Engineering

Genetically Engineering Salmon

Demand for Atlantic salmon has increased, and wild populations of salmon have decreased, mainly due to overfishing and other environmental impacts. Struggling wild populations suggest that commercial fishing is not sustainable at current rates. Farm-raised Atlantic salmon is an alternative to wild-caught fish and reduces pressure on wild populations by providing a reliable salmon source. Salmon can be farmed in ocean pens or in land-based facilities. Some farm-raised salmon are bred for advantageous traits, such as disease resistance.

Farming has drawbacks, though. Farms require space and resources to feed, house, and maintain the fish as they grow. The salmon typically take 28-36 months to reach market weight, and production costs can drive up the price.

FIGURE 14: A normal Atlantic salmon compared to a GM Atlantic salmon of the same age.

Analyze Define the engineering problem outlined for salmon production. What are the important criteria? What constraints might exist for a solution that reduces the stress on wild-caught salmon and on farmers raising these fish?

To solve some of the problems with farming salmon, scientists produced genetically engineered Atlantic salmon. They inserting a growth hormone from Chinook salmon and a promoter from ocean pout into the genome. The promoter allows the growth hormone to be active all year, instead of only part of the year as in normal salmon.

Transgenic Atlantic salmon grow to twice the size of normal Atlantic salmon in the same amount of time. This decreases the time to market weight to as few as 18 months, compared to up to 36 months in normal salmon. So, farmers are able to grow and sell more salmon in a given time period. There are also environmental benefits such as decreased usage and contamination of water resources. The genetically modified salmon are raised in land-based facilities with pollution management and water recycling systems. Genetically modified salmon reduce the impact on wild populations and aquatic ecosystems.

There is still public resistance to eating genetically modified organisms. This represents a social challenge to the success of farming genetically engineered salmon. One of the biggest environmental concerns is the possibility that a GM individual may escape and breed with wild individuals. This could introduce the modified gene into wild populations through any offspring produced, with unknown long-term effects on wild Atlantic salmon or other species.

Explain Design a decision matrix and use it to analyze criteria for the use of commercial fishing, normal salmon farming, and GM salmon farming in meeting the demand for salmon. Weight the criteria on a scale of 0 to 5. What is the best solution based on your criteria? Are there any problems with this solution that can be anticipated and avoided?