Executive Summary

Progress in Q3 included securing a highly qualified histopathologist, developing a refined pathology scoring rubric, and advancing the preparation of histology slides for scoring. Despite internal HR delays in replacing the lead research scientist, candidate interviews are scheduled for the start of the new year. The machine learning ResNet framework is complete and ready to train once ground-truthed data becomes available.

Q3 Project Activities and Achievements

1. **Staffing Update:**
   - **Dr. Nathan Redman's Replacement:** Internal HR delays slowed the hiring process to replace Dr. Nathan Redman, the lead research scientist. Candidate interviews have been scheduled for early January 2025.
2. **Collaboration and Crowdsourcing Progress:**
   - I was contacted by **three international labs** interested in sharing Atlantic salmon and rainbow trout distal intestinal slides. Unfortunately, two of these labs' experiments did not include dietary-induced enteritis. Ongoing discussions are being held with a third lab.
   - **Dr. Salvatore Frasca, DVM, PhD**, a fish pathologist with over 20 years of experience, has formally joined the project as the consulting pathologist. Dr. Frasca's expertise in digital pathology and enteropathy scoring will bring valuable technical insight to the project.
3. **Development of a Formal Pathology Scoring Rubric:**
   - A new pathology scoring rubric was established to better characterize enteropathy associated with dietary perturbations. The scale was developed through:
     - Review of previously established scoring systems:
       - Penn et al. (2010)
       - Uran et al. (2008)
       - Knudsen et al. (2007)
     - Collaboration and input from Dr. Frasca.
     - The new scoring scale assesses multiple histopathological features and is attached.
4. **Scoring of Slides:**
   - Dr. Frasca is currently scoring a set of **48 rainbow trout slides** with graded levels of soybean meal-induced enteritis (SBMIE). An additional **84 slides** are queued for scoring upon completion of the first batch.
5. **ResNet Machine Learning Algorithm Development:**
   - The ResNet ML algorithm is fully scripted and awaiting training data from the manually scored histology slides.
   - Additional work has been completed on upstream **QA/QC modules** to normalize color tones and prevent the model from overfitting artifacts of digital histology images.

Challenges and Adjustments

- **HR Delays:** While HR delays slowed the hiring process for Dr. Redman's replacement, progress has continued with scheduled interviews for January 2025.
- **Crowdsourcing Limitations:** Of the three labs contacted for crowdsourcing, two were unable to provide slides with dietary-induced enteritis. Discussions with the third lab are ongoing to secure additional samples.

Next Steps

- Conduct interviews and finalize the hiring process for the lead research scientist replacement.
- Complete scoring of the current set of **48 rainbow trout slides** and begin scoring the next batch of **84 slides** with Dr. Frasca.
- Continue discussions with international labs to secure additional histology slides.
- Train the ResNet ML model with the ground-truthed histopathologist scores.
- Further refine QA/QC modules and test for robustness against artifacts.

References

- Knudsen, D., Uran, P., Arnous, A., Koppe, W., & Frøkiaer, H. (2007). Saponin-containing subfractions of soybean molasses induce enteritis in the distal intestine of Atlantic salmon. *Journal of Agricultural and Food Chemistry, 55*(6), 2261–2267.
- Penn, M. H., Bendiksen, E. Å., Campbell, P., & Krogdahl, Å. (2010). High level of dietary pea protein concentrate induces enteropathy in Atlantic salmon (Salmo salar L.). *Aquaculture, 310*(3-4), 267–273.
- Uran, P. A., Schrama, J. W., Rombout, J. H., Taverne-Thiele, J. J., Obach, A., & Verreth, J. A. (2008). Soybean meal-induced enteritis in Atlantic salmon (Salmo salar L.) at different temperatures. *Aquaculture Nutrition, 14*(4), 324–330.