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Computer Aided Fish Egg Identification -Black Sea Pelagic Eggs-

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Abstract: One of the most important branches of fisheries research is undoubtedly ichthyoplankton studies. The first step in such studies is to correctly identify eggs and larvae of the fishes; however, since this is a literature-requiring and time-consuming task, it is perhaps the most difficult step. For the researchers who are currently working on or will work on ichthyoplankton, a PC compatible computer program was developed for the identification of pelagic eggs. In this first version, only the Black Sea which predominates in the Turkish fishery is taken into consideration.

Key Words: : Computer Aided Identification, Pelagic Fish Eggs, Black Sea.

Bilgisayar Destekli Balık Yumurtaları Tayini -Karadeniz Pelajik Yumurtaları-

Özet: Balıkçılık araştırmalarının en önemli dallarından biri hiç şüphesiz ihtiyoplankton çalışmalarıdır. bu tip çalışmalarda ilk adım balık yumurta ve larvalarının doğru tayin edilmesidir; ancak bu da uygun literatür isteyen zaman alıcı bir iş olduğundan belki de en zor adımdır. İhtiyoplankton konusunda çalışan veya çalışacak araştırmacılarımıza yardımcı olmak amacı ile pelajik yumurta bırakan balık türlerinin yumurta tayininde kullanılacak PC uyumlu bir bilgisayar programı geliştirilmiştir. Bu programın ilk uyarlamasında yalnız Türk balıkçılığının odak noktasını oluşturan Karadeniz ele alınmıştır.

Anahtar Kelimeler: Bilgisayar Destekli Tanımlama, Pelajik Balık Yumurtası, Karadeniz

Introduction

Ichthyoplankton received nearly no scientific interest before the end of the last century when controversy over the possible dangers of over-fishing was initiated. During that time, it was feared that the trawl net in its passage over the sea bottom might destroy the spawn of fish. Thereafter, growing concern about over-fishing stimulated scientists to study the spawning of fishes. G. O. Sars has a special place in the ichthyoplankton history (Russell, 1976). In 1865 he discovered that the eggs of the cod, haddock and gurnard are planktonic and showed that there is no need for concern over the affects of trawlers on fish spawn.

One of the first synoptic attempts for the identification of fish egg and larvae has been prepared by M'ıntosh and Masterman (1897). This was followed by a more detailed identification key by Ehrenbaum (1905-1909). Similar studies on the ichtyoplankton of the Turkish waters were started in 1957 (Arım, 1975), and followed by Demir (1959, 1968, 1969, 1974), Mater (1978, 1981) and Yüksek (1993).

Ichthyoplankton studies are of great importance for the fisheries biology; reasons for this are summarized as follows:

- Determination of spawning periods and spawning area of the fishes;

- Biomass estimation of the spawning stock;

- Estimation of survival rate and mortality on the newly hatched larvae, and determination of the factors influencing mortality and spawning success;

- over-all evaluation of the fish resources of a given area.

To carry out a study on one of the above given topics, a comprehensive knowledge is necessary about the eggs and larvae that could possibly be found along the area in question. Usually, members of the same family inhabit the same area and eventually spawn at the same time. This makes identification of the eggs more complex because even eggs of different species are very similar in their early stages. Therefore, one should have sufficient knowledge about the eggs and larvae of all possible species, even though only a single species is aimed. Thisis a time consuming task which necessitates sufficient experience and relevant literature.

In order to ease the difficulties encountered by researchers, a computer program for the identification of teleostean fishes having pelagic eggs has been developed. In this first version only the Black Sea, which holds the highest importance for the commercial fishery, is taken into consideration.

The Egg

Most offshore marine teleostean fishes produce pelagic eggs which drift with the plankton in all water layers between the surface and the bottom; the chief exceptions to this among Black Sea species are the gobies (Gobiidae), blennies (Blenniidae) and wrasses (Labridae), which have demersal eggs, and a small number of viviparous species.

Southern Black Sea (Turkish coast) mostly consists of species which spawn pelagic eggs because the shelf area is very narrow and the depth below 100-200 m is anoxic. In this study, therefore, only pelagic eggs are included.

Black Sea fish fauna contains 165 species of teleostean fish (Ivanov and Beverton, 1985); however, only 70 of them are known to spawn in this sea and to have pelagic eggs (Slastenenko, 1956). Besides the pelagics, some demersal eggs, which are normally found adhered to a substrate, may also be found in the pelagic zone. This is especially the case for the eggs of Labridae, which may easily be detached by waves and strong currents. Therefore, although they are known to have demersal eggs, members of the Labridae have been included in the species list of the program (Table 1).

