Carl J. George [1] and Victoria Athanassiou

Biological Laboratories
American University of Beirut

A TWO YEAR STUDY OF THE FISHES APPEARING IN THE SEINE FISHERY OF ST. GEORGE BAY, LEBANON [2]

INTRODUCTION

The coastal habitats of the Levant have changed greatly during the past three millenia. The lands denuded of their plant cover return precipitation quickly to the sea destroying riparian and estuarine communities. The consequent increased supply of sediments, coupled with the increased use of coastal sands for concrete, and the construction of moles, landings, harbors and other sea-side real-estate have altered the regime of sediment movements. The competitive exploitation of sponge, fish, arthropod and mollusc stocks using destructive techniques such as poison, dynamite and the shore seine has decimated natural populations. The discharge of untreated sewage and garbage directly into the sea has smothered the benthos of bays and has so littered the beaches that rat populations hosting the plague flea, *Xenopsylla cheopis*, have reached dangerous proportions. But however influential these assorted autochthonous changes may be, the opening of the Suez Canal in 1869 and the assorted hydrological improvements along the course of the Nile River taking place currently may rank as the most influential of all. Assorted authors have offerred commentary on the exchange of organisms between the Red and Mediterranean Seas. See, in example, the works of Fuchs (1876), Keller (1883), Bavay (1898), Tillier (1902), Tillier and Bavay (1905, 1906), Jordan and Hubbs (1917), Norman (1927, 1929), W. Steinitz (1929), Wimpenny (1930), Chabanaud (1933), Haas and Steinitz (1947), Kosswig (1950), Gruvel

---

[1] Now with the Department of Biological Sciences, Union College, Schenectady, New York, U.S.A.

[2] The work reported here was supported by the A.U.B. Rockefeller Research Grant Numbers 62-6, 38, 41.

(1931, 1936), Ben-Tuvia (1953 a, 1953 b), Gohar (1954), Ben-Tuvia (1955, 1964), Tortonese (1947, 1948, 1951, 1952, 1953, 1964) and George *et al.* (1964, 1965 a, 1965 b). Among the fishes alone at least twenty four (Ben-Tuvia 1966) different erythraean species have become well established as indicated by their ever increasing occurrence along the coasts of Israel, Lebanon, Turkey and the Greek Islands. In Lebanon we have thus far noted *Himantura uarnak* (Forskål), *Dussumieria acuta* Valenciennes, *Saurida undosquamis* (Richardson), *Tylosurus crocodilus* (Le Sueur), *Hemiramphus far* (Forskål), *Hyporhamphus* cf. *dussumieri* (Valenciennes), *Parexocoetus mento* (Valenciennes), *Holocentrum rubrum* Forskål, *Sphyraena chrysotaenia* Klunzinger, *Pranesus pinguis* (Lacépède), *Apogonichthyoides nigripinnis* (Cuvier and Valenciennes), *Upeneus asymmetricus* Lachner, *Upeneus moluccensis* (Bleeker), *Scomberomorus commersoni* (Lacépède), *Atule djeddaba* (Forskål), *Leiognathus klunzingeri* (Steindachner), *Siganus rivulatus* (Forskål), *Siganus luridus* (Rüppell), *Callionymus filamentosus* Valenciennes, *Stephanolepis diaspros* Fraser-Brunner, and *Sphoeroides spadiceus* (Richardson), 21 species in all.

The influence of the Nile on the waters of the Levant and Egypt has been discussed by Emery and George (1963), Emery and Neev (1960), Gruvel (1931), Halim (1960), Steuer (1935), Liebman (1935), Oren and Komarovsky (1961). The eastward moving North African current, the prevailing southwesterly winds of the region, the occurrence of the Nile flood during a period of minimal local precipitation and run-off, and the low density but high fertility of the flood waters strongly concentrates the influence of the phenomenon to the region between the Rosetta distributary and the Levant.

With the completion of the Saad-el-Ali, the new High Dam of Aswan, only a small part of the annual flood will reach the Mediterranean basin but instead will be directed into the atmosphere through the evapotranspiration of an expanded agriculture. This fact coupled with the one that the Bitter Lakes along the course of the Suez Canal are now reaching salinities that no longer constitute an ecological barrier (Wimpenny, 1935; Krauss, 1958; Morcos, 1960) implies that dramatic ecological changes are in store for this region. It thus seems important to detail the conditions of today so that transitions of the future can be defined. The work to be reported on here is directed

toward the establishment of a comparative base to permit evaluation of the changes that are and will be taking place in the fish populations of St. George Bay, Republic of Lebanon.

ACKNOWLEDGEMENTS

This study was possible only with the assistance, goodwill and hearty cooperation of the fishermen of St. George Bay. Father Sagir and his two sons, Mohammad and Hassan, stand at the very fore of this group. They continued to extend their patience and honesty in spite of our diverse (and frequently mysterious) requests. On many different occasions we saw a temporarily wrinkled brow when we refused to allow the wife of one of the fishermen to take the larger specimens of this or that species or when we insisted that even the tiniest ' most useless ' fish be gathered up and added to the study sample. Our hope is that their kindness may someday be repaid with the application of information contained within this paper to improve their conditions of life.

Mr. Ismat Boulos, Director of the Division of Fisheries and Game of the Ministry of Agriculture of the Republic of Lebanon, has been a genuine and unfailing friend and aid throughout the study. He has smoothed out many of the problems that would have forced the premature conclusion of our work.

Mr. Basil Nafpaktitis, Mr. Peter Davies, and Miss Alice Bliss were instrumental in much of the sorting and other manipulations essential to the task.

Mr. Delmas Allen has made a prominent contribution in the production and analysis of the physical and chemical background information.

Mr. Arch Johnston, Miss Diana Manoushagian, and Mr. Dikran Keosheyan of the University Computer Center are to be thanked for their extensive efforts in martialling the many data of this project into analysable form.

Dr. and Mrs. R.E. Lewis of the University Natural History Museum have been generous in making their facilities generally available to us.

Miss Anny Bandikian deserves the fullest praise possible for her splendid work in converting messy, scribbled information into something far more presentable.

The officers and agencies of the FAO, Office of Naval Research and UNESCO also deserve full thanks for their encouragement and support. UNESCO has been particularly generous in supporting the senior author in his recent trip to the Second International Oceanographic Congress in Moscow to give a preliminary report on the work detailed here.

Finally, we would like to thank the University Research Committee as agents for the Rockefeller Foundation in providing the funds essential to the performing of the work involved.

The various specialists who have assisted us in making and confirming identifications have already been acknowledged in an earlier publication dealing with the definition of fish species appearing in local waters but still their kind cooperation deserves a second offer of thanks.

Professor Enrico Tortonese, Professor Joseph Powell, Dr. Adam Ben-Tuvia and Mr. Ismat Boulos are gratefully thanked for their reading of the manuscript and offerring of criticism.

METHODS

The study was begun in June of 1963 and continued for two and one-half years, the first half year of which was directed toward the identification of species (GEORGE, *et al.* 1964) and the selection of appropriate collection and data handling techniques. The commercial shore seine or *jaroofi* was selected as the sampling device and St. George Bay immediately north of the blunt peninsula of Beirut, the site of the authors' laboratory, was chosen as the sampling site.

The *jaroofi* is set from a hand-propelled wooden boat and pulled by warps by a team of fifteen to twenty men. The wings carry 2 cm square mesh netting and the bunt and shallow bag are built of 1 cm square mesh netting, the entire net from one bridle to the other being about 150 meters. The setting of the net at a distance of about 700 meters from shore takes about twenty minutes while the recovery and landing may take two to three hours depending upon the number of workers and the hydrographic conditions. The float and weight sizes are such as to sink the net to the bottom and thus in deeper waters the pelagic species are lost to permit more efficient capture of the more commercially prized benthic and demersal species. At the same time bottom fishing results in the collection of much domestic debris, such as tin cans, cloth, bones, vegetable matter, plastic and rubber

articles and countless other materials, which must be laboriously and unpleasantly sorted out.

Collections were made on either a Tuesday, Wednesday or a Thursday every other week, weather and other conditions permitting. The sampling sector would be visited at about one hour after sunrise and a commercial fisherman with his team would be located. The operation of the net would be observed and if the catch was landed without serious mishap the catch was sampled. The price for each sample was determined at the time, being the subject of considerable discussion and maneuvering depending upon the kinds of fish present, the current market prices, the volume of the catch in question and previous catches, and more embarrassingly, the number of other persons present desiring fish. But after the initial trial period of six months the fishermen were sufficiently familiar with our requirements and were aware that they would obtain the highest prices if they would attend to our requests first. Toxic, useless and the smallest fishes were included as well. This unusual procurement procedure appeared to be quite essential because contractual arrangements as attempted initially usually broke down for one reason or another. Either the net was not being set to the usual distance from shore or not adequately maintained, the market value of fish changed, or another of many different problems arose. In the method used the fishermen received an agreeable price and the sample produced was relatively free of error induced by the study.

The catch sample was made by selecting at random an appropriate pie-shaped slice of the pile of fishes resting on the sand or, less preferably, portions of the fishes arranged by quality in shallow boxes. As soon as financial arrangements were completed the sample was transferred to plastic buckets, and preserved in a 5% sea water formalin for transport to the laboratory. In the laboratory the catch was sorted into species, the members of each species were assigned to 4 mm total length intervals and the groups occupying each interval were weighed *en masse*. Each species was then regrouped and preserved in 10% sea water-fresh water bufferred formalin for possible future study. Data was logged on standard forms which were used to punch IBM data cards, including the index number specific to each fish taken, the date, the exact time and duration of the catch, the fraction of the total catch included in the sample, and the location. The cards for each catch were then submitted to the IBM 1401 for the preparation of a set of species index number cards which were then sorted into numerical sequence

by the IBM Sorter 84. The sequenced index cards were then fed to the IBM Collator 88 along with the entire index collection for the extraction of the full scientific names of the fishes involved. This set of name cards along with the catch data and program were processed resulting in a printout (via IBM Printer 1403) including total numbers and weights, averages and the square root of the product of the total weight in grams of each species times its total number of individuals. The resultant figure is referred to as the ' indgram value '.

Printouts were made with a copy thus allowing the development of species and catch files.

Samples were taken from the sand-gravely sectors of the coast between the Nahr Maout to the south and the Fouar Antelias to the north, a distance of slightly less than three kilometers. This sector has supported a destructive and illegal sand quarrying industry which has resulted in the retreat of the frontage by about forty meters during the last twenty years thus subjecting the nearby coastal railway, the Beirut piped water supply, the north-south coastal telephone, high tension lines and the main coastal highway to actual and potential disturbance. The beach strand is heavily littered with domestic debris transported across the bay from sea side dumps of Beirut. This same debris frequently entered the nets causing delay in sorting and occasionally producing tears in the netting. Commentary on the geological features of the region is found in EMERY and GEORGE (1964). Offshore water conditions are considered by MC GILL (1960). Along shore currents were generally weak and variable depending upon wind direction and force. Tidal amplitude rarely exceeded 50 cm, usually being undetectable. The several rivers debouching into the bay are quite seasonal in character reaching peak flows during January, February, and March and then declining to low levels during the rainless months of July through October. During these drier months these watercourses become extremely foul with sewage, tannery and slaughterhouse wastes and domestic debris.

RESULTS

63 samples were made over the two year period disclosing the presence of 101 fish species, 15 of which were erythraean immigrants. The mean number of species per catch for the two years was 24.1 and 24.6. The total number of specimens analysed was about 288,000 (ca. 4,570/catch) weighing a total of 2,426.8 kg or a mean weight per fish

of 8.5 g. The numbers and weights for all species are reported for the dates of collection in Tables I and II and in Tables III and IV the seasonal occurrence is summarized. An ' o ' in these tables for a particular date represents the presence of less than ten specimens for the species concerned. An ' x ' represents 10 or more. These characters were linked when ever adjacent. When ' x 's were separated by a single catch where the species was absent this date was bridged. When ' o 's were similarly separated a bridge was entered only if they already carried an adjacent bridge. A species was ranked as ' prominent ' whenever three or more linked bridges resulted and ' secondary ' for cases where fewer linked bridges were present. Over the two year period 51 species were thus ranked as ' prominent ' for either one or both years. Of these 51 species the 26 top ranking by weight (249, 078 specimens weighing 2,096.3 kg or 84.5% of the total with a mean weight of 7.8 g.) were compared with one another and for the two years for weight, numbers of individuals and ' indgrams ' (See Table V). This latter measurement is the square root of the product of the weight in grams of a species appearing in the sample times the number of individuals. The comparison was effected by dividing the larger number by the smaller to produce a quotient. Tables VI, VII, and VIII show these quotients ranked from the largest values to the smallest.

Continuity of species occurrence can be approximated from capture to capture date by counting the number of links between consecutive capture periods and dividing this value by the total number of species present in the weekly catch. For example, if forty species are present in the catch of one week while 20 species of the same type appear in the following week the continuity of species will be 50%. In the cases at hand the averages of linkage number divided by the number of species appearing in each catch is almost identical for the two years being 0.72 for 1963-1964 and 1964-1965. The variation in continuity from one season to the next (See Tables III and IV) is also evident but this needs further work to support commentary.

Much can be said about ages and year classes for the many species collected. The central generalization however is that the fishery is based predominantly upon the 0 and 1 years classes. Large numbers of small fishes that net to very little weight are the usual features of the catches, and it is likely that this has been the case for many years in this very ancient fishery. It is very possible but we have no information to the effect that behavioral patterns may have been altered under the in-

fluence of the six or more thousands of years of selective pressure on fishes that frequent shallow waters. We may learn that considerable populations of fishes exist in the offshore waters that are never touched by shore seines or by trawler.

The following few pages summarize the more salient points of natural history regarding the 26 prominent species that were selected for special study. In all cases only the most humble of statistical methods mixed with a considerable amount of 'broad approximation' ('speculation' seems to be too strong a word here!) have been used. This results from the inadequacy of many of the species samples which is a corollary of the circumstances that were unavoidably involved. It is hoped, however, that certain of the 26 prominent species may be the subject of further analyses based on the data produced in this study. Toward this end one set of this data in IBM printout format has been placed in the hands of the Food and Agricultural Organization of the United Nations in Rome and a second has been filed in the Jafet Library of the American University of Beirut. The original punch cards, the most plastic repository of the data along with the programs for their use remain with the Computer Center of the American University. The specimens, almost all of which remain preserved, have been turned over to the United States National Museum for permanent storage.

Boops boops is one of the important species of the seine fishery appearing most abundantly during the months of May through September. The first young enter the catches at sizes of about 40 mm T.L. in late February and continue to appear until mid-July, suggesting a spawning period beginning in late January or early February and continuing through June. A large percentage of the individuals caught are of the 0 year class, less than 100 mm in total length and 13 grams in weight and almost all are less than 150 mm T.L. and 42 grams. In example, in the catch of July 27, 1964, consisting of 1,120 fish, 93.75% were less than 101 mm T.L. making up 82.06% of the weight of the species.

