

NOTIFICATION OF PROPOSED RESEARCH CRUISE

Part A: GENERAL

1. Name of research ship: **RV Pelagia** **Cruise number: 64PE457**

2. Cruise dates: 04-09-2019 until 17-09-2019. Two legs.

- a. LEG1: 4-11 September 2019.
- b. LEG2: 12-17 September 2019

3a. Operating authority: NIOZ Royal Netherlands Institute for Sea Research
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3b. Operating agent: NIOZ Royal Netherlands Institute for Sea Research
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4. Owner: NIOZ Royal Netherlands Institute for Sea Research

5. Particulars of ship:

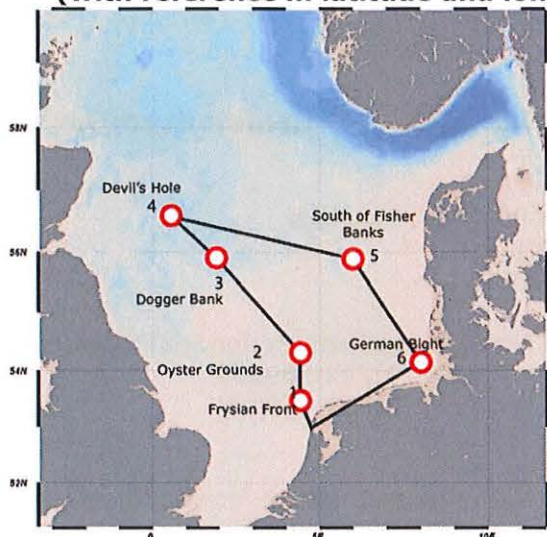
name: Pelagia
nationality: Dutch
overall length: 66.00 meters
maximum draught: 4.00 meters
nett tonnage: 1553 NRT
propulsion: 2 diesel electric Elliot White Gill
Bow Thruster
call sign: PGRQ
IMO nr: 9001461

6. Crew: name of master: J.C. Ellen / E. A. Puijman
number of crew: 12

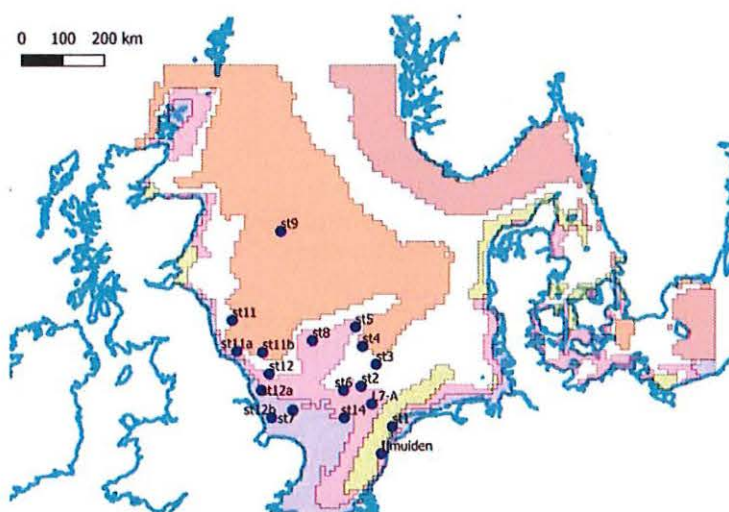
7. Principal investigator name: Karline Soetaert (LEG 1)
Jacco Kromkamp (LEG 2)
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telephone: (+31) 113 577 487
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Chief scientist: name: Peter Kraal (LEG 1)
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8. Geographical area in which the ship will operate: (with reference to latitude and longitude). Leg 1.



Sampling stations for LEG 1 (4-11 September).



Sampling Stations for LEG 2 (12 – 17 September).

9. Brief description of purpose of cruise:

The cruise consists of two legs.

In the first leg (4 to 11 September 2019), the water column and sediment will be sampled for dissolved and particulate phases to characterize water column properties, particle dynamics and investigate benthic-pelagic coupling. Focus is on dynamics of nutrients, oxygen and metals. Six research stations will be visited in areas that experience accumulation of organic-rich, fine-grained sediments and periodic water column stratification and oxygen depletion. The aim is to link depositional conditions to the benthic exchange of metals and nutrients, in order to advance our understanding of biogeochemical dynamics in shelf seas in a changing climate.

