Fourth time ICHA is held in the Southern hemisphere, but **first** time in South America.
ICHÁ CONFERENCE STATISTICS

350 participants from 35 countries (30% students).

145 orals, 2 (x10) ignite talks, 250 posters

(arrows mark ICHA held in southern hemisphere)
Could you please check my ISSHA registration?

New ISSHAmembers struggled to vote for the 2020 venue and for the Council Elections

Ja, ja! Wait until she tries.
ISSHA Elections 2016

EXECUTIVE

President  Vera Trainer (USA)
Vicepresident  Gustaaf Hallegraeff (Australia)
Secretary  Anke Kremp (Finland)
Treasurer  Henrik Enevoldsen (Denmark)
Past President  Beatriz Reguera (Spain)

COUNCIL

Ana Amorin (Portugal)
Christine Band-Schmidt (Mexico)
Keith Davidson (United Kingdom)
Marta Estrada (Spain)
Esther García (Spain)
Phil Hess (France)
Ichiro Imai (Japan)

Ian Jenkinson (China, France)
Karen Lebret (Sweden)
Po Teen Lim (Malaysia)
Wayne Litaker (USA)
Lincoln McKenzie (New Zealand)
Luis Proença (Brazil)
Aurelia Tubaro (Italy)
Homage to Prof Edna Granéli
(the brazilians HAB scientific “mamma”)

Brazilian barbecue and dancing at Edna’s Homage
A rest from all these sessions on Wednesday afternoon.....
Great ISSHA Auction 2016
Outstanding Themes of the Conference

- Climate anomalies, global change, record blooms
- Advanced ‘omics and in situ sensors enabling to test and answer scientific questions limited by technology
- Cyanobacteria: over 60 contributions
Exceptional blooms of *Pseudochatonella* and *Alexandrium* in 2016 began in outer coastal waters and transported into the inland sea; associated with anomalous movement of SE Pacific high pressure region (Clement, Guzmán). Red waters of *Dinophysis* and high DSP levels affecting marine biota in S. Brasil (Mafra, Proença, Alves).

Massive *Pseudo-nitzschia* bloom in W. US also associated with an anomalous warm “blob” of surface waters which stimulated and sustained the bloom along the entire coastline. (Trainer) and exceptional blooms of *Dinophysis* off La Plata estuary, Uruguay, in 2015 (Méndez).

First report in 2015 of a very toxic *Alexandrium* clade on E.Tasmania. Stimulation of an endemic strain by a complex interaction of increased temperature, flood events and changes in the southward extension of the E. Australian Current?? (Hallegraeff)

Modelling of *Cochlodinium*, *Dinophysis*, and *Alexandrium* populations shows expansion of the optimal growth conditions and bloom windows in the N. Atlantic and N. Pacific regions (Gobler)

Increasing ocean acidification projected to favor growth of dinos and cyanobacteria, based on their carbon concentrating mechanisms for photosynthesis (Van de Waal)

Forecasting climate driven changes in HABs will require new research approaches, improved response planning for extraordinary HAB events, better focus IPCC projections for regional changing conditions, and unification of experimental methods (Mark Wells)
TAXONOMY – New Species

The IOC-UNESCO Taxonomic Reference List of Harmful Microalgae, status, or state of the art (Moestrup)

Moestrup et al. 2009  http://www.marinespecies.org/hab/
Alexandrium fragae sp. nov., a new Alexandrium from Brazil (Branco)
Benthic dinoflagellates

- Two new species in the genus *Gambierdiscus*: *Gambierdiscus balechii* sp. nov. from the Celebes Sea (Fraga) *Gambierdiscus lapillus* sp. nov. from the Great Barrier Reef (Australia) (Kretzschmar)
- A new species of *Ostreopsis*: *Ostreopsis rhodeasae* sp. nov. from East Australian coast, with transcripts of enzymes active in the synthesis of PLTs (Verna). Recently described *Ostreopsis fattorussoi* also mentioned
- Taxonomic and genetic approach to planktonic *Prorocentrum* isolated from the South Atlantic (Branco)
- Phylogenetics and morphometrics of newly described species, *Coolia santacroce* and *Coolia palmyreensis* (Karafas)
- Characterization of the cyanobiont-bearing dinoflagellate *Sinophysis canaliculata* from the Canary Islands (Portela)
- **Ultrastructure** and molecular phylogeny on an **undescribed woloszynskioid** dinoflagellate (*Takahashi*)

- List of potential producers of AZAs growing fast: 11 species of *Azadinium*, 10 of the genus *Amphidoma* (*Tillmann & Kroch*)

- Discrimination of the three *Chattonella* species, *C. antiqua*, *C. marina*, *C. ovata* using multiplexed ISSR genotyping by sequencing (MIG-seq) analysis (*Nagai*)

- Identification of the unarmored dinoflagellate genus *Amphidinium* in western Pacific (*Iwataki*)
Cyanobacteria issues

60 studies were presented and distributed in 5 main areas:

- Toxins analysis: 14 studies
- Surveillance and Management: 3 studies
- Ecology and Bloom Dynamics: 5 studies
- Toxicology: 17 studies
- Cell Physiology: 18 studies
- Others: 3 studies
Highlights

✓ Advances on cyanobacterial cell physiology studies and intraspecific diversity analysis (Guedes, Galvanese).

