

## Climate, Morphology, and Chytridiomycosis

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The disappearance of amphibian populations from seemingly pristine upland areas worldwide has become a major focus of conservation efforts in the last two decades, and a parasitic chytrid fungus, *Batrachochytrium dendrobatidis*, is thought to be the causative agent of the population declines. I examined the altitudinal distribution of chytrid infections in three stream-dwelling frog species (*Litoria wilcoxii*, *L. pearsoniana*, and *L. chloris*) in southeast Queensland, Australia, and hypothesized that if *B. dendrobatidis* were responsible for the disappearance of high-altitude frog populations, infection prevalence and severity would be greatest at higher altitudes. Overall, 37.7% of the 798 adult frogs we sampled were infected with *B. dendrobatidis*, and infections were found in all the populations we examined. Contrary to my initial hypothesis, I found no consistent evidence that high-altitude frogs were more likely to be infected than were lowland frogs. Further, frogs from lower altitudes carried fungal infections as severe as their high-altitude counterparts (Figure 1). Thus the reason why only high-altitude amphibian populations disappeared from southeast Queensland remains poorly understood. However, as subtropical frogs at all altitudes are at risk when conditions favor disease outbreaks, I consider them to be at high risk of disease-related decline.

I also conducted disease surveys at 31 lowland sites distributed north-south along 2315km of the Australian east coast, and encompassing 20.8 degrees of latitude. Of 863 *L. lesueuri* sampled, 26% were infected. *Batrachochytrium dendrobatidis* was found at 77% of the sites, including sites at the northern and southern limits of the transect. However, frogs from temperate regions had significantly more severe infections than did their tropical counterparts, often carrying an order of magnitude more *B. dendrobatidis* zoospores (Figure 2). The prevalence and severity of chytrid infections were significantly greater at sites with high rainfall and cool temperatures (Figures 3 & 4). Further, small frogs were both more likely to be infected, and carried more severe infections than larger frogs (Figure 5). This study is the first to identify

factors which limit the distribution and abundance of the *Batrachochytrium dendrobatidis*, and to explain the variation in disease levels among conspecific amphibian populations living in disparate locations. This information is a major addition to our understanding of chytridiomycosis host-pathogen ecology, and will prove useful to amphibian conservation programs.

Figure 1. Relationship between altitude and the number of *Batrachochytrium dendrobatidis* zoospores detected on all infected frogs in the altitudinal study ( $p = 0.060$ ,  $r^2 = 0.012$ ,  $n = 301$ ).

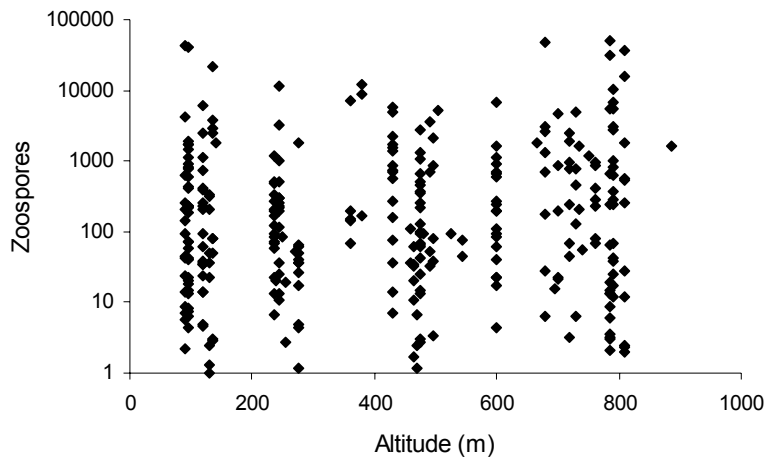


Figure 2. Relationship between latitude and the mean number of *B. dendrobatidis* zoospores detected on frogs at 24 infected sites ( $p = 0.0079$ ,  $r^2 = 0.280$ ).