In the second leg (12-17 September 2019), the topic is foodweb research in the North Sea with emphasis on ecology of phytoplankton, zooplankton, benthic animals, seabirds marine mammals and foraging behaviour and interspecific interactions of charismatic megafauna.

10. Names and dates of intended ports of call:

Embarkation on Texel, 't Horntje, on 04-09-2019

Port of call: Texel, 't Horntje, on 12-09-2019

Disembarkation on Texel, 't Horntje, on 17-09-2019

11. Any special logistic requirements at ports of call:

n/a

Part B: DETAIL

1. Name of research ship: RV Pelagia

2. Cruise dates: 04-09-2019 until 17-09-2019

3. Purpose of research and general operational methods – leg 1 (4-11 September):

The first leg of this research cruise has two objectives:

- Determine physical and chemical water column particle characteristics (size, composition, mineralogy) to elucidate primary production, particle, metal and nutrient transport processes in the water column;
- Quantify benthic exchange of oxygen, metals and nutrients between water column and sediment in relation to depositional conditions, in particular sediment composition and water column redox conditions.

Operational methods at all stations:

- Chemical and physical water column properties will be measured using sensors mounted on a frame that is lowered through the water by winch: salinity, temperature, turbidity, O₂, particle size distribution
- Water column samples will be taken using a CTD/rosette with 12 L bottles. Water column particulates will be isolated by on-board filtration.
- Primary production will be estimated by on-board incubations.
- Surface sediments (0 – 50 cm) will be collected using a box corer or multi corer. Sediments are sectioned at high vertical resolution on-board, and pore-water is collected.
- Sediment cores are used for on-board incubation experiments to determine O₂ consumption, and nutrient and metal fluxes.
- Sediment cores are used for micro-meter resolution profiles of O₂, H₂S and pH in the uppermost sediment.

Additional operational methods at selected stations (Oyster Grounds, German Bight):

- Lander frame with benthic incubation chambers will be used for short (6 – 12 h) in-situ sediment incubations and measurement of rates of oxygen consumption, and benthic nutrient and metal exchange
- Lander frame with eddy covariance array with O₂ sensor will be used for short (6 – 12 h) deployments during which O₂ fluxes between sediment and water column are measured

Purpose of research and general operational methods – leg 2 (12-17 September):

This research is part of the NIOZ research and monitoring into the functioning of the North Sea Ecosystem and will only take samples from the water column. Water sampling will take place using Niskin Bottles attached to a frame also containing a CTD (Conductivity, Temperature, Depth) to measure the physical properties of the water column. In addition net tows for zooplankton will be made. Water samples taken from the Niskin bottles will be used to measure nutrient concentrations, phytoplankton pigments and suspended matter concentrations. The CTD sensor is also equipped with sensors for algal biomass, oxygen concentration, light penetration and turbidity. During sailing from station to station automated on-line measurements of phytoplankton biomass and photosynthetic activity will be made. Megafauna and seabird surveys are conducted as contribution to an international

monitoring programme and will focus on foraging behaviour of charismatic megafauna and seabird distribution in contrasting parts of the North Sea (between the coast and tidal fronts, at the fronts and beyond).

4. Attach chart showing (on an appropriate scale) the geographical area of the intended work, positions of intended stations/hydrographic sections LEG 1 (4-11 September):

