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# Signs of Oil Pollution on Fishes in The Arabian Gulf

O.A. HASHIM, M. AL-HUSSAINI* and A. AL-BAZ*
*Faculty of Marine Science, KAAU, Jeddah, Saudi Arabia,*
**Mariculture & Fisheries Dept., KISR, Kuwait*

ABSTRACT. Forty five fish species were collected from oil polluted areas in the Arabian Gulf during the R/V Mt. Mitchell survey in the region between Kuwait and Qatar (April-May, 1992). A total number of 788 fish individuals were found. The highest number of fish, comprising more than 40%, were found in station A, followed by station D (18%), station E (15%) and station F (11%) respectively.

The most dominant fish species were the slipmouth (*Leiognathus fasciatus*), the pigface bream (*Lethrinus kallopterus*) and the therapon (*Therapon puta*), comprising 27.4%, 11.5% and 11.4% respectively.

The length to weight relationships and otoliths growth of the *Lethrinus kallopterus* were studied. The length to weight relationship is linear. Comparisons between fish from this study with those from unpolluted areas indicate no significant differences in otolith growths.

## Introduction

The Arabian Gulf is a very important navigational and industrial area. It lies between latitude 23.9°-30.25° N and longitude 48°-56°-2.0′ E. It is a shallow area with a depth ranging between 10-100 m. The salinity of the Arabian Gulf ranging between 37.0-40.0‰, and the surface temperature ranging between 10-36°C during winter and summer seasons respectively.

During the Gulf War, a total of 11.0 million barrels (MEPA, Per. Com.) of oil were released by the Iraqi forces to western coastal areas of the Arabian Gulf forming oil slicks covered more than 1200 $km^2$ south westward from Mina Al-Ahmadi to Qatar.

Scientific studies on the fishes of the Arabian Gulf were reported by Blegvad (1948), Bolster (1948), FAO (1957; 1966a; b; 1969), Mahdi (1971), Sabock and Gurr (1969), White and Barwani (1971), Bromiley (1972), Kuronuma and Abe (1972, 1986), Kuronuma (1974), Basson *et al.* (1977), Randall *et al.* (1978), Wray (1979), Al-Sedfy (1982), Sivasubraminiam and Ibrahim (1982), Al-Baharna (1986) and Baddar (1987).

The bream fish species are considered to be of highly importance both commercially and locally. According to Chakraborty *et al.* (1987), the bream species composed about 19% of the total production of marine resources in Saudi Arabia. They found all year along in the fish markets. They live in tropical waters, and are distributed widely along the western Indo-Pacific, the Japanese coasts and Australian waters (Aldonov and Druzhinin, 1978). The Lethrinidae live usually in shallow coastal waters between rocks and around coral reef areas (Wray, 1979; FAO, 1983; Randall, 1983). Length to weight relationships for bream fishes were recently studied by a number of authors, such as Hashem and Shakour (1981) and Al-Dossary (1987).

The aim of this study is to detect any possible sign of pollution on fishes in the Arabian Gulf.

## Materials and Methods

Nine stations, covering the western part of the Arabian Gulf, were established for fish sampling during the period April to May, 1992 (Fig. 1). Weather conditions did not permit leaving station A to station B as the survey plan intended, instead station A was sampled twice. No samples were taken from station C due to unfavourable weather conditions. Table 1 shows the location sites.

Collection of fish was performed with an otter trawl (7.5 m opening, 10.8 m long, 3.8 cm mesh in body and 0.64 cm in the liner of the cod end) at depths ranging between 15-20 m. Tows were of 20-30 minutes in duration and were conducted at 3.3-3.8 knots speed. In addition, line fishing and fish traps were also used, when possible, to collect samples.

The catch was sorted, counted and identified into species. Several sources of references were used to help in the identification of fish species, such as Wray (1979), Randall (1982),Al-Baharna (1986) and Kuronuma and Abe (1986). Individuals of selected fish species, such as the red spotted emperor (*L. kallopterus*), locally known as Shaoor or Sheiry, were examined for length and weight measurements. Twenty six otoliths of some specimens were placed in special envelopes, cut into transverse sections and examined for age determination. 26 spacing between the annular growths were compared between the years and stations.

The growth of the fish through examination of otolith growth was studied in order to detect possible abnormalities after exposure to oil pollution.

