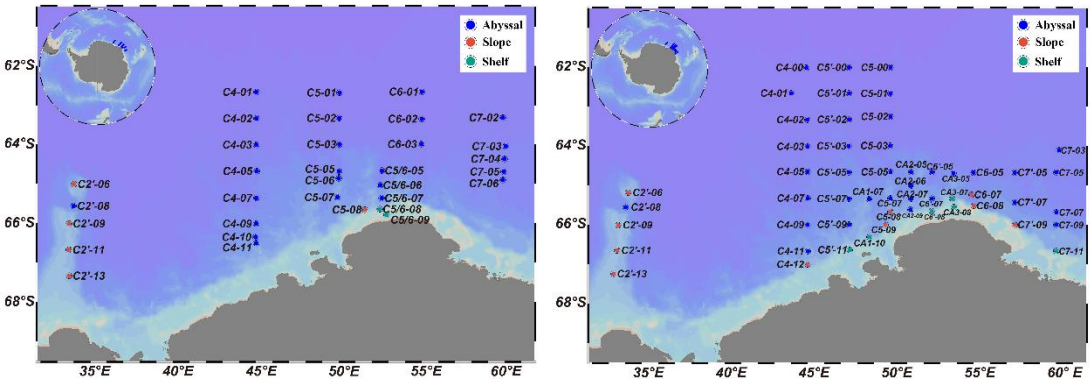
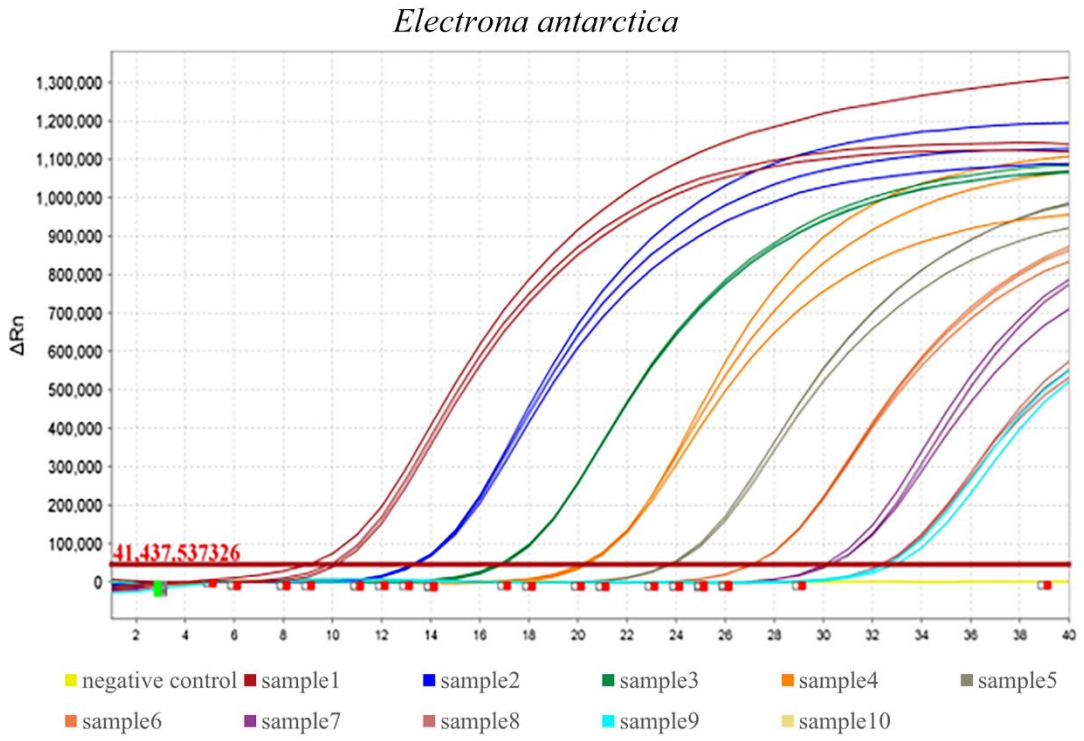
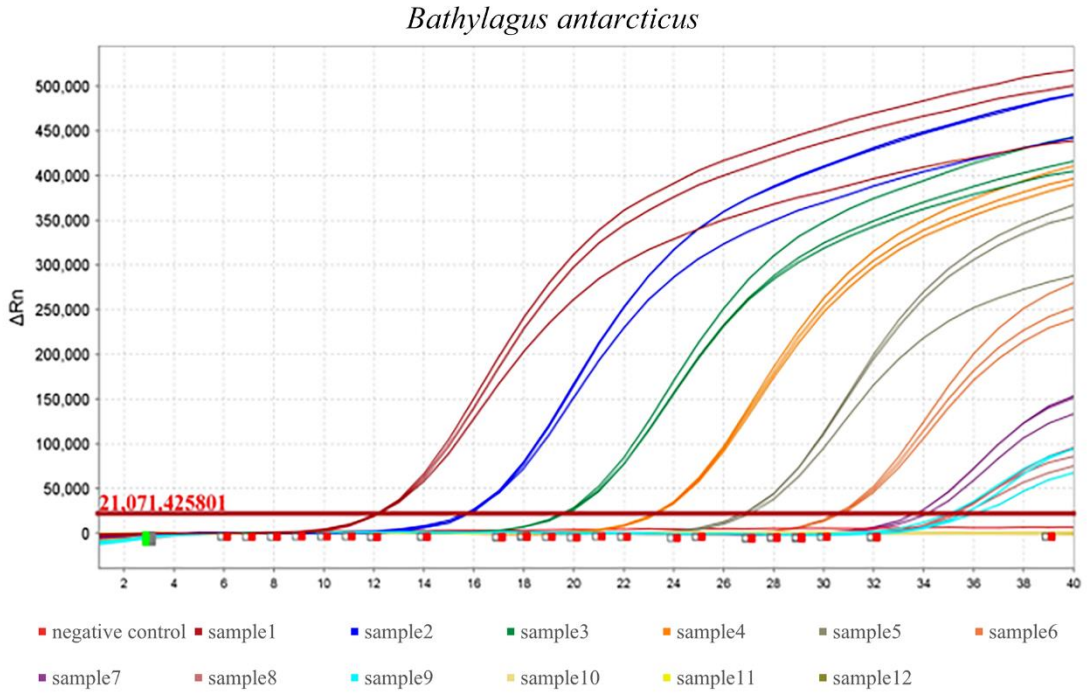