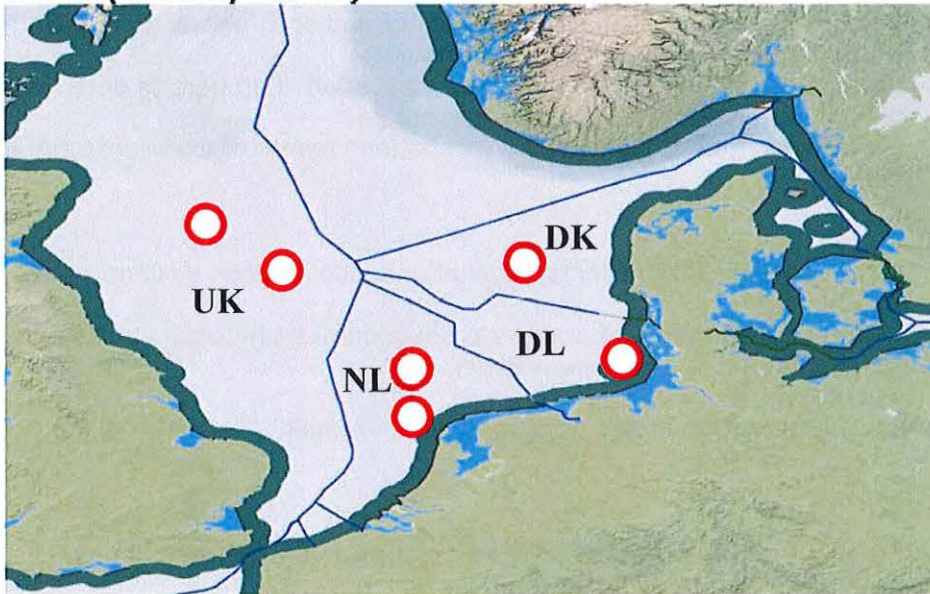
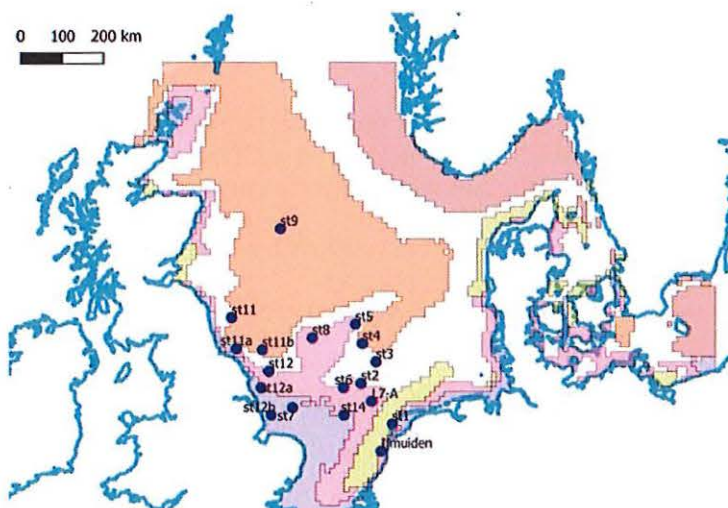


Figure: Approximate station locations within the EEZ (area bordered by thin blue line) and territorial seas (12 nm, covered by dark green zone) of the relevant coastal states (The Netherlands, United Kingdom, Norway, Germany). Map from marineregions.org, EEZmapper.

LEG 2 (12-17 September):

The stations visited are shown on the map below. Transects will follow a zig-zag course to and from to maximise the number of crosses of frontal zones and entries to and from particular water masses.



5a. Type of samples required –

LEG1:

- Surface water samples for phytoplankton characterization and primary production measurements.
- Water column samples to analyse dissolved nutrients, trace metals
- Water column particulates to analyse mineralogy of particulates, and bulk composition of sinking material
- Sediment samples to analyse pore water and solid phase composition (major elements, nutrients, (trace) metals)
- Bottom water samples from benthic incubation chambers to determine release rates of nutrients and trace metals
- Sediment samples from benthic incubation chambers to collect benthic fauna

LEG 2

- Water samples (for nutrients, algal abundance and composition, eDNA, microplastics)
- In-line measurements of primary production and phytoplankton abundance and composition (of surface waters)
- Net tows for zooplankton
- Visual observation of sea birds and sea mammals

5b. Methods by which samples will be obtained (including dredge/core/drill techniques)

LEG 1:

- Surface water samples are collected during transit from the ship's surface water inlet (AquaFlow system)
- Aqueous water column samples will be collected using a CTD/rosette with 12 or 24 L bottles
- Water column particulates will be obtained by on-deck filtration of water column samples, and by using in-situ pumps
- Sediment samples will be obtained with a multi-core (surface sediments, top 50 cm) and for selected station with a piston core (up to 18 m sediment depth)
- Water and sediment samples will be collected from the benthic incubation chambers that are used for in-situ seafloor incubations and measurement of oxygen, nutrient and (trace) metal fluxes.

