

# Total nitrate uptake by an invasive benthic foraminifer in marine sediments

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## **Supplementary material**

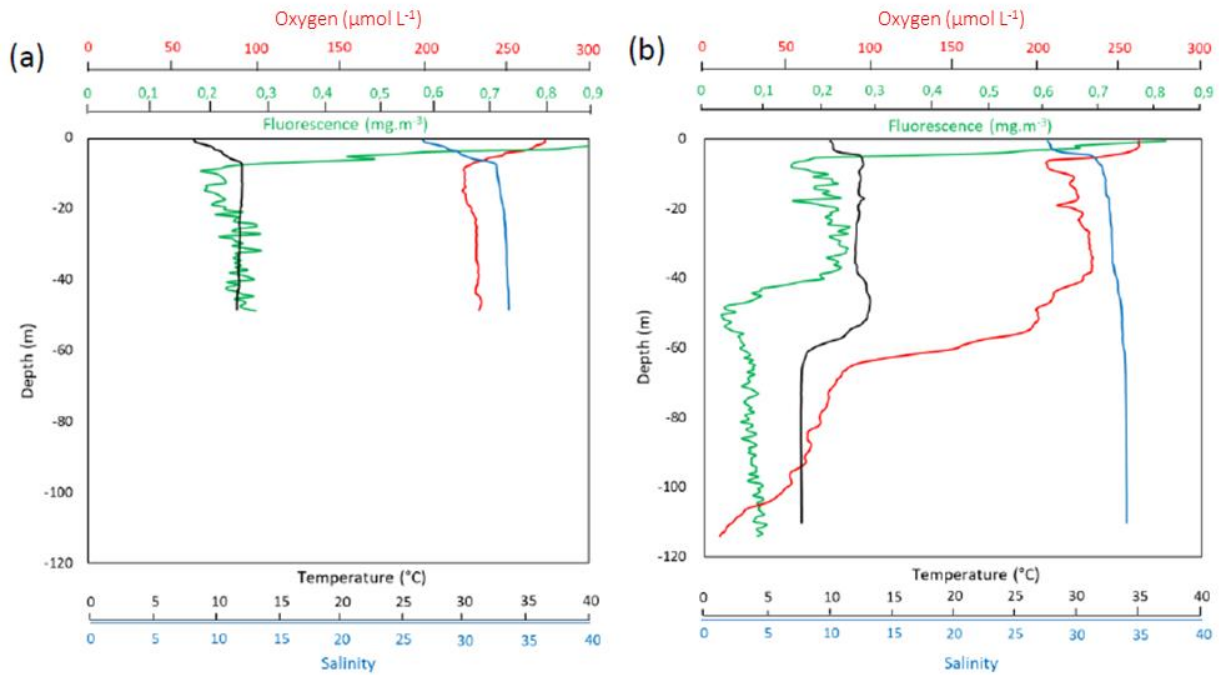


Figure S1. CTD profiles of temperature, salinity, fluorescence and oxygen concentration in the water column of the both stations (a) GF17-3 oxic station (50 m) and (b) GF17-1 hypoxic station (near Alsbäck, 117 m).

Table S1: Total shell volume ( $\mu\text{m}^3$ ) and the biovolume (BV,  $\mu\text{m}^3$ ) corresponding to 75% of the total shell volume measured on the pool of five *Nonionella* sp. T1 from the 1<sup>st</sup> (November 2017) and the 2<sup>nd</sup> (September 2018) cruises in the Gullmar Fjord. Abbreviations: sd (standard deviation), ind. (individual).

