

Fig. S1. Experimental installation for video recording of the behavior of the sea cucumber *Apostichopus japonicus* on the artificial reef in June–September 2021. Designations: C – video camera, FL – flashlight, CB – control block, O – oyster settlement, M – mussel settlement on concrete slabs.

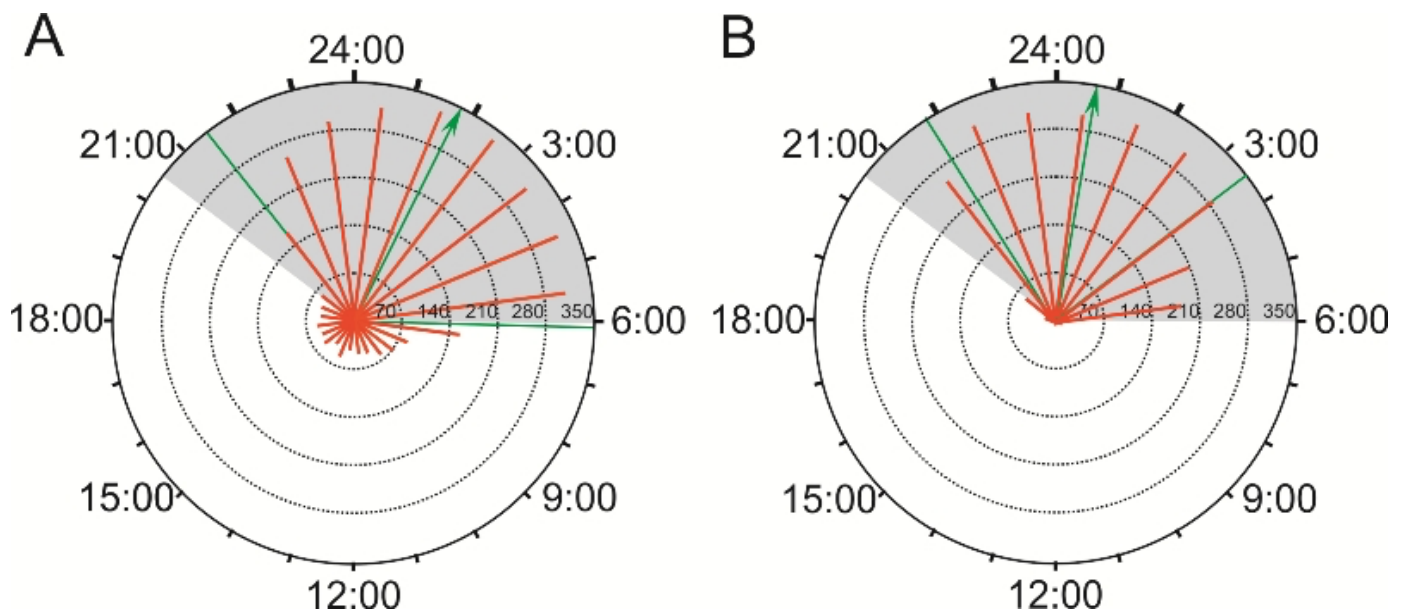


Fig. S2. The 24-h distribution of the total time spent by all *Apostichopus japonicus* adults (A) and juveniles (B) outside shelters on the artificial reef in June–September 2021. Shaded area: time of day when photosynthetically active radiation at the bottom level was less than $7 \mu\text{M m}^{-2} \text{s}^{-1}$. The red solid lines and numbers inside the circle represent the number of hours the sea cucumbers spent outside the shelter in each hour of the day. The green arrows and solid lines indicate the means and standard deviations (circular statistics) of the time interval when sea cucumbers were recorded outside shelters: (A) $01:47 \pm 04:19$ h, (B) $00:41 \pm 02:49$ h.

