

DEPARTMENT OF ANIMAL SCIENCE

The Department of Animal Science, University of Calabar, Calabar was created from the then single unit of Agriculture in January, 1986. From the initial first degree (B. Agric.) Programme, it has grown in infrastructure, number of students and staff population. It now offers Post Graduate Diploma (PGD), Master of Science (M.Sc.) and Doctor of Philosophy (Ph.D) Programmes.

The Department is devoted to producing undergraduate and post graduate students with an environment and opportunity to expand their knowledge and to develop their creative and scholarly abilities.

Based on the above premise, the Department of Animal Science is proud to partner the Research Network on Giant African Land Snails (NetGALs) in hosting the 5<sup>th</sup> International Conference/Workshop on Giant African Land Snails (GALS) with the theme: Sustainable Snail Farming as an enterprise for economic empowerment from 5th to 9th June, 2016. This conference is apt and timely particularly now that the modern trend in animal production is geared towards enhancing animal protein intake adequacy for the teeming population through micro livestock production. Snail farming (heliculture or Achatiniculture) is novel and there is dearth of snail - based research information/data in the current animal agriculture paradigm. Hence, all hands must be on deck to support this worthy initiative by NetGALs.



Dr. Magnus L Anya 8.5c. M.Sc. (Calabar) COM, PGGEE (Calabar) Ph.D (MCMAU)

Furthermore, I hope that the participants (scholars/researchers, entrepreneurs and students) would find a niche in snail farming through this auspicious conference/ workshop.

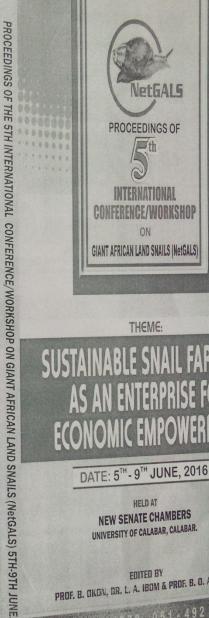
Finally, may I seize this opportunity to welcome all participants to Calabar (Come and Live and Be at Rest). Enjoy the warmest hospitality of our people, alongside the clean and green environment and above all the serenity and peace of the 'Peoples Paradise'

Thank you for coming and wishing you journey mercies to your various Institutions/destinations.

Acting Head of Department Department of Animal Science University of Calabar PAIR 1115 (UPD), Calabar Cross River State, Nigeria 5408 Tel: 4(1)48554-1088

Dr. M. I. Anya (Ag. Head of Department)

note a contact Prince Expensed Frol U.E. Limon Prof E.E. Agong Prof E.Doco Prof & Doco Prof E. Doco Prince E. Agong Prof E. Doco Prof E. Doco Prof E. Doco Prof E. Doco Prince E. Agong Prof E. Doco Prince E. Agong Prof E. Doco Prof E. Doco Prince E. Agong Prof E. Doco Prince E. Doco Prof E. Doco Prof E. Doco Prof E. Doco Prince E. Doco



THEME:

# AS AN ENTERPRISE FOR ECONOMIC EMPOWERMENT

DATE: 5<sup>TH</sup> - 9<sup>TH</sup> JUNE, 2016

HELD AT **NEW SENATE CHAMBERS** UNIVERSITY OF CALABAR, CALABAR.

EDITED BY PROF. B. OKON, DR. L. A. IBOM & PROF. B. O. ASUQUO

ISBN 978-051-492-9

on the 5th International Conference/Workshop on Grant African Land Shalle (Noice at the page 1997)

# RESEARCH NETWORK ON GIANT AFRICAN LAND SNAILS



PROCEEDINGS OF 5<sup>™</sup> INTERNATIONAL CONFERENCE/WORKSHOP

EDITORS
PROF. B. OKON, DR. L. A. IBOM & PROF. B. O. ASUQUO

DEPARTMENT OF ANIMAL SCIENCE FACULTY OF AGRICULTURE, FORESTRY & WILDLIFE RESOURCES MANAGEMENT UNIVERSITY OF CALABAR, CALABAR, NIGERIA Proceedings of the 5th International Conference Workshop on Glant African Land Snats (NetGALS) 5th-9th June

STEERING COMMITTEE Prof. O. A. Osinowo Prof. M. O. Onagbesan Prof. S. O. Onadeko Prof. Daisy Eruybeting	
Prof. Daisy Eruvbetine Prof. A. B. Idowu	

COUNCIL MEMBERS Prof. O. A. Osinowo Chairman Prof. B. Okon Vice Chairman

### NATIONAL EXECUTIVE COMMITTEE

Dr. (Mrs.) F. A. O. Akinnusi - President Dr. L. A. Ibom Vice President Dr. Adeboye Omole Dr. (Mrs.) B. N. Ejidike Dr. (Mrs.) C. I. Ebenebe Secretary Treasurer Financial Secretary PRO Dr. J. A. Abiona Dr. Ime E. Ebenso Editor-in-Chief
 Assistant Editor Dr. Kehinde O. Ademolu Assistant Editor

