CRUISE REPORT

MICROVIR

(64PE217)

2 July – 30 July 2007

Ship : **RV Pelagia**

Cruise Name : **MICROVIR (Virus control of the picophytoplankter *Micromonas pusilla* population dynamics in European waters)**

Cruise Number : **64PE217**

Cruise Period : **2 – 30 July 2007**

Port of departure : **Brest, France**
Port of return : **NIOZ harbour – Texel, Netherlands**

Responsible Institute : **Royal Netherlands Institute for Sea Research (NIOZ)**
Landsdiep 4, 1797 SZ 't Horntje, Texel, The Netherlands

Chief Scientist : **Dr. C. P.D. Brussaard**
Dept. Biological Oceanography

Introduction

Recently, understanding and preserving marine biodiversity has become an important issue and renewed the interest in marine microbial processes. Detailed fundamental knowledge of factors controlling marine biodiversity is crucial to an optimal interpretation and evaluation of estimates on marine biodiversity. Viruses have been recognized as biological agents regulating population dynamics, succession and diversity of the host organisms in marine systems. Viruses infect and lyse many members of the microbial food web including phytoplankton. Viral lysis of an algal host population generally occurs within one day, which indicates that viruses can have a strong impact on phytoplankton population dynamics. Because viruses are typically host-specific pathogens and regularly exhibite a high degree of strain specificity, viral infection impacts specific phytoplankton populations and thus enhances interspecies, and even intraspecies, diversity.

The first evidence of infective algal viruses in seawater was provided for the naked, highly motile flagellate *Micromonas pusilla* of 1-3 µm diameter 25 years ago. *M. pusilla* belongs to the class Prasinophyceae which is considered to have given rise to green algae and land plants. The regulatory role of virus infection for *M. pusilla* population dynamics, production and diversity is nonetheless still poorly studied. Furthermore, with the recent awareness that marine eukaryotic picoplankton (0.2-3 µm diameter) are the most abundant eukaryotes on Earth, research on the relative importance of *M. pusilla* to the total phytoplankton community in time and space is warranted and timely. Despite the fact that *M. pusilla* is considered widely distributed in both oceanic and coastal waters, only a limited number of field studies have actually recorded its presence probably because traditionally the identification of this small flagellate is difficult. Very recently, the development of specific DNA oligonucleotide probes for *M. pusilla* showed that *M. pusilla* is a significant component of phytoplankton communities, even dominating the picoplankton community at a coastal site of the western English Channel all year round.

Viruses have been suggested as an important factor regulating *M. pusilla* population abundance, where the viruses maintain a stable coexistence with the algal host and viral infection keeps the algal biomass below blooms abundance. Decreases in the abundance of *M. pusilla* in the English Channel have been suggested to be due to viral infection. The ability of *M. pusilla* to recover rapidly may indicate the proliferation of one a different *Micromonas* genotype, resistant to the infection of the dominant virus type. Indeed, recent studies showed that the diversity of the genus *Micromonas* is quite complex, consisting of several independent clades.

Viruses infecting *M. pusilla* (MpV) are widespread, originating from coastal waters of New York, Texas, California, British Columbia, Sweden, Italy and The Netherlands, as well as oligotrophic waters of central Gulf of Mexico, Southern Ocean, and central North Sea (MpV isolates from Dutch coastal waters and central North Sea by Brussaard, unpubl. results). The occurrence and abundance of MpV, as well as the genetic diversity and clonal variation of MpV, its impact on *M. pusilla* mortality and population dynamics, have not been studied in European waters.

Furthermore, only two studies actually reported viral mortality rates for *M. pusilla*, but none relate to natural field situations in European waters. The studies do suggest that viruses may be an important mortality factor of *M. pusilla* with a major potential to impact population dynamics. However, complete data set and precise measurements of virally mediated mortality of *M. pusilla* in European waters are lacking. The limited knowledge on virally induced mortality of *M. pusilla* indicates that the loss rate due to viral infection is comparable to microzooplankton grazing rates for picophytoplankton in the size class of *M. pusilla*. Whether phytoplankton are grazed upon or die due to viral lysis, however, has major implications for biogeochemical cycles in marine pelagic food webs. The subsequent release of the algal cell content into the surrounding water upon lysis will result in DOM production, which directly promotes bacterial production. Ecosystem models including virally mediated lysis of phytoplankton show that up to 26% of the organic carbon flows through the viral shunt, with a 33% increase in bacterial production and respiration. Furthermore, a rapid release of intracellular DMSP to the dissolved pool due to viral lysis of *M. pusilla* has been reported. Since DMSP is the principle source of DMS and its release fascilitates bacterial degradation to this trace gas that affects cloud cover, viral lysis might indirectly influence global climate. However, to what extent viral lysis of *M. pusilla* occurs under natural conditions and thus, to what degree it contributes to biogeochemical fluxes is still largely unknown.

Our study is set up to clarify the ecological importance of virus infection for the widely distributed picoplankter *M. pusilla*. Through an integrated study the occurrence and abundance of MpV, as well as the genetic diversity and clonal variation of MpV, and the impact of viruses on *M. pusilla* mortality and population dynamics will be assessed. Different geographical locations will be studied on a temporal scale in order to allow unique and optimal insight into the contribution of *M. pusilla* and its specific viruses to C-flux within the pelagic food web. It will be for the first time that a detailed comparative study on the importance of *M. pusilla* and virus infection as regulating factor will be executed on such a spatially as well as temporarily scale. Newly developed techniques will be used to detecte and quantitate M. pusilla and specific virus. The present study will also explore the existence of distinct populations of MpV for the different study sites. The results of this timely proposed project will largely advance our comprehension of the importance of picophytoplankton and viral control of picophytoplankton population dynamics. The results are expected to provide new insights in our understanding of the functioning and structure of marine pelagic food webs and geochemical cycling. The obtained data will, furthermore, be essential for a more accurate evaluation of mathematical ecosystem models.

The MICROVIR cruise

The MICROVIR cruise, 2 to 30th of July 2007 from Brest, France to Texel, Netherlands. The cruise track is shown in Figure 1, the station details in Table 1 and the participant and crew list in Table 2. This cruise was undertaken as part of larger integrated study with the main merit of assessing the occurrence and abundance of MpV, as well as the genetic diversity and clonal variation of MpV, and the impact of viruses on *M. pusilla* mortality and population dynamics. Different geographical locations were studied in order to allow unique and optimal insight into the contribution of *M. pusilla* and its specific viruses to C-flux within the pelagic food web. It is for the first time that a detailed comparative study on the importance of *M. pusilla* and virus infection as regulating factor is executed on such a spatially scale. Newly developed techniques will be used to detecte and quantitate *M. pusilla* and specific virus. The present study will also explore the existence of distinct populations of *M. pusilla* and MpV for the different stations. The results of this timely project will largely advance our comprehension of the importance of picophytoplankton and viral control of picophytoplankton population dynamics. The results are expected to provide new insights in our understanding of the functioning and structure of marine pelagic food webs and geochemical cycling. The obtained data will, furthermore, be essential for a more accurate evaluation of mathematical ecosystem models.

Highest abundance of *M. pusilla* in the North Sea is expected during summer, explaining the timing of the cruise. Stations were strategically located, representing N-Atlantic water coming in from the English Channel and via the northern part of the North Sea, French and English coastal waters, water from the Skagerrak, and all the different combinations of these waters. As expected, the southern stations represented well mixed conditions whereas the other stations showed clear stratification.

We optimally used the unique opportunity to combine the detailed work on *M. pusilla* and its viruses with more general viral ecological studies focussing on the phytoplankton community, the bacterial community and the viral community in the pelagic as well as the sediment. Besides taking water samples from different depths using a CTD-ROS sampling device (22 bottles of 10 Liter each), we also sampled the benthic boundary layer using a 5 Liter Niskin bottle with a trip weight, a boxcore for sediment samples, a horizontal (10 µm mesh-width) and a vertical (200 µm mesh-width) net, and an in situ pump with a glass fiber filter (GF/C; nominal pore size 1.2 µm). Additional information on the type of watermass was obtained from the ship's clean Aquaflow system for direct measurements of temperature, fluorescence and optical backscatter.

Only some of measurments could be analysed on board, e.g. macronutrients, fresh counts of phytoplankton, numerous samples were stored for later analysis at the laboratory.

Detailed description of the different scientific activities can be found in the following section.

Table 1. Station details MICROVIR – 64PE271 cruise with R/V Pelagia.

Station #	date/time	Lat	Lon	Depth
1	Jul 03 2007 06:15:18	48.76945	-3.94673	65
2	Jul 05 2007 00:09:56	49.16993	-4.83013	101
3	Jul 05 2007 08:25:05	49.32992	-3.32985	76
4	Jul 07 2007 04:33:57	50.00003	-1.00055	57
5	Jul 07 2007 12:12:26	50.20327	0.33052	39
6	Jul 09 2007 04:01:54	51.66628	1.88335	47
7	Jul 09 2007 14:04:25	53.16975	2.87078	32
8	Jul 11 2007 03:04:31	54.4127	4.05228	47
9	Jul 12 2007 06:59:02	54.50032	0.99983	56
10	Jul 12 2007 16:36:10	55.68055	2.27955	83
11	Jul 14 2007 03:03:27	57.00097	3.99947	61
12	Jul 16 2007 19:12:44	57.33052	-0.32993	75
13	Jul 17 2007 22:01:57	58.32982	-0.82953	116
14	Jul 18 2007 07:18:30	59.16977	0.67108	124
15	Jul 19 2007 17:26:04	59.67003	-1.50105	97
16	Jul 20 2007 01:38:42	60.33017	-3.49932	139
17	Jul 21 2007 18:29:24	61.32993	-1.29967	217
18	Jul 22 2007 07:03:29	61.00018	1.99887	133
19	Jul 24 2007 03:04:41	59.33037	4.33015	267
20	Jul 25 2007 06:03:43	57.9195	6.32915	324
21	Jul 25 2007 16:56:04	57.6699	8.67497	142
22	Jul 27 2007 07:31:17	56.50065	7.17197	36
23	Jul 29 2007 07:05:40	55.49988	5.99958	50

Table 2. R/V Pelagia Cruise MICROVIR Participants and Crew listing.

PARTICIPANTS LIST	In alphabetic order…
Name	**Institute/University**
Baas, M. (%)	Royal NIOZ
Brandsma, J. (&)	Royal NIOZ
Brussaard, C.P.D. (Chief Scientist)	Royal NIOZ
Evans, C.	Royal NIOZ
Faber, E. (%)	-
Foulon, E.	Station biologique de Roscoff, France
Hegeman, J.	Royal NIOZ
Martinez, J.	Royal NIOZ
Masquelier, S.	Station biologique de Roscoff, France
Ooijen, J.C. van	Royal NIOZ
Oosterhuis, S.S.	Royal NIOZ
Sa Lago, E.L.	CSIC, Barcelona, Spain
Schmelling, J.W.	Royal NIOZ
Stehouwer, P.P.V. (&)	-
Witte, H. (&)	Royal NIOZ
(%) = Depart on 16th July in Aberdeen, Scotland	**(&) = Embark on 16th July in Aberdeen, Scotland**
CREW LIST	In alphabetic order…
Ellen, J.C. (Captain)	MAS
Heide, R. van der	ST
Kleine, M.D.M. de	2_ENG
Kralingen, J.S. van	2_OFF
Maas, J.J.M.	ST
Mik, G.	CK
Pronk, W.	ST
Seepma, J.	CHENG
Stap, S. van der	CHOFF
Vermeulen, G.P.	AB

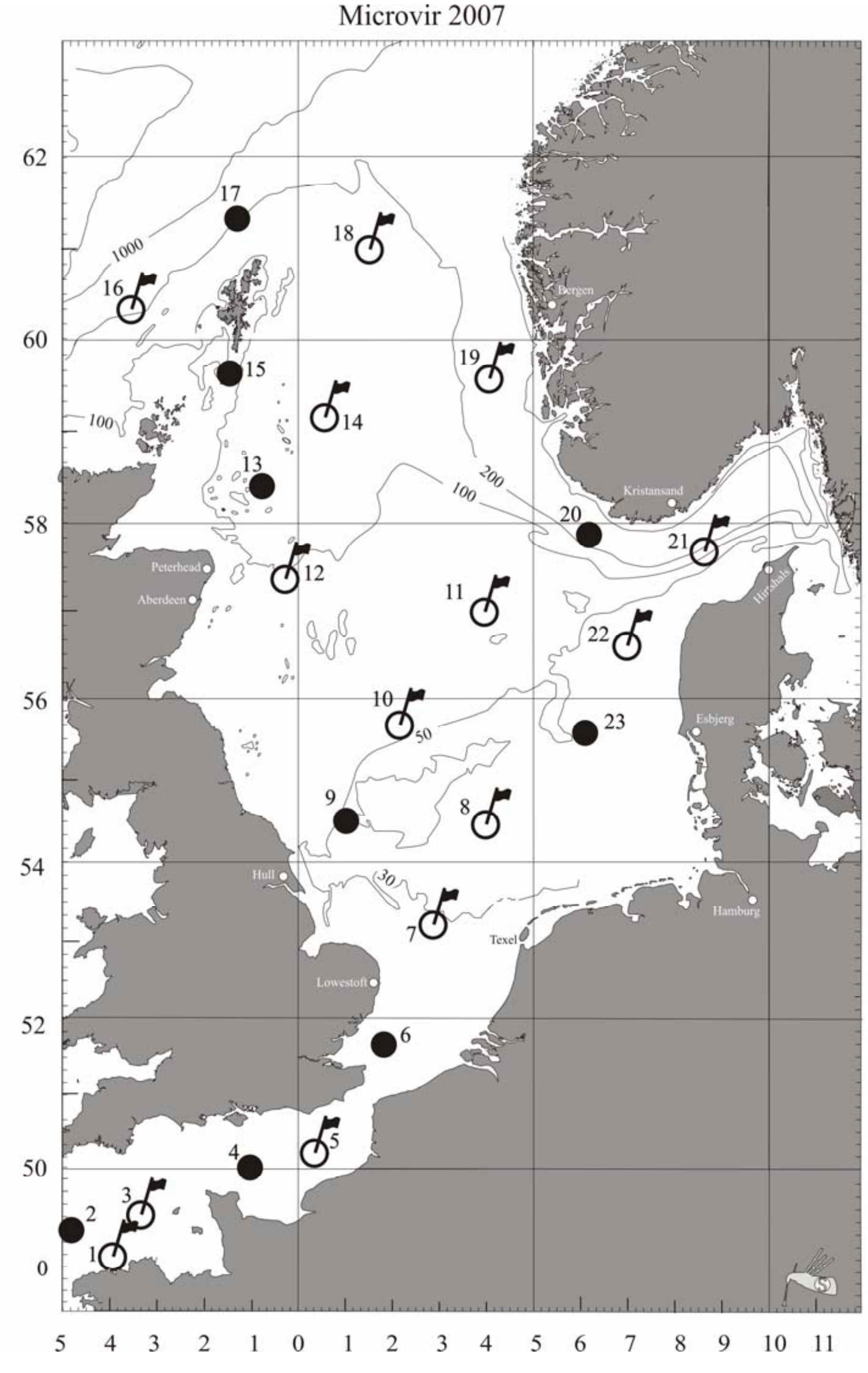


Fig. 1. Cruise track MICROVIR. Flagged stations are the main process stations (CTD, Niskin, Nets, In situ pumping and Boxcoring), whereas the black circles indicate the station at which only CTD-sampling was performed.

Scientific activities:

Nutrient measurements

- Jan van Ooijen –

About 500 samples were taken for the shipboard determination of the nutrients Ammonium, Nitrate + Nitrite (NOx), Phosphate and Silicate. The samples were taken from a Niskin bottle, Incubation Experiments and from NOEX bottles attached to the CTD-frame. These last samples were collected in polypropylene sample bottles after three time rinsing. All samples were filtered on a 0.20 um acrodisc filter, put in a 6ml polyethylene vial and stored dark and cool in a refrigarator at 4°C and were analysed within 18 hours with a autoanalyser based on colorimetry using a Seal Analytical QuAAtro Autoanalyser. A maximum of 40 samples in each run was analysed and all samples were covered during the run with parafilm to prevent evaporation of water and contamination of ammonium out of the air. The methods used were described by Grashoff (1983) and are as follows:

- Phosphate reacts with ammoniummolybdate at pH=1.0 and potassiumantimonyltartrate was used as an inhibitor. The yellow phosphate-molydenum complex was reduced by ascorbic acid to a blue complex and measured at 880nm.
- Nitrate + Nitrite were mixed with a buffer of Imidazol at bpH=7.5 and the nitrate was reduced to nitrite by a copper-coated acdmium coil (efficiency >97%). The total of nitrite was diazotated with sulphanilamide and naphtylenediamine to a pink coloured complex and measured at 550nm as NOx. The reduction efficiency of the cadmium coil was measured each run.
- Ammonium reacts with phenol and sodiumhypochlorite at pH=10.5 to a indo-phenolblue complex. Sodiumcitrate is used as a buffer and complexant for calcium and magnesium at this pH. The colour is measured at 630nm.
- Silicate reacts with ammoniummolybdate to a yellow complex which, after reduction with ascorbic acid forms a blue silica-molybdenum complex that was measured at 800nm. Oxalic acid was used to prevent the formation of a blue phosphate-molybdenum complex.

Calibration standards were prepered freshly every day by dilluting stock solutions of each nutrient in the same nutrient depleted surface ocean water as used for the baseline water. Standards were kept dark and cool in the same refrigarator as the samples. Each run of the system had a correlationcoefficient of at least 0.998. The samples were measured from the surface to the bottom to obtaine the smallest possible carry-over effects. In each run a mixed control standard containing silicate, phosphate, nitrate and ammonium in a constant and well known concentration was measured. This standard was used to check the performance of the analyses and if necessary used to make corrections.

Table 3. The statistics of the analyses within 1 run.

Control Standard	**Phosphate µmol/L**	**Ammonium µmol/L**	**NOx µmol/L**	**Silicate µmol/L**
Average	0.873	0.803	14.008	13.670
Standard deviation (uM)	0.003	0.020	0.017	0.016
St.dev. % full scale	0.31	0.43	0.11	0.09

Table 4. The statistics of the analyses between the different runs.

Control Standard	**Phosphate µmol/L**	**Ammonium µmol/L**	**NOx µmol/L**	**Silicate µmol/L**
Average	0.868	0.800	14.001	13.705
Standard deviation (uM)	0.005	0.025	0.043	0.064
St.dev. % full scale	0.50	0.56	0.29	0.35

Primary production and bacterial production

- Jan Hegeman -

For the primary production samples were taken on all main-stations on three depts. These samples where divided over fourteen 250ml polycarbonate bottles. Six bottles with the surface water, four with the middle water and four with the lower water. In each bottle 5 mCi C-14 bicarbonate was added. The bottles were divided over 7 glas tubes covered with a foil to get 7 different light values. After 24 hours incubation the water in the bottles was filtrated over Whatman GFF glassfiber filters and those were stored in scintillationvials in the freezer.
For the bacterial production samples were taken on all main-stations on three to four depts. Of each sample three greinertubes were filled with 10 ml seawater. One of the three was killed with 0.5 ml concentrated formaldehyde as a blank. Then 40 microliter of a H3-Leucine solution with a concentration of 5 mCi/3ml was added and all tubes were mixed. Incubationtime was 2 hours at seawatertemperature and after that to the tubes containing live bacteria 0.5 ml folmaldehyde was added and they were mixed. Filtation was done over 0.5 micron membrane-filters and those filters were stored frozen in scintillationvials.

