UNIVERSITY OF ABUJA
ABUJA – NIGERIA

FISHERS: Their Life – Our Life

Inaugural lecture series 3

DELIVERED By

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on

Thursday 24th November, 2005

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The Vice-Chancellor and Chairman of Occasion,

The Deputy Vice-Chancellors,

The Registrar and other Principal Officers of the University,

Deans of Academic Faculties, Postgraduate School and Student Affairs,

Heads of Department and Directors of Academic and Support Units,

Distinguished Invited Guests and Friends of the University,

Colleagues from other Universities and other Higher Institutions,

Great UNIBUJA Students,

Other Members of the University Commuynity,

Members of the Press,

Ladies and Gentlemen.

Introduction

Vice-Chancellor Sir, mu Inaugural Lecture is coming many years, about 21 years after I was promoted a Professor in the Department of Biological Sciences at Ahmadu Bello University, Zaria. The non-delivery of an inaugural lecture was not due to lack of interest or will on my part, but because when I became a Professor on October 1st, 1984, Ahmadu Bello University did not have the culture of Inaugural Lecture Series. I suggested the culture to colleagues in my Faculty but the suggestion received no support and it died a natural death. When the idea was suggested to me here sometimes ago by a letter dated 15th March, 2002, I initially turned it down because I saw it as a belated exercise, particularly since I will soon be bowing out of the system. But having though over it for over 3 years, I accepted the idea in August, 2005. The fact that this Lectures is coming at the tail end of my career made me feel that I am actually giving a Valedictory Lecture, and not an inaugural. I am very happy that the University of Abuja decided to imbibe the culture of the Inaugural lecture. May this wisdom continue to grow from strength to strength – Amen. Consequently, I am very delighted to stand before you today (24th November, 2005) to delivery my Inaugural Lecture, the third in the University of Abuja Series. I am more proud because I am one of the pioneer academic staff of this great University.

When I graduate in June, 1969, I had the burning desire to further my education by pursuing a Master's Degree in Zoology. My problem, however, was choosing an area of specialization. Several options were open to me, for example, Entomology (Study of Insects), Parasitology (Study of Parasites), Microbiology (Study of Minute Life), Wildlife Biolgy

(Study of Wild Animals), Freshwater Biology (Study of Life Inside Freshwater Habitats), Marine Biology (Study of Life in Sea or Ocean (Salt Water) Habitats) and a host of several areas of specialization. By divine guidance, I chose Freshwater Biology. On obtaining my Masters in 1971, I did not have any problem in choosing Fisheries Biology as my area of specialization. Why did I choose fish? The answer is simple. I chose fish because, I can easily convert them to food after my research work. Thus, the fish is serving two purposes; research, to earn me a Ph.D degree and also consumption, to nourish my body. Later, I discovered that there is much more to the fish than my two selfish motives.

Fish – My Subject of Study

According to Lagler et al. (1962), Fish are cold blooded animals, typically with backbones, gills and fins and are primarily dependent on water as a medium to live.

When the word FISH is mentioned so many things usually come to the mind of people. To a Pastor, for example, he may be thinking about how Jesus fed multitude with five loaves of bread and some fishes (John 6:9-13; Matt. 15:34-38), to a relaxation bar patron or proprietress of a club, she may be thinking of fish pepper soup at her joint, but to a fishery biologist, fish is an animal of study and research. We all have come in contact with fish either through consumption, aquarium or sport fishing.

Fishes are the most numerous of the vertebrates. The first fishes probably developed about six hundred millions years ago while the bony fishes (Osteichthyes) appeared about 300 million years ago (De Carli, 1975). Since their appearance, fishes have been subjected to the processes of evolution through natural selection and has changed in appearance. The modern fishes come in many shapes and sizes. Figure 1 a and b shows variety of fishes found in freshwater and marine habitats.

DIAGRAM

Figures not drawn to scale

Figure 1a: Some Fishes of Fresh Water habitat (source: Reed et al., 1967).

DIAGRAM

Figures not drawn to scale

Figure 1b: Some Fishes of Marine habitat (source: Schneider, 1990).

Fish is one of the most diversified groups of animals known to man. There are about 30,500 species in existence (Lagler et al, 1977). This means that there are more species of fishes than all other vertebrates combined. It is an important ecological link in the food chain of animals and plants living inside the water. Among the vertebrate inhabitants of water, fish is the most numerous, and in my opinion, the most successful. Their success can be hinged on the following factors which gave them higher advantage of survival:

1. Complete conquer of their environment by full adaptation to living in water;
2. Occurrence of a large number of individuals;
3. Possession of a high degree of physiological adaptations; thus making them to survive under harsh and adverse conditions;
4. Ability to occupy and exploit successfully a wide range of habitats (freshwater, marine and brackish waters);
5. High reproductive (viviparous, ovoviviparous and oviparous capacity which guarantees high survival rate;
6. Adaptability to consume variety of food (carnivorous, herbivorous, omnivorous);

7. Ability to escape from danger and predators.

While I do not want to bother you with scientific names and technicalities, it is important, however, to relate fish to other members of the animal kingdom and other vertebrates and see where they belong taxonomically. Figure 2 shows a simplified diagram of the position of fish in the animal kingdom.

CHART

Figure 2: The Position of Fishes in the Animal Kingdom

As a rule, all fishes live inside water. However, some (for example, *Clarias gariepinus and Periophthamus Papilla*) have been found to venture into land for short or long periods depending on their anatomical modification and circumstances warranting such venture, Fishes colonized all form of aquatic habitats ranging from freshwater to marine and the intertidal brackish water between them.

How does fish satisfy human needs or want?

Let us briefly look at the importance of fish to man

1. Fish as Food

The importance of fish in human nutrition cannot be over-emphasized. Fish is an important and cheap source of animal protein. In Asia, about 50% of animal protein intake comes from fish while in African the proportion is about 18% (William *et al. 1998).* In Nigeria, fish constitute about 40% of animal protein intake and can be as high as 80% in riverine areas (Olatunde, 1992, 2004). Fish is rich in thiamine, riboflavin, vitamins A,D,E, and K, minerals and polyunsaturated fatty acids which are essential for healthy living. The absence of these minerals and vitamins in diets may result in dangerous consequences (Eyo, 2011) as shown on Tables 1 and 2.

Table 1: Sources and Function of Vitamins

VITAMIN	SOLUBILITY	BEST SOURCES	DEFICIENCY	FUNCTIONS
VITAMIN A Retinol Carotene Provitamin A	Fat soluble	Fish, egg, palm oil	Night blindness	Required in the synthesis of visual purple present in the retina of the eye; which is needed for vision in dim light
VITAMIN B1 Thiamine	Water soluble	Fish, liver, grain	Beri-beri	Needed in the metabolism carbohydrates
VITAMIN B2 Riboflavin	-do-	Milk and eggs	1) Cracking of the corners of the mouth 2) Sore skin	Essential for carbohydrate metabolism and a constituent of some enzymes
VITAMIN B3 Niacin Folic acid	-do- -do-	Fish and meat Green vegetable, fish, liver, kidney	Dermatitis Anaemia	Essential for carbonhydrate metabolism Required for the normal development of crythrocytes
VITAMIN B6 Pyridoxine	-do-	Fish, liver, legumes	1) Muscular weakness 2) Insomnia	Actively involved in the metabolism of protein, fat and carbohydrates
VITAMIN B12 Cobalamine	-do-	Fish, liver	Pernicious anaemia	Required in the metabolism amino acids
VITAMIN C Ascorbic acid	-do-	Fruits and fresh vegetable	Scurvy	Maintains the connective tissues, blood capillaries membranes
VITAMIN D Calciferols	Fat soluble	Fish, liver	Rickets in children, Osteomalacia in adults	Essential for calcium and phosphorus metabolism.

