**Supplemental Table 1. Ocean Acidification and Reproduction studies cited in this review**

| **Species** | **pH** | | **Life Stage Exposed** | **Exposure Duration** | | **Reproductive Stage** | | **Key Findings** | | | **Study Type** | **Collection Location Marine Ecoregion** | | **Reference** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cnidaria** |  | |  |  | |  | |  | | |  |  | |  | |
| *Acropora palmata* (coral) | 8.00\*, 7.85, 7.72 | | Eggs & sperm | 4 hours - a few minutes | | Fertilization | | Low pH reduced percent fertilization, exacerbated by decreases in sperm concentration but no effect pH on sperm velocity. | | | Laboratory | Tropical Atlantic | | Albright (2011) | |
| *Orbicella faveolata* (coral) | 8.00\*, 8.94, 7.88, 7.74 | | Eggs & sperm | 7 hours - a few minutes | | Fertilization | | Low pH reduced percent fertilization, exacerbated by decreases in sperm concentration but no effect pH on sperm velocity. | | | Laboratory | Tropical Atlantic | | Albright (2011) | |
| *Acropora tenuis* (coral) | 7.97\*, 8.01, 7.78, 7.74 | | Eggs & sperm | 3 hours | | Fertilization | | Low pH increased minimum sperm concentration required to obtain half of maximum fertilization vastly but no effect of pH on fertilization success. | | | Laboratory | Central Indo-Pacific | | Albright et al. (2013) | |
| *Balanophyllia europaea* (coral)B | 8.10\*, 7.9, 7.7 | | Adults | 8 months | | Gametogenesis and gamete quality; Fecundity and reproductive output | | No effect of pH on distribution and morphology of female and male germ cell maturation stages, fertility, egg and spermary abundance, or gonadal index. | | | Field | Temperate Northern Atlantic | | Caroselli et al. (2019) | |
| *Acropora tenuis* (coral) | 8.18\*, 8.06 | | Eggs & sperm | 2 hours | | Fertilization | | No effect of pH on fertilization rate. | | | Laboratory | Central Indo-Pacific | | Chua et al. (2013) | |
| *Acropora millepora* (coral) | 8.12\*, 8.18\*, 8.06, 8.00 | | Eggs & sperm | 2 hours | | Fertilization | | No effect of pH on fertilization rate. | | | Laboratory | Central Indo-Pacific | | Chua et al. (2013) | |
| *Oculina patagonica (coral)* | 8.00 - 8.30\*, 7.30 - 7.60 | | Adults | 12 months | | Gametogenesis and gamete quality | | No effect of pH on gametogenesis. | | | Laboratory | Temperate Northern Atlantic | | Fine et al. (2007) | |
| *Madracis pharensis* (coral) | 8.00 - 8.30\*, 7.30 - 7.60 | | Adults | 12 months | | Gametogenesis and gamete quality | | No effect of pH on gametogenesis. | | | Laboratory | Temperate Northern Atlantic | | Fine et al. (2007) | |
| *Leptopsammia pruvoti* (coral) B | 8.07\*, 7.87 - 7.40 | | Adults | 3 months | | Gametogenesis and gamete quality; Fecundity and reproductive output | | No effect of pH on distribution and morphology of female and male germ cell maturation stages, diameter of spermaries or eggs, egg and spermary abundance, fertility, or gonadal index. | | | Field | Temperate Northern Atlantic | | Gizzi et al. (2017) | |
| *Acropora digitifera* (coral) | 7.94 - 7.99\*, 7.64 - 7.68 | | Eggs & sperm | 6 hours | | Fertilization | | No effect of pH on fertilization rate. | | | Laboratory | Temperate Northern Pacific | | Iguchi et al. (2015) | |
| *Pocillopora damicornis* (coral) B | ambient\*, ambient + 365 µatm | | Adults | 6 months | | Fecundity and reproductive output | | No effect of pH on number of spawned bundles, number of eggs within spawned bundles, or total number of spawned eggs. | | | Mesocosm | Eastern Indo-Pacific | | Jokiel et al. (2008) | |
| *Montipora capitata* (coral) | ambient\*, ambient + 365 µatm | | Adults | 6 months | | Fecundity and reproductive output | | No effect of pH on number of spawned bundles, number of eggs within spawned bundles, or total number of spawned eggs. | | | Mesocosm | Eastern Indo-Pacific | | Jokiel et al. (2008) | |
| *Astroides calycularis* (coral) B | 8.07\*, 7.87 - 7.40 | | Adults | 3 months | | Gametogenesis and gamete quality; Fecundity and reproductive output | | Low pH delayed spermary development and led to a persistence of mature oocytes in the fertilization period. No effect of pH on abundance, gonadal index, and diameters of eggs or spermaries. No embryos were found in colonies from the most acidic sites. | | | Field | Temperate Northern Atlantic | | Marchini et al. (2021) | |
| *Acropora digitifera* (coral) | 8.00\*, 7.77 - 6.55 | | Sperm | Not specified | | Fertilization | | Low pH reduced sperm motility. | | | Laboratory | Temperate Northern Pacific | | Morita et al. (2010) | |
| *Acropora digitifera* (coral) | 8.05\*, 8.17, 7.74 | | Sperm | 3 minutes | | Fertilization | | Low pH reduced sperm motility. | | | Laboratory | Temperate Northern Pacific | | Nakamura et al. (2012) | |
| *Orbicella faveolata* (coral) | 8.20\*, 8.00 | | Eggs & sperm | 3 hours | | Fertilization | | No effect of pH on fertilization success. | | | Laboratory | Tropical Atlantic | | Pitts et al. (2020) | |
| *Pocillopora damicornis* (coral) B | 7.81 - 8.06\*, 7.51 - 7.74 | | Adults | 105 days | | Timing of reproduction and synchronization | | Low pH delayed release of planula during the peak month of planulation. | | | Mesocosm | Eastern Indo-Pacific | | Putnam et al. (2020) | |
| *Primnoa pacifica* (coral) | 7.75\*, 7.55 | | Adults | 8 months | | Gametogenesis and gamete quality; Fecundity and reproductive output | | Low pH reduced egg diameters and female fecundity but increased oosorption and advancement of spermatogenesis. | | | Laboratory | Temperate Northern Pacific | | Rossin et al. (2019) | |
| *Acropora hyacinthus* (coral) | 8.15\*, 7.85 | | Eggs & sperm | 3 hours | | Fertilization | | No effect of pH on percent fertilization. | | | Laboratory | Temperate Northern Pacific | | Schutter et al. (2015) | |
| *Favites abdita* (coral) | 8.15\*, 7.85 | | Eggs & sperm | 3 hours | | Fertilization | | No effect of pH on percent fertilization. | | | Laboratory | Temperate Northern Pacific | | Schutter et al. (2015) | |
| *Platygyra contorta* (coral) | 8.15\*, 7.85 | | Eggs & sperm | 3 hours | | Fertilization | | No effect of pH on percent fertilization. | | | Laboratory | Temperate Northern Pacific | | Schutter et al. (2015) | |
| *Orbicella faveolata* (coral) | 8.15\*, 7.85 | | Eggs & sperm | 3 hours | | Fertilization | | No effect of pH on percent fertilization. | | | Laboratory | Temperate Northern Pacific | | Schutter et al. (2015) | |
| *Acropora tenuis* (coral) | 8.15\*, 7.85 | | Eggs & sperm | 3 hours | | Fertilization | | No effect of pH on percent fertilization. | | | Laboratory | Temperate Northern Pacific | | Schutter et al. (2015) | |
| *Acropora palmata* (coral) | 8.15\*, 7.85 | | Eggs & sperm | 3 hours | | Fertilization | | No effect of pH on percent fertilization. | | | Laboratory | Temperate Northern Pacific | | Schutter et al. (2015) | |
| *Goniastrea edwardsi* (coral) | 8.10\*, 7.90, 7.70 | | Eggs & sperm | 4 hours | | Fertilization | | Low pH reduced fertilization success. | | | Laboratory | Central Indo-Pacific | | Striewski (2012) | |
| *Orbicella faveolata* (coral) | 8.10\*, 7.90, 7.70 | | Eggs & sperm | 4 hours | | Fertilization | | Low pH caused variation in hybridization success but no effect of pH on fertilization success. | | | Laboratory | Central Indo-Pacific | | Striewski (2012) | |
