

WORLD ENVIRONMENTAL CONSERVATION CONFERENCE 2023

CLIMATE CHANGE PARTNERSHIP ACTIONS FOR SUSTAINABLE FUTURE AND RESTORING LIFE ON EARTH

Proceedings of the 6th edition of World Environmental Conservation Conference

18th – 21st October, 2023

EDITORS: Agele, S. O. (PhD), Balogun, I. A. (PhD), Oluleye, A. (PhD) and Oladeji S. O. (PhD)

Copyright © 2023 World Conservation Environmental Conservation Conference: “Reimagining Contemporary Environmental Conservation Issues in Sustainable Development Goals”.

All rights reserved: No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic magnetic tape, mechanical photocopying, recording or otherwise, without permission from the President, Netlink Environmental Conservation Organization (NECOR).

Production of Proceedings

Netlink Environmental Conservation Organisation
Room 21 Abubakar Adamu Building
Federal University of Technology, Akure.
Design and Printing of Proceedings
Maryj Printing Press
ACAD Fagbote Filling Station Akure-Ilesha Expressway
Phone number: +23407063411658

Copies of Proceedings

Dr. S. O. Oladeji
President, Netlink Environmental Conservation Organisation (NECOR),
Room 21 Abubakar Adamu Building
Federal University of Technology, Akure.
P. M. b. 704, Akure, Nigeria
E-mail: sooladeji@fita.edu.ng.
sooladeji@necorg.org
info@necorg.org.
www.necorg.org.
ISSN: 2705-2850

Scientific Review Committee

Prof. S. O. Agele- Chairman Scientific Committee
Department of Crop, Soil and Pest Management, FUTA
+2348035784751
soagele@futa.edu.ng

Prof. I. A. Balogun
Department of Meteorology,
Federal University of Technology,
Akure.
iabalogun@futa.edu.ng.

Prof. A. Oluleye
Department of Meteorology,
Federal University of Technology,
Akure.
aoluleye@futa.edu.ng.

Dr. S.O. Oladeji
Department of Ecotourism and Wildlife Management, FUTA.
Executive Director, NECOR
+2348030698896
sooladeji@futaedu.ng.
sooladeji@necornrg.org

PREFACE

There is a growing concern on the adverse impacts of climate on biodiversity. This phenomenon is greatly manifested in form of shifting weather patterns threatening global food security, health and species existence. Humanity is at the receiving end of the consequences of climate change hence there is a need to step up actions on all fronts- overtime, everywhere all at once.

This calls for collaboration, partnership and networking to strengthening synergy among relevant stakeholders in a bid to tackling climate change menace. This forms the basis for the theme of this year world Environmental conservation conference: **CLIMATE CHANGE PARTNERSHIP ACTIONS FOR SUSTAINABLE FUTURE AND RESTORING LIFE ON EARTH**. The theme is conceived with a view to create an interface for information sharing and offer opportunities for participants to refine their commitments and pledges in the quest to achieving Sustainability in the face of climate change.

This year World Environmental Conservation Conference is memorable in the sense that it received overwhelming funding from the host - West African Science Service on Climate Change and Adapted Land use). WASCAL is posed to provide information and knowledge at the local, national and regional level to cope with the adverse impacts of climate change. Thus, this conference will offer opportunities for participants to learn from good practices demonstrated and showcase by WASCAL during the course of the conference. It will also strengthen staff-student exchange and provide prospect for Doctorate Research Doctoral Research in West Africa Climate System Programme (DRP WACS) – WASCAL among others.

Special appreciation goes to the management of The Federal University of Technology, Akure the host institution, National Park Service and African Regional Center for Space Science and Technology Education-English (ARCSSTE-E) that co-host this conference. We equally acknowledge other private, individual and corporate organizations that have contributed towards the success recorded in this event.

All the submitted articles were subjected to strict double blind peer-review process by the reviewers that are experts in the area of the particular submitted manuscript. The accepted manuscripts are published in WECC 2023 proceedings and also available for download on the organization website (www.necorn.org).

The accepted manuscripts fall within the underlisted subthemes:

- Climate change adaptation strategies in Agriculture, Forestry and Other Land Use (AFOLU)
- Climate smart city and architectural landscape design
- Retrofitting and decarbonization in tourism and hospitality industry
- Indigenous knowledge and local innovation in climate change adaptation
- Climate risk management, health, safety and hygiene
- Carbon credit-offset marketing/circular economy
- ICT development in environmental conservation (image processing and acquisition, computer vision, graphics, speed, interface technology, HMD devices, GIS: Body Tracking, AI and IOT, VRT, IVE).

We commend our keynote speaker Prof. Douda Kone Director Capacity Building Department, WASCAL Headquarter, Ghana and other guest speakers Prof. Babatunde Rabi, Director General, Chief Executive Office, African Regional Centre for Space Science and Technology Education-English (ARCSSTE-E) and Dr. Goni I. M., Conservator General National Park Service.

It is hoped that researchers, students and policy makers will find the papers in this book very useful. Even though all the papers were reviewed and edited, the content and option expressed remain essentially that of the authors and not necessarily that of Netlink Environmental Conservation Organization.

Dr. Oladeji S. O.

