

Maintenance of Asexuality in Bdelloid Rotifers

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Wilson CG, Sherman PW. 2010. Anciently asexual Bdelloid rotifers escape lethal fungal parasites by drying up and blowing away. *Science* 327: 574-576.

The Bdelloid rotifers are a class of rotifers containing around 450 species all of which have been asexual for tens of millions of years. The Bdelloids are an anomaly however. While asexuality has many apparent advantages relative to sexuality, obligately asexual metazoan species are usually rare and short lived. Why sexual lineages are so much more common in the metazoans is not known for certain but has been the subject of much research. Sex and finding a mate are energetically expensive: they can expose individuals to diseases, reduce the relatedness of parents to offspring, and disrupt favorable gene combinations. To overcome all of these costs, there must be a very strong selective force acting to maintain sexual systems. One of the most prominent theories for why sex has evolved is the Red Queen Theory. This theory postulates that sex is necessary to allow hosts to keep up with the evolution of parasites. It suggests that through genetic recombination, sex is able to meet the fluctuating selection imposed by biotic factors. If this theory is correct, then the Bdelloid rotifers must have some other way of dealing with parasites.

Wilson and Sherman postulated that Bdelloids are able to dry out and disperse to escape parasites. They are able to repeatedly dry up and have been observed to stay in this state for up to nine years. In order to test whether desiccation and dispersal are effective means of fighting off parasites they set up two experiments. First, colonies of rotifers were infected with a known fungal parasite and then subsequently dehydrated for differing lengths of time. Upon rehydration, survival and ability to evade the fungus were observed. The second experiment tested how effective dispersal was as a means of escape. Desiccated rotifers were put on moss along with fungal parasites. The moss was placed in a wind chamber with petri dishes at varying distances as potential dispersal sites. After 7 days of dispersal, the petri dishes were examined for both rotifers and parasites. The experiment was run to test wet dispersal too. For this the rotifers and fungus were kept hydrated through the dispersal period.

The results strongly supported Wilson and Sherman's hypothesis. In the desiccation experiment, dishes that were dehydrated for 14 days or less appeared healthy right after rehydration, but apparently had not rid themselves completely of the fungus and all died. The other treatments, dried for 21 to 35 days, showed much more promising results with 60 to 90.5% of their individuals surviving. The survivorship of each dehydration treatment is shown in Figure 1. Figure 2 shows mean survivorship of the rotifers from the dispersal experiment. It clearly shows that in the dry dispersal experiment there was a high survivorship while in the wet dispersal experiment the animals were not able to escape the fungus. Out of the 24 dry dishes, 17 successfully established colonies and only 7 out of those 17 contained the fungus. The wet dispersal experiment yielded 100% mortality; the rotifers were unable to disperse when kept hydrated and therefore were not able to escape the fungus.

These results suggest an exciting possibility for why the Bdelloid rotifers are able to prosper as asexual metazoans while few asexual lineages do: they can dry up at any stage of life while their fungal parasites are not able to survive desiccation for an extended period. Both drying up and blowing away were shown to be effective on their own. Both one week in the wind chamber and three weeks of dehydration resulted in about 60% survivorship. Since these reactions can be combined for extended lengths of time in nature, they may perhaps be even more effective in a natural setting. Also, these freshwater rotifers can inhabit most any moist habitat and are found worldwide. Because of this, many suitable habitats may be available and dispersal can be made easier.

To follow up on this experiment, future studies might try to focus on more natural situations. Since the rotifers were artificially dehydrated and then rehydrated, the experiment didn't show any reaction from the rotifers themselves. How and how quickly the rotifers would respond to a fungal parasite on their own would prove an interesting experiment. This would also help give a better prediction of a more natural rate of escape. It is known that they can stay dehydrated for years, but how long they might usually stay in this state as a defense isn't known. Do you think the rotifers would be able to quickly respond? What might be a trade-off of long term desiccation?

