THIS WEEK

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Fishy limits

The European Union has set a worrying trend by ignoring scientific advice on overfishing. It must put long-term sustainability plans ahead of short-term political gains.

Fish have a memory capacity that goes far beyond what they are usually given credit for, but do European politicians? If not, the Ghost of Christmas Past could remind ministers of any number of grim scenes from recent years: the decades of overfishing, the large decline in stocks such as cod, and the dire and repeated warnings from scientists that ocean resources are being depleted faster than they can recover.

With a little seasonal flexibility, the Ghost could even show politicians the agreement they signed in 2013 to use proper scientific advice when setting annual fishing quotas, formally known as total allowable catches (TACs). And, if they are still refusing to wake up, the Ghost could take them on a brief trip back to last week, when the policymakers turned their back on that promise.

Never mind the Ghost of Christmas Present: a meeting last week in Brussels saw the giving and receiving of Christmas presents from the politicians to each other, to their domestic fishing industries and to vocal lobby groups. Although the headline news celebrated the recovery of some iconic fish stocks — North Sea cod among them — and the increased licence that fishermen again have to scoop them up in greater numbers, the story beneath the surface was not so happy. For many species, scientific advice was again ignored, and TACs that look unsustainable were agreed.

Cod in the Kattegat Sea, the shallow and treacherous waters between Denmark and Sweden, are still struggling, and face a much more uncertain future than their cousins in the North Sea. The meeting last week offered them little cheer. The agreed TAC is some three times the size of the quota recommended by the International Council for the Exploration of the Sea, the scientific body that advises the European Union. Celtic Sea cod and Southern hake are among the other fish for which scientists had proposed stricter limits than the politicians agreed, and which are now left exposed to overfishing.

One reason why the outcome of the Brussels meeting is so disappointing is that it comes after encouraging signs that the message on overfishing was finally getting through.

Research published last month shows that since 2001, European fisheries TACs have been an average of 20% higher than scientific advice suggested (G. Carpenter *et al. Mar. Policy* **64,** 9–15; 2016). But the picture is improving. The same study found that whereas fishing was 33% above the recommended level in 2001, it was only 7% higher in 2015. There is more scrutiny on fisheries, more public interest and seemingly more political will to tackle the problem than there has been in the past. When promising to respect the scientific advice on quotas in 2013, Europe also pledged to move towards catches based on a different, more ecological, measure of stock health called maximum sustainable yield by 2020.

The message sent last week by the willingness of the European policymakers to ignore scientific advice places a question mark over whether progress can be sustained, and the 2020 target reached. Despite the recovery of some landmark species (only after, it should be said, draconian and last-ditch fishing curbs were placed on them), study after study has shown that many European fish species remain in peril. Just last week, the Marine Stewardship Council, a non-profit organization dedicated to tackling overfishing, suspended all five cod fisheries in the Eastern Baltic Sea from its scheme that awards sustainable status to fish products.

"Sustainable fishing offers more security than haphazard political agreements."

Fishing is a difficult political problem. One analysis has found that overfishing is more likely where fish stocks are large and exploited by a number of different countries (see go.nature.com/mhx6q4).

Low quotas have a genuine social and economic impact on a vulnerable sector and the people who work in it. It is natural that politicians want to protect jobs and maintain livelihoods. But scientists and conservationists want that too. They just think a little further ahead. Ultimately, sustainable fishing offers more security than haphazard political agreements made behind closed doors from year to year.

Announcing the most recent round of TACs, Karmenu Vella, the EU fisheries commissioner, said: "We cannot jeopardise the longer term sustainability for the shorter term considerations." No one could disagree with that. Vella added: "We are on track in our sustainability targets." Universal agreement for that statement will be harder to find. The Ghost of Christmas Yet to Come awaits. ■

Quantum leap

Physicists can better study the quantum behaviour of objects on the atomic scale.

Erwin Schrödinger was an interesting man. Not only did he conceive a most imaginative way to (theoretically) kill a cat, he was in a constant state of superposition between monogamy and not. He shared a household with one wife and one mistress. (Although he got into trouble at Oxford for this unconventional lifestyle, it didn't pose a problem in largely Catholic Dublin.) Just like the chemist Albert Hofmann, who tried LSD (lysergic acid diethylamide) on himself first, Schrödinger might have pondered how it would feel for a person to be in a genuine state of quantum superposition. Or even how a cat might feel.

In principle, quantum mechanics would certainly allow for Schrödinger, or any of us, to enter a state of quantum superposition.

That is, according to quantum theory, a large object could be in two quantum states at the same time. It is not just for subatomic particles.

Everyday experience, of course, indicates that big objects behave classically. In special labs and with a lot of effort, we can observe the quantum properties of photons or electrons. But even the best labs and greatest efforts are yet to find them in anything approaching the size of a cat.

Could they be found? The question is more than head-in-the-clouds philosophy. One of the most important experimental questions in quantum physics is whether or not there is a point or boundary at which the quantum world ends and the classical world begins.

A straightforward approach to clarifying this question is to experimentally verify the quantum properties of ever-larger macroscopic objects. Scientists find these properties in subatomic particles when they confirm that the particles sometimes behave as a wave, with characteristic peaks and dips. Likewise, lab set-ups based on the principle of quantum interference, using many mirrors, lasers and lenses, have successfully found wave behaviour in macromolecules that are more than 800 atoms in size.

