



中外对话 chinadialogue

变动中的国际气候格局

The changing landscape
of climate politics



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控制气候变化，世界需做出改变

'Unprecedented' action needed to control climate change

请听我说：台风灾民向化石燃料公司发出呼吁

Please listen to us: typhoon survivors appeal to fossil fuel firms

中国雾霾治理用错药了吗？

Is China targeting the wrong chemical in effort to cut winter smog?

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“中外对话”是一个独立的非营利性组织，以伦敦、北京、德里和圣保罗为中心开展工作。

“中外对话”的主要业务是其独特的完全双语网站，它通过发表精辟、原创的中外文章、评论和分析，促进世界理解中国崛起带来的全球性生态环境影响，进而共同寻求公平可行的全球环境问题解决之道。

“中外对话”在很多机构的资助下运作，其中包括英国环境、食品和农业事物部、壳牌（中国）以及许多基金会。

关于“中外对话”内部交流刊物及网站

《中外对话》内部交流刊物是“中外对话”网站文章的精华。我们从网站上精心挑选了趣味盎然而极富挑战性的深度报道以及展现科技进步的新闻信息，方便与您的交流。欲阅读更多精彩的文章，请您登陆“中外对话”网站（<http://www.chinadialogue.org.cn>）。

“中外对话”网站以中国前沿环境记者撰写的文章、对国际知名人士的访谈以及对全球重大问题的深入报道为主要内容，通过网站，您可参阅每日全球环境新闻、赏析高质量的文章和参与“零语言障碍”的讨论（双语发布）。

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What is chinadialogue

chinadialogue is an independent, not-for-profit organisation based in London, Beijing, Delhi and Sao Paulo.

chinadialogue's primary vehicle is our website (<http://www.chinadialogue.org.cn>), a unique bilingual platform which promotes a global understanding of the environmental impact of China's rise by publishing informed articles, commentaries and analysis by writers from inside and outside of China. We aim to inform, educate, and contribute to building a global consensus on fair and workable solutions.

chinadialogue is now read in 208 countries and regions and in all regions of China.

About our journal

Produced on a bi-monthly basis, our journal brings you the best articles and reports from *chinadialogue*. If you want to contribute to the discussion you can visit our website (<http://www.chinadialogue.org.cn>) to add your comments and thoughts. Join the debate and be part of the solution.

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控制气候变化，世界需做出改变

IPCC 发出警告，现在若不全力以赴达成 1.5℃ 的温控目标，未来将付出更大代价。

□ 乔伊迪普·格普塔



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相比 2℃，全球变暖控制在 1.5℃ 将减少生态系统、人类健康和福祉面临的挑战性影响，图为美国加州的森林大火。

将 全球变暖控制在比工业化前水平高 1.5℃ 有很多益处，但这一目标的达成将需要“社会各界做出迅速、深远且前所未有的变化。”政府间气候变化专门委员会（IPCC）称。

为此，到 2030 年，全球二氧化碳排放量必须要比 2010 年的水平减

少大约 45%，且在 2050 年达到“净零”排放。

这就要求 2016 到 2035 年间，能源领域的年均投入达到 2.4 万亿美元（以 2010 年价格计算），约占全球 GDP 的 2.5%。不采取或者不及时采取行动带来的损失将远大于此。

目前，全球变暖已达 1℃，带来

的影响显而易见，海平面上升、热浪、冰川退缩、珊瑚死亡、愈加频发和严重的暴风雨、水灾和旱灾。

2015 年 12 月，各国政府在《巴黎协定》中承诺将升温控制在 2℃ 以内，并为 1.5℃ 的温控目标而努力。当时各国政府曾要求 IPCC（由全球各地气候问题专家组成的委员会）

给出达成 1.5°C 温控目标所需采取的行动。

这就是 10 月 8 日 IPCC 发布的报告的由来。在此前长达一周的争吵中，美国对全球科学家的研究发现进行了攻击。石油出口大国沙特阿拉伯紧随美国的步伐。美国总统特朗普已经宣布美国将退出《巴黎协定》，上周特朗普政府的官员们竭尽全力试图弱化该报告的决策者摘要的影响，但总体而言是失败了。现在战场转移到了今年 12 月联合国气候峰会的主办国波兰。

其他国家还需采取更多行动来减少排放。据 IPCC 报告计算，目前各国在《巴黎协定》中做出的承诺将“导致 2100 年全球变暖约 3°C，且之后温度还会持续上升。只有全球二氧化碳排放量在 2030 年之前开始下降，才能避免全球变暖失控，以及未来不得不依赖大规模部署二氧化碳清除技术的境况。”

IPCC 报告

“这份报告释放的一个强烈信息是：极端天气事件更加频发、海平面上升、北极海冰减少以及其他变化已经让我们目睹了全球升温 1°C 的后果。”负责评估气候变化物理科学基础的 IPCC 第一工作组联合主席翟盘茂说道。翟盘茂是中国气象学会秘书长，与中国气象科学研究院、南京大学以及兰州大学都有合作。

将升温控制在 1.5°C 以内有很多益处。到 2100 年，将全球变暖限制在 1.5°C 而非 2°C，全球海平面上升将减少 10 厘米。与全球升温 2°C 导致夏季北冰洋没有海冰的可能性为至少每 10 年一次相比，全球升温

美国总统特朗普宣布美国将退出《巴黎协定》，特朗普政府的官员们竭尽全力试图弱化 IPCC 报告的决策者摘要的影响。

1.5°C 则为每世纪一次。虽然在升温 1.5°C 的情况下，珊瑚礁仍将减少 70-90%，但若升温 2°C，99% 以上的珊瑚礁都将消失殆尽。

“温度每额外升高一点都非常重要，特别是因为升温 1.5°C 或更高，会增加与长期或不可逆转变化相关的风险，比如一些生态系统的损失。”负责研究气候变化影响、适应和脆弱性的 IPCC 第二工作组联合主席汉斯-奥托·波特纳说道。

IPCC 称，将全球变暖限制在 1.5°C 将需要在土地、能源、工业、建筑、交通和城市方面进行“快速而深远的”转型。到 2030 年，全球人为二氧化碳净排放需要比 2010 年的水平减少大约 45%，到 2050 年左右达到“净零”排放。这意味着需要通过去除空气中的二氧化碳来平衡剩余的排放。

如果升温超过 1.5°C，即便是暂时的，就意味着为了到 2100 年使全球升温恢复到 1.5°C 以下，全球将更多地依赖可从空气中去除二氧化碳的技术。报告指出，这些技术的有效性尚未得到大规模验证，有些可能会给可持续发展带来重大风险。

“相比 2°C，将全球变暖控制在 1.5°C 将减少生态系统、人类健康和福祉面临的挑战性影响，从而更容易实现联合国可持续发展目标。”主要研究气候变化减缓的 IPCC 第三

