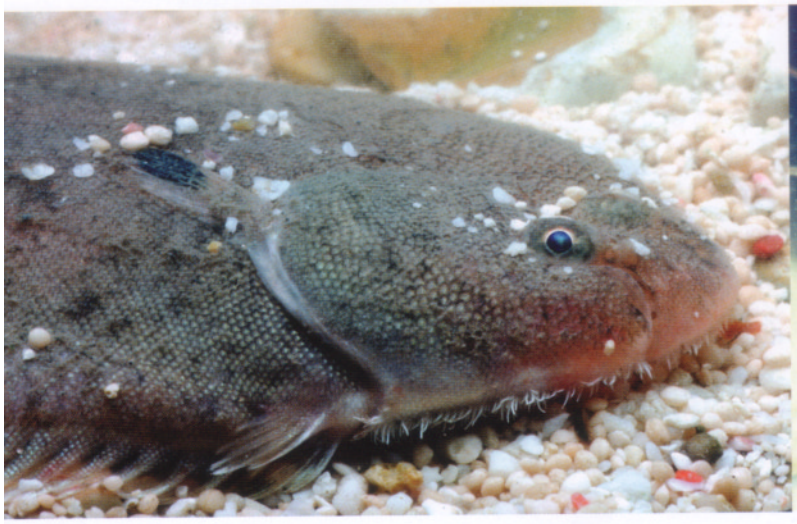
Is climate the main determinant of fish population change?

GIVEN THE WELL-ESTABLISHED INFLUENCES OF THE EL NINO SOUTHERN OSCILLATION, THE PACIFIC DECADAL OSCILLATION AND THE NORTH ATLANTIC OSCILLATION (NAO) ON MANY OF THE WORLD'S MOST IMPORTANT FISHERIES IT IS APPROPRIATE TO ASK: IS CLIMATE THE MAIN DETERMINANT OF POPULATION CHANGE FOR MARINE FISH AND CRUSTACEANS?



Many of the most abundant UK species including bass, *Dicentrarchus labrax*, sole, *Solea solea*, dab, *Limanda limanda*, sea snail, *Liparis liparis* and the prawns *Palaemon serratus* and *Pasiphaea sivado* have all shown dramatic changes in abundance linked to seawater temperature and the NAO. Species with a distribution extending far to the south of Britain such as sole and bass have increased in abundance with seawater warming. More northerly forms such as dab and sea snail have declined.

Our present work on the common shrimp *Crangon crangon* in the Bristol Channel suggests that climate may not be the main influence. The shrimp population probably comprises some 10^{10} individuals and is by far the most abundant macro-crustacean. It is a key species within the food web and is consumed by most of the common fish. Ongoing studies show that there is a small effect of climate in the time series with a slight increase in abundance as seawater temperatures increase.

However, the most striking feature is the stability of the population over a long time period and a highly significant level of density-dependence.

What is producing this control is now a focus of study.

At present I favour competition for space with excluded individuals rapidly succumbing to fish predation.

The recent increase in cod, *Gadus morhua* abundance in the Bristol Channel as temperatures increase is certainly a puzzle as the Bristol Channel is close to the southern edge of the range. For cod as for other gadoid fish it is not simply climatic change that is driving their dynamics.

We have found between species interactions far more difficult than climate influences to disentangle and understand. If this is a general experience, then we may be exaggerating the importance of climate compared to biological control in the literature. There can be no doubt that climate change is capable of producing a great impact on fish communities. But, the production of reliable predictions from models of the effect of climate change will also require inclusion of biological interactions.

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TOP LEFT: Since the 1970s, Bass, *Dicentrarchus labrax*, has increased both the northern extent of their range and their abundance in north-east Atlantic waters. However, climate is probably not the only determinant of successful recruitment, as strong cohorts suppress subsequent recruitment (Henderson & Corps, 1997. *Journal of Fish Biology*, **50**, 2802–295.)

BELOW FROM LEFT TO RIGHT: In British waters the abundance and growth of sole, *Solea solea*, changes with climate (Henderson & Seaby. 2005. *Journal of Marine Biological Association UK*, **85**, 197–204.)

The Atlantic prawn, *Palaemon serratus*, which has recently shown an almost exponential increase in abundance in the Bristol Channel as water temperatures have increased.

The sea snail, *Liparis liparis*, avoids warmer waters and has recently become less abundant in inshore British waters. However, it is unlikely that populations have declined. (Henderson & Seaby, 1999. *Journal of Fish Biology*, **54**, 1161–1176.)

The brown shrimp, *Crangon crangon*, is a dominant species in East Atlantic estuaries and these populations display high stability.

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Henderson, P.A. & Seaby, R.M., 2005. The role of climate in determining the temporal variation in abundance, recruitment and growth of sole *Solea solea* in the Bristol Channel. JMBA **85(1)**, 197–204.