				Required for the development of bone and teeth. Certain amount can be generated from exposing the skin ultraviolet light
VITAMIN E Tocopherol	Fat soluble	Fish, milk and cereal	1) Infertility 2) Weakness of muscles	Plays active role in carbohydrates and protein utilization. Required in the maintenance of muscular activity. Functions as antioxidants
VITAMIN KI	Fat soluble	Fish, liver and vegetables	Haemorrhage	Needed for the formation prothrombin, which is involved the clotting of blood

(Adapted from Eyo, 2001)

Table 2: Sources and Functions of Minerals

MINERALS	BEST SOURCES	DEFICIENCY	FUNCTIONS
Calcium	Fish, milk and snail	Malformation of bones and teeth	Assist in the absorption of iron and healing of wounds
Phosphorus	Fish, milk	Rickets	Require for the formation of bones and teeth
Iron	Fish, liver, eggs, green vegetables	Iron deficiency anaemia	Essential for haemoglobin formation

Iodine	Fish, milk, crabs, water plants	1) Stunted Growth 2 Goitre (enlargement of thyroid gland)	Component of thyroxin which functions in the regulation of metabolic rate, iodised salt can used to prevent deficiency
Fluorine	Fish	Dental carries	Essential in the functioning of cells and in the alkalinity of bile and blood
Potassium	Fish, milk, egg, fruit	Disfunctioning of the heart and respiratory system	

(Adapted from Eyo, 2001)

The polyunsaturated fatty acids are successful in reducing high level of plasma cholesterol. Fish is highly recommended because of its essential Fatty Acids (EFA). The EFA fall into the Omega series which are present in different proportion of lipids of various foods. Fish lipids are high in Omega 3 acids which alleviate the incidence of heart diseases (e.g. arteriosclerosis, coronary thrombosis), cerebrose chlorosis, rheumatoid arthritis and diabetes. It decreases the risk of bowel cancer and reduces insulin resistance in skeletal muscles. Omega – 3 fatty acids also lower the risk of age related muscular degeneration and vision impairment (Eyo, 2001). Fish is a good source of sulphur (Amiengheme, 2005).

Fish is easily digestible and it is not associated with any religious or tribal taboo, as other meat products. For example, certain tribes in Nigeria do not eat snails. Certain religious groups do not eat pork, and the Hindus do not eat beef. The muscles are less tough when compared with beef, mutton, chicken or venison (bush meat). When compared with other sources of meat, fish is easily available in every village in Nigeria. This is made possible because it can be processed by smoking, salting, freezing, frying, icing, canning and drying and sold far away from the areas of capture (Olatunde, 2004). Availability of fish and fish products even in remotest village in Nigeria is a phenomenon taken for granted.

From my studies (Olatunde, 1980) I found that they contained up to 54% protein and 34% of lipids per 100g of dry weight. Some carbohydrates were also detected (Table 3).

Table 3: Chemical Composition of Schilbeids

Samples	Average Chemical Composition					
	g/100g of wet weight		g/100g of dry weight			
	Water	Ash	Organic matter	Lipid	Protein	Carbohydrate
Physaillia pellucida	70.4	8.8	91.2	34.3	47.0	9.9
Eutropius niloticus	74.0	10.8	89.2	29.4	54.2	5.6
Schilbe mystus	72.4	11.7	88.3	32.3	40.7	15.3

(Adapted from Olatunde, 1980)

Apparent fish consumption in Nigeria is estimated to be a little over 6Kg per year. This level is significantly below that of Ghana and Cameroon, which are 20 and 8 – 9 Kg respectively (FAO, 1979). Consumption of fish in Nigeria accounts for approximately 4% of the total protein consumption and 30% of animal protein consumption (FAO, 1993). (FAO, 1995) report also indicated that fish provided about 4% of the protein intake for nearly 2/3 of the world human population.

2. Fish as an Employment Provider

Fish provide means of livelihood to millions of people all over the world. It has been estimated that there are about 12 million artisanal fishermen in the world while about 15 million are engaged in ancillary activities such as processing, preservation and distribution.

According to Federal Department of Fisheries (FDF) (1994), more than 1.0 million people have direct and secondary employment in the fisheries sector in Nigeria. The bulk of these people are part-time fishermen. At the artisanal level an estimated 450,000 fishing families are involved in fish production while 1 000,000 "fish mammies" are involved in processing and marketing.

Fish exploitation contributes about 5% of Nigeria's Gross Domestic Product (GDP) providing jobs for fulltime and part-time fisher folk, boat builders, nets and hook manufacturers, trap producers and fishmongers. There is therefore no doubt that our fishery resources contribute in no small measure to the growth of the nation's economy.

3. Fish as Foreign Exchange Earner

Fish, through export are capable of earning foreign exchange if properly harnessed.

4. Fish as Raw Materials

Trash fishes and small (dwarf) fishes which are not acceptable for human consumption are converted into fish meal for production of animal feeds.

5. Fish in Traditional Medicine

Fish has been in use in preparation of traditional medicine. The electric cat-fish (Malapterurus electricus) and Clarias gariepinus have been used to prepare 'Isoye' which is a local herbal soup taken by students to revitalize their brains.

6. Fish in traditional Marriage

The use of fish as part of the dowry is a popular tradition throughout Nigeria. Big sizes of Gymnarchus niloticus and Clarias gariepinus are fishes popularly involved in such ceremonies. Without these fishes no dowry is complete.

7. Fish as a Decorative Object

We all admire in our sitting rooms and public places good aquaria with gold fishes or other tropical fishes as objects as decoration.

8. Fish for Recreational Activities

In Nigeria and some developed countries fishing is done for leisure and sporting activities. Overseas, Clubs are formed for this. In Nigeria, the Argungun Fishing Festival readily comes to mind.

9. Other Known Uses

According to Moses (1983) some parts of the fish are used for other purposes as follows:

(i) Fish oil besides being used as food, is used in the manufacture of soap;

(ii) Isinglasses is an adhesive made from fish bones.

(iii) The skin of some cartilaginous (Chondricthyes) fishes makes useful leather and polishing materials.

(iv) The scales of some fishes yield a substance that when coated on the inside of glass beads make artificial pearls.

There is no doubt about the usefulness of fish to man.

Research Areas of Focus

I have researched and guided others into the biology of some freshwater (inland) fishes in Nigeria since 1974. My main areas of focus are:-

(i) Food and feeding habits;

(ii) Enzymology;

(iii) Age determination and growth;

(iv) Reproduction and Fecundity.

My lecture will dwell largely on the above issues in fisheries.

