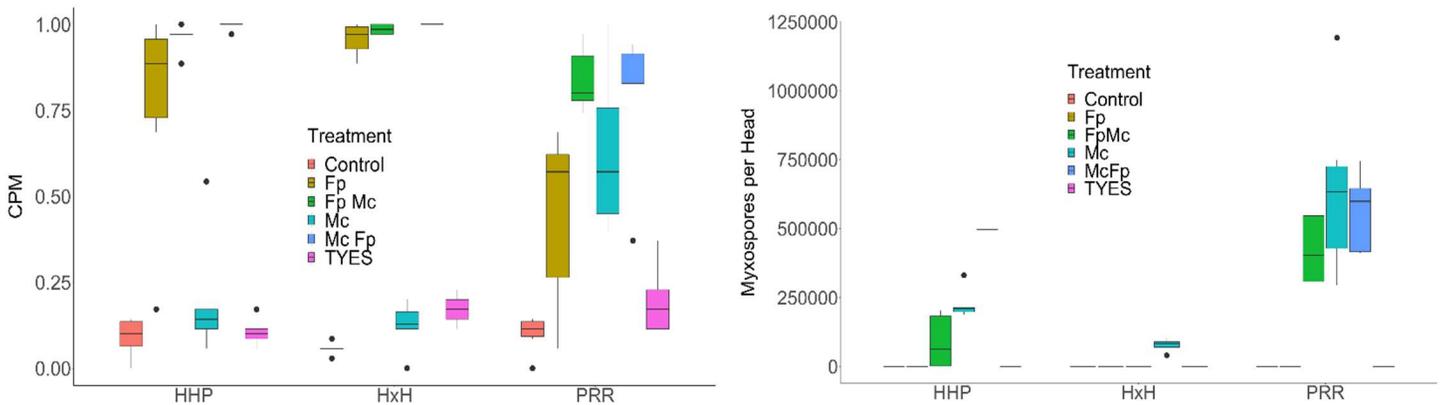




The PRR, HxH, and HHP, the first generation cross between the PRR and HxH, were used for the dual exposure experiment. To test genetic resistance to both pathogens, fish were exposed to *F. psychrophilum*, *M. cerebralis*, or both. Fish were exposed to *F. psychrophilum* using injections under the skin, and to *M. cerebralis* using bath exposure to triactinomyxons, the waterborne infectious stage of the parasite. Mortality from *F. psychrophilum* occurs within 28 days of exposure, and was the first measurable endpoint of the experiment. Fish were then reared for six months to allow development of myxospores, the countable form of *M. cerebralis* in fish, and disease signs and myxospore counts were obtained from the fish remaining at the end of the experiment.

The PRR experienced the lowest cumulative mortality when exposed to *F. psychrophilum*, showing that it was more resistant to *F. psychrophilum* than either the HxH or HHP. However, with higher myxospore counts than either the HxH or HHP, the PRR did not show any resistance to *M. cerebralis*. The HxH had much lower myxospore counts and was more resistant to *M. cerebralis* than the PRR. However, as had been observed in the hatchery, the HxH did not exhibit any resistance to *F. psychrophilum*. The myxospore counts for the HHP were intermediate to those of the HxH and PRR, and the HHP experienced high cumulative mortality when exposed to *F. psychrophilum*, showing that it had not gained resistance to *F. psychrophilum* from the PRR. Coinfection with *F. psychrophilum* and *M. cerebralis* increased mortality in the PRR, HxH, and HHP compared to single-pathogen exposure.



Left: Cumulative percent mortality (CPM) for the HHP, HxH, and PRR across six treatments, 1) control (no pathogen exposure), 2) *F. psychrophilum* only (Fp), 3) exposure to *F. psychrophilum* followed by exposure to *M. cerebralis* (Fp Mc), 4) *M. cerebralis* only (Mc), 5) exposure to *M. cerebralis* followed by exposure to *F. psychrophilum* (Mc Fp), and 6) mock injection with TYES media (TYES). Right: Myxospores per fish head as a measure of *M. cerebralis* infection for the HHP, HxH, and PRR in each of the six treatments at the end of the experiment.

Management Implications

The results of this experiment suggest that it was not possible to create fish that are resistant to both *F. psychrophilum* and *M. cerebralis* using the HxH and PRR. In a follow up experiment, we exposed pure strains and their crosses to *F. psychrophilum* and found that the first generation cross between the Harrison Lake Rainbow Trout and the PRR showed reduced mortality and resistance to *F. psychrophilum*. Therefore, it may be possible to produce Rainbow Trout that are resistant to both pathogens, though their resistance to *M. cerebralis* still needs to be evaluated. More research is needed to determine if other strains not included in these experiments can be used to create fish resistant to both pathogens. Until then, hatchery outbreaks of BCWD in susceptible fish such as the HxH can be reduced by maintaining high water quality, flows, and reduced densities to prevent stressful rearing conditions. Using PRRs in hatcheries where *F. psychrophilum* outbreaks are common will help reduce mortality from BCWD on the unit, but due to their susceptibility to WD, these fish should not be stocked in aquatic systems in which *M. cerebralis* is established.

Associated Literature

Fetherman, E. R., B. Neuschwanger, B. W. Avila, and T. B. Riepe. 2020. Sport Fish Research Studies. Annual Report. Colorado Parks and Wildlife, Aquatic Research Section. Fort Collins, Colorado.