Chapter 7
Fish Species Diversity and Fish Biology

FISH SPECIES DIVERSITY

Entz (1976) and Latif (1984a) divided the High Dam Lake (i.e. Lake Nasser and Lake Nubia) into three sections :

1. Northern section (about 250 km from High Dam), extending southwards from High Dam to Amada or Tushka, is lacustrine.

2. Middle section (southern part of Lake Nasser from Tushka to Daweishat) is semiriverine during the flood season, and lacustrine during the other seasons.

3. Southern section, extending from Daweishat to Akasha in Lake Nubia, is riverine all year round.

Therefore, it can be said that Lake Nasser is almost lacustrine except in its southern part (about 50 km in length), which has riverine characteristics during the flood season. The Lake is eutrophic in some areas (khors), while it is mesotrophic to oligotrophic in the main channel (about 80% of the Lake area). Such characteristics of the Lake affect the fish species diversity which used to be riverine, leading to the dominance of lacustrine fish.

The surface area as well as the volume of water suitable for fish in the khors vary very much due to changing of water level. Khors or flooded flat areas are very different in their characteristics as fish habitats. Thus, it is worthy to know all the changes in surface and volume of water in these areas at different water levels. This knowledge is of great interest for fish stock assessment as well as for the fishery itself. The length of the shoreline and its slope are important for the development of periphyton and littoral fauna, which affect greatly the distribution of tilapiine spp., the most economic and important group of fish, especially abundant on sandy areas. The distribution of the benthic fish food organisms is also affected by the morphology of the Lake. Oligochaetes are important fish food organisms and are mainly restricted to certain areas. Chironomids are most abundant in shallow water (5-10 m deep). Periphyton and phytoplankton are mainly restricted to the upper 2-4 m layer. During June and July, i.e., the period of fast decreasing water level, the periphyton almost disappears from the shore, being transferred into localities above the water level forming sometimes real crusts on the dry shore there. This is especially the case in flat areas, where a decrease of 3-4 m in water level causes the regression of lake water for 5-10 km distance (e.g. in Khor Kalabsha). During the new fast increase of the water level, at the beginning of the flood, there is no time for dense periphyton development. The new green belt of periphyton is observed again only in December or January.

The distribution of zooplankton is mainly affected by oxygen conditions. Because of the depth restrictions during the stagnation period associated with lack of oxygen in the hypolimnion, its amount is affected by the volume of the upper water layers.

Aquatic snails are very abundant on rocky areas, and almost completely absent from flat sandy shores. Thus, the distribution of the vector organisms of Bilharzia is more promoted on rocky than in sandy areas. Generally, the increase of the water level will increase the surface areas and the volume of the shallow water zones not only in absolute values but simultaneously their proportion, as compared with the total surface area of the Lake. Therefore, the uppermost water level plays the most important role in the productivity of the Lake. In other words, increasing water level is accompanied by an increase in the productivity of the Lake. Also, sedimentation of fertile mud especially within the southern region of Lake Nasser causes an increase in Lake productivity.

Generally, the fish species of new impoundments as Lake Nasser were known in the original water where the reservoir is created. However, the response of the "riverine" species to the new environment is different and this results in marked differences in their relative abundance with lacustrine conditions. In the early years, mormyrids disappeared from Lake Kainji, but fish of the genus *Citharinus* became the most important and predatory fish and cichlids increased (Lelek & El-Zarka, 1973).

In Lake Nasser, the 57 fish species recorded since 1964 (Table 78) belong to 16 families: Protopteridae, Polypteridae, Characidae, Citharinidae, Distichodontidae, Mormyridae, Gymnarchidae, Cyprinidae, Clariidae, Bagridae, Shilbeidae, Mochokidae, Malapteruridae, Cichlidae, Centropomidae and Tetraodontidae (Latif 1974a). Some fish species are extremely rare. For example, only one specimen of either *Protopterus aethiopicus* or *Polypterus bichir* was caught. Furthermore, along the course of impoundment, some other species became less common, while others behaved differently. For example, *Chelaethiops bibie* and *Leptocypris* (*Barilius) niloticus* were common in the southern region of the Lake in 1970, but at present they are infrequent. Latif (1974a) pointed out that *Eutropius niloticus, Schilbe uranoscopus, S. mystes, Alestes dentex, A. baremoze, Mormyrus, Labeo* spp. and *Barbus* spp. were more frequent in Lake Nubia than in Lake Nasser. The reverse is true for *Sarotherodon galilaeus, Oreochromis niloticus, Hydrocynus forskalii, Brycinus nurse* and *Bagrus* spp. Again *Schilbe* spp. are more frequent in the southern part of Lake Nubia except during the flood, when these species become common in flooded areas. On the other hand, *Alestes baremoze* and *A. dentex* are repelled by these waters and thus become more common in the southern part of Lake Nasser ahead of the flood than elsewhere in other times. However, *A. baremoze* migrates upstream for spawning in Lake Nubia (Rashid 1977). Similar migration from natural lakes to connecting rivers for spawning have been observed elsewhere (Durand & Loubens 1971, Hopson 1972). Nowadays the most common fish species are 23 (Table, 102). During recent years specimens of *Oreochromis aureus* and *Tilapia zillii* were recorded from the Lake.

In recent years, the Lake fisheries depend only upon a limited number of species, which are given in the order of importance : *Sarotherodon galilaeus, Oreochromis niloticus, Hydrocynus forskalii, Brycinus nurse, Alestes dentex, A. baremoze, Lates niloticus, Bagrus bajad, B. docmack, Synodontis serratus, Barbus bynni, Labeo horie, L. coubie, L. niloticus* and *Eutropius niloticus. Sarotherodon galilaeus* and *Oreochromis niloticus* adapted well to the new conditions in the Lake. The most common open-water species are *Alestes* spp., *Hydrocynus forskalii* and *Eutropius niloticus. Brycinus nurse* and *H. forskalii* are also abundant in inshore waters as are *Lates niloticus, Oreochromis niloticus* and *Sarotherodon galilaeus.*

Today, only two fish species : *Sarotherodon galilaeus* and *Oreochromis niloticus* dominate the fish catch from the Lake, contributing about 90-95% of the total fish production from Lake Nasser. Therefore, *Tilapia* species have proved to be very well adapted and suited to the erratic ecosystem of the Lake. Others are contemporary commercial fish species (i.e. *Hydrocynus* spp., *Synodontis* spp., *Bagrus* spp., *Lates niloticus* and *Brycinus nurse*).

Thus, the species diversity has declined and some species are now restricted only to the southern region of the Lake, while others have vanished completely from it.

The khors (85 major) of Lake Nasser provide the most important habitat for fish to breed and feed, because of their shallowness and abundance of phytoplankton. The open and deep waters of the Lake are relatively poor in fishes inspite of the fact that they are rich (to a certain extent) in plankton.

Table 78 **Fishes recorded in Lake Nasser (Latif 1974a). [Plates 34 –49]**

Family	Species	Local Name	
Protopteridae	*Protopterus aethiopicus*	Dabib El-Hout	دبيب الحوت
Polypteridae	*Polypterus bichir*	Abu-Bichir	أبو بشير
Mormyridae	*Mormyrops anguilloides*	Gamhour	جمهور
	Petrocephalus bane bane	Gelmaya, Arminya	قلميه
	Pollimyrus isidori	Anooma	أنومـــة
	Gnathonemus cyprinoides	Um-Shafika	أم شفيقـــه
	Mormyrus kannume	Um-Bowez	أم بويـــز
	Mormyrus caschive	Boweza	بويـــزه
	Hyperopisus bebe bebe	Kalamya-Babeh	قلميا – بيبه
Gymnarchidae	*Gymnarchus niloticus*	Rayah Niliah	ريه نيليـــه
Characidae	*Hydrocynus forskalii*	Kalb El-Samak	كلب السمك
	Hydrocynus vittatus	Kalb El-Samak	كلب السمك
	Hydrocynus brevis	Kalb El-Samak	كلب السمك
	Alestes dentex	Rayah	ريـــــــه
	Alestes baremoze	Rayah	ريـــــه
	Brycinus nurse	Sardina	سردينه
Distichodontidae	*Distichodus niloticus*	Lessan El-Bagar	لسان البقر
Citharinidae	*Citharinus citharus*	Kamara	قمـــره
	Citharinus latus	Kamara	قمـــره
Cyprinidae	*Chelaethiops bibie*	Bebe	بيبيـــه
	Labeo victorianus	Lebeis Hagari	لبيس حجر
	Labeo niloticus	Lebeis Nili (abyad)	لبيس نيلى
	Labeo coubie	Lebeis Aswad	لبيس أسود
	Labeo horie	Lebeis Aswad	لبيس أسود
	Garra dembeensis	Abu-Kors	أبو قرص
	Barbus bynni	Benni	بنى
	Barbus werneri	Benni	بنى
	Barbus anema	Benni	بنى
	Barbus perince	Benni	بنى
	Barbus neglectus	Benni	بنى
	Raiamas loati	Morgan loti	مرجان لوتى
	Leptocypris niloticus	Bebee–Margan Nili	مرجان نيلى
Clariidae	*Clarias anguillaris*	Hout, Karmout	حوت قرمـــوط
	Clarias gariepinus	Hout, Karmout	حوت قرمـــوط
	Heterobranchus longifilis	Hout, Karmout	حوت قرمـــوط
	Heterobranchus bidorsalis	Hout, Karmout	حوت قرمـــوط
Schilbeidae	*Schilbe (Eutropius) niloticus*	Schilba	شلبه
	Schilbe (Schilbe) mystus	Schilba	شلبه
	Schilbe (Schilbe)uranoscopus	Schilba-Arabi	شلبه عربى
	Siluranodon auritus	Schilba	شلبه
Bagridae	*Bagrus bajad*	Bayad	بياض
	Bagrus docmak	Docmack	دقماق
	Chrysichthys auratus	Gurgar	جرجور

	Chrysichthys rueppelli	Gurgar Schami	جرجور شامى
	Clarotes laticeps	Abu-Meseka	أبو ميسيكه
	Auchenoglanis biscutatus	Halouf	حلوف

Table 78 **(cont.)**

	Auchenoglanis occidentalis	Halouf	حلوف
Mochokidae	*Synodontis schall*	Schall	شال
	Synodontis serratus	Schall	شال
	Synodontis clarias	Schall	شال
	Mochocus niloticus	Mekawkas Nili	مقوقس نيلى
	Chiloglanis niloticus	Kiloglans	كيلوجلانس
Malapteruridae	*Malapterurus electricus*	Rahaad	رعاد
Cichlidae	*Sarotherodon galilaeus*	Bolti Galili	بلطى جاليلى
	Oreochromis niloticus	Bolti Nili	بلطى نيلى
	*Oreochromis aureus**	Bolti Azrak	بلطى أزرق حسانى
	Tilapia zillii	Bolti Akhadar	بلطى أخضر
Centropomidae	*Lates niloticus*	Samous, Ishr-Bayad	ساموس
Tetraodontidae	*Tetraodon linneatus*	Fahaka	فهقة

*** This species was recently recorded in 1996 (SECSF).**

BIOLOGY OF IMPORTANT FISH SPECIES

The study of the biology of Lake Nasser fishes was carried out by various investigators: (Latif 1974b, Latif & Rashid 1972, 1983, Latif & Abdel-Azim 1973b, Abdel-Azim 1974, 1991a and b, Latif *et al.* 1979, Talat 1979, Khallaf & Latif 1987, Latif & Khallaf 1987, Yamaguchi *et al.* 1990, Agyapi 1992a, Mohamed, I. 1992b, Mohamed, S. 1994, Adam 1994, 1995a & b, 1996a & b, Mekkawy *et al.* 1994, Mekkawy & Mohamed 1995, Shenouda *et al.* 1995, Mekkawy, 1996, who studied *Oreochromis niltoicus* and *Sarotherodon galilaeus* - Cichlidae); (Latif 1974b, Latif *et al.*1979, Massoud *et al.* 1985, who studied *Hydrocynus forskalii* - Characidae); (Latif 1974b, Rashid, 1977, Latif *et al.* 1979, who studied *Alestes* spp. - Characidae); (Latif 1974b, Latif & Khallaf 1974a, El-Etreby 1976,1982, Latif *et al.* 1979, who studied Nile perch *Lates niloticus* - Centropomidae); (Latif 1974b, Latif *et al.* 1979, 1984a-c, Abbas 1982, 1986, Mahmoud & Mekkawy 1991, Mekkawy & Mahmoud 1992a, who studied Synodontidae); (Latif 1974b, Khallaf 1977, Latif *et al.* 1979, Latif & Khallaf 1996, who studied Schilbeidae); (Latif 1974b, Latif *et al.* 1979, Khallaf 1985, 1988; Mekkawy 1997 a and b, Shenouda *et al.* 1994a and b, who studied Bagridae); (Latif 1974b, Latif *et al.* 1979, Abdel-Azim 1982, Mekkawy & Mahmoud 1992b, Shenouda 1992 who studied Cyprinidae) and Latif 1974b, Latif *et al.* 1979, El-Etreby 1985, Mekkawy 1990, 1996, Aly 1993, who studied Mormyridae).

When referring to the fisheries of Lake Nasser it is inevitable to mention some of the relevant aspects on the biology of the most important fish species which may be the basis of development and management of lake fisheries.

1. FOOD AND FEEDING HABITS

The work of Latif *et al.* (1979) was the only complete study on the food and feeding habits of the main fish species inhabiting Lake Nasser, hence reference to the results of their work will be reviewed together with recent studies.

Analysis of gut contents of different species of fishes is considered one of the most important methods to estimate the selectivity of natural food and the ecological niche of various species. Furthermore, food analysis is used to determine the natural diet of species concerned and the extent of its availability in its natural habitat. Lake Nasser is rich in various food items including: periphyton, phytoplankton, zooplankton, insect larvae mainly chironomids and molluscs (gastropods and bivalves), oligochaetes, freshwater shrimps and many others). According to their feeding habits fish species inhabiting Lake Nasser can be divided into :

1. Periphyton-plankton feeders : mainly *O. niloticus* and *S. galilaeus*

2. Zooplankton-insect feeders : *Alestes* spp.

3. Omnivores : *Labeo* spp., *Barbus* spp. *Synodontis* sp., schilbeids and mormyrids.

4. Carnivores (piscivores): *Lates niloticus, Hydrocynus* spp., *Bagrus* spp. *Clarias* spp. and *Heterobranchus* spp.

The major food items and their percentage occurrence in the commercial fish species from Lake Nasser are shown in Table 79 (p. 238).

Oreochromis niloticus. Before the construction of Aswan High Dam and during the early years of filling, this species was the major tilapiine sp. contributing a high percentage of the total yield. *Oreochromis niloticus* feeds mainly on plant material: Cyanophyta (*Oscillatoria, Lyngbya, Merismopedia, Dactyloccopsis, Anabaena, Microcystis* spp. etc.) composing 30% of the total food and occurred in 90% of the fish (Latif *et al.* 1979). Diatoms (*Melosira, Navicula, Cymbella, Synedra* spp. etc.) formed about 25% and were recorded in 80% of the guts of examined fish. Chlorophyta (*Cosmarium, Scendesmus, Crucigenia, Volvox* spp. etc.) comprised 22% of the diet and were found in 80% of the guts of fish. The latter authors pointed out that higher plants formed only 7% and occurred in 40% of the fish. Copepods (e.g. *Cyclops* spp.) and Cladocera (e.g. *Daphnia* and *Bosmina* spp.) formed 15% of the food and were found in 20% of the fish. Also, the fish were seen grazing on periphytes (Latif *et al.* 1979). Abdel-Azim (1991b) found that the percentage composition of copepods, rotifers and cladocerans eaten by *O. niloticus* at different localities of Lake Nasser during early spring (1988) were 4.6, 0.05 and 1.25% respectively while during late summer it was 3.89; 0.21 and 1.88%. When considering the length of *O. niloticus* Abdel-Azim (1991a) pointed out that zooplankton constituted about 4.0, 6.9 and 10.4% of the stomach contents of lengths 3.9-9, 9.1-20 and 20.1-45 cm respectively. The food of fry of *O. niloticus* and *S. galilaeus* consisted mainly of nauplius larvae, copepodite stages of Copepoda, cladocerans and rotifers, in addition to other food items (Abdel-Mageed 1995). Mohamed, I. (1992b) mentioned that *O. niloticus* subsists mainly on Dinophyceae (*Peridinium* and *Ceratium* spp.), diatoms (*Melosira, Navicula, Cymbella* spp. etc.), blue-green algae (*Merismopedia,* *Lyngbya and Microcystis* spp.), green algae (*Scendesmus and Staurastrum* spp.) (Table 80).

Sarotherodon galilaeus**.** The gut contents of *S. galilaeus* included more plant food than animal material. Latif *et al*. (1979) mentioned that diatoms and Chlorophytes were common in 90% of the fish, and they formed 40 % of the diet, while cyanophytes were less frequent and were found in small quantities (15%). Zooplankton organisms, cladocerans (*Daphnia* and *Bosmina* spp.) were rarely observed in the guts. Periphytes composed 40% of the food and were recorded in 25% of the guts of fish examined. Zooplankton (mainly copepods and cladocerans) comprised only 5% of the food and appeared in 15% of the fish (Latif *et al*. 1979). It is worth mentioning that *S. galilaeus* is nowadays the major tilapiine species in the total annual fish production (i.e. more than 60% of the annual catch).

Brycinus nurse**.** The percentage occurrence and composition of various food items in the guts of *B. nurse* (Figs. 116 and 117) indicates that insect larvae constitute the major food item (49%), followed by gastropods (25%), cladocerans (17%), copepods (9%), decapods (0.2%) and others (0.2%) (Latif *et al*. 1979).

Alestes baremoze. This species feeds mainly on insects which constitute 41.4% of the gut contents followed by cladocerans (21.9%), phytoplankton (18.5%), gastropods (9.8%) and copepods (8.4%) (Latif *et al*. 1979 - Fig. 118).

Schilbe (Eutropius) niloticus. This species feeds mainly on insect larvae (Chironomidae) and to a lesser extent on Odonata, fishes, water beetles. Worms, freshwater shrimps, bivalves were much less frequent (Latif *et al*. 1979). Fishes more than 23 cm long may feed mainly on other fish species e.g. *Alestes* spp.

Schilbe uranoscopus. Latif *et al*. (1979) mentioned that the gut contents of *Schilbe uranoscopus* included small fishes (*Hydrocynus* spp. and *Alestes* spp.), chironomid larvae and placopteran nymphs. *Cyclops* and *Daphnia* were accidentally ingested, apparently as the fish secures its food from surface waters.

Synodontis spp. They are omnivorous fish, utilizing animal food (fish, worms, molluscs and insects) and some food of plant origin taken incidentally when securing the food from the bottom or the crevices between stones. Both phyto- and zooplankton are occasionally taken by the fish while scooping its insect diet (Latif *et al*. 1979).

***Labeo* and *Barbus* spp.** Latif *et al*. (1979) mentioned that *Labeo* and *Barbus* species are omnivorous, feeding mainly on diatoms, cyanophytes, worms and plant material.On analysing the gut contents of *Labeo* spp. (*Labeo horie, L. coubie, L. niloticus*) and *Barbus bynni,* Abdel-Azim (1982) found that they contain inorganic particles (sand and mud), aquatic plants (macrophytes and epiphytes), phytoplankton (diatoms, cyanophytes and chlorophytes), worms and insect larvae. This food pattern denotes that the above-mentioned

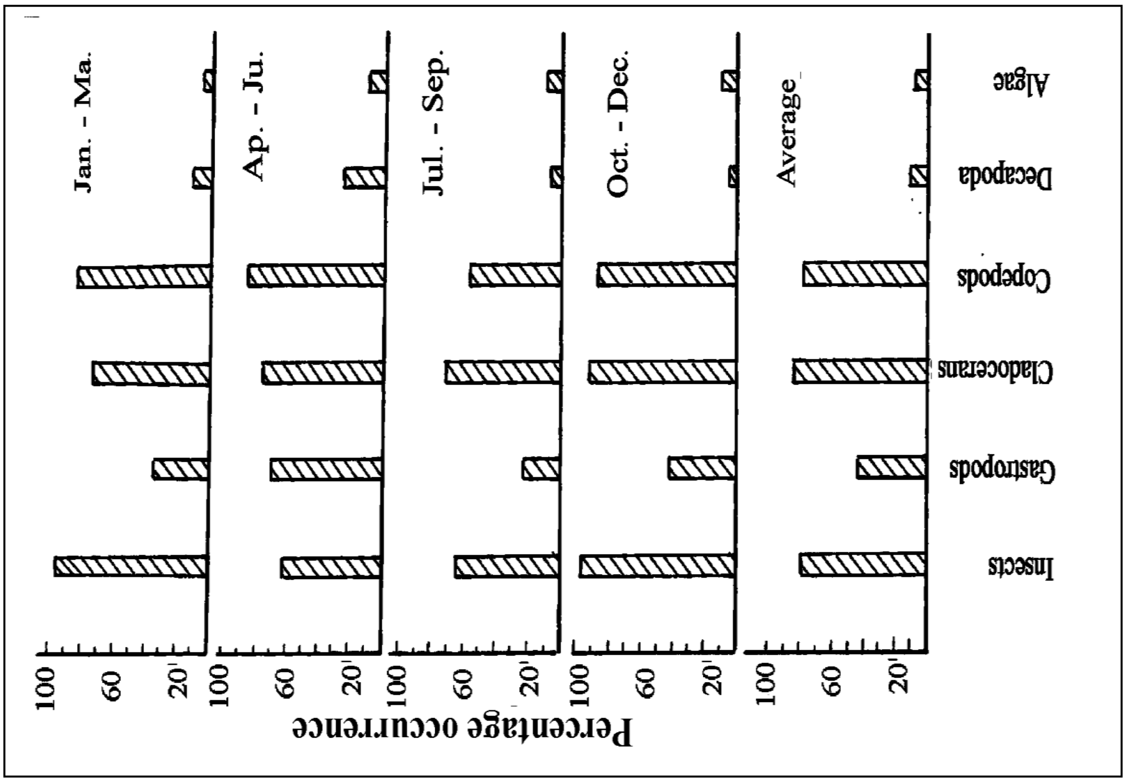


Fig. 116 **Percentage occurrence of different food items in the guts of *Brycinus nurse* (Latif *et al.* 1979).**

