12th FishBase Symposium

# Big Old Data and Shiny New Insights: Using FishBase for Research

Book of Abstracts

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# Big Old Data and Shiny New Insights:
# Using FishBase for Research

Book of Abstracts

12th FishBase Symposium
Beaty Museum of Biodiversity
University of British Columbia, Vancouver, Canada

M.L.D. Palomares, E. Taylor and D. Pauly (editors)

A report prepared by the *Sea Around Us*
for the Paul G. Allen Family Foundation, the Pew Charitable Trusts
and the Consulate General of France in Vancouver

8 September 2014

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12th FishBase Symposium

# Big Old Data and Shiny New Insights: Using FishBase for Research

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| 9:10 – 9:20 | Welcome address | Ted Schmitt | Head, Technology Projects, Vulcan and Paul G. Allen Family Foundation | |
| 9:20 – 9:40 | Welcome address | Rick Taylor | Professor of Zoology, Director and Curator of Fishes, Beaty Museum of Biodiversity, UBC, Vancouver, Canada | etaylor@zoology.ubc.ca |
| 9:40 – 10:00 | Symposium rationale | Daniel Pauly | Principal Investigator, *Sea Around Us*, Fisheries Centre, UBC, Vancouver Canada | d.pauly@fisheries.ubc.ca |
| 10:00 – 10:30 | Coffee break | | | |
| 10:30 – 10:50 | From data to best available knowledge: recent developments in FishBase | Rainer Froese | FishBase Consortium Coordinator, GEOMAR Helmholtz-Centre for Ocean Research, Kiel, Germany | rfroese@geomar.de |
| 10:50 – 11:10 | Catalog of Fishes: the global nomenclator and taxonomic authority for fishes | William N. Eschmeyer | Curator Emeritus, Ichthyology, Academy of Science, San Francisco, California, USA | b.eschmeyer@calacademy.org |
| 11:10 – 11:30 | New classification of bony fishes in FishBase? | Nicolas Bailly | FishBase Project Manager, WorldFish and FishBase Information and Research Group, Los Baños, Philippines | n.bailly@cgiar.org |
| 11:30 – 11:50 | OsteoBase: an online interactive tool for osteological knowledge and identification | Sandrine Tercerie | Chargée de mission Référentiel taxonomique, Service du Patrimoine Naturel, Muséum national d'Histoire naturelle | tercerie@mnhn.fr |
| 11:50-12:10 | FISH-BoL: the global barcoding initiative for all fishes of the world | Robert Hanner | Associate Director, Canadian Barcode of Life Network, Biodiversity Institute of Ontario, University of Guelph, Canada | rhanner@uoguelph.ca |
| 12:10 – 13:30 | Lunch break | | | |

# PROGRAM

| | | | | |
|---|---|---|---|---|
| 13:30 – 13:50 | Multi-model ensemble projections of climate change effects on global marine biodiversity | William Cheung | Associate Professor, Changing Oceans Research Unit, Fisheries Centre, UBC | w.cheung@fisheries.ubc.ca |
| 13:50 – 14:10 | The role of FishBase in trophic ecosystem modelling | Francisco Arreguin-Sanchez (presented by Manuel Zetina-Réjon) | Professor, Centro Interdisciplinario de Ciencias Marinas del IPN, Mexico | farregui@ipn.mx |
| 14:10 – 14:30 | NF-UBC Nereus Program: to advance our understanding of the future of fisheries | Yoshitaka Ota | Co-Director Nereus Program, Fisheries Centre, UBC | y.ota@fisheries.ubc.ca |
| 14:30-14:50 | Making big data available: the University of British Columbia Institute of Fisheries field record lab notebooks experience | Robert Stibravy | Digital Projects Librarian, Digital Initiatives Irving K. Barber Learning Centre, UBC | robert.stibravy@ubc.ca |
| 14:50-15:10 | Spaceship Earth - summary of an unusual international roundtable | Cornelia Nauen (presented by Rashid Sumaila) | Mundus Maris, Brussels, Belgium | info@mundusmaris.org |
| 15:10 – 15:40 | Coffee break | | | |
| 15:40 – 16:00 | IsotopeBase: a new stable isotope-based trophic addition to FishBase and SeaLifeBase | Todd Miller (presented by ML Deng Palomares) | Head of Fisheries, Division of Fish and Wildlife, Commonwealth of the Northern Mariana Islands, Saipan, Marianas Protectorate | tmiller.dfw@gmail.com |
| 16:00 – 16:20 | Problems in capture fisheries in the Philippines: costs of inaction | Vincent Hilomen | Executive Director for Priority Programmes, Biodiversity Management Bureau, Department of Environment and Natural Resources, Republic of the Philippines | vvhilomen@up.edu.ph |
| 16:20 – 16:40 | Estimation of mean trophic level of the bottom trawl fishery in the North-eastern Aegean Sea (Eastern Mediterranean) | Çetin Keskin | Professor, Istanbul University, Faculty of Fisheries, Istanbul, Turkey | seahorse@istanbul.edu.tr |
| 16:40-17:00 | Occurrence of Brazilian freshwater fish species by state | Kátia Freire | Professora Adjunta, Centro de Ciências Biológicas e da Saúde Núcleo de Engenharia de Pesca, Universidade Federal de Sergipe, Sergipe, Brazil and CAPES/Brazil | kfreire2006@yahoo.com.br |
| 17:00-17:20 | Summary and closing | Kostas Stergiou | Chair, FishBase Consortium, Aristotle University of Thessaloniki, Greece | kstergio@bio.auth.gr |

# BACKGROUND

The FishBase Symposium, held in tandem with the FishBase Consortium Annual Meeting, is usually a local event, emphasizing the contributions of the Vice Chair's institution to FishBase (www.fishbase.org), an online information system on all fishes of the world. The FishBase Consortium is made up of 9 international members, i.e., three European natural history museums, three universities (Fisheries Centre, UBC included), and 3 non-government organisations (details at www.fishbase.org/home).

The FishBase Symposium comes to Vancouver in September 2014 with its theme being embodied in the title, "Big Old Data and Shiny New Insights: Using FishBase for Research" in line with the growing use of "big" data in research meta-analyses.

FishBase is used in research. Google Scholar indicates an h-index=10 for 5,217 citations since its first CD-ROM version was released in 1995. Google Web Analytics run on all of the 9 FishBase mirror sites indicates an average of 0.4M unique visits and about 45M hits a month globally. About 21% of this usage is coming from Canada, and about 3% specific to Vancouver (with a browsing average of 9 pages per visit). The UBC community registers a monthly usage average of 3,500 visitors with a browsing average of 11 pages per visit. From a collection of 227 peer-reviewed articles citing or using FishBase data, 39 are from Canadian institutions, the Sea Around Us research group being one of them.

FishBase's coverage is global, and not only specific to fisheries. A recent Web of Science citation analysis, for instance, shows that parasitologists, among others, cite FishBase the most.

Its long history (25 years since inception) permitted an evolution from a global species database geared for use by fisheries scientists to an information system that offers, in addition to scientific and common names, distribution, ecological and biological data, and research tools for a wide range of fish-related disciplines. The Sea Around Us, the Beaty Museum, and a few other Canadian institutions in collaboration with the FishBase Information and Research Group (FIN) contributed to this evolution.

The Symposium scheduled for 8 September 2014 at the Beaty Museum Auditorium, UBC, Vancouver, Canada is a joint event between the Sea Around Us and the Beaty Museum with funding support from the Consulate General of France in Vancouver, the Nereus Program of the Fisheries Centre and the FishBase Information and Research Group, Los Baños, Laguna, Philippines.

# BACKGROUND

FishBase Symposiums are traditionally geared towards the local research community of the organizer's institution. This year however, we endeavour to extend our reach to collaborators from within Canada, the USA, Brazil, Turkey, the Philippines and Europe. The invited speakers are either FishBase users, collaborators, educators with the aim of teaching FishBase as a research tool or researchers with the aim of linking their research or projects with FishBase. They will talk about the importance of FishBase in "big" data research meta-analyses from taxonomy and nomenclature (William Eschmeyer, California Academy of Science; Nicolas Bailly, WorldFish), to Bayesian predictions of life history parameters (Rainer Froese, GEOMAR, Kiel, Germany) and applications to country-specific fisheries-related case studies (Vincent Hilomen, Department of Environment and Natural Resources, Philippines; Çetin Késkin, Istanbul University, Turkey; Kátia Freire, Universidade Federal de Sergipe, Brazil). Studies in global climate change (William Cheung, Changing Oceans Research Unit, Fisheries Centre), ecosystem-based management (Francisco Arreguin Sanchez, Centro Interdisciplinario de Ciencias Marinas del IPN, Mexico), socio-economics (Yoshitaka Ota, Nereus Program, Fisheries Centre) and links with other fish-related projects (Sandrine Tercerie, OsteoBase Muséum National d'Histoire Naturelle, France; Robert Hanner, Fish-BoL, University of Guelph, Canada; Todd Miller, IsotopeBase, Division of Fish and Wildlife, Saipan, Marianas) will complete the gamut of research applications for which FishBase is used.

With the agreement of the invited speakers, the Symposium proceedings will be published in the FishBase section of the journal ACTA Icthyologica et Pescatoria.

It is also hoped that the Symposium will generate more active collaborations between the Fisheries Centre (Sea Around Us in particular) and the representatives of other institutions, and in particular with the Beaty Museum.

# SPONSORS

**The Sea Around Us, Fisheries Centre, UBC**

**The Beaty Museum of Biodiversity, UBC**

**The Consulate General of France in Vancouver**

**The Nereus Program, Fisheries Centre, UBC**

**The FishBase Information and Research Group**

# HOSTS

**Maria Lourdes 'Deng' PALOMARES**
Senior Research Associate, Sea Around Us, Fisheries Centre, UBC;
and Vice-Chair, the FishBase Consortium

Maria Lourdes 'Deng' Palomares is in charge of issues related to FishBase (www.fishbase.org), a scientific database for the world's fishes and Coordinator for SeaLifeBase (www.sealifebase.org), a database patterned after FishBase for all marine organisms other than fish. Deng was appointed by the Board of the FishBase Information and Research Group (FIN, a Philippine NGO acting as the administrator of FishBase and SeaLifeBase) as Associate Scientific Director in September 2012. Originally from the Philippines, Deng obtained her Ph.D. from the Ecole Nationale Supérieure Agronomique de Toulouse (France) in 1991 and worked with the FishBase Project at the International Center for Living Aquatic Resources Management (Manila, Philippines) for 10 years before joining the *Sea Around Us* in 2001. Deng was the FishBase Consortium Vice-Chair in 2006, Chair Elect in 2007, and accepted another appointment as Vice-Chair in 2014. Deng is a marine biologist with an extensive background in software development, which was instrumental in her path towards fisheries science, trophic ecology and eventually biodiversity information systems.

**Eric TAYLOR**
Professor of Zoology, Director and Curator of Fishes,
Beaty Museum of Biodiversity, UBC

Freshwater fishes represent a spectacular adaptive radiation; about 40% of all fishes (which constitute more than 50% of all vertebrates) are found in freshwater habitats which comprise only 0.8% of the Earth's surface area! I am a Professor in the Department of Zoology and my research focuses on understanding patterns of genetic variation within and between natural populations of fishes, the processes that promote and organize such variation, and their relevance to the origins and conservation of biodiversity. In particular, I am interested in population structure and the historical and contemporary processes that influence population structure, speciation and hybridization (both ecological and genetic mechanisms of divergence and persistence in the face of gene flow), and the implications of these processes to biodiversity conservation. We develop and apply techniques in molecular biology to address questions in the evolution and ecology of natural populations. Molecular genetic (utilizing mitochondrial and microsatellite DNA markers, mtDNA and intron sequencing and RFLP analyses), morphological, and ecological, studies are conducted in the general fields of population genetics, molecular ecology and systematics, and conservation genetics and biodiversity. I am also the Director of the Beaty Biodiversity Museum (BBM), the curator of the Fish Collection at the BBM and a member of Biodiversity Research Centre at UBC. I also teach undergraduate courses in Honour's Research (Biology 447) and Diversity and Evolution of Fishes (Biology 465).

# WELCOME ADDRESSES

Ladies and gentlemen,

It is my pleasure to open, on behalf of UBC, this Symposium, which I understand is the 12th in the 20 year existence of the FishBase Consortium, with its predecessors having been held in cities as diverse as Thessaloniki in Greece, Tervuren in Belgium, Qingdao in China and Vancouver in 2006. I hope that those of you who have been here in 2006 will appreciate all the changes that happened in the UBC campus, notably in the facility we are presently are which is now one of our gems.

UBC is a research university and in 1994, when its newly established Fisheries Centre acquired Dr. Daniel Pauly as a newly minted professor of fisheries, we knew that we would have in him a person who would concentrate on international fisheries with emphasis in the tropics. However, we didn't know that we would, through him, also acquire a stake in FishBase.

This is understandable because FishBase, at the time, was only a little fish biodiversity project in the Philippines competing against lots of little projects of this type, a small fish in a large pool. It is only in 1996 that FishBase went online and begun an ascent which is nothing if not extraordinary, regularly reaching over half a million unique users a month, who might get carpal tunnel syndrome from the 40-50 million times they click on of the multiple pages of FishBase every month.

Though FishBase was initially conceived for use by a few hundred fisheries managers in the tropics, the number of its users grew enormously as its content increased in species coverage and depth and now the majority of its users originate from North America, including Canada with 21% of the global usage, of which about 3% is from Vancouver mostly from UBC. At UBC, the major user of FishBase is the Fisheries Centre whose students and researchers all use it routinely; however, other students and researchers throughout UBC also use FishBase. Much of this use goes through the Canadian mirror site www.fishbase.ca, hosted at the UBC IT department, and one of 8 mirror sites throughout the world.

Thus, FishBase is used at UBC much more than most of the scientific journals we subscribe to. In recognition of this fact, I suggest that the FishBase Consortium enter with the UBC library in a dialog about ways it could collaborate with FishBase, such that some of the library holding related to fish would be available through FishBase, and a dedicated version of 'FishBase-at UBC' created to which the library could subscribe. If an arrangement of this sort can be negotiated, you may then turn to other universities in Canada and the USA to propose similar arrangements which could help address the perennial funding problem which, I am told, besets FishBase, as it does many of similar ventures, such as Wikipedia.

I make this suggestion because FishBase represents the best of scientific cooperation. It is international, with over 2,000 formal collaborators in essentially all countries of the world. It is run by a non-profit international consortium that is diverse and based in three continents. And it maintains and deepens a scientific tool that is of universal appeal, used in virtually every university of the world and everywhere else where people work on fish, from the fishing and processing industry to the governments of various countries and back to the tourism industry, not to speak of thousands of kids who used it for their homework. Also, it is an international product with a strong Canadian component. Indeed, I am told that the UBC fish collection that was then housed in the bowels of the Zoology Building, and now part of the Beaty Biodiversity Museum collection, is one of the first museum collections integrated into FishBase, through an agreement between our Professor Don McPhail, now retired, and Daniel Pauly. This gave FishBase the credibility to talk with curators of other collections in North America, thus giving FishBase in the mid-1990s a boost that it needed to get into the big league.

I hope that the collaboration with the UBC library, will give FishBase another similar boost, at least in North America, so that universities and libraries which make wide use of FishBase can do their share in the support of this wonderful tool, and deepen its coverage in the process.

I wish you good luck in your deliberations and good luck to the future of FishBase.

**John W. HEPBURN**
Vice President Research and International,
University of British Columbia

John Hepburn was born in Hamilton, Ontario, and was educated at the University of Waterloo (BSc, 1976), University of Toronto (PhD, 1980), and University of California Berkeley (NATO Postdoctoral Fellow, 1980-82). He began his academic career back at the University of Waterloo, where he was appointed an Assistant Professor of Chemistry and Physics in 1982, and ultimately Chair of Chemistry in 1998. In 2001, he moved to the University of British Columbia as a Professor of Chemistry and Physics & Astronomy, and Head of Chemistry. He became Dean of Science in 2003, and Vice President, Research in 2005. The international portfolio was added to John’s list of responsibilities in August 2009. He has been a Fellow of the A.P. Sloan Foundation, a Foreign Research Fellow of the CNRS (France), and a Canada Council Killam Fellow. He has been awarded the Rutherford Medal and the Noranda Prize and is a Fellow of the Royal Society of Canada, the American Physical Society, and the Canadian Institute for Chemistry. In addition to his work at UBC, John Hepburn currently serves as a Board member for numerous organizations.

# WELCOME ADDRESSES

**Ted SCHMITT**
Head, Technology Projects,
Vulcan and Paul G. Allen Family Foundation

Ted Schmitt leads technology projects for philanthropic initiatives at Vulcan and the Paul Allen Family Foundation. Prior to joining Vulcan, Ted was a Senior Program Officer for the Computer Science and Telecommunications Board at the National Academies of Science, where he directed studies on topics ranging from disaster communications, healthcare IT, to broadband policy. He served as Technical Director at several technology start-ups in Germany, Sweden, and the United States, leading projects applying technology for impact on a range of issues. He started his career in 1984 as a software engineer for IBM, earning patents and several technical achievement awards. Ted holds an MA in International Science and Technology Policy from George Washington University, a BS in Electrical Engineering, and a BA in German from Purdue University. He also studied at Universität Hamburg, Germany.

# WELCOME ADDRESSES

I am very pleased to welcome all to the Twelfth Annual FishBase Symposium: *Big Old Data and Shiny new Insights: Using FishBase for Research* (FishBase 2014) being held at the Beaty Biodiversity Museum (BBM) at the University of British Columbia (UBC, Vancouver).

By way of introduction, the BBM is Vancouver's natural history museum and has been open since October of 2010. The BBM consists of more than two million biological specimens, from fossils to fishes, arranged in six major collections: the Spencer Entomology Collection, the UBC Fish Collection, the UBC Herbarium, the Cowan Tetrapod Collection, the Marine Invertebrate Collection, and the Fossil Collection (which is also a part of the Pacific Museum of the Earth at UBC). These collections (or about 99.9% of them) are housed in state-of-the-art archival units that are arranged in such as way as to provide access to the public in an engaging and educational manner to promote a better understanding of the importance of biodiversity and collections-based research.

The BBM has been very successful since its 2010 opening; we have welcomed over 100,000 visitors from around the world, including literally hundreds of school groups, hosted other symposia and scientific talks, held biodiversity-themed art exhibitions, and engaged in many aspects of biodiversity research.

The vision of the BBM is a world where biodiversity, and its importance to humans, is better understood, valued, and protected. We strive towards this vision by engaging in collections-based research, education, and public outreach.

As the director of the BBM, the curator of fishes, and a professor of zoology, I am particularly pleased that FishBase 2014 is being held at the BBM. First, I encourage any meeting that explores the wonderful world of the biology of fishes and helps us to protect them. Second, FishBase 2014 allows us to showcase the BBM and its tremendous legacy of biological collections from BC, Canada and the world. Finally (and please excuse the boast here), but it is great to have FishBase 2014 at the BBM. The importance of a globally accessible database on fishes that included access to biological collections for research and education was recognized very early on with a partnership between my colleagues Drs. Don McPhail (professor and curator emeritus) and Daniel Pauly who entered into a partnership in 1995 that resulted in the UBC Fish Collection being the **first** to be indexed and accessible through FishBase. This novel partnership grew to 40 collections in FishBase.

Finally, I want to thank our sponsors, the Consulate General of France in Vancouver via Mr Mathieu Leporini, The Nereus Program of the Fisheries Centre via Dr Yoshitaka Ota and The FishBase Information and Research Group via Dr Mary Ann Bimbao.

I also thank Dr. Deng Palomares who, despite my co-chairmanship of this meeting, actually did all the work! I also appreciate the invitation from Deng and Daniel to participate in the meeting, and Deng and I thank the team at the BBM for assisting with meeting logistics. I look forward to an interesting set of talks and discussions.

**Eric B. (Rick) TAYLOR**
Professor of Zoology
Director and Curator of Fishes
Beaty Biodiversity Museum

# SYMPOSIUM RATIONALE

Welcome and please note that I have no PowerPoint presentation – look mommy, no hands…!

One could argue that no symposium, i.e., 'drinking together', needs a rationale; drinking together needs none but then, I don't drink. It could also be argued that doing the 12$^{th}$ of anything needs no rationale – you just do it because you have done it 11 times before. This is also not good. The real rationale is that we are constantly challenged to restate and reaffirm what is behind FishBase and how it can be enhanced and used to best effect by a wide range of people from all walks of life.

The original reason for FishBase was to provide key data for managing fisheries in developing countries in Africa, the Caribbean and the Pacific (ACP) countries, i.e., the former colonies of countries of the European Union, which initially funded FishBase. Its growth was extraordinarily rapid because of an emphasis on content, not design, and because it was opportunity driven, i.e., concentrated on encoding existing data sets. However, FishBase was soon found to be a useful source of data outside of the intended clients, e.g., diving resorts, the Dutch custom office, aquarium shops, and ultimately US high school students working on science projects – all attracted by the content of FishBase.

But new science based on the 'old data' in FishBase took a while to emerge. One major initiative in this will be presented to you by Rainer Froese – the use of FishBase to estimate prior distributions for parameters to be used in Bayesian stock assessments. In a sense, FishBase is now was initially designed for, but for developing and developed countries, which is neat.

This builds on a principle we noted earlier, that 'quantity leads to quality'. Thus, a set of growth parameters, for example is 'validated' if it is within a cloud of other such parameters, in doubt when not, whatever its source - *Nature* or the Tuvalu Department of Fisheries – which brings us to 'Big Science'.

The earliest examples of big science were astronomy, then geography and oceanography. I don't know which precise data are transferred in astronomy, but I know that major discoveries were made by Johannes Kepler and later Nicolaus Copernicus on the basis of painstaking observational data collected by Tycho Brahe by watching the Danish sky for decades with the naked eye. Similarly, Geography built on the knowledge encoded in early maps, which are ancient communication tools. Here knowledge could be accrued cumulatively; Geography was a big science from the onset.

Meteorology and physical oceanography built on this model. Thus, Matthew Maury of the US Navy traded local knowledge about currents, winds and depth soundings against maps generalizing the observations of hundreds of cooperating mariners in the North Atlantic. This established a pattern for these disciplines, which additionally, deal with easy-to-encode numerical observations.

## SYMPOSIUM RATIONALE

But biology, before the advent of DNA sequences, did not seem to have ‘encodable’ knowledge outside of nomenclatural and distributional data. The literature seemed too disparate. What was required, thus, was a re-definition of all aspects of ichthyology in form of multiple choice and numeric fields. This is what allowed for scattered information on fishes to become encodable. This is what permits FishBase, via the power of relational databases, to contribute to science. Because doing science, to a large extent, is establishing relationships between things that were thought to be unrelated. This is FishBase!

**Daniel PAULY**
Principal Investigator, the Sea Around Us, Fisheries Centre
and Professor of Zoology, University of British Columbia

Born in France and raised in Switzerland, Daniel Pauly studied in Germany, where he acquired a doctorate in fisheries biology in 1979, from the University of Kiel. He did his first intercontinental travel in 1971 (from Germany to Ghana for field work related to his Masters) and has since experienced a multitude of countries, cultures, and modes of exploiting aquatic ecosystems in Africa, Asia, Oceania and the Americas. This perspective allowed him to develop tools for managing data-sparse fisheries, as prevailed for example in the Philippines, where Dr. Pauly worked through the 1980s and early 1990s. In 1994, Dr. Pauly became a Professor at the University of British Columbia Fisheries Centre, and was its Director from 2003 to 2008. In 1999, Daniel Pauly founded, and since leads, a large research project devoted to identifying and quantifying global fisheries trends, funded by the Pew Charitable Trusts and called The Sea Around Us after Rachel Carson’s 1951 bestselling book. Daniel Pauly is also co-founder of FishBase (www.fishbase.org), the online encyclopedia of more than 30,000 fish species, and he has helped develop the widely-used Ecopath modeling software. He is the author or co-author of more than 500 scientific and other articles, books and book chapters on fish, fisheries and related topics. Two of news books, reflecting his current interests were published in 2010: “Five Easy Pieces: Reporting on the Global Impact of Fisheries” and “Gasping Fish and Panting Squids: Oxygen, Temperature and the Growth of Water-Breathing Animals”.

# FROM DATA TO BEST AVAILABLE KNOWLEDGE: RECENT DEVELOPMENTS IN FISHBASE[1]

**Rainer FROESE**, GEOMAR, Kiel, Germany; rfroese@geomar.de

In most fields, the number of annually published studies far exceeds the ability of specialists to absorb or even read them. Over the past 24 years, FishBase has selected studies with key information on growth, maturity, mortality, reproduction and diet of fishes and has encoded these data in a standardized form. Yet, this leads to four questions: (1) For a species with many studies on a topic, how can this information be best summarized? (2) For a species with only one available study, how representative is it? (3) For a species with no dedicated study, how can information from related species be used? (4) How can existing information inform a new study? The answer to all of these questions is provided by Bayesian hierarchical inference, where prior and related knowledge is combined with the analysis of new data to provide posterior "best" knowledge with indication of uncertainty. In this example, a certain piece of knowledge, which was available for only a few thousand species, is spread to all 32,000 species of fishes in FishBase. This approach will be expanded stepwise, with the goal to have an estimate of resilience for all fish species in about two years from now.

[1] Cite as: Froese, R. 2014. From data to best available knowledge: new developments in FishBase, p. 13-18. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

## From Data to Best Available Knowledge
## New Developments in FishBase

Rainer Froese, GEOMAR, rfroese@geomar.de
12th FishBase Symposium
Big Old Data and Shiny New Insights: Using FishBase for Research
Beaty Museum of Biodiversity, UBC, Vancouver, 09.09.2014

## Overview

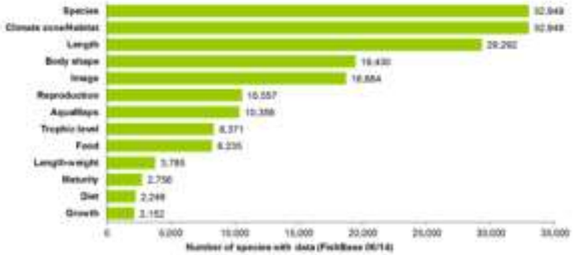
- Data in FishBase as of August 2014
- From Data to Insights
- Example of Qualifying, Summarizing and Spreading Existing Knowledge
- The Most Important Number
- Ongoing Research Towards that Number
- Discussion


## Data in FishBase


## Available Data

## Available Data for Growth

## Data in FishBase




## From Data to Insights

FishBase has compiled thousands of studies on growth, maturity, reproduction, diet, etc

- How can the information be summarized?
- How good is a single study?
- How can new studies be informed?
- How can best estimates for species without studies be derived?

## From Data to Insights

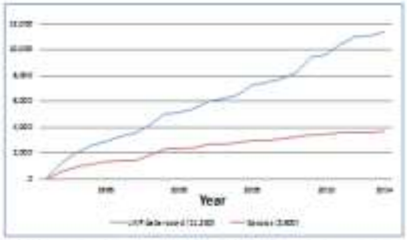
- Assemble all relevant facts, with probability distributions
- Establish their correlations, with probability distributions
- Select suitable models to explain data and predict key parameters
- Let the computer test all possible combinations and select those with highest overall probability

## Bayesian Inference in a Nutshell

- Prior: express existing knowledge (textbook, common sense, logic, best guess, previous studies) with a central value (such as a mean) and a distribution around it (such as a normal distribution and a standard deviation).
- Likelihood function: analyze new data, get the mean and distribution
- Posterior: Combine prior and likelihood into a new, intermediate mean and distribution

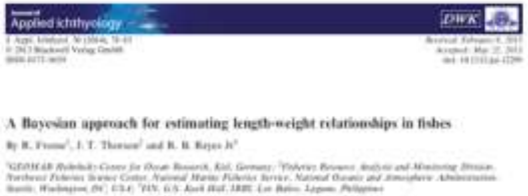
*From data to best available knowledge*, Froese, R.

## Accumulation of LWR and species with LWR

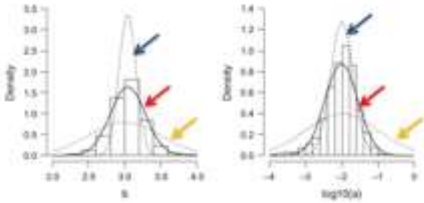



- 3,600 species have LWR; 28,400 do not
- 284 families do not have a single LWR
- Search for refs showed this as a knowledge gap

## Length Weight Relationships




## LWR Across All Studies




Weighted distribution of parameters *b* and log10(*a*) in 5150 studies for 1821 species.
— from mean and standard deviation of the data
— from overall priors derived from the literature
— predictive posterior distribution

## Body shape priors

- Eel-like (1,700 species)
- Elongated (7,300 species)
- Fusiform (7,100 species)
- Short and /or deep (2,600 species)

- Other (700 species; e.g., seahorses)

## LWR Priors

| Body shape | Mean log10(a) | SD log10(a) | Geom. mean a | 95% range a | Mean b | SD b | 95% range b | n |
|---|---|---|---|---|---|---|---|---|
| eel-like | -2.99 | 0.175 | 0.00102 | 0.000464 – 0.00225 | 3.06 | 0.0896 | 2.88 – 3.24 | 162 |
| elongated | -2.41 | 0.171 | 0.00389 | 0.00180 – 0.00842 | 3.12 | 0.0900 | 2.94 – 3.30 | 712 |
| fusiform | -1.95 | 0.173 | 0.0112 | 0.00514 – 0.0245 | 3.04 | 0.0857 | 2.87 – 3.21 | 3478 |
| short & deep | -1.70 | 0.175 | 0.0200 | 0.0182 – 0.0218 | 3.01 | 0.0905 | 2.83 – 3.19 | 798 |
| all | -2.00 | 0.313 | 0.0100 | 0.00244 – 0.0411 | 3.04 | 0.119 | 2.81 – 3.27 | 5150 |

Weighted means and standard deviations of parameters ***a*** and ***b*** from 5150 studies for 1821 species of fishes, by body shape. Geom. mean = geometric mean and 95% range includes about 95% of observations.

