IAEA Ocean Acidification International Coordination Centre OA-ICC

UNIVERSITY OF GOTHENBURG

KUNGL. VETENSKAPS-AKADEMIEN
THE ROYAL SWEDISH ACADEMY OF SCIENCES

Basic training course on ocean acidification

EVT1804704

14-19 March 2022

Capacity Building

Minimizing and addressing ocean acidification

IAEA

Ocean Acidification International Coordination Centre

OA-ICC

THE OCEAN FOUNDATION

futureearth coasts

SCOR

Regeringskansliet

SSE22 SWEDISH SECRETARIAT FOR ENVIRONMENTAL EARTH SYSTEM SCIENCES

NEW ZEALAND FOREIGN AFFAIRS & TRADE MANATŪ AORERE

SPREP Secretariat of the Pacific Regional Environment Programme

+ *in kind* contributions

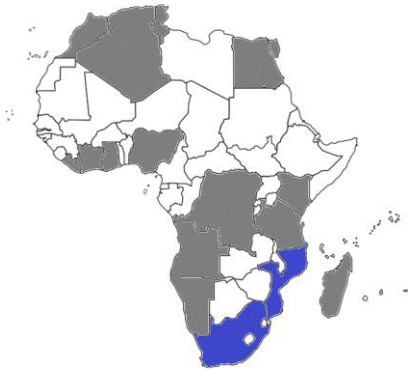
Phase I – basic trainings

2014 – Brazil, Chile

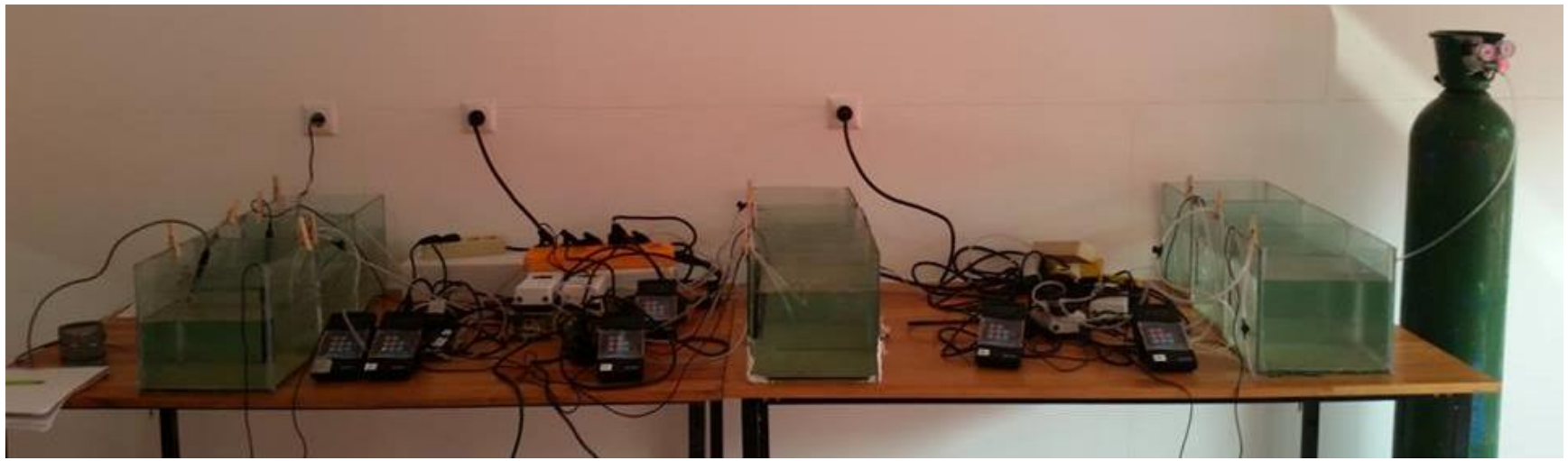
2015 – China, South Africa

2016 – Mozambique, Tasmania, Mauritius, Mexico

2017 – Senegal, Kuwait, Mauritius, Fiji, Costa Rica



Reality check



Capacity evaluation - 2016

INT Expert Meeting
(Monaco October 2016)

