



Scotland's Freshwater Fish Populations: Stocking, Genetics and Broodstock Management



Collecting broodstock

Stocking

Stocking fish into lakes and rivers to supplement existing wild stocks, or establish new stocks, is a common practice in Scotland. Potentially, stocking can enhance fisheries abundance, compensate for habitat loss, restore depressed stocks, enhance abundance above natural levels, or re-establish fish in waters they no longer inhabit. However, unless carried out properly, stocking can depress productivity, in both the short and long term.

Genetics

Like all living things, fish are the product of their genes. Each fish has a copy of genes from its mother and a copy from its father. These usually differ, as do the types and frequencies of gene variants individuals possess — both within and among locations, often in ways important to fish character, survival and reproduction. Indeed, each fish is genetically unique.

Fish in different lakes and rivers, and often in different parts of the same lake or river, usually belong to distinct genetic populations or groups. In these groups breeding is more or less random, but among groups, interbreeding is limited or absent. These basic biological units have

distinct gene pools that have evolved differences to adapt individual fish to their local environments.

Stocking and Genetics

Stocking can cause genetic changes which reduce the quantity and quality of fish recruitment. Two types of problem can arise, depending on the genetic character of the stocked fish: *outbreeding depression* and *inbreeding depression*.

Outbreeding Depression

Crossing fish from different populations is called *outbreeding* and produces types and frequencies of genetic variants that differ from those produced by matings within population. The resulting offspring may have reduced survival and lower reproductive success, i.e. reduced fitness. This is called *outbreeding depression*. Increased fitness from out-crossing, i.e. hybrid vigour has not been observed in wild fish.

Inbreeding Depression

Crossing closely related fish within populations results in *inbreeding*. This produces offspring with lower than normal levels of genetic variability which often show reduced fitness. This is known as *inbreeding depression*.



Broodstock Management

Within a stocking programme, it is possible to control outbreeding and inbreeding depression by taking care in the choice and crossing of the brood fish used to produce the eggs, fry or other life-history stages used.

Minimising Outbreeding

Outbreeding depression is avoided if all broodstock used to produce fish for stocking a given location belong to the same population. If there is an existing population at the location stocked, use native fish for broodstock.

Avoiding outbreeding is not always easy. Most river systems contain multiple populations and population structure is not obvious. Additionally, fish farm escapes are widespread. In practice, the risk of outbreeding depression can be reduced by:

- taking brood fish from the same river or tributary to be stocked;
- testing for multiple populations by molecular genetic analysis;
- monitoring for the presence of farm fish by scale analysis or using molecular markers;
- if adult fish are scarce, smolts or large parr can be collected and reared to provide brood fish.

Minimising Inbreeding

Some inbreeding is unavoidable but the degree can be reduced by:

- minimising the relatedness of fish in specific crosses;
- using many males and females;
- making sure all spawners contribute more or less equally;
- ensuring that the contribution of each cross (i.e. family) to the stocked fish, and to the wild population post-stocking is more or less equal.

To reduce inbreeding, mate all males with all females from the same population found to be ripe on a given day. This can be achieved by:

- dividing spawners into groups of approximately 10 males and 10 females each;
- stripping the females in each group and mixing their eggs;
- dividing the egg mixture into as many batches as there are males;
- fertilising each batch with one male; **do not mix milt** – some males will be more successful than others due to sperm competition if milt is mixed;
- using 'precocious' males, where these occur naturally in the population, to make up male numbers if needed.



Suggested reading:

Salmon and sea trout: to stock or not? 2003. Scottish Fisheries Information Pamphlet No. 22.