President Netlink Environmental Conservation Organization

Convener World Environmental Conservation Conference

TABLE OF CONTENT

Cover Page	i
Preface	iv
Presented Scientific Papers	
CLIMATE CHANGE AND FOOD SECURITY: RISKS AND RESPONSES Olaifa K.A., Agbeja A.O., Akindolu D.R., Akinlade M.S. and Majolagbe M.O.	1-5
GENDER ANALYSIS OF FISH FARMERS' VULNERABILITY AND ADAPTABILITY TO CLIMATE CHANGE IN IDO LOCAL GOVERNMENT AREA OF OYO STATE Ajayi Olusina Tunde¹ Moyib, Taiwo Oluwasesan² Leramo Georgina Fiyinfoluwa³	6-12
GROWTH RESPONSE OF <i>Nauclea diderrichii</i> SEEDLINGS TO ORGANIC MANURE APPLICATION Majolagbe, M. O^{1*}, Ogunwande, O. A¹, Kazeem-Ibrahim, F¹, Olaifa K.A¹, Omidiran Mobolaji O¹, Dahunsi, O.M.²	13-17
ECOLOGICAL VARIATION AND VARYING WATERING REGIMES ON SEEDLING GROWTH PERFORMANCES OF <i>Annona muricata</i> L. Majolagbe, M. O^{1*}, Ogunwande, O. A¹, Williams O. A¹, Olaifa, K.A¹, Kazeem-Ibrahim, F¹, Alagbada O. R¹ and Dahunsi, O. M.²	18-22
URBAN HOME GARDEN PRACTICE AS BIODIVERSITY CONSERVATION STRATEGY IN BENIN CITY, EDO STATE, NIGERIA. Osadolor, N.	23-28
POTENTIAL RESOURCES AND PERCEPTION OF LOCAL COMMUNITIES TOWARDS MOUNTAIN TOURISM DEVELOPMENT: A CASE STUDY OF IYAMOPO MOUNTAIN IN IGBETI, OYO STATE, NIGERIA ¹Odewumi, O. S., ¹Odofin. M. L. and ²Obateru, F. B.	29-38
VALUE CHAIN ANALYSIS OF TILAPIA (<i>Oreochromis niloticus</i>) FOR SUSTAINABILITY AND INCLUSIVENESS OF COMMERCIAL Tilapia CAGE PRODUCTION IN OYAN RESERVOIR, OGUN STATE NIGERIA Olaniyi, A. A., Adeleke, M. L., Fagbenro O. A. and Ayodele I. S.	39-50
MORPHOLOGICAL VARIATIONS IN FRUITS AND SEEDS OF <i>Gambeyaalbida</i> (Don) IN SOUTHWESTERN, NIGERIA Aruwajoye, D. A and Ale, O.O	51-55
ASSESSMENT OF COLLAGEN COMPONENT OF NILE TILAPIA (<i>Oreochromis niloticus</i>) COLLECTED FROM IGBOKODA RIVER, SOUTH-WEST NIGERIA Akinola, J. M., Abidemi-iromini, O. A., and Igejongbon T. F.	56-60
SOIL MOISTURE VARIABILITY OF LAND USE SYSTEMS OF OAU, ILE IFE, SOUTHWESTERN NIGERIA Adewole, A. O.¹, Eludoyin, A. O.¹, Newete, S. W.² and Chirima, G. J.^{2*}	61-67
EMERGENCY PREPAREDNESS MEASURES ADOPTED BY FISH FARMERS TO CLIMATIC HAZARDS IN SOUTHWEST NIGERIA Ayodele T. Awolala¹, Taye T. Amos², O.O. Akinrinola³, D.O. Awolala⁴ and O.A.Thompson⁵	68-72

DETERMINANTS OF HOUSEHOLDS FISH FARMERS' VULNERABILITY TO CLIMATIC HAZARDS IN SOUTHWEST NIGERIA	73-78
Ayodele T. Awolala¹, Taye T. Amos², O.O. Akinrinola³, D.O. Awolala⁴ and O.A.Thompson⁵	
IMPACTS OF SMALLHOLDER FARM PRACTICES ON SOIL CARBON STORAGE POTENTIAL IN AN AGRICULTURAL LANDSCAPE	79-85
Fawole, O. A¹., Olunloyo, O. O²., Adesida, O. A²., Ibiyeye, D. E² and Smart, M. O²	
CLIMATE RISK MANAGEMENT STRATEGIES AMONG SMALLHOLDER FARMERS IN LAGOS STATE, NIGERIA	86-91
*Aminu, F. O., Morakinyo, A. F. and Balogun, E. O.	
BUILDINGS AND CLIMATE CHANGE: INTEGRATING SHADING DEVICES TO SOLAR SYSTEMS	92-98
Fashuyi, S. O.^{1*} & Owolabi, B. O.²	
SPECIES COMPOSITION OF ORNAMENTAL PLANTS IN SELECTED HORTICULTURAL GARDENS IN AKURE SOUTH AND NORTH LOCAL GOVERNMENT AREAS OF ONDO STATE, NIGERIA.	99-106
¹Alonge, O. V. ²Obateru, F. B. and ^{1*}Ogunjemite, B. G.	
DEVELOPMENT OF MATK MARKERS FOR <i>COLA GIGANTEA</i> A. CHEV IN AKURE FOREST RESERVE, ONDO STATE, NIGERIA	107-113
Lawal A.	
HOUSEHOLD PARTICIPATION IN THE CONSERVATION AND UTILIZATION OF NATURAL RESOURCES IN ONDO STATE, NIGERIA	114-122
Shotunde, M. D., Fasina, O. O. and Faloye, A. O.	
ECOSYSTEM CONSERVATION BENEFITS AND FUNCTIONALITY OF SMALLHOLDER AGRICULTURAL LAND USE SYSTEMS OF THE HUMID TROPICS	123-139
Ogunleye¹, Abel, Agele², Samuel & Bolarinwa, Ayodeji	
PHYSIOCHEMICAL ANALYSIS OF WASTE WATER EFFLUENT FROM AMAGBA AND IYANOMO COMMUNITY ABATTOIR IN BENIN CITY, EDO STATE	140-145
^{1,2*}Egharevba, MarvinEwaen.,¹Nwondo , Nonso.Shalom.,¹Uwadiae, Eseosa and ²Wokoma, FridayAdaba	
ASSESSING THE EFFECT OF LANDUSE /LAND COVER CHANGES ON CARBON EMISSION AND ABSORPTION: A CASE STUDY OF AKURE AIRPORT ONDO STATE NIGERIA	146-155
Ogunlade, Simeon Oluwole (PhD)	
FOOD AND FEEDING HABIT OF FLATHEAD GREY MULLET <i>MUGILCEPHALUS</i> (LINNAEUS, 1758) IN ILAJE COASTAL WATERS OF ONDO STATE, NIGERIA	155-160
Amadu, N. O.*, Abidemi-Iromini, A. O., Oladipupo, T. M.	
EVALUATION OF BAMBARA GROUNDNUT (<i>VIGNASUBTERRANEA</i> (L.) VERDC.) ACCESSIONS FOR YIELD PERFORMANCE IN THE RAINFOREST AND SAVANNA AGRO-ECOLOGIES OF NIGERIA	161-166
Sajo A. K*, Afolayan G. O. and Atoyebi O. J.	