<i>Nonionella</i> sp. T1	1 <sup>st</sup> cruise total shell volume	1 <sup>st</sup> cruise BV	2 <sup>nd</sup> cruise total shell volume	2 <sup>nd</sup> cruise BV
ind. 1	$6.7 \cdot 10^{+06}$	$5.0 \cdot 10^{+06}$	$3.1 \cdot 10^{+06}$	$2.3 \cdot 10^{+06}$
ind. 2	$4.5 \cdot 10^{+06}$	$3.4 \cdot 10^{+06}$	$2.4 \cdot 10^{+06}$	$1.8 \cdot 10^{+06}$
ind. 3	$5.1 \cdot 10^{+06}$	$3.8 \cdot 10^{+06}$	$1.4 \cdot 10^{+06}$	$1.0 \cdot 10^{+06}$
ind. 4	$4.9 \cdot 10^{+06}$	$3.7 \cdot 10^{+06}$	$9.2 \cdot 10^{+05}$	$6.9 \cdot 10^{+05}$
ind. 5	$5.8 \cdot 10^{+06}$	$4.4 \cdot 10^{+06}$	$6.2 \cdot 10^{+05}$	$4.7 \cdot 10^{+05}$
Average ( $\mu\text{m}^3$ )	$5.4 \cdot 10^{+06}$	$4.0 \cdot 10^{+06}$	$1.7 \cdot 10^{+06}$	$1.3 \cdot 10^{+06}$
sd ( $\mu\text{m}^3$ )	$0.8 \cdot 10^{+06}$	$0.6 \cdot 10^{+06}$	$1.0 \cdot 10^{+06}$	$0.7 \cdot 10^{+06}$

**Equation S1. Details calculation to correct the denitrification rate of the invasive *Nonionella* sp. T1 of the 1<sup>st</sup> cruise (November 2017). Equation used according to Geslin et al., (2011) and Glock et al., (2019).**

$\ln(\text{denitrification rate } 2^{\text{nd}} \text{ cruise}) * (0.68 * \ln(\text{BV } 1^{\text{st}} \text{ cruise}) - 5.57) / (0.68 * \ln(\text{BV } 2^{\text{nd}} \text{ cruise}) - 5.57) = \ln(\text{corrected denitrification rate } 1^{\text{st}} \text{ cruise})$

Example:  $\ln(21) * (0.68 * \ln(1.3 \cdot 10^{-06}) - 5.57) / (0.68 * \ln(4.0 \cdot 10^{-06}) - 5.57) = \ln(38)$ .

**Table S2: PROFILE software parameters used to generate the nitrate modelling in both stations GF17-3 and GF17-1 in the Gullmar Fjord (see details in Berg et al., 1998).**

PROFILE parameters	GF17-3	GF17-1
Depth at top of calculation domain (cm)	0	0
Depth at bottom of calculation domain (cm)	4.8	4.8
Max number of equally spaced zones in interpretation (1 to 12)	8	8
Type of boundary conditions (4:t=C b=F)	4	4
First boundary condition ( $\mu\text{mol.l}^{-1}$ )	13.1	4.2
Second boundary condition	0	0
Nitrate diffusion coefficient ( $\text{cm}^{-2} \text{s}^{-1}$ ) in water	$1.4 \cdot 10^{-05}$	$1.4 \cdot 10^{-05}$
Expression for sediment diffusivity (Ds) (2: Ds=FI <sup>2</sup> *D)	2	2
Concentration in water column ( $\mu\text{mol L}^{-1}$ )	14.6	5.7
Minimum for production rate	$-1.0 \cdot 10^{+20}$	$-1.0 \cdot 10^{+20}$
Maximum for production rate	$1.0 \cdot 10^{+20}$	$1.0 \cdot 10^{+20}$
Maximum deviation (in %) when accepting a calculated minimum	0.001	0.001
Level of significance in the F statistics	0.01	0.01

**Table S3. Total density (individuals per slice of 10 cm<sup>3</sup>) and relative abundance (%) of the foraminiferal fauna from the GF17-3A and 3C oxic station and from the GF17-1A and 1C hypoxic station of the Gullmar Fjord (GF). The cores were slice every 2 mm from the surface to 20 mm depth and every 5 mm from 20 to 50 mm depth. The foraminiferal sections are divided as: the invasive *Nonionella* sp. T1 species according to Polovodova Asteman and Schönfeld, (2015) and Deldicq et al., (2019), the known denitrifying species in the GF according to Risgaard-Petersen et al., (2006) and Woehle et al., (2018), the non-denitrifying species according to Pina-Ochoa et al., (2010) and the minor other species of the fauna.**