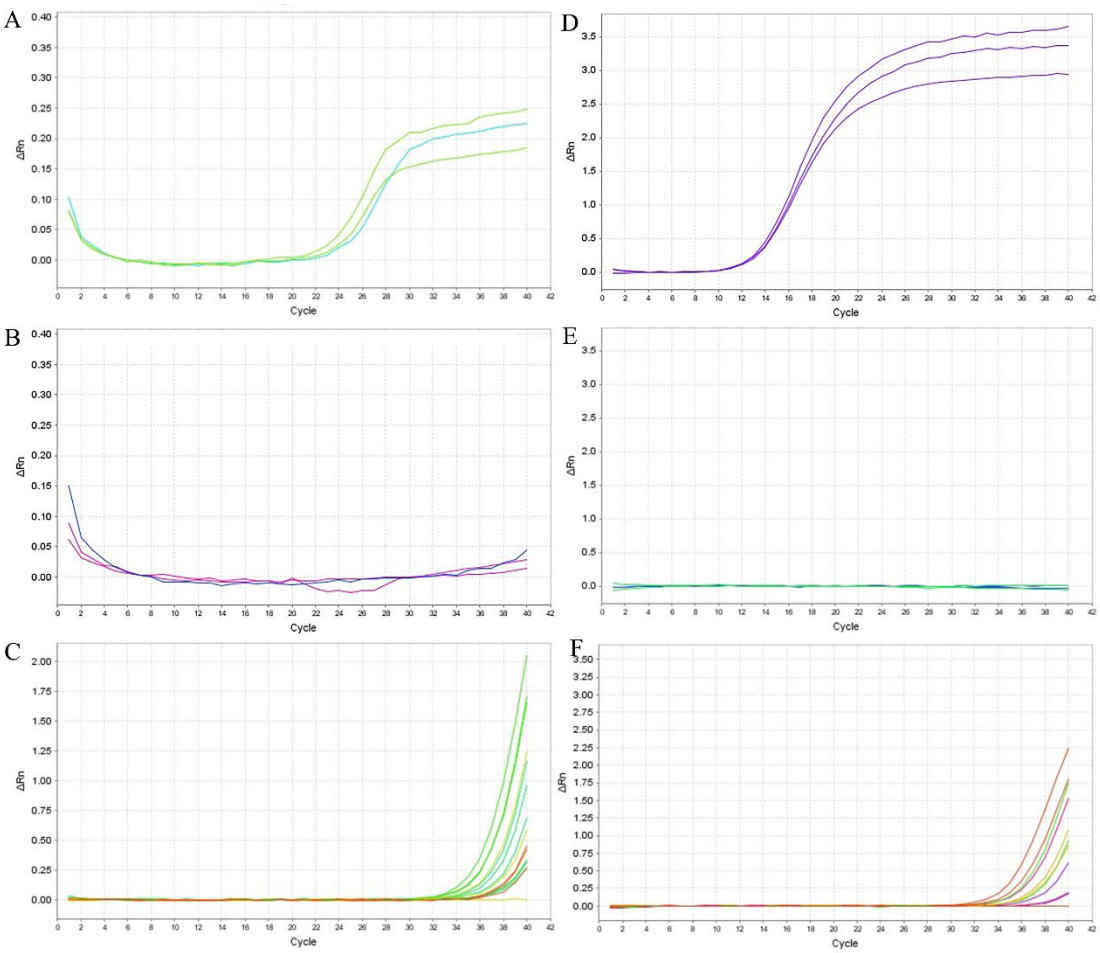
Supplementary Fig. S1 Map of sampling stations divided into abyssal, slope and shelf stations. The left shows the sampling stations in 2021, and the right shows the sampling stations in 2022.



