Nitrogen optake regime doring ANT ARES 2 Croise
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INTRODUCTION

During the ANTARES 2 croise (26 January -27 March 1994) we studied the distribution of phytoplankton and their nitrogen uptake rates along the 62° E meridian (49°00 S -67°00 S). Our main objectives were (1) to determine phytoplankton standing stocks, nitrogen uptake and remineralization rates, (2) to identify spatial, seasonal and/or vertical patterns in the phytoplankton assemblage and nitrogen uptake regime and (3) to relate the pattern in nitrogen uptake regime with phytoplankton standing stock and with the trends in environmental factors.

METHODOLOGY

Nitrogen incubation experiments

Nitrogen uptake and regeneration processes were studied using 15N tracer techniques. Our nitrogen uptake experiments were coupled with the carbon uptake experiments conducted by Dr. C. Lancelot (GMMA, ULB). Sampling was done using 30 L Niskin boules. The position of stations, date and depth of sampling as weIl as the types of incubation experiments carried out are shown in Table 1.

Uptake rates of ammonium and nitrate by phytoplankton as weIl as ammonium regeneration by microheterotrophs were measured for surface and subsurface (at the depth of chlorophyll maximum) samples. This was done for the total population, <10 Jlm and >10 ~m phytoplankton size fractions. Additionally, we conducted incubation experiments to study the effect of reduced light intensity on the nitrogen uptake rate and the influence of increased ammonium concentration on the nitrate uptake rate.

For uptake experiments, water samples were enriched with labelled nitrate or ammonium and incubated on deck for 24 h. Uptake rates were calculated after measuring 15N abundance in the particulate material using emission spectrometry. The results reported here represent only the uptake rates of the total phytoplankton population.

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Table 1. Sampling position and types of incubation experiment carried out ANTARES 2 cruise (26 January to 22 March, 1994). SF = sizefractionated, U = rate, R = ammonium regeneration, L = light vs nitrogen uptake , IN = Inhibitory ~ ammonium on nitrate uptake rate, E = ammonium uptake kinetics

F: Station Date Position Depth (m) Exp. type
A06 25.02.94 66°42 S -61°46 E 35 SF (U, R)
A08 -1 27.02.94 63°57 S -62°02 E 40 SF (U, R)
A08 -2 27.02.94 63°57 S -62°02 E 65 SF (U, R)
A08 -3 28.02.94 63°57 S -62°08 E 65 U, R, L
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U' A04 -1 20.02.94 63°07 S -70°12 E 70 SF (U, R)
A04 -2 19.02.94 62°59 S -70°30 E 20 U, R, IN
A04 -3 21.02.94 63°10 S -70°27 E 70 U, R, L
III A04 -4 21.02.94 63°10 S -70°27 E 70 SF (U, R)
II.J- A04 -5 22.02.94 63°13 S -70°16 E 20 SF (U, R)
I A10 01.03.94 60°56 S -62°03 E 100 U, R, IN, E
A 14 05.03.94 55°01 S -62°07 E 30 SF (U, R)
lJ~ A01 -1 11.02.94 52°06 S -61°59 E 30 SF (U, R)
A01 -2 14.02.94 52°03 S -61°58 E 30 U, R, IN
A16 07.03.94 52°00 S -61°59 E 30 U, R, IN, E
<~ A 18 09.03.94 48°56 S -61°53 E 30 SF (U, R)
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~, The isotope dilution technique was used to detennine ammonium regeneration 1
I(: samples were enriched with labelled ammonium and the isotope dilution due to t unlabel1ed arnmonium through regeneration was fol1owed during the incubation P(
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Phytoplankton standing stocks
Water samples for phytoplankton counting were taken over the upper 150
every station and fixed with neutralized formaldehyde solution. Cel1s in 50 ml
were counted under inverted microscope according the Utennôhl method. Cel1 vo
calculated from cel1 dimensions using appropriate geometry .Carbon biomass w,
from cel1 volume using the conversion factors of Eppley et al.(1979).
PRELIMINARY RESUL TS
Results of nitrate and ammonium uptake rates along with ambient
concentrations and f-ratios are shown in Table 2. Only specific uptake rates a:
here since they indicate the capacity of the ecosystem to assimilate the availa
source. Moreover, it is also a physiological parameter directly influenced by el1
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d"-
and biological factors which regulate the uptake regime of nitrogen. By definition, it is
the
absolute uptake rate per unit biomass (particulate nitrogen) and has a dimension of time
(h-l).
Table 2. Ambient ammonium concentration, specific nitrate (VNO3-) and ammonium
(VNH4+) uptake rate and f-ratio during the ANTARES 2 cruise.

