

Species-specific fertilisation kinetics in two structurally distinct *Desmophyllum* cold-water corals

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Supplementary material

Table S1. Colony-level collection information for D. dianthus and D. pertusum. All D. dianthus colonies were collected from Yervas Buenas, Chile, and all D. pertusum colonies were collected from Tisler Reef, Norway. The table includes collection date, sex, experimental analyses, number of observed spawning events, and associated spawning dates and times for each colony. A dash indicates that sex, spawning date, spawning time, or experimental use was not available. Colony Dd9 was initially recorded as a single colony because two attached polyps were collected together, but was later recognised as two separate individuals and therefore labelled Dd9.1 and Dd9.2; only Dd9.1 was used in fertilisation-curve experiments.

Species	ID	Collection date	Sex	Analyses	Spawning events	Spawning dates	Spawning times
<i>D. dianthus</i>	Dd7	2023-07-02	-	-	0	-	-
<i>D. dianthus</i>	Dd8	2023-07-02	Female	-	1	2023-07-08	20:00
<i>D. dianthus</i>	Dd9.1	2023-07-02	Male	Fertilisation	2	2023-07-06; 2023-07-08	20:00; 19:00
<i>D. dianthus</i>	Dd9.2	2023-07-02	Male	-	2	2023-07-06; 2023-07-08	19:45; 19:00
<i>D. dianthus</i>	Dd10	2023-07-02	Male	-	2	2023-07-06; 2023-07-08	20:30; 18:30
<i>D. dianthus</i>	Dd11	2023-07-02	-	-	0	-	-
<i>D. dianthus</i>	Dd12	2023-07-02	Male	-	1	2023-07-07	18:38
<i>D. dianthus</i>	Dd13	2023-07-02	Male	-	1	2023-07-07	18:00
<i>D. dianthus</i>	Dd14	2023-07-02	Female	-	1	2023-07-07	18:00
<i>D. dianthus</i>	Dd15	2023-07-02	-	-	0	-	-
<i>D. dianthus</i>	Dd16	2023-07-02	-	-	0	-	-
<i>D. dianthus</i>	Dd17	2023-07-02	-	-	0	-	-
<i>D. dianthus</i>	Dd18	2023-07-02	-	-	0	-	-
<i>D. dianthus</i>	Dd19	2023-07-02	Male	Motility	1	2023-07-05	18:00
<i>D. dianthus</i>	Dd20	2023-07-02	Male	Fertilisation	1	2023-07-11	18:00
<i>D. dianthus</i>	Dd21	2023-07-02	Male	-	1	2023-07-05	-
<i>D. dianthus</i>	Dd22	2023-07-02	Male	Fertilisation	1	2023-07-06	19:10
<i>D. dianthus</i>	Dd23	2023-07-02	Female	Fertilisation	1	2023-07-11	17:40
<i>D. dianthus</i>	Dd24	2023-07-02	Female	Fertilisation	1	2023-07-11	18:00
<i>D. dianthus</i>	Dd25	2023-07-02	-	-	0	-	-