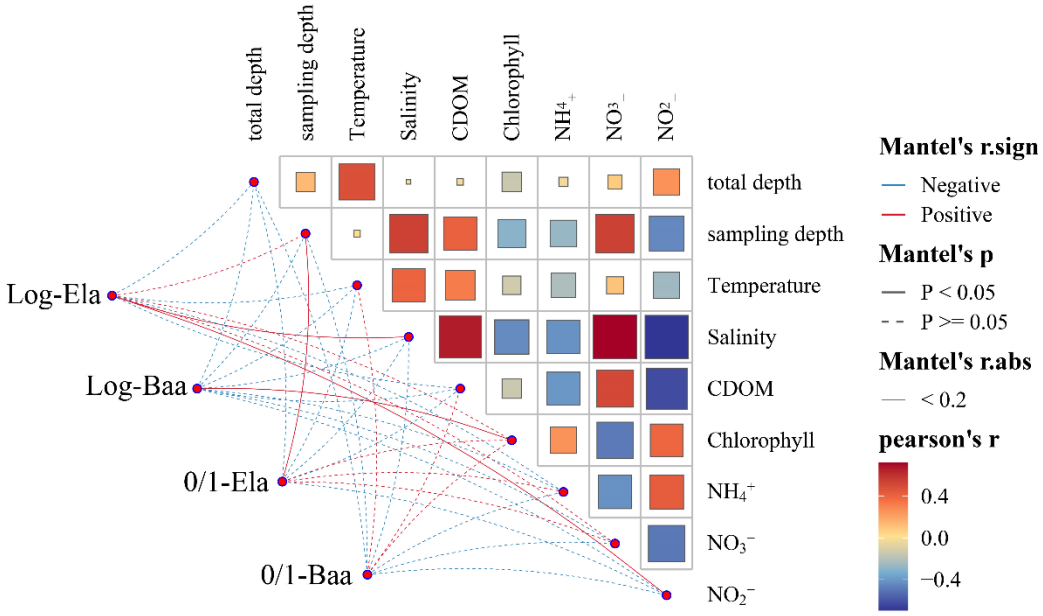
Supplementary Fig. S2 qPCR amplification curve plot for plasmids from *Electrona antarctica* at different concentrations. The amplification information for each sample is shown in Supplementary Table S3.



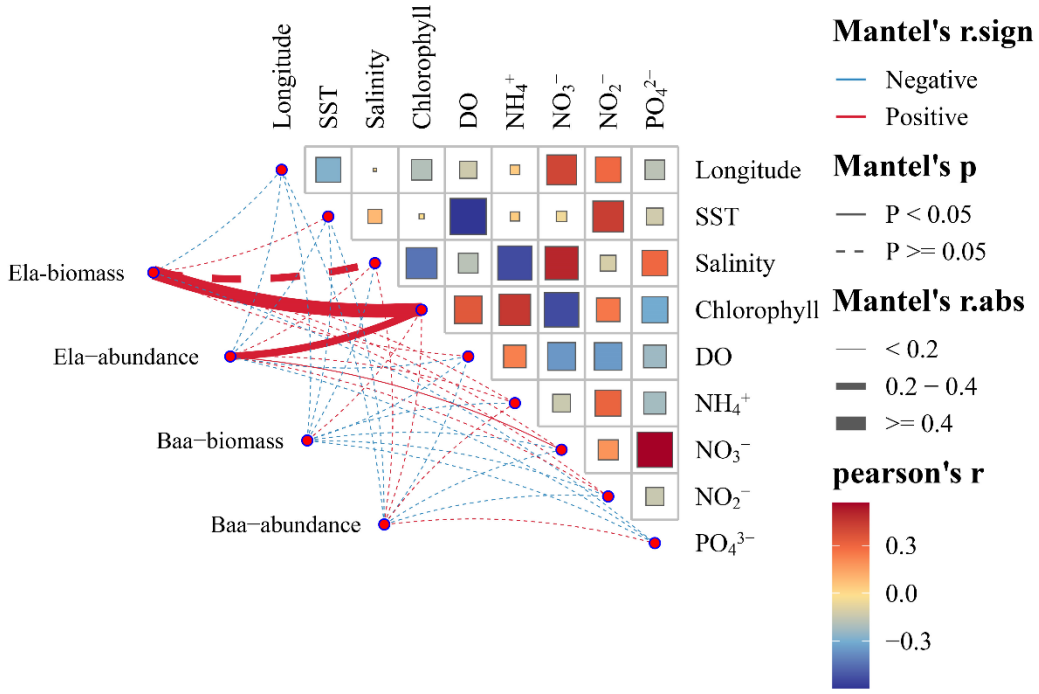
Supplementary Fig. S3 qPCR amplification curve plot for plasmids from *Bathylagus antarcticus* at different concentrations. The amplification information for each sample is shown in Supplementary Table S4.