## LWR for all species
## Example: *Cyclopterus lumpus*

**Estimates of some properties based on models**

Phylogenetic diversity index (Ref. 82805): $PD_{50}$ = 1.0000 [Uniqueness, from 0.5 = low to 2.0 = high].

Bayesian length-weight: a=0.02344 (0.00888 - 0.06186), b=3.02 (2.79 - 3.25), based on LWR estimates for this Subfamily-body shape (Ref. 93245).

Trophic Level (Ref. 69278): 3.9 ±0.1 se; Based on diet studies.

Resilience (Ref. 69278): Low, minimum population doubling time 4.5 - 14 years (K=0.12; tm=3-5; tmax=13; Fec=100,000).

Vulnerability (Ref. 59153): High vulnerability (63 of 100).

Price category (Ref. 80766): Low.

*From data to best available knowledge*, Froese, R.

## Self-Learning Database

- When Daniel and Rainer first discussed about FishBase, they envisioned an artificial intelligence system
- Some years (decades) later, we are getting there:

  the addition of LWRs for 16 species improved LWR quality for over 400 species

## The Most Important Number

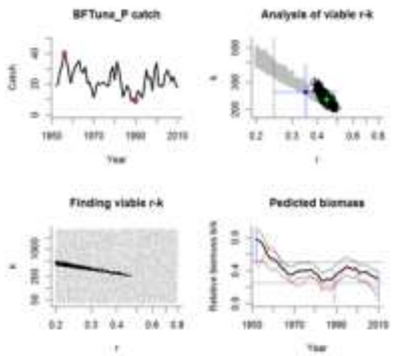
$r_{max}$

maximum intrinsic rate of population increase

Determines:

- productivity ($F_{msy}$)
- population recovery time
- resilience
- vulnerability

## The Most Important Number




Estimating viable r-k pairs from catch and resilience

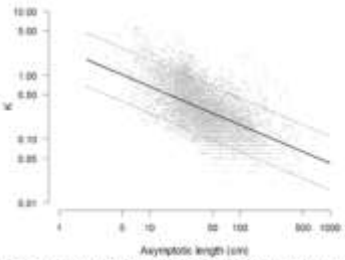
## The Most Important Number

$r_{max}$

is highly correlated with

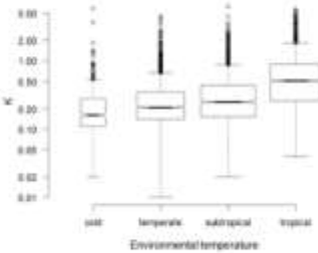
- age at maturity / generation time
- body size
- natural mortality
- somatic growth rate
- metabolism/temperature
- life style / activity

## Ongoing Research



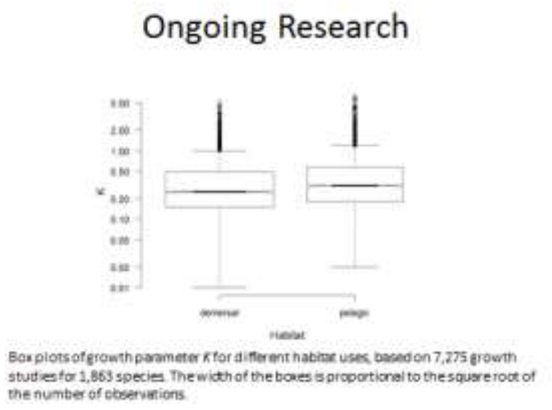

Growth parameter *K* plotted over asymptotic length, based on 7,275 growth studies for 1,863 species, with the bold line representing the mean for demersal subtropical species and with dashed lines indicating the 95% high density interval. Note that these lines would shift upward for tropical species and downward for temperate and cold species, with the same slope.

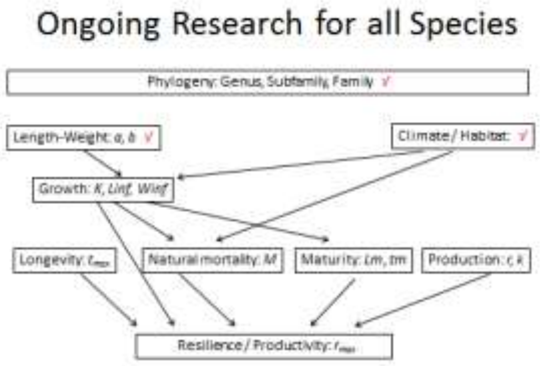
## Ongoing Research

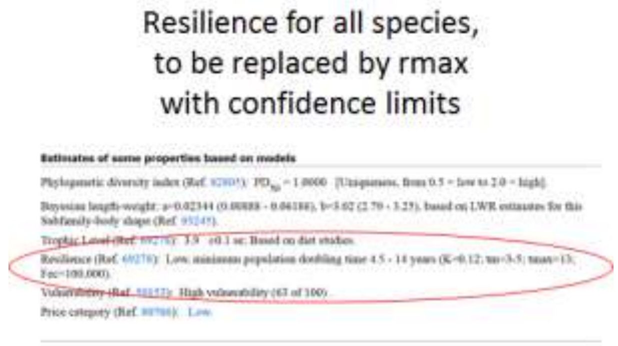



Box plots of growth parameter *K* for different environmental temperatures, based on 7,275 growth studies for 1,863 species. The width of the boxes is proportional to the square root of the number of observations.

*From data to best available knowledge*, Froese, R.




Rainer Froese is senior scientist at the GEOMAR Helmholtz Centre for Ocean Research in Kiel, Germany. Together with Daniel Pauly he ‘invented’ FishBase (www.fishbase.org) and since 1990 he is FishBase Project Leader and Coordinator. FishBase is the most widely used biological information system with over half a million visitors per month. Froese is author of over 100 scientific publications with over 2,000 citations in the primary literature. His research interests range from fish biology, population dynamics, aquatic biodiversity and biogeography to improved fisheries management. He was also a founding member of Species 2000, an initiative to compile scientific names of all organisms on Earth, and of the Ocean Biogeographic Information System (OBIS), the information component of the Census of Marine Life program. In addition to FishBase, Froese coordinates the AquaMaps project, which has created the first global atlas of the living ocean (www.aquamaps.org). This ‘largest-ever’ atlas is now in its third edition, with digital distribution maps for over 17,000 species, including all marine mammals, about half of all marine fishes and several thousand invertebrates such as cephalopods or crustaceans. The atlas shows which of these species occur at any given spot in the Oceans, and also where these species may occur by 2100, given predicted climate change. Froese is fisheries biologist by training and has published numerous papers documenting the worrisome state of global and European fish stocks. Currently he is working on innovative methods to estimate the status of fish stocks for which only limited data are available, i.e., the majority of European as well as global fish stocks. More information and a full list of publications are available on Froese’s personal page at http://www.fishbase.de/rfroese.

# CATALOG OF FISHES: THE GLOBAL NOMENCLATOR AND TAXONOMIC AUTHORITY FOR FISHES[2]

**William N. ESCHMEYER**
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The Catalog of Fishes database (http://research.calacademy.org/ichthyology/catalog) is the nomenclator for fishes, recording their original names, type information and nomenclature issues from the original descriptions of genera and species. It is also the global taxonomic authority file as it gives the current valid name for all original names. It records the intermediary name and taxon assessments and statuses from the primary taxonomic literature since it started in the mid-1980s. It has been maintained for 30 years and includes information on about 55,000 available species and 11,000 genera. About 33,500 species are valid.

New species are being described at an average rate of one species per day for the past 20 years (17 years if only valid species are retained) with a noticeable acceleration at the turn of the millennium (ca. 385/year in the period [1999-2013] against ca. 285/year [1984-1998]). More freshwater species than marine are described constantly since 1955 (between min. 56% in 1984 and max. 65% in 2013 in the past 30 years [1984-2013]). More recently, the list of family names was compiled, and the status of the current list will be presented. The Catalog of Fishes and FishBase share a long history of collaboration since the mid-1990s, and are still cross-checking and synchronizing their data entries. In a way the benefits of the well-known double-entry procedure for database quality control has been rediscovered on the ground. Anyhow, a number of problems regularly emerged from that collaboration, recurrent issues that are undermining rapid progress in data sharing in biodiversity informatics, such as the proper data re-use and citation from third parties in aggregators, and discrepancies between two databases due to different goals and uses, database structure, update frequency, etc. In addition to names, a number of other datasets were collated with the help of a number of ichthyologist colleagues: references, journals, fish collections, and webpage browsing tools were developed to navigate in the classification and to check taxon statistics at one glance. As a recommendation, when colleagues cite fish numbers (total or per family or genus or else), they should rather refer to the Catalog of Fishes that is the most updated, and not anymore to J.S. Nelson’s Fishes of the World: since the latest edition in 2006, ca. 3,300 valid spp. were described (10% of all valid species!) in 229 families (41%) in 1,050 genera (21%).

[2] Cite as: Eschmeyer, W. 2014. Catalog of fishes: the global nomenclator and taxonomic authority for fishes, p. 19-23. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

*Catalog of Fishes*, Eschmeyer, W.

## Catalog of Fishes

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## In the Beginning (Circa 1965-1970)

No PCs
No Google
No internet
No email
No databases
No scanners
No Xerox machines
No word processers
No gps
No trees

## 15 year later (ca 1985)

- PCs (slow)
- Copy machines
- Database software (primitive)

"My 10-year project"

All genera and species of fishes, all original descriptions, location of types, etc., in a database.

## After 1990 What Happened

More workers
Scuba, then rebreathers
New techniques (submersibles, etc.)
More survey work/conservation
Molecular studies/bar coding/gen bank
Better communication (literature, types, etc.)
Xerox machines, then scanners, pdfs
Team approach
Digital photography
Species concepts changed some
Catalog of Fishes/FishBase
Online literature
More journals
More exploration (esp. freshwater)
Difficulty collecting (due to restrictions)

Species per Author (Top 9)

| Author | Valid | Syn. | Undoc. | Total | % valid |
|---|---|---|---|---|---|
| Bleeker | 820 | 794 | 324 | 1938 | 43 |
| Valenciennes | 660 | 958 | 231 | 1850 | 36 |
| Günther | 919 | 562 | 153 | 1634 | 56 |
| Fowler | 572 | 692 | 181 | 1445 | 40 |
| Jordan | 687 | 563 | 107 | 1357 | 51 |
| Boulenger | 789 | 309 | 36 | 1134 | 70 |
| Cuvier | 419 | 513 | 125 | 1057 | 40 |
| Steindachner | 530 | 298 | 210 | 1029 | 52 |
| Regan | 566 | 281 | 87 | 934 | 61 |

## Rhinopias argoliba


*Catalog of Fishes*, Eschmeyer, W.

### Where are the new species?

- A. Few new Taxa:

- North America freshwater.
- Europe freshwater.
- Most of Australia.
- North Pacific, most of Atlantic.
- Antarctica (shallow).
- Shallow reefs.
- Africa freshwaters (except Rift Lakes).
- Mediterranean, Red Sea, Caribbean Sea, Arctic.
- (Large species, pelagic species, commercial species).

***"It is now difficult to find new shallow water reef species"* (J. E. Randall)**

***"There are many new deep reef species but few new genera"* (R. Pyle)**

### Where are the new species?

B. Most New Taxa

- South America freshwater
- Asia freshwater
- Indonesia freshwater
- Indian Ocean
- SW. Pacific
- Certain deep-sea depths
- Deep reefs
- African Rift lakes, Congo basin
- Specialized habitats: seamounts, rises, deep rocky areas
- (Small fishes)

### SPECIES AND SUBSPECIES VS. TIME (ROUNDED AVERAGES)

| *Period* | *Species* | *Subsp.* | *% Subsp.* | *Total* |
|---|---|---|---|---|
| ***1950-59*** | 166 | 26 | 13.4 | 192 |
| ***1960-69*** | 179 | 19 | 9.4 | 198 |
| ***1970-79*** | 196 | 22 | 10.2 | 219 |
| ***1980-89*** | 269 | 14 | 5.0 | 282 |
| ***1990-99*** | 253 | 5 | 2.0 | 258 |
| ***2000-08*** | 399 | 4 | 1.0 | 403 |

- **Total taxa per year increased over the last 50 years**
- **Use of subspecies in fishes has declined substantially**

### Conclusions

Species/subspecies

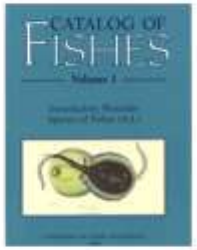
- Decline in new subspecies from about 20% to 1%
- Average per year max about 350-400
- % valid/described – about 50% valid as species, now about 90+ percent
- Describers – about 50 until late 1800s, great increase since 1950
- Molecular – few new species taxa so far, useful for relationships/higher categories

- Estimates: 2000. Maximum, 25000 valid (too low).

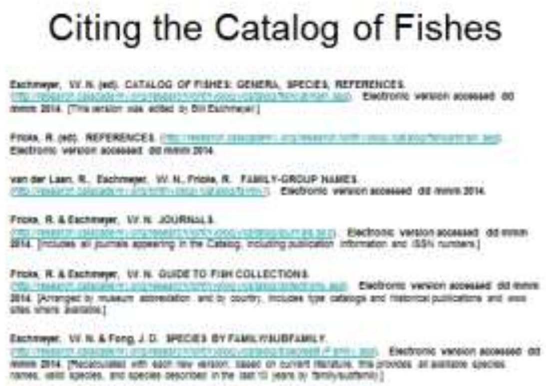
- HOW MANY VALID – 32,400 (now); 40,000 by 2050

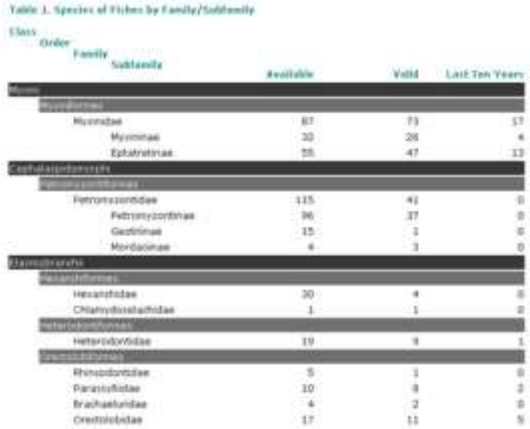
### Catalog of Fishes - 1990

### Catalog of Fishes – 1998 One of Three



*Catalog of Fishes*, Eschmeyer, W.



*Catalog of Fishes*, Eschmeyer, W.



In the early years, my research was in traditional taxonomy - revisions and new taxa primarily of scorpionfishes, stonefishes and their allies. These revisions continued while I spent about 8 years in administration, ending as Director of Research. In the early 1980s, I decided to “organize the information of ichthyology” as I called it. The importance can be summarized in that I did a “little bit of every ichthyologist’s research” - tracking down nearly all original descriptions, building a database of all available names in fishes, going to many collections gathering information on types, solving nomenclatural issues and assisting ichthyologists with inquiries. The first volume of the Catalog of Fishes, treating the genera, was published in 1990. This was followed in 1998 by publication of all genera, species, and original literature. Regular online editions have been posted continuously. New species in 2008 numbered over 500. Into the early 1900s, the number of authors describing new species in a year was about 50; now hundreds of enthusiastic workers per year have the experience of describing new fish taxa and contributing to our knowledge of fishes. It is an interesting time for us all, and I look forward to receiving pdfs weekly. My health is good, and I am as enthusiastic as ever to continue the Catalog of Fishes project.

# NEW CLASSIFICATION OF BONY FISHES IN FISHBASE?[3]

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G. Ortí, The George Washington University, Columbian College of Arts & Sciences, Department of Biological Sciences, 2023 G St. NW, Washington DC, 20052, USA

Since its creation in 1990, FishBase, a global Biodiversity Information System on all finfishes of the World (ca. 33,000 species) has used a mix of the classifications from the four editions of J.S. Nelson's Fishes of the World (FoW 1976, 1984, 1994, 2006) and the intermediary improvements endorsed by W.N. Eschmeyer's in the regular updates of his Catalog of Fishes (CofF). For a longer time, the irresolution of the Acanthomorpha clade was described by G. Nelson (1989) as "the bush at the top of the teleostean tree". Indeed the Perciformes, the most speciose order of that clade (a third of all finfishes), was known to be polyphyletic as early as the 1930s. Although a number of suborders were well defined, their interrelationships were not established even with the starting molecular phylogenetic methods in the 1980s: depending on the gene and taxonomic sampling, the results were contradictory. More recently, the Scorpaeniformes were clearly dismantled by such studies, but in 2006, J.S. Nelson did not endorse the changes yet because he correctly pointed out that without the resolution of Perciformes, nobody would be able to place the suborders that were separated from the Scorpaeniformes new definition!

In 2010, Wiley and Johnson published a new classification of the Teleostei on the basis of evidenced and published morpho-anatomical synapomorphies, addressing J.S. Nelson's issue. In 2013, Betancur-R. et al. published a new phylogeny of the Osteichthyes (bony fishes) on the basis of 21 molecular markers (one mitochondrial and 20 nuclear genes) for 1,410 bony fish taxa from 1,093 genera in 369 families, and all traditionally 49 recognized orders. Besides the resolution of new clades, this analysis confirmed many proposals by Wiley and Johnson. A second iteration was published on the web (www.deepfin.org/Classification_v2.htm) with 1,591 bony fish taxa in total incl. additional 165 genera (total 1,258 over ca. 4,900 valid ones) and 25 families (total 394 over ca. 520 valid ones), taking into account the results of Near et al. (2013) and remarks from other colleagues. The combination of the extensive sampling in genes and taxonomy correlated with the morpho-anatomic synapomorphies makes the classification based on this phylogeny

[3] Cite as: Bailly, N., Betancur, R.R., Wiley, E., Miya, M., Lecointre, G., Orti, G. 2014. New classification of bony fishes in FishBase?, p. 24-30. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

an important milestone in Ichthyology that should be endorsed by many global initiatives and information systems around the world.

FishBase helped to cross-checked the classifications in CofF, FoW2006, and FishBase, and for nomenclature issues: discrepancies are available in a downloadable MS-Excel file in the DeepFin webpage, as well as the list of families not yet examined with a call to ichthyologist colleagues to provide with tissues or already published results that would have been overlooked. On the web, the DeepFin classification webpage and the FishBase family summary pages are already cross-linked.

Can FishBase endorse that new classification at that point? As far as possible, we would like that other initiatives move as well in a short time-span to avoid the confusion for users. Indeed, some intermediary ranks established by that classification are still debatable (and debated!). But the orders and families that are confirmed or newly established will be without doubt the framework for further research in the next 50 years just like the revolutionary classification of Greenwood et al. (1966) has been up to now. As FishBase and CofF do not use the intermediary ranks, the changes incurred should not be a complicated task, but certainly tedious. However, the 9 series strongly supported in Percomorpha could be included because they will help to clarify the overall biological, ecological, biogeographical, exploitation and conservation understanding of that clade using information stored in FishBase. Another novelty is the elevation of polypters at Class rank. Incidentally, the international community through the Catalogue of Life is currently addressing the issues raised at that taxonomic Class level where FoW and CofF were different (6 classes in CofF that were subclasses in FoW): if the DeepFin classification is endorsed as such then amphibians, birds, mammals cannot be classes, which might be a change hardly acceptable by the rest of the society, at least not without a long educational process. Solutions are under study.

Such a classification must be the result of an international collaborative work, just like is FishBase. It is also important that the interoperability between global (CofF, FishBase, ASFIS, CoL, Fish-BoL, IUCN, CITES, WoRMS, FADA, EoL, …), regional (ITIS, ERMS, FaEU, STEP, …), and national (ALA, CaRMS, INPN, …) initiatives is conserved for the convenience of users of one finfish classification. It must not prevent that alternative classifications are confronted within the taxonomic ichthyology community as its scientific work. Such a classification could also be seen as a recognized consensus and a management hierarchy helpful to manage knowledge about finfish. Already a third iteration is planned before the summer so the oral presentation will be based on the new results.

*New classification of bony fishes*, Bailly, N. *et al*.

## New classification of bony fishes in FishBase?

08 September 2014
Beaty Museum of Biodiversity
University of British Columbia, Vancouver, Canada

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**G. Ortí, G. Washington Univ., Washington DC, USA**

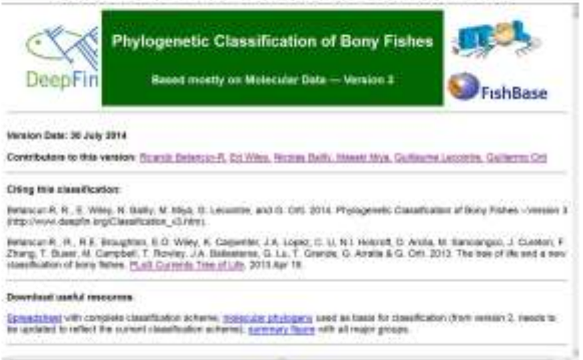
**A new classification of bony fishes published in 2013**


**Material and method** (v1 & **v3)**

- DNA sequence data for **21 molecular markers** (one mitochondrial and 20 nuclear genes)
- 1410 bony fish species (5%) **1596 (4%)**
- 1093 genera (22%)
- 369 families (75%) **394 (79%)**
- 49 orders (100%) **67 (100%)**
- Names up family level checked against CofF
- Names above from Wiley & Johnson 2010
  Wiley, E.O., and G.D. Johnson. 2010. A teleost classification based on monophyletic groups, p. 123-182. In: Origin and Phylogenetic Interrelationships of Teleosts. J. S. Nelson, H. P. Schultze, and M. V. H. Wilson (eds.). Verlag Dr. Friedrich Pfeil, München, Germany.

**Version 3, 30th July 2014**

- Version 2 (27 Nov. 2013) and 3 on the web




**Integrate the DeepFin classification in FishBase? Challenges**

- **Socio-psychological**:
- Resistance to changes, even when well documented (remember Grenwood et al. 1966)
- Competition, recognition, career …

**Integrate the DeepFin classification in FishBase? Challenges**

- **Technical**:
- Reassign species though genera and families, included those missing in the analysis
- Multiclassifications?

**Integrate the DeepFin classification in FishBase? Challenges**

- **Networking**:
- Importance to keep interoperability between information systems:
  Global (CofF, Fow, FishBase, ASFIS, CoL, Fish-BoL, IUCN, CITES, WoRMS, FADA, EoL, ...);
  Regional (ITIS, ERMS, FaEU, STEP, ...), and
  National (ALA, CaRMS, INPN, ...)...

**Integrate the DeepFin classification in FishBase? Challenges**

- **Users**:
- Avoid confusion in the front-end for end-users
- Keeping a back-end dedicated to specialists.

**What changes are we talking about?**

- Two frameworks of reading:
  What matters for CofF and FB:
  The main level point of view:
  (Kingdom, Phylum,)
  Class, Order, Family, Genus, Species
- All intermediary ranks
  What is reported in CofF and DF:
  (Almost) all phylogenetic nodes with given intermediary ranks

**20 ranks in DF classification**

| | |
|---|---|
| Megaclass | Section |
| Superclass | Subsection |
| **Class** | Division |
| Subclass | Subdivision |
| Infraclass | Series |
| Megacohort | Superorder |
| Supercohort | **Order** |
| Cohort | Suborder |
| Subcohort | Infraorder |
| Infracohort | **Family** |

**Pholidichthyiformes with Cichlidiformes?**

Copyright © Jensen, Johnny

Copyright © Fürderer, Heike

**What changes are we talking about?**
**Families "new" 17 (6 really new)**
**168 spp. + ca. 18 = ca. 200 spp (0.6%)**

| | | |
|---|---|---|
| Bembropidae | (SF) | Scorpaenichthyidae |
| Botiidae | (SF) | Diplophidae |
| Congrogadidae | (SF) | Horabagridae |
| Gaidropsaridae | (SF) | Jordaniidae |
| Girellidae | (SF) | Sinipercidae |
| Niphonidae | (Tribe) | Sudidae |
| Paralichthodidae | (SF) | |
| Poecilopsettidae | (SF) | |
| Rhombosoleidae | (SF) | |
| Steindachneriidae | (SF) | |
| Zaniolepididae | (SF) | |

*New classification of bony fishes*, Bailly, N. *et al*.

### What changes are we talking about?
### Families "lost" 19 (124 spp 0.4%)

| | | | |
|---|---|---|---|
| **Centracanthidae** | **Sparidae** | Comephoridae | Cottidae |
| **Phractolaemidae** | **Kneriidae** | Cottocomephoridae | Cottidae |
| **Scaridae** | **Labridae** | Hemitripteridae | Agonidae |
| **Caesionidae** | **Lutjanidae** | Latidae | Centropomidae |
| Abyssocottidae | Cottidae | Microdesmidae | Gobiidae |
| Achiropsettidae | Rhombosoleidae | Olyridae | Bagridae |
| Anotopteridae | Alepisauridae | Omosudidae | Alepisauridae |
| Arapaimidae | Osteoglossidae | Perciliidae | Percichthyidae |
| Bathylutichthyidae | Psychrolutidae | Scomberesocidae | Belonidae |
| | | Sundasalangidae | Clupeidae |

### What changes are we talking about?

- 36 families affected over 502 7% → 496 (330 spp. 1% )
- Number of non-monophyletic families:
  41 in version 2
  30 in version 3

### Non-monophyletic families: issues to be solved
### 30 (1258 spp 4%)

| | |
|---|---|
| Acropomatidae | Macrouridae |
| Agonidae | Nototheniidae |
| Alepocephalidae | Ophidiidae |
| Bathydraconidae | Paralepididae |
| Bathymasteridae | Paralichthyidae |
| Bythitidae | Phosichthyidae |
| Chlorophthalmidae | Polyprionidae |
| Clupeidae | Scombridae |
| Cottidae | Scopelarchidae |
| Gempylidae | Scorpaenidae |
| Grammatidae | Sternopygidae |
| Gymnotidae | Stichaeidae |
| Hemiramphidae | Synodontidae |
| Ipnopidae | Trachichthyidae |
| Labrisomidae | Zenarchopteridae |

### Attempt to define criteria

## Within and constrained by an established phylogeny

- **Morphologic**: The more taxa look alike the more and at higher rank they should be classified together
- **Ecologic**: in particular the life zone (salt or fresh waters)
- **Ontogenic**: about the morphology/anatomy of larvae.
- **Practical**: split speciose taxa vs not multiplying monotypic families

### What changes are we talking about?
### Orders "new"

- **Previously as suborders of Perciformes: 9**

Acanthuriformes
Anabantiformes
Blenniiformes
Gobiiformes
Istiophoriformes (as Xiphioidei)
Kurtiformes
Labriformes
Pholidichthyiformes
Scombriformes

### What changes are we talking about?
### Orders "new"

- **Previously as families (sometimes suborders in FoW) of Osmeriformes (number of families): 4**

Alepocephaliformes (3)
Argentiniformes (4)
Galaxiiformes (1)
Lepidogalaxiiformes (1)

*New classification of bony fishes*, Bailly, N. *et al*.