WATER

According to Lagler et al. (1962) I quote: "Water is highway, byway, communications medium, nursery, playground, school, room, bed, board, drink, toilet and grave for a fish". All the fishes vital functions e.g. feeding, digestion, assimilation, growth, responses to stimuli and reproduction are dependent on water. There is no way we can talk of fish without mentioning water. This is very obvious because water is the most fundamental aspect of the biology of any fish.

Oxygen, light penetration, temperature and absence/presence of toxic materials in the water are the most important. The oxygen (0_2) is very important for survival of fish. Fish require adequate concentrations of dissolved 0_2 for survival and growth. Various studies have shown that fishes can survive in water with a range of 4-8 mg/L of 0_2 concentration (DFRRI, 1988). Water transparency is also of importance because of the light energy which is trapped by the phytoplankton (primary producers) during photosynthesis. Thus, if the transparency of water is less than 10 cm, there will be problem. PH of 6.5 – 9.6 (Boyd, 1979) is also suitable for fish. It is therefore very obvious that anything that will disturb the balance of the aquatic habitat will definitely adversely affect the fish. Turbidity disturbs photosynthesis, and this lessens productivity.

High temperature is not suitable for the fish. Although tropical fishes are known to be able to tolerate high temperatures, there is a limit to their tolerance. A range of 18^0C to 32^0C is suitable for a tropical freshwater fish. High temperature also reduces the amount of oxygen in the water.

High concentration of toxic materials (pollutants) in the water is also very dangerous to the fish. Sources of these pollutants range from household (domestic) to agricultural and industrial wastes.

FOOD AND FEEDING

In order to grow, reproduce and get energy to perform its physical and metabolic functions, fish, like any other living animal, needs adequate nourishment. The fish derives its nutrition principally from protein, lipids and carbohydrates; vitamins and mineral salts are also essential for the development of fish. Both plants and animal food sources which orginate from the water (autochthonous) and from outside the water (allochthonous) form the diets of fish.

In my study of food and feeding habits, the following conclusions were reached:

i. That food selection changes with age and size. The mouth gape and the particulate sizes of the food are of paramount importance. Also, as the fish is growing older its mastery of food gathering techniques becomes progressively perfected. It is therefore expected that the older the fish, the more varieties of food it can utilize. Small size plants (*phytoplankton)* and animals (*zoo plankton*) usually form the diets of fingerlings and juveniles, while larger plants and animals form the diets of the bigger fishes (OLatunde, 1979a).

ii. Fishes feed at different strata of the water. In *Malapterurus electricus* the small sizes feed predominantly at the bottom of the river while the bigger fishes feed at the pelagic zone (Olatunde, 1984).

iii. It was also found that where fishes select the same diet, feeding intensity varies with species of food organism selected. Thus, the food organisms which from principal diet of a fish may be of secondary importance to another. For example, Olatunde & Moneke (1985), in their study of food habits of four mormyrid species in Zaria, found that they were all carnivorous, feeding principally on insects; while *Marcusenius senegalensis* and *Petrocephalus bovei* fed on *chironomid larvae,* with *trichopteran larvae* and dragon fly nymphs as secondary diets respectively. *Mormyrus rume* and *Hippopotamyrus pictus* fed principally on *trichopteran larvae* while Chironomid larvae and *ephemeropteran nymphs* formed the secondary diets respectively (Tables 4,5,6 and 7).

Table 4: Percentage Composition and Relative Importance of Dietary Items in the Food of Marcusenius senegalensis

No. of stomachs with food = 106
No. of stomachs without food = 19
Total number of stomachs examine = 25
Standard lengths of fish examined = 13.5 -22.4cm

Food Items	**% Frequency of Occurrence**	**% Total Points**
Insect remains	71.1	12.5
Adult insects	2.2	0.3
Coleoptera	2.2	0.2
Hemiptera		
Immature insects	16.6	4.1
Ephemeroptera Nymph	9.0	2.2
Dragonfly Nymph	9.0	2.3
Damselfly Nymph	7.8	1.8
Megaloptera Larvae	30.0	6.6
Trichoptera Larvae	26.7	5.8
Coleoptera Larvae	92.2	37.3
Diptera Larvae + Pupae		
Chironomid Larvae	92.2	37.3
Chironomid Pupae	30.0	4.5
Chaoborus Larva	4.4	0.8
Chaoborus Pupae	6.7	1.2
Heleidae Larvae	17.8	1.2
Stratiomyiade Larvae	2.2	0.3
Anthomyiidae Pupae	2.2	0.3
Total insects		81.4
Fish eggs	9.0	0.7
Total Fish		0.7
Ostracods	24.4	2.7
Clam shrimps	17.8	3.2
Copepod (Cyclops)	1.1	0.1
Total Crustacea		5.3
Hydracarina	16.7	0.7
Total Arachnida		0.7
Oligochaetes	7.8	3.5
Total Annelida		3.5

Detritus	17.8	1.5
Total bottom deposits		1.5
Algae	5.6	0.3
Plant remains	2.2	0.3
Seeds	37.8	4.8
Total plant origin		5.4
Others		1.5

(Source: Olatunde and Moneke, 1985)

Table 5: Percentage Composition and Relative Importance of Dietary Items in the Food of Momyrus rume

No. of stomachs with food = 64
No. of stomachs without food = 16
Total number of stomachs examine = 80
Standard lengths of fish examined = 19.4 -37.3cm

Food Items	**% Frequency of Occurrence**	**% Total Points**
Insect remains	47.7	11.9
Adult insects		
Coleoptera	3.3	0.5
Immature insects		
Ephemeroptera Nymph	11.7	4.9
Dragonfly Nymph	16.7	4.8
Trichoptera Larvae	53.3	26.3
Coleoptera Larvae	8.3	1.4
Diptera Larvae + Pupae		
Chironomid Larvae	71.7	24.6
Chironomid Pupae	8.3	1.0
Chaoborus Larva	16.7	2.5
Chaoborus Pupae	3.3	0.2
Heleidae Larvae	45.0	7.8
Anthomyiidae Pupae	1.7	0.1
Total insects		86.0
Ostracods	1.7	0.1
Clam shrimps	3.3	0.8
Total Crustacea		0.9
Water spide	1.7	0.2

Total Arachnida		0.2
Gastropoda	3.3	0.3
Total Mollusca		0.3
Oligochaetes	8.3	3.8
Total Annelida		3.8
Sand and pebble Detritus	11.7 15.0	2.2 2.2
Total bottom deposits		4.4
Plant remains Seeds	11.7 21.7	0.9 2.4
Total plant origin		3.3
Others		1.1

(Source: Olatunde and Moneke, 1985)

Table 6: Percentage Composition and Relative Importance of Dietary Items in the Food of Petrocephalus bovei

No. of stomachs with food = 54
No. of stomachs without food = 15
Total number of stomachs examine = 69
Standard lengths of fish examined = 8.2-9.3cm

