case study of the Czech Republic

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The Czech Republic constitutes a country of long tradition and high end management in recreational fisheries. The detailed evidence system there consisting of complete information about fish stocking and fishing pressure is unique within Europe. Evidence data from last 20 years were processed to evaluate the quality of management and find out the long-term trends. To learn more about social and economical consequences according to anglers' opinion, the questionnaire containing 30 questions of various fields in fisheries, ecology, technology and legislation was distributed within anglers. The responses from almost 7000 correctly filled questionnaires were collected. Although both salmonid and non-salmonid fisheries exhibited increasing trend in the intensity of management (increasing amount of fish stock), the anglers' capture was stagnant in the case of cyprinid and predaceous fishes and even markedly declined in salmonids, especially due to losses caused by overestimated fish predators, namely cormorant, otter and mink. This trend is reflected in decreasing number of anglers, especially within children. A typical Czech angler can be characterized as a man aged from 30 to 39 years, employed, with salary below 800 EUR per month. To carry out his fishing activities he prefers bottom fishing and specializes in cyprinids. Such angler consumes fish meat twice a month in the amount less than 5 kg per year. In regard to applying new rules, he stays conservative.

**Oral** C3.6 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 10:50 – 11:10 am, Seminar Building - Room 1.102

## The role of variance components and survey design in detecting trends in recreational fisheries monitoring data

*TYLER WAGNER*[1], BRIAN IRWIN[2], JAMES BENCE[2], WEIHAI LIU[2], DANIEL HAYES[2]

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High levels of resource exploitation and changing ecological conditions, such as effects from the establishment of non-native species and climate change, emphasize a need to efficiently monitor the status and trends of fish populations. Fishery-independent surveys are one source of this critical information. In the Laurentian Great Lakes basin such surveys are used to monitor percid stocks, which support some of the words largest recreational fisheries. These surveys commonly sample a network of sites within or across lakes over time. Thus, statistical power of surveys depends both on how variation in the target population is structured and how well the survey samples across sources of variability. We developed negative binomial mixed models to decompose the total variation in percid fishery-independent surveys in the Laurentian Great Lakes basin into spatial and temporal components, and used the resulting variance estimates to evaluate potential survey designs. The structure of variation in percid populations varied across the Great Lakes basin, with some among-lake differences consistent with existing hypotheses of how local and regional abiotic factors structure fish populations. We will present results from simulations of different sampling designs employed on populations with different variance structures. These results show how statistical power to detect trends relates to both variance structure and survey design.

**Poster** C8.18 in *Creative methods for managing recreational fishing*

## Community - the foundation for sustainability in fishery management

*P. WALSH*[1], R. CAPLICE[1], J. M. CAFFREY[2]

[1] Irish Angling Development Alliance
[2] Inland Fisheries Ireland

The quality of Ireland's natural fisheries is the envy of many countries and attracts large numbers of anglers each year. The number of watercourses within Ireland generates unique challenges for fisheries development and management. Traditionally, the approach to recreational fisheries management has been based on single species or group models. This is not always the optimum approach and does not necessarily guarantee the maximum output, in terms of resource utilisation. Ireland's watercourses are not the sole preserve of the angler and any development programme must envisage the target water as a multi-purpose user resource, available to the community. In constructing and implementing fisheries development, inputs from a diversity of local interest groups and relevant stakeholders must be considered. The fisheries development plan itself must be informed by scientific metrics on such parameters as the productivity of the water, the fish species or species mix best suited to the water, and the correct locations for placement of angling infrastructure. The plan should consider whether the venue will best suit pleasure or competition anglers, and should ensure that junior and disabled anglers will be accommodated. The use of this community approach to fisheries management has been very successful in Lough Muckno. This high profile lake is *circa* 400ha and straddles the Monaghan / Armagh border. The paper will describe how the model used for the Muckno development can be applied to other fishery developments.

**Oral** T3.3 in *Space, place and recreational fisheries*

August, 04, 11:10 – 11:30 am, Audimax

## Recreational angler characteristics and management implications in a multi-stock, spatially structured fishery

*HILLARY WARD*[1], MICHAEL QUINN[1], JOHN POST[1]

[1] Department of Biological Sciences, University of Calgary

In order to sustain fisheries across landscapes while meeting angler demands, management strategies need to transition from a single stock approach to a landscape prospective. Developing management strategies for recreational fisheries requires an understanding of angler characteristics and factors that influence where, when and how much, anglers choose to fish. We interviewed anglers and assessed fish populations in seven lakes within a multi-stock spatially structured fishery. Our results indicate a diverse angler population that varied in its demographics, skill level and preferences for particular resource attributes. Distinct angler groups were identified using a principal component analysis of revealed preference data, experience measures and performance related factors followed by a hierarchical cluster analysis on significant component scores. The cluster analysis resulted in four distinct angler groups defined by the degree of specialization. Our results provide a preliminary understanding of the level of heterogeneity in where these angler groups choose to fish and how angler characteristics result in the demand for different fishing opportunities and resource characteristics. We demonstrate the complex interactions that arise between angler characteristics, behavior and preference for resource characteristics and use these results to suggest that angler demands be used to match both the productive capacity of systems and management tools that optimize the fishery.