**What changes are we talking about?**
**Orders "new"**

- **Previously as families in Perciformes in various suborders (number of families): 9**

Ephippiformes from Acanthuroidei (2)
Chaetodontiformes from Percoidei (2)
Cichliformes from Labroidei (1)
Carangiformes from Percoidei (5)
Centrarchiformes from Percoidei (2)
Lobotiformes from Percoidei (2)
Pempheriformes from Percoidei (13)
Spariformes from Percoidei (4)
Uranoscopiformes from Trachinoidei (4)

**What changes are we talking about?**
**Orders "new"**

- **Previsously as families in various orders (number of families): 3**

Hiodontiformes (1) from Osteoglossiformes
Holocentriformes (1) from Beryciformes
Stylephoriformes (1) from Lampriformes

**What changes are we talking about?**
**Orders**

- **From 49 to 67 orders**
- **15 as changed ranks from suborders or families**
- **13 with family re-arrangements**

**What changes are we talking about?**
**Orders "lost" 8**

- **Orders in CofF/FB are not any more in DF: 8**
- Gasterosteiformes: In Zoarciformes (Cottioidei:Gasterosteales)
- Gobiesociformes: In Blenniiformes (Gobiesocoidei)
- Lepidosireniformes: In Ceratodontiformes (Lepidosirenoidei)
- Saccopharyngiformes: In Anguilliformes
- Scorpaeniformes: In Perciformes (Scorpaenoidei but restricted circumscription)
- Cetomimiformes: In Beryciformes
- Stephanoberyciformes: In Beryciformes
- Incertae sedis Elassomatidae (In Perciformes in FB): In Centrarchiformes

**What changes are we talking about?**
**Orders "lost" 8**

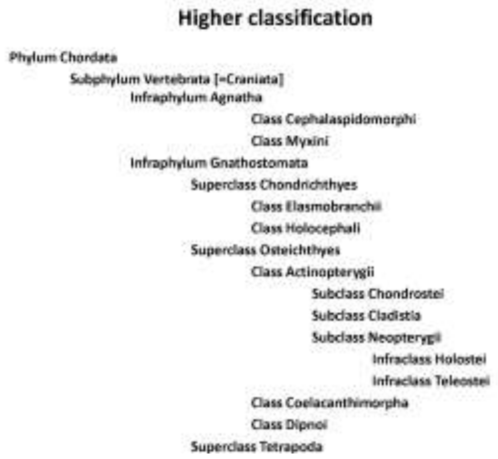
- 9 suborder
- Infrastructure internal access
- What about external dissemination?
- Importance of policies, even for internal uses, for users' information and proper management by the infrastructure

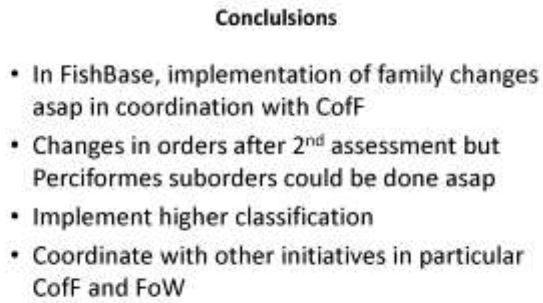
**Higher classification**

**A Higher Level Classification of All Living Organisms,** submitted to PloS One

Michael A. **Ruggiero**,
Dennis P. **Gordon**,
Nicolas **Bailly**,
Thierry **Bourgoin**,
Richard C. **Brusca**,
Thomas C. **Cavalier-Smith**,
Michael D. **Guiry**,
Paul M. **Kirk**.
Thomas M. **Orrell**

*New classification of bony fishes*, Bailly, N. *et al*.





Nicolas Bailly (PhD) is an ichthyologist who specializes in Biodiversity Informatics since 1983, mainly on the database structures for taxonomy and systematics. He is currently the FishBase Project Manager in the Philippines (since 2005). After being the Head of the Philippine Office of the WorldFish Center (now WorldFish) for 5 years (2005-2010), he is now acting as the FIN Scientific Director (FishBase Information and Research Group, 2011-present). He participated to the creation of the FishBase Consortium of which he was the head for one year. He is a scientific advisor for SeaLifeBase. He participated to the following projects under the European EC-FP5, FP6 and FP7, all related to biodiversity informatics: ERMS, ENHSIN, Fauna Europaea, BioCase, ENBI, D4Science (I and II), HighARCS, BioFresh, iMarine, and EU-BON. He organized the 3rd GBIF Governing Board meeting in Paris (2001). He participated in many initiatives on biodiversity information systems at the French national level during his employment at the Muséum National d'Histoire Naturelle in Paris (1992-2005). He is currently the chair of the Taxonomic Group (since 2007) and the vice-chair of the Global Team of the Catalogue of Life (since 2013). He is a co-author of the second iteration of the new classification of bony fishes published on the web on 27 November 2013 (http://www.deepfin.org/Classification_v2.htm).

# OSTEOBASE: AN ONLINE INTERACTIVE TOOL FOR OSTEOLOGICAL KNOWLEDGE AND IDENTIFICATION[4]

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R. Vignes-Lebbe, UMR 7207, Département Histoire de la Terre, MNHN, 57 rue Cuvier, 75231 Paris Cedex 05, France
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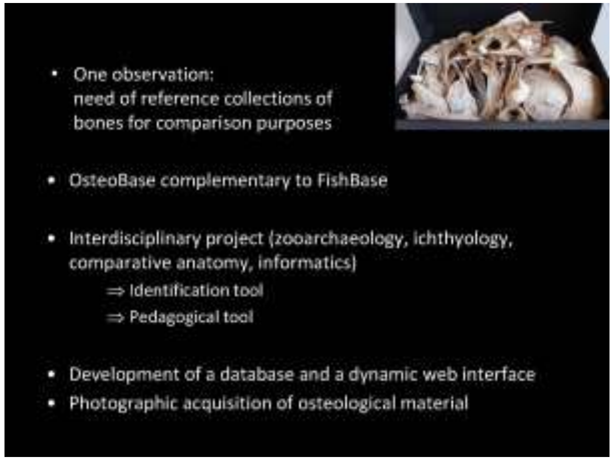
I. Valderrama, UMR 7209, Département Écologie et gestion de la biodiversité, MNHN, 55 rue Buffon, 75231 Paris Cedex 05, France.
N. Bailly, WorldFish Center- FIN/ABIO, c/o IRRI, Khush Hall, IRRI College, Los Baños, Laguna 4031, Philippines
G. Lecointre, UMR 7138, Département Systématique et évolution, MNHN, 57 rue Cuvier, 75231 Paris Cedex 05, France

Bones constitute the essential research material of several fields in biology. To ensure the reliability of osteological identifications, researchers need reference collections for comparison purposes. OsteoBase is an interdisciplinary project that aims to develop an online interactive tool for osteological identification, fish osteology learning and comparative anatomy practice. One of the main originalities of OsteoBase is the navigation through the pictures: the entire osteology can be explored just by hovering and clicking on pictures, and can therefore be used as an educational tool to learn osteology. This bilingual website (English/French) provides a double access to pictures, either by bone or by taxon, which can be sorted by geographical zones. Additional ways to sort and to filter the data will be added when the number of taxa will increase significantly. OsteoBase also manages osteometric data which can be downloaded. This prototype is hosted in the Muséum national d'Histoire naturelle (MNHN, Paris: http://osteobase.mnhn.fr). For the time being, it includes parts of the cranial and post-cranial skeleton of 57 fish species (Actinopterygii) representing 46 families and 18 orders. All the specimens illustrated are housed in the MNHN fishbone collection. A unique link exists between FishBase and OsteoBase species (link 1-1 between both databases) so that users can benefit from the complementary of both tools. This work began with a master training course and then it was supported by different initiatives/programs within the MNHN (ATM Form, e-muséum).

[4] Cite as: Tercerie, S., Béarez, P., Vigne-Lebbe, R., Pruvost, P., Valderrama, I., Bailly, N., Lecointre, G. (2014) OsteoBase, an online interactive tool for osteological knowledge and identificaution, p. 31-38. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

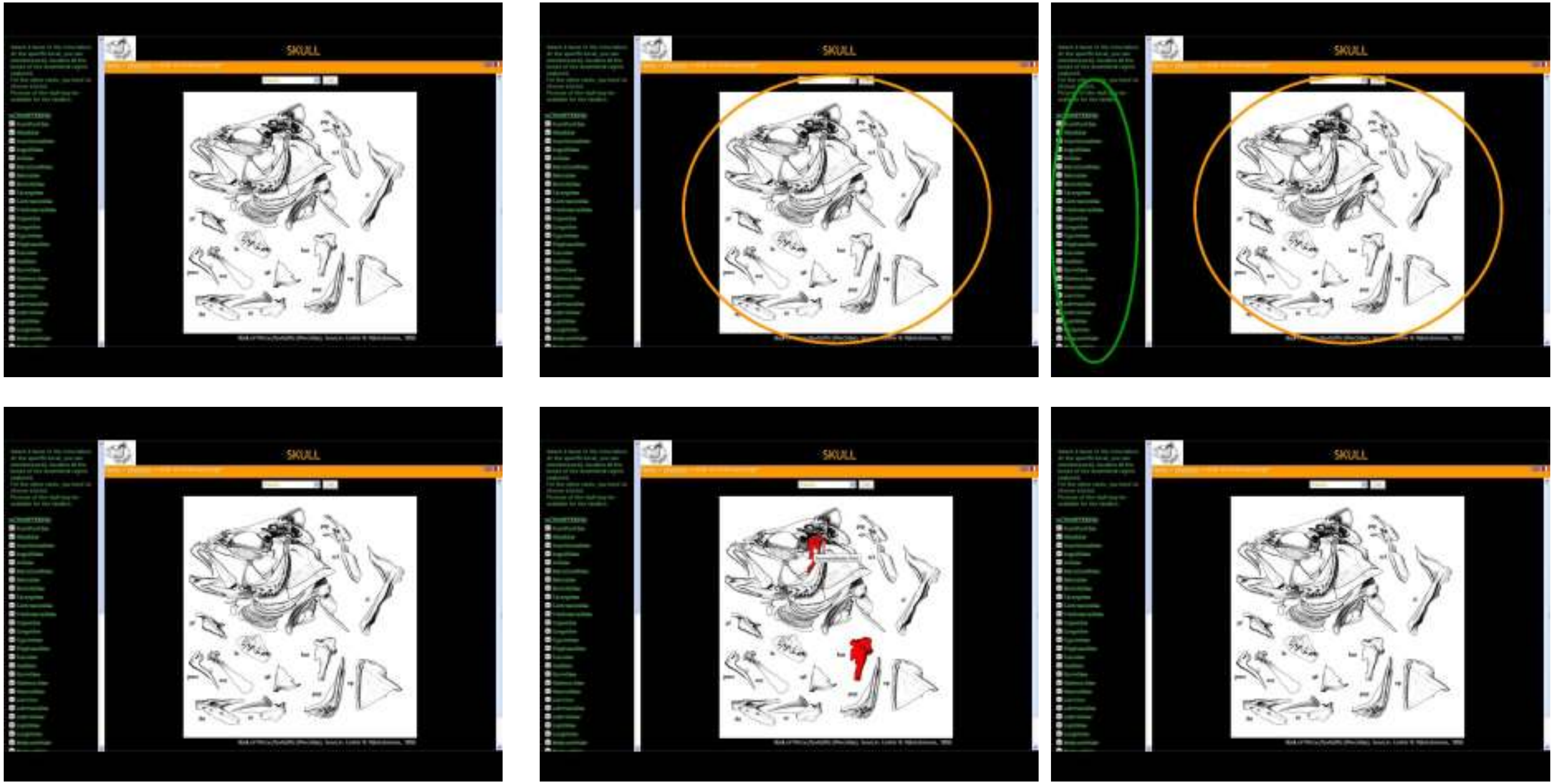
*OsteoBase*, Tercerie, S. *et al*.





*OsteoBase*, Tercerie, S. *et al*.



*OsteoBase*, Tercerie, S. *et al*.



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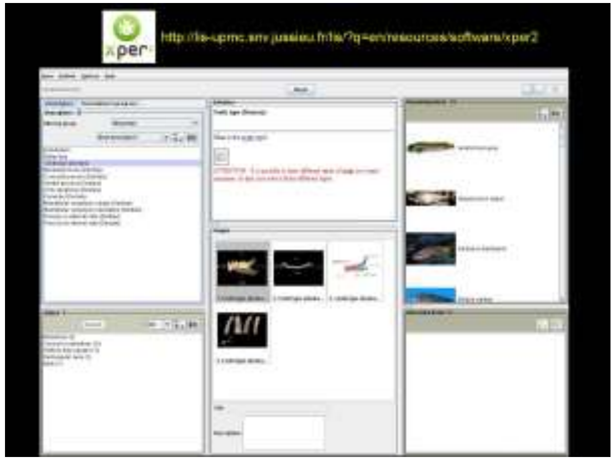

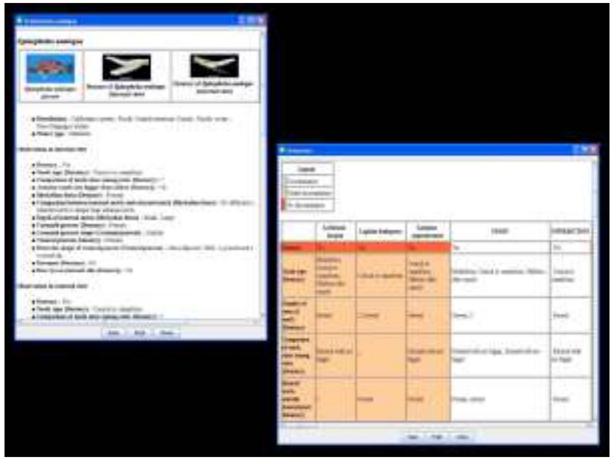


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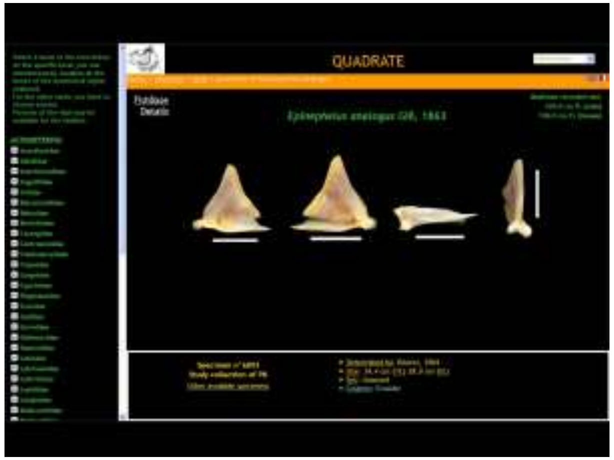
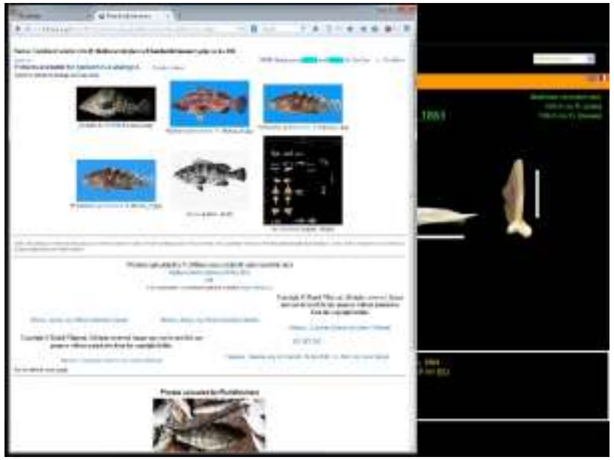
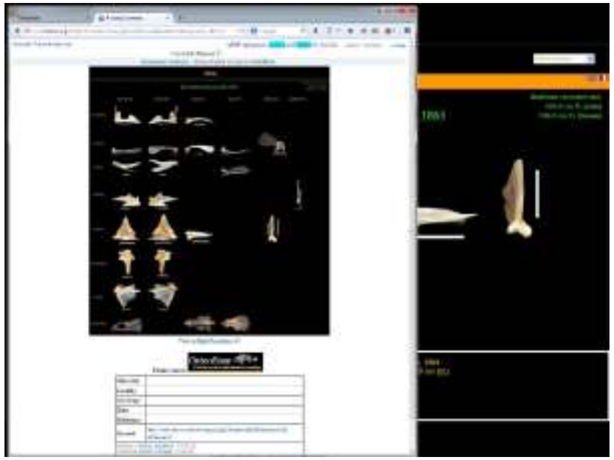
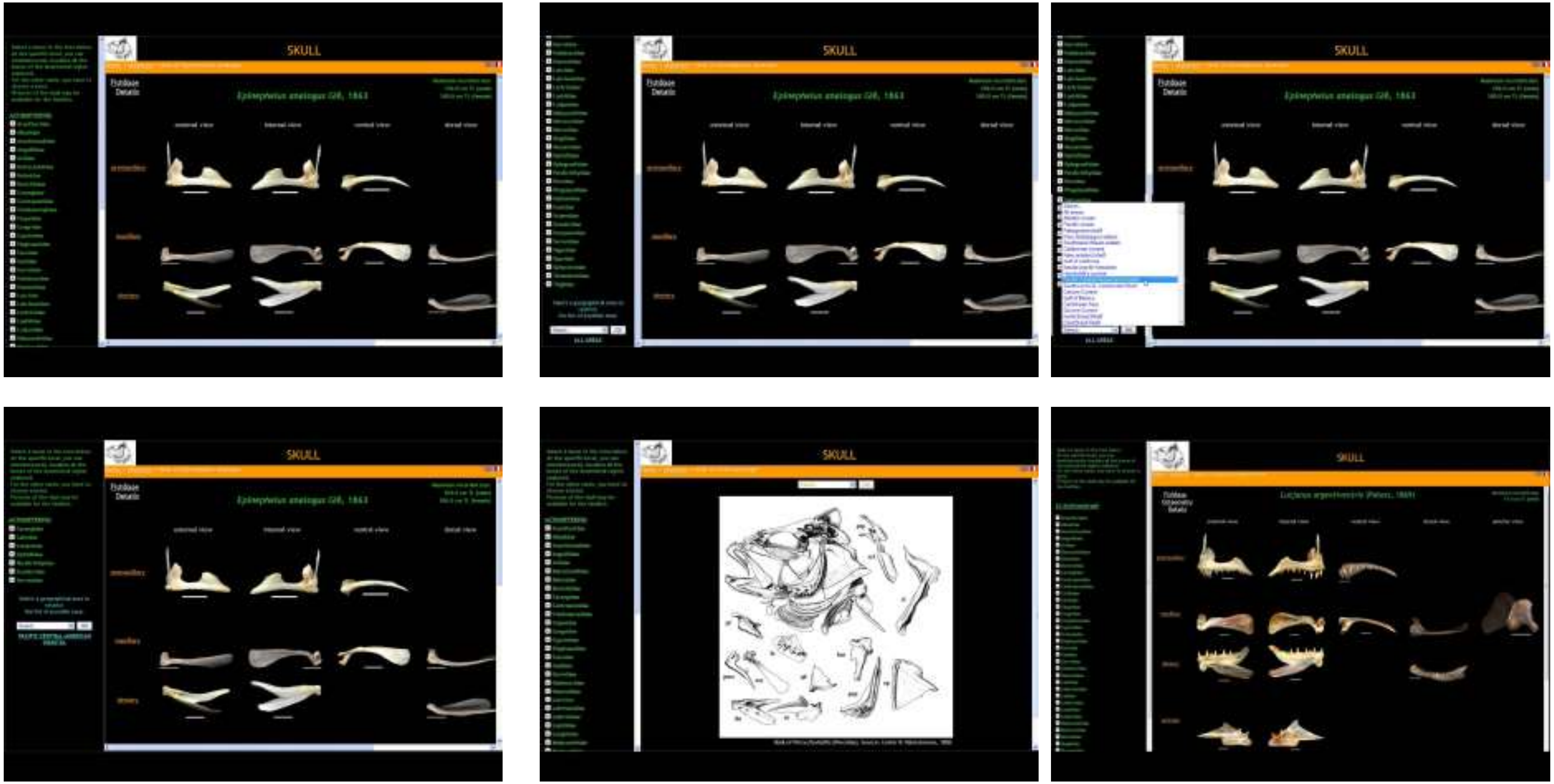




*OsteoBase*, Tercerie, S. *et al*.



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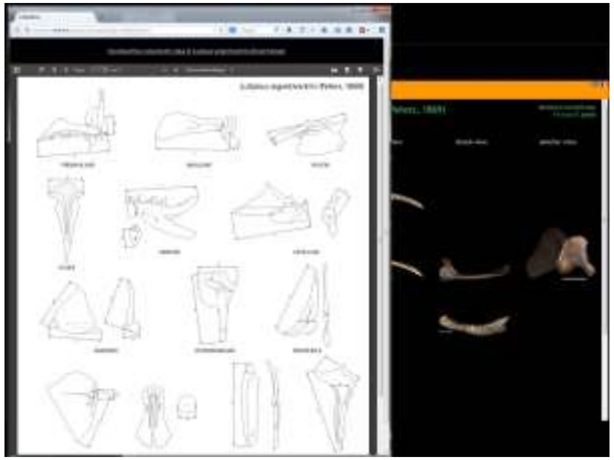

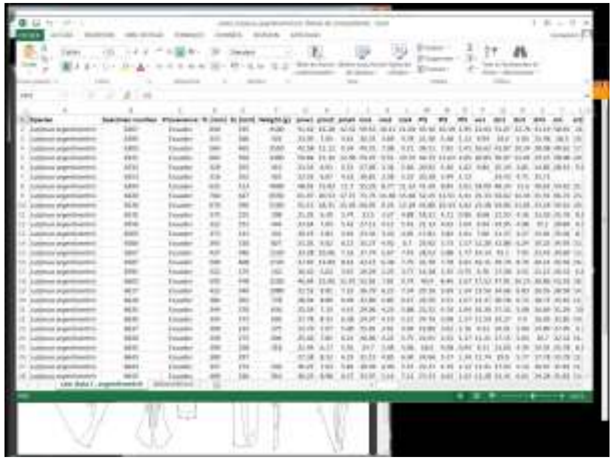

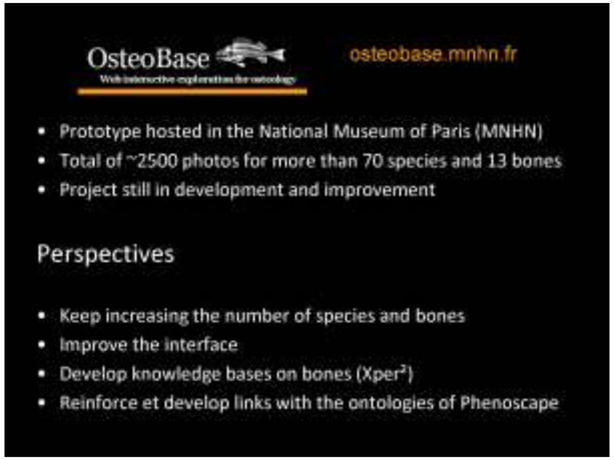



Sandrine Tercerie is currently one of the assignment managers of the French taxonomic register for mainland and overseas, at the Natural Heritage Department, Muséum national d'Histoire naturelle (MNHN), Paris. She has also worked on ontologies and their use in bioinformatics tools to manage morphological data, as a member of a research team focused on acanthomorph systematics (UMR 7138, Systematics and Evolution Department, MNHN). She designed the OsteoBase project during her master's studies at the Université Pierre et Marie Curie (Paris VI) and since then she goes on developing this online interactive tool designed for osteological knowledge and identification.

# FISH-BoL: The global barcoding initiative for all fishes of the world[5]

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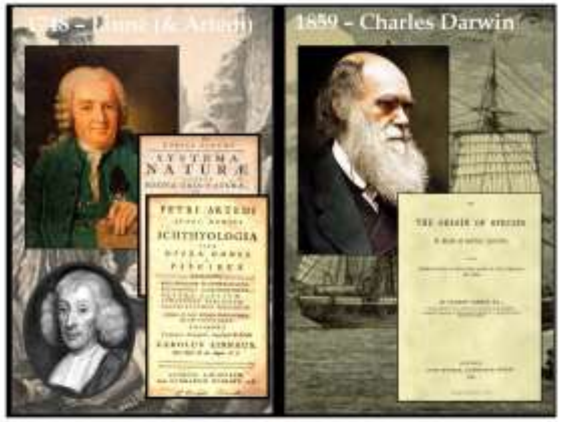
The Fish Barcode of Life Initiative (FISH-BoL) is a global effort to coordinate an assembly of a standardized reference DNA sequence library for all finfish species, one that is derived from voucher specimens with authoritative taxonomic identifications. The benefits of barcoding fishes include facilitating species identification for all potential users, including taxonomists; highlighting specimens that represent a range expansion of known species; flagging previously unrecognized species; and perhaps most importantly, enabling identifications where traditional methods are not applicable, in particular linking eggs and larval stages to the adult forms. About 30% of the 33,000 valid fish species have at least one barcode (more than 10,000), a result stemming from the about 100,000 specimens barcoded since the start of the initiative. Interestingly, more than 2,000 barcode clusters could not be identified: 2,000 over 12,000 in total which may represent the rate of cryptic diversity in fishes (15%). More species remain to be described and named. At the early stages of FISH-BoL, FishBase provided the complete list of names, as well as regional lists for the system information management purposes, broadly based on the FAO fisheries statistics areas. New updates are difficult to integrate though, and FishBase needs to develop the relevant web services to facilitate data exchange. This is also the case with CofF from where the type information, in particular on the type locality, is crucial for the barcoding exercise (having at least one barcode from the type locality to fix the name-barcode links).

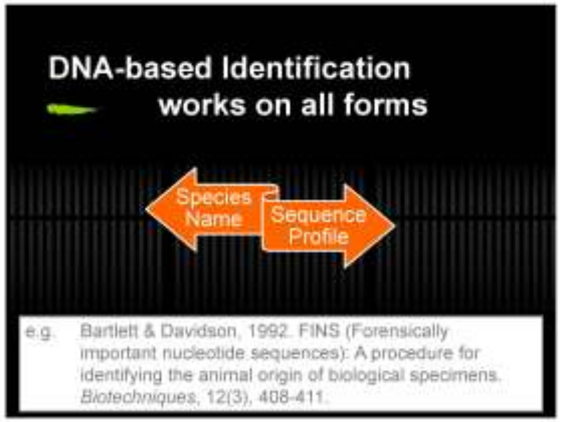
Not all groups of fishes respond satisfactorily to barcode identification (e.g., sturgeons, cichlids in East African lakes), and some additional markers remain to be found and experimented. Also data sharing issues may hide the actual barcode coverage of finfishes. Misidentifications of the voucher specimens are also a difficult issue, generating unnecessary questions about species validity, or genus or even family monophyly. The involvement of specialists is highly appreciated there. However, over the last 9 years the Fish Barcode of Life effort has been creating a valuable public resource in the form of an electronic database containing DNA barcodes, images, and geospatial coordinates of examined specimens. The database contains linkages to voucher specimens, information on species distributions, nomenclature, authoritative taxonomic information, collateral natural history information and literature citations. FISHBoL thus complements and enhances existing information resources, including the Catalog of Fishes, FishBase and various genomics databases. The current status of the initiative will be presented as well as some hints for a future strategy to complete the FISH-BoL catalogue.

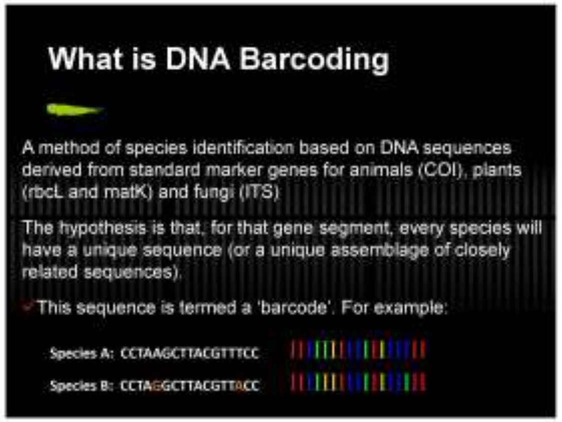
[5] Cite as: Hanner, R. (2014) FISH-BoL: the global barcoding initiative for all fishes of the world, p. 39-52. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

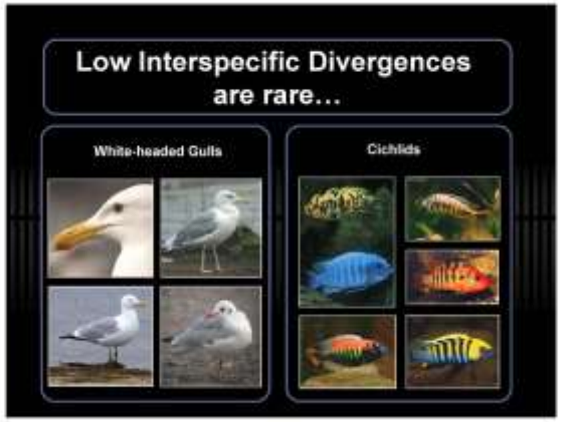
*FISH-BoL*, Hanner, R.