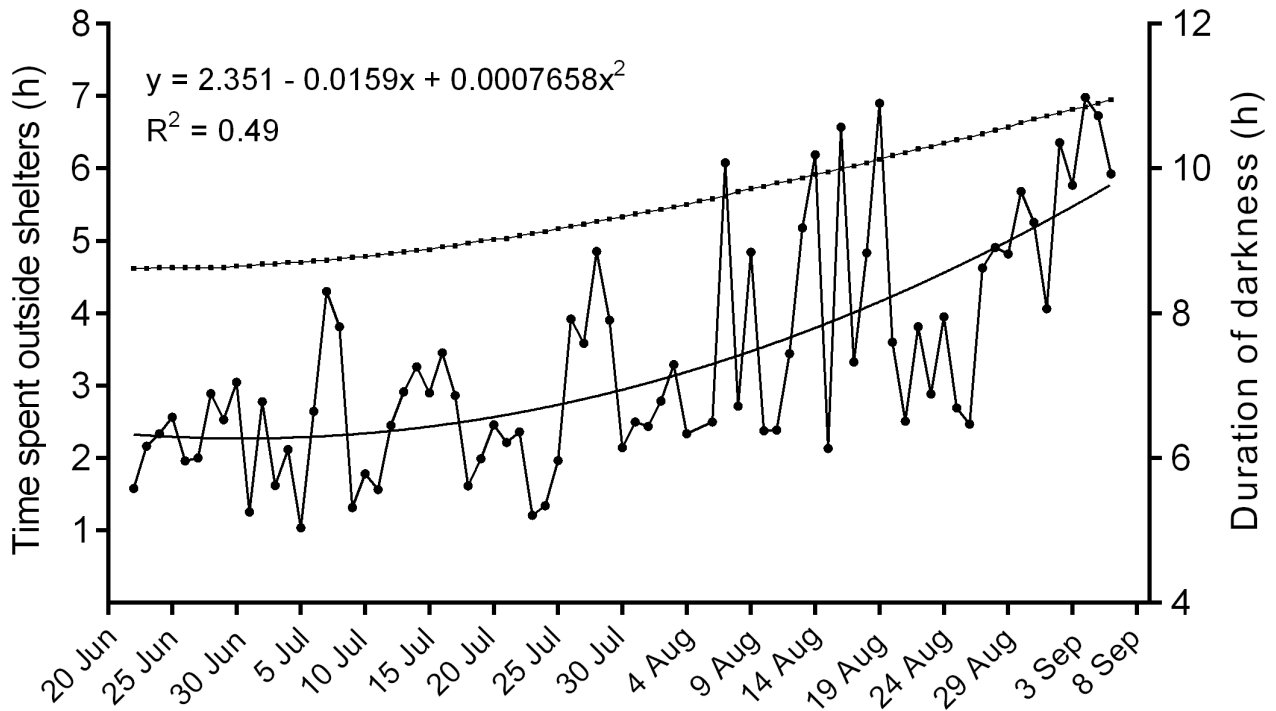


Fig. S3. Seasonal dynamics of darkness duration and time spent outside shelters, counted per one *Apostichopus japonicus* juvenile per day, on the artificial reef in June–September 2021. Small squares connected by a line denote daily darkness duration (h), black circles connected by a line denote the average daily time spent outside shelters (h). The solid curve line corresponds to the non-linear regression equation $y = 2.351 - 0.0159x + 0.0007658x^2$, $n = 76$, $R^2 = 0.49$.