REGIONAL IMPACTS OF AEROSOL RADIATIVE FORCING ON WEATHER AND CLIMATE EXTREME EVENTS IN WEST AFRICA ¹ Akinyoola A. Julius, ² Olueye A., and ² Gbode E. Imoleayo	167-171
ADAPTATION STRATEGIES FOR GROUNDWATER RECHARGE IN A CHANGING CLIMATE: AUCHICASE STUDY Oluseyi Adunola Bamisaiye* ^a	172-178
ANALYSIS OF HEAVY METALS QUALITY OF SURFACE WATER IN THE COASTAL AREAS OF MBO LGA., AKWA IBOM STATE Essang Mfonobong Shaineze ¹ and Adigun Adepoju Ibraheem ²	179-184
PRIORITIZATION OF PROTECTED AREA DEVELOPMENT IN THE ADJOINING COMMUNITIES TO IDANRE FOREST RESERVE, ONDO STATE, NIGERIA ¹ Grace Oluwatosin Amoo*, ¹ Martins Chibuzor Anyanwu	185-192
HOTEL LOCATION AS A KEY DETERMINANT OF HOTEL PERFORMANCE E .A. Akintade ^{1*} , O. O.Olowookere-Ayodele ² . O. B Gbadamosi ³	192-200
ANALYSIS OF LOCAL ECOLOGICAL KNOWLEDGE AND THREAT FACTORS OF TESTUDINE SPECIES IN THE RIVERINE AREAS OF ONDO STATE, NIGERIA Odewumi, O.S. and Eniomodun, I. E.	201-210
MITIGATING THE URBAN HEAT ISLAND EFFECT THROUGH GREEN BUILDING DESIGN IN IBADAN, NIGERIA Lawal, Kolawole Adebayo and OLAGUNJU, Deborah Kemi	211-219
PHYSICAL AND CHEMICAL PROPERTIES OF SOILS OF SELECTED FOREST RESERVES. OYO STATE, NIGERIA. ¹ Olusola, J. A., ² Adeduntan, S. A., ² Agbi, G. R. and ² Akinsuroju, S. D.	220-227
THE INFLUENCE OF CLIMATE CHANGE AND TOPOGRAPHY ON GROUNDWATER AVAILABILITY. Oluseyi Adunola Bamisaiye* ^a	228-233
MONITORING SOWING SEASONS AND WINDOWS FOR SUSTAINABLE SWEET PEPPER PRODUCTION IN OKITIPUPA COASTAL AGROECOLOGY Titilayo O. Oladitan	234-240
INTEGRATED ASSESSMENT MODELING OF CLIMATE CHANGE MITIGATION AND URBAN TREE PLANTING IN FUNAAB AND ITS ENVIRONS, NIGERIA ^{1,2} Ogunlade Babatunde, ¹ Oyerinde O. V., and ² Akande, S.O.,	241-251
ASSESSMENT OF FLOOD VULNERABILITY IN LAGOS STATE, SOUTHWESTERN NIGERIA. Aderotoye, D. A. and Akinbobola, A.	252-259
PERFORMANCE EFFICIENCY OF CONSTRUCTED WETLAND (CW) PLANTED WITH COMMON REED (<i>Phragmites australis</i>) IN THE TREATMENT OF GREYWATER IN AKURE, NIGERIA Alao, Femi ¹ (Ph.D), Olanrewaju, Olugbenga Olawale ¹ (Ph.D) and Oloruntade, Ajayi Johnson ² (Ph.D)	260-263
GREEN HYDROGEN: A SUSTAINABLE ENERGY SOLUTION IN NIGERIA Omeh O. W., Olanrewaju O. O. and Ajayi A. E.	264-269