Food Items	% Frequency of Occurrence	% Total Points
Insect remains	71.1	24.4
Adult insects		
Coleoptera	10.5	2.7
Hemiptera	2.6	0.3
Immature insects		
Ephemeroptera Nymph	5.3	2.4
Dragonfly Nymph	31.6	12.4
Hemiptera Nymph	23.7	5.4
Damselfly Nymph	7.9	3.2
Megaloptera Larvae	2.6	0.4
Trichoptera Larvae	34.2	15.8
Diptera Larvae + Pupae		
Chironomid Larvae	65.8	16.5
Chaoborus Larva	21.1	7.5
Heleidae Larvae	5.3	0.3

Total insects		91.3
Clam shrimps	2.6	0.2
Copepod (Cyclops)	15.8	2.8
Total Crustacea		3.0
Hydracarina	5.3	0.4
Total Arachnida		0.4
Lamellibranchia	2.6	0.1
Total Mollusca		0.1
Oligochaetes	5.3	1.3
Total Annelida		1.3
Seeds	18.4	2.9
Total plant origin		2.9
Others		1.0

(Source: Olatunde and Moneke, 1985)

Table 7: Percentage Composition and Relative Importance of Dietary Items in the Food of Hippopatamyrus pictus

No. of stomachs with food = 29
No. of stomachs without food = 2
Total number of stomachs examine = 31
Standard lengths of fish examined = 15.8-25.1cm

Food Items	% Frequency of Occurrence	% Total Points
Insect remains	65.4	14.6
Adult insects		
Coleoptera	7.7	0.4
Immature insects		
Ephemeroptera Nymph	50.0	25.0
Dragonfly Nymph	7.7	1.6
Damselfly Nymph	11.5	0.8
Megaloptera Larvae	3.9	0.8
Trichoptera Larvae	65.4	35.1
Diptera Larvae + Pupae		
Chironomid Larvae	61.5	13.4
Chironomid Pupae	7.7	0.4
Heleidae Larvae	15.4	2.2
Total insects		94.3

Ostracods	3.9	0.1
Clam shrimps	3.9	0.3
Total Crustacea		0.4
Seeds	23.1	4.2
Total plant origin		4.2
Others		1.1

(Source: Olatunde and Moneke, 1985)

iv. The availability of food organism varies with seasons of the year. At certain periods of the year, some food organisms are generously available while the same organisms become scarce in another period. However, where is always enough for the fish to take at any time all the year round. This phenomenon was noticed in my various studies of food and feeding habits. (Olatunde & Moneke, 1985; Olatunde, 1979a; Olatunde, 1978b) (Figure 3).

v. Fishes often avoid competition for food hence they employ various strategies and discussed under II and III above.

CHART

Figure 3: Season variation food items of *Eutropius niloticus*

(Source: Olatunde, 1978b)

Enzymology

Ability to utilize food materials consumed by any organism depends largely on the capacity of the animal to digest and assimilate the food materials consumed. It has been shown that the types of enzymes present in digestive tract is correlated with diets of the fish (Ben-Tuvia, 1960; Ita, 1971; Fryer & Iles 1972; Fagade, 1982). In the studies of digestive enzymes in the alkimentary tracts of *Physalia pellucida, Eutropius nilotius and Schiibe mystus* (Olatunde & Ogunbiyi 1977; Olatunde et al., 1991) it has been shown (Olatunde, 1978b) that the diet of *E. niloticus* consists of insects, fish and crustaceans. Plant material was also found in the stomachs, although in a small quantity. The relatively high combined proteases and low amylase activities can be correlated with the proportion of protein and carbohydrates in the diets (Table 8).

Table 8: Activities of The Enzymes in the Alimentary Tracts of the Three Common Schilbeid Species in Lake Kainji, Nigeria

	FISH SPECIES		
	P. pellucida	*E. niloticus*	*S. mystus*
Enzymes			
Proteases	Mg tyrosine equivalent formed/mg protein/24hr at 37^0C		

Trypsin	0.97	0.16	3.02
Pepsin	5.48	2.44	3.21
CARBOHYDRASES	Mg glucose equivalent formed/mg protein/24hr at 37^0C		
Amylase	0.00	0.77	5.70
Invertase	0.00	0.00	0.00
Lactase	0.00	0.00	0.00
Maltase	0.00	0.00	0.00
Cellulase	0.00	0.00	0.00

(Adapted from Olatunde and Ogunbiyi, 1977)

The three enzymes detected in Schlibe mystus had relatively high activities. The high trypsin and pepsin activities were not surprising in view of the large amount of fish and insects materials in its diets. Analysis of the diets of *S. mystus (Olatunde, 1979a)* showed that the food consists mainly fish and insects. The food consumed by *P. pellucida* is mainly insects and crustaceans (Olatunde, 1979a). The presence of proteases only in the gut was therefore in perfect agreement with its diet.

AGE DETERMINATION AND GROWTH

In the study of life history and growth of fish, age determination is an important factor. Ability to determine the age of fish is an important tool in fishery biology (Tesch, 1967). Knowledge of age is very useful when information is needed about the following:

(a) Life span of the fish i.e life expectancy.

(b) Age at the attainment of sexual maturity.

(c) Age at which the fish is ready for harvesting.

(d) Stock composition of a given water body i.e year, class composition, dominant year class, declining year class, etc.

(e) Comparative growth rate of fish in different environment thereby determining the success or other wise of the fish in a particular habitat.

(f) Mortality rate as it affects age groups or year classes.

Age determination is based on counting annular configuration in hard parts of the body representing seasonal irregularities in growth. Structures frequently used in this respect are otoliths and scales. Obviously, seasonal differences in tissue activity result in different deposits of extra cellular material in internal skeletal parts during period of favourable and unfavourable seasons. Thus, well-defined alternating annular configurations may be found.

The use of scales to determine the age of fish has been accepted for many years. In scaleless fish, such as the siluroids (Catfishes), age has been determined from year marks (annuli) found in hard bony structures such as otoloths, opecular bones, vertebrae, fins and spines (Sneed, 1951; Cuerrier, 1951; Marzelf, 1955 and Van Der Waal & Schoonbee, 1975). It is now well 1951; Marzelf, 1955 and Van Der Waal & Schoonbee, 1975). It is now well established in temperate parts of the world that rings observed in various hard structures are annual in nature. In areas with less distinct seasonal fluctuations in climatic region such as the tropics, the annual periodicity of ring laid down in hard tissues of some fish is still questionable (De Bont, 1967) but some works have indicated that some tropical fish species do lay annual rings in scales and other hard tissues. Such works include that of *Hydrocynus vittatus* by Balon (1971) *Sargozensis* by Chitravindivelu (1974), *tilapia rendalli* by Bast! (1974) *Clarias gariepinus* by Pivnicka (1974) *Eutropius depressirostris by Gaigher (1969)* and Cerny (1974) and *Schilbe mystus* by Frank (1974).

I successfully used pectoral spines to age *Eutropius niloticus* and *Schilbe mystus* in Lake Kainji, Nigeria (Olatunde, 1979b). Plates 1,2 and 3 show the annuli from sectioned spines of *E. niloticus and S. mystus.*

Apart from aging fish using hard bony structure, analysis of size frequency distribution (Petersen Method), marking and tagging of fishes are also employed, but they all have their limitations. Gaigher (1969) used pectoral fin to determine the age of *Eutropius depressirostris* in Transvaal, South Africa. Fagade (1974) used *otolith* to age *Tilapia melanotheron* in Lagos Lagoon.

