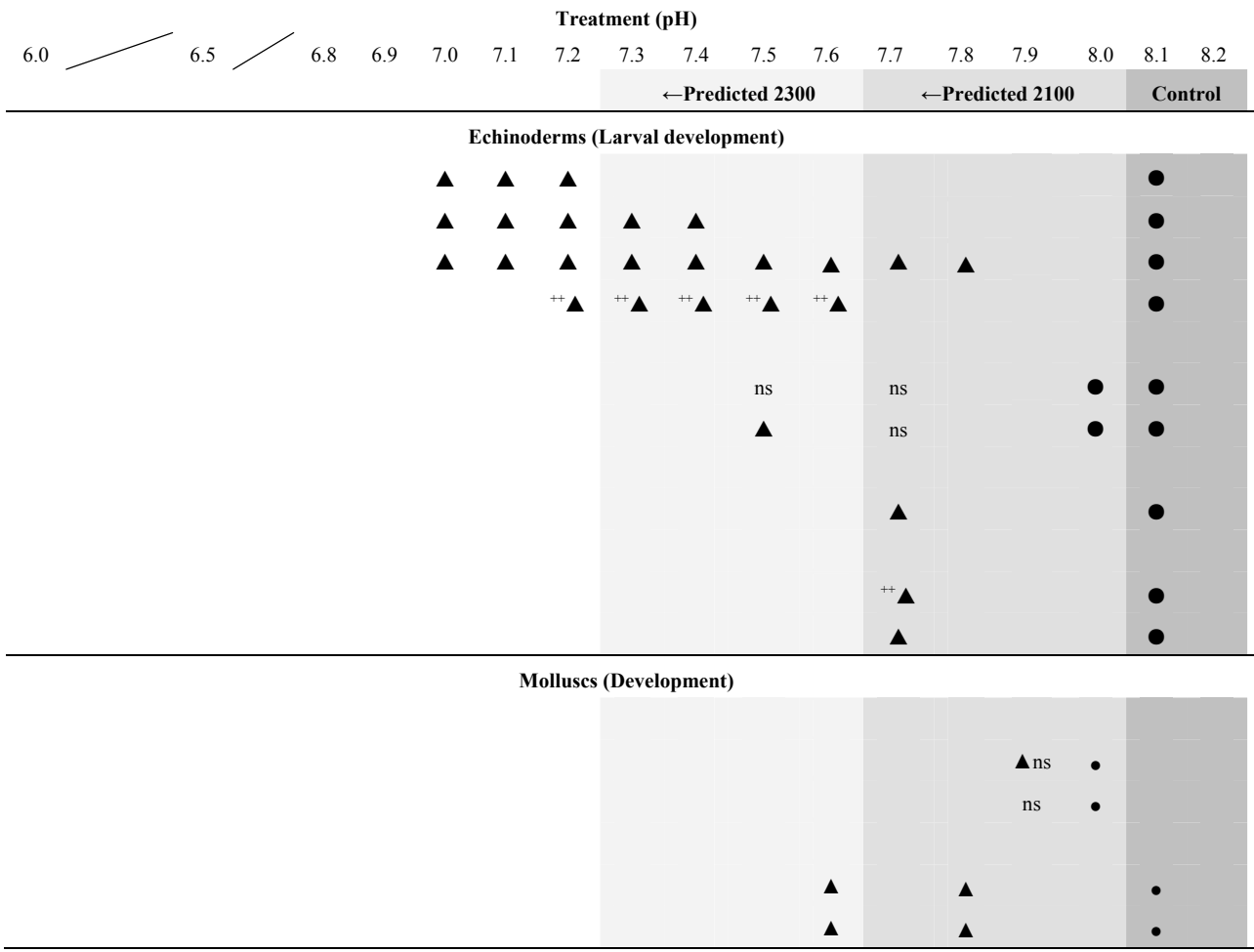
Table S2. Summary of experimental studies on the effects of ocean acidification on marine organisms.

