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EFFECTS OF INTERANNUAL VARIATIONS ON BIOLOGICAL PRODUCTIVITY IN THE TROPICAL WESTERN PACIFIC OCEAN

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INTRODUCTION

Only in the late 70's, have the physical and biological oceanographers been aware of the importance of long term variations in the tropical ocean. The study of such variations in the western Pacific was the reason for undertaking a bi-annual transect along 165E, between 20S and 6-10N, by ORSTOM/Noumea and its SURTROPAC and PROPPAC programmes. The first cruise commenced in January 1984 and was followed by 17 others with a six-month interval, except during the 1986-1988 ENSO event, when a three-month interval could be done between July 1987 and January 1989.

Once variations of biological parameters have been described, their interpretation can be made from hydrological features as it was done previously by Herbland and Voituriez (1979) and Le Borgne (1981) for the Atlantic ocean. Zooplankton biomass was chosen as an index of the amount of living particulate organic matter in the ocean rather than phytoplankton, because it is less sensitive to short-term variability.

ZOOPLANKTON VARIATIONS ALONG 165E

For each transect, a mean biomass was computed between 20S and 6N (Fig.1). Minimum zooplankton standing stock occurs in December 1989, maximum ones, in July 1987, thus producing a ratio of 1:3 between extremes. Part of the variability may be ascribed to seasonal variations, biomasses of January transects being 3/4 of July ones, on average. The other source of variability is the ENSO event of 1986-1988, which brought both the highest and lowest standing stocks.(Dec. 89 transect being excepted) Finally, a trend towards lower values may be observed from July 1987 on, but needs to be confirmed by more transects.

RELATIONS WITH HYDROLOGY

To interprete planktonic variations, a useful parameter to consider is the depth of the nutricline, the level at

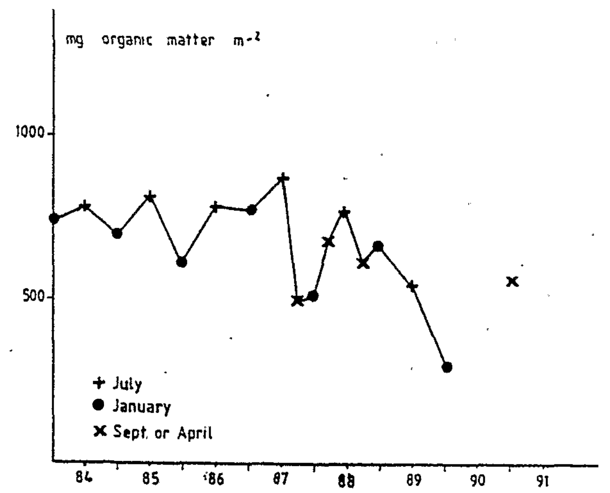

Fig.1. Mean zooplankton biomass along 165E (20S-10N).

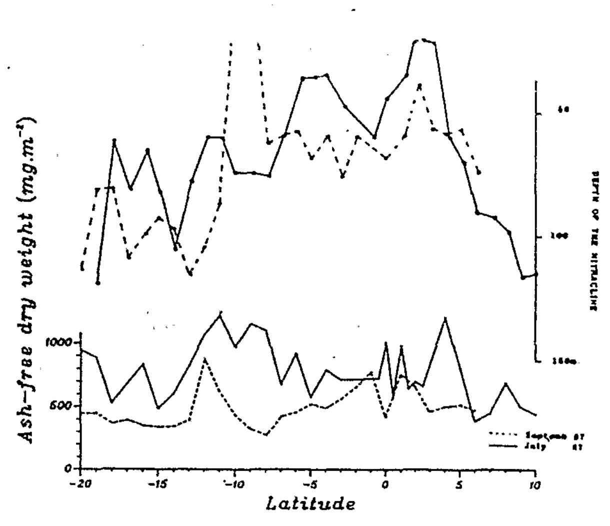

Fig.2. Zooplankton biomasses and depth of nitracline during ENSO.