Phytoplankton, bacterial and viral abundance sampling

- Lisa Faber, Peter Paul Stehouwer and Corina Brussaard -

For all stations of the cruise samples were taken for phytoplankton, bacteria, viruses and infective viruses. Samples for abundance were taken at every depth from each CTD.

Phytoplankton samples were measured fresh using flow cytometry. The sample for infective viruses (15 mL) was stored at 4°C. The other samples including a spare sample for the phytoplankton were fixed, either with glutaraldehyde (0.5% final) or with paraformaldehyde/glutaraldehyde (1%/0.05% final). Samples were flash frozen after fixing for 15-30 min at 4°C. Bacterial samples were analysed on board; further analysis will be performed in the home laboratory.

For the algal composition study, Lugol-fixed samples (100 mL of sample and 2 mL of Lugol's iodine solution) were taken from 2-3 depths per station and stored in the fridge until further analysis.

The basic instrument applied in the single cell analysis of the phytoplankton community were a bench top flow cytometer Coulter XL-MCL and the Becton Dickinson FacsCalibur. These instruments are equipped with a 15mW Argon laser (488 nm excitation) and have emission in the green, orange, and red. In addition forward and side (90º) light scatter are collected. In its basic configuration the size range on the instrument ranged from 2 to ca. 30 µm.

Fresh phytoplankton populations were discriminated using red chlorophyll autofluorescence and scatter (Figure 2). The species/group composition was characterised based on the cellular bio-optical properties, forward- and side scatter and chlorophyll fluorescence, of the algal cells. The main groups were cyanobacteria (phycoerythrin containing *Synechococcus)*, two populations of picophytoplankton and 1-2 populations of nanophytoplankton.

The preliminary results show variable abundances of the picoeukaryotes group at different locations and depths. Cyanobacterial abundance was most often the highest (up to 90% of the total algal abundance obtained by flow cytometry). At stations influenced by North Atlantic water, the relative abundance of pico- and nanophytoplankton was enhanced. Stations with stratified water column clearly showed reduced red autofluorescence of the cyanobacteria in the surface waters. Deep chlorophyll maximum was usually found between 25 and 40 m.

The target species for the MICROVIR cruise, *Micromonas*, belongs to the picophytoplankton. Based on its flow cytometric signature we found it to be present at all stations. However, other picophytoplankters such as *Bathycoccus* showed an overlapping flow cytometric signature. *Ostreococcus* could be distinquised from the other species tested (*Synechococcus sp., Bathycoccus sp., Micromonas pusilla* (various strains), *Phaeocystis globosa, Emiliania huxleyi*). Fluorescent in situ labelling will prove which stations had *Micromonas*, which specific strains of this algal species were present, and in what abundance.

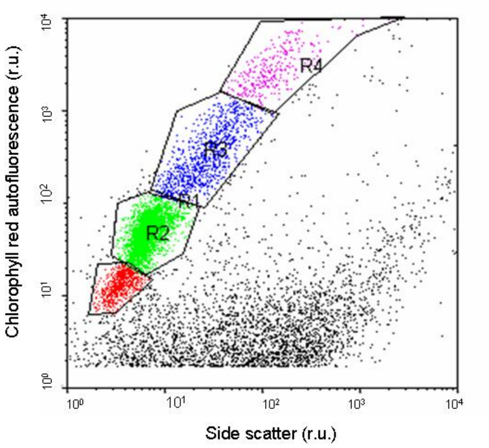


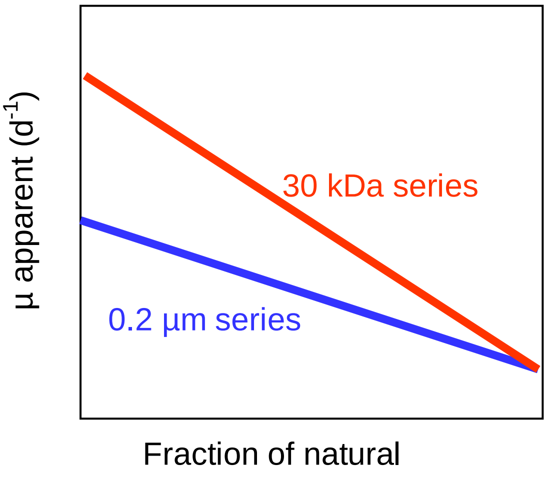
Fig. 2. Typical example of phytoplankton populations in the surface waters.

Phytoplankton viral lysis and microzooplankton grazing ates

- Joaquín Martínez Martínez, Harry Witte and Corina Brussaard –

An adaption of the dilution assay by Landry & Hassett (1982), to estimate simultaneously viral lysis and microzooplankton grazing, was performed at thirteen main stations visited during the Microvir cruise. Series of dilutions were prepared to measure 24h loss rates in the pico- and nanophytoplankton. For each experiment 20 Liters of natural water from 10 m depth (from the CTD-Rosette sampler) were directly placed at in situ temperature and in dimmed light. Ten liters were filtered through AcroPak 200 SUPOR membrane filters with a pore size of 0.2 µm to produce grazers-free water. The principle is that the removal of grazers by dilution allows the algal cells to increase in standing stock over 24 h. The difference in algal concentration over the day provides the growth rate. Plotting the growth rate against the dilution, the slope of the linear regression represents the loss rate due to microzooplankton grazing. Statistical analysis is used to test the significance of the slope. The remaining 10 L were filtered using Vivaflow 200 cartridges (Sartorius) with a 30 KDa cutoff to produce grazers and virus-free water, which provides the loss rate of grazing and viral lysis. From the difference between the two dilutions series the actual virally mediated algal mortality rate can be calculated. Using polycarbonate incubation bottles, natural water (sieved through 200 um mesh-size) was diluted with 0.2 µm and 30 KDa filtered water to 100, 70, 40 and 20% of the total volume (all dilutions in triplicate). Subsamples were taken for flowcytometric counting of the algae (<20 um diameter) at T=0. All incubation bottles were closed (without air bubbles) and placed in an incubator at in situ temperature and irradiance. The sampling and counting of fresh samples was repeated in the same order after 24 hours.

Data processing will be done back in the homelab. Preliminary data analysis shows that 4-5 subpopulations could be distinguished, consisting of cyanobacteria, 2 groups of picoeukaryotic phytoplankton and 2 groups of nanophytoplankton.



0.2 µm diluent : no grazer , virus
slope = grazing rates **G**

30 kDa diluent : no grazer , no virus
slope = grazing + viral lysis rates **G+V**

Thus, viral lysis rate **V** = **(G+V) - G**

Fig. 3. Dilution method principle.

Abundance and diversity of viruses in the North Sea

- Joaquín Martínez Martínez, Harry Witte and Corina Brussaard –

As part of the MICROVIR cruise we have collected samples to investigate the abundance and diversity of aquatic viruses and especially viruses infecting the picoalga *Micromonas pusilla* (MpV) at the 23 different stations in the North Sea using flow cytometry and algal cultures that received natural seawater (10% v/v) in order to screen for infectious algal viruses. In the case of *M. pusilla*, we performed a more detailed screening using the dilution series (MPN) approach so we knew not only that infectious viruses were present but also in what numbers. Exponentially growing algal cultures were used for these screenings. The whole seawater samples collected originated from different depths, between 10 and 50 m, as well from the top layer of the sediment. The inoculated cultures were incubated at their optimum temperature (15 or 22°C) under a light:dark cycle of 12:12 h at 40-50 µmol photons m^{-2} s^{-1}. Cultures without addition of natural seawater served as negative controls. The cultures were visually inspected for clearance (i.e. lysis) and/or for loss of chlorophyll autofluorescence using spectrofluometry for a period of 2-3 weeks. Those cultures that did lyse within this period of time were considered susceptible to infection by viruses in the seawater samples. Subsamples of these cultures will be further propagated and tested for virus particles in the home laboratory.
Furthermore, the study of MpV diversity will be complemented by the phenotypic characterization (i.e. morphology, genome type and size, host range, lytic cycle) of new MpV isolates obtained during the cruise.

Preliminary data indicate that we found infectious MpVs at most stations and for the different depths. Abundance of these infectious MpVs varied with type of *M. pusilla* host strain and station. Also other algal species tested (*Bathycoccus*, *Ostreococcus*, *Synechococcus sp., Phaeocystis globosa, and Emiliania huxleyi*) showed regularly clearance of cultures to which natural seawater was added.

We sampled for viral community composition by concentrating larger volumes of whole seawater by tangential flow filtration using Vivaflow 200 cartridges (Sartorius) with a 30 KDa cutoff. The virus community composition in these samples will be studied using Pulse Field Gel Electrophoresis (PFGE). PFGE is a technique used to separate especially long strands of DNA by length in order to tell differences among samples. It operates by alternating electric fields to run DNA through a gel matrix of agarose. The virus community composition will be given as the number of whole genome bands with different sizes. Most of the known MpVs have a dsDNA genome of approximately 200 Kb. Therefore, the presence of bands this size will potentially indicate the presence of MpVs. In addition, the relative abundance of different virus types can be estimated based on the band intensities. At each station 2-3 depths were sampled. Analysis will be performed at the home laboratory.

Additionally, we intend to go further in the investigation of the *M. pusilla* and their co-occurring virus dynamics by assessing changes in their genotypic composition using specific primers. Seawater was collected at several stations from a depth profile. From each depth sample, 3-6 L of seawater were filtered onto 0.22 µm pore size Sterivex-GP filters (Millipore). The filters were snap frozen in liquid nitrogen and stored at -80°C until further processing for total genomic DNA preparations. The samples will then be analyzed using standard and quantitative PCR, denaturing gradient gel electrophoresis (DGGE) and sequencing techniques. These techniques allow quantitative and qualitative analysis of the MpV-diversity based on differences at the nucleotide level of the chosen genes.

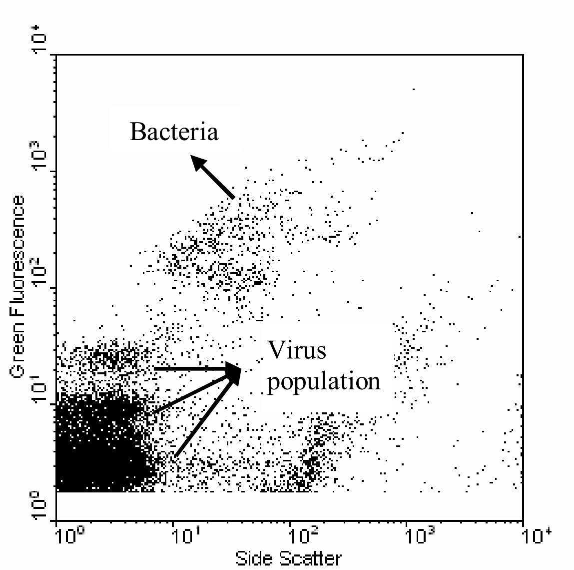


Fig. 4. Representative flow cytometric dot plot showing populations of viruses and bacteria in a sample of natural seawater of station 19.

Richness and diversity of algal and bacterial hosts

- Joaquín Martínez Martínez, Harry Witte and Corina Brussaard –

Samples for qualitative genotypic composition of the algal and bacterial host communities were taken at each station at 2-3 depths, corresponding to the depths of interest for the grazing and viral lysis assays of algae and bacteria. Seawater was collected at several stations from a depth profile. From each depth sample, 3-6 L of seawater were filtered onto 0.8 µm pore size Supor-800 47 mm diameter filters (PALL Corp). The filters were snap frozen in liquid nitrogen and stored at -80^{o}C until further processing for total genomic DNA preparations. The samples will then be analyzed using standard PCR, denaturing gradient gel electrophoresis (DGGE) and sequencing techniques.

Quantitative distribution of picophytoplankton

- Elodie Foulon and Sylvie Masquelier -

During the MICROVIR cruise, we sampled for phytoplankton distribution using Tyramide Signal Amplification Fluorescence *in situ* Hybridization (TSA-FISH) and DAPI (4'6-diamidino-2-phenylindole).

Filters for Tyramide Signal Amplification Fluorescence *in situ* Hybridization (TSA-FISH) were prepared at each station for 2-5 depths ranging from 10 to 200 m. The TSA-FISH technique consists of detection of target cells by hybridizing specific probe which is coupled with an enzyme (Horse Radish Peroxidase) which allows the amplification of the fluorescent signal (see example of hybridization, Figure 5). The use of probes targeting ribosomal RNA and specific to main groups of phytoplankton will allow us to detect and count total eukaryotes, Chlorophyta, Prymnesiophyceae, and the Prasinophyceae. Organisms will be separated into three size classes: smaller than 2 µm, between 2 and 5 µm, larger than 5 µm. Three species of Prasinophyceae, *Micromonas pusilla, Bathycoccus prasinos*, and *Ostreococcus tauri* will be studied with particular attention. Concerning *Micromonas pusilla*, detailed attention will be paid to the distribution of the different genetic clades.

Two types of filters were achieved: filters obtained after prefiltration through 200 µm and filters obtained after prefiltration through 3 µm. For each filter, 90 mL of sea water was fixed for 1 hour at 4°C with paraformaldehyde 10% (1% final concentration) and then filtered through an Anodisc 0.2 µm filter. Steps of dehydration with Ethanol 50% (3 min), 80% (3 min) and 100% (3 min) followed the filtrations. Two replicates were taken for each sample. Filters were stored at room temperature during the cruise and at -80°C back in the lab; or directly at -80ºC for the filters taken for and experiment by J. Martinez. Analysis and data processing will be done back in the lab.

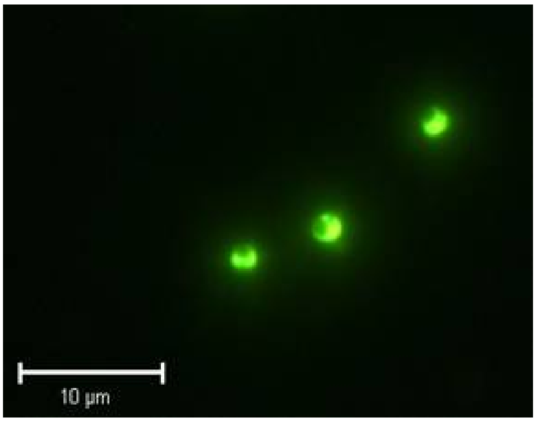


Fig. 5. Culture of *Micromonas pusilla* hybridized with the probe Micro01 (specific to *M. pusilla*).

At each process station filters were stained with the intercalating dye DAPI (4'6-diamidino-2-phenylindole, 5 µg mL^{-1} final concentration). DAPI staining and epifluorescence microscopy allowed us to discriminate eukaryotic from prokaryotic organisms under UV light (360/420 nm) based on the blue staining of the cell nucleus. The presence of chlorophyll under blue light (490/515 nm) allowed us to discriminate autotrophic (photosynthetic) from heterotrophic eukaryotes. The filters will be used principally to count diatoms, dinoflagellates and ciliates, these two later being potential grazers of picophytoplankton.

For each filter, 99 mL of sea water (prefiltration on 200 µm) was fixed with 1 mL of Glutaraldehyde 25% (0.25% final concentration) and then filtered through black 0.8 µm filters. Each filter was placed between slide and cover glass and conserved at -20°C.

Preliminary observations showed that the English Channel plankton community was mainly composed of picoorganisms while in the North Sea, diatoms, dinoflagellates and ciliates seemed to be dominant at certain stations. For example, diatoms were very abundant at stations 5 and 18 and a lot of autotrophic and heterotrophic dinoflagellates were observed at stations 10 and 12 (Figures 6, 7 and 8). Further analysis and data processing will be done back in the lab.

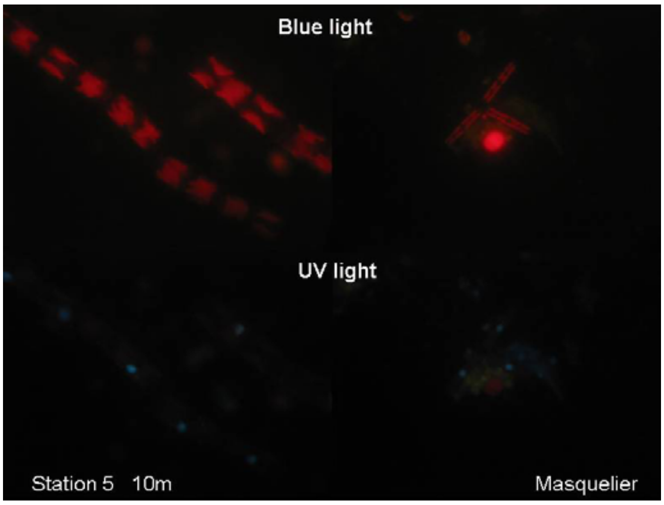


Fig. 6. Pictures of diatoms taken under blue and UV light at station 5 (10m depth), objective 40x.

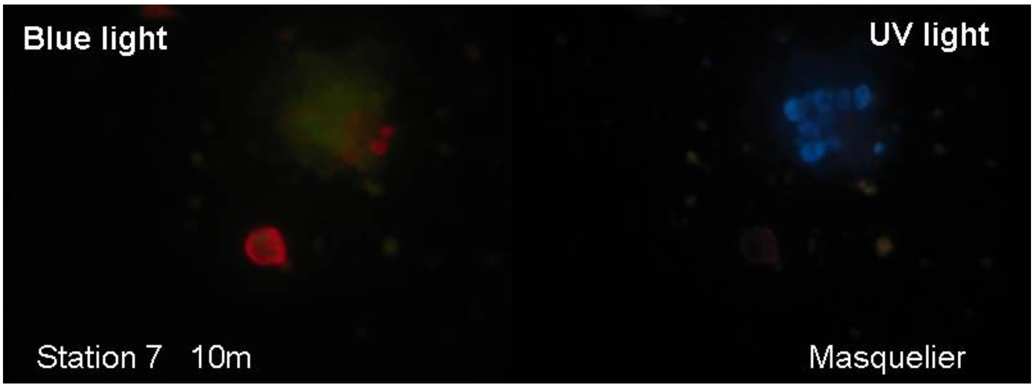


Fig. 7. Autotrophic dinoflagellate and ciliate taken under blue and UV light at station 7 (10m), objective 40x.

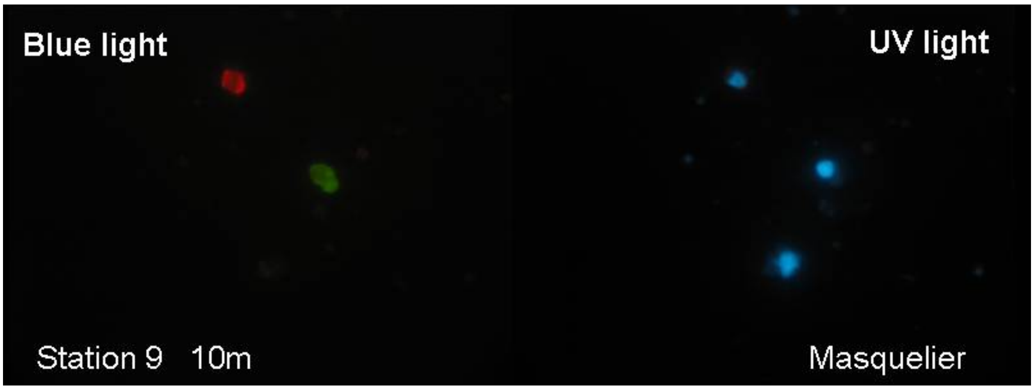


Fig. 8. Autotrophic and heterotrophic dinoflagellates taken under blue and UV light at station 9 (10 m), objective 40x.