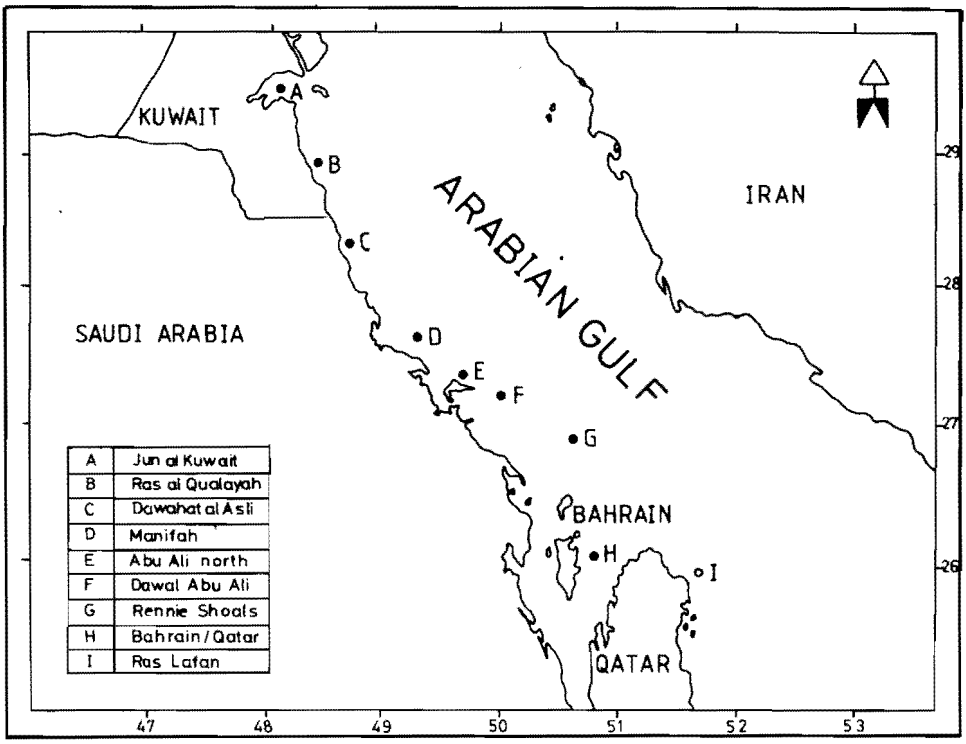


FIG. 1. Map of the survey area between Kuwait and Qatar showing the sampling locations.

TABLE. 1. Description of site locations.

| Station | Date | Latitude | Longitude | Depth | Location |
|---|---|---|---|---|---|
| A | 23/4 | 29°29′ N | 48°02′ E | 30.0 | Jun al Kuwait |
| B | 25/4 | 28°58′ N | 48°22′ E | 17.9 | Ras al Qualayah |
| C | 26/4 | 28°22.2′ N | 48°37.70′ E | 18.3 | Dawhat al Asli |
| D | 27/4 | 27°42.1′ N | 49°15.1′ E | 13.3 | Manifah |
| E | 28/4 | 27°23.6′ N | 49°36.9′ E | 21.3 | Abu Ali, north |
| F | 29/4 | 27°21.6′ N | 49°52.8′ E | 32.0 | Dawal Abu Ali |
| G | 30/4 | 27°2.45′ N | 50°41.75′ E | 34.0 | Rennie Shoals |
| H | 01/5 | 26°8.27′ N | 50°49.64′ E | 14.0 | Bahrain/Qatar |
| I | 02/5 | 25°56.05′ N | 51°39.39′ E | 18.0 | Ras Lafan |

## Results

### *General Distribution*

The survey yielded a total number of 788 fishes comprising 45 fish species (Table 2). The highest numbers of fishes were found in station A (344), followed by stations

TABLE. 2. Frequency occurrence of all the fish species found in each station.