DIAGRAM

Plate 1: Transverse Section of a Pectoral Spine of Eutropius niloticus, aged 4 + years

DIAGRAM

Plate 2: Transverse Section of a Pectoral Spine of Eutropius niloticus, aged 2 + years

DIAGRAM

Plate 3: Transverse Section of a Pectoral Spine of Schilbe mystus, aged 3 + years

Growth Studies

Growth in fishes can be defined as addition of weight and length (tissue) to the already existing structure. It therefore implies that any fish which is growing, is expected to add to its body weight and length as time goes by. By implication, a fish depreciating in length and weight is not growing or has retarded growth. The growth of the fish is genetically determine.

Growth in fishes is unlike growth in most warm blooded animals in that it is relatively inderminate. Cessation of grown is not associated with sexual maturity as it is in most warm blooded animals. Fishes continue to grow throughout life, although growth is relatively slower in larger and older fishes than the smaller and younger ones. Fishes usually exhibit annual cycles of growth. In seasons when food is available in large quantities and other physical and chemical conditions of the water are favourable, growth is faster. The reverse is the case if there is shortage of food and the environmental factors are harsh.

Growth pattern can be mathematically determined, because there is always a relationship between length and weight. This relationship can be determined using the following formula:

$W = aL^b$ (Le Cren, 1951)

Where: a = is constant

b = an exponent (slope)

w = weight of the fish (g)

L = Standard Length of the fish (cm)

The exponent (b) usually fluctuates between 2 and 4 and most frequently near 3 since growth represents an increase in three dimensions. When value of b is 3 or very near 3, the growth is said to be isometric. Where the b value departs from 3, growth is said to be allometric, positively allometric when it is higher than 3 (>3) or negatively allometric when the value is below 3 (<3).

The empirical data which normally give a curvilinear relationship when plotted, (Fig. 4a) can be transformed into logarithms in order to obtain a straight line relationship when plotted on a graph (Fig.4b and C) using the formula: $\text{Log } W = \log a + b \log 1$.

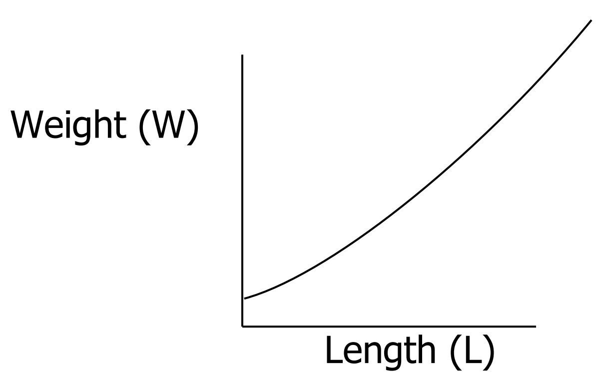

Figure 4a: Length –Weight Relationship in Fishes using Empirical Data

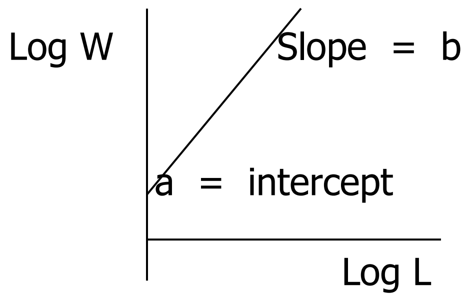

Figure 4b: Length –Weight Relationship in Fishes using Log Data

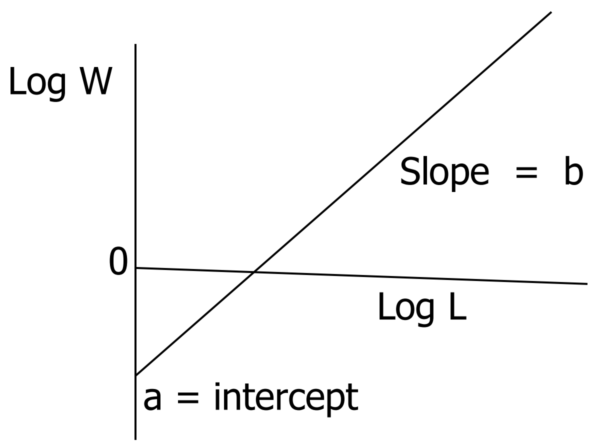

Figure 4c: Length –Weight Relationship in Fishes using Log Data

Thus it is easier to determine the weight of a fish from the length and vice-versa without necessarily measuring the two parameters for an individual fish.

Condition Factor

This is sometimes known as ponderal index and describes the well being of a fish or the state of health of a fish at a given time. This can be calculated using the formula

$$K = W/L^3. \text{ (Le Cren, 1951)}$$

This can also be multiplied by a factor of 100 if centimeter is used for the length, or 1000 if millimeter is used for the length. Usually, there is no fixed K value expected, because of the differences in length and weight of the fish. However, it is expected that if the fish is in good condition, the value must circulate around the mean for the group. Olatunde (1979b) found that the *Schilbeids* in Lake Kainji were in good condition.

REPRODUCTION

Reproduction in fishes is the process by which species are perpetuated and by which, in combination with genetic change, characteristics for new species first appear. Enemies and natural events are selective, and life would soon be extinguished if the reproductory functions are not sufficiently effective.

Sexes are usually separate in fish but normally hermaphrodite species are known. Males develop sperm in their testes and it consists of spermatozoa capable of swimming and is resistant to the external environment for a brief period. The female has an ovary where the eggs mature. Fish can be oviparous, ovoviviparous or viviparous with many intermediate stages. Majority of the fishes are oviparous and they deposit their eggs outside where the males and sperm to them. In this case, fertilization, to some extent is a matter of chance. The possibility that some eggs will not be fertilized exists. The oviparous fishes are characterized by the emission of a high number of eggs. Oviparous fishes produce two kinds of eggs; those that float, those that sink. In ovoviviparous the fertilized egg stays inside the mother's body, her genital organ having developed an incubatory sac. In viviparous fishes the internal sac is adapted in such a way that the egg can be nourished as well as incubated. These last two methods permit the best possible survival. Reproduction is an extremely important event and the search for a suitable place for the young fishes is part of the care taken to ensure the continued survival of the species. Some species such as the Salmon and eel, undertake very long journey to find the right place. Many Salmon and ee's die immediately after reproduction. (Lagler, et al, 1962).

Fish that spend their growing period in freshwater and then go down to the sea to breed are said to be CATADROMOUS (e.g. eels). Those that go from the sea to breed in freshwater are said to be ANADROMOUS (e.g. Salmon and Sturgeon).

Sex and Sexual Dimorphism

In several catfishes, only the males possess external genital papillae. In Lake Kainji, the males of all the *schilbeid species* investigated possess genital papillae. Reynolds (1970) also notice their presence in the males of the schilbeids in Lake Volta. Bhatt (1970, 1971a & b, 1972) reported their presence in some Indian catfishes, *Mystus seenghala, Heterophreustes fossilis, M. cavasius* and *M. vittatus.* Bishai, & Gideira (1968) and Willioughby (1974) observed that some species of *Synodontis* possess genital papillae. Apart from the catfish, these papillae are also found in the males of *Petromyzon sp., Etheostorma nigrum and Roccus chrsops (*Lagler *et al.,* 1962). The genital papilla is an external secondary sexual structure and its function is not known. It is however possible that its presence may help the females in identifying the males during their spawning associations.