Supplementary Fig. S4 Plot of qPCR validation results for specific primers and probes. A, D are the qPCR amplification using *E. antarctica* and *B. antarcticus* as template, respectively; B, D are the qPCR amplification using five other Antarctic fish species and ultrapure water as templates; C, F are the qPCR amplification using eDNA collected from the Southern Ocean as template.



Supplementary Fig. S5 Mantel's test on the relationship between eDNA of two fish species and environmental factors. Ela represents *E. antarctica*, Baa represents *B. antarcticus*, Log represents the Log_{10} transformed eDNA concentration, 0/1 represents absence/presence.



Supplementary Fig. S6 Mantel's test on the relationship between biomass and abundance of two fish species and environmental factors. Ela represents *E. antarctica*, Baa represents *B. antarcticus*. SST represents sea surface temperature, DO represents dissolved oxygen.

Supplementary Table S1 Information on eDNA samples collection

Cruise	Station	Sampling date	Longitude/E	Latitude/S	Bottom depth/m	Sampling depth(m)/Sample size(L)				
						Water sampling layer 1	Water sampling layer 2	Water sampling layer 3	Water sampling layer 4	Water sampling layer 5
S37	C7-06	2021.1.5	59°54.25'	64°53.93'	4065	10m/5L	150m/5L			
S37	C7-05	2021.1.5	59°56.920'	64°41.076'	4179	10m/5L				
S37	C7-04	2021.1.6	60°00.31'	64°21.78'	4196	10m/5L				
S37	C7-03	2021.1.6	60°04.96'	64°02.32'	4359	10m/5L				
S37	C7-02	2021.1.6	59°54.452'	63°18.800'	4347	10m/5L				
S37	C6-01	2021.1.7	55°00.98'	62°39.47'	4993	10m/5L				
S37	C6-02	2021.1.8	55°0.383'	63°20.783'	4868	10m/5L			1000m/5L	4852m/5L
S37	C6-03	2021.1.8	54°58.566'	63°59.152'	4454	10m/5L			1000m/5L	4444m/5L
S37	C5/6-05	2021.1.8	52°35.807'	64°39.468'	4079	10m/5L				
S37	C5/6-06	2021.1.8	52°29.741'	65°1.627'	2830	10m/5L	150m/5L			
S37	C5/6-07	2021.1.10	52°35.321'	65°21.497'	2793	10m/5L			1000m/5L	2783m/5L
S37	C5/6-08	2021.1.10	52°28.500'	65°38.317'	570	10m/5L	200m/5L			510m/5L
S37	C5-08	2021.1.10	51°34.384'	65°39.272'	1345	10m/3.5L	50m/5L	500m/5L	1000m/5L	1314m/5L
S37	C5-07	2021.1.13	49°54.83'	65°20.11'	2116	10m/5L				
S37	C5-06	2021.1.13	49°59.92'	64°51.31'	2400	10m/5L				
S37	C5-05	2021.1.14	50°0.54'	64°40.762'	3568	10m/5L			1000m/5L	3558m/5L
S37	C5-03	2021.1.15	50°2.84'	63°59.52'	4443	10m/5L				
S37	C5-02	2021.1.15	50°1.943'	63°19.591'	4853	10m/5L				
S37	C5-01	2021.1.15	50°2.648'	62°40.621'	5000	10m/5L			1000m/5L	4984m/5L
S37	C4-01	2021.1.16	45°02.33'	62°39.76'	4744	10m/5L				
S37	C4-02	2021.1.16	45°02.336'	63°20.172'	4595	10m/5L			1000m/5L	4583m/5L

