Bioassay data for marine pollution using sea urchin eggs, 1976–1981.

1976

Six experiments for biological assay were made using sea urchin eggs to check marine pollution around the Seto Marine Biological Laboratory.

I. Winter season, February 14. Eggs of *Hemicentrotus pulcherrimus* (A. Agassiz) were used, see Table 1.

II. Spring season, March 19. Eggs of *Hemicentrotus pulcherrimus* were used, see Table 2.

III. Summer season, two experiments were made in July–August, using *Anthocidaris crassispina* (A. Agassiz) eggs.

1. July 9, see Table 3. 2. August 7, see Table 4.

IV. Autumn season, two experiments were made in September–November, using *Anthocidaris crassispina* or *Pseudocentrotus depressus* (A. Agassiz) eggs.

1. September 3, see Table 5. 2. November 26, see Table 6.

(Notes common to all tables: Fertilization membrane formation examined 3 min. after fertilization; minutes and hours in parentheses respectively after First cleavage and Gastrulation indicate the time after insemination; the maturation state of gonads used was nearly ripe to full ripe; Degree of inhibitory effect 0 shows no inhibition, 1 a slight inhibition, 2 a weak and 3 a moderate inhibition by the sea water tested (see Pub. Seto Mar. Biol. Lab., XXI (5/6), p. 391, Table 8, 1974).

1977

Four experiments for biological assay were made using sea urchin eggs to check marine pollution around the Seto Marine Biological Laboratory.

I. Winter season, February 16. Eggs of *Hemicentrotus pulcherrimus* were used, see Table 7.

II. Spring season, April 5. Eggs of *Hemicentrotus pulcherrimus* were used, see Table 8.

III. Summer season, two experiments were made in June–August, using *Anthocidaris crassispina* eggs.

1. June 18, see Table 9. 2. August 1, see Table 10.

(Notes common to all tables: See the notes mentioned above.)

1978

Four experiments were made as follows.

I. Winter season, January 18. Eggs of *Hemicentrotus pulcherrimus* were used, see Table 11.

II. Summer season, three experiments were made in July–August, using *Anthocidaris*

crassispina eggs.

1. July 10 and 21, see Table 12 and 13.
2. August 19, see Table 14.

(Notes common to all tables: See the note mentioned above.)

1979

Three experiments were made as follows.

I. Winter season, January 18. Eggs of *Hemicentrotus pulcherrimus* were used, see Table 15.

II. Summer season, two experiments were made in July–August, using *Anthocidaris crassispina* eggs.

1. July 10, see Table 16. 2. August 24, see Table 17.

(Notes common to all tables: See the note mentioned above.)

1980

Four experiments were made as follows.

I. Winter season, January 24. Eggs of *Hemicentrotus pulcherrimus* were used, see Table 18.

II. Spring season, two experiments were made in March and May, using *Hemicentrotus pulcherrimus* and *Anthocidaris crassispina* eggs.

1. March 9, see Table 19. 2. May 15, see Table 20.

III. Summer season, June 11. Eggs of *Anthocidaris crassispina* were used, see Table 21.

(Notes common to all tables: See the note mentioned above.)

1981

Two experiments were made as follows.

I. Winter season, January 28. Eggs of *Hemicentrotus pulcherrimus* were used, see Table 22.

II. Summer season, July 2. Eggs of *Anthocidaris crassispina* were used, see Table 23.

(Notes common to all tables: See to note mentioned above.)

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Table 1. Results of the Feb. 14, 1976 experiment with eggs of *Hemicentrotus pulcherrimus*.
Wind; 0. Test water temperature; 20°C. (warmed). 6 hours old eggs.