Identification of phytoplankton by light microscopy

- Elodie Foulon and Sylvie Masquelier -
Analysis will be performed by Fabien Jouenne

At each process station plankton was collected with a net of 10 µm mesh at the surface during 10 minutes. Samples (50 mL x2) were fixed with 570 µL of acetic formol and kept at room temperature in the dark. Furthermore, 250 mlLof sea water from the depth of chlorophyll maximum (DCM) were also collected and fixed with 2.5 ml of Glutaraldehyde 25 % (0.25% final concentration) in order to take some images of organisms, undamaged by the net. After identification, all these samples will provide qualitative information on microphytoplankton diversity in the English Channel and the North Sea. Moreover, they allow us to observe the presence of the potential grazers of phytoplankton such as ciliates and heterotrophic dinoflagellates. Pictures taken on these samples will be further added to an image set dedicated to the Microvir Cruise, on the Plankton*Net node of Roscoff (http://planktonnet.sb-roscoff.fr).

Preliminary observations showed that cells larger than 10 µm were rare or absent in the samples from the English Channel while they appeared more abundant in the North Sea (Figure 7). These results corroborate the ones obtained by DAPI staining and epifluorescence microscopy. Analysis and data processing will be done back in the lab by Fabien Jouenne.

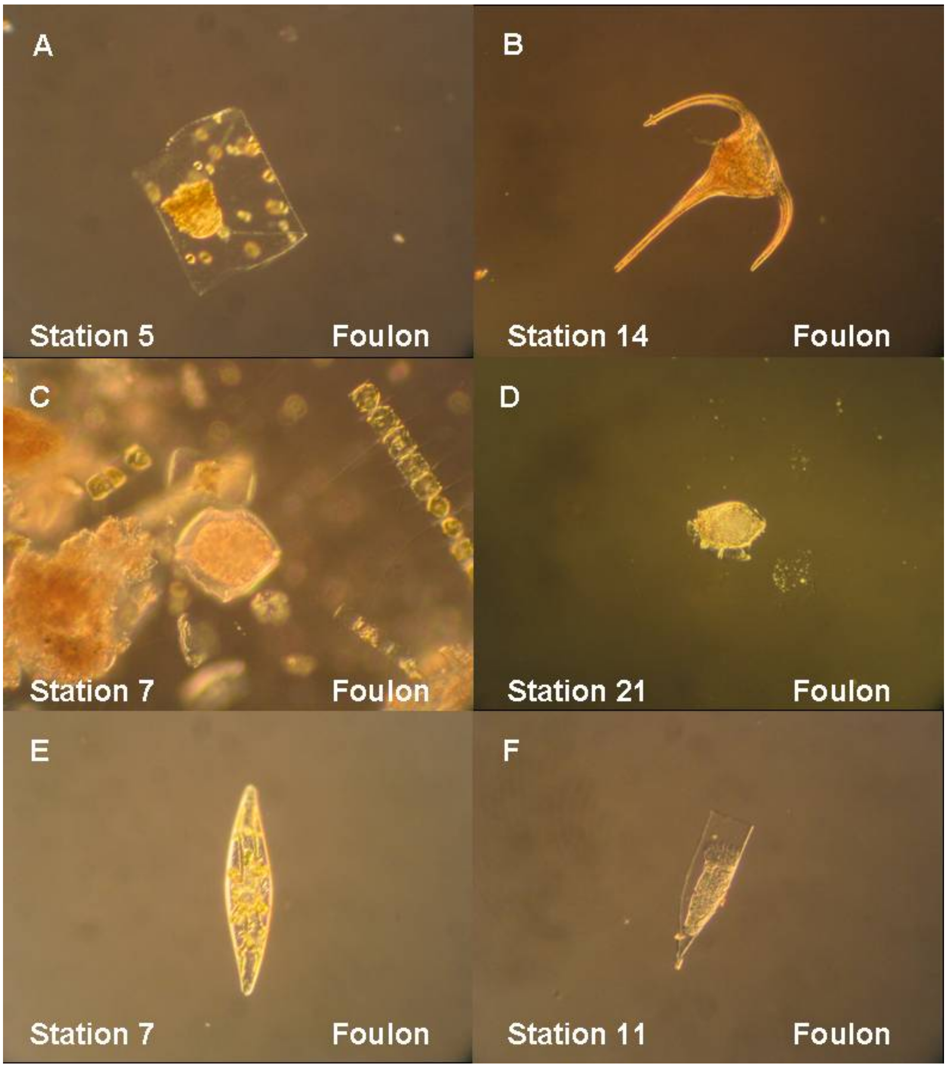


Fig. 9. Pictures taken on light microscopy. (A) diatom *Guinardia* sp. from station 5, objective 20x; (B) dinoflagellate *Ceratium* from station 14, objective 10x; (C) mix of dinoflagellates (*Protoperidinium* sp.) and diatoms from station 7, objective 10x; (D) dinoflagellate (*Dinophysis* sp.) from station 21, objective 10x; (E) diatom (*Pleurosigma* sp.) from station 7, objective 20x; (F) ciliate (tintinnid) from station 11, objective 10x.

Other scientific activities by E. Foulon and S. Masquelier

At each process station, various samples were collected for colleagues at the Station Biologique de Roscoff, France.

1) Serial dilutions were realized in order to isolate cultures of picoplanktonic strains which will improve the RCC (Roscoff Culture Collection: www.sb-roscoff.fr/Phyto/RCC/index.php). Seawater (20 mL) from surface and DCM were filtered on 1.2 µm by gravity. Serial dilutions were realized in three different medium (K medium, medium specific for Chrysophyceae, medium specific for Cryptophyceae) in order to optimize the isolation of different organisms. These medium were diluted in sea water at 1% as final concentration. Cultures are stored at 15°C with a 12:12 dark/light cycle. Analysis and upkeep will be done back in the lab by Florence Le Gall.

2) Samples for DNA extraction for clone libraries were produced in order to assess the diversity of the picoplankton. Seawater (4L; prefiltered through 3 µm) were filtered 0.2 µm in order to extract the DNA. Filters are stored in lysis buffer (20 mM EDTA, 400mM NaCl, 0.75 M sucrose, 50 mM Tris pH 9) at -80°C. Analysis and data processing will be done back in the lab, but the person in charge of these samples and the primers used are still unknown.

3) Samples for Q-PCR analysis were produced. This method consists of the amplification of DNA with specific primers of target organism. As the number of gene copy has to be known for a correct quantification, this method will allow assessing the abundance of genera and key species. Seawater (2L) were filtered on 0.45 µm suppor filters, rinsed with rinsing buffer (20 mM EDTA, 400mM NaCl, 50 mM Tris pH 9) and stored at -80°C. Analysis and data processing will be done back in the lab, but the person in charge of these samples and the primers used are still unknown.

4) Samples for DNA extraction, microscopy and cytometry were produced to assess the abundance and diversity of phototrophic anoxygenic aerobic bacteria (PAA bacteria). Seawater (3L; prefiltered through 3 µm) were filtered 0.2 µm in order to extract the DNA and to assess the diversity of PAA bacteria. Filters are stored in lysis buffer (20 mM EDTA, 400mM NaCl, 0.75 M sucrose, 50 mM Tris pH 9) at -80°C. For the analysis by microscopy and cytometry, 1.5 ml of sea water (total fraction and fraction < 3µm) were fixed with 6 µl of glutaraldehyde 25% (0.1 % final concentration) during 10 min at room temperature, deep frozen in liquid nitrogen and then stored at -80°C. Analysis and data processing will be done back in the lab by Christian Jeanthon.

5) For the first eight process stations, seawater from surface (250 mL) was filtered on 5 µm and stored at 4°C. These samples were collected in order to isolate new viruses of *Emiliania huxlei*. Filtration though 0.45 µm and isolation will be done back in the lab by Antonio Pagarete.

HPLC pigment sampling, secondary production and biomass, and viability

- Swier Oosterhuis -

At the main stations, 5 Liter water samples were taken from the rosette sampler at discrete depths including a bottom water sample using a Niskin bottle that was lowered till approximately 0.5 meter from the bottom. The samples were filtered using Whatman GF/F (nominal pore size 0.7 µm) filters and stored at -80ºC for later analysis.

To estimate zooplankton biomass, vertical net hauls (200 µm mesh-width) were performed at the main stations prior to the water sampling for the chitobiase assay. The whole water column was sampled at the mixed layer stations. At the stratified stations, one haul covered the whole water column while the second haul was done from the thermocline to the surface. The catches were preserved in 5% formalin and stored for later analysis.

In the process of moulting, crustaceans use an enzyme, chitobiase, that plays a role in the degradation of the old exoskeleton into mono aminosugars. These are in turn used for building the new exoskeleton underneath the old skeleton. Once the old exuvium is shed, the enzyme is released freely into the ambient water. A relation between the released enzyme activity and the increase in biomass (secondary production) was found by Oosterhuis et. al. (MEPS, 2000).

During the MICROVIR cruise, the secondary (crustacean) production through the water column was measured at the process stations. Water samples (0.5 L) were taken from the rosette sampler at discrete depths including a bottom water sample using the Niskin bottle. Subsamples (5 mL) were used for the chitobiase assay. The water bottles were stored in a climate container at 15 ºC. The assay was done by adding 200 µL Tris/HCl buffer (final pH=7.5) and 100 µL of the substrate Methylumbelliferyll N-acetyl b-D glucosaminide (final concentration 150 mM). The enzyme activity was measured during a 2 hours incubation period at 25ºC using a spectrofluorometer, exitation 366 nm, emission 450 nm. The activity of the enzyme was measured in the different bottles at discrete time intervals during a period of 24 hours. This gives the degradation rate of the enzyme by mainly bacteria. From the degradation rate and the initial enzyme activity, the total release of chitobiase per day can be calculated. From here, the increase in biomass expressed as mg dry weight per m3 per day (secondary production) can be estimated using the relationship as found by Oosterhuis et. al. (MEPS, 2000).

A trial was done to investigate the viability of the whole community using the probe SYTOX Green. This dye stains fluorescent green after binding to nucleic acids. Only when the cell membrane is compromised is access to the cell possible. This live/dead assay stains by definition the dead cells. At the main stations two 5 mL water samples were taken from the rosette sampler at discrete depths occasionally including a bottom water sample from the Niskin bottle.One sample was not treated and in the other organisms were destructed by sonic sounding. Samples were stained for 10 min after addition of 50 µL SYTOX Green. The fluorescence was read on a spectrofluorometer, excitation 488 nm, emission 530 nm. The ratio of the untreated sample and the homogenized sample gives the percentage of non viable organisms. So far, data have to be analyzed in the laboratory later.

Preliminary results:

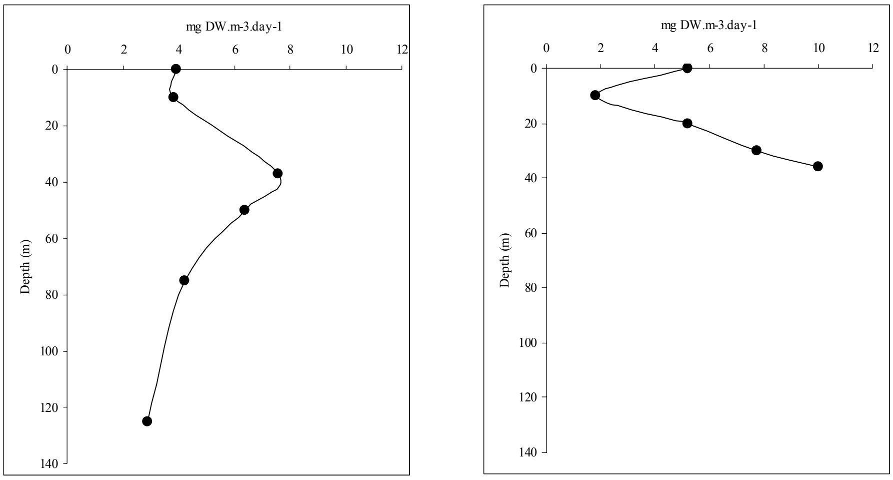


Fig. 10. Example of the production profiles as measured at the stratified station 14.(left panel) and the mixed layer station 22 (right panel).

Table 5. Secondary production expressed as average in the water column and expressed per square meter as calculated from the production profiles.

Station	Sec Prod mgDW.m^3.day^{-1}	Sec Prod mgDW.m^2.day^{-1}
1	17.3	1203
3	9.2	720
5	19.4	728
7	4.2	150
8	13.0	545
10	4.3	250
11	17.0	1162
12	3.1	178
14	5.1	568
16	2.1	500
18	11.0	587
19	6.1	1027
21	14.1	1722
22	5.0	227

Intact polar membrane lipids

- Joost Brandsma and Marianne Baas -

Polar lipids are ubiquitous organic compounds, which make up the cell membranes of most organisms. They normally consist of a glycerol backbone, two hydrophobic fatty acid tails, and a polar head group, although other forms do occur. Within this structural framework, there exists a huge variety of polar lipids, with differences occurring in for example the length and degree of saturation of the fatty acid tails, ester or ether bonding or the type of polar head group. Since many organisms produce polar membrane lipids that are specific for their species or group, these can be used as tracers for their presence (biomarkers) in environmental samples. In addition, most polar lipids, and particularly phospholipids, are fairly labile compounds, meaning they are degraded rapidly upon cell death (White et al.1979; Harvey et al.1986). Thus, quantities of intact polar lipids (IPLs) have been correlated to (microbial) biomass in a variety of environments (e.g. Balkwill et al. 1988).

The aim of this study was to find out which IPLs are present in both the surface waters and sediments of the North Sea, as well as to determine their origin. In order to do this we sampled at all 23 stations of the cruise, either directly in the water with an automated *in situ* pump, or with the CTD and using a 293 mm tabletop filtration unit. In both setups seawater was led through a 0.7 µm GFF filter, in order to collect the particulate matter that is present in the water. Two examples of such filters are shown in Figure 11. The *in situ* pump was used at 13 stations, with a filtered volume ranging from 222 to 536 liter, depending on the amount of material/biomass in the water. The tabletop filtration unit was used at the remaining 10 stations, with a filtered volume ranging from 77 to 140 liter. The filters were immediately stored in the freezer at -20ºC to prevent degradation of the organic material.

In addition, we took sediment samples at 9 different stations, in order to see which IPLs are present in both the top and the deeper sediments (up to 30 cm depth). The samples were taken from a boxcore, which we sub-sampled with a 6 cm wide coring tube. The cores were then cut horizontally into 2 cm thick slices, which were also stored in the freezer at -20ºC.

In the home lab, both the filters and the sediment slices will be freeze-dried to remove any remaining water and then extracted, using organic solvents such as methanol and dichloromethane. This procedure releases the IPLs from their matrix and brings them into solution, which can then be purified and analyzed (after Sturt et al. 2004). Analysis will be done at the home lab by high-performance liquid chromatography (HPLC), coupled to a triple quadrupole mass spectrometer (MS/MS) through an electrospray ionization interface (ESI). The HPLC system separates the various IPLs in a sample according to their electronic charge and mass, while the MS/MS system allows us to obtain the mass spectra of both the molecular ions and their dominant fragments. The ESI finally, is necessary to ionize the IPLs and transfer them into the MS/MS system. Thus, by analyzing the mass spectra of the various molecular ions present in the extracts, we can determine which IPLs are present in each of the samples. The origin of these can be deducted from either the structure of the molecule itself, previously published occurrences, or by analyzing additional pure cultures. If possible, purified IPL standards will be used for quantification of the most abundant or interesting IPLs.

We expect to find (large) shifts in both the types and abundances of various IPLs between stations. If so, these could represent shifts in the microbial/phytoplankton community between different areas, which should then also appear in the data that were collected by other the participants of the cruise.

Fig. 11. The GFF filters containing samples and ready for extraction. The upper filter is from the automated *in situ* pump; the lower filter is from the tabletop filtration unit. Note that the samples were taken at different stations.

Determination of grazing and lytic and lysogenic viral infection of bacteria

- Claire Evans, Corina Brussaard and Joaquin Martinez-Martinez -

Microbial communities comprise the majority of the biomass in the oceans and drive nutrient and energy cycling. During the MICROVIR cruise July 2007 we investigated grazing and lytic and lysogenic viral infection of the bacteria to establish the significance of these mortality processes during the summer in the North Sea.

Grazing of bacteria was investigated using both fluorescently labeled prey and by filtration experiments. In the former fluorescently labeled cyanobacteria or bacteria were gently combined with whole water in 500 ml incubations at approximately 10 to 20% of the natural concentration. Grazing was determined by monitoring the concentration of labeled prey at the start of the experiment and after a 24 h incubation at *in situ* temperature and light. The analysis was completed by flow cytometry and the labeled organisms were distinguished by their green fluorescence. The experiment was conducted at two or three depths during the majority of the process stations. Preliminary analysis indicates that grazing of the cyanobacteria was significant at some the stations examined. Further analysis of the flow cytometry files generated is required to aquire the full data set.

The filtration grazing experiments were completed by comparing the abundance of bacteria in whole water incubations and water from which grazers had been removed by 0.8 µm filtration. In addition a further 0.2 µm filtered treatment was prepared to monitor adsorption of organisms to the incubation vessels walls. Samples for bacteria and viruses were regularly fixed and frozen for later analysis by flow cytometry at the laboratory. Acquisition of the results will only be possible after the analysis of these samples. These experiments were completed art two to three depths at all the process stations.

Rates of lytic viral infection were determined according to the method of Winget et al. (2005). Briefly the bacterial fraction was concentrated and resuspended in virus-free water generated by tangential flow filtration. In this way further infection of the bacteria was prevented and the level of lytic infection in the existing population could be determined by monitoring the production of new viruses and loss of bacteria. Samples were fixed and frozen for bacterial and viral enumeration every 3 h for 12 h. Rates of lysogenic infection were determined by preparing addition replicates and adding the antibiotic Mitomycin C at a final concentration of 1 µg per ml to trigger the lytic production of any lysogenic phage incorporated into the bacterial population. These experiments were completed art two to three depths at all the process stations. Results from these experiments will become available after the analysis of bacterial and viral samples back at the laboratory.

Estimating bacterial production using Thymidine

- Elisabet Laia Sa Lago -

As an approach to the measurement of biomass production by bacteria, one could measure the incorporation rates of tritiated leucine (Leu, an essential aminoacid) or tritiated thymidine (TdR, a nucleotide). Although theoretically one could use TdR uptake if interested in cell division and Leu uptake if interested in biomass production, JGOFS protocols recommend to use both methods simultaneously to yield values of bacterial production by combining them.
During this cruise I have analized the bacterial production using the TdR uptakes to complement the Leu work of my colleague Jan Hegeman. Samples were taken on every "process station" and from several depths (from 3 to 5), depending on the water stratification. We are currently using the Smith and Azam (1992) protocol: samples are taken and dispensed into 5 tubes (labeled a to f), with 1.2 mL sample each one. Two controls (e and f) are killed with 120 ul of TCA 50% . After that, tritiated thymidine is added in all the tubes in a final concentration of 40 nM (this is 24 ul TdR in each tube). After a brief vortex, the tubes are incubated in the dark and in situ temperature during 135-150 minutes. After the incubation, the samples (a to c) are killed with 120 ul TCA 50%, vortexed and stored at -80oC until they can be processed. Analysis of the samples will be made in the laboratory of the Institut de Ciencies del Mar (ICM-CSIC), in Barcelona.

