

▶ policy in developing countries for the World Resources Institute, an environmental think tank in Washington DC. Song expects China to release detailed plans in coming months about how various sectors of its economy will meet the new commitments.

But China is already on track to achieve — and probably exceed — its previous targets. The latest data suggest that the country may have already halted its dramatic rise in coal use, beating the 2020 deadline that it set 2 years ago. China also leads the world in the deployment of renewable energy, investing some US\$110 billion in 2015. At the United Nations climate summit in Paris last year, China committed to halting growth in greenhouse-gas emissions by 2030, but consensus is building that a peak could come by 2025 — if not sooner. In addition to energy trends, the latest forecasts account for slower economic growth, as well as a shift away from heavy manufacturing and the production of steel and other commodities.

Some fear that coal consumption could spike again, along with carbon emissions, if China's slowing economy revives. But a London School of Economics study published on 16 March concludes that this is unlikely (F. Green and N. Stern *Clim. Pol.* http://doi.org/bdmm; 2016). The Chinese government's latest energy data suggest that emissions may have dropped in 2015, says Fergus Green, a policy analyst who co-authored the study with economist Nicholas Stern. This means that China's emissions may have already peaked.

One big question is whether China can rein in oil use in the growing transportation sector, in which the government has been less aggressive. Nonetheless, Finamore says, strict new requirements on air pollution, driven by rising anger among Chinese citizens, are pushing China in the right direction. "This is the new normal."



A killer whale at SeaWorld, which has stopped breeding the animals in captivity.

MAMMALOGY

Clash over killerwhale captivity

Lifespan of animals kept in parks is at centre of dispute.

BY EWEN CALLAWAY

In a decision hailed by animal-rights groups, the US marine-park company SeaWorld Entertainment announced last week that it will no longer breed killer whales. But whether captivity harms the planet's biggest predator is an area of active scientific debate.

The latest arguments centre on two 2015 studies that drew dramatically different conclusions about the lifespans of captive killer whales (*Orcinus orca*), relative to those of wild populations. Although many factors affect wellbeing, an apparent discrepancy between the survival of captive and wild animals has long been cited by activists as evidence of the poor welfare of captive killer whales.

One of the studies¹ is authored by a team largely made up of researchers at SeaWorld, which is headquartered in Orlando, Florida, and owns several animal parks that keep killer whales; the other² is by two former killer-whale trainers at the company who feature in the 2013 documentary film *Blackfish*, which is critical of SeaWorld. In letters published last week^{3,4}, authors from each paper accuse the others of cherry-picking data to support positions on whether the animals should be captive — charges that each team in turn rejects.

Although SeaWorld's captive-killer-whale programme now has an expiration date, the company's existing 23 animals will remain in parks for the rest of their lives, and its pregnant female Takara will give birth in captivity. Another 33 animals are held in other marine parks around the world.

Robust studies of killer whales' longevity are needed to improve the well-being of the remaining captive animals, says Douglas DeMaster, science director at the US National Oceanic and Atmospheric Administration's Alaska Fisheries Science Center in Seattle, Washington.

But the annals of research on captive killer whales are slim. Before 2015, the last major published study⁵ dates to 1995, when US government scientists calculated that the annual survival rate of captive killer whales was several per cent lower than that of a wild population off the coast of Washington state called southern resident killer whales.

In one of the 2015 studies², the former trainers — John Jett, a biologist at Stetson University in DeLand, Florida, and Jeffrey Ventre, a physician at Lakeview Campus Medical Facility in Yakima, Washington — attempted to measure how captive whales have fared since conditions were improved in the 1980s. They pooled data from between 1961 and 2013 on 201 captive killer whales in institutions around the world, including SeaWorld. They concluded that survival rates in captivity have improved since 1985, but that even the most recent survival rates are below those of animals in the wild.

In the other 2015 study¹, researchers led by SeaWorld veterinary surgeon Todd Robeck came to a very different conclusion: that animals now in captivity at SeaWorld's US parks live just as long as wild populations. The researchers looked only at animals held at those parks after 2000, and produced a survival rate that is higher than a rate that they calculated for southern resident killer whales - and equivalent to that of another wild population that lives in the waters off British Columbia, Canada.

Now, each lead author has taken aim at the work of the other. In a letter published in Marine Mammal Science³, Robeck and three colleagues note that Jett and Ventre included in their 2015 study stranded animals, which might have arrived in captivity in poor health, and newborns, which are at particularly high risk of death. This pushes down the apparent survival rate of captive animals, say the researchers.

In the same journal, Jett responds⁴ to that critique, and accuses Robeck's 2015 study of bias because, for instance, it compares captive whales to the southern resident population, which is endangered and exposed to pollutants and shipping traffic, and whose numbers have waxed and waned over the past four decades.

Jett says that his and Ventre's study was intended to take a wide look at captive-killerwhale survival, so they included as many data as possible. But Robeck stands by his critique. "They can include all the animals they want," he says. "The conclusions they made were not based on the evidence they showed."

DeMaster notes that the comparison that Robeck and his colleagues made between captive killer whales and a disturbed wild population is not useful. He adds that it is also difficult to compare the approaches taken by the two teams, because they analyse different animals over different periods.

On 8 March, a further group of researchers entered the fray, criticizing the 2015 Robeck study on another front. In the Journal of Mammalogy⁶, the group charges that Robeck's study implied that evidence for a long postreproductive lifespan in killer whales is an arte-

"People started looking at killer whales in the early 1970s and they weren't immediately experts."

fact stemming from overestimated ages of adults in the early days of research on captive killer whales. "People started looking at killer whales in the early 1970s and they weren't immedi-

ately experts," says Robeck, who has also published a response⁷ to that critique.

The authors of the critique say that the evidence for the post-reproductive lifespan, a rare evolutionary adaptation otherwise seen only in humans and in pilot whales, is robust. "There are whales still alive now that were around in the 70s that haven't had a calf," says one of the authors, Darren Croft, a behavioural ecologist at the University of Exeter, UK. It will take more observation time to put firm numbers on the post-reproductive lifespan of killer whales, says Andrew Foote, an evolutionary ecologist at the University of Bern and another of the co-authors.

The only way to resolve the dispute over the longevity of captive killer whales is for different teams to analyse the same data in the same manner, says DeMaster. Such studies could improve the well-being of captive animals by, for instance, identifying the facilities and husbandry practices that most benefit them.

- 1. Robeck, T. R., Willis, K., Scarpuzzi, M. R. & O'Brien, J. K. J. Mammal. http://dx.doi.org/10.1093/ jmammal/gyv113 (2015).
- 2. Jett, J. & Ventre, J. Mar. Mamm. Sci. 31, 1362-1377 (2015)
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- 5. Small, R. J. & DeMaster, D. P. Mar. Mamm. Sci. 11, 209-226 (1995).
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- 7. Robeck, T. R., Willis, K., Scarpuzzi, M. R. & O'Brien, J. K. J. Mammal. http://dx.doi.org/10.1093/ jmammal/gyw023 (2016).

CORRECTION

The News Feature 'The red-hot debate about transmissible Alzheimer's' (Nature 531, 294-297; 2016) erroneously stated that growth hormone had been derived from the adrenal glands of cadavers. In fact, it came from the pituitary glands.