Euthynnus alletteratus and *Pagellus erythrinus* are the two most important species of the seine fishery in terms of weight. In the 1963-1964 sample series the former ranked first with 283.9 kilograms and the latter ranked second with 90.5 kilograms. In 1964-1965 the situation was reversed with *P. erythrinus* contributing 180.6 and *E. alletteratus* 155 kilograms. Unfortunately *E. alletteratus* is not a favored fish in the Lebanese market. This is apparently due to the ' dryness ' of this oily fish after it has been prepared by frying, the favored local method

for the cooking of fish. Consequently this species rarely exceeds 50 cents per kilogram. Even at this low price (which is about 1/6 of the price of *P. erythrinus*) the fish remain too long on the tables of the vendors in the souks and along the roadsides. It is possible that an advertizing campaign directed toward explaining the palatability of the species when cooked properly along with refrigeration storage of the excess catch of the season would improve the value of this species in the fishery. The fact that the index quotient for this form is one of the lowest of all species studied suggests that it has the season to season constancy appropriate to a stable fishery. Furthermore, its nomadic and sub-oceanic habits mean that it is harvesting the productivity of the offshore waters and is relatively independent of the degenerative influences of an ever increasing landborn coastal pollution.

Young individuals appear in early to mid July replacing small schools of larger individuals (see Table IX). Occasionally the schools of young reach large size and completely dominate the catches (e.g. 15-07-64, 1,296 individuals, 28-07-65, 2,236 individuals). As the season progresses the mean T.L. of samples increases in size until late September and early October when 200-300 mm individuals disappear. In late May and early June large gravid individuals reappear and the cycle is complete. In 1963-1964 the period of visitation was from about mid May on through September while in 1964-1965 this period was much shorter lasting only from the latter part of June through the early part of October, perhaps in response to the lower temperatures of the latter year. The seasonality of these sleek and powerful swimmers is well recognized by the local troll and seine fishermen who watch for their boiling schools.

Pagellus erythrinus or *Jarbeeden* is one of the more favored fish appearing on the Lebanese market often commanding prices of 3 dollars or more per kilogram. This prominent Mediterranean species is one of the four pink fish entering the seine catches, the other three species listed in the order of their importance being *Pagrus ehrenbergi*, *Dentex dentex* and *Pagrus pagrus*.

This fish ranked second in terms of weight of the samples of 1963-1964 contributing 90.5 kg out of the total 942.8 taken, or about 9%. For the 1964-1965 season *P. erythrinus* ranked first with 180.6 kg out of the 1,153.5 kg harvest. In terms of numbers of individuals it ranked third with 16,965 specimens out of 121,210 for 1963-1964 and first with 28,444 individuals out of a total of 127,868 for 1964-1965. These

numbers produce an indgram quotient of 1.42 revealing the relative stability and thus commercial importance of this species.

The first young of the year appear as early as May (e.g. 29-05-64, 21-44 mm T.L.) but in June and July an explosive increase of young occurs which dominates the fishery on through the months of July and August (e.g. 09-07-64, 3,528 individuals, mean T.L. 59 mm; 15-07-64, 3,724 individuals, mean T.L. 63 mm; 27-07-64, 2,500 individuals, mean T.L. 74 mm; 02-06-65, 2,200 individuals, mean T.L. 38 mm; 16-06-65, 6,900 individuals, mean T.L. 47 mm; 23-09-65, 6,327 individuals, mean T.L. 81 mm). This invasion is associated with the departure of the young of the previous year which have usually reached total lengths exceeding 120 mm. The data at hand suggests a maximum spawning pulse in early May (see Table X).

The catch of 16-06-65 is a vivid example of the destructive and degenerate character of the fishery. Of the 6,900 taken none exceeded 64 mm T.L. while the mean weight for the largest size interval represented (e.g. 61-64 mm T.L.) was 4.00 g. The mean weight and total length for the entire series was only 1.83 g and 47 mm respectively. The 12.6 kg of fish taken was sold at about 30 cents a kilogram to be fried and served as a poor grade of *bizri* (Arabic for ' seed '). The larger fishes of the species enter the catch in small numbers in the early spring (e.g. 10-03-65, 113-168 mm T.L., mean T.L. 137 mm; 17-03-65, 105-184 mm T.L., mean T.L. 139 mm; 31-03-65, 141-184 mm T.L., mean T.L. 163 mm).

The pink color of this species along with the appearance of larger specimens occasionally exceeding 50 cm T.L. in the catches of trammel net and set-line fishermen suggest that the preferred habitat of adult specimens is in deeper waters but an important onshore nocturnal migration probably takes place quite regularly, particularly in calmer periods. It is interesting to speculate on the selective influence that this ancient seine fishery of 6,000 years or more duration has had on the habits of this species. Like the selective influences observed in the Japanese night light fishery, investigation may reveal that the behavior of *P. erythrinus* has been significantly modified by the long-term removal of individual, that enter the shallower littoral harvested by seines.

The tropical sub-tropical character of this species is reflected in its disappearance from the catches in the colder winter months.

Pagrus ehrenbergi is an important associate of *Pagellus erythrinus* and like this species has earned itself a prized position on the market under the name of *farreeden*.

Young sea bream first appear in small numbers in early July, quite in contrast to the invasion of the multitudes of the *jarbeeden*, in association with larger individuals of total lengths ranging from about 121 to 200 mm (e.g. 07-07-65, 21-44 mm T.L., 51 individuals, 121-176 mm T.L., 41 individuals; 15-07-65, 25-56 mm T.L., 52 individuals, 129-160 mm T.L., 15 individuals). Small, and assumedly young, fish continue to appear in the catches through December and into early January (e.g. 28-10-64, 25-76 mm T.L., 220 individuals; 02-12-65, 33-80 mm T.L., 92 individuals; 04-08-65, 33-80 mm T.L., ca. 1,300 individuals, mean T.L. ca. 53 mm) suggesting either continuous spawning or periodic spawning from June through early December. In the late winter and early spring small schools of larger fish predominate and contribute some of the most prized fish of the seine fishery (e.g. 03-07-63, 109-220 mm T.L., 32 individuals, mean T.L. 140 mm; 24-06-64, 101-200 mm T.L., 240 individuals, mean T.L. 141 mm; 16-06-65, 109-248 mm T.L., 96 individuals, mean T.L. 140 mm).

Like most slowly swimming demersal species the schools of larger fish are small and heterogeneous in size. An example of this is the catch of 10-03-65 which included 116 individuals ranging in size from 61 to 192 mm T.L. over 334 mm T.L. intervals no interval of which held more than 9.48 and 12.93% of the total weight and total number of individuals of the catch respectively.

P. ehrenbergi ranks third in terms of the indgram quotient after *Boops boops* and *E. alletteratus*.

In 1963-1964 1,978 specimens weighing 50.6 kilograms gave this species a ranking of 10th and 5th for numbers of individuals and total weight respectively. Again the low indgram quotient value connotes the reliability of this species in the fishery and its commercial significance.

Like the forementioned *P. erythrinus* the adults of this species, some reaching 40 cm or more T.L., frequent deeper waters where they are captured by trammel net and set line. Apparently the larvae and fry migrate into the littoral region where they remain for a while before commencing a slow migration back into deeper waters to finally reside in the areas occupied by their parents. Fortunately the loss of young is not as extreme to shore seines as for *P. erythrinus*. In example,

over the study period only 2 instances out of 63 yielded more than 500 young fish (i.e. 03-01-64, 802 individuals; 04-08-65, 1300 individuals).

Epinephelus aeneus, one of the three common epinephelids of the Lebanese coast, frequents sedimentary surfaces of sand and gravel and thus enters the catches of the seine fishery. The other two congeners *E. alexandrinus* and *E. guaza* occur over rocky bottoms.

E. aeneus in keeping with its occupancy of a high trophic level rarely appears in the catches in large numbers, as is illustrated by the fact that of the 48 occurrences of the species (out of 63 catches studied) 47 yielded less than 100 individuals. But still, because of the relatively larger sizes of individual fish and good palatability, this species is commercially valuable.

Young enter the catches in the fall and early winter (e.g. 10-10-63, 69-188 mm T.L., mean T.L. 118 mm; 07-11-63, 41-44 mm T.L., mean T.L. 43 mm; 08-10-64, 49-204 mm T.L., mean T.L. 81 mm; 28-10-64, 37-188 mm T.L., mean T.L. 84 mm; 02-12-64, 37-144 mm T.L., mean T.L. 95 mm; 16-12-64, 53-160 mm T.L., mean T.L. 94 mm). However large numbers rarely appear and the small schools tend to be quite heterogeneous and loose. The absence of smaller individuals suggests that spawning takes place in deeper waters and that the larvae remain there through metamorphosis and for some time thereafter. However, beyond this one broad generalization little can be said about seasonal migratory patterns, perhaps due to the endemicity of the species and the relatively small numbers of individuals comprising the samples.

This demersal species is most likely suffering considerable ecological disturbance in the St. George Bay area due to the large amounts of garbage and detritus being discharged into the Bay. As has been mentioned already the near littoral is often closely choked with debris and the waters are badly discolored with fine particulate materials. At times seines come to shore carrying a cubic meter or more of tin cans, rags, orange peels, and a remarkable multitude of other such odds and ends.

In the first centuries of the Christian era *Mullus barbatus* was one of the most highly esteemed of all the Mediterranean food fishes. Romans watched the variations in color as their '*mullus*', or red fish, died prior to being eaten and today Lebanese enjoy the colors of the same fish known to them as the *Sultan Ibrahim ramli*.

Mullus barbatus ranks 5th out of the twenty-six fish discussed here in terms of the indgram quotient. In mid May and early June, the first hint of the large waves of young to come a few young specimens of 40 to 50 mm T.L. appear in the seine catches (e.g. 14-05-64, 45-48 mm T.L., 1 individual; 09-06-64, 41-48 mm T.L., 2 individuals) and then in late June wave after wave of young are harvested (e.g. 24-06-64, 41-68 mm T.L., mean T.L. 52 mm. 470 individuals; 09-07-64, 37-96 mm T.L., mean T.L. 57 mm, 1,940 individuals; 15-07-64, 41-100 mm T.L., mean T.L. 62 mm; 07-07-65, 41-104 mm T.L., mean T.L. 62 mm, 343 individuals; 15-07-65, 33-108 mm T.L., mean T.L. 60 mm; 1,500 individuals; 28-07-65, 49-116 mm T.L., mean T.L. 79 mm, 3,186 individuals) for the preparation of a fried appetizer called *bizri*. As the summer progresses the population declines in number even though young are occasionally added (e.g. 14-09-65, 29-92 mm T.L., mean T.L. 59 mm) up until early December. The young of the year remain in shallow waters in reduced numbers and are joined by larger individuals through the winter and early spring and may enter the catches, sporadically, in large numbers (e.g. 31-03-65, 93-164 mm T.L., mean T.L. 120 mm). The cycle is complete when these year classes are replaced by the arrival of the new young, coming in after metamorphosis from their larval life in off-shore waters.

This demersal species and its closely related congener, *M. surmuletus*, another important commercial fish of Lebanese waters occurring over rocky bottom, may be facing a serious competitive challenge with the recent arrival of the aforementioned erythrean *Upeneus moluccensis* and *U. asymmetricus*.

During the first half of our study we were confused about the specific status of *Spicara chryselis* and *S. smaris* and failed to separate resultant data. The data presented in tabular form is thus a combination of that taken for the two species. *S. chryselis* is, on the basis of later information, the more common appearing continuously for a short time in June and early July.

Lithognathus mormyrus was taken in every catch made during the study period but only rarely did it contribute conspicuously in either number or weight. Of the more than 7,000 specimens taken only 61 exceeded 150 mm T.L. The young of this circum-African species first appear in the catches in July and August (e.g. 10-07-63, 25-36 mm T.L.; 02-08-63, 25-44 mm T.L.) and again in October and November (e.g. 07-11-63, 17-92 mm T.L.; 28-11-63, 21-80 mm T.L.; 08-10-64,

17-52 mm T.L.; 04-11-64, 21-52 mm T.L.). The absence of young in the late spring and early summer of 1964 was noteworthy and remains unexplained. This point is further accented by the fact that during the 1963-1964 study period when young did appear relatively abundantly, 4,439 fish contributed to the 28 kilograms of this fish taken while in 1964-1965, 2,550 larger fish had a total weight of slightly more than 30 kilograms.

L. mormyrus is one of the more euryhaline fish occurring along the coast of Lebanon entering several hundred meters into the mouths of the Nahr Litani and Nahr Kebir and frequenting areas of the coast where fresh waters enter the sea. It is likely that the pollution of streams and rivers of the Levant will have particular influence on this species.

The size and composition of catches indicate that this species swims in relatively small schools, with 49 of the 66 catches yielding less than 100 individuals. Larger catches exceeding 100 individuals usually consisted of several different spawning, if not year, classes, suggesting that schools may also be relatively slow moving and heterogeneous in composition.

L. mormyrus is a favored fish in the Beirut market but as can be seen from the data presented the shore seine is not an important contributor to the fishery.

Upeneus asymmetricus seemingly misnamed *U. tragula* by several authors is newly reported from the Mediterranean (George and Athanassiou, 1966) and constitutes still another Red Sea immigrant to Lebanese waters. The bionomics of this species have already been discussed (George and Athanassiou, 1966) and need not be restated here. It is sufficient to say that this mullid exhibits considerable ecological adjustment to the local situation in terms of year to year stability of sample size and character. It is conceivable that this species has already displaced a significant part of the indigenous *M. barbatus* population.

Sardina pilchardus, the commercially important sardine of Europe, enters the catch during a well defined period of late spring and early summer (i.e. April 23 through 15 July, 1964; March 31 through June 23, 1965) displacing *Sardinella aurita*. This period of visitation is approximately similar to that of *Trachurus trachurus*, the horse mackerel, one of its important predators. The pilchard ranks second among local sardines in biomass but may exceed at times even *S. aurita* in number as it did in the 1963-1964 study period (26, 605, to 8,396). During the duration of the program less than 3% of the pilchards taken had total

lengths exceeding 80 mm and it was the rare fish which exceeded 130 mm T.L. (e.g. 14-05-64, 171 mm T.L.; 14-01-65, 138 mm T.L.; 31-03-65, 155 mm T.L.; 09-06-65, 131 mm T.L.).

The presence of small fish (25 to 36 mm T.L.) throughout the period of occurrence and the relatively stable sample structure suggests that the visiting fish were spawned during March and May and that St. George Bay is only a point along a still undisclosed migratory route.

Sardinella aurita is one of the most abundant and commercially important fishes of St. George Bay. Young appear in the seine catch in May and June (e.g. 10-03-65, 29-60 mm T.L., mean T.L. 39 mm; 01-04-64, 29-76 mm T.L., mean T.L. 39 mm) and are periodically displaced thereafter by larger individuals (23-04-64, 173-232 mm T.L., mean T.L. 195 mm; 14-04-65, 137-224 mm T.L., mean T.L. 192 mm) for several months until a large population of individuals averaging less than 75 mm T.L. predominates in July and August. Much of the seine fishery is dependent upon this group with 16 out of the 19 large catches (500 fish or more) being based on it. The species dwindles in abundance thereafter until the new spawning in April and May.

Catches were generally confined to coherent, unimodal groups with the upper limit of the largest interval exceeding three times the value of the lower limit of the smallest interval in only four out of 62 catches. This strongly suggests that schools of different sizes have active avoidance mechanisms which are effective up to at least one hundred meters (i.e. the approximate mean radius of the sample area). The character of this behavioral process, if it does exist, would be an interesting and challenging research subject.

The lamp boat (or lamparo) fishery consisting of about 60 different lamp boats in St. George Bay also depends heavily upon this fish along with *Trachurus mediterraneus* and several other species.