| *Orbicella annularis* (coral) | 8.10\*, 7.90, 7.70 | | Eggs & sperm | 4 hours | | Fertilization | | Low pH caused variation in hybridization success. | | | Laboratory | Central Indo-Pacific | | Striewski (2012) | |
| **Crustacea** |  | |  |  | |  | |  | | |  |  | |  | |
| *Eurytemora affinis* (copepod) B | 8.24-8.02\*, 8.02 -7.52 | | Adults | 7, 14, 21, and 48 weeks | | Fecundity and reproductive output | | No effect of pH on hatch rate. | | | Laboratory | Temperate Northern Atlantic | | Almén (2016) | |
| *Gammarus locusta* (amphipod) B | 8.10\*, 7.70 | | Adults | 1 - 2 months | | Mating Behavior | | Low pH reduced long-distance mate tracking in males and mate guarding duration. | | | Laboratory | Temperate Northern Atlantic | | Borges et al. (2018) | |
| *Gammarus locusta* (amphipod) B | 8.10\*, 7.70 | | Adults | 1 - 2 months | | Fecundity and reproductive output | | Low pH reduced egg production but no effect of pH on embryonic development. | | | Laboratory | Temperate Northern Atlantic | | Borges et al. (2018) | |
| *Tigriopus japonicus* (copepod) B | 8.00\*, 7.80 - 6.50 | | Adults | 56 days | | Fecundity and reproductive output | | Low pH reduced hatching success at the lowest pH but there was no effect on the number of broods. | | | Laboratory | Central Indo-Pacific | | Cao et al. (2015) | |
| Gammarus locusta (amphipod) B | 8.10\*, 7.80 | | Adults | 21 days | | Fecundity and reproductive output | | Low pH reduced hatch rate. | | | Laboratory | Temperate Northern Atlantic | | Cardoso et al. (2016) | |
| *Calanoida sp.* (copepod) B | 7.50\*, 7.10- 7.30 | | Adults | 12 days | | Fecundity and reproductive output | | In situ low pH resulted in fewer eggs and reduced hatch rates. | | | Laboratory | Central Indo-Pacific | | Choi et al. (2016) | |
| *Paralithodes camtschaticus* (crab) B | 8.00\*, 7.70 | | Adults | 49 days | | Fecundity and reproductive output, Timing of reproduction and synchronization | | Low pH extended hatching duration, but there was no effect on hatch success. | | | Laboratory | Temperate North Pacific | | Christopher Long et al. (2013) | |
| *Elasmopus rapax* (amphipod) B | 8.00\*, 7.50, 7.00 | | Adults | 22 days | | Gametogenesis and gamete quality | | Unable to produce eggs in low pH conditions. | | | Laboratory | Temperate Northern Atlantic | | Conradi et al. (2019) | |
| *Cyathura carinata* (isopod) B | 8.00\*, 7.00, 6.50 | | Adults | 32 days | | Gametogenesis and gamete quality | | Unable to produce eggs in low pH conditions. | | | Laboratory | Temperate Northern Atlantic | | Conradi et al. (2019) | |
| *Acartia tonsa* (copepod) B | 8.20\*, 7.92 - 7.15 | | From egg to adult | 30 - 96 hours | | Fecundity and reproductive output | | Low pH reduced egg production and hatching success when both parents were exposed but no effect of pH on hatching success when only the mother is exposed. | | | Laboratory | Temperate Northern Atlantic | | Cripps et al. (2014) | |
| *Echinogammarus marinus* (amphipod) B | 8.00\*, 7.50 | | Eggs | 18 days | | Fecundity and reproductive output | | Low pH increased embryonic development time increased but no effect of pH on hatch success. | | | Laboratory | Temperate Northern Atlantic | | Egilsdottir et al. (2009) | |
| *Acartia bifilosa* (copepod) B | 7.87-7.60\*, 7.47 - 7.15 | | Adults | 24 - 26 hours | | Fecundity and reproductive output | | Low pH increased egg production. | | | Laboratory | Temperate Northern Atlantic | | Engström-Östa et a. (2014) | |
| *Semibalanus balanoides* (barnacle) B | 8.07\*, 7.70 | | Adults | 7, 24, 42, 56, 70, 91, and 104 days | | Fecundity and reproductive output | | Low pH reduced hatching time. | | | Laboratory | Temperate Northern Atlantic | | Findlay et al. (2009) | |
| *Tisbe battagliai* (copepod) B | 8.06 - 8.1\*, 7.95 - 7.67 | | Adults | 72 hours - 4 months | | Gametogenesis and gamete quality; Fecundity and reproductive output | | Low pH reduced spermatophore size and increased naupliar production, but no effect of pH on spermatophore attachment or female responses. | | | Laboratory | Temperate Northern Atlantic | | Fitzer et al. (2012) | |
| *Menippe mercenaria* (crab) B | 8.00\*, 7.50 | | Adults | 12 days | | Fecundity and reproductive output | | Low pH reduced hatching success. | | | Laboratory | Tropical Atlantic | | Gravinese (2018) | |
| *Acartia grani* (copepod) B | 8.17\*, 7.96, 7.75 | | Adults | 3 days | | Fecundity and reproductive output | | No effect of pH on egg production or egg hatching success. | | | Laboratory | Temperate Northern Atlantic | | Isari et al. (2016) | |
| *Tigriopus japonicus* (copepod) B | 8.04\*, 6.26 - 5.74 | | Adults | 20 days | | Fecundity and reproductive output; Sex determination, differentiation, and ratio; Timing of reproduction and synchronization | | Extreme low pH reduced hatching success, but there was no effect on sex ratio, timing of mating, or spawning. | | | Laboratory | Temperate North Pacific | | Kita et al. (2013) | |
| *Acartia tsuensis* (copepod) B | 8.23\*, 7.31 | | Adults | 9 days | | Fecundity and reproductive output | | No effect of pH on egg production and hatching rate. | | | Laboratory | Temperate Northern Pacific | | Kurihara and Ishimatsu (2008) | |
| *Acartia steueri* (copepod) B | 8.14\*, 7.40, 6.84 | | Adults | 8 days | | Fecundity and reproductive output | | Low pH decreased egg production. | | | Laboratory | Temperate Northern Pacific | | Kurihara et al. (2004) | |
| *Acartia erythraea* (copepod) B | 8.20\*, 7.02, 6.86 | | Adults | 8 days | | Fecundity and reproductive output | | Low pH decreased hatching rate and increased egg production but no effect of pH on egg production. | | | Laboratory | Temperate Northern Pacific | | Kurihara et al. (2004) | |
| *Palaemon pacificus* (shrimp) B | 8.17\*, 7.89 | | Adults | 30 days | | Fecundity and reproductive output | | Low pH reduced number of females who bore eggs. | | | Laboratory | Temperate Northern Pacific | | Kurihara et al. (2008) | |
| *Acartia tonsa* (copepod) B | 8.12-8.06\*, 7.87-7.49 | | Adults | 41 months | | Fecundity and reproductive output; Timing of reproduction and synchronization | | No effect of pH on egg production or hatching success. Low pH exposure resulted in earlier hatching in females. | | | Laboratory | Temperate Northern Atlantic | | Langer et al. (2019) | |
| *Tigriopus japonicus* (copepod) B | 8.00\*, 7.50, 7.30 | | Adults | 7 days | | Fecundity and reproductive output | | Low pH reduced number of brooding individuals. | | | Laboratory | Central Indo-Pacific | | Lee et al. (2019) | |
| *Acartia ohtsukai* (copepod) B | 7.90\*, 7.60 | | Adults | 5 days | | Fecundity and reproductive output | | Low pH affected egg production. | | | Laboratory | Temperate Northern Pacific | | Lee et al. (2020) | |
| *Calanus finmarchicus* (copepod) B | 8.23\*, 6.95 | | Adults | 72 hours | | Fecundity and reproductive output | | Eggs remained unhatched at low pH but no effect of pH on egg production and disintegration. | | | Laboratory | Temperate Northern Atlantic | | Mayor et al. (2007) | |
| *Centropages typicusand* (copepod) B | 8.04, 7.97\*, 7.85 - 6.71 | | Adults | 4 days | | Fecundity and reproductive output | | Extreme low pH reduced hatching rate and egg production. | | | Laboratory | Temperate Northern Atlantic | | McConville et al. (2013) | |