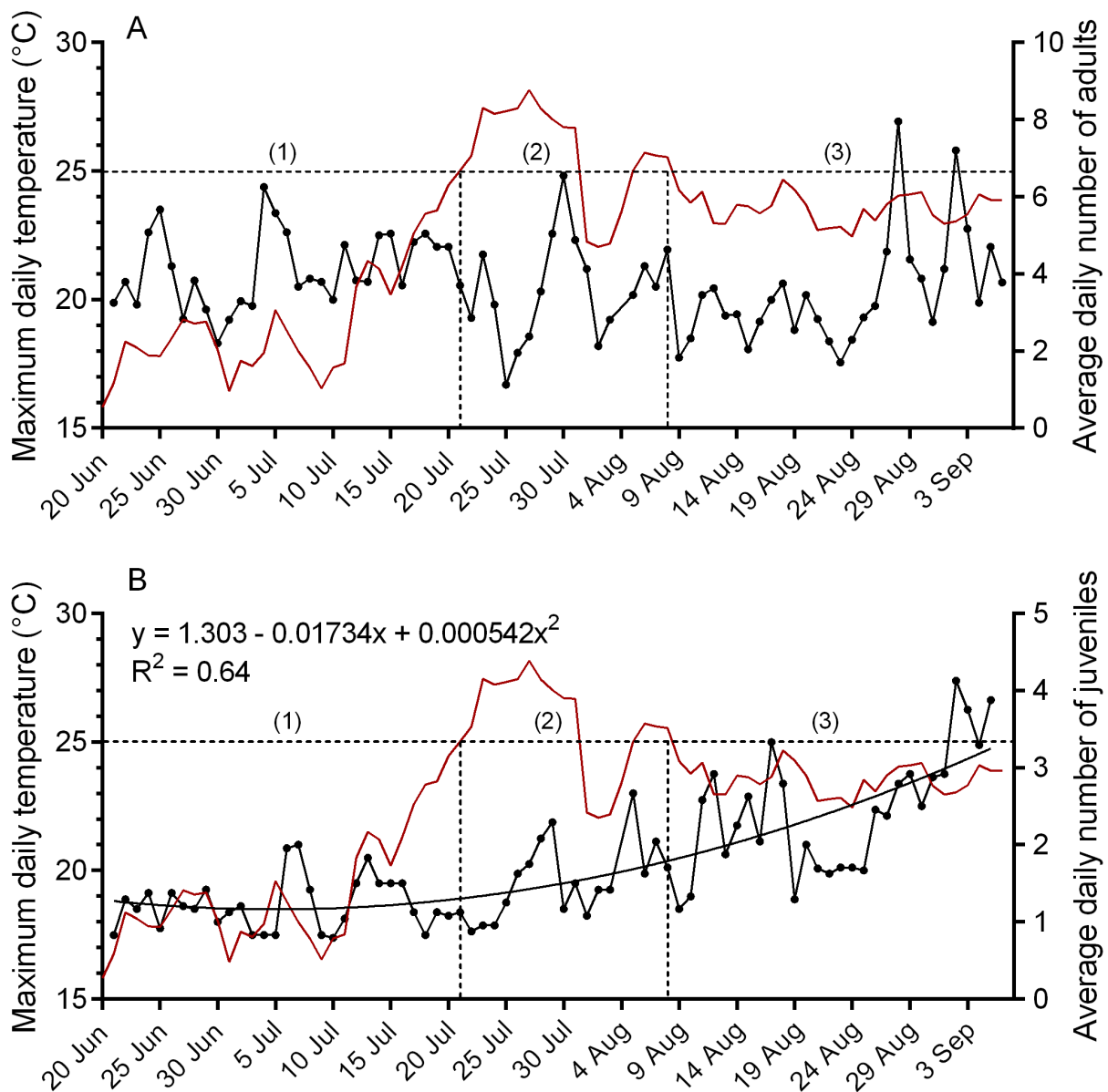


Fig. S4. Seasonal dynamics of the average daily numbers of *Apostichopus japonicus* adults (A) and juveniles (B) and maximum daily temperature (denoted by red solid line without symbols) on the artificial reef in June–September 2021. The horizontal dashed line corresponds to the temperature of 25°C. Vertical dashed lines indicate the following time intervals: (1) 21 June–20 July (the period of gradual warming), (2) 21 July–08 August (the period of strong temperature changes), (3) 09 August–06 September (the period of relatively stable temperature). The curve line corresponds to the non-linear regression equation $y = 1.303 - 0.01734x + 0.000542x^2$, $n = 76$, $R^2 = 0.64$.



Fig. S5. Numerous sea cucumbers *Apostichopus japonicus* demonstrate the spawning behavior and spawn on the upper surface of the artificial reef on 12 July 2021 at 22:26:02.