Other techniques could go larger. Called atom interferometers, they probe atomic matter waves in the way that conventional interferometers measure light waves. Specifically, they divide the atomic matter wave into two separate wave packets, and recombine them at the end. The sensitivity of these devices is related to how far apart they can perform this spatial separation. Until now, the best atomic interferometers could put the wave packets about 1 centimetre apart.

On page 530 of this issue, physicists demonstrate an astonishing advance in this regard. They show quantum interference of atomic wave packets that are separated by 54 centimetres. Although this does not mean that we have an actual cat in a state of quantum superposition, at least a cat could now comfortably take a nap between the two branches of a superposed quantum state. (No cats were harmed in the course of these experiments.)

Making huge molecules parade their wave nature and constructing atom interferometers that can separate wave packets by half a metre are extraordinary experimental achievements. And the technology coming from these experiments has many practical implications: atom interferometers splendidly measure acceleration, which means that they could find uses in navigation. And they would make excellent detectors for gravitational waves, because they are not sensitive to seismic noise.

"A cat could now take a nap between the two branches of a superposed quantum state."

Schrödinger was more of a philosopher than an engineer, so it is plausible that he would not have taken that much interest in the practical ramifications of his theory. However, he would surely have clapped his hands at the prospect that experimenters could one day induce large objects to have quantum properties. And there are plenty of proposals for how to ramp up the size of objects with proven quantum behaviour: a microscopic mirror in a quantum superposition, created through interaction with a photon, would involve about 10^{14} atoms. And, letting their imaginations run wild, researchers have proposed a method to do the same with small biological structures such as viruses.

To be clear, science is not close to putting a person or a cat into quantum superposition. Many say that, because of the way large objects interact with the environment, we will never be able to measure a person's quantum behaviour. But it's Christmas, so indulge us. If we could, and if we could be aware of such a superposition state, then how would we feel? Because 'feeling' would amount to measuring the wave function of the object, and because measuring causes the wave function to collapse, it should really feel like, well, nothing — or perhaps just a grin. ■

Light relief

Nature *digs into the rumours about the effect of festive illuminations on wireless fidelity.*

At the end of the year, it is natural to reflect on the many science success stories of 2015. There was the forging of a climate-change agreement in Paris, and the incredible pictures of Pluto beamed back by the New Horizons spacecraft (for more, see our end-of-year review starting on page 448). Beware, though, for the road of progress is bumpy, and new and old technology can clash.

Christmas can break the Internet, the UK newspapers nearly reported this month. Researchers have found that twinkling fairy lights on a household Christmas tree can interfere with the wireless signal between a router and internet-connected devices.

In Britain, the telephony and airwaves regulator Ofcom released a smartphone app so that people can assess just how bad this seasonal effect is. We at *Nature* know what's expected of us, so we downloaded the app and put it through its paces.

First, the control test. The Nature Towers Wi-Fi was just fine before we illuminated the office Christmas tree, and — to the relief of all — remained completely unaffected once the halls were decked with the requisite tinsel, mistletoe, boughs of holly and festive lighting. Still, before you eat another mince pie and check the online weather forecast for snow, know that the Wi-Fi was seriously compromised by unknown forces once the illuminations had been switched off for the night. What could have be going on?

As Andrew Smith writes on *The Conversation*, your festive illuminations might indeed interfere with your Wi-Fi, but they would have to very powerful — much more so than other household features such as microwaves or fluorescent lights (see go.nature.com/fqy5mr).

The *Daily Mail* newspaper can always be relied on for inventive scientific answers and did not disappoint. Perhaps, it says, goldfish are sabotaging the Wi-Fi? Water, it points out, absorbs radio waves, so you shouldn't place a router near a fish tank, nor (we suppose) in one.

The story, although little more than a sprinkling of seasonal fluff on the tail end of the year in science, does illustrate more serious matters — the many factors, perhaps small and even undetectable, that can throw an experiment.

We all know colleagues whose Southern blots come out like Rorschach tests and who have to rely on the one lab technician who has 'the touch'. *Nature* argues strongly for reproducibility and that experimental details, no matter how small, should be set out for all to see. We have launched a string of publications and platforms to help researchers to do this: *Nature Methods*, *Nature Protocols*, *Scientific Data* and *Protocol Exchange*. However, when one is working just beyond the cutting edge, other factors might be at play — on the edge of detectability and beyond. One of last year's highlights was the discovery, after years of careful testing, that migrating birds can be disoriented by the electromagnetic 'smog' produced by human activity (S. Engels *et al. Nature* **509,** 353–356; 2014).

This finding sits in a contentious field in which researchers seek to explain the seemingly impossible feat in which animals detect and transduce the very weak signals generated by Earth's magnetic field. Festive bulbs are a mere drop in the electromagnetic ocean, from the devices around us to the photons that bring messages from the edge of the cosmos.

In the time it has taken you to read this, about 600 trillion neutrinos will have passed through your body, as well as uncounted dark-matter particles, and perhaps even some schleptons, snoozons, axions and other particles of which science has as no knowledge, yet. That is what next year is for. ■

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CORRECTION

The Editorial 'Fishy limits' (*Nature* **528,** 435; 2015) wrongly implied that the European Commission had set the fishing quotas. They were set by the Council of Ministers.