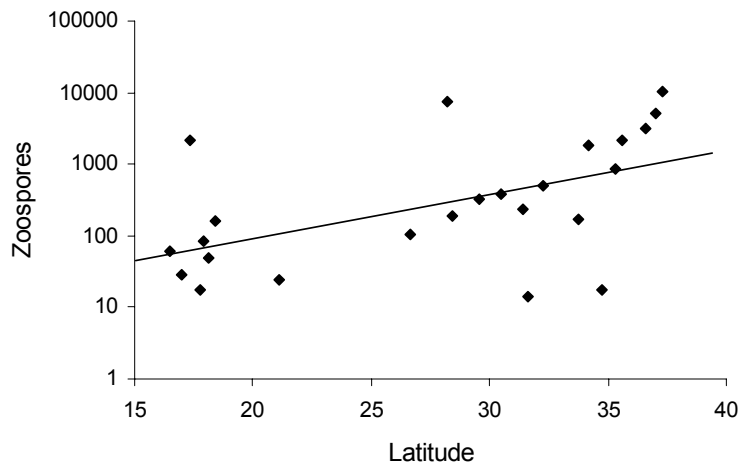


Figure 3. Relationship between the mean temperature of the warmest quarter and the mean number of *B. dendrobatidis* zoospores detected on *L. lesueuri* at 31 sites along the east coast of Australia ( $p = 0.0014$ ,  $r^2 = 0.301$ ).

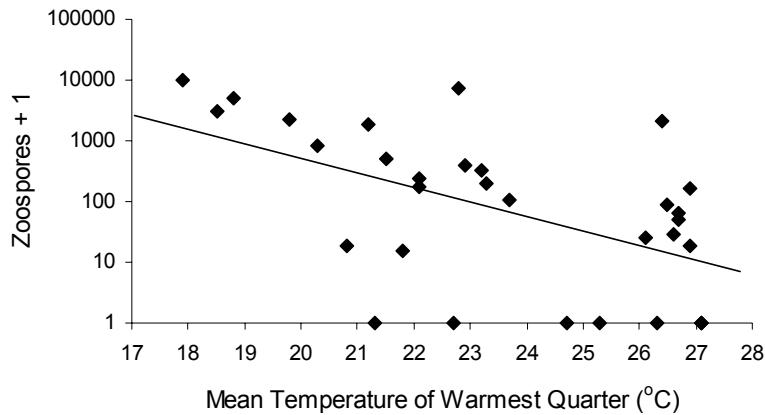


Figure 4. Relationship between the 30-day rainfall and the prevalence of *Batrachochytrium dendrobatidis* infections in *Litoria lesueuri* ( $p = 0.038$ ,  $r^2 = 0.141$ ) at 31 sites along the east coast of Australia.

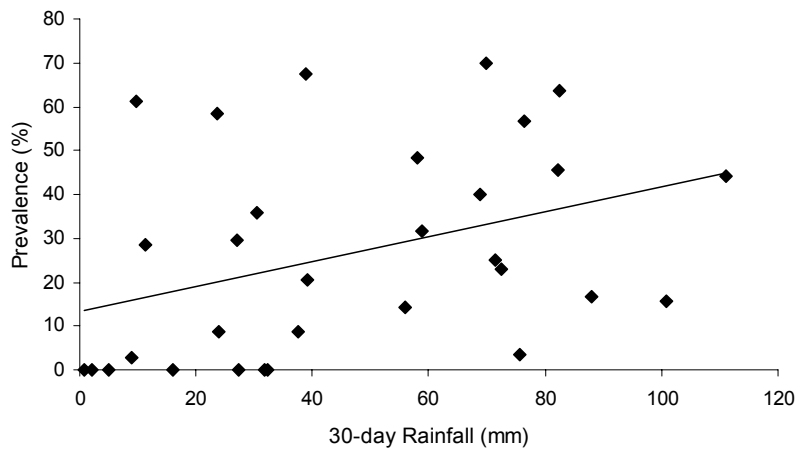


Figure 5. Relationship between mean snout-vent length of *Litoria lesueuri* at infected sites and the mean number of *B. dendrobatidis* zoospores detected on frogs ( $p = 0.0077$ ,  $r^2 = 0.281$ ).