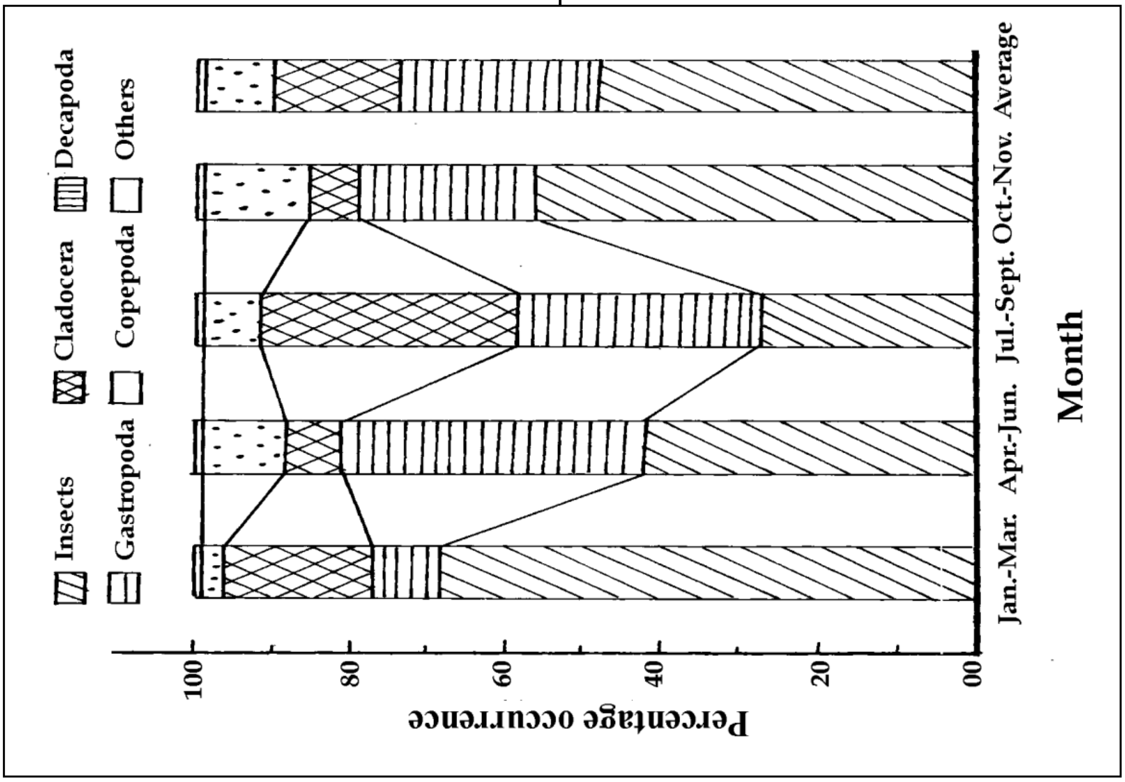


Fig. 117 **Percentage composition of different food items in the guts of *Brycinus nurse* (Latif *et al.* 1979).**

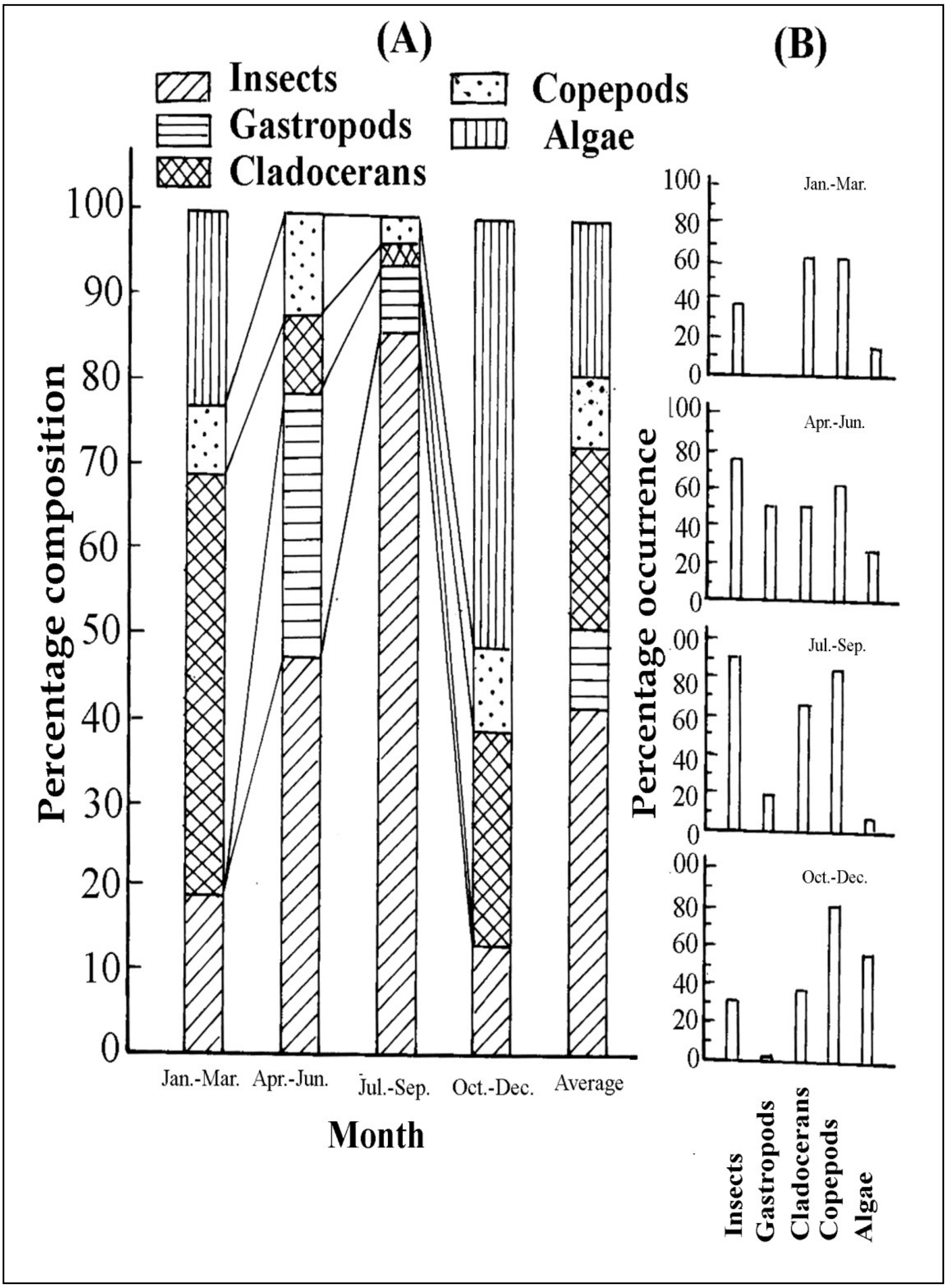


Fig. 118 **A: Percentage volume of different food items in the guts of** ***Alestes baremoze*****, B: Frequency occurrence of different food items in the guts of** ***A. baremoze*** **(Latif** ***et al.*** **1979).**

Table 79 **Major food items and their percentage occurrence for various fish species in Lake Nasser.**

Species	Major food items and their percentage occurrence
Oreochromis niloticus	Cyanophyta (90%); diatoms (80%); Chlorophyta (80%); copepods and cladocerans (20%); higher plants (40%) and periphyton.
Sarotherodon galilaeus	Diatoms (90%); Chlorophyta (90%); Cyanophyta (15%); zooplankton (15%); and periphyton (25%).
Brycinus nurse	Insect larvae; gastropods; cladocerans; copepods and decapods.
Alestes baremoze	Insects, cladocerans, phytoplankton, gastropods and copepods.
Schilbe (Eutropius) niloticus	Insect larvae (chironomids, Odonata); water beetles; shrimps, worms, fishes and bivalves.
Schilbe uranoscopus	Small fish; chironomid larvae; *Cyclops* and *Daphnia*.
***Synodontis* spp.**	Omnivorous: insects; worms; fish; molluscs; food of plant origin, phyto- and zooplankton.
***Labeo* spp.**	Omnivorous mainly Chlorophyceae; Cyanobacteria; diatoms; cyanophytes; worms; plant material etc.
***Mormyrus* spp.**	Omnivorous: aquatic insects, larvae and pupae of chironomids, nymphs of Odonata, Trichoptera larvae, shrimps, detritus, aquatic plants and diatoms.
Hydrocynus forskalii	Fishes (64.9%); insects (26.1%) shrimps (9%), fishes increase with increase of length.
Lates niloticus	Fishes, insects; shrimps (vary with fish length). Large fish feed mainly on fish, *Alestes* spp. tilapias, Nile perch.
***Bagrus* spp.**	Fishes (mainly tilapias, *Alestes*, *Synodontis*, *Mormyrus*, *Labeo*, *Barbus* and *Schilbe* spp.); insect larvae, molluscs and shrimps.
***Clarias* and *Heterobranchus* spp.**	Omnivorous bottom feeders; food of animal origin (insects, fishes etc.) and plant material.

Table 80 **Gut contents of *Oreochromis niloticus* from Khor El Ramla (Mohamed, I. 1992b).**

Phytoplankton		Attached algae	Zooplankton
Chlorophyta	**Bacillariophyta**	**Chlorophyta**	**Cladocera**
Volvox spp.	*Cyclotella* spp.	*Cladophora* spp.	*Bosmina* spp.
Pediastrum spp.	*Synedra* spp.	*Oedogonium* spp.	*Diaphanosoma* spp.
Ankistrodesmus spp.	*Amphora* spp.	*Spirogyra* spp.	*Daphnia spp.*
Scendesmus spp.	*Cymbella* spp.	**Cyanophyta**	*Ceriodaphnia* spp.
Cosmarium spp.	*Cocconeis* spp.	*Oscillatoria* spp.	**Rotifera**
Coelastrum spp.	*Navicula* spp.	*Phormidium* spp.	*Keratella* spp.
Cyanophyta	*Diatoma* spp.	*Lyngbya* spp.	**Ostracoda**
Chroococcus spp.	**Pyrrophyta**	**Bacillariophyta**	*Cypris* spp.
Aphanocapsa spp.	*Peridinium* spp.	*Melosira* spp.	**Copepoda**
Microcystis spp.	*Ceratium* spp.		*Cyclops* spp.
Merismopedia spp.			

Table 81 **Occurrence and ratio of various food items in the guts of *Lates niloticus* according to different length groups (Shrimps = 100%) (Latif *et al. 1979*).**

Length group (cm)	Occurrence (Shrimps as base) %			Ratio		
	Shrimps	Insects	Fish	Shrimps	Insects	Fish
10-14.9	100	220	13.3	1	2.2	0.13
15-19.9	100	416.8	154.2	1	4.2	1.5
20-29.9	100	85	86.4	1	0.8	0.9
>30	100	29	85.4	1	0.3	0.8

fishes secure food materials from the bottom or among aquatic plants. The different food components generally occur at varying degrees in the different periods of the year (Abdel-Azim 1982). Abdel-Mageed (1995) found that the stomach contents of adult *Labeo* spp. contained chironomid larvae, nematode worms, copepods in addition to other food items.

***Mormyrus* spp.** These fishes feed on aquatic insects, freshwater shrimps, annelids and to a less extent fishes (Latif *et al*. 1979). Aly (1993) mentioned that *Mormyrus* spp. feed mainly on larvae and pupae of chironomids, nymphs of Odonata, Corixidae (water bugs), *Cardina nilotica,* larvae of Trichoptera, Cladocera, detritus particles, in addition to aquatic plants and diatoms.

Hydrocynus forskalii. This species is carnivorous feeding on fishes (% occurrence 64.9), insects (% occurrence 26.1) and freshwater shrimps (% occurrence 9.0) (Latif *et al*. 1979). The percentage occurrence of food items of *H. forskalii* varies according to different lengths and during different seasons. The percentage occurrence of fishes increases progressively with length. Thus, fish more than 50 cm total length feed on fishes only (Fig. 119). Furthermore, the percentage occurrence of the various food items shows a remarkable change at the various seasons, which may be attributed to availability of the suitable food items (Fig. 119B).

Lates niloticus. *L. niloticus* is a predator, feeding mainly on fishes, freshwater shrimps and insects (Table 81 - Latif *et al*. 1979). The percentage occurrence of the various food items shows a remarkable variation with the length of fish (Table 81 and Figs. 120 and 121) compared with shrimps as food. Furthermore, the percentage occurrence of the various fish species in the gut contents indicates that *Alestes* spp. is the major food item, followed by catfishes, tilapias and Nile perch (Fig. 121).

Bagrus bajad* and *B. docmak. *Bagrus* species are carnivorous, feeding mainly on fishes (*Tilapia, Alestes, Synodontis, Mormyrus, Labeo, Barbus, Eutropius* spp.), insect larvae, molluscs and freshwater shrimps. The percentage of each food item varies with the fish length which is probably taken as the fish secure the food from the bottom.

Clarias gariepinus, Heterobranchus bidorsalis* and *H. longifilis. Catfishes are omnivorous bottom feeders. Their food consists mainly of animal origin (fishes, insects and molluscs) in addition to plant material (Latif *et al*. 1979).

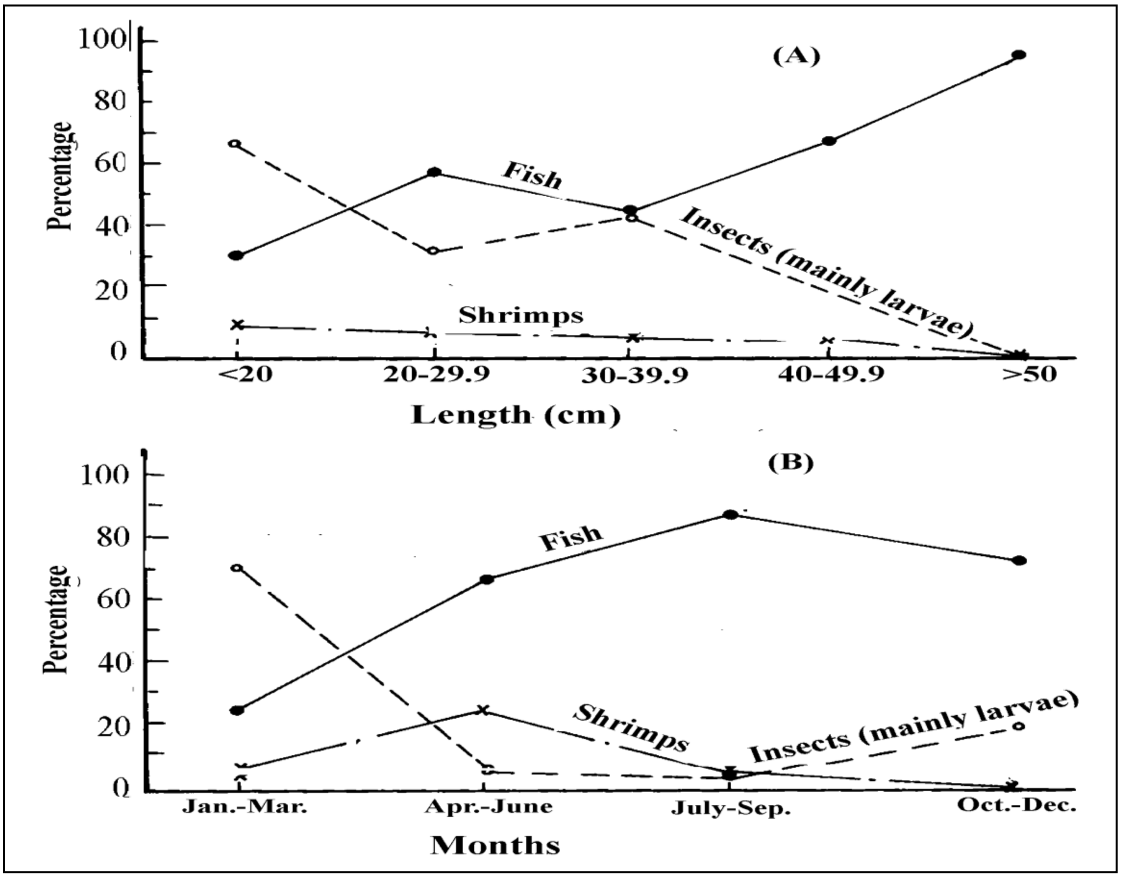


Fig. 119 **Frequency of fish with each food item in the guts of *Hydrocynus forskalii* according to A: length, B: different periods (Latif *et al.* 1979).**

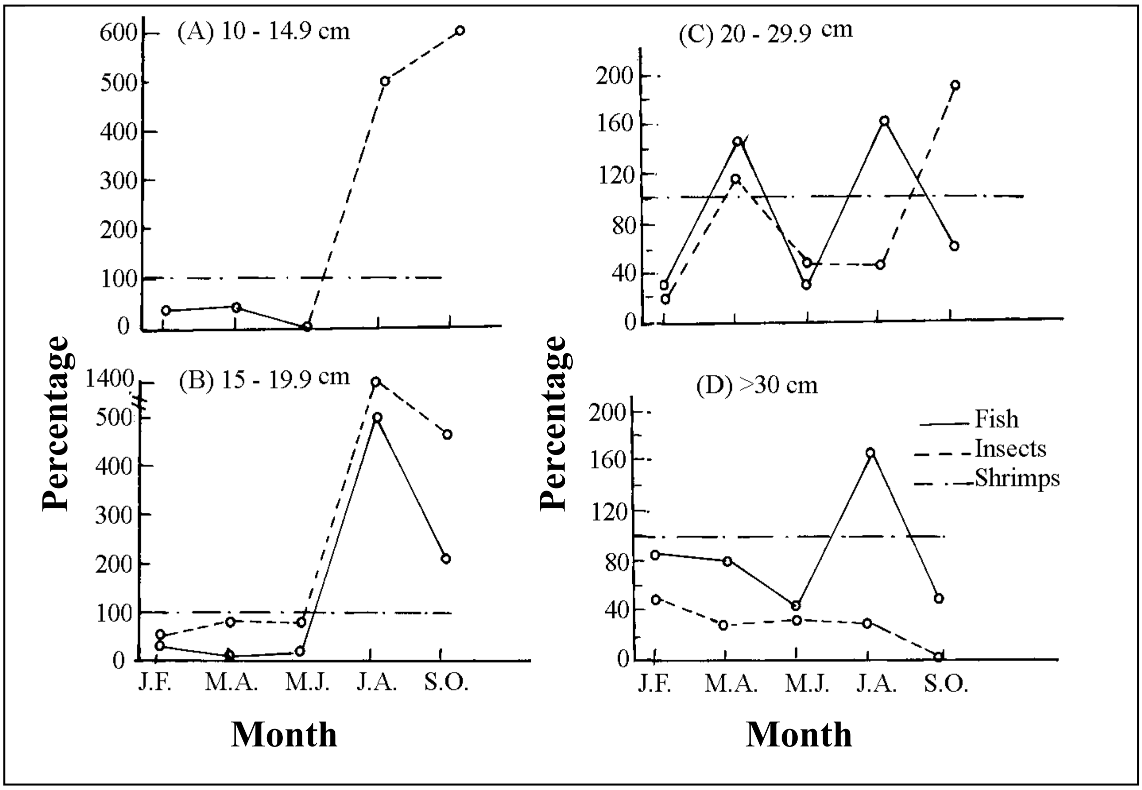


Fig. 120 **Bimonthly frequency occurrence of different food items in the guts of young and adult *Lates niloticus* (Latif *et al* 1979).**

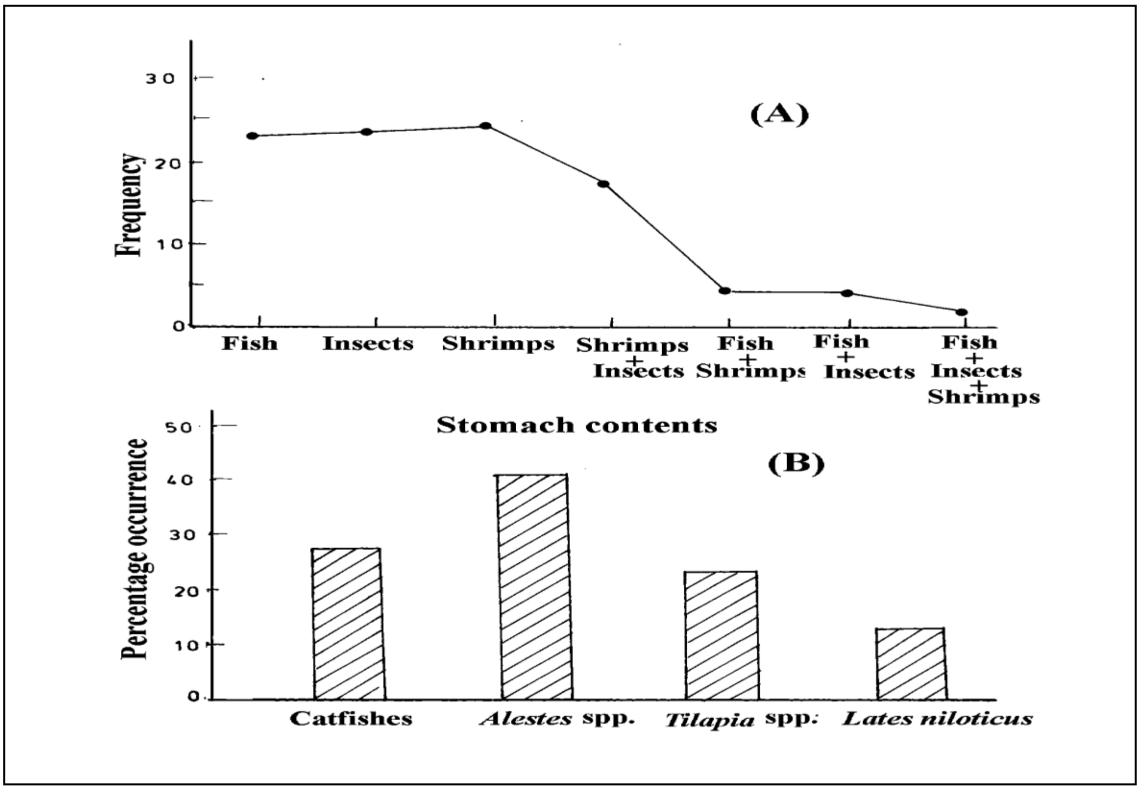


Fig. 121 **Food of *Lates niloticus,* A: frequency of different food items, B: percentage occurrence of different fish species in gut contents (Latif *et al.* 1979).**

2- AGE AND GROWTH

For the development and management of the fisheries of Lake Nasser a knowledge of the biological parameters of the various commercial fish species is of utmost importance. Among these parameters are the age, growth, length weight relationship as well as the calculated lengths and weights of the different age groups. Hence, in the present study reference will be given to the results of various investigators working on the biology of fish inhabiting Lake Nasser (Abdel-Azim 1974, Latif *et al*. 1979- 12 species, Agaypi (1992a) *Tilapia* species, Aly 1993 - mormyrid species, and Adam 1994 - *Tilapia* species).