#### LOCAL ORGANIZING COMMITTEE

Prof. B. O. Asuquo .
Prof. Bassey Okon . Special Technical Adviser Chairman, LOC Dr. L. A. Ibom - Secretary Dr. L. A. Ibom
Dr. (Mrs) H. E. Etta
Wiss Felicia I. Okon
Dr. (Mrs) O. B. Ina-Ibor
Dr. U. E. Ekaluo
Dr. G. S. I. Wogar
Prof. E. I. Inah
Secretary
Treasurer
Financial Secretary
Chairman, Publicity Committee
Chairman, Fund Raising Committee Proceedings of the 5th International Conference/Workshop on Giant African Land Snafs (NetGALS) 5th-5th June

#### TABLE OF CONTENTS

	ON IEMIS
1,	SUSTAINABLE SNAIL FARMING AS AN ENTERPRISE FOR ECONOMI
	Prof. A. B. I. Udedibie = = = =
2.	SUSTAINABLE SNAIL FARMING THROUGH BREEDING Prof. Udo Herbert
3.	ENTREPRENEURIAL POTENTIALS AND CHALLENGES OF SNAIL FARMING IN
	Dr.E.E.Ukpong = = = = = = = 11-14
4.	PROSPECTS OF GIANT AFRICAN LAND SNAILS IN THE NIGERIAN CHANGE AGENDA: AN OVERVIEW FROM NUTRITIONAL, HEALTH AND ECONOMIC PERSPECTIVES
	A. J. Henry, L. A. Ibom, G. E. Obiosio and J. D. Owoyemi = = = 15-18
5.	CARCASSAND COST BENEFITS OF FEEDING SNAILS DIETS WITH CASSAVA PEEL-PALM KERNEL CAKE MIXTURES Popoola', Y. A., Harry', B. J., Fayenuwo', J. O., Adekunlo', O. F., Ajasin', F. O., Okpeze', V. E., Odejide', O. J. and Omole', A. = = = = 19-22
6.	PHENOTYPIC CORRELATIONS AMONG GROWTH TRAITS OF ARCHACHATINA MARGINATA SNAILS OFFSPRING IN CALABAR, NIGERIA "Ibom, L.A., Okon, B. and Patani, I. = = = = = 23:26
7.	2020
1.	EFFECTS OF FEEDING TIME ON GROWTH AND NUTRITIVE VALUE OF GIANT AFRICANLAND SNAIL (Archachatina marginata) FLESH *Onadeko, D.E; Sumola, M.O; Idowu, A.B. and Ademolu, K.O. = = 27.30
8.	INFLUENCES OF MEXICAN SUNFLOWER (TITHONIA DIVERSIFOLIA) AND WILDCAPE GOOSEBERRY (PHYSALIS ANGULATA) IN GROWTH PERFORMANCE OF GIANT AFRICAN LAND SNAIL (ARCHACHATINA MARGINATA)
	Ejidike, B. N and Oyinbo, F. K = = = = = = 31-35
9,	PHENOTYPIC VARIATIONS IN REPRODUCTIVE TRAITS OF TWO STRAINS OF ARCHACHATINA MARGINATA SNAILS (VAR. OVUM AND VAR. SATURALIS) AND THEIR CROSSES
	'lbom, L.A., 'Patani, I., 'Okon, B. and 'Okon, F. I. = = = = 36-42
10.	PRELIMINARY STUDIES ON THE GROWTH PERFORMANCE AND SURVIVAL RATE OF GIANT AFRICAN LAND SNAIL (Archachatina marginata, Swaison) FED VARYING
	LEVELS OF MORINGA-BASED LEAF MEAL RATIONS Imran, G.T.; N.J. Ogundun; Adebisi-F., T.A. Adesina. T.A. and Aruya, I.B. = 43-47
11.	ECONOMIC IMPLICATIONS OF SNAIL PRODUCTION IN MGBIRICHI - OHAJI, IMO
	STATE, NIGERIA = = = = = = 48-53 E.O. Ahaotu = = = = = = 48-53
12.	PHENOTYPIC DIFFERENTIATION OF GROWTH TRAITS AND CURVES OF F, HATCHLINGS FROM CROSSES BETWEEN TWO ECTOTYPES OF ARCHACHATINA
	MARGINATAVAR OVUM L. A. Ibom J. D. Owoyeini and A. E. Akpe

