

**Table S1. Biochemical concentration integrated within euphotic water column at each station in the Yellow Sea, 2018. FM represents sum of carbohydrates, proteins, and lipids.**

Season	Station	Chlorophyll <i>a</i> (mg m <sup>-2</sup> )	Carbohydrates (g m <sup>-2</sup> )	Proteins (g m <sup>-2</sup> )	Lipids (g m <sup>-2</sup> )	FM (g m <sup>-2</sup> )	Calorie Content (Kcal m <sup>-2</sup> )	Calorie Content/ chlorophyll <i>a</i> (Kcal (mg) <sup>-1</sup> )
Winter	307-03	1.8	1.6	0.6	0.6	2.8	15.3	8.6
	307-05	1.7	1.2	0.4	1.2	2.8	18.6	10.7
	307-09	3.7	2.6	0.5	2.0	5.1	32.3	8.7
	309-03	7.3	2.9	1.0	1.3	5.3	30.2	4.1
	309-05	4.2	3.6	0.6	1.8	6.0	35.4	8.4
	309-09	4.1	3.1	0.8	1.6	5.5	32.2	7.8
	310-09	3.9	4.5	1.0	2.1	7.6	44.0	11.3
	311-05	2.4	1.4	0.3	0.6	2.3	13.4	5.7
	311-09	2.3	1.6	0.2	1.1	2.9	18.0	7.7
	312-09	1.3	2.2	0.2	1.1	3.5	20.3	16.2
	Mean	3.3	2.5	0.6	1.3	4.4	26.0	8.9
	S.D.	1.8	1.1	0.3	0.5	1.8	10.2	3.3
Spring	307-03	6.1	1.1	0.6	0.4	2.2	12.0	2.0
	307-05	5.0	1.0	0.4	0.4	1.7	9.9	2.0
	307-09	17.9	1.4	1.9	2.3	5.5	37.5	2.1
	309-03	46.1	1.9	1.3	3.2	6.4	45.7	1.0
	309-05	60.0	4.1	2.7	3.3	10.1	63.0	1.1
	309-09	18.7	2.7	1.9	2.2	6.7	42.0	2.2
	310-03	24.1	1.1	1.1	1.1	3.3	20.9	0.9

	311-07	14.7	2.4	0.9	1.1	4.4	25.3	1.7
	312-05	22.2	3.1	1.1	1.7	5.8	34.4	1.6
	312-09	96.6	4.3	2.2	2.2	8.7	50.6	0.5
	Mean	31.1	2.3	1.4	1.8	5.5	34.1	1.5
	S.D.	28.6	1.2	0.7	1.0	2.7	17.2	0.6
Summer	307-03	3.0	0.7	0.2	0.3	1.2	6.6	2.2
	307-05	11.2	3.5	1.2	2.2	6.8	41.5	3.7
	307-09	9.6	5.1	1.2	3.2	9.5	58.1	6.1
	308-06	11.0	6.9	1.7	4.6	13.2	81.7	7.4
	309-03	21.0	8.8	1.6	4.2	14.5	84.5	4.0
	309-05	14.9	11.0	0.9	5.7	17.6	104.2	7.0
	309-09	14.1	8.5	1.4	5.4	15.3	94.1	6.7
	311-07	8.2	11.8	1.1	4.9	17.8	101.0	12.4
	311-09	10.7	9.4	0.9	4.2	14.6	84.0	7.9
	312-09	17.2	6.9	1.4	5.0	13.3	83.3	4.8
	Mean	12.1	7.3	1.2	4.0	12.4	73.9	6.2
	S.D.	5.0	3.4	0.4	1.7	5.2	30.3	2.8
Fall	307-03	5.4	1.8	0.4	0.7	2.9	15.9	3.0
	307-05	26.1	4.6	1.4	2.0	8.0	45.1	1.7
	307-09	29.9	9.1	1.2	5.5	15.8	95.8	3.2
	308-06	9.7	4.0	0.9	3.3	8.2	52.5	5.4
	309-03	22.5	6.0	1.3	3.6	10.9	66.2	2.9
	309-07	18.6	6.3	1.5	3.2	11.1	65.1	3.5
	310-06	12.1	9.3	1.3	4.1	14.7	83.8	6.9
	311-07	25.9	7.1	1.5	3.2	11.8	67.8	2.6
	311-09	14.2	10.0	1.2	4.0	15.3	85.9	6.1