ASSESSING FARMERS' USE OF CLIMATE CHANGE ADAPTATION PRACTICES AMONG YAM FARMERS IN OSUN STATE, NIGERIA Afolabi, O. O. and Arifalo, S. F.	270-275
AWARENESS OF WILDLIFE CONSERVATION PRACTICES IN HOST COMMUNITIES OF OLD OYO NATIONAL PARK, NIGERIA Olugbenga Mayowa AGBOOLA, Ph.D.	276-283
SIMULATION AND PROJECTION OF EXTREME PRECIPITATION OVERWEST AFRICA USING MULTIMODEL ENSEMBLE IN COUPLED MODELINTERCOMPARISON PROJECT PHASE MODELS (CMIP6) Odunmorayo, M. T.	284-291
INVESTIGATING THE SPATIO-TEMPORAL CLIMATOLOGY OF SAHELIAN RAINFALL OVER WEST AFRICA REGION Balogun, I. A. and Arowolo, A. V.	292-295
MODELLING THE IMPACT OF CLIMATE CHANGE ON OSUN OSOGBO SACRED GROVE Oladeji S. O., Lawal O. Y., Akande S. O. and Salami O. M.	296-304
AOD SPATIAL-TEMPORAL VARIABILITY OVER WEST AFRICA: AN EOF-BASED INVESTIGATION Ayomide Victor Arowolo	305-311
MODELLING THE IMPACTS OF CLIMATE CHANGE ON GROUNDWATER POTENTIAL ZONES IN NORTHERN NIGERIA ^{1,2}Raphael, A.E., ^{2,3}Akande, S.O., ³Akintola O.A, ¹Popoola, O.J., ^{2,3}Olajire, O.O., ^{1,4}Adeseko, A.A., and ²Aregbesola, O. J.	312-321
CLIMATE CHANGE IMPACT AND RISK ASSESSMENT OF LASSA FEVER PREVALENCE IN PART OF EDO AND ONDO STATES OF NIGERIA ¹Ibikunle, T.F., ²Akande, S.O., ³Olajire, O.O., ⁴Aderotoye D.A⁵ Abioye V.O	322-330
EFFECTS OF DROUGHT AND REHYDRATION ON THE GROWTH AND BIOCHEMICAL ATTRIBUTES OF CITRUS PROVENANCES: IMPLICATIONS FOR SEEDLING MORTALITY AND SURVIVAL Agele, Samuel; Sajo Adeola; Akinnagbe, Opeyemi & Oladele, Iyanuoluwa	331-341
MITIGATING THE CLIMATE CHANGE EFFECTS THROUGH TREE SPECIES CONSERVATION AND URBAN GREEN SPACE PLANNING IN AKURE, NIGERIA. ¹Abioye V. O., ²Akande S. O., ³Akinwonmi F. C.	342-351
ASSESSMENT OF URBAN HEAT ISLAND IN AWKA, ANAMBRA STATE Olajire Olabanji O.^{1&2}, Nwachukwu, Edmond I.^{2&3}, Akande Samuel O.¹, Akintola O. A., Balogun, I. A.²	352-365
BIODEGRADATIONTRAITS OF BIOPLASTICS BLENDS, LOW-DENSITY POLYETHYLENE, AND CELLULOSE IN TROPICAL SOIL UNDERCONTROLLED HOME COMPOSTING CONDITIONS ¹Dada, O. E. and ²Akintoye, P. O.	366-370

MODELLING SOIL LOSS AND IDENTIFICATION OF EROSION HOTSPOTS USING THE RUSLE MODEL AND MULTI-CRITERIA DECISION ANALYSIS IN ODO WATERSHED, ANAMBRA STATE *Olabanji Odunayo Aladejana¹; Ebimaro, Jessica Onuwamagbe¹	371-376
WILLINGNESS OF VISITORS TO PAY FOR INCREASED WILDLIFE POPULATION IN T. A. AFOLAYAN WILDLIFE PARK AND OBAFEMI AWOLOWO UNIVERSITY ZOO *Adetola, B. O. and Atansuyi A. P.	377-388
ASSESSMENT OF STRUCTURAL INTERVENTION FOR FLOOD MANAGEMENT IN THE CORE OF AKURE, NIGERIA *Afolami, A. J.¹, Owolabi, B. O.² & Salaudeen, O. A.¹	389-395
PERFORMANCE EVALUATION OF LANDSAT 8 AND SENTINEL 2A FOR SURFACE WATER AREA MAPPING AT A LOCAL SCALE: A CASE STUDY OF ISE FOREST RESERVE, NIGERIA *Olaniyi, O. E., Komolafe I., Ajayi, S. R., Aderonmu E. A., and Adeola, A. J.	396-404
INVESTIGATION OF PHYSICO-CHEMICAL WATER QUALITY OF FISH FARM IN FEDERAL UNIVERSITY OF TECHNOLOGY AKURE, NIGERIA *¹Aderonmu E. A, Aderonmu O. A² and Akinbuwa O³.	405-410
ASSESSMENT OF NOISE POLLUTION AND THE POTENTIAL HEALTH EFFECTS ON MARKETERS' IN ARAKALE ROAD, AKURE, NIGERIA. *Adewale James Afolami¹, Kolawole Opeyemi Morakinyo², David Tonaoluwa Akinloye¹, & Oluwatimilehin Ayobami Adeyemi¹	411-422
ECOLOGICAL IMPACT OF GRANITE QUARRYING ACTIVITIES ON VEGETATION IN TWO QUARRY SITES IN AKURE, ONDO STATE, SOUTHWESTERN NIGERIA ¹Agbede, I.K.; ²Muoghalu, J.I, ¹Agbede, Y. E.	423-435
EFFICACY OF TANNIN EXTRACT FROM CAPE GOOSEBERRY ROOT <i>Physalisperuviana</i> AS EGG DE-ADHESION AGENT DURING ARTIFICIAL PROPAGATION OF AFRICAN CATFISH <i>Clariasgariepinus</i> Alo, O. F.¹; Adebayo, O.T.¹	436-444
GENDER DIFFERENTIALS IN THE ADAPTATION STRATEGIES EMPLOYED BY YAM FARMERS IN COMBATING CLIMATE CHANGE IN KWARA STATE, NIGERIA Ayodele Omowunmi Veronica¹ and Ayodele Omotayo Samuel²	445-451
NUTRIENT ASSESSMENT AND FERTILITY CAPABILITY CLASSIFICATION OF SOILS IN RAIN FOREST AGROECOLOGICAL ZONE OF SOUTHWEST NIGERIA Fawole, O. A¹., Olunloyo, O. O²., Smart, M. O²., Adesida, O. A²., Ibiyeye, D. E² and Isola, J. O²	452-458
ASSESEMENT OF CLIMATE CHANGE EFFECTS ON TOMATO YIELD IN EDO STATE, SOUTH SOUTHERN NIGERIA Olotu, Y.¹, Ikhazuagbe, O.², Rodiya, A.A.³ and Olarinde, O.⁴	459-470
THE UTILITY OF PARTICIPATORY GEOGRAPHIC INFORMATION SYSTEM FOR ASSESSING COMMUNITY-LEVEL RESILIENCE TO FLOOD DISASTERS Felix N. BUBA* and Tobie C. MBARGA MBARGA**	471-477
ADOPTION OF CUSTOMIZED BIODEGRADABLE MULCH FILMS FOR ADVANCING FOOD SECURITY AND SAFETY IN NIGERIA *Dada, Omotola Esther, Omotoriogun Taiwo Crosby, and Osulale, Olayinka Olayemi	478-482

FOOD AND FEEDING HABIT OF FLATHEAD GREY MULLET *MUGILCEPHALUS* (LINNAEUS, 1758) IN ILAJE COASTAL WATERS OF ONDO STATE, NIGERIA

Amadu, N. O. *, Abidemi-Iromini, A. O., Oladipupo, T. M.