Build a questionnaire

Distribute to existing network

Extend the database

Identify needs, challenges and opportunities

Questionnaire

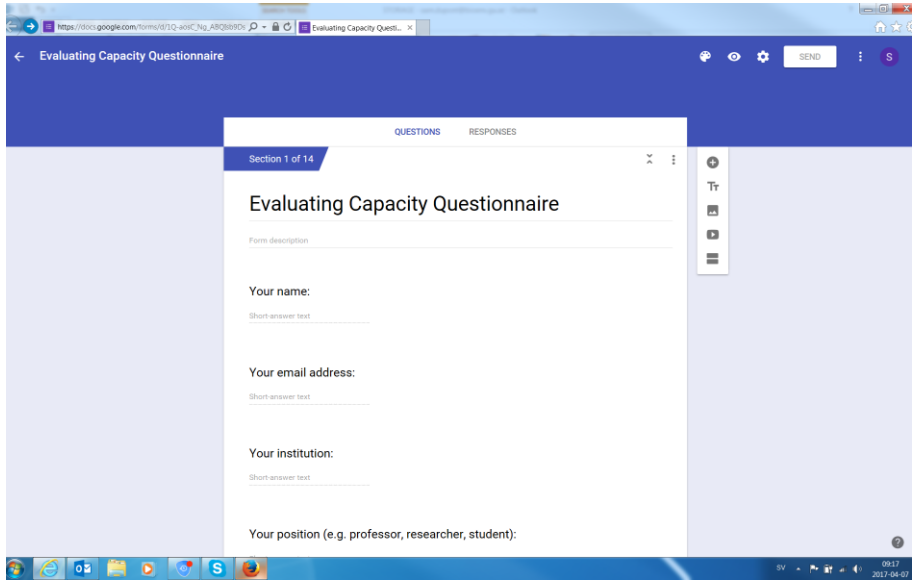
Expertise & Motivation

Infrastructure, equipment & human resources

Regional strength and marine resources

Challenges & Barriers

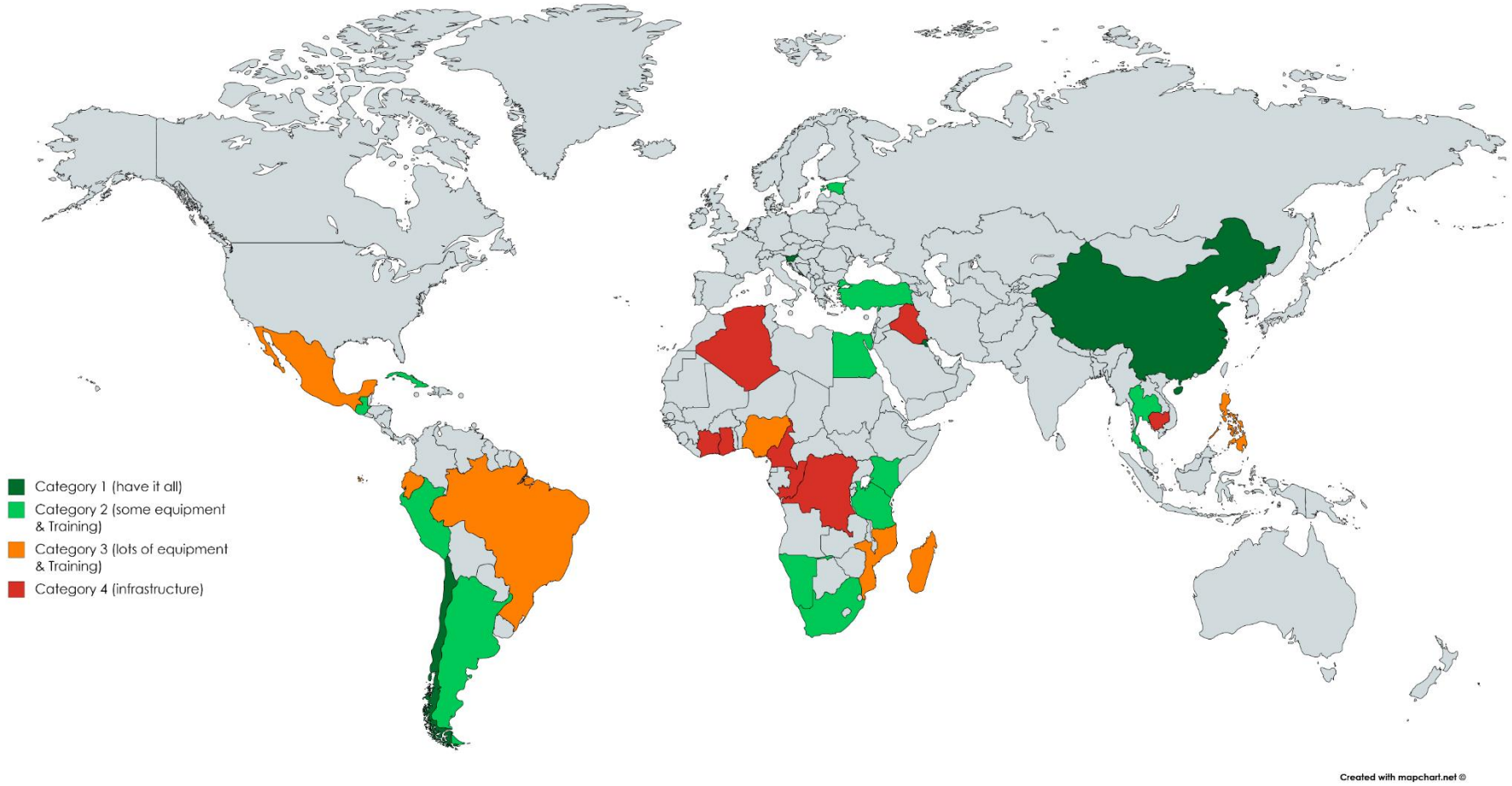
Other resources & contacts



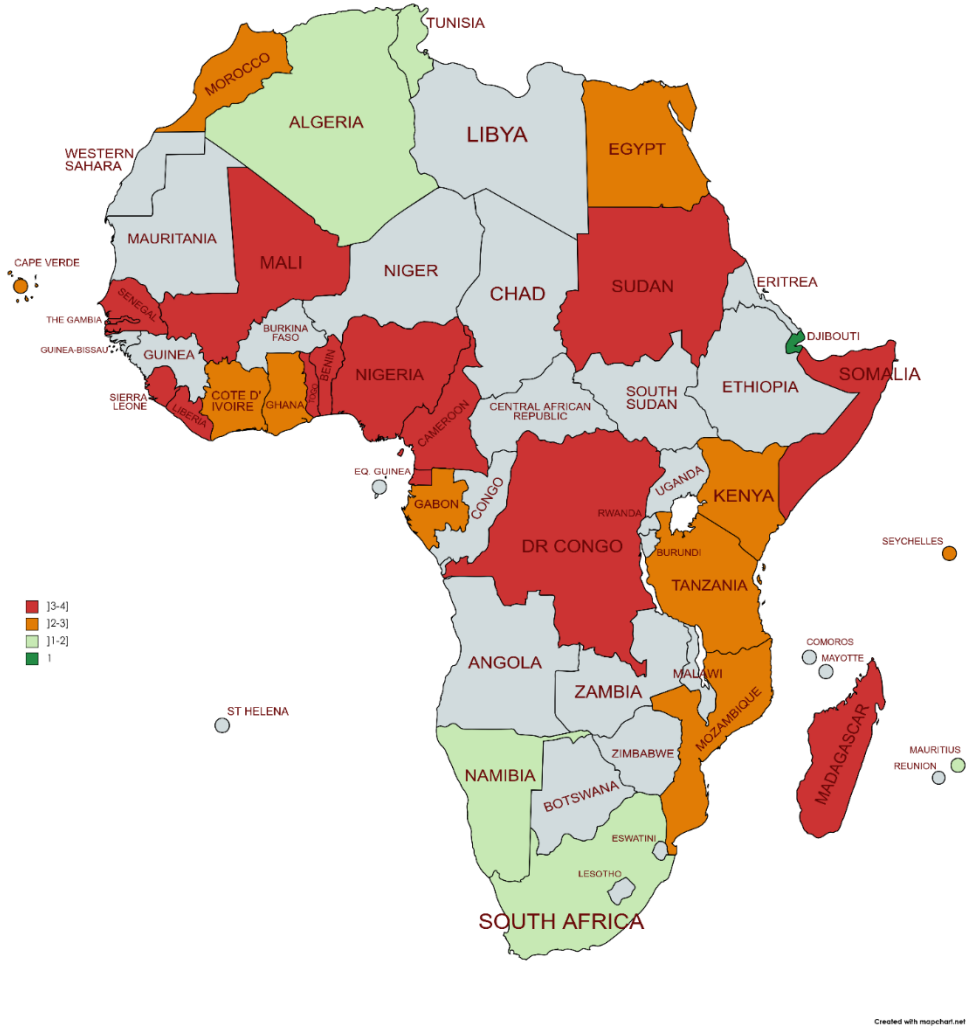