312-09	20.3	8.8	0.9	3.0	12.7	69.4	3.4
Mean	18.4	6.7	1.2	3.2	11.1	64.8	3.9
S.D.	8.0	2.7	0.3	1.3	4.0	22.9	1.7

**Table S2. Biochemical concentration integrated within euphotic water column at each station in the South Sea of Korea, 2018. FM represents sum of carbohydrates, proteins, and lipids.**

Season	Station	Chlorophyll <i>a</i> (mg m <sup>-2</sup> )	Carbohydrates (g m <sup>-2</sup> )	Proteins (g m <sup>-2</sup> )	Lipids (g m <sup>-2</sup> )	FM (g m <sup>-2</sup> )	Calorie Content (Kcal m <sup>-2</sup> )	Calorie Content/ chlorophyll <i>a</i> (Kcal (mg) <sup>-1</sup> )
Winter	204-04	10.0	4.7	0.3	1.1	6.0	31.0	3.1
	205-03	11.1	4.6	0.3	1.3	6.2	33.1	3.0
	205-05	17.4	4.6	0.3	1.6	6.5	36.2	2.1
	206-03	5.6	3.0	0.4	1.1	4.5	24.9	4.5
	207-03	9.3	7.7	1.1	1.9	10.7	55.5	6.0
	313-09	3.2	2.6	0.2	0.9	3.7	20.4	6.4
	314-03	42.3	3.3	0.9	1.5	5.7	32.9	0.8
	314-07	4.7	2.2	0.1	0.6	3.0	15.9	3.4
	400-14	14.7	3.9	0.6	1.3	5.8	31.8	2.2
	400-25	13.4	3.7	0.5	1.4	5.6	31.0	2.3
	Mean	13.2	4.0	0.5	1.3	5.8	31.3	3.4
	S.D.	11.2	1.5	0.3	0.4	2.1	10.6	1.8
Spring	204-04	34.3	6.2	1.4	1.9	9.5	50.8	1.5
	205-03	43.6	4.4	2.1	2.5	9.1	54.1	1.2
	205-05	59.0	5.8	1.8	2.0	9.6	52.8	0.9
	206-03	89.7	7.9	3.2	3.3	14.4	81.6	0.9
	207-03	29.1	6.5	1.9	2.4	10.9	60.6	2.1
	313-09	36.2	4.3	1.6	2.1	8.0	46.4	1.3
	314-03	25.7	9.6	1.4	2.2	13.2	67.8	2.6

	314-05	28.4	5.3	1.2	2.0	8.5	47.2	1.7
	314-09	21.8	3.3	0.8	1.8	5.9	34.7	1.6
	400-27	45.0	4.6	1.4	1.9	7.9	44.3	1.0
	Mean	41.3	5.8	1.7	2.2	9.7	54.0	1.5
	S.D.	20.3	1.9	0.7	0.5	2.6	13.2	0.6
Summer	205-03	11.0	6.9	0.0	4.0	11.0	66.7	6.1
	205-05	17.7	5.1	0.1	3.2	8.4	52.0	2.9
	206-03	12.3	8.6	0.0	5.7	14.3	89.3	7.3
	207-03	17.1	11.4	0.0	5.5	17.0	99.4	5.8
	313-07	13.2	8.1	0.0	5.6	13.7	86.1	6.5
	314-03	33.4	7.1	0.6	5.9	13.7	88.9	2.7
	314-05	12.7	10.3	0.0	7.5	17.8	113.9	9.0
	314-09	17.4	9.2	0.2	5.6	15.0	91.9	5.3
	400-14	7.6	10.0	0.0	5.1	15.1	89.7	11.9
	400-25	11.2	6.3	0.0	3.5	9.8	59.0	5.2
	Mean	15.4	8.3	0.1	5.2	13.6	83.7	6.3
	S.D.	6.7	1.9	0.2	1.2	2.9	18.0	2.6
Fall	203-03	41.2	2.7	1.4	7.6	11.7	91.1	2.2
	204-04	17.7	1.3	1.0	1.6	3.8	25.5	1.4
	205-03	42.4	2.4	1.3	2.8	6.6	44.2	1.0
	206-03	56.5	2.3	2.1	3.3	7.8	52.9	0.9
	207-03	50.7	5.9	1.9	4.6	12.4	78.3	1.5
	313-03	27.6	4.3	1.9	4.2	10.4	68.4	2.5
	313-09	19.2	2.2	1.3	2.5	6.1	40.3	2.1
	314-03	21.6	3.6	1.6	4.1	9.3	62.7	2.9
	314-09	24.2	2.6	1.4	3.0	7.1	47.2	2.0