Estimating converions factors for the thymidine method

- Elisabet Laia Sa Lago -

Conversion factors are needed to transform activity (incorporation rate of tritiated thymidine) to accurate rates of bacterial production, i.e., cells (or cellular C or N) produced per unit volume or area per unit time. This conversion depends on detailed information about several cellular components, e.g., the amount of DNA and protein per cell, the ratio of thymine to total DNA and others that are difficult to measure routinely for a natural bacterial assemblage, so they are often taken from the literature values, even from pure bacteria cultures, and they are referred to as "theoretical conversion factors". An alternative approach is to estimate these conversion factors with experiments using natural bacterial assemblages taken directly from the aquatic system being examinated. The empirical conversion factors are calculated by directly comparing incorporation of radiolabelled TdR with the increase in bacterial biomass overtime. The conceptual disadvantage of them is that all other information about the physiology and biochemistry of macromolecular synthesis is ignored. But in the other hand, the advantages include: (1) they are calculated with natural bacterial assemblages; (2) the factors are measured for the particular system being studied, and literature values are not assumed; and (3) many processes that would cause problems with theoretical conversion factors are "corrected" by using empirical conversion factors. Normally, bacterial growth is matched by loss processes (e.g., grazing) and thus, bacterial abundance is relatively constant over time (hours to days). Since it is necessary to obtain an absolute measure of bacterial growth, the key is to eliminate grazing and other processes that lead to loss of bacterial biomass. Grazers such as microflagellates can be removed by filtration. Loss due to both grazers and probably viruses can be substancially reduced by dilution.

During the MICROVIR cruise, 6 conversion factors experiments at 6 process stations were estimated. Both techniques were tested, this is filtering and diluting. For each experiment, 2L of surface (10m) water sample were taken. All this volume was filtrated through 0.8 um polycarbonate filters. After that, a 60% volume of this water, this is 1.6L, was filtrated through GF/F filters (aprox. 0.2 um). We placed together in a bottle both filtered volumes of water, and incubated in the dark at in situ temperature during 6 days. Subsamples of conversion factors experiments bottles were taken every 8h during the first 32h and once a day after that. Processing of the samples will be made in the laboratory of the Institut de Ciencies del Mar (ICM-CSIC), in Barcelona.

Analysis of CTD-labelled bacteria by flow cytometry

- Elisabet Laia Sa Lago -

The 5-cyano-2,3-ditolyl tetrazolium chloride (CTC) is a monotetrazolium dye wich produces fluorescent formazan (CTF) when it is chemically or biologically reduced. The CTF is deposited intracellularly. Thus, the analysis of CTC labelled bacterial abundance by flow cytometry give us an estimation of respiring bacteria in the water samples. This is another approach to estimate the activity of bacteria in the water samples, which can be compared with the radiolabeling methods used to estimate bacterial production. Samples were taken from every process station of the cruise, from one (surface water) to three depths. Two replicates of 50 µL water sample were placed in tubes, plus 50 µL of CTC solution, and incubated between 90 and 120 min in the dark at in situ temperature. After the incubation, the samples were fixed and stored at -80ºC after a flash-freeze in liquid nitrogen. The samples will be analyzed in the home laboratory.

Boxcore sampling

- Corina Brussaard and Claire Evans -

For a pilot study, we took sediment samples using a boxcore at the main process stations. The goal was to sample for viruses and bacteria over depth (maximum appr. 15 cm depth), sample for infectious algal viruses. Besides the sediment we also sampled the overlaying water. The data will be compared to the water column data, including the Niskin bottle sample from 0.5 m above the sediment. A wide range of substrates was observed between the different stations, from big stones to coarse sand to heavy (sandy) clay.

The sediment samples were sliced into appr. 1.5 cm thick slices (10 cc using a 50 cc syringe that was transformed into a subcore), after which the attached viruses were released by adding a buffer and placing on a shaker for 20 min. Following centrifugation, the supernatant was used for subsamples for counting on MPN. Subsamples for counting were fixed with glutaraldehyde (25% EM grade, 0.5% final concentration) and flash frozen in liquid N_2 after which the samples were stored at -80ºC. Remaining supernatant were stored at 4 degrees.

Besides these syring subcores, we also sampled 1-4 larger cores which were frozen until further analysis (sediment type, chlorophyll content etc.). Part of these cores were taken for CEFAS colleagues, UK with whom we collaborate.

Acknowledgements

We like to express special thanks to Captain John Ellen and the crew of the R/V Pelagia and the technical assistance of DZT (JanWillem Schmelling). We thank the NIOZ- Marine Research Facilities (MRF), NIOZ-Marine Technology (MT) and NIOZ-Data Management (DM) for on-shore and onboard support. The cruise was supported by the Research Council for Earth and Life Sciences (ALW) with financial aid from the Netherlands Organisation for Scientific Research (NWO).

TABLE 1: Overview of sampling per parameter for the different stations

	A	B	C	D	E	F	G	H	I	J	K	L
1	**MICROVIR CTD DATABASE**											
2												
3												
4				**PI**	**C. Brussaard / J. Martinez**			**C. Brussaard / J. Martinez**				
5				**Investigator**	Lisa Faber			Claire Evans				
6												
7												
8	**STATION #**	**CAST #**	**Appr. Depth**	**parameter**	phytoplankton FCM	virus FCM	bacteria FCM	Viral reduction	grazing bacteria	FLB/FLC	Lugols	lysogeny
9			**m**	**unit**	ml-1	ml-1	ml-1					
10	1	1	47		x	x	x					
11			25		x	x	x					
12			10									
13	1	6	10									
14	1	8	50		x	x	x	x	x			
15			25		x	x	x	x	x			
16			10		x	x	x	x	x			
17	1	10	50		x	x	x			x	x	
18			25		x	x	x			x	x	
19			10		x	x	x			x	x	
20	1	12	50		x	x	x					
21			25		x	x	x					
22			10		x	x	x					
23	2	3	75		x	x	x					
24			50		x	x	x					
25			30		x	x	x					
26			25		x	x	x					
27			20		x	x	x					
28			15		x	x	x					
29			10		x	x	x					
30	3	1	50		x	x	x					
31			25		x	x	x					
32			10		x	x	x					
33	3	3	10									
34	3	6	50		x	x	x	x	x			
35			25		x	x	x	x	x			
36			10		x	x	x	x	x			
37	3	10	50		x	x	x			x	x	
38			25		x	x	x			x	x	

	A	B	C	D	E	F	G	H	I	J	K	L
39			10		x	x	x			x	x	
40	3	12	50		x	x	x					
41			25		x	x	x					
42			10		x	x	x					
43	4	1	40		x	x	x					
44			25		x	x	x					
45			10		x	x	x					
46	5	1	30		x	x	x					
47			25		x	x	x					
48			10		x	x	x					
49	5	4	35		x	x	x					
50			25		x	x	x	x	x			
51			10		x	x	x	x	x			
52	5	8	25		x	x	x			x	x	
53			10		x	x	x			x	x	
54	5	10	25		x	x	x					
55			10		x	x	x					
56	6	1	25		x	x	x					
57			10		x	x	x					
58	7	1	25		x	x	x					
59			15		x	x	x					
60			10		x	x	x					
61			5		x	x	x					
62	7	4	25		x	x	x					
63			20		x	x	x	x	x			
64			10		x	x	x	x	x			
65	7	8	20		x	x	x			x	x	
66			10		x	x	x			x	x	
67	7	11	20		x	x	x					
68			10		x	x	x					
69	8	3	35		x	x	x					
70			30		x	x	x	x	x			
71			25		x	x	x	x	x			
72			20		x	x	x					
73			15		x	x	x					
74			10		x	x	x	x	x			
75	8	6	35		x	x	x					
76			30		x	x	x					
77			25		x	x	x					

	A	B	C	D	E	F	G	H	I	J	K	L
78			20		x	x	x					
79			15		x	x	x					
80			10		x	x	x					
81	8	11	35		x	x	x					
82			30		x	x	x			x	x	
83			25		x	x	x					
84			20		x	x	x					
85			15		x	x	x					
86			10		x	x	x			x	x	
87	8	14	35		x	x	x					
88			30		x	x	x					
89			25		x	x	x					
90			20		x	x	x					
91			15		x	x	x					
92			10		x	x	x					
93	9	1	45		x	x	x					
94			40		x	x	x					
95			35		x	x	x					
96			27.5		x	x	x					
97			20		x	x	x					
98			10		x	x	x					
99	10	1	70		x	x	x					
100			60		x	x	x					
101			50		x	x	x					
102			38		x	x	x					
103			35		x	x	x					
104			25		x	x	x					
105			20		x	x	x					
106			10		x	x	x					
107	10	4	70		x	x	x					
108			60		x	x	x					
109			50		x	x	x					
110			40		x	x	x	x	x			
111			30		x	x	x	x	x			
112			20		x	x	x					
113			10		x	x	x	x	x			
114	10	8	70									
115			60									
116			50									

	A	B	C	D	E	F	G	H	I	J	K	L
117			40									
118			30									
119			20									
120			10									
121	10	11	70		x	x	x					
122			60		x	x	x					
123			50		x	x	x					
124			40		x	x	x					
125			30		x	x	x			x	x	
126			20		x	x	x					
127			10		x	x	x			x	x	
128	11	1	50		x	x	x					
129			40		x	x	x	x	x			
130			30		x	x	x					
131			27		x	x	x	x	x			
132			20		x	x	x					
133			15		x	x	x					
134			10		x	x	x	x	x			
135	11	5	40		x	x	x					
136			30		x	x	x					
137			10		x	x	x					
138	11	9	40		x	x	x					
139			29		x	x	x			x	x	
140			20		x	x	x					
141			10		x	x	x			x	x	
142	12	1	50		x	x	x					
143			35		x	x	x					
144			20		x	x	x					
145			10		x	x	x					
146			10									
147	12	2	65		x	x	x					
148			50		x	x	x					
149			35		x	x	x					
150			30		x	x	x	x	x			x
151			20		x	x	x					
152			10		x	x	x	x	x			x
153	12	6	50		x	x	x					
154			35		x	x	x					
155			20		x	x	x					

	A	B	C	D	E	F	G	H	I	J	K	L
156			10		x	x	x					
157	12	8	50		x	x	x					
158			40		x	x	x					
159			30		x	x	x			x	x	
160			20		x	x	x					
161			10		x	x	x			x	x	
162	13	1	100		x	x	x					
163			75		x	x	x					
164			50		x	x	x					
165			35		x	x	x					
166			20		x	x	x					
167			10		x	x	x					
168	14	1	100		x	x	x					
169			75		x	x	x					
170			60		x	x	x					
171			50		x	x	x					
172			35		x	x	x					
173			20		x	x	x					
174			10		x	x	x					
175	14	5	75		x	x	x					
176			60		x	x	x					
177			50		x	x	x					
178			35		x	x	x			x		
179			20		x	x	x					
180			10		x	x	x			x		
181	14	10	100		x	x	x					
182			75		x	x	x					
183			50		x	x	x					
184			35		x	x	x	x	x			x
185			20		x	x	x					
186			10		x	x	x	x	x			x
187	14	11	75		x	x	x					
188			50		x	x	x				x	
189			35		x	x	x				x	
190			20		x	x	x					
191			10		x	x	x				x	
192	15	1	75		x	x	x					
193			50		x	x	x					
194			20		x	x	x					

	A	B	C	D	E	F	G	H	I	J	K	L
195			10		x	x	x					
196	16	1	120		x	x	x					
197			90		x	x	x					
198			75		x	x	x					
199			75									
200			50		x	x	x					
201			20		x	x	x					
202			10		x	x	x					
203	16	2	125		x	x	x					
204			100		x	x	x					
205			75		x	x	x					
206			50		x	x	x					
207			30		x	x	x					
208			20		x	x	x					
209			10		x	x	x					
210	16	7	125		x	x	x					
211			100		x	x	x					
212			75		x	x	x					
213			50		x	x	x					
214			30		x	x	x			x	x	
215			20		x	x	x					
216			10		x	x	x			x	x	
217	16	11	125		x	x	x					
218			100		x	x	x					
219			75		x	x	x					
220			60		x	x	x					
221			50		x	x	x					
222			30		x	x	x					
223			20		x	x	x	x	x			x
224			10		x	x	x	x	x			x
225	16	12	100		x	x	x					
226			80		x	x	x					
227			50		x	x	x					
228			40		x	x	x					
229			20		x	x	x					
230			10		x	x	x					
231	18-niskin bottles	22	10		x	x	x					
232	18-niskin bottles	23	20									
233	18-niskin bottles	26	30		x	x	x					

	A	B	C	D	E	F	G	H	I	J	K	L
234	18-niskin bottles	27	50		x	x	x					
235	18-niskin bottles	16	60		x	x	x					
236	18-niskin bottles	28	75		x	x	x					
237	18-niskin bottles	29	134		x	x	x					
238	18	35	125		x	x	x					
239			110		x	x	x					
240			75		x	x	x					
241			50		x	x	x					
242			40		x	x	x					
243			30		x	x	x					
244			20		x	x	x	x	x			x
245			10		x	x	x	x	x			x
246	18	37	110		x	x	x					
247			75		x	x	x					
248			50		x	x	x					
249			50									
250			35		x	x	x					
251			25		x	x	x					
252			20		x	x	x					
253			10		x	x	x					
254	19	1	257		x	x	x					
255			200		x	x	x					
256			150		x	x	x					
257			100		x	x	x					
258			60		x	x	x					
259			50		x	x	x	x	x			x
260			40		x	x	x					
261			30		x	x	x					
262			20		x	x	x					
263			10		x	x	x	x	x			x
264	19	5	260		x	x	x					
265			50		x	x	x					
266			40									
267			30									
268			20									
269			10		x	x	x					
270												
271	19	8	260		x	x	x					
272			100		x	x	x					

	A	B	C	D	E	F	G	H	I	J	K	L
273			100									
274			60		x	x	x					
275			50		x	x	x					
276			30		x	x	x					
277			20		x	x	x					
278			10		x	x	x					
279	20	1	300		x	x	x					
280			200		x	x	x					
281			100		x	x	x					
282			70		x	x	x					
283			35		x	x	x					
284			20		x	x	x					
285			20									
286			10		x	x	x					
287	21	1	137		x	x	x					
288			100		x	x	x					
289			75		x	x	x					
290			50		x	x	x					
291			30		x	x	x					
292			20		x	x	x					
293			10		x	x	x					
294			5		x	x	x					
295	21	2	100		x	x	x					
296			60		x	x	x					
297			40		x	x	x	x	x			x
298			30		x	x	x					
299			20		x	x	x					
300			10		x	x	x	x	x			x
301	21	6	80		x	x	x					
302			55		x	x	x					
303			35		x	x	x					
304			20		x	x	x					
305			10		x	x	x					
306	21	8	139		x	x	x					
307			80		x	x	x					
308			55		x	x	x					
309			40		x	x	x					
310			30		x	x	x					
311			20		x	x	x					

	A	B	C	D	E	F	G	H	I	J	K	L
312			20							x	x	
313			10		x	x	x			x	x	
314	22	1	30		x	x	x					
315			25		x	x	x					
316			20		x	x	x					
317			10		x	x	x					
318	22	6	20		x	x	x			x	x	
319			10		x	x	x			x	x	
320	22	10	27		x	x	x					
321			20		x	x	x	x	x			x
322			10		x	x	x	x	x			x
323	22	11	27		x	x	x					
324			20		x	x	x					
325			10		x	x	x					
326	23	2	40		x	x	x					
327			35		x	x	x					
328			30		x	x	x					
329			20		x	x	x					
330			10		x	x	x					

	M	N	O	P	Q	R	S	T	U	V	W	X
1				**C. Brussaard / J. Martinez** Joaquin Martinez Martinez					**C. Brussaard / J. Martinez** Jan van Ooijen			
2												
3												
4												
5												
6												
7												
8	**STATION #**	**CAST #**	**Appr. Depth**	dilution assay	PFGE	qPCR virus	DGGE	MPN	Phosphate	Ammonium	NOx	Silicate
9			**m**	d-1				infective virus ml-1	µmol/l	µmol/l	µmol/l	µmol/l
10	1	1	47						0.151	0.78	1.39	1.65
11			25						0.153	0.79	1.38	1.64
12			10						0.154	0.75	1.38	1.63
13	1	6	10		x							
14	1	8	50			x	x	x	0.146	0.73	1.49	1.76
15			25						0.144	0.70	1.49	1.77
16			10	x		x	x	x	0.141	0.68	1.50	1.77
17	1	10	50						0.162	0.82	1.45	1.67
18			25						0.160	0.81	1.45	1.67
19			10						0.157	0.75	1.48	1.70
20	1	12	50						0.157	0.89	1.34	1.60
21			25						0.158	0.89	1.35	1.61
22			10						0.157	0.88	1.35	1.60
23	2	3	75						0.200	1.33	1.67	1.64
24			50		x				0.198	1.31	1.65	1.63
25			30						0.170	1.14	1.44	1.57
26			25		x				0.044	0.23	0.21	1.17
27			20						0.044	0.23	0.21	1.16
28			15						0.040	0.23	0.20	1.13
29			10		x				0.044	0.23	0.20	1.12
30	3	1	50						0.087	0.61	1.03	1.68
31			25						0.084	0.56	1.02	1.67
32			10						0.084	0.54	1.02	1.65
33	3	3	10									
34	3	6	50						0.094	0.57	1.30	1.79
35			25						0.095	0.57	1.31	1.77
36			10		x				0.098	0.59	1.39	1.81
37	3	10	50		x			x	0.095	0.58	1.30	1.81
38			25		x	x		x	0.095	0.55	1.31	1.79

	M	N	O	P	Q	R	S	T	U	V	W	X
39			10	x	x	x		x	0.094	0.57	1.31	1.79
40	3	12	50				x		0.082	0.56	1.04	1.65
41			25			x	x		0.083	0.57	1.05	1.66
42			10			x	x		0.080	0.54	1.03	1.64
43	4	1	40						0.078	0.47	1.47	1.42
44			25						0.081	0.46	1.47	1.43
45			10						0.077	0.47	1.47	1.43
46	5	1	30						0.026	0.18	0.29	0.36
47			25						0.027	0.18	0.24	0.36
48			10						0.024	0.12	0.13	0.33
49	5	4	35						0.024	0.18	0.24	0.29
50			25						0.025	0.17	0.22	0.30
51			10	x	x				0.023	0.17	0.21	0.30
52	5	8	25		x			x	0.020	0.22	0.26	0.32
53			10	x	x			x	0.019	0.19	0.21	0.31
54	5	10	25			x	x		0.014	0.20	0.12	0.24
55			10			x	x		0.013	0.36	0.09	0.25
56	6	1	25		x		x	x	0.029	0.13	0.02	0.19
57			10		x		x	x	0.024	0.12	0.01	0.18
58	7	1	25						0.068	0.28	0.61	0.35
59			15						0.069	0.27	0.58	0.34
60			10						0.065	0.25	0.60	0.34
61			5						0.068	0.26	0.60	0.35
62	7	4	25						0.060	0.33	0.64	0.32
63			20						0.061	0.32	0.59	0.31
64			10	x	x				0.060	0.31	0.58	0.32
65	7	8	20		x			x	0.071	0.12	0.10	0.37
66			10	x	x			x	0.072	0.15	0.10	0.37
67	7	11	20			x	x		0.053	0.26	0.46	0.26
68			10			x	x		0.046	0.24	0.51	0.26
69	8	2/3	35						0.308	0.69	0.34	2.41
70			30		x			x	0.261	0.24	0.19	2.07
71			25		x			x	0.134	0.07	0.07	0.49
72			20						0.105	0.07	0.06	0.19
73			15						0.094	0.06	0.05	0.04
74			10		x			x	0.081	0.08	0.07	0.04
75	8	6	35						0.300	0.66	0.36	2.38
76			30						0.272	0.30	0.22	2.30
77			25						0.155	0.13	0.10	0.82

