

# Nature and Culture: Retrospective of FSBI 2004 in London

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From Monday 19 to Friday 23 July 2004, over one hundred delegates from across the world gathered at Imperial College London for the FSBI Annual International Symposium, organized in association with the European Aquaculture Society. Motivated by the rapid development of aquaculture and the consequent need to better understand the biology of fish domestication and the interactions between cultured and wild fish, the conference sought to review and synthesize recent developments in the field.

Following an ice breaker reception on Monday evening, formal proceedings took off on Tuesday. The day was devoted to the processes and outcomes of fish domestication. Eugene Balon's Jack Jones Memorial Lecture provided a sweeping survey of domestication in fish and other animals. It included a lively account of the biological and social history of cyprinid domestication in Europe and Asia, as well as an exploration of the role of epigenetic processes in domestication. Cultured fish inevitably enter a process of domestication, involving genetic and developmental responses to the culture environment as well as targeted manipulations of the cultured organism. However, few fish species can yet be considered fully domesticated in the sense that they have been manipulated genetically to show variation not seen in the wild and are highly dependent on human support. Papers by Ivan Jaric and Guillaume Mairesse illustrated how domestication can inadvertently change fish morphology and quality attributes of fish products. Whether inadvertent or deliberate, domestication is the result of human action. Randy Brummett showed how social and economic factors influence farming practices and thus the domestication process in African tilapias, often with undesirable consequences such as selection for poor growth and inbreeding. Domestication is also reciprocally linked to ownership of animals, a topic explored in lucid legalese by Bernie Walrut. If your fish intends to return after release, it's definitely yours!

The afternoon session delved deeper into the biology of domestication. Felicity Huntingford's keynote reviewed behavioural responses to culture, their proximate causes, and implications for production and welfare. She also dealt at length with the difficulties of experimentally separating genetic and developmental effects of culture. Impacts of hatchery rearing on anti-predator behaviour and aggression were further investigated in a series of papers by Lorraine Hawkins, Stefano Malavasi, Annamari Salonen and Heikki Hirvonen. Marie-Laure Begout, Stephen Cotterell and Eva Enders compared aspects of swimming activity and performance between wild and cultured fish, or cultured fish subject to different manipulations. Clearly, domestication is all but inevitable under culture conditions, and careful management of the process is important to either enhance its impact for the benefit of production, or minimize certain responses for the benefit of conservation aquaculture.

Tuesday evening offered an opportunity to visit conservation aquaculture in action, courtesy of the Zoological Society of London and their aquarium curator Heather Koldewey. On a perfect summer evening, we stayed on at the Zoo for a barbecue watched by hungry bears undergoing inadvertent domestication.

Life history responses to culture were the focus of Wednesday morning. Health reasons unfortunately prevented John Thorpe from delivering his keynote in person. His paper, presented and occasionally extended by Marc Mangel, illustrated how the

“pampering” of fish under culture conditions gives rise to greatly accelerated and simplified life histories as fish give up on predator avoidance and other costly endeavours in favour of rapid growth and reproduction. This response is largely beneficial to aquaculture, but fish destined for release may be put on to life history trajectories that reduce their post-release fitness or threaten life history diversity in wild populations. John Armstrong’s experiments using growth hormone treated Atlantic salmon found little evidence for costs of fast growth in the short term. However, James Orpwood showed that hatchery salmon tend to be displaced by wild salmon when refuges are limited. Lifetime performance of cultured fish in the wild is almost always lower than that of wild conspecifics, as shown in field experiments by Andy Ferguson, John Joyce and Carlos Garcia de Leaniz. There are multiple contributing factors including cultured stock origin, domestication history and density-dependent population processes.

In the afternoon we moved on to genetics and evolution in widely cultured species. Fred Utter kicked off with a review and historical perspective. It is now widely appreciated that the genetic structure of natural populations is important to both fisheries productivity and population survival. To preserve this structure and the processes maintaining it, cultured stocks should be separated from wild stocks at reproduction and harvest. The only exception is conservation aquaculture in support of acutely threatened populations. Fisheries enhancements may benefit from emulating natural population structure within the cultured stock. In practice of course, intentional and accidental releases of cultured fish provide ample opportunity for genetic interactions. Field studies by Knut Jorstad, Anti Vasemagi and Rosa Maria Araguas suggest that introgression by cultured fish is often lower than might be expected, but can be significant and progressive where releases are substantial or occur over extended periods. Hybridization between closely related populations can be difficult to detect but, as Juha-Pekka Vaha showed, methods are becoming increasingly powerful. Where hybridization between cultured and wild stocks does occur, fitness effects are dependent on characteristics of the source populations as shown by contrasting case studies presented by Jeff Hutchings and Bill Smoker. Frank Thrower’s study illustrated how genetic variation for life history phenotypes can be preserved in cultured or translocated populations even in the absence of opportunities for expression of the relevant traits.