Categories

Categorie	Have	Need
#1	Everything	Collaboration, Communication
#2	Infrastructure, most equipment	Some equipment (e.g. kit), Advanced training
#3	Infrastructure, little/no equipment	Most equipment (e.g. balance), Basic training
#4	No Infrastructure, little/no equipment	Everything Basic training

First evaluation – 2017



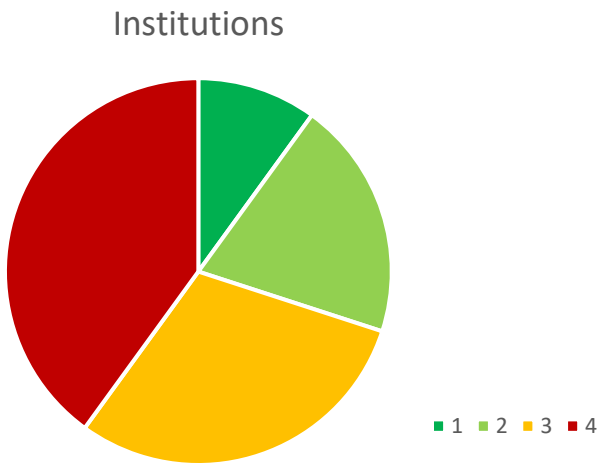
New evaluation (2021)