| English name | *Latin name* | A | B | D | E | F | G | H | I | Sum |
|---|---|---|---|---|---|---|---|---|---|---|
| Slipmouth | *Leiognathus fasciatus* | 174 | | 42 | | | | | | 216 |
| Red Spotted Emperor | *Lethrinus kallopterus* | | | | 6 | 42 | 19 | | 24 | 91 |
| Therapon spp. | *Therapon puta* | 13 | 21 | 46 | 10 | | | | | 90 |
| Indian mackerel | *Rastrellger kanagurta* | | | | 28 | 5 | | | | 33 |
| Snapper spp. | *Lutjanus malabricus* | 21 | | 9 | | | | | | 30 |
| Jack spp. | *Alectis indicus* | 19 | | 10 | | | | | | 29 |
| Tongue sole | *Solea bleekeri* | 28 | | | | | | | | 28 |
| Snapper spp. | *Lutjanus johni* | 27 | | | | | | | | 27 |
| Threadfin bream | *Nemipterus tolu* | | 3 | 22 | 1 | | 1 | | | 27 |
| Slender shad | *Ilisha melstoma* | 15 | | | 10 | | | | | 25 |
| Rabbit fish | *Siganus canaliculatus* | | | | 16 | | 3 | | | 19 |
| Goat fish | *Parupeneus heptacanthus* | 4 | | | 14 | | | | | 18 |
| Cat fish | *Arius thalalssinus* | 14 | | | 0 | | | | | 14 |
| Areolate grouper | *Epinephelus areolatus* | | | | 4 | 9 | | | | 13 |
| Halfspotted | *Cephalopholis hemistiktos* | | 3 | 2 | | 6 | 1 | 1 | | 13 |
| Snapper spp. | *Lutjanus* spp. | | | | 4 | 8 | | | | 12 |
| Grunt spp. | *Scolopsis taeniatus* | | | 2 | 4 | 3 | | | | 9 |
| Silvery croaker | *Otolithes argenteus* | 9 | | | | | | | | 9 |
| Flathead fish | *Platycephalus indicus* | | 2 | | 5 | | | | | 7 |
| Porgy | *Acanthopagrus bifasciatus* | | | | 1 | 6 | | | | 7 |
| Spotted Grunt | *Pictorhinchus pictus* | | | 3 | | 2 | 1 | | 1 | 7 |
| Clownfish | *Amphiprion* spp. | | | | 2 | | 3 | | | 5 |
| Coral grouper | *Cephalopholis miniatus* | | | | | 2 | 3 | | | 5 |
| Flounder | *Pseudorhombus arsius* | | | 1 | 1 | | 2 | | | 4 |
| Lizard Fish | *Surida* spp. | | | 3 | 1 | | | | | 4 |
| Sardine | *Sardinella perforata* | 4 | | | | | | | | 4 |
| Bream spp. | *Argyrops filamentosus* | | | | 3 | 1 | | | | 4 |
| Bream spp. | *Rhabdosargus haffara* | 2 | | | | 1 | | | | 3 |
| Butterfly fish | *Heniochus naucrates* | 2 | | 1 | | | | | 1 | 4 |
| Greasy grouper | *Epinephelus tauvina* | 1 | | | 2 | | | | | 3 |
| Threadfin spp. | *Polydactylus sextarius* | 3 | | | | | | | | 3 |
| Threadfin fish | *Platycephalus sextarius* | 2 | | | 1 | | | | | 3 |
| Tripod fish | *Triacanthus biaculeatus* | | 1 | | | | | 1 | 1 | 3 |
| Trunkfish | *Ostraciidae* spp. | | | | | 1 | 2 | | | 3 |
| Cat shark | *Chilosyllium griseum* | 2 | | | | | | | | 3 |
| Bream spp. | *Acanthopagrus latus* | | | 1 | 1 | | | | | 2 |
| Shark Sucker | *Echeneis naucrates* | | 1 | | | | 1 | | | 2 |
| Therapon spp. | *Therapon theraps* | 2 | | | | | | | | 2 |
| Trigger fish | *Abalistes stellaris* | | | | 2 | | | | | 2 |
| Anchovy | *Engraulididae* spp. | 1 | | | | | | | | 1 |
| Cobia | *Rachycentron canadus* | | | | 1 | | | | | 1 |

TABLE. 2. Contd.

| English name | *Latin name* | A | B | D | E | F | G | H | I | Sum |
|---|---|---|---|---|---|---|---|---|---|---|
| Spanish mackerel | *Scomberomorus commerso* | | | | | | 1 | | | 1 |
| Mojarra | *Gerres filamentous* | | | | | | 1 | | | 1 |
| Puffer fish | *Arothron stellatus* | | | | 1 | | | | | 1 |
| Ray | *Rhinopterus adspersa* | 1 | | | | | | | | 1 |
| Sum | | 344 | 31 | 142 | 118 | 86 | 38 | 2 | 27 | 788 |
| Percentage | | 43.7 | 3.9 | 18.0 | 15.0 | 10.9 | 4.8 | 0.3 | 3.4 | 100.0 |

D (142), E (118) and F (86), comprising 44%, 18%, 15% and 11% respectively. There was hardly any fish found in station H. Only two fish species were recorded (Fig. 2). The most dominant fish species were the Slipmouth (*Leiognathus fasciatus*), Red Spotted Emperor (*L. kallopterus*) and Therapon (*Therapon puta*) respectively. They make up to 50% of the total catch, being 27.4%, 11.5% and 11.4% respectively (Table 3, Fig. 3).