<i>D. dianthus</i>	Dd26	2023-07-02	Female	Fertilisation	2	2023-07-06; 2023-07-08	18:30; -
<i>D. dianthus</i>	Dd27	2023-07-02	Female	-	1	2023-07-08	18:00
<i>D. dianthus</i>	Dd28	2023-07-02	-	-	0	-	-
<i>D. dianthus</i>	Dd29	2023-07-02	-	-	0	-	-
<i>D. dianthus</i>	Dd30	2023-07-02	Male	Fertilisation	1	2023-07-11	-
<i>D. dianthus</i>	Dd32	2024-06-16	Male	Fertilisation; Motility	4	2024-06-27; 2024-07-03; 2024-07-14; 2024-07-19	23:10; 00:27; 19:30; 18:10
<i>D. dianthus</i>	Dd33	2024-06-16	Female	-	2	2024-06-27; 2024-07-03	23:30; 00:45
<i>D. dianthus</i>	Dd34	2024-06-16	Male	-	2	2024-06-27; 2024-07-19	23:30; 17:40
<i>D. dianthus</i>	Dd35	2024-06-16	Male	-	2	2024-07-14; 2024-07-19	19:30; 17:45
<i>D. dianthus</i>	Dd36	2024-06-16	Male	Motility	3	2024-06-27; 2024-07-14; 2024-07-18	23:30; 19:30; 18:53
<i>D. dianthus</i>	Dd37	2024-06-16	-	-	0	-	-
<i>D. dianthus</i>	Dd38	2024-06-16	Male	Contact time; Motility	2	2024-06-27; 2024-07-21	23:00; 16:43
<i>D. dianthus</i>	Dd39	2024-06-16	Male	Fertilisation; Motility	3	2024-06-27; 2024-07-08; 2024-07-14	23:00; 16:30; 19:50
<i>D. dianthus</i>	Dd40	2024-06-16	Female	-	2	2024-06-28; 2024-07-08	00:59; 16:45
<i>D. dianthus</i>	Dd41	2024-06-16	Male	Contact time	3	2024-06-27; 2024-07-12; 2024-07-25	23:50; 20:25; 20:40
<i>D. dianthus</i>	Dd42	2024-06-16	Male	-	2	2024-07-08; 2024-07-21	16:45; 21:10
<i>D. dianthus</i>	Dd43	2024-06-16	Male	Contact time; Fertilisation; Motility	4	2024-06-27; 2024-07-14; 2024-07-21; 2024-07-25	23:45; 19:30; 17:55; 20:40
<i>D. dianthus</i>	Dd44	2024-06-16	Female	Fertilisation	5	2024-06-28; 2024-07-03; 2024-07-08; 2024-07-14; 2024-07-19	00:05; 01:40; 16:50; 21:00; 19:50
<i>D. dianthus</i>	Dd45	2024-06-16	Male	Motility	2	2024-07-12; 2024-07-21	19:45; 17:10
<i>D. dianthus</i>	Dd46	2024-06-16	-	-	0	-	-
<i>D. dianthus</i>	Dd47	2024-06-16	Male	-	1	2024-07-21	16:49
<i>D. dianthus</i>	Dd48	2024-06-16	Female	-	5	2024-06-28; 2024-07-03; 2024-07-12; 2024-07-14; 2024-07-19	00:25; 00:07; 20:00; 21:00; 20:00
<i>D. dianthus</i>	Dd49	2024-06-16	Female	Contact time	2	2024-07-21; 2024-07-25	17:00; 20:10
<i>D. dianthus</i>	Dd50	2024-06-16	Female	Contact time	4	2024-07-14; 2024-07-18; 2024-07-19; 2024-07-21	18:30; 18:45; 18:22; 17:45
<i>D. dianthus</i>	Dd51	2024-06-16	Male	Contact time; Motility	1	2024-07-21	16:30
<i>D. dianthus</i>	Dd52	2024-06-16	Male	Contact time; Motility	3	2024-07-14; 2024-07-18; 2024-07-21	18:30; 18:45; 16:43

<i>D. dianthus</i>	Dd53	2024-06-16	-	-	0	-	-
<i>D. dianthus</i>	Dd54	2024-06-16	Male	Contact time; Fertilisation; Motility	3	2024-07-03; 2024-07-18; 2024-07-19	00:16; 19:07; 19:30
<i>D. dianthus</i>	Dd55	2024-06-16	Female	Fertilisation	4	2024-06-28; 2024-07-03; 2024-07-08; 2024-07-12	00:20; 00:30; 16:50; 19:54
<i>D. dianthus</i>	Dd56	2024-06-16	Male	Fertilisation; Motility	4	2024-06-27; 2024-07-02; 2024-07-08; 2024-07-12	23:40; 23:45; 16:30; 19:40
<i>D. pertusum</i>	LL36	2022-11-25	Male	Fertilisation; Motility	1	2023-02-11	-
<i>D. pertusum</i>	LL37	2022-11-25	-	-	0	-	-
<i>D. pertusum</i>	LL38	2022-11-25	Female	Fertilisation	2	2023-02-10; 2023-02-11	-; 22:35
<i>D. pertusum</i>	LL39	2022-11-25	Female	-	0	-	-
<i>D. pertusum</i>	LL40	2022-11-25	Female	-	0	-	-
<i>D. pertusum</i>	LL41	2022-11-25	Female	-	0	-	-
<i>D. pertusum</i>	LL42	2022-11-25	-	-	0	-	-
<i>D. pertusum</i>	LL43	2022-11-29	Female	Fertilisation	3	2023-02-10; 2023-02-11; 2023-02-13	-; 22:35; 17:25
<i>D. pertusum</i>	LL44	2022-11-29	Female	Fertilisation	1	2023-01-25	-
<i>D. pertusum</i>	LL45	2022-11-29	Female	Fertilisation	2	2023-01-26; 2023-01-27	-; -
<i>D. pertusum</i>	LL46	2022-11-29	Female	Fertilisation	3	2023-01-23; 2023-01-25; 2023-01-26	-; -; -
<i>D. pertusum</i>	LL47	2022-12-16	Male	Fertilisation; Motility	5	2023-01-25; 2023-01-26; 2023-01-27; 2023-02-09; 2023-02-10	-; -; -; 19:00; -
<i>D. pertusum</i>	LL48	2022-12-16	Male	Fertilisation; Motility	6	2023-01-23; 2023-01-24; 2023-02-03; 2023-02-11; 2023-02-13; 2023-03-02	-; -; -; -; -
<i>D. pertusum</i>	LL49	2023-01-19	-	-	0	-	-
<i>D. pertusum</i>	LL50	2023-01-19	-	-	0	-	-
<i>D. pertusum</i>	LL51	2023-01-19	-	-	0	-	-
<i>D. pertusum</i>	LL52	2023-11-17	Male	Fertilisation; Motility	3	2024-02-16; 2024-02-24; 2024-03-21	19:40; 11:20; 09:00
<i>D. pertusum</i>	LL53	2023-11-17	Male	-	0	-	-
<i>D. pertusum</i>	LL54	2023-11-17	Male	Fertilisation; Motility	2	2024-02-07; 2024-03-21	23:20; 10:00
<i>D. pertusum</i>	LL55	2023-11-17	-	-	0	-	-
<i>D. pertusum</i>	LL56	2023-11-17	-	-	0	-	-
<i>D. pertusum</i>	LL57	2023-11-17	Female	-	0	-	-
<i>D. pertusum</i>	LL58	2023-11-17	Male	-	0	-	-
<i>D. pertusum</i>	LL59	2023-11-17	Male	Fertilisation; Motility	3	2024-01-18; 2024-02-18; 2024-02-25	13:00; 09:10; 16:40

