

REPORT ON THE COMMON SPECIES AND CHARACTERISTICS OF THE PHYTOPLANKTON OF THE TYRRHENIAN BRACKISH PONDS

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Treating about the brackish waters of the tyrrhénian littoral some ponds have been taken into consideration : the lakeponds of Fondi, lago Lungo, Paola (Sabaudia) and Fogliano - all spread along the coast line from Gaeta to Anzio- as well as the lake of Massaciuccoli (Viareggio) and the Tortoli pond (gulf of Orosei) in Sardinia.

The characteristics of all these waters are an inconstant salinity, excessive thermic variations, shallow depths and moderately or well oxygenated superficial strata. Yet, while the three latter factors are to be found alike in the foregoing basis, their salinities happen to be, on the contrary, considerably different.

In conformity with the classification issued by BRUNELLI which, because commonly used up to now when classifying the Mediterranean brackish waters, is highly significative in my opinion, Fondi and Massaciuccoli have to be considered as oligohaline ponds while the lakes of Patria and lago Lungo offer remarkable fluctuations from oligohaline to mesohaline; on the other hand, Sabaudia is mesohaline while, on account of the utmost inconstancy of its conditions during dryness, the pond of Tortoli offers poli-isohaline and even iperhaline characters.

The saline degree of Fogliano swings from 3 - 4 ‰ up to 25 ‰ - i. e. from mesohaline up to polihaline - with even higher climax. Its proceeding is discontinuous and its irregularities appear of great importance when taking into account that such different salinities are to be met with from zone to zone on samples collected on the same day.

As to the Calambrone, it is indeed a canal and not a littoral pond : and, according to the wind and tide, its saline degree offers remarkable differences from one zone to the other.

After having given some brief news, an abridgement is offered, with the following table, regarding the discovery of some microphyte belonging either to plankton as well as to the eleoplankton.

The table shows that not all the species more commonly met with are typically brackish ones : while the species *Melosira moniliformis* (syn. *M. Borreri*), *M. sulcata*, *Chaetoceros subtilis*, *C. wighamii* (euryhaline, eurythermic), *Synedra Gaillonii*, *S. tabulata* (syn. *S. affinis*), *S. cristallina*, *Suriella striatula*, *Campylodiscus eebeneis*, *Prorocentrum scutellum*, *Dinophysis acuminata* (eurythermic, euryhaline), *Glenodinium lenticula*, *Goniaulax spinifera* may be reckoned to the brackish species; as to the rest they are generally considered marine species.

Typically marine, indeed, are *Chaetoceros decipiens*, *C. affinis*, *C. curvisetus*, which may even be found in great number also in brackish ponds : what happens when the conditions of the pond are favourable and chiefly when the inflow of sea water trails them into the basin.

It can be of some interest to draw one's attention on the fact that finding of *Chaetoceros* occurs more frequently in some ponds (lago Lungo, for instance) than in others (1) though the salinity has undergone no variation apparently in connection with these finding (the salinity of Lago Lungo was always beneath 19 ‰).

Always numerous and characteristics are the species of *Navicula*, *Pleurosigma*, *Nitzschia*, but, unfortunately, they were not often classified and cannot, therefore, be taken into consideration.

Espèces	Fondi	Massaciuccoli	Sabaudia	Lago Lungo	Patria	Fogliano	Tortoli	Calambrone
<i>Melosira moniliformis</i>			o	o	o	o	o	o
<i>M. sulcata</i>			o					o
<i>Chaetoceros decipiens</i>				+				
<i>C. affinis</i>			o		o	o		o
<i>C. curvisetus</i>			o	o				
<i>C. subtilis</i>			o		+			
<i>C. wighamii</i>			+					
<i>Striatella unipunctata</i>			o			+	+	o
<i>Synedra ulna</i>	o	o						
<i>S. Gaillonii</i>						+	o	
<i>S. tabulata</i> syn <i>S. affinis</i>	o			o	o			
<i>S. cristallina</i>			o		+			
<i>S. undulata</i>				o	o		o	
<i>Cocconeis scutellum</i>			o	?			o	
<i>Pleurosigma elongatum</i>				o	o			
<i>Nitzschia closterium</i>			o		o			
<i>Surirella striatula</i>			o		o	o		o
<i>Campylodiscus eebeneis</i>		o	o		o		+	o
<i>Exuviella cordata</i>					+			
<i>E. compressa</i>			?	+				
<i>E. marina</i>						o	?	
<i>Prorocentrum scutellum</i>			o	+	o			?
<i>P. micans</i>			+	+	o	+	+	o
<i>Dinophysis acuminata</i>			o			o		
<i>Glenodinium lenticula</i>		o	o		o			
<i>G. borgei</i>		o	o					
<i>Peridinium cinctum</i>	o							
<i>Goniaulax spinifera</i>						o	+	o
<i>Ceratium hirundinella</i>				o				