| *Temora longicornis* (copepod) B | 8.04, 7.97\*, 7.85 - 6.71 | | Adults | 4 days | | Fecundity and reproductive output | | No effect of pH on hatching rate or egg production. | | | Laboratory | Temperate Northern Atlantic | | McConville et al. (2013) | |
| *Amphibalanus amphitrite* (barnacle) B | 8.20\*, 7.40 | | Adults | 11 weeks | | Timing of reproduction and synchronization | | No effect of pH on egg onset time. | | | Laboratory | Temperate Northern Atlantic | | McDonald et al. (2009) | |
| *Chionoecetes bairdi* (crab) B | 8.09\*, 7.80, 7.50 | | Adults | 2 years | | Gametogenesis and gamete quality; Fecundity and reproductive output | | Low pH increased dead hemocyte cells, and resulted in smaller egg clutches, and reduced egg viability. | | | Laboratory | Temperate Northern Pacific | | Meseck et al. (2016) | |
| *Cancer magister* (crab) B | 8.00\*, 7.50, 7.10 | | Adults | 22 days | | Fecundity and reproductive output | | Low pH affected hatch time, but no effect of pH on egg hatching probability. | | | Laboratory | Temperate Northern Pacific | | Miller et al. (2016) | |
| *Balanus improvisus* (barnacle) B | 8.10\*, 7.50 | | Adults | 5 days - 16 months | | Gametogenesis and gamete quality; Fecundity and reproductive output | | Failed to brood or release embryos in low pH but no effect of pH on gonad development. | | | Laboratory | Temperate Northern Atlantic | | Pansch et al. (2018) | |
| *Labidocera spp.* (copepod) B | 8.00\*, 7.80 | | Adults | 10 days | | Gametogenesis and gamete quality | | No effect of pH on oocyte maturation. | | | Laboratory | Central Indo-Pacific | | Smith et al. (2017) | |
| *Chionoecetes bairdi* (crab) B | 8.10\*, 7.80, 7.50 | | Adults | 2 years | | Fecundity and reproductive output | | Low pH reduced hatching success. | | | Laboratory | Temperate North Pacific | | Swiney et al. (2016) | |
| *Calanus glacialis* (copepod) B | 8.00\*, 7.50 | | Adults | 7 days | | Gametogenesis and gamete quality; Fecundity and reproductive output | | No effect of pH on oogenesis or hatching success. | | | Laboratory | Temperate Northern Atlantic | | Thor et al. (2018) | |
| *Pseudocalanus acuspes* (copepod) B | 8.05\*, 7.75, 7.54 | | Adults | 2 weeks | | Fecundity and reproductive output | | Low pH reduced fecundity. | | | Laboratory | Temperate Northern Atlantic | | Thor and Dupont (2014) | |
| *Acartia bifilosa* (copepod) | 267 - 565 µatm\*, 867 - 1525 µatm | | Adults | 45 days | | Fecundity and reproductive output | | Low pH affected hatch success but no effect of low pH on egg production. | | | Laboratory | Temperate Northern Atlantic | | Vehmaa et al. (2016) | |
| *Acarita sp.* (copepod) B | 8.30 - 7.65\*, 7.60 - 7.31 | | Adults | 5 days | | Fecundity and reproductive output | | Low pH reduced hatch rate and egg production | | | Laboratory | Temperate Northern Atlantic | | Vehmaa et al. (2012) | |
| *Acartia bifilosa* (copepod) B | 8.00\*, 7.60 | | Adults | 24- 38 hours | | Gametogenesis and gamete quality; Fecundity and reproductive output | | No effect of pH on egg production or egg viability. | | | Laboratory | Temperate Northern Atlantic | | Vehmaa et al. (2013) | |
| *Calanus glacalis* (copepod) B | 8.20\*, 7.60, 6.90 | | Adults | 7 days | | Fecundity and reproductive output | | Low pH reduced hatching success but no effect of pH on egg production | | | Laboratory | Temperate Northern Atlantic | | Weydmann et al. (2012) | |
| *Acartia clausi* (copepod) B | 8.02\*, 7.95 - 7.71 | | Adults | 20 days | | Fecundity and reproductive output | | No effect of pH on egg abundance. | | | Laboratory | Temperate Northern Atlantic | | Zervoudaki et al. (2017) | |
| *Centropages typicus* (copepod) B | 8.02\*, 7.95 - 7.71 | | Adults | 20 days | | Fecundity and reproductive output | | No effect of pH on egg abundance. | | | Laboratory | Temperate Northern Atlantic | | Zervoudaki et al. (2017) | |
| *Acarita clausi* (copepod) B | 8.09\*, 7.83 | | Adults | 24 hours | | Fecundity and reproductive output | | Low pH reduced egg production. | | | Laboratory | Temperate Northern Atlantic | | Zervoudaki et al. (2014) | |
| *Acartia pacifica* (copepod) B | 8.17\*, 7.84 - 6.92 | | Adults | 8 days | | Fecundity and reproductive output | | No effect of pH on egg production or hatching success. | | | Laboratory | Central Indo-Pacific | | Zhang et al. (2011) | |
| *Acartia spinicauda* (copepod) B | 8.17\*, 7.84 - 6.92 | | Adults | 8 days | | Fecundity and reproductive output | | Low pH reduced egg production and hatching success. | | | Laboratory | Central Indo-Pacific | | Zhang et al. (2011) | |
| *Centropages tenuiremis* (copepod) B | 8.17\*, 7.84 - 6.92 | | Adults | 8 days | | Fecundity and reproductive output | | Low pH reduced egg production and hatching success. | | | Laboratory | Central Indo-Pacific | | Zhang et al. (2011) | |
| ***Echinodermata*** | | |  |  | |  | |  | | |  |  | |  | |
| *Salmacis virgulata* (sea urchin) | 8.20\*, 8.00 - 7.60 | | Adults | 14 days | | Gametogenesis and gamete quality | | Low pH damaged ovarian cells. | | | Laboratory | Western Indo-Pacific | | Anand et al. (2021) | |
| *Paracentrotus lividus* (sea urchin) | 8.00\*, 7.50 - 6.00 | | Eggs & sperm | 90 minutes | | Fertilization | | Low pH reduced fertilization. | | | Laboratory | Temperate Northern Atlantic | | Basallote et al. (2017) | |
| *Strongylocentrotus droebachiensis* (sea urchin) | 8.13\*, 8.05 - 7.20 | | Eggs & sperm | 1 - 3 hours | | Fertilization | | Low pH conditions decreased egg intracellular pH, increased polyspermy risk, and reduced fertilization rate | | | Laboratory | Arctic † | | Bögner et al. (2014) | |
| *Heliocidaris erythrogramma* (sea urchin) | 8.20\*, 7.60 - 7.90 | | Eggs & sperm | 20 hours | | Fertilization | | No effect of pH on fertilization. | | | Laboratory | Temperate Australasia | | Byrne et al. (2009) | |
| *Centrostephanus rodgeresii* (sea urchin) | 8.25\*, 7.90 - 7.60 | | Eggs & sperm | 15 minutes | | Fertilization | | No effect of pH on percent fertilization. | | | Laboratory | Temperate Australasia | | Byrne et al. (2010) | |
| *Heliocidaris erythrogramma* (sea urchin) | 8.25\*, 7.90 - 7.60 | | Eggs & sperm | 2 hours | | Fertilization | | No effect of pH on fertilization. | | | Laboratory | Temperate Australasia | | Byrne et al. (2010) | |
| *Heliocidaris erythrogramma* (sea urchin) | 8.25\*, 7.90 - 7.60 | | Eggs & sperm | 15 minutes | | Fertilization | | No effect of pH on percent fertilization. | | | Laboratory | Temperate Australasia | | Byrne et al. (2010) | |
| *Heliocidaris tuberculata* (sea urchin) | 8.25\*, 7.90 - 7.60 | | Eggs & sperm | 15 minutes | | Fertilization | | No effect of pH on percent fertilization. | | | Laboratory | Temperate Australasia | | Byrne et al. (2010) | |
| *Patiriella regularis* (sea star) | 8.25\*, 7.90 - 7.60 | | Eggs & sperm | 2 hours | | Fertilization | | No effect of pH on percent fertilization. | | | Laboratory | Temperate Australasia | | Byrne et al. (2010) | |
| *Tripneustes gratilla* (sea urchin) | 8.25\*, 7.90 - 7.60 | | Eggs & sperm | 15 minutes | | Fertilization | | No effect of pH on percent fertilization. | | | Laboratory | Temperate Australasia | | Byrne et al. (2010) | |