Differnces in sizes were alkso noticed. According to Nikolsky (1963) the females are usually larger than the males, although in some few species of Cyprinoids, the males and larger. Sex size differences usually reflect sexual differences in growth rates. In Lake Kainji the female *schilbeids* are generally larger than the males (Olatunde, 1978a). Similar size differences have been noted in Lake Volta by Reynolds (1974) for *P. pellucida* and*Siurandon auritus* and in some other fish by several workers. The advantage of the differences in size is not known. However, it has been noticed that in most cases where males are larger, the males often protect the offspring, thus larger size might be a protective adaptation (Nikolsky, 1963). Similarly, larger size in females can also be taken as an adaptation to their reproductive functions e.g. production of eggs, nest building, care of the young etc.

Sex Ratio

The sex ration indicated that more females than males are caught in all *schilbeid species* investigated. The sex ratio was found to vary with season and among age group and sizes, although the overall patter of more females was maintained, (Olatunde, 1978a).

A preponderance of females during the breeding season was also seen in Hu'sa Ilisha by Mathur (1964), in *Ophisthopierus tardoore* by Radharkrishman (1963) and *Mystus a or* by Saigal, (1964). In *Siluranodon auritus* only two males were captured and nearly all the females captured were gravid. This might indicate sexual segregation, with females arriving at the spawning grounds before the males (Ehrenbaun, 1909: Scheuring, 1929), although in some fishes e.g *Catostomus sp.,* and *Semotilus sp.,* the males arrive first (Lagler *et al,* 1962*).* In P. pellucida wide variations in sex ratio did not occur thought the year. Preponderance of females may be an adaptation for the survival of the species in their new environment; since more females means greater population fecundity. This is however based on the assumption that one male is capable of fertilizing eggs from several females. Sex ratio divergencies might also be explained by partial segregation of ripe forms, either through habitat preferences or school formation, thus rendering one sex more vulnerable to capture than the other (Reynolds, 1974).

The preponderance of females in species other than the *schilbeids* has been reported in some freshwater species in tropical and temperat countries. Willoughby (1974) noted this in some species of *Synodontis* in Lake Kainji – Nigeria, while Reynolds (1974) recorded the same in *Clupeidae* and *Barbus* species in Lake Volta in Ghana. In the temperate region, Penezak (1967) and Lelek (1959) recorded more females than males in *Leucscus leuciscus* and *Squalus cephalus*.

Size at Maturity

The general trend was that the males mature at a slightly smaller size than the females. Sexual maturity can be assessed by either consideration of size or age of fish. In cases where maturity is size dependent, first maturity is attained at very small sizes (Imevbore, 1970). In the species whose maturity depends on age, this is influenced by the growth rate of the fish (Imevbore, 1970). Thus a fish with faster growth will mature at a bigger length than a fish with slow growth rate. This is true of *E, niloticus* and *S. mystus* whose males and females exhibit differential growth rate, with faster growth in females than in males (Olatunde, 1978a).

In Lake Volta, Reynolds (1974) noted that the males of the pelagic fish which include *P. pellucida*, mature at a smaller size than the females. This was also noted in *Eutropius depressirostris* by Groenewald (1964) and in *S. mystus* and *E. niloticus* in the River Niger before the impoundment by Imevbore (1970). The same phenomenon was noted in Barbus by Qasim & Qayyum (1964) and Reynolds (1973 & 1974) and in many *clupeids* by Reynolds (1974). Ben-Tuvia (1960) and Mathur (1964).

Reproductive Cycle

Most tropical fish species are known to breed during the rains when the water level is high. Many workers have observed this in several freshwater fishes in various water bodies in Africa. Daget (1954) observed this in the Upper Niger, Blache (1964), in Lake Chad, Reed et al. (1967) in rivers of Northern Nigerian, Wellcome (1969) and Okedi (1969) in East African Lakes.

Before the impounding of the Middle Niger in 1968, studies conducted by Banks *et al, (1965),* Imevbore (1970) and Motwani & Kanwai (1970) revealed that several species of fish, including schilbeids, breed during the rainy season. At that time, breeding took place mostly between June and September during an annual cycle and the swamps served as spawning grounds. The swamps were also fund to offer food and protectin for the young fish (Imevbore & Bakare, 1974). After the formation of the lake, the breeding season for most species remained virually the same (Imevbore & Okpo, 1975; Willoughby, 1974; Lewis, 1973 and Lelek, 1972) despite the changes in the environment.

Spawning Periodicity

The analysis of egg sizes indicated that *E. niloticus* and *S. mystus* spawn once during the breeding season while fractional spawning occurs in *P. pellucida*. Most species with a prolonged spawning season are fractional spawners. Reynolds (1974) observed that *P. pellucida* in Lake Volta is a fractional spawner.

Fractional spawning and prolonged spawning seasons are characteristics of some tropical and subtropical species of fish. In temperate water, only a small number of fish exhibit fractional spawning, while none exists in the Arctic region (Nikolsky, 1963).

Fractional spawning has evolved in some species as an adaptation to food supply. According to Nikolsky (1963) it also ensures the preservation of the species under unfavourable spawning conditions.

Fecundity

Fecundity of fish is defined by Bagenal (1968) as the number of ripening eggs in the female prior to the next spawning period. The need to know the number of eggs being carried by an individual underscores the importance of reproduction in the life of fishes. Thus a fish which is highly fecund has higher chances of perpetuating itself than a fish which is less fecund. The fecundity of fish can be correlated with the size and age of fish (Tables 9 and 10).

Table 9: The Fecundity of Eutropius niloticus in Lake Kainji

S.I of fish (cm)	Wt. of fish (g)	Gonad Wt. (g)	Fecundity (mean estimate of five determinations	Standard deviation	Number of eggs per gram wt. of ovary
17.0	60	6.80	13,905	166	2,044
17.8	61	6.34	13,918	707	2,195
18.0	66	7.07	16,146	229	2,283
91.0	75	5.50	14,907	252	2,710
19.5	83	10.24	15,496	833	1,513
20.0	110	8.43	21,920	696	2,600
20.6	120	8.00	16,758	762	2,095
21.0	145	12.00	26,675	799	2,140
21.1	135	9.45	21,841	1344	2,311

(Adapted from Olatunde, 1978a)

Table 10: The Fecundity of *Physailia pellucide* in Lake Kainji

Standard length of fish (cm)	Weight of fish (g)	Gonad weight (g)	Total Fecundity (mean of 5 determinations)	Standard deviation
6.2	2.2	0.15	1704	101
6.8	3.0	0.18	1204	96
6.8	3.0	1.23	1755	37
6.9	3.6	0.24	1655	229
7.0	4.0	0.48	1145	58
10.0	11.0	0.99	2267	230
10.2	9.0	0.75	1689	200
10.2	11.0	1.18	3370	254

10.3	10.0	0.93	3923	439
10.6	11.0	0.59	1697	198
10.7	12.0	0.82	1763	112
12.4	13.0	1.01	2847	285
11.5	14.0	0.93	3863	490
11.3	14.0	0.90	3519	248
11.6	11.0	0.64	2420	86

(Adapted from Olatunde, 1978a)

Fecundity studies allow researchers to obtain data relating to population stability and year-to-year class fluctuation in production.

