CFCE ACCRA 2019
19 - 21 AUGUST

BOOK OF ABSTRACTS

2ND CONFERENCE ON FISHERIES AND COASTAL ENVIRONMENT

Theme: Fisheries and Coastal Governance in Contemporary Times

USAID FROM THE AMERICAN PEOPLE

MOFAD
MINISTRY OF FISHERIES AND AQUACULTURE DEVELOPMENT
FISHERIES COMMISSION

THE UNIVERSITY OF RHODE ISLAND
GRADUATE SCHOOL OF OCEANOGRAPHY
CRC COASTAL RESOURCES CENTER

UNIVERSITY OF CAPE COAST

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2nd Conference on Fisheries and Coastal Environment (CFCE), Accra 2019
Theme: Fisheries and coastal governance in contemporary times

The second edition of the Conference on Fisheries and Coastal Environment is jointly organised by the Centre for Coastal Management (CCM), the Department of Fisheries and Aquatic Sciences of the University of Cape Coast (UCC), the Sustainable Fisheries Management Project of the Coastal Resources Center (CRC) - University of Rhode Island (URI), and the Ministry of Fisheries and Aquaculture Development (MoFAD) Ghana.

The Conference was designed to strengthen policy linkages and enable researchers, journalists, and think tanks connect their voices to the sustainable fisheries and coastal development agenda of Ghana. Following the success of the first edition in September 2017 and the growing challenges of the coastal and marine environment of West Africa, CCM has collaborated with partners to execute the second edition with a regional focus. The Conference provides an opportunity for a holistic discussion on coastal and marine resources, which are shared by millions of people, yet, threatened by a multiplicity of factors including poor management. CFCE Accra 2019 features panel discussions, keynote presentations and session papers. During this edition of the Conference, opportunity is also given to industry and projects within the sector to showcase key products and milestones as well as emerging technologies for the sustainable management of fisheries and coastal resources.

CFCE Accra 2019 is funded by the United States Agency for International Development (USAID) through the University of Cape Coast (USAID/UCC Fisheries and Coastal Management Capacity Building Support Project) and University of Rhode Island (USAID/GHANA Sustainable Fisheries Management Project).

CFCE 2019 Organising/Planning Committee:

Denis Worlanyo Aheto, CCM-UCC
Brian Crawford, SFMP
Raymond Babanawo, SFMP
Benjamin Betey Campion, KNUST
Maurice Knight, SFMP
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Mark Newton, USAID-Ghana
Ellis Ekekpi, USAID-Ghana
Matilda Quist, MoFAD Fisheries Commission
Yaa Tiwaah, MoFAD Fisheries Commission

Special acknowledgement to all staff of the Department of Fisheries and Aquatic Sciences - UCC, Centre for Coastal Management - UCC, the Sustainable Fisheries Management Project, and others at the Office of the USAID-Ghana Mission, who were very instrumental to the success of the second edition of the Conference on Fisheries and Cosatal Environment, Accra 2019.

About the Partner Institutions

Centre for Coastal Management, University of Cape Coast
World Bank Africa Centre of Excellence in Coastal Resilience (ACECoR)

Since its inception in 2013, the Centre for Coastal Management has played a pioneering role and fostered demand-driven research, professional education and community services with an ultimate goal of collectively identifying and implementing strategies for building more resilient coastal communities.

To achieve this requires the skills of many disciplines. The Centre through its programmes, works with a broad range of experts not limited to fisheries scientists, climatologists, oceanographers, coastal ecologists, chemists, geographers, geologists, health professionals and economists. In addition, we engage practitioners committed to the policy and institutional aspects of human development and coastal environmental sustainability such as the national and local government authorities including coastal resource managers, planners, engineers, and disaster management officials at regional and district levels.

Our technical advisory services and decision support tools make the Centre an important reference point that provides opportunities for students, university faculty and research scientists to engage in interdisciplinary research or dialogue to promote understanding of the complex coastal environmental and social challenges. I am pleased that the Centre is committed to providing awareness on these issues and contributing to solutions around its core functions to effect changes that moves us towards healthier coastal ecosystems and human communities.

As I look at the growth over the past few years, more so now as the World Bank Africa Centre of Excellence in Coastal Resilience (ACECoR), I am extremely proud of what we have achieved, and even more excited about our outlook for an equally promising future. CCM is a success story that would not be possible without the contribution of our local and international partners who have shared in our vision and have contributed to our incredible journey thus far. We look forward to continuing to serve and engage with all other stakeholders in the future. We appreciate the ongoing support received from those who are interested in CCM's activities and we look forward to working with all prospective partners. We pledge to continue in our efforts to exceed expectations.

Prof. Denis Worlanyo Aheto
Director, Centre for Coastal Management
University of Cape Coast, Ghana

Department of Fisheries and Aquatic Sciences, University of Cape Coast

The Department of Fisheries and Aquatic Sciences is one of six departments in the School of Biological Sciences. The location of the University, which borders the Gulf of Guinea with the highest marine fish production in Ghana, offers the Department the opportunity to expose students to a vast array of opportunities in fisheries, coastal marine and brackish water studies. The Department offers a four-year Undergraduate programme leading to the award of Bachelor of Science (BSc) degree in Fisheries and Aquatic Sciences. Our Postgraduate programmes lead to the award of Master of Philosophy MPhil and Doctoral (PhD) degrees focusing on the four key areas of specialization: Aquaculture, Fisheries Science, Limnology and Oceanography as well as Integrated Coastal Zone Management. In addition, the Department offers annual professional short course on Climate-Change Adaptation.

Our curriculum and capacity-building strategy are driven by three major development goals. These revolve around maintaining a high ecological health integrity of aquatic ecosystems and resources therein; improving the livelihoods of people dependent on these aquatic systems and to sustainably increase fish production to meet our country's food and nutrition security objectives.

Dr. Noble Kwame Asare
Head, Department of Fisheries and Aquatic Sciences
University of Cape Coast, Ghana

Coastal Resources Center, University of Rhode Island

In Rhode Island and around the globe, the Coastal Resources Center (CRC) at the Graduate School of Oceanography, University of Rhode Island catalyzes the aspirations of coastal communities to help them become more effective stewards of their marine resources—food, people, and place. To implement best practices, craft sound policy, and promote equitable governance, an interdisciplinary CRC team partners with stakeholders to apply science and promote innovation. We empower these communities by facilitating collaboration, advancing knowledge, building capacity, and providing management tools. CRC's work is focused on:

- safe, local, abundant, and sustainable seafood
- thriving coastal communities, and
- vibrant, well-managed oceans, coasts, and watersheds.

Foreword

In 2017, the University of Cape Coast (UCC) as part of its USAID funded Fisheries and Coastal Management Capacity Building Support Project organized the first Conference on Fisheries and Coastal Management in Accra to drive home the need for consensus building on sustainable management of Ghana's coastal resources. This second Conference reaffirms the commitment of the University of Cape Coast (UCC) to the sustainability of Ghana's fisheries and coastal resources which contribute significantly to food security, employment and poverty alleviation. UCC is most grateful to the United States Agency for International Development (USAID) for supporting our capacity building efforts through provision of scholarships to students, equipment for teaching and learning, and establishment of a Fisheries and Coastal Management Laboratory in our university.

I am happy to note that the partnership of UCC's Fisheries and Coastal Management Capacity Building Support Project and the University of Rhode Island's Sustainable Fisheries Management Project (SFMP) over the past five years, has led to development of a dual degree program for our universities to promote academic and research exchanges, and other important academic partnerships for our mutual benefit. Unfortunately, USAID support for these two projects will terminate next year. It is to mark the end of the projects that this National Symposium is being held to highlight their achievements, success stories and inherent challenges.

I wish to express my sincere gratitude to members of the planning and organizing committee from the two universities, the Ministry of Fisheries and Aquaculture Development, and the Fisheries Commission for the great job done towards realization of this dream. Indeed, the Conference would provide an important platform for researchers, journalists, political representatives and representatives from civil society groups to connect around issues of vital national interest concerning sustainable fisheries and coastal management in Ghana. The theme of the Conference, "FISHERIES AND COASTAL GOVERNANCE IN CONTEMPORARY TIMES", is therefore very appropriate as it encompasses the full spectrum of issues confronting our marine and coastal environment.

The conference will have plenary sessions to discuss issues of (1) Marine Spatial Planning: Local, National and Sub-Regional Dimensions and Opportunities; (2) Closed Season: At Whose Cost and for Whose Benefits; (3) Closed Seasons: Implications for Fisheries Management in Ghana; (4) Community-Based Fisheries Management; (5) Legal reforms; (6) Stock Assessment: Implications for Sustainable Fisheries Management; and (7) Post-harvest issues (processing, loss, marketing, transport, storage, etc.). Discussions on these topics will be of great significance at this critical time when key stakeholders: government, fisheries practitioners, scientists and the private sector, are deeply concerned about the decline in fisheries output, and the ongoing coastal degradation. Recent estimates show that annual yields of small pelagics have declined from approximately 130,000 metric tonnes (MT) ten years ago to about 30,000 MT. The reasons for this drastic decline, include over fishing, weak enforcement of regulations, lack of stakeholder engagement, a counterproductive premix fuel subsidy, and widespread illegal, unreported and unregulated fishing practices.

I am pleased to note that this conference provides the needed platform for engagement among a variety of stakeholders to promote the collective decision-making processes, and to advocate voluntary compliance of fisheries management regulations. I am also aware that the conference seeks to promote collective problem solving and to strengthen legislation on the role of traditional authority in coastal management. The conference is thus an innovation that will contribute to improving upon management measures needed to rebuild the fisheries and bring about the needed reforms we seek to achieve. I am informed that the conference will address the need for sustainable management of other coastal resources such as mangroves, beaches, lagoons and estuaries in the country, including the rational management of our oil and gas resources which have been politically and economically difficult to address. This would be in the interest of the long-term health and sustainability of not only the fisheries, but related sectors of the Ghanaian economy.

I am optimistic that the conference will help to mobilize relevant stakeholders to address this important goal, and give momentum and political will to sustainably manage the fisheries and coastal resources with effects lasting well beyond this conference. In order to improve the health of the fisheries and coastal resources, a number of short and long-term measures need to be put in place. I would like to take this opportunity to urge all the participants, students, scientists, government and civil society groups to work together towards this goal.

Finally, I would like to once again express my sincerest appreciation to the USAID, the Ministry of Fisheries and Aquaculture Development (MoFAD), the Fisheries Commission of Ghana, and the University of Rhode Island, sister universities and research institutions in Ghana for partnering UCC in this important national event. Together we can rebuild the fish stocks and sustainably manage our coastal resources to bring the benefits that we all desire. I wish to also commend the Centre for Coastal Management and the Department of Fisheries and Aquatic Sciences at the University of Cape Coast for living up to their mandates, and to all other international and local organizations, and civil society groups for consenting to participate in this special event.

I wish you fruitful deliberations.

Prof. Joseph Ghartey Ampiah

Vice-Chancellor
University of Cape Coast
Ghana

2ND CONFERENCE ON FISHERIES AND COASTAL ENVIRONMENT PROGRAMME

TIME	ACTIVITY		
08:30	Registration	19 August 2019	
DAY 1	**Opening session**	19 August 2019	
09:00	Agenda overview and conference objectives by Dr. Raymond Babanawo, Chief of Party, USAID Sustainable Fisheries Management Project (SFMP), Coastal Resources Centre, University of Rhode Island		
09:10	Brief Remarks by Mr. Steven E. Hendrix, Ag. Mission Director, USAID/Ghana		
09:20	Opening and welcome address by Hon. Francis K.A. Codjoe, (MP), Deputy Minister for Fisheries and Aquaculture Development		
09:40	Photo Session		
DAY 1	**Morning session**	19 August 2019	
09:50 10:20	**Chair/Moderator:** Dr. Brian Crawford, Program Manager, SFMP; Coastal Resources Centre, University of Rhode Island **Keynote presentation** by Prof. Rashid Sumaila, University of British Colombia, Canada ***Topic: Global trends in fisheries in the context of the blue economy: Implications for Ghana.*** **Plenary Panel:** - Prof. Martin Tsamenyi, Emeritus Professor, Former Director of Australian National Centre for Ocean Resources and Security - Prof. Wisdom Akpalu, Institute for Natural Resources in Africa - Representative, UN Food and Agriculture Organization (FAO)) - Representative, Fisheries Committee for the West Central Gulf of Guinea(FCWC) - Representative, World Bank-Country Office - Sajid Anwar, World Bank – Washington, WACA **Rapporteur:** Ms. Ivy Akuoko Gyimah		PLENARY SESSION 1
11:00	Coffee/Tea Break	**Poster and Exhibition Session**	
11:45	**Oral Presentations** (10+5 mins each) **Thematic Area 1:** Marine and Coastal Environment and Management ***Break-out room:*** *K. Nti Amoah* | ***Rapporteur:*** *Gertrude Lucky Aku Dali* **Thematic Area 2:** Fisheries Science and Fisheries Biology ***Break-out room:*** *Che Yong* | ***Rapporteur:*** *Miriam Yayra Ameworwor* **Thematic Area 3:** Fisheries Management and Postharvest Fish Value Chain | ***Break-out room:*** *Goto Hall* | ***Rapporteur:*** Mr. Emmanuel Gasu **Thematic Area 4:** Aquaculture and Livelihoods ***Break-out room:*** *Afua Amenuah* | ***Rapporteur:*** *Mr. Lawrence Ahiah* **Thematic Area 5:** Cross-cutting issues in fisheries and Coastal management | ***Break-out room:*** Akiyokato | ***Rapporteur:*** *Mr. Kusi Boateng*		SCIENTIFIC PARALLEL SESSION 1
13:00	Lunch Break	**Poster and Exhibition Session**	

2ND CONFERENCE ON FISHERIES AND COASTAL ENVIRONMENT PROGRAMME

TIME	ACTIVITY	
DAY 1	**Afternoon session** 19 August 2019	
14:00 14:20	**Organizer/Chair/Moderator:** Mr. Fredua Agyeman, Director of Environment, Ministry of Environment, Science, Technology and Innovation (MESTI) **Keynote paper/presentation** by Mr. Carl Fiati, Environmental Protection Agency (EPA) ***Topic: Marine Spatial Planning: Local, National and Sub-Regional Dimensions and Opportunities*** **Plenary Panel:** - Representative, Petroleum Commission on Safe Sea Access Framework - Mr. Abaka Edu, Fisherman - Mr. Godfrey Baidoo-Tsibu, Fisheries Commission of Ghana - Representative, Centre for Environment and Health Research and Training - Mr. Stephen Kankam, Hen Mpoano **Rapporteur:** Ms. Alberta Jonah	PLENARY SESSION 2
15:00	Break	**Poster and Exhibition Session**
15:30 16:00	**Chair/Moderator:** Prof. Joseph Aggrey-Fynn, Department of Fisheries and Aquatic Sciences, UCC **Keynote paper/presentation** by Prof. Patrick Ofori-Danson (University of Ghana & Member, SFMP Scientific and Technical Working Group) ***Topic: Fishing Closed Season: At Whose Cost and for Whose Benefits?*** **Plenary Panel:** - Ms. Doris Yeboah, Head M&E, Fisheries Commission (FC) - Mr. Jojo Solomon, National Executive Member, Ghana National Canoe Fishermen Council (GNCFC) - Mrs. Emelia Abaka Edu, Vice President, National Fish Processors and Traders Association (NAFPTA) - Mr. Daniel Owusu, Secretary, National Fisheries Association of Ghana (NAFAG) - Mr. Richster Nii Amarfio, Director, Laif Fisheries Company - Prof. Kobina Yankson, Chairman, SFMP Scientific and Technical Working Group **Rapporteur:** Ms. Yaa Tiwaah Amoah	PLENARY SESSION 3

2ND CONFERENCE ON FISHERIES AND COASTAL ENVIRONMENT PROGRAMME

TIME	ACTIVITY	
DAY 1	**Afternoon session**	19 August 2019
17:00	**Oral Presentations** (10+5 mins each) **Thematic Area 1:** Marine and Coastal Environment and Management ***Break-out room:*** *K. Nti Amoah* | ***Rapporteur:*** *Gertrude Lucky Aku Dali* **Thematic Area 2:** Fisheries Science and Fisheries Biology ***Break-out room:*** *Che Yong* | ***Rapporteur:*** *Miriam Yayra Ameworwor* **Thematic Area 3:** Fisheries Management and Postharvest Fish Value Chain | ***Break-out room:*** *Goto Hall* | ***Rapporteur:*** Mr. Emmanuel Gasu **Thematic Area 4:** Aquaculture and Livelihoods ***Break-out room:*** *Afua Amenuah* | ***Rapporteur:*** *Mr. Lawrence Ahiah* **Thematic Area 5:** Cross-cutting issues in fisheries and Coastal management | ***Break-out room:*** Akiyokato | ***Rapporteur:*** *Mr. Kusi Boateng*	SCIENTIFIC PARALLEL SESSION 2
18:00	**Closing**	
DAY 2	**CFCE**	20 August 2019
08:30	Registration	
09:00	Opening and recap of previous day's activities and overview of day's agenda by Dr. Benjamin Campion, Kwame Nkrumah University of Science and Technology (KNUST)	
DAY 2	**Morning session**	20 August 2019
10:00	**Chair/Moderator:** Prof. John Blay, Department of Fisheries and Aquatic Sciences, University of Cape Coast ***Topic: Closed Seasons: Implications for Fisheries Management in Ghana*** **Panellists:** - Prof. Francis Nunoo, Department of fisheries and Marine Science, University of Ghana - Mr. Alex Sabbah, Head, Monitoring Control and Surveillance (MCS), FC - Mr. Joe Kramo, Ghana Inshore Fishers Association (GIFA) - Mrs. Emelia Abaka Edu, Vice President, NAFPTA - Mrs. Richner Odonkor, Deputy Head, Marine Fisheries Management, FC **Rapporteur:** Mr. Joshua Adotey	BREAK-OUT WORKING GROUP 1 **ROOM: K. NTI AMOAH**