<i>D. pertusum</i>	LL60	2023-11-17	Female	-	1	2024-01-19	08:15
<i>D. pertusum</i>	LL61	2023-11-17	-	-	0	-	-
<i>D. pertusum</i>	LL62	2023-12-01	Female	Fertilisation	3	2024-01-18; 2024-02-24; 2024-03-21	13:00; 10:00; 08:45
<i>D. pertusum</i>	LL63	2023-12-01	Female	Fertilisation	2	2024-01-19; 2024-02-20	08:15; 13:00
<i>D. pertusum</i>	LL64	2023-12-01	Female	Contact time; Fertilisation	4	2024-01-18; 2024-01-19; 2024-01-19; 2025-03-02	13:00; 08:11; 20:00; 02:00
<i>D. pertusum</i>	LL65	2023-12-14	Female	Fertilisation	1	2024-02-18	13:00
<i>D. pertusum</i>	LL66	2023-12-14	Male	-	0	-	-
<i>D. pertusum</i>	LL67	2023-12-14	-	-	0	-	-
<i>D. pertusum</i>	LL68	2023-12-14	Male	-	0	-	-
<i>D. pertusum</i>	LL69	2023-12-14	Male	Fertilisation; Motility	1	2024-02-20	12:00
<i>D. pertusum</i>	LL70	2023-12-14	Female	Fertilisation	1	2024-02-07	10:00
<i>D. pertusum</i>	LL71	2023-12-14	Male	Motility	1	2024-02-25	20:20
<i>D. pertusum</i>	LL72	2023-12-14	Male	Fertilisation; Motility	4	2024-02-07; 2024-02-08; 2024-02-16; 2024-02-25	20:00; 20:30; 17:40; 20:20
<i>D. pertusum</i>	LL73	2024-11-21	Female	-	0	-	-
<i>D. pertusum</i>	LL74	2024-11-21	Female	-	0	-	-
<i>D. pertusum</i>	LL75	2024-11-21	Male	Motility	2	2025-01-26; 2025-03-01	14:00; 07:45
<i>D. pertusum</i>	LL76	2024-11-21	Female	-	1	2025-02-05	14:09
<i>D. pertusum</i>	LL77	2024-11-21	Male	-	1	2025-01-26	14:00
<i>D. pertusum</i>	LL78	2024-11-21	Male	-	0	-	-
<i>D. pertusum</i>	LL79	2024-11-21	Male	Contact time; Fertilisation; Motility	5	2025-01-20; 2025-01-22; 2025-02-09; 2025-02-22; 2025-03-02	12:48; 15:50; 09:00; 01:00; 01:30
<i>D. pertusum</i>	LL80	2024-12-13	Male	Fertilisation; Motility	3	2025-02-06; 2025-02-09; 2025-02-22	23:15; 09:00; 00:40
<i>D. pertusum</i>	LL81	2024-12-13	Male	Fertilisation; Motility	1	2025-02-05	14:00
<i>D. pertusum</i>	LL82	2024-12-13	Female	-	0	-	-
<i>D. pertusum</i>	LL83	2024-12-13	Female	Fertilisation	1	2025-02-06	23:30
<i>D. pertusum</i>	LL84	2024-12-13	Female	-	0	-	-