S37	C4-03	2021.1.17	45°01.487'	64°00.000'	4425	10m/5L				
S37	C4-05	2021.1.17	45°02.79'	64°40.6'	3957	10m/3L				
S37	C4-07	2021.1.17	45°1.729'	65°21.156'	3501	10m/1L			1000m/5L	3501m/5L
S37	C4-09	2021.1.18	45°1.16'	66°0.653'	3319	10m/1.5L				
S37	C4-11	2021.1.18	45°1.16'	66°30.16'	2125	10m/2.5L			1000m/4L	2125m/4L
S37	C4-10	2021.1.20	44°59.262'	66°20.863'	2641	10m/1.55L				
S37	C2'-08	2021.1.24	33°59.098'	65°33.492'	3276	10m/2L				
S37	C2'-06	2021.1.25	34°0.424'	65°0.165'	1588	10m/2.55L			1000m/5L	1578m/5L
S37	C2'-09	2021.1.25	33°43.438'	66°0.359'	1225	10m/2L				
S37	C2'-11	2021.1.25	33°42.629'	66°40.169'	1256	10m/2.5L		500m/5L		1194m/5L
S37	C2'-13	2021.1.26	33°43.320'	67°19.955'	1308	10m/2.5L		500m/5L		1272m/5L
S38	C2'-06	2022.1.27	34°10.280′	65°11.110′	1493				1000m/3L	1492m/3L
S38	C2'-08	2022.1.28	34°00.570′	65°33.270′	3222	1m/3L		500m/3L		3222m/3L
S38	C2'-09	2022.1.29	33°34.340′	66°00.420′	1134	1m/3L		500m/3L		1134m/3L
S38	C2'-11	2022.1.29	33°30.160′	66°38.910′	1163	1m/3L		500m/3L		1158m/3L
S38	C2'-13	2022.1.29	33°17.950′	67°14.870′	1094	1m/3L		500m/3L		1094m/3L
S38	C4-12	2022.2.2	44°59.750′	67°00.100′	1672	1m/3L			1000m/3L	1672m/3L
S38	C4-09	2022.2.3	45°00.030′	65°59.950′	3224	1m/3L			1000m/3L	3224m/3L
S38	C4-11	2022.2.3	45°01.040′	66°40.330′	2159	1m/3L			1000m/3L	2159m/3L
S38	C5'-11	2022.2.7	47°32.700′	66°38.420′	578	1m/3L	200m/3L			518m/3L
S38	C5'-09	2022.2.7	47°30.030′	65°59.600′	2646	1m/3L		500m/3L	1000m/2.2L	
S38	C5'-07	2022.2.7	47°29.050′	65°20.070′	2656	1m/3L		300m/1.5L		
S38	C5'-05	2022.2.8	47°29.380′	64°39.690′	3090	1m/3L		500m/3L	1000m/3L	
S38	C4-07	2022.2.8	45°00.740′	65°19.690′	3522	1m/3L				3522m/3L
S38	C4-05	2022.2.9	44°59.960′	64°39.320′	3900	1m/3L		500m/3L	1000m/3L	

S38	C4-03	2022.2.9	45°00.160′	64°00.680′	4255	1m/3L	500m/3L	1000m/3L	
S38	C5'-03	2022.2.10	47°28.880′	63°59.790′	4260	1m/3L	500m/1L	1000m/1L	
S38	C5'-02	2022.2.11	47°30.070′	63°19.600′	4624	1m/3L	500m/3L	1000m/3L	
S38	C5'-01	2022.2.11	47°30.180′	62°39.540′	4519	1m/3L	500m/3L	1000m/3L	
S38	C5'-00	2022.2.11	47°29.620′	62°00.040′	4943	1m/3L	500m/3L	1000m/2.7L	
S38	C4-00	2022.2.14	44°56.360′	62°00.340′	4886	1m/3L			
S38	C4-01	2022.2.14	44°00.280′	62°39.520′	4758	1m/3L	500m/3L		4748m/3L
S38	C4-02	2022.2.14	44°59.160′	63°19.750′	4583	1m/3L			
S38	C5-00	2022.2.15	50°00.200′	62°00.030′	5106	1m/3L	500m/3L	1000m/3L	
S38	C5-01	2022.2.16	49°59.670′	62°39.840′	4982	1m/3L		1000m/3L	
S38	C5-02	2022.2.16	50°00.170′	63°15.060′	4870	1m/3L	500m/3L	1000m/3L	
S38	C5-03	2022.2.17	49°59.250′	63°59.590′	4411	1m/3L			
S38	C5-05	2022.2.20	50°00.250′	64°39.650′	3627	1m/3L	500m/3L	1000m/3L	
S38	C5-07	2022.2.20	49°59.920′	65°19.570′	2092	1m/3L		1000m/2.5L	2000m/3L
S38	C5-08	2022.2.21	49°59.920′	65°40.120′	1816	1m/3L	500m/3L	1000m/3L	
S38	C5-09	2022.2.21	49°41.710′	65°59.810′	1453	1m/3L	500m/1.2L	1000m/1.5L	
S38	CA1-10	2022.2.22	48°43.450′	66°18.740′	1010	1m/3L	500m/3L		1004m/3L
S38	CA2-09	2022.2.24	51°12.900′	65°58.500′	2229	1m/3L		1000m/3L	
S38	C6'-08	2022.2.25	52°29.510′	65°39.100′	270	1m/3L			
S38	CA2-07	2022.2.26	51°15.080′	65°20.080′	2230	1m/3L			
S38	CA1-07	2022.2.26	48°42.060′	65°20.820′	2305	1m/3L			
S38	CA2-06	2022.3.3	51°15.190′	65°00.170′	3047	1m/3L	500m/3L	1000m/3L	
S38	CA2-05	2022.3.3	51°15.250′	64°39.660′	2823	1m/3L	500m/3L	1000m/3L	
S38	C6'-05	2022.3.3	52°30.036′	64°39.584′	2977	1m/3L	500m/3L	1000m/3L	
S38	C6'-07	2022.3.4	52°29.930′	65°19.750′	2896	1m/3L		1000m/2L	