GF17-3A	Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-25	25-30	30-35	35-40	40-45	45-50	Total density per species	Relative abundance (%)
invasive species	<i>Nonionella</i> sp.T1	9	6	15	24	14	18	15	15	17	7	14	6	19	45	91	122	436	34
known denitrifying species in GF	<i>Globobulimina turgida</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Globobulimina auricula</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
candidate denitrifying species	<i>Bolivina pseudopunctata</i>	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	4	0
	<i>Stainforthia fusiformis</i>	2	0	0	1	3	1	0	0	2	0	1	0	0	0	0	0	10	1
non-denitrifying species	<i>Bulimina marginata</i>	22	48	37	32	30	35	12	14	26	26	15	6	25	26	73	43	471	37
	<i>Cassidulina laevigata</i>	10	41	4	19	9	2	2	24	3	1	0	0	0	0	0	0	114	9
	<i>Leptohalysis scotti</i>	2	1	6	6	4	9	9	6	17	29	13	8	6	5	5	9	134	11
minor other species	<i>Ammonia falsobecari</i>	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	3	0
	<i>Bolivina skagerakensis</i>	0	0	3	0	0	0	0	0	3	0	0	0	0	0	0	0	6	1
	<i>Bolivina spathulata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Bolivina</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Cribrostomoides nitidum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Eggerella scabra</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Elphidium clavatum-selseyensis</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	<i>Hyalinea balthica</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
	<i>Lenticulina</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Liebusella goesi</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Nonionella labradorica</i>	0	0	4	0	3	0	0	0	0	3	0	0	0	0	0	0	0	10
	<i>Nonionella turgida</i>	1	0	1	1	6	9	0	0	0	0	2	0	0	0	0	0	0	20
	<i>Pyrgo williamsoni</i>	4	9	0	5	1	0	0	0	0	0	0	0	0	0	0	0	0	19
	<i>Quinqueloculina bosciiana</i>	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2
	<i>Quinqueloculina seminulum</i>	1	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	7
	<i>Quinqueloculina stalkerii</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	<i>Reophax subfusiformis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Scutulons</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Stainforthia loeblichii</i>	1	0	3	2	1	0	0	2	0	1	0	0	0	0	0	0	0	11
	<i>Textularia earlandi</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Textularia sagittula</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	other species	0	0	1	2	0	0	0	1	0	2	0	1	0	1	0	0	0	7
		Total density per slice	53	111	73	93	73	75	40	63	68	68	45	22	52	77	170	175	1256

GF17-3C	Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-25	25-30	30-35	35-40	40-45	45-50	Total density per species	Relative abundance (%)	
invasive species	<i>Nonionella</i> sp.T1	17	45	34	82	63	35	41	25	56	51	56	98	145	140	89	88	1063	74	
known denitrifying species in GF	<i>Globobulimina turgida</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Globobulimina auricula</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
candidate denitrifying species	<i>Bolivina pseudopunctata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Stainforthia fusiformis</i>	0	2	2	0	2	1	0	0	1	0	0	0	0	0	0	0	8	1	
non-denitrifying species	<i>Bulimina marginata</i>	18	9	9	16	11	2	2	2	1	2	0	0	1	0	0	1	75	5	
	<i>Cassidulina laevigata</i>	15	14	15	12	9	5	9	0	0	0	0	0	0	0	0	0	79	5	
	<i>Leptohalysis scotti</i>	15	9	8	16	7	7	12	5	21	11	9	3	2	1	3	0	128	9	
minor other species	<i>Ammonia falsobecconi</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Bolivina skagerakensis</i>	1	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	
	<i>Bolivina spathulata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Bolivina</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Cribrostomoides nitidum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Eggerella scabra</i>	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	
	<i>Elphidium clavatum-selseyensis</i>	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	
	<i>Hyalinea balthica</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Lenticulina</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Liebusella goesi</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Nonionella labradorica</i>	0	5	1	3	0	4	1	7	7	4	1	0	0	0	0	0	31	2	
	<i>Nonionella turgida</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Pyrgo williamsoni</i>	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3	0	
	<i>Quinqueloculina bosclana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Quinqueloculina seminulum</i>	3	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	8	1	
	<i>Quinqueloculina stalkeri</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Reophax subfusiformis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Scutulons</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	<i>Stainforthia loeblichii</i>	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	
	<i>Textularia earlandi</i>	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	
	<i>Textularia sagittula</i>	6	7	1	2	0	3	0	0	0	0	0	0	0	0	0	0	18	1	
	other species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Total density per slice		80	98	74	134	91	57	65	38	85	68	66	101	148	141	92	88	1428	100