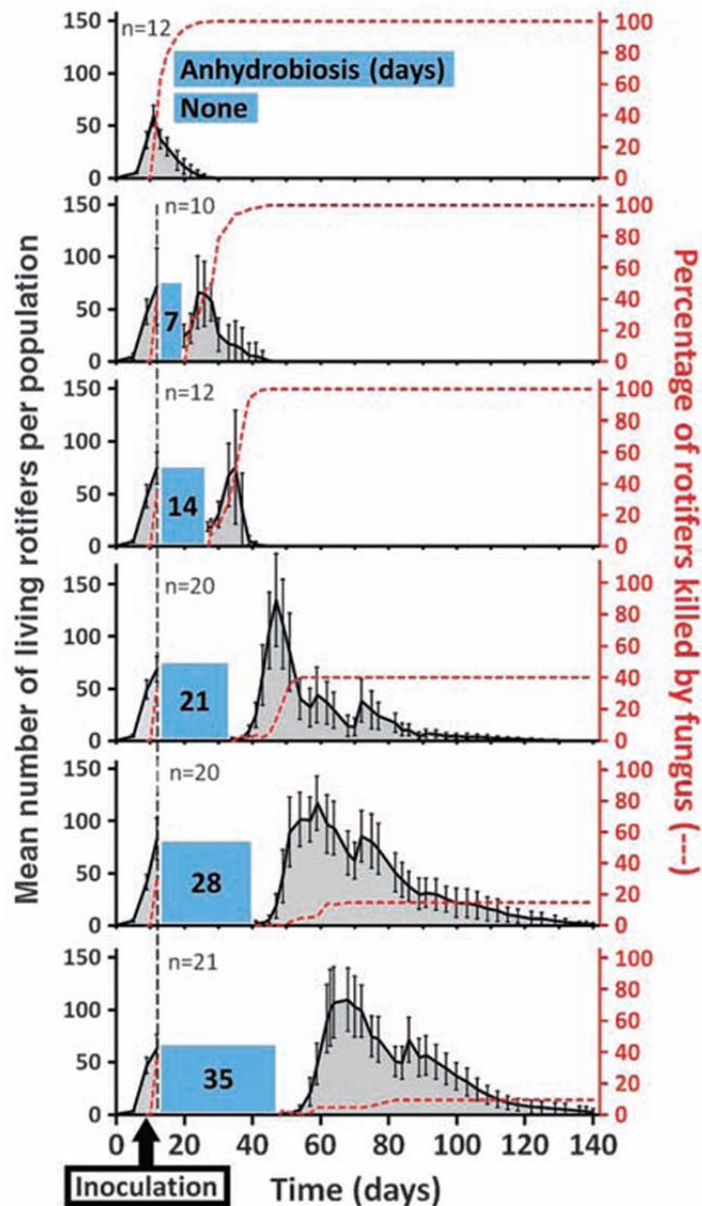


Figure 1. Graphs of rotifer population from desiccation experiments. The grey area shows surviving rotifers while the dotted lines represent overall mortality. The results clearly show an increased defense against the fungus with increased duration of dehydration. Adapted from Wilson and Sherman, 2010.

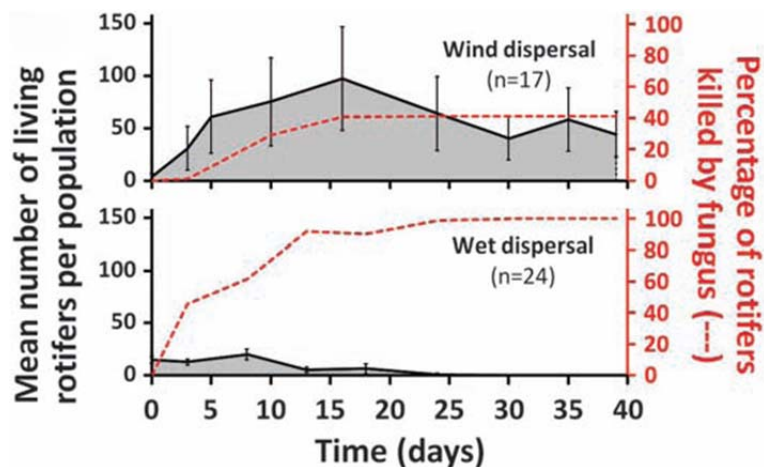


Figure 2. Results from the wind chamber experiment. The grey area represents living population, while the dotted line represents mortality percentages. As can be seen, dry dispersal is an effective means of escaping parasites while wet dispersal is not. Adapted from Wilson and Sherman, 2010.