### *Population Studies*

*A – Length-Weight Relationship*

A total number of 79 fish individuals, with a sex ratio of 1:1 being recorded. The total lengths of both sexes ranged between 17-60 cm (Table 4), and the total weights

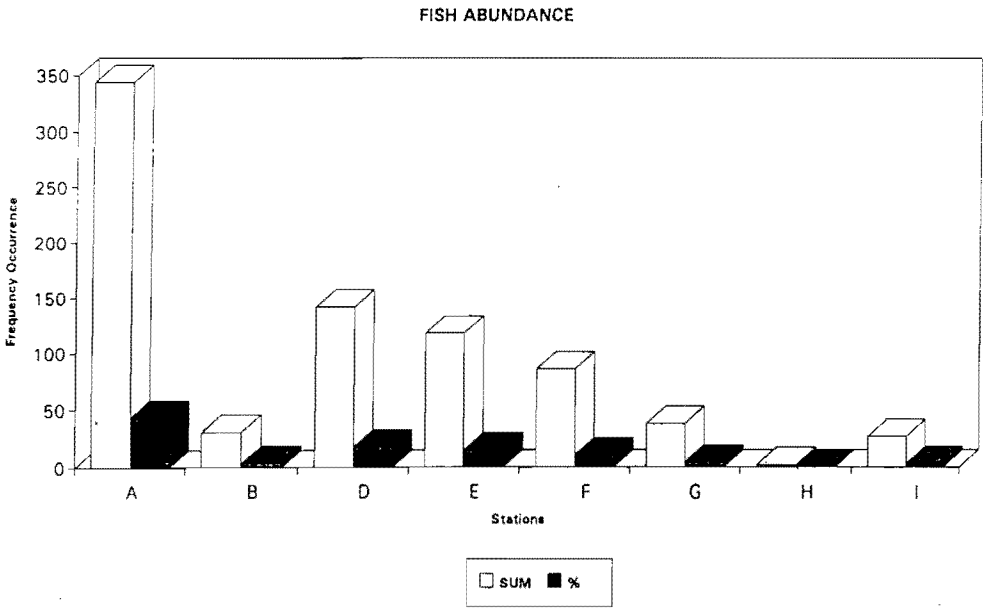


FIG. 2. Frequency occurrence of fish collected from each station.

TABLE. 3. The most dominant fish species found in all stations.

| English name | Latin name | Number | Percentage |
|---|---|---|---|
| Slipmouth | *Leiognathus fasciatus* | 216 | 27.4 |
| Pigface bream | *Lethrinus kallopterus* | 91 | 11.5 |
| Therapon | *Therapon puta* | 90 | 11.4 |
| Sum | | 397 | 50.3 |

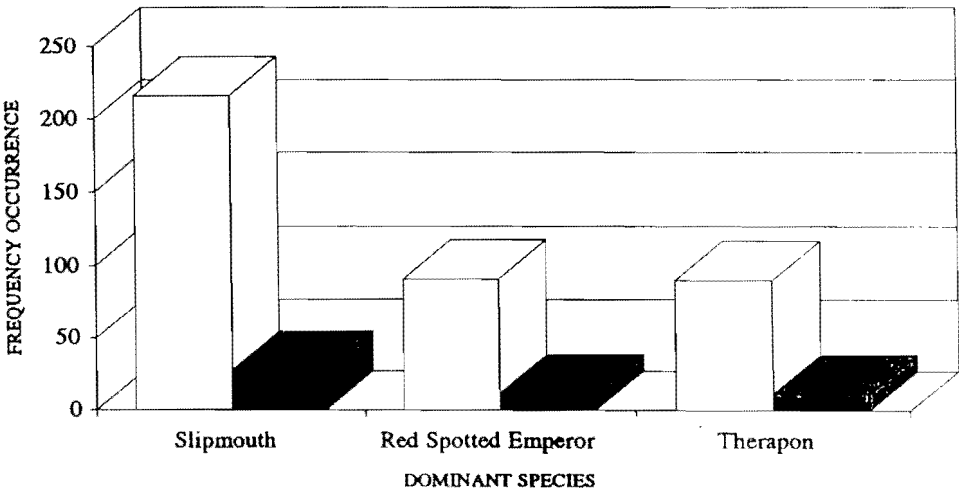


FIG. 3. The most dominant fish species found in all stations.

