Fishing for genetic information

The high throughput efficiency provided by Tecan's HS 4800™ Pro Hybridization Station makes all the difference to researchers in Canada looking at the spawning patterns of salmon stocks, and at the effect that changes in the environment have on fish survival and migration.

Sockeye on the Adams River spawning ground

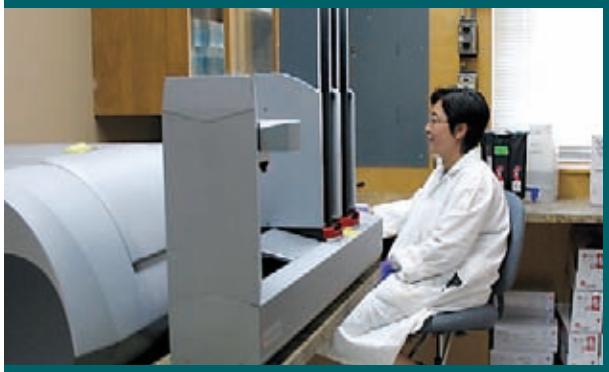
Capturing sockeye in the Fraser River

In today's fast-changing environment, the global management of fish stocks in our oceans is a problem that is now being addressed from a genomics perspective. Dr Kristina Miller, head of Molecular Genetics at the Pacific Biological Station in British Columbia, Canada, has been overseeing a genomics-based research program looking at fish populations since 2004: "The aim of the program is to use genomics technologies to better understand the physiology of migrating fish and to develop tools to assess salmon condition for use in the management of wild salmon stocks. We are particularly focused on predicting how salmon will respond physiologically and behaviorally to the changing conditions in the aquatic environment," she explained.

Salmon are born in a stream and spend one to two years there before migrating out into the ocean. Depending on the species, they can spend one to four years in the ocean, before returning to the same stream in which they were born, where they will reproduce and die. Kristina continued: "Salmon migrate a very long distance and it is a daunting task to predict in any given year how many fish will come back from each stock. In the past, managers relied on overall abundance estimates to decide when and where to open and close fisheries, but now, using genetically-based stock identification done in my lab, we can tell managers within 18-24 hours what stocks are present in a mixed stock test fishery. This technology has allowed the in-season management of salmon in British Columbia to move towards stock-based management, specifically targeting fisheries on healthy, abundant stocks and implementing conservation strategies for stocks that need protection."

With the success of the stock ID program, the team has moved on to more challenging tasks, using genomics to develop tools that can stage the condition and predict the behavior and fate of migrating salmon. The team uses a combination of molecular biology, population genetics and telemetry technologies to compile all the information it can on the salmon populations under investigation. Of these, cDNA microarray technology is a particularly important technique, based on microarray slides developed for salmon and containing over 16,000 spotted gene elements in Ben Koop's laboratory at the University of Victoria, British Columbia, for the Genomic Research on Atlantic Salmon Project (GRASP).

This linkage of genomics with telemetry has allowed them to use wild-caught salmon to identify behavior- and fate-associated biomarkers. As Kristina explained: "By combining genomics with radio tagging we can go out into the ocean, capture a number of fish and insert radio tags into their oral cavities, allowing us to track their movements all the way back to the spawning ground. Simultaneously we take non-lethal biopsy samples of gill or muscle tissue, and by then extracting and amplifying RNA in the laboratory we can gain an insight into the physiological state of the salmon at the time of tagging. The ability of salmon to adjust to stressful factors such as increases in water temperature and changes in salinity are all critical for survival. We are continually searching for physiological and genetic reasons why



Tecan's LS Reloaded, Tecan's HS 4800 Pro Hybridization Station

some fish stocks are able to withstand high water temperatures, and others are not; why some can easily reconfigure their gills to make the shift from a high saline marine environment to a low saline freshwater environment, but others can't; and even why some fish enter the river at the wrong time and face conditions that they are not adapted to withstand." The team has successfully used this approach on wild-caught salmon to provide a mechanistic understanding of salmon condition and fate. Importantly, they have discovered biomarkers in salmon that can predict how quickly salmon will enter the river and their probability of making it to the spawning grounds.

Since the early days of the program, the workload of processing microarrays has steadily increased, as each new set of results leads to further lines of investigation. The group soon turned to automation and now relies heavily on the HS 4800 Pro Hybridization Station from Tecan, which replaced manual techniques and routinely runs 24 microarray slides every day.

Shaorong Li in the lab

Kristina commented: "One of the most important things for me is minimizing technical variance and this is a huge advantage of the HS 4800 Pro. Apart from the time it saves us on throughput, this instrument gives us an exceptionally high consistency rate. From having a drop-out rate of around 20 %, we now rarely have to repeat any slides and then not for hybridization problems." Laboratory technician, Shaorong Li, agreed: "Before we had this instrument we used a manual approach which was time-consuming and much less efficient. However, with the Tecan platform, you can load the samples and leave it overnight and when you return in the morning, everything is done and the slides are dry and ready for scanning. It has high throughput capability and the slide quality is much better than the traditional manual approach. Crucially, results are consistent and technical variance is reduced, and this, combined with the time and money-saving aspects, make this system a clear winner in efficiency."

Kristina and her team developed the entire hybridization protocol and shared this with the group at the University of Victoria, who initially provided the microarray slides. She added: "We made it clear to them that the HS 4800 Pro system was essential to the success of our experiments and they, in turn, purchased one on this recommendation."

The bottleneck in the process is now reading the slides once they have been hybridized, and the team in British Columbia is already tackling this with the purchase of Tecan's LS Reloaded™ scanner with auto-loading facility. Kristina concluded: "We would like to soon progress to running 48 slides a day, which the HS 4800 Pro system can handle easily, but we couldn't even consider this without increasing our capacity to load and read the slides after processing. The LS Reloaded will make a huge difference to this, allowing us to just walk away while it loads and processes the slides far quicker than we could before."

For more information about Tecan's HS 4800 hybridization stations, visit
www.tecan.com/hs4800

For more information about Tecan's LS Reloaded laser scanner, visit
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