A comparison of the total fecundity of the schilbeids with some common catfishes in the Family Mochokiadae in Lake Kainji shows that the fecundity of the schilbeids is generally low. The variation in total fecundity within species and between different species is expected because fish species are known to exhibit wide variations in their fecundity. (Bagenal, 1966).

Apart from *Siluranodon auritus,* all other species show an increase fecundity with an increase in length and weight of the fish. This is a general trend in most fishes (see Bagenal, 1957, 1966; Pope *et al.,* 1961; Pitt, 1964; Fagade & Olaniyan, 1972; Mann, 1973, 1974, 1976). In *Siluranodon auritus,* very narrow variations exist among the lengths and weights of the specimens examined and this thought to account for the narrow variations in the fecundity. Thus no general increase in fecundity was observed with the increase in light or weight of fish. A similar situation was found in *Ictalurus melas* by Dennison & Bulkley (1972).

It can be seen that the life of fishes is an interesting one, patterned to ensure maximum survival in water. Let us now see how our life affects the life of fishes in water.

How our Life Affects the Life of Fishes

Man has been known from creation to dominate the world and everything therein, (Genesis 1:26). Their activities have been known to affect the environment positively, and most of the time negatively also. Fish life had been affected in so many ways through the activities of man. The following are such activities:

(i) Pollution

(ii) Overfishing

(iii) Obnoxious Fishing Methods

(iv) Post-Harvest Losses

Water Pollution

It is common knowledge that our source of water today is serving so many purposes – principally for domestic use (drinking, cooking, washing or clothes). Others are irrigation and carrying domestic and industrial wastes. Through such multiuse, our waters (rivers, lakes, spring) are being seriously abused thereby causing pollution.

Pollutants, depending on their sources, degrade the environment and make water bodies unfit for sustainable management. They kill fish and other organisms, cause deoxygenation and produce acidic water. They also cause high temperature, affects nutrition, physiological and reproductive behaviours of the fish.

Moreover, fishes that escape death may accumulate these toxic materials in their tissues, and when eaten, the toxic effect may be passed to consumers through chain effect (Oladimeji, 1987). It is also repulsive, driving fish away from their breeding and feeding ground, thereby causing scarcity in such areas and over concentration in areas they migrate to such overcrowding may cause competition for space, nutrient and 02 in such an area. Other effects include reduced growth (Drilling & Smith, 1926) and anaemic conditions in fishes (Dawson, 1935). They also affect the terrain.

Over Fishing

Because of the ignorance of people that the fishery resouces are unlimited, people fish indiscriminately without any recourse to some good management practices. Sometimes water bodies are overfished. Ita

(1982) provided some evidence to show this in Lake Kainji. The observation for Kainji Lake possibly applies to most of our inland water bodies.

Overfishing occurs when the following become obvious (Ita, 1982):

1. Decline in catch per unit effort
2. Increase in fishing effort which is not resulting in increase in catch.
3. Low productivity in littoral area.

Effect of overfishing is very obvious, there is rapid decline in fish population, low catches in larger mesh net, and consistently high catches small nets, increase in cost of catching a unit weight of fish associated with increase in effort without relative increase in the catch.

Use of Obnoxious Fishing Methods

People practice unorthodox or obnoxious fishing methods for various reasons. Babalola (1991) listed the following as some of the reasons for such practices:

(i) Non-availability and high cost of fishing materials.

(ii) Reduced or poor catch per unit effort.

(iii) Ignorance of devastating effects of this practice on fishery.

The following are the popular and most frequently used obnoxious fishing techniques:

(a) **Use of small net meshes** such as 25.4mm, 19.0mm, 12.7mm and 6.3m

(b) **Use of local poisonous herbs/roots/seed** such as **Ba**sia Latifolia, *Cotom tiglium (powdered seed), Atiletia pachyeurpa (foot powder) Milleti plsetuliu (seed powder) Basrrangtenla deutangala (seed powder), Lamutudus Indiea, Camellia smetsis and tobacco seed powder*

(c) **Chemicals**: Use of poisonous chemicals such as Gammalin 20; motor vehicle battery water, Bleaching powder, Anhydrous ammonial; diesel oil/Petrol, Kerosene, and Sodium carbide

(d) **Explosives:** Use of explosives such as hand grenades, dynamites and bomb.

The effect on fish can be summarized as follows:

Fish eggs, fry, fingerlings and adults are killed or rendered permanently sterile, fish killed with poison are unsafe for human consumption. The environment is also adversely affected, making it unsafe for other uses and other inhabitants.

There is no doubt that the way we lead our life definitely affects the life of fishes. Where then do we go from here?

RECOMMENDATIONS

Fishes are renewable natural resources which should be exploited rationally on sustainable basis. It is therefore imperative that, to derive maximum benefits from the, we have to evolve effective integrated management strategies. Our management options should therefore make the resources available:

- now and in the future
- at the time we need them
- to those who do not produce them
- in very good condition
- at affordable prices
- should enhance economic well being of the fisher folks; and
- should be environmentally friendly

Management Strategies

In a keynote address presented by me (Olatunde, 1999) to the Fisheries Society of Nigeria (FISON) during their 13th Annual Conference, the following managements options were highlighted:-

(A) Management of the Fish Environment

A friendly environment will bring forth healthy and wholesome fish on the table. Because of the multiple use of water bodies, fish habitats are often polluted either consciously or unconsciously as already discussed. Therefore, for effective management of the fish environment, the following steps should be taken:

Water

1. **Legislation against pollution:** The Decree on Inland Fisheries (1992) stresses the need to protect fishes from pollution and prohibit "any discharge of chemicals, substances or drugs, poisons or any noxious or polluting substances into any water frequented by fish or that flow into such water".
2. **Reduction waste:** Waste at their sources can be reduced by use of low and non-waste technologies which involve concepts like resources recovery, waste recycling and residue utilization.
3. **Use of Impact Assessment Studies:** agencies set aside to enforce and monitor environment should conduct impact assessment studies with the aim of establishing standards for specific pollutants.

4. **Avoidance of contaminated water:** In case of aquaculture, water heavily contaminated by pesticides, industrial or domestic wastes for culture purposes must be avoided.

5. The dredging of water basin to remove excessive silt is obligatory.

6. **Reservoir Maintenance:** In case of reservoirs, all obstructions like tree stumps must be cleared to enhance fishery activities.