	M	N	O	P	Q	R	S	T	U	V	W	X
78			20						0.097	0.06	0.07	0.04
79			15						0.091	0.06	0.07	0.03
80			10						0.079	0.07	0.07	0.05
81	8	11	35						0.312	0.81	0.38	2.54
82			30			x	x		0.284	0.57	0.28	2.22
83			25				x		0.089	0.06	0.06	0.12
84			20						0.084	0.07	0.06	0.02
85			15						0.083	0.06	0.05	0.06
86			10			x	x		0.072	0.06	0.05	0.34
87	8	14	35						0.309	0.77	0.33	2.51
88			30						0.273	0.31	0.20	2.24
89			25						0.122	0.07	0.03	0.39
90			20						0.099	0.08	0.03	0.10
91			15						0.082	0.07	0.03	0.21
92			10						0.079	0.09	0.05	0.24
93	9	1	45						0.523	0.46	5.61	3.38
94			40		x			x	0.486	0.47	5.35	3.30
95			35						0.408	0.40	4.35	2.92
96			27.5		x			x	0.158	0.23	1.18	1.73
97			20						0.033	0.09	0.04	1.02
98			10		x			x	0.030	0.09	0.03	1.00
99	10	1	70						0.709	0.08	7.51	4.00
100			60						0.699	0.08	7.43	3.82
101			50						0.679	0.09	7.27	3.78
102			38						0.580	0.20	5.52	2.98
103			35						0.299	0.19	1.61	1.21
104			25						0.070	0.09	0.07	0.36
105			20						0.056	0.10	0.03	0.30
106			10						0.044	0.08	0.03	0.28
107	10	4	70						0.706	0.09	7.48	3.94
108			60					x	0.709	0.10	7.43	3.93
109			50						0.690	0.10	7.36	3.83
110			40					x	0.605	0.15	6.09	3.17
111			30					x	0.095	0.10	0.28	0.45
112			20						0.051	0.10	0.06	0.30
113			10	x	x				0.044	0.10	0.07	0.30
114	10	8	70						0.713	0.08	7.55	3.97
115			60						0.705	0.08	7.54	3.91
116			50						0.700	0.09	7.45	3.85

	M	N	O	P	Q	R	S	T	U	V	W	X
117			40		x			x	0.648	0.10	7.01	3.66
118			30		x			x	0.080	0.09	0.20	0.35
119			20						0.051	0.09	0.03	0.28
120			10	x	x			x	0.043	0.08	0.03	0.27
121	10	11	70						0.719	0.08	7.55	3.99
122			60						0.709	0.09	7.48	3.92
123			50						0.689	0.08	7.34	3.83
124			40				x		0.657	0.09	6.96	3.72
125			30			x	x		0.061	0.09	0.04	0.28
126			20						0.051	0.08	0.04	0.29
127			10			x	x		0.048	0.09	0.04	0.28
128	11	1	50						0.591	2.76	3.49	3.31
129			40						0.587	2.76	3.47	3.30
130			30						0.541	2.55	3.26	3.23
131			27						0.028	0.07	0.06	0.09
132			20						0.023	0.07	0.23	0.13
133			15						0.024	0.07	0.05	0.08
134			10	x	x				0.026	0.08	0.05	0.10
135	11	5	40		x			x	0.585	2.90	3.44	3.25
136			30		x			x	0.500	2.26	2.97	2.93
137			10	x	x			x	0.020	0.07	0.03	0.07
138	11	9	40			x	x		0.610	2.79	3.44	3.11
139			29			x	x		0.426	1.80	2.43	2.66
140			20						0.031	0.08	0.04	0.15
141			10			x	x		0.020	0.08	0.02	0.07
142	12	1	50						0.451	0.80	4.40	2.75
143			35						0.289	0.53	2.24	1.93
144			20						0.063	0.07	0.04	0.89
145			10						0.063	0.06	0.04	0.88
146			10									
147	12	2	65						0.472	0.84	4.57	2.92
148			50						0.468	0.86	4.55	2.89
149			35						0.434	0.87	4.09	2.73
150			30						0.108	0.19	0.18	1.13
151			20						0.062	0.08	0.06	0.88
152			10	x	x				0.059	0.08	0.04	0.88
153	12	6	50		x			x	0.447	0.83	4.33	2.75
154			35		x			x	0.318	0.74	2.38	2.07
155			20						0.070	0.11	0.04	0.86

	M	N	O	P	Q	R	S	T	U	V	W	X
156			10	x	x			x	0.071	0.09	0.05	0.87
157	12	8	50			x	x		0.450	0.78	4.34	2.76
158			40						0.437	0.78	4.18	2.69
159			30			x	x		0.349	0.66	3.07	2.25
160			20						0.071	0.08	0.07	0.89
161			10			x	x		0.067	0.07	0.03	0.87
162	13	1	100						0.684	0.32	9.26	3.74
163			75						0.651	1.13	7.96	3.53
164			50						0.464	1.68	4.88	1.58
165			35						0.100	0.26	0.88	0.72
166			20						0.030	0.06	0.04	0.43
167			10						0.025	0.07	0.05	0.42
168	14	1	100						0.796	0.08	11.26	3.86
169			75						0.787	0.08	11.25	3.81
170			60						0.708	0.07	10.08	3.30
171			50		x				0.315	0.08	3.84	0.78
172			35		x				0.035	0.12	0.08	0.20
173			20						0.020	0.09	0.04	0.21
174			10		x				0.015	0.06	0.04	0.21
175	14	5	75						0.796	0.08	11.37	3.92
176			60						0.672	0.07	9.57	2.94
177			50			x	x		0.136	0.14	0.46	0.36
178			35			x	x		0.038	0.14	0.04	0.16
179			20						0.018	0.06	0.05	0.22
180			10			x	x		0.021	0.06	0.06	0.23
181	14	10	100						0.773	0.07	11.14	3.78
182			75						0.749	0.07	11.12	3.67
183			50						0.278	0.08	3.10	0.75
184			35						0.089	0.23	0.12	0.23
185			20						0.013	0.09	0.05	0.18
186			10	x	x				0.011	0.05	0.05	0.19
187	14	11	75						0.754	0.08	11.10	3.74
188			50					x	0.185	0.09	1.20	0.51
189			35					x	0.045	0.13	0.05	0.20
190			20						0.010	0.06	0.04	0.17
191			10	x				x				
192	15	1	75						0.332	2.06	2.34	1.25
193			50		x				0.328	2.05	2.26	1.23
194			20		x				0.309	2.05	1.92	1.15

	M	N	O	P	Q	R	S	T	U	V	W	X
195			10		x				0.299	1.93	1.83	1.13
196	16	1	120									
197			90						0.739	0.08	11.79	4.01
198			75						0.685	0.08	10.95	3.19
199			75									
200			50						0.599	0.72	8.95	2.57
201			20						0.272	0.91	3.60	1.22
202			10						0.258	0.89	3.51	1.20
203	16	2	125						0.764	0.04	11.89	4.18
204			100						0.747	0.07	11.71	3.96
205			75						0.665	0.65	9.88	3.11
206			50		x				0.510	1.14	7.07	2.03
207			30						0.294	0.83	4.11	1.15
208			20		x				0.262	0.55	3.74	1.02
209			10		x				0.244	0.47	3.54	1.08
210	16	7	125						0.765	0.06	11.92	4.18
211			100						0.761	0.07	11.86	4.14
212			75						0.675	0.26	10.36	3.07
213			50			x	x		0.643	0.50	9.66	3.03
214			30						0.503	1.21	6.81	2.03
215			20			x	x		0.299	0.75	4.15	1.11
216			10			x	x		0.396	0.84	5.50	1.58
217	16	11	125						0.766	0.07	11.79	4.31
218			100						0.764	0.05	11.75	4.28
219			75						0.685	0.07	10.67	3.17
220			60									
221			50					x	0.583	0.84	8.31	2.50
222			30						0.390	1.15	5.19	1.55
223			20					x	0.284	0.77	3.77	1.31
224			10	x				x	0.214	0.17	3.17	1.14
225	16	12	100						0.755	0.09	11.64	4.13
226			80						0.686	0.09	10.74	3.16
227			50						0.605	0.62	8.82	2.51
228			40						0.565	0.89	8.01	2.34
229			20						0.317	0.94	4.14	1.33
230			10						0.213	0.10	3.13	1.14
231	18-niskin		10		x	x			0.014	0.07	0.03	0.17
232	18-niskin		20		x	x			0.191	0.76	2.05	0.99
233	18-niskin		30						0.463	1.48	5.95	1.88

	M	N	O	P	Q	R	S	T	U	V	W	X
234	18-niskin		50		x		x		0.513	0.95	7.19	1.91
235	18-niskin		60						0.763	0.09	12.02	4.13
236	18-niskin		75						0.803	0.09	12.25	4.61
237	18-niskin		134						0.945	0.13	12.93	6.29
238	18	35	125						0.949	0.06	12.93	5.75
239			110						0.944	0.09	12.89	5.75
240			75						0.885	0.10	12.77	5.97
241			50						0.408	1.95	4.64	1.17
242			40						0.318	2.06	3.04	0.85
243			30						0.220	1.47	2.02	0.54
244			20	x	x				0.124	0.87	0.96	0.41
245			10	x	x				0.014	0.07	0.05	0.07
246	18	37	110						0.937	0.08	13.07	5.74
247			75						0.788	0.08	12.28	4.39
248			50			x	x		0.494	0.87	7.34	1.74
249			50									
250			35						0.290	1.68	2.93	0.80
251			25	x		x	x		0.059	0.21	0.51	0.43
252			20						0.035	0.13	0.13	0.21
253			10	x		x	x		0.019	0.08	0.06	0.06
254	19	1	257						0.827	0.07	11.28	5.75
255			200						0.765	0.06	10.38	4.18
256			150						0.759	0.08	10.30	4.47
257			100						0.754	0.08	10.23	4.34
258			60						0.719	0.09	10.07	4.62
259			50						0.642	0.09	9.15	4.03
260			40						0.526	0.08	7.70	3.22
261			30						0.313	0.08	4.49	1.86
262			20		x				0.035	0.08	0.20	0.61
263			10	x	x				0.012	0.07	0.07	0.03
264	19	5	260						0.818	0.05	11.24	5.74
265			50									
266			40									
267			30						0.557	0.10	7.99	3.42
268			20						0.403	0.07	5.91	2.45
269			10						0.009	0.08	0.06	0.05
270	19	7	10	x					0.017	0.07	0.05	0.03
271	19	8	260						0.826	0.08	11.11	5.63
272			100						0.755	0.10	10.41	4.71

	M	N	O	P	Q	R	S	T	U	V	W	X
273			100									
274			60						0.709	0.09	10.07	4.43
275			50		x	x	x	x	0.644	0.07	9.08	4.06
276			30						0.314	0.09	4.46	1.87
277			20		x	x	x	x	0.023	0.29	0.11	0.41
278			10		x	x	x	x	0.012	0.08	0.03	0.03
279	20	1	300						0.800	0.06	11.24	4.74
280			200						0.746	0.07	10.43	3.71
281			100						0.719	0.07	10.19	3.94
282			70									
283			35		x				0.426	0.05	5.82	2.23
284			20		x				0.023	0.10	0.15	0.90
285			20									
286			10		x				0.011	0.07	0.07	0.39
287	21	1	137						0.726	0.26	10.20	4.20
288			100						0.635	1.29	6.91	3.77
289			75						0.654	0.46	8.65	3.88
290			50						0.487	0.07	7.07	2.30
291			30						0.028	0.07	0.02	0.23
292			20						0.019	0.07	0.03	0.19
293			10						0.003	0.06	0.03	0.01
294			5						0.011	0.06	0.03	0.03
295	21	2	100						0.668	0.68	8.53	3.99
296			60						0.646	0.12	9.40	3.69
297			40						0.184	0.09	1.73	0.62
298			30						0.022	0.07	0.27	0.32
299			20						0.010	0.07	0.05	0.13
300			10	x	x				0.008	0.08	0.06	0.04
301	21	6	80						0.632	0.39	8.56	3.48
302			55		x			x	0.616	0.07	8.65	3.91
303			35						0.032	0.09	0.04	0.29
304			20		x			x	0.009	0.08	0.05	0.06
305			10	x	x			x	0.008	0.08	0.06	0.03
306	21	8	139						0.661	0.69	8.37	3.98
307			80						0.651	0.07	9.23	3.93
308			55			x	x		0.615	0.08	8.60	3.97
309			40			x	x		0.099	0.08	0.04	0.47
310			30						0.021	0.18	0.02	0.27
311			20						0.009	0.09	0.03	0.14

	M	N	O	P	Q	R	S	T	U	V	W	X
312			20									
313			10			x	x		0.006	0.07	0.03	0.01
314	22	1	30						0.039	0.10	0.06	3.20
315			25		x				0.024	0.10	0.05	2.48
316			20						0.022	0.08	0.01	2.20
317			10		x				0.017	0.08	0.02	1.83
318	22	6	20			x	x					
319			10			x	x		0.024	0.09	0.01	2.13
320	22	10	27						0.031	0.12	0.05	1.99
321			20						0.028	0.08	0.06	1.94
322			10	x	x				0.026	0.12	0.38	2.06
323	22	11	27						0.019	0.09	0.03	1.61
324			20						0.018	0.08	0.02	1.53
325			10	x					0.017	0.07	0.03	1.54
326	23	2	40		x				0.344	2.47	1.19	7.13
327			35						0.337	2.45	1.17	7.16
328			30		x				0.132	1.12	0.49	3.02
329			20						0.011	0.09	0.05	0.00
330			10		x				0.010	0.06	0.04	0.00

	Y	Z	AA	AB	AC	AD	AE	AF	AG
1									
2									
3									
4				**C. Brussaard / J. Martinez**		**J. Gasol**			**J. Brandsma**
5				Jan Hegeman		Elisabet Laia Sa Lago			Marianne Baas
6									Joost Brandsma
7									
8	**STATION #**	**CAST #**	**Appr. Depth**	primary production	bacterial production	bact prod (TdR)	Bact FCM (CTC)	Conversion factors	Lipids (120L)
9			**m**	µgC l-1 d-1	µgC l-1 d-1	µgC l-1 d-1	ml-1		
10	1	1	47						
11			25						
12			10						
13	1	6	10						x
14	1	8	50	x					
15			25	x					
16			10	x					
17	1	10	50		x	x	x		
18			25		x	x	x		x
19			10		x	x	x		x
20	1	12	50				x		
21			25				x		
22			10				x		
23	2	3	75						
24			50						
25			30						
26			25						
27			20						
28			15						
29			10						
30	3	1	50			x	x		
31			25			x	x		
32			10			x	x		
33	3	3	10						x
34	3	6	50	x					
35			25	x					
36			10	x					
37	3	10	50		x	x	x		
38			25		x	x	x		

	Y	Z	AA	AB	AC	AD	AE	AF	AG
39			10		x	x	x		
40	3	12	50						
41			25						
42			10						x
43	4	1	40						
44			25						
45			10						
46	5	1	30						
47			25						
48			10						x
49	5	4	35						
50			25	x					
51			10	x					
52	5	8	25		x	x	x		
53			10		x	x	x	x	
54	5	10	25						
55			10						
56	6	1	25						
57			10						x
58	7	1	25						
59			15						
60			10						
61			5						
62	7	4	25						
63			20	x					
64			10	x					
65	7	8	20		x	x	x		
66			10		x	x	x	x	
67	7	11	20						
68			10						
69	8	3	35						
70			30	x					
71			25						
72			20	x					
73			15						
74			10	x					
75	8	6	35						
76			30		x	x	x		
77			25			x	x		

	Y	Z	AA	AB	AC	AD	AE	AF	AG
78			20		x	x	x		
79			15						
80			10		x	x	x		
81	8	11	35						
82			30						
83			25						
84			20						
85			15						
86			10						
87	8	14	35						
88			30						
89			25						
90			20						
91			15						
92			10						
93	9	1	45						
94			40						
95			35						
96			27.5						
97			20						
98			10						
99	10	1	70						
100			60						
101			50						
102			38						
103			35						
104			25						
105			20						
106			10						
107	10	4	70						
108			60						
109			50						
110			40	x					
111			30	x					
112			20						
113			10	x					
114	10	8	70			x			
115			60						
116			50						

	Y	Z	AA	AB	AC	AD	AE	AF	AG
117			40		x	x	x		
118			30		x	x			
119			20			x	x		
120			10		x	x	x		
121	10	11	70						
122			60						
123			50						
124			40						
125			30						
126			20						
127			10						
128	11	1	50						
129			40	x					
130			30						
131			27	x					
132			20						
133			15						
134			10	x					
135	11	5	40		x				
136			30		x				
137			10		x	x		x	
138	11	9	40						
139			29						
140			20						
141			10				x		
142	12	1	50						
143			35						
144			20						
145			10						
146			10						
147	12	2	65						
148			50	x					
149			35						
150			30	x					
151			20						
152			10	x					
153	12	6	50		x	x			
154			35		x	x			
155			20			x			

	Y	Z	AA	AB	AC	AD	AE	AF	AG
156			10		x	x	x		
157	12	8	50						
158			40						
159			30						
160			20						
161			10						
162	13	1	100						
163			75						
164			50						
165			35						
166			20						
167			10						x
168	14	1	100						
169			75						
170			60						
171			50						
172			35						
173			20						
174			10						
175	14	5	75						
176			60						
177			50						
178			35						
179			20						
180			10						
181	14	10	100						
182			75						
183			50	x					
184			35	x					
185			20						
186			10	x					
187	14	11	75			x			
188			50		x				
189			35		x	x			
190			20			x			
191			10		x	x	x	x	
192	15	1	75						
193			50						
194			20						

	Y	Z	AA	AB	AC	AD	AE	AF	AG
195			10						x
196	16	1	120						
197			90						
198			75						
199			75						
200			50						
201			20						
202			10						x
203	16	2	125						
204			100						
205			75						
206			50						
207			30						
208			20						
209			10						
210	16	7	125						
211			100						
212			75						
213			50						
214			30						
215			20						
216			10						
217	16	11	125						
218			100						
219			75						
220			60						
221			50	x					
222			30	x					
223			20						
224			10	x					
225	16	12	100						
226			80		x	x			
227			50		x	x			
228			40			x			
229			20		x	x			
230			10		x	x	x		
231	18-niskin	22	10						
232	18-niskin	23	20						
233	18-niskin	26	30						

	Y	Z	AA	AB	AC	AD	AE	AF	AG
234	18-niskin	27	50						
235	18-niskin	16	60						
236	18-niskin	28	75						
237	18-niskin	29	134						
238	18	35	125						
239			110						
240			75						
241			50	x					
242			40						
243			30						
244			20	x					
245			10	x					
246	18	37	110						
247			75						
248			50		x	x			
249			50						
250			35			x			
251			25		x	x			
252			20						
253			10		x	x	x	x	
254	19	1	257						
255			200						
256			150						
257			100						
258			60						
259			50	x					
260			40						
261			30						
262			20	x					
263			10	x					
264	19	5	260						
265			50		x	x			
266			40						
267			30			x			
268			20		x	x			
269			10		x	x	x	x	
270									
271	19	8	260						
272			100						

	Y	Z	AA	AB	AC	AD	AE	AF	AG
273			100						
274			60						
275			50						
276			30						
277			20						
278			10						
279	20	1	300						
280			200						
281			100						
282			70						
283			35						
284			20						
285			20						
286			10						x
287	21	1	137						
288			100						
289			75						
290			50						
291			30						
292			20						
293			10						
294			5						
295	21	2	100						
296			60						
297			40	x					
298			30						
299			20	x					
300			10	x					
301	21	6	80						
302			55		x	x			
303			35		x	x			
304			20		x	x			
305			10		x	x	x		
306	21	8	139						
307			80						
308			55						
309			40						
310			30						
311			20						