Population structure for the horse mackerel, *Trachurus mediterraneus*, was quite different for the two years studied. In 1964 individuals smaller than 41 mm T.L. and larger than 132 mm T.L. were never taken, however, in 1965 small individuals (e.g. 12-05-65, 17-80 mm T.L., ave. T.L. 42 mm) and larger specimens (e.g. 21-04-65, 89-240 mm T.L., ave. T.L. 162 mm) were relatively common. In the spring of 1964 horse mackerel were absent while in the spring of 1965 they were taken in almost every catch beginning in January. Part of the explanation may reside in the local abundance of the large blue jelleyfish *Rhizostoma*

pulmo, an important associate of young *Trachurus* in 1965, but catch data does not support this directly. In example, on 14-01-65 more than 25 *R. pulmo* were taken with only 2 specimens of *T. mediterraneus* and on 14-04-65 seventy five jelleyfish were taken with only ten specimens of *T. mediterraneus* and 2 of *T. trachurus*.

But regardless of the variability outlined, spawning appears to commence in April and May (e.g. 12-05-65, 17-80 mm T.L., mean T.L. 42 mm) and to continue well on into the fall (02-12-64, 57-72 mm T.L., mean T.L. 67 mm; 28-01-65, 49-108 mm T.L., mean T.L. 72 mm). Again paralleling the behavior of other local species the largest individuals appear in the spring (31-03-65, 77-192 mm T.L., mean T.L. 151 mm; 14-04-65, 93-80 mm T.L., mean T.L. 136 mm; 21-04-65, 89-240 mm T.L., mean T.L. 162 mm) to disappear with the appearance of the young of the year.

The niche specialization of *T. trachurus* and *T. mediterraneus* remains a question. They are definitely distinct and sympatric, but *T. mediterraneus* is about ten times more abundant and present for a greater part of the year, *T. trachurus* appearing only during the three months of March, April and May (e.g. catches of March 4 through May 29, 1964 and March 17 through May 12, 1965).

The young of *Caranx fusus* appear in the seine catches of St. George Bay in August and September (e.g. 21-08-63, 41-69 mm T.L., mean T.L. 56 mm; 24-08-64, one fish in 29-32 mm T.L. interval; 14-09-16, 45-104 mm T.L., mean T.L. 71 mm; 25-08-65, 49-56 mm T.L., mean T.L. 52 mm) and then are joined and apparently displaced by older year classes until the largest and oldest fish disappear just prior to the appearance of the new young of the year. These more senior fishes vary broadly about the commercially useful size of 300 mm T.L. (e.g. 09-06-64, 245-276 mm T.L. mean T.L. 263 mm; 01-07-64, 341-352 mm T.L., 345 mm; 09-06-65, 213-272 mm T.L., mean T.L. 243 mm; 23-06-65, 337-352 mm T.L., mean T.L. 345 mm).

This more commercially dependable species may experience significant competition in the future from the erythrean *C. djeddaba* which has only recently (26-10-63, 16-12-64, 14-04-65) been noted in St. George Bay.

The anchovy, *Engraulis encrasicholus*, is one of the most regularly present species taken in the shore seine catches of St. George Bay disappearing only briefly during August and September when water temperatures are at their maximum.

Their small size permits them to escape through the meshes of the net thus making the appraisal of their habits speculative, however, a fall and winter spawning commencing in late September and ending in January and a spring spawning in April are suggested (e.g. 26-10-63, 21-68 mm T.L., ave. T.L. 32.12; 07-11-63, 21-48 mm T.L., ave. T.L. 33 mm; 03-01-64, 25-76 mm T.L., ave. T.L. 40 mm; 20-01-64, 25-84 mm T.L., ave. T.L. 45 mm; 08-05-64, 29-92 mm T.L., ave. T.L. 44 mm; 08-10-64, 29-72 mm T.L., ave. T.L. 47 mm; 14-01-65, 29-76 mm T.L., ave. T.L. 40 mm; 05-05-65, 29-100 mm T.L., ave. T.L. 52 mm).

Sizes are small with only four fish out of more than 4,000 measured exceeding 100 mm T.L. An exceedingly unusual fish was one taken on 02-08-63 with a T.L. of 150 mm. In June a small percentage of the larger fishes exhibit a broadening of the silver flank stripe to just short of the midventral line and a distinctly larger eye. It is conceivable that this represents a second species of *Engraulis* in the Mediterranean but it is more likely a senescence or postspawning phenomenon.

A significant disparity in size was noted for July through September of 1964 and 1965. In example 84 fishes of 09-07-64 had an average T.L. of 47 mm while 51 fishes of 07-07-65 had an average T.L. of 63 mm. This difference seems best related to the lower average daily temperatures of the latter year because population densities and dates of the spring spawning were similar.

Trachinotus glaucus appeared in more than 50% (36/63) of the catches being most abundant in the warmer months. This small member of the Carangidae favors the turbullent waters of the surf-washed sandy littoral.

The young of the year are first caught in July and August (e.g. 03-08-64, 37-40 mm T.L., mean T.L. 38.5 mm; 23-06-65, 29-32 mm T.L., mean T.L. 30.5 mm; 07-07-65, 25-40 mm T.L., mean T.L. 31.7 mm T.L.) replacing larger individuals and remain in the area to grow and to be joined by older year classes, as reflected by samples with relatively large average individual weights (e.g. 25-09-63, 69-112 mm T.L., mean T.L. 91.5 mm. T.L.; 10-10-63, 85-264 mm T.L., mean T.L. 108.9 mm T.L.; 08-10-64, 37-172 mm T.L., mean T.L. 116.2 mm T.L.). In late fall and early winter the young disappear leaving the largest individuals behind (e.g. 20-01-64, 41-176 mm T.L., mean T.L. 132.5 mm; 04-03-64, 153-156 mm T.L., mean T.L. 154.5 mm; 23-09-65, 162-228 mm T.L., mean T.L. 190.5 mm) and these decline in number as the winter progresses.

Trachinotus glaucus in the least commercially valuable of the six representatives of the native Carangidae, its low ranking being due to its small size and boniness.

Pagellus acarne, congener of one of Lebanon's most valuable commercial fishes, *P. erythrinus*, is of highly seasonal occurrence, appearing in March and departing in early July. In 1963-1964 this visitation took place a week or two earlier than in the following year.

Spawning takes place in either off-shore waters or in other latitudes because very small individuals rarely occur. The smallest specimens (3 individuals) taken during the two year study fell in the 41-44 mm T.L. interval and were taken on 15-04-64. On the other hand large individuals are also absent from the seine fishery the largest specimens taken falling in the 149-152 mm T.L. interval (14-05-64). The mean range in T.L. for the samples studied was 51.8-105.7 mm for 1963-1964 and 54.2-102.5 mm for 1964-1965.

These sleek, schooling fishes occur throughout the Mediterranean and in the eastern Atlantic from the British Isles to the Canaries. The movement of this more nomadic member of the Sparidae poses an interesting problem. Although *P. acarne* rarely contributes significantly to the seine fishery, (the catch of 12-05-65 with 1,200 individuals weighing a total of 11.9 kg. is an exception) it does appear in greater numbers and in larger sizes in the local lamparo and trammel net catches. The moderate seasonal dependability and the probability of large migrant populations somewhat removed from local influences at more critical life stages suggest that this species merits a much more detailed commercial study.

One of the most firmly established erythraean immigrants is the rabbitfish, *Siganus rivulatus*. Today it is one of the commonest fishes of St. George Bay entering the catches of trammel net, hook and line and seine fishermen in large numbers. Another member of the genus, *S. luridus*, is also present but has not yet gained such importance.

The young appear quite regularly in the month of July (e.g. 27-07-64, 25-40 mm T.L., mean T.L. 32 mm; 07-07-65, 25-32 mm T.L., mean T.L. 29 mm) and thereafter up to about October in wave after wave. The millions of young abound over rocky outcroppings grazing on the relatively abundant early summer algal cover. Apparently population pressures are such as to drive many young out into the sandy and gravely littoral where they can be taken by shore seine. Unfortunately these fishes are bony, poisonous (spines) and rarely exceed sizes greater

than 150 mm T.L. as is illustrated by the fact that of the more than 22,000 specimens taken during the study only 9 had total lengths exceeding this value!

This active invader appears to occupy much the same ecological niche as *Boops salpa*, another sleek fast-schooling herbivore. It will be interesting to observe whether or not *Siganus rivulatus* displaces *Boops salpa* in areas to the north where this latter species is currently common.

Sphyraena chrysotaenia is another Red Sea immigrant that has apparently successfully established itself in the eastern Mediterranean. Individuals ranging in size from about 175-300 mm T.L. (e.g. 20-01-64, 169-226 mm T.L., mean T.L. 196 mm; 07-02-64, 173-212 mm T.L., mean T.L. 194 mm; 26-02-64, 213-276 mm T.L., mean T.L. 245 mm; 15-04-64, 265-276 mm T.L., mean T.L. 271 mm; 14-05-64, 281-312 mm T.L. mean T.L. 297; 14-01-65, 129-252 mm T.L., mean T.L. 193 mm; 11-02-65, 137-216 mm T.L., mean T.L. 188 mm; 24-02-65, 193-220 mm T.L. mean T.L. 207 mm) occur in the catches from January onwards till the appearance of young in June and July (e.g. 10-07-63, 37-68 mm T.L., mean T.L. 54 mm; 24-06-64, 61-64 mm T.L., mean T.L. 63 mm; 30-06-65, 45-56 mm T.L., mean T.L. 48 mm; 07-07-65, 45-52 mm T.L., mean T.L. 49 mm; 15-07-65, 41-76 mm T.L., mean T.L. 62 mm) when they depart. Several year classes are commonly taken together during the summer months. In the fall a second spawning is assumed to take place as based on the appearance of young (e.g. 28-10-64, 45-104 mm T.L., mean T.L. 81 mm).

In 1963-1964 273 individuals (wt. 29,923 g) were taken while in 1964-1965 3,444 (wt. 82,913 g) appeared suggesting ecological maladjustment possibly resulting from competition with *Sphyraena* sp.

Pomadasys incisus, frequently referred to as *Pristipoma bennetti*, is the single representative of the Pomadasyidae, the ' grunters ', in the Mediterranean. In Lebanon this actively schooling carnivore is common but has little commercial significance because of the small size of individuals entering the fishery. In our program this species was taken 36 times, 32 times of which the mean T.L. was less than 100 mm.

P. incisus is unusual among fishes entering the St. George Bay fishery in that it appears to spawn once annually in mid to late summer (e.g. 26-10-63, 110 specimens 17-32 mm T.L., mean T.L. 23.1 mm; 04-11-64, 11 specimens 17-44 mm T.L., mean T.L. 32.7 mm) and to be most abundant in the late fall and winter. In the early spring and on through the summer, i.e. March through July, the population avoids

the seines, most likely moving off into deeper waters. This behavior seems quite out of keeping with what might be expected of a species characteristic of warmer coastal waters.

1963-1964 was a much stronger year than the following, perhaps due to warmer temperatures prevailing. This species is still another example of the large group of local species which reach maturity quickly and at a small size. The long standing seine fishery of the region may have an important role in producing this phenomenon.

Examination of several thousand specimens of *Sphyraena* from the coast of Lebanon has revealed that three different forms are present, *Sphyraena sphyraena*, common in the western Mediterranean but not here, the erythraean *S. chrysotaenia* commonly missidentified as *S. obtusata*, and *Sphyraena* sp. which is the subject of a paper now in preparation. This latter species is an endemic Mediterranean form showing many affinities with *S. sphyraena*.

Sphyraena sp. is present in the waters of St. George Bay for much of the year. Young individuals appear for the first time in June (e.g. 19-06-63, 57-84 mm T.L., mean T.L. 71 mm; 24-06-64, 73-84 mm T.L., mean T.L. 77 mm; 16-06-65, 57-92 mm T.L., mean T.L. 75 mm) and remain in association with older year classes to add a second annual spaning class in the fall (e.g. 28-08-63, 73-76 mm T.L., mean T.L. 75 mm; 07-11-63, 37-72 mm T.L., mean T.L. 50 mm; 04-11-64, 49-116 mm T.L., mean T.L. 86 mm). During the colder months only the more senior year classes remain (e.g. 20-01-64, 249-284 mm T.L., mean T.L. 267 mm; 14-01-65, 233-388 mm T.L., mean T.L. 283 mm; 28-01, 253-284 mm T.L., mean T.L. 270 mm; 24-02-65, 269-308 mm T.L., mean T.L. 289 mm). 1965 was a distinctly stronger year for this species possibly being related to the lower temperatures prevailing, but a reciprocal relationship with the erythraean *S. chrysotaenia* may also be involved. If we are correct in our belief that *Sphyraena* sp. is in reality an endemic species we may have still another case of an immigrant species competing with a Mediterranean form for a niche.

Trachurus trachurus, the horse mackerel of commercial fame in western Europe is significantly displaced by the autochthonous (assumedly) *T. mediterraneus* discussed in earlier paragraphs. The Mediterranean horse mackerel is another one of Lebanon's distinctively seasonal species appearing quite regularly in March and departing in late May. The interaction, ethological and genetic, of this species with its congener is an interesting problem still to be examined locally. We can

say, however, that the two species are not mutually exclusive, at least under the sampling conditions, because individuals of similar sizes of both species do occur concurrently. Whether or not they school together is still a question.

The range in size for 1963-1964 was 33-196 mm T.L. and for 1964-1965 was 65-96 suggesting considerable variability from season to season and, because of small size, little commercial value. These sleek, fast swimming carangids that are gathered in local waters are probably the warmer water outliers of the grand schools of the Eastern Atlantic which seasonally penetrate into the range of the *T. mediterraneus* during the period immediately subsequent to the coldest months of the year.

Sardinella maderensis ranks third in importance after *Sardinella aurita* and *Sardina pilchardus*, at least in reference to the shore seine fishery with catches rarely including more than 50 individuals. Of the 38 appearances of the species only four exceeded 50 and only one exceeded 100. Individuals smaller than 100 mm T.L. dominate during the months of July through September (e.g. mean T.L. 24-08-64, 72 mm; 31-08-64, 71 mm; 14-09-64, 78 mm; 04-08-65, 95 mm; 11-08-65, 91 mm) while individuals larger than 100 mm T.L. are more abundant in November through June (e.g. mean T.L. 05-12-63, 155 mm; 20-01-64, 156 mm; 15-04-64, 125 mm; 04-11-64, 155 mm; 16-12-64, 160 mm; 29-12-64, 169 mm; 11-02-65, 145 mm; 12-05-65, 209 mm). However there is considerable overlap and the data suffers from small sample size. There is also the suggestion of a smaller size class in December and January (e.g. 20-12-63, 57-72 mm T.L.; 03-01-64, 45-76 mm T.L.) indicating that there may be at least two different spawning periods during the year, one in the late spring around June and a second in the fall in October and November. These results have reasonable agreement with the synopsis of Ben-Tuvia (1960). The season to season irregularity and paucity of this species suggests that St. George Bay is one of its marginal habitats.

Smaller individuals (e.g. ave. T.L. 10-07-63, 130.50 mm; 09-07-64, 137.50 mm; 28-07-65, 163 mm) of *Seriola dumerili* appear in the summer when water temperatures reach 27°C. and give way to larger individuals as the season progresses to eventually terminate with the largest individuals (ave. T.L. 26-10-63, 380 mm; 14-09-64, 332 mm) leaving when water temperatures again dip below 27°C. The arrival of these

fast swimming predators generally follows that of one of their more important prey species *Sardinella aurita.*

The fact that individuals smaller than 129 mm T.L. were never taken in samples along with the steady increase in average total lenghts over the season suggests that spawning does not take place in local coastal waters but that this spawning, wherever it does takes place, is of a well defined and restricted duration.