Location (depth)	Fertiliz.	First cleavage (90 min.)			Gastrulation (24 hrs.)			Other notes	Degree of inhibitory effect
	membrane formation	1 cell	2 cell (normal)	multi-cell (polyspermy)	permanent blastula	gastrula (normal)	exo-gastrula	abnormal develop.	
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	98.5 99.5	5.5 1.5	92.5 97.0	2.0 1.5	1.5 3.0	98.0 96.5	0.5 0.5		0
Water from open sea side of Hatakejima Surface	97.0 98.5	6.5 4.0	91.5 95.5	2.0 0.5	2.0 3.5	98.0 96.5	0 0		0
Water from land side of Hatakejima Surface	98.5 98.0	15.5 7.0	82.5 91.5	2.0 1.5	2.0 3.0	98.0 97.0	0 0		1
Bottom (27)	99.0 98.0	14.5 6.0	81.0 80.5	4.5 3.5	6.5 9.0	92.5 90.5	1.0 0.5		1
Sea water from Tsunashirazu cove Surface	97.5 96.0	8.5 12.5	87.0 84.0	4.5 3.5	1.0 4.5	98.5 94.5	0 1.0		1
Bottom (5)	98.5 97.0	20.5 12.0	78.5 83.5	1.5 4.5	24.5 21.0	75.0 78.5	0.5 0.5		2

Table 2. Results of the March 19, 1976 experiment with eggs of *Hemicentrotus pulcherrimus*.
Wind; NW2. Test water temperature; 13°C. 8 hours old eggs.

Location (depth)	Fertiliz.	First cleavage (120 min.)			Gastrulation (24 hrs.)			Other notes	Degree of inhibitory effect
	membrane formation	1 cell	2 cell (normal)	multi-cell (polyspermy)	permanent blastula	gastrula (normal)	exo-gastrual	abnormal develop.	
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	99.0 99.0 99.5	1.5 1.0 0.5	98.5 99.0 99.5	0 0 0	1.5 1.0 1.0	98.5 99.0 99.0	0 0 0		0
Water from land side of Hatakejima Surface	97.5 96.0 96.0	3.0 4.5 2.5	97.0 95.5 96.0	0 0 1.5	2.0 1.5 1.5	98.0 98.5 98.5	0 0 0		0
Sea water from Tsunashirazu cove Surface	98.0 95.5 96.0	2.5 6.0 4.5	96.0 94.0 92.0	1.5 0 3.5	2.5 1.5 2.5	97.5 98.5 97.5	0 0 0		2

Table 3. Results of the July 9, 1976 experiment with eggs of *Anthocidaris crassispina*.
Wind; SE1. Test water temperature; 25°C. 4 hours old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (60 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (20 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	99.0	1.0	99.0	0	0.5	99.5	0		0
	99.5	1.0	99.0	0	0	100	0		
	98.0	2.5	97.5	0	2.0	98.0	0		
Water from open sea side of Hatakejima Surface	99.5	2.0	98.0	0	1.0	99.0	0		0
	99.0	1.5	98.5	0	0.5	99.5	0		
	98.5	2.0	98.0	0	1.5	98.5	0		
Bottom (25)	99.0	1.5	98.5	0	2.0	98.0	0		0
	98.5	3.5	96.5	0	1.0	99.0	0		
	99.0	2.0	98.0	0	1.5	98.5	0		
Water from land side of Hatakejima Surface	98.5	2.0	98.0	0	1.5	98.5	0		0
	98.0	2.5	97.5	0	2.0	98.0	0		
	97.0	3.5	96.5	0	2.0	98.0	0		
Bottom (27)	96.5	5.5	94.5	0	3.0	97.0	0		0
	98.0	4.5	95.5	0	2.0	98.0	0		
	97.5	5.0	95.0	0	1.5	98.5	0		
Sea water from Tsunashirazu cove Surface	96.0	5.0	94.0	1.0	7.0	93.0	0	slightly delay	3
	94.5	6.0	93.5	0.5	8.5	91.5	0		
	95.5	5.0	95.0	0	7.5	92.5	0		
Bottom (5)	97.0	3.0	97.0	0	4.0	96.0	0		1
	96.0	4.5	95.5	0	5.0	95.0	0		
	95.0	6.0	94.0	0	3.5	96.5	0		

Table 4. Results of the Aug. 7, 1976 experiment with eggs of *Anthocidaris crassispina*.
Wind; 0. Test water temperature; 28°C. 3 hours old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (50 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (15 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%		%		
Running sea water of Laboratory	98.0	2.5	97.5	0	0.5	99.5	0		0
	97.0	4.0	96.0	0	1.0	99.0	0		
Water from open sea side of Hatakejima Surface	98.5	2.0	98.0	0	1.0	99.0	0		0
	98.0	2.5	97.5	0	1.5	98.5	0		
Sea water from Tsunashirazu cove Surface	95.0	6.0	94.0	0	5.0	95.0	0		1
	96.5	5.0	95.0	0	4.5	95.5	0		
Bottom (5)	91.0	10.5	89.5	0	13.0	87.0	0		2
	93.5	8.5	91.5	0	11.5	88.5	0		

Table 5. Results of the Sep. 3, 1976 experiment with eggs of *Anthocidaris crassispina*.

