

CONTRIBUTIONS TO THE ECOLOGICAL STUDY OF THE ADRIATIC LITTORAL

by JOZE STIRN

On the base of the systematic research of the infralittoral and circalittoral areas of the Adriatic sea during a few years period with the classic and the direct methods (diving, automatic photography and television) we can preliminary establish that the benthos of the South Adriatic sea by system PERES-PICARD (1956) belongs to the combination of the east and the west type (TORTONESE, 1958) and that the benthos of the North Adriatic sea, especially that of the Kvarner bay, is typologically pure western.

Because of the uncommon phenomena in Kvarner bay we have paid especial attention to that area where we can see that the associations from the hard and the soft bottom of the circalittoral expands as a rule their areal to the whole infralittoral even to the inferior limits of the mediolittoral. At the searching of the reasons of that phenomena we have found the explanation for some characteristic organisms in the specific conditions of the ground and the illumination on the steep or even vertical parts of the coast and the islands. The general ground for this are without doubt the warmth conditions in that area what has geniously established already LORENZ (1883) and his, unfortunately rare, successors (ZALOKAR, 1942) at the research of the Kvarner bay.

As the indicator of the specific hydrographical conditions of the Kvarner bay has already LORENZ mentioned the fact that are just in Kvarner bay the best fishing grounds of the *Nephrops norvegicus* (L.) in Mediterranean to what he has attribute even the glacial relict character. But this is contradicted as a rule by KARLOVAC (1953) who has established large new fishing grounds in the High Adriatic, only he has wrongly attributed the distribution of *Nephrops norvegicus* (L.) to the type of bottom. We can see this already out of his own data where we can learn that is the areal of *Nephrops norvegicus* (L.) only in Kvarner bay in the depths of 30-80 m but in the other parts of the Adriatic and Mediterranean from 100-250 m. The comparation of the warmths conditions shows is that are the season's temperatures in Kvarner bay already in the depths of 80 m (10°-13°8) lower as in the Middle Adriatic in 150 m of depth (11-15°). So we have here the distribution of the stenoterm organism who prospers only in the areas where the seasons temperatures move from 10-14° what is in Adriatic normally possible only in the depths from 100-250 m but in Kvarner bay in the depths from 30-80 m.

The specific warmths conditions in Kvarner bay shows us the added diagram where we can see that are the season's temperatures in Kvarner far more balanced and far more under the temperatures so of those of the Middle Adriatic as well of those in North Adriatic.

The reasons of this unusual cooling down of Kvarner-water are partially meteorologically (wind bura) and first of all caused by the numerous terrestrial and even more by inderwater carst springs which supplies subterranean water with the constant temperatures from 8°7-10°5 which in the summer season cools and in the winter warms up the water-body of Kvarner bay.

The quantity of fresh water supply in Kvarner is great during the whole year. The hydrological calculation of the hinterland shows us the water quantity which is almost the same as this of the river Neretva (the average year flux 200 m³/s/for example), but the difference

is that in Kvarner the springs are strewed arround, under the sea and always very cold what explains us their great cooling effect on the deeper layers of the Kvarner water-body.

To the above mentioned warmsth conditions and partialy to the vertical parts of coast in the shadow we attribute the anomalies in the distribution of benthonic organisms and the infiltration of the circalittoral associations to the inferior limits of the mediolittoral in the Kvarner area.

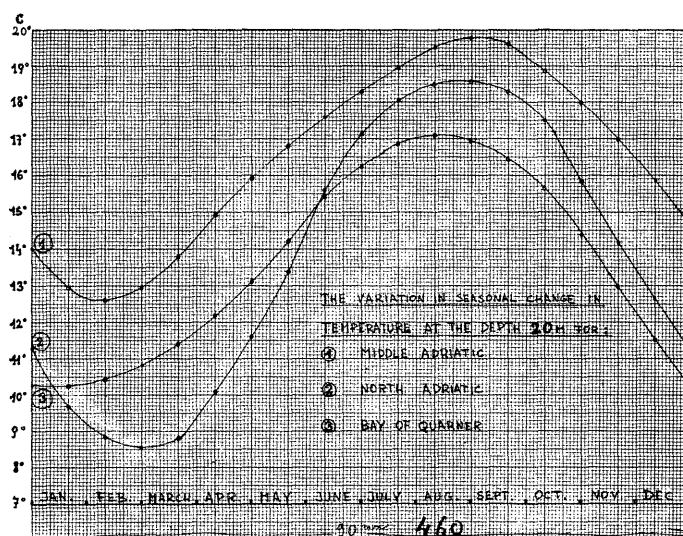


FIGURE I

Through that point we have systematically researched the horizontal and vertical distribution of the benthonic organisms of the infra- and circalittoral on the whole part of Kvarner about what will be reported in another publication.