Sufficient data was gathered to strongly suggest that the ratio of range in size in mm to average total length in mm increases with an increase in size, a situation which raises several interesting problems regarding the selection for size in this species.

Upeneus moluccensis, commonly misidentified as *Mulloidichthys auriflamma* in the eastern Mediterranean, is still another Red Sea immigrant. It has found favor in the markets of Beirut and further north along the coast receiving the name Sultan Ibrahim Yahoodi or the Jewish Sultan Ibrahim. It can be easily recognized by the vivid yellowish-orange longitudinal stripes on each side of the body. Gravid fish appear in the coastal waters of the Lebanon in June through August in schools more or less segregated by sex. The males are somewhat the smaller generally being less than about 125 mm T.L. while the females are larger. The young of the year appear in September, November and December with the mean lengths of individuals being about 75 mm T.L. (e.g. 18-09-63, 83 mm T.L.; 25-09-63, 61.93 mm T.L.; 25-10-63, 75.64 mm T.L.; 08-10-64, 68 mm T.L.; 28-10-64, 67.74 mm T.L.; 04-11-64, 69.86 mm T.L.; 02-12-64, 73.90 mm T.L.). Several different stocks of young must be involved as mid-season samples occasionally have smaller total lengths than samples taken earlier.

163 specimens were collected in 1963-1964 while 3,005 were taken in 1964-1965 suggesting that this species has not yet adjusted ecologically to the area. It is conceivable that the endemic mullids, *Mullus barbatus* and *Mullus surmuletus* are ' putting up a good fight ' for the niche that this new immigrant is challenging.

The deeper dwelling *Dentex dentex* parallelling the overflowing of *Diplodus sargus* from its rocky habitat seems to have expanded during the months of June and July of 1964 into the shallows while during 1964-1965 this species was uncommon. One sample of 530 individuals taken on 24-06-64 ranged from 37 to 104 mm T.L. with an average of 78 mm T.L. and an average weight of 8.64 gm. Of the 923 specimens taken over the two year study period (839 were taken during 1963-1964)

only 25 exceeded 150 mm T.L. The appearance of one specimen of the 33-36 mm T.L. interval on 26-07-63 (preliminary study period), a single specimen of the 37-40 mm T.L. interval on 24-06-64 and a third specimen of the 29-32 mm T.L. interval on 02-06-65 suggests that spawning may take place in June.

The young of *Diplodus sargus* appear during the months of June through September apparently overflowing from adjacent rocky base-rock outcroppings and bolder breakwaters. The catches for the two years differ strikingly with 273 individuals appearing in 1963-1964 and 3,545 in 1964-1965. An April spawning is suggested by the presence of 25-28 mm T.L. specimens in early May. In 1964-1965 the population seems to have reached its peak in July and August with thousands of small specimens of about 75 mm T.L. entering the nets. This is another example of where the young of the year make the dominant contribution to the catch. Of the 3,818 specimens taken during the two years of the study only 6 exceeded 150 mm T.L.!

The lizard fish, *Saurida undosquamis*, another immigrant from the Red Sea, appears to occupy much the same ecological niche as the endemic *Synodus saurus*. 1,133 specimens (total weight 36,437.5 gms.) were collected in 1963-1964 while only 88 (total weight 3,755.3 gms) were taken during 1964-1965 revealing a well-defined dissimilarity between the two years. The appearance of this benthic carnivore may be related to the absence of thermal stratification more or less evident during the late winter and early spring months. A single specimen falling in the 13-16 mm T.L. interval was collected on 7 November, 1963, suggesting at least one spawning period in late October. The schools are composed of individuals of diverse lengths ranging from 125 to 300 mm T.L. Catch dates which exemplify this distinctive character are 07-02-64, 19-03-64, 01-04-64, 15-04-64, 28-04-64, 08-05-64 and 29-05-64. Average lengths and weights commonly approximated 170 mm and 39 g. In example 50 fishes taken on 01-04-64 had an average total length of 167.94 mm and an average weight of 37.73 gms. A second sample of 50 fish for 08-05-64 had an average length of 170.06 mm and an average weight of 39.64 g.

DISCUSSION

Relatively few problems have emerged regarding the identification of materials collected. One however, that of the presence of a second member of the genus *Hyporhamphus*, does merit attention. Tortonese

(1952) reported on the presence of four different species of the Hemiramphidae or halfbeaks in the eastern Mediterranean, inclusive of the Suez Canal. These are *Hemiramphus marginatus* Cuvier, *Hemiramphus far* Forskål, *Hyporhamphus picarti* (Valenciennes) and *Hyporhamphus dussumieri* (Valenciennes), the second and forth listed being erythraean immigrants. Ben-Tuvia (1966) in his summary of information dealing with the immigration of Red Sea fishes into the Mediterranean listed only *Hemiramphus far* indicating that *Hyporhamphus dussumieri* has not yet penetrated beyond the Suez Canal. On 16 December, 1964, we were fortunate to collect in one seine haul several different specimens of two different species of *Hyporhamphus*. One conforms well to existing descriptions of *H. picarti* while the second, far more difficult to place, appears to be in reality *H. dussumieri*. We outline the diagnostically more important characteristics on a specimen housed in the Museum of Natural History of the American University of Beirut (AUBMNH p-716). Upper jaw triangular, slightly broader than long, with large, thin, obscure scales; dorsal fin approximating anal fin in size and form but slightly longer at its base and inserted slightly anteriorly; caudal conspicuously forked with longer marginal rays at least twice as long as the medial shorter ones; D 15, C 15, A 17, P 11, V 6, gill rakers upper arm 10, gill rakers lower arm 20, L.l. ca. 50; T.L. 170 mm, S.L. 145 mm, nose (lower jaw) to anterior of orbit 35 mm, nose to posterior or orbit 42 mm, nose to posterior margin of operculum 51 mm, nose to anterior insertion of dorsal 120 mm, nose to anterior insertion of anal 121 mm, body depth 13 mm. Colors in alcohol preserved material: mid-dorsal with longitudinal stripe paralleled by single thin lines, one each side running from occiput to anterior insertion of dorsal fin; dark longitudinal lateral stripe running from upper margin of operculum to base of the caudal fin, widest in the zone between the medial fins; small irregular maculae extending into caudal base; margins of caudal fin dusky, 2-3 longitudinal series of parentheses-shaped markings above the lateral line; upper and lower jaws dark but ivory extending out onto lower jaw mid-ventrally; base of pectoral fin lightly but distinctly marked with a dark band; ventral surfaces dull ivory. Color in freshly caught material: ground color silvery white, longitudinal lateral band silvery, dorsal surfaces irridescent, flashing, blue-green; distal part of lower jaw orange-pink.

The above features conclusively set the two forms apart. Particularly useful characteristics are: the shape of the caudal fin (that of *H. picarti*

has medial rays which are more than one-half the length of the longer marginal rays), the mid-dorsal color pattern (in *H. picarti* the middle stripe is the narrowest while in *H.* cf. *dussumieri* it is much broader than the adjacent ones), the shape of the upper jaw (in *H. picarti* it is longer than broad while in *H.* cf. *dussumieri* it is broader than long), and the length of the lower jaw (in *H. picarti* the distance from the anterior margin of the mouth to the tip of the lower jaw exceeds the distance from the anterior margin of the jaw to the anterior insertion of the pectoral fin while in *H.* cf. *dussumieri* the reverse is true). When similarly sized specimens of the two species are compared *H. picarti* has a lighter general body construction.

In our sampling program both species must be considered rare and of the two *H.* cf. *dussumieri* was extremely rare with only two specimens appearing in the course of the two and one-half year study. It will still, however, be interesting to watch for a possible displacement of the endemic by the immigrant form.

Three patterns of occurrence appear. First there are the residents which are demersal, commercially prized and present for most of the year. Good examples are *Pagellus erythrinus*, *Pagrus ehrenbergi* and *Lithognathus mormyrus*. Secondly there are the actively schooling nomadic forms which enter the area in large numbers during well defined seasons of the year. These species are particularly valuable to the seine fishery, apparently because their stocks are dependent upon other than local conditions. *Seriola dumerili*, *Sardinella aurita*, *Sardinella maderensis* and *Sardina pilchardus* are good examples of this group. Thirdly there are the ' irregulars ', those species entering the study area in a capricious and irregular manner which may contribute significantly to the fishery. Good examples are *Upeneus moluccensis* and *Sphyraena chrysotaenia*, both of which are erythraean species that have become well established in the Mediterranean but which apparently have not yet become well integrated ecologically.

These three groups all have the common property of being visitors to the sandy-muddy areas of the littoral that are harvested by the seine. Apparently these areas have been so relentlessly swept with these fishing devices that true resident populations can never reestablish themselves. Consequently the fishes that are caught are either daily migrants that move on and off shore or along shore each day, seasonal migrants which enter and leave with the seasons or species which enter irregularly as accidentals.

June through September are the months of abundant young, and commonly there is a decline in the latter part of this period during late July and August. This pattern is explainable on the basis of adaptation of local species to the peak in productivity which occurs in the spring, based on increased insolation and relatively high nutrient levels and the second peak which takes place in September following the local and southerly fertilizing influence of the Nile flood. It will be worth while to give particular attention to this latter period now that Nile waters are no longer entering the Mediterranean in their former quantities.

The late winter and early spring are periods dominated by the relatively larger individuals of many of the species. This is a time when the older year classes enter the littoral zone and when the young of the year have not yet arrived. Unfortunately this is a time when strong winds and violent seas are frequent, thus limiting the seine fishery at a time when it might be more productive.

In the spring the young of the year may enter the catches almost explosively in large numbers or population size of this class may build slowly. *Pagellus erythrinus* and *Lithognathus mormyrus* are examples, respectively, of the two patterns. Frequently the arrivals of young displaces the large individuals. The ethological aspects of this phenomenon are interesting but perhaps difficult to study. The previously mentioned case for *Sardinella aurita* is one of the better cases in point.

The species composition of the catches suggests both tropical and boreal aspects. The large number of species taken (101) along with good representation of tropical species and genera represents the tropical influence while the bulk contribution of a small percentage of this number suggests the boreal influence. Our catches strongly indicate that the eastern Mediterranean (really the entire sea) is truly a hybrid situation having both tropical, sub-tropical and boreal species and conditions.

The importance of the Sparidae and closely related Mullidae is noteworthy with 10 of the 26 important species belonging to these two families. Local fisheries research should give particular attention here. Associational indices and stomach analysis based on the data and specimens already at hand would be a good beginning.

The detailing of the ' guiding background conditions ' will be the task of more subtle statistical techniques. Simple Pearson-product-moment correlation coefficients were erected for twelve different parameters such as salinity, water temperature, barometric pressure, rain

fall, etc., with little success. The highest value achieved was. 404. Multiple regression analyses will undoubtably be necessary.

The statements on the 26 discussed species must not be construed to be applicable to seine hauls taken at all times during the day. Clearly, population structure changes dramatically over each twenty-four hour period with many species migrating into deeper waters during the early morning to return at dusk. This is why the seine fishermen generally restrict their activities to the predawn and dawn periods. Catches made later on in the day are not worth the effort. The details of this should be the subject of a local fisheries study. This problem was approached during our work but the expense and complexities of maintaining a seine team on duty over a twenty four hour period precluded any accomplishment along these lines.

The erection and use of the ' indgram ' value bears considerable defense. It comes about through the need to combine the properties of weight and numbers of individuals ecologically. It is clear that 1,000 large fish are ecologically much different than 1,000 small fish. The same can be said for 1,000 grams of large fish and 1,000 grams of small fish. Neither weight data nor data on the numbers of individuals says enough alone; both must be used together and this produces disadvantages in graphing and tabulation. A first step would be to multiply the two values together but the resulting numbers are often too large and too unwieldy. The next step is to extract the square root of this product returning the figure to manipulable size. In Tables VI, VII, and VIII these quotients for weights, numbers and individuals have been extracted and placed in order for 26 different species. It will be noticed that in the case of weights and numbers there is a tendency for the species to appear in ecological groupings but this quality emerges far more clearly in the case for indgrams. The species first appearing in the list are ' irregular ' in one way or another. The first listed, *Saurida undosquamis* is an erythraean immigrant. *Diplodus sargus* is an erratic immigrant from adjacent rocky headlands and other base rock exposures. *Dentex dentex* is a local migrant from greater depths.

Upeneus moluccensis is another Red Sea immigrant. Beginning with *Trachurus trachurus* and continuing on through *Sardina pilchardus* is a group of rapidly swimming, schooling forms that tend to be seasonal in character and carnivorous in food habits with the exception of the erythraean *Siganus rivulatus*. These fishes are generally mid-water swimmers that swim in schools of relatively uniform size. They are

sleek, streamlined animals that are rarely stationary. They are important in the Lebanese fishery but more or less on a seasonal basis. The next seven species (excluding *Spicara chryselis* and *S. smaris*) are known to most Lebanese as important food fishes. They are demersal bottom feeding forms that appear in seine catches for a large part of the year. They are the dependable fishes that a fisherman expects to capture most of the time. They are carnivores favoring larger prey.

The next to last mentioned species *Euthynnus alletteratus* is quite distinctive as the only important scombrid of the seine fishery. It is one of the largest fishes of the group accenting the trend from smaller to larger fishes as one moves down the series.

Boops boops, the last species, is an active mid-water feeder forming large schools that also play an important role in the fishery. It is usually in the top ten contributers to the annual seine fishery by weight.

A comparison of the arrangement of the species appearing in the weight and numbers lists reveals some pattern of the type described above but nothing as orderly as this. This fact suggests that there may indeed be some validity in the use of the indgram value. Beyond the arrangement of fishes by character it also suggests the extent to which immigrant species have entered into local community structure. The penetration of *Upeneus asymmetricus*, *Siganus rivulatus* and *Sphyraena chrysotaenia* ' deep ' into the list of import commercial and regular species suggests that they have integrated well into the local scene, possibly displacing forms which once occupied the area. The great similarity in both body form and habit of *Boops salpa* with *Siganus rivulatus* suggests that this may be one example of displacement. The same may be said for the Mediterranean *Sphyraena* sp. and the Red Sea, *S. chrysotaenia* and the Mediterranean *Synodus saurus* and the erythraean *Saurida undosquamis*. It would be worth while to see if areas still outside of the range of the three erythraean forms still reveal *Boops salpa*, *Sphyraena* sp. and *Synodus saurus* in dominance. It will also be interesting to see the relationship of the erythraean *Upeneus moluccensis* and *U. asymmetricus* and the Mediterranean *Mullus barbatus*. Of the 21 immigrant fish species five enter this list. Five out of 26 or slightly less than 20% suggests the ecological importance of the erythraean invasion.

The tables of seasonal occurrence (Tables III and IV) have been based on numbers alone. Similar tables could be prepared for weights using parallel criteria and techniques but a more interesting table could

be constructed using indgrams. This has not yet been done and represents an interesting opportunity for further work. It is possible that the results would permit a better categorization of the fishes of the coastal waters of the Lebanon, and elsewhere, than already exists.