	Y	Z	AA	AB	AC	AD	AE	AF	AG
312			20						
313			10						
314	22	1	30						
315			25						
316			20						
317			10						
318	22	6	20						
319			10						
320	22	10	27	x					
321			20	x					
322			10	x					
323	22	11	27		x	x			
324			20		x	x			
325			10		x	x	x		
326	23	2	40						
327			35						
328			30						
329			20						
330			10						

	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
1															
2															
3															
4				**S. Oosterhuis / M. Baars**			**E.Foulon / N. Simon and S. Masquelier / D. Vaulot**								
5				Swier Oosterhuis			Elodie Foulon and Sylvie Masquelier								
6															
7															
8	**STATION #**	**CAST #**	**Appr. Depth**	Sec. prod.	HPLC	Viability	DNA	FISH	DAPI	QPCR	Cyto	Microscopy	Virus Ehux	Taxonomy	Cultures
9			**m**					ml-1	ml-1		ml-1	ml-1			
10	1	1	47	x			x	x	x	x	x	x		x	
11			25				x	x	x	x	x	x			
12			10				x	x	x	x	x	x			
13	1	6	10												
14	1	8	50		x	x									
15			25		x	x									
16			10												
17	1	10	50						x						
18			25						x						
19			10						x				x	x	x
20	1	12	50	x	x	x									
21			25	x	x	x									
22			10	x	x	x									
23	2	3	75					x							
24			50					x							
25			30												
26			25					x							
27			20												
28			15												
29			10					x							
30	3	1	50			x									
31			25			x									
32			10												
33	3	3	10												
34	3	6	50												
35			25												
36			10												
37	3	10	50	x			x	x	x	x	x	x			
38			25				x	x	x	x	x	x			

	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
39			10				x	x	x	x	x	x	x	x	x
40	3	12	50		x										
41			25		x										
42			10		x										
43	4	1	40					x							
44			25					x							
45			10					x							
46	5	1	30			x									
47			25			x									
48			10			x									
49	5	4	35												
50			25												
51			10												
52	5	8	25	x											
53			10	x											
54	5	10	25		x		x	x	x	x	x	x			
55			10		x		x	x	x	x	x	x	x	x	x
56	6	1	25					x							
57			10					x							
58	7	1	25			x									
59			15			x									
60			10			x									
61			5												
62	7	4	25												
63			20												
64			10												
65	7	8	20	x			x	x	x	x	x	x	x	x	x
66			10	x			x	x	x	x	x	x			
67	7	11	20		x										
68			10		x										
69	8	3	35	x											
70			30	x											
71			25	x											
72			20												
73			15												
74			10												
75	8	6	35												
76			30				x	x	x	x	x	x			x
77			25				x	x	x	x	x	x			

	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
78			20				x	x	x	x	x	x			
79			15												
80			10				x	x	x	x	x	x	x	x	x
81	8	11	35		x										
82			30		x										
83			25		x										
84			20		x										
85			15		x										
86			10		x										
87	8	14	35												
88			30		x										
89			25												
90			20		x										
91			15												
92			10		x										
93	9	1	45					x							
94			40					x							
95			35					x							
96			27.5					x							
97			20					x							
98			10					x							
99	10	1	70			x									
100			60												
101			50												
102			38			x									
103			35												
104			25												
105			20			x									
106			10												
107	10	4	70												
108			60												
109			50												
110			40												
111			30												
112			20												
113			10												
114	10	8	70	x				x							
115			60	x											
116			50												

	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
117			40	x			x	x	x	x	x	x		x	x
118			30				x	x	x	x	x	x			
119			20	x			x	x	x	x	x	x			
120			10				x	x	x	x	x	x	x		x
121	10	11	70												
122			60		x										
123			50												
124			40		x										
125			30		x										
126			20												
127			10		x										
128	11	1	50												
129			40												
130			30												
131			27												
132			20												
133			15												
134			10	x											
135	11	5	40	x			x	x	x	x	x	x			
136			30				x	x	x	x	x	x		x	x
137			10	x			x	x	x	x	x	x	x		x
138	11	9	40		x	x									
139			29		x	x									
140			20		x	x									
141			10		x	x									
142	12	1	50			x									
143			35			x									
144			20			x									
145			10			x									
146			10												
147	12	2	65												
148			50												
149			35												
150			30												
151			20												
152			10												
153	12	6	50	x			x	x	x	x	x	x			
154			35	x			x	x	x	x	x	x		x	x
155			20	x			x	x	x	x	x	x			

	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
156			10	x			x	x	x	x	x	x	x		x
157	12	8	50		x										
158			40		x										
159			30		x										
160			20		x										
161			10		x										
162	13	1	100					x							
163			75					x							
164			50					x							
165			35					x							
166			20					x							
167			10					x							
168	14	1	100												
169			75	x											
170			60												
171			50	x											
172			35	x											
173			20												
174			10	x											
175	14	5	75		x										
176			60												
177			50		x										
178			35		x										
179			20		x										
180			10		x										
181	14	10	100												
182			75												
183			50												
184			35												
185			20												
186			10												
187	14	11	75				x	x	x	x	x	x			
188			50				x	x	x	x	x	x			
189			35				x	x	x	x	x	x			
190			20				x	x	x	x	x	x		x	x
191			10				x	x	x	x	x	x			x
192	15	1	75					x							
193			50					x							
194			20					x							

	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
195			10					x							
196	16	1	120												
197			90												
198			75												
199			75												
200			50												
201			20												
202			10												
203	16	2	125												
204			100												
205			75												
206			50												
207			30												
208			20												
209			10												
210	16	7	125												
211			100												
212			75		x	x									
213			50		x	x									
214			30		x	x									
215			20		x										
216			10		x	x									
217	16	11	125												
218			100												
219			75												
220			60												
221			50												
222			30												
223			20												
224			10												
225	16	12	100	x											
226			80	x				x			x	x			
227			50	x			x	x	x	x	x	x			
228			40				x	x	x	x	x	x			
229			20	x			x	x	x	x	x	x			
230			10	x			x	x	x	x	x	x		x	x
231	18-niskin	22	10		x	x									
232	18-niskin	23	20		x	x									
233	18-niskin	26	30		x	x									

	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
234	18-niskin	27	50		x	x									
235	18-niskin	16	60	x											
236	18-niskin	28	75		x	x									
237	18-niskin	29	134		x	x									
238	18	35	125												
239			110												
240			75												
241			50												
242			40												
243			30												
244			20												
245			10												
246	18	37	110												
247			75					x							
248			50				x	x	x	x	x	x			
249			50				x	x	x	x	x	x			
250			35				x	x	x	x	x	x			
251			25				x	x	x	x	x	x		x	x
252			20				x	x	x	x	x	x			
253			10				x	x	x	x	x	x			x
254	19	1	257												
255			200												
256			150												
257			100												
258			60												
259			50												
260			40												
261			30												
262			20												
263			10												
264	19	5	260	x											
265			50	x			x	x	x	x	x	x			
266			40				x	x	x	x	x	x			
267			30	x			x	x	x	x	x	x			
268			20	x			x	x	x	x	x	x		x	x
269			10	x			x	x	x	x	x	x			x
270															
271	19	8	260												
272			100												

	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
273			100												
274			60												
275			50		x	x									
276			30		x	x									
277			20		x	x									
278			10		x	x									
279	20	1	300												
280			200					x							
281			100					x							
282			70												
283			35					x							
284			20					x							
285			20												
286			10					x							
287	21	1	137												
288			100												
289			75												
290			50												
291			30												
292			20												
293			10												
294			5												
295	21	2	100	x											
296			60	x											
297			40												
298			30												
299			20	x											
300			10	x											
301	21	6	80		x	x	x	x	x	x	x	x			
302			55		x	x	x	x	x	x	x	x		x	x
303			35				x	x	x	x	x	x			
304			20		x	x	x	x	x	x	x	x			
305			10				x	x	x	x	x	x			x
306	21	8	139												
307			80												
308			55												
309			40												
310			30												
311			20												

	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV
312			20												
313			10												
314	22	1	30												
315			25				x	x	x	x	x	x			
316			20				x	x	x	x	x	x			
317			10				x	x	x	x	x	x		x	x
318	22	6	20												
319			10												
320	22	10	27												
321			20												
322			10												
323	22	11	27												
324			20												
325			10												
326	23	2	40					x							
327			35					x							
328			30					x							
329			20					x							
330			10					x							

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**MICROVIR Niskin Bottle DATABASE**													
2														
3														
4				**PI**	**C. Brussaard / J. Martinez**			**C. Brussaard / J. Martinez**				**S. Oosterhuis / M. Baars**		
5				**Investigator**	Lisa Faber			Jan van Ooijen				Swier Oosterhuis		
6														
7	**STATION #**	**CAST #**	**depth (m)**	**parameter**	phytoplankton FCM	virus FCM	bacteria FCM	Phosphate	Ammonium	NOx	Silicate	Secondary production	HPLC	Viability
8				**unit**	ml-1	ml-1	ml-1	µmol/l	µmol/l	µmol/l	µmol/l			
9	1	5			x	x	x					x		
10	1	13			x	x	x						x	
11	1	14			x	x	x							
12	3	4			x	x	x							x
13	3	11										x		
14	3	13			x	x	x						x	x
15	5	2			x	x	x							x
16	5	11			x	x	x					x	x	
17	7	2												x
18	7	9			x	x	x	0.075	0.13	0.09	0.38	x		
19	7	12											x	
20	8	8			x	x	x	0.303	0.68	0.31	2.45	x		
21	8	12			x	x	x	0.322	0.89	0.42	2.72		x	
22	8	15			x	x	x	0.298	0.64	0.28	2.18		x	
23	10	2			x	x	x	0.710	0.11	7.51	4.04			x
24	10	9						0.716	0.11	7.56	3.97	x		
25	10	12			x	x	x						x	
26	10	17			x	x	x							
27	11	6			x	x	x	0.597	2.94	3.48	3.32	x		
28	11	10											x	x
29	11	12												
30	11	13												
31	12	7			x	x	x	0.465	0.465	0.465	0.465	x		
32	12	9											x	
33	12	14			x	x	x							
34	14	6						0.804	0.804	0.804	0.804	x	x	
35	14	12			x	x	x							
36	16	8			x	x	x	0.770	0.770	0.770	0.770		x	x
37	18	29	134		x			0.770	0.770	0.770	0.770		x	x
38	21	9	142		x	x	x	0.670	0.89	8.16	3.99	x	x	
39	22	2	37		x	x	x					x	x	x
40	22	7						0.034	0.13	0.04	2.40			

	A	B	C	D	E
1	**MICROVIR Nets DATABASE**			**S. Oosterhuis / M. Baars** Swier Oosterhuis	**Roscoff** Elodie Foulon and Sylvie Masquelier
2					
3					
4					
5					
6					
7	**STATION #**	**CAST #**	**parameter**	Vertical net	10 um net
8					
9	1	2		x	
10	1	4		x	
11	1	9		x	
12	3	7			x
13	3	8			
14	3	9		x	
15	5	5			x
16	5	6		x	
17	5	7		x	
18	7	5			x
19	7	6		x	
20	7	7		x	
21	8	3			x
22	8	4		x	
23	8	5		x	
24	10	5			x
25	10	6		x	
26	10	7		x	
27	10	13		x	
28	10	14		x	
29	10	15		x	
30	11	2			x
31	11	3		x	
32	12	3		x	
33	12	4		x	
34	12	5		x	
35	12	10		x	
36	12	11		x	
37	12	12			x
38	14	2		x	
39	14	3		x	
40	14	4			x
41	16	3			
42	16	4			x
43	16	5		x	
44	16	6		x	
45	18	11			x
46	18	12		x	
47	18	13		x	
48	18	38			x
49	19	2			
50	19	3		x	
51	19	4		x	x
52	21	3			
53	21	4		x	
54	21	5		x	x
55	22	3			x
56	22	4		x	
57	22	5		x	

	A	B	C	D	E
1	**MICROVIR Pump DATABASE**				
2					
3			**PI**	**J. Brandsma**	**J. Martinez**
4			**Investigator**	Marianne Baas	Marianne Baas
5				Joost Brandsma	Joost Brandsma
6					
7					
8	**STATION #**	**CAST #**	**parameter**	Lipids	DNA sample
9					
10	1	3		1 h; 0 L	
11	1	11		1 h; 0 L	
12	5	9		1; 392	
13	7	10		1; 474	
14	7	13			1h ; 438 l
15	8	9		1h; 0 l	
16	8	10		1h ; 536 l	
17	8	13			1h ; 498 l
18	10	10		1 h; 474 l	
19	10	16			1h ; 418 l
20	11	7		1h ; 0 l	
21	11	8		1h ; 462 l	
22	11	11			1h ; 319 l
23	12	13		1h ; 387 L	
24	12	16			35min ; 193 L
25	14	7			1h ; 60 L
26	14	13		1h ; 470 L	
27	16	9		1h ; 331 L	
28	16	13			1h ; 243 L
29	18	15		1h ; 182 L	
30	18	36			1h ; 205 L
31	19	6		45 min ; 211 L	
32	19	9			1h ; 189 L
33	21	7		1h ; 332 L	
34	21	10			1h ; 234 L
35	22	8		1h ; 222 L	
36	22	12			1h ; 299 L
37	23	1		1h ; 503 L	

	A	B	C	D	E	F	G	H
1	**MICROVIR Boxcore DATABASE**							
2								
3								
4			**PI**	**C. Brussaard / J. Martinez**			**J. Brandsma**	**UK-MEC / C. Brussaard**
5			**Investigator**	Claire Evans			Marianne Baas	C. Brussaard/ C. Evans/ M. Baas
6							Joost Brandsma	
7	**STATION #**	**CAST #**	**parameter**	virus FCM	bacteria FCM	MPN	core slized for lipids	core frozen for various parameters
8			**unit**	ml-1	ml-1	infective virus ml-1		
9	1	7		x	x	x		
10	3	5		x	x	x		
11	5	3		x	x	x		
12	7	3		x	x	x	x	
13	7	14						UK1
14	7	15						UK2
15	7	16						UK3
16	8	16		x	x	x		
17	8	17					x	UK
18	10	3		x	x	x	x	
19	10	18						UK
20	11	14		x	x	x	x	
21	12	15		x	x	x	x	
22	14	9		x	x	x	x	
23	18	34		x	x	x		
24	19	11		x	x	x	x	
25	21	11		x	x	x	x	
26	22	9		x	x	x	x	

abbreviation	explanation
FCM	flow cytometry
dilution assay	Landry and Hassett-based dilution assay for microzooplankton grazing and viral lysis phytoplankton
PFGE	viral diversity
qPCR virus	concentrate for qPCR viral primer work (Micromonas viruses)
DGGE	richness of phytoplankton community, richness of bacterial community
MPN	endpoint dilution to know infective viruses per ml for Micromonas and yes/no for different algal species
Viral reduction assay	viral lysis rates of bacteria
grazing on bacteria	using 0.2 and 0.8 um filtrations
FLB	grazing on fluorescently labelled bacteria
FLC	grazing on fluorescently labelled cyanobacteria
Lugol	phytoplankton and microzooplankton composition qualitatively
Nox	Nitrate + Nitrite
CTC	respiration activity of Bacteria
BP	Bacterial production
Conversion factors	Experiments to correct the results of bacterial production
Sec. prod.	Secondary production by copepods
HPLC	algal pigments
Viability	comnunity viability
Vertical net	WP 200 um
DNA	clone libraries for Euk (eukaryotes <3 um) and Prok (prokaryotes)
FISH	fluorescent in situ hybridisation using specific probes for organism of interest
DAPI	For counting dinoflagellates, ciliates, diatoms.
QPCR	For future studies, in case of need
Cyto	flow cytometry
Microscopy	Observation in epifluorescence microscopy of phototrophic anoxygenic aerobic bacteria (PAA)
Virus Ehux	Isolation of Ehux viruses
Taxonomy	Quantitative analysis of large phytoplankton
Cultures	Isolation of pico organisms
Net 10µm	Qualitative analysis of large phytoplankton
core	sediment core from boxcore for lipids work

TABLE 2. Summary of physics and inorganic macronutrients per CTD

station	CTD (cast)	Bottle	Depth	Lat	Long	depth bottom	depth	temp	salinity	fluorescence	PO4	NH4	Nox	SiOH4
			appr. (m)			m	DepSM	T090C	Sal00	flC-ug/L	µM	µM	µM	µM
1	1	16	10	48.76945	-3.94673	65	9.392	14.4793	35.3389	0.1881	0.154	0.75	1.38	1.63
1	1	8	25	48.76945	-3.94673	65	25.126	14.4697	35.3375	0.1690	0.153	0.79	1.38	1.64
1	1	1	50	48.76945	-3.94673	65	47.682	14.4774	35.3374	0.2148	0.151	0.78	1.39	1.65
1	8	10	10	48.77025	-3.94693	65	9.725	14.6106	35.3088	0.2057	0.140	0.68	1.49	1.76
1	8	9	10	48.77025	-3.94693	65	9.252	14.6115	35.3101	0.2140	0.141	0.68	1.50	1.77
1	8	6	25	48.77025	-3.94693	65	22.692	14.6057	35.3168	0.2949	0.142	0.70	1.49	1.77
1	8	5	25	48.77025	-3.94693	65	23.810	14.6072	35.3164	0.2339	0.144	0.70	1.49	1.77
1	8	2	50	48.77025	-3.94693	65	49.492	14.6015	35.3194	0.2828	0.147	0.73	1.49	1.78
1	8	1	50	48.77025	-3.94693	65	49.639	14.6027	35.3191	0.1972	0.146	0.73	1.49	1.76
1	10	15	10	48.77013	-3.94995	65	10.584	14.5494	35.3382	0.1966	0.157	0.76	1.47	1.70
1	10	14	10	48.77013	-3.94995	65	10.413	14.5373	35.3386	0.1889	0.157	0.75	1.48	1.70
1	10	8	20	48.77013	-3.94995	65	20.962	14.5237	35.3384	0.1491	0.161	0.80	1.45	1.67
1	10	7	20	48.77013	-3.94995	65	20.760	14.5208	35.3386	0.1462	0.160	0.81	1.45	1.67
1	10	2	50	48.77013	-3.94995	65	51.425	14.5200	35.3372	0.1554	0.159	0.81	1.45	1.67
1	10	1	50	48.77013	-3.94995	65	51.157	14.5191	35.3371	0.1666	0.162	0.82	1.45	1.67
1	12	5	10	48.76967	-3.95013	65	11.407	14.5710	35.3411	0.1466	0.157	0.88	1.35	1.60
1	12	3	25	48.76967	-3.95013	65	22.182	14.5131	35.3418	0.1843	0.158	0.89	1.35	1.61
1	12	1	50	48.76967	-3.95013	65	49.564	14.4821	35.3453	0.1633	0.157	0.89	1.34	1.60
2	3	14	10	49.16993	-4.83013	101	9.501	14.9373	35.4198	0.3399	0.044	0.23	0.20	1.12
2	3	12	15	49.16993	-4.83013	101	14.984	14.9323	35.4192	0.2919	0.040	0.23	0.20	1.13
2	3	9	21	49.16993	-4.83013	101	21.068	14.9374	35.4195	0.3388	0.044	0.23	0.21	1.16
2	3	7	25	49.16993	-4.83013	101	24.555	14.9323	35.4196	0.3653	0.044	0.23	0.21	1.17
2	3	5	30	49.16993	-4.83013	101	29.344	13.8283	35.4411	0.1706	0.170	1.14	1.44	1.57
2	3	3	50	49.16993	-4.83013	101	50.177	13.7020	35.4429	0.1176	0.198	1.31	1.65	1.63
2	3	1	74	49.16993	-4.83013	101	74.129	13.6950	35.4435	0.1293	0.200	1.33	1.67	1.64
3	1	7	10	49.32992	-3.32985	76	7.088	14.6007	35.662	0.2948	0.084	0.54	1.02	1.65
3	1	4	25	49.32992	-3.32985	76	24.273	14.5967	35.2661	0.2456	0.084	0.56	1.02	1.67
3	1	1	50	49.32992	-3.32985	76	51.508	14.6060	35.2641	0.2414	0.087	0.61	1.03	1.68
3	6	12	10	49.32925	-3.33645	76	11.192	14.6802	35.2546	0.2581	0.098	0.59	1.39	1.81
3	6	6	25	49.32925	-3.33645	76	24.760	14.6786	35.2556	0.3022	0.095	0.57	1.31	1.77
3	6	1	50	49.32925	-3.33645	76	51.118	14.6745	35.2574	0.3265	0.094	0.57	1.30	1.79
3	10	14	10	49.32998	-3.32987	76	13.374	14.7302	35.2433	0.2843	0.094	0.57	1.31	1.79
3	10	7	25	49.32998	-3.32987	76	24.731	14.7323	35.2424	0.2370	0.095	0.55	1.31	1.79
3	10	1	50	49.32998	-3.32987	76	48.899	14.7295	35.2431	0.2242	0.095	0.58	1.30	1.81
3	12	14	10	49.33015	-3.33017	76	9.918	14.6065	35.2778	0.2706	0.080	0.54	1.03	1.64
3	12	7	25	49.33015	-3.33017	76	25.957	14.5618	35.2755	0.2454	0.083	0.57	1.05	1.66
3	12	1	50	49.33015	-3.33017	76	51.461	14.5692	35.2757	0.2512	0.082	0.56	1.04	1.65
4	1	9	10	50.00003	-1.00055	57	10.128	15.0000	35.0401	0.1914	0.077	0.47	1.47	1.43
4	1	5	25	50.00003	-1.00055	57	23.337	15.0060	35.0414	0.1850	0.081	0.46	1.47	1.43
4	1	1	40	50.00003	-1.00055	57	40.877	15.0077	35.041	0.1906	0.078	0.47	1.47	1.42
5	1	4	10	50.20327	0.33052	39	9.537	15.1411	34.8892	1.4054	0.024	0.117	0.134	0.334
5	1	2	25	50.20327	0.33052	39	25.239	15.0425	34.8924	1.7525	0.027	0.181	0.244	0.362
5	1	1	30	50.20327	0.33052	39	28.308	15.0408	34.8926	1.3771	0.026	0.184	0.288	0.359
5	4	7	10	50.20358	0.3306	42	9.558	15.0932	34.8986	1.4670	0.023	0.165	0.212	0.299
5	4	2	25	50.20358	0.3306	42	25.047	15.0979	34.898	2.0295	0.025	0.169	0.218	0.300
5	4	1	35	50.20358	0.3306	42	35.309	15.0994	34.8982	1.6704	0.024	0.177	0.240	0.291