	Proceedings of the 5th International Conference-Workshop on Glant African Land Shalls (NetGALS) 5th-9th June	
13.	HAEMOLYMPH MINERAL COMPONITION	Proceedings of the 5th International Conference/Workshop on Giant African Land Shalis (NetCALS) 5th-5th June.
	HAEMOLYMPH MINERAL COMPOSITION OF TWO SPECIES OF LAND SNAIL FED WITHMORINGA OLEIFERA LEAF MEAL 'Anazodo, A. C., 'Ebenebe, C. I. and 'Amobi, M. I. = = = 60-63	25. REPRODUCTIVE PERFORMANCE OF F, ARCHACHATINA MARGINATA SNALLS OBTAINED BY CROSSING FIRST FILIAL GENERATIONS OF HETEROZYGOUS AND HOMOZYGOUS BLACK-SKINNED SNAILS IN CALABAR, NIGERIA
14.	PREVALENCE OF ZOONOTIC PATHOGENIC BACTERIA (YERSINIA PESTIS) IN THE GUT OF GIANT AFRICAN LAND SNAIL (ARCHACHATINA MARGINATA) SOLD IN UYO	Ott, B. O., Ibom, L. A. and Okon, B. = = = = = 120-126
	Ebenso, I. E., "Effiong, O. E.," Ndelekwute, E. K., 'Ademolu, K. O.' and lbom, L. A.' = = = = 64-67	26. ACHATINA FULICA (EX. BORA): ITS POTENTIAL IN COMMERCIAL SNAIL FARMING FORADEQUATE MEAT SUPPLY AND EXPORT Omidiji, M. O. and Amusan, J. A. = = = = = = = 127-130
15.	SNAIL FARMING: A VERITABLE ACTIVITY FOR LIVELIHOOD SECURITY AND WEALTH CREATION  Onyenso, A.I. and L.N. Onyenweaku = = = = 68.71	<ol> <li>COMPARATIVE EVALUATION OF CARCASS CHARACTERISTICS OF TWO SNAIL BREEDS (ARCHACHATINA MARGINATA AND ACHATINA ACHATINA) IN CALABAR, NIGERIA</li> </ol>
	- 00-11	lbom, L. A. ', Okon, F. I.', Okon, B. ', and Akpe, A. E.' = = = = 131-134
16.	EFFECTS OF MORINGA OLEIFERA LEAF MEAL ON GROWTH PERFORMANCE OF TWO SNAILSPECIES (ARCHACHATINA MARGINATAAND ACHATINA FULICA)  *Ebenebe, C. I., *Anazodo, A. C. and *Amobi, M. I. = = = 72-77	28. REPRODUCTIVE PERFORMANCE AND HISTOLOGICAL CHANGES IN THE REPRODUCTIVE ORGANS OF ARCHACHATINA MARGINATA VAR. SATURALIS FED DIFFERENT TYPES OF FORAGES
17.	EVALUATION OF THE PHENOTYPIC CHARACTERS OF Archachatina marginata	Ina-lbor, O. B <sup>1</sup> ., Okon, B <sup>2</sup> ., Ibor, B. I <sup>3</sup> . and Ibom, L. A <sup>2</sup> = = = 135-138
	HATCHLINGS FED LEAVES OF Phyllanthus amarus (Schonn. and Thonn.)  *Etta, H. E.', Okon, E. A.' and Iwara, E. E.' = = = 78-84	29. CONSERVATION OF GENETIC DIVERSITY AMONG GIANT AFRICAN LAND SNAILS: A TOOL FOR SUSTAINABLE HELICULTURE 1. 4. hom G. F. Objesja and N. I. liem = = = = = 139.142.
18.	EFFECT OF GARDEN SNAIL (Limicolaria aurora) MEAL FED AS REPLACEMENT FOR	Emilyon, C. Soloto and Marion
	FISH MEAL ON SERUM AND HÀEMATOLOGICAL PARAMETERS OF BROILER BIRDS Etienam-Umoh, I. S., Okon, B. and Nsa, E. E. = = = 85-87	<ol> <li>THE EFFECT OF SEX PARTNERS' STAGE OF DEVELOPMENT ON GROWTH AND REPRODUCTIVE PERFORMANCE OF GIANT AFRICAN LAND SNAIL (Archachatina marginata)</li> </ol>
19.	EFFECTS OF PHASES OF GROWTH AND NUMBER OF WHORLS ON GROWTH CURVES OF PUREBRED AND CROSSBRED Archaechatina marginata (S) SNAILS	Esue, S.; Subair, M.; Bamidele, J. A.; Jayeola, O. A., Ademolu, K. O. and Idowu, A. B. = = = 143-147
	UKON, B., IDOM, L.A., ASuquo, B.O. and Odo, O.T.	<ol> <li>CARCASS CHARACTERISTICS OF ACHATINA FULICA FED WITH CARICA PAPAYA LEAVES, AMARANTHUS SPINOSUS LEAVES AND TELFAIRIA OCCIDENTALIS</li> </ol>
20.	COMPARATIVE EVALUATION OF THE PROXIMATE COMPOSITION OF GARDEN SNAIL (Limicolaria aurora) MEATAND FISH MEAL Etienam-Umoh, I.S., Okon, B. and Nsa, E. E. = = = 94-96	LEAVES CARCASS CHARACTERISTICS OF ACHAINA FULUA FED WITH CARDA PAPAYA LEAVES, AMARANTHUS SPINOSUS LEAVES AND TELFAIRIA OCCIDENTALIS FAVES
21.	TRAITS MEASUREMENTS AS PREDICTOR OF BODY WEIGHT IN	Ihenacho, R. A., Ahaotu, E. O., Ayo – Enwerem, C. M. and Oguegbuchulam, M. N. = = = 148-150
	BLACK SKINNED AND WHITE SKINNED ARCHARDAGA HINDHING AND WHITE SKINNED AND WHITE SK	<ol> <li>PERFORMANCE CHARACTERISTICS OF ACHATINA FULICA FED WITH CARICA PAPAYA LEAVES, AMARANTHUS SPINOSUS LEAVES AND TELFAIRIA</li> </ol>
22.	STRUCTURAL MODIFICATION OF SNAIL HOUSES FOR BETTER PERFORMANCE IN THE TROPICS  = = = 103-108	OCCIDENTALIS LEAVES  Thenacho, R.A., Ahaotu, E. O., Ihiala, P. O. and Oguegbuchulam, M. N. = 151-154
	At- I Adenivi Amusan.	OF CIANT AFRICAN LAND SNAIL (ARCHACHATINA MARGINATA
23.	IMPORTANCE OF SNAIL FARMING BY-PRODUCTS IN WEST AFRICAN COUNTRIES	SATURALIS) EGGS IN DIFFERENTIACOS MAIN = = = = 155-159
	ECONOMIES  *Ekwu, U. S., Egbu, C. F., Ebenebe, C. P., Nwankwo, S. and Uzochukwu, I. E. 109-113  *Ekwu, U. S., Egbu, C. F., Ebenebe, C. P., Nwankwo, S. and Uzochukwu, I. E. 109-113	34. EVALUATION OF INCUBATION PERIOD, % HATCHABILITY, % MORTALITY AND % SURVIVABILITY OF THREE MATING GROUPS OF ARCHACHATINA MARGINATA \$180,164
24.	SNAIL FARMING: RISK FACTORS, DISEASES AND CONSERVATION PRACTICE IN	SNAILS Akpe, A. E., Ibom, L. A., Okon, B. and Owoyemi, J. D. = = = = 160-164
	SNAIL FARMING: NISK PACIFIC STATE THE HUMID TROPICS  *Ekwu, U.S'., Egbu, C.F'., Ebenebe, C.I'., Nwankwo, S.U'and Uzochukwu, I.E' 114-119  *Ekwu, U.S'., Egbu, C.F'., Ebenebe, C.I'., Nwankwo, S.U'and Uzochukwu, I.E' 114-119	