2ND CONFERENCE ON FISHERIES AND COASTAL ENVIRONMENT PROGRAMME

TIME	ACTIVITY	
DAY 2	**Morning session** 20 August 2019	
10:00	**Chair/Moderator:** Mr. Kofi Agbogah, Executive Director, Hen Mpoano ***Topic: Community-Based Fisheries Management*** **Panellists:** - Mr. Abraham Asare; Program Officer, Development Action Association (DAA) - Mr. Theophilus Boachie-Yiadom, Program Officer, Friends of Nation (FoN) - Mr. Balertey Gommey; Program Officer, Hen Mpoano - Rev. Michael Kodie, Zonal Officer, Ada, FC - Dr. Precious Mattah; Centre for Coastal Management, UCC **Rapporteur:** Ms. Elizabeth Effah	**BREAK-OUT WORKING GROUP 2 ROOM: K. NTI AMOAH**
10:00	**Chair/Moderator:** Prof. Martin Tsamenyi (Emeritus Professor and Former Director of Australian National Centre for Ocean Resources and Security) ***Topic: Legal reforms*** **Panellists:** - Mr. Thomas Insaidoo, Regional Director, FC, Central Region - Mr. Papa Yaw Atobrah, Regional Director, FC, Northern Region - Prof. Denis W. Aheto, Project Manager, USAID-UCC Fisheries and Coastal Management Project, UCC & Dir. Africa Centre of Excellence in Coastal Resilience - Mr. Richster Nii Amarfio, Director, Laif Fisheries Company - Mr. Jojo Solomon, National Executive Member, Ghana National Canoe Fishermen Council (GNCFC) **Rapporteur:** Mr. Kwadwo Kyei-Yamoah	**BREAK-OUT WORKING GROUP 3 ROOM: CHE YONG**
10:00	**Chair/Moderator:** Mr Paul Bannerman, Deputy Executive Director, Fisheries Commission ***Topic: Stock Assessment: Implications for Sustainable Fisheries Management*** **Panellists:** - Prof. Patrick Ofori-Danson, University of Ghana &Member, SFMP Scientific and Technical Working Group - Mr. Kofi Amador, Head, Fisheries Scientific Survey Division (FSSD), FC - Dr. Isaac Okyere, Lecturer, Dept. of Fisheries and Aquatic Sciences, University of Cape Coast, - Mr. John Dickson Eshun, Fisherman, Axim - Ms. Jemimah Etornam Kassah, PhD Student, Dept. of Fisheries & Aquatic Sciences, UCC **Rapporteur:** Ms. Michelle Clottey	**BREAK-OUT WORKING GROUP 4 ROOM: GOTO HALL**

2ND CONFERENCE ON FISHERIES AND COASTAL ENVIRONMENT PROGRAMME

TIME	ACTIVITY	
DAY 2	**Morning session** 20 August 2019	
10:00	**Chair/Moderator:** Mr. Samuel Manu, Head, Post-Harvest Unit, FC ***Topic: Post harvest issues (processing, loss, marketing, transport, storage etc.)*** **Panellists:** - Mrs. Doris Owusu, Programs Specialist, Resonance Global - Ms. Matilda Quist, Head, Marine Fisheries Management, FC - Mrs. Lydia Sasu, Executive Director, DAA - Mr. Nicholas Smith, Programs Manager, CEWEFIA - Dr. Kojo Agyapong Afrifah, Faculty of Renewable Natural Resources, Kwame Nkrumah University of Science and Technology (KNUST) - Mr. Emmanuel Kwarteng, Project Manager, SNV **Rapporteur:** Ms. Lesley Ntim	**BREAK-OUT WORKING GROUP 5 ROOM: AFUA AMENUAH**
11:00	Coffee/Tea Break	**Poster and Exhibition Session**
11:30	**Reports from groups Session Chairs** (5 Groups; 10 mins each) **Moderator:** Dr. Noble Asare, Head, Department of Fisheries and Aquatic Sciences, UCC	
12:20	**Oral Presentations** (10+5 mins each) **Thematic Area 1:** Marine and Coastal Environment and Management ***Break-out room:*** *K. Nti Amoah* | ***Rapporteur:*** *Mrs. Rebecca Essamuah* **Thematic Area 2:** Fisheries Science and Fisheries Biology ***Break-out room:*** *Che Yong* | ***Rapporteur:*** *Ms. Paulina Okpei* **Thematic Area 3:** Fisheries Management and Postharvest Fish Value Chain | ***Break-out room:*** *Goto Hall* | ***Rapporteur:*** Mr. Isaac Kofi Osei **Thematic Area 4:** Aquaculture and Livelihoods ***Break-out room:*** *Afua Amenuah* | ***Rapporteur:*** *Mr. William Dogah* **Thematic Area 5:** Cross-cutting issues in fisheries and Coastal management | ***Break-out room:*** Akiyokato | ***Rapporteur:*** *Ms. Sheila Fynn-Korsah*	**SCIENTIFIC PARALLEL SESSION 3**
13:00	Lunch Break	**Poster and Exhibition Session**

2ND CONFERENCE ON FISHERIES AND COASTAL ENVIRONMENT PROGRAMME

TIME	ACTIVITY
DAY 2	**Afternoon session** 20 August 2019
14:00	**Oral Presentations** (10+5 mins each) **Thematic Area 1:** Marine and Coastal Environment and Management ***Break-out room:*** *K. Nti Amoah* | ***Rapporteur:*** *Mrs. Rebecca Essamuah* **Thematic Area 2:** Fisheries Science and Fisheries Biology ***Break-out room:*** *Che Yong* | ***Rapporteur:*** *Ms. Paulina Okpei* **Thematic Area 3:** Fisheries Management and Postharvest Fish Value Chain | ***Break-out room:*** *Goto Hall* | ***Rapporteur:*** Mr. Isaac Kofi Osei **Thematic Area 4:** Aquaculture and Livelihoods ***Break-out room:*** *Afua Amenuah* | ***Rapporteur:*** *Mr. William Dogah* **Thematic Area 5:** Cross-cutting issues in fisheries and Coastal management | ***Break-out room:*** Akiyokato | ***Rapporteur:*** *Ms. Sheila Fynn-Korsah*
15:00	**Messages from Partners:** - Fisheries and Aquaculture Society of Ghana (FASoG) - University of Rhode Island (URI) - Fisheries Committee for the West Central Gulf of Guinea (FCWC) - Environmental Justice Foundation (EJF) - West Africa Coastal Areas Project (WACA) **Chair/Moderator:** Mr. Michael Arthur-Dadzie (Esq), Executive Director, FC
15:40	**Summary of Scientific Parallel Sessions** (10 mins each) **Chair/Moderator:** Mr. Michael Arthur-Dadzie (Esq), Executive Director, FC
16:30 - 17:00	Brief Overview of Illegal Fish Transhipment '*Saiko*' by Mr. Kofi Agbogah, Executive Director, Hen Mpoano **Screening of documentary on Illegal Fish Transhipment '*Saiko*'**
18:00	**Closing**

SCIENTIFIC PARALLEL SESSION 4

2ND CONFERENCE ON FISHERIES AND COASTAL ENVIRONMENT PROGRAMME

DAY 3 21 August 2019

TIME	ACTIVITY
08:00	Registration & Arrival of Dignitaries Musical Interlude
	CLOSING CEREMONY
09:30	Welcome Address by Prof. Joseph Ghartey Ampiah, Vice-Chancellor, University of Cape Coast
09:45	Message from Dr. Gifty Ako-Adounvo, Vice Provost for International Initiatives and Academic Partnerships, University of Rhode Island
10:00	Voices of fishermen and fishmongers from the regions (2 people)
10:10	Presentation of Communique by Prof. Denis W. Aheto (Project Manager, USAID-UCC Fisheries and Coastal Management Project, UCC & Dir. Africa Centre of Excellence in Coastal Resilience)
10:20	Remarks by Ambassador Stephanie S. Sullivan, U.S. Ambassador to Ghana
10:30	Address by Hon. Francis K.A. Codjoe (MP), Deputy Minister for Fisheries and Aquaculture Development (MOFAD)
10:50	Musical Interlude
11:00	Keynote Address by the Hon. Yaw Osafo-Marfo, Senior Minister, Republic of Ghana
11:40	Photographs, exchange of pleasantries, interaction with journalists
12:00	Lunch
13:00	**Departure**

Master of Ceremony: Mrs. Mary Ama Bawa
Rapporteurs: Mr. Joshua Adotey, Ms. Alberta Jonah, Mr. Kwadwo Kyei-Yamoah

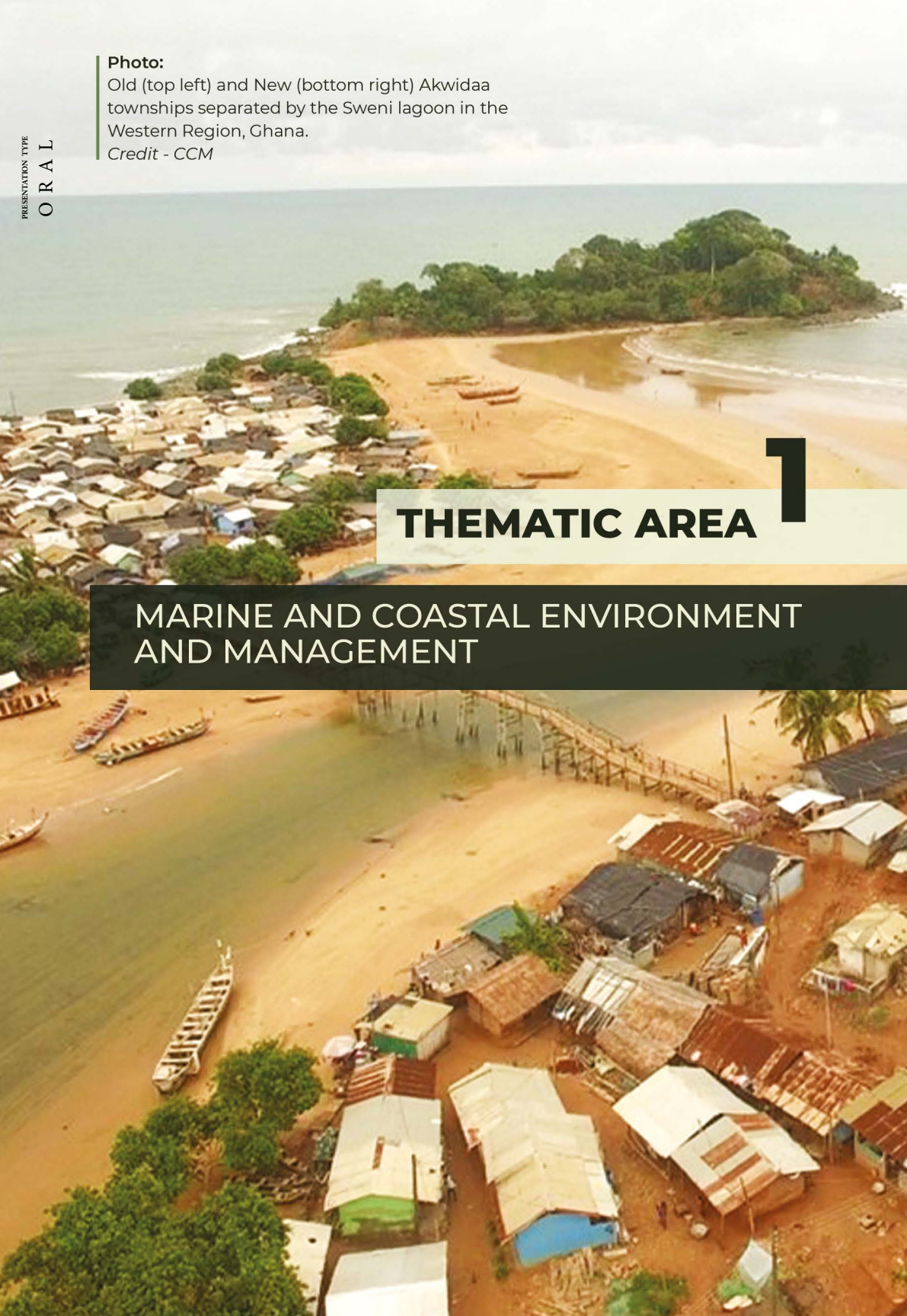
ABSTRACTS

2ND CONFERENCE ON FISHERIES AND COASTAL ENVIRONMENT

ACCRA, 19-21 AUGUST 2019

PRESENTATION TYPE
ORAL

Photo:
Old (top left) and New (bottom right) Akwidaa townships separated by the Sweni lagoon in the Western Region, Ghana.
Credit - CCM



THEMATIC AREA 1

MARINE AND COASTAL ENVIRONMENT AND MANAGEMENT

PRESENTATION TYPE
ORAL

Implications of spatio-temporal land use/land cover changes for regulating and provisioning ecosystem services in the coastal landscape of south-western Ghana, West Africa

Stephen Kankam[1*] and Christine Fürst[1]

[1] *Institute of Geosciences and Geography, Martin-Luther-Universität Halle-Wittenberg (MLU), Germany*

*Corresponding author: skankam@henmpoano.org

Coastal landscapes in south-western Ghana face land use threats driven by oil and gas infrastructure development, agriculture expansion and artisanal mining. An assessment of two decades of land use pressures on the landscapes' capacities to supply ecosystem services was conducted using Landsat data sourced from the United States Geological Survey (USGS) remote sensing and benefit transfer approaches. Indicators for regionally relevant provisioning and regulating ecosystem services supplied by the landscape were selected from existing literature. Using the Africover classification scheme, land cover data spanning approximately a decade each before and after the commercial production of oil and gas were used to generate typical land cover classes for a representative coastal landscape. The capacities of the coastal landscapes to provide food, fish, fuel wood and sequester greenhouse gases were quantified. Results of the assessment indicate a trends in land use change towards agricultural (food and perennial tree crop) expansion with concomitant increase in the coastal landscapes' capacity to supply provisioning services over the period. However, coastal land use patterns are were observed to have a net negative impact on regulating ecosystem services such as carbon storagesequestration.

Keywords: Coastal landscapes, Spatio-temporal, Land use/landcover, Benefits transfer, Ecosystem services.

PRESENTATION TYPE
ORAL

A cross-sectoral integrated approach to coastal community development: Lessons from population, health and environment integration in the Greater Amanzule wetland landscape

Stephen Kankam[1], Adiza Ama Owusu[1], Kim Farnham Egan[2], Nancy Harris[2] and Clive Mutunga[3]

[1] *Hen Mpoano (Our Coast), Ghana*
[2] *John Snow Training and Research Inc, USA*
[3] *Office of Population and Reproductive Health, USAID, Washington DC*

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Rural coastal communities think holistically about their development. They recognize that the health and sustainability of their coastal natural resources is are linked to their individual, household and community health. However, most development interventions in the communities have predominantly advanced a sectoral focus. Small scale fisheries management, forestry and agricultural development initiatives have addressed sectoral elements and failed to recognize interlinked population and health issues, thus, limiting synergistic cross-sectoral outcomes. To examine the potential of cross-sectoral integrated approaches for sustainable coastal community development, Hen Mpoano, in partnership with the Advancing Partners and Communities (APC) project and with funding from USAID, implemented a population, health and environment (PHE) initiative in selected coastal communities of the Greater Amanzule wetland landscape. Premised on the notion that coastal ecosystem health is intricately linked to the health of dependent human population, The project integrated voluntary family planning and reproductive health into existing conservation, land management and livelihood enhancement activities. Results from the project intervention indicate that; a) given requisite training, coaching and mentoring support, local conservation actors and village savings and loans association (VSLA) members will become agents for diffusing disseminating information and knowledge on reproductive health and family planning in coastal communities; b) access to health care information and services reinforces conservation of coastal ecosystems and vice versa c) integrated approaches that reflect the holistic nature of development have greater potential to generate better and more development outcomes across multiple sectors. To be successful, development projects need to invest in integrated approaches and build functional, dynamic and adaptive local structures and institutions for coastal community development.

Keywords: population, health and environnent, community development, integrated approaches, cross-sectoral

PRESENTATION TYPE
ORAL

Analysis of land cover changes in the Greater Amanzule Wetland area in southwestern Ghana

Justice Camillus Mensah[1*], Stephen Kankam[1] and David Afo-Kangah[2]

[1]*Hen Mpoano (Our Coast), Takoradi*
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This study investigated land use changes in the Greater Amanzule Wetland (GAW) area in south western Ghana. Multi-temporal land cover changes were determined using two satellite images from 2000 and 2018. The purpose of the study was to analyze driving factors of land use changes before and after the oil exploitation in the country. Land use land cover (LUCC) maps were derived from the Landsat images using supervised classification method (maximum likelihood) in ArcGIS 10.6.1 software. A modified version of the Globcover UN Classification System was used to derive eight LULC classes. To analyze the changes in LULC over the period, the Land change modeler in the IDRISI Selva Software was used. The results indicate that cropland was the largest class occupying an area of 29% in 2000 and 35% in 2018. During the 18-year period, the largest land cover change was the conversion of shrubland, croplands and wetland areas into rubber farms. During this period, the extent of rubber increased over 240%. Artificial areas and wetlands also increased by 54% and 22% respectively due to urbanization, oil and gas onshore infrastructure and mining activities. Mangroves, on the other hand decreased steadily at an annual rate of 0.25%. The identified land cover changes have the potential to impact negatively on the hydrology of the rich fresh water ecosystem. Though there are prospects for the burgeoning rubber industry in Ghana, the study also revealed potential food security issues in the area. It was concluded that international trade, urbanization, local population growth, agriculture diversification and industrialization are the main drivers of the land cover changes in the GAW area.

Keywords: Greater Amanzule Wetlands; land use land cover change; multi-temporal analysis; remote sensing

PRESENTATION TYPE
ORAL

Kinetic modelling of Silver (Ag-110m) in Bloody Cockle *Anadara senilis* under contrasting exposure regimes in a Ghanaian coastal lagoon

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Concerns of chemical contamination have received little attention, particularly, in aquatic animals in Ghana. In this study, the uptake, depuration and subcellular fractionation were explored in the bloody cockle *Anadara senilis* sampled from the Narkwa lagoon in the Central Region of Ghana. Following cockle's acclimation to two different salinity regimes (38 and 26 psu), samples were exposed to environmentally realistic concentration of radiotracer of silver (Ag-110m) under simulated laboratory conditions. Results of experimental mesocosm indicated that cockles acclimated to high salinity regimes incorporated Ag faster than those at lower salinity. The concertation factors were estimated as 474 and 164 for high and low salinity conditions whereas uptake rate constants were 53 and 13 d^{-1} respectively. The cockle showed a relatively long retention capacity with a biological half-life of 58 and 21 days respectively for high and low salinities. The subcellular insoluble fraction which contains the metal rich granules and cellular debris contributed the largest proportion of Ag in the cockle that accounted for the low rate of depuration. The efficient accumulation and retention capacities of Ag in the cockle confirms its usefulness as a bioindicator species capable of providing time-integrated information on ambient levels in coastal ecosystems in Ghana.

