# Reproductive strategy of the Antarctic tardigrade, *Acutuncus antarcticus*, contributing to its widespread distribution within Antarctica

Megumu Tsujimoto[1], Peter Convey[2], and Satoshi Imura[1]
[1]*National Institute of Polar Research*
[2]*British Antarctic Survey*

The natural environment in Antarctica is considered the most extreme and variable on Earth in terms of low temperature, limited water availability and short growing season. The harsh environments of Antarctica constrain its terrestrial ecosystems to be relatively simple, comprising a limited flora of bryophytes, lichens, algae and cyanobacteria, and an invertebrate fauna of micro-arthropods, nematodes, tardigrades, rotifers and protozoans. Terrestrial organisms living in these environments are known to demonstrate a variety of physiological and life-history traits that enable them to survive. Nevertheless, knowledge is currently limited mainly to the micro-arthropod groups of mites and springtails, with some information also available on nematodes.

The limno-terrestrial microfauna of nematodes, tardigrades and rotifers are amongst the most diverse and dominant groups of invertebrates in Antarctica. Tardigrades are found in most terrestrial and freshwater Antarctic ecosystems, including some remote nunatak regions where even the otherwise ubiquitous nematodes are absent. In continental lakes and pools, in particular, tardigrades are one of the major community components.

*Acutuncus antarcticus* is an endemic tardigrade species known to be widespread and common in both terrestrial and freshwater habitats in Antarctica. In order to investigate the reproductive strategy of this tardigrade species and how this might contribute to its adaptation to the Antarctic environment, we observed reproduction of *A. antarcticus* under constant laboratory conditions. Juveniles of *A. antarcticus* hatched within a 24 h period were reared at either 20°C, 15°C, 10°C or 5°C in the dark on agar plates with Volvic® water and the green alga *Chlorella* sp. Individual tardigrades were inspected daily for 220 d and their survival, egg production and subsequent egg hatching were recorded. We studied 68 individuals at 15°C and 29 individuals at each of the other temperatures. The larger sample size at 15°C was utilized to investigate the effect of age on reproduction of this species in more detail, and the multi-temperature treatment examined the effect of temperature on development overall.

Under the rearing environment at 15˚C, the egg hatching success of *A. antarcticus* was exceptionally high compared to most previous studies in other tardigrade species. High hatching success could be an important life-history characteristic contributing to this species being one of the most widespread and often common and dominant species within its Antarctic habitats of occurrence, where there is a general requirement to reproduce in a very limited period of time during the summer. Additionally, only weak effects of age were observed on oviposition interval and hatching success, with the former increasing slightly and the latter decreasing slightly with age. The majority of the individuals continued oviposition until shortly before death, with no suggestion of a post-reproductive lifespan. Our observations suggest that any decline in fertility with age in this species of tardigrade is minimal. Prolonged maintenance of reproductive ability gives an advantage in extended life cycles in the natural environment of Antarctica. The minimal reproductive senescence of *A. antarcticus* revealed in our study might be an important factor contributing to the successful establishment and widespread distribution of this species within the Antarctic region. Furthermore, the multi-temperature treatment study revealed reproductive success remained substantial at 10°C and 15°C. These data indicate the optimum temperature range for growth and reproduction in *A. antarcticus* is around 10 - 15°C, matching summer habitat temperatures often achieved within soil, moss cushions and even the benthos of some shallow lakes and ponds in Antarctica.