The Identification of the Pelagic Eggs

There is a long list of diagnostic characteristics used for the identification of pelagic eggs. This long list has been proposed by several authors and is comprised by taking only Black Sea spawners into account. A total of 28 distinctive features of the 70 teleostean fishes are selected through a literature survey on the studies carried out along the Mediterranean and especially in the Black Sea (Russell, 1976; Ehrenbaum, 1905-1909; Arım, 1957; Demir, 1959; Demir, 1968; Demir, 1969; Demir, 1974; Mater, 1981; Cunningham, 1889; D'Ancona, 1956; Dekhnik, 1973; Olivar and Fortuna, 1991; Vodyanitski and Kazanova, 1954). For each character, all possible alternatives are determined and numerically coded. For each species, relevant codes of 28 characters are stored in the program in a 70 x 28 matrix form. The characters used in the program for the identification of the pelagic eggs of the Black Sea are as follows:

Meristic character related with EGG:

- Shape (ovoidal or spheric);
- membrane (Smooth or sculptured surface);
- thickness of the membrane;
- size of perivitelline space;
- presence or absence of oil globules;
- position of the oil globule;
- homogeneous, partly segmented or fully segmented yolk sac;
- appearance of egg sac (opaque or hyaline);
- presence or absence of pigmentation on yolk sac or oil globule.

Metric properties are:

- Size of the egg and oil globule.

Other features:

- location of the sampling area (offshore or coastal),
- date of the occurence (specifies spawning season).

Characters belonging to eggs with EMBRYO:

- Pigmentation pattern on the embryo;
- degree of pigmentation of the head, eye, dorsal part, anus and tail;
- width of the embryo.

Table 1. List of species whose egg may possibly be found in the pelagic zone of the Black Sea.

Bothidae	Pomatomidae
Arnoglossus kessleri	*Pomatomus saltator*
Callionymidae	Sciaenidae
Callionymus fasciatus	*Sciaena umbra*
Callionymus lyra	*Umbrina cirrosa*
Callionymus pusillus	Scomberidae
Callionymus risso	*Euthynnus alletteratus*
Carangidae	*Sarda sarda*
Trachurus mediterraneus	*Scomber japonicus*
Trachurus trachurus	*Scomber scombrus*
Centracanthidae	*Thunnus thynnus*
Spicara flexuosa	Scophthalmidae
Spicara smaris	*Psetta maxima maeotica*
Clupeidae	*Scophtalmus rhombus*
Sardina pilchardus	Scorpaenidae
Sardinella aurita	*Scorpaena notata*
Sprattus sprattus	*Scorpaena porcus*
Engraulidae	Serranidae
Engraulis encrasicholus	*Serranus cabrilla*
Gadidae	*Serranus hepatus*
Gaidropsarus mediterraneus	*Serranus scriba*
Merlangius m. euxinus	Soleidae
Labridae	*Buglossidium luteum*
Coris julis	*Solea nasuta*
Ctenolabrus rupestris	*Solea vulgaris*
Labrus viridis	Sparidae
Symphodus cinereus	*Boops boops*
Symphodus ocellatus	*Dentex dentex*
Symphodus roissali	*Diplodus annularis*
Symphodus rostratus	*Diplodus puntazzo*
Smphodus tinca	*Diplodus sargus*
Lophiidae	*Lithognathus mormyrus*
Lophius piscatorius	*Oblada melanura*
Meluccidae	*Pagellus erythrinus*
Merluccius merluccius	*Sarpa salpa*
Moronidae	*Sparus aurata*
Dicentrarchus labrax	Sphyraenidae
Mugilidae	*Sphyraena sphyraena*
Liza aurata	Trachinidae
Liza ramada	*Trachinus draco*
Liza saliens	Triglidae
Mugil cephalus	*Aspitrigla cuculus*
Mullidae	*Eutrigla gurnardus*
Mullus barbatus	*Trigla lucerna*
Mullus surmuletus	Uronoscopidae
Ophidiidae	*Uronoscopus scaber*
Ophidion rochei	Xiphiidae
Pleuronectidae	*Xiphias gladius*
Platicthys flesus luscus	Zeidae
	Zeus faber

The descriptions of these characters are given in Figure 1.