Wind; 0. Test water temperature; 25.5°C. 3 hours old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (60 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (18 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	95.5	6.0	94.0	0	0.5	99.5	0		0
	98.0	2.5	97.5	0	2.0	98.0	0		
	96.5	5.0	95.0	0	1.0	99.0	0		
Water from open sea side of Hatakejima Surface	96.0	5.0	95.0	0	0.5	99.5	0		0
	98.5	3.0	97.0	0	1.5	98.5	0		
	96.0	4.5	95.5	0	1.0	99.0	0		
Bottom (25)	95.5	5.5	94.5	0	1.0	99.0	0		0
	98.5	2.0	98.0	0	1.5	98.5	0		
	95.5	5.5	94.5	0	1.5	98.5	0		
Water from land side of Hatakejima Surface	94.5	6.5	93.5	0	5.0	95.0	0		1
	97.0	5.0	95.0	0	4.0	96.0	0		
	94.0	8.0	92.0	0	6.5	93.5	0		
Bottom (27)	92.0	10.0	90.0	0	8.5	91.5	0	slightly delay	3
	95.0	7.0	93.0	0	11.5	88.5	0		
	91.5	9.5	90.5	0	14.0	86.0	0		
Sea water from Tsunashirazu cove Surface	93.5	9.0	91.0	0	9.0	91.0	0		2
	96.0	7.5	92.5	0	10.0	90.0	0		
	92.0	8.5	91.5	0	13.0	87.0	0		
Bottom (5)	91.0	11.0	98.0	0	13.5	86.5	0	slightly delay	3
	92.5	10.0	90.0	0	16.5	83.5	0		
	89.0	12.5	87.5	0	18.5	81.5	0		

Table 6. Results of the Nov. 26, 1976 experiment with eggs of *Pseudocentrotus depressus*.

Wind; 0. Test water temperature; 15°C. 8 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (110 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (24 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	95.5	9.5	90.5	0	2.0	98.0	0		0
	98.0	2.5	97.5	0	3.5	96.5	0		
Water from open sea side of Hatakejima Surface	95.0	8.0	92.0	0	1.5	98.5	0		0
	98.5	2.0	98.0	0	3.0	97.0	0		
Water from land side of Hatakejima Surface	94.0	10.0	90.0	0	4.5	95.5	0		1
	97.5	2.5	97.5	0	6.0	94.0	0		
Bottom (27)	92.5	12.0	88.0	0	12.5	87.5	0		2
	95.5	5.0	95.0	0	10.0	90.0	0		
Sea water from Tsunashirazu cove Surface	93.5	11.0	89.0	0	8.5	91.5	0		1
	97.0	3.5	96.5	0	6.5	93.5	0		
Bottom (5)	93.0	10.5	89.5	0	13.5	86.5	0		2
	95.0	5.0	95.0	0	11.5	88.5	0		

Table 7. Results of the Feb. 16, 1977 experiment with eggs of *Hemicentrotus pulcherrimus*.
Wind; NW2. Test water temperature; 12°C. 8 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (120 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (24 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	100	0.5	99.5	0	0.5	99.5	0		0
	98.5	2.0	98.0	0	1.0	99.0	0		
	99.0	1.0	99.0	0	0.5	99.5	0		
Water from land side of Hatakejima Surface	98.5	2.0	98.0	0	1.5	98.5	0		0
	98.0	3.0	97.0	0	1.0	99.0	0		
	98.5	2.5	97.5	0	1.5	98.5	0		
Bottom (27)	97.0	4.0	96.0	0	3.5	96.5	0		1
	96.5	5.0	95.0	0	4.0	96.0	0		
	98.0	2.5	97.5	0	5.0	95.0	0		
Sea water from Tsunashirazu cove Surface	98.0	3.0	97.0	0	2.5	97.5	0		0
	97.5	5.5	94.5	0	2.0	98.0	0		
	96.0	5.0	95.0	0	3.0	97.0	0		
Bottom (5)	92.5	8.5	91.5	0	5.0	95.0	0		1
	91.0	9.5	90.5	0	6.5	93.5	0		
	92.5	9.0	91.0	0	7.5	92.5	0		