Average score: 3.05 ± 0.16 / 4

Scores - Institutions

Average score: 2.90 ± 0.13 / 4



Urgent needs in West Africa

Level I training, e.g. India, January 2020

Basic level OA training course in Kolkata, India, 25-29 January 2020 hosted by local Indian institute

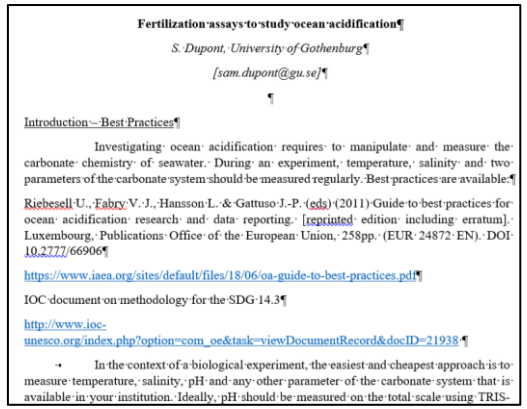
Level II training, e.g. Kenya, October 2020

WIOMSA – Ocean Acidification measurements in the Western Indian Ocean

REGIONAL TRAINING COURSE ON OCEAN ACIDIFICATION EXPERIMENTAL SET UP
21-25 OCTOBER 2019,
Mombasa Kenya

Level II training, e.g. Kenya, October 2020

Best Practices
&
Joined experiment



Fertilization assays to study ocean acidification

S. Dupont, University of Gothenburg

[sam.dupont@gu.se]

Introduction – Best Practices

Investigating ocean acidification requires to manipulate and measure the carbonate chemistry of seawater. During an experiment, temperature, salinity and two parameters of the carbonate system should be measured regularly. Best practices are available:

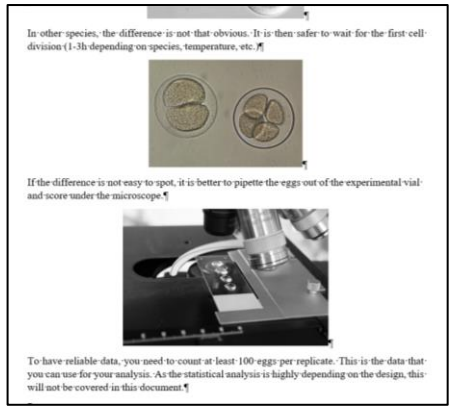
Riebesell U., Fabry V. J., Hansson L. & Gattuso J.-P. (eds) (2011) Guide to best practices for ocean acidification research and data reporting. [reprinted edition including erratum]. Luxembourg, Publications Office of the European Union, 258pp. (EUR 24872 EN). DOI 10.2777/66906

https://www.iaea.org/sites/default/files/18/06/oa-guide-to-best-practices.pdf

IOC document on methodology for the SDG 14.3

http://www.ioc-unesco.org/index.php?option=com_oe&task=viewDocumentRecord&docID=21938

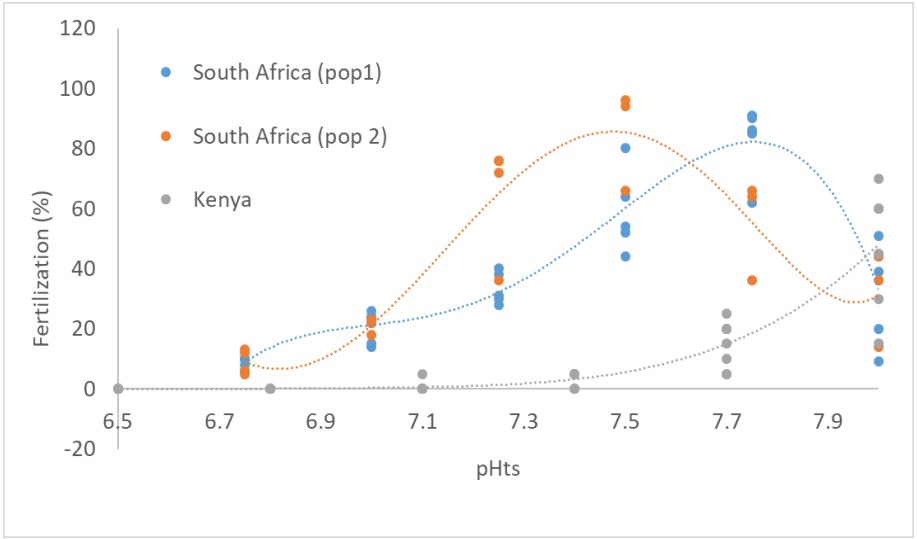
→ In the context of a biological experiment, the easiest and cheapest approach is to measure temperature, salinity, pH and any other parameter of the carbonate system that is available in your institution. Ideally, pH should be measured on the total scale using TRIS-



In other species, the difference is not that obvious. It is then safer to wait for the first cell division (1-3h depending on species, temperature, etc.).

If the difference is not easy to spot, it is better to pipette the eggs out of the experimental vial and score under the microscope.