**Poster** C3.29 in *New methodological tools to survey and assess recreational fisheries*

## Comparison of sea-based recreational and commercial cod catches in the German Baltic Sea

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The German recreational fishery removes a considerable amount of cod biomass (*Gadus morhua*) from the western Baltic cod stock. In order to estimate recreational fishery data annual surveys are performed. In this study we evaluate the use of length frequency distributions and length-weight relationships of boat-based recreational cod catches to estimate yearly sea-based catches. Over a period of two months length and weight compositions of 891 cod were collected around the island of Fehmarn (ICES subdivision 22). Data collection was realised via on-site surveys. Self-organized fishing trips and access point surveys were used to record catches of small boats. Charter vessel trips formed the complementary mode of sea angling for cod and were analysed by sampling charter vessel trips of different operators. Results of the statistical analysis indicate that there is no significant difference in length and weight composition between (a) recreational catches of small boats, (b) recreational catches of charter vessels and (c) the commercial fleet. We conclude that the length frequency distribution of recreational cod catches from charter vessel sampling and the use of the length-weight relationships from the commercial fleet are sufficient to conduct a cost-effective survey of the recreational fishery.

**Oral** T2.3 in *Change, adaptation and evolution in recreational fisheries*

August, 02, 11:10 – 11:30 am, Audimax

## Use of Google insights for search in fisheries

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We used Google Insights for Search, which allows one to examine the prevalence of different search terms used in internet searches, to examine document patterns in fishing-related searches made in several languages including English, Spanish, German, and French. Our results show seasonal, long-term, and geographic patterns in searches for fishing-related terms that are consistent with known participation rates in different fisheries (i.e., carp fishing, pike fishing). We also examined searches for terms relevant to recent or ongoing fishery issues and observed a close temporal correspondence between search terms and media reports. Insights for Search provides a low cost and timely index of interest by anglers, and the general populace, in fishing and fishing-related issues and a means of assessing interest in rapidly developing issues.

**Oral** C5.9 in *Social and biological factors affecting catch efficiencies by anglers*

August, 03, 11:30 – 11:50 am, Seminar Building - Room 1.101

## Capture technique and fish personality: angling targets timid bluegill sunfish, *Lepomis macrochirus*

*ALEXANDER WILSON*[1], BINDER THOMAS[2], MCGRATH KEEGAN[3], COOKE STEVEN[3], GODIN JEAN-GUY[3]

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Size-selective harvesting associated with commercial and recreational fishing practices has been shown to alter life history traits through a phenomenon known as fishing-induced evolution. This phenomenon may be a result of selection pathways targeting life-history traits directly or indirectly through correlations with behavioral traits. Here, we report on the relationship between individual differences in behavior and capture technique (beach seining versus angling) in wild-caught juvenile bluegill sunfish (*Lepomis macrochirus*). Fish caught by using both a seine net and by angling were individually tested under standardized laboratory conditions for their boldness, water-column use, and general activity. Observed inter-individual differences in boldness were strongly correlated with method of capture in the wild. Fish caught by angling were more timid and had fewer ectoparasites than fish caught using a seine net. However, this relationship did not carry over to an experiment in a large outdoor pool with seine-caught, individually tagged wild fish, where bolder individuals were more likely to be angled in open water away from refuges than more timid individuals, based on their previously assessed boldness scores. Our study is both novel and important, as it describes the relationship between capture technique and boldness in a natural population and underscores the potential risk of sampling biases associated with method of animal capture for behavioural, population, and conservation biologists.

**Oral** T1.10 in *Stock, stocking and the future of recreational fisheries*

August, 01, 4:10 – 4:30 pm, Audimax

## Introduction of arctic char (*Salvelinus alpinus*) and lavaret (*Coregonus lavaretus*) and its impact on the recreational fisheries in lake Kals, Latvia

*MATISS ZAGARS*[1], ARMANDS ROZE[1]

[1] Trout breeding and research Ltd.

Before 1990 lake Kals was state managed and its fisheries were in a healthy state. However from 1990 to 2007 the fisheries were not systematically managed and the lake received a high fishing pressure resulting in a depletion of the fish stocks. In 2007 “Lake Kals society” acquired the management rights of the lake and introduced licensed and controlled industrial and recreational fisheries. In order to create an attractive environment for recreational fishermen arctic char and lavaret were introduced into the lake. In total 30000 juvenile and adult individuals of both species were released from 2007 to 2009 and a publicity campaign in media to inform about the project was started. In 2010 a study to assess the biological and economical consequences of the introduction was performed. Individuals of the introduced and resident fish species were collected, their morphological characteristics measured and gut contents analyzed. Information on the changes in the amount of purchased fishing permits and income of local businesses was also collected. The data indicate that the introduced fish species have very limited negative effect on resident fish fauna illustrated by a very low spatial and trophic niche overlap. The rise in the amount of purchased fishing permits and incomes of local businesses in its turn indicate a positive economical effect of the project. Thus we conclude that the introduction has created positive economical effect without negatively affecting environment.