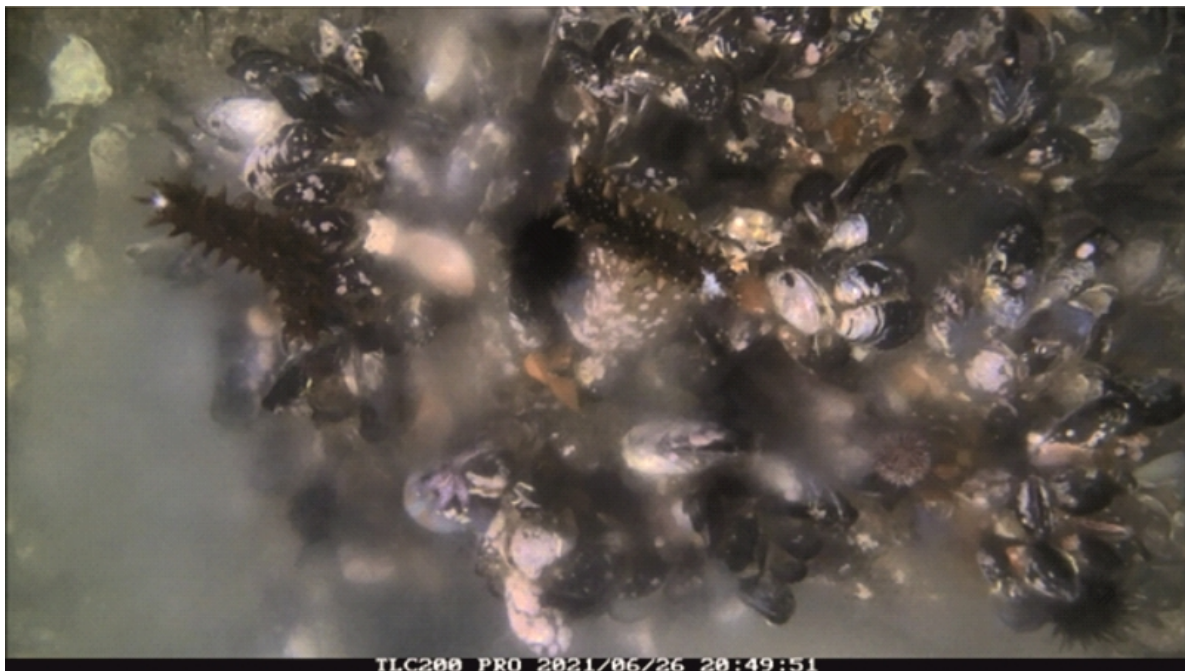


Fig. S6. Simultaneous spawning of *Apostichopus japonicus*, mussels *Crenomytilus grayanus* and oysters *Crassostrea gigas* on the artificial reef on 26 June 2021 at 20:49:51.