GF17-1A	Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-25	25-30	30-35	35-40	40-45	45-50	Total density per species	Relative abundance (%)
invasive species	<i>Nonionella</i> sp.T1	0	1	0	1	1	0	0	9	15	19	21	2	2	3	1	1	74	5
known denitrifying species in GF	<i>Globobulimina turgida</i>	0	1	1	0	0	0	0	1	0	1	0	0	0	1	0	0	5	0
	<i>Globobulimina auricula</i>	0	0	1	0	0	0	1	0	1	0	1	2	0	0	1	2	8	1
candidate denitrifying species	<i>Bolivina pseudopunctata</i>	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
	<i>Stainforthia fusiformis</i>	8	4	13	3	1	5	0	0	0	2	0	1	1	1	3	2	43	3
non-denitrifying species	<i>Bulimina marginata</i>	83	130	165	63	115	112	51	36	32	38	23	19	16	14	24	17	937	64
	<i>Cassidulina laevigata</i>	27	47	46	13	30	12	38	4	4	5	2	2	1	0	2	1	234	16
	<i>Leptohalysis scotti</i>	19	10	6	3	5	2	4	0	0	2	5	0	3	4	1	1	65	4
minor other species	<i>Ammonia falsobecconi</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
	<i>Bolivina skagerakensis</i>	0	0	5	1	0	1	0	0	0	1	0	0	0	0	0	0	8	1
	<i>Bolivina spathulata</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Bolivina</i> sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
	<i>Cribrostomoides nitidum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Eggerella scabra</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Elphidium clavatum-selseyensis</i>	0	1	1	0	0	1	1	0	0	0	1	0	0	0	0	1	6	0
	<i>Hyalinea balthica</i>	1	4	2	1	1	0	1	0	0	0	0	0	0	0	0	0	11	1
	<i>Lenticulina</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Liebusella goesi</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Nonionella labradorica</i>	2	2	2	0	0	7	3	4	0	0	2	0	0	0	0	0	20	1
	<i>Nonionella turgida</i>	0	0	1	0	1	0	1	2	2	6	2	0	0	0	0	0	15	1
	<i>Pyrgo williamsoni</i>	0	1	0	0	0	0	0	0	0	0	1	2	0	0	0	0	4	0
	<i>Quinqueloculina bosclana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Quinqueloculina seminulum</i>	3	2	7	1	2	0	0	1	0	0	0	0	0	0	0	0	16	1
	<i>Quinqueloculina stalkeri</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Reophax subfusiformis</i>	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	<i>Scutulons</i> sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Stainforthia loeblichii</i>	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
	<i>Textularia earlandi</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Textularia sagittula</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
other species	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
Total density per slice		143	207	249	86	156	139	99	56	55	73	59	27	24	24	33	26	1457	100