Length-weight Relationship

Oreochromis niloticus (Fig. 122)

Log W = -1.6193 + 2.9723 Log. L. (1965) } Abdel-Azim (1974)
Log W = -1.4961 + 2.8773 Log. L. (1966) } Abdel-Azim (1974)
Log W = -1.6891 + 3.0230 Log. L. (1970) } Abdel-Azim (1974)
$W = 0.165 \times 10^{-2} L^{2.60}$ 1982 Agaypi (1992a)
LogW = -4.2343 + 2.9396 Log. L (1989/1990) Adam (1994)
$W = 2.466 \times 10^{-2} L^{2.9310}$ (1989/1990) Mekkawy *et al.* (1994)
$W = 0.0736 \times 10^{-2} L^{2.8422}$ (1996) SECSF (1996)

Sarotherodon galilaeus (Fig. 123)

Log W = -1.7899 + 3.1240 Log L. (1972/1973) Abdel-Azim (1974)
$W = 0.165 \times 10^{-2} L^{2.6}$ (1982) Agaypi (1992a)
Log W = -3.7929 + 2.7792 Log L. (1989/1990) Adam (1994)
$W = 3.145 \times 10^{-2} L^{2.8687}$ (1989/1990) Mekkawy & Mohamed (1995)
$W = 0.2534 \times 10^{-2} L^{2.4490}$ (1996) SECSF (1996)

Brycinus nurse

Log W = - 4.8230 + 3.0925 Log L. (SL in mm)

Alestes baremoze

Log W = - 1.9436 + 3.0702 Log L. (SL in cm)

Hydrocynus forskalii

Log W = - 2.0143 + 3.0644 Log L. (SL in cm)

Lates niloticus

Log W = - 4.3870 + 2.907 Log L. (SL in mm)

Eutropius niloticus

Log W = - 5.2825 + 3.1602 Log L. (SL in mm)

Labeo coubie

Log W = - 1.4130 + 2.9059 Log L. (SL in cm)

Labeo horie

Log W = - 1.3617 + 2.8661 Log L. (SL in cm)

Labeo niloticus

Log W = - 1.881 + 3.1472 Log L. (SL in cm)

Labeo forskalii

Log W = - 1.4661 + 2.8820 Log L. (SL in cm)

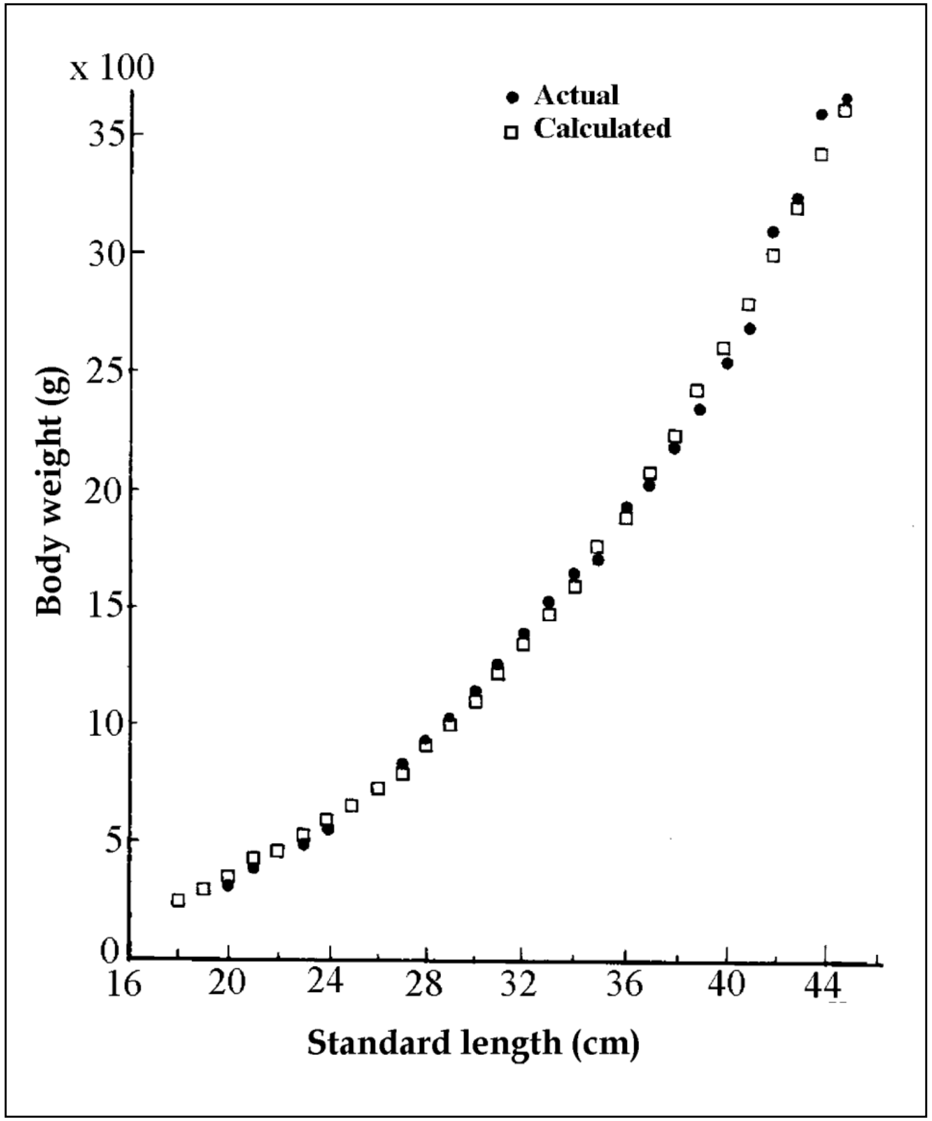


Fig. 122 **Length-weight relationship of** ***O.niloticus*** **(Adam 1994 and 1996b).**

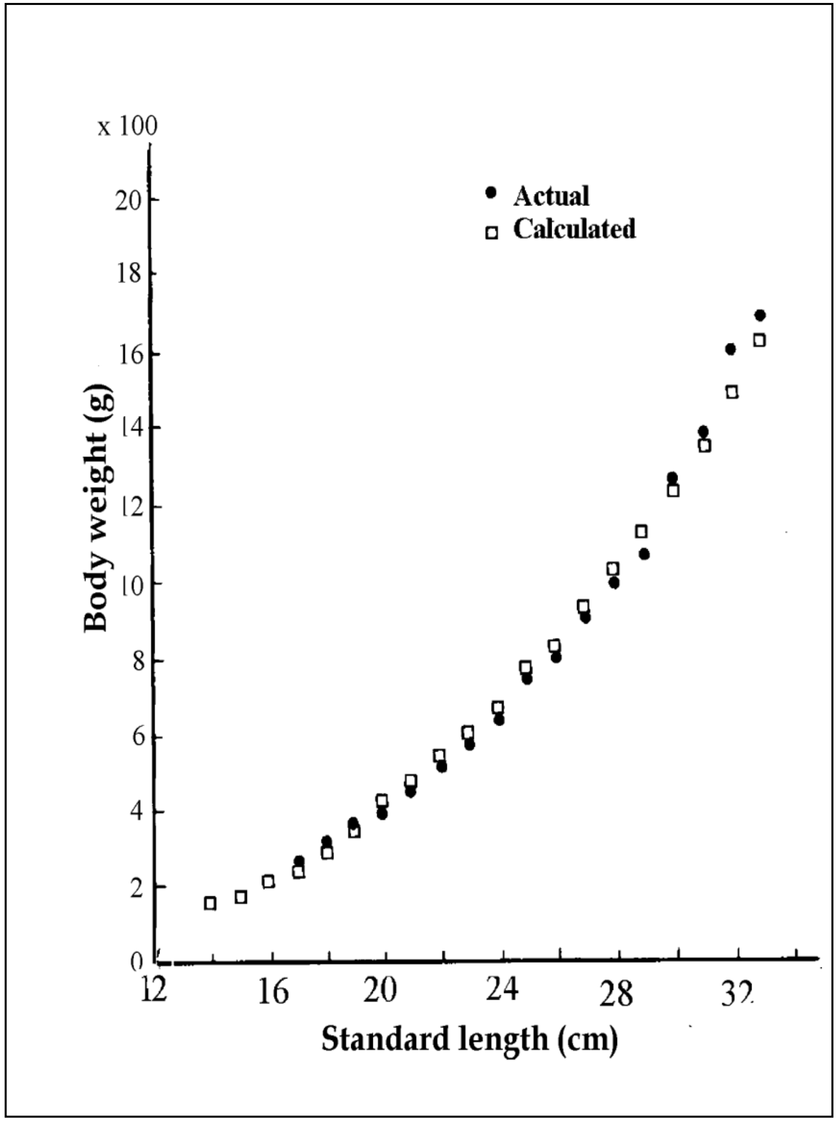


Fig. 123 **Length-weight relationship of** ***S. galilaeus*** **(Adam 1994).**

Log W = - 1.7230 + 3.0805 Log L. (SL in cm)

Bagrus docmak and ***Bagrus bajad*** (El-Badawy 1991)

Log W = - 4.4779 + 2.8802 Log L. for *Bagrus docmak.*

Log W = - 4.3332 + 2.7858 Log L. for *Bagrus bajad*.

The value of the exponent, being 2.88 and 2.78 for *B. docmak* and *B. bajad* respectively, shows that growth of these two species is allometric (Ricker 1975).

Mormyrus kannume (Aly 1993 - Fig. 124).

Log W = - 5.0332 + 3.0145 Log L.

Mormyrus caschive (Aly 1993 - Fig. 125).

Log W = - 4.83857 + 2.9359 Log L.

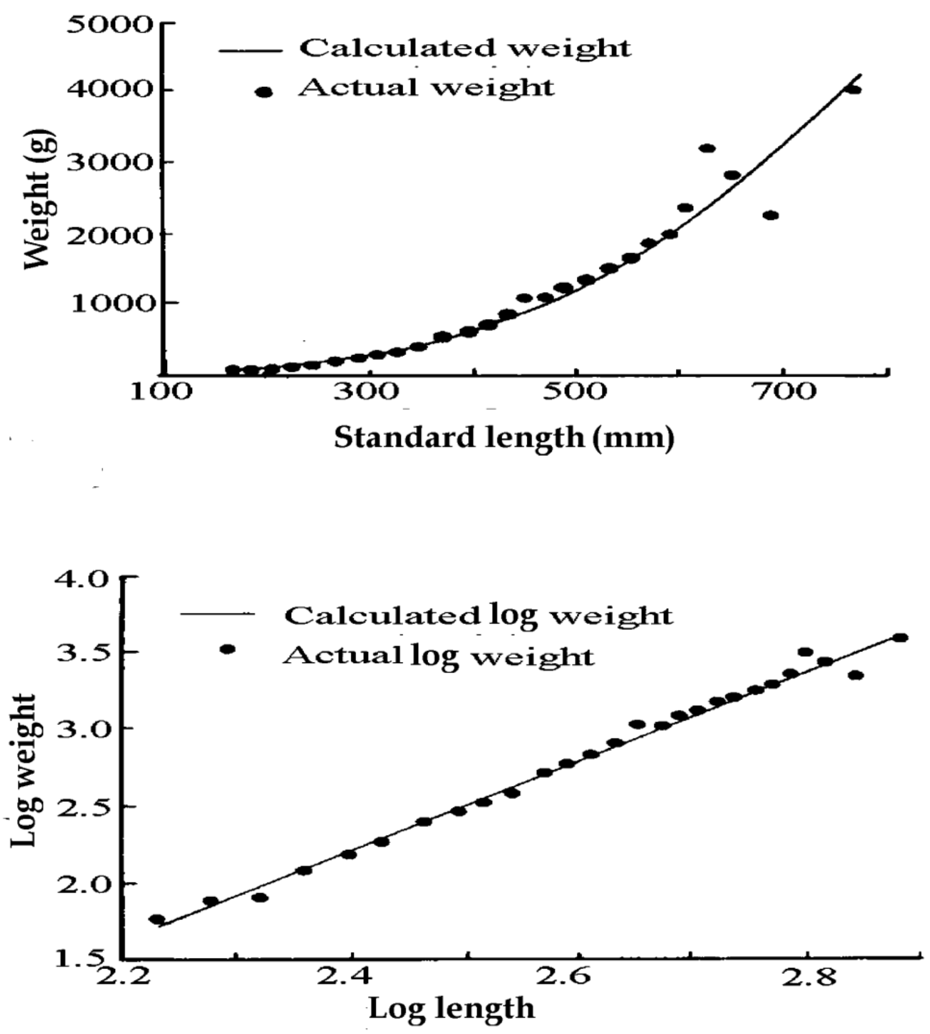


Fig. 124 **Length-weight relationship of *Mormyrus kannume* from Lake Nasser (Aly 1993).**

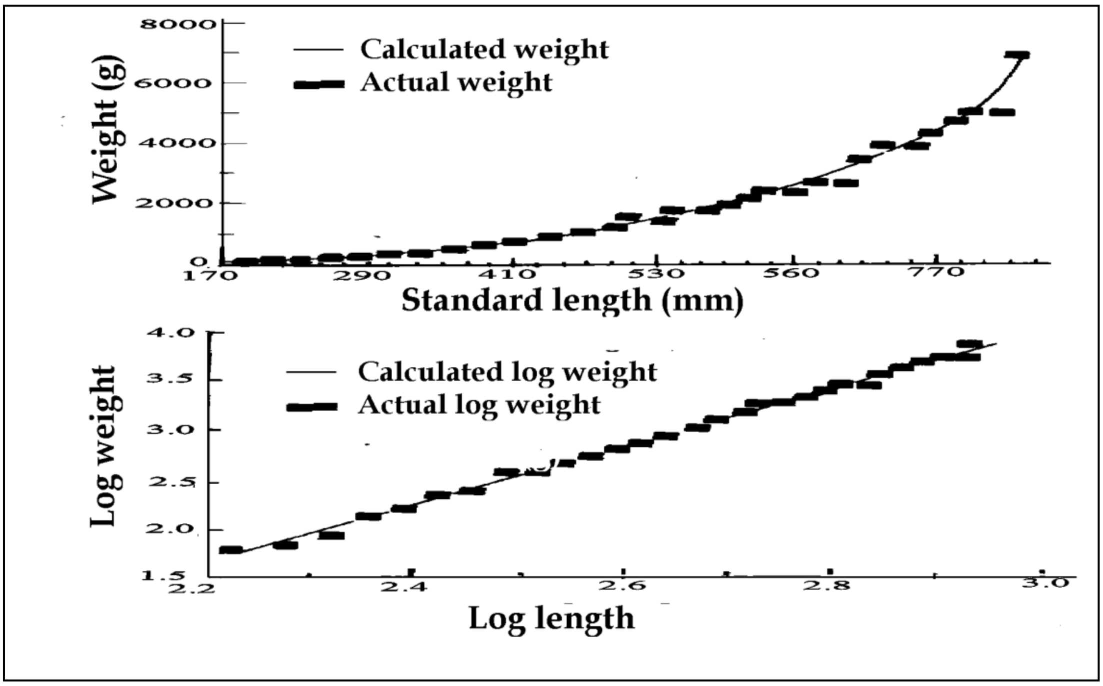


Fig. 125 **Length-weight relationship of *Mormyrus caschive* (Aly 1993).**

Condition factor

Adam (1994 and 1996b) calculated the condition factor of *O. niloticus* and *S. galilaeus* in Lake Nasser (Fig. 126). It is obvious that the condition factor of *O. niloticus* for all length groups ranged between 3.90 and 4.45. The values of condition factor did not vary significantly with the increase in length and the fluctuations in these values have no particular trend. In case of *S. galilaeus,* the condition factor for all length groups ranged between 4.36 and 5.47 (Fig. 126). It is obvious that the condition factor values mostly decrease with the increase of body length.

Growth in length

Due to the fact that the life span of fish species is variable, fishes of Lake Nasser attain different age groups. Latif *et al.* (1979) calculated the standard length for the different age groups of some fish species from Lake Nasser (Fig. 127). It is obvious that *Lates niloticus* has the highest length value (i.e. 130 cm). On the other hand, *Brycinus nurse* has the lowest length value. The length attained by the oldest age group of a given species may be attained by another one at a younger age (Latif *et al.* 1979).

Aly (1993) calculated the standard lengths and increments for the different age groups of both *Mormyrus caschive* and *M. kannume* (Fig. 128). Adam (1994) calculated the standard lengths and increments for the different age groups of both *Oreochromis niloticus* and *Sarotherodon galilaeus* (Tables 82 and 83 and Fig. 129). The average actual standard lengths of *O. niloticus* for the successive age groups I to IV were 24.10, 29.95, 35.40, and 39.15 cm, while the calculated lengths were 17.26, 25.82, 32.15, and 37.72 cm respectively (Table 82). For *S. galilaeus* the average standard lengths for the successive age groups I to III were 22.35, 25.00 and 27.45

cm, however, the average calculated lengths were 16.16, 22.17 and 25.82 cm respectively (Table 83). These values are in accordance with those previously recorded in 1982 by Agaypi (1992a) who showed that *O. niloticus* attains 21.8 cm and 420 g, 26.3 cm and 500 g, 31.6 cm and 1100 g. and 39 cm and 2000 g at the first to fourth year of life, while *S. galilaeus* attains 20.6 cm and 400 g, 22.8 cm and 480 g and 25.2 cm and 700 g at age 1-3 years. The low values of lengths as given by back calculation may be attributed to the fact that they indicate the length of fish when the annual ring is formed.

The average calculated lengths of *O. niloticus* and *S. galilaeus* for different age groups, recorded by different authors are presented in Tables 84 and 85, respectively. It is obvious that, in all cases, the growth rate of *O. niloticus* is higher than that of *S. galilaeus.* Furthermore, Agaypi (1992a) in his studies on the growth of both *Tilapia* species collected during 1982 from six different fishing areas in the Lake, found that fish of both species caught from the southern region are larger in size (length and weight) than those collected from the northern areas.

Comparing the growth rates at different years of life of *O. niloticus* in Lake Nasser (Table 84) suggests that sizes recorded during 1989/1990 (Adam 1994) are much less than those recorded in 1970 (Abdel-Azim 1974) i.e. a decrease of the growth rate in recent years.

Table 82 **Actual and calculated lengths of *O. niloticus* for different age groups (Adam 1994).**

Age group	Actual standard length (cm)			Calculated length (cm)		No. of fish examined
	Range	Average	Increment	Average	Increment	
I	18-29	24.10	24.10	17.26	17.26	276
II	24-36	29.95	5.85	25.82	8.56	520
III	28-40	35.40	5.45	32.15	6.33	405
IV	34-45	39.15	3.75	37.72	5.57	73

Table 83 **Actual and calculated lengths of *S. galilaeus* for different age groups (Adam 1994).**

Age group	Actual standard length (cm)			Calculated length (cm)		No. of fish examined
	Range	Average	Increment	Average	Increment	
I	14-26	22.35	22.35	16.16	16.16	732
II	20-31	25.00	2.65	22.17	6.01	502
III	24-33	27.45	2.45	25.82	3.65	48

The growth rate of *O. niloticus* and *S. galilaeus* collected from different water bodies is presented in Tables 86 and 87 which show that the growth rate of *Tilapia* spp. in Lake Nasser is higher than that from other lakes, except for *O. niloticus* at Jebel Aulia (Sudan), where the growth rate is higher than that in Lake Nasser in the first and second years of life, and the values are nearly equal in the third year, while in the fourth year, the growth rate of fish in Lake Nasser is higher.