S38	CA3-07	2022.3.4	53°42.888′	65°19.998′	809	1m/3L		500m/3L		809m/3L
S38	CA3-08	2022.3.4	53°49.700′	65°32.740′	250	1m/3L	150m/3L; 210m/3L			
S38	C6-07	2022.3.5	54°53.520′	65°13.990′	1482	1m/3L		500m/3L	1000m/3L	
S38	C6-08	2022.3.5	55°01.004′	65°30.834′	1015	1m/3L				
S38	C7'-07	2022.3.5	57°29.870′	65°25.880′	3174	1m/3L		500m/3L	1000m/3L	
S38	C7-11	2022.3.6	59°59.992′	66°39.881′	863	1m/3L				
S38	C7-09	2022.3.7	60°00.000′	65°59.910′	2674	1m/3L		500m/3L	1000m/3L	
S38	C7'-09	2022.3.7	57°30.390′	65°59.840′	1558	1m/3L				
S38	C7-07	2022.3.7	59°55.769′	65°19.388′	3898	1m/3L		500m/3L	1000m/3L	
S38	CA3-05	2022.3.9	53°48.383′	64°41.369′	3434	1m/3L		500m/3L	1000m/3L	
S38	C6-05	2022.3.9	55°00.050′	64°40.130′	4096	1m/3L				
S38	C7'-05	2022.3.10	57°29.584′	64°40.390′	3789	1m/3L				
S38	C7-03	2022.3.10	60°10.981′	64°06.258′	4308	1m/3L				
S38	C7-05	2022.3.11	59°59.950′	64°39.930′	4143	1m/3L				

S37 represent the cruises of 37th Chinese Antarctic Scientific Expedition (CHINARE) in 2021

S38 represent the cruises of 38th Chinese Antarctic Scientific Expedition (CHINARE) in 2022