which nutrient are detected in the photic layer (i.e. enlighted layer of the ocean), since they are taken up by the vegetal production (primary production). In the ocean, production is a function of nutrient inputs to the photic zone, and the depth of the nutricline is the result of a balance between uptake and inputs of nutrient: the shallower the nutricline, the greater the amount of light and the greater the production. Along 165E, a variety of situations may be observed: equatorial upwelling with surface nitrate, shallow or deep

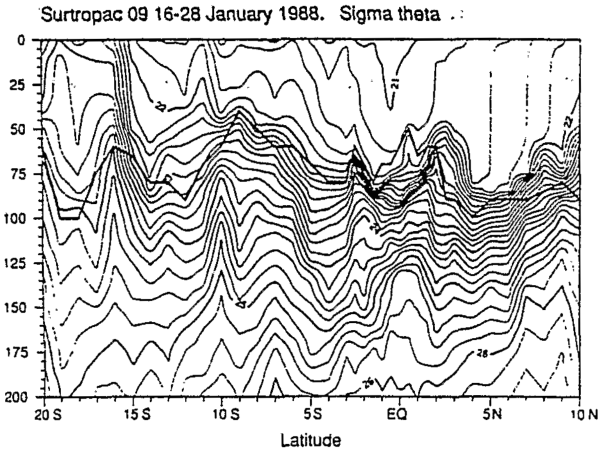

Fig.3. Vertical density (in kg.m−3) profiles in January 1988.

nitraclines (i.e. nitrate conc.>0.1 mmole.m−3) associated with low or strong density gradients. On fig.2, both the depth of the nitracline and the biomass have been shown for two transects: a shallower nitracline in July 1987 generates higher zooplankton stocks than 3 months later. However, the depth of the nutricline needs be combined with the nitrate gradient also, to allow the nitrate fluxes to be taken into account. Variations of both the depth and the nitrate gradient under the photic zone are linked with the density vertical structure : Fig.3 and 4 represent variations of density with depth along the transect during two periods with no upwelling. Although the nitracline depth is not much different, except at the equator, biomasses are much lower in December 1989. The reason deals with the nitrate content under the photic zone, which is linked closely to the density structure: the 25kg.m−3 isopycne, associated with the 5 mmole.NO3 l−1 isoline is 50m deeper in Dec. 1989 than in Jan. 1988.

Modelling such relationships is presently under study and should allow the assessment of pelagic biomasses and production to be made from hydrology, in order to follow temporal variations. It is important for fisheries and even more for the assessment of variations in the uptake of carbon dioxide by marine primary production. Thus, it has been shown by Blanchot *et al.*(1989), carbon uptake is 2.5 times greater in the equatorial area along 165E when upwelling occurs than during ENSO events.

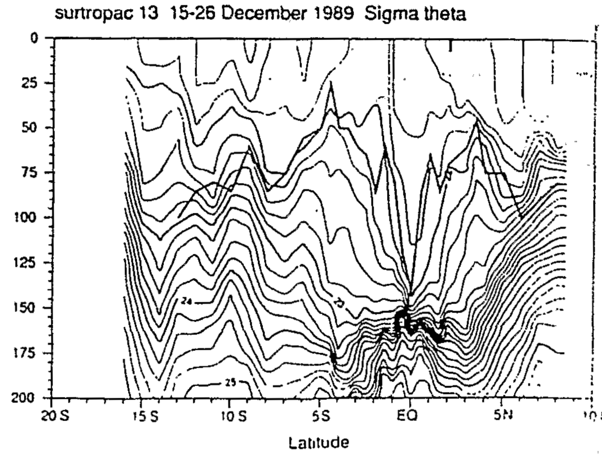

Fig.4 Vertical density profiles along 165E in December 1989.

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Questioner: Reid Basher, New Zealand Meterological Service, Wellington

Question: Does anyone have any information on what happened to fishing in the South Pacific during El Nino events?

Answer: Yes, during El Nino fishing occurs at approximately 10S whereas normal upwelling gives fishing grounds at equator. Reports from Samoa indicate reduced fishing during 1982/83, but there is confusion over other ENSO effects due to ciguateria, etc. The situation is complicated by a several year time lag due to time for juveniles to mature. Thus it is not only just the physical upwelling effects that must be considered.