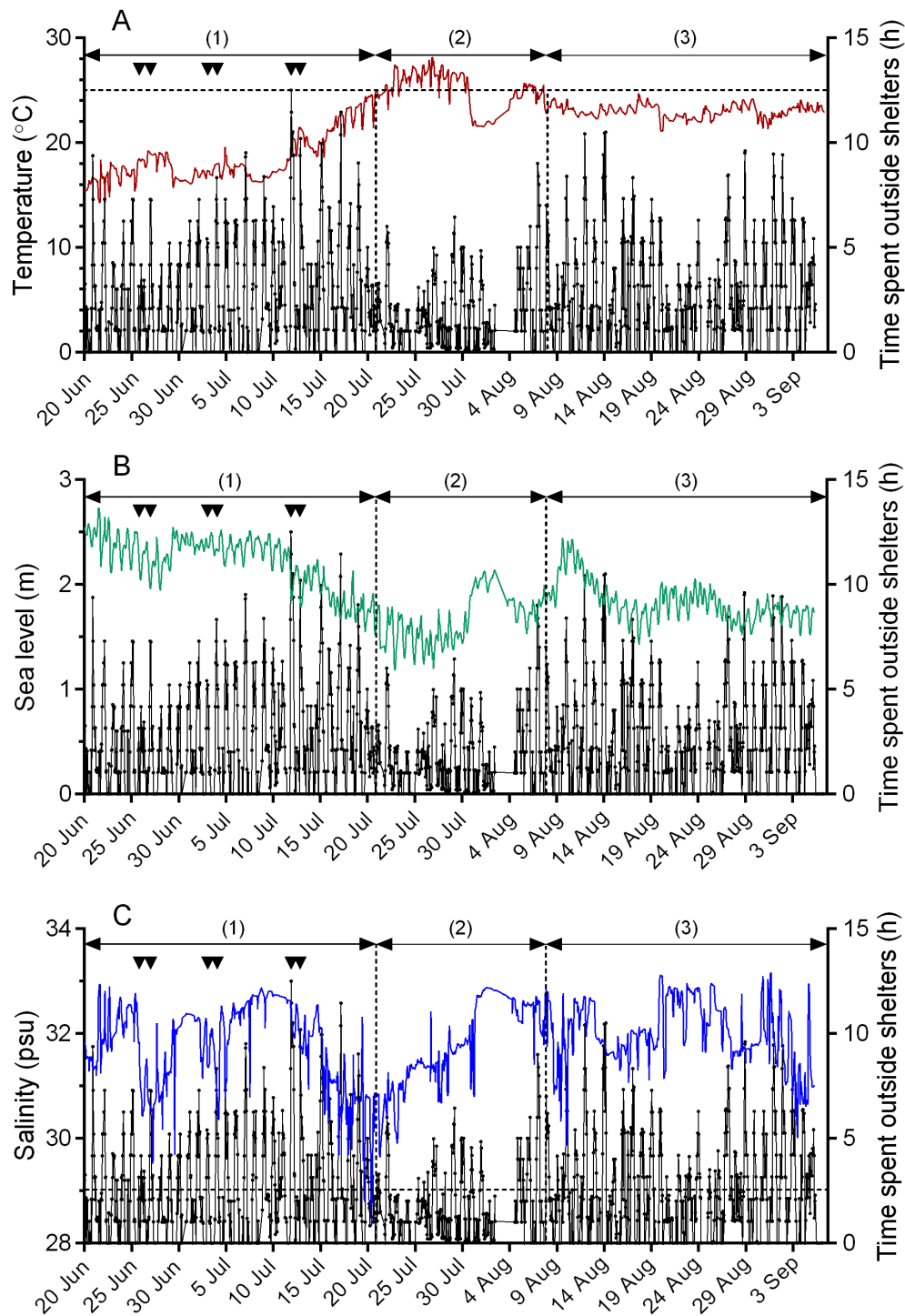


Fig. S7. Seasonal dynamics of environmental variables and the activity of *Apostichopus japonicus* adults (represented as the total time spent by all adult sea cucumbers outside shelters during 1 h and denoted by black line with symbols) on the artificial reef in June–September 2021. Data for environmental variables are presented as average hourly values. Black triangles indicate the dates when *A. japonicus* spawning events were observed. (A) Temperature. The horizontal dashed line corresponds to a temperature of 25°C. Horizontal arrowhead lines and vertical dashed lines indicate the following time intervals: (1) 21 June–20 July (period of gradual warming), (2) 21 July–08 August (the the period of strong temperature changes), (3) 09 August–06 September (the period of relatively stable temperature). (B) Sea level. Horizontal arrowhead lines and vertical dashed lines indicate the time intervals as in (A). (C) Salinity. The horizontal dashed line corresponds to a salinity of 29 psu. Horizontal arrowhead lines and vertical dashed lines indicate the time intervals as in (A).