Treatment (pH)																	Study- Author/ Species/ Stage
6.0	6.5	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	
							←Predicted 2300				←Predicted 2100				Control		
Echinoderms (Larval development)																	
																	Kurihara & Shirayama [52]—*Hemicentrotus pulcherrimus*
		▲		▲			▲			▲		△		●			• Development of pluteus
																	Kurihara *et al*.[53]
					▲		▲			▲	ns			●			• Size—*Hemicentrotus pulcherrimus*
					▲		▲				▲	ns			●		• Size—*Echinometra mathaei*
																	Dupont *et al.* [61]—*Ophiothrix fragilis*
											▲		▲		●		• Survival
											▲		▲		●		• Body rod length from day 2
											▲		▲		●		• Asymmetry from day 2
											▲		▲		●		• Development
																	Dupont *et al*. [32]—C*rossaster pappossus*
											++▲				●		• Increased growth & development rates
											ns				●		• Survival
											ns				●		• Skeletogenesis
																	Clark *et al.* [60]—4 sea urchins
▲	ns			ns					▲ns					●			• *Sterechinus neumayeri* (Antartica) 7 days
▲	ns			ns					ns		▲ns			●	●		• *Evechinus chloroticus* (New Zealand) 9–13 days
▲	▲			ns					ns		△			●		●	• *Pseudechinius huttoni* (New Zealand)
▲	▲			ns					ns			▲		●		●	• *Tripneustes gratilla* (Cook Is, tropical)
																●	Ericson *et al.* [54]—*Sterechinus neumayeri*
				ns			ns				ns			●			• Day 1–2 Cleavage, abnormal embryos, or coeloblastula

Table S2. *Cont.*