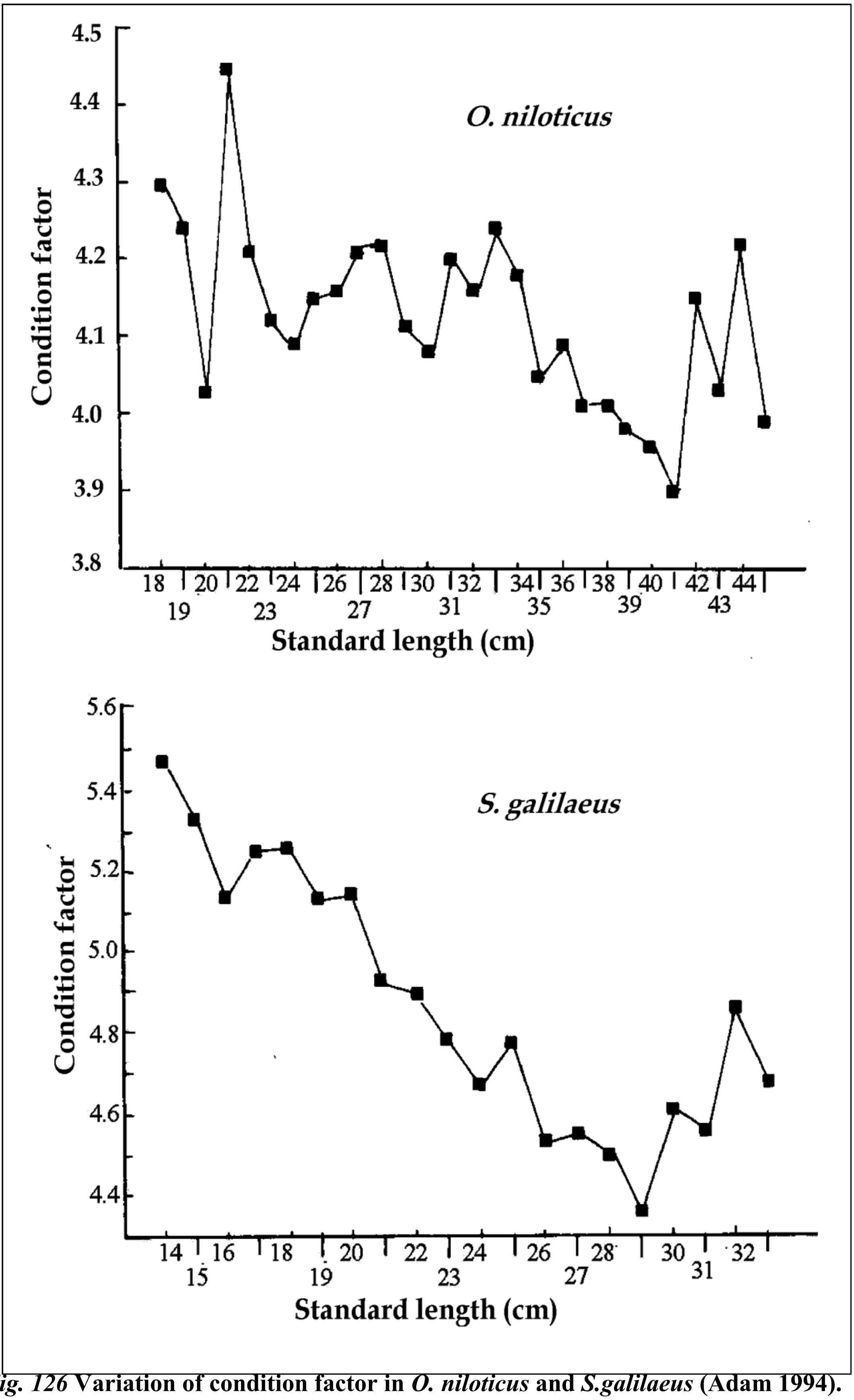


Fig. 126 **Variation of condition factor in *O. niloticus* and *S.galilaeus* (Adam 1994).**

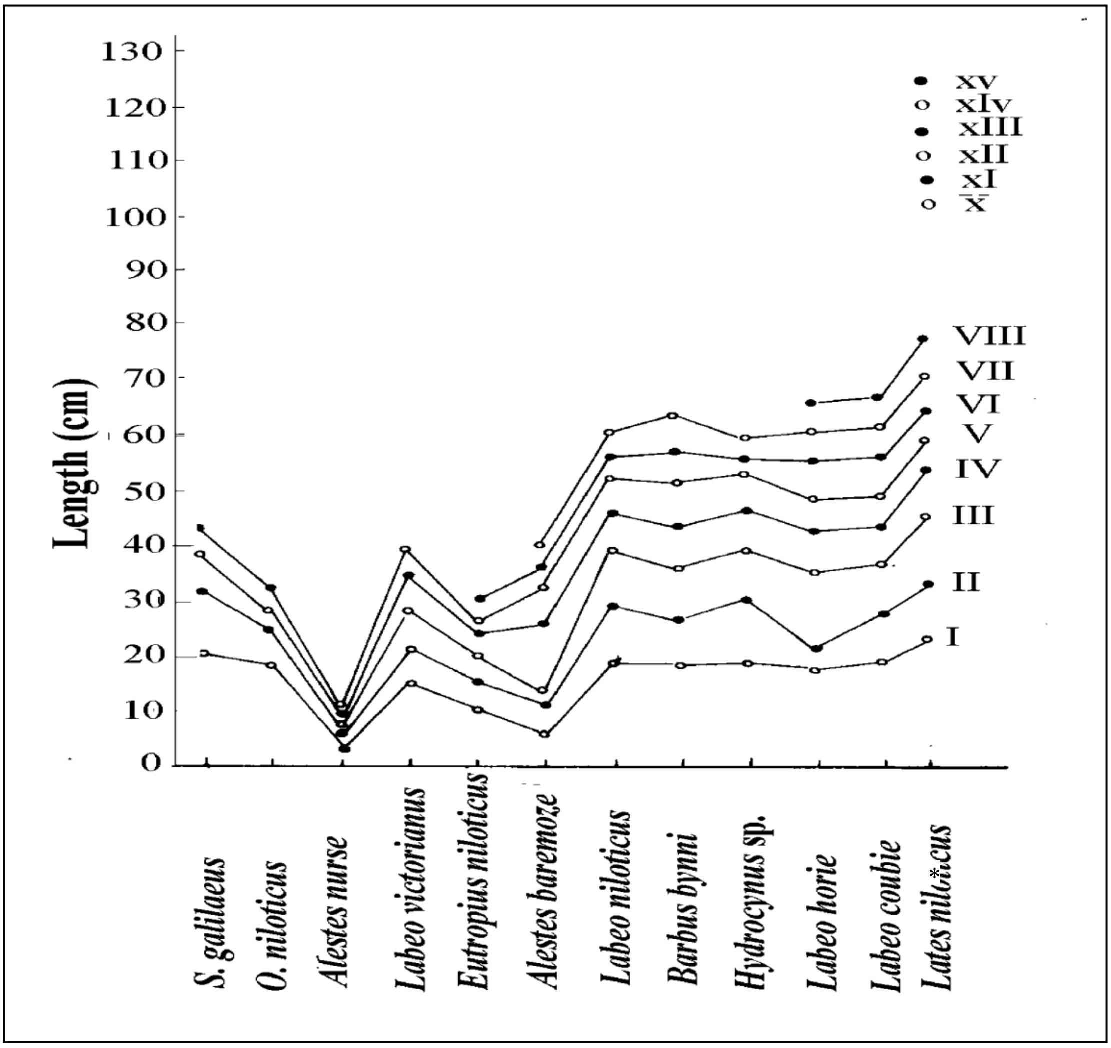


Fig. 127 **Calculated standard length for different age groups of some fish species (Latif *et al.* 1979).* *Lates niloticus* attains a length of 130 cm, at age group XV.**

Table 84 **Average calculated lengths of *O. niloticus* from Lake Nasser at different age groups (Different authors and periods).**

Author		Average calculated length (cm) for different age groups				Remarks
		I	II	III	IV	
Adam (1994) 1989-1990 (combined sexes)		17.26	25.82	32.15	37.72	SL
Yamagauchi *et al.* (1990)	♀	16.8	25.2	30.1	32.9	SL
	♂	17.3	25.4	30.9	34.7	SL
Agaypi (1992a) 1982		21.8	26.2	31.6	39.0	1-4 years (actual)
Abdel-Azim (1974) 1964/1970 (combined sexes)		20.0	29.6	35.5	40.2	SL

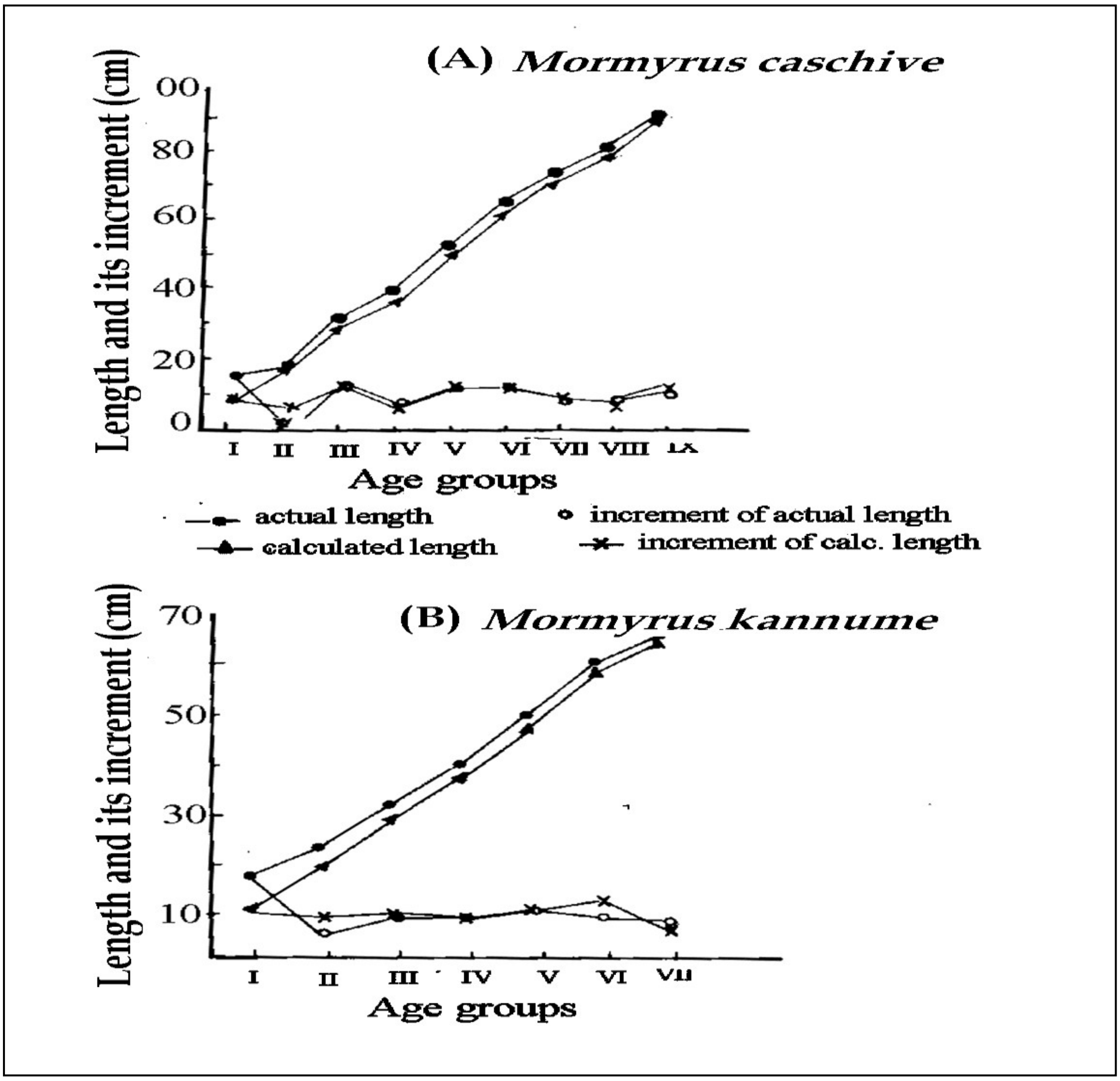


Fig. 128 **Growth in length of A:** ***Mormyrus caschive,*** **B:** ***Mormyrus kannume*** **(Aly 1993).**

Table 85 **Average calculated lengths of** ***S. galilaeus*** **from Lake Nasser at different age groups (Different authors and periods).**

Author		Average calculated length (cm) for different age groups				Remarks
		I	II	III	IV	
Adam (1994) 1989-1990 (combined sexes)		22.35	25.00	27.45	-	SL
Yamagauchi *et al.* (1990)	♀	13.4	19.7	23.4	25.6	SL
	♂	13.9	20.5	23.8	25.5	SL
Agaypi (1992b) 1982		15.4	17.2	19.1	-	1-3 years (actual)
Latif *et al.* (1979)		23.7	30.5	34.2	38.8	SL (years of life)
Abdel-Azim (1974) 1964/1970 (combined sexes)		18.63	24.76	28.06	32.20	SL

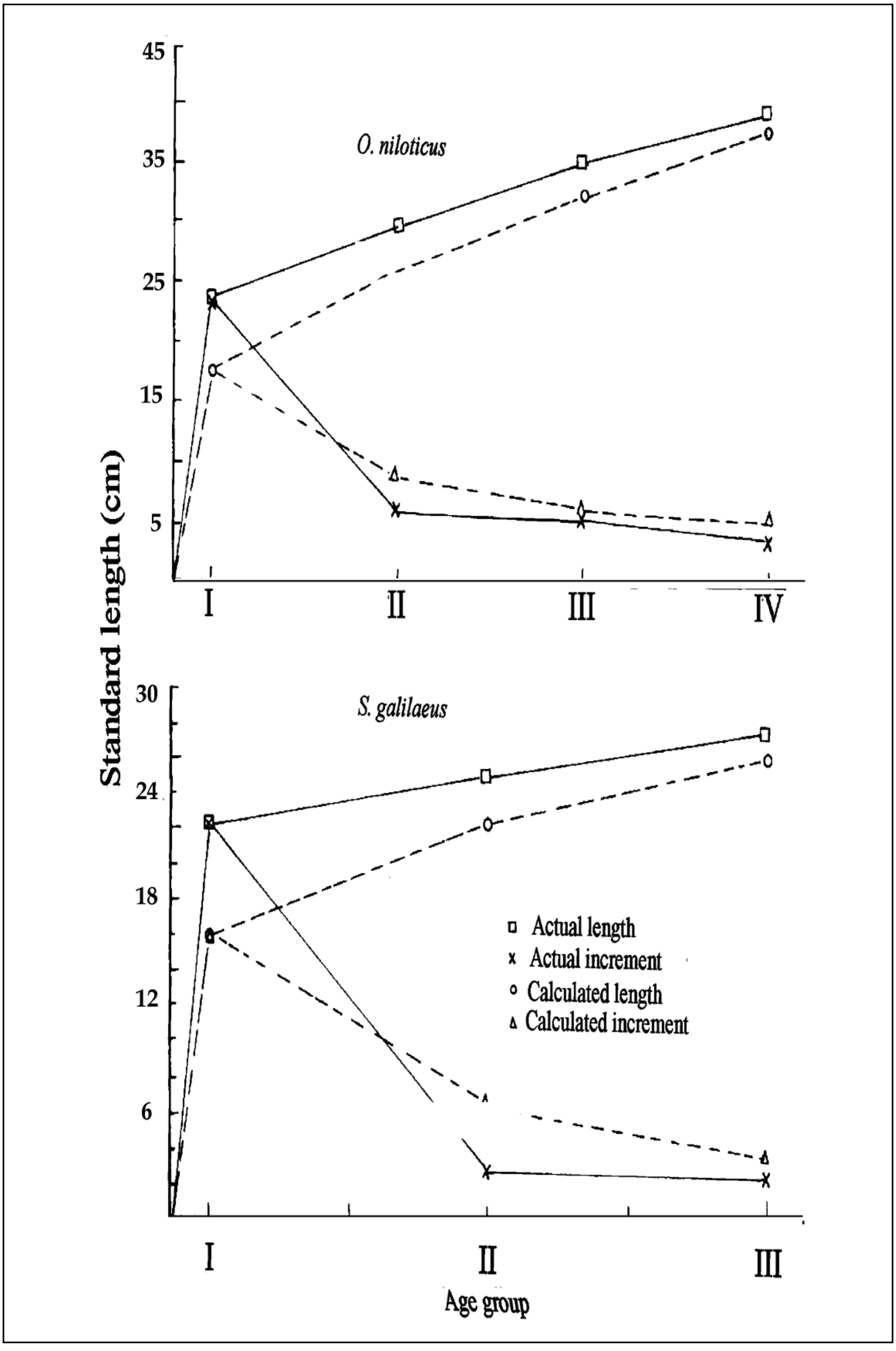


Fig. 129 **Growth in length of *O. niloticus* and *S. galilaeus* (Adam 1994).**

Growth in weight

The length-weight equations and the calculated lengths of the most important fish species in Lake Nasser, were used to obtain the calculated weights of different age groups. The calculated weights for different age groups of 14 fish species are presented in Table 88 (Latif *et al*. 1979 and Aly 1993, Fig. 130). From their results, it is obvious that the difference between different fish species, even those belonging to the same genus is more prominent with weight than with length. The results indicate that *Oreochromis niloticus* of age group IV has a calculated weight of 2836 g as compared with 1344 g for *Sarotherodon galilaeus* (i.e. more than twice).

Table 86 **Growth rate of *O. niloticus* in different localities.**

Lake and author	Calculated length (cm) of *O. niloticus* at the end of each year				
	1	2	3	4	5
Lake Nasser (Adam 1994)	17.26	25.82	32.15	37.72	--
Lake Nasser (Latif *et al.* 1979)	26.0	37.8	45.5	50.8	-
Lake Maryut (Jensen 1958)	9.20	20.50	25.70	28.80	-
Lake Maryut (El Zarka *et al.* 1970)	8.40	21.20	29.20	32.70	37.60
Beteha Area, Syria (El Bolock & Koura 1961)	9.90	16.40	20.40	27.50	--
Jebel Aulia, Sudan (Mahdi 1972)	24.40	28.80	32.00	36.00	43.70
Lake Tchad (Fryer & Iles 1972)	13.4	22.9	28.0	31.8	35.2*

*Actual total length at age (years)

Table 87 **Calculated total lengths (cm) of *Sarotherodon galilaeus* in different localities.**

Lake and author	Years of Life					
	1	2	3	4	5	6
Lake Nasser (Adam 1994) (1989-1990)	22.35	25.0	27.45	--	--	Standard length
Lake Nasser (Latif *et al.* 1979)	23.7	30.5	34.2	38.8	--	--
Lake Maryut (Jensen 1958)	8.3	21.6	25.3	27.7	28.1	29.8
Lake Tiberias (Ben Tuvia 1960)	13.8	22.7	37.4	31.5	32.5	34.1
Lake Tchad (Blache *et al.* 1964)	13.2	22.3	27.0	30.2	31.4	--

On the basis of the aforementioned length-weight relationships, Latif *et al.* (1979) calculated the weight of fishes for some selected lengths (Table 89 and Fig.131).

From the previous results it is obvious that some fish species are slender (as *Eutropius niloticus, Hydrocynus forskalii, Alestes baremoze*), others have heavier bodies (as *Labeo niloticus, L. forskalii, Lates niloticus* and *Barbus bynni*) and still others as *Sarotherodon galilaeus* and *Oreochromis niloticus* have the heaviest weight (Latif *et al.* 1979).

The calculated weights and the annual increments of growth in weight of *Bagrus docmak* and *B. bajad* for different age groups were recorded by El-Badawy (1991) (Tables 90 and 91). There is a significant difference in growth between *Bagrus bajad* and its relative *Bagrus docmak* which grows faster and lives for a longer age (Tables 90 and 91).

Adam (1994) calculated the weights and the annual increments of growth in weights of *Oreochromis niloticus* and *Sarotherodon galilaeus* for different age groups (Tables 92 and 93 and Fig. 132). In case of *O. niloticus,* the growth increment in weight for age-group I was the lowest (in contrast to length). The growth increment increased progressively in the older ages up to age group IV. It is obvious that the average weights of *O. niloticus* were higher than those of *S. galilaeus (*Tables 92 and 93). For *S. galilaeus,* the calculated weight of age group I was nearly equal to that of *O. niloticus;* while those of age groups II and III were lesser than the calculated values for the same age groups of *O. niloticus.* The growth increment in weight of *S. galilaeus* was the lowest for age group I, then increased at age-group II and decreased at age group III. When comparing the calculated lengths of *O. niloticus* and *S. galilaeus* given by Latif *et al*. (1979) and those found by Adam (1994) (Tables 86 and 87) it can be seen that calculated lengths of both species at various age groups during 1994 were lesser than those at 1974 suggesting a decrease in growth during the last two decades.

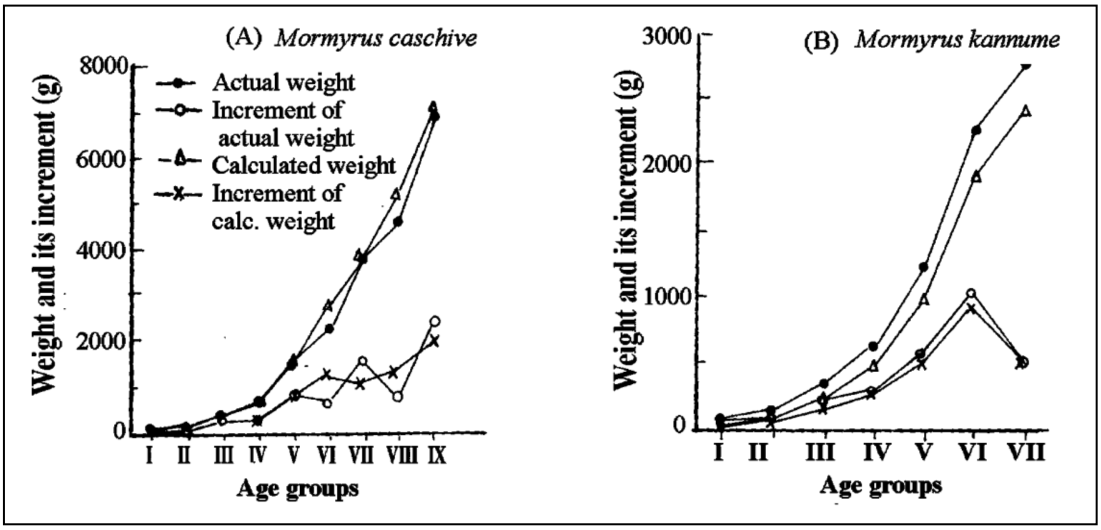


Fig. 130 **Growth in weight of A:** ***Mormyrus caschive,*** **B:** ***Mormyrus kannume*** **(Aly 1993).**

Table 88 **Calculated weights (g) of various fish species from Lake Nasser at different age groups (Latif *et al.* (1979).**

Fish species	Age Group									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Oreochromis niloticus	412.4	1301.0	2209.0	2836.00						
Sarotherodon galilaeus	315.5	674.9	943.5	1344.0						
Brycinus nurse	1.21	4.79	10.81	19.52	34.52					
Labeo forskalii	95.5	274.5	624.2	924.2	1332.0					
Eutropius niloticus	13.0	60.5	105.0	185.0	221.0	360.0				
Alestes baremoze	3.37	27.27	100.8	265.18	497.49	705.97	977.0			
Labeo niloticus	139.9	540.3	134.2	2260.5	3335.0	4395.0	5404			
Barbus bynni	156.1	521.9	1168	2107.7	3569.3	4922.5	6736			
Hydrocynus forskalii	815	331.1	731.6	1262	1861	2215	2556			
Labeo horie	172.2	708.2	1638	2615	3864	5429	6826	8271		
Labeo coubie	210.5	584.3	1180.9	2238.2	3181.3	4801	6232	7232		
Lates niloticus**	300	850	2350	3611	4598	6098	6250	1150	- - - -	20400*
Mormyrus caschive *	59.65	73.5	376.8	647.6	1446.75	2669.1	3779.8	5109.0	7061.9	- - - -
Mormyrus kannume *	11	68	219	477	990.5	1905.6	2422	- - - -	- - - -	- - - -

*Aly (1993), ***L. niloticus* attains 15 years old and 50.75 kg body weight.

