Scientist spotlight

Advancing aquaculture with Benchmark Genetics

Innovation-led breeding to support global aquaculture

The role of selective breeding in global aquaculture production is growing rapidly. In comparison to terrestrial livestock, aquaculture comprises a substantially larger and more diverse range of species. These species are typically at a much earlier stage of domestication, meaning there is huge potential to harness genetic variation to improve production via well-designed breeding programs. This fact, coupled with increasing consumer demand for healthy proteins and substantial investments in cutting-edge technologies, means the industry is entering a new era of innovation and scale. To sustain this momentum, the integration of advanced technologies in breeding, health, and production is key to driving both industry growth and long-term sustainability. For example, since its commercial beginnings in the 1960s, the salmon farming industry has experienced remarkable growth and is now projected to reach a market value of $53 billion by 2030 [1]. This rapid expansion positions salmon farming as one of the fastest-growing food production industries worldwide [2].

Among the technologies contributing to this rapid rise in uptake of selective breeding in aquaculture is high-throughput genotyping using microarray platforms, which is taking on a pivotal role. Genotyping tools enable key applications such as genomic selection and parentage assignment, greatly improving breeding accuracy and stock management. By supporting smarter, data-driven breeding decisions, genotyping technologies help produce healthier, more resilient fish with improved reproductive performance, playing a vital role in advancing sustainable aquaculture.

With such a wide range of species at varying stages of technical development, innovative and tailored genotyping solutions are essential to make the technology both accessible and affordable to the industry. Benchmark Genetics and Thermo Fisher Scientific develop genotyping solutions and facilitate access to the benefits of genomics for a wide range of aquaculture species and sectors.

Dr. Carolina Peñaloza, Genotyping Services Lead, Benchmark Genetics

Benchmark Genetics: a leader in aquaculture genetics

Benchmark Genetics is a leader in aquaculture breeding and genetics, serving customers in more than 50 countries. The company's core operations center on the supply of genetically improved Atlantic salmon (*Salmo salar*) and whiteleg shrimp (*Penaeus vannamei*) for commercial farming. In addition to its core product lines, Benchmark Genetics provides a growing portfolio of genetic services, including breeding program design, genomic evaluations, and strategic advisory support. The company has supported more than 40 breeding programs in more than 30 different species. Benchmark Genetics has recently expanded into genotyping services. This evolution strengthens its role as a comprehensive solutions provider—offering advanced, data-driven technologies that empower aquaculture producers to improve performance, resilience, and sustainability across the value chain.

Setting the benchmark for aquaculture genotyping

Two years after launching Benchmark Genetics Genotyping Services, which is focused on genotyping and the design of bespoke genetic solutions, Benchmark Genetics is helping

to transform aquaculture breeding on a global scale. Guided by Dr. Carolina Peñaloza, Genotyping Services Lead for Benchmark Genetics, the unit leverages the company's large internal genotyping volumes to offer external clients high-quality, cost-effective genotyping and single-nucleotide polymorphism (SNP) array development globally.

"We're seeing increasing demand, not just for genotyping with our wide range of tools, but also for customized solutions tailored to specific species and needs," said Dr. Peñaloza. "For many species, high-throughput genotyping tools simply didn't exist, and by making them affordable and accessible, we're helping producers unlock the full potential of their stocks and improve productivity."

To support Benchmark Genetics, Thermo Fisher develops customized genotyping microarrays tailored to the needs of aquaculture producers and researchers. These genotyping technologies are especially valuable for emerging species, as they provide the essential starting point for building strong, high-performing breeding programs.

Shared innovation: A dual-species success story in clam genotyping

A notable case study in Benchmark Genetics' expanding portfolio is the codevelopment of a dual-species SNP array for two commercially significant mollusk species: the Manila clam (*Ruditapes philippinarum*) and the grooved carpet shell (*Ruditapes decussatus*). This collaborative project united research institutions across Europe [3] with Benchmark Genetics for the purpose of designing a single, shared genotyping tool.

By pooling expertise and resources, the consortium successfully reduced development costs while maximizing the functionality of a single platform. Sharing one array across two species proved to be a cost-effective solution, lowering the financial and technical barriers to entry for bivalve breeding programs. This initiative exemplifies how strategic collaboration can extend the benefits of advanced genetic technologies to previously underserved species—unlocking new potential for selective breeding and accelerating genetic gains in the bivalve sector.

Advantages of using Axiom microarrays to improve aquaculture breeding programs

Applied Biosystems™ Axiom™ genotyping technology from Thermo Fisher offers the high resolution, flexibility, and scalability needed for a broad range of aquaculture applications. From analyses of genetic diversity and pedigree assignment to genomic selection and genome-wide association analyses, Applied Biosystems™ Axiom™ arrays support accurate, data-driven decision-making in breeding programs.

Axiom arrays have already been developed and made available for many of the world's most important aquaculture species. Furthermore, the Applied Biosystems™ Axiom™ myDesign™ platform further enables the development of custom genotyping arrays for new or emerging species. Benchmark Genetics, with products and support from Thermo Fisher, provides an array design service for multiple clients.

Through its collaboration with Thermo Fisher, Benchmark Genetics offers access to the full Axiom array catalog along with an expanded portfolio of genotyping solutions. Thermo Fisher offers widely-trusted genotype solutions that enable its customers to deliver outstanding results.

References

1. "Salmon Market Size & Share Analysis - Growth Trends & Forecasts (2025 - 2030)," Salmon Market, Mordor Intelligence, n.d., **mordorintelligence.com/industry-reports/salmon-market**
2. "Overview," Farmed Salmon, World Wildlife Fund, n.d., **worldwildlife.org/industries/farmed-salmon**
3. The consortium is a collaborative initiative within the EU-funded projects "ShellFishBoost" (project ID: SBEP23_00051) and "IGNITION" (Grant agreement: 101084651), and the STARS@UNIPD grant "ASAP", coordinated by the GEMMA lab (Genomics, Ecotoxicology, and Microbiology in Marine Animals) at the Department of Comparative Biomedicine and Food Science, University of Padova (Italy), in partnership with the University of Santiago de Compostela (Spain), the Interdisciplinary Centre of Marine and Environmental Research of the University of Porto (Portugal), and the Roslin Institute (UK), and with the involvement of the hatcheries Oceano Fresco (Portugal) and Satmar (France).

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