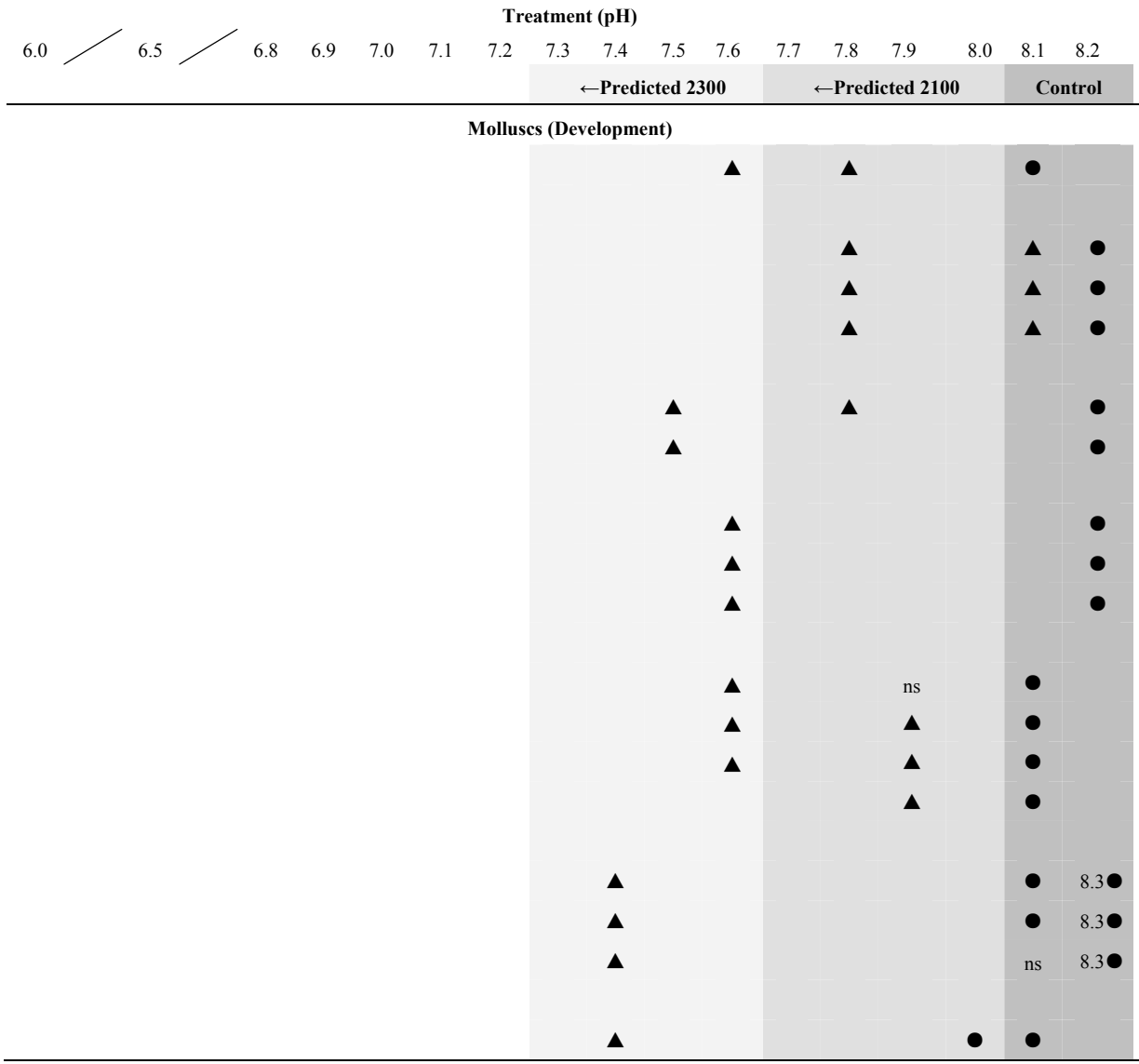
Treatment (pH)																	Study- Author/ Species/ Stage
6.0	6.5	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	
							←Predicted 2300				←Predicted 2100				Control		
Echinoderms (Larval development)																	
				▲			ns				ns			●			• Day 6 abnormal and size
																	Byrne *et al.* [34]—*Heliocidaris erythrogramma*
										ns		ns			●		• Cleavage
																	Byrne *et al.* [120]—*Heliocidaris erythrogramma*
										▲		▲			●		• Calcification
										▲		▲			●		• Development
										▲		▲			●		• Spine formation
																	Sheppard Brennand *et al.* [45]—*Tripneustes gratila*
										▲		▲			●		• Growth
																	O'Donnell *et al*. [79]—*Strongylocentrotus franciscanus*
													▲	●			• Changed gene expression profile heat stress gene *hsp70*
																	O'Donnell *et al.*[80]—*Lytechinus pictus*
												▲	●				• Size, arm length, shape
												▲	●				• Gene expression: biomineralization, skeletogenesis, energy metabolism,
												++▲	●				• Gene expression: some acid-base, ion regulation
																	Moulin *et al*. [42]—*Paracentrotus lividus*
		▲		▲		▲		▲		▲		ns		●			• Cleavage
		▲		▲		▲		ns		ns		ns		●			• Rod size
		▲		▲		▲		▲		ns		ns		●			• Abnormality
																	Martin *et al*.[121]—*Paracentrotus lividus*
				▲											●		• Delayed pluteus development