Table 89 **Calculated weights (g) at different lengths of various fish species from Lake Nasser (Latif *et al.* 1979).**

Fish species	Standard length (cm)			
	10	15	20	30
	Calculated weight (g)			
Hydrocynus forskalii	11.2	38.9	93.9	325.2
Eutropius niloticus	10.9	39.3	97.5	351.3
Alestes baremoze	13.4	59.9	112.4	390.5
Labeo niloticus	23.2	66.1	163.5	585.7
Labeo forskalii	26.0	83.8	192.1	617.9
Lates niloticus	26.7	86.9	200.4	651.5
Barbus bynni	22.8	79.4	192.6	671.7
Labeo horie	31.9	102.1	232.9	744.2
Labeo coubie	31.1	101.0	233.1	757.5
Sarotherodon galilaeus	49.7	143.7	305.4	885.7
Oreochromis niloticus	62.8	168.5	354.3	1058.0

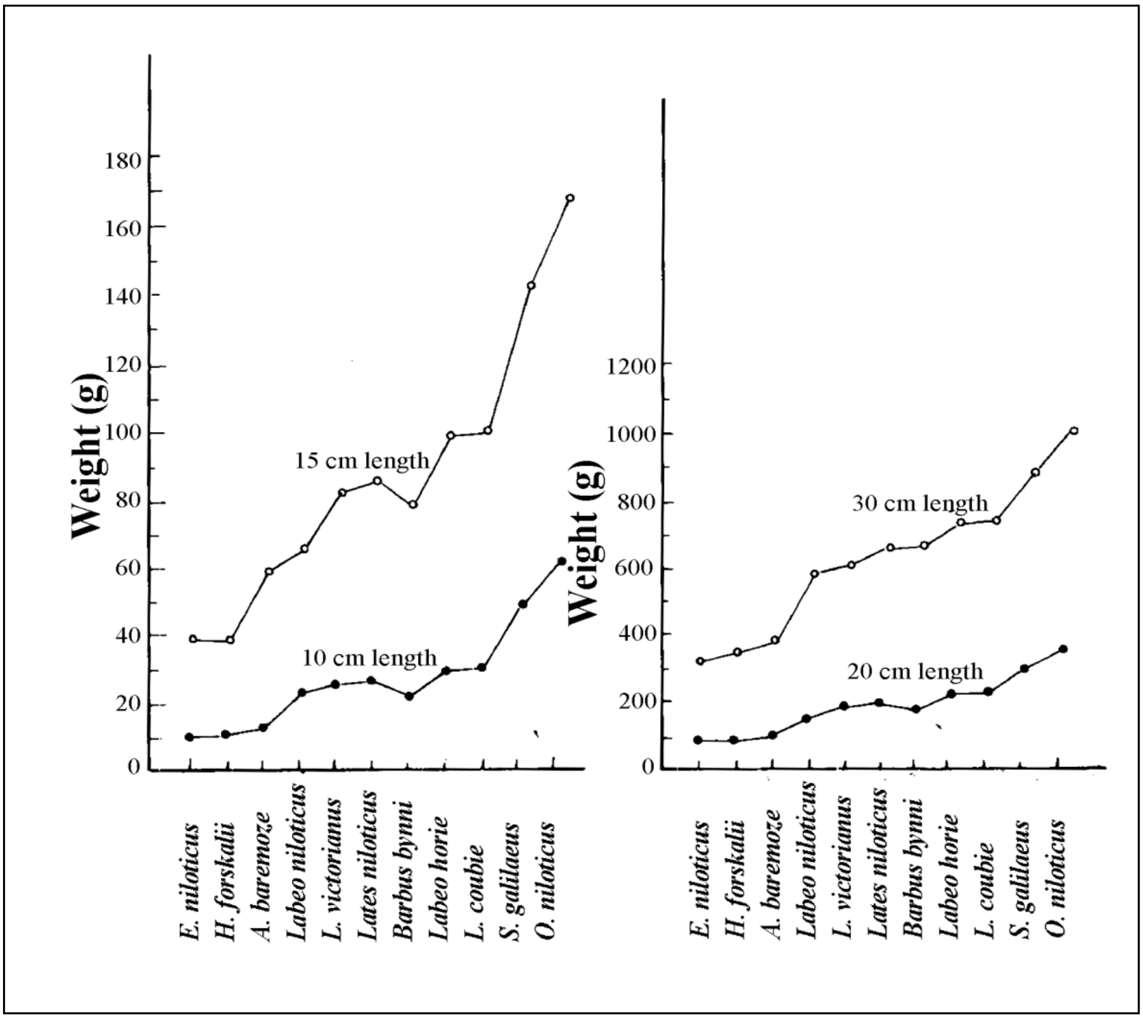


Fig. 131 **Calculated weights of some common species for some selected lengths (Latif *et al.* 1979).**

Table 90 **Actual and calculated weights and increments of *Bagrus docmak* for different age-groups (El-Badawy 1991).**

Age-group	Actual weight (g)		Calculated weight (g)		% weight from total
	Average	Increment	Average	Increment	
I	320	320	189	189	2.93
II	762	442	439	250	6.81
III	1388	626	1264	825	19.62
IV	2411	1023	1685	421	26.16
V	4346	1935	2688	1003	41.73
VI	11430	7084	6442	3754	100

Table 91 **Actual and calculated weights and increments of *Bagrus bajad* for different age-groups (El-Badawy 1991).**

Age-group	Actual weight (g)		Calculated weight (g)		% weight from total
	Average	Increment	Average	Increment	
I	428	428	253	253	11.5
II	833	405	588	335	26.84
III	1577	744	1013	425	46.23
IV	2166	589	1513	500	69.06
V	2789	623	2191	678	100

Table 92 **Actual and calculated weights and increments of *O. niloticus* for different age-groups (Adam 1994).**

Age-group	Actual weight (g)		Calculated weight (g)		% weight from total
	Average	Increment	Average	Increment	
I	598.10	598.10	219.58	219.58	10.04
II	1153.15	555.05	717.82	498.24	32.82
III	1866.45	713.30	1367.30	649.48	62.52
IV	2553.56	687.11	2187.12	819.82	100

Table 93 **Actual and calculated weights and increments of *S. galilaeus* for different age-groups (Adam 1994).**

Age-group	Actual weight (g)		Calculated weight (g)		% weight from total
	Average	Increment	Average	Increment	
I	539.92	539.92	221.15	221.15	27.17
II	746.17	206.25	532.78	311.63	65.47
III	970.63	224.46	813.82	281.04	100

Effect of impoundment on the growth of *Tilapia* spp. in Lake Nasser

Comparing the lengths and weights of *O. niloticus* and *S. galilaeus* recorded by Abdel-Azim (1974) during the early filling of Lake Nasser (1964/70) and those of Adam (1994) (Tables 82, 83, 92 and 93 and Fig. 132), Mekkawy *et al*. (1994) and Mekkawy & Mohamed (1995) during 1989/1990 and the calculated lengths of both species given by Latif *et al*. (1979) (Figs. 133 and 134) a remarkable decrease in size is observed for both tilapiine species during the last two decades.

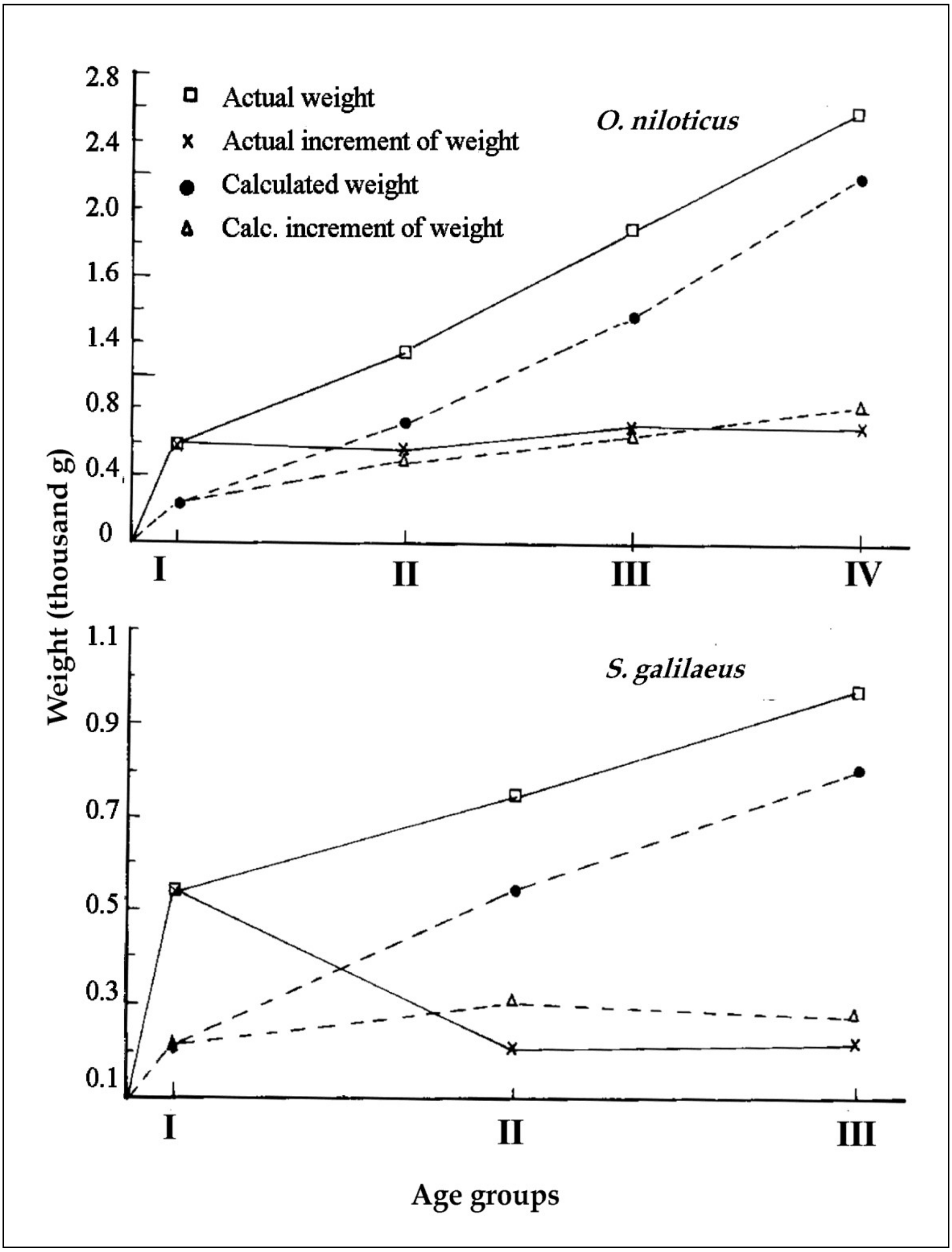


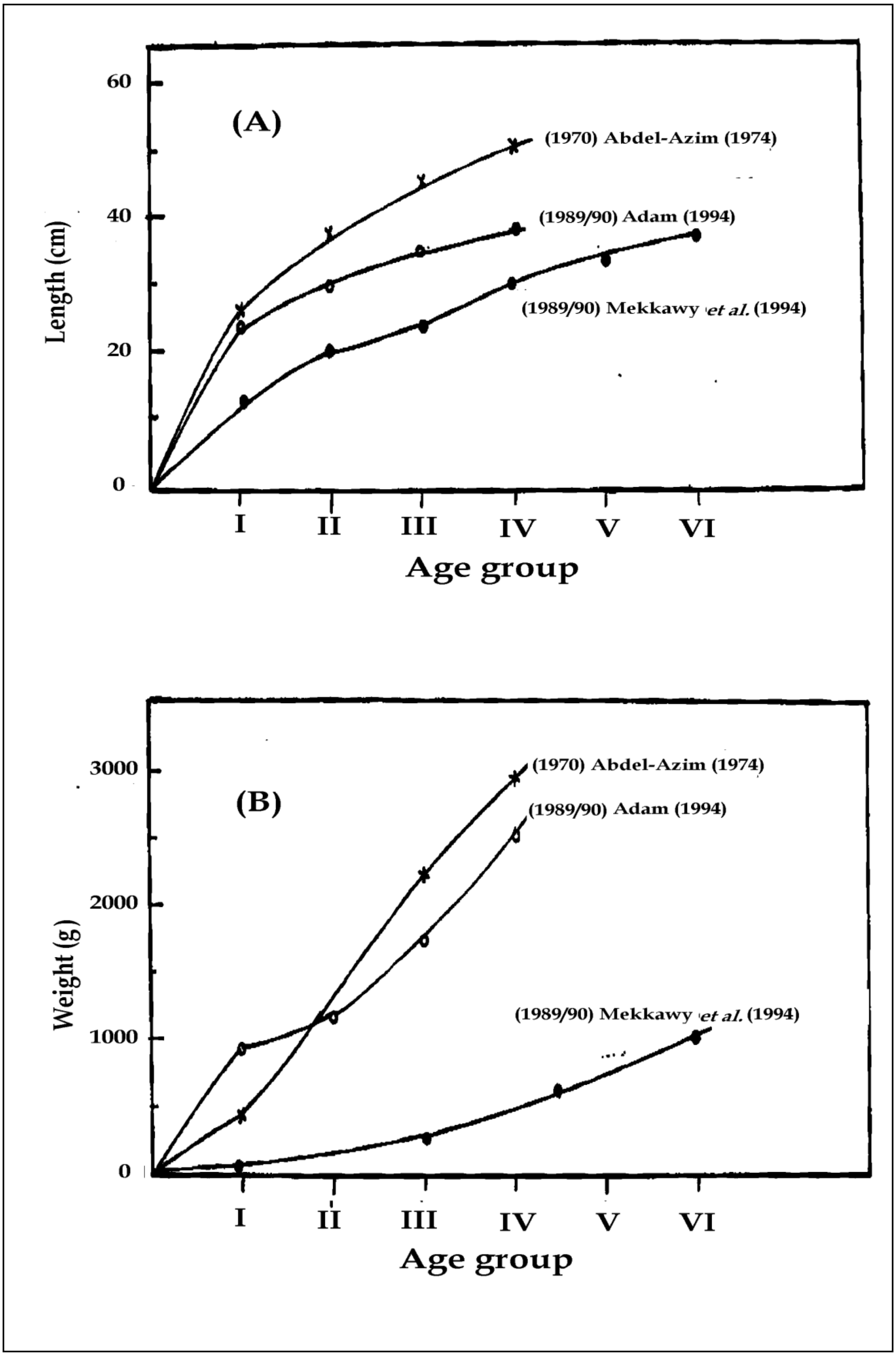
Fig. 132 **Actual and calculated weight of *O. niloticus* and *S. galilaeus* (Adam 1994).**

When considering the results obtained by Adam (1994) and those of Mekkawy *et al*. (1994), and Mekkawy & Mohamed (1995), on the growth of both tilapiine species in Lake Nasser, during the same period (1989-1990), remarkable differences between their results are noticed. Thus, while Adam (1994) mentioned that the actual weights of *O. niloticus* at age groups I-IV ranged between 598.1 and 2553.6 g (Table, 92), Mekkawy *et al*. (1994) pointed out that the range was 150-875 g (Fig. 133B) for the same age groups. Moreover, Adam (1994) showed that the weights of *S. galilaeus* ranged between 539.9 and 970.6 g (Table, 93) for age group I-III. Mekkawy & Mohamed (1995) indicated that this range was 80-220 g (Fig. 134B) for the same age groups. It seems that figures given by Mekkawy *et al*. (1994) and Mekkawy & Mohamed (1995) are too low and do not represent the actual sizes of both tilapiine species fished during recent years. This view is supported by the results of recent studies carried out on the fisheries of Lake Nasser (SECSF, 1996) at four sectors covering the Lake (Khors: 1-El Ramla, Dihmit, Kalabsha, 2-Absco, Garf Hussein, Allaqi, 3-Wadi El Arab, Korosko, Thomas, Afiah, 4-Enaba, Tushka, Hemadeh) which showed the following:-

1. The percentage of *O. niloticus* of 500 g and less (less than 25 cm long) was about 6.3% of the total production by weight and more than 25% of the total number fished. The highest percentage (9.5%) was that for fish collected from sector 1, while that from the other sectors ranged from 2.5-3.8% where fish more than 500 g and 30 cm long were dominant. Furthermore, the average weight of *O. niloticus* collected from all sectors more than 500 g ranged from 532.9 to 4253.3 g and 23-47.9 cm long. Referring to the sizes recorded by Mekkawy *et al* (1994- Fig. 133) it is obvious that the maximum length and weight of *O. niloticus* was 34 cm and 875 g, being much less than that recorded by Adam (1994) and SECSF (1996).

2. The percentage weight of *S. galilaeus* less than 500 g and less than 23 cm long was 87% of the total production representing 92.1% of the total fish production by weight from sector 1 (El Ramla, Dihmit and Kalabsha). Furthermore, fishes ranging from 13 to 22.9 cm long ranged from 142.5 to 483.9 g; while those from 23 to 31 cm ranged from 557.1 to 1150 g. Thus, it seems that the dominant size of *S. galilaeus* was less than 23 cm long and less than 500g. When referring to Fig. 134, it is obvious that figures recorded by Mekkawy *et al* (1994) showing a maximum length of 23.5 cm and weight of 310 g for age group V, are much lower than those given by Adam (1995a & b) working during the same period and less than those recorded in 1996 (SECSF).

Nevertheless, it seems that during the last two decades a decrease in size of both tilapiine species occurred, being more remarkable in fishes from the northern region than from the southern one. This may be attributed - among other factors - to the effect of impoundment of Lake Nasser. Similar observations on the effect of impoundment on the diversity and biological characteristics of cichlids were reported for Lake Kainji (Lelek 1973, Balogun 1986), Lake Kariba (Balon & Coche 1974), Lake Kamburu (Dadzie 1980), Lake



(A)
60
40
20
0
Length (cm)
(1970) Abdel-Azim (1974)
(1989/90) Adam (1994)
(1989/90) Mekkawy et al. (1994)
I
II
III
IV
V
VI
Age group
(B)
3000
2000
1000
0
Weight (g)
(1970) Abdel-Azim (1974)
(1989/90) Adam (1994)
(1989/90) Mekkawy et al. (1994)
I
II
III
IV
V
VI
Age group

Fig. 133 **Growth in length (cm) A; and weight (g), B; of different age groups of *O. niloticus* during different periods.**

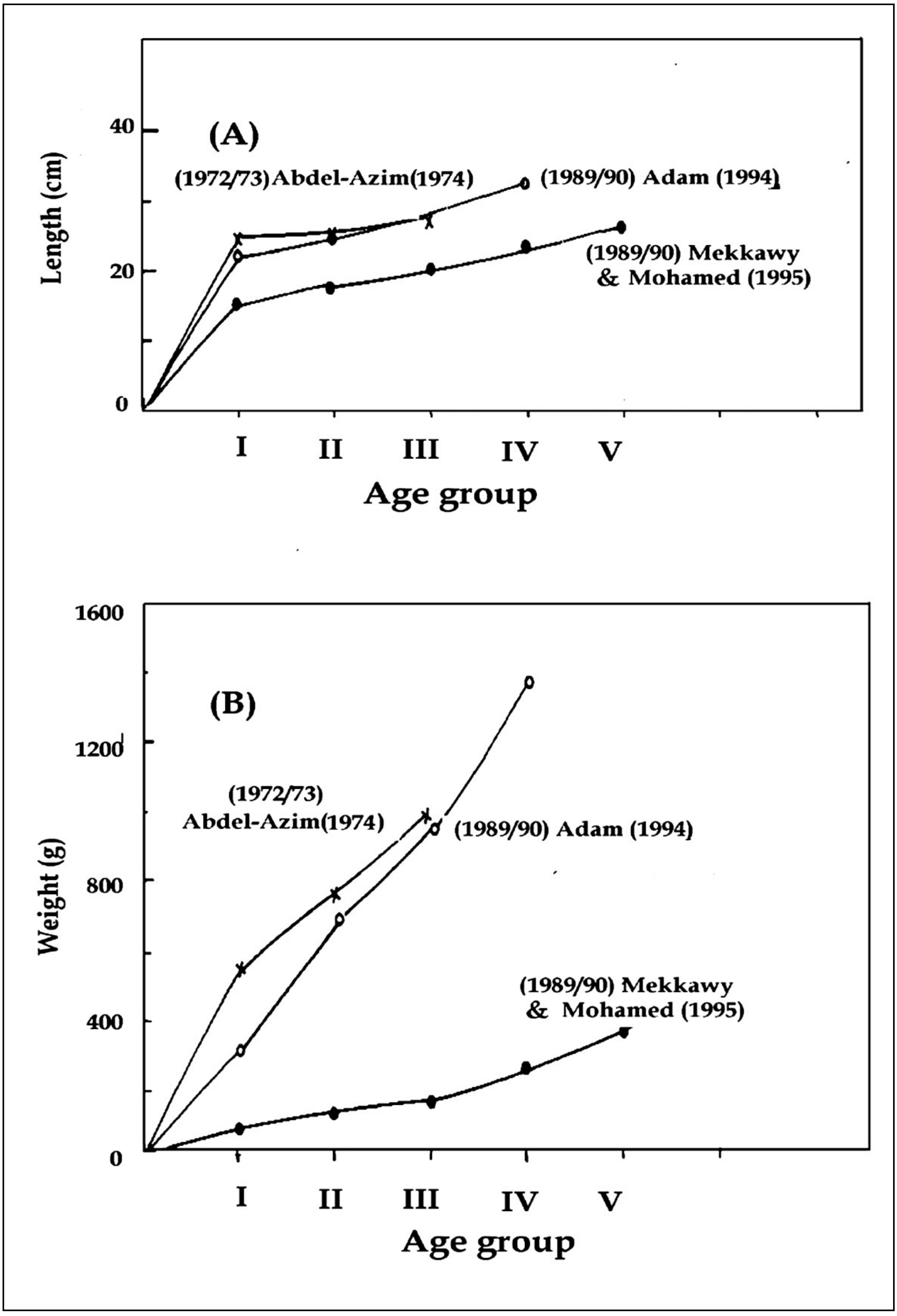


Fig. 134 **Growth in length (cm) A: and weight (g), B: of different age groups of *S. galilaeus* during different periods.**

Itezkitezhi (Kapasa & Cowx 1991) and Lake Nubia (Ali 1984). Mekkawy & Mohamed (1995) concluded that cichlids, especially *O. niloticus* and *S. galilaeus,* had a great ability, as reflected by their past impoundment prominence in the normal and dry conditions in the aged lakes, to adapt to the new lacustrine habitat, to feed on different items and to spawn successfully in a balanced equilibrium with the ecological and biological conditions. Furthermore, among tilapiine fishes *S. galilaeus* were able to adapt to special environmental factors and to predominate (Ben-Tuvia *et al*. 1992) in Lake Kinnert (Lake Tiberias) at the time at which *O. niloticus* declined (Ben-Tuvia 1960) and disappeared completely from the Lake (Ben-Tuvia *et al.* 1992). In Lake Nasser and other Egyptian lakes, *O. niloticus* has a higher growth rate than *S. galilaeus.* Further investigations on the other fish species of Lake Nasser are needed to find out the effect of impoundment and whether a decrease in their growth rate occurred in recent years on the basis of previous studies on the growth of these species.