Table 8. Results of the Apr. 5, 1977 experiment with eggs of *Hemicentrotus pulcherrimus*.
Wind; 0. Test water temperature; 15°C. 8 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (110 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (24 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	98.5	2.5	97.5	0	1.5	98.5	0		0
	99.0	1.5	98.5	0	1.0	99.0	0		
	97.0	4.0	96.0	0	0.5	99.5	0		
Water from open sea side of Hatakejima Surface	98.5	2.0	98.0	0	2.0	98.0	0		0
	98.5	1.5	98.5	0	0.5	99.5	0		
	98.0	3.0	97.0	0	1.0	99.0	0		
Water from land side of Hatakejima Surface	97.0	5.0	95.0	0	2.0	98.0	0		0
	96.0	6.0	94.0	0	3.0	97.0	0		
	95.5	5.5	94.5	0	3.5	96.5	0		
Bottom (27)	93.0	9.0	91.0	0	8.0	92.0	0		1
	95.0	6.0	94.0	0	8.5	91.5	0		
	93.5	7.5	92.5	0	6.0	94.0	0		
Sea water from Tsunashirazu cove Surface	96.5	4.5	95.5	0	6.5	93.5	0		1
	95.0	6.0	94.0	0	8.0	92.0	0		
	94.5	7.0	93.0	0	5.0	95.0	0		
Bottom (5)	91.5	9.5	90.5	0	11.5	88.5	0		2
	93.0	9.0	91.0	0	10.0	90.0	0		
	90.5	11.5	88.5	0	10.5	89.5	0		

Table 9. Results of the June 18, 1977 experiment with eggs of *Anthocidaris crassispina*.
Wind; 0. Test water temperature; 23°C. 4 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (60 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (20 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	98.5	2.5	97.5	0	1.0	99.0	0		0
	97.0	3.5	96.5	0	1.5	98.5	0		
Sea water from Tsunashirazu cove Surface	96.5	7.0	93.0	0	3.0	97.0	0		1
	95.0	8.0	92.0	0	5.0	95.0	0		
Bottom (5)	92.0	11.5	88.5	0	5.5	94.5	0		1
	90.5	13.0	87.0	0	9.0	91.0	0		

Table 10. Results of the Aug. 1, 1977 experiment with eggs of *Anthocidaris crassispina*.
Wind; 0. Test water temperature; 28°C. 3 hrs. old eggs.

Location (depth)	Fertiliz. membrane fromation	First cleavage (50 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (15 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	97.5	4.0	96.0	0	1.0	99.0	0		0
	98.0	2.5	97.5	0	2.0	98.0	0		
	99.0	2.0	98.0	0	1.5	98.5	0		
Sea water from Tsunashirazu cove Surface	95.0	11.5	88.5	0	7.5	92.5	0		1
	93.0	15.0	85.0	0	9.0	91.0	0		
	94.0	10.5	89.5	0	8.5	91.5	0		
Bottom (5)	90.0	17.0	83.0	0	10.5	89.5	0		2
	88.5	22.0	78.0	0	13.0	87.0	0		
	89.0	15.0	85.0	0	12.5	87.5	0		

Table 11. Results of the Jan. 18, 1978 experiment with eggs of *Hemicentrotus pulcherrimus*.
Wind; NW1. Test water temperature; 19°C. (warmed). 6 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (90 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (24 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	99.5	1.0	99.0	0	0.5	99.5	0		0
	98.5	2.0	98.0	0	1.0	99.0	0		
	97.0	3.5	96.5	0	1.0	99.0	0		
Sea water from Tsunashirazu cove Surface	97.0	4.0	96.0	0	1.5	98.5	0		0
	95.5	6.0	94.0	0	2.5	97.5	0		
	96.0	5.0	95.0	0	2.0	98.0	0		
Bottom (5)	91.5	10.0	90.0	0	5.5	94.5	0		1
	93.0	9.0	91.0	0	3.5	96.5	0		
	92.0	9.0	91.0	0	6.5	93.5	0		

Table 12. Results of the July 10, 1978 experiment with eggs of *Anthocidaris crassispina*.