Table S2. *Cont.*



Study- Author/ Species/ Stage
• Morphology
• Post-oral and antero-lateral arm length
• Rod size
• Protein and biomineralization genes
Yu *et al*.[122]—*Strongylocentrotus purpuratus*
• Development
• Size
Stumpp *et al*.[83]—*Strongylocentrotus purpuratus*
• Scope for growth and development
Stumpp *et al*.[82]—*Strongylocentrotus purpuratus*
• Genes, ATP synthase regulat6ion
• Genes, calcification
Zippay & Hofmann [74]—*Haliotis rufescens*
• Thermal tolerance varied with development stage
• Gene expression *ap24, engrailed genes*
Byrne *et al*.[120]—*Haliotis coccoradiata*
• Calcification
• Development

Table S2. *Cont.*



Study- Author/ Species/ Stage

- Abnormal

Crim *et al*. [123]—*Haliotis kamtschatkana*

- Survival
- Shell size
- Abnor mality

Comeau *et al*. [68]—*Cavolinia inflexa*

- Size
- Shape

Elllis *et al*. [63]—*Littorina obtusata*

- Embryo viability, activity and physiology
- Size
- Heart Rate

Gazeau *et al*. [65]—*Mytilus edulis*

- Hatching rates
- Size at hatching
- Size *larvae*
- Shell thickness

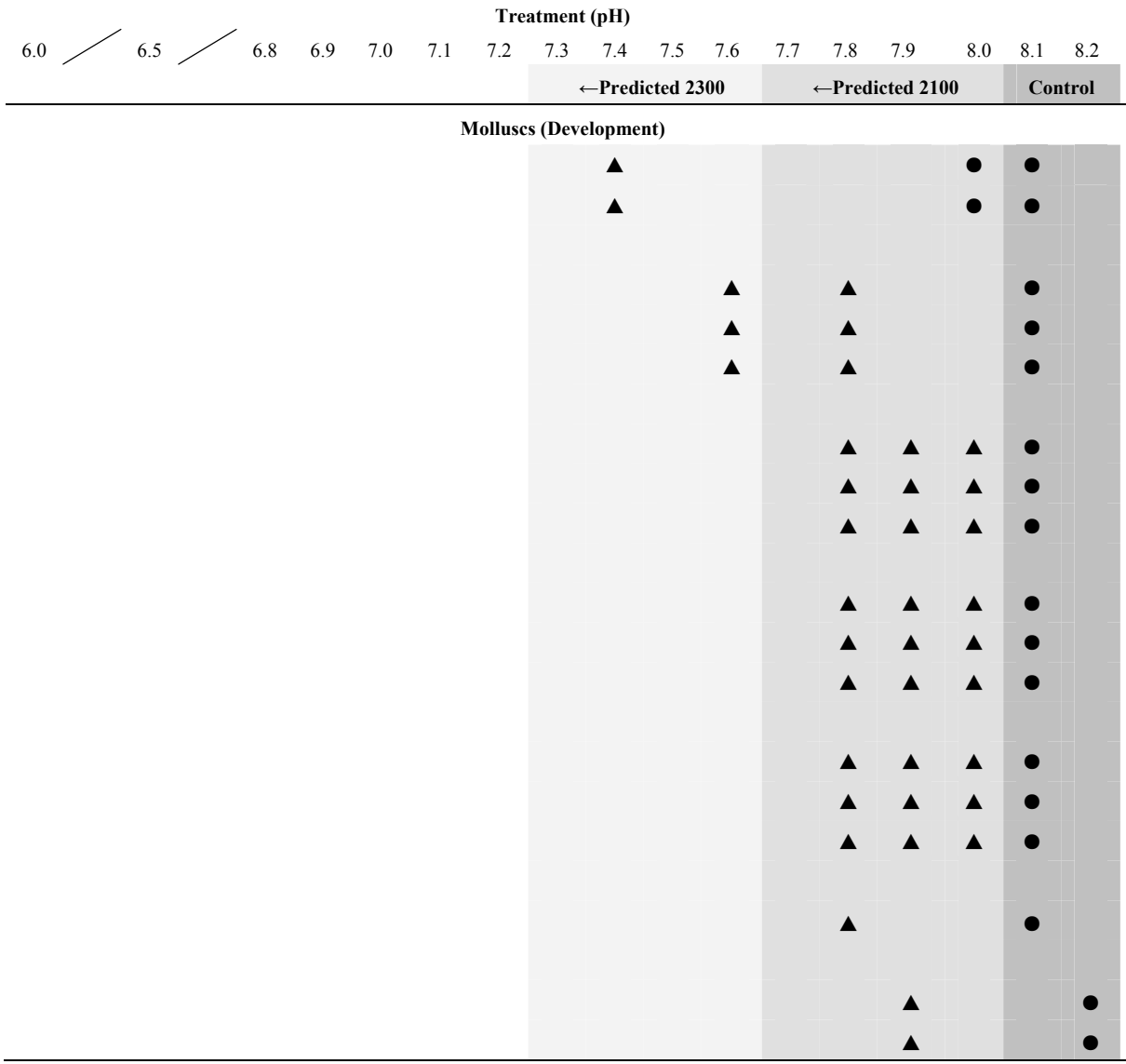
Kurihara *et al*. [33]—*Crassostrea gigas*

- Development
- Abnormal
- Growth

Kurihara *et al*. [57]—*Mytilus galloprovincialis*

- Development

Table S2. *Cont.*



Study- Author/ Species/ Stage

- Abnormal—6days
- Growth 54hr, 120 hr, 6days

Watson *et al*. [64]—*Saccostrea glomerata*

- Survival
- Growth & development
- Shell abnormality

Parker *et al.*[35]—*Saccostrea glomerata*

- Survival
- Growth & development
- Abnormality

Parker *et al*. [39]—*Crassostrea gigas* (x temperature)