7. Construction of fish shelters, provision of fish ladders at dams to facilitate spawning migrations.

8. Beach clearing and restructuring to facilitate easy use of some gears e.g. beach seine net are important.

9. Weed clearing to facilitate easy access and maximum primary production is of equal importance.

10. When planning to construct any dam, at all the sectors involved should do the planning together in a "multi-disciplinary approach system"

The Fish

In some localities, some traditional management strategies are put in place by the communities. These sometimes include closed season, gear and equipment control or restriction, water tenure or ownership of portion of water, freeing of immature fish captured, fish intensification and obtaining permission from head fisherman. Some of these traditional measures by the communities are not seriously intended or geared towards conservation. Rather, they can lead to over exploitation if not consciously applied. It is, however, gratifying to note that conscious efforts are now being made to conserve and manage our fish stock resources through the following:-

(a) Fish Stock Assessment

Long or short-term assessment of our fish stock is mandatory for effective management planning. The data generated can be effective management planning. The data generated can be evaluated, and appropriate management strategies put in place.

(b) Protection of Fish Resources

Sustainability depends on the careful balance between fish harvest (mortality) and regenerative capacity (recruitment) of the fish stocks. Upsetting the balance in favour of one of these two factors can result in either over fishing or under exploitation of the resources.

In a situation where recruitment is not allowed either by massive killing or harvesting of gravid females or pre-spawning population through the use of bad fishing methods over fishing occurs. It is therefore imperative that control and regulatory measures be put in place to curb bad fishing practices. Because most water bodies are freely accessible, unlimited number of fisherfolks operate freely and with all sorts of fishing gears and techniques. To ensure sustainability, the following had to be enforced:-

(i) **Closed Seasons:** a time when fishing in prohibited either because it is spawning season or immediate post-spawning season when the newly recruited fish stocks are moving midstream or to allow for restoration of over-exploited water bodies.

(ii) **Closed Areas:** areas protected from any fishing activity during breeding season because they are identified as spawning or breeding ground.

(iii) **Meshsize Regulation:** the main aim of this is to prevent catching young immature fish and over exploitation of the fish stock. Minimum meshize is specified e.g. gill net not less than 7.6cm, lift net 3.8cm and clap nets, cast nets or webbing trap not less than 5.1cm.

(iv) **Control of Fishing Population through Registration and Licensing of Fishermen:** Two fishermen per boat per square kilometer of the river can be registered and licensed for inland water bodies.

(v) **Prohibition of the use of obnoxious fishing methods:** This guards against indiscriminate killing of fish. Fish killed by these methods are usually not wholesome and therefore not fit for human consumption.

(vi) **Depleted reservoirs can be restocked through transplanting of species:** Species should be carefully chosen to maintain a balance of population. Species can be collected from the wild or produced for stocking through induced breeding. Control should be put in place to exclude over exploitation of juveniles of the introduced species.

(vii) **Establishment of Fish Sanctuary:** This is a new management approach to conservation in this part of the world. In this practice, certain water bodies are entirely protected from fishing activities. Minimum and regulated fishing activities are usually allowed only at certain times of the year, notably during annual fishing festivals.

(viii) **Promulgation of Laws:** For this to be effectively implemented, there must be legal framework put in place. We are happy that the

Inland Fisheries Decree of 1992 is already available for implementation. We are also aware that sine states have put in place Fishery Edicts regulating fishery activities in their states, e.g. Ondo and Niger. Provisions are also made for the monitoring, control and surveillance of rivers, lakes and dams, but sometimes these are not effectively carried out.

Post-Harvest Management

It is already a known fact that about 50% of our harvested fish do not reach the consumers because of post-harvest losses (Olatunde, 2004). Fish is a perishable commodity; once it is out of water, deterioration sets in. Consequently, post-harvest management is very important if we want the resource to be available in wholesome condition. Most of the post-harvest management techniques are based on indigenous technology. We are all familiar with the traditional processing techniques e.g. salting, smoking, sun-drying and fermentation. In areas where supply of power is available and regular, freezing and icing are also done.

Fishing handling and preparation before processing are very important and a condition to ensure good product. De-scaling, gultting, washing and moisture drying are basic. All the above must be done under hygienic condition.

Out of the processing techniques mentioned above, smoking is the most commonly used. But the high cost of firewood and low heat efficiency of some traditional kilns make the process expensive and time consuming.

Our modern management practices should involve the use of efficient smoking kilns such as *Chokor* smoker which is recently introduced to the country. Community woodlots can be introduced to alleviate high cost of firewood. Well-packaged fish reduces losses due to insect infestateion. Use of insecticides by direct spraying of products should be discouraged. Marketing strategies should eliminate so many middle men in order to make the price affordable o everybody. For sustainability in this subsector:

(i) Fisherfolks should be assisted with Outboard Motors to ensure speedy delivery of fresh fish in good condition.

(ii) Efficient transportation system should be in place to ensure that both fresh and processed fish reach consumers in reasonable time and in good condition.

(iii) Researches should be funded to put in place technology appropriate to our own peculiar situation.

(iv) Inspectorate and quality control measures should be instituted to protect consumers.

(v) God extension strategies are important for educating the rural processors who are mainly women.

(vi) Community smoking kilns should be established to help processors who are financially week.

CONCLUSION

THE

Ultimate aim of all these studies is to make fish available to Nigerians. Since fish demand cannot be satisfied by supply from artisanal sources a serious look should be taken at developing our a aquaculture system. Development of homestead fishpond, which can be started by individuals at their backyard to large-scale intensive culture, should be encouraged. Since every fish produced cannot be consumed at once, there is need to seriously strengthen the post-harvest technology as ready discussed.

The need to harness our natural resources for our benefit is becoming more obvious particularly in the face of malnutrition and poverty amongst us. Apart from the traditional ways of fish utilisation, there is need to open up new grounds. All parts of the fish are useful. Investment opportunities abound in fish, this includes fish canning, minced fish, fish fingers, sausages, burgers, cakes, balls etc, there should be no room for wastage. I advise all of you to invest in fish; you will not regret it.

Finally and in a lighter mood take this fish figurative expressions along with you for your consumption, (Hornby, 1955):

(a) An odd fish – refers to a queer person

(b) A big fish – is an important person.

(c) Drink like a fish – means somebody who likes drinking.

(d) A fish out of water – is a person in a strange environment.

(e) Have bigger/other fish to fry – means have something more important to do.

(f) Fishy – causing feeling of doubt or suspicion.

(g) Cold fish – is somebody who shows no feeling to somebody else

(h) Queer or odd fish – someone who has not been out of his house for years.

Vice Chancellor sir, ladies and gentlemen, I wish to thank you for your patience and cooperation. May God continue to provide fish for us on our tables and may we not fish in troubled waters. Amen.

Thank you and God bless.

PICTURES

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ACKNOWLEDGEMENT

My full gratitude goes to God for everything and to my late parents who nurtured me and sharped my life.

I am particularly grateful to Prof. A.P. Mead, who offered me admission, and who continued to encourage me when I was finding Science a bit difficult during my preliminary science years.

I acknowledge the priceless contributions of my wife and children for their ever ready support and endurance particularly during the difficult years.

I do appreciate Professor A.A oladimeji, Professor J.O Omole and Dr. Gboyega Kolawole who read through the manuscript and made corrections and Alhaji Abba Y. Abdullahi who computer processed the power point presentation.

I as well thank my numerous friends and colleagues who through their interactions had influenced me in one way or another.

I thank the Vice-Chancellor Prof. Nuhu Omeiza Yaqub for providing the enabling environment which made this inaugural lecture possible.

To all of you present for finding time to come and listen to my lecture. I say, 'Thank you!'.