for the males and females were 139-1279 g and 95-2791 g respectively. Figure 4 shows that the weight increases with increasing length. However, highest numbers of male and female fish were found at lengths of 24 cm and 25 cm respectively.

Regression analysis for male and female species, as shown in Tables (5, 6), shows linear relationship for each sex. The equations for male and female species are as follows :

$$W = 40.85\ L - 749.4 \qquad \text{(Male)}$$

$$W = 52.68\ L - 1068.15 \qquad \text{(Female)}$$

where W is the total weight and L is the total length.

*B – Age Determination*

Otoliths examined for age determination comprised fish sizes ranged from 18 to 26 cm total length, with a mean of 22.9 cm. The ages ranged between 2-9 years, with a mean of 5.2 years (Fig. 5, 6).

TABLE. 4. Total length (cm), total weight (g) and numbers of *L. kallopterus*.

| T.L. (cm) | Male T.W. (g) | No. | Female T.W. (g) | No. |
|---|---|---|---|---|
| 17 | – | 0 | 95 | 1 |
| 18 | – | 0 | 109 | 2 |
| 19 | 139 | 2 | 140 | 4 |
| 20 | 160 | 1 | 126 | 5 |
| 21 | 226 | 3 | 143 | 5 |
| 22 | 157 | 1 | 174 | 2 |
| 23 | 179 | 2 | 187 | 2 |
| 24 | 212 | 8 | 197 | 3 |
| 25 | 245 | 4 | 247 | 5 |
| 26 | 260 | 3 | 265 | 1 |
| 27 | 295 | 1 | – | 0 |
| 28 | 367 | 1 | 188 | 1 |
| 29 | 366 | 1 | – | 0 |
| 30 | 390 | 1 | – | 0 |
| 32 | 422 | 2 | – | 0 |
| 33 | – | 0 | 399 | 1 |
| 34 | 586 | 2 | 404 | 1 |
| 35 | – | 0 | 509 | 1 |
| 36 | 670 | 2 | 610 | 1 |
| 37 | 759 | 3 | – | 0 |
| 39 | – | 0 | 715 | 1 |
| 40 | 962 | 1 | – | 0 |
| 42 | 900 | 1 | – | 0 |
| 44 | 1279 | 1 | 1158 | 1 |
| 45 | – | 0 | 1220 | 1 |
| 60 | – | 0 | 2791 | 1 |
| Sum | | 41 | | 41 |

Statistical comparisons for 1990/91 and 1991/92 annuli spacing for *L. kallopterus* showed no significant differences ($t_{(0.05)} = 2.0264$, $P = 0.1243$), although the means showed slight differences: 1990/91 = 113.5 um and 1991/92 = 102.0 um. Comparisons were also made for 91/92 annuli for fish taken from station F and station I. There were no significant differences ($t_{(0.05)} = 3.1824$, $P = 0.2867$), with means of 97.2 um and 122.5 um respectively.

| **Comparison** | **Test** | **N** | **P** |
|---|---|---|---|
| 1990/91 & 1991/92 | t-test | 40 | 0.124 |
| Stations F & I | t-test | 22 | 0.286 |