3. REPRODUCTIVE BIOLOGY

The knowledge of reproductive biology : spawning season, length at first maturity, fecundity, etc. is one of the most important aspects in the development of fisheries by suggesting the suitable time for protection of fisheries, suitable size to be fished and also to prevent over-exploitation.

Spawning season

Based on the analysis of gonad index (Table 94), egg diameter and frequency of maturity stages, fishes of Lake Nasser may be assorted into three main groups:

a. The first group of fishes have a relatively long spawning season (e.g. *Lates niloticus, Brycinus nurse, Oreochromis niloticus, Sarotherodon galilaeus*). Two peaks at least were recorded, the first peak during March-May and the second during August-September (Figs. 135 and 136).

b. The second group particularly females are mature only in July, August and September (e.g. *Eutropius niloticus, Alestes baremoze, Mormyrus kannume, M. caschive, Labeo coubie, L. horie, Barbus bynni* (Figs. 137 - 139), *Synodontis schall, Schilbe uranoscopus, Petrocephalus bane, and Mormyrops anguilloides*). Spawning probably coincides with the commencement of the flood, which may stimulate this process. In other words, they are summer spawners.

c. Winter spawners mainly *Labeo niloticus*.

Spawning behaviour

O. niloticus and *S. galilaeus* are nest builders that prepare the nests in fine sand, sometimes with fine gravel in shallow waters particularly in khors or inundated areas. *Bagrus* spp. build also nests on the bottom substrate, close to some rocky areas. *Lates niloticus* is extremely different as it lays pelagic eggs. Large individuals of *Clarias gariepinus* were seen very actively swimming and thrashing about amid partially submerged weeds, during the spawning season, an act which is probably connected with spawning.

It seems that most fishes of Lake Nasser have limited movements for their spawning runs especially *Tilapia* spp. which move to the shallow coastal waters with sandy bottom where they build their nests. However, *Alestes baremoze* behave differently as males and females move upstream beyond the Second Cataract and Amada area. There, they dwell along the narrow part of the reservoir where they become affected by the early washes of the flood which probably induces the process of spawning. This spawning behaviour of *Alestes baremoze* is similar to that occurring in other African waters. Thus, Daget (1952) recorded mass spawning of this species in the middle of Niger coinciding with heavy rain which causes sudden drop of temperature. Hopson (1972) postulated that mass movement of *A. baremoze* from Lake Tchad to the river takes place each year at the flood time and that this migration is primarily connected with spawning.

Macroscopic peculiarities of the gonads

Maturity stages. The monthly frequency (%) of different maturity stages of *O. niloticus* is graphically presented in Fig. 140 (Adam, 1994). It is obvious that for females *O. niloticus,* the mature stages (IV and V) increased gradually from 29% in January to reach the maximum value (86%) in April. Then, a decline was noticed in July (24%), followed by a slight increase in August and September (27% and 28% respectively). A sharp decrease was observed in October and November to reach 8% only, followed by a slight increase (11%) in December (Fig. 140). The frequency of mature testes of *O. niloticus* increased gradually from 24% in January to 78% in April, followed by a progressive decrease to reach 25% in June. A gradual increase was noticed during the period from July till September (29%; 31% and 46% respectively). A sharp decrease was recorded in October (15%), followed by an increase of 21% in November to 28% in December (Fig. 140). These results suggest that *O. niloticus* is a multispawner spawning about 2-3 times during the year with a maximum in March-May.

Gonad index (GI). On analyzing the gonad index of Lake Nasser fishes, Latif *et al.* (1979) assorted two main groups. The first one: *Brycinus nurse, O. niloticus, S. galilaeus* and *Lates niloticus* have prolonged spawning season with two peaks (March - May and August - September, Figs. 135 and 136). The second group of fishes: *A. baremoze; Eutropius niloticus, Labeo coubie, L. horie, Barbus bynni, Synodontis schall, Schilbe uranoscopus,* are mature only during the period July-September (Fig. 137).

The monthly variations of gonad index of *Mormyrus kannume* and *M. caschive* were studied by Aly (1993). Fig. 138 shows a gradual increase of the gonad index of females and males of *M. kannume* in June which attains its maximum (6.2 and 0.44 respectively) in July followed by a sharp decrease in the value of gonad index till October. For *M. caschive,* almost the same trend was observed (Fig. 139)

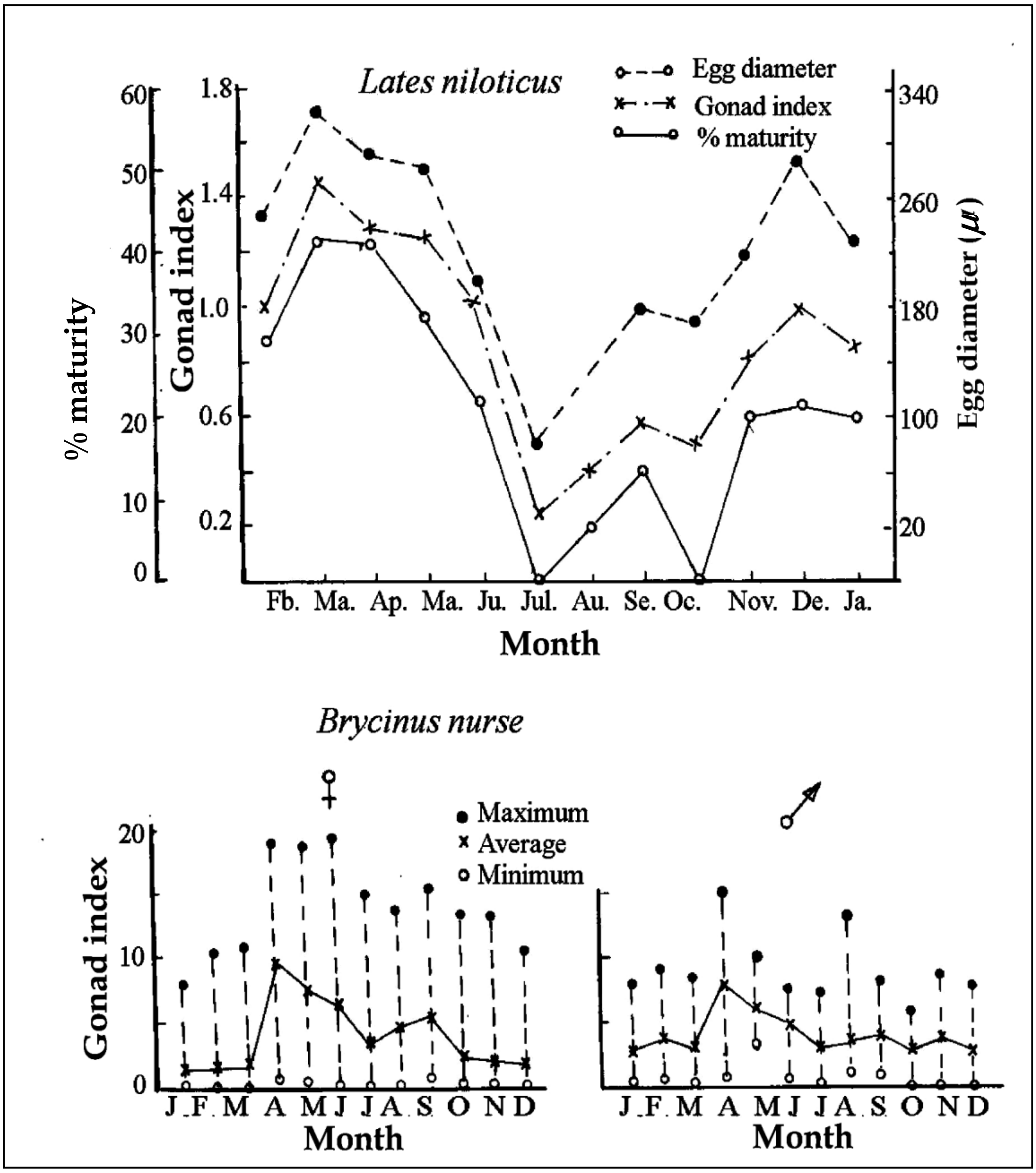


Fig. 135 **Gonad index of *Lates niloticus* and *Brycinus nurse* (Latif *et al.* 1979)**

Studies of Adam (1994) on the monthly variations of gonad index of *Oreochromis niloticus* (females and males) (Fig. 136) showed a gradual increase of the mean value of gonad index of female *O. niloticus* from January (0.540) to February (0.835) to March (1.266) then reached its maximum in April (1.408), followed by a decrease (0.909) in May. The mean gonad index of male *O. niloticus* was 0.117, 0.206 and 0.101 in March, April and May respectively (Fig. 136). However some females and males are mature during all months of the year. Adam (1994) concluded that the main spawning season of *O. niloticus* is during the period from March to May, and the second one in September. Latif and Rashid (1972) found that whether in female or male *O. niloticus* the average gonad index has two modes, appearing in April and September in females, being a month earlier in males.

Adam (1996a) pointed out that the spawning season of *S. galilaeus* extends from March to September. The monthly maximum gonad index (GI) of females ranged from 2.415 to 6.317 indicating that some females are fully mature and spawn allover the year. The monthly maximum (GI) of males ranged from 0.080 to 0.310 during all months, an indication that some males are fully mature and spawn allover the year. It is concluded that one of the reasons that may account for the predominance of *S. galilaeus* in Lake Nasser over *O. niloticus* is that its spawning extends throughout the year, while spawning of *O. niloticus* occurs about 2-3 times during the year. This suggests a competition for the spawning grounds of both species which have the same spawning behaviour. Furthermore, in *S. galilaeus* both parents are mouth brooders while in *O. niloticus* only females are mouth brooders.

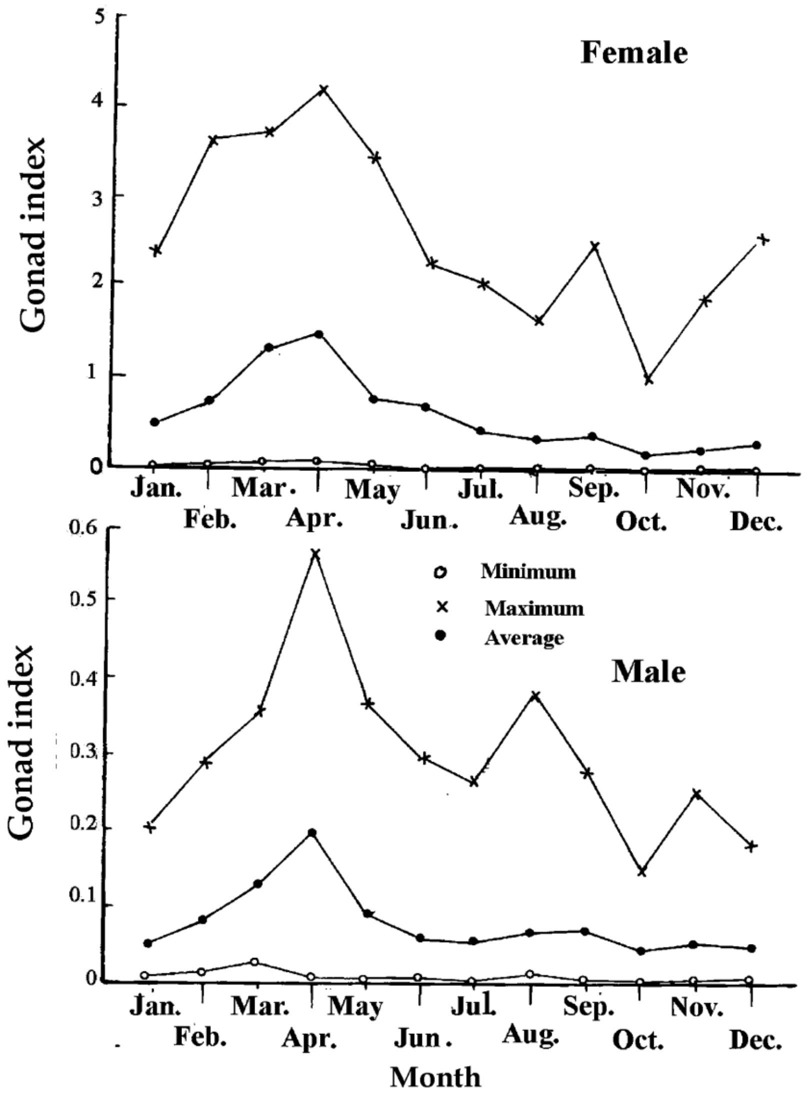


Fig. 136 **Monthly variation of gonad index of *O. niloticus* (Adam 1994).**

Table 94 **Gonad index of mature-ripe females of different species during spawning periods.**

Species	Period		Gonad Index Maximum	Minimum
		A. Cichlids		
Oreochromis niloticus	Jan.	- March	3.75	0.1
	April	- June	4.3	0.2
Sarotherodon galilaeus	Feb.	- March	5.83	2.12
	April	- May	4.21	1.58
	June	- August	3.53	0.97
	Dec.	- Nov.	3.73	1.06
		B. Centropomids		
Lates niloticus	Feb.	- June	5.14	1.01
	September		2.12	0.58
	Nov.	- Dec.	2.86	0.82
		C. Characins		
Brycinus nurse	Jan.	– March	11.30	1.59
	April	- June	19.95	1.8
	July	- Sept.	15.53	1.7
Alestes baremoze	July	- August	15.12	0.98
Hydrocynus forskalii	Jan.	- March	9.38	1.25
	April	-	12.51	4.54
	May	-	5.49	0.98
	July	- August	6.76	1.52
		D. Cyprinids		
Barbus bynni	March -	July Nov.	9.0	0.5
	Sept. -		6.8	1.0
Labeo niloticus	Dec.	- Feb.	18.87	0.82
	April	- August	--	2.09
Labeo coubie	May	- Sept.	4.29	0.50
Labeo horie	April	- July	13.48	--
		E. Catfishes		
Bagrus bajad	August	- April	2.22	--
Bagrus docmak	August	- May	1.47	0.66
Synodontis schall	July	- August	15.75	1.36
Synodontis serratus	July	- May	5.87	0.53
Clarias gariepinus	October		4.27	--
Eutropius niloticus	July	- Sept.	11.7	--
Schilbe uranoscopus	July	- Sept.	7.71	3.63
		F. Mormyrids		
Mormyrus kannume	May	- August	6.3	3.8
	Jan	- April	3.5	1.2
Mormyrus caschive	May	- August	6.8	5.0
	Jan.	- April	4.0	0.7
Petrocephalus bane	July	- August	4.07	0.50
Mormyrops anguilloides	July	- August	0.90	0.50

Ref. Rashid (1995), Adam (1994), Aly (1993), Abdel Shahid *et al*. (1993), Latif *et al*. (1979).

Egg characteristics. The mature or ripe eggs of most fishes of commercial importance in Lake Nasser are large in size (600-2800 μ) and can be seen by the naked eye. The eggs are spherical in most fishes or pear-shaped in

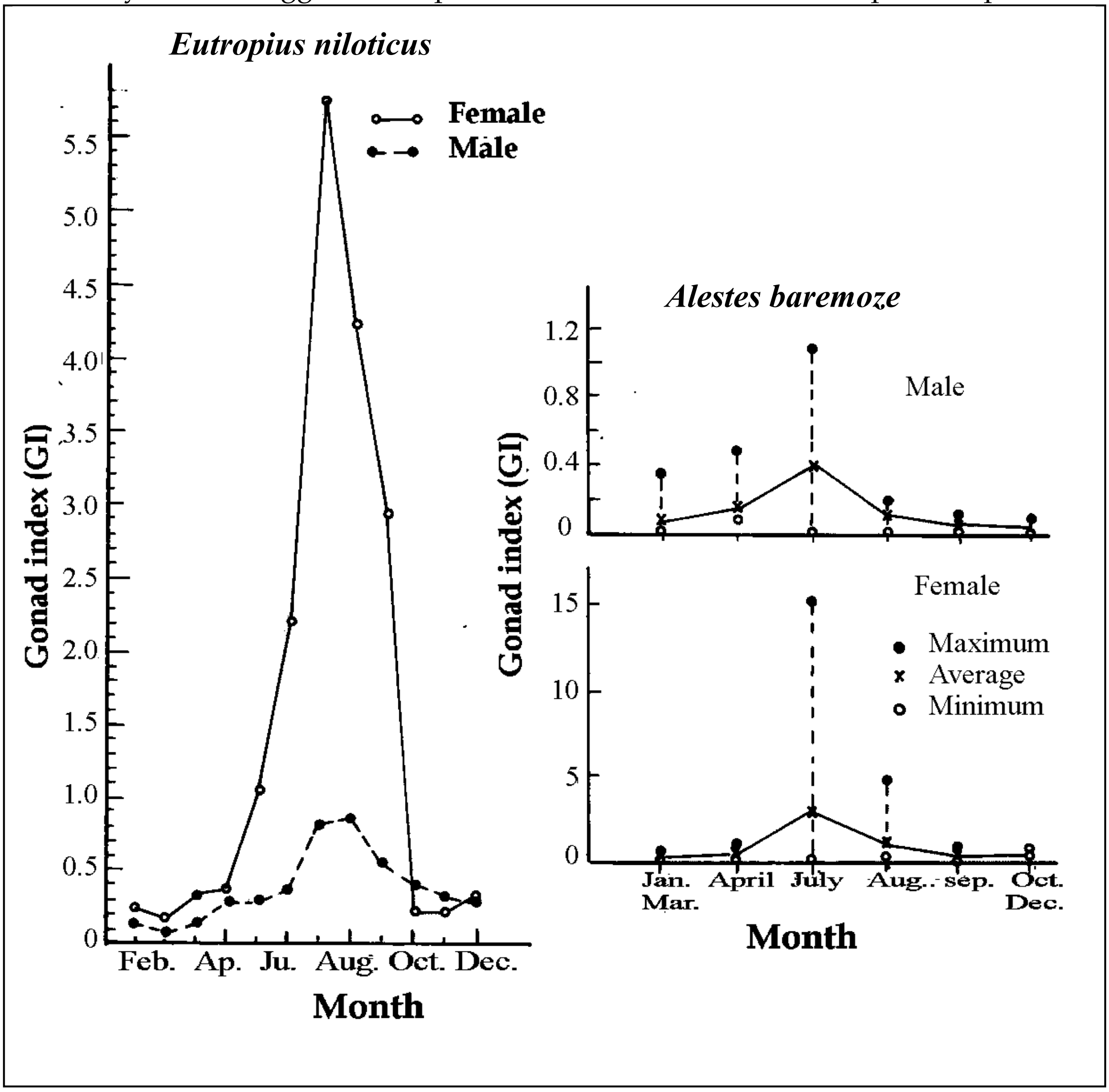


Fig. 137 Gonad index of *Eutropius niloticus* and *Alestes baremoze* (Latif *et al.* 1979).

Oreochromis niloticus . The colour of eggs is orange in *Barbus* species, cream in *Lates niloticus*, greenish-gray in *Labeo* spp. The eggs vary in size from one species to another. The smallest are the pelagic eggs of *Lates niloticus* (600-775μ), while the largest are those of *Oreochromis niloticus* (2800 μ) and *Sarotherodon galilaeus* (2500 - 2800 μ) (Table 95).