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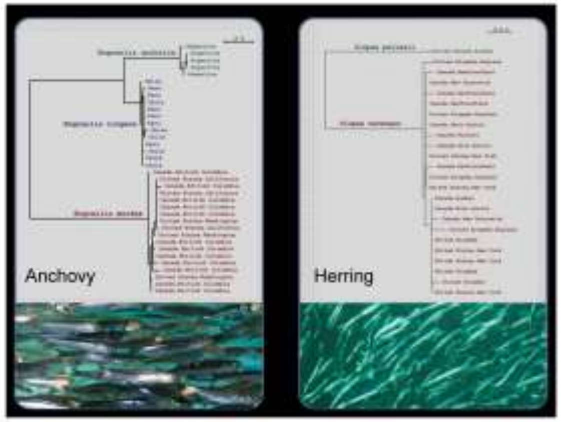


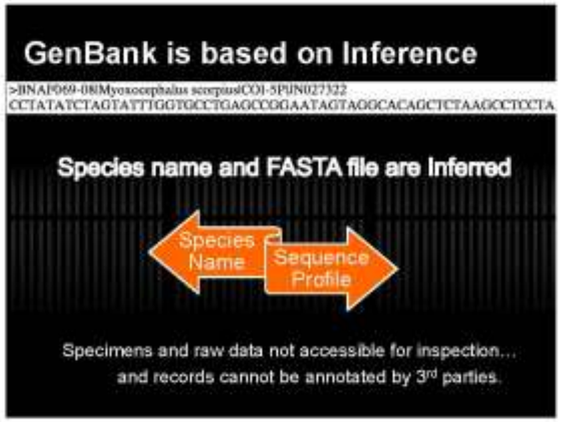


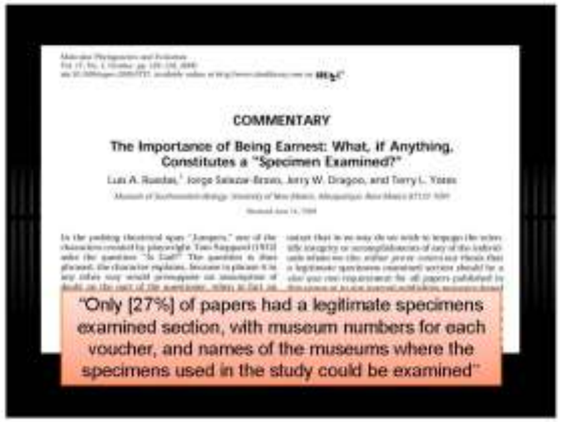


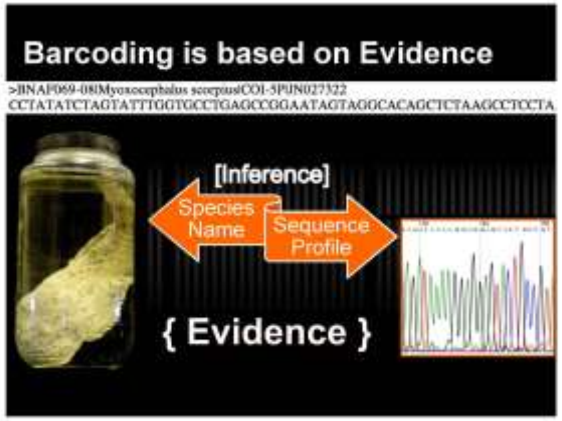



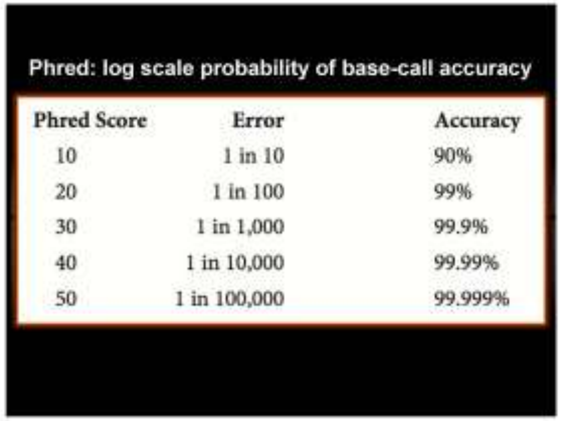

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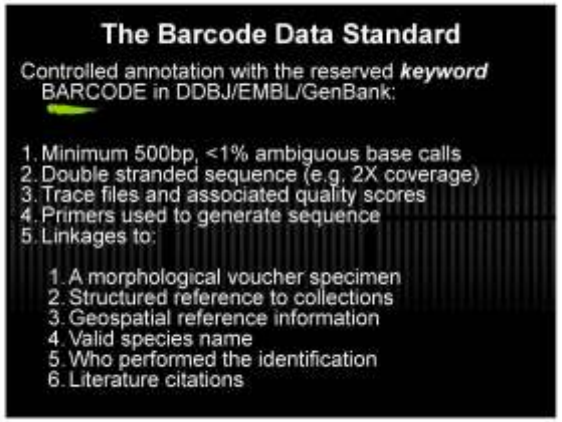


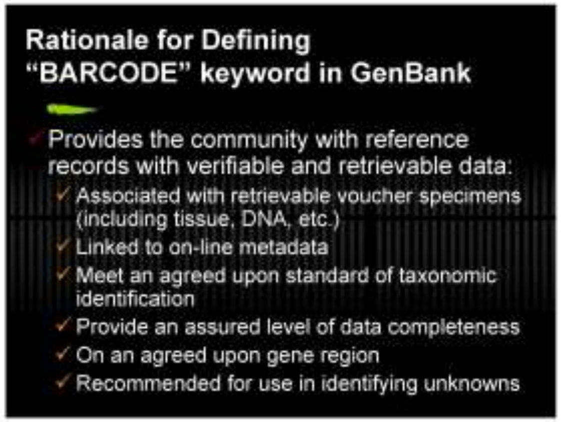





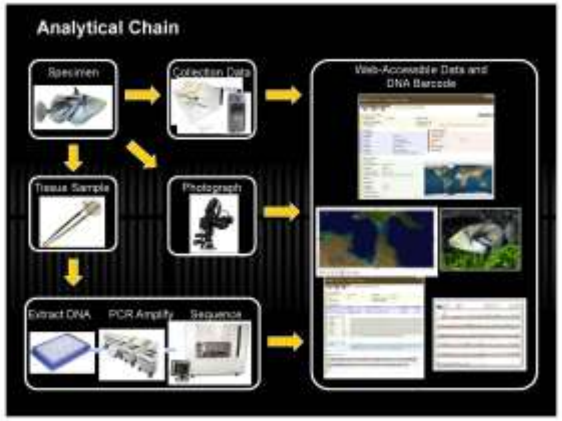

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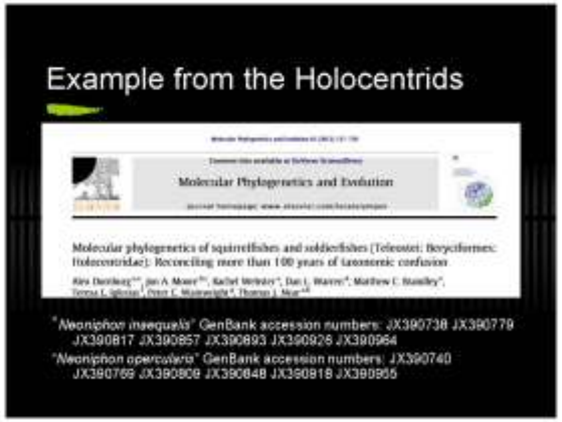
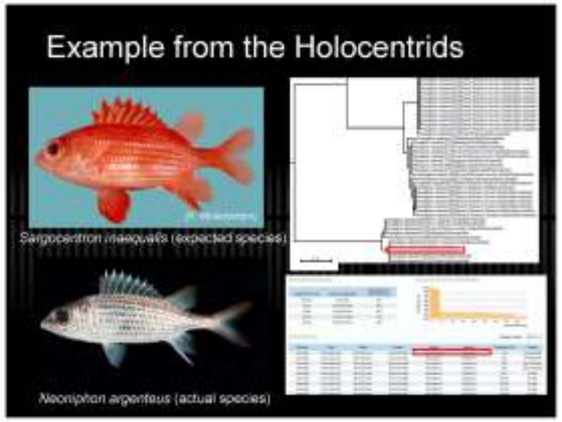
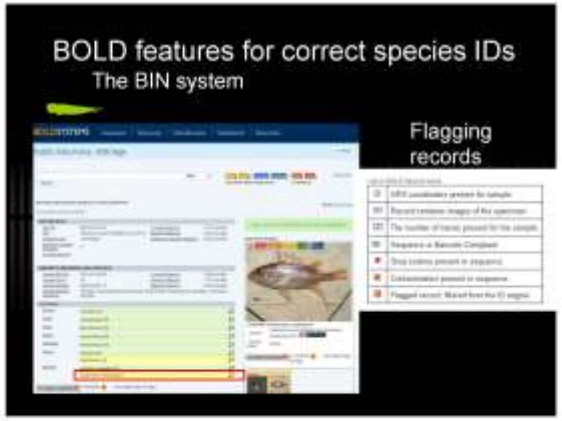
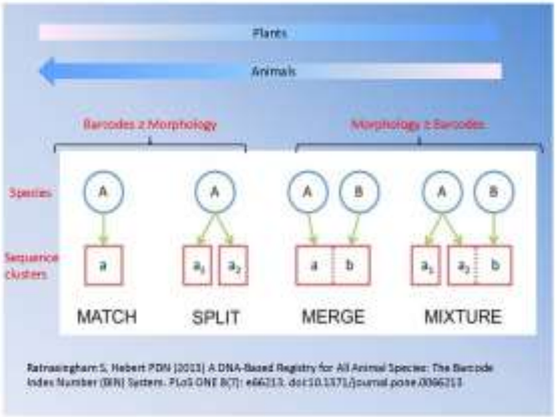
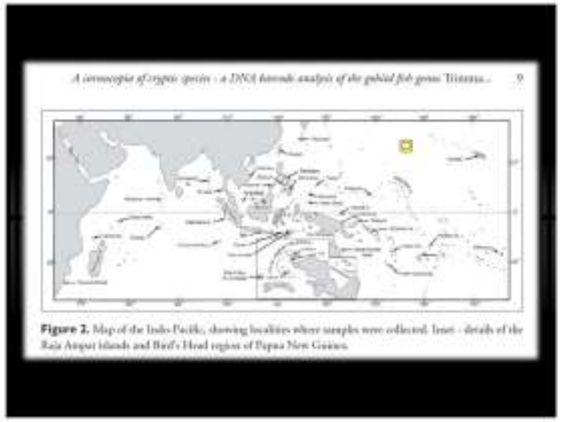


*FISH-BoL*, Hanner, R.



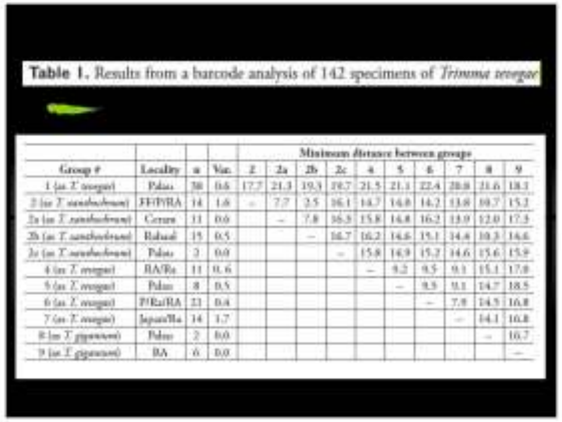
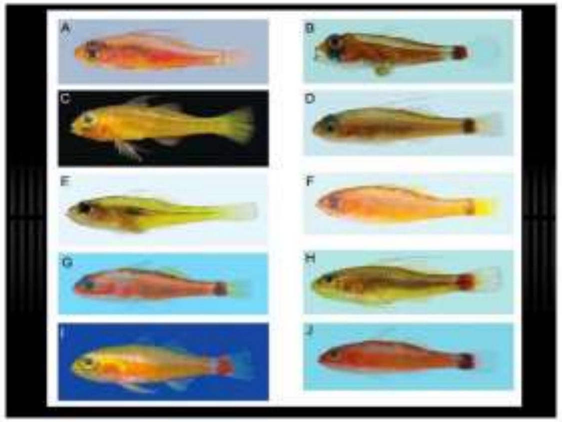
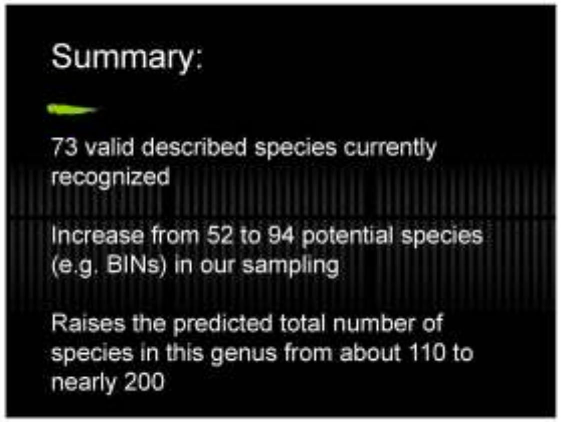


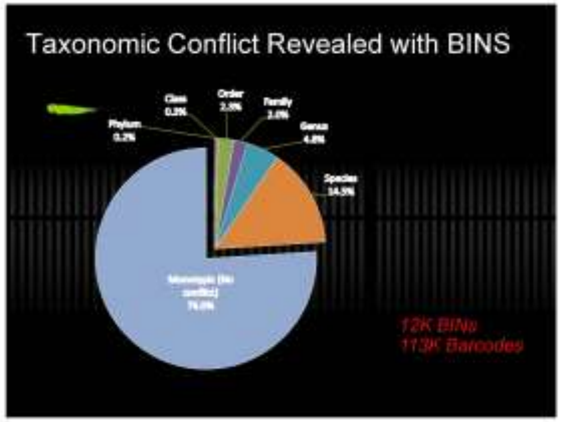
**Table 1.** Results from a barcode analysis of 142 specimens of *Trimma tevegae*

| Group # | Locality | n | Var. | 2 | 2a | 2b | 2c | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Minimum distance between groups | | | | | | | | | |
| 1 (as *T. tevegae*) | Palau | 38 | 0.6 | 17.7 | 21.3 | 19.3 | 19.7 | 21.5 | 21.1 | 22.4 | 20.8 | 21.6 | 18.1 |
| 2 (as *T. xanthochrum*) | FF/P/RA | 14 | 1.6 | – | 7.7 | 2.5 | 16.1 | 14.7 | 14.8 | 14.2 | 13.8 | 10.7 | 15.2 |
| 2a (as *T. xanthochrum*) | Ceram | 11 | 0.6 | | – | 7.8 | 16.5 | 15.8 | 14.8 | 16.2 | 13.9 | 12.0 | 17.3 |
| 2b (as *T. xanthochrum*) | Rabaul | 15 | 0.5 | | | – | 16.7 | 16.2 | 14.6 | 15.1 | 14.4 | 10.3 | 14.6 |
| 2c (as *T. xanthochrum*) | Palau | 2 | 0.0 | | | | – | 15.8 | 14.9 | 15.2 | 14.6 | 15.6 | 15.9 |
| 4 (as *T. tevegae*) | RA/Ra | 11 | 0.6 | | | | | – | 9.2 | 9.5 | 9.1 | 15.1 | 17.0 |
| 5 (as *T. tevegae*) | Palau | 8 | 0.5 | | | | | | – | 9.5 | 9.1 | 14.7 | 18.5 |
| 6 (as *T. tevegae*) | P/Ra/RA | 23 | 0.4 | | | | | | | – | 7.9 | 14.5 | 16.8 |
| 7 (as *T. tevegae*) | Japan/Ra | 14 | 1.7 | | | | | | | | – | 14.1 | 16.8 |
| 8 (as *T. gigantum*) | Palau | 2 | 0.0 | | | | | | | | | – | 16.7 |
| 9 (as *T. gigantum*) | RA | 6 | 0.0 | | | | | | | | | | – |

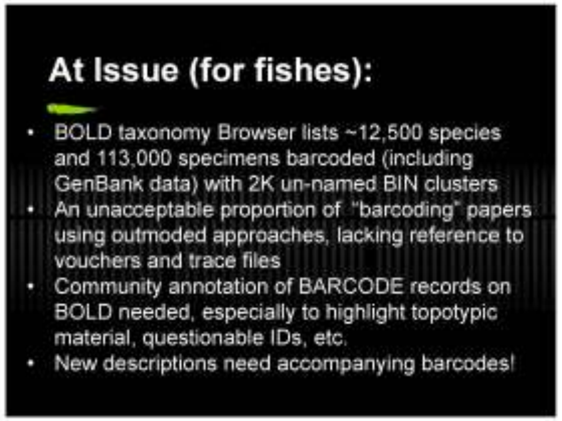


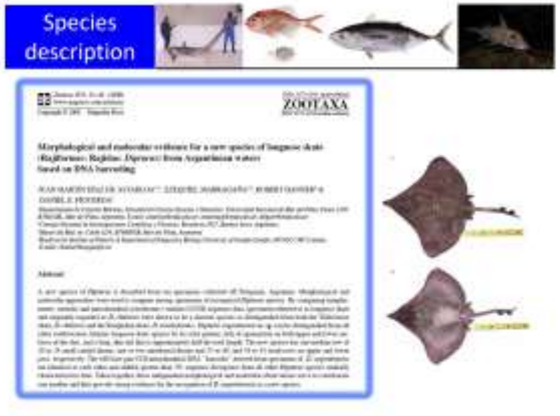
*FISH-BoL*, Hanner, R.

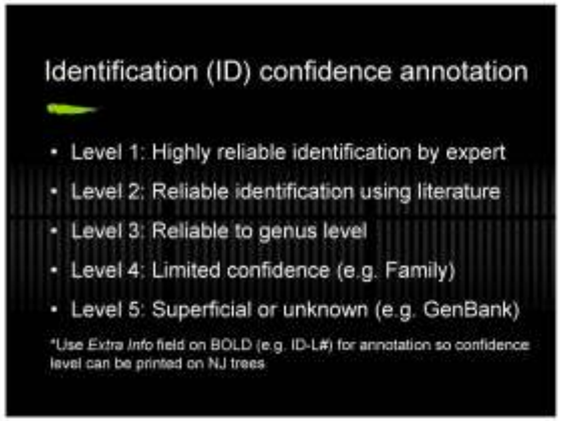






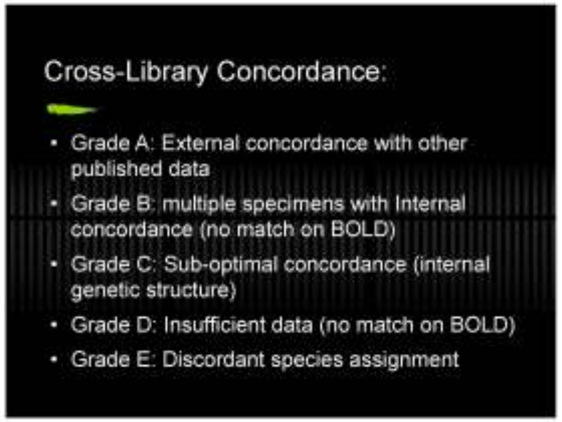



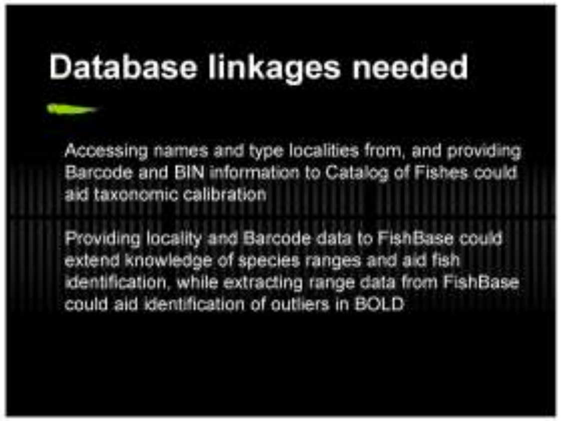
*FISH-BoL*, Hanner, R.


A Ranking System for Reference Libraries of DNA Barcodes: Application to Marine Fish Species from Portugal

Abstract










Food Research International
DNA barcoding detects market substitution in North American seafood
1. Introduction


RESEARCH COMMUNICATIONS
Smoke, mirrors, and mislabeled cod: poor transparency in the European seafood industry


Public Health Response to Puffer Fish (Tetrodotoxin) Poisoning from Mislabeled Product
ABSTRACT

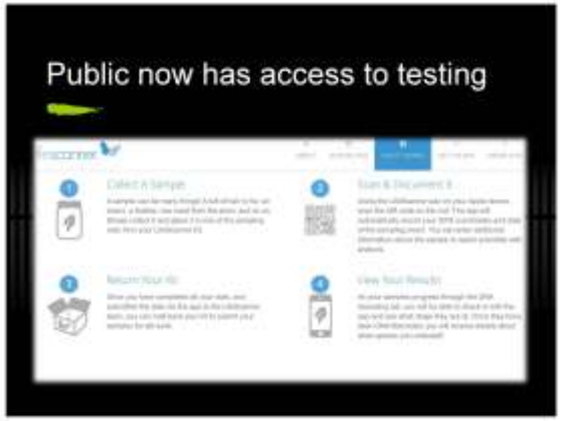

OCEANA
Oceana Study Reveals Seafood Fraud Nationwide
Oceana Study Reveals Seafood Fraud Nationwide


Key Results:
• Mislabeling was found in 27 of the 46 fish types tested (59%)
• 44% of all the grocery stores, restaurants and sushi venues visited sold mislabeled seafood
• Between one-fifth to more than one-third of the halibut, grouper, cod and Chilean seabass samples were mislabeled
• Only seven of the 120 red snapper samples were honestly labeled
• Species on the FDA "Do Not Eat" list for sensitive groups were mislabeled as other species (e.g. Tilefish, King Mackerel)


Seafood Fraud: over 100 studies
http://oceana.org/en/our-work/promote-responsible-fishing/seafood-fraud/seafood-fraud-map

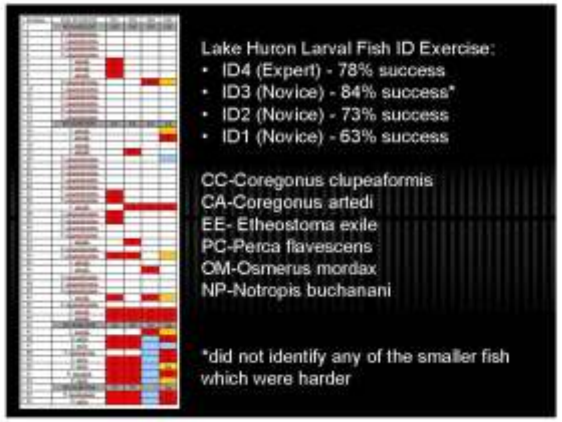
*FISH-BoL*, Hanner, R.

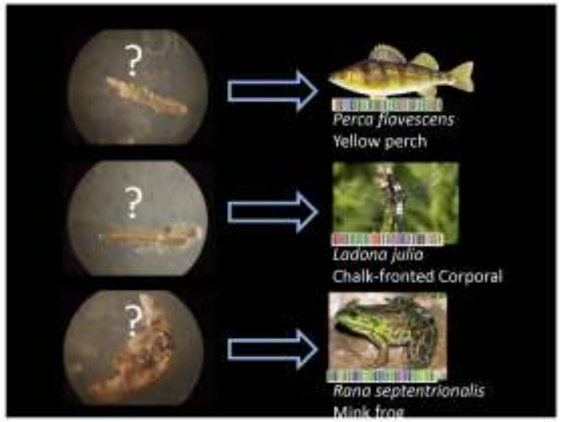


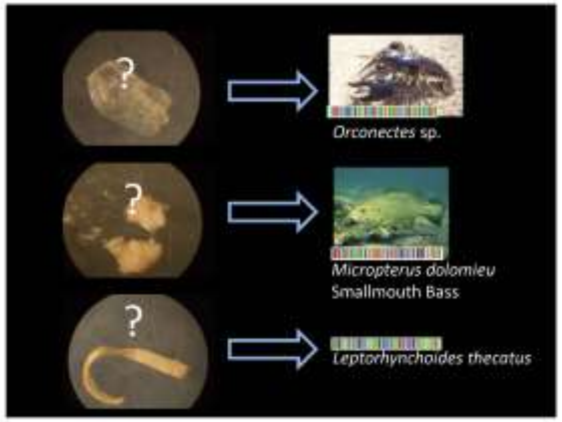



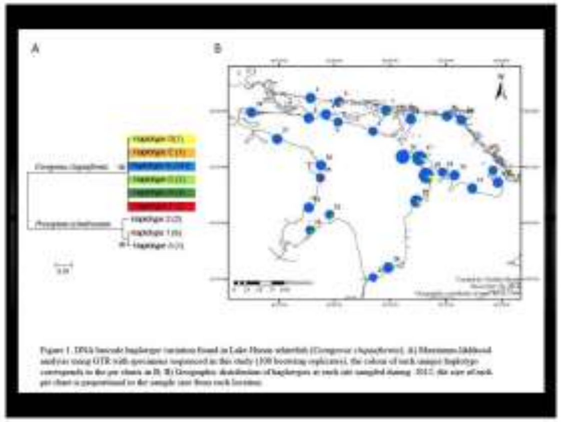


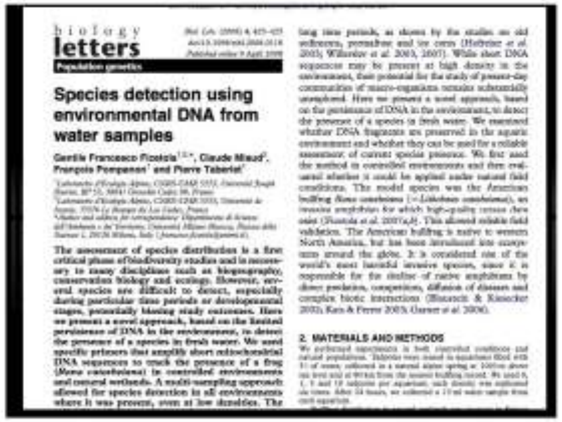
*FISH-BoL*, Hanner, R.

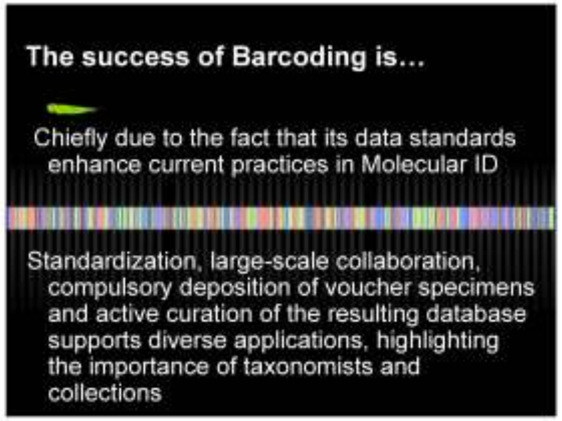


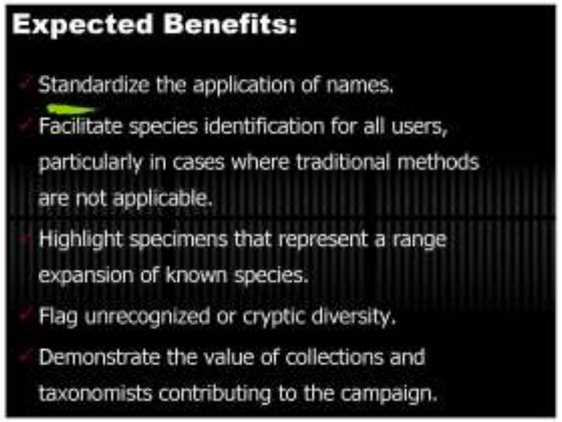




Expected Benefits:
Standardize the application of names.
Facilitate species identification for all users, particularly in cases where traditional methods are not applicable.
Highlight specimens that represent a range expansion of known species.
Flag unrecognized or cryptic diversity.
Demonstrate the value of collections and taxonomists contributing to the campaign.


Need for a Taxonomic Revolution?
ZOOTAXA
Editorial
Zoological taxonomy at 250: showcasing species descriptions in the cyber era
Time to change how we describe biodiversity


Future of Taxonomy?
Sequencing our way towards understanding global eukaryotic biodiversity
Standardised workflow
Future high-throughput workflow

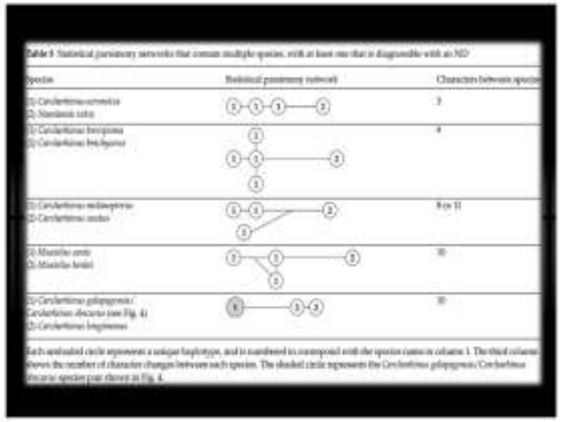

International Barcode of Life Project
Imagine...
5 Years
5M Specimens
500K Species

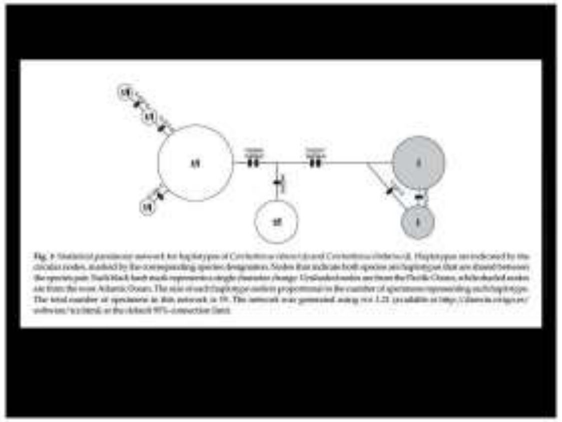

DNA- A Digital Future for Biodiversity
Core Facilities
Mass Analyses
Handheld Devices

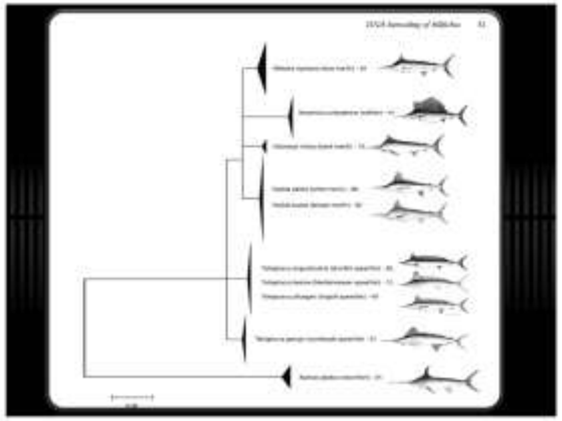

Acknowledgments:
Members of the Hanner lab (past & present)
Paul Hebert & the Biodiversity Institute of Ontario (BIO) staff
Royal Ontario Museum
Jon Deeds and Haile Yancy, US FDA
Participants of the FISH-BOL Campaign
The International Barcode of Life Project (iBOL.org)

*FISH-BoL*, Hanner, R.