400-14	60.7	2.5	1.9	3.3	7.7	52.2	0.9
Mean	36.2	3.0	1.6	3.7	8.3	56.3	1.7
S.D.	16.1	1.3	0.4	1.6	2.7	19.3	0.7

**Table S3. Biochemical concentration integrated within euphotic water column at each station in the East China Sea, 2018. FM represents sum of carbohydrates, proteins, and lipids.**

Season	Station	Chlorophyll <i>a</i> (mg m <sup>-2</sup> )	Carbohydrates (g m <sup>-2</sup> )	Proteins (g m <sup>-2</sup> )	Lipids (g m <sup>-2</sup> )	FM (g m <sup>-2</sup> )	Calorie Content (Kcal m <sup>-2</sup> )	Calorie Content/ chlorophyll <i>a</i> (Kcal (mg) <sup>-1</sup> )
Winter	204-04	10.0	4.7	0.3	1.1	6.0	31.0	3.1
	205-03	11.1	4.6	0.3	1.3	6.2	33.1	3.0
	205-05	17.4	4.6	0.3	1.6	6.5	36.2	2.1
	206-03	5.6	3.0	0.4	1.1	4.5	24.9	4.5
	400-14	14.7	3.9	0.6	1.3	5.8	31.8	2.2
	400-25	13.4	3.7	0.5	1.4	5.6	31.0	2.3
	Mean	13.2	4.0	0.5	1.3	5.8	31.3	3.4
	S.D.	11.2	1.5	0.3	0.4	2.1	10.6	1.8
Spring	204-04	34.3	6.2	1.4	1.9	9.5	50.8	1.5
	205-03	43.6	4.4	2.1	2.5	9.1	54.1	1.2
	206-03	89.7	7.9	3.2	3.3	14.4	81.6	0.9
	207-03	29.1	6.5	1.9	2.4	10.9	60.6	2.1
	313-09	36.2	4.3	1.6	2.1	8.0	46.4	1.3
	314-03	25.7	9.6	1.4	2.2	13.2	67.8	2.6
	314-05	28.4	5.3	1.2	2.0	8.5	47.2	1.7
	314-09	21.8	3.3	0.8	1.8	5.9	34.7	1.6
	400-27	45.0	4.6	1.4	1.9	7.9	44.3	1.0
	Mean	41.3	5.8	1.7	2.2	9.7	54.0	1.5
	S.D.	20.3	1.9	0.7	0.5	2.6	13.2	0.6
Summer	205-03	11.0	6.9	0.0	4.0	11.0	66.7	6.1

	205-05	17.7	5.1	0.1	3.2	8.4	52.0	2.9
	206-03	12.3	8.6	0.0	5.7	14.3	89.3	7.3
	207-03	17.1	11.4	0.0	5.5	17.0	99.4	5.8
	313-07	13.2	8.1	0.0	5.6	13.7	86.1	6.5
	314-03	33.4	7.1	0.6	5.9	13.7	88.9	2.7
	314-05	12.7	10.3	0.0	7.5	17.8	113.9	9.0
	314-09	17.4	9.2	0.2	5.6	15.0	91.9	5.3
	400-14	7.6	10.0	0.0	5.1	15.1	89.7	11.9
	400-25	11.2	6.3	0.0	3.5	9.8	59.0	5.2
	Mean	15.4	8.3	0.1	5.2	13.6	83.7	6.3
	S.D.	6.7	1.9	0.2	1.2	2.9	18.0	2.6
Fall	203-03	41.2	2.7	1.4	7.6	11.7	91.1	2.2
	204-04	17.7	1.3	1.0	1.6	3.8	25.5	1.4
	205-03	42.4	2.4	1.3	2.8	6.6	44.2	1.0
	206-03	56.5	2.3	2.1	3.3	7.8	52.9	0.9
	207-03	50.7	5.9	1.9	4.6	12.4	78.3	1.5
	313-03	27.6	4.3	1.9	4.2	10.4	68.4	2.5
	313-09	19.2	2.2	1.3	2.5	6.1	40.3	2.1
	314-03	21.6	3.6	1.6	4.1	9.3	62.7	2.9
	314-09	24.2	2.6	1.4	3.0	7.1	47.2	2.0
	400-14	60.7	2.5	1.9	3.3	7.7	52.2	0.9
	Mean	36.2	3.0	1.6	3.7	8.3	56.3	1.7
	S.D.	16.1	1.3	0.4	1.6	2.7	19.3	0.7