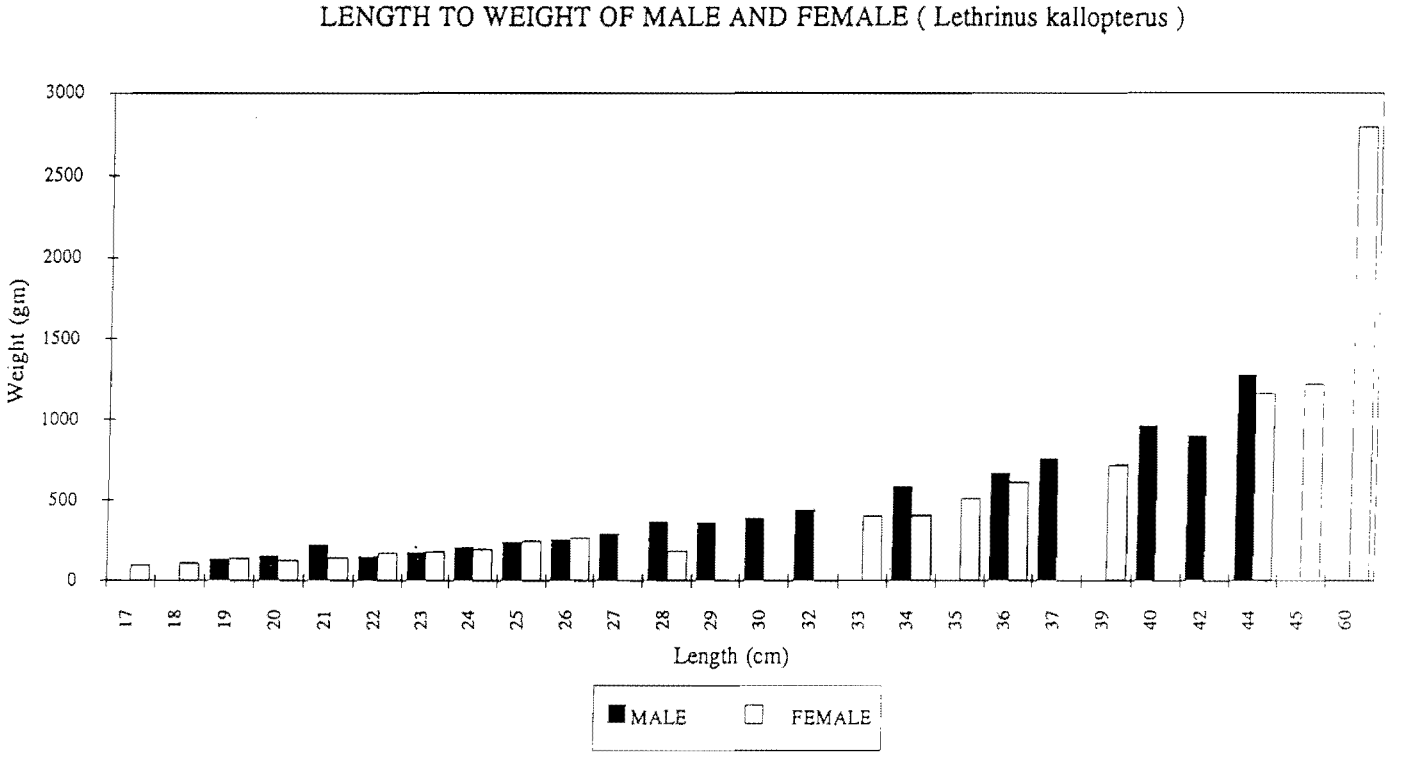


FIG. 4. The relationship between length and weight of male and female *Lethrinus kallopterus*.

TABLE 5. Regression analysis for male *L. kallopterus*.

Regression analysis – linear model : Y = a + bx

| Parameter | Estimate | St. error | T. value | Prob. level |
|---|---|---|---|---|
| Intercept | – 749.401 | 84.5903 | – 8.85918 | 0.00000 |
| Slope | 40.8455 | 2.78798 | 14.6505 | 0.00000 |

Analysis of variance

| Source | Sum of squares | Df | Mean squares | F - ratio | Prob. level |
|---|---|---|---|---|---|
| Model | 1742814.1 | 1 | 1742814.1 | 215 | 0.00000 |
| Error | 138036.0 | 17 | 8119.76 | | |
| Total (corr.) | 1880850.1 | 18 | | | |

| Correlation coefficient | R - squared | St. error of est. |
|---|---|---|
| 0.962606 | 92.66% | 90.1097 |

TABLE 6. Regression analysis for female *L. kallopterus*.

