

# The nature of the Lessepsian migration through the Suez Canal

by

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## Introduction

In the century which passed since the opening of the Suez Canal in 1869, the scientific interest in the faunal interchange between the Atlanto-Mediterranean and the Indopacific Red Sea faunas has never decreased. It did not increase however at a justified rate. The task of monitoring the changes, both in the Canal and the open sea, needed concentrated effort, an extending of the research areas and also a methodological diversification of the research. While even the most basic aspects at the descriptive level could not be fulfilled, since incomplete knowledge in the past cannot be made good for and the chronic lack of taxonomists is a worldwide problem, new aspects of research are already needed in order to understand the phenomena. Reproductive biology, comparative ecology and behaviour, population ecology and genetics, comparative parasitology will necessarily concentrate attention to particular cases. This should not lead, as it may, to a neglect of the general surveying of the migration.

This is the reason also for the fact that after hundred years we are still in the stage in which we have to grasp for the most basic features of the Lessepsian migration. This basic knowledge has considerably increased lately, due to a joint project of the Hebrew University and the Smithsonian Institution, which from 1967 till now\* has collected thousands of samples in the area, among them from the Suez Canal itself. Information is now coming in from such animal groups as ostracods, halacarids, mysidaceans, nematods, bryozoans, etc., in which the migration has never been studied before.

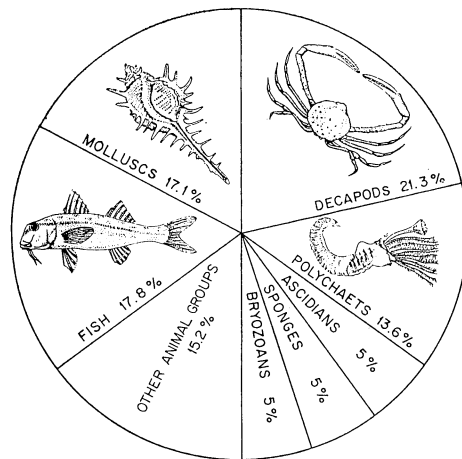


FIG. 1. — Percentual importance of the different animal groups among the Indopacific migrants into the Mediterranean (after Steinitz, 1970 slightly modified).

\* Date of publication, winter 1973.

### What is a Lessepsian migrant ?

H. STEINITZ [1967, 1969] is keeping up to date a list of migrant species, using the incoming information from all the taxa. A total of 140 animal species are known to date to have migrated from the Red Sea into the Mediterranean. A number of 41 migrants in the opposite sense are also listed by STEINITZ.

Necessarily at this stage, attention has to be focused to *new* species in either seas. There is indeed also an interchange of conspecific populations from both seas [STEINITZ, 1968]. This is however a most difficult and perhaps also less important research topic.

In order to decide if a species has invaded the Atlanto-Mediterranean region or the Indopacific, *through* the Lessepsian Canal, we have to use all the tools of the zoogeography and also the knowledge of the pleistocenic history of the area [POR, 1969]. In both these fields, one can use only positive evidence, since negative data may be due to incomplete knowledge.

A species known in the Mediterranean and in other parts of the Indopacific realm should not be considered a Lessepsian migrant for the sole reason that it has not been reported before from the Red Sea. Five of the polychets considered by FISHELSON & RULLIER [1969] to be mediterranean invaders of the Red Sea are known for long from the Indian and Pacific Oceans. They did not need the new waterway in order to reach the Red Sea.

If a presumed immigrant in both senses is found also along the coasts of West Africa, this simple fact should disqualify the species from the list of proved migrants. Such species had ample opportunities in the past to spread along the African coasts the other way round. In many cases even, such species will turn out to have a circumtropical distribution. Another three presumed migrant polychaets into the Red Sea, listed by FISHELSON & RULLIER [*op. cit.*] fall into this category. The sipunculid *Aspidosiphon elegans*, which according to WESENBERG-LUND [1957] migrated into the Red Sea, and *Golfingia* which did the same according to HYMAN [1959] should be dismissed from the migrant list for the same reason. Three species of polychets considered Indopacific by LAUBIER 1966, migrants into the Mediterranean are most probably circumtropical species. The shark *Carcharinus brevipinna* and the pelagic fish *Parexocoetus mentho* are both known also from West Africa [BEN TUVIA, 1966] and most probably not Lessepsian migrants into the Mediterranean.

One should be careful also, considering the fouling organisms. Spreading by ship fouling, is a world-wide and, strictly speaking, adventive phenomenon, superimposed on the « normal » zoogeographical processes. In a way, such famous cases as *Mercierella enigmatica* and *Elminius modestus* have most probably also used the Suez Canal in their spectacular spread, since almost all the ship trade from the Far East came that way. Therefore polychaet species of the genus *Hydroides*, some bryozoan species, the wood borer *Chelura terebrans*, carried through the Canal by ships, should clearly be separated from the much more interesting cases in which species extended their area by natural means.

If in a species, presumably Lessepsian migrant, there is a combination between a very early record (after the opening of the Canal in 1869) and also at a considerable distance from the Canal outlet, caution is recommended. Indopacific species found in the Black Sea or in the Adriatic, could not reach these localities in such a short time. *Pteria occa* found in 1895 in Tunis, *Metrocarpa nigrum* found also there, *Halophilina stipulacea* frequent at Rhodes in 1895, have probably reached the Mediterranean before 1869.