Table S2. Summary of fertilisation assays by date, species and cross. Fertilisation class (High, Low, Never) was assigned based on model predictions at a fixed benchmark sperm concentration (10^4 sperm mL^{-1} for *Desmophyllum dianthus* and 10^6 sperm mL^{-1} for *Desmophyllum pertusum*). P(fertilisation probability ≥ 0.5 at benchmark) represents the posterior probability that predicted fertilisation at the benchmark concentration was at least 0.5 (i.e. half of the eggs fertilised). Predicted fertilisation at benchmark corresponds to the posterior median fertilisation probability at that concentration. Egg and sperm ages are reported in hours at the time of the experiment; values marked with an asterisk (*) indicate protocol-based estimates (3 h) for experiments in which gametes were fresh, and age was not explicitly recorded.

Date	Species	Cross	Fert. class	Egg age (h)	Sperm age (h)	Benchmark label	P(fertilisation probability ≥ 0.5 at benchmark)	Predicted fertilisation at benchmark
23-07-06	<i>D. dianthus</i>	Dd22-Dd26	High	3*	3*	10^4	0.999	0.765
23-07-06	<i>D. dianthus</i>	Dd09.1-Dd26	High	3*	3*	10^4	0.937	0.616
23-07-11	<i>D. dianthus</i>	Dd20-Dd23	High	3*	3*	10^4	1	0.935
23-07-11	<i>D. dianthus</i>	Dd20-Dd24	High	3*	3*	10^4	1	0.937
23-07-11	<i>D. dianthus</i>	Dd30-Dd23	High	3*	3*	10^4	1	0.974
24-07-03	<i>D. dianthus</i>	Dd32-Dd55	High	4.2	4.2	10^4	1	0.956
24-07-03	<i>D. dianthus</i>	Dd54-Dd44	High	1.8	3.2	10^4	1	0.922
24-07-03	<i>D. dianthus</i>	Dd54-Dd55	High	3	3.2	10^4	1	0.987
24-07-03	<i>D. dianthus</i>	Dd56-Dd55	High	3.8	4.6	10^4	1	0.999
24-07-08	<i>D. dianthus</i>	Dd39-Dd44	High	2.1	3.1	10^4	1	0.911
24-07-08	<i>D. dianthus</i>	Dd43-Dd44	High	2.2	3.2	10^4	1	0.999
24-07-08	<i>D. dianthus</i>	Dd56-Dd44	High	2	3	10^4	1	1
23-01-23	<i>D. pertusum</i>	LL48-LL46	Low	3*	2.4	10^6	0	0.325
23-01-25	<i>D. pertusum</i>	LL47-LL44	High	3*	12	10^6	0.999	0.874
23-01-25	<i>D. pertusum</i>	LL47-LL46	High	3*	1	10^6	0.989	0.666
23-01-26	<i>D. pertusum</i>	LL47-LL45	High	3*	5.5	10^6	1	0.813
23-01-26	<i>D. pertusum</i>	LL47-LL46	High	3*	5.5	10^6	0.989	0.666
23-02-11	<i>D. pertusum</i>	LL36-LL38	High	12	3*	10^6	1	0.845
23-02-11	<i>D. pertusum</i>	LL36-LL43	High	12	3*	10^6	1	0.892
23-02-11	<i>D. pertusum</i>	LL48-LL38	Low	3*	3*	10^6	0.753	0.576
23-02-11	<i>D. pertusum</i>	LL48-LL43	Low	3*	3*	10^6	0.677	0.549
24-02-07	<i>D. pertusum</i>	LL72-LL70	Never	12.8	2.5	10^6	NA	NA
24-02-08	<i>D. pertusum</i>	LL54-LL70	Never	15	1.8	10^6	NA	NA
24-02-18	<i>D. pertusum</i>	LL59-LL65	Low	0.7	4.2	10^6	0.603	0.522
24-02-20	<i>D. pertusum</i>	LL69-LL63	High	7	8	10^6	1	0.685
24-03-21	<i>D. pertusum</i>	LL54-LL62	High	5.9	4.7	10^6	0.808	0.582
24-03-21	<i>D. pertusum</i>	LL52-LL62	Low	3.6	3.3	10^6	0.19	0.447
25-01-20	<i>D. pertusum</i>	LL79-LL64	Low	2.3	3.8	10^6	0	0.053
25-02-07	<i>D. pertusum</i>	LL80-LL83	Never	3.2	3.6	10^6	NA	NA
25-02-07	<i>D. pertusum</i>	LL81-LL83	Never	3.2	3.1	10^6	NA	NA

