

# Please, do disturb

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## *Scientists discover how noise maintains entire marine ecosystems*

Noise is usually nothing more than a disturbance, but sometimes it can be useful. Researchers have discovered that noise could bring order to chaotic systems, protect and maintain entire marine ecosystems, and even make the chemical industry greener. This research is reported today in a special Einstein Year issue of the New Journal of Physics published jointly by the Institute of Physics and the German Physical Society (Deutsche Physikalische Gesellschaft).

Changsong Zhou and a group of physicists at the University of Potsdam, Germany, are studying chaotic systems, known as excitable media. The firing of neurons in the brain is an example of such a system, as is the growth and receding of blooms of plankton in the sea. Such systems do not become excited by small signals but if they are stimulated above a threshold amount, then they give it their all: neurons fire and plankton blooms.

"Similarly, excitable non-linear behaviour is also found in chemical reactions", explains Zhou, "where an external pressure or light can push a reaction down one route instead of another."

Zhou and his colleagues have found that the key to this sort of excitation is chaotic mixing and noise. The researchers demonstrated how a non-linear system can be controlled to become synchronized even when its stimulus is below the threshold by the addition of noise to the system.

The results based on their model study imply that oscillatory behaviour in many natural systems, rather than being disturbed by noise, is thus sustained by it. For instance, the "noise" in a marine ecosystem due to temperature changes, ocean currents, wind-driven waves, fluctuations in nutrient levels, the movement of schools of fish, and wind-driven waves affect how plankton blooms grow and recede. If the conditions are below an optimum the plankton do not grow, but they can be forced into action by noise, and once they are stimulated the whole system is activated and a marine landscape is quickly blanketed by the bloom.

Zhou's results suggest that without noise such blooms might be physically unable to flourish in some areas or might not follow the usual seasonal cycles. "Noise might be essential to maintaining the stability and the persistence of marine ecosystems," Zhou says. This research might therefore help environmental scientists predict or even prevent toxic plankton blooms by observing the natural noise that affects them.

Zhou and his colleagues also suggest that noise might usefully be used to control chemical reactions. They explain that random disturbances in industrial mixing tanks could be promoted to make a reaction proceed more efficiently and so reduce chemical waste, making the chemical industry a little more environmentally friendly.

Source: Institute of Physics

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