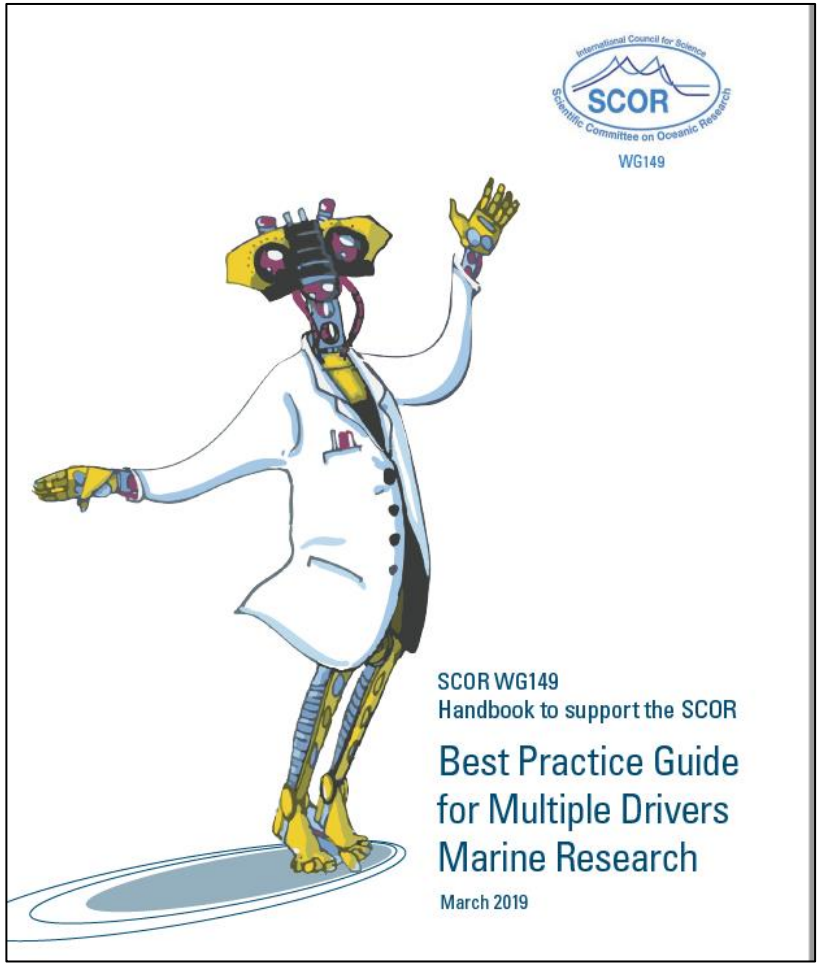
To have reliable data, you need to count at least 100 eggs per replicate. This is the data that you can use for your analysis. As the statistical analysis is highly depending on the design, this will not be covered in this document.



First data
&
First paper for WIOMSA journal

Level III training, e.g. Monaco, June 2019

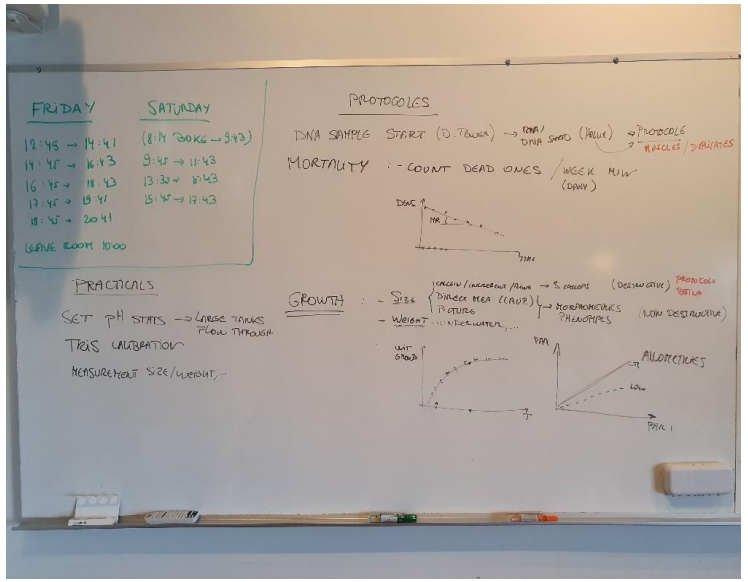
Multiple stressors



Level IV Collaborative research; e.g. Sweden, August 2019

IAEA CRP (2018-2022):