*Table S3. Experimental structure of fertilisation assays for *Desmophyllum dianthus* and *D. pertusum*. The table summarises the date, replicate structure, and sperm concentrations tested for each fertilisation experiment. “Run” indicates repeated experimental assays conducted for the same male–female cross; non-replicated crosses have a single run. Replicate timing specifies whether repeated runs were conducted on the same day or on different days. Sperm concentrations are reported as sperm mL⁻¹.*

Species	Cross	Date	Run	Replicate timing	Concentrations tested (sperm mL ⁻¹)
<i>D. dianthus</i>	Dd09.1-Dd26	23-07-06	1	not replicated	0, 10000, 50000, 1e+05, 2e+05, 3e+05
<i>D. dianthus</i>	Dd22-Dd26	23-07-06	1	not replicated	0, 10000, 50000, 1e+05, 2e+05, 3e+05, 4e+05, 9e+05, 1e+06
<i>D. dianthus</i>	Dd20-Dd23	23-07-11	1	not replicated	0, 500, 1000, 2500, 5000, 10000, 25000, 50000, 1e+05, 2e+05, 3e+05, 4e+05, 5e+05, 6e+05, 7e+05, 8e+05, 9e+05, 1e+06, 5e+06
<i>D. dianthus</i>	Dd20-Dd24	23-07-11	1	not replicated	0, 500, 1000, 2500, 5000, 10000, 25000, 50000, 1e+05, 2e+05, 3e+05, 4e+05, 5e+05, 6e+05, 7e+05, 8e+05, 9e+05, 1e+06, 5e+06
<i>D. dianthus</i>	Dd30-Dd23	23-07-11	1	not replicated	0, 500, 1000, 2500, 5000, 10000, 50000, 1e+05, 2e+05, 3e+05, 4e+05, 5e+05, 6e+05, 7e+05, 8e+05
<i>D. dianthus</i>	Dd32-Dd55	24-07-03	1	not replicated	0, 500, 1000, 5000, 10000, 1e+05, 5e+05, 1e+06
<i>D. dianthus</i>	Dd54-Dd44	24-07-03	1	not replicated	0, 500, 1000, 5000, 10000, 1e+05, 5e+05, 1e+06
<i>D. dianthus</i>	Dd54-Dd55	24-07-03	1	not replicated	0, 500, 1000, 5000, 10000, 1e+05, 5e+05, 1e+06
<i>D. dianthus</i>	Dd56-Dd55	24-07-03	1	not replicated	0, 500, 1000, 5000, 10000, 50000, 1e+05, 250000
<i>D. dianthus</i>	Dd39-Dd44	24-07-08	1	not replicated	0, 50, 100, 250, 500, 1000
<i>D. dianthus</i>	Dd43-Dd44	24-07-08	1	not replicated	0, 50, 100, 250, 500, 1000
<i>D. dianthus</i>	Dd56-Dd44	24-07-08	1	not replicated	0, 50, 100, 250, 500, 1000
<i>D. pertusum</i>	LL48-LL46	23-01-23	1	not replicated	0, 160000, 8e+05, 1600000, 3200000, 4800000, 6400000, 8e+06, 9600000, 11200000
<i>D. pertusum</i>	LL47-LL44	23-01-25	1	not replicated	0, 160000, 8e+05
<i>D. pertusum</i>	LL47-LL46	23-01-25	1	different days	0, 160000, 4e+05, 8e+05, 3200000
<i>D. pertusum</i>	LL47-LL45	23-01-26	1	same day	0, 3200000, 1.6e+07
<i>D. pertusum</i>	LL47-LL45	23-01-26	2	same day	0, 160000, 8e+05, 1600000
<i>D. pertusum</i>	LL47-LL46	23-01-26	2	different days	0, 1600000
<i>D. pertusum</i>	LL36-LL38	23-02-11	1	not replicated	0, 160000, 4e+05, 8e+05
<i>D. pertusum</i>	LL36-LL43	23-02-11	1	not replicated	0, 160000, 4e+05, 8e+05
<i>D. pertusum</i>	LL48-LL38	23-02-11	1	not replicated	0, 160000, 8e+05, 1600000
<i>D. pertusum</i>	LL48-LL43	23-02-11	1	not replicated	0, 160000, 8e+05, 1600000
<i>D. pertusum</i>	LL72-LL70	24-02-07	1	not replicated	0, 10000, 20000, 30000, 40000, 50000, 125000, 250000
<i>D. pertusum</i>	LL54-LL70	24-02-08	1	not replicated	0, 20000, 30000, 1e+05
<i>D. pertusum</i>	LL59-LL65	24-02-18	1	not replicated	0, 50000, 1e+05, 175000, 375000, 675000