Department of Fisheries and Aquaculture Technology, Federal University of Technology, Akure

Amadu, Nimota Opeyemi - nimatamadu@gmail.com / +234 816 969 0663

ABSTRACT

Unlike cultured fish species with fixed feeding regimen, gut content investigation is aimed at obtaining data on food, feeding habits, and condition factor of fish caught from the wild. The present study aimed to provide information on the type of food needed by *Mugilcephalus* in Ilaje coastal waters of Ondo state. Two hundred and forty samples of *Mugil cephalus* were procured monthly from fisher folks at the landing sites of the study areas from November 2021 to April, 2022. The natural food of *M. cephalus* was studied from the stomach contents of the fish. The stomach fullness was graded as empty, one-quarter full, half full, three-quarter full and full. The stomach contents were analyzed using two methods; frequency of occurrence method and numerical methods. Percentage of empty stomach ranged from 15% to 31.67%, while full stomach wasn't encountered throughout the study period. The stomach contents contained two groups of food items: algae (blue-green, diatoms and dinoflagellates) and detritus. The results showed that *M. cephalus* feeds on topmost layer of sediment which is rich in detritus and micro algae. These results indicate that *M. cephalus* are benthic feeders.

Keywords: Ecology, Coastal waters, *M. cephalus*, Nigeria.

INTRODUCTION

To comprehend the functional significance of the fish within their habitat, it is crucial to fully understand the life cycle of species (Abdel-Aziz and Gharib, 2007). For the better management of fish stock, knowledge of food is essential as it forms the most important factor regulating or influencing the abundance, growth and migration of fishes. It is also fundamental to determining the population level of the aquatic biota, thereby providing information on the seasonal and life history changes of fish, since the types and magnitude of food available in consonance with the season it occurs plays a pivotal role in the history of fish (Akinwumi, 2003; Olawusi-Peters *et al.*, 2015). According to Abdel-Aziz and Gharib (2007), studies on fish natural food consumption could offer details on the trophic interactions in aquatic ecosystems, which could be used to develop management strategy alternatives in a multi-species fishery.

In community ecology, it is crucial to investigate diet composition and stomach content as the utilization of resources by organisms has a substantial impact on population interaction. (Adewumi *et al.*, 2014). Additionally, these studies can provide valuable insights into the positioning of fish within their food web and aid in the development of management strategies for multispecies fisheries (Adeyemi *et al.*, 2009).

Mugilcephalus are commonly known as Flathead grey mullet. The family Mugilidae, which the species belongs, originates from order Perciformes (Perch-like fish). The family consists of 18 genera and 81 species (FAO, 2014). Nigeria's fisheries resources are supported by the highly important commercial food fish known as mullets. Asuquo *et al.* (2015) noted that they contain high quality meat and their taste is very palatable. The mullets make up a sizeable portion of the catch made by local fishermen in estuaries and lagoons (Isangedighi *et al.*, 2009). They eat mostly benthic organisms, such as diatoms, aquatic macrophytes, benthic rotifers, larvae, fish eggs, cyclops, copepods, organic detritus, and minute algal cells, and they are able to survive. They swim at an angle to the bottom, raking their mouths through the sediments as they scoop up the food.

Previous studies have been carried out on food and feeding ecology of several fish species (Fagade and Olaniyan, 1972; Akinwumi 2003; Oso *et al.*, 2006; Abowei 2009; George *et al.*, 2013; Olawusi-Peters *et al.*, 2015; Abdul *et al.*, 2016; Abidemi-Iromini, 2019; among others). But there is little or no information on the food and feeding habit of *M. cephalus* in the areas selected for this study. Hence, this study will provide more information on the specie, to complement existing data in the management and culture of the species.

MATERIALS AND METHODS

Study Area

The study areas (Obi, Idi-Egbin, Okesiri and Araromi) are located in Ilaje Local Government Area (Fig. 1), the coastal region of Ondo State which lies within latitude 6°10' to 6°50'N and longitude 2°45' to 6°09'E (Jiboye *et al.*, 2019). Ilaje is bounded in the west, east, north, and south by Ogun State, Ese-Odo LGA and Edo state, Irele LGA, Bight of Benin and the Atlantic Ocean, respectively. Nigeria's coastline stretches from Lagos to the Cross River (about 963 km), with over 20 million people living along the coastal area (Jiboye *et al.*, 2019). The

southwestern coastal area of Nigeria extends from Nigeria/Benin Republic border and terminates at the Ondo-Edo border with Ilaje having the longest coastline in West Africa.