工作组联合主席普利亚达而什·舒克拉说道。舒克拉在艾哈迈德巴德印度管理学院和斯坦福大学任教。

可能产生的影响

IPCC 称，以目前的速度，升温很可能在 2030 至 2052 年之间达到 1.5°C。基于过去和目前的温室气体（主要是二氧化碳）排放情况，人为造成的变暖可能会以每 10 年 0.2°C 的速率增加。

仅过去的排放还不足以让地球升温 1.5°C，所以如果各国能采取行动，就还有希望。控制全球气温在 2100 年之前上升不超过 1.5°C，有两种方法——先超越限值，再回到限值内，或者一直控制在限值之内。IPCC 警告称，第一种选择的更大。“有些影响可能是长期或不可逆转的，比如说生态系统的损失。”

到 2100 年，1.5°C 温控目标之下全球海平面上升高度将比 2°C 低 0.1 米。此后海平面将继续上升，其幅度和速度取决于未来的排放路径。南极冰盖的不稳定和格陵兰冰盖不可逆转的流失可能造成海平面在未来数百至数千年内上升数米。在全球变暖 1.5 到 2°C 之间的情况下，这些不稳定性都可能被触发。

以模型为基础，对全球海平面平均上升幅度（相对于 1986 至 2005 年）

的预测显示,到 2100 年 1.5℃温控目标下的上升幅度为 0.26 至 0.77 米,比 2℃低 0.1 米。这就意味着多达 1000 万人将免于暴露在相关风险之中。

炎热天数将增加

即便气温上升控制在 1.5℃以内,陆地上大多数地区的炎热天数预计都将增加,以热带最甚。

随着全球变暖 1.5℃,健康、生计、粮食安全、水供应、人类安全和经济增长面临的气候风险都将加剧,若变暖 2℃则风险还会进一步增加。

即便在 1.5℃限值之内,弱势和脆弱群体、一些原著民族和依靠农业或沿海生计的当地社区也面临着更高的风险。风险异常高的地区包括北极生态系统、旱地地区、小岛屿发展中国家和最不发达的国家。但若坚持这一限值,到 2050 年就能让数以亿计的人口免于贫困和暴露在气候风险中。

将气候变暖控制在 1.5℃之内就意味着可以减少玉米、稻米、小麦等谷物作物的收获损失,尤其是撒哈拉以南非洲、东南亚和中南美洲等地的作物损失,并且稻米和小麦的营养损失也会减少。

根据未来的社会经济条件,将全球变暖控制在 1.5℃以内能让面临用水压力影响的世界人口比例减少多达 50%,但各地区之间存在相当大的差

异。如果 1.5℃温控目标得以实现,许多小岛屿发展中国家的干旱情况或将改变,用水压力也会随之降低。

升温若超过 1.5℃,人类暴露在各种复杂的气候风险中的可能性也会增加,亚洲和非洲地区将会有更多人口陷入贫困。IPCC 警告说,能源、粮食和水资源的风险会叠加,越来越多的人和地区会面临更加严峻的危险,也会变得更加不堪一击。

将气温升高控制在 1.5℃之内,生物多样性和生态系统受到的影响也会较少。在 1.5℃温控方案下,被研究的 10.5 万个物种中,9.6% 的昆虫、8% 的植物和 4% 的脊椎动物预计将失去超过一半的地理分布。相比之下,2℃温控方案对应的数值为 18%、16% 和 8%

针对其他生物多样性相关风险的影响(如森林火灾和入侵物种的扩散),1.5℃的影响也都低于 2℃。

将气温升高限制在 1.5℃之内还可以控制海洋温度、酸度的上升和海水含氧量的下降。这将减少海洋生物多样性、渔业和生态系统的风险,保护它们服务于人类的功能和作用。近来北极海冰和温水珊瑚礁生态系统的变化正是这样的例子。

通往安全的路径

专家已经模拟了坚持 1.5℃升温上限的不同路径。若要不出这一上

限,或仅在有限范围内超过这一上限,全球人为二氧化碳净排放到 2030 年就必须 2010 年的水平上降低约 45%,并在 2050 年左右达到净零排放。相比之下,如果上限是 2℃,多数路径下,2030 年的二氧化碳排放只需在 2010 年水平上下降约 20%,并在 2075 年左右达到净零排放。

这些 1.5℃温控路径还需大幅削减甲烷和黑碳的排放(到 2050 年,二者均需在 2010 年水平上降低至少 35%),同时减少大多数制冷气溶胶(也是强有力的温室气体)的使用。IPCC 称“能源部门内广泛采取的缓解措施可以减少非二氧化碳的排放。此外,针对非二氧化碳排放的缓解措施可以减少农业部门的一氧化二氮和甲烷排放,垃圾部门的甲烷排放、以及一些黑碳和氢氟烃的排放源。”

报告指出,许多非二氧化碳温室气体排放的减少让空气质量得到改善,为人类创造了直接的、切身的健康利益。

IPCC 称,这些路径可以通过各种缓解战略来执行,但都需从大气中去除数量不等的二氧化碳,加上在农业、林业和其他土地利用部门内结合使用生物能和碳捕捉与封存技术以及除碳技术,但它没有提到的是,碳捕捉与封存技术目前仍然缺乏商业可行性。

正如预期的那样,坚持 1.5℃温控目标的路径在未来 20 年间将表现出更迅速、更明显的系统变化。到 2050 年,可再生能源电力供应预计将占电力供应总量的 70% 至 85%。模型显示,配备碳捕捉与封存技术的核电和化石燃料发电的份额预计将会增长,天然气发电约占全球总发电量的 8%。

坚持 1.5℃温控目标的路径在未来 20 年间将表现出更迅速、更明显的系统变化。到 2050 年,可再生能源电力供应预计将占电力供应总量的 70% 至 85%。

根据这些路径方案，到 2050 年煤炭使用将几乎为零。这势必会令印度的政策制定者感到担忧，他们仍打算到本世纪中叶左右，从煤炭中获得 45% 的电力。

在这些方案中，到 2050 年工业二氧化碳排放预计将比 2010 年水平下降 75% 到 90%。IPCC 称，可以把电气化、氢气、可持续的生物原料、产品替代、碳捕获、利用和封存等新老技术实践结合起来，以实现这一目标。专家警告称，仅依靠提高工业能效和工艺效率削减碳排放还不足以将全球变暖严格控制在 1.5°C 以内或在有限范围内超过这一限值。

这些路径还需改变土地和城市规划实践，同时大幅减少交通和建筑的碳排放。交通运输部门的低排放最终能源的份额将从 2020 年的不到 5% 增加至 2050 年的约 35% 到 65%。

IPCC 路径的一大问题在于，他们预计大片原本用于种植粮食作物和饲养牲畜的土地将用于生产生物燃料。专家们已经意识到了这一问题，并称“限制土地需求的缓解方法包括对土地的可持续集约化利用、生态系统修复以及向资源密集程度较低的饮食的转变。”