<i>D. pertusum</i>	LL69-LL63	24-02-20	1	not replicated	0, 10000, 20000, 30000, 40000, 70000, 80000, 1e+05, 175000, 5e+05, 625000, 725000, 850000, 1e+06
<i>D. pertusum</i>	LL52-LL62	24-03-21	1	same day	0, 50000, 1e+05, 2e+05, 4e+05, 550000
<i>D. pertusum</i>	LL52-LL62	24-03-21	2	same day	0, 50000, 1e+05, 2e+05, 4e+05, 550000
<i>D. pertusum</i>	LL54-LL62	24-03-21	1	not replicated	0, 50000, 1e+05, 2e+05, 4e+05
<i>D. pertusum</i>	LL79-LL64	25-01-20	1	same day	0, 10000, 1e+05, 6e+05, 1e+06
<i>D. pertusum</i>	LL79-LL64	25-01-20	2	same day	0, 10000, 1e+05, 6e+05, 1e+06
<i>D. pertusum</i>	LL80-LL83	25-02-07	1	not replicated	0, 30000, 3e+05, 6e+05
<i>D. pertusum</i>	LL81-LL83	25-02-07	1	not replicated	0, 30000, 3e+05, 6e+05

Table S4. Temporal dynamics of average path velocity (VAP) of sperm in *D. dianthus* and *D. pertusum* (mean, 95% CI). Sperm were classified as motile (VAP 20–80 $\mu\text{m s}^{-1}$) and progressively motile sperm (VAP >80 $\mu\text{m s}^{-1}$).

Velocities ($\mu\text{m s}^{-1}$)				
<i>D. pertusum</i>			<i>D. dianthus</i>	
Time bins	Motile VAP	Progressive VAP	Motile VAP	Progressive VAP
0-5h	45.30 (43.79-46.81)	106.50 (104.17-108.84)	41.22 (40.23-42.20)	121.81 (118.52-125.10)
15-20h	45.86 (42.73-48.99)	93.25 (90.06-96.43)	35.73 (33.88-37.58)	124.66 (117.66-131.67)
25-30h	43.57 (40.22-46.92)	83.41 (80.95-85.87)	30.63 (9.41-51.85)	–

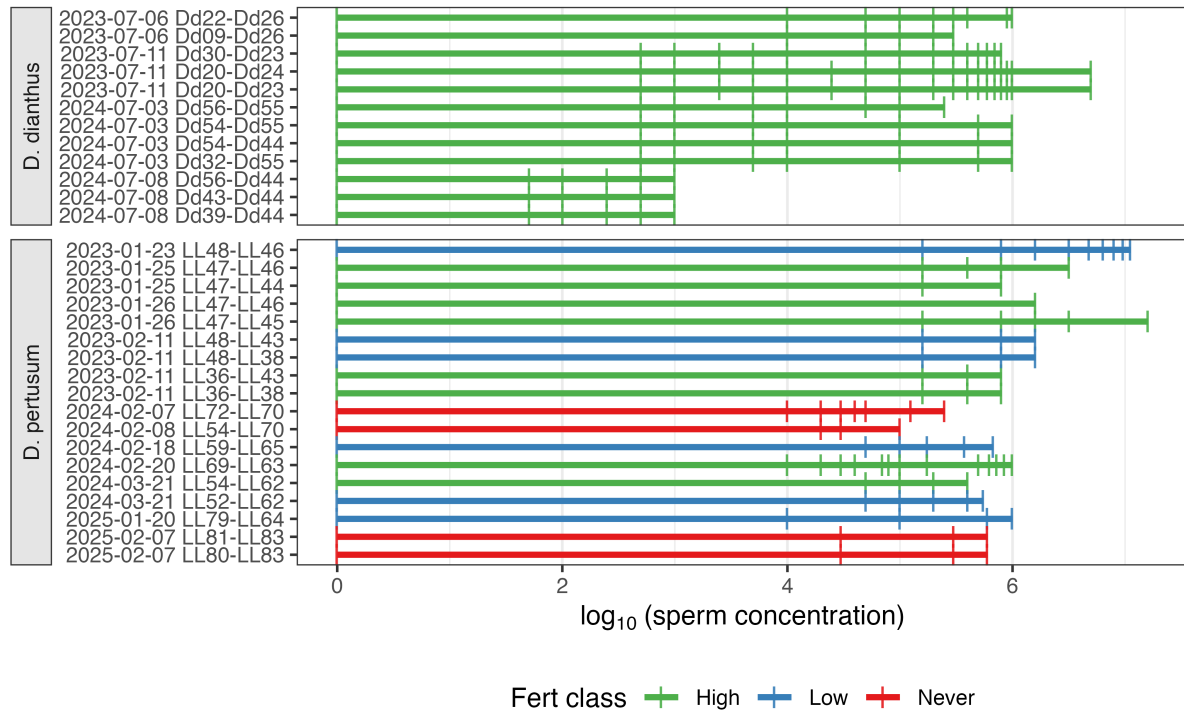


Figure S1. Sperm concentration ranges tested per cross for *Desmophyllum dianthus* (top) and *Desmophyllum pertusum* (bottom). Horizontal lines show the range of concentrations tested (log₁₀ scale), and tick marks indicate individual dilution steps. Colours denote fertilisation class (High, Low, Never) based on model predictions at species-specific benchmark concentrations (10⁴ and 10⁶ sperm mL⁻¹, respectively).