- Development—48 hr
- Abnormality
- Size

Parker *et al.* [39]—*Saccostrea glomerata*

- Development—48 hr
- Abnormality
- Size

Parker *et al*. [43]—*Saccostrea glomerata*

- Size of spat- Selected lines > wild

Parker *et al.* [59]—*Saccostrea glomerata*

- Growth
- Development

Table S2. *Cont.*

Treatment (pH)																		Study- Author/ Species/ Stage
6.0	/	6.5	/	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	
									←Predicted 2300				←Predicted 2100				Control		
Molluscs (Development)																			
															▲			●	• Survival
																			Miller *et al*. [124]—*Crassostrea ariakensis*
														ns	ns		ns	●	• Growth
														ns	ns		ns	●	• Calcification
																			Miller *et al*. [124]—*Crassostrea virginica*
														▲	▲		ns	●	• Growth
														▲	ns		ns	●	• Calcification
																			Gutowska *et al*., [70]—*Sepia officinalis*
							ns	ns								●			• Growth
							ns	ns								●			• Metabolic rate
							$^{++}$▲	ns								●			• Increased calcification
																			Gutowska and Melzner [62]—*Sepia officinalis*
								●											• pCO_2 in embryos
																			Lacoue-Labarthe *et al.* [71]—*Sepia officinalis*
												ns		ns			●		• Egg and hatchling weight
												$^{++}$▲					●		• ^{110m}Ag uptake
												▲					●		• ^{109}Cd uptake
														▲			●		• ^{65}Zn uptake
																			Talmage & Gobler [67]—*Mercenaria mercenaria* & *Argopecten irradians*
											▲			▲		▲		●	• Metamorphosis
											▲			▲		▲		●	• Growth
											▲			▲		▲		●	• Survival

Table S2. *Cont.*

Treatment (pH)																		Study- Author/ Species/ Stage
6.0	/	6.5	/	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	
									←Predicted 2300				←Predicted 2100				Control		
Molluscs (Development)																			
											▲			▲		▲		●	• Shell thickness
											▲			▲		▲		●	• Lipid content
																			Range *et al*. [69]—*Ruditapes decussatus*
											ns			ns		●			• Calcification rate
											ns			ns		●			• Size
											ns			ns		●			• Weight
																			Waldbusser *et al*. [44]—*Mercenaria spp*.
										▲						●			• Size dependency of calcification rate
												▲				▲			
										▲		▲				●			• Calcification
																			Lischka *et al.* [66]—*Limacina helicina*
												▲		ns		ns		●	• Shell increment: diameter
												▲		△		ns		●	• Shell increment
												▲		▲		ns		●	• Shell degradation
												▲		ns		ns		●	• Mortality

Table S2. *Cont.*

Treatment (pH)																	Study- Author/ Species/ Stage
6.0	/	6.5	/	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	
									←Predicted 2300				←Predicted 2100				Control		
Echinoderms (Fertilisation)																			
																			Kurihara and Shirayama [52], Kurihara *et al.* [53]
				▲		△				△		ns				●			• *Hemicentrotus pulcherrimus*
				▲			▲		△△				ns	ns			●		• *Echinometra mathaei*
																			Havenhand *et al.* [56]—*Heliocidaris erythrogramma*
													▲				●		• Fertilisation success
													▲				●		• Sperm speed
													▲				●		• Sperm motility
												△		ns	ns			●	Byrne *et al*. [34]—*Heliocidaris erythrogramma*
												ns		ns				●	Byrne *et al*.[47]- *Heliocidaris erythrogramma*
																			Byrne *et al.* [48]
												ns		ns	ns			●	*Heliocidaris erythrogramma*
												△		ns	ns			●	*H.tuberculata*—(Little Bay)
												ns		ns	ns			●	*Tripneustes gratila*—(Coffs Harbour)
												ns		ns	ns			●	*Centrostephanus rodgersii* (Little Bay)
												ns		ns	ns			●	*Patiriella regularis* (Hobart)
																			Reuter *et al.* [55]—*Strongylocentrotus franciscanus*
											▲			▲		●			• Fertilisation efficiency
											▲			ns		●			• Time of egg block to polyspermy
																			Moulin *et al.* [42]—*Paracentrotus lividus*
				▲		▲		▲		▲		▲		ns		●			• Fertilisation rate
																			Ericson *et al*. [54]—*Sterechinus neumayeri*
						ns			ns				ns			●			• Optimal or above optimal sperm
						▲			▲				ns			●			• Suboptimal sperm