✓ New reports about human oral exposure in different continents (South America and Africa) and a relevant case study about recreational exposure to microcystins with serious risk of death (Sedan, Pedro)

✓ Nodularin records in South America (Costa, Silveira)

✓ Increasing surveillance and management data from different regions;

✓ Continued exploration of clay and flocculants for removing cells and/or cyanotoxins (Magalhães, Bogarín)
Benthic HABs
Progress in the ecology of *Gambierdiscus* (Leaw, Adachi, Larsson, Sassenhagen).

Modelling *Gambierdiscus* bloom dynamics (Parsons, Kibler).

More data on distribution of *Gambierdiscus* including some new reports: Cuba (Díaz Asencio, Moreira), El Salvador (Quintanilla), Canary Islands (Rodríguez), Colombian Caribbean (Ruiz Gómez), Brazil (Nascimento) Philippines (Azanza) and their expansion to new areas (Larsson).

Monitoring CFP in Phillipines (Rañada).

New data on their toxicity (Pisapia, Riobó) and for the first time the transfer of their toxins to herbivorous fish in laboratory conditions (Clausing).

*Ostreopsis* ecology (Lemée, Catania). Many reports worldwide which shows it is a very common genus.
BIOLOGY, ECOLOGY....

- The diversity, specificity and role of parasites affecting various dinoflagellate species (Garcés, Reñé). Parasites in Guanabara Bay (Salomon)
- The still mysterious role of BMAA: who produces it? which are the effects (Lage)
- Allelopathic interactions received considerable attention. *A minutum* affects the diatom’s thylakoids and cell membranes, apparently involving ROS (Long). Mucilage plus non-identified substances (PUFAs?) involved in the capture of *Mesodinium* by *Dinophysis* (Mafra)
- *Alexandrium minutum* now forms dense blooms in the Bay of Brest; cyst records (sediments dating, PCR detection) shows it was absent before 1990 (Siano). The Galician shelf acts as a *Dinophysis* reservoir of active (high µ) cells when washed off the Rías during upwelling events (Reguera)
‘OMICS enabling deeper studies on physiology, evolution/ ecology improved monitoring...
• Genetics applied to life cycle, population structure and evolution: Transcriptomics, qPCR, microsatellites (Montresor)

• Genome of *Pseudo-nitzschia multistriata* sequenced; transcriptomics allowed investigations on genes involved in sex (Ferrante)/ Genomic studies on the complex mechanisms regulating mRNA transcription (Place)

• A novel technique for mapping the proteome of *Pyrodinium bahamense* (Subong).

• Exploring evolutionary pathways through which STX-synthesis genes have been transferred from cyanobacteria to dinoflagellates (Mendoza-Flores)
Strong Focus in XVII ICHA Meeting for molecular tools for HAB monitoring
qPCR-based molecular assays (R. Ruvindy, R. Paterson, M.I. Ferrante, ...)

- Targeting DNA instead of Toxins/Highly accurate/Cost-effective
- Rapid & Flexible:
  - Species determination
  - Saxitoxin gene

Detection + Prediction >>>> Harvesting Management

qPCR is not a «silver bullet» (R. Paterson) and needs more information on responsible genes, copy number per cell, changes in toxin production along the cell cycle (Azadinium, DA, etc)
Multiple studies using qPCR for HAB cell and cyst detection and enumeration: (Mora, Patterson, Siano) including use of saxitoxin genes as the target (Savela, Piccini, Buch, Ruvindy)
- Considerable promise for rapid quantitation, but some issues remain due to variable DNA copy number

Continued development of molecular assays for identifying and enumerating cells in monitoring programs: (Medlin – developed phylochips for multiple HAB species tested in 5 countries; Holguin – Lab on a Chip, electrochemical detector; Sprong – fully automated, ship-based algal biosensor using electrochemical detection and phylochips)
- Despite extensive development and testing, broad acceptance of molecular assays by research and regulatory communities not yet achieved