| *Patiriella regularis* (sea star) | 8.15\*, 7.80, 7.60 | | Eggs & sperm | 15 minutes | | Fertilization | | No effect of pH on fertilization. | | | Laboratory | Temperate Australasia | | Byrne et al. (2013) | |
| *Acanthaster* spp. (sea star) | 8.20, 8.00 - 7.40 | | Eggs & sperm | 30 minutes | | Fertilization | | Low pH reduced sperm speed and motility, and fertilization. | | | Laboratory | Central Indo-Pacific | | Caballes et al. (2017) | |
| *Echinometra lucunter* (sea urchin) | 8.20\*, 7.50 | | Eggs & sperm | N/A | | Fertilization | | No effect of pH alone on fertilization. | | | Laboratory | Tropical Atlantic | | Caetano et al. (2021) | |
| *Psammechinus miliaris* (sea urchin) | 8.06\*, 7.96 -7.67 | | Sperm | N/A | | Fertilization | | Low pH increased sperm swimming speed. | | | Laboratory | Temperate Northern Atlantic | | Caldwell et al. (2011) | |
| *Paracentrotus lividus* (sea urchin) | 8.18\*, 7.71 | | Eggs & sperm | N/A | | Fertilization | | Low pH reduced sperm speed, count, motility, path linearity, and straightness. | | | Laboratory | Temperate Northern Atlantic | | Campbell et al. (2016) | |
| *Lytechinus variegatus* (sea urchin) | 8.10\*, 7.70 | | Adults | 98 days | | Gametogenesis and gamete quality | | Low pH increased soluble protein storage. | | | Laboratory | Temperate Northern Atlantic | | Challener et al. (2014) | |
| *Paracentrotus lividus* (sea urchin) | 8.00\*, 7.70 | | Eggs & sperm | 15 minutes, 100 minutes, and 200 minutes | | Fertilization | | Low pH reduced fertilization. | | | Laboratory | Temperate Northern Atlantic | | Cohen-Rengifo et al. (2013) | |
| *Echinometra lucunter* (sea urchin) | 8.50\*, 8.00 - 7.00 | | Eggs & sperm | 40 minutes | | Fertilization | | Low pH reduced fertilization. | | | Laboratory | Tropical Atlantic | | da Silva Souza et al. (2019) | |
| *Odontaster validus* (sea star) | 8.12\*, 7.80, 7.60 | | Adults | 2 months | | Gametogenesis and gamete quality | | No effect of pH on gonado-somatic index and individual variability. | | | Laboratory | Southern Ocean | | Dell'Acqua et al. (2019) | |
| *Sterechinus neumayeri* (sea urchin) | 8.12\*, 7.80, 7.60 | | Adults | 1 month | | Gametogenesis and gamete quality | | No effect of pH on gonado-somatic index but variability exists between individuals. | | | Laboratory | Southern Ocean | | Dell'Acqua et al. (2019) | |
| *Strongylocentrotus droebachiensis* (sea urchin) | 8.07\*, 7.69 | | Adults | 4 - 16 months | | Gametogenesis and gamete quality; Fecundity and reproductive output | | Low pH reduced egg production but had no effect on egg quality. | | | Laboratory | Temperate Northern Atlantic | | Dupont et al. (2013) | |
| *Tripneustes gratilla* (sea urchin) | 8.10\*, 7.80, 7.60 | | Larval phase through adulthood | 140 days | | Gametogenesis and gamete quality | | Low pH reduced gonad index. | | | Laboratory | Temperate Australasia | | Dworjanyn and Byrne (2018) | |
| *Sterechinus neumayeri* (sea urchin) | 8.00\*, 7.70, 7.50 | | Eggs & sperm | 4 hours | | Fertilization | | No effect of pH on fertilization at ambient temperature. | | | Laboratory | Southern Ocean | | Ericson et al. (2012) | |
| *Sterechinus neumayeri* (sea urchin) | 8.01\*, 7.70 - 7.00 | | Eggs & sperm | 7 hours | | Fertilization | | Low pH reduced fertilization, but the effect was dependent on sperm concentration. | | | Laboratory | Southern Ocean | | Ericson et al. (2010) | |
| *Pseudoboletia indiana* (sea urchin) | 8.12\*, 7.85, 7.69 | | Eggs & sperm | 1 hour | | Fertilization | | Low pH reduced fertilization but there was mating pair variability. | | | Laboratory | Temperate Australasia | | Foo et al. (2014) | |
| *Centrostephanus rodgersii* (sea urchin) | 8.10\*, 7.60 | | Eggs | 1 - 30 minutes | | Fertilization | | Low pH reduced jelly coat area more quickly. | | | Laboratory | Temperate Australasia | | Foo et al. (2015) | |
| *Echinometra mathaei* (sea urchin) | 8.10\*, 7.60 | | Eggs | 1 - 30 minutes | | Fertilization | | Low pH reduced jelly coat area more quickly. | | | Laboratory | Temperate Australasia | | Foo (2015) | |
| *Heliocidaris erythrogramma* (sea urchin) | 8.10\*, 7.80, 7.60 | | Eggs & sperm | 10 min | | Fertilization | | No effect of pH on fertilization. | | | Laboratory | Temperate Australasia | | Foo et al. (2016) | |
| *Arbacia lixula* (sea urchin) | 8.00\*, 7.70, 7.50 | | Eggs | 5 min | | Fertilization | | Low pH reduced egg jelly coat size from control vents but was robust for urchins from low pH vents. | | | Laboratory | Temperate Northern Atlantic | | Foo et al. (2018) | |
| *Heliocidaris erythrogramma (sea urchin)* | 8.00, 7.80, 7.60 | | Eggs | 30 min | | Fertilization | | No effect of pH on egg jelly coat. | | | Laboratory | Temperate Australasia | | Foo et al. (2018) | |
| *Heliocidaris tuberculata (sea urchin)* | 8.00, 7.80, 7.60 | | Eggs & sperm | 30 min | | Fertilization | | Low pH reduced egg jelly coat size, leading to increased sperm motility, velocity, and path linearity. | | | Laboratory | Temperate Australasia | | Foo et al. (2018) | |
| *Strongylocentrotus franciscanus* (sea urchin) | 7.99 - 8.00\*, 7.36 - 7.94 | | Eggs & sperm | 20 minutes | | Fertilization | | Low pH had an effect on fertilization sensitivity depending on sperm:egg ratios | | | Laboratory | Temperate Northern Pacific | | Frieder (2014) | |
| *Strongylocentrotus purpuratus* (sea urchin) | 7.99 - 8.00\*, 7.36 - 7.94 | | Eggs & sperm | 20 minutes | | Fertilization | | Low pH had an effect on fertilization sensitivity depending on sperm:egg ratios | | | Laboratory | Temperate Northern Pacific | | Frieder (2014) | |
| *Arbacia lixula* (sea urchin) | 8.10\*, 7.70, 7.40 | | Eggs & sperm | 15 minutes, 105, minutes, 210 minutes | | Fertilization | | Low pH decreased fertilization rate after 15 min. At other time points, the trend was only significant at low temperatures. | | | Laboratory | Temperate Northern Atlantic | | García et al. (2018) | |
| *Diadema africanum* (sea urchin) | 8.10\*, 7.70, 7.40 | | Eggs & sperm | 210 minutes | | Fertilization | | Low pH decreased fertilization. | | | Laboratory | Temperate Northern Atlantic | | García et al. (2018) | |
| *Paracentrotus lividus* (sea urchin) | 8.10\*, 7.70, 7.40 | | Eggs & sperm | 15 minutes | | Fertilization | | Low pH increased fertilization rate after 15 min. | | | Laboratory | Temperate Northern Atlantic | | García et al. (2018) | |
| *Sphaerechinus granularis* (sea urchin) | 8.10\*, 7.70, 7.40 | | Eggs & sperm | 15 minutes | | Fertilization | | No effect of pH on fertilization. | | | Laboratory | Temperate Northern Atlantic | | García et al. (2018) | |
| *Arbacia lixula* (sea urchin) | 8.20\*, 7.90 | | Eggs & sperm | N/A | | Fertilization | | No effect of pH on fertilization. | | | Laboratory | Temperate Northern Atlantic | | Gianguzza et al. (2014) | |
| *Arachnoides placenta* (sand dollar) | 8.10\*, 7.80 - 7.00 | | Eggs & sperm | 17 hours | | Fertilization | | Low pH reduced fertilization. | | | Laboratory | Temperate Australasia | | Gonzalez-Bernat et al. (2013) | |
| *Odontaster validus* (sea star) | 8.10\*, 7.80 - 7.00 | | Eggs & sperm | 17 hours | | Fertilization | | Low pH only impacted percent fertilization at low sperm concentrations. | | | Laboratory | Temperate Australasia | | Gonzalez-Bernat et al. (2013) | |