Table S2. *Cont.*

Treatment (pH)																		Study- Author/ Species/ Stage
6.0	/	6.5	/	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	
									←Predicted 2300				←Predicted 2100				Control		
Molluscs (Fertilisation)																			
										ns						●	●		Kurihara *et al*. [57]—*Mytilus galloprovincialis*
																			Havenhand and Schlegel [49]—*Crassostrea gigas*
														ns			●		• Swimming speed
														ns			●		• Motility
																			Parker *et al*. [35,39]
														▲	▲	▲	●		*Crassostrea gigas*
														▲	▲	▲	●		*Saccostrea glomerata*
												ns		ns	ns			●	Byrne *et al*. [48]—*Haliotis coccoradiata*
Crustaceans (Decapods)																			
																			Kurihara *et al*. [87]—*Palaemon pacificus*
												▲			▲		•		Survival adults 15–30 weeks
												▲			ns		•		Growth 15–30 weeks
												ns			ns		•		Feeding 15–30 weeks
												▲			▲		•		Moulting 15–30 weeks
															▲		•		2nd antennae length
															ns		•		Oxygen consumption 15–30 weeks
															△		•		Egg production
																			Arnold *et al*. [92]—*Homarus gammarus*

Table S2. *Cont.*

Treatment (pH)																	Study- Author/ Species/ Stage
6.0	/	6.5	/	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	
									←Predicted 2300				←Predicted 2100				Control		
Crustaceans (Decapods)																			
																	ns	8.4●	• Length
																	▲	8.4●	• Mass
																	▲	8.4●	• Ca/Mg
																			Walther *et al.*[93]—*Hyas araneus*
									▲				▲				●		• Development delay
									▲				▲				●		• Growth
									▲				▲				●		• Fitness
																			Walther *et al*[97]—*Hyas araneus*x tempx latitude
									▲				▲				●		• Calcification
													ns						
(Crustaceans) Amphipods																			
																			Egilsdottir *et al.* [94]—*Echinogammarus marinus*
											ns					●			• Oxygen uptake post-brooding females
											ns					●			• Number of hatchlings
											ns					●			• Total Ca content
											▲					●			• Developmental time only with lowered salinity
																			Hauton *et al*. [88]—*Gammarus locusta*
											ns			△			●		• Survival 28–30 days
											ns			ns			●		• Growth 28–30 days
											++▲▲			ns			●		• Gene expression *gapdh* gene 28–30 days

Table S2. *Cont.*

Treatment (pH)																		
6.0	/	6.5	/	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	**Study- Author/ Species/ Stage**
									←Predicted 2300				**←Predicted 2100**				**Control**		
Corals																			
																			Suwa *et al*. [98]
									▲			▲						●	• Planula survival—*Acropora tenuis*
									ns			ns						●	• Planula survival—*Acropora digitifera*
									▲			△							• Polyp size—*Acropora digitifera*
									▲			△							• Algal infection—*Acropora digitifera*
																			Jokiel *et al*. [125]
														ns	ns			●	• Recruitment—*Pocillopora damicornis*
														ns	ns			●	• Gametes—6 months *Montipora capitata*
																			Anlauf *et al*. [99]—*Porites panamensis*
														ns			●		• Survival
														ns			●		• Settlement
																			Morita *et al*. [126]—*Acropora digitifera* (coral)
									▲			▲	▲	▲		●			• Sperm motility
																			Albright *et al*.[58]—*Acropora palmate*
														▲	▲	●			• Fertilisation
														▲	▲	●			• Settlement
														▲	▲	●			• Post-settlement growth
																			Albright *et al*.[100]—*Porites astreoides*
														▲	▲	●			• Metabolism
														▲	▲	●			• Settlement
														▲	▲	●			• Post-settlement growth
																			Holcomb *et al*.[127]—*Astrangia poculata*

Table S2. *Cont.*

Treatment (pH)																		Study- Author/ Species/ Stage
6.0	/	6.5	/	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	
														←Predicted 2300		←Predicted 2100	Control		
									Corals										
														▲		●			• Calcification
																			Krief *et al*. [128]—*Stylophora pistillata* & *Porites sp.*
								▲			▲						●		• Skeletal growth
								▲			▲						●		• Zooxanthellae density
								++▲			++▲						●		• Biomass
								++▲			++▲						●		• Zooxanthellae chlorophyll concentration
																			Rodolfo-Metalpa *et al*. [129]—*Cladocera caespiitose*
														ns	ns		●		• Calcification
									Coralline Algae										
																			Martin & Gattuso. [116]—*Lithophyllum cabiochate*
														▲		•			• Mortality (algal necroses)
														▲		•			• Net calcification (temp & CO_2)
														++▲		•			• Dissolution of algal thalli