GF17-1C	Species	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-25	25-30	30-35	35-40	40-45	45-50	Total density per species	Relative abundance (%)
invasive species	<i>Nonionella</i> sp.T1	2	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4	1
known denitrifying species in GF	<i>Globobulimina turgida</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Globobulimina auricula</i>	0	0	0	0	0	0	0	11	1	1	1	0	0	0	0	0	14	2
candidate denitrifying species	<i>Bolivina pseudopunctata</i>	2	1	1	1	1	1	5	2	1	4	0	0	0	0	0	0	18	2
	<i>Stainforthia fusiformis</i>	11	8	0	0	0	0	1	1	1	0	1	0	0	0	0	0	23	3
non-denitrifying species	<i>Bulimina marginata</i>	31	38	66	17	31	9	11	12	12	1	3	1	2	2	2	4	244	30
	<i>Cassidulina laevigata</i>	9	24	26	20	11	7	5	9	6	3	0	0	0	0	0	0	119	15
	<i>Leptohalysis scotti</i>	21	12	17	8	17	14	17	18	35	31	18	18	6	17	24	19	293	36
minor other species	<i>Ammonia falsobeccari</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Bolivina skagerakensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Bolivina spathulata</i>	0	2	2	0	0	1	0	0	0	0	0	0	0	0	0	0	5	1
	<i>Bolivina</i> sp.	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
	<i>Cribrostomoides nitidum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Eggerella scabra</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Elphidium clavatum-selseyensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	<i>Hyalinea balthica</i>	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	3	0
	<i>Lenticulina</i> sp.	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0
	<i>Liebusella goesi</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Nonionella labradorica</i>	1	0	1	0	0	2	0	0	3	0	0	0	0	0	0	0	7	1
	<i>Nonionella turgida</i>	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	4	0
	<i>Pyrgo williamsoni</i>	2	2	6	1	2	1	1	5	3	1	0	0	0	0	0	0	24	3
	<i>Quinqueloculina bosciiana</i>	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
	<i>Quinqueloculina seminulum</i>	3	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	8	1
	<i>Quinqueloculina stalkerii</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	<i>Reophax subfusiformis</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	<i>Scutulons</i> sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	<i>Stainforthia loeblichii</i>	1	1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	5	1
	<i>Textularia earlandi</i>	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	<i>Textularia sagittula</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	other species	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0	4	1
		Total density per slice	85	96	123	47	63	38	41	61	63	43	27	20	9	20	26	24	786

**Table S4: Relative abundance (%) of the main foraminiferal species of the Gullmar Fjord per zones defined by nitrate modelling profiles. In the GF17-3 oxic station, three zones are delimited: the nitrification zone from 0 to 12 mm depth, the 1<sup>st</sup> denitrification zone from 12 to 35 mm depth and the 2<sup>nd</sup> denitrification zone from 35 to 50 mm depth, then the foraminiferal relative abundance of the total core from 0 to 50 mm depth. In the GF17-1 hypoxic station, one zone is delimited by the nitrate modelling profile: the nitrification zone from 0 to 16 mm depth. Then, the rest of the core corresponded to the undetected nitrate zone from 16 to 50 mm depth. In the core GF17-1A from 14 to 25 mm depth *Nonionella* sp. T1 relative abundance reached until 26 % of the fauna. The foraminiferal sections are divided as: the invasive *Nonionella* sp. T1 species according to Polovodova Asteman and Schönfeld, (2015) and Deldicq et al., (2019), the known denitrifying species in the GF according to Risgaard-Petersen et al., (2006) and Woehle et al., (2018), the non-denitrifying species according to Pina-Ochoa et al., (2010) and the minor other species of the fauna.**

GF17-3A	Species	Average density from 0-12 mm depth zone	Average density from 12-35 mm depth zone	Average density from 35-50 mm depth zone	Total average density from 0-50 mm depth zone
invasive species	<i>Nonionella</i> sp.T1	18	27	60	34
known denitrifying species in GF	<i>Globobulimina turgida</i>	0	0	0	0
	<i>Globobulimina auricula</i>	0	0	0	0
candidate denitrifying species	<i>Bolivina pseudopunctata</i>	1	0	0	0
	<i>Stainforthia fusiformis</i>	2	1	0	1
non-denitrifying species	<i>Bulimina marginata</i>	42	34	34	37
	<i>Cassidulina laevigata</i>	16	7	0	9
	<i>Leptohalysis scotti</i>	6	25	5	11
minor other species	other species (<5%)	16	6	1	8
	% by zone	100	100	100	100

GF17-3C	Species	Average density from 0-12 mm depth zone	Average density from 12-35 mm depth zone	Average density from 35-50 mm depth zone	Total average density from 0-50 mm depth zone
invasive species	<i>Nonionella</i> sp.T1	50	78	98	74
known denitrifying species in GF	<i>Globobulimina turgida</i>	0	0	0	0
	<i>Globobulimina auricula</i>	0	0	0	0
candidate denitrifying species	<i>Bolivina pseudopunctata</i>	0	0	0	0
	<i>Stainforthia fusiformis</i>	1	0	0	1
non-denitrifying species	<i>Bulimina marginata</i>	12	2	0	5
	<i>Cassidulina laevigata</i>	13	2	0	5
	<i>Leptohalysis scotti</i>	11	13	1	9
minor other species	other species (<5%)	13	5	0	6
	% by zone	100	100	100	100