Evaluating the Impacts of Ocean Acidification on Seafood - A Global Approach



Level IV Collaborative research; e.g. Sweden, August 2019

Evaluating·the·impacts·of·ocean·acidification·on·seafood·–·a·global·approach¶

Experimental·design·&·Methodologies¶

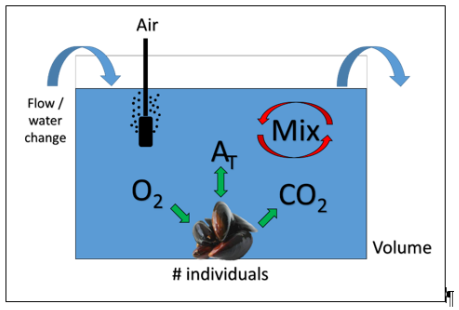
¶

Introduction¶

→ This·document·is·a·summary·of·the·discussion·held·in·Sweden·(August·2019)·during·the·

alkalinity,·accumulation·of·excretion·products,·or·accumulation·of·microbes,·as·a·consequence·of·biological·activity.·These·changes·can·have·a·feedback·effect·on·the·tested·organism·and·be·dependent·on·pH/pCO_2.·Under·those·conditions,·the·observed·effects·may·not·be·due·to·the·direct·effect·of·pH/pCO_2·but·an·indirect·effect·due·to·experimental·artefacts.·¶

→ Several·parameters·should·be·taken·into·account·while·designing·your·experimental·unit·(Figure·3):¶

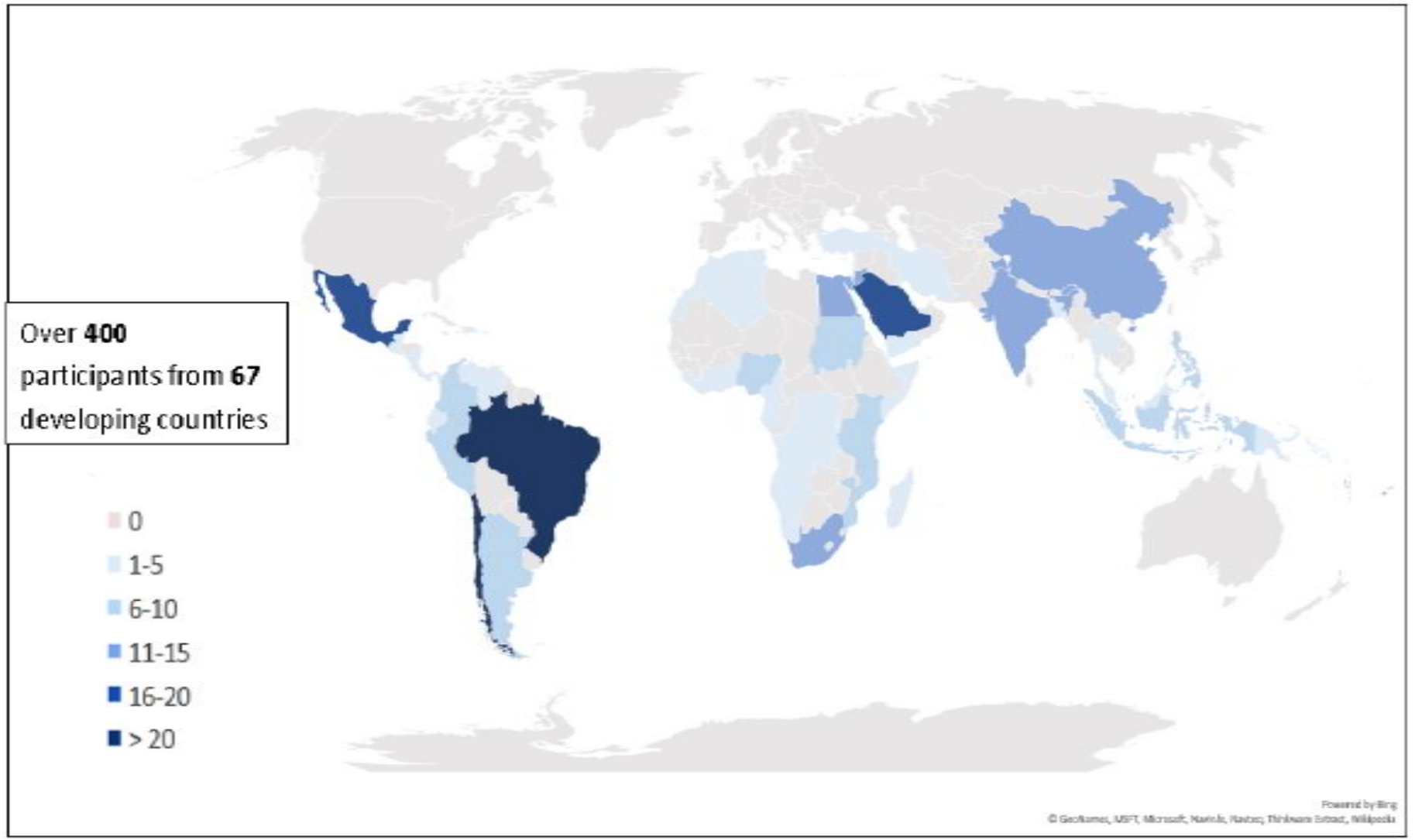


¶

Figure·3·–·Parameters·influencing·the·seawater·quality·in·an·aquarium·system¶

✓·**Tested· species**:· every· organism· has· a· specific· physiology· and· has· the· potential· to· influence·the·seawater·chemistry·in·a·different·way.·Key·factors·to·take·into·account· are·the·size·and·the·metabolism·(bigger·organisms·and·faster·metabolism·will·consume· more·oxygen·and·produce·more·CO_2),·photosynthetic·ability·(consumption·of·CO_2·and· production· of· oxygen),· ability· to· calcify· (and· then· have· an· influence· on· seawater· carbonate· chemistry),· etc.· Some· species· will· also· require· some· structure· in· the·

