Analysis Phase	Research Question	Model ID	Statistical Method	Key Fir...
Laboratory Development				
Discovery	Can immune genes predict infection costs?	**DISC-1**	Linear regression (PC1, PC2 → weight loss)	Signific... predict...
Optimization	Can machine learning improve prediction?	**DISC-2**	Random forest (19 genes → weight loss)	Substa... achieve...
Validation	Is the model reliable?	**DISC-3**	Train-test cross-validation	Strong...
Field Translation				
Detection	Does the model work in wild populations?	**FIELD-1**	Predicted vs. observed infection status	Success... infectic...
Discrimination	Can it distinguish parasite species?	**FIELD-2**	Predicted loss by species identity	Species...
Scaling	Does it correlate with infection severity?	**FIELD-3**	Predicted loss vs. parasite load	Scales... intensit...
Biological Validation				
Physiological relevance	Does it capture real health impacts?	**PROOF-1**	Predicted loss vs. body condition	Correla... body w...
Specificity	Is the response Eimeria-specific?	**PROOF-2**	Predicted loss vs. parasite community	Specific... infectic...

[1] Significance levels: *p < 0.05, **p < 0.01, ***p < 0.001

[2] Progressive sample sizes reflect train→test validation approach

[3] E.f: Eimeria falciformis; E.r: E. ferrisi

Framework progresses from basic linear prediction ($R^2 = 0.106$) through machine learning optimization ($R^2 = 0...$
biological relevance.