Proceedings of the 5th International Conference Workshop on Gierr African Lans Smalls (NetGALS) sin the June

REPRODUCTIVE PERFORMANCE OF F, ARCHACHATINA MARGINATA SNAILS OBTAINED BY CROSSING FIRST FILIAL GENERATIONS OF HETEROZYGOUS AND HOMOZYGOUS BLACK-SKINNED SNAILS IN CALABAR, NIGERIA

Otu, B. O., Ibom, L. A. and Okon, B. Department of Animal Science, University of Calabar, Calabar, Nigeria

Corresponding author: allisiousbisongotu@yahoo.com

The reproductive performance of F<sub>2</sub> snalls (Archachalina marginata var. saluralis) obtained by crossing first filial generation heterozygous snalls and first filial generation homozygous snalls was evaluated. 40 sexually malured F, snalls, 20 each of homozygous black and heterozygous black were crossed to generate the F, snalls. The F, snalls were raised to sexually maturity and their reproductive performance monitored and compared to that of their parents. The results shows a significant (p<0.05) difference in thereproductive parameters of the three mating groups from the terminal point of the juvenile phase up to the point of sexual parameters of the unextending groups norm to lemma point one province prose up of the point sense malurity with exception of the mean hatchling shell mouth length which was not significantly (p.0.05) different. The results confirmed an improvement on the reproductive performance of the F, snaits compared to the parents crossbred snails in all the parameters under study with exception of percent (%) hatchability in which the F, heterozygous snalls performed better than the F, homozygous and F, snalls. The result of this study further established the possibility of improving the performance of snails to produce a hybrid snail that can meet the expectations of farmers through cross breeding.

Keywords:

#### Introduction

As the world is ushered into the modern era of civilization and increased global population, food and its availability will continue to be a investment. This research therefore focused major issue, which will definitely have profound impacts on the lives of humans than ever of hybrid snails generated by crossing before. Unequivocally, protein is essential for the growth, development and maintenance of the body cells, tissues and organs. However, high levels of cholesterol have placed a limitation to the extent which most livestock contribute to the much needed animal protein intake (USDA, 2006). Availability of safe and reliable source of protein is an essential prerequisite for sustainable human development. Wosu (2003) reported that snails contain higher protein and low cholesterol levels when compared to other animal protein 
The snails were managed intensively in sources, thus making them health friendly.

performance of giant African land snails in performance throughout the experimental order to increase their contribution to the much needed animal protein in Nigeria is inevitable, with the depleting population of wild snails due to drought, over hunting and effect of global clutch size (number of eggs per lay), mean egg warming in general. This could probably be weight at lay (g), mean egg length at lay (mm) done by making crosses of several mean egg width at lay (mm), mean hatchling generations and then evaluating the body weight at hatch (g), mean hatchling shell

performance of the hybrid snails which can meet the productive expectation of farmers, and as such bring about quicker returns on on evaluation of the reproductive performance heterozygous black-skinned first filial generation snails with Homozygous blackskinned first filial generation.