**Table S4. Biochemical concentration integrated within euphotic water column at each station in the East Sea, 2018. FM represents sum of carbohydrates, proteins, and lipids.**

Season	Station	Chlorophyll <i>a</i> (mg m <sup>-2</sup> )	Carbohydrates (g m <sup>-2</sup> )	Proteins (g m <sup>-2</sup> )	Lipids (g m <sup>-2</sup> )	FM (g m <sup>-2</sup> )	Calorie Content (Kcal m <sup>-2</sup> )	Calorie Content/ chlorophyll <i>a</i> (Kcal (mg) <sup>-1</sup> )
Winter	103-07	50.8	7.0	1.2	2.9	11.2	63.3	1.2
	103-11	92.9	4.6	1.9	3.5	9.9	61.9	0.7
	105-05	19.6	6.3	0.5	2.9	9.7	56.3	2.9
	105-07	27.6	9.3	0.8	3.8	13.9	78.8	2.9
	105-11	27.0	9.9	0.7	3.2	13.8	74.5	2.8
	107-05	34.5	6.4	1.0	3.2	10.6	62.1	1.8
	107-07	17.5	4.8	0.1	2.7	7.6	45.8	2.6
	209-05	22.0	7.9	0.6	3.2	11.7	66.0	3.0
	209-08	49.8	7.5	0.9	4.3	12.7	76.2	1.5
	Mean	38.0	7.1	0.9	3.3	11.2	65.0	2.1
	S.D.	23.9	1.8	0.5	0.5	2.1	10.4	0.9
Spring	102-06	59.7	3.1	3.8	3.4	10.3	66.3	1.1
	103-04	44.7	4.1	1.5	2.0	7.5	43.7	1.0
	103-10	70.9	3.7	3.5	3.7	11.0	70.1	1.0
	104-05	62.3	3.2	2.5	2.7	8.4	52.4	0.8
	104-09	61.8	3.3	2.5	3.0	8.8	55.9	0.9
	105-10	36.7	3.3	1.7	2.0	7.0	42.1	1.1
	106-03	43.1	3.2	2.4	2.4	8.0	48.8	1.1
	106-10	40.2	5.0	2.5	3.5	11.0	67.8	1.7
	107-07	34.9	3.7	3.1	3.1	9.9	61.4	1.8

	209-07	46.6	3.3	1.7	2.3	7.3	44.6	1.0
	Mean	50.1	3.6	2.5	2.8	8.9	55.3	1.2
	S.D.	12.5	0.6	0.8	0.6	1.5	10.6	0.3
Summer	102-09	12.0	4.4	1.3	3.0	8.7	53.5	4.5
	103-09	17.9	4.6	1.1	4.0	9.7	63.0	3.5
	104-04	12.7	4.1	0.6	2.4	7.1	42.7	3.4
	104-11	8.1	4.2	0.9	3.5	8.5	55.1	6.8
	105-07	8.4	5.1	1.0	3.9	9.9	62.8	7.5
	105-11	12.4	5.4	1.3	3.7	10.3	63.9	5.1
	106-05	17.4	3.9	1.7	3.0	8.6	54.1	3.1
	107-03	8.0	2.6	0.8	2.1	5.5	34.7	4.4
	107-07	10.7	4.9	1.1	3.0	9.0	54.9	5.2
	209-07	18.1	6.3	1.	4.5	12.4	77.5	4.3
	Mean	12.6	4.5	1.1	3.3	9.0	56.2	4.8
	S.D.	4.0	1.0	0.3	0.8	1.9	11.8	1.4
Fall	102-07	46.2	3.0	1.5	4.5	8.9	63.1	1.4
	103-05	40.5	3.5	1.4	4.7	9.6	67.0	1.7
	103-09	28.2	2.1	1.2	4.1	7.4	54.1	1.9
	104-08	56.3	3.2	3.0	4.3	10.4	70.0	1.2
	105-03	25.2	2.8	0.9	2.5	6.2	40.3	1.6
	105-11	22.3	2.6	1.3	3.5	7.4	50.9	2.3
	106-07	17.5	3.5	0.9	6.7	11.1	82.8	4.7
	107-03	33.6	3.5	1.6	3.2	8.3	53.5	1.6
	107-07	18.1	3.5	0.9	4.7	9.2	64.5	3.6
	209-04	26.0	2.0	0.9	2.4	5.3	36.0	1.4
	Mean	31.4	3.0	1.4	4.1	8.4	58.2	2.1
	S.D.	12.7	0.6	0.6	1.3	1.8	14.1	1.1