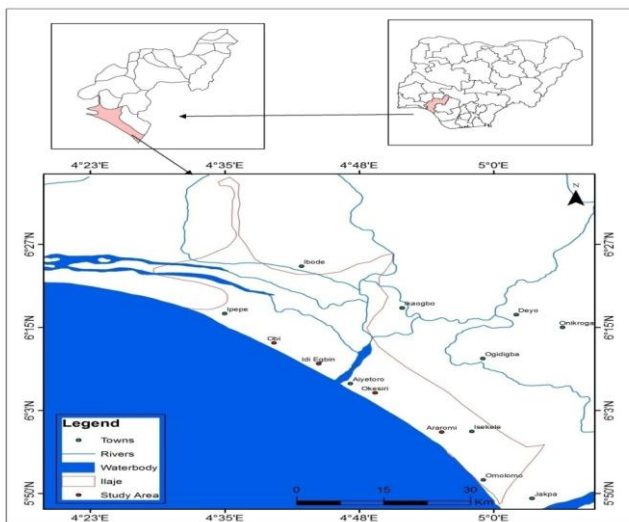


Figure 1: Map of Ilaje LGA showing the study areas

Collection and Identification of Samples

Two hundred and forty samples of *Mugilcephalus* were procured monthly from fisher folks at the landing sites of the study areas from November 2021 to April, 2022. The fishes were identified using the keys provided by Olaosebikan and Raji (2013). The fish samples were stored in ice chest cooler and transported to the Limnology laboratory, Department of Fisheries and Aquaculture Technology, Federal University of Technology, Akure.

Analysis of Stomach Contents

The individual fish gut was carefully extracted by opening the abdominal segment of the fish. The gut (tip of the oesophagus to the end of the rectum (George *et al.*, 2013) were removed using forceps. Fish stomachs were dissected and the fullness were graded as {full (4/4), three quarter full (3/4), half full (2/4), one-quarter full (1/4), and empty (0/4)} according to Adewunmi *et al.* (2014).

The stomach contents were mixed with 2.0 ml distilled water in a petri-dish for proper separation and easy identification of food items and were viewed under Olympus Research Microscope Model No: XSZ-107BN at a magnification of x40. The observed organisms were identified using plankton catalogue by Smith (1997). The various items in the fish stomach were analyzed using frequency of occurrence and numerical methods as described by Hyslop (1980).

Frequency of occurrence Method: In this method, the number of times a particular food item occurred in the stomach is counted and expressed as a percentage of the total number of stomachs with food (empty stomachs excluded). This is expressed as:

$$\% \text{ occurrence of a food item} = \frac{\text{Total number of stomachs with the particular food item}}{\text{Total number of stomachs with food}} \times 100$$

Numerical Method: In this method, the number of each food item in each stomach is counted and expressed as a percentage of the total number of all food items (grand total of all items). This is expressed as:

$$\% \text{ number of a food item} = \frac{\text{Total number of particular food item}}{\text{Total number of all food items}} \times 100$$

RESULTS

The analysis of the stomach fullness condition of *Mugilcephalus* is presented in Table 1. Percentage of empty stomach ranged from 15% in Araromi to 31.67% in Okesiri. The remaining percentages of the fish sampled had one-quarter, half and three-quarter fullness of stomach. Samples with full stomach weren't encountered during this study.

The food items identified in the gut of *M. cephalus* with their respective percentage frequencies of occurrence and percentage numerical evaluation across the sampling stations over the collection period are shown in Table 2. The stomach contents contained two groups of food items: algae (blue-green, diatoms and dinoflagellates) and detritus. The abundant food items consumed in Obi were the diatoms, *Nitzschia sp.* (number: 37.33%; occurrence: 58.33%) and *Navicula sp.* (number: 33.33%; occurrence: 10.42%). The most frequently consumed food item were detritus accounting for 58.33% occurrence. Blue-green algae, *Nostoc sp.* (number: 22.67%; occurrence: 56%); diatoms, *Nitzschia sp.* (number: 22%; occurrence: 44%) were the most abundant food items in the stomach of the samples from Idiegbin. The most abundant

food item consumed in Okesiri was the diatoms. In Araromi, detritus was the most common food item ingested by *M. cephalus*, which accounted for 100% of occurrence.

Table 1: Degree of Stomach Fullness in *Mugilcephalus* from Obi, Idiegbin, Okesiri and Araromi.

Degree of Fullness (%)	OBI		IDIEGBIN		OKESIRI		ARAROMI	
	N	%	N	%	N	%	N	%
Empty (0)	12	20	10	16.67	9	15	19	31.67
One-quarter	20	33.33	38	63.33	32	53.33	25	41.67
Half	18	30	12	20	11	18.33	16	26.67
Three-quarter	10	16.67	0	0	8	13.33	0	0
Full (100)	0	0	0	0	0	0	0	0

Table 2: Diets composition observed in the gut of *Mugilcephalus* from Obi, Idiegbin, Okesiri and Araromi

Water	OBI		IDIEGBIN		OKESIRI		ARAROMI	
	O%	N%	O%	N%	O%	N%	O%	N%
Baccilariophyta (Diatoms)								
<i>Naviculasp</i>	10.42	33.33	18.0	14	-	-	15.67	15.53
<i>Nitzschiasp</i>	52.08	37.33	44.0	22	46.34	31.52	60.78	21.52
<i>Melosirasp</i>	-	-	40.0	19.33	-	-	33.33	13.04
Pyrrophyta (Dinoflagellate)								
<i>Ceratiumsp</i>	-	-	36.0	12.67	36.59	15.22	41.18	14.91
Cyanophyta (Blue-green algae)								
<i>Nostocsp</i>	43.75	32	56.0	22.67	56.10	40.22	62.75	24.22
<i>Oscillatoriasp</i>	4.17	10.67	16.0	9.33	17.07	13.04	17.65	11.18
Detritus	58.33	-	44.0	-	95.12	-	100.0	-

%O = % occurrence; % N= % numerical

DISCUSSION

The percentage of empty stomachs was as high as 31.67% (Okesiri) in the present study. This finding is in agreement with the work of Soyinka (2008) who recorded 40.9% empty stomach and emphasized that the grey mullet typical food retention duration was 4-5 hours. Osibona and Eniola (2011) analysis showed that 23.73% of all the species (*Clarias gariepinus*, *Tilapia zilli*, *Pentamus quinquarius* and *Pseudolithostypus*) from Nigerian coastal waters had empty stomach. Majority of mullets probably digest their food while being caught in the nets. Additionally, some fishes may have regurgitated their food after being caught. Therefore, the level of fullness in mullet stomachs is unlikely to reflect feeding intensity (Soyinka, 2008).