Table S1. Length (cm) of adult *Apostichopus japonicus* on the artificial reef at the beginning of the period of observations in 2021

No.	Mean	SD	n
1	10.70	0.29	3
2	12.10	0.72	3
3	14.95	0.22	3
4	15.96	0.69	3
5	16.91	0.69	3
6	17.48	0.57	3
7	18.87	0.77	3
8	19.95	0.95	3
9	20.08	0.77	3
10	21.60	0.29	3
11	21.79	0.29	3
12	22.48	0.29	3

Table S2. Length (cm) of young *Apostichopus japonicus* on the artificial reef at the beginning and end of the period of observations

No.	June 7, 2021			September 4, 2021		
	Mean	SD	n	Mean	SD	n
1	4.56	0.19	3	5.45	0.11	3
2	5.38	0.22	3	5.19	0.11	3
3	4.88	0.11	3	5.19	0.29	3
4	4.56	0.00	3	5.70	0.19	3
5	4.62	0.22	3	6.14	0.11	3
6	3.36	0.11	3	5.00	0.11	3
7	3.55	0.10	3	5.07	0.11	3
8	3.36	0.10	3	5.95	0.29	3
9				6.14	0.29	3
10				6.65	0.19	3
11				5.76	0.29	3

Table S3. The average daily number of *Apostichopus japonicus* adults on the artificial reef in time intervals of different temperatures in June–September 2021. The following time intervals were tested: (1) 21 June–20 July (the period of gradual warming), (2) 21 July–08 August (the period of strong temperature changes), (3) 09 August–06 September (the period of relatively stable temperature). Means for different time intervals were compared using one-way ANOVA followed by Holm–Sidak's multiple comparison test

Statistical parameter	(1) 21 June–20 July	(2) 21 July–08 August	(3) 09 August–05 September
n	30	18	29
Mean ± SD	4.12 ± 0.98	3.60 ± 1.30	3.51 ± 1.42
Range	2.21–6.25	1.13–6.54	1.71–7.96
Comparison between the intervals:			
(1) 21 June–20 July		Mean diff. = – 0.5173, <i>p</i> = 0.30	Mean diff. = – 0.6010, <i>p</i> = 0.52
(2) 21 July–08 August			Mean diff. = 0.08371, <i>p</i> = 0.82

Table S4. The average daily number of *Apostichopus japonicus* juveniles on the artificial reef in time intervals of different temperatures in June–September 2021. The following time intervals were tested: (1) 21 June–20 July (the period of gradual warming), (2) 21 July–08 August (the period of strong temperature changes), (3) 09 August–06 September (the period of relatively stable temperature). Means for different time intervals were compared using one-way ANOVA followed by Holm–Sidak's multiple comparison test. Bold numbers denote statistical significance at the *p* < 0.05 level

Statistical parameter	(1) 21 June–20 July	(2) 21 July–08 August	(3) 09 August–05 September
n	30	18	28
Mean ± SD	1.22 ± 0.34	1.53 ± 0.50	2.45 ± 0.80
Range	0.79–2.00	0.88–2.67	1.17–4.13
Comparison between the intervals:			
(1) 21 June–20 July		Mean diff. = 0.3093, <i>p</i> = 0.30	Mean diff. = 1.225, <i>p</i> < 0.0001
(2) 21 July–08 August			Mean diff. = –0.9159, <i>p</i> < 0.0001

Table S5. Total time (h) spent by all adult sea cucumbers *Apostichopus japonicus* outside shelters for 1 h of observations on the artificial reef in time intervals of different temperatures in June–September 2021 (see Fig. 6). The following time intervals were tested: (1) 21 June–20 July (the period of gradual warming), (2) 21 July–08 August (the period of strong temperature changes), (3) 09 August–06 September (the period of relatively stable temperature). Medians for different time intervals were compared using the Kruskal–Wallis test followed by Dunn's multiple comparison test. Bold numbers denote statistical significance at the $p < 0.05$ level

Statistical parameter	(1) 21 June–20 July	(2) 21 July–08 August	(3) 09 August–06 September
n	730	372	678
Median	2.00	1.20	2.08
Range	0–12.50	0–9.00	0–10.50
Comparison between the intervals:			
(1) 21 June–20 July		Mean rank diff. = –125.4, $p = 0.0145$	Mean rank diff. = 23.84, $p > 0.99$
(2) 21 July–08 August			Mean rank diff. = –149.2, $p = 0.0018$