Wednesday evening saw a well attended poster session with a good glass of wine sponsored by Blackwell Publishing. Posters covered a wide diversity of topics, with the development of new seabream species for Mediterranean aquaculture, and the role of aquaculture in the conservation of freshwater fish being particular foci.

Thursday was devoted to applied aspects: conservation aquaculture, fisheries enhancement and the impacts of farm escapees on wild stocks. Mikhail Chebanov reviewed sturgeon stock enhancement, while Jonathan Carr reported on the (low) effectiveness of releasing captive reared spawners to supplement imperilled wild salmon populations. Behavioural deficits of cultured fish released into the wild and ways of addressing them were discussed by Elizabeth Fairchild, John Burke and Miroslav Ciesla. Helge Paulsen and Ayesha Taylor provided two studies of successful stocking initiatives in marine and freshwater systems. The population dynamics theory of fisheries stock enhancement was discussed by Kai Lorenzen, who emphasized the need to consider the full life cycle and ecological as well as genetic interactions when assessing enhancement programmes.

Ian Fleming’s keynote to the afternoon session considered how the reproductive ecology of cultured fish often serves to minimize interbreeding with wild fish and thus genetic introgression. He also discussed possible advantages to allowing mate

choice within culture environments. Extensive field studies by Sean Hayes, Ravi Chatterji and Jan Baer studies showed that competitive interactions between cultured and wild salmonids can sometimes be minimized by divergent life histories, and in any case tend to favour wild fish where they do occur. Andi Stephens presented a prototype tool for population-level assessment of risks to wild populations from escapes of farmed salmon. Disease interactions between farmed and wild fish were discussed by Edmund Peeler, who emphasized the importance of understanding disease population dynamics and the factors influencing transmission rates. Ondrej Slavik and Kathleen Beyer investigated the contribution of escapes from aquaculture facilities to the spread of two exotic species in Europe.

Symposium dinner on Thursday night was punctuated by the award of the Beverton medal to Andy Ferguson. Very appropriate too, given that many of his lifetime contributions to fish biology have addressed genetic interactions between wild and cultured fish. In addition, visiting AFS President Ira Adelman offered his impressions of the symposium and a comparative perspective on AFS and FSBI.

Friday morning was wrap-up time, with four papers by Keith Nislow, Marc Suquet, Maria Spedicato and Ove Skilbrei considering how studies on the comparative biology of wild and cultured fish and their interactions provide insights into fundamental biology. A synthesis paper by the convenors opened a lively discussion on lessons from recent research, management implications and the way forward. So what have we learned? There have been rapid and exciting developments in some areas central to the theme: population genetics, the extent and dynamics of contemporary adaptation, the role of behaviour and phenotypic plasticity in the ecology of wild and cultured populations. Studies of domestication or wild-cultured fish interactions have played a significant part in these developments, and thus contributed a great deal to basic fish biology. However, the bigger picture remains sketchy. We have accumulated much data on disparate aspects of domestication, but there has been little attempt to integrate these within a process framework. Our understanding of cultured-wild fish interactions at the population level remains poor, despite much progress in understanding short-term behavioural interactions and measuring levels of genetic introgression. Focused integration across disciplines and scales is likely to hold the key to further progress: integration of ecological and genetic considerations, over the life cycle, and from individuals to populations. Badly needed improvements in the management of cultured-wild fish interactions will require a quantitative analysis of effects and tradeoffs, based on an integrated framework accounting for the dynamics and genetics of wild populations as well as the biological characteristics and release patterns of cultured fish. Much remains to be done, and my prediction is that it will be exciting as well as useful!

My thanks go to all presenters whose insightful contributions were the lifeblood of the symposium, to Tricia Ellis Evans who made organizing the meeting easier than I ever expected, to my co-convenors Malcolm Beveridge and Marc Mangel, and to JFB supplement editor Robin Welcomme. A generous contribution from the Worshipful Company of Fishmongers enabled us to provide financial support to many student participants.

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