**Supplementary Table 2.** Environmental tolerances of zooplankton in Southern Ocean ecosystems (based on empirical studies). n/a = data not available.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Taxa** | **Species/group**  | **Habitat variable** | **Life stage** | **Measured zooplankton variable** | **Optimum**  | **Lower limit** | **Upper limit (\* = lethal)** | **References+** |
| **Antarctic krill**A picture containing shape  Description automatically generated | *E. superba* | *p*CO2 | Embryo | Hatching success  | 380-1000µatm  | 380µatm | ≥1250µatm200 µatm\* | Kawaguchi et al. (2011, 2013)  |
| Embryo | Duration of embryonic development post hatching  | 380-1000µatm | 380µatm | ≥1250µatm200 µatm\* | Kawaguchi et al. (2013) |
| Post larvae | Ingestion | 325µatm (ambient condition) (note ingestion rate increased by 3.5 times at 672µatm)  | n/a | n/a | Saba et al. (2012) |
| Nutrient excretion | 32 µatm (ambient condition) (note increased excretion at higher *p*CO2 treatment) | n/a | n/a | Saba et al. (2012) |
| Survival | Survival at 1000 -2000 μatm *p*CO2 slightly higher than 400 μatm *p*CO2 (ambient condition) | n/a | 4000µatm | Ericson et al. (2018) |
| Growth | 400-2000µatm (no difference from ambient condition) | n/a | 4000µatm | Ericson et al. (2018) |
| Fat storage | 400µatm | n/a | 4000µatm | Ericson et al. (2018) |
| Maturation | 400-2000µatm (no difference from ambient condition) | n/a | 4000µatm (delay in ovarian development) | Ericson et al. (2018) |
| Haemolymph pH | No significant difference observed in Haemolymph pH at 1000-2000μatm *p*CO2 from 400μatm *p*CO2 (ambient condition) | n/a | A linear trend of decreasing haemolymph pH withincreasing *p*CO2 | Ericson et al. (2018) |
| *p*CO2 and temperature combined | Post larvae  | Feeding (ingestion and clearance rates of chlorophyll) | 0°C and pH 8.1 (= ambient conditions) | 0°C and pH 7.7  | 3°C and pH 7.7 | Saba et al. (2021) |
| Growth  | 0°C and pH 8.0 (= ambient conditions) | n/a | Temperature being dominant driver (lower growth rates at higher temperature) | Saba et al. (2021) |
| Metabolic rate | 0°C and pH 8.1 (= ambient conditions) | n/a | Low pH (effect of temperature noted on smaller krill 31 - 35 mm only) | Saba et al. (2021) |
| Acid-base physiology | No disturbance observed at 0°C and pH 8.1, 0°C and pH 7.7, 3°C and pH 8.1, and 3°C and pH 7.7 | n/a | n/a | Saba et al. (2021) |
| Survival | No difference observed between 0°C and pH 8.1 (ambient condition), and 0°C and pH 8.1 | n/a | 3°C and pH 7.7 | Saba et al. (2021) |
| Temperature | Post larvae  | Instantaneous growth  | 0.4°C | ≤1°C | 5°C | Atkinson et al. (2006), Tarling et al. (2016a) |
| Weight-specific respiration | 0-2°C (non-South Georgia krill) 2-4°C (South Georgia krill) | -1°C (non-South Georgia krill) 2°C (South Georgia krill) | 5.5°C (South Georgia krill) | Tarling (2020) |
| Embryo | Hatch success | 0-3°C (= range assessed in the study) | NoneYoshida et al. (2004) found successful hatching at lowest temperatures | >5°C | Yoshida et al. (2004), Perry et al. (2020) |
| Temperature and salinity  | Not specified | Temperature and salinity tolerance | 35 ppt at ambient temperature  | -4°C at 45 ppt | n/a | Aarset and Torres (1989) |
| Chlorophyll-*a* | Adult | Growth and survival | Half saturation constant for growth in summer (mm d-1) is 0.328 mg m-3 and for growth (% per intermoult period) is 0.498 mg m-3 | n/a | n/a | Ross and Quetin (1989), Ross et al. (2000), Atkinson et al. (2006), Murphy et al. (2017), Piñones and Fedorov (2016) |
| **A picture containing shape  Description automatically generatedOther euphausiids** | *E. crystallorophias* | Temperature | Adult | Growth | -1.8-1°C | n/a | 14.7°C | Cascella et al. (2015)  |
| *T. macrura* | Chlorophyll-*a* | Adult | Reproduction | n/a | n/a | n/a | Saenz et al. (2020) 20 mg m-3 does not appear to be lethal |
|  |  | Temperature | Adult | Growth | >0-<10°C | 0°C | 8-10°C | Couzin-Roudy et al. (2014), Discoll et al. (2015), Wallis et al. (2017) |
| **A picture containing sitting, light  Description automatically generatedCopepods** | Herbivorous copepods | Temperature | Adult | Thermal tolerance of species in southwest Atlantic | -1.5-4.8°C |  | -1.6°C | Tarling et al. (2018) |
| *Metridia gerlachei* and *Calanus propinquus* | Salinity | Adult | Survival | n/a | ~33 | >34 ppt\* (experimental)34-35+ ppt (field) | Gradinger and Schnack-Schiel (1998) |
| *Calanoides acutus* and *R. gigas* | Chlorophyll-*a* | Post larval | Egg production  | n/a | n/a | Egg production does not increase appreciably above ~3 mg m-3 (0-60 m)  | Shreeve et al. (2002) |
| **Salps**A picture containing icon  Description automatically generated | *Salpa thompsoni* | Temperature | Embryo | % of failed embryos | -2-8°C | 2°C | 8°C | Henschke and Pakhomov (2019) |
| Adult | Abundance | 3-5°C | ~-2°C | ~8°C | Henschke and Pakhomov (2019) |
| Adult | Abundance | 2-5°C | ~-1.8°C | ~12.5°C | Wessels et al. (2018) |
| Chlorophyll-*a* | Embryo | % of failed embryos | 0-2 mg m-3 | 0 mg m-3 | 2 mg m-3 | Henschke and Pakhomov (2019) |
| Adult  | Feeding | <1.5 mg m-3 | <0.1 mg m-3 | >5 mg m-3 | Reinke (1987), Huntley et al. (1989), Perissinotto and Pakhomov (1997, 1998a, b) |
|  **Pteropods** A picture containing arrow  Description automatically generated | *Limacina helicina antarctica* | *p*CO2  | Embryo | Egg organogenesis | pH 8.0 (387µatm) | n/a | pH 7.8 (750µatm) (exposure duration important) | Manno et al. (2016) |
| Adult and juveniles | Calcification, growth, shell dissolution, and survival | Ωar ≥1.5 | Ωar = 0.9 | n/a | Bednaršek et al. (2012b, 2014, 2017b, 2019) |
| *p*CO2 and temperature combined | Larvae | Survival and growth | 1.7°C and pH 8.1 (364µatm) | n/a | 3.5°C and pH 7.6 (1200µatm)  | Gardner et al. (2018) |

**+** See main paper for full reference details