#### Materials and methods

Forty sexually mature Archachatina marginata snails were used in this study, twenty each of the heterozygous black-skinned first filial generation and homozygous black-skinned first filial generation. The two snail groups were mated to each other, to generate the F, snails. wooden cages kept under trees with canopies The improvements of the reproductive to provide a suitable environment for optimum period (41weeks). Data collected on the reproductive performance of the F2 crossbred and the parent crossbred included mean

length at hatch (mm), mean hatchling shell observed might be attributed to the age of the width at hatch (mm), mean hatchling shell 'mouth' length at hatch (mm), mean hatchling shell 'mouth' width at hatch (mm), mean number of eggs hatched (per clutch), mean incubation period (days) and percent (%) hatchability.

#### Statistical analyses

The Completely Randomized Design (CRD) was used for this experiment. Data collected were subjected to statistical analysis using student t-test and observed means were separated using the least significant difference method.

The Statistical model used for the experiment

µ+B,+e, Where:

Single Observation

Common Mean HB.

Effect of Genotype on reproduction parameters

Random error effects iind  $(0, \delta^2)$ 

#### Results and Discussion

The results of the reproductive parameters of the F, snails and that of F, heterozygous and F, homozygous snails are presented on Table 1. The mean clutch size per lay of the three groups were significantly (p< 0.0.5) different. The F, snails recorded the highest mean value of 6.89 eggs followed by the F, homozygous snails which recorded 6.44 eggs, while the F, heterozygous snails recorded 6.00 eggs. These results compared favourably with the mean clutch size range of 5.08 to 6.58 reported by Owoyemi (2014) for Archachatina marginata. More so, the result is similar to the value of 5.23 for mean clutch size of the purebred White-skinned of A. marginata reported by Ibom et al. (2008). Ubua et al. (2012) also reported mean clutch size of 7.70 and 5.0 for A. marginata ovum and A. marginata saturalis respectively. These results go a long way to shows that there is a likely sustainable improvement in the clutch size of hybrid snails obtained through cross breeding as a result of bringing together of genes for egg production from the F., parents to the F, hybrid snail. The variation in the mean clutch size

snails, size and the interactive effect of the environment. This is in agreement with the report of Okon and Ibom (2012) on variation of mean clutch size of A. marginata parent snails.

The mean egg weight at lay of the three groups of snails were significantly (p<0.0.5) different. The F, snails recorded the highest mean egg weight value at lay value (1.49g), followed by the F, homozygous snails which recorded 1.46g, while the F, heterozygous snails recorded 1.24g. The results are similar to 1.20g for Black-skinned × Black-skinned (BS × BS) mating group and 1.01g for White-skinned × White-skinned (WS × WS) mating group reported by Owoyemi (2014). Okon (2013) reported similar mean egg weight values of 1.83g for Black-skinned snails and 1.08g for white-skinned (albino) snails. More so, the results recorded in this study are similar to the mean value of 1.05g for albino snails reported in Ibom et al. (2008). However, the results were lower than the mean egg weight of 1.73g and 1.57g reported by Ubua et al. (2012) for A. marginata ovum and A. marginata saturalis respectively. The variation in the mean egg weight at lay may be attributed to variation in the body weight of the F, parent snails used in the study, genotype, age of the parent snails at point of lay and the prevailing environmental or climatic conditions during the period of study. These findings are in agreement with the report of Okon et al. (2010a) on the variation of mean egg weight of A. marginata snails.

The mean egg length values of the crossbred snails at lay were significantly (p<0.05) different between the three groups. The F, snails recorded mean egg length value of 1.59mm, followed by the F, homozygous snails that recorded 1.51mm, while F, heterozygous recorded 1.35mm. The values obtained in this study compared favourably with the values of 1.61mm and 1.43mm for black-skinned snails and white-skinned (albino) snails respectively reported by Ibom et al. (2008). However, the results of this study were lower than the mean egg length values of 16.8mm for Black-skinned snails and 14,3mm for white-skinned (albino) snails reported by Okonta (2012). More so, the results differed from the mean egg length values of 19.70mm for Black-skinned snails

observed between the groups in this study could be attributed to the inherent genetic composition of the snails and the weight and age of the snails at point of lay. This corroborated the report of Okon et al. (2010a). The mean egg width of the crossbred snails at lay were significantly (p<0.05) different between the groups. The F, snails recorded mean egg width value of 1.43mm, followed by the F, homozygous snails which recorded 1.25mm, while the F, heterozygous recorded 1.22mm. The values obtained in this study compared favourably with the values of 1.29mm and 1.05mm for black-skinned snails and white-skinned (albino) snails respectively, as reported by Ibom et al. (2008). However, the results of this study were lower than the mean egg width at lay values of 13.2mm for Blackskinned snails and 10.7mm for white-skinned (albino) snails reported by Okonta (2012). More so, the results differ from the mean egg width values of 14.20mm for Black-skinned snails reported by Amubode (1994). However, the variations observed within the groups for this trait could be attributed to the inherent genetic makeup of the snails, the weight and age of the snalls at point of lay, which agree with the report of Okon et al. (2010a).