Table S6. Time (h) spent outside shelters, counted per one *Apostichopus japonicus* adult per day, on the artificial reef in time intervals of different temperatures in June–September 2021 (see Fig. 7A). The following time intervals were tested: (1) 21 June–20 July (the period of gradual warming), (2) 21 July–08 August (the period of strong temperature changes), (3) 09 August–06 September (the period of relatively stable temperature). Medians for different time intervals were compared using the Kruskal–Wallis test followed by Dunn's multiple comparison test. Bold numbers denote statistical significance at the $p < 0.05$ level

Statistical parameter	(1) 21 June–20 July	(2) 21 July–08 August	(3) 09 August–06 September
n	30	18	29
Median	4.62	3.62	5.08
Range	2.92–8.51	1.08–5.78	1.80–7.70
Comparison between the intervals:			
(1) 21 June–20 July		Mean rank diff. = –20.09, $p = 0.0078$	Mean rank diff. = 1.096, $p > 0.99$
(2) 21 July–08 August			Mean rank diff. = –21.18, $p = 0.0048$

Table S7. Time (h) spent outside shelters, counted per one *Apostichopus japonicus* juvenile per day, on the artificial reef in time intervals of different temperatures in June–September 2021 (see Fig 7B). The following time intervals were tested: (1) 21 June–20 July (the period of gradual warming), (2) 21 July–08 August (the period of strong temperature changes), (3) 09 August–06 September (the period of relatively stable temperature). Medians for different time intervals were compared using the Kruskal–Wallis test followed by Dunn's multiple comparison test. Bold numbers denote statistical significance at the $p < 0.05$ level

Statistical parameter	(1) 21 June–20 July	(2) 21 July–08 August	(3) 09 August–05 September
n	30	18	28
Median	2.39	2.61	4.72
Range	1.03–4.30	1.21–6.08	2.13–6.98
Comparison between the intervals:			
(1) 21 June–20 July		Mean rank diff. = 10.01, $p = 0.3853$	Mean rank diff. = 29.26, $p < 0.0001$
2) 21 July–08 August			Mean rank diff. = 19.125, $p = 0.0118$

Table S8. The values of environmental variables (mean and range) during spawning events of *Apostichopus japonicus* on the artificial reef in 2021

Date of spawning start	Period	Temperature, °C	Salinity, psu	Sea level, m
26 June	Throughout the spawning event	18.31 (18.22–18.45)	31.22 (30.90–31.94)	2.11 (2.04–2.22)
	6 h period before spawning	18.18 (17.37–18.49)	32.01 (31.80–32.44)	2.38 (2.22–2.51)
28 June	Throughout the spawning event	18.38 (18.33–18.43)	30.56 (30.54–30.59)	1.97 (1.95–1.99)
	6 h period before spawning	19.05 (18.92–19.17)	30.64 (30.59–30.69)	2.05 (1.95–2.20)
4 July	Throughout the spawning event	16.65 (16.64–16.66)	31.38 (31.35–31.40)	2.37 (2.37–2.37)
	6 h period before spawning	16.95 (16.54–17.34)	31.88 (31.35–32.29)	2.41 (2.37–2.44)
5 July	Throughout the spawning event	18.00 (18.00–18.00)	30.66 (30.52–30.80)	2.33 (2.33–2.33)
	6 h period before spawning	17.94 (17.90–17.98)	31.06 (30.80–31.44)	2.32 (2.27–2.34)
12 July	Throughout the spawning event	20.46 (20.34–20.52)	32.11 (31.99–32.31)	1.90 (1.85–2.01)
	6 h period before spawning	18.91 (18.27–20.47)	32.56 (32.31–32.65)	2.18 (1.89–2.34)
13 July	Throughout the spawning event	21.44 (21.38–21.50)	31.74 (31.70–31.78)	1.88 (1.96–1.90)
	6 h period before spawning	21.19 (20.53–21.50)	32.01 (31.70–32.26)	2.04 (1.90–2.15)