Keywords: Kinetic Modelling, Silver, Radiotracer, Salinity

PRESENTATION TYPE
ORAL

Assessing beach volume changes in the coastal area of the Volta Delta

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The beaches along the eastern coast of Ghana are generally sandy and dominated by coastal erosion. Previous studies have estimated erosion rates and trends using various data sources including satellite imagery, orthophotos and historical maps. However little has been done to assess seasonal variability of these beaches using high-resolution temporal and spatial data. Such information is relevant for coastal engineers and scientist as well as policy makers for decision-making. This study investigates seasonal beach volume dynamics along the Dzita beach on the east of the Volta Estuary using unmanned aircraft systems (UASs). Monthly surveys were carried out from May 2018 to May 2019. High resolution Digital Elevation Models (DEMs) and orthophotos were constructed using the structure from motion and multi-view stereo techniques. Beach volume changes were assessed over the period. The results show highest volume loss was recorded in September 2018, which coincides with the period with the highest waves arriving in the region. Overall, though the beach recovers after such extreme events, it is unable to recover fully over one seasonal cycle. The results show that with regular surveys using UAVs seasonal beach dynamics can be assessed which will inform appropriate interventions.

Keywords: Sediment volume, Sandy beaches, UAVs, Photogrammetry, Volta Delta

PRESENTATION TYPE
ORAL

Reflective beach evolution: Validation of video intertidal topography with Unmanned Aircraft Systems (UAS)

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The use of video camera systems (VCS) to monitor coastal dynamics has been in existence for about three decades. VCS enable a high spatiotemporal frequency analysis of shoreline migration. Video camera usage to measure beach intertidal profile evolution has not been standardized globally and the capacity to obtain accurate results requires authentication by other techniques. Applications are mostly site specific due to differences in installation. This study examines the accuracy of the intertidal topographic data derived from a video camera system compared to unmanned aircraft systems (UAS) based surveys of a low-energy reflective beach. Using one year of 15-minute VCS data and one year of monthly UAS observations, the data shows a good agreement (r>0.8) between UAS and VCS intertidal profiles. Intertidal profile elevations were underestimated in VCS that is linked to camera view angle. Beach slopes are found to vary between 0 and 0.5, with steep beach in May to July and gentle beach in December. High beach dynamics occur between August and September that corresponds with high wave conditions. The data suggest the steep nature of the beach could influence sediment drift on the beach. The data suggests that long term VCS measurements could make it possible to produce video-derived elevation data virtually as accurate as UAS products, and therefore make an effective tool for coastal managers.

Keywords: Video camera, Unmanned aircrafts, Intertidal morphology, Shoreline change

PRESENTATION TYPE
ORAL

From picture to practice: Practical examples and applied uses for high-resolution UAV Imagery

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For centuries, fishers throughout the Western and Central Regions have sought safe refuge in protected coves and beaches, with hundreds of landing sites and beaches used to offload and process catch, moor or beach boats and construct temporary living camps. Over time, these sites often grew into dense settlements that are perilously exposed to waves and flooding. Moderate sea level rise, salt water intrusion, reduction in fish catch, changes in coastal region crops, and multiple impacts of coastal erosion and flooding have become major threats to life and property in coastal areas. Coastlines and flood plains are dynamic systems that are desirable, yet risky places to build, whether or not people recognize those dangers. As population grows and development intensifies in the region, demand for land is rising, even in increasingly precarious shoreline locations. New residential and industrial developments are filling in available land and impoverished citizens are pushed further into marginal, unsafe flood prone areas to live. UAV systems satisfy an important niche for researchers, filling the void between course satellite imagery and traditional, expensive aerial or field surveys. From a planning perspective, these new technologies excel at capturing information relevant at smaller scales and have the ability to provide managers with real data for issue analysis and policy development. This session will focus on the applied use of UAV imagery to quantify the extent or magnitude of local concerns and provide actionable information to environmental managers. Common issues related to shoreline erosion, community vulnerability, environmental degradation and impacts from coastal development will all be discussed.

Keywords: SFMP; UAV; shoreline erosion; coastal flooding; sea level rise; spatial planning

PRESENTATION TYPE
ORAL

Assessing stress in Brown Mussels to monitor coastal water quality in Ghana

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A simple, reliable and affordable method for the assessment of coastal water quality, using brown mussels *Perna perna*, was explored. The stress on stress (SoS) or survival in air (SiA) bio-assay was adapted for use by trained lay-persons, as a biomarker for future assessment of micro-contaminants such as poly-aromatic hydrocarbons (PAHs) and trace metals. Series of experiments were executed with mussels from Iture (Cape Coast), Africa Beach (Takoradi) and Princess Town (Ahanta West). Median lethal times (LT_{50}) and condition indices (CI) were assessed from January to June, 2019. Ranges of LT_{50}s have been associated with the following conditions: less than 96 hours (<4 days) indicates mussels are severely stressed; between 96 and 168 hours (4 to 7 days) indicates mussels are stressed; more than 168 hours (>7 days) indicates healthy mussels. Similarly, the CIs have been used to derive assessment criteria: CI less than 10 means condition is very poor; CI between 10 and 19.9 means condition is poor; CI between 20 and 29.9 means condition is good and CI more than 30 means condition is excellent. The method of assessing the LT_{50} and CI was found suitable for use by trained citizens. However, no direct relationship was apparent between LT_{50} and CI, and more data covering other months are needed to decide upon the assessment criteria. The CI at Africa Beach and Princess Town followed the same trend and appeared to decrease during spawning. Other experiments are needed to assess the relationship between LT_{50}, CI and the concentration of micro-contaminants and physico-chemical parameters (such as salinity and turbidity) in the water column or sediments.

Keywords: *Perna perna*, Stress-on-stress, Survival-in-air, LT_{50}, Condition index

PRESENTATION TYPE
ORAL

Assessment of sediment flux dynamics in the lower Ankobra River Estuary of Ghana

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Rivers serve as an important link between land and sea, carrying huge volumes of nutrient-rich water to the world's ocean and playing a vital role in marine productivity and global biogeochemical cycles. The quantity of materials (suspended and dissolved) discharged to the sea is highly dependent on land use and human activities within river catchments. In Ghana, the southwestern and coastal river basin systems have been highly influenced by intense human activities, predominantly surface mining, resulting in increased sediment runoff during rainfall. The objective of this study is to provide current data about temporal dynamics associated with sediment discharges at the lower Ankobra River Estuary. The study used monthly measurements of tidally averaged instantaneous sediment concentrations and flow rates measured close to the mouth of the river, during a sixteen month period. Annual sediment load for the Ankobra River was estimated to be about 3.5 million tonnes, using measurements for the period June 2017 to May 2018. Our estimate is twice that estimated in a recently published global study and about 9 times higher than a recent local study. The results indicate that sediment yield is highly influenced by rainfall, with inter-month variations occurring in response to total rainfall during the period. The study recorded the highest sediment load of 1.1 million tonnes for September 2018 compared to 0.2 million tonnes for the previous September, as a result of extreme and low rainfall occurring during those respective months. Furthermore, reduced river stage and discharge in the dry season results in reduced reflection of the high tide wave and high slack time during ebb tide leading to improved transparency and higher salinities during the period. The study recommends periodic sediment flux studies of the southwestern river and coastal system to allow for assessment of the effectiveness of land use management interventions.

Keywords: Sediment flux, Human impacts, River catchment management, Tidal, Ankobra River

PRESENTATION TYPE
ORAL

Making a case for a large-scale study of the Coral Reef Ecosystems of Ghana: Preliminary Results from Cape Three Points

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Coral reefs are known areas of high biologically diverse ecosystems supporting many species of benthic and pelagic organisms. However, in Ghana, very few records exist about the occurrence of corals, the extent, areas they occur, their diversity and current threats they are facing. In this paper, we present preliminary findings from a diving expedition about 1 km of the coast of Cape Three Points. The objective of the survey was to collect information about the status of the benthic habitats, the diversity of corals, fish and invertebrate and their biomasses towards making a case for a large scale study of Ghana's coast to map coral reefs. Making use of 8 divers during a two day period, 20 50 m line transects laid perpendicular to the shoreline were surveyed. Using the standard underwater visual census (UVC) technique, fish species diversity and abundance were recorded in a moving 5 m box, and all mobile invertebrates counted within 1 m on either side of the transect line. Ten 0.5 x 0.5 m quadrats were also placed at 5 m intervals at alternating sides of the transects and type of substrate and percentage cover estimated. Fish and invertebrate biomasses were computed for each transect and habitat type, as well as types of corals and their extent mapped out for the Cape Three Points area, illustrating the wealth of corals available in the area. The study recommends more detailed surveys to be carried out to support decision-making regarding the management of corals for the area.

Keywords: coral reefs, underwater visual census; fish community structure; Ghana's coast

PRESENTATION TYPE
POSTER

Using high resolution Unmanned Aerial Vehicle (UAV) imagery to assess vulnerability of coastal communities - A case of Anlo Beach community, Ghana

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High resolution UAV Imagery was used to evaluate the extent of coastal erosion of Anlo Beach, a coastal fishing community in the Shama District of Ghana. Anlo Beach is located on a sand spit at the mouth of the Pra River, and is sandwiched between the extensive Pra estuary to the North and the open ocean to the south. This precarious position makes Anlo Beach vulnerable to extreme events from both directions, and over the last two decades high wave events and riverine overflow have heavily impacted large portions of the community. UAV flights of the area were conducted between June, 2016 and March, 2018 to monitor ongoing changes. In June 2017, after a period of extensive rain, the community experienced widespread flooding. To protect property from further inundation, members of the local community breached the sand spit in an effort to speed the transfer of water from the estuary to the sea. This disruption of the natural equilibrium initiated a chain of events that dramatically altered the hydrodynamic flow at the mouth of the Pra River, leading to extreme erosion and loss of property. These images, coupled with pre-event imagery, have allowed researchers to quantify the magnitude of physical transformation and personal loss that have occurred. This session will highlight the condition and demonstrate the value that rapidly deployed UAVs and quality imagery bring to the visualization and policy processes. High-resolution UAV imagery is an effective tool that can facilitate community sensitization and education, provide policy makers and local government structures the opportunity to improve coastal spatial planning.

Keywords: UAV, Coastal erosion, Pra River, High-resolution imagery

PRESENTATION TYPE
ORAL

Simulating phytoplankton response to river catchment management interventions and climate change in the Ankobra River Estuary

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The nutrient-phytoplankton-zooplankton (NPZ) model is a common research tool used to model the interactions among nutrient, phytoplankton and zooplankton in aquatic systems. In this paper, a model is presented that simulates the NPZ interactions in the Ankobra River Estuary over an annual cycle. The objective of the model is to explore phytoplankton (as an indicator of productivity) response to different scenarios of river catchment management and increases in estuarine water temperature as a result of climate change. Field surveys of nutrients and chlorophyll concentrations were carried out from May 2017 to September 2018, serving as the natural conditions to simulate and the starting conditions for the model. The model agrees very well with the observed data and illustrates that phytoplankton growth in the Ankobra River Estuary is highly dependent on light availability. The model supports the theory that undertaking river catchment management that reduces water turbidity will favour primary productivity, which may ultimately cascade up the food web to improve fisheries productivity.

Keywords: NPZ model, Phytoplankton biomass, Estuarine turbidity, Climate change, River catchment management

PRESENTATION TYPE
ORAL

Environmental Monitoring of Urban Coastal Areas using Unmanned Aerial Vehicles: A case study of the Fosu Lagoon, Cape Coast, Ghana

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The use of unmanned aerial vehicles (UAVs) as technological tools in monitoring coastal environments has scaled up in recent times due to their advantages over other methods as cost-effective measures that provide spatially detailed data and harnessed with the ability to reach remote areas. This study explored the use of the fixed wing Bramor UAV by C-Astral Aerospace in monitoring land use patterns, major point sources of pollution, and littoral vegetation cover in the Fosu lagoon catchment of the Cape Coast metropolis. Flights were done in December 2019, to collect high resolution data (up to a few centimetres) which were preliminarily processed using Pix4D Software. Processed data were analysed using ArcGIS tools by ESRI to view and assess elevation and multispectral components of a created geodatabase. The results give indications of poor land use, uncontrolled point sources of pollution, and a highly compromised littoral vegetation buffer. Ghana's environmental policies regarding siting of municipal developments, discharge of wastewater/effluent into surface water/watershed, and recommended riparian buffer perimeter width of 30m for wetlands must be reinforced. The study provides high resolution baseline information (imagery) for future monitoring leading to efficient decision-making for sustainable coastal zone management by relevant institutions.

Keywords: Unmanned aerial vehicles (UAVs), Monitoring, Land use, Pollution, Littoral vegetation, Coastal zone management

PRESENTATION TYPE
POSTER

Seasonal dynamics of nutrients at the sediment-water interface and water quality in the Pra River Estuary

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Unregulated land use change and land cover conversion to other uses has resulted in huge discharges of terrestrially derived materials into the coastal marine environment. The result is deleterious changes to the quality of marine ecosystems. This paper assesses the seasonal dynamics of water quality, sediment grain size, nutrient flux at the sediment-water interface and primary productivity of the Pra River Estuary. Field surveys were conducted in September-October 2017 for wet season surveys and January-February 2018 for dry season surveys. Sediment core samples were taken for laboratory nutrient flux incubations, sediment grain size and organic matter content analyses. Water samples were also collected and analysed for seasonal concentrations of chlorophyll-a. Mean salinity and turbidity were significantly different during the wet and dry seasons at the lower Pra River Estuary. Salinity was 8.1 PSU ± 1.8 for the wet season and 35.8 PSU ± 0.9 during the dry season. Wet season had a mean turbidity of 404.43 NTU ± 23 indicating high sediment load discharge while the mean turbidity at the dry season was 7.52 NTU ± 1.2. Sediment incubations for nutrient exchange at the sediment-water interface also indicated that there was high nitrate flux into the water column in both the wet and dry seasons, while sediments served as a sink for phosphate during the wet season but released nutrients into the water column during the dry season. The study concludes that high fluvial discharge of sediment during the wet season significantly affect primary productions and nutrient dynamics within coastal ecosystems.

Keywords: Nutrient flux, Sediment-water interface, Water quality, Pra River Estuary

PRESENTATION TYPE
ORAL

Study of macroinvertebrates in relation to sediments in three coastal lagoons in the Cape Coast area, Ghana

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Aquatic macroinvertebrates have been considered reliable indicators of water quality due to their abundance in numbers, short life cycles and feasibility in sampling. They are also readily affected by their surroundings. This study strives to assess the influence characteristics such as sediment particle size and organic matter content have on the occurrence of macroinvertebrates in three coastal lagoons in the Central Region of Ghana. Species composition and Shannon-Wiener Diversity indices were calculated to evaluate the macroinvertebrate communities, while particle size analysis and organic matter content were determined to evaluate the nature of sediment in the lagoons. The findings showed that pollution tolerant organisms such as *Capitella capitata* was dominant in Benya and Brenu lagoons, while chironomid larvae, another pollution indicator, dominated in Fosu Lagoon. Diversity indices of 1.46, 0.80 and 0.47 were recorded in was recorded in Benya, Brenu and Fosu lagoons respectively. Medium sand was the sediment recorded in all three water bodies. Organic matter content had an inverse relationship with biodiversity, but sediment particle size did not show consistent trend in its relationship with biodiversity. The low diversity indices recorded and the presence of pollution indicator organisms suggest that these water bodies are under stress and need to be managed to restore their ecological integrity.

Keywords: Aquatic macroinvertebrates, Sediment particle size, Organic matter content, Coastal lagoons, Pollution indicator, Ecological integrity

PRESENTATION TYPE
ORAL

Ecological study of the Benya and Sakumo II lagoons in Ghana

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Increasing incidence of environmental degradation has necessitated regular monitoring of coastal water bodies. This study investigated some environmental parameters in relation to benthic macroinvertebrates in Benya and Sakumo II lagoons. Sampling was done quarterly from June 2016 to March 2017 with June and September representing the wet season and December and March representing the dry season. pH, dissolved oxygen, conductivity, salinity, nitrate and phosphate were significantly higher in the dry season than the wet season in the Benya Lagoon. Temperature and turbidity showed no significant difference. In the Sakumo II Lagoon, pH, dissolved oxygen, temperature and phosphate were significantly higher in the dry season than the wet season. Salinity, turbidity and nitrate were however higher in the wet season whiles conductivity did not show significant difference between seasons. Nitrate and phosphate concentrations in both lagoons were above the recommended levels of 1.0 mg/l and 0.1 mg/l respectively. Organic matter was significantly higher in the wet season in the Benya Lagoon but did not show any significant difference in the Sakumo II Lagoon. Both lagoons had coarse sand in the wet season and medium sand in the dry season. Shannon-Wiener Diversity indices were higher in the wet season (H' = 1.433 for Benya Lagoon and 0.747 for Sakumo II Lagoon) than the dry season (H' = 1.263 and 0.708 for Benya and Sakumo II lagoons respectively). Decrease in nitrate, phosphate and organic matter content significantly increased benthic macroinvertebrates abundance. Pollution indicator species namely *Capitella capitata* dominated the Benya lagoon while *Chironomus* sp. and *Limnodrilus* sp. dominated the Sakumo II lagoon. The dominance of these three species coupled with high nitrate and phosphate concentrations indicate stress, especially, induced by organic pollution. Sustainable management measures need to be put in place for these lagoons and similar coastal water bodies.

Keywords: Environmental degradation, Pollution, Benthic macroinvertebrates, Coastal water bodies, Lagoons

PRESENTATION TYPE
ORAL

Carbon storage and sequestration assessment in the Greater Cape Three Points area towards the design of Marine Protected Area

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Mangrove forests are vital blue carbon ecosystems that support coastal countries because of the array of services they provide for human well-being. Mangrove forests are however considered one of the most vulnerable coastal ecosystems in the wake of today's fast developing coastal economies. Economic related activities such as construction of hotels, resorts and aquaculture farms, demand for fuelwood, and port or dam construction, have contributed to depletion of mangrove forests across many coastal areas in the world. To enhance implementation of the "blue economy" phenomenon, which encourages development of a framework where spatial planning is used as a tool to integrate conservation and sustainable use of coastal and marine resources in Ghana, estimates of blue carbon stocks must be ascertained to facilitate proper management. This paper presents application of the InVEST Carbon Storage and Sequestration model to estimate the amount of carbon currently stored and sequestered in the Greater Cape Three-Points area (GCTP). Carbon stocks from 4 different carbon pools in the GCTP area were estimated using field sampling techniques following Kauffman and Donato (2012) protocols. Amount of carbon estimated in the three mangrove systems considered by the study – Cape Three points bay, Nyan river estuary and Enhole lagoon – were 3197.71 MgC/ha, 4346.82 MgC/ha and 5983.16 MgC/ha respectively. This compliments efforts to assess critical coastal ecosystems in the area to identify prospects for the design of MPA(s). Outputs of the model will fit into zoning plans that will facilitate comprehensive management decision-making.