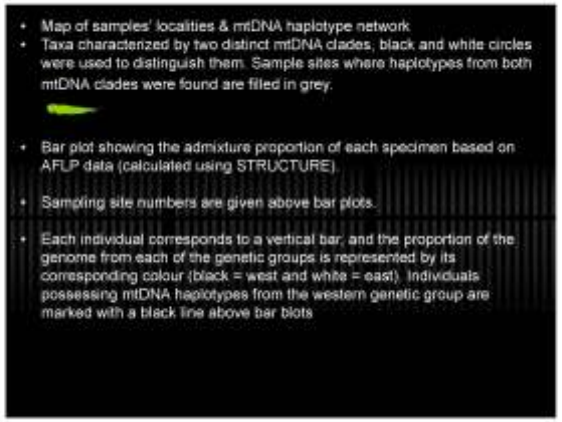


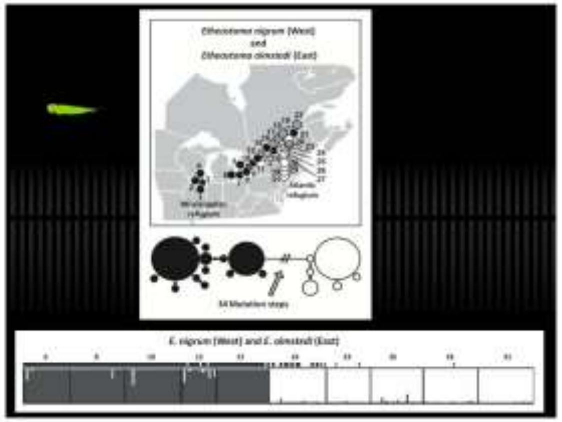


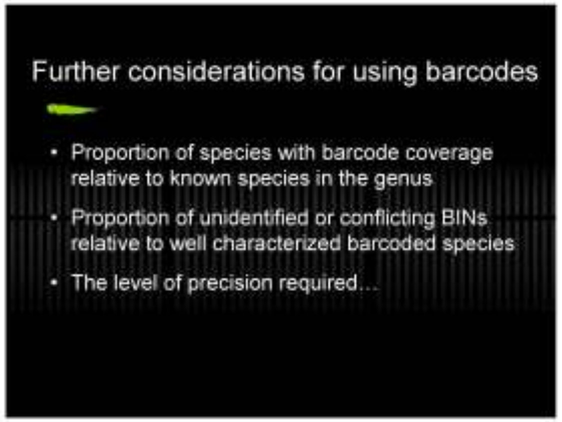




*FISH-BoL*, Hanner, R.






Robert Hanner is the Associate Director for the Canadian Barcode of Life Network, headquartered at the Biodiversity Institute of Ontario, University of Guelph. He currently chairs the Database Working Group of the Consortium for the Barcode of Life (CBOL) and also serves as Campaign Coordinator for the Fish Barcode of Life (FISH-BOL) initiative, a project of global scale that aims to assemble a standard reference sequence library for the molecular identification of all fishes. Dr. Hanner is a Past President of the International Society for Biological and Environmental Repositories (ISBER). Prior to his arrival in Guelph (August of 2005), he served as the Scientific Program Director for the Coriell Cell Repositories (at the Coriell Institute for Medical Research) and prior to that, he was a Curatorial Associate at the American Museum of Natural History where he spearheaded the establishment of the Ambrose Monell Collection for Molecular and Microbial Research.

# MULTI-MODEL ENSEMBLE PROJECTIONS OF CLIMATE CHANGE EFFECTS ON GLOBAL MARINE BIODIVERSITY[6]

**William CHEUNG**
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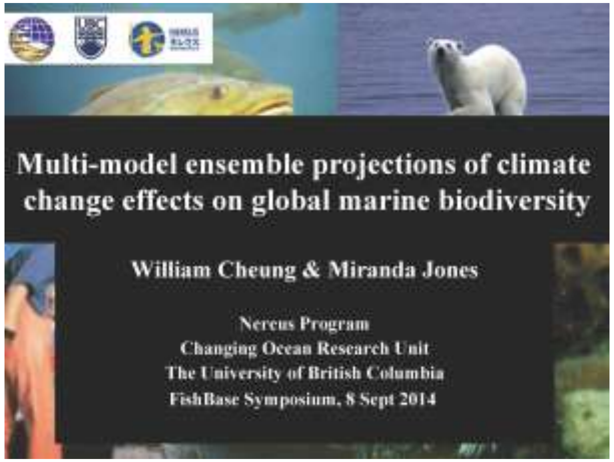
w.cheung@fisheries.ubc.ca

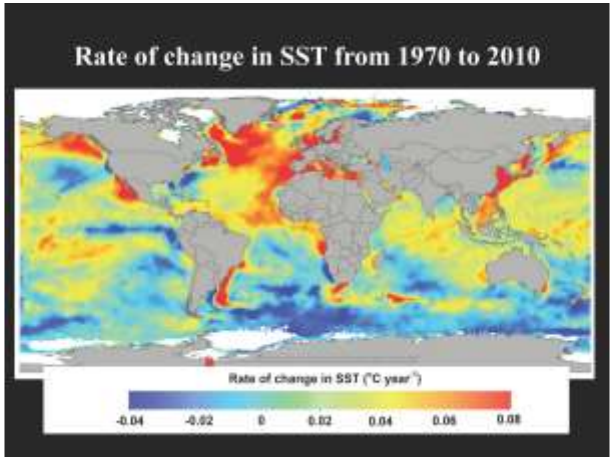
Species Distribution Models (SDMs) are important tools to explore the effects of future global changes in biodiversity. Previous studies show that variability is introduced into projected distributions through alternative datasets and modelling procedures. However, a multi-model approach to assess biogeographic shifts at the global scale is still rarely applied, particularly in the marine environment. Here we apply three SDMs to assess the global patterns of change in species richness, invasion and extinction intensity in the world's oceans. Specifically, AquaMaps, Maxent and the Dynamic Bioclimate Envelope Model are three commonly applied approaches in the marine environment and have been evaluated and validated in previous studies. We make species-specific projections of distribution shift using each SDM, subsequently aggregating them to calculate indices of change across a set of 802 species of exploited marine fishes and invertebrates. Results indicate an average poleward latitudinal shift across species and SDMs at a rate of 15.5 and 25.6 km per decade for a low and high emissions climate change scenario respectively. Predicted distribution shifts result in hotspots of local invasion intensity in high latitude regions while local extinctions were concentrated near the equator. Specifically, between 10°N and 10°S, we predicted that, on average, 6.5 species would become locally extinct per 0.5° latitude under the climate change emissions scenario RCP (Representative Concentration Pathway) 8.5. Average invasions were predicted to be 2.0 species per 0.5° latitude in the Arctic Ocean and 1.5 species per 0.5° latitude in the Southern Ocean. These averaged global hotspots of invasion and local extinction intensity are robust to the different SDM used and coincide with high levels of agreement.

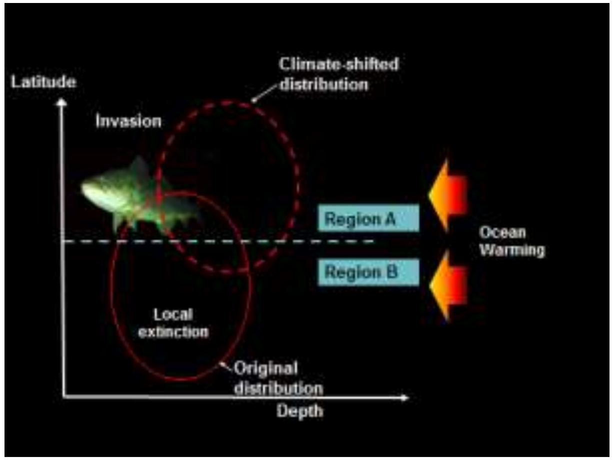
[6] Cite as: Cheung, W. (2014) Multi-model ensemble projections of climate change effects on global marine biodiversity, p. 53-57. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

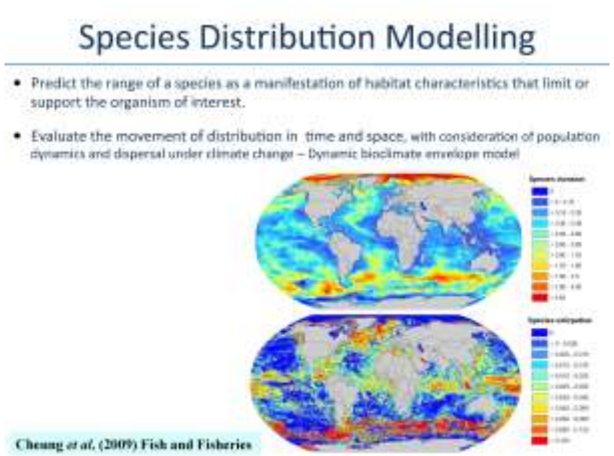
*Multi-model ensemble projections on climate change*, Cheung, W.

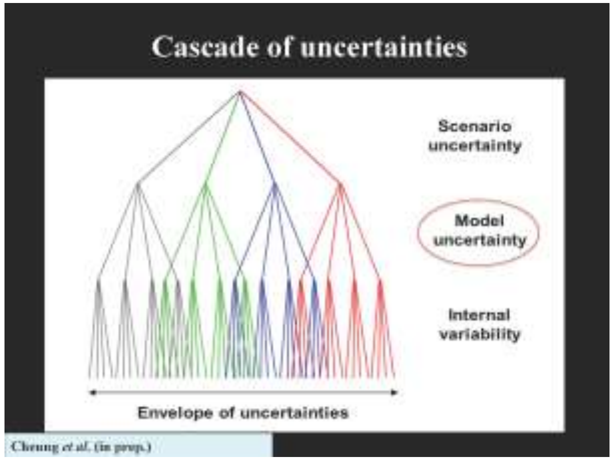






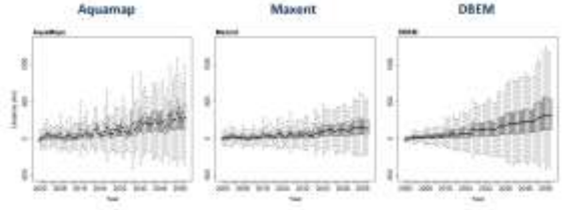



*Multi-model ensemble projections on climate change*, Cheung, W.

## The Models

- AquaMaps (Kaschner *et al.* 2006; 2008) (in FishBase)
  - Simple, trapezoidal response curve
- Maxent (Phillips *et al.* 2004; 2006)
  - Complex Bayesian approach
- Dynamic Bioclimate Envelope Model (DBEM) (Cheung *et al.* 2008; 2011)
  - Delimiting approach, incorporating logistic population growth model, ecophysiology and dispersal

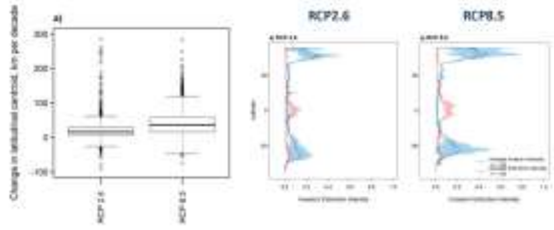
## Projected Distribution Shifts (RCP8.5)




- 900 species of exploited fishes and invertebrates globally;
- Year: 2000 to 2050, RCP 2.6 and RCP 8.5;
- Driven by outputs from GFDL ESM2M.

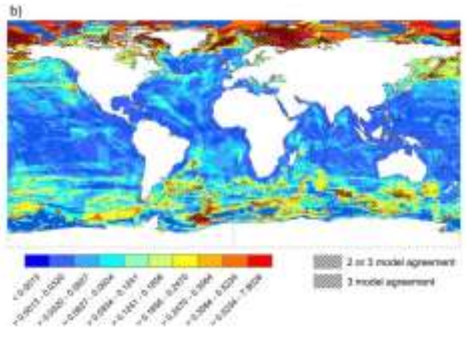
Jones and Cheung (in press) ICES Journal of Marine Science

## Projected Invasion and local extinction

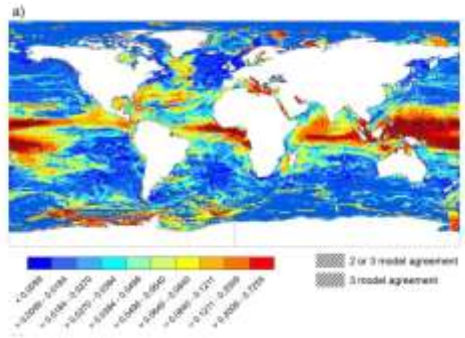



Jones and Cheung (in press) ICES Journal of Marine Science

## Invasion intensity (RCP 8.5)

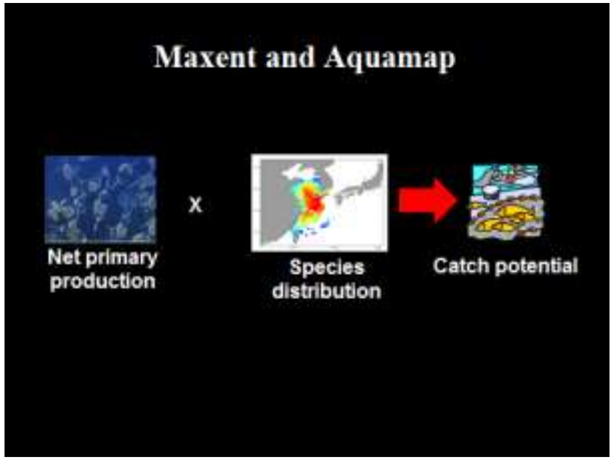


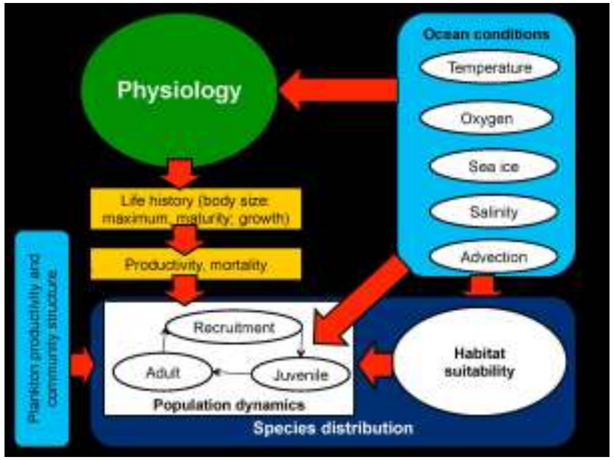

## Extinction intensity (RCP 8.5)

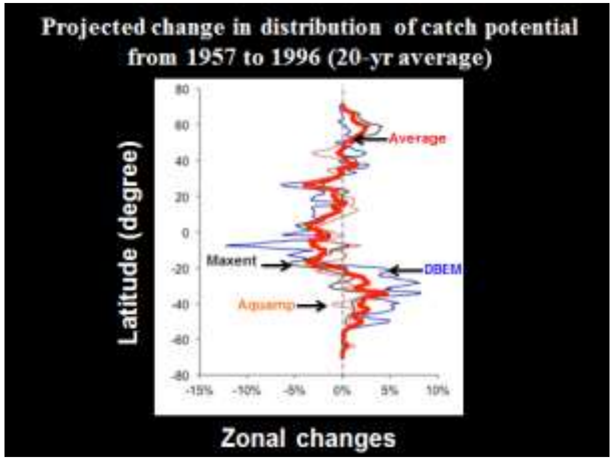


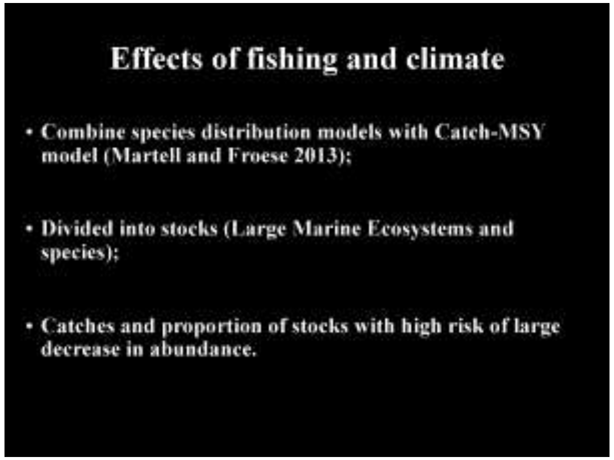

**How projections of catch potential differ between species distribution models?**

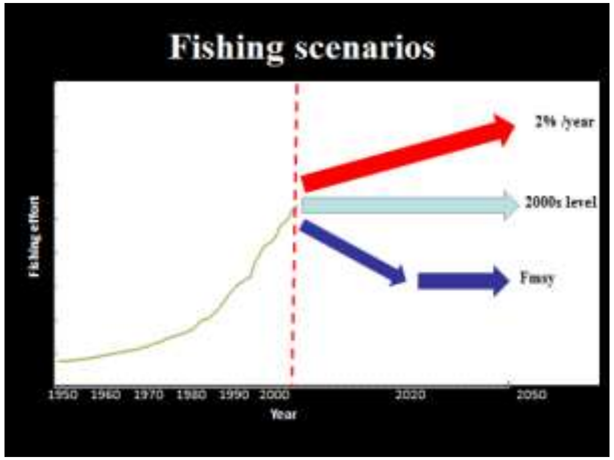
*Multi-model ensemble projections on climate change*, Cheung, W.

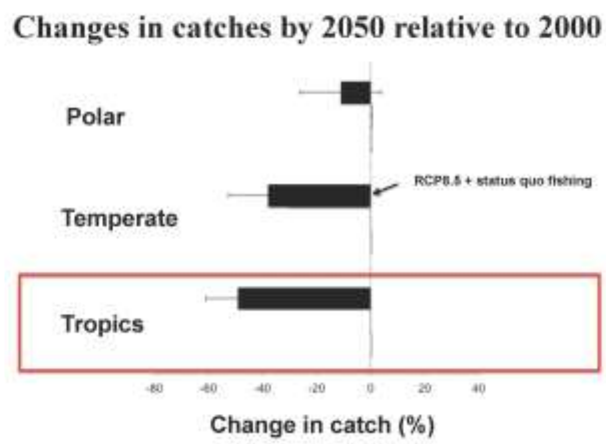


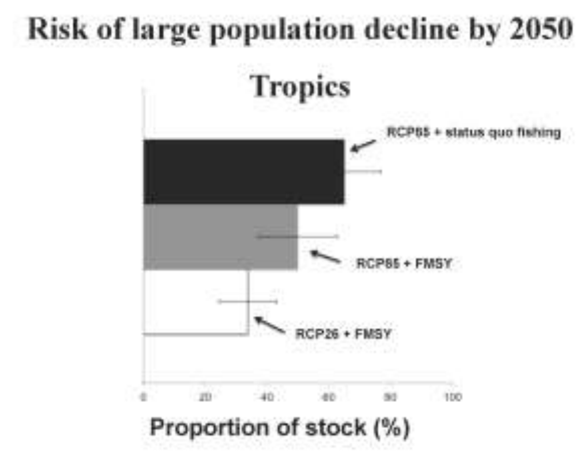



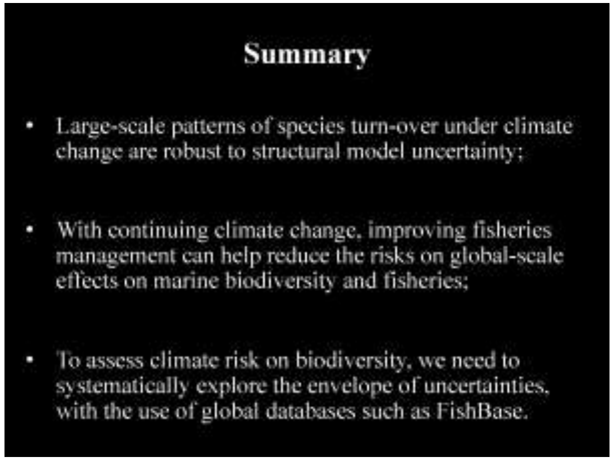



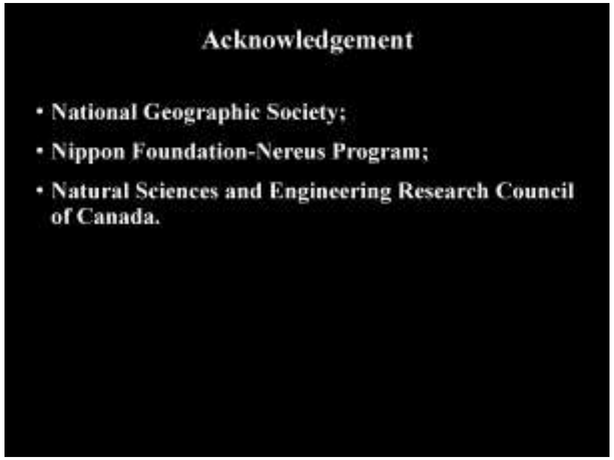



*Multi-model ensemble projections on climate change*, Cheung, W.




William Cheung is an Assistant Professor at the UBC Fisheries Centre since 2011, and is head of the Changing Ocean Research Unit (CORU). William obtained a BSc. (Biology) in 1998, and subsequently a M.Phil. in 2001 from the University of Hong Kong. After working in WWF Hong Kong for two years, he moved to Vancouver and completed his PhD in Resource Management and Environmental Studies in the UBC Fisheries Centre in 2007. He then worked as a postdoctoral fellow in the *Sea Around Us* project for two years. From 2009 to 2011, he was Lecturer in Marine Ecosystem Services in the School of Environmental Sciences, University of East Anglia in the UK. Currently, his main research area is on assessing impacts of fishing and climate change on marine ecosystems and their goods and services, and studying ways to reconcile trade-offs in their management. Specifically, he develops empirical and numerical simulation models to examine the impacts of climate change on marine biodiversity and fisheries, globally and in various regional seas. He applies interdisciplinary approaches to evaluate the trade-offs between ecological, economic and social objectives in managing coastal social-ecological systems. Moreover, his research involves the development and application of original approaches to study historical changes in fish stocks and ecosystems. He works on various interdisciplinary research projects with global collaboration networks in the UK, China, Australia, Africa, USA and Canada. He has been a member of the IUCN Groupers and Wrasses Species Specialist Group since 2005 and serves on the editorial board of *Fish and Fisheries* and *International Journal of Sustainable Society*.

# THE ROLE OF FISHBASE IN TROPHIC ECOSYSTEM MODELLING[7]

**Francisco ARREGUIN-SANCHEZ**, Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marinas (CICIMAR), Apartado Postal 592, La Paz, 23090, Baja California Sur, México; farregui@ipn.mx

and Gustavo de la Cruz Aqüero, **Manuel J. Zetina-Réjon (presentor)**, Pablo del Monte-Luna, Mirtha Albañez-Lucero, Arturo Tripp-Quezada, José de la Cruz Agüero; CICIMAR

In 1995, Dr Rainer Froese invited Mexican scientists to join FishBase. At that time, ichthyologists responsible for collections and fish ecologists were not fully convinced of the benefits of sharing data at a global level. Fisheries biologists were more open to FishBase because they recognized the value of easily accessible data for modelling as a base tool for natural resources management. The FishBase module in Mexico begun in 1996 with a small grant from CONABIO (National Commission of Biodiversity) to contribute to a database of Mexican fishes using FishBase as a bridge. A strong link between FishBase and trophic ecosystem modelling began, which we assume has a parallel history in other parts of the world. Today, the role of FishBase in trophic ecosystem modelling is more than indubitable; it is almost inseparable. Take the input scheme of the software Ecopath with Ecosim (EwE) as an example. FishBase contributes with both, inputs and/or confirmation-validity of model parametrization. Primary information, such as species distribution, habitat, occurrence and depth ranges help in constructing the components of an ecosystem. Once an ecosystem is constructed, modelers turn to FishBase to assemble Ecopath input parameters (P/B, Q/B, diets, food items, predators, trophic levels, etc.). Once an Ecopath model is balanced, modelers may proceed to time-dynamic modelling of the ecosystem using Ecosim. For this, FishBase links from species groups to catch time series (to FAO catch statistics via ISCAAP codes, or to the *Sea Around Us* reconstructed catches database), recruitment time series, or specific information to identify environmental variables that force a species' production. The next step, time-space modelling with Ecospace, is also facilitated with the relevant FishBase data on fish habitats, occurrences, ecology, swimming speed, among others. Globally, FishBase provides a powerful base that supports interpretations of EwE outputs, to create realistic scenarios of ecosystem management or to test theoretical hypotheses. Last but not the least, FishBase plays a relevant role in teaching the practice of ecosystem modelling. CICIMAR, for instance, offers an Ecopath course each semester since mid 1996. FishBase is used throughout this course as a basic tool to obtain information on and thus construct an ecosystem model, and in addition, to learn about fish around the world. In this contribution, we show some examples where FishBase and EwE interact in the process of constructing trophic ecosystem models.

[7] Cite as: Arreguin-Sanchez, F, de la Cruz Aqüero, G, Zetina-Réjon, MJ, del Monte-Luna, P, Albañez-Lucero, M, Tripp-Quezada, A, de la Cruz Agüero, J (2014) The role of FishBase in trophic ecosystem modelling, p. 58-64. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

*FishBase in trophic ecosystem modelling*, Arreguin-Sanchez, F. *et al.*

12th FishBase Symposium

# Big Old Data and Shiny New Insights: Using FishBase for Research

*FishBase in trophic ecosystem modelling*, Arreguin-Sanchez, F. *et al*.

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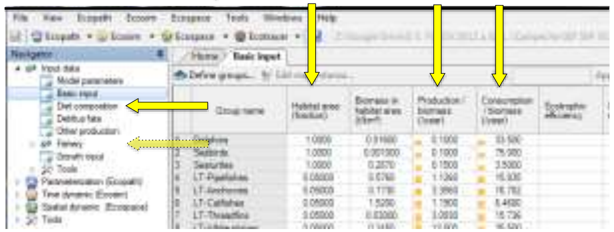
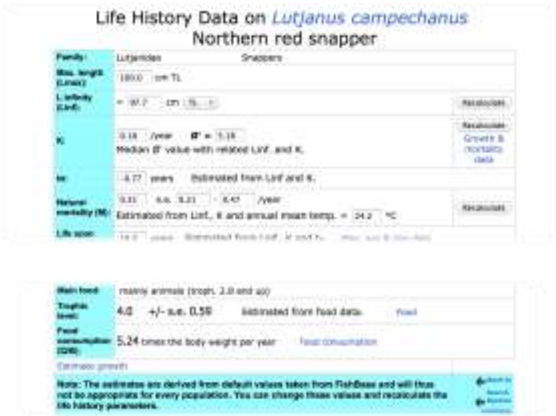
***Selecction of functional groups:***

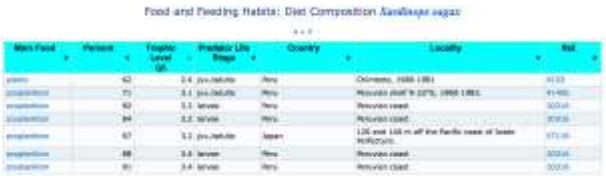
- *Ocurrence*
- *Distributon*
- *Habitat*



*P/B , Q/B, … or parameters to estimate them*




*Diets…*




*after the* ***Balancing*** *process …*

*… the* ***Consistency*** *test*

FishBase *Offers a number of values of P/B (non-exploited) and for Q/B for the species ( or functional groups ) to check or provide inputs,*

*… but also to test estimated outputs as result of model parametrization (by observing ranges).*

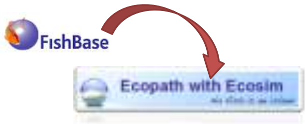
testing consistency of Ecopath

using FishBase

*Other parameters estimated by the model can also be used for the the consistency test*

*Omnivory*
*Predation rates*
*Respiration*
*Prey overlap*
*Predator overlap*

*FishBase in trophic ecosystem modelling*, Arreguin-Sanchez, F. *et al*.