报告指出，适应气候变化的影响将带来许多好处。“若管理得当，旨在增强人类和自然系统抵御气候变化能力的适应办法能够与可持续发展产生许多协同效应，如确保粮食和水安全、减少灾害风险、改善卫生条件、维持生态系统服务、扶贫和促进平等。增加对有形的社会基础设施的投资是提高社会抵御力和适应力的关键条件。”

IPCC 补充道，“减少排放的适应方法可以在大多数部门和系统转型

过程中发挥协同作用，帮助节约成本，例如土地管理可以减少排放和灾害风险，低碳建筑的设计目的中也包括高效制冷。”

报告指出，降低低排放和适应性投资风险的政府政策有助于调动社会资本，提高其他公共政策的有效性。

总体而言，“2030 年的排放越低，此后控制全球变暖不超过 1.5°C 或在有限范围内超过这一限值面临的挑战就越小。不及时采取行动减少温室气体排放将面临成本升级、高排放基础设施锁定、资产搁置、以及应对气候变化的中长期选择缺乏灵活性等挑战，” IPCC 警告称。🔄

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‘Unprecedented’ action needed to control climate change

Trillions of dollars required annually to limit devastating impacts of global warming but inaction will cost more, warns IPCC

□ Joydeep Gupta

Restricting global warming to 1.5 degrees Celsius could limit the most disastrous impacts of climate change, but doing so will require “rapid, far-reaching and unprecedented changes in all aspects of society,” according to a new scientific report commissioned by the United Nations.

For this, the world must reduce its carbon dioxide emissions by 45% by 2030 (from 2010 levels), and reach “net zero” by 2050, according to a study by the Intergovernmental Panel on Climate Change (IPCC).

This will require an annual average investment of around US\$2.4 trillion (at 2010 prices) between 2016 and 2035, representing approximately 2.5% of global gross domestic product (GDP). The cost of inaction and delay, however, will be many times greater.

Global warming has already reached 1°C with the effects evident in rising sea levels; and the greater frequency of heat waves, glacier retreat, coral reef deaths, severe storms, floods and droughts.

In December 2015, governments from around the world pledged in the Paris Agreement to limit warming to 2C, with the aspirational goal of a 1.5-degree limit. At that time, governments asked the IPCC – a collective of international scientists – to produce a report outlining the action needed to curb global temperatures at 1.5°C above preindustrial levels.

This was the report the IPCC released on October 8, following a week-long fracas that saw the US and oil-export-dependent Saudi Arabia attack the findings of 97% of the world’s scientists, who agree that climate change is happening and is human caused. President Trump has already announced that the US will withdraw from the Paris Agreement. Last week, his bureaucrats tried their best to water down the report’s summary for policymakers. By and large, they failed. The battleground now shifts to Poland, which is hosting the next UN climate summit this December.

The IPCC report calculates that current national pledges, made under the Paris Agreement, will “result in a global warming of about 3C by 2100, with warming continuing afterwards. Avoiding overshoot and reliance on future large-scale deployment of carbon dioxide removal can only be achieved if global CO₂ (carbon dioxide) emissions start to decline well before 2030.”

The findings

“One of the key messages that comes out very strongly from this report is that we are already seeing the consequences of 1°C of global warming through more extreme weather, rising sea levels and diminishing Arctic sea ice, among other changes,” says Panmao Zhai, co-chair of IPCC Working Group I, which assesses the

"Limiting global warming to 1.5°C compared with 2°C would reduce challenging impacts on ecosystems, human health and well-being, making it easier to achieve the UN Sustainable Development Goals."

—Priyadarshi Shukla, co-chair of IPCC Working Group III.

physical science basis of climate change. Zhai heads the Chinese Meteorological Society and is associated with the Chinese Academy of Meteorological Sciences, Nanjing and Lanzhou universities.

There are many benefits to limiting warming to 1.5C: sea level rise would be 10 centimetres lower compared to a 2C scenario; summer sea melt the Arctic would happen once per century, compared to at least once per decade; coral reefs would still decline by 70-90%, but they would decline by over 99% if temperature rise reached 2C.

"Every extra bit of warming matters, as warming of 1.5°C or higher increases the risk associated with long-lasting or irreversible changes, such as the loss of some ecosystems," says Hans-Otto Pörtner, co-chair of IPCC Working Group II, which addresses climate change impacts, adaptation and vulnerability.

Limiting warming to 1.5C would require "rapid and far-reaching" transitions in land management, energy, industry, buildings, transport and cities, says the IPCC, balanced by removing CO₂ from the air.

If temperature rise overshoots 1.5C even temporarily, the world will be more dependent on technologies to remove CO₂ from the air to return to a 1.5C ceiling by 2100. These are unproven at large scale, and some may carry significant risks for sustainable development, the report notes.

"Limiting global warming to 1.5C compared with 2C would reduce challenging impacts on ecosystems, human health and well-being, making it easier to achieve the UN Sustainable Development Goals," says Priyadarshi Shukla, co-chair of IPCC Working Group III, which deals with the mitigation of climate change. Shukla teaches at the Indian Institute of Management Ahmedabad and at Stanford University.

Likely impacts

Based on current rates, warming is likely to reach 1.5C between 2030 and 2052, according to the report. Estimated human-caused warming is increasing at 0.2C per decade due to past and on going emissions of greenhouse gases, mainly carbon dioxide.

Past emissions alone are unlikely to warm the earth by 1.5C, so there is hope if countries take immediate action. There are two ways the world can reach the 1.5-degree ceiling by 2100; either by overshooting it followed by retrospective action, or by keeping within the ceiling. The first option is riskier: "Some impacts may be long-lasting or irreversible, such as the loss of some ecosystems."

These irreversible impacts — or tipping points — include Antarctic and Greenland ice sheet melt, which could result in a multi-metre sea level rise over hundreds to thousands of years. These instabilities could be triggered around 1.5°C to 2C of global warming.

Model-based projections of global mean sea level rise (relative to 1986 - 2005) suggest a range of 0.26 to 0.77 metres by 2100 for 1.5°C global warming; 0.1 metres less than for a global warming of 2C. This reduction implies that up to 10 million fewer people would be exposed to related risks.

The human impacts

On land, the number of hot days is projected to increase in most regions, with the highest increases in the tropics, even if global temperature rise is kept within 1.5C. Climate-related risks to health, livelihoods, food security, water supply, security and economic growth are all expected to rise with global warming.

Disadvantaged and vulnerable populations, some indigenous peoples, and agricultural and coastal livelihoods are at greater risk. Regions at disproportionately higher risk include Arctic ecosystems, dry land regions, small-island developing states and least developed countries. But sticking to the limit could reduce the number of people exposed to climate-related risks and poverty by several hundred million by 2050.