Keywords: Conservation, Mangroves, Carbon stocks, Greater Cape Three Points Area, InVEST

PRESENTATION TYPE
POSTER

Mapping the ocean to support policy making and sustainable ocean management: A local, regional and global call for collaboration and coordination to build a complete bathymetric map

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Bathymetry (the measurement of depth of water in oceans, seas, or lakes) maps give information on the shape of the seafloor, and are important for establishing marine protected areas, understanding fish habitat and trawlable habitats, ocean modeling, geo-hazard assessment, biodiversity and safety of navigation and maritime routes. Unfortunately, only about 15 % of the world's oceans have been mapped with direct measurement, and most of what we know about the shape of the global seafloor is predicted based on satellite observations. The Nippon Foundation - GEBCO Seabed 2030 Project, is a collaborative effort that seeks to motivate the international community to complete mapping of the world's ocean by 2030. By assembling all available and new bathymetric data into the freely accessible GEBCO ocean map. Seabed 2030 seeks to empower the world to make policy decisions, use the ocean sustainably, and undertake scientific research that is informed by a detailed understanding of the global ocean floor. To achieve a goal of this magnitude, scientists, government, industry players and the public as a whole, have to work together to share all existing bathymetry data, and collect new data with expeditions to 'map the gaps'. This is a global call to help increase our knowledge of the seafloor and of the planet. Researchers in the marine sector, government, public and all stakeholders of the marine and coastal environment will benefit from the resulting GEBCO products, such as the recently released GEBCO 2019 bathymetry grid. Capacity building and stakeholder engagement are critical for this project. The Nippon Foundation / GEBCO Certificate Program in Ocean Bathymetry, has been very successful in growing a new generation of scientists and ocean mappers since 2004. The alumni of this program, many of whom are based in Africa, form a global network that is working toward advancing this global effort. These networks of people working to map our oceans are going to be important as we collate and archive date to help us better understand our oceans and support implementation of a Blue Economy and policy making to achieve Sustainable Development Goals.

Keywords: Bathymetry, Data, Mapping, Seabed 2030, GEBCO

PRESENTATION TYPE
POSTER

Valuation of provisioning services of two mangrove ecosystems in Ghana

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Mangrove forests provide a variety of valuable uses or ecosystem services including provisioning services such as fuel wood, timber and shell fish that contribute to human wellbeing. Inhabitants of coastal communities depend greatly on mangrove resources to meet their livelihoods and other economic needs. This study was undertaken to estimate the value of provisioning services provided by mangrove ecosystems in order to evaluate their direct contribution to coastal livelihoods in communities around the Kakum and Pra River estuaries. Information on utilization of mangrove resources was gathered through field surveys in ten communities from May to August 2018. Using purposive and snowball sampling techniques, 136 respondents were used. It was observed that 50% of the respondents exploited only mangrove for fuel wood and poles, whilst 44.9% exploited only fishery resources such as crabs, periwinkles and tilapia. About 66 % of the respondents engaged in other occupations such as farming and trading while 34 % depended solely on mangrove resource harvesting as their main occupation. Weekly mangrove income earned by respondents was about US $ 2 - 60 (GH¢10 - 650.00) and this formed an average of 68.42 ± 2.32 % of their total weekly income. Almost all the respondents (94.10 %) regarded mangrove ecosystems as their main source of livelihood and did not agree to any alternative use(s) of these mangrove ecosystems. From the findings, it can be deduced that the mangrove ecosystems contribute significantly to the livelihoods of the inhabitants, and it is recommended that conservation efforts should be put in place to ensure their sustainability.

Keywords: Provisioning services, Mangrove ecosystems, Kakum Estuary, Pra Estuary, Livelihoods

PRESENTATION TYPE
ORAL

Assessing shoreline changes and their impacts using high resolution images

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Anlo Beach is a fishing community located in the Shama District of the Western Region. Over the years, geomorphic changes in the lower part of the Pra estuary has resulted in displacement of people and loss of livelihood assets. With the use of high resolution images, this study sought to assess the shoreline changes that have occurred over a 3 year period (2015 -2017) along the Anlo Beach and its impact on the community. Built up and shoreline datasets digitized from the images were analysed using ArcGIS 10.3. The results showed that the highest and the lowest rate of erosion were about 101 and 3.4 metres respectively with most of the losses occurring between 2016 and 2017. Changes in the built up data also revealed that about 109 structures including schools have been lost to the sea. This study provided valuable and comprehensive baseline information on shoreline changes which can serve as a guide for the residents in Anlo beach and other stakeholders to manage the risk.

Keywords: Coastal erosion, livelihood assets, geomorphic changes, estuary, Shama District

PRESENTATION TYPE
ORAL

SFMP Capacity Development Group Session: Mapping Opportunities in the Ghana Fisheries Sector Institutional Ecosystem.

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Panelist Organizations:
Friends of the Nation (FoN): Kyei Yamoah
Development Action Associates (DAA): Lydia Sasu
Ghana National Canoe Fishermen's Council (GNCFC): Jojo Solomon
National Fish Processors and Traders Association (NAFPTA): Emelia Abaka-Edu
Ghana Industrial Trawler's Association (GITA): Gilbert Sam
Fisheries Commission/ Fisheries Scientific and Survey Division (FC/FSSD): Paul Bannerman
University of Cape Coast (UCC): Denis Aheto

In Ghana's fisheries sector, a robust institutional ecosystem of engaged and performant, representative, transparent, and accountable Government, public university, and civil society organizations is of critical importance to drive and sustain the transformational change urgently needed to reverse unsustainable resource exploitation and secure fisheries livelihoods. The institutional ecosystem is key because the size and geographic scope of the sector, and especially the artisanal sub-sector, surpasses the capacity of the government operating with limited human and financial resources to manage with a top down approach. Fishers, processors and other stakeholders are likewise limited in their capacity to coordinate and effectively take concerted action to manage common resources for their own benefit without organization and representation at scale. USAID/SFMP assisted MOFAD and the FC to rebuild targeted marine fisheries stocks and catches through adoption of responsible fishing practices. The project facilitated organizational capacity assessment and development with 19 government, university, and CSOs actors to accomplish this aim. This session will highlight SFMP's capacity development outcomes from the perspective of beneficiary organizations. Organization representatives will give a 5 minute presentation as follows:

1. Three key ways their organization better serves the sector as a result of improved capacity due to SFMP support
2. Three key things most appreciated about other organizations' contributions to the sector resulting from improved capacity due to SFMP.
3. Vision for the organizations' roles in contribution to the institutional ecosystem for sustainable fisheries management.

Following presentations participants will visit stations for each organization for additional input on most appreciated contributions of each. A facilitated plenary will follow with organizations reporting out on a new idea from the visit to stations. The facilitator will close with highlights drawing on ideas from the session for point 3 above and conclusions.

Keywords: Ghana, Fisheries, Capacity, Organizational, Institutional, Co-Management

PRESENTATION TYPE
ORAL

Beyond the Imagery: SFMP Lessons for Building Technical Capacity for, and Long-term Sustainability of, a UAV Monitoring Program

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Advances in technology over the last decade have made Unmanned Aerial Vehicles (UAVs), and the imagery they capture, a valuable tool for environmental research and scientific analysis. With a wide array of sensors currently available, systems can be tailored to specific needs including localized base mapping, elevation modelling, vegetation analysis or health, wetland delineation and coastal monitoring. The Ghana Sustainable Fisheries Management Project (SFMP) entered into a multi-year collaborative effort between its partners and the University of Cape Coast's (UCC) Department of Geography and Regional Planning and the Centre for Coastal Management (CCM) to capitalize on emerging UAV technologies for mapping and managing the coastal landscape. Early successes using a low-cost recreational UAV to monitor vulnerable communities and ecosystems demonstrated the effectiveness of high-resolution imagery to overcome the existing absence of current, accurate information at the small scales localized spatial planning and resource management efforts demand. These successes led to the acquisition of a more advanced fixed-wing UAV system capable of longer flight times and multiple camera sensor options. This partnership has directly led to the training and licensing of 7 Ghanaian UAV pilots and aerial surveys of 25 communities. In total more than 320,000 images have been collected covering 125km^2. While the technology itself is well documented what is lacking is an accurate summary of the enabling conditions and components required to institutionalize UAV technologies to achieve long-term, sustainable success. Beyond the UAV there are real costs, both human and material, that must be considered before integrating these new technologies. This talk will provide an honest review of the SFMP UAV activities, providing insight, lessons learned and highlighting potential pitfalls to success.

Keywods: SFMP, UAV, Enabling conditions, Coastal management, Spatial planning

PRESENTATION TYPE
POSTER

Assessment of heavy metal concentration in fish and water from the Ankobra River Basin

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Arsenic (As), mercury (Hg) and lead (Pb), are toxic heavy metals that occur naturally in the environment. However, their levels are on the rise due to anthropogenic activities posing threat to fish and human health. The study aimed at contributing to scientific knowledge by assessing the concentrations of heavy metals in fish and water which will inform coastal managers and policy makers on the appropriate management interventions for the sustainable use of the Ankobra River in the Western Region of Ghana. An analytical cross-sectional study was conducted to determine the concentration of As, Hg and As in fish and water from the Ankobra River basin. As, Hg and Pb levels in the tissues of different fish species *Sarotherodon melanotheron*, *Clarias gariepinus*, *Mugil cephalus*, *Pseudotolithus brachygnathus* and *Lutjanus goreensis*, and water samples were measured using the Atomic Absorption Spectrophotometer (AAS) Pinnacle 900T (Perkin Elmer, USA). Heavy metal concentration was in the order Hg>As>Pb in the study area. Overall, the mean concentrations of Hg and As were highest in fish (2.09 ± 1.29 mg/g and 2.80 ± 1.52 mg/g respectively). Hg levels were higher in water (1.46 ± 4.26 mg/L), followed by As (1.40 ± 1.78 mg/L) and Pb (0.14 ± 0.10 mg/L) respectively. However, the variability of overall heavy metal levels in water and fish were significantly different ($p = 0.016$ and 0.020 respectively). Generally, there were significant differences in all the levels of As, Hg and Pb in water and fish in the Ankobra River. As, Hg, As, Pb levels in Ankobra were above the WHO recommended levels for pristine freshwater ecosystems and may therefore pose a threat to aquatic and human health. Therefore, it is imperative to pursue a drive for effective management interventions for the sustainable use of the ecosystem.

Keywords: Heavy metals, Management interventions, Fish, Water

PRESENTATION TYPE
POSTER

Assessing microbial nutrient regeneration in selected coastal water bodies in the Central Region of Ghana

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Inorganic nutrients such as phosphates and nitrates are ecologically important in determining the level of biological productivity of aquatic systems. Both allochthonous and autochthonous nutrients are predominantly derived from the degradation of organic matter in the environment as well as direct input from anthropogenic activities. In the aquatic environment, aerobic microbial activities have been reported to predominantly facilitate the remineralization of both dissolved and particulate organic matter. In addition, the process of microbial remineralization is enhanced through aggregation of particulate organic matter. Although nutrients are essential to the ecological functions of aquatic ecosystems, higher concentration levels may also prove detrimental to these functions. The main objective of this study was to investigate the rate of microbial nutrient regeneration in two coastal aquatic systems. A laboratory simulated aggregation experiment was carried out over a 2-week period in June 2019 using water and sediment samples from the Fosu Lagoon and the Kakum River Estuary (closed and open systems respectively) in the Central Region of Ghana. Water samples from aggregated and non-aggregated treatments were analysed every two days for dissolved phosphate and nitrate concentration levels through spectrophotometry. Also, replicate sediment samples from the different treatments were analysed for percentage organic matter content using the loss-on-ignition method. From the results sedimentary organic matter load in the Fosu Lagoon was on the average over 270% higher than that of the Kakum River Estuary. Spatial and temporal variations in nutrient concentrations at both sampling locations were observed. The rate of total phosphate and nitrate regeneration in both coastal water bodies through microbial activities was significantly correlated to organic matter content ($p < 0.001$ for all treatments) and significantly higher in aggregated samples ($p < 0.05$ for all treatments). Higher organic matter load resulted in higher nutrient regeneration. These observations were attributed to higher colonization of particulate organic matter by microbial assemblages and facilitated by the aggregation dynamics.

Keywords: Microbial ecology, Nutrient regeneration, Organic matter, Coastal waters

PRESENTATION TYPE
POSTER

Object based land cover classification using RGB Unmanned Aerial Vehicle imagery

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Classifying remote sensing data, especially, red, green and blue (RGB) orthoimage is a challenging task in remote sensing. Object based classification has proven to be suitable for land cover mapping over the pixel-based approaches. However, it's potential for the classification of Unmanned Aerial Vehicle (UAV) RGB images is less explored. This study assessed the reliability of two object based classification algorithms for coastal vegetation mapping using UAV RGB images. UAV surveys were carried out in Kakum estuary located in Cape Coast, Ghana at two different years (2016 and 2017). Image segmentation was carried out using the Mean-Shift (MS) algorithm, while classification was performed by the means of two supervised classifiers, Random Trees (RT) and Support Vector Machines (SVM) implemented in the ArcGIS pro. For both years, the results show a very high accuracy level for both the RT and SVM classifiers, with kappa coefficient values ranging from 0.832 to 0.873 for RT and from 0.825 to 0.847 for SVM. The study also showed the reliability of UAV imagery for coastal vegetation monitoring.

Key words: Unmanned Aerial Vehicle (UAV), Land cover classification, Support Vector Machine (SVM), Random Trees (RT) Accuracy Assessment

PRESENTATION TYPE
ORAL

Unmanned Aerial Vehicle based methodology for rapid flood risk assessment of coastal communities

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Annually, flood causes significant damage to life and property of coastal communities such as Shama District in the Western Region of Ghana. Questions related to the frequency, magnitude and spatial extent of flood hazards; flood risk elements within communities; level of physical vulnerability and the estimated risks have proven quite difficult and expensive, especially, for communities in less developed countries where economic and technological challenges are major barriers. This study presents a methodology for rapidly providing answers to the flood risk problems of coastal communities by deploying low cost unmanned aerial vehicle (UAV) technologies and participatory mapping and field observation approaches, facilitated by open source geographic information systems software. Although not a typical 2D hydrologic analysis, the method uses UAV data and raster-based GIS methods to successfully provide a means of simulating hourly flood depth and movement, using locally available data and UAV images. The methodology captioned Rapid Flood Risk Assessment for Coastal Communities, provides a means of using UAV derived images and digital elevation models to assess and communicate the risk of coastal flooding and the vulnerability of fisheries infrastructure and other structures and populations in such communities.

Keywords: Coastal floods, UAVs, Participatory mapping, Flood risk, Physical vulnerability

PRESENTATION TYPE
ORAL

Modelling the environmental impacts of marine debris on ocean mesoscale eddies along the Gulf-of Guinea

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Research on the ocean current systems have revealed that the accumulation, distribution and movement of marine debris from land- and ocean-based sources have resulted in generation of ocean mesoscale eddies and gyres globally. The decreases in pellets suggest that changes in litter input are rapidly visible in the environment not only close to presumed sources, but also far from land. Floating plastic debris is rapidly from the ocean surface to other as-yet undetermined sinks in the marine environment. The study was conducted in the Gulf of Guinea region of the North Atlantic. Monthly, seasonal and annual satellite-sourced sea surface temperature data were obtained from the National Oceanic and Atmospheric Administration (NOAA) and Advanced very-high-resolution radiometer (AVHRR). High resolution Sentinel-2, and ASTER satellite images and aerial photographs were acquired to track the distribution of marine pollutants along the Gulf of Guinea. Physical ground-truthing inspections using the Real-Time Differential Global Positioning System (RTK-DGPS) device were used to derive satellite altimetry and geometric correction. Classification modelling techniques and machine learning algorithms were used to estimate the quantitative and qualitative information about the abundance and accumulation of marine plastics and micro plastics would be obtained by developing a threshold model for monitoring transparent plastic-mulched coasts. The recommendations from this research thus improve strategies and policy measures needed to fight the observable and projected climate change impacts on marine life. This has affected the socioeconomic aspect of aquaculture through changes in seawater chemistry, sediment transport, and decrease in seawater pH (acidification) and thus generating excess heat in the ocean.