… about Ecosim
input data

FishBase
support

… time series of catch found
in FishBase help to calibrate
time dynamics model

FAO – Sea Around Us – recruitment

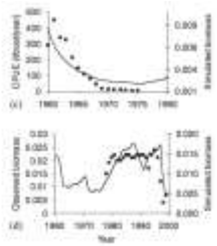
… in addition to other local or
global sources

time series of
local abundance (biomass, cpue…),
primary production,
forcing environmental variables

## Fitting time series in Northern Gulf of California

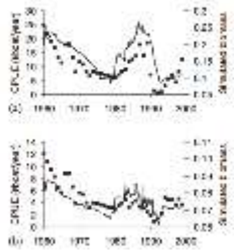
*(Lercari & Arreguín-Sánchez 2008)*

Totoaba (*Totoaba macdonaldi*)



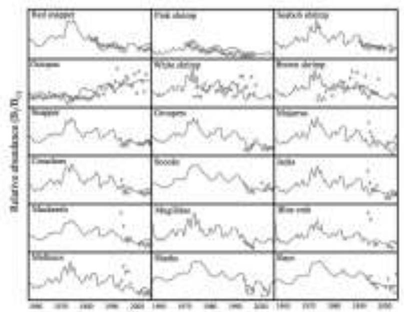
Sea lion (*Zalophus californianus*)

Blue shrimp (*Litopenaeus stylirostris*)



Brown shrimp (*Farfantepenaeus californiensis*)

## Fitting time series for Campeche Bank model



*FishBase in trophic ecosystem modelling*, Arreguin-Sanchez, F. *et al*.

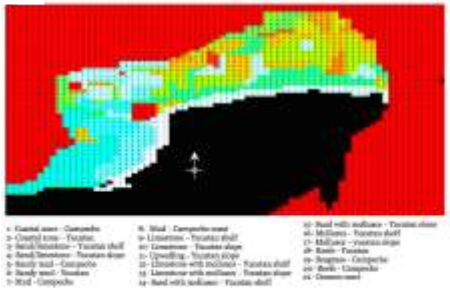
… about Ecospace input data

Fishbase provides inputs like…

Geo-referenced maps
Ocurrence
Species distribution
Habitat
Depth ranges

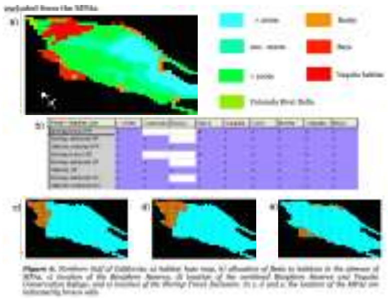
Map constructed with Ecospace showing habitats in the Campeche Bank, México.

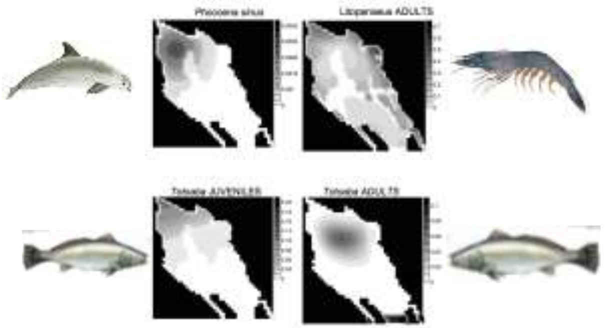
Color / numbers indicates habitat



Map constructed with Ecospace showing habitats and distribution of fishing fleets in the Northern Gulf of California, México.

Color / numbers indicates habitat





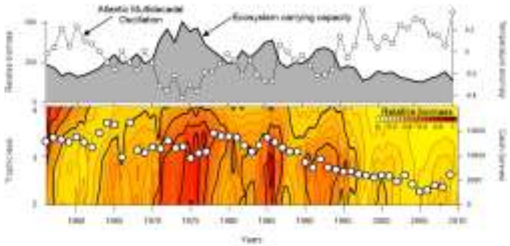
Ecospace outputs for the Northern Gulf of California showing species distribution

At this step we have a (consistent) model, as a tool to test hypotheses

Next two slides show briefly an application towards an …
"*ecosystem approach to fisheries management and sustainability*"

…so, we can identify limits of fishing of fish stocks in an ecosystem, derived from the holistic concept of "*ecosystem limit reference level*".

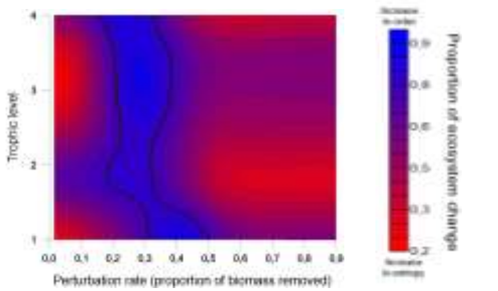
ecosystem evolution




(taken from Arreguín-Sánchez et al. 2014. Fisheries, AFS, accepted)

… this is an example of how we can link FishBase to ecosystem modeling, in our case "Ecopath with Ecosim", using outputs to advice directly fisheries management.

***"ecosystem limit reference level" concept***




(taken from Arreguín-Sánchez et al. 2014. Fisheries, AFS, accepted)


FishBase
Ecopath with Ecosim

The Role of Fis… …phic Ecosystem Modelling

thanks

*Francisco Arreguín-Sánchez, Gustavo de la Cruz Agüero, **MANUEL J. ZETINA-REJÓN**, Pablo del Monte-Luna, Hilda O. Albañez-Lucero, Arturo Tripp-Valdez, José de la Cruz-Agüero*

*Instituto Politécnico Nacional, Centro Interdisciplinario de Ciencias Marina* *farregui@ipn.mx*

*FishBase in trophic ecosystem modelling*, Arreguin-Sanchez, F. *et al*.

Francisco Arreguín-Sánchez is Professor at the National Polytechnic Institute at the Interdisciplinary Center of Marine Sciences (CICIMAR), in La Paz, Baja California Sur, Mexico. His research is focused on fish population dynamics, stock assessment and management; and since 1991 strongly involved in dynamics of exploited ecosystems, with emphasis on fisheries management. As FishBase Mexico coordinator (1995) he organizes the collection of data from the literature and internal research reports, and to convince Mexican ichthyologists to collaborate with FishBase, especially those holding scientific collections. He was director of CICIMAR (2001-2004), is member of the Mexican Academy of Sciences, and of the National System of Researchers. At the present he leads the Laboratory of Dynamics and Management of Aquatic Ecosystems and, through the active projects, his group maintain direct collaboration with more than 10 international scientific institutions and 15 at national level, as well as a strong and permanent linkage with governmental entities involved in management and conservation of living marine resources.

# NF-UBC NEREUS PROGRAM: TO ADVANCE OUR UNDERSTANDING OF THE FUTURE OF FISHERIES[8]

**Yoshitaka OTA**
Nereus Program Co-Director and Nippon Foundation Senior Research Fellow, Fisheries Centre, UBC; y.ota@fisheries.ubc.ca

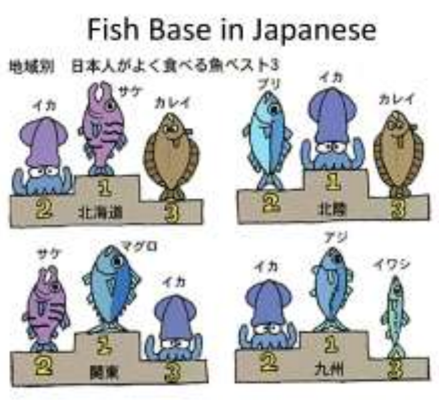
The NF-UBC Nereus Program is an international marine science initiative aiming to advance our understanding of the future of fisheries at the global scale. By forming a collaborative research network of 7 research institutes—including UBC, Princeton University, Duke University, the University of Cambridge, the World Conservation Monitoring Centre, Stockholm Resilience Centre, and Utrecht University—we account for the complex socio-ecological systems of global fisheries and ocean governance in our projections regarding the future of fisheries and the world's oceans.

With an interdisciplinary approach that addresses climate change, marine biodiversity, coastal systems, fisheries economics, ocean governance, and marine anthropology, our assessments of the mechanistic dynamics that guide future ecological changes and corresponding impacts to fisheries are supported by international datasets. In particular, FishBase has provided essential data required for projections regarding changes in species distributions and abundances at various scales.

These collaborative initiatives provide vital opportunities to explore analytical gaps, combine interdisciplinary research perspectives, and create new datasets. However, it is important to acknowledge the full 'supply chain' required to produce these datasets, and to ensure that those who have gathered the data are not alienated from the final product. I argue that there is a need not only to promote meaningful academic interaction between data collectors and end users, but also to advance new ideas and support collective creativity above pragmatism.

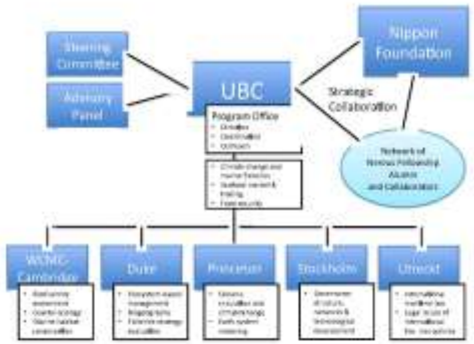
[8] Cite as: Ota, Y (2014) NF-UBC Nereus Program: to advance our understanding of the future of fisheries, p. 65-69. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

*NF-UBC Nereus Program*, Ota, Y.

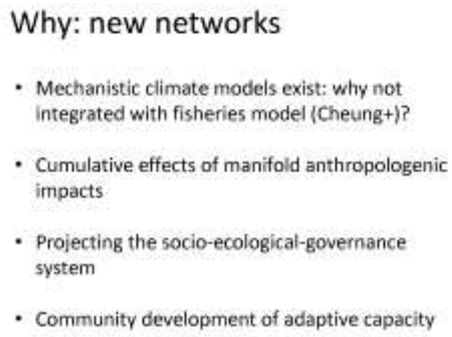


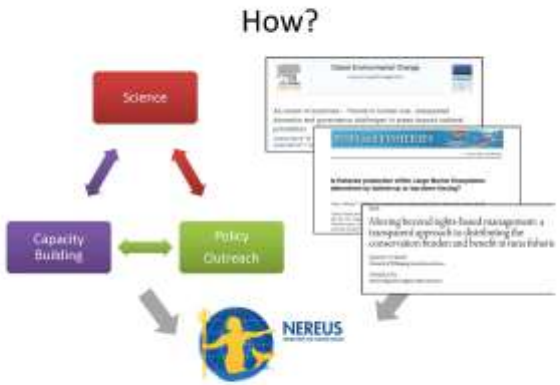


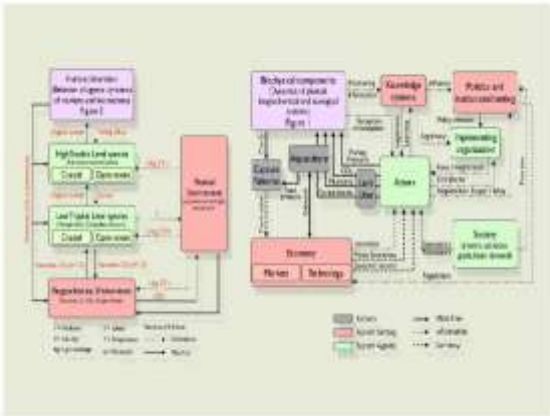


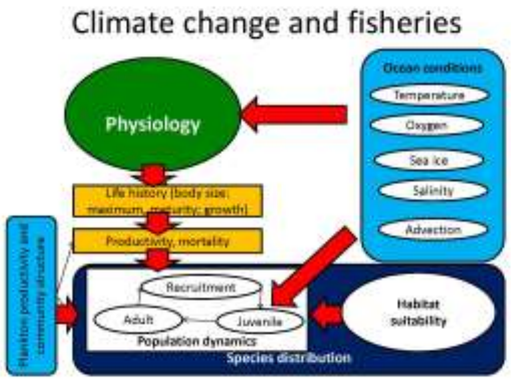
*NF-UBC Nereus Program*, Ota, Y.





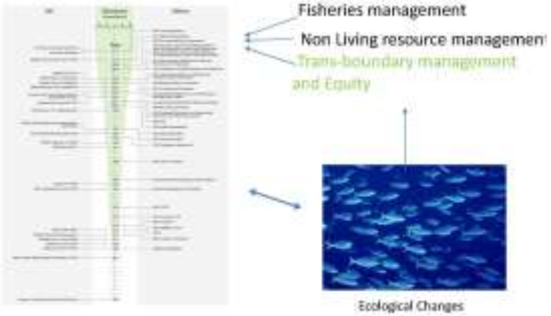


*NF-UBC Nereus Program*, Ota, Y.

## Collaboration research approach

| Key Questions | Thematic Topics | Local Scale | Regional Scale | Global scale |
|---|---|---|---|---|
| How will the ocean capacity support fisheries change in the future? | • Temperature • Oxygen • Acidification • Primary production | • Oxygen effect on fish distribution in the CCS • Ocean Acidification in the CCS | • Changes of Oxygen minimum zones • Ocean Acidification in the Arctic Ocean • Regional differences in model fidelity | • Oxygen variability • PH and saturation changes • Climate induces inter-annual variability |
| How will the distribution of key fisheries change in the future? | • Distribution • Food Web • Biodiversity • Habitat Types | | • Key stone species • Pelagic Habitat Change | • Trophic interactions • Deep Pelagic biogeography |
| How will fisheries management and governance adapt to deal with "management mission" in the future? | • Ecosystem based approach • Ocean governance | Oceanographic [illegible] Oceans Pacific Blue Fin Tuna [illegible] fishing | • Conservation burden of migratory stock • RFMO governance | • High sea governance • Fisheries industry changes • Trans-boundary management |
| Human Dimension | • Fisheries Economics • Socio-economic change of coastal communities • Development of aquaculture | Climate change impact on BC indigenous fisheries | • Fisheries business model • Use of corporate social responsibility • List of global indigenous fisheries | • Aquaculture and resilience of global food portfolio • Externalities in seafood |

## Governance and Legal context




How:

- Investigation of ecological mechanism
- prediction and scenarios (simulating impact)
- Perturbations, resilience, and ecosystem collapse
- Communication and policy

Prediction and Scenario:

United Nations : Informal Consultative Process on Ocean and Law of the sea


Investigation of ecological mechanism:

Elucidating the drivers of global fisheries production


Mcowen et al (2014) Is fisheries production within LME determined by Bottom up or top-down forcing, Fish and Fisheries

Improvements

## *NF-UBC Nereus Program*, Ota, Y.



Yoshitaka Ota received his PhD in anthropology from University College London in 2006. As a social anthropologist, he specializes in fishing practices, including the economics, social organization and lifestyles attached to this activity. For 18 months, he lived in Palau, Micronesia, learning fishing as an apprentice of a famous spear-fisherman in town. Through fieldwork, he became interested in socio-cultural aspects of fisheries, particularly how social changes reflect upon the value and materiality of fish and how they create a new social dynamic in the human-ecosystem relationship. While conducting post-doctoral research in the UK, he worked at the University of Kent (Department of Anthropology and Durrel Institute of Conservation and Ecology) for an ethnographic project on English small-scale fisheries and the CHARM Project, an interdisciplinary fisheries management research initiative developed for the Eastern English Channel. He has worked on field-based research projects in various locations—Palau (Micronesia, 2000-2001), the English Channel (UK and France, 2003-2009 for ESRC Funded project on European small-scale fisheries), Ache (Indonesia, 2007, for the post-tsunami assessment of local fisheries), Victoria (Australia, 2007, for BA-funded research)—all of which developed his interest in theoretical and methodological perspectives on marine, environmental and socio-economic issues affecting coastal communities. In 2008, he returned to Japan to join a policy think-tank in Tokyo—the Ocean Policy Research Foundation — which specializes in research and policy suggestions for both international and domestic marine management and ocean governance. At the foundation, Dr Ota worked on issues concerning community-based management, coastal habitat reconstruction (Sato-Umi) and Marine Spatial Planning. In 2011, Yoshitaka joined UBC's Fisheries Centre as the Co-Director of the NF-UBC Nereus program, a partnership between the Nippon Foundation and UBC dedicated to developing an interdisciplinary approach towards the promotion of sustainable fisheries. He is also passionate about supporting the post-tsunami relief for the northern Japanese fisheries communities. He conducted his first research on fisheries communities affected by the disaster in summer 2011.

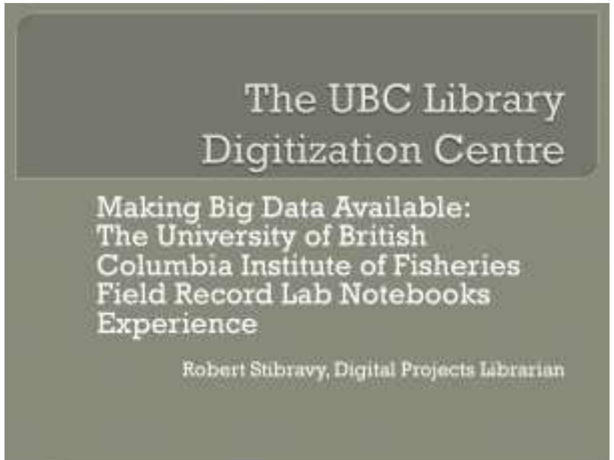
# MAKING BIG DATA AVAILABLE: THE UNIVERSITY OF BRITISH COLUMBIA INSTITUTE OF FISHERIES FIELD RECORD LAB NOTEBOOKS EXPERIENCE[9]

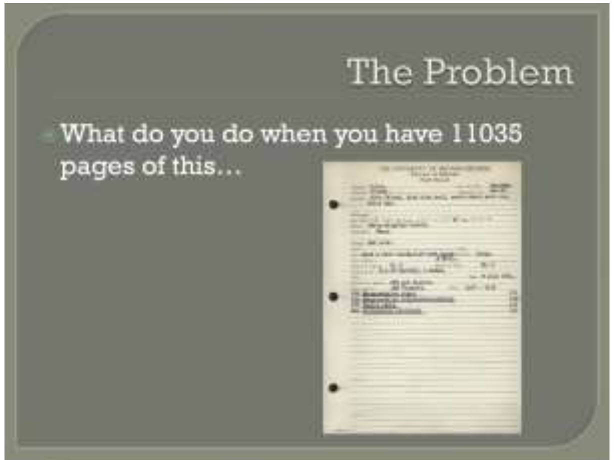
**Robert STIBRAVY**
Librarian, Digital Projects, Digital Initiatives,
Irving K. Barber Learning Centre, UBC; robert.stibravy@ubc.ca

From May 2013 through June of 2014 Rick Taylor, Director and Curator of Fishes, Beaty Museum of Biodiversity and Rob Stibravy, Digital Projects Librarian at the the University of British Columbia Library's Digitisation Centre collaborated on the conversion of 11,200 pages of field records from the Museum's collection from analogue to digital format. Find out how this was accomplished, what the challenges were and how these data will be accessible to researchers and the world at large.

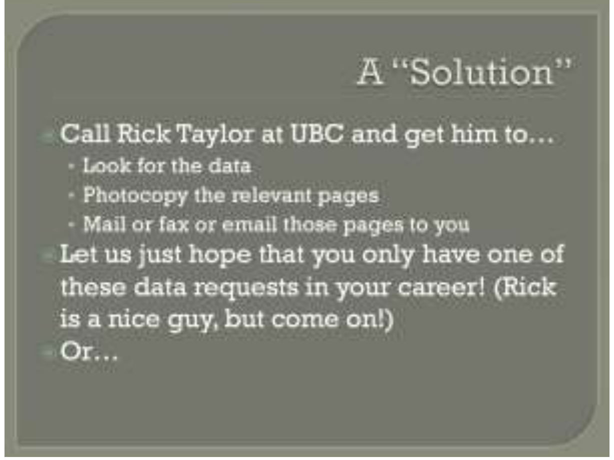
[9] Cite as: Stibravy, R (2014) Making big data available: the University Of British Columbia Institute of Fisheries Field Record Lab notebooks experience, p. 70-73. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

*Making big data available*, Stibravy, R.

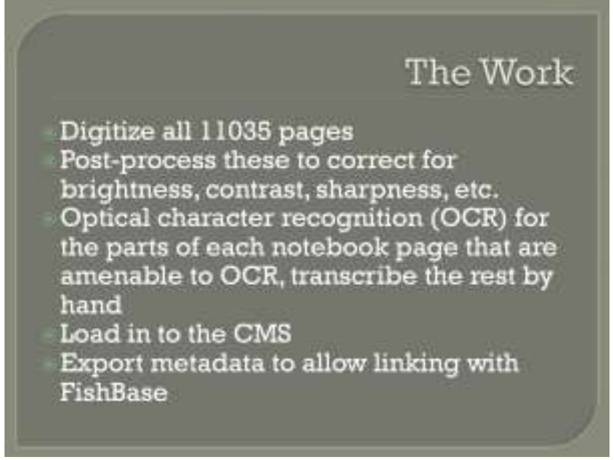










**Fujitsu fi-6670A**

High speed document scanner – this is what we scan large document collection with

## Results

- 11035 pages of difficult-to-access data available to the world
- A proof of concept for future endeavours of this nature and the realization that "it can be done!"
- Cost: approximately $22K CAD (not including existing infrastructure)
- Nice to have: domain expertise for better quality control and possibly faster work

## The Work (cont.)

- The scanning and the post-processing go well – we have done this before
- But (there is always a "but") the OCR is a washout – and that leaves us with a single choice
- Full Hand Transcription!
- Uh oh!

## Q & A

- Questions or Comments?
- Thank you/Maraming salamat/ Dankeschön/Arigatō/Merci/Gracias/ Dankjewel/Teşekkür ederim/Obrigado!

## The (New) Solution

- Hand transcription – at first look this does not seem to be practical
- Sampling various pages, however, and testing these with several different people doing the transcription gives us a result of 12-15 months with two students working on it and my project management
- In the end it takes about 14 months

## Work With Us!

- Interested in working with us on a project and are UBC affiliated or have a collaborator who is?
- Visit digitze.libary.ubc.ca or contact me to discuss your idea
- Thanks again!

## *Making big data available*, Stibravy, R.

Rob Stibravy is a Digital Projects Librarian at the University of British Columbia Library's Digitisation Centre. He has an undergraduate degree in Integrative Biology from the University of California, Berkeley and a Master of Library and Information Science from the University of British Columbia School of Library, Archival and Information Science. He manages digital projects for the Library and oversees the Digitisation Centre's infrastructure.

# SPACESHIP EARTH - SUMMARY OF AN UNUSUAL INTERNATIONAL ROUNDTABLE[10]

**Cornelia E. NAUEN**
*Mundus maris* – Sciences and Arts for Sustainability, Brussels, Belgium;
ce.nauen@mundusmaris.org – www.mundusmaris.org

The diversified uses and users of FishBase are a good illustration of making the hidden potential of data and information visible, once they become available in the public domain and can be used in both planned and unexpected ways. Using FishBase for art work was certainly not in the original intentions, but has become yet another one of the unexpected uses. It opens up opportunities for storytelling and listening to stories as an exploration of what lies hidden between the data and disciplines and what new insights and action opportunities we gain from the confrontation of diverse expertise and experiences.

Concern for the gravity of threats to the ocean was the motivation to host the international roundtable “Spaceship Earth” at the Peter Wall Institute for Advanced Studies in Vancouver in an unconventional format. Blending science, arts, diverse disciplines, cultures and practices, the roundtable created the conditions to discover rich trajectories to our individual and collective sustainability in relation to maritime and coastal sub-systems. Methods of action research combined with art of hosting approaches created the conditions for new collective intelligence and new storylines to emerge. The individual and group learning journeys of participants embarked on led to a host of action lines. Several projects aiming to bring about change are already underway or even accomplished. The greatest challenge is to keep the energy and motivation to act during the roundtable alive once participants have returned to their respective working environments. But the format has certainly potential to bridge the well-known gap between knowledge and action.

[10] Cite as: Nauen, C (2014) Spaceship Earth - summary of an unusual international roundtable, p. 74-77. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

## Spaceship Earth - Summary of an Unusual International Roundtable

**Cornelia E. Nauen [1]**
**presented by U. Rashid Sumaila [2]**

**(1) Mundus maris**
**Sciences and Arts for Sustainability asbl**
**(2) Fisheries Economics Unit**
**University of British Columbia**

**FishBase Symposium, Vancouver, 08/09/2014**

### Unexpected Consequences

Public EU funding for FishBase was justified in the 1990s as support to fisheries sector administrations in developing countries. Through the FB guest book we found users and uses in:

- Fisheries Departments
- Students in school and higher education
- Recreational fishers and angling trip organisers
- Artists
- Customs Services…

Source: Nauen, C.E., 2006. Implementing the WSSD decision of restoring marine ecosystems by 2015 – Scientific information support in the public domain. *Marine Policy,* 30:455-461.

### The Challenges are becoming bigger and more interconnected

Need to question eternal growth: reality check

- The resources on Earth are finite, even though we are very ingenious in finding new technical fixes - right now by borrowing from the future
- Our Earth is quite unique within the accessible parts of the universe, we better make it work
- We produce enough food to feed everybody, but 1 billion is obese and 1 billion is hungry
- Three major "environmental" challenges: Overfishing, climate change with acidifcation and pollution – how to act more

### Glocal

The tyranny of small decisions is at least partially to blame for the sorry state of affairs of the ocean and its inhabitants

- sector and disciplinary perspectives prevail

- most individuals and companies optimise their decision for local conditions only.

Yet the ocean is a global system and interconnected not only hydrologically, biologically, but economically, socially and in so many other dimensions.
But, many are not engaged or even aware...

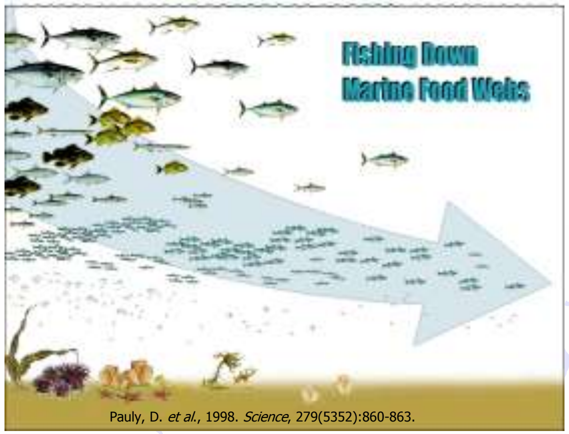
### New understanding, fresh narratives

So, we are looking for new perspectives on 'old problems' that should be

- Cross-fertilised from a variety of fields of experience and enquiry to ensure robustness,
- Grounded locally, where operational capabilities are,
- but conscious of global connections.

They should be understandable to and understood by the many

**Thus**: How to tell stories about the ocean that engage? One well-known visual example.




Pauly, D. *et al.*, 1998. *Science*, 279(5352):860-863.

*Spaceship Earth*, Nauen, C.

## Spaceship Earth – International Roundtable at PWIAS

Scientists, practitioners, artists from different places and cultures were invited to 5 days of intense exchange using participatory research methods.

The aim was to generate new insights through crossfertilization and unconventional ways of learning in order to initiate new projects and other actions for ocean health.

## Listening to and telling stories that matter

Sharing examples of good experiences in different fields allowed to harvest a fair number of principles that contribute to "success" and can be used in future action.

Another method used to blend what we already know in different professions and cultures was "mind mapping". We clustered ideas around big concepts.

## Levers and Learning Journeys

Analysing our mindmap and the big challenges to the ocean, we extracted what we considered "levers" enabling action for positive change.

Instead of "broadcasting" individual work results, with often little impact, we went on learning journeys the following day to find innovative ways for acting on the levers identified.

## The "big issues" we identified

- Resource overexploitation
- Climate collapse
- Pollution
- Institutions
- Global capital
- Social inequality
- Human affect and emotions
- The connectedness of issues

"**Levers for action**" are, among others, passionate people, engaging narratives ...

## Learning journeys spawning projects

Groups and individuals focused on different levers reporting back from their learning journeys, through recitals, film, scientific papers, exhibition planning thus opening minds for new opportunities.

The scene was set for project planning using the Pro-Action Café format in smaller groups and reporting the results back to the whole group again.

## Working on project proposals arising

- How to model Spaceship Earth? - Alan Mackworth
- Can we capture our experience in an open access book? - Cornelia Nauen
- What other written output can we produce? - Rashid Sumaila
- What does it take to bring "Fish-Credits" currency on its way? - Paolo Dini
- Can we expand the conversation to include eco-theology and build on the aboriginal spirituality? - Nigel Haggan
- What do we need to do to produce a contrasted global video interview about the ocean? - Dyhia Belhabib

*Spaceship Earth*, Nauen, C.

**Robi Smith's art inspired by FishBase**

**For more …**

**http://www.spaceshipearth.pwias.ubc.ca**

**http://www.mundusmaris.org**

**We encourage and welcome cooperation**
to use FishBase for developing ever more engaging stories that shift perceptions about what is necessary and possible and enable positive change.


**Thanks!**

**info@mundusmaris.org**

Cornelia Nauen holds a PhD in marine ecology/fisheries science from Kiel University, Germany. She worked in FAO's Fisheries Department starting in the late 1970s in relation to the species identification programme (biodiversity) and on aquatic and coastal pollution issues (consumer safety levels in and advisories). Between 1986 and 2012, she served in the European Commission in development cooperation and in international science cooperation. Subject areas were aquatic resources management and restoration, water systems and policy and lately science and innovation policy cooperation with Latin America. Critically engaged science to support policy and action for social inclusion and living and being in sustainable ways were a major focus. Since 2010 she heads the international non-profit association Mundus Maris – Sciences and Arts for Sustainability. Mundus Maris seeks to combine scientific concepts with practice embedded in local and global cultural spaces. It supports awareness raising and education about the ocean, e.g. through promoting conversations that matter and enable action. In May 2014, she co-organised the international Roundtable "Spaceship Earth" at the Peter Wall Institute for Advanced Studies at UBC Vancouver.