| *Paracentrotus lividus* (sea urchin) | 8.08\*, 7.93 | | Adults; Eggs & sperm | 2 hours - 6 months | | Fertilization | | Low pH increased sperm swimming speed but decreased fertilization success. | | | Mesocosm | Temperate Northern Pacific | | Graham et al. (2016) | |
| *Heliocidaris erythrogramma* (sea urchin) | 8.10\*, 7.70 | | Eggs & sperm | 4 hours | | Fertilization | | Low pH reduced sperm swimming speed, motility, and fertilization success. | | | Laboratory | Temperate Australasia | | Havenhand et al. (2008) | |
| *Echinometra* sp. *EE* (sea urchin) | 8.10\*, 7.70 | | Adults | 11 months | | Gametogenesis and gamete quality | | No effect of pH on gametogenesis. | | | Laboratory | Temperate Northern Atlantic | | Hazan et al. (2014) | |
| *Sterechinus neumayeri* (sea urchin) | 8.00\*, 7.80, 7.60 | | Eggs & sperm | 30 minutes | | Fertilization | | No effect of pH on fertilization at any sperm concentration. | | | Laboratory | Southern Ocean | | Ho et al. (2013) | |
| *Asterias rubens* (sea star) | 7.90\*, 7.50, 7.20 | | Adults | 85 days | | Gametogenesis and gamete quality | | Lowest pH reduced gonad weight. | | | Laboratory | Temperate Northern Atlantic | | Hu et al. (2018) | |
| *Ancanthaster* spp. (sea star) | 8.01\*, 7.74 | | Adults; Eggs & sperm | 130-145 days | | Gametogenesis and gamete quality; Fertilization | | Low pH reduced egg volume but there was no effect of pH on gonadosomatic index or fertilization. | | | Laboratory | Central Indo-Pacific | | Hue et al. (2020) | |
| *Strongylocentrotus purpuratus* (sea urchin) | 8.03, 7.87, 7.76, 7.61 | | Eggs & sperm | 30 seconds | | Fertilization | | Low pH increased fertilization success, but this effect varied by site. | | | Laboratory | Temperate Northern Pacific | | Kapsenberg et al. (2017) | |
| *Acanthaster planci* (sea star) | 8.10\*, 7.80, 7.60 | | Eggs & sperm | 2 hours | | Fertilization | | No effect of pH on fertilization. | | | Laboratory | Central Indo-Pacific† | | Kamya et al. (2014) | |
| *Tripneustes gratilla* (sea urchin) | 8.00\*, 7.77 | | Adults | N/A | | Gametogenesis and gamete quality | | No effect of pH on egg size. | | | Laboratory | Central Indo-Pacific† | | Karelitz et al. (2019) | |
| *Hemicentrotus pulcherrimus* (sea urchin) | 7.80 | | Adults | 8 months | | Gametogenesis and gamete quality | | Low pH delayed gonad development and shortened spawning period. | | | Laboratory | Temperature Northern Pacific | | Kurihara 2008 | |
| *Echinometra mathaei* (sea urchin) | 8.11\*, 7.82, 7.71, 7.33, 7.12, 6.79 | | Eggs & sperm | 15 minutes | | Fertilization | | Lowest two pH conditions reduced fertilization rate. | | | Laboratory | Temperature Northern Pacific | | Kurihara and Shirayama 2004 | |
| *Hemicentrotus pulcherrimus (sea urchin)* | 8.01\*, 7.77, 7.61, 7.38, 7.03, 6.83 | | Eggs & sperm | 15 minutes | | Fertilization | | Lowest pH reduced fertilization rate. | | | Laboratory | Temperature Northern Pacific | | Kurihara and Shirayama 2004 | |
| *Hemicentrotus pulcherrimus* (sea urchin) | 7.61, 7.03 | | Adults | 9 months | | Gametogenesis and gamete quality | | No effect of pH on gametogenesis. | | | Laboratory | Temperature Northern Pacific | | Kurihara et al. 2013 | |
| *Lytechinus variegatus* (sea urchin) | 8.10\*, 7.80 | | Eggs & sperm | 1 hour | | Fertilization | | No effect of pH on fertilization. | | | Laboratory | Tropical Atlantic | | Lenz et al. (2019) | |
| *Paracentrotus lividus (sea urchin)* | 8.00\*, 7.40, 7.70 | | Eggs & sperm | 20 minutes | | Fertilization | | Low pH compromised egg actin dynamics but there was no effect of pH on sperm indicution. | | | Laboratory | Temperate Northern Atlantic | | Limatola et al. (2020) | |
| *Paracentrotus lividus* (sea urchin) | 8.00\*, 7.40, 7.70 | | Adults | 60 days | | Gametogenesis and gamete quality | | Low pH increased gonadosomatic index in females and decreased in males. | | | Laboratory | Temperate Northern Atlantic | | Marčeta et al. (2020) | |
| *Paracentrotus lividus* (sea urchin) | 8.10\*, 7.90, 7.70, 7.50, 7.25, 7.00 | | Eggs & sperm | 3 days | | Fertilization | | No effect of pH on fertilization. | | | Laboratory | Temperate Northern Atlantic | | Martin et al. (2011) | |
| *Holothuria* spp. (sea cucumber) | 8.00, 7.80, 7.70, 7.60, 7.30, 6.60 | | Sperm | N/A | | Fertilization | | Low pH decreased sperm motility. | | | Laboratory | Temperate Northern Pacific | | Morita et al. (2010) | |
| *Paracentrotus lividus* (sea urchin) | 8.00\*, 7.60, 6.80 | | Eggs & sperm | 2 hours | | Fertilization | | Lower pH decreased fertilization but those collected from tidepools with higher pH fluctuations were less impacted. | | | Laboratory | Temperate Northern Atlantic | | Moulin et al. 2011 | |
| *Centrostephanus rodgersii* (urchin) | 8.10\*, 7.80 - 7.04 | | Eggs & sperm | 30 minutes | | Fertilization | | Low pH decreased fertilization. | | | Laboratory | Temperate Australasia | | Pecorino et al. (2013) | |
| *Echinometra lucunter (sea* urchin) | 8.00\*, 7.70, 7.40 | | Eggs & sperm | 40 minutes | | Fertilization | | Low pH decreased fertilization. | | | Laboratory | Tropical Atlantic | | Pereira et al. (2020) | |
| *Strongylocentrotus franciscanus* (sea urchin) | 8.04\*, 7.81, 7.55 | | Eggs & sperm | 30 seconds | | Fertilization | | Low pH reduced ability to block polyspermy. | | | Laboratory | Temperate Northern Pacific | | Reuter et al. (2011) | |
| *Paracentrotus lividus* (sea urchin) | 8.00\*, 7.50, 7.00, 6.50, 6.00 | | Eggs & sperm | N/A | | Fertilization | | Low pH reduced fertilization. | | | Laboratory | Temperate Northern Atlantic | | Riba et. al (2016) | |
| *Strongylocentrotus fragilis* (sea urchin) | 7.69\*, 7.63 - 7.57 | | Adults | N/A | | Gametogenesis and gamete quality | | Low pH reduced gonad index. | | | Field | Temperate Northern Pacific | | Sato et al. (2018) | |
| *Heliocidaris erythrogramma* (sea urchin) | 8.12\*, 7.80, 7.60 | | Eggs & sperm | 10 minutes | | Fertilization | | Low pH reduced sperm motility, with inter-individual variability in fertilization. | | | Laboratory | Temperate Australasia | | Schlegel et al. (2012) | |
| *Centrostephanus rodgersii* (sea urchin) | 8.12\*, 7.80, 7.60 | | Sperm | 2 seconds | | Fertilization | | No effect of pH on sperm swimming behavior. | | | laboratory | Temperate Australasia | | Schlegel et al. (2015) | |
| *Sterechinus neumayeri* (sea urchin) | 8.05\*, 7.97, 7.83 | | Eggs & sperm | 18-24 hours | | Fertilization | | Low pH increased time for complete block to polyspermy but response to fertilization success varied between mating pairs. | | | Laboratory | Southern Ocean | | Sewell et al. (2014) | |
| *Strongylocentrotus droebachiensis* (sea urchin) | 8.10\*, 6.98 | | Adults | 56 days | | Gametogenesis and gamete quality | | Low pH hindered gonad growth. | | | Laboratory | Temperate Northern Atlantic | | Siikavuopio et al. (2007) | |
| *Arbacia* sp.(sea urchin) | 8.15, 7.60, 7.40, 7.30, 7.20, 7.10, 7.00, 6.90, 6.80, 6.70, 6.60 | | Eggs & sperm | 5 minutes | | Fertilization | | Lower pH treatments blocked fertilization. | | | Laboratory | N/A | | Smith and Clowes (1924) | |
| *Asterias* sp.(sea star) | 8.15, 7.60, 7.40, 7.30, 7.20, 7.10, 7.00, 6.90, 6.80, 6.70, 6.60 | | Eggs & sperm | 5 minutes | | Fertilization | | Lower pH treatments blocked fertilization. | | | Laboratory | N/A | | Smith and Clowes (1924) | |