Where help is provided



North East Atlantic hub of the Global Ocean Acidification Observing Network

Need a training for EU members

IAEA | Ocean Acidification International Coordination Centre OA-ICC

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Basic training course on ocean acidification

EVT1804704

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OA-ICC Capacity Building - Evaluation

Part I – Bibliographic analysis (HBA – Carla Edworthy)

Methods

- ✓ 8 trainings – 2015 – 2017

Cape Town	South Africa	2015	Level I	26 participants
Xiamen	China	2015	Level I	28 participants
Flic en Flac	Mauritius	2016	Level I	20 participants
Ensenada	Mexico	2016	Level I	20 participants
Inhaca	Mozambique	2016	Level II (Bio)	16 participants
Mauritius	Mauritius	2017	Level II (Che)	6 participants
Dakar	Senegal	2017	Level I	18 participants
Aqaba	Jordan	2018	Level I	25 participants

- ✓ Literature search for 104 individual participants
  [10 years before the course – present]
  Google scholar, scopus, research gate
  Divide into ”OA” and ”not OA”

General database – Summary [All]

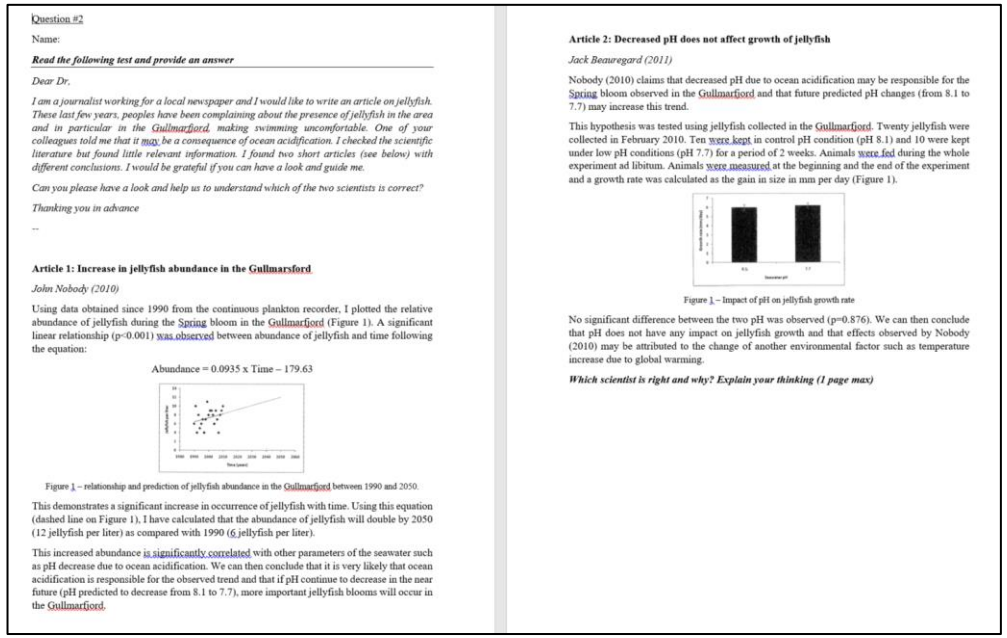
	BEFORE	AFTER	
Publishing on OA			23.8% new authors in the field
% publications on OA	6.31±2.33	10.29±2.21	

OA-ICC Capacity Building - Evaluation

Part II – Learning outcome - Science (HBA – Celeste Sánchez Noguera)

Methods

- ✓ Pre- and post-tests



Question #2

Name:

Read the following test and provide an answer

Dear Dr,

I am a journalist working for a local newspaper and I would like to write an article on jellyfish. These last few years, peoples have been complaining about the presence of jellyfish in the area and in particular in the Gullmarfjord, making swimming uncomfortable. One of your colleagues told me that it may be a consequence of ocean acidification. I checked the scientific literature but found little relevant information. I found two short articles (see below) with different conclusions. I would be grateful if you can have a look and guide me.

Can you please have a look and help us to understand which of the two scientists is correct?