Limiting warming to 1.5C will mean smaller yield losses

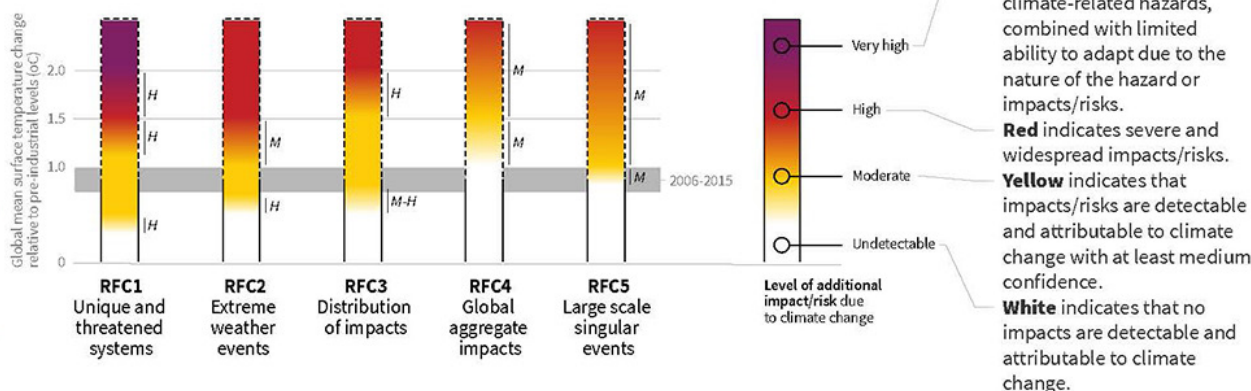
in maize, rice, wheat, and potentially other cereal crops, particularly in sub-Saharan Africa, Southeast Asia, and Central and South America. The effect on the nutritional quality of rice and wheat will be the same.

Depending on future socioeconomic conditions, limiting global warming to 1.5C may reduce the proportion of the world population exposed to more water stress by up to 50%, although there is considerable variability between regions. Many small island developing states

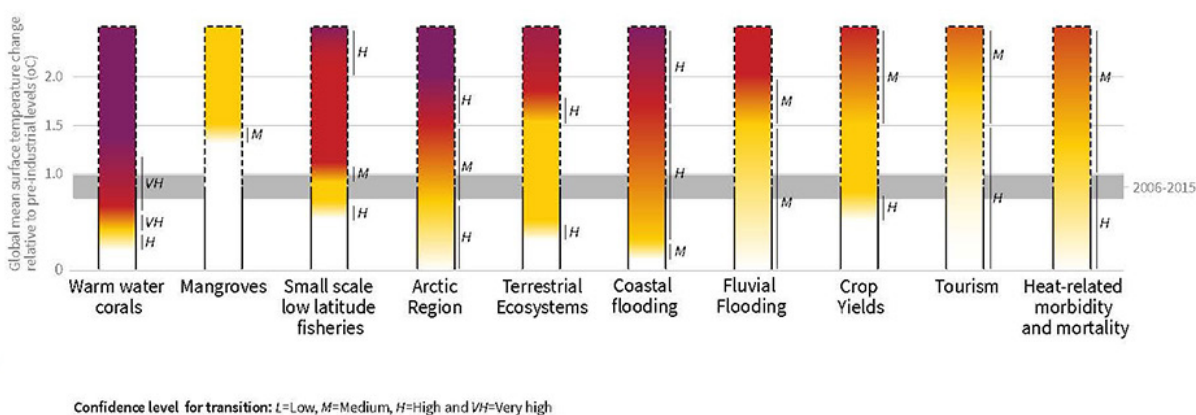
How the level of global warming affects impacts and/or risks associated with the Reasons for Concern (RFCs) and selected natural, managed and human systems

Five Reasons For Concern (RFCs) illustrate the impacts and risks of different levels of global warming for people, economies and ecosystems across sectors and regions.

Impacts and risks associated with the Reasons for Concern (RFCs)



Impacts and risks for selected natural, managed and human systems



Source: IPCC Special Report on Global Warming of 1.5°C

will experience lower water stress as a result of projected changes in aridity when global warming is limited to 1.5C.

Exposure to multiple and compound climate-related risks increases above that level, with more people susceptible to poverty in Africa and Asia. Risks to energy, food and water could overlap and worsen current hazards and vulnerabilities for increasing numbers of people and regions, warns the IPCC.

There will be less impact on biodiversity and ecosystems, too. Of 105,000 species studied, 9.6% of insects, 8% of plants and 4% of vertebrates are projected to lose over half of their geographic range at 1.5C, compared with 18% of insects, 16% of plants and 8% of vertebrates at 2C. Impacts associated with other biodiversity-related risks such as forest fires, and the spread of invasive species, are lower at 1.5°C compared to 2C of global warming.

Keeping warming to 1.5C would also limit the rise in ocean temperature and acidity and the decrease in ocean oxygen levels. That will reduce risks to marine biodiversity, fisheries, and ecosystems, and their functions and services to humans, as shown by recent changes to Arctic sea ice and warm water coral reef ecosystems.

Pathways to safety

The experts have modelled various pathways to stick to the 1.5C ceiling. If it is not to be overshoot, or overshoot only by a limited extent, global net CO₂ emissions by humans have to decline by about 45% from 2010 levels by 2030, reaching net zero around 2050. In contrast, for limiting global warming to below 2C, CO₂ emissions are projected to decline by about 20% by 2030 in most pathways and reach net zero around 2075.

These 1.5C pathways also

need deep cuts in emissions of methane and black carbon (35% or more of both by 2050 relative to 2010) and reduction in most cooling aerosols, which are potent greenhouse gases. The IPCC says: “Non-CO₂ emissions can be reduced as a result of broad mitigation measures in the energy sector. In addition, targeted non-CO₂ mitigation measures can reduce nitrous oxide and methane from

agriculture, methane from the waste sector, some sources of black carbon, and hydrofluorocarbons.”

Improved air quality from reductions in many non-CO₂ emissions provide direct and immediate health benefits, notes the report.

These pathways can be followed through different mitigation strategies, but all use carbon dioxide removal from the atmosphere to varying amounts, plus Bioenergy with Carbon Capture and Storage (BECCS) and removals in the Agriculture, Forestry and Other Land Use (AFOLU) sector, the IPCC says. What it does not say is that Carbon Capture and Storage remains a commercially unviable technology.

As expected, pathways that stick to the lower limit show more rapid and pronounced system changes over the next two decades. Renewables are projected to supply 70–85% of electricity in 2050. Shares of nuclear and fossil fuels with CCS are modelled to increase, allowing natural gas to generate about 8% of global electricity in 2050.

In these pathways, the use of coal falls almost to zero by 2050. This is bound to worry Indian policymakers, who are still talking about getting 45% of the country’s electricity from coal around the middle of the century.