In this present study, *M. cephalus* fed majorly on algae (blue-green, diatoms and dinoflagellates) and detritus. Diatoms were the most abundant algal food items in the diet of *M. cephalus* by number, while detritus was most abundant by occurrence which corroborate with the findings of Jamabo and Maduako, (2015) who reported plant materials, diatoms, algae and dinoflagellate constituted the main food of *Mugilcephalus* from Elechi Creek, Niger Delta, Nigeria. Fagade and Olaniyan (1973) studied food and feeding inter-relationship of the fishes in Lagos Lagoon; Soyinka and Okonkwo, (2012) studied food and biometric features of the grey mullet from Epe Lagoon and Lawson and Jimoh, (2010) studied aspects of the biology of grey mullet in Lagos lagoon. Diatoms and organic detritus (bottom deposits) were identified as the key food items in the stomach of mullets in these researches. Isangedighiet al., (2009) also observed mud particles, diatoms, green algae, blue green algae, dinoflagellates, microarthropods and macroarthropods from the stomach content of *Mugilcephalus* in the Cross River Estuary, Niger Delta, Nigeria. Soyinka (2008) however, reported that salinity play important role in differentiating food items aquatic organisms feed on. Thus, *M. cephalus* from high brackish water, consumed other food items such as crustaceans, molluscs, annelids, plant materials, fish parts, sand grain and desmids which is an indication of the omnivorous feeding habit of the species. Odum (1970) suggested that grey mullet demonstrated a clear preference for living plant material (algae) over plant detritus when both are in abundance. Whereas, Wells (1984) hypothesized that grey mullet in Waikato River and Lake Waahi, showed little or no preference for algae over macrophyte detritus, and that their diets were consistent with the availability of both food types in the two habitats.

Adult grey mullet are herbivores and primarily eat diatoms and algae that are grazed from soft bottom mud, with the exception of areas with submergent vegetation where they frequently consume attached algae (McDonough and Wenner, 2003). Juveniles are omnivores and feed on zooplankton and phytoplankton. To emphasize further, earlier research revealed that juveniles and adults consume various types of food. According to Blaber and Whitfield (1977), juveniles initially feed on zooplankton species exclusively before transitioning to a mixture food feeder and finally a plant feeder.

In relation to water body, the body size and gut contents of the fish species collected from this study stations- Obi, Idiegbin, Okesiri and Araromi follow similar trend. Although, the size range of the fish species in this study were within juveniles and adults size as reported by Soyinka (2008), Soyinka and Okonkwo (2012). The food items consumed by *M. cephalus* from Coastal waters of Ondo State revealed the kind of environment in which they were collected. According to Nwankwo and Akinsoji (1989), the diatoms *Navicula sp.*, *Melosira sp.*, and *Nitzschia sp* are typically found clinging to submerged plants or substrates. This suggests that *M. cephalus* has the potential to graze food in water (Soyinka, 2008).

The results of this study show that the reported foods correlate with the biology of *M. cephalus*, which is a benthic feeder that consumes dead and decaying organic debris deposited at the habitat bottom layers as well as algae made up of Bacillariophyceae, Chlorophyceae, and Mediophyceae as well as other benthic organisms, and this aligns with the findings of De Silva and Wijeyaratne (1977) and Soyinka, (2008). In comparison with other aquatic ecosystems, food items reported in this present study were similar to those found in the gut of *Mugilcephalus* in freshwater habitats such as Lake Waahi and Waikato River in New Zealand (Wells, 1984). Similar gut contents were also reported in *M. cephalus* found in Mexican waters (Sanchez Rueda, 2002) and from Lake Pulicat in India (Rengaswamy, 1973).

REFERENCES

- Abdel-Aziz, N. E. and Gharib, S. M. (2007). Food and feeding habits of round Sardinella (*Sardinella aurita*) in El-Mex Bay, Alexandria, Egypt. *Egyptian Journal of Aquatic Research*, 33: 202-221.
- Abdul, W. O., Omoniyi, I. T., Adekoya, E. O., Adeosun, F. I., Odulate, O. O., Idowu, A. A., Olajide, A. E. and Olowe, O. S. (2016). Length-Weight Relationship and Condition Factor of some commercial fish species in Ogun State Coastal Estuary, Nigeria. *Ife Journal of Agriculture*, 28 (1): 1-10.
- Abidemi-Iromini, A. O. (2019). Assessment of stomach contents of *Oreochromis niloticus* from the Lagos Lagoon, Nigeria. *International Journal of Fisheries and Aquaculture*. 11(1): 1-6.
- Abovei, J. F. N. (2009). The morphology, abundance, condition factor and length-weight relationship of *Ethmalosa fimbriata* from Nkoro River, Niger Delta Nigeria. *Advance Journal of Food Science and Technology*, 1(1): 51-56.
- Adewumi, A. A., Idowu, O. E. and Bamisile, S. T. (2014). Food and feeding habits of *Clarias gariepinus* (Burchell, 1822) in Egbe Reservoir, Ekiti state, Nigeria. *Animal Research International*, 11 (3): 2041-2047.
- Adeyemi, S. O., Bankole, N. O., Adikwu, I.A. and Akombu, P. M. (2009). Food and feeding habits of some commercially important fish species in Gbedikere Lake, Bassa, Kogi, State, Nigeria. *International Journal of Lakes and Rivers*, 2 (1): 31-36.
- Akinwumi, F.O. (2003). Food and feeding habits of *Tilapia zilli* (Pisces: Cichlidae) in Ondo State University fish farm (Department of Environmental Biology and Fisheries). Proceedings of 16th Annual Conference of Fisheries Society of Nigeria (FISON). pp 195-198.
- Asuquo, P. E., Eyo, V. O., Ikechukwu, C. C. (2015). Feeding ecology, Length-weight relationship and condition factor of *Mugilcephalus* (Pisces: Mugilidae; Linnaeus, 1758) from Cross River Estuary, Nigeria. *European Academic Research*. 11(12): 15276-15294.
- Blaber, S. J. M. and Whitfield, A. K. (1977). The feeding ecology of juvenile mullet (Mugilidae) in south-east African estuaries. *Biological Journal of the Linnaean Society* 9, 277-284.
- De Silva, S. S. and Wijeyaratne, M. J. S. (1977). Studies on the biology of young grey mullet, *Mugilcephalus*. *Food and Feeding Aquaculture*, 12 (2): 157-167.
- Fagade, S. O. and Olaniyan, C. I. (1972). The biology of the West African shad *Ethmalosa fimbriata* (Bodwich, 1825) in the Lagos Lagoon, Nigeria. *Journal of Fish Biology*. 4 (4): 519-533.
- Fagade, S. O. and Olaniyan, C. I. O. (1973). The food and feeding interrelationship of the fishes in the Lagos Lagoon. *Journal of Fish Biology*, 5: 205 – 255.
- Food and Agriculture Organization of the United Nations, (2014) Species Identification Guide for Fishery Purposes, Rome, FAO, 2350.
- George, U. U., Idung, J. U., Andem, A. B., Okorafor, K. A. and Mowang, D. (2013). Diet Composition and Condition factor of *Ethmalosa fimbriata* in the Cross River Estuary. *Greener Journal of Biological Sciences*, 3 (6): 244-252.
- Hyslop, E. J. (1980). Stomach content analyses- A review of methods and their application. *Journal of Fish Biology*, 17: 411-429.