GF17-1A	Species	Average density from 0-16 mm depth zone	Average density from 16-50 mm depth zone	Total average from 0-50 mm depth zone
invasive species	<i>Nonionella</i> sp.T1	2	15	5
known denitrifying species in GF	<i>Globobulimina turgida</i>	0	0	0
	<i>Globobulimina auriculata</i>	0	2	1
candidate denitrifying species	<i>Bolivina pseudopunctata</i>	0	0	0
	<i>Stainforthia fusiformis</i>	2	4	3
non-denitrifying species	<i>Bulimina marginata</i>	66	61	64
	<i>Cassidulina laevigata</i>	19	5	16
	<i>Leptohalysis scotti</i>	4	6	4
minor other species	other species (<5%)	7	7	6
	% by zone	100	100	100

GF17-1C	Species	Average density from 0-16 mm depth zone	Average density from 16-50 mm depth zone	Total average from 0-50 mm depth zone
invasive species	<i>Nonionella</i> sp.T1	0	0	1
known denitrifying species in GF	<i>Globobulimina turgida</i>	0	0	0
	<i>Globobulimina auricula</i>	0	0	0
candidate denitrifying species	<i>Bolivina pseudopunctata</i>	3	1	2
	<i>Stainforthia fusiformis</i>	3	1	3
non-denitrifying species	<i>Bulimina marginata</i>	35	11	30
	<i>Cassidulina laevigata</i>	19	2	15
	<i>Leptohalysis scotti</i>	24	75	36
minor other species	other species (<5%)	13	10	14
	% by zone	100	100	100

**Equation S2. Calculation example of the corrected denitrification rate ( $\mu\text{mol m}^{-2} \text{d}^{-1}$ ) and the contribution (%) of *Nonionella* sp. T1 to nitrogen cycle.**

Corrected denitrification rate =  $38 \text{ pmol ind}^{-1} \text{d}^{-1} = 3.8 \cdot 10^{-5} \mu\text{mol ind}^{-1} \text{d}^{-1}$

Corrected denitrification rate ( $\mu\text{mol m}^{-2} \text{d}^{-1}$ ) =  $(3.8 \cdot 10^{-5} \mu\text{mol ind}^{-1} \text{d}^{-1}) * 841 \text{ Nonionella sp. T1 (counted specimens in the denitrifying zones 1.2 to 5 cm depth, Table 2, GF17-3A) / (PI * } 250 \mu\text{m}^2 / 10000/10000) \text{ the cross section area of the microtube} = 1.63 \cdot 10^{-7} \mu\text{mol m}^{-2} \text{d}^{-1}$ .

Contribution A (%) = Foraminifera denitrification / Denitrification estimated by PROFILE from nitrate porewater.

Contribution A (%) from GF17-3A =  $(1.63 \cdot 10^{-7} \mu\text{mol m}^{-2} \text{d}^{-1} * 100) / 3.52 \cdot 10^{-7} \mu\text{mol m}^{-2} \text{d}^{-1}$  (sum of the two porewater denitrifying zones, Fig. 6 d, Table 2) = 46%.

Contribution B (%) = Foraminifera denitrification / (Foraminifera denitrification + Denitrification estimated by PROFILE from nitrate porewater).

Contribution B (%) from GF17-3A =  $(1.63 \cdot 10^{-7} \mu\text{mol m}^{-2} \text{d}^{-1} * 100) / (3.52 \cdot 10^{-7} \mu\text{mol m}^{-2} \text{d}^{-1} + 1.63 \cdot 10^{-7} \mu\text{mol m}^{-2} \text{d}^{-1})$  sum of the two porewater denitrifying zones, Fig. 6 d, Table 2) = 32%.