The gross approximation of the annual yield of the seine fishery in St. George Bay can be based on the data at hand. The 32 catches of 1963-1964 yielded an average of 34.4 kilograms and the 31 catches of 1964-1965 produced an average of 42.8 kilograms but in that certain months of the year had a larger number of catches these figures must be corrected to remove this bias. This was done by producing an average for each of the months and then taking the average of these averages. The resultant figures for 1963-1964 and 1964-1965 were respectively 33.2 and 37.1 kg, the average of which is 35.2 kg. Usually, commercial seine fishermen shoot their nets about twice a day except on excessively windy days, Sundays, and other holidays during the closed season, May 15 through August 15. Summarizing these assorted inactive days we approximate that 200 days remain for fishing. This suggests that 13.240 and 14.840 metric tons were taken in 1963-1964 and 1964-1965 producing an average for the two years of the study of 14.040 metric tons per year per seine fishing team. In that three teams usually work in the Bay area we may approximate that the seine fishery yields about 52 metric tons annually. A very approximate figure for the value of their catch is is 1.50 Lebanese pounds per kg. This means that the fishery's annual gross is about 78,000 or 26,000 LL per fishing team. In that about 25 shares per team are involved, that is about 15 for the pullers, and about 10 for the owner, net and boat, the annual income per share for a 200 day working year is about 5.20 LL. If a 365 day working year is considered, the annual income per share drops to about 2.85 LL or about 95 cents per day. Unfortunately, this low figure attracts only the most illiterate, poor and otherwise unemployable persons to pull the nets. Frequently young male Syrian immigrants, some in the country without working permits or permission, fill these positions. Sadly enough the future looks even darker. The increasing population of the Bay area is resulting in extreme alteration of the fishing grounds in terms of sand removal, loss of seinable frontage (i.e. through the erection of stone breakwaters and aprons), increased pollution and build up of benthic detrital materials such as tin cans, plastic, rags, and so on. Unfortunately the authors find themselves in the position of having to recommend on a strictly commercial basis that the seine fishery in the Bay area be dis-

continued which is antithetical to the initial intent of this program, that is, the establishment of a comparative base that may be used for comparison at a later date assuming that the fishery continues in its present condition. We can only wait and see what happens. See the works of GRUVEL (1931) and HORNELL (1935) for further comments on the fisheries of the Levant.

Much exciting work remains to be done on the ecology of fishes in the Eastern Mediterranean but of all the problems that will emerge the ones which should receive the fullest attention are the changes that will take place under the influence of erythraean species entering the Mediterranean through the Suez Canal and the influence of reduced freshening and nutrient supply from the Nile River.

Table I — Number of individuals of 26 species of fishes taken during a shore seine study for 1963-1964 and 1964-1965, in St. George Bay, Lebanon

Scientific Name	Number of Individuals	
	1963-1964 I	1964-1965 II
Sardina pilchardus	26,605	15,881
Engraulis encrasicholus	17,915	7,901
Pagellus erythrinus	16,965	28,444
Siganus rivulatus	15,878	6,330
Trachurus mediterraneus	12,294	9,989
Sardinella aurita	8,396	24,409
Pomadasys incisus	6,090	1,329
Boops boops	4,721	5,807
Lithognathus mormyrus	4,439	2,550
Spicara chryselis & S. smaris	2,475	2,305
Mullus barbatus	2,113	6,608
Pagrus ehrenbergi	1,978	3,973
Euthynnus alletteratus	1,932	2,388
Saurida undosquamis	1,133	88
Trachurus trachurus	1,051	151
Upeneus asymmetricus	953	2,872
Dentex dentex	839	84
Sphyraena sp.	702	1,144
Sphyraena chrysotaenia	638	3,444
Caranx fusus	521	407
Pagellus acarne	418	1,443
Epinephelus aeneus	362	633
Trachinotus glaucus	333	1,385
Diplodus sargus	273	3,545
Sardinella maderensis	236	773
Upeneus moluccensis	163	3,005
Total	129,725	136,888
X[a]	129,725 X =	136,888
	X =	1.06

a. In that the number of catches for the two years was not the same the figures of Column I may be multiplied by 1.06 for better comparison with the data of Column II.

Table II — Total weights by year for 26 species of fishes taken during a two year study in St. George Bay, Lebanon

Scientific Name	Total Weights (in grams) 1963-1964 I	1964-1965 II
Euthynnus alletteratus	283,932.3	154,828.0
Pagellus erythrinus	90,524.7	180,593.4
Sardinella aurita	58,252.9	104,807.4
Pagrus ehrenbergi	50,569.0	65,999.8
Siganus rivulatus	39,544.5	20,623.5
Trachurus mediterraneus	39,351.6	48,554.2
Saurida undosquamis	36,437.5	3,755.3
Sphyraena chrysotaenia	29,923.0	82,913.6
Boops boops	28,830.3	54,051.6
Caranx fusus	28,128.7	15,057.1
Lithognathus mormyrus	28,071.8	30,510.2
Sardina pilchardus	24.382.2	30,897.0
Mullus barbatus	22,891.2	67,509.8
Epinephelus aeneus	19,747.5	30,345.9
Dentex dentex	14,169.5	3,088.5
Engraulis encrasicholus	11,889.6	8,947.3
Pomadasys incisus	9,951.1	7,039.4
Upeneus asymmetricus	7,494.0	11,078.0
Sphyraena sp.	7,451.4	107,395.7
Spicara chryselis & S. smaris	4,934.9	4,203.4
Trachinotus glaucus	4,241.8	9,683.0
Pagellus acarne	3,757.3	12,676.1
Trachurus trachurus	3,210.1	1,052 0
Upeneus moluccensis	3,097.1	17,243.4
Sardinella maderensis	2,934.4	30,629.9
Diplodus sargus	1,720.5	26,238.2
Totals	855,438.9	1,129,721.7
X[a]	855,438.9 X =	1,129,721.7
	X =	1.32

a. In that the number of catches for the two years were not the same the figures of Column (I) may be multiplied by 1.32 for better comparison with the data of Column (II).

Table III — Fishes occurring in seine catches in St. George Bay, Lebanon, beginning 10-10-63 and ending 25-09-64. Circles signify less than 10 fish per catch while X's indicate 10 or more. Linkages are drawn between adjacent symbols and between alternate X's and linked circles.

SPECIES (Number; wt. in grams)	Date of Collection																																
	10-10-63	26-10-63	07-11-63	28-11-63	05-12-63	20-12-63	03-01-64	20-01-64	07-02-64	26-02-64	04-03-64	19-03-64	01-04-64	15-04-64	23-04-64	08-05-64	14-05-64	29-05-64	09-06-64	24-06-64	01-07-64	09-07-64	15-07-64	20-07-64	27-07-64	03-08-64	10-08-64	17-08-64	24-08-64	31-08-64	14-09-64	25-09-64
Ariosoma balearica (1; 21.0)	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Atherina hepsetus (40; 56.9)	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Atherina mochon (27; 69.7)	.	.	.	.	.	.	.	.	X	.	0	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Atule djeddaba[e] (1; 121.0)	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Auxis thazard (53; 927.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	X	.	.	.	.	.	.	.
Balistes capriscus (23; 8,970.5)	.	X	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	0	-X	.	.	.
Belone belone (2; 38.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.
Blennius sanguinolentus (38; 584.8)	.	.	.	X	.	0	.	.	X	.	0	.	.	.	0	.	.	0	.	0	.	.	.	.	.	.	.	0	.	.	X	.	.	.
Boops boops (4,721; 28,830.3)	X	.	.	X	-	0	-	0	-	.	-	X	-	X	-	X	-	X	-	X	-	X	.	.	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	.	.
Boops salpa (304; 3,373.5)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	X	-	0	-	X	-	.	-	X	.	.	X	.	.	.	.	.	.	.
Bothus podas ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caecula imberbis (18; 233.5)	.	.	.	.	.	.	.	X	-	0	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Callionymus filamentosus[e] (203; 1,456.5)	.	0	.	X	-	.	-	0	-	0	-	0	-	0	.	.	0	-	0	-	X	.	.	.	X	-	X	-	X	-	X	-	0	.	.	.	.	0	-	0	-	X	-	X

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																																			
	10-10-63	26-10-63	07-11-63	28-11-63	05-12-63	20-12-63	03-01-64	20-01-64	07-02-64	26-02-64	04-03-64	19-03-64	01-04-64	15-04-64	23-04-64	08-05-64	14-05-64	29-05-64	09-06-64	24-06-64	01-07-64	09-07-64	15-07-64	20-07-64	27-07-64	03-08-64	10-08-64	17-08-64	24-08-64	31-08-64	14-09-64	25-09-64
Caranx fusus (521; 28,128.7)	X	-	X	-	X	-	.	.	-	X	-	X	.	.	.	.	.	.	.	.	X	-	.	.	-	X	.	.	.	.	.	.	.	X	-	0	-	0	-	X
Caranx rhonchus (65; 830.3)	X	.	.	0	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	-	0	-	.	.	X	-	0	-	0	-	.	.
Chauliodus sloanei (2; 1.1)	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Coris julis ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crenilabrus cinereus (7; 110.5)	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dactylopterus volitans (57; 2,951.0)	.	.	.	.	0	-	0	-	X	-	0	.	.	.	0	-	0	.	.	.	X	-	X	-	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dasyatis pastinaca (1; 659.0)	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dentex dentex (839; 14,169.5)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	-	.	-	X	-	X	-	.	-	X	-	X	-	0	-	.	-	0	-	0	.	.
Dentex gibbosus (105; 2,216.0)	X	.	.	.	.	.	X	.	.	.	.	.	0	-	X	.	.	X	.	.	.	X	-	X	-	X	.	.	.	.	.	0	-	0	.	.	0					
Dicentrarchus labrax (64; 140.5)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	-	X	-	0	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicentrarchus punctatus (20; 508.5)	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	0	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.
Diplodus annularis (125; 1,077.5)	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	X	-	0	-	.	-	X	-	0	-	0	.	.	X	.	.	.	.	.	.	.	.
Diplodus sargus (273; 1,720.5)	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	X	-	.	-	X	-	X	-	.	-	X	-	0	-	0	-	0	-	.	-	X	.	.	.	.
Diplodus trifasciatus (39; 399.5)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	0	.	.	.	X	.	0	.	.	0	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																																	
	10-10-63	26-10-63	07-11-63	28-11-63	05-12-63	20-12-63	03-01-64	20-01-64	07-02-64	26-02-64	04-03-64	19-03-64	01-04-64	15-04-64	23-04-64	08-05-64	14-05-64	29-05-64	09-06-64	24-06-64	01-07-64	09-07-64	15-07-64	20-07-64	27-07-64	03-08-64	10-08-64	17-08-64	24-08-64	31-08-64	14-09-64	25-09-64
Diplodus vulgaris (837; 11,880.0)	.	.	.	.	0	.	.	0	-	0	-	0	.	.	.	.	0	-	0	-	.	-	X	-	.	-	X	-	X	-	X	-	X	.	.	.	.	.	.	.
Dussumieria acuta[e] (52; 404.0)	X	-	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Echeneis naucrates (72; 6,375.5)	.	X	.	.	.	.	.	.	.	.	.	.	.	0	-	0	-	0	.	.	0	-	X	-	.	-	X	-	X	.	.	0	.	.	.	.	X	.
Engraulis encrasicholus (17,915; 11,889.6)	0	-	X	-	0	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	0	-	0	-	X	-	0	-	X	-	X	-	X	-	0	-	X	-	0	.	.	.	.	.	.	.
Epinephelus aeneus (362; 19,747.5)	X	-	X	-	0	-	.	-	X	-	X	-	X	-	0	-	X	-	0	-	X	-	0	-	X	.	.	X	.	.	0	-	X	-	X	-	X	-	X
Epinephelus alexandrinus (27; 700.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	0	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Epinephelus guaza ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euthynnus alletteratus (1,932; 283,932.3)	.	.	.	.	.	.	X	.	.	.	.	X	.	.	.	.	X	-	X	-	X	-	X	-	.	-	0	-	X	-	X	-	0	-	X	-	X	-	X	-	X	-	.	-	X
Gobius niger jozo (2,256; 9,538.7)	0	.	.	.	X	.	.	X	-	X	-	0	-	X	-	0	-	X	-	0	-	X	.	0	.	0	-	X	.	.	.	.	.	.	.	.	.	.	.
Hemiramphus far[e] (257; 9,714.0)	.	-	0	-	X	-	X	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	0	-	X	-	0	-	X	-	0	-	0	-	0	-	X	-	.	-	X	-	X
Hyporhamphus cf. *dussumieri*[e] ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hyporhamphus picarti (15; 244.0)	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	X
Leiognathus klunzingeri[e] (632; 2,668.6)	X	-	0	.	.	.	0	-	0	.	0	.	.	0	.	0	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X
Lichia amia (5; 906.5)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	0	.	.	0	.	0	.	0	.	.	.	.	.	.	.

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																																					
	10-10-63	26-10-63	07-11-63	28-11-63	05-12-63	20-12-63	03-01-64	20-01-64	07-02-64	26-02-64	04-03-64	19-03-64	01-04-64	15-04-64	23-04-64	08-05-64	14-05-64	29-05-64	09-06-64	24-06-64	01-07-64	09-07-64	15-07-64	20-07-64	27-07-64	03-08-64	10-08-64	17-08-64	24-08-64	31-08-64	14-09-64	25-09-64
Lithognathus mormyrus (4,439; 28,071.8)	X	X	X	X	X	X	0	X	X	X	X	X	0	X	0	0	X	X	X	X	X	X	X	X	X	X	0	0	0	X	X	X
Lobotes surinamensis (1; 29.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.
Merluccius merluccius (2; 107.5)	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mugil auratus (68; 1,201.5)	.	.	.	.	X	.	.	.	.	.	.	X	.	.	.	.	.	.	0	.	.	.	.	0	0	.	.	.	.	.	.	.
Mugil cephalus (5; 3,305.0)	.	.	0	.	0	.	.	.	0	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mugil saliens (17; 3,220.0)	0	.	.	.	.	.	.	.	X	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mullus barbatus (2,113; 22,891.2)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	X	.	0	X	.	.	X	X	X	X	.	.	X	X	X	X	0	.
Mullus surmuletus (434; 2,003.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	X	.	.	X	X	.	.	X	.	.	0	.	.	.
Mycteroperca rubra (175; 1,501.5)	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	X	X	X	X	0	0	.	.
Oblada melanura (11; 141.5)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	0	.	.	.	.
Orcynopsis unicolor ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pagellus acarne (418; 3,757.3)	.	.	.	.	.	.	.	.	.	.	.	.	0	0	0	0	X	X	0	X	.	.	X	.	.	.	.	.	.	.	.	.
Pagellus erythrinus (16,965; 90,524.7)	X	.	.	0	.	.	X	.	0	.	.	X	0	X	X	.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0
Pagrus auriga (279; 12,510.4)	.	.	.	.	0	0	0	0	0	.	.	.	0	.	.	0	0	X	0	X	0	X	X	.	.	0	.	.	0	.	.	.