# ISOTOPEBASE: A NEW STABLE ISOTOPE-BASED TROPHIC ADDITION TO FISHBASE AND SEALIFEBASE[11]

**Todd MILLER,** Division of Fish and Wildlife, Commonwealth of the Northern Mariana Islands, Saipan, Marianas Protectorate; tmiller.dfw@gmail.com
and Maria L.D. Palomares, *Sea Around Us*, Fisheries Centre, UBC, Vancouver, Canada.

Over the last two decades stable isotope analysis (SIA) has become one of the most common and widely used tools in aquatic trophic ecology. Stable isotopes of both carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) are used in measuring organism relative trophic position, ontogenetic shifts and source production, and can be expanded in understanding organism movement/migration, biomagnification of contaminants, and as a precursor measure of eutrophication. As a result SIA has amassed a large literature base of stable isotope values and trophic level estimates across species and ecosystems that can be integrated into biodiversity information portals such as SeaLifeBase. Here we introduce IsotopeBase, a new addition to FishBase and SeaLifeBase that contains literature-based isotope values ($\delta^{15}N$, $\delta^{13}C$ and $\delta^{34}S$) and isotope-based trophic level estimates of invertebrates, fish, birds and marine mammals. The addition of IsotopeBase allows for direct linking of isotope values and trophic levels in space and time to the range of parameters provided in SeaLifeBase. In addition, IsotopeBase provides linear equations for ontogenetic length-isotope shifts in species of invertebrates and fish. Presently IsotopeBase has values for over 1,000 taxonomic groups/species from invertebrates, fish, birds and marine mammals from marine and estuarine systems around the world. The isotope values and trophic level estimates are linked to location and time, therefore providing researchers with temporal-spatial benchmarks from which to compare isotope values (baselines) and potential changes in relative trophic position of species. Limitations and assumptions in the use of stable isotopes as trophic estimates exist however, and IsotopeBase addresses these by an evaluation protocol to limit spurious assignments of trophic level and to help guide the user.

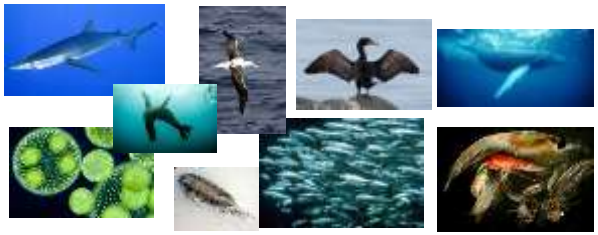
[11] Cite as: Miller, T, Palomares MLD (2014) IsotopeBase: a new stable isotope-based trophic addition to FishBase and SeaLifeBase, p. 78-81. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

*IsotopeBase*, Miller, T. and Palomares, M.L.D.

δ15N δ13C

## IsotopeBase: a new stable isotope-based trophic addition to FishBase and SeaLifeBase

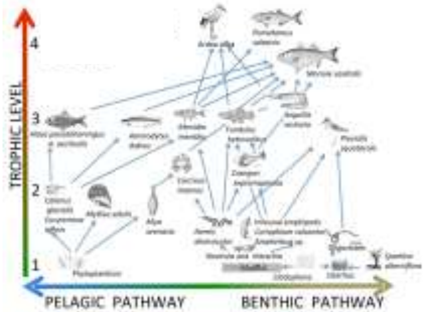
Todd W. Miller & Maria L. Palomares



## Stable isotopes in ecology

The primary stable isotopes used are from Carbon and Nitrogen

Nitrogen ($\delta^{15}N$)
- Relative trophic level
- Eutrophic conditions (high $\delta^{15}N$)



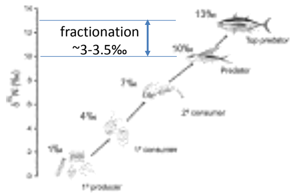

Carbon ($\delta^{13}C$) - Sources of primary production

http://pie-lter.ecosystems.mbl.edu/content/trophic-structure

## $\delta^{15}N$ – Trophic Level Measures

Nitrogen isotopes can measure relative trophic across a wide range of taxa and size classes

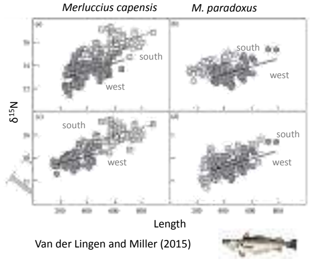
Relative Trophic Level




http://www.spc.int/oceanfish/en/

Ontogenetic shifts

Cape hake *Merluccius capensis* Deep water hake *M. paradoxus*




Van der Lingen and Miller (2015)

## $\delta^{15}N$ – Eutrophication

The primary stable isotopes used are from C and N

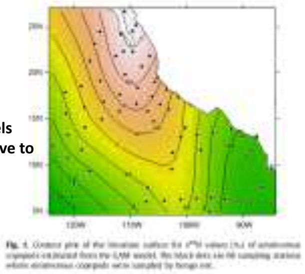
- Baseline $\delta^{15}N$ can indicate eutrophication

Areas that exhibit denitrification express high $\delta^{15}N$ values from phytoplankton, and this is expressed as high values through the food web.

Here we see copepods with elevated levels from areas that are more eutrophic relative to more offshore waters.

($\delta^{13}C$ would show a similar pattern)

Isoscape of $\delta^{15}N$

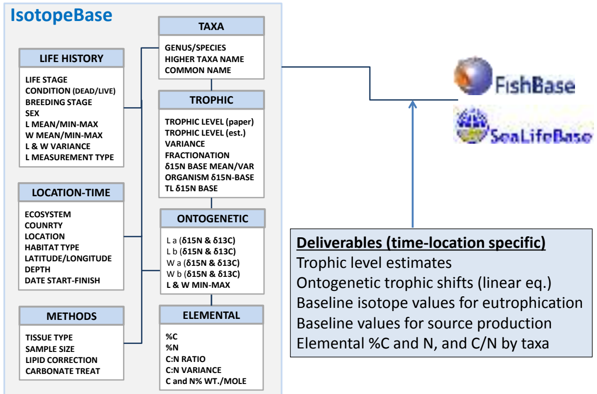


Olson et al. (2010)

## Overview of IsotopeBase Methods

1) Paper Review: Published literature is reviewed and screened for reporting isotope values and trophic levels (when provided)
2) Taxa: IsotopeBase includes all reported organisms (algae, zooplankton, fish, birds, and marine mammals).
3) Trophic levels:
   a. Record TL when given
   b. When TL is not provided, in some cases IsotopeBase can calculate (if there's a baseline).
   c. If TL cannot be assigned, raw isotope data is still provided.
4) Other information: life history stage, size, sample time-location, isotope methods, and how trophic level was calculated.
5) Duration: It takes ~1-2 hrs to review a paper, but this decreases with experience as the reviewer knows what to look for and how to report it.

## IsotopeBase Structure & Integration into FishBase and SeaLifeBase




**Deliverables (time-location specific)**
Trophic level estimates
Ontogenetic trophic shifts (linear eq.)
Baseline isotope values for eutrophication
Baseline values for source production
Elemental %C and N, and C/N by taxa

# *IsotopeBase*, Miller, T. and Palomares, M.L.D.

## IsotopeBase Integration into FishBase and SeaLifeBase

### IsotopeBase – current entries

**3100 entries**
**110 papers reviewed**
**Total count of genera and species by group**

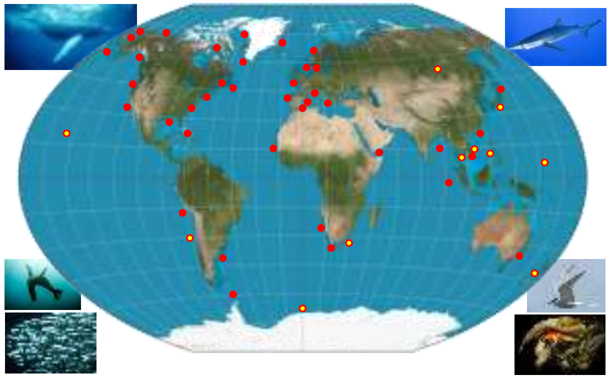
| Taxonomic group | Genus | Species |
|---|---|---|
| **Algae** | **65** | **70** |
| Seagrasses and plants | 16 | 16 |
| Gelatinous (Cnidaria) | 16 | 16 |
| Echinodermata (urchins, sea stars) | 42 | 44 |
| **Gatropoda (snails)** | **24** | **24** |
| **Cephalopoda (squid, octopus)** | **32** | **32** |
| **Bivalve (clams, scallops)** | **53** | **52** |
| **Crustacea (copepods, crab, krill)** | **249** | **250** |
| Annelida (polychaete worms) | 20 | 20 |
| Other inverts (corals, etc) | 50 | 49 |
| **Fish** | **592** | **590** |
| Sea turtles | 2 | 2 |
| **Birds (marine)** | **57** | **57** |
| Seals/sea lions/walrus | 12 | 12 |
| Dolphins/porpoise/orchas | 7 | 7 |
| Whales | 15 | 15 |
| Other mammals (otters, bears) | 3 | 3 |
| TOTAL | 1255 | 1259 |

FishBase
SeaLifeBase

**Deliverables (time-location specific)**
Trophic level estimates
Ontogenetic trophic shifts (linear eq.)
Baseline isotope values for eutrophication
Baseline values for source production
Elemental %C and N, and C/N by taxa

## Current Geographic Coverage of IsotopeBase

Within IsotopeBase ● Locations in-progress ○



## IsotopeBase Integration into FishBase and SeaLifeBase

FishBase SeaLifeBase
IsotopeBase

**Ecology**
Fisheries
Ecosystem models
Climate change
Migration studies

**Pollution & Biomagnification**
Persistent Organic Pollutants (POPs)
Heavy metals (e.g. Hg)

**Biogeochemistry**
Nutrient dynamics
Hypoxia
Climate change
Eutrophication

Research fields that use stable isotopes in conjunction with information from FishBase and SeaLifeBase.

## IsotopeBase Integration into FishBase and SeaLifeBase

FishBase SeaLifeBase
IsotopeBase

**Synthesis projects for research (BSc, MSc and PhD)**
- **Ecosystem comparisons of food webs**
- **Fishing impacts on food web structure (comparative studies)**
- **Global nutrient dynamics – N fixation and upwelling sources**
- **Pollutants and regional-global variation in biomagnification**
- **Tracing global trends in eutrophication and hypoxia**

## Assumptions and limitations of using stable isotopes

**1) Fish, birds, and marine mammals move around a lot, and they may cross over different baselines.**

**2) Isotopic fractionation factor ($\delta^{15}N$ ~3.4‰) is not well-resolved.** Fractionation varies by relative trophic level and protein content of diet. IsotopeBase can always correct this as we understand more.

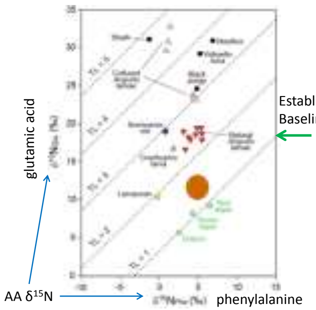
**3) Tissue/isotope turnover rate – how long does it take to isotopically match diet? This can also vary.**

**The above will eventually be resolved as the field of isotope ecology grows. IsotopeBase can easily adjust to these changes.**

## The future of IsotopeBase

From only approximately 100 papers we obtained values from over 1250 species covering the major ecosystems; there remains >1000 papers that can be added, and this number grows monthly.

New Advances:
**Compound Specific Stable Isotope Analysis**
- Accurate for trophic level
- Expansive
- New component of IsotopeBase




http://www.aori.u-tokyo.ac.jp

*IsotopeBase*, Miller, T. and Palomares, M.L.D.

### Conclusions

- **IsotopeBase** provides the first globally-centralized source of stable isotope data for ecologists; this information will be directly linked to the central biodiversity portals of **SeaLifeBase** and **FishBase**
- Specific deliverables from IsotopeBase are (by time and location):
    - Trophic level estimates
    - Ontogenetic trophic shifts (linear eq.)
    - Baseline isotope values for eutrophication
    - Baseline values for source production
    - Elemental %C and N, and C/N by taxa
- Limitations and assumptions for using stable isotopes – mobile/migrating animals, and unknowns in trophic fractionation (TF) and isotope turnover rates exist.
- IsotopeBase can adjust trophic level estimates as new information is obtained on TF and turnover rates.
- Advances in compound-specific stable isotope (CSSI) methods are addressing the above limitations, and IsotopeBase is planning to include CSSIs.

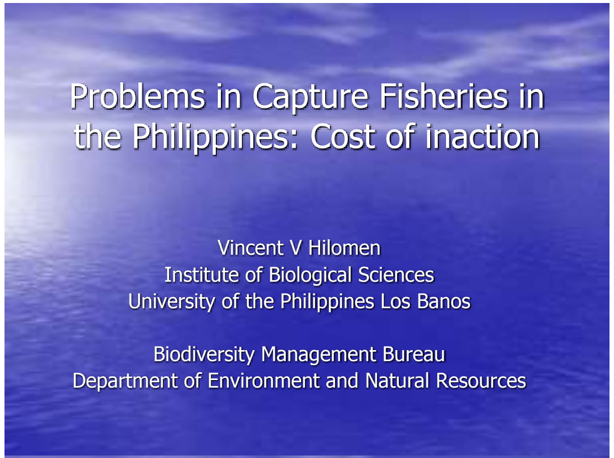
Todd Miller is the Head of Fisheries for the Commonwealth of the Northern Mariana Islands (CNMI), Marianas Protectorate (USA). He received his PhD from Oregon State University in Fisheries studying trophic ecology of the Northern California Current pelagic ecosystem. From there he moved to a post-doctoral and eventually Associate Professor position at Ehime University in Japan, performing food web and pollution research in Japan, Philippines, Vietnam, South Africa and Namibia. His current position in the CNMI covers life history evaluation, ecology and management of coral reef and bottom fishes. Recent projects include studying trophic plasticity of parrotfishes and surgeonfishes related to phase shifts in coral reef systems, and examining genetic connectivity of reef fishes along the Marianas Archipelago.

# PROBLEMS IN CAPTURE FISHERIES IN THE PHILIPPINES: COSTS OF INACTION[12]

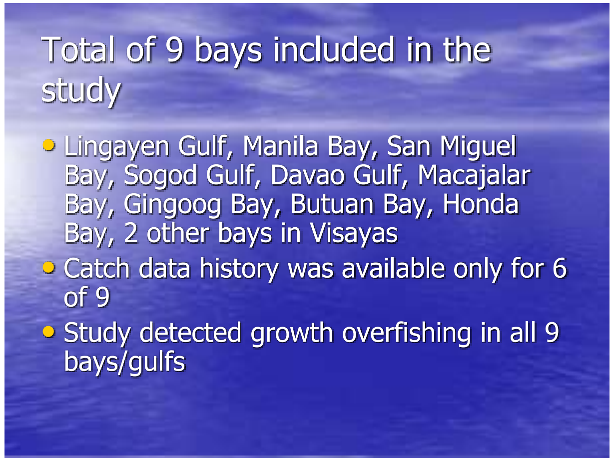
**Vincent HILOMEN**
Biodiversity Management Bureau, Department of Environment and Natural Resources, Republic of the Philippines; vvhilomen@up.edu.ph

The various problems in capture fisheries in the Philippines were revisited and the costs of inaction were evaluated for the small trawl fishery in San Miguel Bay in the Bicol region. Length-frequency data were obtained for *Alepes djedabba*, the fourth most abundant catch in San Miguel Bay in 2001. Size at first sexual maturity for *A. djedabba* was determined at 13.4 cm. Nearly 89% of the catch of *A. djedabba* was below the size at first sexual maturity. Information on the growth rates of *A. djedabba* was obtained from FishBase to determine length of time fish reaches size at first sexual maturity from actual mean size of catch. Results show the mean size of the catch will exceed size at first sexual maturity in about 4 months. The shift in the length frequency data of fish was projected to 4 months using a natural mortality rate of 20%. The biomass of actual catch and the projected catch was evaluated and valued using current prices. Results showed that catching this fish at sizes above the size at sexual maturity increases catch biomass nearly 3 times and monetary value 4.3 times than actual practice. The gain for waiting for this fish to grow before they should recruit to the fisheries was estimated at about PhP 6,600 per day per trawl and translates to PhP 76M annually for this species alone. Important strategies to change fishing practices of locals are discussed in the paper.

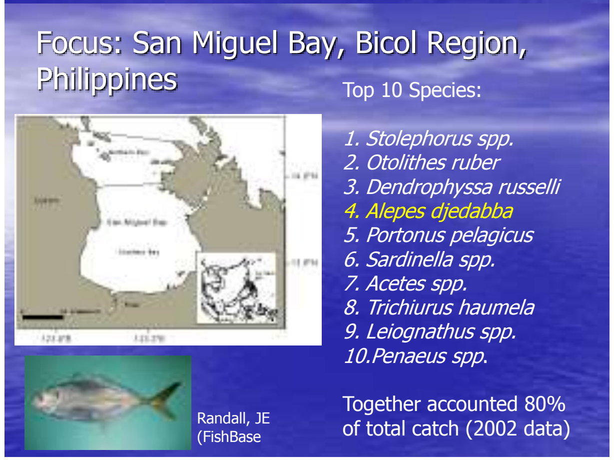
[12] Cite as: Hilomen, V (2014) Problems in capture fisheries in the Philippines: costs of inaction, p. 82-85. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

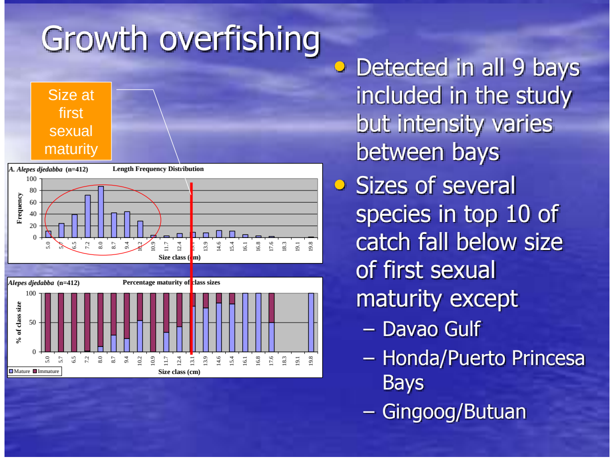

Problems in Capture Fisheries in the Philippines: Cost of inaction
Vincent V Hilomen
Institute of Biological Sciences
University of the Philippines Los Banos
Biodiversity Management Bureau
Department of Environment and Natural Resources


Problems in capture fisheries in the country
Overfishing
– Multi-gear/multi-species fisheries
– Gear conflicts (commercial vs artisanal)
– Destructive fishing methods (e.g. trawl, blast fishing)
Habitat degradation
Burgeoning population
Poor enforcement of relevant laws
Research inadequacies


Total of 9 bays included in the study
Lingayen Gulf, Manila Bay, San Miguel Bay, Sogod Gulf, Davao Gulf, Macajalar Bay, Gingoog Bay, Butuan Bay, Honda Bay, 2 other bays in Visayas
Catch data history was available only for 6 of 9
Study detected growth overfishing in all 9 bays/gulfs


Need to communicate problem with policy makers…
Do not listen to usual presentation of findings and new ideas
BUT we get their attention if shown monetary value of resources…
There was a need to be creative…
FishBase information…


Focus: San Miguel Bay, Bicol Region, Philippines
Top 10 Species:
1. Stolephorus spp.
2. Otolithes ruber
3. Dendrophyssa russelli
4. Alepes djedabba
5. Portonus pelagicus
6. Sardinella spp.
7. Acetes spp.
8. Trichiurus haumela
9. Leiognathus spp.
10. Penaeus spp.
Together accounted 80% of total catch (2002 data)
Randall, JE
(FishBase


Growth overfishing
Size at first sexual maturity
Length Frequency Distribution
Percentage maturity of class sizes
Detected in all 9 bays included in the study but intensity varies between bays
Sizes of several species in top 10 of catch fall below size of first sexual maturity except
– Davao Gulf
– Honda/Puerto Princesa Bays
– Gingoog/Butuan

## Implications of growth overfishing

- Can lead to recruitment overfishing where the ability of stocks to naturally replenish is impaired (from bad to worse)
- Productivity is not optimal
- Substantial reduction in larger size classes
- Removing individuals with better genetic material early (those that mature at a larger size)

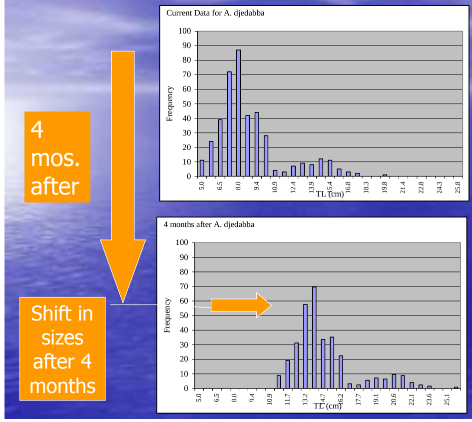
## What if…

- Set legal size limits to a select suite of commercially important species (initially)
  - Gear restriction (size of hooks, mesh sizes)
- Allow fish to grow a little more before harvesting
  - Collect and grow in cages
- Organize fishers into cooperatives
  - Police their ranks

## How much do we gain for waiting? (conversely how much do we lose if we do not wait)

- Consider current data from a typical catch in one of the bays
  - Examine number and size structure of catch
- Obtain total weight of observed catch using length-weight relationship
- Allow theoretical growth period to reach sizes slightly above length at first sexual maturity (in the case of *Alepes djedabba* (salay-salay), 8 to 14 cm will be 4 months)
- Factor in 20% mortality (e.g. predation and disease)
- Re-compute total weight of theoretical catch
- Compare:
  - Previous biomass to re-computed biomass
  - Cost of previous catch to new catch
  - Extrapolate to annual catch

## Shift in size structure after 4 months




## Is it worth the wait?

| | Current | 4 mos. after | Difference | Increase |
|---|---|---|---|---|
| **Biomass (kg)** | 35.9 | 104.1 | 68.2 | 2.9 |
| **Value (Php)** | 2,018.00 | 8,649.00 | 6,631.00 | 4.3 |
| **Bank (at 9%)** | 2,018.00 | 2033.14 | 15.14 | 1.008 |

Extrapolate to annual catch for San Miguel Bay

| **Annual Catch in San Miguel** | **Current** | **4 mos. after** | **Difference** |
|---|---|---|---|
| **Biomass (T)** | 411.4 | 1192.9 | 781.6 |
| **Value (Php)** | 23,122,857 | 99,112,388 | 75,989,531 |

## The gain in waiting 4 months or a mere 6 cm increase in length…

- Php 6,600 per day for mini-trawls in San Miguel Bay for example
- This translates to nearly 76M Php annually
- This figures represent potential opportunity for *Alepes djedabba* ALONE, the 4th most abundant catch in San Miguel Bay.
- So think how much is there to gain if we wait for fish to grow a little before we catch them…




Vincent V. Hilomen has nearly 28 years of work experience as a marine biologist specializing in reef fish ecology, fisheries and marine protected areas. His work experience includes 26 years in the academe teaching basic and advance zoology courses, particularly, in allied fields of marine science. His academic experience include more than 23 years of studies for marine protected areas, coastal resources management, fisheries biology, and marine biodiversity projects in marginalized sectors of society in the Philippines for purposes of planning and policy formulation. He has also conducted studies for environmental impact studies, monitoring coastal environment, surveys for baseline assessment of coastal environment for a wide variety of sectors such as oil and gas, mining industry, power plants, coastal industrial areas and ecotourism. His experience covers projects in coastal baseline assessment in the ASEAN Region and the Middle East. He is presently on secondment Associate Professor in Zoology of the Institute of Biological Sciences, University of the Philippines Los Baños and is the Executive Director for Priority Programmes of the Biodiversity Management Bureau of the Department of Environment and Natural Resources.

# ESTIMATION OF MEAN TROPHIC LEVEL OF THE BOTTOM TRAWL FISHERY IN THE NORTH-EASTERN AEGEAN SEA (EASTERN MEDITERRANEAN)[13]

**Çetin KESKIN**
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Commercial discards of bottom trawl was studied in fishing grounds around Gökçeada Island in the north-eastern Aegean Sea. All the samples were collected on board a commercial trawler under commercial fishing conditions between 70 and 410 m depth from December 2009 to February 2010. A total of 3143 kg of biomass were caught in the 28 valid hauls. Of that amount, 2101 kg (67%) were landed and 1042 kg (33%) were discarded. Eighty nine fish species comprised the 85% of the total catch. Eight fish species were always landed, 49 always discarded, and 32 appeared both in the landed and the discarded fractions. Mean weighted trophic level of the discarded fishes was significantly lower than landed. The results of this short time study show that bottom trawl fishery removes higher trophic level species from the ecosystem and support fishing down effect.

[13] Cite as: Keskin, Ç (2014) Estimation of mean trophic level of the bottom trawl fishery in the north-eastern Aegean sea (eastern Mediterranean), p. 86-90. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

## Estimation of mean trophic levels of the bottom trawl fishery in the North-eastern Aegean Sea (Eastern Mediterranean)

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## Agenda

- Introduction
  - Objective of the study
- Study Area
  - Bottom trawl fishery in the NE Aegean
  - Fishing reguletion in Turkey
- Sampling
- Results
- Main Points
- Suggestions

## Introduction

The impact of fishing activities on the ecosystems:

✓Reduced species abundances, changes in size and species composition, and modifications of species life-history traits (e.g., Gislason *et al.* 2000),

✓By-catch and discards (Kelleher 2005; Davies *et al.* 2009)

✓Decrease in trophic levels *vs* the removal of the large size, high-trophic level species (e.g., Pauly et al., 2002)

## Objective

- Testing the MTL of landed species differs from that of the discarded ones
- The MTL of discarded and landed species changes with depth

## Study area


## General view on demersal fishery in the Aegean Sea

**Demersal species landings** in the Aegean Sea are about 31% of its total fisheries production (Tırasın and Ünlüoğlu, 2012).

A total of 5,725 fishing boats (32%) are located in the Aegean Sea of which:

83 are bottom trawlers,
17 are trawler-purse seiners (combined)
89 are purse seiners, and 5,056 are small scale fishing boats.

*Trophic level of Northeastern Aegean Sea bottom trawl fishery*, Keskin, Ç.

## The current fishing regulations in Turkey:

i) minimum mesh size and landing sizes
ii) closed areas and seasons
iii) gear or fishing methods restrictions and bans
iv) catch prohibition for some species

## Target species include:

- Red mullet *Mullus barbatus*
- European hake *Mercluccius merluccius*
- Pandoras (*Pagellus* spp.)
- Norway lobster *Nephrops norvegicus*
- Rose shrimp *Parapenaeus longirostris*
- Giant red shrimp *Aristeomorpha foliacea* (Risso)

## Sampling stations

Figure 1. Map of the study area around Gökçeada Island (north-eastern Aegean Sea; eastern Mediterranean) showing the position of the trawl samples analysed (circles).

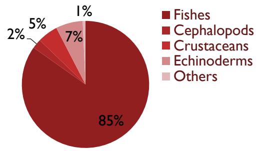
## Sampling

- Sampling period: Winter, 2010
- Onboard a commercial vessel (24 m length and 141.5 GRT)
- Cod-end stretched diamond mesh size: 44 mm
- Depth range: 70 and 410 m
- Haul duration:
  1-2 hour <100 m
  3-4 hour in deeper waters

## Results

28 valid hauls.
Total biomass = 3143 kg

89 fish species:
always landed: 8
always discarded: 49
landed and the discarded fractions: 32



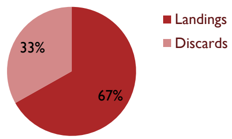




Figure 1. General summary of the results for the trawl samples analyzed.

## Existence groups of samples

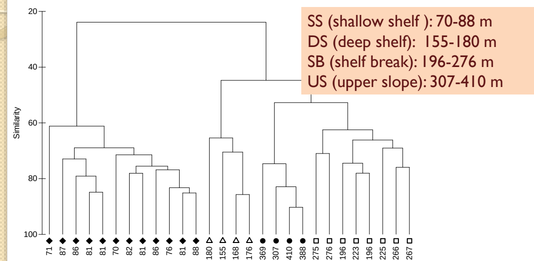



Figure 2. Cluster analysis of the species abundance (individuals/h) in the trawl samples.

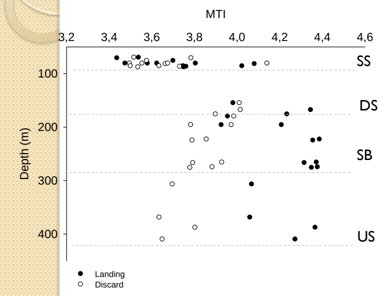
*Trophic level of Northeastern Aegean Sea bottom trawl fishery*, Keskin, Ç.