Continued use of ‘omic technologies for HAB studies: (Nagai, - metatranscriptomics; Tomasino – HTS metabarcoding to detect HAB species in monitoring programs; John – proteome map of Pyrodinium bahamense; Rengefors – RAD-tag sequencing to explore spreading of HAB species; Sassenhagen – microsatellite markers for studies of Gambierdiscus connectivity)
A nice take-home message from new generation molecular methods such as cell proteome analysis (B.J. Jereza)

**Jigsaw Puzzle**

It’s always the 
**small pieces**
that make the 
**big picture.**

**JIGSAW PUZZLE ANALOGY**

**kintsukuroi**

(n.) (v. phr.) "to repair with gold"; the art of repairing pottery with gold or silver lacquer and understanding that the piece is more beautiful for having been broken
Quite OK
Models need refinement

Conceptual models developed
Very scarce *in situ* rates and behaviour
We need to take the microscope underwater

(Reguera et al, GEOHAB Synthesis, Paris 2013)
Considerable advancement in the use of *in situ* sensors/biosensors and autonomous underwater vehicles for HAB studies

**Campbell** – Imaging FlowCytobot (IFCB) for early warning of HABs, resolution of phytoplankton community structure, long-term time series. Both dock (cabled) and mobile platforms.

**Brosnahan** – Uncabled IFCB deployment with solar power, automated winch, and WiFi for real-time profiling of IFCB and other sensors; unprecedented resolution of life cycle transitions underlying *Alexandrium* blooms; co-deployment of IFCB and ESP (Environmental Sample Processor).

**Kudela** – Use of multiple technologies for HAB studies (wave-powered profilers, AUVs, ESPs, IFCBs, and satellite remote sensing).

**Siemering** – Satellite guided glider in mapping of hydrography and chlorophyll in HAB monitoring and forecasting.
HAB detection and early warning using IFCB (Campbell)

- Early warning of 7 HAB events in the Gulf of Mexico (Dinophysis and Karenia)
- Automated e-mail and text alerts sent to managers and others

Campbell et al., 2010
In situ co-deployment of IFCB and ESP and other autonomous sensors

(Brosnahan)

High-frequency, high resolution data throughout all phases of an *Alexandrium* bloom revealing dynamics of growth (in situ growth rates), migration, gamete formation and fusion, and toxicity. Conclusion: Bloom cells swim faster, divide faster, form more gametes, and are more toxic than suggested from past laboratory studies.
Fish Killers

Massive 2016 Chilean *Pseudochattonella/ Alexandrium catenella* bloom (Rojas, Guzman, Aquilera, Villanueva, Montes) triggered social unrest (round table).

*Hallegraeff*, hypothesis of synergism of free fatty acids (EPA, DHA, OPA) release with ROS in various blooms (*Chattonella, Heterosigma, Karenia, Cochlodinium*). Recently killed fish (ichthyotoxins) are fit for human consumption (except *Karenia brevis*).

More investment needed in fish farm emergency harvest techniques, including fine-ground clays which at environmentally acceptable concentrations can mop up ichthyotoxins (*Seger*).

Novel chemical structures were reported for metabolites from *Prymnesium* (Hansen, Andersen, Rasmussen) and *Karlodinium armiger* (Larsen, Binzer).
Monitoring, management, mitigation

- Tidal front S. Irish Sea, initiation site of high density *D. acuta* blooms (*Raine*)
- Potential role of winter chilling in governing *Alexandrium* excystment; new prediction opportunities (*Fisher*)
- Greater diversity of methods to control HABs; refinement of clay treatment with reduced cost and environmental impact (*Seger*)
- Use of algicidal bacteria to control dinoflagellates and different polysaccharide gels to absorb PST toxins (*Imai, Teron*).
- A collaborative partnership between interdisciplinary researchers, public health staff, and local stakeholders, to achieve HAB risk assessment and management in Equador (*Borbore-Cordova*)
Toxins

- Novel class of prymnesins (B and C-type), the true fish killers; fatty acids + ROS enhanced effects
- 16 new AZAs reveal large chemical diversity in this genera Azadinium and Amphidoma
- Some novel STX-analogue in G. catenatum
- Several reports on uncharacterised allelopathic compounds

Methods

- Passive sampling
- HRMS, non-targeted analysis-omics

More papers on CFP/Gambierdiscus, but still large problems in organism and toxin detection
Effects of HABs in shellfish and other higher trophic level organisms

HABs can modify bivalves’ susceptibility to pathogens (Abi-Khalil)

HAB impacts on bivalves are not always due to known toxins (e.g. PST, DTX, OA..), but can be associated to other un-characterized bioactive compounds produced by the HAB species (Borcier, Basti)

Intravenous Lipid Injection (ILE) increases the clearance of PbTx in turtle tissues and ameliorates symptoms (Cocilova)
¡OBREGADO, AMIGOS BRASILEIROS!