Wind; 0. Test water temperature; 27°C. 3 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (50 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (15 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	99.5	0.5	99.5	0	0.5	99.5	0		0
	98.5	1.0	99.0	0	0.5	99.5	0		
Sea water from Tsunashirazu cove Surface	97.0	3.0	97.0	0	1.5	98.5	0		0
	95.5	5.0	95.0	0	2.0	98.0	0		
Bottom (5)	93.5	7.5	92.5	0	4.5	95.5	0		1
	91.5	11.5	88.0	0.5	7.0	93.0	0		

Table 13. Results of the July 21, 1978 experiment with eggs of *Anthocidaris crassispina*.

Wind; 0. Test water temperature; 28°C. 3 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	Frist cleavage (50 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (15 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	100	0.5	99.5	0	0.5	99.5	0		0
	99.0	1.5	98.5	0	1.0	99.0	0		
	98.5	1.0	99.0	0	1.5	98.5	0		
Water from open sea side of Hatakejima Surface	99.0	1.0	99.0	0	0.5	99.5	0		0
	98.5	2.0	98.0	0	0.5	99.5	0		
	99.0	1.0	99.0	0	1.0	99.0	0		
Water from land side of Hatakejima Surface	97.0	3.5	96.5	0	2.5	97.5	0		0
	98.0	2.5	97.5	0	1.0	99.0	0		
	96.5	4.0	96.0	0	5.1	98.5	0		
Bottom (27)	95.5	5.0	94.5	0.5	3.5	96.5	0	slightly delay	3
	92.5	8.5	91.5	0	5.5	94.5	0		
	91.0	10.5	89.5	0	6.5	93.5	0		
Sea water from Tsunashirazu cove Surface	94.5	6.0	94.0	0	3.0	97.0	0		1
	95.0	5.5	94.5	0	3.5	96.5	0		
	93.5	8.5	91.5	0	5.5	94.5	0		
Bottom (5)	90.5	10.5	89.5	0	7.5	92.5	0	slightly delay	3
	89.5	12.0	88.0	0	8.0	92.0	0		
	87.5	13.0	87.0	0	9.5	90 5	0		

Table 14. Results of the Aug. 19, 1978 experiment with eggs of *Anthocidaris crassispina*.
Wind; 0. Test water temperature; 28°C. 3 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (50 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (15 hrs.) permanent blastrula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running	99.5	0.5	99.5	0	0.5	99.5	0		0
sea water of	99.0	1.5	98.5	0	1.0	99.0	0		
Laboratory	98.0	2.0	98.0	0	1.5	98.5	0		
Sea water from	95.5	6.0	94.0	0	3.0	97.0	0		
Tsunashirazu	93.5	8.0	92.0	0	4.0	96.0	0		1
cove	92.5	9.5	90.5	0	5.5	94.5	0		
Surface									
	90.5	10.5	89.5	0	11.5	88.5	0	slightly	
Bottom (5)	87.5	14.5	85.5	0	9.5	90.5	0	delay	3
	89.0	10.5	89.0	0.5	10.0	90.0	0		

Table 15. Results of the Jan. 18, 1979 experiment with eggs of *Hemicentrotus pulcherrimus*.
Wind; NW1. Test water temperature; 20°C. (warmed). 6 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (90 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (24 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running	99.0	1.5	98.5	0	0.5	99.5	0		0
sea water of	100	0.5	99.5	0	0.5	99.5	0		
Laboratory	99.0	1.0	99.0	0	1.0	99.0	0		
Sea water from	98.5	2.5	97.5	0	1.5	98.5	0		
Tsunashirazu	98.0	0.5	99.5	0	2.0	98.0	0		0
cove	97.0	4.0	96.0	0	1.5	98.5	0		
Surface									
	90.5	5.0	95.0	0	4.5	95.5	0		
Bottom (5)	93.0	6.5	93.5	0	6.0	94.0	0		1
	91.0	10.5	89.5	0	8.5	91.5	0		