Supplementary Table S2 Information on RMT trawl survey

Cruise	Station	Sampling date	Longitude/E	Latitude/S	Trawl duration/h	Average trawl speed/kn	Maximum trawl depth/m	Individuals of E. antarctica	Total weight of E. antarctica/g	Individuals of B. antarcticus	Total weight of B. antarcticus/g
S37	C7-05	2021.1.5	59°56.920′	64°41.076′	2.25	3	1339	23	19.539	35	88.09
S37	C7-03	2021.1.6	60°04.96′	64°02.32′	2.25	3	1095	18	33.5235	39	205.68
S37	C6-02	2021.1.8	55°0.383′	63°20.783′	1.58	3	1312	25	34.4627	43	207.14
S37	C5/6-09	2021.1.10	66°32.69′	52°40.20′	2.28	3	1364	15	44.4536	32	180.64
S37	C5-06	2021.1.13	49°59.92′	64°51.31′	2.25	3	1164	8	44.4536	43	133.2
S37	C5-03	2021.1.15	50°2.84′	63°59.52′	2.43	2.5	1141	19	20.236	30	139.27
S37	C4-07	2021.1.17	45°1.729′	65°21.156′	2.53	3	1458	15	4.8707	10	69.81
S37	C4-11	2021.1.18	45°1.16′	66°30.16′	2.75	3	1276	69	5.468	41	87.79
S37	C2'-11	2021.1.25	33°42.629′	66°40.169′	1.72	3	850	12	24.8889	43	150.37
S37	C2'-13	2021.1.26	33°43.320′	67°19.955′	2.12	3	1132	21	52.4916	25	135.89
S38	C2'-06	2022.1.27	34°10.280′	65°11.110′	1.72	2.5	530	34	12.23	0	0
S38	C2'-09	2022.1.29	33°34.340′	66°00.420′	1.72	2.5	-	13	7.48	17	22.91
S38	C5-00	2022.2.15	50°00.200′	62°00.030′	1.13	2.5	590	23	20.04	3	3.6
S38	C5-02	2022.2.16	50°00.170′	63°15.060′	2.53	2.5	1200	17	25.2	25	54.51
S38	C5-07	2022.2.20	49°59.920′	65°19.570′	2	2.5	1100	42	180.2	18	99.63
S38	CA1-10	2022.2.22	48°43.450′	66°18.740′	2.3	2.5	1100	48	604.15	9	45.24
S38	CA2-05	2022.3.3	51°15.250′	64°39.660′	2	2.5	1200	8	20.87	56	499.05
S38	C6'-07	2022.3.4	52°29.930′	65°19.750′	2.5	2.5	1050	34	131.22	50	345.25
S38	CA3-07	2022.3.4	53°42.888′	65°19.998′	1.78	2.1	760	25	146.02	3	2.63
S38	C6-07	2022.3.5	54°53.520′	65°13.990′	1.92	2.2	1070	39	172.47	15	37.33
S38	C7-09	2022.3.7	60°00.000′	65°59.910′	1.9	2.1	1030	11	20.05	3	10.68

“-” indicate no information

S37 represent the cruises of 37th Chinese Antarctic Scientific Expedition (CHINARE) in 2021

S38 represent the cruises of 38th Chinese Antarctic Scientific Expedition (CHINARE) in 2022

Supplementary Table S3 qPCR amplification information for plasmids from *Electrona antarctica* at different concentrations

Sample	Copy number	Dilution ratio	Reporter group	Quencher group	Ct value	Mean value of CT	CT SD
sample1	1341626390	10^9	FAM	NFQ-MGB	9.800	9.587	0.635
sample1	1341626390	10^9	FAM	NFQ-MGB	8.872	9.587	0.635
sample1	1341626390	10^9	FAM	NFQ-MGB	10.088	9.587	0.635
sample2	134162639	10^8	FAM	NFQ-MGB	13.253	13.254	0.080
sample2	134162639	10^8	FAM	NFQ-MGB	13.175	13.254	0.080
sample2	134162639	10^8	FAM	NFQ-MGB	13.334	13.254	0.080
sample3	13416263.9	10^7	FAM	NFQ-MGB	16.617	16.724	0.119
sample3	13416263.9	10^7	FAM	NFQ-MGB	16.702	16.724	0.119
sample3	13416263.9	10^7	FAM	NFQ-MGB	16.852	16.724	0.119
sample4	1341626.39	10^6	FAM	NFQ-MGB	20.277	20.155	0.122
sample4	1341626.39	10^6	FAM	NFQ-MGB	20.156	20.155	0.122
sample4	1341626.39	10^6	FAM	NFQ-MGB	20.033	20.155	0.122
sample5	134162.639	10^5	FAM	NFQ-MGB	23.596	23.640	0.078
sample5	134162.639	10^5	FAM	NFQ-MGB	23.731	23.640	0.078
sample5	134162.639	10^5	FAM	NFQ-MGB	23.594	23.640	0.078
sample6	13416.2639	10^4	FAM	NFQ-MGB	27.032	27.013	0.018
sample6	13416.2639	10^4	FAM	NFQ-MGB	27.008	27.013	0.018
sample6	13416.2639	10^4	FAM	NFQ-MGB	26.998	27.013	0.018
sample7	1341.62639	10^3	FAM	NFQ-MGB	29.950	30.109	0.138
sample7	1341.62639	10^3	FAM	NFQ-MGB	30.203	30.109	0.138
sample7	1341.62639	10^3	FAM	NFQ-MGB	30.175	30.109	0.138
sample8	134.162639	10^2	FAM	NFQ-MGB	32.305	32.271	0.053
sample8	134.162639	10^2	FAM	NFQ-MGB	32.210	32.271	0.053
sample8	134.162639	10^2	FAM	NFQ-MGB	32.297	32.271	0.053
sample9	13.4162639	10^1	FAM	NFQ-MGB	32.412	32.151	0.821
sample9	13.4162639	10^1	FAM	NFQ-MGB	31.231	32.151	0.821
sample9	13.4162639	10^1	FAM	NFQ-MGB	32.809	32.151	0.821
sample10	1.34162639	10^0	FAM	NFQ-MGB	Undetermined	-	-
sample10	1.34162639	10^0	FAM	NFQ-MGB	Undetermined	-	-
sample10	1.34162639	10^0	FAM	NFQ-MGB	Undetermined	-	-
negative control	-	-	FAM	NFQ-MGB	Undetermined	-	-
negative control	-	-	FAM	NFQ-MGB	Undetermined	-	-
negative control	-	-	FAM	NFQ-MGB	Undetermined	-	-