| *Heliocidaris erythrogramma* (sea urchin) | 8.00\*, 7.90, 7.70 | | Eggs & sperm | 10 minutes | | Fertilization | | Low pH caused inter-individual variability in fertilization success. | | | Laboratory | Temperate Australasia | | Smith et al. (2019) | |
| *Lytechinus pictus* (sea urchin) | 8.00\*, 7.90, 7.70 | | Eggs & sperm | 10 minutes | | Fertilization | | Low pH caused inter-individual variability in fertilization success. | | | Laboratory | Temperate Australasia | | Smith et al. (2019) | |
| *Strongylocentrotus purpuratus* (sea urchin) | 8.20\*, 7.90, 7.60 | | Eggs & sperm | 20 minutes | | Fertilization | | No impact of pH alone on fertilization. | | | Laboratory | Temperate Northern Pacific | | Stavroff (2014) | |
| *Strongylocentrotus droebachiensis* (sea urchin) | 7.80\*, 7.51, 7.10 | | Adults | 10 - 45 days | | Gametogenesis and gamete quality | | Low pH reduced energy expenditure on developing gonads. | | | Laboratory | Temperate Northern Atlantic | | Stumpp et al. (2012) | |
| *Psammechinus miliaris* (sea urchin) | 7.98\*, 7.70 | | Adults | 70 days | | Gametogenesis and gamete quality; Fertilization | | Low pH resulted in smaller eggs but higher fertilization rates. | | | Microcosm | Temperate Northern Atlantic | | Suckling et al. (2014) | |
| *Sterechinus neumayeri* (sea urchin) | 7.99\*, 7.70, 7.54 | | Adults | 6 - 17 months | | Gametogenesis and gamete quality | | Low pH reduced egg size, but after some time eggs were larger at low pH. | | | Microcosm | Southern Ocean† | | Suckling et al. (2015) | |
| *Hemicentrotus pulcherrimus* (sea urchin) | 7.99\*, 7.96, 7.92, 7.78, 7.69, 7.59 | | Eggs & sperm | N/A | | Fertilization | | No effect of pH on sperm motility and speed. | | | Laboratory | Temperate Northern Pacific | | Sung et al. (2014) | |
| *Strongylocentrotus nudus* (sea urchin) | 7.99\*, 7.96, 7.92, 7.78, 7.69, 7.59 | | Eggs & sperm | N/A | | Fertilization | | Sperm and eggs exposed to low pH had reduced fertilization rates but there was no effect of pH on sperm motility and speed. | | | Laboratory | Temperate Northern Pacific | | Sung et al. (2014) | |
| *Acanthaster planci* (sea star) | 8.10\*, 7.90, 7.60 | | Eggs & sperm | 2 seconds - 10 minutes | | Fertilization | | Low pH reduced sperm motility, velocity, and fertilization. | | | Laboratory | Central Indo-Pacific† | | Uthicke et al. (2013) | |
| *Echinometra mathaei* (sea urchin) | 8.10\*, 7.90, 7.70, 7.50 | | Adults | 15 minutes - 7 weeks | | Gametogenesis and gamete quality | | No effect of pH on egg size. | | | Laboratory | Central Indo-Pacific† | | Uthicke et al. (2013) | |
| *Echinometra* sp. *A* (sea urchin) | 8.10\*, 7.90 | | Adults | 77 days | | Gametogenesis and gamete quality | | No effect of pH on gonad weight and condition. | | | Laboratory | Central Indo-Pacific† | | Uthicke et al. (2014) | |
| *Echinometra* sp. *A* (sea urchin) | 8.06\*, 7.89, 7.79 | | Adults | 20 months | | Gametogenesis and gamete quality | | No effect of pH on gamete development | | | Mesocosm | Central Indo-Pacific† | | Uthicke et al. (2020) | |
| *Cucumaria frondosa* (sea cucumber) | 8.03\*, 7.63 | | Adults | 19 weeks | | Gametogenesis and gamete quality; Timing of reproduction and synchronization | | Low pH and time affected male gonad index, gonad maturation, and spawning events. Low pH affected female egg shape, spawning success, and lipid profile. | | | Laboratory | Temperate Northern Atlantic | | Verkaik et al. (2016) | |
| *Strongylocentrotus purpuratus* (sea urchin) | 7.87, 7.57 | | Adults | 4 months | | Gametogenesis and gamete quality | | Females exposed to low pH had wider egg variability and reduced lipid content but no effect of low pH on egg size and protein content. | | | Laboratory | Temperate Northern Pacific | | Wong et al. (2019) | |
| *Amphiura filiformis* (brittle star) | 8.00\*, 7.70, 7.30, 6.80 | | Adults | 40 days | | Gametogenesis and gamete quality | | No effect of pH on gametogenesis but experiment was conducted during a period generally classified with latent reproductive growth | | | Mesocosm | Temperate Northern Atlantic | | Wood et al. (2008) | |
| *Strongylocentrotus intermedius* (sea urchin) | 8.00\*, 7.71 - 7.51 | | Eggs & sperm | 5 minutes, 15 minutes, 30 minutes, 60 minutes | | Fertilization | | No effect of pH on fertilization. | | | Laboratory | Temperate Northern Pacific | | Zhan et al. (2016) | |
| *Hemicentrotus pulcherrimus* (sea urchin) | 8.06\*, 7.76 - 7.55 | | Eggs & sperm | 15 minutes | | Fertilization | | No effect of pH on fertilization. | | | Laboratory | Temperate Northern Pacific | | Zhan et al. (2017) | |
| *Glyptocidaris crenularis* (sea urchin) | 7.98\*, 7.68 - 7.48 | | Eggs & sperm | 15 minutes | | Fertilization | | Low pH decreased fertilization rate and increased percentage of abnormal fertilized eggs. | | | Laboratory | Temperate Northern Pacific | | Zhan et al. (2018) | |
| **Mollusca** |  | |  |  | |  | |  | | |  |  | |  | |
| *Tridacna maxima* (clam) | 8.10\*, 7.60 | | Eggs & sperm | 2 hours | | Fertilization | | No effect of low pH on fertilization. | | | Laboratory | Eastern Indo-Pacific | | Armstrong et al. (2019) | |
| *Crassostrea gigas* (oyster) | 8.09\*, 7.76, 7.37 | | Eggs & sperm | 4 hours | | Fertilization | | Low pH decreased fertilization rate. | | | Laboratory | Temperate North Atlantic | | Barros et al. (2013) | |
| *Mytilus edulis* (mussel) | 8.10\*, 7.60 | | Eggs & sperm | 2 hours | | Fertilization | | No effect of low pH on fertilization. | | | Laboratory | Temperate North Atlantic | | Bechmann et al. (2011) | |
| *Haliotis rufescens* (abalone) | 7.90\*, gradient from ~7.15 to 7.95 | | Eggs & sperm | 600 seconds | | Fertilization | | Low pH decreased fertilization rate. | | | Laboratory | Temperate Northern Pacific | | Boch et al. (2017) | |
| *Crassostrea virginica* (oyster) | 7.9\*,  7.5, 7.1,  6.7 | | Adults | 5 weeks | | Gametogenesis and gamete quality; Fertilization; Sex determination, differentiation, and ratio | | Low pH reduced or inhibited gametogenesis rate and female prevalence but no effect of pH on fertilization. | | | Laboratory | Temperate North Atlantic | | Boulais et al. (2017) | |
| *Laternula elliptica* (clam) | 7.98\*, 7.65 - 7.80 | | Eggs & sperm | 4 - 48 hours | | Fertilization | | Low pH increased fertilization rate as a sole stressor. | | | Laboratory | Southern Ocean † | | Bylenga et al. (2015) | |
| *Haliotis coccoradiata* (abalone) | 8.25\*, 7.90 - 7.60 | | Eggs & sperm | 15 minutes | | Fertilization | | No effect of low pH on fertilization. | | | Laboratory | Temperate Australasia | | Byrne et al. (2010) | |
| *Crassostrea virginica* (oyster) | 7.90\*, 7.70, 7.50 | | Adults | 14, 28 days | | Gametogenesis and gamete quality; Sex determination, differentiation, and ratio | | Low pH increased percentage of mature gametes and reproductive tissue but no effect of pH on sex ratio. | | | Laboratory | Temperate Northern Atlantic | | Clements et al. (2021) | |
| *Adamussium colbecki* (scallop) | 8.12\*, 7.80, 7.60 | | Adults | 34 days | | Gametogenesis and gamete quality | | Low pH resulted in more advanced gametes and higher prevalence of anomalous gonad tissue. | | | Laboratory | Southern Ocean | | Dell’Acqua et al. (2019) | |
| *Elysia clarki* (sea slug) B | 8.00\*, 7.60 | | Adults | 4 weeks | | Fecundity and Reproductive Output | | Low pH reduced number of egg masses laid by adults. | | | Laboratory | Tropical Atlantic † | | Dionísio et al. (2017) | |