Keywords: Accumulation, Environment, Pollutants, Aquaculture

PRESENTATION TYPE
ORAL

THEMATIC AREA 2

FISHERIES SCIENCE AND FISH BIOLOGY

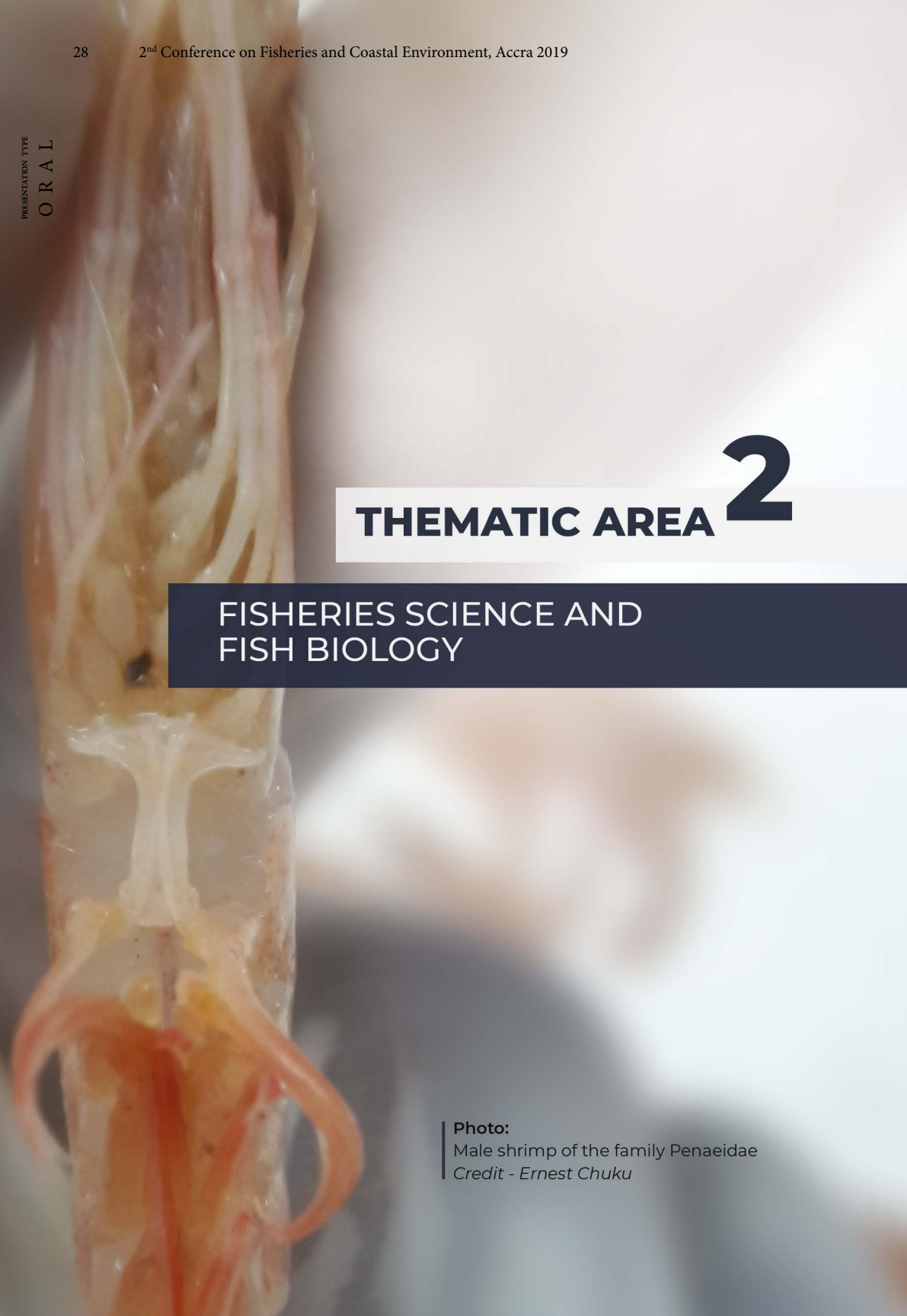

Photo:
Male shrimp of the family Penaeidae
Credit - Ernest Chuku

PRESENTATION TYPE
ORAL

Habitat distribution and biology of penaeid shrimps in Ghanaian waters

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Penaeid shrimps are crustaceans which are of high commercial value. A review of literature revealed a dearth of relevant information of these important food resources in Ghana. The study was therefore, conducted to provide relevant information on the distribution patterns, sex ratio and growth patterns on the penaeid stock. Monthly samples were collected from commercial artisanal fishermen from October 2017 to May, 2018. Secondary source of data was extracted from an experimental survey undertaken by Fridtjof Nansen vessel in 2005 in the waters of Ghana and was used to map the habitat distribution of the penaeid shrimps. The penaeid species encountered in the order of their abundance were *Parapenaeopsis atlantica* (86%), *Farfantepenaeus notialis* (14.66%), *Melicertus kerathurus* (2.65%), *Penaeus monodon* (0.71%) and *Metapenaeopsis miersi* (0.48%). *P. atlantica* and *M. kerathurus* were found to be more abundant at shallower depth ranging between 17.0 m – 29 m whiles *F. notialis* occurred at deeper depth from 29.0 m – 57 m. Sex ratios deviated from 1:1 ratio (in favour of females) for *P. atlantica*, *M. kerathurus* and *M. miersi*. However, there was a condition of equilibrium in the sex ratios for *F. notialis* and *P. monodon*. Mean carapace length and weight were 1.99 ± 0.01 cm and 5.00 ± 0.05 g for *P. atlantica*, 2.91± 0.04 cm and 22.7 ± 0.74 g for *F. notialis*, 3.23 ± 0.12 cm and 24.73 ± 1.85 g for *M. kerathurus*, 1.14 ± 0.04 cm and 1.70 ± 0.19g for *M. miersi*, and 4.36 ± 0.15 cm and 55.01 ± 5.87 g for *P. monodon* respectively. *P. atlantica* and *M. miersi* exhibited allometric growth whiles *M. kerathurus*, *F. notialis* and *P. monodon* exhibited isometric growth. Females were observed to be larger than males for all species except *M. kerathurus*. The study indicated that the penaeid shrimps inhabit distinct depth ranges and these findings could be used for future management strategies for the sustainable exploitation of the penaeid shrimps in the country.

Keywords: Penaeid shrimps, distribution, growth, sex ratio, fisheries

PRESENTATION TYPE
ORAL

Characteristics of the bottom set gillnet fishery in the central region of Ghana

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Gillnets are extensively used in Ghana. Among the coastal regions, Central region is noted for set nets. The present study was conducted to describe aspects of the bottom set gillnet fishery. The study reports on the bottom set gillnet fishery at some locations in the Central region. Characteristics of the fishery were investigated through field observations and interviews. A total of 58 fishermen aged between 16 – 70 years were interviewed from three study sites. Majority of respondents (70.7%) entered the fishery as a family occupation and most of them (84.2%) had no secondary occupation. A lot more fishermen (74.1%) own fishing nets as compared to owning canoes (53.4%). Fishing businesses were found to involve sole ownership or partnerships. The fishery was dominated by canoes of 7-10 m length and exploit demersals. Some sociocultural practices in the fishery such as canoe and net ownership tend to conceal information critical for management. This may lead to management policies and strategies being made based on underreported data with dare consequences on the fisheries. The bottom set gillnet fishery was found to land a diversity of species displaying a rich demersal resource and possible ecologically delicate habitat, a critical information for management.

Keywords: Bottom set gillnet fishery, Fishermen, Sociocultural, Catch

PRESENTATION TYPE
POSTER

Management implications of the use of a standard von Bertalanffy growth function in stock assessment using ELEFAN_GA_boot on an oyster (*Crassostrea tulipa*) fishery in the Densu Delta, Ghana

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The management implications of the utilisation of a seasonalised and standard von Bertalanffy growth function (VBGF) inputs in the Thompson and Bell model using the ELEFAN_GA_boot on the deepwater oyster fishery in Densu Delta was investigated using 12 months samples from November 2017 to October 2018. The ELEFAN_GA_boot was used in determining the growth and mortality parameters and exploitation rates. The oysters exhibited negative allometric and seasonality in growth. Comparatively, the seasonalised VBGF procedure fits the shell height data better. The VBGF estimates by the two approaches were found to be comparable except in the growth coefficient. The growth parameters obtained by the seasonalised and standard VBGF were asymptotic length, L_∞ = 16.68, 16.73 cm SH; growth coefficient K = 0.43, 0.39 yr^{-1}; t_{anchor} = 0.43; 0.48 and growth performance index, Φ' = 2.09 (same for both procedures), respectively. The instantaneous total mortality, natural mortality and fishing mortality for seasonalised and standard VBGF approach of the oyster fishery were estimated as 1.92 ± 0.08 and 1.92 ± 0.09 yr^{-1}; 1.27 and 1.20 yr^{-1}; 0.56 and 0.72 yr^{-1}, respectively. Both procedures indicated that the oysters were under-exploited, i.e. $E_{cur} < E_{msy}$. However, unlike the seasonalised approach, the standard method indicated that $F_{cur} > F_{0.5}$. Concerning the standard VBGF fed Thompson and Bell model for the oyster fishery at the deep portion of Densu Delta, fishing mortality must be reduced, which could be supported by the harsh environmental conditions. Consequently, a decline in yield and profit is realised whereas its counterpart showed that the fishery was healthy; hence, no need for a reduction in fishing mortality.

Keywords: Biomass, soVBGF, Sustainability, Thompson and Bell model, TropFishR, Yield

PRESENTATION TYPE
ORAL

Population dynamics of *Sardinella aurita* within Ghana's coastline

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According to the United Nations, 200 million people depend on fishing as their source of food or livelihood. However, current fishing practices threaten the security of marine populations. Dramatic examples such as the collapse of the cod industry in Newfoundland in the early 1990s illustrate that fishing without appropriate limitations can have detrimental effects on fish populations and on the people and economies that depend on them. Understanding how populations of marine life can be harvested sustainably is vital to the economies of nations and to the well-being of millions.Following the declining stocks of Sardinella aurita within Ghana's coastline, we examine some population models and parameters of this species as a guide for managing this important stock sustainably. Using Sardinella Aurita data from the Fisheries Survey and Scientific Division (FSSD) of the Ministry of Fisheries and Aquaculture Development (MoFAD), we present dynamic models that seek to analyze and inform the policy makers on appropriate fisheries management processes and present answers to a critical question among the fishing community; should the government encourage seasonal fishing?

Keywords: Sardinella aurita, Ghana coastline, population dynamics, mathematical models

PRESENTATION TYPE
POSTER

Distribution, relative abundance and CPUE of three seabreams from Ghanaian waters

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Pagrus caeruleostictus, *Dentex canariensis* and *Dentex gibbosus* are three of the commercially important seabreams landed on the shores of Ghana. This study explored the catch trends in the landings and distribution of the seabreams in Ghanaian waters. Monthly data were collected from February 2016 to July 2017 from three fishing sites along the coast. Secondary data from fish statistical records comprising of catch and effort data from the artisanal fisheries were collected from the Fisheries Scientific Survey Division (FSSD) of the Ministry of Fisheries and Aquaculture Development (MoFAD), and from the Fridtjof Nansen 2006 and 2016 cruise reports. The data from the Fridtjof Nansen cruise reports were used to map out the habitat distributions of the three species in the years 2006 and 2016 using ArcMap 10.5. The catch per unit effort (CPUE) was calculated for only *P. caeruleostictus* and *D. gibbosus* from the year 2000 to 2017, since that of *D. canariensis* were unavailable. It was observed that the three species were distributed from shallow to deeper waters, with *P. caeruleostictus* being the most widely distributed and occurring more in shallower waters. *D. canariensis* was sparsely distributed and found more on the western side, while *D. gibbosus* occurred in deeper waters. It was also observed that the catches of *P. caeruleostictus* and *D. gibbosus* had declined over the past decade, though the effort seems to have been fairly stable. *P. caeruleostictus* was the most abundant species out of the three, making up about 56 % of the total fish samples collected; while *D. gibbosus* was the least (11 %). The results suggested that distribution of the seabreams in 2006 had changed slightly from 2016, while the abundance declined from 2008 to 2017. The decreasing trends in catches, coupled with the changes in distribution of the species requires rigorous conservation measures.

Keyword: *Pagrus caeruleostictus*, *Dentex canariensis*, *Dentex gibbosus*, Ghana

PRESENTATION TYPE
ORAL

Growth, recruitment and mortality of commercially important species belonging to the family Sciaenidae encountered in the coast of Ghana

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Population parameters for some major fishes of Sciaenidae from the coastal waters of Ghana were assessed using length frequency data obtained from August 2017 to June 2019 through experimental fish trawl along the coast of Greater Accra Region of Ghana. Trawling was performed quarterly for an average of one hour at an average speed of 3.0 km/hr. In all, 399 fish samples were measured and the retrieved data analysed with FiSAT II. The assessed fish species included *Pteroscion peli* (165 samples) and *Pseudotolithus senegalensis* (234 samples). The asymptotic lengths ($L\infty$) were 19.4 cm and 41.5 cm for *Pteroscion peli* and *Pseudotolithus senegalensis* respectively. The growth and total mortality rate recorded for *Pteroscion peli* was 0.48 per year and 1.86 per year respectively, whereas that of *Pseudotolithus senegalensis* was 0.50 per year and 1.63 per year respectively. Both fish species exhibited continuous recruitment with minor and major recruitment peaks. The fishing mortality rate was estimated as 0.66 and 0.63 per year for *Pteroscion peli* and *Pseudotolithus senegalensis* respectively. Natural mortality rate (M) estimated for *Pteroscion peli* and *Pseudotolithus senegalensis* was 1.20 and 1.00 per year respectively. Exploitation rates (E) of *Pseudotolithus senegalensis* (E = 0.39) and *Pteroscion peli* (E = 0.36) were far below the optimum exploitation level of 0.5, suggesting under-exploitation of *Pteroscion peli* and *Pseudotolithus senegalensis* occurring in Ghana's coastal waters.

Keywords: *Pteroscion peli, Pseudotolithus senegalensis,* fisheries, management, Ghana

PRESENTATION TYPE
ORAL

Preliminary studies on the distribution, abundance and market potential of the African Bonytongue Fish, *Heterotis niloticus* (Cuvier, 1829) in the Ashanti Region, Ghana

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The aquaculture industry has grown substantially based mainly on Nile Tilapia (*Oreochromis niloticus*) production. However, in recent years the demand to produce alternative species to diversify the industry has greatly increased. This study was conducted to obtain preliminary information on the distribution, relative abundance and market potential of the African Bonytongue (*Heterotis niloticus*), a native fish species in Ghana, in an attempt to determine the aquaculture potential. The study assessed fishers' knowledge of African Bonytongue using questionnaire and catch composition by quantifying fish landings from Owabi and Barekese Reservoirs and also market potential through a survey of four main markets in the Ashanti Region. A total of 72 respondents were involved in the survey made of fishers, fish traders and consumers. Results revealed that most of the African Bonytongue sold in the Ashanti Region are from eight sources, the major being Yeji a town on the Volta Lake in Ghana. It also showed that although the species is caught in the Barekese Reservoir, current catches are low and do not meet the demand for even the population within the Barekese town. In terms of numbers *H. niloticus* was 7.5 % of the catch, however in terms of weight it formed 45.1 % of the catch with an average weight of 1.97 Kg. Low catches were mainly attributed to overexploitation of the fish even during the breeding season. The African Bonytongue has a relatively high demand and therefore quite expensive on the market. They were found in all the markets surveyed although not so common and were mostly sold in smoked, salted and fermented forms. The results suggest that the demand is high but supply is woefully inadequate. Culturing of this species seem to be the only solution to help meet this deficit and diversify aquaculture in Ghana.

Key words: *Heterotis niloticus,* Alternative aquaculture species, Distribution, Abundance, Market potential

PRESENTATION TYPE
ORAL

Age of Atlantic chub mackerel (*Scomber colias* Gmelin 1789) in Ghanaian waters determined using sagittal otoliths

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A major problem of tropical fisheries is the inability of hard parts to be used for ageing due to the perceived absence of distinct seasons, and the absence of logistics as well as equipment for ageing. As a result, length-based methods which may not accurately reflect the true age structure of a given species are usually employed. *Scomber colias* is one of the four dominant small pelagic fish species landed in Ghana. Age estimates were derived from sagittae of specimens (n = 403) in commercial artisanal landings from February 2016 to July 2017. Evidence of the deposition of annual growth rings was proven by edge type analysis and validated using marginal increment width analysis. The percentage of hyaline edges as seen under reflected light was lowest from July to September 2016, indicative of a yearly growth spurt during the major upwelling season. This was further validated by marginal increment analysis. The ages of fish as determined by otolith analysis ranged from 0-8 years, with the species attaining up to 46 % of asymptotic length in the first year of growth. A mean length-at-age key was also developed which will be helpful to estimate the age of the species given a particular length in the field, or when hard parts cannot be obtained. The results of this study indicate that the species in Ghana can be aged successfully using otoliths, has a fast growth rate in the first year and is relatively long lived. This is the first time otoliths have been used to successfully age the species in Ghana.

Keywords: *Scomber colias,* Otoliths, Atlantic chub mackerel, Fish age, Sagittae

PRESENTATION TYPE
ORAL

THEMATIC AREA 3

FISHERIES MANAGEMENT AND POSTHARVEST FISH VALUE CHAIN

Photo:
Helping hands lift pan full of fish off the head of a fish processor at a landing beach on the coast of Amissano, Ghana.
Credit - Ernest Chuku

PRESENTATION TYPE
ORAL

Fishing methods and sustainability of marine fisheries in Western Region of Ghana

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Ghana's marine fishery industry has over the years evolved from being that of highly traditional to a mix of traditional and modern fleet with an increase in the number and types of gears used. This study presents findings on the changing fishing methods in Ghana's marine fishery along the western coast and an assessment of potential effects of changing fishing methods on sustainability of Ghanaian marine fishery. The Ali Poli Watsa (APW) is the most commonly used gear in the marine fisheries of the Western Region as it has been handed down for generations. Other gears used are the beach seines, set nets, drift gill nets, the purse seine, and set nets. With time, fishers have introduced other fishing techniques such as Light Fishing, monofilament nets and fishing accessories that would make it easy to locate fish populations as a means of increasing their catch. The new fishing gears and accessories drive intensification and the initial results are marked spikes in fish catch. These spikes decrease with time because it is achieved at the expense of fish habitat destruction. After declines, fishers find and introduce new techniques and the cycle is repeated. This creates a zig-zag pattern of increasing and decreasing fish catch but a general reduction in total catches over the years. This development poses a major threat to sustainability of the marine fishery but in the absence of accurate data, it is difficult to correctly establish biological risk of stock. To effectively address the issue of sustainability, the marine fishery in Ghana would need fishery specific data on target stocks; conduct scientific stock assessments to define reference points for specific fishery. The introduced closed seasons should be used to collect required data for effective management of Ghana's marine fishery.

Keywords: Fishing methods, Ghana fisheries, Ffisheries sustainability, Fisheries management

PRESENTATION TYPE
ORAL

Use of closed season in the management of demersal fisheries and its impact on artisanal fishers in Ghana: A case of the industrial trawlers

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As part of the stock recovery strategy in the marine sector, the Ministry of Fisheries and Aquaculture Development and the Fisheries Commission, Ghana developed the National Marine Fisheries Management Plan (2015-2019) with the appropriate strategies. Among these is the institution of closed seasons for all fleet. The objective of the study was to examine closed season for industrial trawlers' and its impact on the artisanal fishers. Thirty (30) trawler vessel operators were interviewed in 2017. In addition, impact assessment (for a total of 5 months closed season from 2016 to 2018) was undertaken in 2018 through focus group discussions with fishermen, processors and traders. All industrial operators interviewed were members of Ghana Industrial Trawlers Association, most (56.7%) received information on closed season from the association and channel of communication included letters (76.7%) and phone calls (10.0%). A good number of the operators (73%) acknowledged that the period between notification and actual observation was adequate for the preparation towards the exercise. Most trawlers (66.7%) were on anchorage at Tema and Takoradi while 30.0% were fishing in foreign waters, mainly Cote d'Ivoire. Some activities undertaken during the closed season were: maintenance of gear and vessels, and fishing in foreign waters. Identified benefits of closed season to the operators included vessel servicing and other maintenance works, reduced turnaround time, improved landing. Also, there were improved fish landings and species composition in 2018 as compared to 2017 for the artisanal sector. Cuttlefish, cassava fish, kingfish and ray fish were reported in 2017 and 2018. The Volta Region report recorded increased landings of barracuda, cassava fish, horse mackerel and redfish. Flat and round *Sardinella*, cassava fish, barracuda, shad/bonga fish were the main species landed in three selected communities in the Greater Accra Region. All groups interviewed attested to the usefulness of the closed season.