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																																
	10-10-63	26-10-63	07-11-63	28-11-63	05-12-63	20-12-63	03-01-64	20-01-64	07-02-64	26-02-64	04-03-64	19-03-64	01-04-64	15-04-64	23-04-64	08-05-64	14-05-64	29-05-64	09-06-64	24-06-64	01-07-64	09-07-64	15-07-64	20-07-64	27-07-64	03-08-64	10-08-64	17-08-64	24-08-64	31-08-64	14-09-64	25-09-64
Pagrus ehrenbergi (1,978; 50,569.0)	X	X	0	.	.	0	X	X	0	0	.	.	X	X	X	X	X	.	.	X	X	X	X	X	.	.	X	0	0	0	X	X	X	X
Pagrus pagrus (361; 7,851.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	X	.	.	.	.	.	0	.	.	.	.	.
Panturichthys fowleri (10; 440.5)	.	.	.	.	0	0	.	.	0	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Parexocoetus mento[e] (1,152; 10,720.0)	.	X	0	X	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pomadasys incisus (6,090; 9,951.1)	X	0	X	X	X	X	0	X	X	X	X	X	0	0	X	.	X	.	X	.	.	.	.	.	.	.	0	.	X	.	.	.	.	.
Pomatomus saltator (149; 398.3)	.	0	.	.	X	.	.	0	.	0	.	.	.	.	.	.	.	.	.	.	0	X	.	X	.	.	0	.	.	0	.	.	.	.
Puntazzo puntazzo (8; 31.8)	.	.	.	.	.	.	.	0	0	0	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhinobatos cemiculus (12; 9,464.0)	0	0	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.
Sarda sarda ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sardina pilchardus (26,605; 24,382.2)	.	.	.	X	.	.	.	.	.	.	.	.	.	.	X	X	X	X	X	X	X	X	X	.	.	.	.	.	.	.	.	.	.	.
Sardinella aurita (8,396; 58,252.9)	X	X	.	.	X	.	.	X	X	X	X	.	.	0	0	X	X	X	.	0	.	.	0	0	.	.	X	X	X	X	0	0	0	0	0
Sardinella maderensis (236; 2,934.4)	X	0	.	.	0	0	0	0	X	0	0	.	.	0	0	.	.	.	0	X	.	.	.	X	.	.	.	.	.	0	0	0	0	0
Saurida undosquamis[e] (1,133; 36,437.5)	.	X	0	.	.	0	X	0	X	.	.	X	X	X	X	X	.	.	X	0	.	0	.	X	.	.	.	.	.	.	0	.	0
Sciaena umbra (2; 32.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																																
	10-10-63	26-10-63	07-11-63	28-11-63	05-12-63	20-12-63	03-01-64	20-01-64	07-02-64	26-02-64	04-03-64	19-03-64	01-04-64	15-04-64	23-04-64	08-05-64	14-05-64	29-05-64	09-06-64	24-06-64	01-07-64	09-07-64	15-07-64	20-07-64	27-07-64	03-08-64	10-08-64	17-08-64	24-08-64	31-08-64	14-09-64	25-09-64
Scomber japonicus colias (1,336; 3,039.8)	.	.	.	.	.	.	.	.	.	.	.	0	0	0	0	X	0	X	0	X	0	0	X	.	.	.	.	.	.	.	.	.
Scyris alexandrinus (72; 6,228.0)	X	.	0	.	.	X	X	.	.	0	0	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0	0	X	X	0
Seriola dumerili (782; 81,598.5)	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	X	X	X	X	X	X	X	X	.
Serranus cabrilla (54; 368.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0	.	X	.	.	.	.	.	.	.	0	.	.	.	.
Serranus hepatus ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Serranus scriba (3; 95.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
Siganus luridus[e] (72; 694.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	0	.	0	0	.	.	.	.
Siganus rivulatus[e] (15,878; 39,544.5)	.	.	.	.	.	.	.	.	.	.	.	0	.	0	.	.	.	X	0	X	.	.	X	.	X	X	0	X	X	.	X	0
Sparisoma cretense ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sparus auratus (3; 318.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	0	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphoeroides spadiceus[e] (19; 2,703)	X	.	.	.	.	0	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.
Sphyraena sp. (702; 7,451.4)	.	.	0	0	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	0	0	X	X	.	0	.	.	.	X	.	.	.
Sphyraena chrysotaenia[e] (638; 29,923.0)	X	.	.	0	X	X	X	.	.	X	X	0	X	.	.	0	X	.	.	X	0	0	X	X	.	0	.	.	.	0	.	.	.
Spicara maena ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																																			
	10-10-63	26-10-63	07-11-63	28-11-63	05-12-63	20-12-63	03-01-64	20-01-64	07-02-64	26-02-64	04-03-64	19-03-64	01-04-64	15-04-64	23-04-64	08-05-64	14-05-64	29-05-64	09-06-64	24-06-64	01-07-64	09-07-64	15-07-64	20-07-64	27-07-64	03-08-64	10-08-64	17-08-64	24-08-64	31-08-64	14-09-64	25-09-64
Spicara smaris (See *S. chryselis*)	.	.	.	.	.	.	.	.	0	.	.	.	0	.	0	-	0	-	0	-	X	-	.	-	X	-	.	.	-	X	-	0	-	X	.	.
Spicara chryselis (2,475; 4,934.9)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spondyliosoma cantharus (73; 769.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	X	.	.	0	.	X	.	.
Stephanolepis diaspros[e] (157; 1,623.6)	.	.	.	.	.	0	-	X	.	.	.	.	0	-	0	-	.	-	X	.	.	.	.	.	X	-	0	-	0	-	X	-	X	-	.	-	X	-	0
Stromateus fiatola ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trachurus mediterraneus (12,294; 39,351.6)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	-	X	-	X	-	X	-	X	-	X	.	.	.	X	-	0	.	.
Trachurus trachurus (1,051; 3,210.1)	.	.	.	.	.	.	.	.	.	.	0	-	X	-	0	-	X	-	X	-	.	-	0	-	X	.	.	.	.	.	.	.	.	.	.	.	.
Trachinus draco (16; 116.5)	.	.	.	.	.	0	.	.	0	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trachinus vipera (12; 37.9)	.	.	.	.	.	0	.	0	-	0	-	0	-	0	-	0	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trachinotus glaucus (333; 4,241.8)	X	-	0	.	.	X	.	.	X	-	0	-	0	-	0	-	0	.	0	.	.	.	.	.	0	.	0	-	0	-	.	-	0	-	X	-	X	-	X
Trichiurus lepturus (262; 6,909.3)	X	.	.	.	X	.	.	0	-	X	-	.	-	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.
Trigla hirundo (719; 8,222.6)	.	.	.	.	.	.	.	X	.	.	.	.	0	-	X	-	X	-	X	-	0	-	X	-	X	-	X	-	.	-	X	.	.	.	.	.	0
Tylosurus acus[e] (38; 10,159.5)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	0	.	.	X	.	.	.
Umbrina cirrosa (46; 657.5)	X	-	0	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	0	.	.

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																																					
	10-10-63	26-10-63	07-11-63	28-11-63	05-12-63	20-12-63	03-01-64	20-01-64	07-02-64	26-02-64	04-03-64	19-03-64	01-04-64	15-04-64	23-04-64	08-05-64	14-05-64	29-05-64	09-06-64	24-06-64	01-07-64	09-07-64	15-07-64	20-07-64	27-07-64	03-08-64	10-08-64	17-08-64	24-08-64	31-08-64	14-09-64	25-09-64
Upeneus moluccensis[e] (163; 3,097.1)	.	0	.	.	.	.	.	.	.	.	.	.	.	X	-	X	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
Upeneus asymmetricus[e] (953; 7,494.0)	X	-	X	-	X	-	X	-	.	.	-	X	-	X	-	0	-	X	.	.	0	-	0	-	0	.	.	.	X	-	0	.	.	.	.	.	0	.	0	-	X	-	0	-	X	-	X
Uranoscopus scaber ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Xyrichthys novacula (45; 1,293.0)	.	.	X	-	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Number of species in sample[a c]	27	24	17	15	20	25	21	25	32	14	17	19	23	30	22	16	23	28	31	34	20	32	31	18	30	27	23	30	29	32	19	20						
Number of links between catches[b c]	17	12	13	11	15	17	14	20	14	11	9	13	17	16	16	16	19	24	23	27	27	24	18	19	17	18	19	21	24	18	15							

a. Average number of species per catch = 24.1.

b. Average number of links between catches or 'continuity' = 17.4.

c. Average number of links between catches divided by average number of species per catch = 0.72 = 'coefficient of continuity'.

d. Due to misidentification *S. chryselis* has been included with *S. smaris* above.

e. A Red Sea immigrant.

Table IV — Fishes occurring in seine catches in St. George Bay, Lebanon, beginning 08-10-64 and ending 23-09-65. Circles signify less than 10 fish per catch while X's indicate 10 or more. Linkages are drawn between adjacent symbols and between alternate X's and linked circles.

SPECIES (Number; wt. in grams)	Date of Collection																														
	08-10-64	28-10-64	04-11-64	02-12-64	16-12-64	29-12-64	14-01-65	28-01-65	11-02-65	24-02-65	10-03-65	17-03-65	31-03-65	14-04-65	21-04-65	05-05-65	12-05-65	02-06-65	09-06-65	16-06-65	23-06-65	30-06-65	07-07-65	15-07-65	18-07-65	04-08-65	11-08-65	25-08-65	01-09-65	08-09-65	23-09-65
Argyrosomus regius (42; 8,290.0)	.	.	.	.	0	-	0	-	X	-	X	-	X	-	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ariosoma balearica (75; 1,018.0)	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Atherina hepsetus ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Atherina mochon (4; 14.5)	.	.	.	.	.	.	.	.	0	.	.	0	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Atule djeddaba[e] (5; 116.0)	.	.	.	.	0	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Auxis thazard (200; 5,700.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.
Balistes capriscus (22; 1,354.0)	0	.	.	.	.	.	.	.	.	0	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
Belone belone ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Blennius sanguinolentus (29; 579.2)	.	.	.	.	.	.	.	.	0	-	X	-	0	-	0	.	0	.	.	.	0	.	.	X	.	.	.	.	.	.	.	.	.
Boops boops (5,807; 54,051.6)	X	.	.	0	.	.	0	-	X	-	X	-	X	.	.	.	0	-	X	.	.	X	-	X	-	X	-	0	-	0	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X
Boops salpa (5; 95.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.
Bothus podas (230; 3,934.9)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	X	.	.	X	-	.	-	X	-	X	-	X	-	X	-	X	.
Caecula imberbis (3; 83.9)	0	.	.	.	.	.	.	.	.	0	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																														
	08-10-64	28-10-64	04-11-64	02-12-64	16-12-64	29-12-64	14-01-65	28-01-65	11-02-65	24-02-65	10-03-65	17-03-65	31-03-65	14-04-65	21-04-65	05-05-65	12-05-65	02-06-65	09-06-65	16-06-65	23-06-65	30-06-65	07-07-65	15-07-65	18-07-65	04-08-65	11-08-65	25-08-65	01-09-65	08-09-65	23-09-65
Callionymus filamentosus[e] (89; 559.2)	.	X	-	0	-	X	-	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	0	.	.	X	-	X	-	X	.	.	.
Caranx fusus (407; 150,057.1)	X	-	X	-	X	-	X	-	X	.	0	.	X	-	0	.	.	.	.	.	.	.	X	-	.	-	X	.	.	.	.	.	.	0	-	X	-	X	-	X
Caranx rhonchus (849; 10,468.0)	X	-	X	-	X	-	X	-	X	-	0	-	0	-	0	-	X	-	X	.	.	.	0	-	0	-	0	-	X	-	X	.	.	X	-	X
Chauliodus sloanei ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Coris julis (14; 20.9)	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crenilabrus cinereus ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dactylopterus volitans (42; 1,439.7)	0	-	0	-	.	-	X	.	.	.	.	.	X	-	.	-	X	.	0	.	.	0	.	.	0	-	0	.	.	0	.	.	.	.	.	.	.
Dasyatis pastinaca (1; 184.0)	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dentex dentex (84; 3,088.5)	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	0	.	.	.	.	X	.	.	X	-	X	.	.
Dentex gibbosus (11; 460.5)	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.
Dicentrarchus labrax (7; 111.0)	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicentrarchus punctatus (20; 297.5)	.	.	.	.	.	X	.	.	.	0	.	.	.	.	.	.	.	.	.	0	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.
Diplodus annularis (57; 411.3)	0	-	0	.	.	.	.	.	.	.	.	0	.	.	.	.	0	.	.	0	.	.	.	.	.	.	.	.	X	.	.	X
Diplodus sargus (3,545; 26,238.2)	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																																
	08-10-64	28-10-64	04-11-64	02-12-64	16-12-64	29-12-64	14-01-65	28-01-65	11-02-65	24-02-65	10-03-65	17-03-65	31-03-65	14-04-65	21-04-65	05-05-65	12-05-65	02-06-65	09-06-65	16-06-65	23-06-65	30-06-65	07-07-65	15-07-65	18-07-65	04-08-65	11-08-65	25-08-65	01-09-65	08-09-65	23-09-65
Diplodus trifasciatus (28; 152.5)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	-	0	.	.	X	.	.	.	.	.	.	.	.
Diplodus vulgaris (18; 124.5)	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	0	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.
Dussumieria acuta[e] (341; 9,127.6)	.	.	.	.	0	.	X	-	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Echeneis naucrates (38; 4,024.5)	0	-	0	-	0	.	.	.	.	.	.	.	.	.	0	-	0	-	0	.	.	0	-	0	.	.	0	-	0	-	X	.	.	.
Engraulis encrasicholus (7,901; 8,947.3)	X	-	X	-	0	-	X	-	X	-	.	.	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X
Epinephelus aeneus (633; 30,345.9)	X	-	X	-	0	-	X	-	X	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0
Epinephelus alexandrinus (8; 73.4)	0	-	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.
Epinephelus guaza (4; 56.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.
Euthynnus alletteratus (2,388; 154,828.0)	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	-	0	-	X	-	X	-	X	-	0	-	X	-	X	.	.
Gobius niger jozo (241; 2,577.1)	0	-	0	.	.	.	0	.	.	.	X	-	.	-	X	-	0	-	0	.	.	0	-	0	-	.	-	0	-	0	-	.	-	X	-	X	.	.	.	.
Hemiramphus far[e] (45; 2,199.5)	.	0	.	.	.	0	.	0	-	0	-	X	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	0	.
Hyporhamphus cf. *dussumieri*[e] (2; 26.0)	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hyporhamphus picarti (5; 35.0)	.	.	.	.	0	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leiognathus klunzingeri[e] (1,430; 5,094.9)	X	-	0	-	.	-	X	-	X	-	0	-	0	-	X	-	.	-	X	-	X	-	X	-	X	-	X	-	X	-	0	-	X	.	.	.	.	.	.	X