**Oral** C5.5 in *Social and biological factors affecting catch efficiencies by anglers*

August, 02, 4:40 – 5 pm, Seminar Building - Room 1.101

## Juvenile growth and adult behaviour determine angling vulnerability of pike (*Esox lucius*) in their natural environment

*PETR ZAJICEK*[1], THOMAS KLEFOTH[1], THILO PAGEL[1], ROBERT ARLINGHAUS[1]

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Early life growth and corresponding experiences are known to shape behavioural patterns in later life stages of fish, but are largely unexplored in terms of their relation to individual vulnerability to angling (VA). We compared early life growth (first year post hatching, based on scale reading and back-calculation of length-at-age) of 155 angled and 233 electro-fished pike (*Esox lucius*) in a small (25 ha) natural lake in 2007 - 2008. Additionally, to study the potential relationship between early life growth, adult behaviour and VA, an acoustic telemetry system was employed in the same study lake in 2009 to obtain high resolution behavioural data (accuracy: 6.96 m ± 4.95 m) of 60 adult pike (N = 26 caught by angling, N = 18 electro-fished, N = 16 caught by both methods) equipped with an acoustic transmitter (burst rate 9.2 s). Using logistic regression models we found early life growth and hatching year to be significant predictors of VA, together explaining 31% of the variance. Furthermore, adult behaviour, as determined by acoustic telemetry, was related to VA in adult fish, indicating strong behavioural differences between vulnerable and non-vulnerable pike. This indicates the selective potential of intensive recreational fishing, which may lead to fisheries-induced evolution towards reduced vulnerability to angling.

**Oral** C3.8 in *New methodological tools to survey and assess recreational fisheries*

August, 02, 11:30 – 11:50 am, Seminar Building - Room 1.102

## Tagging fishers, not fish: Capture-recapture methods for estimating population size of specialized recreational fisheries

*MITCHELL ZISCHKE*[1], SHANE GRIFFITHS[2], KENNETH POLLOCK[3]

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[2] CSIRO Marine and Atmospheric Research
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Specialized recreational fisheries (e.g. game fishing) are gaining popularity in response to increased affordability of new fishing technologies (e.g. electric reels, sonar) and knowledge transfer between fishers (e.g. internet forums). These fisheries can exert considerable fishing pressure on large predatory species, many shared with commercial fisheries. These specialized fishers comprise a “hard-to-reach” population, who are rare within the wider, and cannot be cost-effectively located due to an absence of a complete list frame (e.g. fishing license). However, population size estimates for these fisheries are essential for expansion of survey catch rates to estimate total catch. Capture-recapture methods were developed to estimate the size of the specialized pelagic sport fishery off eastern Australia. Innovative (time-location sampling) and traditional (access point survey) survey methods to were used to “capture” and subsequently “recapture” fishers within a sampling universe. Closed and open capture-recapture models proved suitable for estimating fisher population size; however large variance resulting from few recaptures affected extrapolated total catch estimates. While further refinement is needed, this case study demonstrates the usefulness of capture-recapture methods for recreational fishing surveys, particularly for hard-to-reach specialized fisheries.

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# Sightseeing Tips for Berlin

| | |
|---|---|
| 1. TV-Tower: | S-Bahn Station Alexanderplatz |
| 2. Brandenburger Gate: | S-Bahn Station Brandenburger Tor |
| 3. German Reichstag: | S-Bahn Station Brandenburger Tor |
| 4. Potsdamer Platz: | S-Bahn Station Potsdamer Platz |
| 5. Museum Island: | S-Bahn Station Friedrichstraße |
| 6. East-Side-Gallery: | S-Bahn Station Ostbahnhof |

# Selection of Bars, Clubs and Cafés

**You want to explore the true German outside beer places – we suggest:**

| | |
|---|---|
| Prater Biergarten: | U-Bahn Station Eberswalder Straße (U2)<br>**www.pratergarten.de** |
| Strandbar Spree: | S-Bahn Station Oranienburger Straße (S1)<br>**www.bartime.de** |
| BundesPresseStrand | S-Bahn Station Hauptbahnhof<br>**www.derbundespressestrand.de** |

**You want to explore nice restaurants, cafés and bars – we suggest:**

| | |
|---|---|
| Hackescher Markt: | S-Bahn Station Hackescher Markt |
| Oranienburger Straße: | S-Bahn Station Oranienburger Straße |
| Simon-Dach-Straße: | S-Bahn Station Warschauer Straße |
| S-Bahnbögen Friedrichstraße: | S-Bahn Station Friedrichstraße |
| Pfefferberg (Prenzlauer Berg): | U-Bahn Station Senefelder Platz (U2) |