Keyword: Closed season, Impact, Industrial trawlers, Ghana

PRESENTATION TYPE
ORAL

Rethinking the neglected shellfish fishery on the Keta Lagoon, Ghana

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Keta Lagoon is home to various shellfishes but the shellfish fishery on the lagoon has received little attention. Through a value chain analysis of shellfish fishery on the Keta Lagoon, this study sought to understand the structure, functions and distribution of costs and benefits along the value chain of shellfish fishery on the Keta Lagoon and identify opportunities to generate greater economic returns and incentives for increased investments. Data was collected from six landing sites and four markets along the Keta Lagoon in order to document the shellfishes of commercial importance in the Keta lagoon, assess the methods and gears employed currently in the shellfish fishery and assess the economic performance and competitiveness of the commercially important shellfishes in the lagoon. Four shellfishes were found to be commercially important on the Lagoon and these include shrimps (Pennaeus spp.), blue-swimming crabs (Callinectes spp.), mangrove periwinkles (Littorina spp.) and whelks (Busycotypus spp.). Fishers on the lagoon mainly use nets and traps for harvesting shrimps and crabs whilst hand-picking is used in harvesting the periwinkles and the whelks. The fishers employing handpicking consider it to be an inefficient and unsuitable method of shellfish harvesting on the lagoon. Various preservation and processing methods employed by retailers and processors include icing and refrigeration, sprinkling of water, smoking, boiling and frying. On the shellfish value chain are various actors including fishers, input sellers, wholesalers, and retailers, processors till the consumers. The biggest earners along the shrimp fishery value chain are the retailers who earn GHS 245 per week. Wholesalers make the most profit from the blue-swimming crab fishery; making GHS 178.88 per week. Weaknesses and challenges of the shellfish fishery on the Keta lagoon limit production and economic gains but it equally has strengths and opportunities, which highlight great potential and opportunities to maximize production and improve gains.

Keywords: Value Chain Analysis; Shellfish fishery; Keta Lagoon; neglected fishery

PRESENTATION TYPE
ORAL

AIS data 2012-2018 show trawler intrusions have moved to the southern edges of Ghana's Inshore Exclusive Zone

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Automatic Information System (AIS) derived information on sampled trawler fishing effort (hours fished) within Ghana's Exclusive Economic Zone (EEZ) was analysed for the period 2012-2018. Publicly available data were obtained from Global Fishing Watch (GFW) for the period 2012-2016 and for 2017 and 2018 (until 30 June) through a license granted to the author by GFW. Trawler intrusions in the Inshore Exclusive Zone (IEZ), which is reserved for small semi-industrial vessels, canoes and recreational fishing vessels, were extracted and hours fished per month and year calculated. Sampled trawler fishing effort within the IEZ as a percentage of total sampled trawling fishing effort within the EEZ decreased fourfold from 15.6% in 2012 to 3.8% in 2015. From 2015-2018 it remained stable at 4-5%. Concurrently a fourfold increase in sampled trawler fishing effort was apparent in patches of less than 30m depth on the continental shelf. However, there is ambiguity if these patches are covered by the Fisheries Act 625 (2002) of Ghana. Trawler intrusions were highest during the main (July-October) and minor (January-February) upwelling periods. Activities of the Fisheries Enforcement Unit unlikely reduced trawler intrusions into the IEZ, as this process was already ongoing for two years preceding its inauguration. However, the abrupt shift away from trawler fishing activity in the Central Region in 2014 might well have been caused by FEU activities. Coastal fishing communities complaining about trawler intrusions in the IEZ can profitably use AIS data to substantiate their claims and push the government for law enforcement and sanctions.

Keywords: AIS, EEZ, IEZ, FEU, GFW

The role of fisheries subsides in the overexploitation of marine fisheries: The case of Ghana

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Undesirable fisheries subsidies reduce the cost of fishing and thereby lead to increased fishing effort. They reduce economic efficiency by encouraging overcapacity and overfishing, thereby making the problems of open access fisheries worse. This paper examines the case of Ghana with an emphasis on the somewhat unique fuel subsidy that was established in 1992 and remains in place today. Field interviews of seventy (70) motorized canoe owners were used to explore the impact of the Ghana "premix" fuel subsidy programme on fisheries exploitation. The interviews consisted of a semi-structured questionnaire applied at landing beaches in each of Ghana's four coastal regions. Premix fuel is a blend of petrol and motor oil for use in outboard engines used by the artisanal canoe sector and purchased at distribution sites with a tax exemption on the retail price making its cost close to 70% less than the non-exempt cost of fuel per litre. Between 2011 and 2018 the cost to government of foregone tax revenues averaged US$45.7 million annually. Fuel constituted 66% of operating costs on average across the different artisanal fisheries. About 75% of the fishermen could stop fishing or fish significantly less if the premix fuel subsidy was reduced or eliminated. It was also found that with the removal of the fuel subsidy, at least 61% of fishermen would be realizing losses for every gallon of fuel. These findings provide support for phasing out the fuel subsidy and investing, instead, in other "beneficial" subsidies.

Keywords: Artisanal fisheries, Fisheries subsidies, Fisheries overexploitation, Fisheries management, Ghana, Premix fuel

PRESENTATION TYPE
ORAL

Improving local smoked fish quality: Market perspective

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Ninety-five percent of the fish produced in Ghana is smoked and 70 to 80 percent of the Ghanaian population consume smoked fish, on average. However, supplies of smoked fish in Ghana is subject to many challenges such as food waste and losses, decreasing profitability among fish processors and high risk of fish safety issues among consumers. There is a need to identify ways through which markets can help improve the quality of smoked fish to ensure food safety and increase profit among the various actors in the value chain. The Food and Agriculture Organisation Global Initiative on Food Loss and Waste Reduction attributes post-harvest losses in developing countries to financial, managerial, technical, harvesting and processing techniques. To improve the post- harvest value chain, the Government of Ghana has adopted a certification scheme to improve post-harvest regulation of the fisheries sector. A study conducted among two groups (supermarket -operators and consumers) revealed that supermarket operators and its consumers have different opinions towards locally smoked fish sold in Ghana. Sixty percent of supermarkets operators do not sell smoked fish, yet, consumers who purchase items from the supermarkets do consume smoked fish. The supermarket rated the quality of local smoked fish as poor whilst the consumers rated it to be very good. In contrast to consumers' opinion, 90 percent are willing to pay a price premium for improved smoked fish quality. This suggests that in order for fish processors to obtain better returns from smoked fish and sell smoked fish in the advanced markets, there is the need to identify and understand demand of the market, market trends, consumer needs and preferences and factors that lead to acceptance and rejection of smoked fish that deliver better economic returns and improve economic livelihoods of fish processors in Ghana.

Keywords: Smoked fish, Supermarkets, Consumers, Value chain

PRESENTATION TYPE
ORAL

Assessing artisanal light fishing in the Ningo-Prampram District: A case study of the Ahwiam and Lekpongunor fishing communities

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Light fishing involves the technique of aggregating fish by artificial light. Nowadays, the use of light equipment such as the Power generator, 1000 Megawatts bulbs, Switchboard and electric wires or cables for attracting fish and increasing catch is a common practice and has been regarded as one of the most advanced, efficient and successful methods for aggregating fishes by fisher folks. The study was conducted in two coastal communities, Ahwiam and Lekpongunor in the Ningo-Prampram District and noted among other coastal communities for artisanal fishing. The purpose of this study was to access artisanal light fishing practices by these communities with respect to its sustainability, how informed are fishermen with respect to light fishing and the effectiveness of the fishing regulations against such operations. Most of the negative effects associated with the light fishing are catching of immature fish stocks, overfishing and the dwindling levels of fishing output. Different data collection strategies were employed in the study and data was analyzed qualitatively. The study also identified and sought for awareness creation, education for fishermen on unsustainable fishing operations by Fisheries Commission, fishermen involvement in the decision-making processes and tightening of the enforcement system to help keep the fishery resources healthy for sustainable exploitation.

Keywords: Ahwiam, Lekpongunor, Fishermen, Switchboard, Overfishing

PRESENTATION TYPE
POSTER

Value chain mapping of the croakers in Ghanaian fishery

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This study considered a value chain mapping of croakers (*Pseudotolithus* species) in four landing beaches in the Central and Western Regions of Ghana. The aim of the research was to develop a value chain map for the croaker industry in Ghana. Croakers play a significant role in the commercial activities of the fishermen and other actors in the value chain, and contribute positively to the total income of the fishermen and these actors. Data for the study was collected from both primary and secondary sources between 2017 and 2018. The primary data was generated from input suppliers, fishermen, fish processors, marketers (retailers and wholesalers) and consumers using a pre-tested structured questionnaire and key informant interviews using checklists. A total of five hundred respondents (500) comprising two hundred and twenty-four fishermen (224), two hundred and thirty-one processors and retailers (231) and forty-five wholesalers (45) were interviewed for the study. Actors were interviewed on their operational cost, value addition method, returns on investment, point of sale of their products (marketing centres), sources of credit, knowledge of institutions working closely with actors etc. The actors formed the main links on the chain. Value chain worked better in an enabling environment with the presence of facilitating services. A value chain map was then developed between the actors and the various support systems surrounding the croaker fishery. A value chain mapping facilitates a clear understanding of the sequence of activities, the key actors and relationships involved in the value chain.

Keywords: Value chain analysis, Croakers, Value chain mapping, Enabling environment, Facilitating services

PRESENTATION TYPE
ORAL

Assessing the economic incentive for marine fishing among coastal communities in Ghana

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Fish provides a substantial proportion of animal protein in Ghana, accounting for over 60% of total animal protein intake. Marine fisheries contributes over 80% of all fish consumed and exported. While there is a sizable industrial fishing fleet, more than two-thirds of Ghana's total marine fish catch is accounted for by coastal community fishers. Marine fisheries are the primary source of income for more than 200 coastal villages. However, recent assessments indicate that fish landings in most fishing communities have declined, leading to declining fishery livelihoods in fishing communities. Monetizing fishing incentives implies fishing income would be the main reason why marine fishers ply their trade. This is based on Adam Smith's assertion that the self-interest of fishers, not their benevolence would make them provide fish for everyone else. Thus in the face of declining livelihoods, this study sought to assess the role of fishing income as an incentive for sustained marine fishing among Ghana's coastal communities. To construct a fishery production function, the study obtained a yield-effort function which gives a steady-state relationship between marine fish yield and fishing effort, where fishing income represents the yield. Cross-sectional data was employed, based on a probability sample of 378 marine fishers from 5 fishing communities in Ghana. The study finds that fishing income, level of education of fishers and fishing trip duration were not significant determinants of sustained fishing in the communities. Ownership of fishing vessel and the age of fishers were however significant determinants of sustained fishing. Therefore, the fisheries sector should provide incentives for the youth to reside in fishing communities and ensure easy access to fishing gear, to sustain marine fishing for growth. Economic implications of the findings for Ghana's fishing industry are further discussed.

Keywords: Changes in fishing income, Coastal community fishers, Economic incentives, Ghana

PRESENTATION TYPE
POSTER

Assessment of traditional governance systems in support of artisanal fisheries management in the Western Region of Ghana

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The research aimed to investigate the traditional governance systems in support of artisanal fisheries management by studying the existing traditional governance systems, current role played by major stakeholders and associated challenges, the types of conflicts within the existing traditional governance systems and a functional fisheries governance system that incorporates all stakeholders for sustainable fisheries management. The study was conducted in the six coastal districts in the Western Region of Ghana. Data was collected through key informant interviews, in-depth interviews and focus group discussions from October 2017 to April 2018). Recorded data were transcribed and categorized under common themes and issues. The results indicates that the existing traditional governance systems include fishing holidays, ban on fishing during festivals, denunciation of illegal fishing activities and conflicts resolution. It was observed that the chief fisherman, chief fishmonger and fishers are the main bodies that form the structural hierarchy in terms of traditional fisheries governance ruling. The roles played by major stakeholders and this includes arbitration, implementation of fisheries laws, regulating fisheries efforts. It was also observed that the types of conflicts occurring at different levels within the sector was as a result of low compliance of fisheries laws by uncooperative stakeholders. Again it was revealed that the execution of roles by stakeholders was ineffective due to political barriers, lack of legal backing and lack of reverence for traditional authorities. Findings from this study suggests that Government should empower chief fishermen and involve the active participation of Paramount Chiefs in traditional fisheries governance to enhance good cooperate governance for fisheries sustainability.

Keywords: Traditional governance systems, Artisanal fisheries management, Stakeholders, Fishermen

PRESENTATION TYPE
ORAL

From science to impact: Application of scientific innovations and technologies to help rebuild small pelagic stocks and monitor their response to fisheries and climate variability

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Small pelagic species are the main source of animal protein for many coastal populations in Ghana. However, small pelagic stocks have already experienced signs of decline and spatial shifts of their distribution and abundance driven mainly by overfishing and climate change. Recent stock assessments reported that these stocks are severely overfished and that overfishing is still occurring at an alarming rate. Prolonged state of overfishing has also altered reproductive output, growth, and recruitment successes of several fish stocks with severe consequences on people's livelihoods and food security. The development and implementation of management policies have, in most cases, not been effective because of a failure to use all available sources of information and knowledge. Available science and technologies can provide a basis for measuring changes in fish stocks, for understanding how marine ecosystems operate, and for predicting how a change in environmental conditions might affect production. However, science cannot provide a basis for choosing human goals with respect to the management of these systems. The USAID-funded projects - SFMP and UCC's Fisheries and Coast Managemt Project - to assist the government of Ghana improve fisheries stock assessment and management through capacity building and the introduction of modern technologies and scientific techniques. The Scientific and Technical Working Group, formed by SFMP, played a significant role in developing new stock assessment techniques and management recommendations through an open and transparent process. The use of modern technologies to collect fisheries data and local ecological knowledge enabled public familiarity with scientific and decision making processes. The greater level of information exchange among scientists, policymakers, and the public created an avenue for public debate to rely on science in guiding decisions on fisheries management. The introduction of data collection using smartphones has brought about tremendous change in the fisheries sector and its management systems. Fisheries managers are now able to adjust management measures based on the quick reporting and dissemination of the impact assessments. For example, the implementation of the closed fishing season was supported by electronic surveys to collect biological and socio-economic data to assess the impact before, during and after the closed season. Overall the science and technology have recently been evolving into valuable tools for fisheries management and co-ordination of MSC and marketing activities. Unfortunately, political issues remain a barrier to the uptake of technology in some parts of fisheries management, especially regarding transparency and availability of information which improve voluntary compliance as it tends to engage stakeholders in the debate of decision making processes.

PRESENTATION TYPE
ORAL

Fish packaging and transport: Challenges and options to control postharvest loses

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Postharvest food loses is an emerging challenge for governments and seriously affects food security. As Ghana's population grows, the increasing demand for fish as a source of protein can partly be met by increased supply of fish through reduction in postharvest loses using effective packaging and transport that ensure waste reduction in the fish supply chain. This study therefore assessed the smoked fish supply chain in terms of the packaging and transporting systems being to facilitate storage, trade and retailing. Additionally, the study sought to identify primary, secondary, and tertiary packaging systems that could help address the bottle necks observed and minimize smoked fish waste across the supply chain. The study showed that, smoked fish was mainly packaged in cane woven baskets lined with paper from used cement bags and loaded on open trucks to the markets. In the major markets, they are stored in warehouses in the same packages. Within market/town transport is done on push carts, wheelbarrows and use of head porters. Key drawbacks to this approach of packaging, storage and transportation are significant loses in quality and quantity through deterioration, degradation and breakages. Packaging systems that addresses these drawbacks have been identified.

Keywords: Fish, Packaging, Transportation, Postharvest loses, Supply chain

PRESENTATION TYPE
ORAL

Gamma irradiation decontamination of Polycyclic Aromatic Hydrocarbons and organochlorine pesticides in processed fish in Ghana: Implications and prospects

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Polycyclic Aromatic Hydrocarbons (PAHs) and Organochlorine pesticides (OCPs) are the most hazardous class of organic chemicals in the environment. Some have been banned or restricted in several countries. Major sources of PAHs include incomplete burning of organic materials and charcoal grilled meat and fish and that of OCPs include food and agricultural industries. Their presence in water bodies and food at high concentrations is of environmental and public health concerns. Their removal from processed fish through the use of gamma irradiation is imperative. Seven PAHs and eight OCPs residues were investigated in six species of processed fish purchased from markets in three coastal Regions of Southern Ghana. Gas chromatographic analysis was employed for PAHs and OCPs determination before and after gamma irradiation. Observed means of PAHs in non-irradiated smoked fish samples ranged from 11.75µg/kg to 39.37µg/kg ($p = 0.05$), with B(b)F = 39.37µg/kg, ($p = 0.05$), and non-irradiated sundried fish recorded PAHs of 5.76µg/kg to 47.68µg/kg, ($p = 0.05$). Irradiated sundried fish: 0.32µg/kg to 29.73µg/kg ($p = 0.05$) at 7.5kGy, and B(b)F = 39.37µg/kg to 29.73µg/kg, ($p = 0.406$), Smoked fish recorded 7.54µg/kg to 22.30µg/kg ($p = 0.05$) at 7.5kGy, with B(b)F = 33.55µg/kg to 22.30µg/kg ($p = 0.05$) at 7.5kGy. OCPs in the non-irradiated fishes were 0.1mg/kg - 93mg/kg and in irradiated sundried fish, 0.0mg/kg - 29.73mg/kg ($p = 0.001$) at 7.5kGy.

Keywords: Environmental Risk Limit, Gamma Irradiation Decontamination, Maximum Permissible Concentrations

PRESENTATION TYPE
ORAL

Impact of governance on small pelagic fish value chains and food security in Ghana

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Although small pelagic fish chains contribute strongly significantly to the food security, health and development of poor urban consumers in developing countries, limited attention has been given to their role. Moreover, most work on seafood is about production and little about consumer food security, and therefore there is a lack of understanding of how governance of the fish chains affect consumer food security outcomes. This paper examines the governance structures and power relations in the post-harvest chains of small pelagics that may influence fish food security of poor consumers in the cities of Accra and Tamale. Using structured questionnaires, the paper collects primary data from 200 fish chain actors mainly processors, wholesalers and retailers was collected, and interviews relevant external actors such as state and non-state institutions interviewedto generate information. The findings reveal spot market as the main governance typology dominating fish chains. However, relational governance has also emerged over time based on trust and family ties. Governance of small pelagic fish chains by institutions and associations is weak and is biased towards fish capture, and less attention given to fish as food along the post-harvest segment of the chains. Thus, governance of the post-harvest fish chain is rather weak or non-existent. This has serious food security implications for consumers. It is recommended that the capacity of regulatory institutions should be improved for them to work collaboratively to enhance overall chain functioning and improve fish quality and safety. Chain actors should be encouraged to form associations to facilitate access to them.