Station	Depth (rn)	Sarnpl. date	Sarnpl. position	NH4+ (IJ.M)	VNO3- (h-1)	VNH4+ (h-1)	f-ratlo
AO6	35	25.02.94	66°42 S -61°46 E	0.37	0.0010	0.0015	0.40
A08- 1	40	27.02.94	63°57 S -62°02 E	0.42	0.0004	0.0017	0.17
A08 -2	65	28.02.94	63°57 S -62°02 E	0.53	0.0009	0.0019	0.31
A04 - 2 & 5	20	19&22.2.94	63°00 S -70°00 E	0.35	0.0007	0.0016	0.30
A04 - 1 &3	70	21.02.94	63°00 S -70°00 E	0.08	0.0023	0.0030	0.43
A10	100	01.03.94	60°56 S -62°03 E	0.13	0.0012	0.0007	0.65
A14	30	05.03.94	55°01 S -62°07 E	0.30	0.0011	0.0013	0.47
A01 -1	30	11.02.94	52°06 S -61°59 E	0.26	0.0004	0.0002	0.66
A16	30	07.03.94	52°00 S -61°59 E	0.43	0.0016	0.0030	0.35
A18	30	09.03.94	48°56 S -61°53 E	0.48	0.0075	0.0025	0.75

Specific nitrate (VNO3-) and ammonium (VNH4+) uptake rates range, respectively, from
0.0004 h-l to 0.0075 h-l and from 0.0002 h-l to 0.0049 h-l. Similar nitrogen uptake rates
were measured by Slawyk (1979) in the same area. Uptake rates in the surface layer «40
rn)
averaged to 0.0017 h-l both for nitrate and ammonium. Excluding station A18 (49°00 S),
the
latitudinal variation in specific nitrate uptake rate was small. Moreover, ammonium
uptake
rates were slightly higher in the two northemmost stations (A16 and A18). Although few
data (stations A04 and A08) are available, both nitrate and ammonium uptake rates seem
higher for deeper samples. At these stations the fluorescence profile showed a maximum
close to the thermocline and might suggest healthy and active phytoplankton thriving
there.
Temporal variations in nitrate and ammonium uptake rates were implicated from repeated
sampling at 52°00 S (Stations A01 and A16). Station A01 was sampled almost one month
before station A16. During this period we observed an increase both ambient ammonium
concentration and uptake rates of nitrate and ammonium.
The fraction of the total nitrogen taken up as nitrate represents the proportion of new
production to the total primary productivity and is designated as f-ratio. f-ratio ranged
from
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0.17 to 0.75 (Table 2). Since correction for isotope dilution was not done at this moment
fo'
ammonium uptake rates, the ammonium uptake rates and f-ratios are minimal and maxima
estimates, respectively. Mean f-ratio in the surface water amounted to 0.44, indicating
system largely based on regenerated production (i.e. f-ratio< 0.5). At 52°00 S the
increase i
ambient ammonium concentration during one month period was accompanied by a decreas

in f-ratio. The f-ratio appears to increase with depth.
f:: : Phytoplankton biomass along the transect ranged from 326.8 mg C m-2 to 1831.3 mg m-2. The phytoplankton assemblage was characterised by dominance of dinoflagellates ar diatoms. On average, diatoms contributed 35.2%, dinoflagellates 37.4% and flagellat 27.4% of the total phytoplankton biomass. High diatom biomass was observed betwe~ ~I, 58°00 S -64°00 S. Flagellate biomass was higher in the northernmost and southern mc stations.
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