A last group of would-be migrants, is a number of highly euryhaline organisms, the « Isthmus fauna » [POR, 1968], living in hypersaline water-bodies of the Sinai peninsula. These organisms, such as *Aphanius dispar*, *Pirenella conica*, *Mytilus variabilis*, have populated the hypersaline lakes and swamps of the Isthmus of Suez, long before the Suez Canal has been cut through.

### Migrant biota and ways of migration

The above expressed views are logically connected with a certain concept of the migration process itself.

STEINITZ's list of migrants [*op. cit.*] already offers some clues. The percentual importance of the different animal groups (Fig. 1) and even the lack of some of them from that list, is self evident. Planktonic animal groups, benthonic taxa with planktonic larvae, animals living on rocky substrate, meio-benthic organisms are missing or absent to a large extent. The successful migrants are found among the littoral fish, nectobenthic invertebrates and littoral level bottom or suspension resistant benthic animals.

Migration is a step-by-step advance of these animals along a « sieving channel » with at least three major sieving sites : 1. The northern part of the Gulf of Suez, with low minimum temperatures of 16° — 17° C (a decrease of 5 — 6° C as compared with the open Red Sea); 2. The turbid Bitter Lakes in which there are no hard bottoms, no throughgoing currents and the salinities are stratified; 3. The outlet into the Mediterranean, at Port Said, where prevalence of level bottoms, occasional salinity decreases (in the past !) and not at last the competition, are the limiting factors.

In the step-by-step migration, the time factor is especially important for the level bottom meio-benthos, small, slightly moving burried animals. Although the Canal itself is already to a large extent inhabited by Red Sea immigrants, they did not, or only to a small extent, spread out and colonize the Mediterranean [POR & MARCUS, 1972; LERNER-SEGGEV, 1972].

The best criteria to decide if an animal can be considered a Lessepsian migrant is its very presence in the Bitter Lakes or elsewhere in the Canal system, perhaps also the presence in the northern Gulf of Suez and the existence (sometimes difficult to ascertain) of a « take-off » period at Port Said before the successful plunge into the open Mediterranean.

### Direction and future of Lessepsian migration

Lessepsian migration is an one-way invasion, from the Red Sea to the Mediterranean. Sometimes the list of the opposite-sense immigrants seems to increase. But these, to the possible exception of the fish, invariably turn out to be old Indopacific residents or else, circumtropical or wide-spread organisms.

The one-way sense of the migration has not changed over decades. The Bitter Lakes have been from the very first years inhabited by Red Sea immigrants, they still form the great majority there. In some cases, the different phases of the migration can be followed. *Asterina wega* and *Leucosia signata*, found by the Cambridge Expedition (1924) in the Bitter Lakes, have in the meanwhile invaded the Mediterranean. *Penaeus japonicus* was recorded in 1924 by Fox [1927] from Port Said; in 1930 MONOD found it at Iskenderun. *Neptunus pelagicus* reached Port Said in 1898; in 1924 it was already fished near Haifa [W. STEINITZ 1927].

To predict the future of the Lessepsian migration, one has to consider first the eventual changes at the main « sieving » levels.

It is most probable that all the Red Sea animals, capable to live under the subtropical conditions of the northern Gulf of Suez, already settled it during the past millenia. The Bitter Lakes, despite a widespread opinion, do not constitute the changing link in the process. As shown before [POR, 1969] the surface and the inshore waters of the Lakes were never intolerably hypersaline for the littoral fauna of the Red Sea. The same fauna found there in the first years is still inhabiting the Bitter Lakes. The Lakes will probably always have a salinity of at least 45-46 ‰, regardless of the dissolution of the fossile salt bed at the bottom : this is the normal salinity in every semi-isolated lagoon fed by Red Sea waters. A more saline bottom layer will also persist, continuously formed by the inflow of the hypersaline waters from the surrounding saline pools. The bottom there will also remain sedimentary for the next future.

Radical changes are bound to occur however, and are already occurring, at the Mediterranean end. After the closing of the Asswan dam, salinity at Port Said is remaining constant at around 39 ‰, the normal salinity of the Mediterranean. The sharp drop in the nutrient contents in the Levant Sea will create a new set of interspecific relations in the whole area.

It is a matter of importance to all Mediterranean marine biologists to study these future changes.

A neglected aspect of the migration is that of the « edge phenomena ». There is absolutely no information on the limits and the reasons why the migrant species come to a stop, somewhere in the Aegean area. The big islands of Cyprus, Crete and Rhodes, give good examples in which the problem of the invasion of isolated island habitats by an essentially littoral fauna can be studied.

The direct westward, anticlockwise direction of spread along the North African shore will also be open to the Lessepsian migrants following the disappearance of the brackish barrier in front of the Nile Delta. This will be an opportunity to recapitulate early stage of the Indopacific invasion, not studied in time, along the Levantine coasts.

It may be thus said that the migration problem is more and more shifting its emphasis to the understanding of the colonisation of the Mediterranean by the Lessepsian migrants.

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