Mean hatchling body weight at hatch of the three groups were significantly (p<0.0.5) different. The F, group recorded the highest mean value of 0.97g, followed by F, homozygous group with 0.92g, while the F, heterozygous recorded 0.83g. The results recorded in this study compared favourably with 1.14g for Black-skinned × Black-skinned (BS × BS) mating group and 0.77g for Whiteskinned × White-skinned (WS × WS) mating group reported by Okon et al. (2012). Okon (2013) reported similar mean hatchling weight values at hatch; 1.21g for Black-skinned snails and 0.87g for white-skinned (albino) snails. The results recorded in this study were higher than the mean hatchling weight values at hatch; 0.73g and 0.53g reported by Owoyemi (2014) for Black-skinned × Black-skinned (BS × BS) mating group and White-skinned × White-skinned (WS x WS) mating group of Archachatina marginata respectively. The variation in mean hatchling weight at hatch may be attributed to variation in the mean egg

reported by Amubode (1994). The variations weights of the crossbred parent snalls used in the study, genotype, age and size of the parent snails at point of lay and the prevailing environmental or climatic conditions during the period of study. The results of this study have shown a probable predictable developmental pattern of the three mating groups of snails, as reflected by the hatchlings mean weight at hatch. This finding compares with the report of Ibom (2009) who opined that the weight of hatchlings at day-old is an indicator for hatchlings developmental pattern.

> The mean hatchling shell length at hatch of the three groups of snails were significantly (p<0.0.5) different. The F, snails recorded the highest mean value of 1.66mm, followed by the homozygous snails which recorded 1.39mm, while the F, heterozygous snails recorded 1.14mm. The results recorded in this study compared favourably with 1.41mm for Black-skinned × Black-skinned (BS × BS) mating group and 1.32mm for White-skinned × White-skinned (WS × WS) mating group reported by Ibom et al. (2011). The results also compared favourably with the range of 1.15mm to 1.38mm reported by Okon et al. (2010a) for hatchlings shell length at hatch of Archachatina marginata snails. However, Okon et al. (2012) reported very high mean hatchlings shell length at hatch value of 14.30mm for Black-skinned × Black-skinned (BS × BS) A. marginata snails and 14.0mm for White-skinned × White-skinned (WS × WS) A marginata snails. The variation in the mean hatchlings shell length at hatch of the parent snails could be attributed to differences in the strains used, the ages of the snails at mating, sizes of the snails, incubation conditions as well as other environmental conditions during incubation and eventual hatching of eggs These findings agreed with the postulations of Okon et al. (2012) that body measurements could reflect a probable predictable developmental pattern of snails, as reflected by the hatchlings shell length at hatch. This finding also corroborated the report of Ibom (2009) that day-old hatchling shell length could serve as an indicator for hatchlings development pattern.

Mean hatchlings shell width at hatch of the three mating groups were significantly ings of the 5m international Conference Workshop on Garr African Land Shads (NetGALS) 5th time.

(p<0.0.5) different. The F<sub>s</sub> hybrid snails recorded the highest mean value of 1.28mm. followed by the F, hornozygous which recorded 1.09mm, while the F, heterozygous recorded a mean value of 0.94mm. These results are similar to 1.16mm for Black-skinned × Blackskinned (BS × BS) mating group and 1.08mm for White-skinned × White-skinned (WS × WS) mating group reported by Ibom et al. (2011). However, the results were lower than the mean hatchlings shell width at hatch value of 11.80mm for Black-skinned × Black-skinned (BS x BS) A. marginata snails and 10.30mm for White-skinned × White-skinned (WS × WS) A. marginata snails reported by Okon et al. (2012). The variation in the mean hatchling shell width at hatch of the parent snails could be attributed to differences in the strains used, the ages of the snails at mating, sizes of the snails, incubation conditions as well as other environmental conditions during incubation and eventual hatching of eggs. These findings agreed with the postulations of Okon et al. (2012) that body measurements could reflect a probable predictable developmental pattern of the two mating groups of snails, as reflected by the hatchlings shell width at hatch. This finding also corroborated the report of Ibom (2009) that day-old hatchlings shell width could serve as an indicator for hatchlings development.

The mean hatchlings shell 'mouth' length at hatch results of the three mating groups (Table 1) were not significantly (p>0.0.5) different. F, group recorded the highest numerical mean value of 1.15mm, followed by the F, homozygous which recorded 0.92mm, while the F, heterozygous recorded 0.89mm. The results are similar to 1.05mm for Black-skinned × Black-skinned (BS × BS) mating group and 0.96mm for White-skinned × White-skinned (WS × WS) mating group reported by Ibom et al (2011). However, Owoyemi (2014) reported hatchlings shell 'mouth' length value at hatch of 0.90cm for Black-skinned × Blackskinned (BS x BS) A. marginata snails and 0.80cm for White-skinned × White-skinned (WS × WS) A. marginata snails. The variation in the mean hatchlings shell 'mouth' length at hatch of the snails could be attributed to differences in the strains used, the ages of the snails at mating, sizes of the snails, incubation conditions as well as other environmental

conditions during incubation and eventual hatching of eggs. These findings also agreed with the postulations of Okon et al. (2012) that body measurements could reflect a probable predictable developmental and morphological pattern of the two mating groups of snails, as reflected by the hatchlings shell 'mouth' length