Supplementary Methods

SM1. Statistical model specification

SM1.1 Temporal models of sperm motility

Model structure

Percentage motility responses were modelled using a beta likelihood:

$$y_i \sim \text{Beta}(\mu_i, \phi)$$

with mean parameter:

$$\text{logit}(\mu_i) = \alpha + \beta_{\text{species}[i]} + f_{\text{species}[i]}(t_i) + u_{\text{male}[i]}$$

where:

- y_i is the proportion of motile or progressively motile sperm
- t_i is time after spawning (hours)
- $f_{\text{species}}(t)$ is a species-specific smooth function of time
- $u_{\text{male}} \sim \mathcal{N}(0, \sigma_{\text{male}}^2)$ is a random intercept for male identity

Smooth terms were implemented as thin-plate regression splines with a low basis dimension ($k = 3$) to capture nonlinear temporal trends while avoiding overfitting.

The precision parameter was modelled as constant:

$$\phi > 0$$

Priors

Weakly informative priors were specified as follows:

- Fixed effects:

$$\beta \sim \mathcal{N}(0, 1.5)$$

- Random-effect standard deviation:

$$\sigma_{\text{male}} \sim \text{Exponential}(1)$$

- Beta precision parameter:

$$\phi \sim \text{Gamma}(2, 0.1)$$

Smooth terms were estimated using the default penalisation priors implemented in brms.

Computation and model checking

Models were fitted in brms using Hamiltonian Monte Carlo (four chains, 4,000 iterations, 2,000 warm-up; adapt_delta = 0.999; max_treedepth = 15). Convergence was assessed using $\hat{R}$ statistics, effective sample sizes, and visual inspection of trace plots. Model adequacy was evaluated using posterior predictive checks.

SM1.2 Temporal models of sperm velocity (VAP)

Model structure

Velocity responses (motile VAP and progressive VAP) were modelled using a gamma likelihood with a log link:

$$y_i \sim \text{Gamma}(\mu_i, \text{shape})$$

with mean structure:

$$\log(\mu_i) = \alpha + \beta_{\text{species}[i]} + f_{\text{species}[i]}(t_i) + u_{\text{male}[i]}$$

where:

- y_i is the average path velocity (VAP; $\mu\text{m s}^{-1}$) of motile or progressively motile sperm
- t_i is time after spawning (hours)
- $f_{\text{species}}(t)$ is a species-specific smooth function of time
- $u_{\text{male}} \sim N(0, \sigma_{\text{male}}^2)$ is a random intercept for male identity

Smooth terms were implemented as thin-plate regression splines with a low basis dimension ($k = 3$) to allow flexible nonlinear temporal trends while avoiding overfitting.

The gamma shape parameter was modelled as constant:

$$\text{shape} > 0$$

Priors

Weakly informative priors were specified as follows:

- Fixed effects:

$$\beta \sim N(0, 1.5)$$

- Random-effect standard deviation:

$$\sigma_{\text{male}} \sim \text{Exponential}(1)$$

- Gamma shape parameter:

$$\text{shape} \sim \text{Exponential}(1)$$

Smooth terms were estimated using the default penalisation priors implemented in brms.

Computation and model checking

Models were fitted in brms using Hamiltonian Monte Carlo (four chains, 4,000 iterations, 2,000 warm-up; adapt_delta = 0.999; max_treedepth = 15). Convergence was assessed using $\hat{R}$ statistics, effective sample sizes, and visual inspection of trace plots. Model adequacy was evaluated using posterior predictive checks.

