

EVOLUTION

# Shrinking fish

## Fisheries-induced evolution in the Yellow Sea

Ongoing research indicates that undesirable genetic changes are taking place in Yellow Sea fish stocks as a result of commercial exploitation. These findings are the outcome of collaborative research between IIASA and the Yellow Sea Fisheries Research Institute (YSFRI) in Qingdao, China.

Today, fishing is the dominant source of mortality in most commercially exploited fish stocks. According to the United Nation's Food and Agricultural Organization (FAO), world capture fisheries have reached a ceiling, with three stocks out of four being maximally exploited or overexploited. Since all fish species were genetically adapted to the environmental conditions experienced prior to intensive exploitation, the current, drastically altered conditions cannot possibly leave their life-history patterns unaffected.

Consequently, fishing is not merely changing the numbers of fish in the sea but is also altering their genetic composition. Together with its network of international collaborators, IIASA's Adaptive Dynamics Network (ADN) Program has found indications of fisheries-induced genetic changes in more than 10 exploited fish stocks in the North Atlantic Ocean. This evolutionary dimension of fisheries has been overlooked or downplayed for decades, so that fisheries scientists and managers are just now awakening to the formidable risks posed by further unmanaged, fisheries-induced evolution.

Based on contacts initiated by the National Natural Science Foundation of China in 2002, YSFRI's Xianshi Jin and IIASA's Mikko Heino and Ulf Dieckmann are examining whether fisheries-induced evolution is occurring in the Yellow Sea (map). Exploitation pressures in this region have been high throughout the past few decades. Stocks like that of small yellow croaker nowadays comprise much smaller fish than in earlier years (bar charts). Also, the stock's proportion of mature fish at any given length has increased considerably (line chart). The latter observation agrees well with predictions of fisheries-induced evolution: exploited fish are under selective pressure to leave offspring as early in life as possible, before being removed from the gene pool by the fishery.

Implications of fisheries-induced evolution for sustainable yield, stock stability, and recovery potential are grave. Once this blind spot in perceiving the consequences of human exploitation is overcome, a new generation of fisheries scientists and managers will need scientific tools to cope with the threats of undesired fisheries-induced evolution. ■

**Further information** IIASA's Adaptive Dynamics Network Program at [www.iiasa.ac.at/Research/ADN](http://www.iiasa.ac.at/Research/ADN)

**Dr Ulf Dieckmann** is the leader of IIASA's Adaptive Dynamics Network Program. **Dr Mikko Heino** is a research scholar at IIASA's Adaptive Dynamics Network Program. **Dr Xianshi Jin** is a professor at the Yellow Sea Fisheries Research Institute.

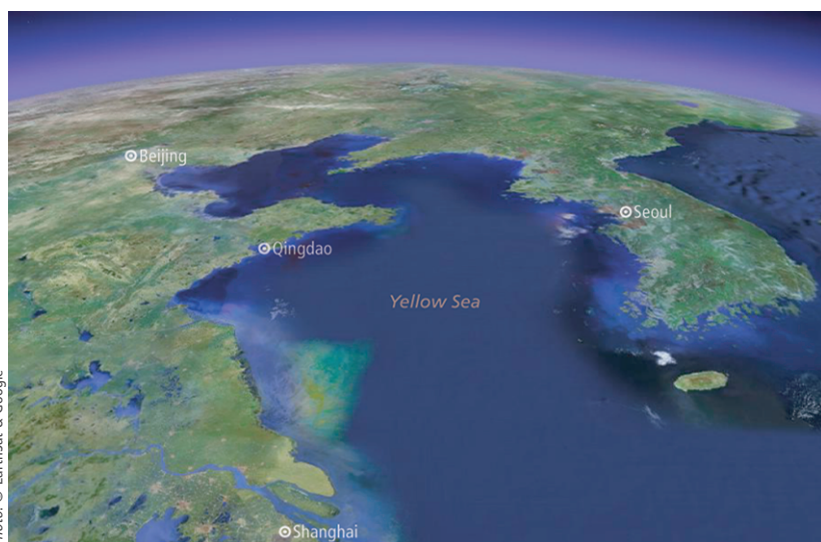
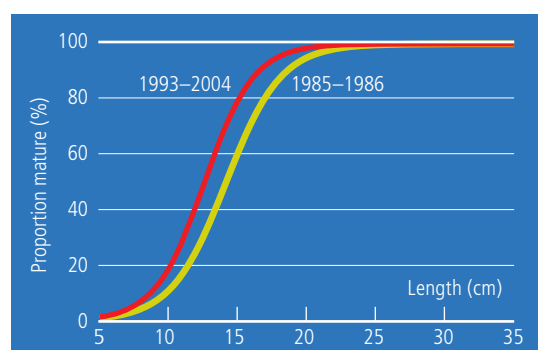
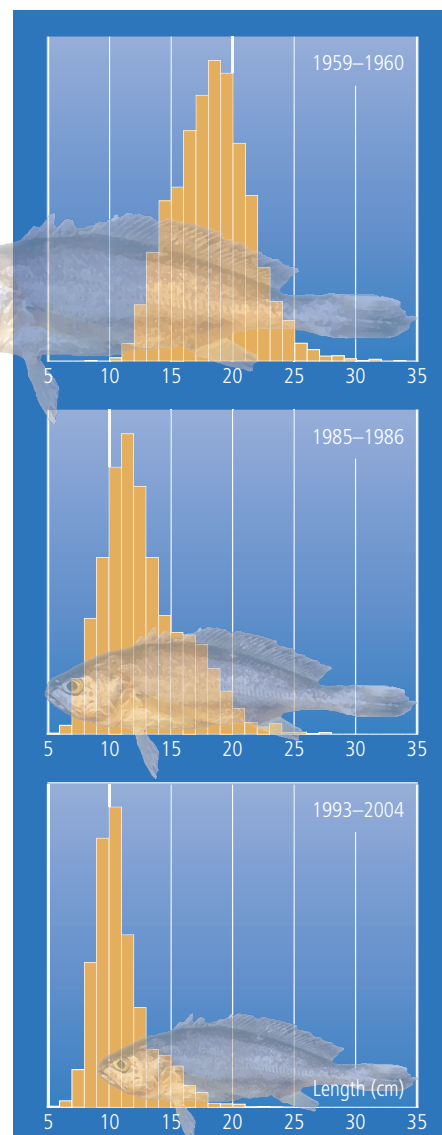


Photo: © EarthSat & Google



(Bar charts) During the past 40 years, the length distribution of small yellow croaker has shifted toward much smaller fish, evidencing heavy exploitation and, presumably, fisheries-induced evolution. The images of the fish represent the declining average length from 19.2 cm to 13.8 cm to 11.9 cm.

(Line chart) During the past 20 years, the proportion of mature small yellow croaker at any given length has increased considerably, a trend highly suggestive of fisheries-induced evolution.

(Map) The Yellow Sea is situated between China and Korea. Its shallow depths of up to 80 meters are home to about 300 fish species. During the second half of the 20th century, overfishing led to the replacement of highly valued larger species such as small yellow croaker by less-valued smaller species such as anchovy.