NOTE. — PATRIA : from unpublished data kindly given by Prof. MARGALEF.
 SABAUDIA : in course of being studied by DE ANGELIS.
 MASSACIUCCOLI : the occurrence of the finding of a more limited number of species is also due to the fact that the researches were mainly carried out on zooplankton.

TABLE I. — Species more frequently met with into the Tyrrhenian ponds
 (o present species, + species very much numerous)

Among Dinoflagellates, *Exuviella marina*, and *E. compressa*, which may frequently found in the lago Lungo's waters, they both have the characteristics of appearing always in considerable amounts and long periods, an even more noteworthy character in the case of *Prorocentrum*, chiefly when *micans*.

The prevalent fresh water species which one meets with are exclusively *Synedra ulna*, *Peridinium cinctum*, *Glenodinium borgei*, wich we have recorded not on account of their being exceptionally rich species of our ponds but because representatives of a rich and characteristic

facies of low salinity environments: thoroughly disappearing, at any rate, as soon as the salinity raises.

As to the other vegetal species which have been found in the Tyrrhenian ponds, the species *Microcystis*, *Chroococcus*, *Oscillatoria*, *Lyngbya*, *Spirulina*, *Spirogira*, *Zygnema*, are abundant wherever the salinity allows ⁽¹⁾, as well as, and above all, such fresh water species which one meets with in the neighboring of plants and pond bottom, or banks.

But one of the most characteristic plankton species, eurythermic and euryhaline, usually found in our ponds is *Gomphosphaera aponia* (CANNICCI, 1944).

Owing to wide diffusion of the species mentioned on the first table, the species which we recorder on the second one deserve a particular attention among the foregoing ones. Some of them, i. e. *Striatella unipunctata*, *Exuviella compressa*, *E. marina*, *Prorocentrum micans*, *Goniaulax monacantha*, are considered as marine species.

Exuviella compressa and *E. marina* may be deemed as cosmopolite, in any way one finds them widely distributed throughout Europe and even in Northern European countries. A cosmopolite species may be considered, indeed, *Prorocentrum micans* utmost diffused into the brackish habitat we studied, and considered in the North Sea as a neritic and estuary's species. We may here remark that abnormal *Prorocentrum micans* species have been obtained in culture, but, indeed, natural morphological differences may be also observed, determined by causes which appear still undecided (BURSA, 1959). The writer has, on the other hand, remarked variations of the *Prorocentrum micans* also in the pond of Sabaudia and also in this case it is easy to attach such differences to particular conditions of environment.

Only *Striatella unipunctata* is commonly met with in the Mediterranean while in North Europe it is less diffused.

In considering *Exuviella* and *Prorocentrum* as cosmopolite, what in the marine habitat has to be constructed chiefly under the eurythermic meaning, a remarkable saline endurance has necessarily to be also attributed to these species: furthermore, either *Exuviella* as *Prorocentrum* are species, the multiplication of which, appears to be more intense in the pond rather than in the sea - some flowering in exceptional conditions and into coastal waters excepted - (FORTI, 1906; ALLEN, 1946). This leads one to believe that their growing finds particularly suitable conditions whereas there is a remarkable abundance of organic substances.

Along the Tyrrhenian coast-line *Campylodiscus eebeneis* is met with in any high saline ponds, nay, into the pond of Tortoli, notwithstanding the remarkable fluctuations of saline degree, it is found with utmost steadiness.

Goniaulax spinifera is very commonly found in Sardinia (and not merely into the pond Tortoli): not so often, instead, in the ponds of the Italian peninsula.

Though not belonging to the phytoplankton, *Tintinnopsis ampanula* and *T. beroidea* have to be added to the foregoing species on account of their being closely connected with the characteristic facies of these ponds: they are species commonly met with in the Mediterranean sea and which, as *Prorocentrum micans* offer notable morphological variations.