Keywords: Value chain, Chain governance, Food security, Small pelagic fish, Accra, Tamale

PRESENTATION TYPE
ORAL

THEMATIC AREA 4

AQUACULTURE AND LIVELIHOODS

Photo:
West African mangrove oyster (*Crassostrea tulipa* lamarck 1819) cultured on racks in the Narkwa Lagoon, Ghana.
Credit - Ernest Chuku

PRESENTATION TYPE
ORAL

Towards oyster culture in Ghana: Some physicochemical parameters as indicators of suitability of three water bodies

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Oyster culture as a supplementary livelihood for many coastal communities is becoming paramount in many West African countries. Temperature, salinity, dissolved oxygen, pH and turbidity are among the key environmental factors that influence the physiological wellbeing (also known as condition index) of oysters. This study therefore investigated these physicochemical parameters in three coastal water bodies in Ghana and their influence on condition index of the resident oysters as a means of determining the suitability of the water bodies for oyster culture. The five environmental parameters measured were within limits that indicated good ecological health for all three water bodies. They fluctuated in similar patterns in the water bodies during the study period but Narkwa Lagoon had the highest and lowest mean temperatures (31.99 ± 0.72 °C and 24.86 ± 0.31 °C respectively). The highest and lowest mean salinities of 31.96 ± 0.89 ppt and 2.67 ± 0.82 ppt were recorded in Densu Delta. The highest dissolved oxygen (DO) of 8.58 ± 0.47 mg/L was recorded in Whin Estuary and the lowest of 1.16 ± 0.09 in Narkwa. The pH was highest (9.90 ± 0.32) in Densu and lowest (6.57 ± 0.08) in Narkwa. Narkwa and Densu respectively had the highest (78.19 ± 18.01 NTU) and lowest (6.32 ± 0.13 NTU) turbidity records. Oysters in the three water bodies had condition indices (CI) ranging from 33.25-63.25% in Whin, 32.87-53.30% in Narkwa and 33.18-53.86% in Densu. Linear Regression Analysis conducted showed that physicochemical parameters had strong influence on the CI of oysters from the water bodies. It is concluded that all the three water bodies could be considered as suitable sites for oyster culture provided other important factors such as their bacterial load and heavy metal concentrations are found to be acceptable.

Keywords: Oyster culture; Condition index, Physicochemical parameters, Estuary, Lagoon, Delta

PRESENTATION TYPE
ORAL

Effects of plant protein diets on the nutrient composition and sensory properties of Nile tilapia *(Oreochromis niloticus)*

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This study evaluated the effect of diets formulated from four plant protein ingredients (soybean (SBM), groundnut meal (GNM), copra meal (CM) and cotton seed meal (CSM) at different proportions to contribute 80% of the dietary protein requirement of Nile Tilapia. A commercially available tilapia feed served as the control diet. All-male Nile tilapia fingerlings (~70.0g) were stocked at 2 fish m^2 in 15 earthen ponds (150m^2) at KNUST- Kumasi for 21-weeks. The treatments were randomly assigned in triplicate to the experimental ponds. At the end of the experiment, fillets of cultured fish were analysed to determine the effects of the formulated diets on the body composition, sensory properties, fatty acids profile, liver and intestine histology. The results indicated that there were no significant differences ($P<0.05$) in the body composition, fatty acids profile and sensory properties of tilapia fillets. However, the diet composed of 80% SBM had the highest protein content (19.40%), while the highest lipid content (2.80%) was observed in fish fed control diet. Twenty-five fatty acids were identified in the fish fillets. Alpha-linolenic acid (n-3) was highest (18.58%) in fish fed SBM diet, while the highest (19.27%) alpha-linoleic (n-6) acid was recorded in fish fed Diet 2(10% GNM, 10% CSM, 30% CM, 30% SBM). The highest docosahexaenoic acid (DHA) 4.38 % was found in fish fed the farm made feed (20%GHM, 40%SBM, 20%CM). Histologically, all experimental diets resulted in higher fat deposition in the fish liver but had no effect on the intestine of the cultured fish. The plant protein diets had no effects on the nutritional composition and sensory properties of Nile tilapia.

Keywords: Fatty acids, Body composition, Nile tilapia, Plant protein, Sensory properties.

PRESENTATION TYPE
ORAL

Proximate composition of different declared crude protein contents of the most commonly used commercial tilapia feed in Ghana

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Use of feed is imperative in successful fish farming irrespective of the culture system being used. Regardless of fish species and fish size, the feed used for its rearing must meet the fish's nutritional requirements, particularly protein and lipids for survival and healthy growth. This study was carried out to establish if the nutrient contents of different tilapia feed types produced by the largest commercial fish feed producing company in Ghana by name *Raanan*, had the actual nutrient contents as declared by the company on the labels of the feeds. Samples of four of its tilapia feeds of stated crude protein (CP) contents 30.0, 33.0, 38.0 and 40.0% were taken from a newly procured consignment. The proximate composition [moisture (M), crude protein (CP), crude lipid (CL), crude fibre (CF), carbohydrate and ash] of the feeds were analysed in triplicates. The analysed parameters for each feed type either deviated positively or negatively from the producer's declared figures. The analysed CP contents of the feeds ranged from 30.6 to 38.1%. Aside from the declared 30.0 CP feed, the figures recorded for the other feeds were less than the declared ones. The analysed CL contents ranged from 2.2 to 3.5% whilst the declared figures ranged from 5.0 to 7.0%. The carbohydrate contents of all the feeds had no written specification; hence, the deviations could not be quantified. The costs of the feeds during the study were 4.20, 4.35, 5.65 and 5.75 GHS kg^{-1} for 30.0, 33.0, 38.0 and 40.0% CP contents respectively. Since the prices of the feeds were based on their declared CP contents, it is recommended that the use of any of the feeds for a particular fish size should depend on the profitability of using that feed and not necessarily on its declared crude protein content by the manufacturer.

Keywords: Nutrient content, Nutritional requirements, Profitability, Raanan fish feed

PRESENTATION TYPE
ORAL

Profitability of using different crude protein contents of the most commonly used commercial tilapia feed for Nile tilapia (*Oreochromis niloticus*) fingerlings production in Ghana

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For economical tilapia fingerling production, the use of appropriate feed in terms of its crude protein (CP) content and its cost are crucial. The profitability of using different declared CP contents of the most commonly used brand of commercial tilapia feed by fish farmers in Ghana to produce an average of 5.0 g Nile tilapia, *Oreochromis niloticus*, fingerlings was investigated. The CP contents were 30.0, 33.0, 38.0 and 40.0% designated A, B, C and D respectively. The study was carried out in hapa-in-pond system and it lasted 9 weeks. The nutrient contents of the feeds as declared by the producer were compared with analyzed figures. A stocking density of 50 tilapia fry m^{-2}, at an initial mean weight of 0.03 ± 0.00 g and two replicates of each feed treatment were studied. The fish were fed at 20% of their body weight five times a day at 2 hour time interval from 0800 to 1600 GMT. Water quality parameters were monitored weekly in both the open pond and in the experimental hapas. Analyzed crude protein contents of the feeds were 30.6, 32.8, 36.5 and 38.1 for A, B, C and D respectively whilst those of lipids were 2.2, 2.5, 3.5 and 3.4% as against 5.0, 6.0, 6.0 and 7.0% respectively. Nile tilapia fry in the various feed treatments attained final mean weights of 4.69 ± 1.92, 5.21 ± 2.11, 4.42 ± 1.94, and 5.47 ± 2.19 for feeds A, B, C and D respectively, with figures for B and D being significantly higher (Tukey's HSDT, $P < 0.05$). The 30.0% declared CP content feed recorded the highest profitability index as well as the least investment and incidence costs. Hence, the 30.0% CP content of the studied brand of commercial tilapia feed is recommended for Nile tilapia fingerling production.

Keywords: Fish farmers, Hapa-in-pond system, Nutrient contents, Profitability index

PRESENTATION TYPE
ORAL

Assessment of an aquaponics system for urban aquaculture in Ghana

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Aquaponics systems have been promoted as environmentally friendly food production systems and the nature of these systems offers a potential for use in urban spaces. This study explored the feasibility of an aquaponics system as an urban food production system for Nile tilapia, *Oreochromis niloticus* and Lettuce, *Lactuca sativa* using a modified Intermediate Bulk Containers (IBC) as the system unit. The study was divided into two experiments; experiment 1 assessed the survival and growth of Nile tilapia and lettuce at a stocking density (SD) of 100 fish per m3 and a feeding rate (FR) of 5% body weight for 40 days, and experiment 2 assessed the survival and growth of tilapia, and nutrient production for 90 days using four different treatments (SD 250 & FR 3%; SD 250 & FR 2%; SD 200 & FR 3%, and SD 200 & FR 2%) as well as the profitability of the system for raising tilapia. For the 1st experiment, fish grew from 10g to 33.06g in 40 days, however, plant growth was poor due to low nutrient levels (2.4 mg l^{-1} NO3) and pest infestation. Water quality parameters recorded in the study were within optimum range for tilapia culture. In the 2nd experiment, there were no significant differences among the treatments in terms of fish growth and water quality. The SD 200 from the enterprise budget developed was more profitable than the SD 250. The increased fish stocking density even at a reduced feeding rate in 2nd experiment resulted in relatively higher nitrate levels in the grow bed water than in the 1st experiment. This was however below the recommended range for lettuce (5-150 mg L-1). Stocking density and feeding rate did not significantly affect growth but profitability per the current fish size produced will be higher at 200 fish per tank.

Keywords: Aquaculture, Aquaponics, Feeding rates, Lettuce, Nile tilapia, Stocking density

PRESENTATION TYPE
ORAL

The effects of plant protein diets on zooplankton succession and abundance and Nile tilapia (*Oreochromis niloticus*) fingerling production in earthen ponds

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In semi intensive aquaculture systems, both natural food and supplementary feeds are important because they help boost productivity of the fish. This study assessed the effects of two formulated diets; Diet 1(40% soybean meal inclusion) and Diet 2 (50% soybean meal inclusion) and a commercial feed (control) on zooplankton composition and succession and growth of Nile tilapia fingerling in 1m3 nylon mesh hapas mounted in six 200 m2 earthen ponds for 40 days. The hapas were stocked with fish of average size 3g at 100 fish/m3. Each treatment had 16 replicates and diets were assigned using completely randomized block design. Fish sampling was done every 10 days from eight randomly selected hapas to assess growth and 10 fish were collected for gut content analysis. Three, 10L water samples were collected from each treatment prior to the experiment and then every three days afterwards and processed for zooplankton identification and enumeration. The results showed that growth performance was better in control treatment followed by Diet 1 and Diet 2 treatment groups respectively. The only significant difference in growth parameters were between the control and Diet 2 treatment groups ($p<0.05$). The major groups of zooplanktons identified were rotifers, copepod nauplii, copepods and cladocerans. Rotifers were the most dominant zooplankton group both in the pond water and diet of the fingerlings accounting for 51.8, 50.1 and 42.3% of zooplankton in the ponds administered Control, Diet 1 and Diet 2 feeds respectively. Peak rotifer abundance was on the 15th and 21st and were 2112, 2858 and 3358 per m3 respectively for the ponds administered Control, Diet 1 and Diet 2 feeds. Cladocerans were the least represented zooplankton group accounting for between 7.7 - 8.9% of total zooplankton abundance among the treatments. Overall, there were no significant dietary effects ($p>0.05$) on individual and total zooplankton abundance over the experimental period.

Keywords : Zooplankton, Plant protein diets, Gut content, Fingerling, Hapas

PRESENTATION TYPE
ORAL

Effects of different feeding strategies on growth performance, feed utilization and economic returns of Nile tilapia (*Oreochromis niloticus*) production in fertilized earthen ponds

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Balancing the use of complete commercial feed with optimum fish growth is a major challenge facing the aquaculture industry, owing to the fact that underfeeding and overfeeding have effects on growth, water quality and returns on investments. This study was conducted to evaluate the effects of different feeding strategies on Nile tilapia production in nine ponds (150- 200m^2). Growth performance, feed utilization, water quality and economic performance under three feeding strategies were determined. Sex-reversed Nile tilapia (~60g) were cultured for five months under three feeding strategies: alternate-day full ration, 66.7% and 75% of the full ration. Fish were fed a commercial feed (30% crude protein) between 3% and 1.5% body weight. At the end of the experiment, significant differences ($P<0.05$) were observed in growth performance (final mean weight, absolute growth rate and weight gain) among the treatments. Fish fed 75% of the full ration recorded the highest final weight (411.3 ± 39.32g) followed by 66.7% of the full ration (352.0 ± 9.17g) and alternate-day full ration (227.8 ± 22.17g). Fish that received the alternate-day full ration had the lowest feed intake (223.8 ± 29.77gfish-1) and a better feed conversion ratio (1.30±0.12) compared to 66.7% (1.51±0.12) and 75% (1.52±0.09) treatments. Feed restriction had no effect on water quality. Feed cost and the cost of producing tilapia were significantly different ($P=0.0002$) among the treatments. While the cost of production was lowest in fish that received the alternate-day full ration, it had the lowest economic returns (408.10 ± 42.31GHc) compared to fish that received 75% of the ration (799.40 ± 96.64GHc) thus, tilapia can be cultured in fertilized ponds and fed up to two-thirds of the ration without any negative impact on growth and economic returns

Keywords: Feeding strategies, Feed restriction, Nile tilapia, Fertilized ponds

PRESENTATION TYPE
ORAL

Current status of antibiotic use and resistance in some selected aquaculture farms of the Central Region of Ghana

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To prevent or treat bacterial diseases in aquaculture farms, antibiotics may be administered. The aim of this study was to assess the use of antibiotics and determine the antibiotic resistance status of bacteria in water and fish sampled from selected aquaculture farms in the Central Region of Ghana. Questionnaires were administered to obtain information on antibiotic usage and other farming practices. Bacteria isolations were made on MacConkey agar, which enabled the determination of coliform counts of tilapia (*Oreochromis niloticus*), catfish (*Clarias gariepinus*) and water samples. Representative coliforms were identified using biochemical tests and stored for subsequent analyses. The antibiotic resistance profile of the stored coliforms was determined using Mueller Hinton agar. All farms were found to use formulated feed purchased from shops and did not use antibiotics as prophylactics, but occasionally applied antibiotics and other antimicrobials during disease outbreaks. Generally, the coliform load of water samples exceeded that of fish samples. Water samples recorded coliform loads ranging between 0.3 x 105 and 294 x 105 cfu/ml. The coliform loads of catfish and tilapia ranged from 0.009 x 105 to 3.3 x105 cfu/g and 0.012 to 0.14 x 105 cfu/g respectively. In all, 63 coliforms were identified with the highest frequency of 18 recorded for Citrobacter freundii followed by 12 and 11 isolates identified as Klebsiella pneumonia and Escherichia coli respectively. The remaining 22 isolates were identified as belonging to other genera of enteric bacteria. The highest percentage of antibiotic resistance was recorded for Ampicillin (96.83 %) whiles the least was recorded for Gentamicin (6.35 %). The findings of this study, which suggest the presence of coliforms and some level of antibiotic resistance in aquaculture farms, point to the urgent need for strict monitoring measures to be put in place by the Fisheries Commission and the Food and Drugs Authority.

Keywords: Antibiotic resistance, Aquaculture farms, Coliforms, Ghana.

PRESENTATION TYPE
ORAL

Antibiotic use in aquaculture management: A review

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The sustainability of aquaculture production can only be achieved when fish are healthy and free from diseases. Fish disease management involves the combination of preventing the onset of disease and instituting measures to reduce losses from diseases when they occur. Different microbial pathogens such as parasites, bacteria, fungi and viruses have been reported to be responsible for most diseases encountered in aquaculture. As a result, antimicrobial medications have been explored as drugs capable of suppressing the growth of microbial pathogens. Some of the literature available focused on list of fish species, the causative organism and name of diseases whereas others essentially provide information on antibiotics that are used in aquaculture. This appraisal therefore sought to fill gaps regarding current information by compiling all available data concerning diseases in aquaculture and the appropriate antibiotics required for use in treatment and prevention of fish diseases. The class of antibiotics, their mode of action and the toxic effects of reportedly used antibiotics have also been discussed. Currently in some aquaculture farms, new methods with improved molecular techniques are employed in the detection and management of diseases. Biocontrol through the use of probiotics has also been adopted in some other farms as a means to prevent and treat diseases. The current review provides information that would potentially enhance treatment strategy in aquaculture systems. An urgent need is required for regulatory approval of antibiotics for use in combating diseases in aquaculture to minimize resistance of causative microbial pathogens to antibiotics.

Keywords: Aquaculture; Fish diseases; Antibiotics

PRESENTATION TYPE
ORAL

Influence of socio-economic factors on tourist patronage of the Elmina beach

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Elmina is one of the major tourist destinations in Ghana due to its many historical monuments and beach. It is a great tourists' site because of the presence of Elmina castle and Fort St. Jago. Tourists seem to visit the castle more than the beach which is 50 – 100 m from the castle. The beach is faced with a myriad of challenges including erosion, pollution and no commitment to coastal management plans to guarantee a high quality beach. This research investigated factors that could make the Elmina beach an ideal destination for tourists. Questionnaires were employed to collect data on 100 beach users. A non-probability sampling technique was used to collect data on beach users' socio-economic characteristics while the multiple linear regression model was employed to get the predominant factor influencing tourist attendance. Data shows poor sanitation is the main aspect disliked by beach users. Interestingly, 74% of beach users are willing to pay per visit for its quality maintenance. Users predominantly (28%) are willing to pay five Cedis (GH¢ 5) per visit because they are largely dissatisfied with its current condition. Most tourists prefer comfort (29%) to all factors that influence attendance to the beach followed by water cleanliness (20%) and security (13%) on the beach. Respondents believe that low level of security puts the lives of beach users at peril. Some beach users (16%) are unaware of coastal erosion; it reduces the carrying capacity while devaluing the aesthetic value of the beach. Adequate social amenities, regular clean-up exercises, public education and enforcement of coastal bye-laws are some of the proposed measures to make the Elmina beach an ideal beach destination for local and foreign tourists.