Adam (1994) studied the monthly variation in the size of the oldest ovarian eggs of *O. niloticus* (Fig. 141). The latter author found that the average egg diameter increased from 1675 μ in January to reach its maximum value (2150μ) in May, followed by a sharp decrease to 1708 μ in June and 1701 μ in July. Again, the average value increased from 1750 μ to 1842 μ in August and

September respectively, followed by a sharp decrease (1461μ) in October, 1450 μ in November and finally increased to 1525 μ in December. Thus the monthly

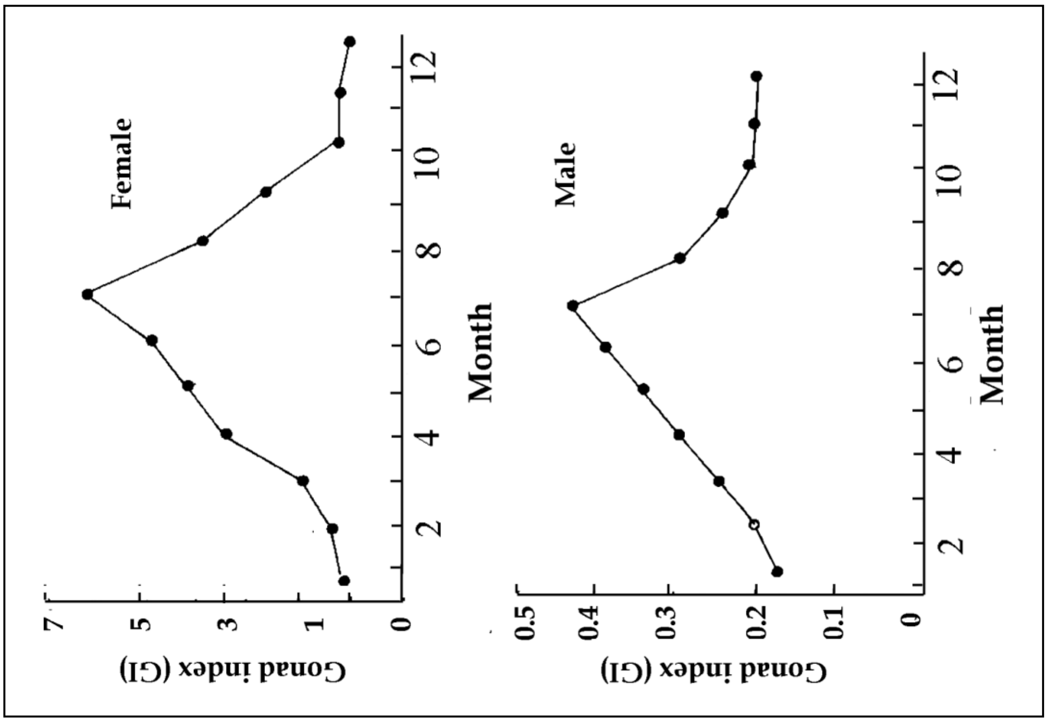


Fig 138 **Monthly gonad index of *M. kannume* (Aly 1993).**

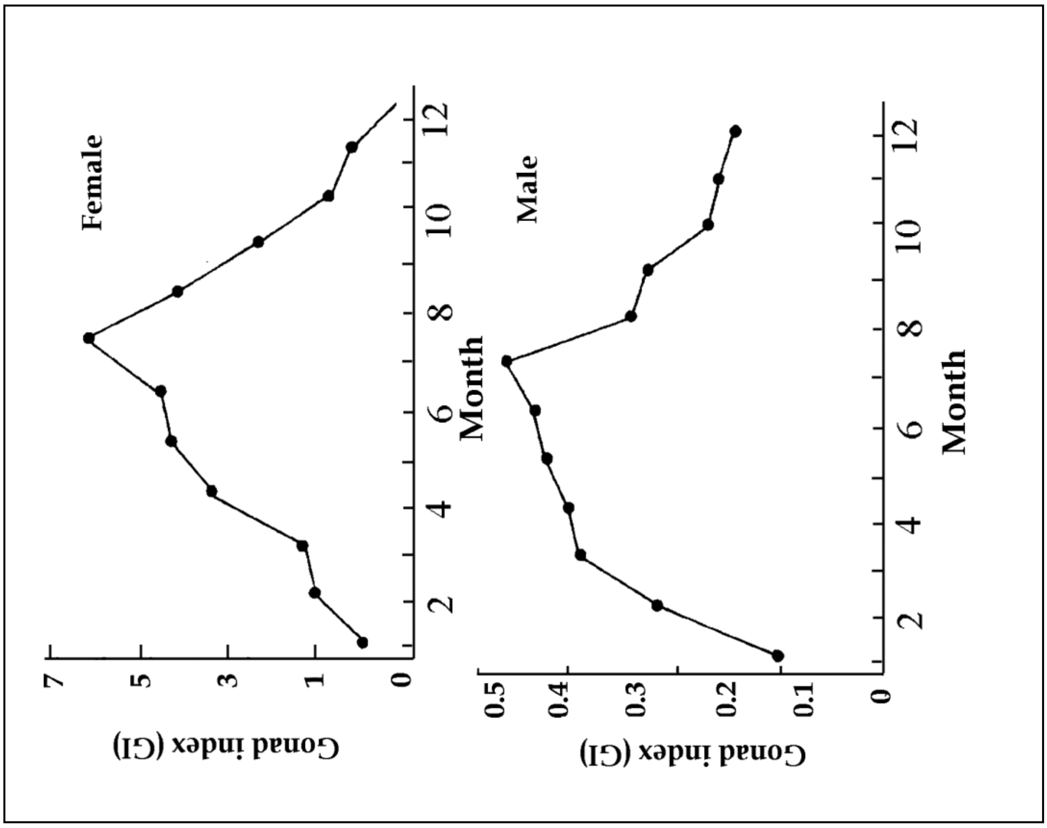


Fig 139 **Monthly gonad index of *M. caschive* (Aly 1993).**

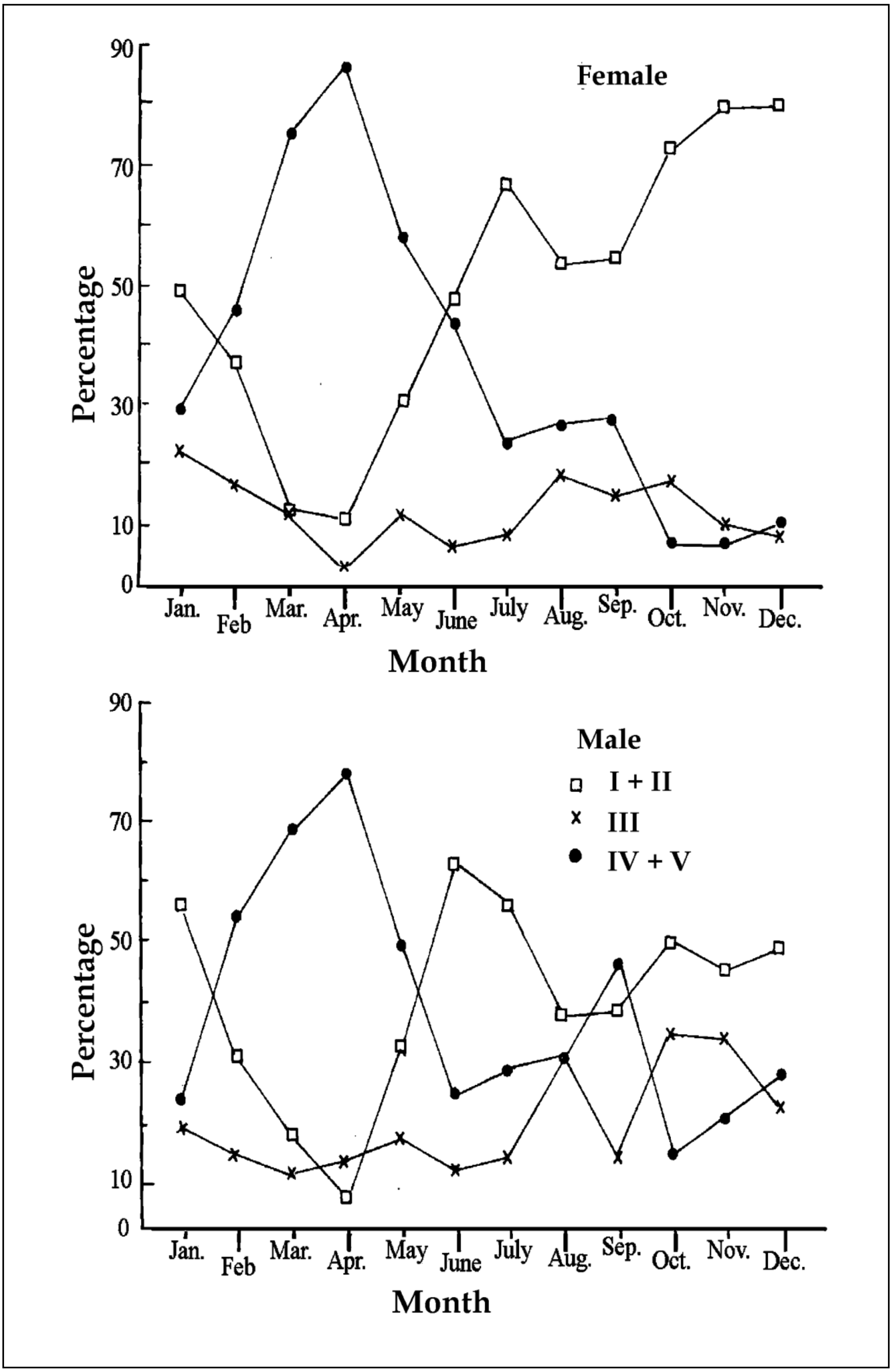

Female
Percentage
90
70
50
30
10
0
Jan.
Feb
Mar.
Apr.
May
June
July
Aug.
Sep.
Oct.
Nov.
Dec.
Month
Male
I + II
III
IV + V
Percentage
90
70
50
30
10
0
Jan.
Feb
Mar.
Apr.
May
June
July
Aug.
Sep.
Oct.
Nov.
Dec.
Month

Fig. 140 **Monthly percentage frequency of different maturity stages of *O. niloticus* (Adam 1994).**

pattern of egg diameter of *O. niloticus* (Fig. 141) was, to some extent, similar to that of gonad index (Fig. 136). There are two peaks (in May and September) for the average values of egg diameter. The egg diameter of *O. niloticus* is somewhat larger (2800 μ) than the egg diameter of *S. galilaeus* (2500-2800 μ) (Table 95 - Aly 1993).

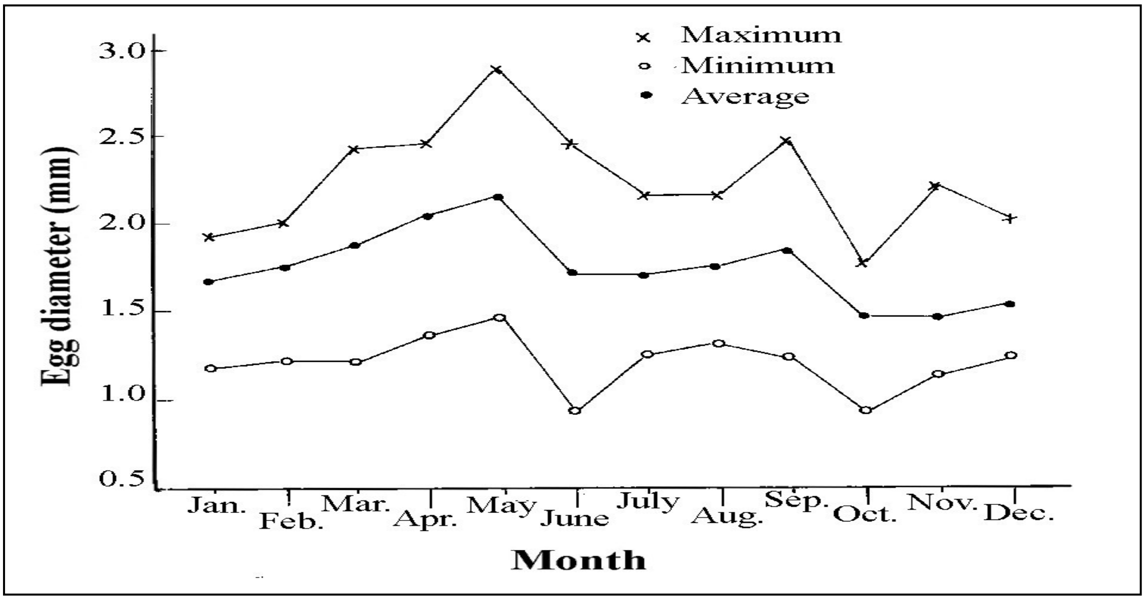


Fig. 141 **Minimum, maximum and average diameter of oldest eggs of *O. niloticus* in different months (Adam 1994).**

Table 95 **Diameter of mature ripe eggs of important fish species (Aly 1993).**

Species	Egg-diameter (μ)
Lates niloticus	600-775
Brycinus nurse	800-825
Alestes baremoze	935
Schilbe uranoscopus	800-825
Eutropius niloticus	850-1025
Hydrocynus forskalii	850-950
Labeo coubie	1000-1050
Labeo horie	1050-1200
Labeo niloticus	1050-1225
Synodontis serratus	1200-1225
Synodontis schall	1200-1260
Bagrus docmak	1350-1425
Mormyrus kannume	1925-2170
Mormyrus caschive	2100-2500

Oreochromis niloticus	2800
Sarotherodon galilaeus	2500-2800

First sexual maturity

The knowledge of size and age at the first sexual maturity of the commercial fish species is of utmost importance in the development and management of the fisheries of Lake Nasser. Studies by various investigators (Entz & Latif 1974, Latif *et al.* 1979, Abdel-Azim 1982, Aly 1993) on the sexual maturity of different fish species from Lake Nasser shows the smallest size of various fish species when their first maturity is attained (Table 96).

Table 96 **The smallest length of various fish species in Lake Nasser, attaining their first sexual maturity (Entz & Latif 1974, Latif *et al.* 1979, 1984b and c, Abdel-Azim 1982 and Aly 1993).**

Species	**Minimum length at first sexual maturity (cm)**	
	♂	♀
Oreochromis niloticus	23	26
Sarotherodon galilaeus	--	16
Hydrocynus forskalii	30.5	29.5
Brycinus nurse	4.5	6
Alestes baremoze	20	23
Mormyrus kannume	32	34.6
Mormyrus caschive	40	32.3
Mormyrus anguilloides	50	50
Petrocephalus bane	17	18
Labeo niloticus	53	55
Labeo coubie	35	36
Labeo horie	--	33
Barbus bynni	--	57
Bagrus docmak	--	60
Synodontis serratus	31	35
Synodontis schall	24	28
Eutropius niloticus	16	18
Lates niloticus	38	30

Fecundity

It is obvious that *O. niloticus* and *S. galilaeus* have the lowest values of fecundity, being mouth breeders, while *Lates niloticus* has the highest egg production (Table 97). The absolute fecundity ranges between 1.4 thousand, in *S. galilaeus* to 618.3 thousand in *Lates niloticus* (Table 97 A.) Also, the fecundity varies greatly with age as in *Mormyrus caschive* and *Mormyrus kannume* (Table 97B, Fig. 142). The fecundity of *Eutropius niloticus* and *Alestes baremoze* lies between that of *Tilapia* spp. and *Lates niloticus*. Thus, while the absolute fecundity ranges from 7.2 thousand for *Tilapia* spp. to 618.3 thousand for *Lates niloticus*, it ranges between 55 and 223.7 thousand eggs for age groups VI-VII (Table, 97 B) for *Eutropius niloticus* and *A. baremoze* (Latif *et al*. 1979).

As the fisheries of Lake Nasser is based on two major fish species i.e. *O. niloticus* and *S. galilaeus,* hence reference to various parameters of fecundity are referred to, based on studies by Aly (1993) and Adam (1994).

Table 97 Absolute **fecundity (number of ovarian mature/ripe eggs) during the peak of spawning season of various fish species in Lake Nasser.**

A. Variation with length

Species	**Standard length range (cm)**	**Average absolute fecundity (thousand)**	**Relative fecundity eggs/cm**
Oreochromis niloticus	26-45	2.9-7.0	88-186
Sarotherodon galilaeus	17.5-34.5	1.4-7.2	80-209
Brycinus nurse	6.5-13.5	6.5-24.5	1000-1815
Eutropius niloticus	20-34	31-65	1425-1832
Alestes baremoze	24-42	28.5-223.7	1187-5326
Lates niloticus	27.8-51.5	89.3-618.3	3208-12006
Mormyrus kannume	34.6	0.6-7.8	25-152
Mormyrus caschive	32.3	0.5-5.8	19-120

B. Variation with age

Age group	*S. galilaeus*	*Oreochromis niloticus*	*Lates niloticus*	*Alestes baremoze*	*Eutropius niloticus*	*Mormyrus caschive*	*Mormyrus kannume*
I	3300	3516	--	--	--	--	--
II	4400	4170	139,000	--	--	--	--
III	4900	5175	262,000	28,500	30,500	1,730	1,601
IV	5600	6090	481,900	97,900	37,500	3,734	3,450
V	--	-	--	140,800	48,500	7,948	6,363
VI	--	-	--	206,600	55,000	11,138	--
VII	--	-	--	223,700	--	--	--

1. *Oreochromis niloticus*

For *O. niloticus* the following relationships were determined (Adam 1994):

Absolute fecundity

a. Fecundity versus length. The average number of eggs increased from 2485 to 7003 for the body length from 26 to 45 cm (Fig. 143). The relation between the two variables is as follows:

Log F = 0.5816 + 1.9948 Log L

(F = number of eggs, L = body length cm)

b. Fecundity versus weight . The average number of eggs increased from 2789 to 5729 for the body weight from 700 to 3500 g (Fig. 144). The relation between fecundity and body weight is as follows :

Log F = 2.2385 + 0.4321 Log W

(F = number of eggs; W = body weight)

c. Fecundity versus age. The average number of eggs increased from 3516 to 6090 for the age groups I to IV (Fig. 145). The relation is described by the following equation:

Log F = 3.5455 + 0.3796 Log A

(F = number of eggs, A = age of fish)

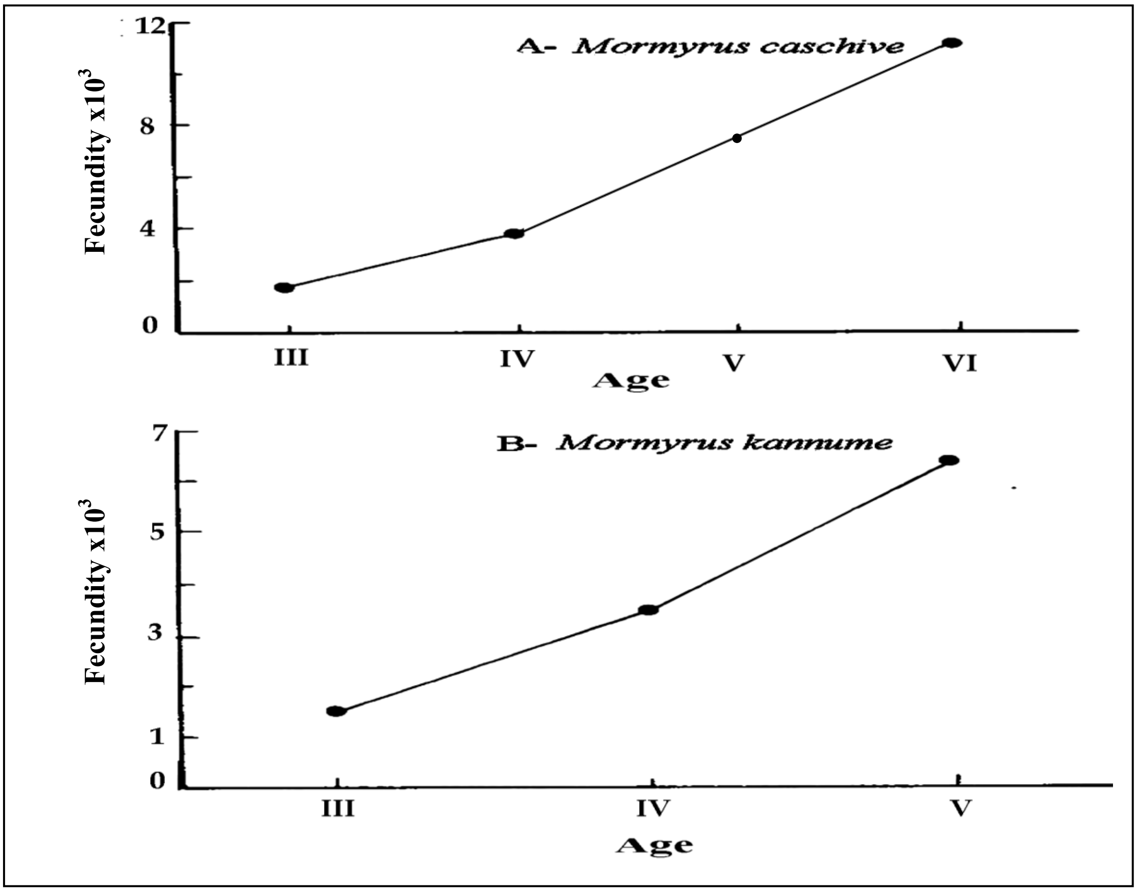


Fig. 142 **Fecundity variation with age of A:** ***Mormyrus caschive,*** **B:** ***Mormyrus kannume*** **(Aly 1993).**

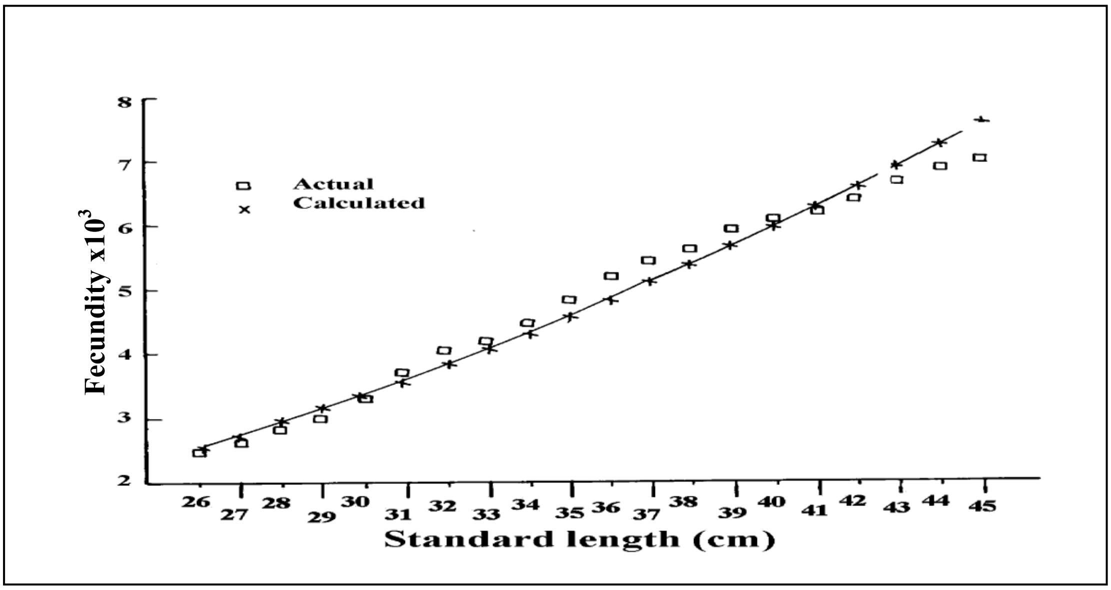


Fig. 143 **Variation of absolute fecundity with length of *O. niloticus* (Adam 1994).**