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																														
	08-10-64	28-10-64	04-11-64	02-12-64	16-12-64	29-12-64	14-01-65	28-01-65	11-02-65	24-02-65	10-03-65	17-03-65	31-03-65	14-04-65	21-04-65	05-05-65	12-05-65	02-06-65	09-06-65	16-06-65	23-06-65	30-06-65	07-07-65	15-07-65	18-07-65	04-08-65	11-08-65	25-08-65	01-09-65	08-09-65	23-09-65
Lichia amia (136; 25,849.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	0	-	0	.	.	0	.	.	X	-	.	-	X	-	X	-	X
Lithognathus mormyrus (2,550; 30,510.2)	X	-	0	-	0	-	X	-	X	-	0	-	X	-	X	-	X	-	0	-	.	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X
Lobotes surinamensis (1; 26.6)	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merluccius merluccius ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mugil auratus (201; 6,129.0)	.	.	.	.	0	-	X	.	0	.	X	.	.	.	0	.	0	.	0	-	X	-	X	-	X	-	X	0	-	0	.	.	.	.	.	0	.
Mugil cephalus (136; 25,928.0)	.	X	-	X	-	.	-	0	-	X	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mugil saliens (9; 721.5)	.	.	.	.	.	0	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mullus barbatus (6,608; 67,509.8)	X	-	.	-	X	-	X	-	X	-	.	-	X	-	X	.	.	.	.	.	.	0	.	X	-	X	-	X	.	.	.	.	.	.	.	.	.
Mullus surmuletus (1,138; 7,160.6)	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	-	X	-	X	-	X	-	X	.	.	.	X	-	X	-	X	-	X	-	.	-	X
Mycteroperca rubra (20; 185.5)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	-	0	.	.	.	.	.	.
Oblada melanura (20; 21.5)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	0	.	.	.	.	.	.	.	.	.	.	.
Orcynopsis unicolor (14; 8,427.0)	.	.	.	0	.	.	0	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pagellus acarne (1,443; 12,676.1)	.	.	.	.	.	.	.	.	.	.	0	-	0	-	X	-	0	-	X	-	0	-	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pagellus erythrinus (28,444; 180,593.4)	X	-	X	.	0	.	.	.	.	.	0	-	X	-	X	-	X	-	.	-	X	.	.	X	-	0	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X

SPECIES (Number; wt. in grams)	Date of Collection																																
	08-10-64	28-10-64	04-11-64	02-12-64	16-12-64	29-12-64	14-01-65	28-01-65	11-02-65	24-02-65	10-03-65	17-03-65	31-03-65	14-04-65	21-04-65	05-05-65	12-05-65	02-06-65	09-06-65	16-06-65	23-06-65	30-06-65	07-07-65	15-07-65	18-07-65	04-08-65	11-08-65	25-08-65	01-09-65	08-09-65	23-09-65
Pagrus auriga (51; 1,875.5)	.	.	.	.	.	.	.	.	.	.	.	0	.	.	0	.	.	X	.	.	X	.	.	.	X	.	.	.	0	.	.
Pagrus ehrenbergi (3,973; 65,999.8)	X	-	X	-	0	-	X	.	.	.	X	-	X	-	.	-	X	-	X	.	.	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	X
Pagrus pagrus (50; 514.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	-	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
Panturichthys fowleri ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Parexocoetus mento[e] (42; 55.4)	.	0	-	0	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X
Pomadasys incisus (1,329; 7,039.4)	.	.	0	-	X	-	.	-	X	-	X	-	X	-	X	.	.	0	.	0	.	.	.	.	.	X	.	.	.	0	-	X
Pomatomus saltator (42; 840.5)	.	.	.	X	-	.	-	X	-	0	-	0	-	X	.	.	0	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.
Puntazzo puntazzo ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhinobatos cemiculus (27; 5,050.1)	0	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	0	-	X	-	0	.
Sarda sarda (5; 4,994.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sardina pilchardus (15,881; 30,897.0)	.	.	.	0	-	0	.	0	.	.	.	.	X	-	X	-	X	-	X	-	X	-	.	-	X	-	X	-	X	.	.	.	.	.
Sardinella aurita (24,409; 104,807.4)	X	-	X	-	X	-	X	-	X	-	0	-	X	-	X	-	X	-	X	-	X	-	X	-	X	-	.	-	X	-	X	.	.	X
Sardinella maderensis (773; 30,629.9)	.	X	-	0	-	X	-	X	-	X	-	.	-	X	-	0	.	.	.	.	.	.	.	.	0	-	0	-	0	-	0	.	.	.
Saurida undosquamis (88; 3,755.3)	.	0	.	.	.	.	.	.	.	.	X	-	X	-	X	-	0	-	X	.	.	0	.	.	0	.	.	.	X	.	.	.	.	.

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																														
	08-10-64	28-10-64	04-11-64	02-12-64	16-12-64	29-12-64	14-01-65	28-01-65	11-02-65	24-02-65	10-03-65	17-03-65	31-03-65	14-04-65	21-04-65	05-05-65	12-05-65	02-06-65	09-06-65	16-06-65	23-06-65	30-06-65	07-07-65	15-07-65	18-07-65	04-08-65	11-08-65	25-08-65	01-09-65	08-09-65	23-09-65
Sciaena umbra ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scomber japonicus colias (410; 749.2)	.	.	.	.	.	.	.	.	.	.	.	.	.	0	-	0	-	X	-	X	-	0	-	0	-	0	.	0	.	.	.	.	.
Scyris alexandrinus (440; 8,675.9)	0	-	.	-	X	-	X	.	.	.	X	.	0	.	.	.	.	.	.	.	.	.	0	-	0	-	X	-	X	-	X	-	X	-	X	-	X
Seriola dumerili (144; 15,661.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	-	X	-	0	-	X	-	X	.	.
Serranus cabrilla (1; 12.0)	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Serranus hepatus (7; 12.5)	0	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	0	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.
Serranus scriba ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.
Siganus luridus (24; 253.0)	0	-	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Siganus rivulatus (6,330; 20,623.5)	X	-	X	-	.	-	0	-	0	-	0	.	.	X	-	X	-	X	-	0	-	0	.	.	X	-	0	-	X	-	X	-	X	-	0	-	X
Sparisoma cretense (2; 148.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sparus auratus (50; 1,607.4)	.	.	.	0	.	.	.	.	.	.	.	0	.	0	-	0	.	.	0	.	.	0	.	0	-	0	-	X	-	X	-	-	X	.	.	.
Sphoeroides spadiceus[e] (155; 6,181.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	-	0	-	-	X	-	-	X
Sphyraena sp. (1,144; 107,395.0)	0	-	0	-	0	-	0	-	X	-	X	-	X	-	X	0	-	X	-	X	-	0	-	X	-	X	-	0	-	X	.	.	.	.	0	-	X
Sphyraena chrysotaenia[e] (3,444; 82,913.0)	0	-	0	-	0	-	X	-	X	-	X	-	X	-	X	-	X	0	.	.	.	.	.	.	.	0	-	0	-	0	-	X	.	.	.	.	X

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																																	
	08-10-64	28-10-64	04-11-64	02-12-64	16-12-64	29-12-64	14-01-65	28-01-65	11-02-65	24-02-65	10-03-65	17-03-65	31-03-65	14-04-65	21-04-65	05-05-65	12-05-65	02-06-65	09-06-65	16-06-65	23-06-65	30-06-65	07-07-65	15-07-65	18-07-65	04-08-65	11-08-65	25-08-65	01-09-65	08-09-65	23-09-65
Spicara maena (14; 89.6)	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spicara smaris (430; 220.0)	X	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Spicara chryselis (1,879; 3,983.4)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	X	X	.	0	X	.	.	X	.	.	.	0	X
Spondyliosoma cantharus ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stephanolepis diaspros[e] (430; 3,570.2)	X	X	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	0	X	X	X	X	X	X	.	.
Stromateus fiatola (6; 98.0)	.	.	.	.	.	0	.	0	.	0	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trachurus mediterraneus (9,989; 48,554.2)	.	.	.	0	.	.	0	X	.	.	X	0	X	X	X	X	.	.	X	X	X	X	X	X	0	X	X	0	.	.	X	X
Trachurus trachurus (151; 1,052.0)	.	.	.	.	.	.	.	.	.	.	.	0	0	0	X	0	X	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.
Trachinus draco ( )	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trachinus vipera (34; 124.7)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	0	.	0	.	.	.	.	.	.	.	.	.
Trachinotus glaucus (1,385; 9,683.0)	X	.	.	X	X	0	X	0	0	X	0	.	.	.	.	.	.	.	.	.	0	.	X	X	.	.	X	X	X	0	0	X
Trichiurus lepturus (564; 2,412.8)	.	.	.	.	X	X	0	0	0	X	0	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trigla hirundo (298; 2,412.8)	0	0	.	.	.	.	.	0	.	0	X	X	X	X	X	.	0	X	X	.	0	.	.	.	.	.	.	.	.	.	.	X
Tylosurus acus[e] (3; 1,825.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	0	.	.

(follows)

SPECIES (Number; wt. in grams)	Date of Collection																																					
	08-10-64	28-10-64	04-11-64	02-12-64	16-12-64	29-12-64	14-01-65	28-01-65	11-02-65	24-02-65	10-03-65	17-03-65	31-03-65	14-04-65	21-04-65	05-05-65	12-05-65	02-06-65	09-06-65	16-06-65	23-06-65	30-06-65	07-07-65	15-07-65	18-07-65	04-08-65	11-08-65	25-08-65	01-09-65	08-09-65	23-09-65
Umbrina cirrosa (49; 890.0)	X	-	.	-	0	-	X	-	X	-	X	.	.	0	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	0	.	.	0	.				
Upeneus moluccensis[e] (3,005; 17,243.4)	X	-	X	-	X	-	X	.	.	.	.	.	.	.	.	X	.	0	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.				
Upeneus asymmetricus[e] (2,872; 11,078.0)	X	-	X	-	0	-	X	.	.	X	-	X	.	.	X	-	X	-	0	-	X	.	.	.	.	.	.	.	.	X	-	X	-	0	-	X	-	0	-	X
Uranoscopus scaber (20; 388.0)	.	0	.	.	.	.	.	.	.	.	.	.	.	X	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Xyrichthys novacula (4; 142.0)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.				
Number of species in sample[a c]	35	32	23	30	25	23	22	26	21	28	20	24	19	30	23	10	17	29	23	23	30	16	26	32	27	28	25	26	22	23	28							
Number of links between catches[a b]	27	23	22	19	20	15	19	17	17	16	17	17	17	19	10	10	9	16	15	17	13	14	20	22	22	23	21	21	16	19								

a. Average number of species per catch = 24.6.

b. Average number of links between catches = 17.6.

c. Average number of links between catches divided by average number of species per catch = 0.72 = 'coefficient of continuity'.

e. A Red Sea immigrant.

Table V — Indgram values[a] for 26 species of fishes taken by shore seine during 1963-1964 and 1964-1965, in St. George Bay, Lebanon.

Scientific Name	Number of Indgrams[a]	
	1963-1964 I	1964-1965 II
Pagellus erythrinus	37,848.89	69,863.63
Sardina pilchardus	30,553.21	22,003.17
Trachurus mediterraneus	21,938.56	15,136.68
Siganus rivulatus	21,148.64	10,331.01
Sardinella aurita	19,382.13	42,965.37
Euthynnus alletteratus	14,730.61	17,321.89
Engraulis encrasicholus	14,281.01	8,120.65
Mullus barbatus	12,149.38	19,722.82
Boops boops	11,268.04	16,147.02
Lithognathus mormyrus	9,471.70	7,601.67
Pagrus ehrenbergi	9,319.57	14,507.65
Pomadasys incisus	7,784.74	3,058.65
Saurida undosquamis	5,695.96	564.49
Sphyraena chrysotaenia	4,108.84	14,414.64
Spicara chryselis & S. smaris	3,494.84	3,115.39
Caranx fusus	3,284.30	2,236.03
Dentex dentex	3,248.28	433.09
Upeneus asymmetricus	2,672.41	5,640.57
Epinephelus aeneus	2,557.78	4,017.17
Sphyraena sp.	2,151.31	10,908.87
Trachurus trachurus	1,836.79	398.56
Pagellus acarne	1,253.22	4,276.87
Trachinotus glaucus	1,188.49	3,662.10
Sardinella maderensis	733.47	4,982.82
Upeneus moluccensis	711.77	6,797.87
Diplodus sargus	665.55	9,222.57
Totals	243,479.49	317,451.25
X[b]	243,479.49 X =	317,451.25
	X =	1.30

a. The indgram value equals the square root of the product of the individual sample weights in grams times the number of individuals in each sample.

b. In that the number of catches for the two years were not the same the figures of Column (I) may be multiplied by 1.30 for better comparison with the data of Column (II).

Table VI — Quotients of the larger annual catch by numbers of individuals[a] divided by the smaller for 1963-1964 and 1964-1965, St. George Bay, Lebanon. The numbers of individuals for 1964-1965 were adjusted prior to calculation by multiplying by 1.06.

Scientific Name	Quotients
Upeneus moluccensis	17.39
Saurida undosquamis	13.64
Diplodus sargus	12.25
Dentex dentex	10.59
Trachurus trachurus	7.38
Sphyraena chrysotaenia	5.09
Pomadasys incisus	4.86
Trachinotus glaucus	3.92
Pagellus acarne	3.26
Sardinella maderensis	3.09
Mullus barbatus	2.95
Upeneus asymmetricus	2.84
Sardinella aurita	2.74
Siganus rivulatus	2.66
Engraulis encrasicholus	2.40
Pagrus ehrenbergi	1.89
Lithognathus mormyrus	1.85
Sardina pilchardus	1.78
Epinephelus aeneus	1.65
Pagellus erythrinus	1.58
Sphyraena sp.	1.54
Caranx fusus	1.36
Trachurus mediterraneus	1.30
Euthynnus alletteratus	1.17
Boops boops	1.16
Spicara chryselis & S. smaris	1.14

a. See these values in Table I.

Table VII — Quotients of the larger annual sample by weight in grams[a] divided by the smaller for 1963-1964 and 1964-1965 for 26 species of fish taken by shore seine in St. George Bay, Lebanon. The weights for 1963-1964 were adjusted prior to calculation by multiplying by 1.32.

Scientific Name	Quotients
Saurida undosquamis	12.81
Diplodus sargus	11.55
Sphyraena sp.	10.92
Sardinella maderensis	7.91
Dentex dentex	6.06
Upeneus moluccensis	4.22
Trachurus trachurus	4.03
Pagellus acarne	2.56
Siganus rivulatus	2.53
Caranx fusus	2.47
Euthynnus alletteratus	2.42
Mullus barbatus	2.23
Sphyraena chrysotaenia	2.10
Pomadasys incisus	1.87
Engraulis encrasicholus	1.75
Trachinotus glaucus	1.73
Spicara chryselis & S. smaris	1.55
Pagellus erythrinus	1.51
Boops boops	1.42
Sardinella aurita	1.36
Lithognathus mormyrus	1.21
Epinephelus aeneus	1.16
Upeneus asymmetricus	1.12
Trachurus mediterraneus	1.07
Sardina pilchardus	1.04
Pagrus ehrenbergi	1.01

a. See these values in Table II.

Table VIII — Quotients of the larger sums of indgram values[a] divided by the smaller[b] for 1963-1964 and 1964-1965 for 26 species of fish taken by shore seine in St. George Bay, Lebanon. The indgram values for 1963-1964 were adjusted by multiplying by 1.30 prior to calculation.

Scientific Name	Quotient
Saurida undosquamis	13.12
Diplodus sargus	10.66
Dentex dentex	9.75
Upeneus moluccensis	7.35
Trachurus trachurus	5.99
Sardinella maderensis	5.23
Sphyraena sp.	3.91
Pomadasys incisus	3.31
Sphyraena chrysotaenia	2.70
Siganus rivulatus	2.66
Pagellus acarne	2.63
Trachinotus glaucus	2.37
Engraulis encrasicholus	2.29
Caranx fusus	1.91
Trachurus mediterraneus	1.88
Sardina pilchardus	1.81
Sardinella aurita	1.71
Upeneus asymmetricus	1.62
Lithognathus mormyrus	1.62
Spicara chryselis & S. smaris	1.46
Pagellus erythrinus	1.42
Mullus barbatus	1.25
Epinephelus aeneus	1.21
Pagrus ehrenbergi	1.20
Euthynnus alletteratus	1.11
Boops boops	1.10

a. Indgram value equals the square root of the product of the total weight in grams times the number of individuals.

b. See these values in Table V.