5	8	9	10	50.2032	0.3304	39	10.319	15.1010	34.8946	1.7646	0.019	0.189	0.214	0.312
5	8	1	25	50.2032	0.3304	39	25.047	15.0988	34.8955	1.5036	0.020	0.219	0.257	0.320
5	10	7	10	50.2033	0.32993	37	9.966	15.1377	34.8911	1.6457	0.013	0.355	0.090	0.247
5	10	1	25	50.2033	0.32993	37	25.027	15.1321	34.8916	1.5439	0.014	0.203	0.120	0.240
6	1	5	10	51.66628	1.88335	47	9.241	15.6994	35.0235	0.2960	0.024	0.121	0.006	0.180
6	1	1	25	51.66628	1.88335	47	24.672	15.7078	35.0227	0.3851	0.029	0.133	0.018	0.191
7	1	10	5	53.16975	2.87078	32	5.333	15.1740	34.0252	0.7042	0.068	0.26	0.60	0.35
7	1	7	10	53.16975	2.87078	32	10.572	15.1649	34.0236	0.9080	0.065	0.25	0.60	0.34
7	1	4	15	53.16975	2.87078	32	15.399	15.1368	34.0244	0.7859	0.069	0.27	0.58	0.34
7	1	1	25	53.16975	2.87078	32	24.836	15.1194	34.0239	0.7577	0.068	0.28	0.61	0.35
7	4	7	10	53.16522	2.81025	31	9.828	15.2059	34.0135	0.6610	0.060	0.31	0.58	0.32
7	4	2	20	53.16522	2.81025	31	19.603	15.2160	34.0079	0.7516	0.061	0.32	0.59	0.31
7	4	1	25	53.16522	2.81025	31	24.645	15.2166	34.0046	0.7527	0.060	0.33	0.64	0.32
7	8	7	10	53.16638	2.80823	30	9.923	15.1143	34.1723	0.4150	0.072	0.15	0.10	0.37
7	8	1	20	53.16638	2.80823	30	20.475	15.1141	34.1717	0.2666	0.071	0.12	0.10	0.37
7	11	12	10	53.16627	2.8086	31	10.383	15.2377	33.9806	0.8857	0.046	0.24	0.51	0.26
7	11	1	20	53.16627	2.8086	31	20.213	15.2245	33.9987	0.7992	0.053	0.26	0.46	0.26
8	3	18	10	54.41277	4.04992	46	9.503	15.4006	34.8011	0.0459	0.081	0.08	0.07	0.04
8	3	17	15	54.41277	4.04992	46	15.102	15.0841	34.8559	0.0494	0.094	0.06	0.05	0.04
8	3	13	20	54.41277	4.04992	46	20.088	14.8149	34.8491	0.0574	0.105	0.07	0.06	0.19
8	3	7	25	54.41277	4.04992	46	25.364	11.9459	34.8116	0.4400	0.134	0.07	0.07	0.49
8	3	2	30	54.41277	4.04992	46	29.651	11.4624	34.8008	0.6131	0.261	0.24	0.19	2.07
8	3	1	35	54.41277	4.04992	46	35.126	11.2780	34.7934	0.3142	0.308	0.69	0.34	2.41
8	6	19	10	54.41295	4.05033	46	9.827	15.4110	34.7859	0.0552	0.079	0.07	0.07	0.05
8	6	18	15	54.41295	4.05033	46	14.471	15.1037	34.8427	0.0605	0.091	0.06	0.07	0.03
8	6	13	20	54.41295	4.05033	46	19.514	14.8793	34.8536	0.0689	0.097	0.06	0.07	0.04
8	6	8	25	54.41295	4.05033	46	24.534	12.0887	34.8087	0.3112	0.155	0.13	0.10	0.82
8	6	2	30	54.41295	4.05033	46	29.918	11.4811	34.7828	0.5829	0.272	0.30	0.22	2.30
8	6	1	40	54.41295	4.05033	46	36.975	11.3007	34.7908	0.3760	0.300	0.66	0.36	2.38
8	11	18	10	54.41328	4.05015	46	9.601	15.3786	34.7281	0.0826	0.072	0.06	0.05	0.34
8	11	17	15	54.41328	4.05015	46	15.108	14.9576	34.8217	0.1110	0.083	0.06	0.05	0.06
8	11	12	20	54.41328	4.05015	46	20.306	14.7933	34.8127	0.1308	0.084	0.07	0.06	0.02
8	11	7	25	54.41328	4.05015	46	24.883	14.5372	34.802	0.1334	0.089	0.06	0.06	0.12
8	11	2	30	54.41328	4.05015	46	31.037	11.3725	34.7991	0.3679	0.284	0.57	0.28	2.22
8	11	1	35	54.41328	4.05015	46	35.459	11.2941	34.7953	0.2674	0.312	0.81	0.38	2.54
8	14	6	10	54.41317	4.04222	48	9.486	15.3489	34.754	0.1291	0.079	0.09	0.05	0.24
8	14	5	15	54.41317	4.04222	48	13.407	15.3223	34.7587	0.1152	0.082	0.07	0.03	0.21
8	14	4	20	54.41317	4.04222	48	19.351	14.7349	34.8481	0.0992	0.099	0.08	0.03	0.10
8	14	3	25	54.41317	4.04222	48	24.617	12.3976	34.7744	0.3617	0.122	0.07	0.03	0.39
8	14	2	30	54.41317	4.04222	48	29.560	11.4537	34.7933	0.7708	0.273	0.31	0.20	2.24
8	14	1	35	54.41317	4.04222	48	34.646	11.2660	34.7912	0.3418	0.309	0.77	0.33	2.51
9	1	10	10	54.50032	0.99983	56	10.047	14.7818	34.5506	0.1602	0.030	0.09	0.03	1.00
9	1	9	20	54.50032	0.99983	56	18.876	14.4488	34.5506	0.2110	0.033	0.09	0.04	1.02
9	1	6	28	54.50032	0.99983	56	27.751	12.9940	34.5161	0.3525	0.158	0.23	1.18	1.73
9	1	5	34	54.50032	0.99983	56	34.959	9.1694	34.5431	0.1134	0.408	0.40	4.35	2.92
9	1	2	40	54.50032	0.99983	56	39.930	8.9514	34.5536	0.0784	0.486	0.47	5.35	3.30
9	1	1	45	54.50032	0.99983	56	45.043	8.9239	34.5622	0.0689	0.523	0.46	5.61	3.38
10	1	8	10	55.68055	2.27955	83	9.535	14.6911	34.8743	0.1210	0.044	0.08	0.03	0.28
10	1	7	20	55.68055	2.27955	83	20.519	14.3861	34.8866	0.1210	0.056	0.10	0.03	0.30

10	1	6	25	55.68055	2.27955	83	25.033	13.3244	34.9141	0.1786	0.070	0.09	0.07	0.36
10	1	5	35	55.68055	2.27955	83	34.971	10.7264	34.9439	0.2098	0.299	0.19	1.61	1.21
10	1	4	38	55.68055	2.27955	83	38.498	8.2955	34.9877	0.2539	0.580	0.20	5.52	2.98
10	1	3	50	55.68055	2.27955	83	49.656	8.0440	34.9967	0.1380	0.679	0.09	7.27	3.78
10	1	2	60	55.68055	2.27955	83	59.779	7.9811	34.9957	0.1005	0.699	0.08	7.43	3.82
10	1	1	70	55.68055	2.27955	83	70.925	7.9214	34.9968	0.0692	0.709	0.08	7.51	4.00
10	4	14	10	55.68005	2.28	83	10.940	14.7304	34.8784	0.1167	0.044	0.10	0.07	0.30
10	4	10	20	55.68005	2.28	83	20.724	14.3962	34.8883	0.1394	0.051	0.10	0.06	0.30
10	4	7	30	55.68005	2.28	83	31.720	13.1391	34.9157	0.2125	0.095	0.10	0.28	0.45
10	4	4	40	55.68005	2.28	83	40.380	8.1441	34.9932	0.2810	0.605	0.15	6.09	3.17
10	4	3	50	55.68005	2.28	83	50.244	7.9318	34.9975	0.0910	0.690	0.10	7.36	3.83
10	4	2	60	55.68005	2.28	83	60.272	7.9251	34.9985	0.0797	0.709	0.10	7.43	3.93
10	4	1	70	55.68005	2.28	83	70.243	7.9253	34.9986	0.0576	0.706	0.09	7.48	3.94
10	8	17	10	55.6805	2.28127	82	9.548	14.6844	34.8744	0.0900	0.043	0.08	0.03	0.27
10	8	15	20	55.6805	2.28127	82	19.854	13.5038	34.9166	0.1412	0.051	0.09	0.03	0.28
10	8	9	30	55.6805	2.28127	82	29.768	13.1896	34.908	0.1962	0.080	0.09	0.20	0.35
10	8	4	40	55.6805	2.28127	82	40.091	8.1103	34.9949	0.1656	0.648	0.10	7.01	3.66
10	8	3	50	55.6805	2.28127	82	49.364	7.9755	34.9961	0.0757	0.700	0.09	7.45	3.85
10	8	2	60	55.6805	2.28127	82	59.785	7.8838	34.9949	0.0400	0.705	0.08	7.54	3.91
10	8	1	70	55.6805	2.28127	82	69.662	7.8865	34.9948	0.0595	0.713	0.08	7.55	3.97
10	11	17	10	55.68058	2.28083	83	9.589	14.9056	34.876	0.0551	0.048	0.09	0.04	0.28
10	11	16	20	55.68058	2.28083	83	19.471	14.6214	34.8717	0.1319	0.051	0.08	0.04	0.29
10	11	10	30	55.68058	2.28083	83	31.035	13.1785	34.9124	0.2015	0.061	0.09	0.04	0.28
10	11	4	40	55.68058	2.28083	83	40.537	8.1634	34.9939	0.1733	0.657	0.09	6.96	3.72
10	11	3	50	55.68058	2.28083	83	49.260	8.0717	34.996	0.1332	0.689	0.08	7.34	3.83
10	11	2	60	55.68058	2.28083	83	59.805	7.9079	34.996	0.0540	0.709	0.09	7.48	3.92
10	11	1	70	55.68058	2.28083	83	70.202	7.9026	34.9962	0.0624	0.719	0.08	7.55	3.99
11	1	14	10	57.00097	3.99947	61	9.813	14.6800	34.4747	0.1305	0.026	0.08	0.05	0.10
11	1	13	15	57.00097	3.99947	61	14.682	14.5125	34.5892	0.1357	0.024	0.07	0.05	0.08
11	1	12	20	57.00097	3.99947	61	19.681	14.5044	34.5972	0.1556	0.023	0.07	0.23	0.13
11	1	10	26	57.00097	3.99947	61	26.740	13.7851	34.6737	0.3242	0.025	0.07	0.06	0.08
11	1	6	30	57.00097	3.99947	61	30.191	7.6226	35.1135	0.2379	0.541	2.55	3.26	3.23
11	1	2	40	57.00097	3.99947	61	39.674	7.6012	35.1133	0.1545	0.587	2.76	3.47	3.30
11	1	1	50	57.00097	3.99947	61	50.282	7.6037	35.1135	0.1254	0.591	2.76	3.49	3.31
11	5	13	10	56.99978	3.99958	61	10.119	14.7060	34.4695	0.1475	0.020	0.07	0.03	0.07
11	5	7	30	56.99978	3.99958	61	30.851	7.7139	35.1088	0.2824	0.500	2.26	2.97	2.93
11	5	1	40	56.99978	3.99958	61	40.137	7.6093	35.114	0.1298	0.585	2.90	3.44	3.25
11	9	14	10	57.00018	4.00108	61	9.753	14.6036	34.5606	0.1505	0.020	0.08	0.02	0.07
11	9	13	20	57.00018	4.00108	61	20.224	14.5659	34.57	0.1558	0.031	0.08	0.04	0.15
11	9	7	30	57.00018	4.00108	61	29.449	8.3882	35.0808	1.3160	0.426	1.80	2.43	2.66
11	9	1	40	57.00018	4.00108	61	39.556	7.6085	35.1136	0.1237	0.610	2.79	3.44	3.11
12	1	4	10	57.33052	-0.32993	75	11.071	13.0246	34.7601	0.2658	0.063	0.06	0.04	0.88
12	1	3	20	57.33052	-0.32993	75	20.359	12.9553	34.772	0.2925	0.063	0.07	0.04	0.89
12	1	2	35	57.33052	-0.32993	75	35.009	10.3491	34.7749	0.1504	0.289	0.53	2.24	1.93
12	1	1	50	57.33052	-0.32993	75	50.709	9.5176	34.7841	0.0534	0.451	0.80	4.40	2.75
12	2	18	10	57.3313	-0.33155	77	10.814	13.0498	34.7773	0.2191	0.059	0.08	0.04	0.88
12	2	13	20	57.3313	-0.33155	77	20.152	12.9975	3.7805	0.2836	0.062	0.08	0.06	0.88
12	2	8	25	57.3313	-0.33155	77	26.058	12.2286	34.7762	0.2461	0.108	0.19	0.18	1.13
12	2	7	35	57.3313	-0.33155	77	35.138	9.5990	34.7905	0.0552	0.434	0.87	4.09	2.73

12	2	2	50	57.3313	-0.33155	77	50.290	9.4733	34.7917	0.0351	0.468	0.86	4.55	2.89
12	2	1	65	57.3313	-0.33155	77	65.047	9.4652	34.7922	0.0495	0.472	0.84	4.57	2.92
12	6	17	10	57.33048	-0.33	75	10.234	13.0724	34.7736	0.2420	0.071	0.09	0.05	0.87
12	6	13	20	57.33048	-0.33	75	19.269	13.0099	34.7699	0.2174	0.070	0.11	0.04	0.86
12	6	7	35	57.33048	-0.33	75	34.729	10.1397	34.7624	0.1185	0.318	0.74	2.38	2.07
12	6	1	50	57.33048	-0.33	75	49.638	9.5795	3.7861	0.0554	0.447	0.83	4.33	2.75
12	8	14	10	57.33023	-0.3291	74	9.605	13.0085	34.75	0.1881	0.067	0.07	0.03	0.87
12	8	12	20	57.33023	-0.3291	74	20.575	12.9035	34.7558	0.2822	0.071	0.08	0.07	0.89
12	8	7	30	57.33023	-0.3291	74	32.163	10.2340	34.7925	0.1327	0.349	0.66	3.07	2.25
12	8	6	40	57.33023	-0.3291	74	40.523	9.6361	34.7835	0.0425	0.437	0.78	4.18	2.69
12	8	1	50	57.33023	-0.3291	74	50.483	9.5655	34.7859	0.0606	0.450	0.78	4.34	2.76
13	1	6	10	58.32982	-0.82953	116	10.002	13.0292	35.0358	0.1529	0.025	0.07	0.05	0.42
13	1	5	20	58.32982	-0.82953	116	19.865	12.7306	35.0669	0.3487	0.030	0.06	0.04	0.43
13	1	4	35	58.32982	-0.82953	116	34.434	11.1795	35.1379	0.5806	0.100	0.26	0.88	0.72
13	1	3	50	58.32982	-0.82953	116	49.725	9.2938	35.2268	0.0483	0.464	1.68	4.88	1.58
13	1	2	75	58.32982	-0.82953	116	74.975	8.7575	35.224	0.0347	0.651	1.13	7.96	3.53
13	1	1	100	58.32982	-0.82953	116	100.377	8.5892	35.2253	0.0265	0.684	0.32	9.26	3.74
14	1	18	10	59.16977	0.67108	124	7.930	13.0528	35.1567	0.0971	0.015	0.06	0.04	0.21
14	1	16	20	59.16977	0.67108	124	19.478	13.0544	35.1572	0.1047	0.020	0.09	0.04	0.21
14	1	12	35	59.16977	0.67108	124	34.335	9.9716	35.2097	0.1767	0.035	0.12	0.08	0.20
14	1	8	50	59.16977	0.67108	124	50.987	8.4258	35.218	0.0872	0.315	0.08	3.84	0.78
14	1	6	60	59.16977	0.67108	124	61.982	7.6032	35.2252	0.0352	0.708	0.07	10.08	3.30
14	1	2	75	59.16977	0.67108	124	74.141	7.4522	35.2251	0.0341	0.787	0.08	11.25	3.81
14	1	1	100	59.16977	0.67108	124	101.505	7.5437	35.2253	0.0415	0.796	0.08	11.26	3.86
14	5	17	10	59.16973	0.67032	126	10.824	13.0679	35.1546	0.1140	0.021	0.06	0.06	0.23
14	5	15	20	59.16973	0.67032	126	19.930	13.0663	35.1552	0.1193	0.018	0.06	0.05	0.22
14	5	11	35	59.16973	0.67032	126	35.273	10.3198	35.2211	0.2834	0.038	0.14	0.04	0.16
14	5	7	50	59.16973	0.67032	126	49.993	9.0791	35.2117	0.1421	0.136	0.14	0.46	0.36
14	5	5	60	59.16973	0.67032	126	60.739	7.6721	35.2196	0.0458	0.672	0.07	9.57	2.94
14	5	1	75	59.16973	0.67032	126	75.269	7.5570	35.2252	0.0366	0.796	0.08	11.37	3.92
14	10	14	10	59.16887	0.66983	125	9.288	13.0483	35.1663	0.1307	0.011	0.05	0.05	0.19
14	10	11	20	59.16887	0.66983	125	19.668	13.0462	35.165	0.1222	0.013	0.09	0.05	0.18
14	10	8	35	59.16887	0.66983	125	35.520	9.8443	35.2145	0.1747	0.089	0.23	0.12	0.23
14	10	5	50	59.16887	0.66983	125	50.108	8.7593	35.2124	0.1012	0.278	0.08	3.10	0.75
14	10	3	75	59.16887	0.66983	125	74.915	7.6221	35.2342	0.0417	0.749	0.07	11.12	3.67
14	10	1	100	59.16887	0.66983	125	100.300	7.6002	35.2337	0.0351	0.773	0.07	11.14	3.78
14	11	19	10	59.16968	0.66898	124	9.552	13.0516	35.1653	0.0590	0.010	0.05	0.05	0.17
14	11	11	20	59.16968	0.66898	124	20.223	13.0503	35.1643	0.1086	0.010	0.06	0.04	0.17
14	11	7	35	59.16968	0.66898	124	34.626	10.2277	35.1978	0.2480	0.045	0.13	0.05	0.20
14	11	3	50	59.16968	0.66898	124	50.452	9.0182	35.2106	0.1200	0.185	0.09	1.20	0.51
14	11	1	75	59.16968	0.66898	124	74.704	7.5990	35.2334	0.0419	0.754	0.08	11.10	3.74
15	1	10	10	59.67003	-1.50105	97	9.982	11.0862	35.2482	0.2701	0.299	1.93	1.83	1.13
15	1	7	20	59.67003	-1.50105	97	19.481	10.9155	35.2537	0.2512	0.309	2.05	1.92	1.15
15	1	3	50	59.67003	-1.50105	97	50.782	10.8964	35.2646	0.2000	0.328	2.05	2.26	1.23
15	1	1	75	59.67003	-1.50105	97	75.027	10.8919	35.2729	0.1755	0.332	2.06	2.34	1.25
16	1	12	10	60.33017	-3.49932	139	9.577	12.1586	35.3169	0.8631	0.258	0.89	3.51	1.20
16	1	9	20	60.33017	-3.49932	139	18.152	11.9722	35.3201	1.0941	0.272	0.91	3.60	1.22
16	1	6	50	60.33017	-3.49932	139	51.492	10.8244	35.407	0.0580	0.599	0.72	8.95	2.57
16	1	3	75	60.33017	-3.49932	139	75.126	10.4026	35.4156	0.0307	0.685	0.08	10.95	3.19