Regression analysis – linear model : Y = a + bx

| Parameter | Estimate | St. error | T. value | Prob. level |
|---|---|---|---|---|
| Intercept | – 1068.18 | 171.344 | – 6.23414 | 0.00001 |
| Slope | 52.681 | 5.37096 | 9.80849 | 0.00000 |

Analysis of variance

| Source | Sum of squares | Df | Mean squares | F - ratio | Prob. level |
|---|---|---|---|---|---|
| Model | 6374688.8 | 1 | 6374688.8 | 96 | 0.00000 |
| Error | 1126427.9 | 17 | 66260.5 | | |
| Total (corr.) | 7501116.7 | 18 | | | |

| Correlation coefficient | R - squared | St. error of est. |
|---|---|---|
| 0.921863 | 84.98% | 257.411 |

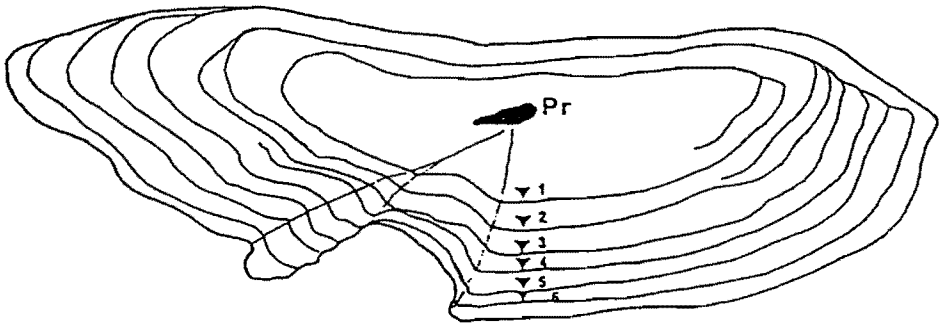


FIG. 5. Transverse section of sagittal sections of *Lethrinus kallopterus* (age = 6 years).

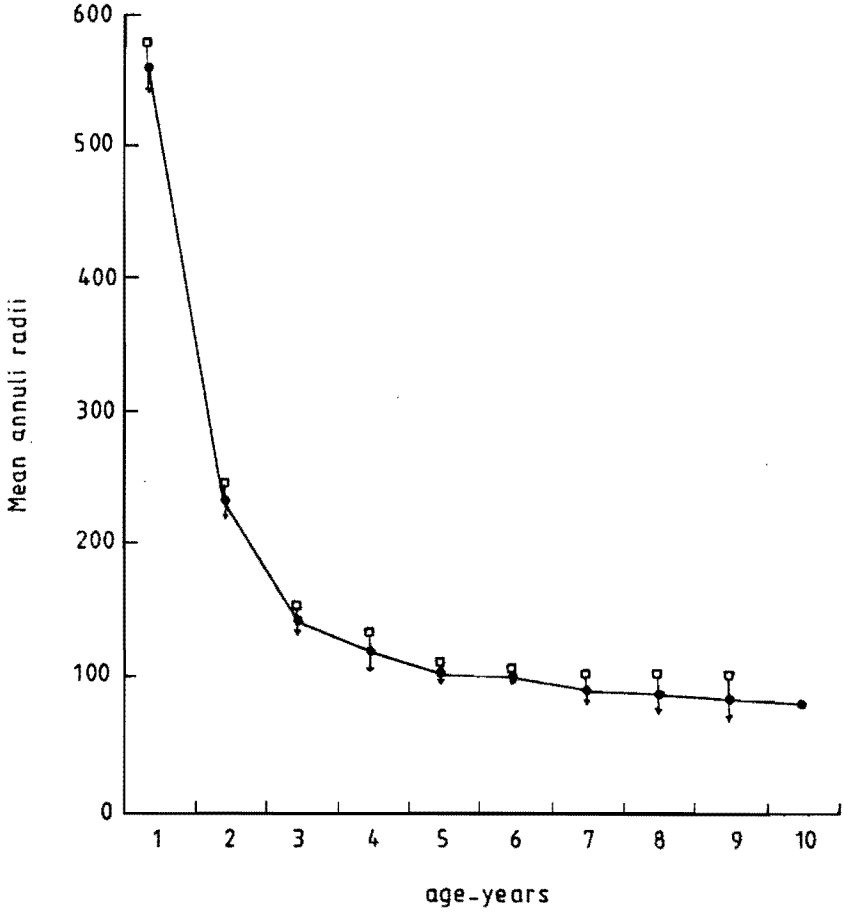


FIG. 6. Mean annuli radii verse age for *Lethrinus kallopterus*.

## Discussions

The results show that the highest number of fish were collected from station A (44%). This is because station A was sampled twice as indicated earlier. However, most of the species found were very young, which means that this location could be a very good nursery area. Moreover, the bottom topography was very smooth and thus suitable for trawling.

