

## **The chicken or the egg: is the immune response of South American fur seal pups the cause or the consequence of parasitic burden?**

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Metazoan parasites are a major cause of morbidity and mortality in marine mammals. In the Northern Chilean Patagonia hookworm disease is the main cause of pup mortality in South American fur seals. Previous investigations suggest that hookworm mortality is driven by parasitic burden since pups with high burden usually die because of hookworm disease. Therefore, this project aimed to determine the main factors that drive the parasitic burden in South American fur seal pups. To answer this question the epidemiology of hookworm infection in South American fur seals was studied in the Austral summer of 2017 at Guafo Island, Northern Chilean Patagonia. Additionally, field experiments were conducted in order to characterize the immune response of fur seal pups against hookworms and to understand if this immune response was due to the parasitic burden or if the immune response affected the parasite load in a pup. Two hundred and twenty pups and 15 adult females were captured between December 2016 and March 2017. One hundred and twenty pups were recaptured between 2 and 5 times in order to follow the progression of hookworm infection and the pup's health status. Fur seal pups became infected with hookworms only through their mother's colostrum during their first days of life. Larvae reached the small intestine and remained in the host for 30 to 65 days until they were cleared from the intestine through an immune mediated mechanism. Therefore, transmission of infective stages, in an initial phase, is given by the concentration of hookworm larvae in the colostrum and/or milk and the number of larvae that survive in the small intestine. Fur seal pups with a more reactive immune system (higher level of T-lymphocyte proliferation) had shorter hookworm infection compared to pups with lower immune system reactivity, however the hookworm burden was not different between these two groups. Pups with higher burden developed higher levels of anti-hookworm antibodies. These pups with highly reactive immune system cleared hookworms sooner and survived the infection. In multivariate models, the infectious period (the number of days a pup is infected with hookworms and releasing hookworm eggs) along with the level of immune response were the most significant predictors of hookworm related mortality. Parasitic burden in South American fur seals is most likely driven by a combination of concentration of infective larvae in the colostrum or milk and the survival rate of infective larvae in the pups' intestine. However, once infection has been established the immune response of the fur seal pups modulates the dynamics of the infection mainly by reducing the time hookworms live in the fur seal pups intestine.

The funds received from the Society for Marine Mammalogy were critical to accomplish the research objectives and were used to fund travel expenses and purchase disposable sampling tools such as syringes, needles and blood tubes. The results from this project and additional data have been submitted for publication and should be available soon for the marine mammal scientific community.