

Theme session T

Practical application of genetic stock identification (GSI) for conservation, management and restoration of diadromous fish species.

Conveners: Dennis Ensing (UK) and Philip McGinnity (Ireland)

The theme session consisted of 13 presentations held over three oral sessions and one poster session followed by a wide ranging panel discussion at the end of the meeting. The session emphasized the practical application of genetic stock identification for fisheries and conservation purposes. The session was very well attended varying over the day between 30 and 60 participants.

At the same time as adding a new term to the scientific lexicon of 'bucket biology' Gottesfield's presentation got proceedings underway showing, with a high probability of assignment, that GSI could be used to identify at least 30 distinct population groups within the Skeena river sockeye salmon smolt run, with each of these population groupings having a specific run time. Some very interesting ecological insights were presented that indicate that the populations to run first are generally those closest to the sea. It would appear also that a substantial change in the smolt run time for Skeena sockeye has occurred recently and this is due to loss of specific population groupings rather than a general change in run timing for each individual group. The importance of smolt run phenology in respect of the environmental match-mismatch hypothesis was further explored by Carr-Harris. She observed that in good years the peak in juvenile salmon abundance will coincide with the zooplankton peak abundance and that any deviation between the two will result in a reduction in productivity. She also reported that individual population components in the Skeena river sockeye stock experienced considerable variation in zooplankton quality and quantity as prey items depending on the timing of their entry into the sea, with higher lipid value species of zooplankton available early on in the season. Resourcing Skeena river work was an issue with the slack being picked up by the voluntary rather than the state sector. There are big challenges for management on the horizon with new facilities for oil and gas exportation being planned. Righton reported on how advances in telemetry were elucidating knowledge of the biology of Atlantic salmon at sea. His paper, based on the tracking the migrations of post-spawning kelts provided a number of new and exciting insights into the behaviour of populations emanating from different geographical regions, principally the likelihood of considerable spatial segregation in the ocean, that fish move away rapidly from the coast on entering the sea and that unlike post-smolts fish from southern latitudes swim against prevailing currents to get the feeding grounds. It would appear that populations originating in northern rivers utilize the polar front as either an aid to orientation of rich source of food. As the polar front will likely retreat considerably in response to projected climate change such a strategy will inevitably result in longer migrations and potentially reduced survival. Subsequent discussions on this paper highlighted the need to look at the behaviours of post-smolts in the sea and the enormous research potential of integrating observations from both telemetry and genetic studies. Gilbey also demonstrated the enormous potential of combining telemetry with GSI in his presentation on determining migratory behaviour in Atlantic salmon in physiographically complex Scottish coastal environments. In addition Gilbey reported on the application and increased

population resolving power of single nucleotide polymorphism (SNP) based markers for identifying subregional and river population groups in the Scottish east coast. In his analysis of the genetic structure of historical and contemporary Atlantic salmon populations in the River Shannon (Ireland), a large impounded river entering the sea on the west coast of Ireland, Coughlan reported on the failure of hatchery based mitigation to maintain wild populations under such circumstances. Interestingly, his genetic data acquired from an analysis of wild fish returning to the river would suggest that they were new strays from other neighbouring rivers rather than the progeny of fish that had spawned previously above the impoundment. These strays show remarkable ongoing potential for recolonization and population re-establishment should passage problems at the impoundment be resolved. Atlantic salmon are exploited in mixed-stock fisheries in the River Teno/Tana main stem, which target the 30+ subpopulations in the river complex. In his presentation Erkinaro demonstrated how on the basis of catch statistics, catch (scale) samples and their genetic analyses, population-specific exploitation in the main stem can now be estimated in time and space, for different fishing gears and user groups and for different life history groups. Similarly, Whitlock showed in her multistock model for coastal Atlantic salmon fisheries in the Baltic Sea how capture and genetic information can be accommodated to improve the accuracy of Bayesian mixed-stock models. A study of sea trout captured in the Irish Sea using GSI methods facilitated by a new genetic baseline of trout samples collected from British and Irish rivers by Prodohl illustrated the complexity of trout behaviour in the marine environment. However, he was quick to point out several weaknesses in the baseline due to inadequate sampling, which only emerged following a retrospective assessment of assignment efficiency. Among these the possibility of a shared post glaciation phylogeographic history of Welsh and Southern Irish populations and a failure in some instances to distinguish between the progeny of resident trout and sea trout collected for the establishment of the baseline as being among the most difficult to resolve. Stevens and subsequently King also provided tantalising insights into the biology of the sea trout. They were able to get some indication of variations in straying tendency among south of England trout populations. Their results suggest that trout in these rivers are naturally curious and will explore non-natal waters, but that this curiosity does not necessarily result in gene flow. There was some suggestion that similar geologies in parent catchments may give rise to higher straying rates. Was showed how hydroelectric installations can have a devastating affect on the biology of affected trout populations and consequently on genetic population structuring. Her work suggests that contemporary structuring is a good indicator of past anthropogenic affects. In the final formal paper of the day Sabatino presented data on two different shad species, *Alosa alosa* and *Alosa fallax* demonstrating how genetic data could reveal new insights into the biology of these fish particularly in respect to gene flow. A lively debate ensued on the origins and phylogeographic history of the Killarney shad, *Alosa fallax killarnensis*, and how despite easy access to the sea it has adopted an entirely freshwater existence.

Panel Discussion

The discussion session was chaired superbly by Drs Ó Maoileidigh and Dannewitz. Summing up their impressions of the Theme Session T they made the following observations at the commencement of the panel discussion. First, that it was very apparent that genetic techniques were very much now in common use and the mainstream in respect of their input into stock assessment, conservation, management and restoration of diadromous fish species. Second, that a cross-disciplinary combination of multiple techniques, i.e. genetic stock identification, telemetry,

experimentation and modelling had enormous potential to resolve difficult fisheries management questions. Third, making the link between neutral molecular variation and adaptive variation is an imminent challenge, but that the development new genetic tools, e.g. next generation sequencing, gene expression studies, SNP chips suggested a period of substantial technological advancement in this regard. The panel discussion as it progressed was wide ranging touching on many pertinent issues relevant to management and conservation of diadromous species. These included the relevance of post-glacial colonization processes to genetic population structuring and how observed structuring in contemporary populations might be interpreted or maybe misinterpreted. The example of alternative explanations for the origin of pike in Ireland was given as an example of a potential difficulty. Sometime was spent discussing various strategies for identifying and prioritizing population components for conservation, particularly where populations are small and where populations might be grouped into interrelated meta-populations. It was agreed that we all have to be careful in how genetic information is used in such assessments. The perennial issue of stocking was discussed and reference was made as to how experimentation utilizing genetic techniques had provided significant empirical information on the negative affects on recipient populations of the practice. It was apparent from various discussions that some confusion arises due to the multifaceted, multidisciplinary nature of genetics i.e. on one hand the exploitation of neutral genetic variations for individual identification, population assignment and parentage assignment and on the other hand an understanding of how genes regulates biological processes. Some of the final exchanges between the floor and the audience related to how probability accompanying assignments is managed in the context of providing management advice. The consensus was that this was an emergent property of the statistical process and could easily be accommodated by managers in their use of such data to support decision-making processes.

A clear recommendation emerged from the discussion that biological material from which DNA might be recovered should be a core element of every fisheries sampling programme (e.g. the European Union (EU) Data Collection Framework (DCF) the new EU Data Collection Multiannual Programme (DC-MAP)), whether or not the material would be analysed immediately, and that the material should be secured using appropriate protocols. It was also recommended that funding be made available for the development and maintenance of genetic baselines for diadromous species as it was essential to management and conservation purposes.