## Discards and landings for each group

Table 3. Biomasses (kg/h) of discards (D) and landings (L) by groups in the North-eastern Aegean Sea. * $p<0.01$

| | SS (70-88 m) | DS (155-180 m) | SB (196-276 m) | US (307-410 m) | *Post-hoc* |
|---|---|---|---|---|---|
| n | 12 | 4 | 8 | 4 | |
| D | 32.89±13.13 | 14.03±2.8 | 12.72±13.56 | 10.77±1.84 | SS>DS=SB=US* |
| L | 45.64±19.3 | 31.04±3.8 | 25.37±9.19 | 35.37±20.01 | SS=DS=SB=US |

## Mean Trophic Index by each group for discards and landings




In the whole catch;
Landings; MTI =4.0
Discards; MTI = 3.8
t-test; p: 0.0001

Amongst the groups;
Discard: DS>SB=US=SS*
Landing: DS=SB=US>SS*
Anova; $p<0.001$

## Major points

- ✓ In the North-estern Aegean, The MTI of the discarded fish was significantly smaller than that of the landed fish.
- ✓ The MTI of the whole catch (3.9) was lower than in the past [$TMI_{1998}$ =4.1; It was estimated by using Gurbet and Kara (1999)]
- ✓ Mediterranean hake, *Merluccius merluccius*, the deeper self water (155-180 m) around Gökçeada was the main discarded fish with high troph (discasd size changed: 10 to 23 cm; mod: 14 cm).

## Finally,

The negative impact of trawl fishery cannot be handled only with the present fishing regulations in Turkey, since this can affect food web structure and ecosystem functioning.

## Suggestions

For better fisheries governance,

- Strict enforcement of the fisheries rules is requested and needed
- There are some closed areas (Saroz Bay) and around Gökçeada Island, but;
- Management plan for the Saroz Special Protected Area is needed, but there is NO MANAGEMENT Plan right now
- For Gökçeada, a very small protected area exists, but this area should be enlarged.

- NEVERTHELESS:

- Protection of the fisheries stocks in the Northern Aegean Sea, concerted action is needed between Turkey and Greece, mostly with shared stocks.
- High Sea marine protected area is one of the option for the protection of the demersal stocks .

*Trophic level of Northeastern Aegean Sea bottom trawl fishery*, Keskin, Ç.

Çetin Keskin received MSc and PhD degrees in Fisheries Science from the Institute of Science, University of İstanbul in 1994 and 2002, respectively. In 1994, she became a Research Assistant at the Department of Marine Biology, Faculty of Fisheries at the University of İstanbul, and stayed on to become Assistant Professor in 2006, and Associate Professor in 2013. Her current research interests include diversity, distribution and community structure of fishes in the eastern Mediterranean. FishBase has been one of her interests after her postdoc in 2013 at the Fisheries Centre, UBC.

# OCCURRENCE OF BRAZILIAN FRESHWATER FISH SPECIES BY STATE[14]

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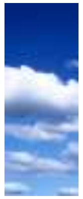
and Isaac Trindade Santos, LEP/UFS; Thaisa Accioly de Souza, Laboratório de Oceano, Departamento de Botânica, Ecologia e Zoologia, Universidade Federal do Rio Grande do Norte (UFRN), Campus Universitário Lagoa Nova, Natal – Rio Grande do Norte – Brasil, CEP: 59078-970; Danyhelton Douglas Farias Dantas, Laboratório de Ecologia Aquática (LEA)/UFRN; Ronaldo Angelini, Departamento de Engenharia Civil/UFRN

Brazil possesses the highest diversity of freshwater fishes in the world, with 3,152 species reported. It is followed by China, Indonesia, the Democratic Republic of the Congo, and United States of America with 1,605, 1,209, 1,138, and 1,001 species, respectively. All the other countries have less than 1,000 freshwater fish species. Brazil has a large continental area and very diverse hydrographic basins. One of the initial steps when planning to carry out a study is to secure a checklist of species found in that study area (such as state, river, basin). Except for some rare cases, such as the state of Pernambuco for which an electronic atlas was prepared, there is no list easily available for freshwater fish species by state in Brazil. FishBase currently has a partial list for freshwater species that reports 1-68 species by state, which is unrealistic and reveals that no effort was done yet to compile a more comprehensive list. Thus, we propose a study to be primarily based on CLOFFSCA to remedy this situation. This database will be complemented by information provided by local sources, and the data will be made available through FishBase. This new list, together with a database for common names for freshwater fish species, previously compiled by the first author will allow for the reconstruction of catch statistics for Brazilian continental waters that should also be made online for wider and easy usage. Preliminary results indicate the occurrence of 11-444 species by state, with the highest fish diversity found in the state of Amazonas, whereas the highest diversity of marine fishes is found in the state of Rio de Janeiro.

[14] Cite as: Freire, K, Trinidade-Santos, I, de Souza, TA, Farias Dantas, DD, Angelini, R (2014) Occurrence of Brazilian freshwater fish species by state, p. 91-94. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

*Brazilian freshwater fish species by state*, Freire, K. *et al.*



# OCCURRENCE OF BRAZILIAN FRESHWATER FISH SPECIES BY STATE

Kátia de Meirelles Felizola Freire*, Isaac Trindade Santos, Thaisa Accioly de Souza, Danyhelton Douglas Farias Dantas & Ronaldo Angelini

*Universidade Federal de Sergipe, Brazil/CAPES

FishBase Symposium, Vancouver – September 8, 2014

## INTRODUCTION

- Brazil has the highest diversity of freshwater fish species in the world: 3163 spp. (Froese & Pauly, 2014)
- It is followed by China (1605), Indonesia (1209), the Democratic Republic of the Congo (1138), and United States of America (1001)
- Brazil has a large continental area and very diverse hydrographic basins.
- Except for some rare cases, such as the state of Pernambuco for which an electronic atlas was prepared, there is no list easily available for freshwater fish species by state in Brazil.

## OBJECTIVE

- To compile data of occurrence of Brazilian freshwater by state for all 26 states
- To report occurrence by main water bodies and establish the link between these water bodies and the basins defined by ANA (Brazilian Water National Agency)
- To set the stage to the reconstruction of commercial catches in Brazilian inland waters

## METHODS

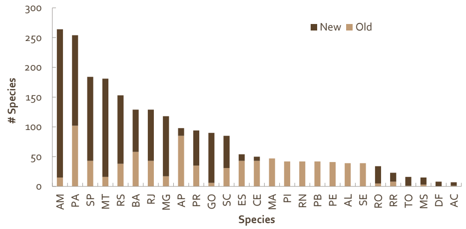
- Compilation started with a national publication
  - ✓ Buckup, P.A., N.A. Menezes & M.S. Ghazzi, 2007. Catálogo das espécies de peixes de água doce do Brasil. Museu Nacional, Rio de Janeiro. 195 p.
  - ✓ Reis, R.E., S.O. Kullander & C.J. Ferraris Jr., 2003. Check list of the freshwater fishes of South and Central America (CLOFFSCA). EDIPUCRS, Porto Alegre. 734 p.

## METHODS

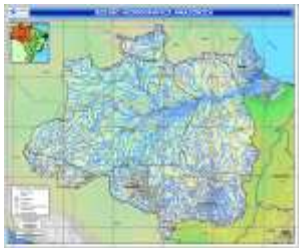
- Remote Data Entry into the Philippine server (www.fishbase.ph) – Isaac Trindade
- Database in MS Access with occurrence by river/basin/stream

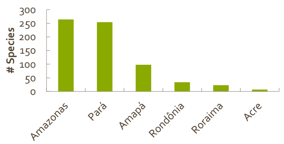
Landing database by state (by common name) → Database of fish common names by state and corresponding scientific name → Database of fish species by state (this work) → **Final landing database by taxon (fresh water)**

## RESULTS



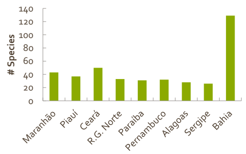

## RESULTS – Northern Brazil (592)





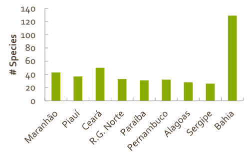

| SPECIES | Acre | Amapá | Amazonas | Pará | Rondônia | Roraima | TOTAL |
|---|---|---|---|---|---|---|---|
| Pseudanos trimaculatus | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| Pseudanos gracilis | | | 1 | 1 | 1 | 1 | 4 |
| Myleus rhomboidalis | | 1 | | 1 | | 1 | 3 |
| Anchoviella jamesi | | 1 | 1 | 1 | | | 3 |
| Anchoviella guianensis | | 1 | | 1 | | 1 | 3 |
| Ossancora asterophysa | | | 1 | 1 | 1 | | 3 |

## RESULTS- Northeastern Brazil (197)



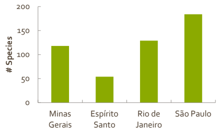

## RESULTS- Northeastern Brazil (197)

| SPECIES | Alagoas | Bahia | Ceará | Maranhão | Paraíba | Pernambuco | Piauí | R.G. Norte | Sergipe |
|---|---|---|---|---|---|---|---|---|---|
| Anchoa spinifer | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Anchoviella lepidentostole | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Aspistor luniscutis | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Awaous tajasica | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Bagre marinus | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Carcharhinus leucas | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Centropomus ensiferus | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Centropomus parallelus | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Centropomus pectinatus | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Ctenogobius shufeldti | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Cynoscion acoupa | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Eleotris pisonis | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Eucinostomus argenteus | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gerres cinereus | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gobiomorus dormitor | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gobionellus oceanicus | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Lycengraulis grossidens | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Odontesthes perugiae | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Odontognathus mucronatus | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Oligoplites palometa | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Pristis pectinata | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Pristis pristis | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Rhinosardinia bahiensis | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Stictorhinus potamius | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |



*Brazilian freshwater fish species by state*, Freire, K. *et al*.

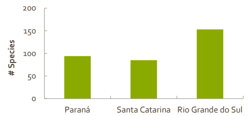
## RESULTS- Southeastern Brazil (485)



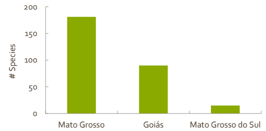

| SPECIES | Espírito Santo | Minas Gerais | Rio de Janeiro | São Paulo |
|---|---|---|---|---|
| Anchoa spinifer | 1 | | 1 | 1 |
| Anchoviella lepidentostole | 1 | | 1 | 1 |
| Aspistor luniscutis | 1 | | 1 | 1 |
| Awaous tajasica | 1 | | 1 | 1 |
| Bagre marinus | 1 | | 1 | 1 |
| Brycon insignis | 1 | | 1 | 1 |
| Carcharhinus leucas | 1 | | 1 | 1 |
| Centropomus parallelus | 1 | | 1 | 1 |
| Ctenogobius shufeldti | 1 | | 1 | 1 |
| Cynoscion acoupa | 1 | | 1 | 1 |
| Eleotris pisonis | 1 | | 1 | 1 |
| Eucinostomus argenteus | 1 | | 1 | 1 |
| Gerres cinereus | 1 | | 1 | 1 |
| Gobiomorus dormitor | 1 | | 1 | 1 |
| Gobionellus oceanicus | 1 | | 1 | 1 |
| Loricariichthys castaneus | 1 | | 1 | 1 |
| Lupinoblennius paivai | 1 | | 1 | 1 |
| Lycengraulis grossidens | 1 | | 1 | 1 |
| Odontesthes perugiae | 1 | | 1 | 1 |
| Oligoplites palometa | 1 | | 1 | 1 |
| Pristis pectinata | 1 | | 1 | 1 |
| Pristis pristis | 1 | | 1 | 1 |

## RESULTS- Southern Brazil (266)

| SPECIES | Paraná | Santa Catarina | Rio Grande do Sul |
|---|---|---|---|
| Bagre marinus | 1 | 1 | 1 |
| Carcharhinus leucas | 1 | 1 | 1 |
| Ctenogobius shufeldti | 1 | 1 | 1 |
| Cynoscion acoupa | 1 | 1 | 1 |
| Glanidium melanopterum | 1 | 1 | 1 |
| Gobiomorus dormitor | 1 | 1 | 1 |
| Gobionellus oceanicus | 1 | 1 | 1 |
| Lycengraulis grossidens | 1 | 1 | 1 |
| Mugil liza | 1 | 1 | 1 |
| Odontesthes argentinensis | 1 | 1 | 1 |
| Odontesthes perugiae | 1 | 1 | 1 |
| Platanichthys platana | 1 | 1 | 1 |
| Pristis pectinata | 1 | 1 | 1 |




## RESULTS – Center-West (291)

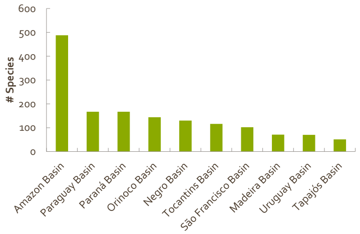


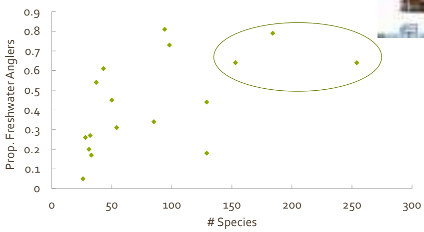

| SPECIES | Mato Grosso | Mato Grosso do Sul | Goiás |
|---|---|---|---|
| Farlowella jauruensis | 1 | 1 | |
| Tetragonopterus denticulatus | 1 | | 1 |

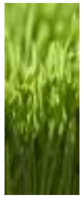
IBAMA (2007). Estatística da Pesca. 2007. Grandes regiões e unidades da federação. Brasília, Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis: 113 p.


## EXPECTED OUTPUT

- **REVISITING CATCH DATA OFF BRAZILIAN MARINE WATERS (1950-2010)**
  - ✓Freire, Kátia de Meirelles Felizola[1]; Aragão, José Augusto Negreiros[2]; Araújo, Ana Rosa da Rocha[3]; Ávila-da-Silva, Antônio Olinto[4]; Bispo, Maria Camila dos Santos[5]; Canziani, Gonzalo Velasco[6]; Carneiro, Marcus Henrique[7]; Gonçalves, Fernanda Damaceno Silva[8]; Keunecke, Karina Annes[9]; Mendonça, Jocemar Tomasino[10]; Moro, Pietro S.[11]; Motta, Fabio S.[12]; Olavo, George[13]; Pezzuto, Paulo Ricardo[14]; Santana, Raynara Filho[15]; Santos, Roberta Aguiar dos[16]; Trindade-Santos, Isaac[17]; Vasconcelos, José Airton[18]; Vianna, Marcelo[19]; and Divovich, Esther[20].
  - ✓To be published at the Fisheries Center Research Reports (2014)
- Start: SERGIPE - undergraduate thesis (2014.2)



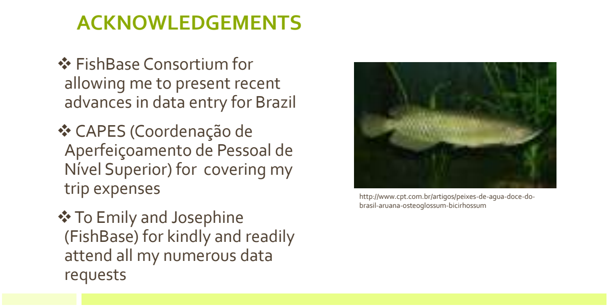



**WHERE TO GO FROM HERE?**

- Compiling landing statistics for the state of Sergipe (starting point) – ungraduate thesis
- Link between common and scientific name for Sergipe based on local sources (database of names)
- Reconstruct catch statistics for Sergipe by taxon
- Extension of the catch database to other states
- Make national catch database available online through the Instituto de Pesca de Santos (São Paulo)

*Brazilian freshwater fish species by state*, Freire, K. *et al*.

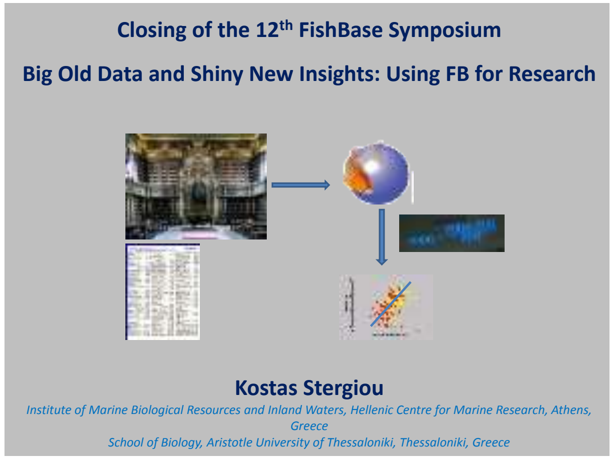


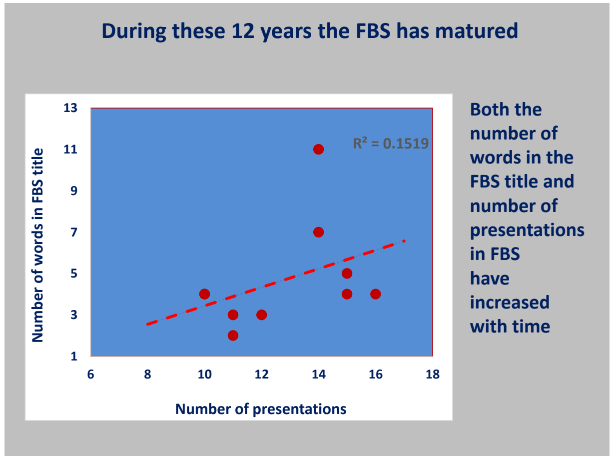

Kátia Freire was born in Sergipe, Brazil and moved to Rio Grande do Sul to do her undergraduate study in Oceanology. She got her MSc in Biological Oceanography also in Rio Grande do Sul, while studying feeding habits of *Engraulis anchoita* in southern Brazil. She moved to Rio Grande do Norte where she did a specialization in Statistics. She worked in Paraíba and Pernambuco as a professor and researcher, respectively. In 2000, she moved to Vancouver, Canada to pursue her PhD with Dr. Daniel Pauly studying the impact of fisheries on the ecosystem of north-eastern Brazil. Back in Brazil she got teaching/researcher positions in the states of Bahia, Rio Grande do Norte and more recently Sergipe. Katia's other interests include children's books, common names of fishes, and instrumental English. She has been contributing to FishBase since 2001 and to SeaLifeBase since 2010. Katia joins the FishBase Symposium with funding via the CAPES/Brazil.

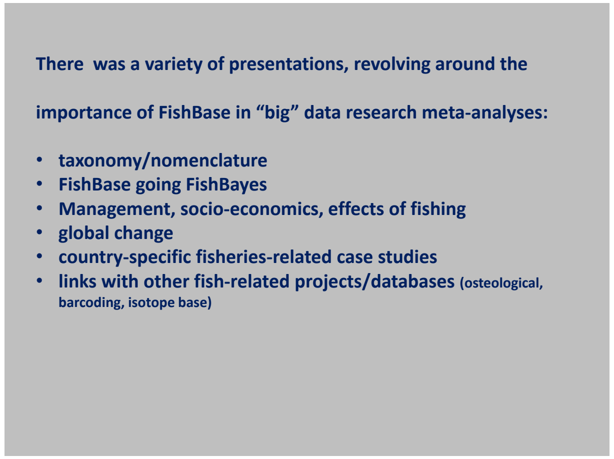
# CLOSING REMARKS

## CLOSING OF THE 12TH FISHBASE SYMPOSIUM: BIG OLD DATA AND SHINY NEW INSIGHTS: USING FISHBASE FOR RESEARCH [15]

**Konstantinos I. Stergiou**
Aristotle University of Thessaloniki and
Institute of Marine Biological Resources and Inland Waters; kstergio@hcmr.gr




[15] Cite as: Stergiou, K (2014) Closing of the 12th FishBase Symposium: Big Old Data and Shiny New Insights: Using FishBase for Research, p. 95-97. In: Palomares, MLD, Taylor, E, Pauly, D (eds.), 12th FishBase Symposium, Big Old Data and Shiny New Insights: Using FishBase for Research. September 8, 2014, Beaty Museum of Biodiversity, University of British Columbia, Vancouver, Canada. A report prepared by the *Sea Around Us* to the Paul G Allen Family Foundation and the Pew Charitable Trusts.

# CLOSING REMARKS

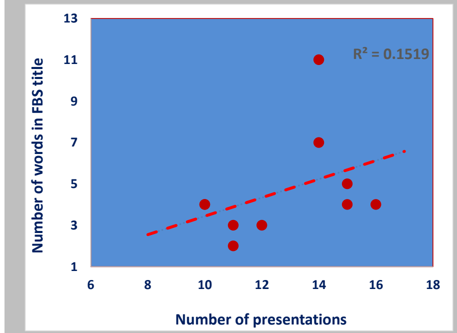
## The FishBase Symposium (FBS)…

**5 September 2002** **1st FBS in**
**Royal Museum for Central Africa,**
**Tervuren, Belgium**
**8 oral presentations**

**Since then, FBS has been an integral part of the**

**FBC annual meetings**

**During these 12 years the FBS has matured**




**Both the number of words in the FBS title and number of presentations in FBS have increased with time**

### History of the FishBase Symposium (FBS)

| FBS | Title | Year | Location | Date | Place | Talks |
|---|---|---|---|---|---|---|
| 1st | | 2002 | Tervuren, Belgium | 5 Sep | RMCA | 8 |
| 2nd | FishBase uses | 2004 | Paris, France | 2 Sep | MNHM, Grande Galerie de l'Évolution | 11 |
| 3rd | Fish and more | 2005 | Thessaloniki, Greece | 31 Aug | AUTh, Central Library | 12 |
| 4th | Fish in ecosystems | 2006 | Vancouver, Canada | 6 Sep | FC-UBC, Aquatic Ecosystems Research Laboratory | 11 |
| 4 | Fish Diversity and Aquatic Databases | 2007 | Tervuren, Belgium | 5 Sep | RMCA, Okapi Room | 15 |
| 6th | | 2008 | Quingdao, China | 1 Sep | CAFS, Yellow Sea Fisheries Research Institute, R 1601 | 17 |
| 7th | Darwin, names and databases | 2009 | Rome, Italy | 9 Sep | FAO, Iran Room | 10 |
| 8th | 20 years of FishBase | 2010 | Kiel, Germany | 6 Sep | IFM-GEOMAR | 16 |
| 9th | Biogeographical modelling in FishBase | 2011 | Stockholm, Sweden | 5 Sep | NHM | 10 |
| 10th | Fish diversity: a look from different angles | 2012 | Tervuren, Belgium | 11 Sep | RMCA, Conference room (CAPA Building) | 14 |
| 11th | More fish and more | 2013 | Thessaloniki, Greece | 2 Sep | AUTh, Center for Dissemination of Scientific Results | 15 |

## Impact of FishBase

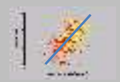
**FishBase has been evolved into a highly**

- **dynamic**
- **versatile**
- **ecological tool for**

**fish and fisheries research.**

**This is because it has transformed**

**Information** **into** **knowledge**



**Overall, during 2002-2014:**

- **12 symposia organized**
- **8 cities in 8 countries**
- **number of talks delivered increased to about 14-16**
- **153 talks**

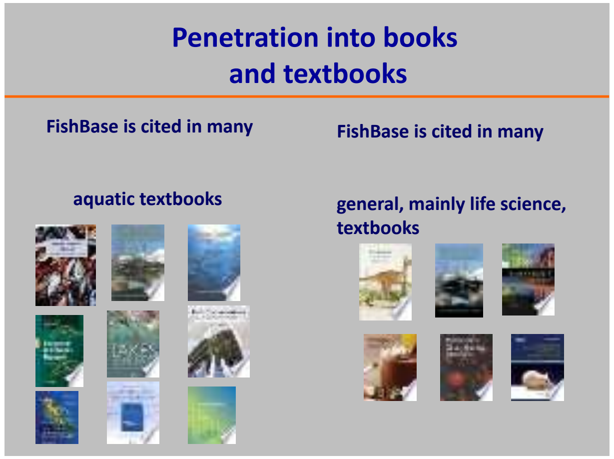
**These talks were on various aspects related to:**

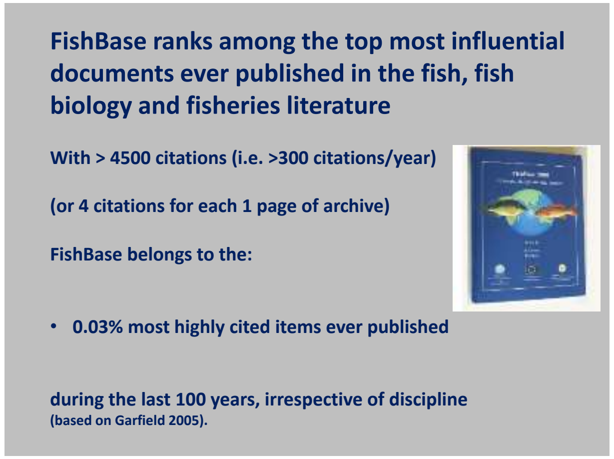
- **Informatics**
- **Fish and non-fish**
- **Charles Darwin**
- **Biodiversity**
- **Modeling**
- **Ecosystems, conservation, management.**

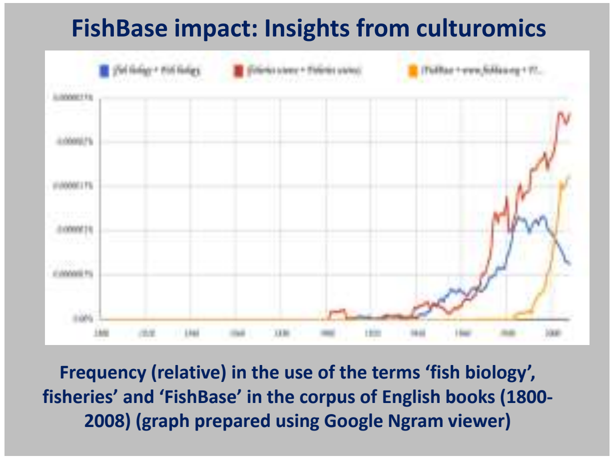
**FishBase as a reference has penetrated into the**

- **primary aquatic**
- **general literature**
- **review literature**
- **aquatic and general books and textbooks**

# CLOSING REMARKS




In 1985-1994, Kostas was a research associate at the National Centre for Marine Research (NCMR, now HCMR, Greece). In 1995-2001, he served as an Assistant Professor, and since 2006 as a Professor at the School of Biology, Aristotle University of Thessaloniki. He teaches both under-graduate and graduate courses on Ichthyology, Fisheries Biology, Fisheries Resources and Management and Time-Series Analysis. He was the Director of the Laboratory of Ichthyology, School of Biology in 2007-2013. His research interests are on fish life-history and population dynamics, fisheries ecology, modeling and forecasting, and ecosystem management, and bibliometrics. He was a member of the EU STCFM committee (1997-2002) and the Coordinator of the Fishery Science Task of CIESM (International Commission for the Scientific Exploration of the Mediterranean Sea). In 2001-2004, he became the Head of the CIESM Subcommittee on Living Resources and co-Chair of the CIESM Committee on Living Resources and Marine Ecosystems in 2004-2007. He acted as the National Coordinator of FishBase for Greece (since 1998) and since 2004 is the representative of the Aristotle University (School of Biology, Department of Zoology) to the FishBase Consortium. He serves on the Editorial Board of the journals Fisheries Research, Ethics in Science and Environmental Politics and Journal of Biological Research. He is also a contributing editor of the journal Marine Ecology Progress Series, Associate Editor for the FishBase Section (responsible for 'Short Communications in Ichthyology') in the journal Acta Ichthyologica et Piscatoria, Associate Editor for the journal Mediterranean Marine Science and Academic Editor of the journal Plos-One. He has contributed about 135 papers in peer-reviewed journals, 20 book chapters, one book, as well as more than 220 other publications (i.e. conference proceedings, special publications, newspaper and magazine articles) and co-authored 25 technical reports.

# ACKNOWLEDGEMENTS

We wish to thank the sponsors who made the participation of most of our speakers possible, the key people being:

- Mr Mathieu Leporini, Scientific Attaché, Consulate General of France in Vancouver;
- Dr Yoshitaka Ota, Program Co-Director of the Nereus Program; and
- Dr Mary Ann Bimbao, Executive Director, FishBase Information and Research Group.

We equally wish to thank those who helped in the organization of this Symposium:

- Ms Alice Dubot, Press and Communications Advisor, Consulate General of France in Vancouver;
- Ms Nicole Gibillini, Sea Around Us Communications Officer, UBC Graduate School of Journalism;
- Ms Mairin Kerr, Marketing, Communications and Events Coordinator and Ms Jacqueline Chambers, Education and Outreach Manager, Beaty Biodiversity Museum;
- Mr Michael Yap, Ms Joann Glorioso, Ms Rachel Atanacio and Mr Daryl Nikasius Santos, FishBase Information and Research Group;
- Ms Dayna Szule, Sea Around Us Administrative Assistant, whose help was instrumental in ironing the small but many details of this Symposium's organization and Ms Pamela Rosenbaum, Fisheries Centre Manager, who guided us through the many other details we overlooked.

Finally, we are grateful to the Paul G Allen Family Foundation for the generous grant to the Sea Around Us, which includes a sub grant to the FishBase Information and Research Group.

This report is the product of a scientific collaboration between the Pew Charitable Trusts and the Sea Around Us.

**www.seaaroundus.org**

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