Supplementary Table S4 qPCR amplification information for plasmids from *Bathylagus antarcticus* at different concentrations

Sample	Copy number	Dilution ratio	Reporter group	Quencher group	Ct value	Mean value of CT	CT sd
sample1	1341626390	10^9	FAM	NFQ-MGB	12.17989	12.13106	0.059425
sample1	1341626390	10^9	FAM	NFQ-MGB	12.06489	12.13106	0.059425
sample1	1341626390	10^9	FAM	NFQ-MGB	12.14839	12.13106	0.059425
sample2	134162639	10^8	FAM	NFQ-MGB	15.78167	15.67934	0.089008
sample2	134162639	10^8	FAM	NFQ-MGB	15.61987	15.67934	0.089008
sample2	134162639	10^8	FAM	NFQ-MGB	15.63649	15.67934	0.089008
sample3	13416264	10^7	FAM	NFQ-MGB	19.61099	19.57963	0.073538
sample3	13416264	10^7	FAM	NFQ-MGB	19.49561	19.57963	0.073538
sample3	13416264	10^7	FAM	NFQ-MGB	19.63228	19.57963	0.073538
sample4	1341626	10^6	FAM	NFQ-MGB	23.28511	23.20223	0.071779
sample4	1341626	10^6	FAM	NFQ-MGB	23.16065	23.20223	0.071779
sample4	1341626	10^6	FAM	NFQ-MGB	23.16093	23.20223	0.071779
sample5	134162.6	10^5	FAM	NFQ-MGB	27.00039	26.83507	0.145415
sample5	134162.6	10^5	FAM	NFQ-MGB	26.72695	26.83507	0.145415
sample5	134162.6	10^5	FAM	NFQ-MGB	26.77787	26.83507	0.145415
sample6	13416.26	10^4	FAM	NFQ-MGB	30.575	30.5744	0.09945
sample6	13416.26	10^4	FAM	NFQ-MGB	30.67356	30.5744	0.09945
sample6	13416.26	10^4	FAM	NFQ-MGB	30.47466	30.5744	0.09945
sample7	1341.626	10^3	FAM	NFQ-MGB	34.02235	33.74321	0.242497
sample7	1341.626	10^3	FAM	NFQ-MGB	33.62278	33.74321	0.242497
sample7	1341.626	10^3	FAM	NFQ-MGB	33.5845	33.74321	0.242497
sample8	134.1626	10^2	FAM	NFQ-MGB	35.18517	35.23611	0.207918
sample8	134.1626	10^2	FAM	NFQ-MGB	35.46477	35.23611	0.207918
sample8	134.1626	10^2	FAM	NFQ-MGB	35.0584	35.23611	0.207918
sample9	13.41626	10^1	FAM	NFQ-MGB	35.52587	35.83047	0.265383
sample9	13.41626	10^1	FAM	NFQ-MGB	36.01175	35.83047	0.265383
sample9	13.41626	10^1	FAM	NFQ-MGB	35.95381	35.83047	0.265383
sample10	1.341626	10^0	FAM	NFQ-MGB	Undetermined	-	-
sample10	1.341626	10^0	FAM	NFQ-MGB	Undetermined	-	-
sample10	1.341626	10^0	FAM	NFQ-MGB	Undetermined	-	-
sample11	-	10^-1	FAM	NFQ-MGB	Undetermined	-	-
sample11	-	10^-1	FAM	NFQ-MGB	Undetermined	-	-
sample11	-	10^-1	FAM	NFQ-MGB	Undetermined	-	-
sample12	-	10^-2	FAM	NFQ-MGB	Undetermined	-	-
sample12	-	10^-2	FAM	NFQ-MGB	Undetermined	-	-
sample12	-	10^-2	FAM	NFQ-MGB	Undetermined	-	-

negative control	-	NTC	FAM	NFQ-MGB	Undetermined	-	-
negative control	-	NTC	FAM	NFQ-MGB	Undetermined	-	-
negative control	-	NTC	FAM	NFQ-MGB	Undetermined	-	-