16	1	2	90	60.33017	-3.49932	139	90.263	10.1144	35.4131	0.0375	0.739	0.08	11.79	4.01
16	1	1	120	60.33017	-3.49932	139				0.0320				
16	2	18	10	60.3305	-3.4998	138	9.937	12.1497	35.3255	1.3308	0.244	0.47	3.54	1.08
16	2	14	20	60.3305	-3.4998	138	19.909	12.0253	35.3302	1.3444	0.262	0.55	3.74	1.02
16	2	9	30	60.3305	-3.4998	138	29.976	11.9695	35.3314	0.8988	0.294	0.83	4.11	1.15
16	2	5	50	60.3305	-3.4998	138	49.700	11.3489	35.3798	0.2742	0.510	1.14	7.07	2.03
16	2	3	75	60.3305	-3.4998	138	74.509	10.4834	35.4076	0.0343	0.665	0.65	9.88	3.11
16	2	2	100	60.3305	-3.4998	138	100.609	10.1523	35.4143	0.0465	0.747	0.07	11.71	3.96
16	2	1	120	60.3305	-3.4998	138	125.023	10.1158	35.415	0.0391	0.764	0.04	11.89	4.18
16	7	18	10	60.33002	-3.49995	140	10.245	12.3407	35.3232	0.3039	0.396	0.84	5.50	1.58
16	7	14	20	60.33002	-3.49995	140	20.242	11.9666	35.3376	1.0093	0.299	0.75	4.15	1.11
16	7	9	30	60.33002	-3.49995	140	28.667	11.2345	35.388	0.1791	0.503	1.21	6.81	2.03
16	7	5	50	60.33002	-3.49995	140	49.762	10.9401	35.4027	0.0942	0.643	0.50	9.66	3.03
16	7	3	75	60.33002	-3.49995	140	74.002	10.5080	35.4123	0.0428	0.675	0.26	10.36	3.07
16	7	2	100	60.33002	-3.49995	140	100.739	10.0816	35.4128	0.0432	0.761	0.07	11.86	4.14
16	7	1	125	60.33002	-3.49995	140	124.402	10.0729	35.4128	0.0359	0.765	0.06	11.92	4.18
16	11	18	10	60.32972	-3.49938	139	10.145	12.3482	35.3203	1.8421	0.214	0.17	3.17	1.14
16	11	14	20	60.32972	-3.49938	139	20.281	12.2208	35.3140	1.7762	0.284	0.77	3.77	1.31
16	11	9	30	60.32972	-3.49938	139	30.429	11.6916	35.3492	0.4813	0.390	1.15	5.19	1.55
16	11	7	50	60.32972	-3.49938	139	45.973	10.9599	35.4032	0.0747	0.583	0.84	8.31	2.50
16	11	3	75	60.32972	-3.49938	139	74.301	10.3946	35.4144	0.0294	0.685	0.07	10.67	3.17
16	11	2	100	60.32972	-3.49938	139	99.586	10.0378	35.4124	0.0360	0.764	0.05	11.75	4.28
16	11	1	125	60.32972	-3.49938	139	125.336	10.0356	35.4118	0.0193	0.766	0.07	11.79	4.31
16	12	18	10	60.3299	-3.49972	139	10.017	12.3378	35.3203	1.8094	0.213	0.10	3.13	1.14
16	12	12	20	60.3299	-3.49972	139	20.131	11.8688	35.3262	1.5337	0.317	0.94	4.14	1.33
16	12	11	40	60.3299	-3.49972	139	39.344	10.9400	35.4035	0.0846	0.565	0.89	8.01	2.34
16	12	7	50	60.3299	-3.49972	139	49.847	10.8448	35.4085	0.0439	0.605	0.62	8.82	2.51
16	12	3	80	60.3299	-3.49972	139	80.748	10.3934	35.4155	0.0157	0.686	0.09	10.74	3.16
16	12	1	100	60.3299	-3.49972	139	100.092	10.0747	35.4122	0.0148	0.755	0.09	11.64	4.13
18	2	niskin	10	60.99987	1.99997	134					0.021	0.04	0.02	0.06
18	4	niskin	20	61.00017	1.99968	133					0.031	0.09	0.04	0.23
18	14	niskin	30	61.00007	2.00023	133					0.402	1.77	4.83	1.65
18	8	niskin	50	61.00008	1.99997	133					0.465	1.13	6.43	1.83
18	16	niskin	60	61.00038	2.00047	133					0.763	0.09	12.02	4.13
18	22	niskin	10	60.99972	2.00055	133					0.014	0.07	0.03	0.17
18	25	niskin	20	61.00018	2.00122	133					0.191	0.76	2.05	0.99
18	26	niskin	30	60.99963	2.00075	133					0.463	1.48	5.95	1.88
18	27	niskin	50	60.99973	1.99968	134					0.513	0.95	7.19	1.91
18	28	niskin	75	61.00013	2.00102	133					0.803	0.09	12.25	4.61
18	29	niskin	135	60.99958	2.00023	134					0.945	0.13	12.93	6.29
18	35	14	10	61.0004	2.00053	133	10.447	13.3139	34.1353	0.2115	0.014	0.07	0.05	0.07
18	35	10	20	61.0004	2.00053	133	21.093	10.2946	35.2606	0.3357	0.124	0.87	0.96	0.41
18	35	9	30	61.0004	2.00053	133	30.768	9.8354	35.3301	0.2098	0.220	1.47	2.02	0.54
18	35	8	40	61.0004	2.00053	133	40.587	9.6078	35.3381	0.0911	0.318	2.06	3.04	0.85
18	35	4	50	61.0004	2.00053	133	50.036	9.3354	35.3351	0.0450	0.408	1.95	4.64	1.17
18	35	3	75	61.0004	2.00053	133	74.861	8.6011	35.3475	0.0269	0.885	0.10	12.77	5.97
18	35	2	110	61.0004	2.00053	133	109.731	8.1430	35.3319	0.0364	0.944	0.09	12.89	5.75
18	35	1	125	61.0004	2.00053	133	124.603	8.1147	35.3316	0.0380	0.949	0.06	12.93	5.75
18	37	19	10	61.00008	1.9998	133	9.848	13.6418	33.9309	0.1811	0.019	0.08	0.06	0.06

18	37	15	20	61.00008	1.9998	133	19.770	13.0971	34.4505	0.2049	0.035	0.13	0.13	0.21
18	37	10	25	61.00008	1.9998	133	24.342	10.8101	35.0846	0.9330	0.059	0.21	0.51	0.43
18	37	8	35	61.00008	1.9998	133	35.829	9.7711	35.3383	0.2555	0.290	1.68	2.93	0.80
18	37	3	50	61.00008	1.9998	133	51.187	9.3927	35.3437	0.0368	0.494	0.87	7.34	1.74
18	37	2	75	61.00008	1.9998	133	74.335	8.9560	35.3561	0.0107	0.788	0.08	12.28	4.39
18	37	1	110	61.00008	1.9998	133	110.389	8.1734	35.3333	0.0367	0.937	0.08	13.07	5.74
19	1	19	10	59.33037	4.33015	267	10.060	14.6295	30.3727	0.2330	0.012	0.07	0.07	0.03
19	1	14	20	59.33037	4.33015	267	19.640	11.0647	32.7341	0.3873	0.035	0.08	0.20	0.61
19	1	12	30	59.33037	4.33015	267	30.059	9.0371	33.8607	0.2509	0.313	0.08	4.49	1.86
19	1	11	40	59.33037	4.33015	267	40.097	7.6477	34.3829	0.0772	0.526	0.08	7.70	3.22
19	1	7	50	59.33037	4.33015	267	49.840	7.4359	34.6528	0.0396	0.642	0.09	9.15	4.03
19	1	6	60	59.33037	4.33015	267	59.750	7.3108	34.8018	0.0292	0.719	0.09	10.07	4.62
19	1	5	100	59.33037	4.33015	267	99.986	7.2956	34.9988	0.0282	0.754	0.08	10.23	4.34
19	1	3	150	59.33037	4.33015	267	150.030	7.1388	35.0603	0.0129	0.759	0.08	10.30	4.47
19	1	2	200	59.33037	4.33015	267	200.189	7.1195	35.0967	0.0095	0.765	0.06	10.38	4.18
19	1	1	257	59.33037	4.33015	267	258.138	7.2753	35.1909	0.0192	0.827	0.07	11.28	5.75
19	5	18	10	59.32988	4.33015	270	10.023	14.7080	30.1884	0.2242	0.009	0.08	0.06	0.05
19	5	13	20	59.32988	4.33015	270	20.021	10.5851	33.0291	0.3510	0.403	0.07	5.91	2.45
19	5	11	30	59.32988	4.33015	270	29.686	8.3596	34.1188	0.1397	0.557	0.10	7.99	3.42
19	5	9	40	59.32988	4.33015	270	39.920	7.7287	34.5194	0.0479	0.644	0.07	9.12	4.05
19	5	3	50	59.32988	4.33015	270	49.831	7.4043	34.6627	0.0413				
19	5	1	260	59.32988	4.33015	270	259.284	7.2783	35.1918	0.0221	0.818	0.05	11.24	5.74
19	7	1	10	59.32995	4.32938	267	9.531	14.5923	30.4150	0.2013	0.017	0.07	0.05	0.03
19	8	18	10	59.33003	4.32938	267	10.173	14.5724	30.4721	0.1551	0.012	0.08	0.03	0.03
19	8	14	20	59.33003	4.32938	267	19.846	11.4566	32.4891	0.4320	0.023	0.29	0.11	0.41
19	8	11	30	59.33003	4.32938	267	30.088	9.0062	33.9183	0.2659	0.314	0.09	4.46	1.87
19	8	7	50	59.33003	4.32938	267	50.515	7.4697	34.6132	0.0452	0.644	0.07	9.08	4.06
19	8	6	60	59.33003	4.32938	267	59.481	7.2683	34.7290	0.0456	0.709	0.09	10.07	4.43
19	8	3	100	59.33003	4.32938	267	100.314	7.2935	35.0003	0.0247	0.755	0.10	10.41	4.71
19	8	1	260	59.33003	4.32938	267	258.540	7.2664	35.1888	0.0271	0.826	0.08	11.11	5.63
20	1	12	10	57.9195	6.32915	324	9.838	14.8926	32.2032	0.5071	0.011	0.07	0.07	0.39
20	1	9	17	57.9195	6.32915	324	17.022	10.9588	33.9858	0.7428	0.023	0.10	0.15	0.90
20	1	6	35	57.9195	6.32915	324	34.868	8.0709	34.8187	0.1452	0.426	0.05	5.82	2.23
20	1	3	100	57.9195	6.32915	324	100.214	7.3953	35.0760	0.0191	0.719	0.07	10.19	3.94
20	1	2	200	57.9195	6.32915	324	199.770	7.2253	35.1259	0.0173	0.746	0.07	10.43	3.71
20	1	1	300	57.9195	6.32915	324	299.805	7.3037	35.1992	0.0150	0.800	0.06	11.24	4.74
21	1	16	5	57.6699	8.67497	142	5.001	16.2628	30.5290	0.2236	0.011	0.06	0.03	0.03
21	1	14	10	57.6699	8.67497	142	9.894	16.2633	30.5755	0.2276	0.003	0.06	0.03	0.01
21	1	12	20	57.6699	8.67497	142	19.990	13.5512	34.8600	0.3625	0.019	0.07	0.03	0.19
21	1	10	30	57.6699	8.67497	142	30.686	10.1792	34.9687	0.3492	0.028	0.07	0.02	0.23
21	1	8	50	57.6699	8.67497	142	50.194	8.2289	35.1073	0.0657	0.487	0.07	7.07	2.30
21	1	6	80	57.6699	8.67497	142	77.705	7.6891	35.1135	0.0465	0.654	0.46	8.65	3.88
21	1	3	100	57.6699	8.67497	142	97.756	7.5285	35.0955	0.0393	0.635	1.29	6.91	3.77
21	1	1	140	57.6699	8.67497	142	137.857	7.8184	35.1938	0.0354	0.726	0.26	10.20	4.20
21	2	18	10	57.66983	8.6703	146	9.106	16.0871	30.7674	0.1967	0.008	0.08	0.06	0.04
21	2	14	20	57.66983	8.6703	146	19.840	12.4046	34.8682	0.2890	0.010	0.07	0.05	0.13
21	2	12	30	57.66983	8.6703	146	30.141	10.4939	35.0091	0.2349	0.022	0.07	0.27	0.32
21	2	8	40	57.66983	8.6703	146	40.825	9.1889	35.1222	0.2488	0.184	0.09	1.73	0.62
21	2	3	60	57.66983	8.6703	146	59.676	7.8515	35.1296	0.0412	0.646	0.12	9.40	3.69

21	2	1	100	57.66983	8.6703	146	99.838	7.6876	35.1192	0.0498	0.668	0.68	8.53	3.99
21	6	18	10	57.66998	8.66982	148	9.369	16.0578	30.6825	0.2380	0.008	0.08	0.06	0.03
21	6	14	20	57.66998	8.66982	148	19.770	13.1981	34.6307	0.2362	0.009	0.08	0.05	0.06
21	6	9	35	57.66998	8.66982	148	34.703	10.1978	34.9876	0.3108	0.032	0.09	0.04	0.29
21	6	5	60	57.66998	8.66982	148	59.274	7.8762	35.0741	0.0513	0.616	0.07	8.65	3.91
21	6	1	80	57.66998	8.66982	148	78.905	7.8199	35.1059	0.0404	0.632	0.39	8.56	3.48
21	8	19	10	57.67002	8.6726	144	9.591	16.1889	30.7092	0.2820	0.006	0.07	0.03	0.01
21	8	16	20	57.67002	8.6726	144	20.054	12.1924	34.7941	0.2594	0.009	0.09	0.03	0.14
21	8	14	30	57.67002	8.6726	144	30.101	10.4363	34.9929	0.2145	0.021	0.18	0.02	0.27
21	8	10	40	57.67002	8.6726	144	40.079	9.5308	35.0519	0.3688	0.099	0.08	0.04	0.47
21	8	6	55	57.67002	8.6726	144	54.996	7.9175	35.0719	0.0418	0.615	0.08	8.60	3.97
21	8	3	80	57.67002	8.6726	144	79.721	7.7942	35.0993	0.0491	0.651	0.07	9.23	3.93
21	8	1	140	57.67002	8.6726	144	138.967	7.6802	35.1065	0.0447	0.661	0.69	8.37	3.98
22	1	14	10	56.50065	7.17197	36	10.603	15.4311	34.3749	0.5265	0.017	0.08	0.02	1.83
22	1	9	20	56.50065	7.17197	36	19.748	15.2787	34.3612	0.5737	0.022	0.08	0.01	2.20
22	1	5	25	56.50065	7.17197	36	24.117	15.1995	34.3512	0.5874	0.024	0.10	0.05	2.48
22	1	1	30	56.50065	7.17197	36	30.274	14.8854	34.3249	0.4857	0.039	0.10	0.06	3.20
22	6	8	10	56.50055	7.17068	36	10.562	15.2116	34.3780	0.6498	0.024	0.09	0.01	2.13
22	6	2	20	56.50055	7.17068	36	18.815	15.2118	34.3763	0.6008	0.025	0.09	0.06	2.16
22	10	12	10	56.50015	7.17015	36	9.006	15.3914	34.3549	0.4868	0.026	0.12	0.38	2.06
22	10	6	20	56.50015	7.17015	36	20.221	15.3950	34.3553	0.5022	0.028	0.08	0.06	1.94
22	10	1	26	56.50015	7.17015	36	26.490	15.3877	34.3540	0.5875	0.031	0.12	0.05	1.99
22	11	12	10	56.50008	7.16938	37	9.362	15.5546	34.3807	0.5748	0.017	0.07	0.03	1.54
22	11	6	20	56.50008	7.16938	37	19.984	15.5403	34.3792	0.5811	0.018	0.08	0.02	1.53
22	11	1	27	56.50008	7.16938	37	27.134	15.5339	34.3785	0.5405	0.019	0.09	0.03	1.61
23	2	18	10	55.50017	5.99953	49	9.932	15.9796	34.7423	0.2035	0.010	0.06	0.04	0.00
23	2	13	20	55.50017	5.99953	49	19.919	15.9827	34.742	0.2894	0.011	0.09	0.05	0.00
23	2	9	30	55.50017	5.99953	49	32.295	11.2015	34.7315	0.4797	0.132	1.12	0.49	3.02
23	2	6	35	55.50017	5.99953	49	36.764	10.2464	34.7129	0.1236	0.337	2.45	1.17	7.16
23	2	1	40	55.50017	5.99953	49	40.062	10.2440	34.711	0.102	0.344	2.47	1.19	7.13