In these pathways, CO₂ emissions from industry are projected to be about 75–90% lower in 2050 relative to 2010. The IPCC says this can be achieved through combinations of new and existing technologies and practices, including electrification, hydrogen, sustainable bio-based feedstock, product substitution, and carbon capture, utilisation and storage. In industry, emissions

"Targeted non-CO₂ mitigation measures can reduce nitrous oxide and methane from agriculture, methane from the waste sector, some sources of black carbon, and hydrofluorocarbons."

— IPCC Special Report of Global Warming of 1.5C.

reductions by energy and process efficiency by themselves are insufficient for limiting warming to 1.5C with no or limited overshoot, the experts warn.

These pathways would also need changes in land and urban planning practices, as well as deep emissions reductions in transport and buildings. In the transport sector, the share of low-emission final energy would rise from less than 5% in 2020 to about 35–65% in 2050.

One big problem with the IPCC pathways is that they project moving large tracts of land from raising food crops and livestock to biofuels. The experts are aware of the problem, and say, “Mitigation options limiting the demand for land include sustainable intensification of land use practices, ecosystem restoration and changes towards less resource-intensive diets.”

The report refers to the many advantages of adaptation to climate change impacts. “Adaptation options that reduce the vulnerability of human and natural systems have many synergies with sustainable development, if well managed, such as ensuring food and water security, reducing disaster risks, improving health conditions, maintaining ecosystem services and reducing poverty and inequality. Increasing investment in physical and social infrastructure is a key

enabling condition to enhance the resilience and the adaptive capacities of societies.”

The IPCC adds, “Adaptation options that also mitigate emissions can provide synergies and cost savings in most sectors and system transitions, such as when land management reduces emissions and disaster risk, or when low carbon buildings are also designed for efficient cooling.”

Government policies that lower the risk of low-emission and adaptation investments can facilitate the mobilisation of private funds and enhance the effectiveness of other public policies, the report points out.

Overall, “The lower the emissions in 2030, the lower the challenge in limiting global warming to 1.5C after 2030 with no or limited overshoot. The challenges from delayed actions to reduce greenhouse gas emissions include the risk of cost escalation, lock-in in carbon-emitting infrastructure, stranded assets, and reduced flexibility in future response options in the medium to long-term,” the IPCC warns. ☞

This story originally appeared on The Third Pole.

Joydeep Gupta is South Asia director of The Third Pole

波兰气候大会艰难完成谈判

波兰气候大会取得足够进展，最终就《巴黎协定》实施细则达成一致，但各方并非完全满意。

□ 中外对话



波兰气候大会会场

随着“加时”一天的联合国气候大会在波兰卡托维兹落下帷幕，《巴黎协定》仍将按部就班地推进，但各国在大会上达成的妥协将使得应对气候变化的工作更加艰难。

过去一年里，全球经历了山火、热浪以及飓风等极端天气事件，这些

事件的影响都因为气候变化而更加严重。对此，科学家们对不作为带来的危险提出了警告。据研究人员计算，各国承诺的温室气体减排量还远远不够。用于帮助发展中国家适应气候变化影响的资金非常少，更不用说处理气候变化已经造成的损害了。

政府谈判代表一如既往地争吵。尽管如今导致全球变暖的温室气体大部分都是富裕国家排放的，但是他们仍旧不愿帮助贫穷国家。美国总统唐纳德·特朗普的谈判代表在本次大会上几乎否认了所有历史性责任。

会议之所以陷入争吵，最后拖入“加时”，是因为巴西想要核证其多年来削减的排放量。核证减排量（CER）是《京都议定书》（将于2020年结束）的一部分。巴西希望2020年以后在《巴黎协定》之下继续保留这些核证减排量，但富裕国家表示反对。用一位欧盟代表的话来说就是，他们不满意在没有“充分核算”的情况下收集的核证排放量。印度和中国支持巴西，但既没有公开表态，态度也不坚定。因此这一问题将留待明年处理。

此次大会的一大积极成果在于，各国政府同意在2020年之前更新气候计划。一些国家（主要是发展中国家）在为期两周的大会期间宣布已经在做准备。由此，各国就实施细则达成一致，这意味着《巴黎协定》可以在2020年合法运作起来。联合国的气候一把手帕特里夏·埃斯皮诺萨为此松了一口气，称：“这是国际社会应对气候变化的决定性路线图”。

联合国秘书长古特雷斯在大会结束时发表讲话，谈到明年9月召开的高级别气候会议，并补充说自己的5个优先事项是“减缓气候变化的雄心、适应气候变化的雄心、气候融资的雄心、对技术合作和能力建设的雄心、以及技术创新的雄心”。

无差别对待

但各国签署实施细则的前提是发展中国家同意和发达国家一样报告并

核算本国的气候行动，这给缺乏资源和能力的国家带来了额外的负担。反过来，富裕国家也必须同意提高其帮助发展中国家应对气候变化而提供的资金的“可预测性”。这一保证虽遭到美国的反对，但还是获得通过。尽管总统特朗普希望退出，但美国在2020年之前无法合法退出《巴黎协定》，因而不得不继续参与谈判。

外界对贫穷国家和富裕国家必须以同样的方式对其所有气候行动进行核算的要求感到相当不安。印度首席谈判代表拉维·尚卡·普拉萨德对目前以及2023年的无“区别对待”表示担忧。2023年开始全球将启动5年一次的“全球盘点机制”，确定各国政府是否仍坚持执行《巴黎协定》。按照目前的趋势，各国的工作还远远不够。

一些与会者和观察员仍然看到了希望。《巴黎协定》的主要缔造者、现任欧洲气候基金会首席执行官劳伦斯·图比娅娜说：“尽管遇到了种种阻力，《巴黎协定》在第24次缔约方大会上仍在稳步推进，这充分体现了它设计理念中所包含的坚韧。实施细则中做出的决定为我们不断建立对多边主义的信心以及加快全球的转型步伐奠定了坚实的基础。”

前《联合国气候变化框架公约》秘书长克里斯蒂安娜·菲格雷斯说：“实施细则不能让所有人都百分之百满意，但这是向前迈出的重要一步，明年至关重要。”

中国的现状

面对今年国内碳排放量的再次上升，中国面临着巨大压力，必须加大行动。“中国必须采取紧急行动，遏制住碳排放上扬的趋势，”绿色和平组织东亚气候与能源政策高级官员李硕说。

尽管国内存在种种问题，中国仍在谈判中发挥了建设性作用，李硕补充道。“一份切实可靠的实施细则能够通过，在透明度和审查机制问题上能够达成具有约束力的共同规则，中国功不可没。这些气候会谈也表明，中国越来越多地扮演着发达国家和发展中国家之间主要桥梁的角色，帮助推动发展中国家承担更多的责任。”