- Isangedighi, I. A., Udo, P. J. and Ekpo, I. E. (2009). Diet composition of *Mugilcephalus* (Pisces: Mugilidae) in the Cross River Estuary, Niger Delta, Nigeria. *Nigerian Journal of Agriculture, Food and Environment*. 5(2-4):10-15.
- Jamabo, A. N. and Maduako, N. C. (2015). Food and feeding habits of *Mugilcephalus* (Linnaeus, 1758) in Elechi Creek, Niger Delta, Nigeria. *International Journal of Fisheries and Aquaculture* 7(3): 25-29.
- Jiboye, J. O., Ikporukpo, C. O., and Olatubara, C. O. (2019). Causes of environmental degradation in the coastal areas of Southwest, Nigeria. *European Journal of Sustainable Development Research*, 3 (2): 79.
- Lawson, E. O. and Jimoh, A. A. (2010). Aspects of the biology of grey mullet, *Mugilcephalus*, in Lagos lagoon, Nigeria. *Aquaculture, Aquarium, Conservation and Legislation International Journal of the Bioflux Society*. 1 (3): 181-194.
- McDonough, C. J. and Wenner, C. A. (2003). Growth, recruitment and abundance of juvenile *Mugilcephalus* in South Caroline estuaries. *Fisheries Bulletin*, 101: 343-357.
- Nwankwo, D. I. and Akinsoji, A. (1989). The benthic algal community of a sawdust deposition site in Lagos Lagoon. *International Journal of Ecology and Environmental Sciences*. 15: 197 – 204.
- Odum, W. E. (1970). Utilization of the direct grazing and plant detritus food chains by the striped mullet, *Mugilcephalus*, pp 222-240, In: J.J. Steele (ed) Marine food chains, Oliver and Boyd, Ltd, Edinburgh, Scotland
- Olaosebikan, B. D. and Raji, A. (2013). *Field guide to Nigeria freshwater fishes*. (Revised Edition), University of Ilorin Press, Nigeria, pp 1-89.
- Olawusi-Peters, O. O., Ajibare, A. O. and Olowoyeye, I. M. (2015). Gut content analysis and condition factor of *Ethmalosafimbriata* (Bowditch, 1825) from Badagry Lagoon, Nigeria. Proceedings of the 8th Annual Conference School of Agriculture and Agricultural Technology. Federal University of Technology, Akure. Pp 185-190.
- Osibona, A. O. and Eniola E. B. (2011). Diet composition of four commercially economic important species from Nigerian coastal waters. *Asian Journal of Microbiology, Biotechnology and Environmental Sciences* 13(4): 599-604.
- Oso, J. A. Ayodele, I. A. and Fagbuaro, O. (2006). Food and feeding habits of *Oreochromis niloticus* (L.) and *Sarotherodon galilaeus* (L.) in a Tropical Reservoir. *World Journal of Zoology*, 1 (2): 118-121.
- Rengaswamy, C. P. (1973). Studies on the age and growth and food habit of the grey mullet (*M. cephalus*, L) of the Lake Publicat India, Barrackpore. *Journal of Inland Fisheries Society*, 5: 9-22.
- Sanchez Rueda P. (2002). Stomach content of *Mugilcephalus* and *Mugil curema* (Mugiliformes: Mugilidae) with emphasis on Diatoms in the Tamiahua Lagoon. *Revista de Biología Tropical*, 50(1): 245-252.
- Smith, D. L. (1997). *A Guide to Marine and Coastal Plankton and Marine Invertebrate Larvae*; Kendall/Hunt Dubuque.
- Soyinka, O. O. (2008). The feeding ecology of the grey mullet, *Mugilcephalus* (Linnaeus, 1758) from high brackish water in South-west Nigeria. *African Journal of Biotechnology*, 7 (22): 4192-4198.
- Soyinka, O. O. and Okonkwo, I. C. (2012). Food and Biometric features of the Grey Mullet, *Mugilcephalus* (Linnaeus) from Epe Lagoon. *Nigerian Journal of Fisheries*, 9 (1): 455-459.
- Wells, R.D.S. (1984). The food of the grey mullet, *Mugilcephalus* (L.) in Lake Waahi and the Waikato River at Huntly, New Zealand. *Journal of Marine and Freshwater Research*, 18: 13 – 19.