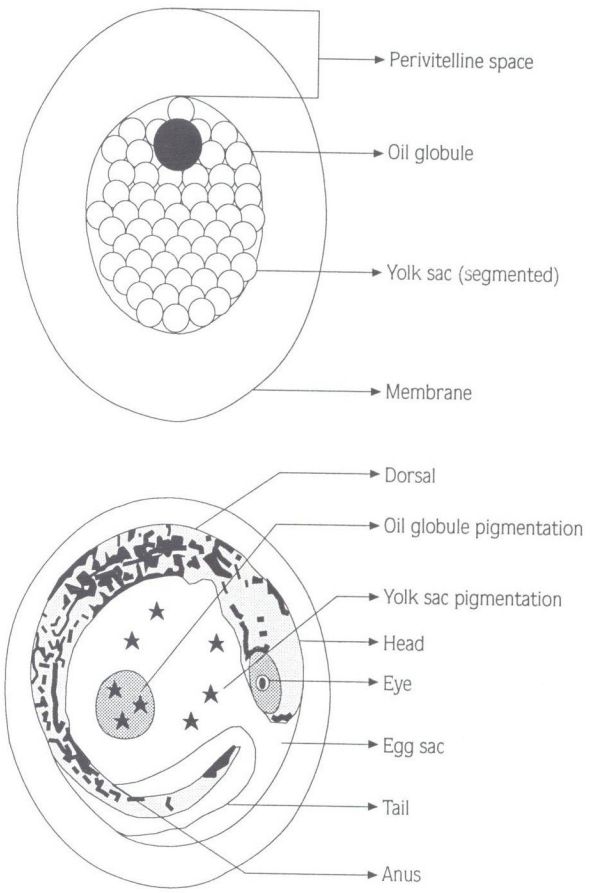

Figure 1. Illustrative description of the characters used in the program.

In the program, characters and all descriptive options are given in pull-down menus. The user may select one of these menus and define as much of it as he/she desires. One need not complete the whole set of definitions given in the program. In this way, *users are* not obliged to answer all questions, which may be difficult for the more inexperienced scientists. Also, for some certain species having unique diagnostic characters (such as anchovy with ovoidal egg), it is not necessary to define all the items given in the program. As the characters are selected and defined, the program stores those values in an array which is called the "user's array". In any step of the program, the user may initialize the identification. In this case, the user's array is compared with the matrix bearing coded diagnostic characters of 70 species. The *user's array* acts as a filter and each column of the matrix in which coded characters of a species are stored is compared

with the codes in the *user's array*. The columns having exactly the same codes as those of the array are filtered and listed on the screen (Figure 2). The user should pay great attention not to define and enter uncertain or suspicious characters into the user's array since the program searches for an absolute match between entered and matrix values. Otherwise, incorrect definitions would lead to erroneous identification.

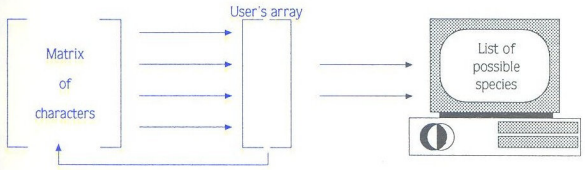

Figure 2. Diagram for the algorith.

The number of possible species listed on the screen depends on the number of characters defined by the user. The more characters he or she defines, the less number of species there will be listed on the screen. After each trial, to give more flexibility to the character definition, the program loops the user back to change or revise previously defined characters (Figure 3).

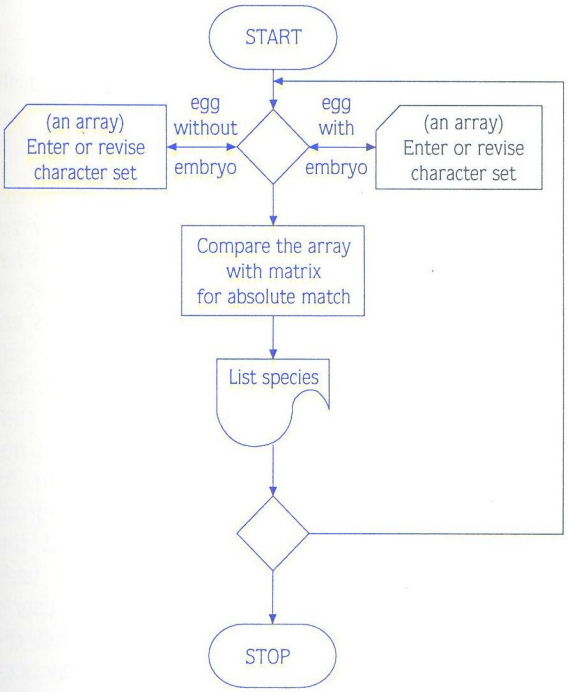

Figure 3. Flowchart

Conclusion

This program has been developed solely for the pelagic eggs of the Black Sea fishes. Most of the characters are categorical for the species; however, some others, especially those defined by time and dimension (such as spawning season and diameters of oil globule), show regional irregularities. It should be kept in mind that compared with the other surrounding seas, the Black Sea has specific physical peculiarities, such as temperature, which trigger spawming action and salinity by which osmosis may alter the morphological structure of the eggs of inhabited species. The use of this program in its complete form should therefore be limited to the Black Sea. However, it may be applied to other seas if the characters which bear regional influence are avoided.

By defining characters related with the egg only, it is possible in many instances to identify its species. There are, however, a number of species which have eggs of very similar characteristics when they are in the very early stages. In this case it is only possible to identify these in the late stages of development when the embryo is well advanced and has assumed a characteristic pigmentation pattern. This program may not be adequate for such eggs collected in early stages before development of the embryo.

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