The mean hatchling shell 'mouth' width at hatch of the three mating groups (Table 1) were significantly (p<0.0.5) different. The F, snails recorded the highest numerical mean value of 0.95mm, followed by F, homozygous which recorded 0.84mm, while the F, heterozygous recorded 0.74mm, Also, there is similarity between the results of this study and 0.67mm for Black-skinned × Black-skinned (BS × BS) mating group and 0.65mm for White-skinned × White-skinned (WS × WS) mating group reported by Ibom et al. (2011). Owoyemi (2014) reported hatchlings shell 'mouth' width value at hatch of 0.51cm for Black-skinned × Black-skinned (BS × BS) A. marginata snails and 0.30cm for White-skinned × White-skinned (WS × WS) A. marginata snails. The variation in the mean hatchlings shell 'mouth' width at hatch of the parent snails could be attributed to differences in the strains used, the ages of the snails at mating, sizes of the snails, incubation conditions as well as other environmental conditions during incubation and eventual hatching of eggs. These findings agreed with the postulations of Okon et al. (2012) that body measurements could reflect a probable predictable developmental and morphological pattern of the two mating groups of snails, as reflected by the hatchlings shell 'mouth' width

The mean incubation period of the three mating groups were not significantly (p>0.0.5) different. The F2 snails recorded the highest numerical mean value of 26.44 days, followed by F, homozygous which recorded 26.33 days, while the F, heterozygous recorded 25.44 days. The results recorded in this study compared favourably with a range values of 25 - 30 days for Black-skinned × Black-skinned (BS × BS) mating group and 20 - 37 days for White-skinned × White-skinned (WS × WS) mating group reported by Okon et al. (2012b). More so, Okon et al. (2012a) reported

Proceedings of the 5th International Conference-Workshop on Giant African Land Sheets (NerGALS) 5th 9th June

incubation periods of 11 - 30 days, 16 - 30 days and 15 - 30 days for black-skinned x black-skinned purebred cross, white-skinned x white-skinned purebred cross and blackskinned x white-skinned crossbred cross of A achatina. Owoyemi (2014) reported range of incubation period of 10 – 25days (mean of 18 days) for Black-skinned × Black-skinned (BS × BS) A marginata snails and 10 - 27 days (mean value of 17 days) for White-skinned x White-skinned (WS × WS) A. marginata snails. The differences in the mean incubation period could be attributed to differences in the strains used, the ages of the snails at mating, sizes of the snails, incubation conditions as well as other environmental conditions during incubation.

These findings agreed with the findings of Okon et al. (2012). The results of mean percent (%) hatchability of the three mating groups were significantly (p<0.0.5) different. The F, heterozygous snails recorded the highest mean value of 88.41%, followed by F, homozygous which recorded 88.09%, while the F, snails recorded mean value of 87.43%. The results recorded in this study were higher than the value of 52.45% for Black-skinned  $\times$ Black-skinned (BS × BS) mating group and 38.33% for White-skinned × White-skinned (WS × WS) mating group reported by Okon et al. (2010a) at the first filial generation (F<sub>1</sub>). Percent hatchability value range of 29 to 100% (mean of 53.75%) for Black-skinned × Blackskinned (BS × BS) A. marginata snails and 0 to 83.0% (mean of 50.50%) for White-skinned × White-skinned (WS × WS) A. marginata snails was reported by Owoyemi (2014). Okon et al.

(2012a) reported percentage hatchability of 76.28% for purebred black-skinned genotype 76.28% for purebred white-skinned genotype and 69.27% for crossbred genotype of A achatina. The differences in the mean percent hatchability could be attributed to differences in the strains used, the ages of the snails at mating, sizes of the eggs, incubation conditions as well as other environmental conditions during incubation. These findings agreed with the findings of Okon et al. (2009).

## Conclusion and Recommendations

This study on the evaluation of the reproductive performance of F, Archachatina marginata snails obtained by crossing first filial generation heterozygous black-skinned and first filial generation homozygous blackskinned snails in Calabar has shown that there is possibility of improving on the reproductive performance of giant African land snails through cross breeding. This will result in the development of hybrid snails that can breed through, in order to increase their contribution to the much needed animal protein in Nigeria and as such feel the gap created by the depleting population of wild snails due to drought, over hunting and effect of global

We therefore strongly recommend the intensification of crossbreeding research to take advantage of the additive genetic effect of genes so as to facilitate the development of hybrid snails which can meet the productive expectation of farmers, and as such bring about quicker returns on investment.