然而，政府间气候专门委员会表示必须在12年内减少几乎一半的排放量，而中国在国内认真减排的同时仍在投资发展中国家的高碳排放项目，这不禁令人担忧。

“全球的去碳化趋势正在日益扩大，因此中国‘一带一路’倡议之下的投资必须符合《巴黎协定》。”创绿研究院主任白韞雯说。

需要更强有力的行动

鉴于发展中国家已经在努力管理和适应气候变化，民间社会领袖对今年的大会表示失望。

国际气候变化领袖、国际行动援助组织的哈吉特·辛格表示：“每年都

“外界对贫穷国家和富裕国家必须以同样的方式对其所有气候行动进行核算的要求感到相当不安。2023年开始全球将启动5年一次的“全球盘点机制”，确定各国政府是否仍坚持执行《巴黎协定》。”

有超过 2000 万人因突发的极端天气事件而被迫流离失所。官方对损失的监测显示，尽管这些社区的意见最终得到了表达，但整个世界在气候变化问题上仍旧袖手旁观，仿佛在观看一场慢镜头的车祸。”

辛格补充说：“没有资金，气候危机根本无法解决。《巴黎协定》实施细则在实际融资和行动方面的倒退令人非常沮丧。”

最不发达国家集团主席恩达卢（Gebre Jember Endalew）指出，生活在 47 个最不发达国家的近 10 亿人受到的打击往往最重，受苦最多，应对气候变化的能力也最低。他呼吁各国“在 2020 年之前根据公平分配

的原则，修订并提高自身（对《巴黎协定》）的国家自主贡献”。

印度马恒达集团首席可持续发展官高希（Anirban Ghosh）说：“政策制定者应该从气候大会上带回一个明确的信息——提升气候承诺的目标，同时向企业发出明确且坚定的政策信号。”

希望仍在

尽管今年大会的结果让许多人倍感失望，但也有好消息。世界银行宣布，2021 年起对气候行动的投资将增加一倍，约达 2000 亿美元，并且承诺通过绿色气候基金和最不发

达国家基金向发展中国家提供更多资金，帮助其应对气候变化，而气候变化适应基金则首次突破 1 亿美元大关。资产总额加起来超过 30 万亿美元的全球 400 多家投资方呼吁各国领导人加强气候行动。

全球最大的集装箱运输公司马士基承诺到 2050 年将排放量降为零，成为本行业的减排标杆。美国能源巨头埃克森美孚承诺到 2050 年实现无碳发电，宜家集团则承诺到 2030 年将生产过程中的碳排放减少 80%。40 多个主要时尚品牌、零售商和供应商还推出了《时尚业气候行动宪章》，共同应对其造成的气候影响。

Climate talks scrape through difficult round of negotiations

There was enough progress on the Paris ‘rulebook’ to get it signed off, but no one left Poland entirely happy

□ chinadialogue

The Paris Agreement just about remained on track as the UN climate summit concluded a day behind schedule in Katowice, Poland, but only with compromises that make it more difficult to combat climate change with any seriousness.

Following a year of extreme weather events including wildfires, heat waves, and hurricanes that were made even worse by climate change, scientists have warned of the dangers of inaction. Researchers calculate that national pledges to control emissions of greenhouse gases (GHG) are nowhere near enough. There is little money to help developing countries adapt to climate change effects, let alone deal with the loss and damage it is already causing.

Still, government negotiators continue to bicker. Rich nations demur at helping poor ones, though most of the GHGs that are warming the world have been emitted by them. US President Donald Trump’s negotiators have almost killed any notion of historical responsibility at this summit.

The bickering that delayed the summit finale arose because Brazil wanted credit for the emissions it has reduced over the years. These Certified Emission Reductions (CER) are part of the Kyoto Protocol regime that ends in 2020. Brazil wanted to carry CERs beyond 2020 under the Paris Agreement regime, but richer nations objected, saying they were not satisfied that CERs had been collected with “sufficient accounting”, as one EU delegate put it. India and China supported the Brazilian position, but

neither strongly nor publicly. The matter remains unresolved and will be taken up next year.

A positive from this year’s talks is that governments did agree to update their climate plans by 2020. Several countries – mostly from the developing world – announced during the two-week talks that they were already making preparations. With that, the work programme was signed off, which means the Paris Agreement can become legally operational in 2020. A relieved UN climate chief Patricia Espinosa said, “This is a roadmap for the international community to decisively address climate change”.

In a message delivered at the end of the summit, UN secretary general Antonio Guterres spoke of the high-level climate meet he has called next September and added that his five priorities would be “ambition in mitigation, ambition in adaptation, ambition in finance, ambition in technical cooperation and capacity building, ambition in technological innovation”.

No differentiation

But the work programme was signed off only when developing countries agreed to report and account for their climate actions in the same way as developed ones. This places an additional burden on countries that lack resources and capacity. In turn, rich nations agreed to increase the



China's special representative Xie Zhenhua

“predictability” of the money they will provide to help developing countries respond. This last assurance came despite opposition from the United States, which remains in the negotiating rooms because the country cannot legally withdraw from the Paris Agreement until 2020, though President Trump wants to do so.

There was considerable disquiet over the requirement that rich and poor nations will have to account for all their climate actions the same way. India’s chief negotiator, Ravi Shankar Prasad, expressed his concern about this lack of “differentiation” now and in 2023, when a “global stocktake” is scheduled to see if governments are still on track to stick to the Paris Agreement. By current trends, they will be nowhere near it.

Some participants and observers still saw signs of hope. Laurence Tubiana, key architect of the Paris Agreement and now CEO of the European Climate Foundation, said, “Despite all the headwinds, the Paris Agreement has stayed course at COP24 (the 24th Conference of Parties), demonstrating the kind of resilience it has been designed

for. The decisions made here on the Paris rulebook give us a solid foundation to keep building trust in multilateralism and accelerate the transition all across the world.”

Christiana Figueres, former head of the UN Framework Convention on Climate Change (UNFCCC), said, “No one is entirely happy with this rulebook, but it is an important step. Next year is critical.”

The Chinese reality

Following another uptick in China’s carbon emissions this year, the country is under pressure to ramp up action. “Leaders in Beijing must take urgent action to wrest emissions away from the upward path,” said Li Shuo, senior climate and energy policy officer at Greenpeace East Asia.

But despite the problems at home, China continues to play a constructive role in the negotiations, he added. “China was an enabler of a solid rulebook with binding common rules for transparency and review. These talks also showed China’s increasing role as the principal broker

between developed and developing countries. This role helped to nudge developing countries into taking on more responsibilities.”

Yet, with the IPCC saying there are just 12 years to reduce global emissions by almost half, concerns persist that while China is taking emissions reduction seriously at home, it's still investing in high carbon projects in developing countries.

“The world is seeing an increasing trend of decarbonisation, thus, China's investment under the Belt and Road Initiative must be in line with the Paris Agreement,” said Bai Yunwen, director of Greenovation Hub, China.

Stronger action required

With developing countries already struggling to manage and adapt to climate change, civil society leaders expressed disappointment with this year's talks.