Table 16. Results of the July 10, 1979 experiment with eggs of *Anthocidaris crassispina*.
Wind; S1. Test water temperature; 27°C. 3 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (50 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (15 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running	98.5	1.5	98.5	0	0.5	99.5	0		0
sea water of	97.0	3.5	96.5	0	1.0	99.0	0		
Laboratory	99.0	1.0	99.0	0	0.5	99.5	0		
Water from	99.5	0.5	99.5	0	0.5	99.5	0		
open sea side	98.5	2.0	98.0	0	1.0	99.0	0		0
of Hatakejima	100	0.5	99.5	0	0	100	0		
Surface									
Water from	97.5	3.0	97.0	0	3.0	97.5	0		
land side of	95.5	5.0	95.0	0	2.5	98.5	0		0
Hatakejima	96.5	4.5	95.5	0	1.5	95.5	0		
Surface									
	93.5	7.0	93.0	0	4.5	97.0	0		
Bottom (27)	91.5	8.5	91.5	0	5.5	94.5	0		1
	92.5	8.0	91.0	1.0	6.0	94.0	0		
Sea water from	94.5	5.0	95.0	0	2.5	97.5	0		
Tsunashirazu	95.0	5.5	94.5	0	1.5	98.5	0		0
cove	96.5	4.0	96.0	0	0.5	99.5	0		
Surface									
	91.5	10.5	89.5	0	4.5	95.5	0		
Bottom (5)	89.5	11.5	88.5	0	7.5	92.5	0		2
	88.0	13.0	87.0	0	11.0	89.0	0		

Table 17. Results of the Aug. 24, 1979 experiment with eggs of *Anthocidaris crassispina*.
Wind; 0. Test water temperature; 27°C. 3 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (50 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (15 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	99.5	1.0	99.0	0	0.5	99.5	0		0
	98.0	2.0	98.0	0	1.0	99.0	0		
	98.5	1.5	98.5	0	0.5	99.5	0		
Sea water from Tsunashirazu cove Surface	94.5	6.0	94.0	0	3.0	97.0	0		1
	92.5	8.5	91.5	0	4.5	95.5	0		
	93.0	9.0	91.0	0	5.5	94.0	0.5		
Bottom (5)	89.5	10.5	89.5	0	6.5	93.5	0	slightly delay	3
	88.0	12.0	88.0	0	7.0	93.0	0		
	87.5	14.0	86.0	0	8.5	91.5	0		

Table 18. Results of the Jan. 24, 1980 experiment with eggs of *Hemicentrotus pulcherrimus*.
Wind; NW1. Test water temperature; 19°C. (warmed). 6 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (90 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (24 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	98.5	2.0	98.0	0	0.5	99.5	0		0
	99.0	1.0	99.0	0	0	100	0		
	97.5	3.0	97.0	0	1.0	99.0	0		
Sea water from Tsunashirazu cove Surface	97.0	3.5	96.5	0	2.0	98.0	0		0
	98.0	2.5	97.5	0	1.5	98.5	0		
	96.5	4.0	96.0	0	2.5	97.5	0		
Bottom (5)	92.0	8.5	91.5	0	4.5	95.5	0		1
	91.5	9.0	91.0	0	5.5	94.5	0		
	89.5	11.0	89.0	0	6.0	94.0	0		

Table 19. Results of the Mar. 9, 1980 experiment with eggs of *Hemicentrotus pulcherrimus*.
Wind; 0. Test water temperature; 19°C. (warmed). 6 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (90 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (24 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	99.0	0.5	99.5	0	0	100	0		0
	99.5	0.5	99.5	0	0.5	99.5	0		
	98.0	1.0	99.0	0	1.5	98.5	0		
Sea water from Tsunashirazu cove Surface	98.0	2.5	97.5	0	2.0	98.0	0		0
	95.5	5.0	95.0	0	2.5	97.5	0		
	97.0	4.0	96.0	0	1.5	98.5	0		
Bottom (5)	92.5	8.0	92.0	0	4.5	95.5	0		1
	91.0	9.5	90.0	0.5	5.5	94.0	0.5		
	93.0	8.5	91.5	0	6.0	93.5	0.5		

