
Tekst 4

Fish farming**High-tech breeders**

TOKYO

- 1 **T**HE Japanese are great guzzlers of fish, but fish are in finite supply. And farming them to increase that supply can be tricky, because many species are susceptible to disease when crowded together. That fact is the impetus behind a study led by Takashi Sakamoto of the Tokyo University of Marine Science and Technology. Dr Sakamoto is using a combination of modern genetic techniques and classical breeding to produce fish that can survive crowding without falling ill.
- 2 His first task was to establish genetic maps for each of the species involved – flounders, trout and amberjack. Such a map is not a complete DNA sequence, which would be unnecessarily detailed, but rather a set of signposts, with which a geneticist can navigate his way around an animal's chromosomes. The signposts are places where DNA routinely differs within a species from one individual to another, and does so in characteristic ways. When sperm and eggs form, blocks of DNA from a creature's mother and father are swapped around, 7. If you have enough signposts it is possible to follow these blocks through the generations.
- 3 Dr Sakamoto now has genetic maps for hundreds of individual fish, and he also has data, collected in collaboration with Japan's three main fishery-research institutes, on how well these fish did when faced with plague or pestilence. He has thus been able to tease out which versions of which signposts are associated with rude health.
- 4 It is not the signposts themselves which confer protection from disease. That is done by nearby genes. However, gene and signpost travel together from parent to offspring, so the presence of the one can be inferred from the presence of the other. And that gives Dr Sakamoto an invaluable head-start when it comes to breeding disease-resistant fish. He is able to see how many resistance genes have ended up in each animal and then pick the most resistant to breed from. He thus gains much of the advantage that might come from actual genetic engineering (i.e., directly transplanting resistance genes into fish eggs) without having to do the engineering itself.
- 5 It also means he can breed healthier fish without necessarily knowing what the health-giving genes are – though it would obviously be a bonus to have such knowledge, and he is indeed busy searching the DNA near the relevant signposts to find the truth.
- 6 Dr Sakamoto's research group has already managed to produce flounders which are resistant to viral lymphocystis (a serious problem on flounder farms) and these are now in the shops. It has also produced trout

that are immune to a bacterial infection called cold-water disease, and it is now working on amberjack that will be less likely to suffer infestations of monogenean, a parasitic flatworm. The upshot should be healthier, cheaper fish – and happier fish farmers.

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- 1p 6 What is the function of paragraph 1?
- A to describe Dr Sakamoto's clinical research into fish breeding systems
 - B to explain the need for breeding fish in view of the growing population
 - C to outline Dr Sakamoto's motivation behind breeding fish that are disease resistant
 - D to provide background information on the technology of genetic engineering and fish
- 1p 7 Which of the following fits the gap in paragraph 2?
- A affecting the signposts
 - B concealing genetic strings
 - C taking the signposts with them
 - D transforming genetic information
- 2p 8 Geef van elk van de volgende beweringen aan of deze wel of niet overeenkomt met de inhoud van alinea 3 en 4.
- 1 While carrying out his research programme, Dr Sakamoto deliberately infected fish.
 - 2 Genetic maps provide scientists with information about the presence of resistance genes.
 - 3 The selection of fish for breeding is based on how many disease resistant genes they have.
 - 4 Dr Sakamoto's genetically modified fish provide information on their resistance to contagious diseases.
- Noteer het nummer van elke bewering, gevolgd door "wel" of "niet".
- The subtitle of this article has been left out.
- 1p 9 Which of the following was the original subtitle?
- A Dr Sakamoto is fishing in troubled waters by mapping genes
 - B Healthy fish, healthy people
 - C How to benefit from genetics without genetically engineering fish
 - D There is something fishy about genetic engineering