As table 2 shows, *Melosira*, *Striatella*, *Synedra*, *Campylodiscus* and *Prorocentrum* have remarkably broad salinity limits: more restricted these limits appear to be, in the case of the other species; nevertheless, the data to this purpose are not so numerous as to allow the issuing of conclusive results. However, it has been remarked - in the pond of Tortoli - that although the variation of salinity attained 37 ‰ (October 1952) and was of about 19 ‰ (March 1952) *Melosira moniliformis*, *Prorocentrum micans* and *Tintinnopsis beroidea* are still present as they are in many of the other ponds which have been studied, mainly along the littoral of the Gulf of Oristano (Sardinia).

(1) Owing to insufficient salinity, they are always lacking in the lake of Massaciuccoli.

(2) Chiefly in the pond of Fondi e Massaciuccoli.

Considering that no particular research has been carried out with such a view, and that we do not dispose of sufficiently numerous data to this purpose, it can be deemed rather hazardous to deal with limits of salinity between which the species' survival may be assured: nevertheless, we may deem that the data on hand are indicative to assure that the species before mentioned, mainly those which have been recorded in table 2, are able to adapt themselves between the above mentioned limits of salinity. At least it cannot be affirmed for certain, that in such conditions multiplication may occur.

Espèces	isohaline	mesohaline	poli-isohaline	iperhaline
<i>Melosira moniliformis</i>		o	o	?
<i>Striatella unipunctata</i>		o	o	o
<i>Synedra gaillonii</i>		o	o	
<i>Surirella striatula</i>		?	o	
<i>Campylodiscus eebeneis</i>		?	o	?
<i>Exuviella compressa</i>		o		
<i>E. marina</i>		?	?	
<i>Prorocentrum scutellum</i>		o	o	
<i>P. micans</i>		o	o	o
<i>Dinophysis acuminata</i>		o	o	
<i>Glenodinium lenticula</i>		o	o	
<i>G. spinifera</i>		o		o
<i>Tintinnopsis beroidea</i>		o	o	o
<i>T. campanula</i>		o		
<i>Peridinium cinctum</i>	o			
<i>G. borgei</i>	o			

TABLE II. — *Wideky diffused species which are found in great number and for long periods thus showing evident acclimatation into the Tyrrhenian ponds.*

By all that we may deduce :

1^o) All the species recorded in table 2 are largely diffused throughout the Tyrrhenian ponds and, the two last ones excepted, have all to be considered as representatives of the Tyrrhenian brackish water's flora.

2^o) Many of the species which we have considered as brackish offer strongly marked morphological variations.

3^o) *Prorocentrum micans* is so widely spread through nearly all the environnements that, beyond being deemed eminently eurythermic and euryhaline, it can be considered, indeed, as a characteristic element of the Tyrrhenian brackish habitat and, in general, of the Western Mediterranean Sea (not taking into account the Northern African coasts). Jointly with *Prorocentrum micans* one even meets - as indicatives of these brackish waters - with, *Melosira moniliformis* and with *Tintinnopsis beroidea* and *Campylodiscus eebeneis* nevertheless, these species, although largely diffused and often observed together and sometimes even with *Striatella unipunctata*, *Synedra Gaillonii* or *Prorocentrum scutellum*, must be considered as specie and as characteristic associations.

4^o) Nevertheless, owing to the constant exchange of waters with the sea, and because of the fact, that all the hereinbefore species are met with either in sea waters as in fresh waters, a distinct specification of the phytoplankton species as exclusively brackish as in the case of some animal species, is really difficult.

5^o) With regard to the adaptability of these species in a highly selective environment, their interest becomes greater specially in respect with the study of the selective influences exercised by the habitat upon the genetic factors, and the influence which the continuous variations of the environment have upon the installed species' survival and multiplication.

SUMMARY

Phytoplankton more frequently met with in some of the ponds of the Tyrrhenian littoral is examined mainly in connection with salinity of the ponds. The author's deduction is that some of such species (*Prorodentrum micans*, *Melosira moniliformis*, *Tintinnopsis beroidea*, *Campylodiscus ecbeneis*) are characteristic of those brackish waters and that the carrying out of researches as to the environment's influences upon the genetic factors of those of the foregoing species for which it could be possible, would be of great interest.

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