Conservation of Dolly Varden in Alaska

Genetic mixed-stock analysis for management of a subsistence resource

Introduction
Dolly Varden are an important resource for residents of Western and Arctic Alaska. In some communities, Dolly Varden comprise over 80% of the subsistence fishery catch. However, population assessment and management are challenging for anadromous Dolly Varden because they home to spawn in their natal streams, overwinter in freshwater lakes and rivers in mixed aggregates, and are harvested in subsistence fisheries when populations are mixed for overwintering or migrating between marine and freshwater environments. Key management objectives for Dolly Varden in Alaska are the estimation of the stock compositions for subsistence catches and overwintering aggregates.

Mark-recapture and radio telemetry have often been used to track the migration patterns of Dolly Varden.

Subsistence user preparing Dolly Varden.

Male Dolly Varden from the Togiak National Wildlife Refuge.

These techniques indicate the presence of stocks in mixtures but not their relative contributions. Mixed-stock analysis (MSA) using genetic characters takes advantage of the fact that genetic differences occur among populations in species that home to spawn. This method is commonly used to estimate the contributions of stocks of Pacific salmon in commercial, test, and sport fisheries. It can also be effective in estimating stock components of Dolly Varden mixtures.

Residents of several communities in Bristol Bay harvest Dolly Varden from the Togiak River for subsistence use. Mark-recapture and radio telemetry experiments suggest that Dolly Varden overwinter as mixed aggregates in the Togiak River mainstem and Togiak Lake, but that they home to individual tributaries to spawn. Can MSA be used to identify tributary components in subsistence catches and overwintering aggregates?

Methods
We sampled 286 prespawning Dolly Varden from three tributaries of the Togiak River: Kashaiak River, Ongivinuck River, and Trail Creek (Figure 1). Allele frequencies at seven microsatellite loci identified by the Conservation Genetics Laboratory (CGL) were assayed in tributary samples, and in samples collected from Cobblestone River and Kivalina River in northwestern Alaska for comparison at a larger spatial scale.

Results

We detected significant differences in allele frequencies among all the populations sampled (Figure 2). Further, F_{ST}, a measure of population subdivision, was significant for all collections. This indicates that Dolly Varden home to spawn with enough fidelity to lead to genetic differences among Dolly Varden populations within and among rivers. Simulation analyses were then used to test whether allele frequency differences among collections are large enough for MSA. Conditional maximum likelihood estimates of population contributions were made for 1000 artificial mixes from a single population so that mean contribution estimates should equal 100%. Mean contribution estimates for Kashaiak River, Ongivinuck River, Trail Creek, Cobblestone River and Kivalina River were close to or exceeded 90% (Figure 3).

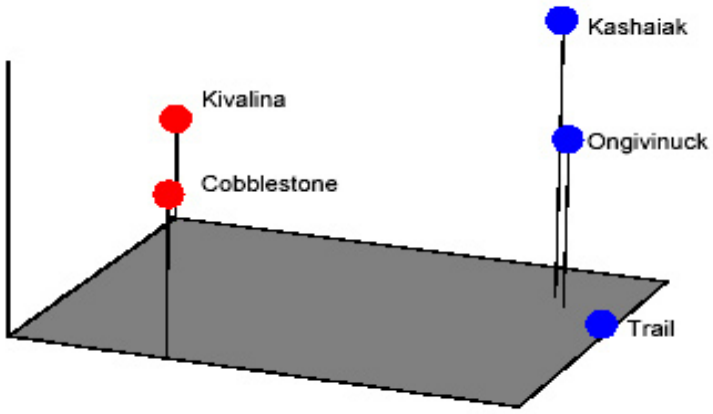

Figure 2. Genetic relationships among Dolly Varden sampled in this study.

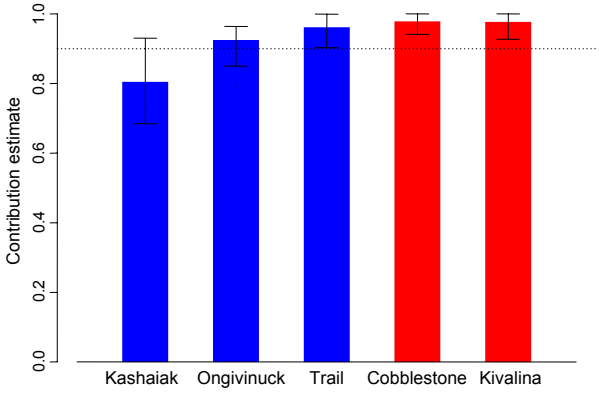

Figure 3. Mean mixture estimates for simulated mixtures of Dolly Varden from Kashaiak River, Ongivinuck River, Trail Creek, Cobblestone River, and Kivalina River are close to or exceed 90%.

Management Applications

Identification and conservation of local reproductive units are essential to the long-term sustainability of a resource. Knowledge of genetic differences among tributary populations of Dolly Varden should be incorporated into management programs to maintain genetic variability and possible local adaptations among tributary populations to sustain productivity. Given the highly migratory nature of Dolly Varden, genetic data from populations covering broad geographic areas will be needed for accurate MSA. However, as these data are collected, MSA will provide a method to estimate the number and relative abundance of Dolly Varden overwintering in the Togiak River system and the stock contributions to harvests.

Subsistence gillnetting in Bristol Bay.

The CGL is conducting similar projects with Alaska Department of Fish and Game to estimate the origin of Dolly Varden overwintering in the Wulik and Noatak rivers in northwestern Alaska and the stock contributions to subsistence catches by residents of Kaktovik in Arctic Alaska. Stock composition data collected through these studies will allow managers to evaluate the impact of subsistence fishing on stocks of Dolly Varden, delineate important stock-specific overwintering areas, and provide a new method for documenting migration patterns. The population information collected will also provide a better overall understanding of the genetic diversity of Dolly Varden in Alaska.

The Conservation Genetics Laboratory was established in Anchorage, Alaska in 1987 as the first conservation genetics facility in the Fish & Wildlife Service. The large modern facility features six DNA sequencers and maintains a staff of 12 geneticists, biologists and technicians dedicated to working with others to conserve, protect and enhance, fish, wildlife, plants and their habitats for the continuing benefit of the American people.

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