| *Mytilus galloprovincialis* (mussel) | 8.00\*, 7.60, 7.80 | | Eggs & sperm | 10 minutes - 2 hours | | Fertilization | | Low pH decreased fertilization rate and sperm motility. | | | Laboratory | Temperate Australasia | | Eads et al. (2016) | |
| *Perna canaliculus* (mussel) | 8.30\*, 8.10\*, 7.70, 7.30 | | Eggs & sperm | 4 - 6.5 hours (varied by trial) | | Fertilization | | Low pH reduced fertilization rate, depending on sperm concentration. | | | Laboratory | Temperate Australasia | | Ericson (2010) | |
| *Mytilus galloprovincialis* (mussel) | 8.10\*, 7.80 | | Sperm | 4 hours | | Fertilization | | Low pH decreased sperm motility, mitochondrial activity and pHi but no effect of pH on sperm vitality and oxidative state. | | | Laboratory | Temperate North Atlantic | | Esposito et al. (2020) | |
| *Crassostrea gigas* (oyster) | 8.03\*, 7.86, 7.74 | | Sperm | 10 minutes | | Fertilization | | Low pH increased sperm motility in an established population but no effect of pH in a recently invaded population. | | | Laboratory | Temperate North Atlantic | | Falkenberg et al. (2019) | |
| *Mytilus galloprovincialis* (mussel) | 8.10\*, 7.80 | | Adults | 21 days | | Fertilization | | Low pH increased percent abnormal sperm in both settings; sperm motility, mitochondrial membrane potential, intracellular pH, and lipid peroxidation differed temporally and among settings. | | | Field & Laboratory (microcosm) | Temperate North Atlantic | | Gallo et al. (2020) | |
| *Saccostrea glomerata* (oyster) | 8.10\*, 7.80 | |  | 8 weeks | | Gametogenesis and gamete quality | | Low pH increased egg lipid content. | | |  | Temperate Australasia | | Gibbs et al. (2021a; 2021b) | |
| *Crassostrea gigas* (oyster) | 8.10\*, 7.80 | |  | 8 weeks | | Gametogenesis and gamete quality | | No effect of low pH on egg lipid content. | | |  | Temperate Australasia | | Gibbs et al. (2021a; 2021b) | |
| *Crassostrea angulata* (oyster) | 8.20\*, 7.90 - 7.60 | | Eggs & sperm | 2 hours | | Fertilization | | Low pH did not affect fertilization rate as a sole stressor. | | | Laboratory | Central Indo-Pacific | | Guo et al. (2020) | |
| *Haliotis discus hannai* (abalone) | 8.20\*, 7.90 - 7.60 | | Eggs & sperm | 2 hours | | Fertilization | | Low pH did not affect fertilization rate as a sole stressor. | | | Laboratory | Central Indo-Pacific | | Guo et al. (2020) | |
| *Tegillarca granosa* (clam) | 8.10\*, 7.80, 7.40 | | Eggs | 1 hour prior to insemination | | Fertilization | | Low pH increased polyspermy rate. | | | Laboratory | Temperate Northern Pacific | | Han et al. (2021) | |
| *Crassostrea gigas* (oyster) | 8.15\*, 7.85 | | Eggs & sperm | 1 hour | | Fertilization | | No effect of low pH on sperm swimming speed, motility, or fertilization rate. | | | Laboratory | Temperate North Atlantic | | Havenhand and Schlegel (2009) | |
| *Haliotis discus hannai* (abalone) | 8.02\*, 7.96 - 7.73 | | Eggs & sperm | 15 hours | | Fertilization | | Low pH decreased fertilization rate only at severe treatments  (pH ≤ 7.49) compared to control (pH 8.02) | | | Laboratory | Temperate Northern Pacific | | Kimura et al. (2011) | |
| *Babylonia japonica*  (snail) B | 8.10\*, 7.60 - 6.70 | | Adults | 80 days | | Fecundity and Reproductive Output | | No effect of low pH on the number of spawning events or number of egg capsules produced. | | | Laboratory | Temperate Northern Pacific | | Kita et al. (2013) | |
| *Mytilus edulis* (mussel) | 8.10\*, 7.70, 7.30 | | Adults only, Adults & gametes | 8 hours - 4 weeks | | Fertilization | | Low pH decreased fertilization rate but effect was mitigated by parental exposure. | | | Laboratory | Temperate Northern Pacific | | Kong et al. (2019) | |
| *Pinctada margaritifera* (oyster) | 8.20\*, 7.80, 7.40 | | Adults | 100 days | | Gametogenesis and gamete quality | | No effect of low pH on gametogenic stage. | | | Laboratory | Eastern Indo-Pacific | | Le Moullac et al. (2016) | |
| *Mytilus galloprovincialis* (mussel) | 8.00\*, 7.60 | | Sperm & eggs (only sperm pre- exposed) | 10 minutes - 2 hours | | Fertilization | | Low pH increased fertilization rate in the presence of egg-derived chemicals. | | | Laboratory | Temperate Australasia | | Lymbery et al. (2019) | |
| *Crepidula onyx* (snail) B | 8.0\*, 7.7,  7.3 | | From veliger larvae to sexual maturity | >36 months | | Fecundity and Reproductive Output | | Long-term low pH exposure reduced number of brooded larvae released per individual. | | | Laboratory | Central Indo-Pacific | | Maboloc & Chan (2021) | |
| *Limacina helicina antarctica* (pteropod) | 8.00\*, 7.80, 7.60 | | Adults | 8 days | | Fecundity and Reproductive Output | | Low pH resulted in fewer eggs which were smaller and had less carbon content. Low pH increased number of spawning events. | | | Laboratory | Southern Ocean | | Manno, Peck & Tarling (2016) | |
| *Crassostrea gigas* (oyster) | 8.10\*, 7.50, 7.80 | | Adults | 4 weeks | | Fertilization | | Low pH decreased sperm motility and increased the prevalence of ruptured eggs when spawned. | | | Laboratory | Temperate Southern Africa | | Omoregie et al. (2019) | |
| *Turbo cornutus* (snail) | 8.00\*, 7.8 - 7.4 | | Eggs & sperm | 2 hours | | Fertilization | | No effect of low pH on fertilization. | | | Laboratory | Temperate Northern Pacific | | Onitsuka et al. (2014) | |
| *Saccostrea glomerata* (oyster) | 375 µatm\*, 600 µatm, 750 µatm, 1000 µatm | | Eggs & sperm | 2 hours | | Fertilization | | Low pH decreased fertilization rate. | | | Laboratory | Temperate Australasia | | Parker et al. (2009) | |
| *Saccostrea glomerata* (oyster) | 8.20\*, 7.91 | | Adults | 8 weeks | | Gametogenesis and gamete quality | | No effect of low pH on egg lipid content or egg size. | | | Laboratory | Temperate Australasia | | Parker et al. (2017) | |
| *Saccostrea glomerata* (oyster) | 8.20\*, 7.91 | | Adults | 8 weeks | | Gametogenesis and gamete quality; Fecundity and reproductive output; Sex determination, differentiation, and ratio; Timing of reproduction and synchronization | | Low pH decreased gametogenesis, gonad area, and fecundity but increased female prevalence. | | | Laboratory | Temperate Australasia | | Parker et al. (2018) | |
| *Saccostrea glomerata* (oyster) | 8.20\*, 7.8 | | Adults | 5 weeks | | Gametogenesis and gamete quality | | No effect of low pH on egg size. | | | Laboratory | Temperate Australasia | | Parker et al. (2021) | |
| *Saccostrea glomerata* (oyster) | 8.20\*, 8.00 - 7.83 | | Eggs & sperm | 2 hours | | Fertilization | | Low pH decreased fertilization rate. | | | Laboratory | Temperate Australasia | | Parker, Ross and O'Connor (2010) | |
| *Crassostrea gigas* (oyster) | 8.2\*, 8.00 - 7.83 | | Eggs & sperm | 2 hours | | Fertilization | | Low pH decreased fertilization rate. | | | Laboratory | Temperate Australasia | | Parker, Ross and O'Connor (2010) | |
| *Astarte crenata* (mussel) | ~7.85-7.95\*, ~7.75-7.85 | | Adults | 135 days | | Gametogenesis and gamete quality | | No effect of low pH on egg size frequency distribution. | | | Laboratory | Arctic † | | Reed et al. (2021) | |
| *Bathyarca glacialis* (mussel) | ~7.85-7.95\*, ~7.75-7.85 | | Adults | 120 days | | Gametogenesis and gamete quality | | No effect of low pH on egg size frequency distribution. | | | Laboratory | Arctic † | | Reed et al. (2021) | |