Harjeet Singh, global lead on climate change at ActionAid International, said, “More than 20 million people a year are being forcibly displaced by sudden, extreme weather events. The agreement to now officially monitor losses shows that, although these communities are finally being heard, the world is still standing back and watching climate change like it's a slow-motion car crash.”

He added: “The climate crisis simply cannot be fixed without financing. It's hugely frustrating to see a Paris rulebook that goes backwards on delivering real finance and real action.”


Chair of the Least Developed Countries Group, Gebru Jember Endalew, pointed to the nearly one billion people living in the 47 least developed countries that are often hit

the hardest, suffer the most, and have the least capacity to cope with climate change. He called on countries “to revise and enhance their nationally determined contributions (to the Paris Agreement) before 2020 in line with their fair share”.

Anirban Ghosh, chief sustainability officer at Mahindra Group, India, said, “Policy makers should return from COP with one clear message – an increase in ambitious climate commitments, coupled with clear and confident policy signals to business.”

Cause for hope

While the outcome of this year's UN summit disappointed many, there were bright moments, too. The World Bank announced it will double investment in climate action to about US\$200 billion from 2021. More money was also pledged to help developing countries through the Green Climate Fund and the Least Developed Countries Fund, while the Adaptation Fund crossed the US\$100 million mark for the first time. More than 400 global investors with over US\$30 trillion in assets called on global leaders to increase climate action.

The world's largest container shipping company Maersk put down a marker for the sector by pledging to bring its emissions down to zero by 2050. US energy giant Xcel Energy promised zero-carbon power by 2050, while IKEA Group pledged to slash carbon emissions from production processes by 80% by 2030. Over 40 major fashion brands, retailers and suppliers also launched the Fashion Industry Charter for Climate Action to collectively address their climate impacts. 

美国必须采取气候行动，或自食其果

到 2100 年，气候变化每年给美国带来的损失将超过 1000 亿美元。

□ 谭·科普塞



美国平均每年的森林大火防控支出为10亿美元。2015年，由于受极端干旱影响，这一费用已经突破20亿美元

感恩节节过后的周五通常只有两件事情：疯狂购物和“打扫”剩下的火鸡。但是，今年有些不同。11月23日下午，特朗普政府发布了一份名为《国家气候评估》的重要报告。报告描述了气候变化可能对美国产生的巨大影响和改变。选择

在这个时间发布报告，本来是想避免媒体和公众的关注和审查，因为报告结果与特朗普的气候政策大相径庭。但是如果是有意为之，那么这么做不仅未能躲过公众的视线，反而开启了一场有关气候变化的新的全国大讨论。

不作为的代价

共有 13 个联邦政府机构和 300 多位科技学家参与了这份报告的撰写。报告指出，美国已经开始尝到气候变化的苦果。气候变化导致风暴的破坏性更强，热浪更加致命，山火

更加频发，过敏更加严重，一些疾病也越来越普遍。

这些影响很有可能在美國范围内进一步恶化。到 2050 年，美国有些地区的居民可能会比其他地区多忍受一两个月温度超过 38 摄氏度的极端高温天气。到 2100 年，酷暑在美国东南部将成为“家常便饭”。

到那时，某些地方每年山火的过火面积将是现在的 6 倍。这个数字听起来不免让人觉得不寒而栗。过去几周，一连串的森林火灾肆虐美国西部地区，烧毁了天堂镇，造成至少 88 人死亡。美国平均每年的森林大火防控支出为 10 亿美元。而 2015 年，由于受极端干旱影响，美国对抗森林大火的总费用已经突破 20 亿美元。而 2017 年，仅前 8 个月，这笔支出就已经“成功地超过了”20 亿美元。

到本世纪末，气候变化相关影响给美国某些行业带来的损失有可能突破 1000 亿美元。世界资源研究所的安德鲁·莱特也参与了本次报告的撰写。他表示：“除非我们现在出手抑制气候变化，否则将来美国经济的所有领域都将难逃这场灾难。”

令人生疑的气候策略

尽管发布了这份报告，但联邦政府的代表们仍然对其结果提出了

质疑。特朗普总统表示“我不相信这份报告”，而白宫新闻发言人莎拉·赫卡比·桑德斯则错误地认为，报告“并非以事实为依据”，而是“基于极端的模拟情景，与现实长期趋势相矛盾”。而美国环境保护署（EPA）则引用右翼媒体《每日电讯》（The Daily Caller）的文章对报告提出质疑。这种反应受到广泛嘲笑。

为什么要质疑科学？因为特朗普总统放松了温室气体减排监管规定，大力推广使用化石燃料，同时还试图降低美国生产的汽车和卡车的燃油效率。所有这些行动大大增加了《国家气候评估》（National Climate Assessment）中提到的严重气候变化影响的发生概率。

民主党人呼吁行动起来

对于美国的气候政治来说，这份报告发布的时间点非常耐人寻味。今年 11 月初，美国民主党赢得了众议院的控制权，而气候变化政策在选举过程中发挥了关键作用。超过半数的新任众议院议员都拒绝接受来自化石燃料利益集团的任何资金。

选举结果对气候政策来说应该算是个好消息。众议院的民主党议员很有可能会立即重新组建一个气候变化委员会，而 2011 年时民主党失去众议院控制权时该委员会曾被

解散。该委员会会对政府代表们的应对气候变化的不当行为提出质询，同时也会对环境保护署和内政部门的内部腐败提起指控。

一些民主党人则希望能够尽快采取更积极的行动。民主党激进派的亚历山大·奥卡西奥·科尔蒂斯发推文表示：“如果我们不能立即开始应对气候变化问题，人类就将灭亡……只认可气候变化的重要性还不够，我们必须让它成为紧急要务。”目前，她正积极劝说民主党同僚共同发起一个名为“绿色新政”的项目，大规模投资可再生能源领域。然而，由于共和党仍然把控着总统席位和参议院控制权，民主党目前可能还无法在联邦政府层面推动这项政策。

不过，州一级政府还是传来了好消息。十几位赢得州选举的候选人都在其竞选计划中表示，将推动自己所在州远离化石燃料，拥抱可再生能源。由于面临相对较少的地方政治阻力，这些州长们也更有机会快速地推动当地气候政策改革。^⑤

谭·科普塞，气候联结 (Climate Nexus) 网站总监

The US must act now on climate or pay heavily later

Climate change could cost the country more than US\$100 billion annually by 2100

□ Tan Copsey

The Friday after Thanksgiving is usually a day for chaotic shopping and gorging on leftover Turkey, but this year was a little different. In the early afternoon, the Trump Administration released a major new report, the National Climate Assessment, that describes how climate change will dramatically impact and alter America. Releasing it at this time should have hidden the report from press and public scrutiny, as its results stand in stark contrast to the policies pursued by Trump. But if this was the strategy, it backfired horribly. Instead, it began a new, national conversation about climate impacts.

The cost of inaction

The report, which includes input from 13 federal government agencies and contributions from more than 300 scientists, shows that Americans are already paying for climate change. It has made storms more damaging, heat waves deadlier, wildfires more common, allergies worse and some diseases more widespread.