	-	nozygous black-skinned snails.  Mating groups/crosses  F2 F.BB F.BB			
Mean Clutch Size (per lay)	F <sub>2</sub>	F <sub>1</sub> BB	FIBW		
Mean egg weight at lay (g)	- 3		. 1011	44	
Mean eon lonett	6.89ª	6.44	6.00°	SEA 0.35	
Mean egg length at lay (mm)	1.49	1.46 ab			
width at lay /	1.59°	1.51 ab	1.24	0.06	
Medit Hatchling Body waish	1.43ª		1.00	0.04	
Mean hatchling shall least	0.97	1.25	1.22 bc	0.04	
Mean hatchling shell length at hatch (mm) Mean hatchling shell length at hatch (mm)		0.92 <sup>ab</sup>	0.83	0.03	
	1.66	1.39	1.14°	0.01	
Mean hatchling Shell 'Mouth' Length at hatch (mm)	1.28ª	1.09	0.94ª	0.01	
Mean hatchling Shell 'Mouth' width at hatch	1.15	0.92	0.89	0.02	
(mm) Mean incubation period (days)	0.95 <sup>a</sup>	0.84 <sup>b</sup>	0.74°	0.01	
% hatchability	26.44 <sup>a</sup>	26.33 <sup>ab</sup>	25.44°	0.80	
F <sub>2</sub> = Second filial generation, F <sub>4</sub> BB = First filial	87.43°	88.09 <sup>ab</sup>		3.69	

filial generation, F<sub>1</sub>BB = First filial generation Homozygous Black, F<sub>1</sub>BW = First filial generation Heterozygous Black, SEM = Standard Error of Mean \*Means with different superscript along the same row are significantly different (p<0.05).

#### References

- Amubode, F. O. (1994). Growth and Reproductive Performance of Two Species of African
- Giant Snails (Achatina achatina and Archachatina marginata). Journal of Tropical ForestryResources, 9and 10:68-74.
- Ibom, L. A., Okon, B. and Essien, A. (2008). Morphometric analysis of eggs laid by two ectotypes of Snails Archachatina marginata (Swainson) raised in captivity. Global Journal Agricultural Science, 7(2):119-121.
- Ibom, L. A. (2009). Variations in reproductive and growth performance traits of whiteskinned x black-skinned African giant snail hatchlings [Archachatina marginata (Swainson)] in Obubra, Nigeria. Doctor of Philosophy Thesis, Department of Animal Science, University of Calabar, Calabar, Nigeria. Pp. 166.
- Ibom, L.A., Okon, B. and Adinya, I.B. (2011). Evaluation of Growth and body Traits of Snails obtained from the crossbreeding of Blacked-skinned and White-skinned snails [Archachatina marginata (S)] in the Niger Delta area of Nigeria. African Journal of Agricultural Research. 6 (2):4968-4972.
- Okon, B., Ibom, L. A., Williams, M. E., and Etukudo, O. M. (2010a). Effects of parity on Breeding and Morphometric Traits of Eggs Hatchling of F1 Crossbred of Snails (Archachatina marginata var. saturalis). Journal of Agriculture. Biotechnology and Ecology 3(1):36 -
- Okonta, B. O. (2012). Performance of giant African land Snails Archachitina marginata (Swainson) fed with selected diets. Global Journal of Bio-Science and Biotechnology, 1 (2) 182-185.
- Okon, B. and Ibom, L. A. (2012). Snail Breeding and Snailery Management. Freshdew Productions, Calabar, Nigeria.1-97.

- Okon, B., Ibom, L. A., Ettah, H. E. and Ukpuho, L. E. (2012a). Effects of Genotype.
- Protein and Energy on the Reproductive and Growth Traits of Parent and F Hatchlings of Achatina achatina (L) snails in Nigeria. International Journal o (Applied Science and Technology,
- Okon, B., Ibom, L.A., Nsa, E.E. and Ubua, J.A. (2012b). Reproductive and Growth Traits of Parents and F, Hatchlings of Achatinaachatina (L) snails under Mixed Feeding Regime with Graded Levels of Swamp taro (Caricapapaya). Journal of Agricultural Sciences; 4 (11):289 – 297.
- Okon, B. (2013). Genetic improvement of Giant African Land Snails (GALS). Proceedings of the 2<sup>rd</sup> International Conference/Workshop on Giant African Land Snails (NETGALS), 2 - 5 June,
- Owoyemi, J. E. (2014). Phenotypic differentiation of the reproductive traits of parent snails and growth traits of F1 hatchlings from crosses between two ectotypes of *Archachatina marginata* var. ovum, M. Sc. Thesis, Department of Animal Science, University of Calabar (Unpublished).
- USDA (2006). Nutritional value of the snail. From USDA standard Reference 19
- From USUA: standard Renerence 19-2006, www.usda.gov. Ubua, J. A., Ibom, L. A., Expo, T. E. and Aaron, H. A. (2012). Evaluation of the Reproductive characteristics thus subspecies of African Giant Land Shalo subspecies of African Giant Land Shalo Avaluations mannings, Journal and Archachatina marginata ovum and Archachatina marginata saturalis fed oil parciachanna marginiaia samirans via ou palm fruits in swamp forest zone of Nigeria. Continential Journal of Agnocultral Science (6) 29–33. Wosu, L. O. (2003). Commercial snails in West
- Africa, A Guide. Published by AP Express Publishers Ltd. Nigeria.