| *Mytilus edulis* (mussel) | 8.00\*, 6.00, 6.50, 7.00, 7.50 | | Eggs & sperm | N/A | | Fertilization | | Low pH decreased or inhibited fertilization rate, but only at severely low pH (6.0). | | | Laboratory | Temperate North Atlantic | | Riba et al. (2016) | |
| *Crassostrea gigas* (oyster) | 8.00\*, 6.00, 6.50, 7.00, 7.50 | | Eggs & sperm | N/A | | Fertilization | | Low pH decreased or inhibited fertilization rate, but fertilization was not fully inhibited in severely low pH (6.0). | | | Laboratory | Temperate North Atlantic | | Riba et al. (2016) | |
| *Bathymodiolus septemdierum* (mussel) | NA\*, 5.20, 5.80, 5.90, 7.00, 7.30 | | Adults | NA | | Gametogenesis and gamete quality | | No effect of extreme low pH at hydrothermal vents on egg size or gametogenesis. | | | Field | Central Indo-Pacific | | Rossi & Tunnicliffe (2017) | |
| *Mimachlamys asperrima* (scallop) | 8.20\*, 7.89 - 7.69 | | Eggs & sperm | 2- 24 hours | | Fertilization | | Low pH decreased fertilization rate. | | | Laboratory | Temperate Australasia | | Scanes et al. (2014) | |
| *Saccostrea glomerata* (oyster) | 8.12\*, 7.83 | | Adults | 8 weeks | | Gametogenesis and gamete quality | | No effect of low pH on egg size or lipid content. | | | Laboratory | Temperate Australasia | | Scanes et al. (2018) | |
| *Tegillarca granosa* (clam) | 8.10\*, 7.80, 7.40 | | Eggs & sperm | 30 - 60 minutes | | Fertilization | | Low pH decreased fertilization rate and sperm velocity. | | | Laboratory | Temperate Northern Pacific | | Shi et al. (2017a) | |
| *Tegillarca granosa* (clam) | 8.07\*, 7.80, 7.40 | | Eggs only, sperm only, eggs & sperm | 1 hour | | Fertilization | | Low pH decreased fertilization rate when eggs or sperm were exposed, and effects was amplified when both gametes were exposed, and similar effects were found for HCL- and pCO2-modulated water. Sperm motility decreased with increasing pCO2-modulated water only. | | | Laboratory | Temperate Northern Pacific | | Shi et al. (2017b) | |
| *Idiosepius pygmaeus* (squid) | 8.05\*, 7.78 | | Breeding adult pairs | 14 days | | Gametogenesis and gamete quality, Fecundity and reproductive output; Mating behavior | | Low pH decreased egg clutch size and vitelli size but increased egg swelling when breeding pairs were exposed. No effect of low pH on fertilization rate or egg area. Females laid more dense egg clutches in low pH, but no other mating behaviors were affected. | | | Laboratory | Central Indo-Pacific | | Spady et al. (2019) | |
| *Ostrea lurida* (oyster) B | 7.80\*, 7.30 | | Adults | 2 days | | Gametogenesis and gamete quality; Fecundity and Reproductive Output; Sex determination, differentiation, and ratio; Timing of reproduction and synchronization | | Winter exposure to low pH decreased spermatogenesis rate and increased brood size but there was no effect of pH on timing of spawning, total reproductive output, oogenesis, or sex ratio. | | | Laboratory | Temperate Northern Pacific | | Spencer et al. (2020) | |
| *Cyclina sinensis* (clam) | 8.20\*, 7.80, 7.40 | | Eggs & sperm | 2 days | | Fertilization | | Low pH decreased fertilization rate. | | | Laboratory | Temperate Northern Pacific | | Sui et al. (2019) | |
| *Limecola balthica* (clam) | 7.70\*, 7.00, 6.30 | | Eggs & sperm | 1 hour | | Fertilization | | Low pH decreased fertilization rate. | | | Laboratory | Temperate North Atlantic | | Świeżak et al. (2018) | |
| *Perna perna* (mussel) | 8.10\*, 7.60, 7.00, 6.50, 6.00 | | Eggs & sperm | 1 hour | | Fertilization | | Low pH decreased fertilization rate. | | | Laboratory | Temperate South America | | Szalaj et al. (2017) | |
| *Macoma balthica* (clam) | 8.10\*, 7.80, 7.50 | | Eggs & sperm | 24 hours | | Fertilization | | Low pH decreased fertilization rate. | | | Laboratory | Temperate North Atlantic | | Van Colen et al. (2012) | |
| *Crassostrea gigas* (oyster) | 7.82\*, 7.31 | | Adults | 52 days | | Gametogenesis and gamete quality; Sex determination, differentiation, and ratio | | No effect of pH on gametogenesis or sex ratio. | | | Laboratory | Temperate Northern Pacific | | Venkataraman et al. (2019) | |
| *Mytilus galloprovincialis* (mussel) | 8.00\*, 7.60 | | Sperm | a few minutes | | Fertilization | | Low pH decreased sperm motility and swimming speed. | | | Laboratory | Temperate North Atlantic | | Vihtakari et al. (2013) | |
| *Macoma calcarea* (clam) | 380 µatm\*, 1000 µatm | | Sperm | up to 1 hour | | Fertilization | | Low pH decreased sperm swimming speed decreased but no effect of pH on fertilization rate or sperm motility. | | | Laboratory | Temperate North Atlantic | | Vihtakari et al. (2016) | |
| *Mytilus galloprovincialis* (mussel) | 380 µatm\*, 1000 µatm | | Sperm | up to 4.5 hours | | Fertilization | | Low pH decreased fertilization success, sperm motility and swimming speed. | | | Laboratory | Temperate North Atlantic | | Vihtakari et al. (2016) | |
| *Argopecten irradians* (scallop) | 8.30\*, 7.60 | | Eggs & sperm | 15 minutes | | Fertilization | | Low pH decreased fertilization rate. | | | Laboratory | Temperate Northern Pacific | | Wang et al. (2016) | |
| *Mytilus coruscus* (mussel) | 8.10\*, 7.70, 7.30 | | Eggs & sperm | 2 hours | | Fertilization | | Low pH decreased fertilization rate. | | | Laboratory | Temperate Northern Pacific | | Wang et al. (2020) | |
| *Mytilus coruscus* (mussel) | 8.10\*, 7.70, 7.30 | | Adults | 20 days | | Gametogenesis and gamete quality | | Low pH reduced gonadosomatic index (GSI) and sex steroid concentration. | | | Laboratory | Temperate Northern Pacific | | Wang et al. (2021) | |
| *Argopecten irradians* (scallop) | 7.96\*, 7.30 | | Eggs & Sperm,  Adults during spawning | 45 minutes - 24 hours | | Fertilization | | Low pH decreased fertilization rate in one experiment, had no effect in another. | | | Laboratory | Temperate North Atlantic | | White et al. (2014) | |
| *Ostrea lurida* (oyster) B | 8.00\*, 8.00, 7.50 | | Adults | ~50 days | | Fecundity and Reproductive Output; Timing of reproduction and synchronization | | Low pH resulted in fewer larvae released and delayed release time in one trial (not sign.). | | | Laboratory | Temperate Northern Pacific | | Wippel (2017) | |
| *Ruditapes philippinarum* (clam) | 8.00\*, 7.70, 7.40 | | Adults | 70 days | | Gametogenesis and gamete quality, Timing of reproduction and synchronization | | Low pH reduced number of animals to successfully spawn. | | | Laboratory | Temperate Northern Pacific | | Xu et al. (2016) | |
| *Musculista senhousia* (mussel) | 8.10\*, 7.70 | | Adults | 40 days | | Gametogenesis and gamete quality | | Low pH decreased spawning rate (when induced) and increased egg size. | | | Laboratory | Temperate Northern Pacific | | Zhao et al. (2019) | |

The subscript B after the species name indicates that the species is a brooder (copulation using ovipositor in the case of the squid or lay fertilized egg masses in the case of the sea slug).

\*An asterisk next to a pH level indicates control or ambient conditions.

† The obelisk symbol next to the collection location indicates that the collection Ecoregion is different from the experimental Ecoregion.

In the case where pH was not reported, pCO2 values were used in this table.