Keywords: Tourists, Beach quality, Elmina, Coastal erosion

PRESENTATION TYPE
ORAL

Development of a Multiplex PCR assay for detection of bacterial pathogens in cultured Nile tilapia (*Oreochromis niloticus*) and catfish (*Clarias gariepinus*) in Ghana

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Bacterial infections and their associated diseases in fish have been responsible for huge economic losses in the aquaculture industry in Ghana and beyond. Bacteria identification by conventional culturing method, the gold standard, is time consuming and limited to culturable pathogens with specified conditions. However, molecular genetic techniques including polymerase chain reaction (PCR) has provided a modern and rapid avenue for detecting pathogens. Six target bacterial pathogens of economic importance to aquaculture; *Streptococcus agalactiae*, *Streptococcus iniae*, *Staphylococcus aureus*, *Aeromonas hydrophilla, Edwardsiella ictaluri* and *Flavobacterium columnare* were investigated by PCR in this study. To further increase the speed in detecting infections, a multiplex PCR-based assay was designed for the simultaneous detection of the pathogens. The specific detection was carried out directly on clinical samples of naturally infected fish (*O. niloticus* and *C. gariepinus*), without prior culturing. The results indicated greater than 90% sensitivity and 100% specificity for each of the six bacterial pathogens tested. Three of the pathogens (*Streptococcus agalactiae, Streptococcus iniae* and *Staphylococcus aureus*) were isolated in a multiplex reaction. *Streptococcus* infections were found to be highly prevalent in most aquaculture farms in Ghana. Prevalence of target pathogens in the two fish species studied were found to be significant (p value <0.01) and traceable to variations in the salinity, conductivity and dissolved oxygen concentrations of the already thermal stressed pond / cage water they were reared in. Molecular techniques employed in this study represent the first to be used by a fish health laboratory in Ghana for rapid detection of pathogens in diseased fish, and per the high throughput, accuracy, and low cost of this PCR assay, it could be a useful alternative to the culture-based method for the routine diagnosis of infectious diseases in fish.

Keywords: Fish Diseases; Molecular Diagnosis; Streptococcus agalactiae; Physico-chemical Parameters; Ghana

PRESENTATION TYPE
POSTER

Comparative study of aspects of the biology of *Clarias gariepinus* and *Heterobranchus longifilis* from River Offin, towards the culture development of the latter

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The study was conducted to examine some aspects of the biology of *Heterobranchus longifilis* in comparison to *Clarias gariepinus* as a move towards the culture development of *H. longifilis*. Hydrographic parameters of the water and individuals of the two fish species were sampled monthly from September 2017 to August 2018 from river Offin. Morphometry, sex, gonads and stomach contents of the fish were examined in the laboratory. Normal tropical temperature, low dissolved oxygen and high turbidity were recorded in the Offin River. *C. gariepinus* were more abundant and bigger in size than *H. longifilis*, though *H. longifilis* were found to be in better condition than *C. gariepinus*. However, the conditions of the two species were below average condition (< 1). Length-weight analysis revealed isometric growth in both species. Both species explored similar food items with plants dominating their diets. Sex ratio of males to females of *C. gariepinus* was found to be 1:1 and 1.5:1 for *H. longifilis*. The reason for the deviation for *H. longifilis* from the expected 1:1 ratio is not clear. The two species were highly fecund but *C. gariepinus* (1,750 - 88,930) was found to be more fecund than *H. longifilis* (39,170 - 53,891). Fecundity increases as a function of fish size and gonad weight in *C. gariepinus*. The rainy season, from April to July marked the major spawning period for C. gariepinus but could extend to August. Spawning period for *H. longifilis* could not be established due to insufficient samples producing an "irregular" GSI pattern. Females consistently have higher GSI values than males for both species. *H. longifilis* is therefore recommended for aquaculture with call for culture-based experiments.

Keywords: *Clarias gariepinus*, *Heterobranchus longifilis*, River Offin, Biology

PRESENTATION TYPE
ORAL

Investigating Nile tilapia (*Oreochromis niloticus*) mortalities in cages on Lake Volta in Ghana

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Nile tilapia cage culture on the Lake Volta is the main (90%) aquaculture production system in Ghana. Recent mass mortalities in cages on the lake have resulted in huge losses, yet little is known on the causes of fish death. This study sought to identify major causes of fish mortalities and to estimate the direct economic impact of fish mortalities on selected cage farms on Lake Volta in Ghana. For causes of mortalities, field observations of water quality and sampling of moribund fish on 5 cage farms for observation and bacteria count were done and supported by questionnaires administered to 23 farms. The direct economic loss from fish mortalities was calculated from information provided. The cause of mortalities was identified to have been stress induced immuno-compromised fishes as a result of overcrowding in cages (average 350 fish/m^3) and poor water quality, which predisposed fish to opportunistic bacteria (*Citrobacter freundii*, *Aeromonas veronii*, *Staphylococcus saprophyticus*, *Streptococcus agalactiae* and *Pseudomonas putida* out of 14 different bacteria isolated), leading to infection and subsequent mortalities. Bacteria load on moribund fish sampled were beyond the acceptable standards for fresh fish. The study revealed an average mortality rate of 48% in 2018 on the 23 surveyed cage farms on the Lake due to disease outbreak. An estimated total of 2,467.3 mt of fish which translated into GHS 23,439,350.00 (1$= GHS 5.30) was lost. The study recommends a proactive approach to disease outbreak via establishing a disaster risk reduction protocol for fish health and welfare on the side of the government of Ghana in consultation with respective stakeholders. Farmers are advised to reduce stocking densities and space out cages to encourage water exchange while maintaining proper husbandry practices on farms. Etiological study with bacterial isolates is recommended to validate their causality.

Keywords: Nile tilapia, Lake Volta, Cage aquaculture, Fish mortalities, Economic impact, *Citrobacter freundii*

PRESENTATION TYPE
POSTER

Backyard farming of the African catfish, *Clarias gariepinus* for sustainable livelihood and food security for coastal communities

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Fisheries from the marine sector are dwindling mainly as a result of overfishing hence must be augmented with culture fish for sustainable livelihood and food security. The African catfish, *Clarias gariepinus* production has gained considerable importance in Ghana. This species has several desirable attributes that make it an attractive aquaculture species and has the capacity and potential of bridging the wide gap between fish demand and supply. The fish is highly suitable for farming because of its relative easy to spawn and grow in improvised systems such as concrete tanks, poly-containers, fibre tanks, plastic-lined ditches with little technological requirement. It does not require specialized feed, readily accepts artificial feed, tolerate high stocking densities and grows rapidly even under poor water quality conditions and above all it is highly sought after in local markets and economically viable. Due to the decline in capture fisheries, over-reliant on marine resources for survival and the need to diversify livelihoods to reduce pressure on resources, coastal communities could take advantage of the culture of this species for economic opportunities by the sale of its fingerlings or table-size and also to meet their nutritional requirements thereby sustaining their livelihoods. The fingerlings of the African catfish matures within eight weeks of spawning to an average size of 2 grams and marketable-size within a period of 4-5 months. Table-size fish is either sold fresh at the farm gate or smoked for more value addition and sold later. Pictorial annotation methods are used to present a stepwise approach to advocate for alternative livelihood through backyard farming of the African catfish in improvised systems.

Keywords: Sustainable livelihood, Food security, African catfish, Coastal communities

PRESENTATION TYPE
ORAL

Increasing the productivity of Nile tilapia (*Oreochromis niloticus*) in earthen ponds with solar aeration systems

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Low production outputs from ponds have been attributed to several factors including poor feed and water quality, particularly low dissolved oxygen (DO) levels. This study evaluated the efficiency of a solar aeration system in maintaining DO levels above 2 mg l^{-1} during low oxygen periods (12:00 - 8:00am) and whether stocking densities in aerated ponds could be doubled or tripled. All male *Oreochromis niloticus* fingerlings (~20g) were stocked at density of 2 fish m^{-2} without aeration (control), followed by 2, 4 and 6 fish m^{-2} with aeration in triplicate in twelve 150 m^2 earthen ponds for 150 days at FRNR farm. Fish were fed with a commercial tilapia feed (30% crude protein) at 3% body weight and sampled monthly to assess growth and feed utilization. Fish growth and water quality were monitored throughout this period. Water quality variables (temperature, pH, conductivity) were found to be within the suitable range for optimum growth of Nile tilapia. Significant differences in growth ($p<0.05$) among the treatments were observed at the end of the study. However, highest final body weight was recorded in 2 fish m^{-2} aerated ponds (379.8 ± 23.47 g) with the lowest in the 6fishm^{-2} aerated ponds (228.1 ± 11.48 g). Feed conversion ratio was good for all treatments with the lowest of 1.15 in ponds stocked at 6 fish m^{-2}. Total production cost was higher in aerated ponds (GHS 4031.02) compared to the non-aerated ponds (GHS 1773.27). The net profit was highest (GHS 3557.30) for 6 fish m^{-2} aerated treatment and least (GHS 591.80) for 2 fish m^{-2} aerated treatment. This study demonstrated that solar aeration system is an economically efficient mechanism that has the potential to improve growth, feed utilization and yield of Nile tilapia at high stocking densities.

Keywords: Growth, Feed utilization, Water quality, Yield, Aerated ponds, Production cost

PRESENTATION TYPE
ORAL

Comparison of growth and heterosis of F_1 hybrids of black-chinned tilapia (*Sarotherodon melanotheron*) from four populations in Ghana

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The current study evaluates the growth performance, survival rate, feed conversion ratio and heterosis (hybrid vigour) of four populations of *Sarotherodon melanotheron* from Fosu (F) Lagoon, Brimsu (B), Baifikrom (R) and Weija (W) reservoirs in 4 × 4 diallel crosses aimed at producing a hybrid with high growth, reproductive and survival traits to enhance aquaculture production. The F_1 offspring produced through the diallel crosses were stocked in 6 m^3 hapas at density of 120 fry per hapa and fed thrice daily at 10 % biomass with 40 % crude protein feed. Each hybrid set-up was triplicated resulting in 48 hapas, and the fish were monitored for 90 days. The results indicated that four hybrids (female Baifikrom × male Fosu (RF), female Fosu × male Weija (FW), female Brimsu × male Weija (BW), and female Baifikrom × male Brimsu (RB)) were significantly ($P < 0.05$) heavier in harvest body weight compared to their parental stocks and other hybrids. The hybrid, FB exhibited the poorest growth performance among all the hybrids. Among the purebreeds the Weija (WW) strain exhibited the highest growth whereas the Brimsu (BB) strain was the poorest. Regarding heterosis, the hybrid, RF exhibited the highest of 22.17 ± 5.52 %, whereas WR was the poorest (0.17 ± 1.95 %). The heterosis of RF was not significantly different from RB, BW and FW, indicating that all these four hybrids possess superior growth traits compared to the existing *S. melanotheron* strains. Based on these results, a synthetic base population can be formed from these best performing hybrids for selective breeding, regardless of their genetic makeup.

Keywords: Crossbreeding, Growth performance, Heterosis, Hybrid, *Sarotherodon melanotheron*

PRESENTATION TYPE
ORAL

Adoption of Ahotor Oven by fish processors in the Central Region of Ghana

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The Ahotor oven has been introduced in Ghana to solve the health and energy inefficiency challenges of the old traditional fish smoking ovens. However, in the Central Region where it was first introduced, some fish processors still employ use the old traditional smokingChorkor oven, despite the numerous benefits of the newly improved one. This research assessed the adoption of Ahotor oven by fish processors in Central Region; by identifying factors that contributed to the uptake, continual use and non-use of Ahotor oven by the fish processors. Stratified random sampling was used to select a total number of 72 fish processors from three fishing communities which were, Elmina, Moree and Winneba. A survey of 26 users and 46 non-users of Ahotor oven was then conducted to collect primary data using semi-structured questionnaires. Secondary data was also collected from key stakeholders and relevant literature. From the survey, 26 users and 46 non-users of Ahotor oven answered the questionnaires. Majority of the users have a relatively higher level of knowledge about Ahotor oven. The study found that the major rolesactions of the Ahotor oven developers that influenced uptake and use of the oven included organization of education and training programs, construction of free ovens and building of Ahotor fish processing centers. The study also revealed that a greater number of fish processors opted for Ahotor oven because of its trialability (many adopted after the trial stage) and comparative advantage (health and economic benefits) over their old existing ovens. The major challenges faced in uptake of the oven included high initial cost of construction, design issues, lack of land space for construction and financial implications of obtaining the oven. It was therefore suggested that the Ahotor oven developers should improve the design of the oven, revise the financial scheme introduced and educate fish processors more about the purchasing process.

Keywords: Fish processing, Fish smoking, Fish smoking ovens, Uptake, Challenges

PRESENTATION TYPE
ORAL

Antibacterial potentials of *Lactobacillus plantarum* from fermented food origin as probiotic candidate in the treatment of African catfish *(Clarias gariepinus)* bacterial diseases

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Over the years, research on lactic acid bacteria isolated from fish gut against fish gram negative and fish gram positive pathogenic bacteria have been carried out. In this study, lactic acid bacteria of fermented food origin (wara and fufu) were examined for their probiotic potentials against fish bacterial pathogens. Probiotic properties which include morphological and biochemical tests were carried out on the probiotics isolates. Samples from fermented cow milk (wara) and fermented cassava (fufu) were collected and stored in ice as: SW6 (sample 6 from wara), SW5 (sample 5 from wara,) SW4 (sample 4 from wara), SF4 (sample 4 from fufu), SF3 (sample 3 from fufu), and SF2 (sample 2 from fufu). A 10-fold Serial dilution was carried out homogenously. De Man, Rogosa and Sharpe (MRS) agar and de Man, Rogosa and Sharpe (MRS) broth were prepared and used for bacterial growth according to manufacturer's recommendations. Presumptive identification of lactic acid bacteria was carried out through physiological and biochemical characterisations. These included gram staining, catalase and oxidase production, cell morphology, colonial characteristics, pH determination, antibiotics susceptibility test and bile salt tolerance. Molecular characterisation was carried out for the identification of lactic acid bacteria isolates. The results revealed that the isolates were gram-positive, catalase negative, rod-like, cocci, non-haemolytic, non-pathogenic and appeared in clusters. The inhibition zones were observed in SW6 (24.7 ± 0.6 mm) against *Aeromomas hydrophila*, SF4 produced inhibition zone of (16.3 ± 0.6 mm) against *Aeromomas hydrophila*, inhibition zone of (18.5 ± 0.7 mm) was produced in SF3 against *Bacillus subtilis*. All the isolates were susceptible to Chloramphenicol, Ampicillin, Clindamycin and Erythromycin. Molecular characterisation of isolates with high inhibition zones using 16S ribosomal RNA gene partial sequence identified two probiotic strains as SW6 and SF4. These strains were 99% identical to *Lactobacillus plantarum* strains R762 and AT4. It was deduced from this study that, for the purpose of bio-conservation, probiotics isolated from fermented food origin could replace fish gut probiotics in treatment of fish bacterial diseases.

Keywords: Lactic acid bacteria, Antibacterial potential, Fish pathogens, Fermented foods

PRESENTATION TYPE
ORAL

Comparative study on cold storage of fish in Wa and Sunyani municipalities in Ghana

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The study was conducted in Wa and Sunyani municipalities of the Upper West and Bono Regions. The main objective of the study was to compare the activities of cold storage operations within both municipals, using the registered cold stores as main study target. Cluster sampling, random sampling in selection of customers and unregistered cold stores; semi-structured interviews using questionnaires were used to obtain data from customers. Personal observations were made on storage facility type and location of cold stores. This study revealed that there are more unregistered cold stores than the registered cold stores in both municipalities. Total storage capacities for registered cold stores surveyed were 365 and 287 metric tonnes for Wa and Sunyani municipalities respectively. The study revealed that 52% of customers in Wa buy for further processing whiles 36% from Sunyani buy for same purpose. Also, 28% and 48% buy for retailing purposes in Wa and Sunyani respectively whilst 20% and 16% buy for home consumption in Wa and Sunyani respectively. Horse mackerel and Salmon were fish patronized most in both municipalities. All nine registered cold stores found within both municipalities had similar storage procedures. Problems encountered in relation to customers and operators, operators and their suppliers, operators and their equipment include; complaints about fish price, high cost of fish product and sudden breakdown of freezing compartments respectively. This study recommends further studies in other municipalities to identify the storage of fish to ensure safety. In addition, the impact of cold storage business on socio-economics should be studied. Finally, Government (Wa and Sunyani Municipal Assembly) should ensure that registration process is made easy and affordable to small-scale cold store operators. Government should also make available vehicles for effective monitoring process.

Keywords: Fish, Utilization, Cold storage, Processing, Freezing

PRESENTATION TYPE
ORAL

Preliminary studies on hatchability and larval survival of the African River Prawn *Macrobrachium vollenhovenii*

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The physicochemical and biological parameters in the natural environment of the Africa River Prawn (*Macrobrachium vollenhovenii*) in the lower Volta River were studied as a prelude to the preliminary studies on the breeding and larval rearing of the species in captivity. Temperature, dissolved oxygen, salinity, pH, alkalinity, ammonia-nitrogen and nitrite-nitrogen levels were monitored at six sampling sites on the river from Agave-Afedome in the Volta region to Ada Foah in the Greater Accra region. The water quality data was combined with information on river depth, underwater aquatic vegetation and prawn dominance to determine the required water quality variables for the hatching and larval rearing of *Macrobrachium vollenhovenii* in captivity. Broodstock were collected from the catch of artisanal fishers at Agave-Afedome, Volta Region and acclimatized to culture tanks and fed feed containing 37% protein. Gravid prawns were maintained in 60-litre tanks and egg development monitored at a salinity of 8 ppt until hatching. Larval rearing was conducted at varying salinity (0, 4, 8, 12, 16 and 20 ppt) levels to determine the optimum salinity for larval survival and development. Larval survival and growth were optimum at 80% in salinities between 8-16 ppt but were hampered by ammonia levels higher than 0.1 mgL^{-1} and alkalinity levels below 80 mgL^{-1} $CaCO_3$. Although, hatching was successful, larvae did not grow to the post larval stage due to unbalanced ionic composition of the rearing water. Further studies are recommended to resolve the water quality challenges to ensure successful larval development.

Keywords: Prawn, *Macrobrachium vollenhovenii,* Larval rearing, Water quality, Hatchability

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