Table IX — Numbers, total lengths and weights of *Euthynnus alletteratus* for late June and July for 1963, 1964 and 1965 illustrating the disappearance and appearance, respectively, of larger and smaller individuals.

Date	Total Length Interval (in mm)	Mean Total Length (in mm)	Number
26-06-63	421-436	429	3
19-07-63	85-88	87	1
14-08-63	113-220	179	53
24-06-64	573-608	591	13
09-07-64	61-108	81	50
15-07-64	97-144	119	1,296
30-06-65	473-520	506	20
07-07-65	49-96	80	12
15-07-65	81-116	96	20
28-07-65	125-212	160	2,236

Table X — Mean total lengths for a series of samples of *Pagellus erythrinus* taken in 1964 and 1965, St. George Bay, Lebanon, illustrating increase in total length after the spring spawning.

Date of Sample	Number of Individuals in Sample	Mean Total Length (in mm)
29-05-64	55	39
09-06-64	115	42
24-06-64	102	53
01-07-64	31	57
09-07-64	98	59
15-07-64	98	63
20-07-64	125	72
27-07-64	100	74
03-08-64	100	75
02-06-65	100	38
09-06-65	74	49
16-06-65	100	47
23-06-65	40	55
30-06-65	100	61
07-07-65	98	62
15-07-65	50	67
28-07-65	57	76
11-08-65	43	77
25-08-65	40	79
01-09-65	20	83
08-09-65	35	87

REFERENCES CITED

Bavay A. - 1898 - Note sur les mollusques du canal de Suez. - *Bull. Soc. Zool., France*, 23: 1-161.

Ben-Tuvia A. - 1953 a - Mediterranean fishes of Israel. - *Bull. Sea Fish Res. Sta., Haifa*, No. 8, 40 p.

Ben-Tuvia A. - 1953 b - New erythraean fishes from the Mediterranean coast of Israel. - *Nature*, 172: 464-465.

Ben-Tuvia A. - 1955 - Two Indo-Pacific fishes. *Dasyatis uarnak* and *Upeneus moluccensis*, in the Eastern Mediterranean. - *Nature*, 176 (4494): 1177-1178.

Ben-Tuvia A. - 1960 - Synopsis on the systematics and biology of *Sardinella maderensis* (Lowe). - *FAO Fish Biol. Syn.* No. 19: 497-519.

Ben-Tuvia A. - 1964 - Two siganid fishes of Red Sea origin in the Eastern Mediterranean. - *Bull. Sea. Fish. Res. Sta., Haifa*, No. 37, 10 p.

Ben-Tuvia A. - 1966 - Red Sea fishes recently found in the Mediterranean. - *Copeia* (2): 254-275.

Chabanaud P. - 1933 - Sur divers poissons de la mer Rouge et du canal de Suez. - *Bull. Inst. Oceanogr.* 627: 1-12.

Emery K.O. and D. Neev. - 1960 - Mediterranean beaches of Israel. - *Israel Geol. Surv. Bull.*, No. 26, 23 p.

Emery K.O. and C.J. George - 1963 - The shores of Lebanon. - *Misc. Pap. Nat. Sci., Amer. Univ. Beirut*, No. 1, 10 p.

Fuchs T. - 1878 - Die geolog. Beschaffenheit der Landenge von Suez. - *Denkzchr. d. k. Akad. Wiss., Wien, Math. Naturw. Cl.*, 38 (2): 1-25.

George C.J., V. Athanassiou and I. Boulos - 1964 - The fishes of the coastal waters of Lebanon. - *Misc. Pap. Nat. Sci. Amer. Univ. Beirut.*, No. 4, 27 p.

George C.J. and V. Athanassiou - 1965 - On the occurrence of *Scomberomorus commersoni* (Lacépède) in St. George Bay, Lebanon. - *Doriana*, IV (157): 1-4.

George C.J. and V. Athanassiou - 1966 - Observations on *Upeneus asymmetricus* Lachner, 1954, (Pisces) in St. George Bay, Lebanon. - *Ann. Mus. Storia Nat. Genova*, LXXVI: 68-74.

Gohar H.A.F. - 1954 - The place of the Red Sea between the Indian Ocean and the Mediterranean. - *Publ. Hydrobiol. Res. Inst., Fac. Sci., Univ. Istanbul*, Series B., 2 (213): 47-81.

Gruvel A. - 1929 - De l'influence du percement du canal de Suez sur la faune marine des cotes de Syrie. - *Compt. Rendu Acad. Sci. Paris*, 188: 1697-1699.

Gruvel A. - 1931 - Les Etats de Syrie: Richesses marines et fluviales: exploitation actuelle avenir. - Soc. d'Editions Geogr., Mar. Col., Paris, 453 p.

Gruvel A. - 1936 - Contribution à l'étude de la bionomie générale et de l'exploitation de la faune du canal de Suez. - *Mem. Inst. d'Egypte*, 29: 1-255.

Haas G. and H. Steinitz - 1947 - Erythraean fishes on the Mediterranean coast of Palestine. - *Nature*, 160: 28.

Halim Y. - 1960 - Observations on the Nile bloom of phytoplankton in the Mediterranean. - *Jour. Cons. Inst. Expl. Mer.*, 26 (1): 57-67.

Hornell J. - 1935 - Report on the fisheries of Palestine. - Crown Agents for the Colonies, London, 106 p.

Jordan D.S. and C.L. Hubbs - 1917 - Notes on a collection of fishes from Port Said, Egypt. - *Annal. Carnegie Mus.*, 11 (18): 461-468.

KELLER C. - 1883 - Die Fauna im Suez Canal und die Diffusion der Mediterranean und Erythräischen Tierwelt. - *Neme Denkschr. Schweiz. Ges. Natwiss.*, 28 (ser. 3, Vol. 8) (3.1): 1-39.

KOSSWIG C. - 1950 - Erythräische Fische im Mittelmeer und der Grenze der Ägäis. - Syllegomena biologica Festschrift Kleinschmidt Lutherstadt Witternberg, 203-212.

KRAUSS W. - 1958 - Eine Bemerkung zur Abnahme des Salzgehaltes im Suezkanal. - *Stsch. Hydrog. Z.*, 11 (3): 109-112.

LIEBMAN E. - 1935 - Oceanographic observations on the Palestine coast. - *Comm. Intern. Expl. Sci. Mer. Medit.: Rapp. Proc. Verbaux*, 9: 181-185.

MC GILL D.A. - 1960 - A preliminary study of the oxygen and phosphate distribution in the Mediterranean Sea. - *Deep Sea Res.*, 7: 259-269.

MORCOS S.A. - 1960 - Die Verteilung des Solzgehaltes im Suez Canal. - Kieler Meeresforsch, 16 (1): 133-154.

NORMAN J.R. - 1927 - Report on the fishes, zoological results of the Cambridge Expedition to the Suez Canal, 1924. - *Trans. Zool. Soc. London*, 22, 3 (12): 375-390.

NORMAN J.R. - 1929 - Note on the fishes of the Suez Canal. - *Proc. Zool. Soc. London*, 615-616.

OREN O.H. and B. KOMAROVSKY - 1961 - The influence of the Nile flood on the shore waters of Israel. - *Rapp. Proc. reunions. C.I.E.S.M.M.*, 16 (3): 655-659.

STEINITZ W. - 1929 - Die Wanderung indopazifischer Arten ins Mittelmeer seit Beginn der Quartärperiode. - *Int. Rev. ges. Hydrob.*, 22: 1-90.

STEWR A. - 1935 - The fishery grounds near Alexandria. I. Preliminary Report. - *Fish. Res. Direct. Egypt. Not. Mem.* 8.

TILLIER J.D. - 1902 - Le canal de Suez et sa faune ichtyologique. - *Mem. Soc. Zool. France*, 14: 279-318.

TILLIER L. et BAVAY A. - 1905 - Les mollusques testacés du Canal de Suez. - *Bull. Soc. Zool. France*, 30: 1-170.

TILLIER L. et BAVAY A. - 1906 - Au sujet des mollusques testacés du Canal de Suez. - *Bull. Soc. Zool. France*, 31: 1-129.

TORTONESE E. - 1947 - Biologia del Canale di Suez. *Hist. Nat., Rome*, 2: 41-44.

TORTONESE E. - 1948 - Ricerche zoologiche nel Canale di Suez e dintorni. II. Pesci. - *Arch. Zool. Ital.*, 33: 275-292.

TORTONESE E. - 1951 - I caratteri biologici del Mediterraneo orientale e i problemi relativi. - *Arch. Zool. Ital.*, 36 suppl.: 207-251.

TORTONESE E. - 1952 - Gli Hemirhamphidae del Mediterraneo (Pisces Synentognathi). - *Boll. Ist. Mus. Zool. Univ. Torino*, 30 (3): 1-8.

TORTONESE E. - 1952 - Some field notes on the fauna of the Suez Canal (Timsah and Bitter Lakes). - *Hidrobiologi* 1 (1): 1-6.

TORTONESE E. - 1953 - Su alcuni pesci Indo-Pacifici immigrati nel Mediterraneo Orientale. - *Boll. Zool.*, 29 (4-6): 73-81.

TORTONESE E. - 1964 - The main biogeographical features and problems of the Mediterranean fish fauna. - *Copeia*, 1964 (1): 98-107.

WIMPENNY R.S. - 1930 - Some hydrographic data from the Suez Canal, 1928-1929. - *Bull. Coastguards Fish Serv.*, No. 1, 7 p.

ABSTRACT

A two year study of the seine fishery and fishes of St. George Bay, Republic of Lebanon, is detailed. The study was begun in the spring of 1963 and concluded in the fall of 1965. 63 catches consisting of 288,000 specimens comprising 101 species and weighing 2.4 metric tons were considered. Data reduction was accomplished by means of the IBM 1401 processing unit and ancillary equipment. The fishery is essentially based on young-of-the-year and 1 year class individuals with the mean weight per fish being about 8.5 g. The seine fishery yield for the St. George Bay area is approximated at 52 metric tons with a daily share value per fisherman being about 95 cents. The mean weight of the catches was 35.1 kg. Of the 101 species collected 51 species were considered 'prominent' on the basis of their seasonal occurrence and 26 of these were considered 'important' and discussed in considerable detail in terms of times of the appearance of young, commercial importance, etc. These 26 species comprise 84.5% of the total weight of all fish taken. For 1963-1964 the average number of species per catch was 24.1 For 1964-1965 the average was 24.6. The continuity of species from one catch was 0.72 or 72%. That is, on the average, 72% of the fish appearing in one catch will appear in the following catch when an approximately two week interval between catches is used.

Of the 101 species taken 16 were of Red Sea origin, supposedly entering the Mediterranean through the Suez Canal. These are *Pranesus pinguis* (Lacépède), *Callionymus filamentosus* Valenciennes, *Atule djeddaba* (Forskål), *Dussumieria acuta* Valenciennes, *Hemiramphus far* (Forskål), *Hyporhamphus* cf. *dussumieri* (Valenciennes), *Sphoeroides spadiceus* (Richardson), *Leiognathus klunzingeri* Linnaeus, *Parexocoetus mento* (Valenciennes), *Saurida undosquamis* (Richardson), *Siganus rivulatus* (Forskål), *Siganus luridus* (Ruppell), *Sphyraena chrysotaenia* Klunzinger, *Stephanolepis diaspros* Fraser-Brunner, *Upeneus moluccensis* Bleeker, and *Upeneus asymmetricus* Lachner. Of these sixteen, five (*Saurida undosquamis*, *Upeneus moluccensis*, *Upeneus asymmetricus*, *Sphyraena chrysotaenia*, and *Siganus rivulatus*) were placed in the 'important' category due to their relatively high contribution in terms of both number and weight to the fishery.

Finally, a technique for the combination of numbers of individuals and weights (in grams) in different samples to produce a single arithmetic term ('indgram') of high ecological significance was explored with certain positive results, namely the ordering of species in terms of their general ecology (i.e. nomadic, demersal, erratic, etc.) when quotients were produced by dividing the larger annual 'indgram' total by the second smaller annual indgram total for the two year study period.

RIASSUNTO

Viene dettagliatamente riferito uno studio biennale della pesca con reti a strascico e dei pesci della baia di S. Giorgio (Libano). Lo studio ebbe inizio nella primavera del 1963 e si concluse nell'autunno del 1965. Furono prese in considerazione 63 catture con un complesso di 288.000 esemplari appartenenti a 101 specie e pesanti 2,4 tonnellate. La elaborazione dei dati fu eseguita per mezzo del calcolatore IBM 1401. La pesca si basa soprattutto su individui giovani dell'anno e aventi un anno di età; il peso medio di ciascun pesce è di circa 8,5 gr. Il rendimento della pesca a strascico nell'area della baia di S. Giorgio è di circa 52 tonnellate, con un guadagno giornaliero di circa 95 centesimi per pescatore. Il peso medio delle catture era di 35,1 Kg. Delle 101 specie raccolte, 51 furono considerate « preminenti » in base alla loro presenza stagionale e 26 di queste furono considerate « importanti » e discusse con notevoli dettagli per ciò che si riferisce alla comparsa dei giovani, importanza commerciale, ecc. Queste 26 specie costituiscono l'84,5% del peso totale di tutti i pesci catturati. Nel 1963-64 il numero medio di specie per cattura fu di 24,1. Nel 1964-65 il numero medio fu 24,6. La continuità delle specie in una cattura fu 0,72 o 72%, cioè in media 72% dei pesci comparsi in una cattura ricompaiono nella cattura successiva se si considera un intervallo di circa 2 settimane tra le catture.

Delle 101 specie catturate, 16 erano originarie del Mar Rosso, ritenute penetrate in Mediterraneo attraverso il Canale di Suez. Queste sono *Pranesus pinguis* (Lacépède), *Callionymus filamentosus* Valenciennes, *Atule djeddaba* (Forskål), *Dussumieria acuta* Valenciennes, *Hemiramphus far* (Forskål), *Hyporhamphus* cf. *dussumieri* (Valenciennes), *Sphoeroides spadiceus* (Richardson), *Leiognathus klunzingeri* Linnaeus, *Parexocoetus mento* (Valenciennes), *Saurida undosquamis* (Richardson), *Siganus rivulatus* (Forskål), *Siganus luridus* (Ruppell), *Sphyraena chrysotaenia* Klunzinger, *Stephanolepis diaspros* Fraser-Brunner, *Upeneus moluccensis* Bleeker, e *Upeneus asymmetricus* Lachner. Di queste, 16,5 (*Saurida undosquamis*, *Upeneus moluccensis*, *Upeneus asymmetricus*, *Sphyraena chrysotaenia*, *Siganus rivulatus*) furono poste nella categoria « importante » in seguito al loro relativamente alto reddito peschereccio tanto per il numero quanto per il peso.

Infine, una tecnica per combinare i numeri degli individui e i pesi (in grammi) nei diversi saggi, così da ottenere un unico termine aritmetico (« indgramma ») di alto significato ecologico fu indagata con certi risultati positivi, ossia l'ordinamento delle specie in base alla loro ecologia generale (nomadi, demerse, erratiche, ecc.) quando i quozienti erano ottenuti dividendo l'« indgramma » totale e maggiore annuale per il secondo « indgramma » totale minore annuale per il periodo di studio di due anni.