Thanking you in advance

--

Article 1: Increase in jellyfish abundance in the Gullmarsfjord

John Nobody (2010)

Using data obtained since 1990 from the continuous plankton recorder, I plotted the relative abundance of jellyfish during the Spring bloom in the Gullmarfjord (Figure 1). A significant linear relationship ($p<0.001$) was observed between abundance of jellyfish and time following the equation:

Abundance = 0.0935 x Time – 179.63

Figure 1 – relationship and prediction of jellyfish abundance in the Gullmarfjord between 1990 and 2050.

This demonstrates a significant increase in occurrence of jellyfish with time. Using this equation (dashed line on Figure 1), I have calculated that the abundance of jellyfish will double by 2050 (12 jellyfish per liter) as compared with 1990 (6 jellyfish per liter).

This increased abundance is significantly correlated with other parameters of the seawater such as pH decrease due to ocean acidification. We can then conclude that it is very likely that ocean acidification is responsible for the observed trend and that if pH continue to decrease in the near future (pH predicted to decrease from 8.1 to 7.7), more important jellyfish blooms will occur in the Gullmarfjord.

Article 2: Decreased pH does not affect growth of jellyfish

Jack Beauregard (2011)

Nobody (2010) claims that decreased pH due to ocean acidification may be responsible for the Spring bloom observed in the Gullmarfjord and that future predicted pH changes (from 8.1 to 7.7) may increase this trend.

This hypothesis was tested using jellyfish collected in the Gullmarfjord. Twenty jellyfish were collected in February 2010. Ten were kept in control pH condition (pH 8.1) and 10 were kept under low pH conditions (pH 7.7) for a period of 2 weeks. Animals were fed during the whole experiment ad libitum. Animals were measured at the beginning and the end of the experiment and a growth rate was calculated as the gain in size in mm per day (Figure 1).

Figure 1 – Impact of pH on jellyfish growth rate

No significant difference between the two pH was observed ($p=0.876$). We can then conclude that pH does not have any impact on jellyfish growth and that effects observed by Nobody (2010) may be attributed to the change of another environmental factor such as temperature increase due to global warming.

Which scientist is right and why? Explain your thinking (1 page max)

- ✓ % correct answers
- ✓ # of scientific concepts [/7]
- ✓ # science keywords [/35]

Methods

- ✓ 6 trainings – 2015 – 2018

○ Cape Town	South Africa	2015	Level I	26 participants
○ Xiamen	China	2015	Level I	28 participants
○ Flic en Flac	Mauritius	2016	Level I	20 participants
○ Ensenada	Mexico	2016	Level I	20 participants
○ Aqaba	Jordan	2018	Level I	25 participants
○ Hobart	Tasmania	2018	Level I	25 participants

Summary

	BEFORE	AFTER
% correct answers		
# scientific concepts		
# scientific words		

Success stories



2016 – First contact: High CO_2 world & GOA-ON (Tasmania)

2016 – **Basic training** in Ensenada (Mexico)

2017 – **Experiment** in Sweden (KVA grant)

2017 – **Host** for basic training in Costa Rica + first biological experiment

2018 – **Trainer** in Sweden + **Mentee,** exchange mentor (Vargas) + New equipment and development of research (**grant**), **Advanced training** in Monaco

2019 - **Training** on Multiple Stressors in Monaco, **Lead** CRP project for Costa Rica, **Founder** of the Central America network and **Host** of the first meeting in Costa Rica

2020 – **Steering Committee** - LAOCA

2022 – **Host** for the advanced communication training

Opportunities: Level 1-2 – Multiple stressors

Basic Training Course on Multiple Stressors

Monaco (IAEA), Villefranche-sur-Mer (LOV)

IAEA | Ocean Acidification International Coordination Centre OA-ICC

FONDATION PRINCE ALBERT II DE MONACO

Check: https://news-oceanacidification-icc.org/

Opportunities: Level 3 – Meta-analyses

ANALYSIS
https://doi.org/10.1038/s41558-021-01269-2
nature climate change
Check for updates

Upper environmental pCO_2 drives sensitivity to ocean acidification in marine invertebrates

Cristian A. Vargas[1,2,3]✉, L. Antonio Cuevas[1,3], Bernardo R. Broitman[3,4], Valeska A. San Martin[3], Nelson A. Lagos[3,5], Juan Diego Gaitán-Espitia[6] and Sam Dupont[7,8]

frontiers in Marine Science
ORIGINAL RESEARCH
published: 19 May 2021
doi: 10.3389/fmars.2021.602601
Check for updates

Synthesis of Thresholds of Ocean Acidification Impacts on Echinoderms

Nina Bednaršek[1,2], Piero Calosi[3], Richard A. Feely[4], Richard Ambrose[5], Maria Byrne[6], Kit Yu Karen Chan[7], Sam Dupont[8], Jacqueline L. Padilla-Gamiño[9], John I. Spicer[10], Faycal Kessouri[1], Miranda Roethler[1], Martha Sutula[1] and Stephen B. Weisberg[1]*

Opportunities: Level 3 - communication