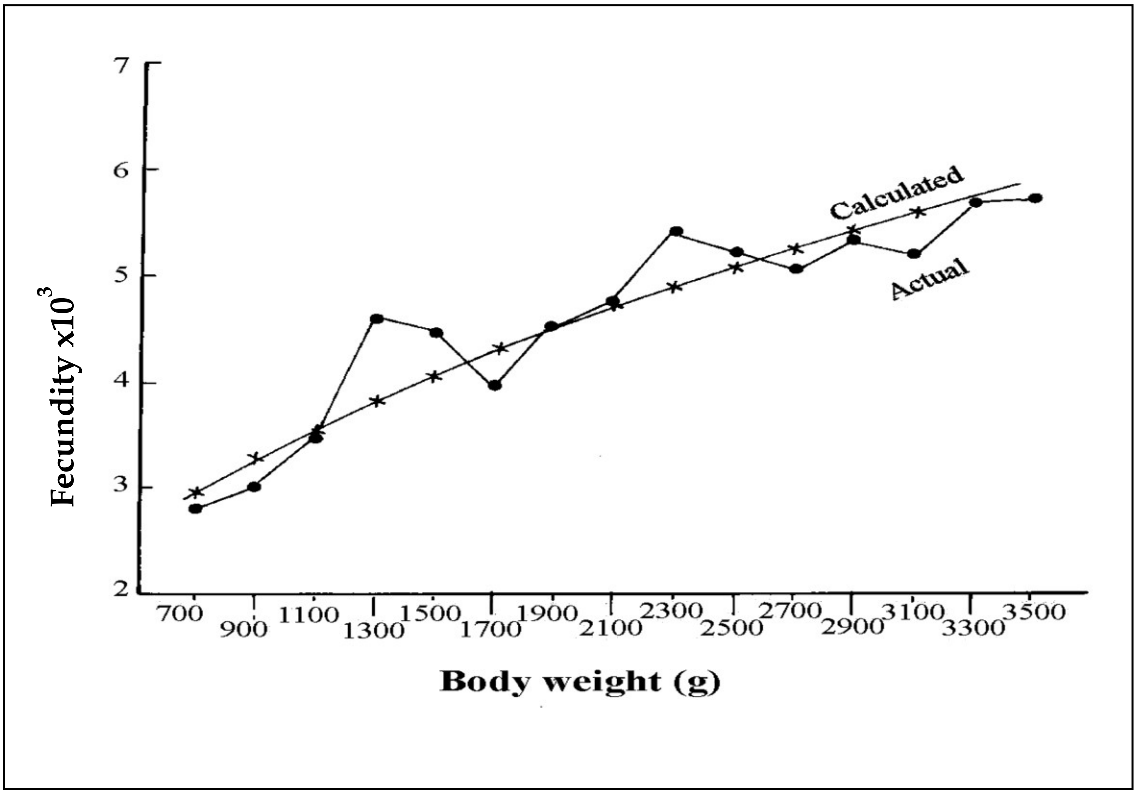


Fig. 144 **Variation of absolute fecundity with weight of *O. niloticus* (Adam 1994).**

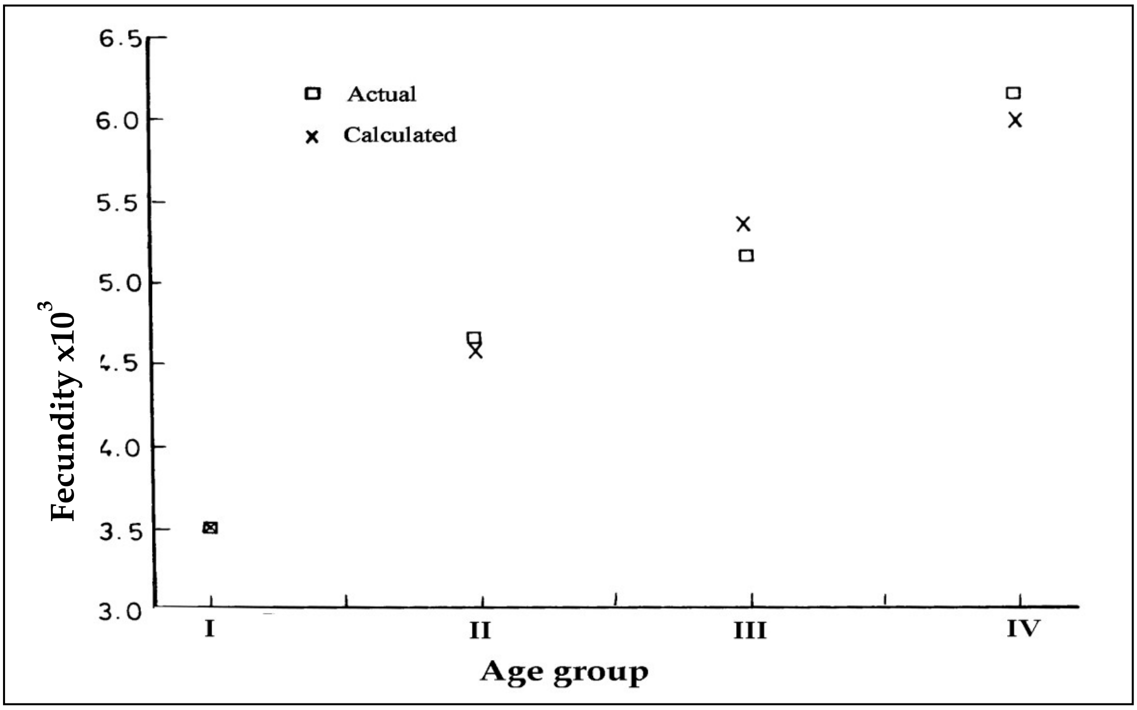


Fig. 145 **Variation of absolute fecundity with age of *O. niloticus* (Adam 1994).**

d. Fecundity versus gonad index. The average number of eggs ranged between 3205 and 6185 for the gonad index from 1.0 to 4.2 (Fig. 146). The relation is fit to the following equation:

Log F = 3.4959 + 0.4761 Log GI

(F= number of eggs, GI = average gonad index).

Adam (1994) concluded that the absolute fecundity of *O. niloticus* increased with length, weight, age and gonad index.

Relative fecundity

a. Relative fecundity versus length. The relative fecundity increases with the increase of body length and its value ranges between 88.32 and 186.06/cm for the body length range of 26 to 45 cm (Fig. 147). This relation is represented by the following equation :

Log RF = 0.1520 + 1.3032 Log L

(RF = relative fecundity, L= standard length).

b. Relative fecundity versus weight. The relative fecundity increases with the increase of body weight up to 1300 g, and its value ranges between 2.44 and 3.33 egg/g. For the body weight ranging from 1500 to 2500 g, the relative fecundity decreases progressively from 2.92 to 1.97 egg/g with the exception of average body weight 2300 g as it is 2.88 egg/g. The relative fecundity increases from 2.16 to 3.32 egg/g for body weight ranging from 2700 to 3500 g (Fig.148). The fluctuations of the relative fecundity with the body weight do not exhibit any particular pattern. The relation is described as follows:

Log RF = 0.4394 - 0.0045 Log W

(RF = relative fecundity, W = body weight)

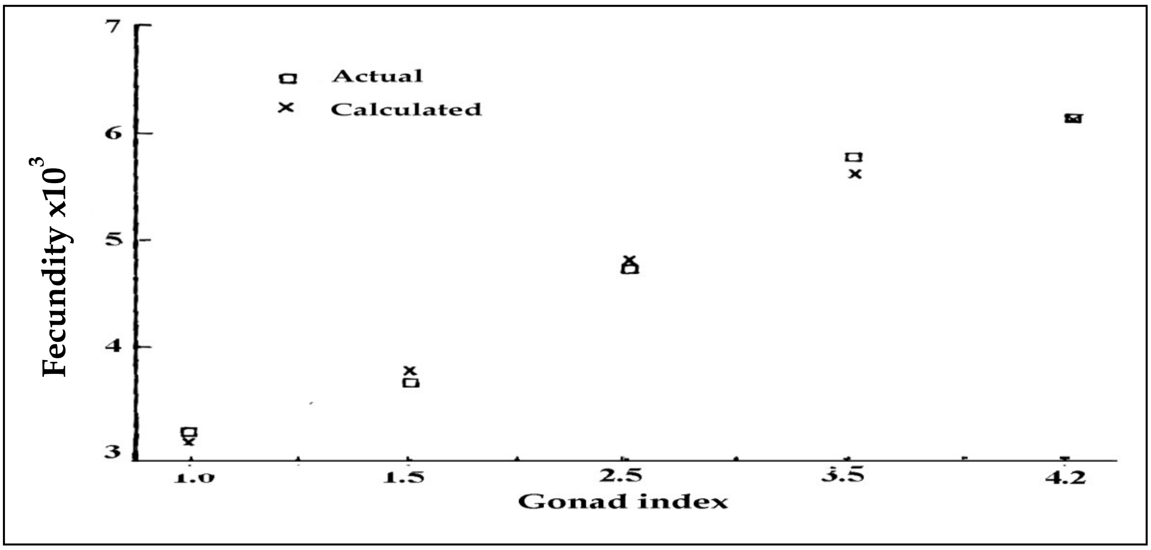


Fig. 146 **Variation of absolute fecundity with gonad index of** ***O. niloticus*** **(Adam 1994).**

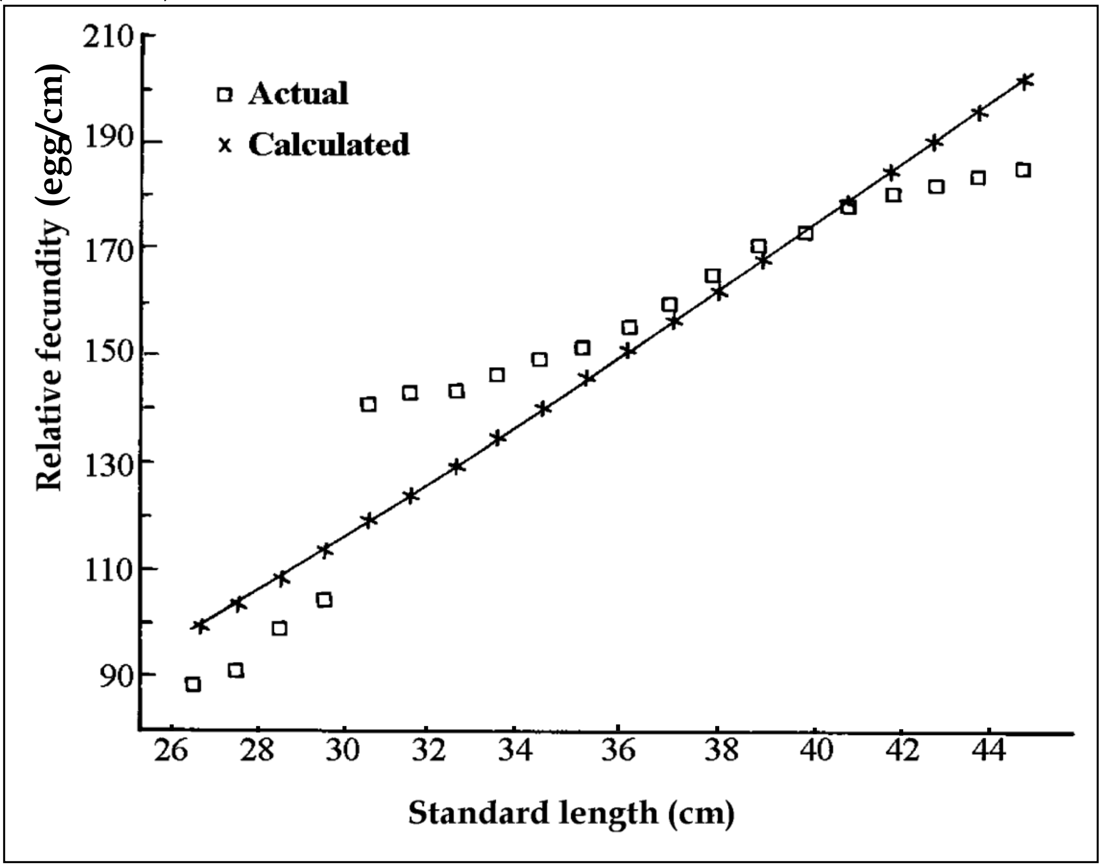


Fig. 147 **Variation of relative fecundity with length of** ***O. niloticus*** **(Adam 1994).**

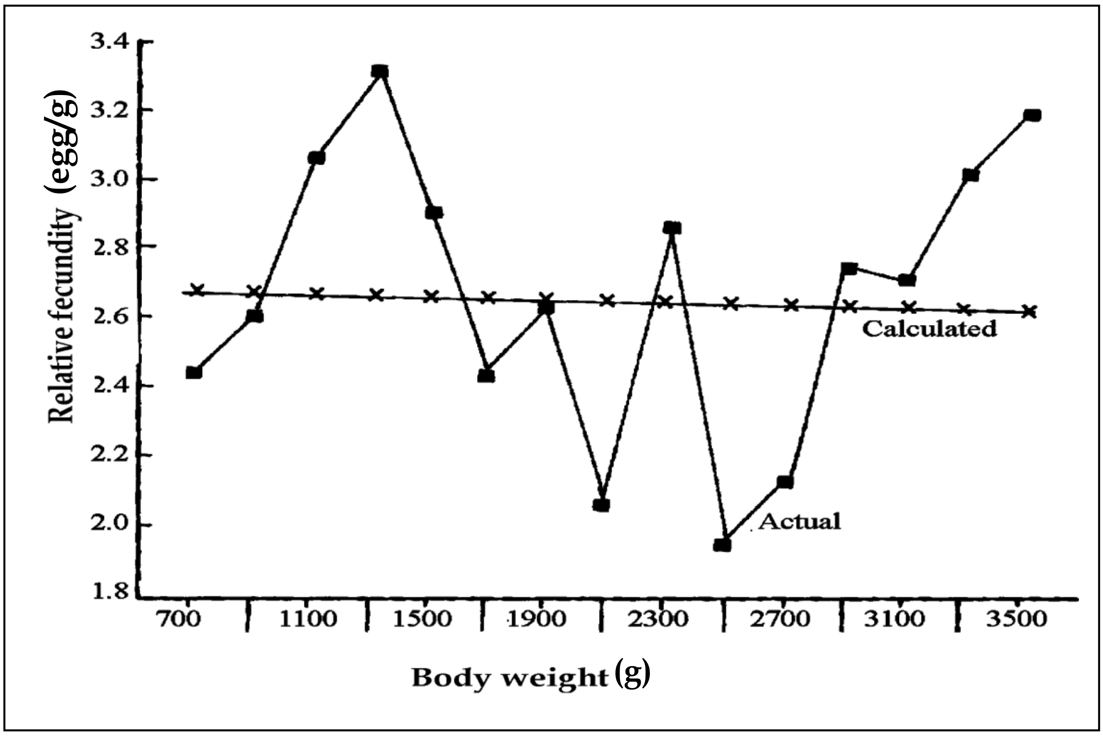


Fig. 148 **Variation of relative fecundity with weight of *O. niloticus* (Adam 1994).**

2. *Sarotherodon galilaeus*

Aly (1993) calculated the absolute fecundity for *S. galilaeus* as follows:

(a) Fecundity versus length. The average number of eggs increased from 1400 to 7200 for the body length from 17.5 to 34.5 cm (Table 97A).

(b) Fecundity versus age. The average number of eggs increased from 3300 to 5600 for the age groups I to IV (Table 97B).

CONCLUSIONS

The **food** and **feeding habits** of fish species in Lake Nasser may be divided into:

1. Periphyton-plankton feeders. a) *Oreochromis niloticus* which feeds on : periphyton (Chlorophyta, Cyanophyta and diatoms), phytoplankton (Chlorophyta, Cyanophyta, diatoms and Dinophyceae) and zooplankton (Cladocera, Rotifera, Ostracoda and Copepoda).

b) *Sarotherodon galilaeus* feeds on: Periphyton (Chlorophyta, Cyanophyta and diatoms), phytoplankton (diatoms, Chlorophyta and Cyanophyta) and zooplankton (copepods and cladocerans).

2. Zooplankton-insect feeders. a) *Brycinus nurse* which feeds on copepods, decapods, cladocerans, insect larvae and gastropods. (b) *Alestes baremoze* feeds on copepods, cladocerans, insects, gastropods and phytoplankton.

3. Omnivores including *Eutropius niloticus* which feed on: insect larvae, water beetles, Odonata, worms, freshwater shrimps, bivalves and fishes. *Synodontis* spp. feed on: animal food including fishes, worms, molluscs and insects, in addition to food of plant origin and phytoplankton. *Schilbe uranoscopus* feed on small fish, chironomid larvae, nymphs of Pleocoptera, copepods and cladocerans. Mormyrids feed on larvae and pupae of chironomids, nymphs of Odonata, Corixidae (water-bugs), larvae of Trichoptera, cladocerans, detritus, aquatic plants, diatoms, freshwater shrimps and fishes. *Labeo* spp. and *Barbus* spp., their food consists of diatoms, cyanophytes, worms and plant material.

4. Carnivores including *Lates niloticus* which feed mainly on fish, freshwater shrimps and insects. The percentage occurrence of fish increases with age. *Bagrus* spp. feed on fishes, freshwater shrimps, insects and molluscs. While, *Clarias gariepinus* and *Heterobranchus* spp. are bottom feeders feeding on fish, insects, molluscs and plant food. *Hydrocynus forskalii* feed on fishes, insects and freshwater shrimps.

It is to be noted that oligochaetes are always underestimated when investigating stomach contents of fish, as they are very readily digestible and leave no observable traces.

Some fish species, in Lake Nasser, are slender (as *Eutropius niloticus, Hydrocynus forskalii, Alestes baremoze)*, others have heavier bodies (as *Labeo niloticus, L. forskalii, Lates niloticus* and *Barbus bynni*) and still others as *Sarotherodon galilaeus* and *Oreochromis niloticus* have the heaviest weights.

The length-weight relationship and **condition factor** of the commercial fishes in Lake Nasser, calculated by different authors, are given. The growth rate in length of *O. niloticus* is higher than that of *S. galilaeus*. Growth rates of both tilapiine species are higher in the southern region of the lake than those inhabiting the northern region.

The difference in calculated weights between different fish species, even those belonging to the same genus is more prominent with weight than with length. *O. niloticus* of age group III has an average actual weight of 1866 g as compared with 971 g for *S. galilaeus.* The growth increment in weight for age-group I of *O. niloticus* is the lowest and increases progressively in the older ages up to age group IV. The average weights of *O. niloticus* are higher than those of *S. galilaeus.* For *S. galilaeus,* the calculated weight of age group I is nearly equal to that of *O. niloticus*; while those of age groups II and III are less than the calculated values for the same age groups in *O. niloticus*. The growth increment in weight of *S. galilaeus* is the lowest for age group I, then increases in age-group II and decreases in age-group III.

Comparing the calculated growth in length and weight of *O. niloticus* and *S. galilaeus* during the last two decades suggests a marked decrease in the growth rate of both tilapiine species during recent years. The effect of impoundment on the growth of both *Tilapia* spp. is discussed.

The calculated weights for different age-groups of 14 fish species in Lake Nasser are presented. There is a significant difference in growth between *Bagrus bajad* and *B. docmak*. The latter species grows faster and lives for longer age.

As for **reproduction** of fishes of Lake Nasser three main groups can be distinguished: -

a. Fishes which have prolonged spawning season mainly with two peaks during spring and autumn (*O. niloticus, S. galilaeus, Brycinus nurse* and *Lates niloticus*).

b. Summer spawners (*Alestes baremoze, Eutropius niloticus, Labeo coubie, Labeo horie, Barbus bynni, Mormyrus kannume* and *M. caschive*)

c. Winter spawners as *Labeo niloticus*

O. niloticus, S. galilaeus and Bagrus spp. are nest builders, while *Lates niloticus is* extremely different as it lays pelagic eggs. *Alestes baremoze* undergoes a spawning migration which coincides with flood as both sexes move upstream behind the Second Cataract and Amada, dwelling along the narrow part of the reservoir affected by the early washes of the flood thus inducing spawning.

Monthly percentage frequency of different maturity stages in *O. niloticus* (males and females) suggest multiple spawning with a maximum during March-May and September. *Sarotherodon galilaeus* spawns most of the year as mature fishes are encountered all the year round. Monthly variations of gonad index of the commercial fish species in Lake Nasser are shown, indicating the spawning season of these species.

Fish eggs vary in size from one species to another. The smallest are the pelagic eggs of *Lates niloticus* (600-775 μ) while the largest are those of *O. niloticus* (2800μ) and *S. galilaeus* (2500-2800 μ). The monthly variations in the size of the oldest ovarian eggs of *O. niloticus* are given, an indication of their spawning season which coincides with both gonad index and maturity stages.

The size at first sexual maturity of the commercial fish species in Lake Nasser is mentioned, *Bagrus docmak* being the longest (60 cm for females) and *Brycinus nurse* being the smallest as its first maturity is attained when 6 cm long.

The absolute fecundity ranges between 1.4 thousand in *S. galilaeus* to 618.3 thousand in *Lates niliticus.* Variations of absolute and relative fecundities with length, weight, age and gonad index for *O. niloticus* are given. For *S. galilaeus,* the absolute fecundity versus length and age are calculated.

One of the reasons that may account for the predominance of *S. galilaeus* over *O. niloticus* in Lake Nasser during the last decade, may be the competition for spawning sites as both species are nest builders and have a similar spawning behaviour. Furthermore, considering the gonad index, maturity stages and dominance of mature eggs shows that *S. galilaeus* may spawn throughout the whole year, while *O. niloticus* spawns 2-3 times with two peaks during March-May and August-September. In addition in *S. galilaeus* both parents are mouth brooders, while in *O. niloticus* females are the only mouth brooders.