LEG 2:

- Water samples will be taken by Niskin bottles attached to a Rosette samples (a combined system with bottles and a CTD)
- Phytoplankton primary production will be measured with an active fluorescence method (FRRF)
- Phytoplankton abundance will be measured with a flow cytometer
- Zooplankton will be sampled using net tows
- Birds and sea mammals will be visually observed

6. Details of moored equipment: No moored equipment.

7. Explosives: No explosives.

8. Detail and reference of:

a. Any relevant previous/future cruises:

Our research expedition is part of the 2019 research programme of the NIOZ North Sea Research Centre, which consist of three cruises (May, September, October). The first of these cruises (64PE452) (8 – 23 May) has sampled the central-western North Sea, focusing on food webs and primary production in the water column. Immediately following leg 1 research leg (64PE452), a second leg (12-04-2019 until 17-09-2019) will be undertaken with more or less the same goals as 64PE452 but in a different season. The third and last cruise takes place in October 2019, and will focus on water column geochemistry (CO₂, CH₄ dynamics) in the central-western North Sea.

c. Any previous published research data relating to the proposed cruise:

d.

LEG 1:

Le Guitton, M.; Soetaert, K; Sinnighe Damsté, JS; Middelburg, JJ. 2015. Biogeochemical consequences of vertical and lateral transport of particulate organic matter in the southern North Sea: a multiproxy approach. *Estuarine and Coastal Shelf Sciences*, 165, 117-127.

Tiano, Justin C., Rob Witbaard, Magda J.N. Bergman, Pieter van Rijswijk, Anton Tramper, Dick van Oevelen, Karline Soetaert, 2019. Acute impacts of bottom trawl gears on benthic metabolism and nutrient cycling" *ICES journal of Marine Science, ICES Journal of Marine Science*, fsz060, <https://doi.org/10.1093/icesjms/fsz060>.

LEG 2:

Aardema, H. M., M. RIjkeboer, A. Lefebvre, A. Veen, and J. C. Kromkamp. 2018. High resolution in situ measurements of photosynthesis and abundance in the Dutch North Sea. *Ocean Sciences* **submitted**.

Camphuysen C.J., B. Scott & S. Wanless 2006. Distribution and foraging interactions of seabirds and marine mammals in the North Sea: multi-species foraging assemblages and habitat-specific feeding strategies. In: Boyd I.J., Wanless S. and Camphuysen C.J. (eds) *Top predators in Marine Ecosystems: monitoring change in upper trophic levels*: 82-97. Cambridge Univ. Press, Cambridge.

Scott B.E., J. Sharples, O.N. Ross, J. Wang, G.J. Pierce & C.J. Camphuysen 2010. Sub-surface hotspots in shallow seas: fine scale limited locations of marine top-predator foraging habitat indicated by tidal mixing and sub-surface chlorophyll. *Mar. Ecol. Progr. Ser.* 408: 207-226.

9. Names and addresses of scientists of the coastal state in whose waters the proposed cruise takes place with whom previous contact has been made:

Joint Nature Conservancy Council, seabirds team, Aberdeen, Mark Lewis, Registered Office: Monkstone House, City Road, Peterborough, Cambridgeshire PE1 1JY. <http://jncc.defra.gov.uk/>

Andy Webb, Managing Director, Phoenix Court, Earl Street, Cleator Moor, Cumbria, CA25 5AU, Tel: +44(0)1224 040436, Mob: +44(0)7850 766491, andy.webb@hidefsurveying.co.uk, www.hidefsurveying.co.uk

10. State:

a. Whether visits to the ship in port by scientist of the coastal state concerned will be acceptable:

Embarkation and disembarkation is on Texel without any additional port calls, so no visits are possible.

b. Whether it will be acceptable to carry on board an observer from the coastal state for any part of the cruise and dates and ports of embarkation/-disembarkation:

For LEG 1: Yes, noting that the small maximum scientific crew (12 persons) on RV Pelagia would mean that an observer on board would immediately affect our ability to perform the required scientific tasks.

For LEG 2: Yes, if the situation arises, there is no objection to an observer

c. When research data from intended cruise is likely to be made available to the coastal state and if so, by what means:

Specific preliminary data (CTD profiles, other water column parameters) will be stored in publically accessible NIOZ data repositories. Other data can be shared upon reasonable request. Research data will be made publically available by means of scientific publication in open source journals.