Table S2. *Cont.*

Treatment (pH)																
6.0 / 6.5 /	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	**Study- Author/ Species/ Stage**
						←**Predicted 2300**				←**Predicted 2100**				**Control**		
(Crustaceans) Copepods																
																Kurihara *et al*. [53,86]
	ns					ns							●			• Adults survival—*Acartia steueri*
			ns										●			• Adult survival—*Acartia erythraea*
	▲					ns							●			• Egg production—*Acartia steueri*
	▲		△										●			• Egg production—*Acartia erythraea*
	▲		ns			ns							●			• Hatching rate—*Acartia erythraea*
	▲		▲			ns							●			• Mortality—*Acartia erythraea*
																Kurihara & Ishimatsu [50]—*Acartia tsuensis*
						ns								●		• Survival
						ns								●		• Development and Promosome length
						ns								●		• Egg production 2 generations
						ns								●		• Hatching 2 generations
																Mayor *et al*. [95]—*Calanus finmarchicus*
		ns													●	• Adult Biomass C/N ratio
		ns													●	• Egg production
		▲													●	• Produced nauplii
		▲													●	• Remained unhatched
		▲													●	• Disintegrated

Table S2. *Cont.*

Treatment (pH)																	
6.0	/	6.5	/	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	**Study- Author/ Species/ Stage**
									←Predicted 2300				**←Predicted 2100**				**Control**		
									(Crustaceans) Barnacles										
																			McDonald *et al*. [91]—*Amphibalanus amphitrite*
										ns								●	• Cyprid size 96–120 hr
										ns								●	• Nauplii survival to attachment & metamorphosis
										△								●	• Juvenile to adult growth 8 weeks
										ns								●	• Egg production 11 weeks post settlement
										▲								●	• Adult Adhesion
										▲								●	• Basal plate ash weight of $CaCO_3$
										▲								●	• Wall shell penetrometry
																			Findlay *et al*. [96]—*Semibalanus balanoides*
													▲			●			• Adult survival 104 days
													▲			●			• Adult shell mineralogy
													▲			●			• Hatching
													▲			●			• Developmental Rate
																			Findlay *et al*. [90]—2 barnacles *Semibalanus balanoides* and *Elminius modestus*
													ns			●			• Calcium content—*S. balanoides* & *E. modestus*
													ns			●			• Survival—*S. balanoides* & *E. modestus*
													ns			●			• Growth—*S. balanoides*
													▲			●			• Growth—*E. modestus*
																			Findlay *et al*. [89]—*Semibalanus balanoides*
									▲				▲				●		• Growth & development
									ns				ns				●		• Mineral composition of shell
									ns				ns				●		• Survival

Table S2. *Cont.*

Treatment (pH)																		Study- Author/ Species/ Stage
6.0	//	6.5	//	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	
									←Predicted 2300					←Predicted 2100			Control		
									Fish										
																			Munday *et al*. [102]—*Amphiprion percula*
												▲		▲			●		• Olfactory Response Settlement
												ns		ns			●		• Morphology, Swimming, Feeding, Nasal cavity
																			Munday *et al*. [103]—*Amphiprion percula*
														ns			●		• Embryonic duration
														ns			●		• Egg survival
														ns			●		• Size at hatching
														▲			●		• Energy (yolk sac)
														ns			●		• Swimming speed
														▲			●		• Newly hatched larvae, length, weight
																			Munday *et al*. [104]—*Amphiprion percula*
														ns	ns	●			• Embryonic duration, egg survival, size at hatching
														++▲	++▲	●			• Growth rate
														ns	ns	●			• Swimming speed
																			Munday *et al*. [105]—*Acanthochromis polyacanthus*

Table S2. *Cont.*

Treatment (pH)																		Study- Author/ Species/ Stage
6.0	//	6.5	//	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	
									←Predicted 2300					←Predicted 2100			Control		
									Fish										
														ns				●	• Size, shape, symmetry of otoliths
														$^{++}$▲				●	• Growth, survival
																			Munday *et al*. [106]—*Amphiprion percula*
												▲		ns				●	• Otolith area, maximum length
												ns		ns				●	• Symmetry and Otolith Chemistry
																			Frommel *et al*. [51]—*Gadhus morhua*
												ns				●			• Sperm speed
												ns				●			• Sperm motility
												ns				●			• Sperm rate of change in direction
																			Kikkawa *et al*. [101]—*Pagrus major* &
																			Sillago japonica
▲																	●		• Hatching
▲																	●		• Survival

Key to symbols: ● Control; ns Not significant; Δ Trend decreasing with pH; ▲ Significant decrease with pH; $^{++}$▲ Significant increase with pH.