Table 20. Results of the May 15, 1980 experiment with eggs of *Anthocidaris crassispina*.
Wind; 0. Test water temperature; 20°C. 6 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (85 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (24 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	97.5	4.0	96.0	0	1.5	98.5	0		0
	98.5	1.5	98.5	0	1.0	99.0	0		
	97.0	4.0	96.0	0	1.0	99.0	0		
Water from open sea side of Hatakejima Surface	98.0	2.5	97.5	0	0.5	99.5	0		0
	97.5	3.0	97.0	0	1.0	99.0	0		
	98.5	2.0	98.0	0	0.5	98.5	0		
Water from land side of Hatakejima Surface	96.5	5.5	94.5	0	3.5	96.5	0		0
	97.0	4.5	95.5	0	4.0	96.0	0		
	95.0	6.0	94.0	0	2.5	97.5	0		
Bottom (27)	91.5	9.0	91.0	0	6.5	93.5	0		1
	94.0	6.5	93.5	0	7.0	93.0	0		
	90.5	10.5	89.5	0	8.5	91.5	0		
Sea water from Tsunashirazu cove Surface	95.5	6.0	94.0	0	3.5	96.5	0		0
	97.0	4.5	95.5	0	2.5	97.5	0		
	93.5	4.0	96.0	0	3.5	96.5	0		
Bottom (5)	90.5	10.5	89.5	0	5.5	94.5	0		1
	89.0	12.0	88.0	0	7.5	92.5	0		
	85.5	15.0	85.0	0	8.5	90.5	1.0		

Table 21. Results of the June 11, 1980 experiment with eggs of *Anthocidaris crassispina*.
Wind; 0. Test water temperature; 25°C. 4 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (60 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (20 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	1.0	%	%	%	%	%		
Running sea water of Laboratory	99.0	2.5	99.0	0	0.5	99.5	0		0
	98.0	0.5	97.5	0	1.0	99.0	0		
	99.5		99.5	0	0.5	99.5	0		
Sea water from Tsunashirazu cove Surface	98.5	1.5	98.5	0	0.5	99.5	0		1
	96.5	4.0	96.0	0	2.5	97.5	0		
	97.0	4.5	95.5	0	5.5	94.5	0		
Bottom (5)	90.0	11.5	88.5	0	8.0	92.0	0		2
	88.0	12.0	87.0	1.0	9.5	90.0	0.5		
	86.5	15.0	85.0	0	10.5	89.5	0		

Table 22. Results of the Jan. 28, 1981 experiment with eggs of *Hemicentrotus pulcherrimus*.
Wind; 0. Test water temperature; 19°C. (warmed). 6 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (90 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (24 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	0	%	%	%		
Running sea water of Laboratory	99.5	0.5	99.5	0	0	100	0		0
	99.0	1.5	98.5	0	0.5	99.5	0		
	98.5	1.5	98.5		0.5	99.5	0		
Sea water from Tsunashirazu cove Surface	97.5	3.0	97.0	0	1.5	98.5	0		0
	96.5	3.5	96.5	0	1.0	99.0	0		
	98.0	2.0	98.0	0	1.5	98.5	0		

Table 23. Results of the July 2, 1981 experiment with eggs of *Anthocidaris crassispina*.

Wind; 0. Test water temperature; 27°C. 3 hrs. old eggs.

Location (depth)	Fertiliz. membrane formation	First cleavage (50 min.) 1 cell	2 cell (normal)	multi-cell (polyspermy)	Gastrulation (15 hrs.) permanent blastula	gastrula (normal)	exo-gastrula	Other notes abnormal develop.	Degree of inhibitory effect
(m)	%	%	%	%	%	%	%		
Running sea water of Laboratory	99.5	0.5	99.0	0.5	0.5	99.5	0		0
	99.0	0.5	99.5	0	1.0	99.0	0		
	99.5	3.0	97.0	0	1.0	99.0	0		
Water from open sea side of Hatakejima Surface	97.5	2.5	97.0	0.5	1.0	99.0	0		0
	97.0	3.0	96.5	0.5	1.5	98.5	0		
	99.0	3.5	96.5	0	2.0	98.0	0		
Water from landside of Hatakejima Surface	97.0	4.0	95.0	1.0	1.5	98.5	0		0
	97.0	7.0	92.5	0.5	2.0	98.0	0		
	98.5	7.0	93.0	0	1.5	98.5	0		
Sea water from Tsunashirazu cove Surface	96.5	5.5	94.5	0	2.0	98.0	0		0
	97.5	6.5	93.5	0	2.5	97.5	0		
	97.0	7.5	92.5	0	1.5	98.5	0		