SCIENTIFIC EQUIPMENT

11. Complete the following table - include a separate copy for each coastal state (indicate "Yes" or "No" if applicable). LEG 1 (4-11 September)

COASTAL STATE: UNITED KINGDOM

Marine scientific equipment used	water depth (m)	fisheries research	distance of research to coast in nautical miles			
				< 3	3-12	12-50
CTD	30 - 100	no	no	yes	yes	yes
Vertical zooplankton net	30 - 100	no	no	yes	yes	yes
FastOcean FRRF	3 - 100	no	no	yes	yes	yes
CytoSense Flow cytometer	3 - 100	no	no	yes	yes	yes

List of intended sampling stations during Pelagia cruise – LEG 1 (4-11 September 2019)

Number	Station	Coordinates
1	Frysian Front	53.4°N, 4.3°E
2	Oyster Grounds	54.5°N, 4°E
3	Dogger Bank	56.0°N, 2.0°E
4	Devil's Hole	56.6°N, 0.5°E
5	South of Fisher Banks	56.0°N, 6.4°E
6	German Bight	54.1°N, 8.1°E

List of intended sampling stations during Pelagia cruise – LEG 2 (12-17 September 2019)

station	latitude	longitude
st1	53.18574	4.795903
L7-A	53.65	4.08
st2	54.01673	3.71765
st3	54.45744	4.232013
st4	54.81697	3.766383
st5	55.2034	3.526109
st6	53.92712	3.105884
st7	53.52156	1.3308
st8	54.93361	2.019561
st9	57.0425	0.913371
st11	55.33602	-0.78187
st11a	54.71944	-0.62175
st11b	54.69672	0.273404
st12	54.26745	0.506651
st12a	53.92985	0.234263
st12b	53.36948	0.586964
st13	53.52156	1.3308
st14	53.36677	3.126309
Ijmuiden	52.61562	4.402557

References

- Aardema, H. M., M. Rlijeboer, A. Lefebvre, A. Veen, and J. C. Kromkamp. 2018. High resolution in situ measurements of photosynthesis and abundance in the Dutch North Sea. *Ocean Sciences* **submitted**.
- Alguero-Muniz, M., S. Alvarez-Fernandez, P. Thor, L. T. Bach, M. Esposito, H. G. Horn, U. Ecker, J. A. F. Langer, J. Taucher, A. M. Malzahn, U. Riebesell, and M. Boersma. 2017. Ocean acidification effects on mesozooplankton community development: Results from a long-term mesocosm experiment. *PLoS ONE* **12**.
- Benedetti-Cecchi, L., T. Crowe, L. Boehme, F. Boero, A. Christensen, A. Grémare, F. Hernandez, J. C. Kromkamp, E. Nogueira García, G. Petihakis, J. Robidart, I. Sousa Pinto, and A. Zingone. 2018. Strengthening Europe's Capability in Biological Ocean Observations. in *Á.*

- Muñiz Piniella, P. Kellett, K. Larkin, and J. J. Heymans, editors. Future Science Brief 3 of the European Marine Board. European Marine Board, Ostende.
- Camphuysen C.J., B. Scott & S. Wanless 2006. Distribution and foraging interactions of seabirds and marine mammals in the North Sea: multi-species foraging assemblages and habitat-specific feeding strategies. In: Boyd I.J., Wanless S. and Camphuysen C.J. (eds) Top predators in Marine Ecosystems: monitoring change in upper trophic levels: 82-97. Cambridge Univ. Press, Cambridge.
- Kromkamp, J., E. Capuzzo, and C. J. M. Philippart. 2017. Measuring phytoplankton primary production: review of existing methodologies and suggestions for a common approach.
- Le Guitton, M.; Soetaert, K; Sinninghe Damsté, JS; Middelburg, JJ. 2015. Biogeochemical consequences of vertical and lateral transport of particulate organic matter in the southern North Sea: a multiproxy approach. *Estuarine and Coastal Shelf Sciences*, 165, 117-127.
- Tiano, Justin C., Rob Witbaard, Magda J.N. Bergman, Pieter van Rijswijk, Anton Tramper, Dick van Oevelen, Karline Soetaert, 2019. Acute impacts of bottom trawl gears on benthic metabolism and nutrient cycling" *ICES journal of Marine Science, ICES Journal of Marine Science*, fsz060, <https://doi.org/10.1093/icesjms/fsz060>.
- Maat, D. S., and C. P. D. Brussaard. 2016. Both phosphorus- and nitrogen limitation constrain viral proliferation in marine phytoplankton. *Aquatic Microbial Ecology* 77:87-97.
- Thyssen, M., S. Alvain, A. Lefebvre, D. Dessailly, M. Rijkeboer, N. Guiselin, V. Creach, and L. F. Artigas. 2015. High-resolution analysis of a North Sea phytoplankton community structure based on in situ flow cytometry observations and potential implication for remote sensing. *Biogeosciences* 12:4051-4066.