The lowest number of fish (only two) was recorded in station H (near Bahrain). These observations were confirmed by the divers who hardly found any fish, because most of the habitat were damaged. This may be due to the enormous quantities of brown algae which were found covering the coral reefs habitats. Although very few fish were recorded in station I (near Qatar), obvious observations indicated extremely high abundance of fish. This is because the bottom topography was not suitable for trawling and that most of the fish collected were taken by hand lines.

The study of the length to weight relationship of the *L. kallopterus,* as one of the most commercially important species (Wray, 1979), indicates a linear relationship as shown by the regression analysis. Similar results were reported by Hashem and Shakour (1981) and Al-Dossary (1987). The total length and total weight were considered in the present study. Many authors also recommended that the total length and weight should be used to draw the length to weight relationships (Aldonov and Druzhinin, 1978; Hashem and Shakour, 1981).

The study of length to weight relationship is usually used to help determine the lengths and weights of fish in the presence of either the length or the weight only. Tables 4 and 5 show that the correlation coefficient, which indicates the strength of the relationship between the variables L (length) and W (weight), for male and female were 0.963 and 0.923 respectively. These values are very close to 1.0 and that the closer the correlation coefficient value to 1.0, the closer the relationship between variables is.

The results of the age determination study indicate that oil impact on growth of the studied species was not statistically significant. However, any true differences in otolith growth might be explained by several factors, such as temperature, food limitation and/or incorporation of low concentrations of oil pollutants. Oil pollution has long and short-term effects on fisheries production. The impact might be on food webs, fish life cycle or the whole marine ecosystem. A recent investigation indicated that the diversity of zooplankton species, as good food source for young fish, in Kuwait waters have changed since the oil spill (Al-Yamani *et al.*, 1992). Oil could cause severe mortality to fish eggs (Slade, 1982; Mori *et al.*, 1983) and larvae (Moles *et al.*, 1987; Mori *et al.*, 1984). Success of larval hatching is also related to concentration of oil (Onuoha and Nwadukwe, 1990).

The effect on population density of those species with short life spans such as phytoplankton and zooplankton including fish larvae, and shrimp would be conspicuous in short term. Mathews (1992) showed that shrimp landings from Saudi

Arabia fishing grounds were decreased dramatically. Other reports also showed that coastal areas of ecological importance such as nursery areas for shrimp and fish have been damaged. This would have a short-term effect in the case of short-lived species such as shrimp, or a long-term effect on fish. Effects on the latter might be seen in the year-class strength of the impacted species of subsequent years.

More detailed population studies are recommended in this aspect to investigate the long-term impact of oil pollution on the fish stocks of the affected areas.

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# شواهـــد على تلـــوث بترولي في أسمـــاك الخليـــج العربي

عثمان عبده هاشم ، محسن الحسيني* و علي الباز*

كلية علوم البحار ، جامعة الملك عبد العزيز ، جـدة - المملكة العربية السعودية ؛

*قسم الاستزراع والمصايد ، معهد الكويت للأبحاث العلمية - الكويت

المستخلص . تم جمع ٤٥ عينة من الأسماك من مناطق ملوثة بالخليج العربي وذلك من خلال الرحلة العلمية لسفينة الأبحاث «ماونت متشل» في المنطقة الواقعة بين دولتي الكويت وقطر خلال الفترة من إبريل إلى مايو ١٩٩٢م .

تمكن فريق البحث من جمع ٧٨٨ سمكة من محطات البحث المختلفة ، وقد لوحظ وجود أكثر الأسماك عددًا والتي تزيد نسبتها عن ٤٠٪ بالمحطة الأولى A ثم تبعتها المحطة الرابعة D (١٨٪) ، فالمحطة الخامسة E (١٥٪) ثم المحطة السادسة F (١١٪) على التوالي .

أشارت النتائج أيضًا إلى أن أكثر أنواع الأسماك شيوعًا هي : *Leiognathus fasciatus* ، *Lethrinus kallopterus* ، *Therapen puta* والتي تشكل مانسبته ٢٧,٤٪ و ١١,٥٪ و ١١,٤٪ على التوالي . وبدراسة علاقات الطول بالوزن بالنسبة للنوع *L. kallopterus* وجد أن العلاقة خطية ، وعند مقارنة أسماك هذه المنطقة بأخرى جمعت من مناطق غير ملوثة اتضح عدم وجود اختلافات هامة خاصة فيما يتعلق بالنمو .