A special attention we have paid to the ecological research of the close vicinity of underwater springs. Here we have established that the most organisms typical for the primary hard bottom of the circalittoral (g. *Alcyonium*, *Eunicella*, *Parazoanthus*, *Epizoanthus*, *Axinella*, *Petrosia*, *Retepora*, *Porella* f.e.) just in the close vicinity of the underwater springs reach the highest horizon of their vertical distribution, that is extremely 1-2 m under the average sea level but only there where they are not in the contact with the fresh water and where the salinity does not sink under 25 p. 100.

In the close vicinity of the underwater springs many times in the contact with the fresh water we have found extraordinarily beautiful developed associations, with all characteristic accompanied organisms, which are normaly typical only for the secundar hard bottom of the Adriatic circalittoral from the 30 m depth down which was described by NIKOLIC (1957) as the association *Hippodiplosia foliacea* SOL. This association is composed so :

<i>Hippodiplosia foliacea</i> SOL.	++++	<i>Bugula avicularia</i> L.	+
<i>Ebalia</i> sp.	++++	<i>Parazoanthus axinellae</i> SCH.	+
<i>Pillumnus birtellus</i> (L.)	+++	<i>Pontonia custos</i> FORS.	o
<i>Ophiothrix fragilis</i> (ABIL.)	+++	<i>Microcosmos sulcatus</i> (COQ.)	o
<i>Pecten varius</i> (L.)	++	<i>Peysonellia squamaria</i> (GMEL.)	o
<i>Cellaria fistulosa</i> L.	++	<i>Udotea petiolata</i> BORG.	o
<i>Halecium halecinum</i> (L.)	++	<i>Pandalina brevirostris</i> (ROTH.)	o
<i>Polychaeta</i> adet.	++	<i>Ebalia tumefacta</i> (MONTH.)	o
<i>Spongiaria</i> adet.	+	<i>Porella cervicornis</i> PALLAS	o

When we have searched the ecological facts which cause such an anomaly we have established on the base of the systematical examinations of salinity, temperature, illumination and the other environmental factors that :

the illumination has not a great influence because we find the corms *Hippodiplosia foliacea* SOL. from the depths of 3 - 30 m in the shadowed and also in the well illuminated parts of bottom,

the type of the bottom is not essential because we find the corms so on the soft bottom where they are making the secondary hard bottom as well as on the rocky (under the different angles inclined) parts of the coast,

the salinity is not essential because it changes during the year from 11-33 p. 1000.

the leading factor is water temperature.

About the importance of the warmths conditions for the described phenomena we have the following arguments;

the association *Hippodiplosia foliacea* SOL. is distributed in the Adriatic generally only on the sediments bottom under 30 m that is under the normal termocline of the Adriatic;

the association *H. foliacea* is distributed at the underwater springs in Kvarner in the highest horizon that is extremely 3 m under the sea level only there where the springs work and cool down the whole summer, while at the springs which stop working in the worst aridity and so stop also the cooling we have them only under 17 m what shows us the termocline in the northern part of the Kvarner bay.

Out of the above mentioned data and on the base of the experimental research follows that the *Hippodiplosia foliacea* SOL. as well as the most of the companions of this association's center are the stenoterm organisms living in the areas temperated during the year from 10 — 16°C which in the relations with the other environmental factors shows a great euryvalenity. The euryhalinic character is conected paralely and causaly on condition that the low salinity is caused by the oligotrophic fresh water with low temperature and great quantity of the calcium ions.

About the processes of the osmoregulation which are concerted with those phenomena we will report in another publication.

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