SM1.3 Egg presence models

Egg presence effects on sperm motility were analysed using Bayesian generalised linear mixed-effects models fitted separately for each species and response variable using paired egg-absent/egg-present observations. Percentage responses (percent motile and percent progressive sperm) were rescaled to the open interval (0, 1) using the Smithson & Verkuilen (2006) transformation and modelled with a beta likelihood and logit link:

$$y_{ij} \sim \text{Beta}(\mu_{ij}, \phi_{ij})$$
$$\text{logit}(\mu_{ij}) = \alpha + \beta \text{egg}_{ij} + u_j$$

with paired-event random intercepts:

$$u_j \sim \mathcal{N}(0, \sigma_{\text{event}}^2)$$

Precision was modelled as treatment-specific using a log link:

$$\log(\phi_{ij}) = \alpha_{\phi} + \beta_{\phi} \text{egg}_{ij}$$

Velocity responses (motile VAP and progressive VAP) were modelled using a gamma likelihood with a log link:

$$y_{ij} \sim \text{Gamma}(\mu_{ij}, \kappa_{ij})$$
$$\log(\mu_{ij}) = \alpha + \beta \text{egg}_{ij} + u_j$$

with paired-event random intercepts:

$$u_j \sim \mathcal{N}(0, \sigma_{\text{event}}^2)$$

The gamma shape parameter was modelled as treatment-specific (log link):

$$\log(\kappa_{ij}) = \alpha_{\kappa} + \beta_{\kappa} \text{egg}_{ij}$$

Priors

Priors were specified on the linear predictor (logit scale for beta means; log scale for gamma means and auxiliary parameters):

Mean model intercepts

- Beta models: $\alpha \sim \mathcal{N}(0, 1)$
- Gamma models: $\alpha \sim \mathcal{N}(\log(100), 1)$

Egg (treatment) effects

- Beta mean: $\beta \sim \mathcal{N}(0,0.5)$
- Gamma mean: $\beta \sim \mathcal{N}(0,0.3)$

Auxiliary (dispersion/shape) submodels

- Beta precision (log ϕ) intercept: $\alpha_\phi \sim \mathcal{N}(2,1)$
- Beta precision egg effect: $\beta_\phi \sim \mathcal{N}(0,0.5)$
- Gamma shape (log κ) intercept: $\alpha_\kappa \sim \mathcal{N}(3,1)$
- Gamma shape egg effect: $\beta_\kappa \sim \mathcal{N}(0,0.3)$

Random-effect standard deviations

- $\sigma_{\text{event}} \sim \text{Students-}t^+(3,0,2.5)(\text{half-Students-}t, \text{constrained } > 0)$

Computation and model checking

Models were fitted in brms using Hamiltonian Monte Carlo (four chains, 4,000 iterations, 2,000 warm-up; adapt_delta = 0.99; max_treedepth = 13). Convergence was assessed using $\hat{R} < 1.01$ and effective sample sizes. Model adequacy was evaluated using posterior predictive checks.

Paired (within-event) egg effects

Species-level paired effects were estimated by computing, for each posterior draw, the within-event difference in the expected response (egg-present – egg-absent) and averaging across events. For proportion outcomes, differences are reported in percentage points. Results are reported as posterior medians with 95% highest-density intervals (HDIs).

SM1.4 Fertilisation curve models

Fertilisation responses were modelled using Bayesian hierarchical binomial regression:

$$y_{ij} \sim \text{Binomial}(n_{ij}, p_{ij})$$
$$\text{logit}(p_{ij}) = \alpha + \beta \cdot x_{ij} + u_{0j} + u_{1j}x_{ij}$$

Where:

$$x_{ij} = \log_{10}(\text{concentration}_{ij} + 1)$$

and (u_{0j}, u_{1j}) are cross-specific random intercepts and slopes with a multivariate normal distribution.

Priors

- Intercept: $\alpha \sim \mathcal{N}(0,5)$
- Slope: $\beta \sim \mathcal{N}(0,3)$
- Random-effect SDs: $\sigma \sim \text{Exponential}(1)$
- Random-effect correlation matrix: LKJ(2)

Benchmark probabilities and C_{50} thresholds were derived from posterior predictive distributions. C_{50} uncertainty was estimated using posterior draws and summarised using posterior medians and 95% HDIs.

SM1.5 Contact-time models

Fertilisation success under varying sperm concentration and contact time was modelled using Bayesian binomial regression:

$$y_i \sim \text{Binomial}(n_i, p_i)$$

$$\text{logit}(p_i) = \alpha + \beta_1 x_i + \beta_2 x_i^2 + \beta_3 \text{time}_i + \beta_4 (x_i \times \text{time}_i)$$

where

$$x_i = \log_{10}(\text{conc}_i + 1), y_i = \text{eggs_fertilised}_i, n_i = \text{eggs_found}_i.$$

A random intercept for experiment was included for *D. dianthus*; the *D. pertusum* model was fitted without random effects.

Priors

For both species:

- Intercept:
 $\alpha \sim \text{Students-}t(3,0,2.5)$
- Fixed effects (including polynomial and interaction terms):
 $\beta_k \sim \mathcal{N}(0,2)$

For *D. dianthus* only:

- Random intercept SD:
 $\sigma_{\text{experiment}} \sim \text{Exponential}(2)$

Posterior medians and 95% HDIs are reported.