These impacts are likely to get worse across the country. Depending on the region, Americans could experience an additional month or two of days with maximum temperatures above 38C by 2050. This severe heat will become commonplace in the south-east by 2100.

By this time, annual acreage burned by wildfires could increase by as much as six times in some places. This figure seems especially chilling as a series of fires have ravaged western parts of the country over the past few weeks, destroying the town of Paradise, and killing at least 88 people. The US spends an average of about US\$1 billion annually to fight wildfires, but spent over US\$2 billion in 2015 due to extreme drought. Costs exceeded US\$2 billion in the first eight months of 2017.

In some sectors, losses driven by the impacts of climate change could exceed US\$100 billion annually by the end of the century. Andrew Light, of the World Resources Institute, one of the many who worked on the report, said: “There is essentially no sector of the US economy which will not suffer unless we get a handle on climate change pollution.”

Depending on the region, Americans could experience an additional month or two of days with maximum temperatures above 38C by 2050. This severe heat will become commonplace in the south-east by 2100.

A doubtful strategy

Despite releasing the report, representatives of the federal government have questioned its results. President Trump said: “I don’t believe the report”, while White House Press Secretary Sarah Huckabee Sanders incorrectly argued that the report was “not based on facts” but on “the most extreme modelled scenario, which contradicts long-established trends”. The Environmental Protection Agency attempted to question the report by citing articles from the right-wing website The Daily Caller. This response has been widely ridiculed.

Why question the science? Because President Trump has weakened rules on greenhouse gas emissions, promoted fossil fuel use, and tried to reduce the fuel efficiency of US-made cars and trucks. All of these actions have increased the probability of the severe climate impacts the National Climate Assessment describes.

Democrats want action

The report comes at an interesting moment in US climate politics. Democrats won control of the House of Representatives in early November, with climate change playing a major role in the election campaign. More than half of the new House members have refused to accept any money from the fossil fuel industry.

The election results are generally good news for climate policy. Democrats in the House are likely to

immediately reform a select committee on climate change, which was abandoned when they lost control of the chamber to Republicans in 2011. The committee will grill Administration representatives on their inadequate response to climate change, as well as allegations of corruption inside both the Environmental Protection Agency and Department of Interior.

Some Democrats want to go further, sooner. Alexandria Ocasio-Cortez, from the party’s progressive wing, tweeted: “People are going to die if we don’t start addressing climate change ASAP”, and “It’s not enough to think it’s ‘important’. We must make it urgent”. She is pushing fellow Democrats to push for a “Green New Deal” with widespread investment in renewable energy. However, Democrats are unlikely to be able to push through policy at the federal level while Republicans hold the executive and Senate.

There is better news at the state level, where a dozen of the candidates who won governor races campaigned on plans to move their states away from fossil fuels and toward renewable energy. Governors in these states are likely to have a better shot at creating immediate change as most face less obstructive local political environments. ☞

Tan Copsey is a director at Climate Nexus, a strategic communications group dedicated to highlighting the impacts of climate change and clean energy solutions in the United States.

请听我说：台风灾民向化石燃料公司发出呼吁

那些制造污染的企业是否侵犯了菲律宾公民的人权？
一项针对这一问题的调查正在菲律宾进行。

□ 伊莎贝拉·卡明斯基

菲律宾毁灭性台风中的幸存者呼吁碳排放大户尊重他们的人权并采取行动应对气候变化。

在上周伦敦的一场令人动容的听证会上，菲律宾人权委员会听取了菲律宾最近极端天气受害者的个人证词。委员会也听取了专家在气候变化科学、风险和法律领域的证词。

调查的内容是关于 47 家大型煤炭、石油、采矿和水泥公司在开采大量化石燃料或进行碳强度很高的工业活动过程中是否违反了菲律宾公民的人权，包括其生命权、居住权、健康权、获得安全食物权和自决权。

这次调查始于 2016 年绿色和平东南亚分部和其他当地团体要求对该事项进行调查的一次请愿。菲律宾人权委员会先是在国内进行了四

次听证会，然后将听证扩展到纽约和伦敦，以听取更广泛群体的证言并为此次调查赢得更多国际关注。

台风之灾

最近在伦敦政治经济学院举行的这场听证会上，维罗妮卡·卡博描述了 2009 年的台风“凯萨娜”是如何毁掉她在菲律宾的家园的。由于和家人不在一起，她不得不趟着齐腰深的洪水走了 7 个小时，把干衣服以及装在锅里的米饭和阿斗波（传自西班牙的一种菲律宾菜肴）带给他们。“终于见到他们时，我很高兴，因为他们是安全的。”

这场台风对菲律宾来说是毁灭性的，造成数百人死亡和数十亿美

元的损失。卡博在接下来的几个月里一直忙着清理他们家的淤泥，努力抢救任何还能使用的东西。她父亲感染了钩端螺旋体病，不得不在医院治疗。她说：“我觉得我们丧失了一部分尊严。”

委员会还听取了一位台风“海燕”幸存者的证词，这是菲律宾历史上遭遇的最严重的一次风暴灾害。玛丽埃尔·巴卡森如今在伦敦当研究护士，她描述了这场灾难在五年后依然留给自己家人在感情、社会和身体上的影响。她所认为的人生最重要的事情也发生了改变。“之前我担心的东西都很肤浅，但这次经历打开了我的思路。”

尽管听证会要求被调查的 47 家企业（包括壳牌、道达尔、碧辟、埃克森莫比尔和雪佛龙）发表意见，但它们无一出席。不过，其中几家企业以书面的形式对人权委员会是否对他们有权调查提出了质疑，认为气候变化并未违反人权。

当被问及是否有话对这些企业说时，卡博说：“可能我还是要呼吁

化石能源企业的不作为导致了多个举世瞩目的气候责任案例。罗达·维尔亨博士是一位接手过此类案件的律师，她阐释了气候变化诉讼在世界各地不断增加，法院对涉及人权诉求的案件进行审理的情况。

这些公司，请听一听我们的声音，考虑一下我们的遭遇。”

让企业可被问责

菲律宾人权委员会是一个独立机构，任务是调查该国违反人权的情况。该机构无权让企业付出法律责任或对其进行罚款。但它的报告可以作为菲律宾制定新法律的参考，并且该组织也希望自己收集的证据可以被全世界的政策制定者、律师和气候运动发起者所用。

在这次听证会上，专家们向菲律宾人权委员会提交了多项归因研究，计算了私人企业对全球变暖的贡献有多大。位于美国的非政府组织气候责任研究所的理查德·黑德阐释了其具有里程碑意义的“碳巨头”研究项目，这个研究显示了每个世界最大的煤炭、石油、天然气和水泥企业自工业革命以来的二氧化碳排放量。这次在菲律宾的调查主要着眼于该项目中涉及到的上市公司，其中很多都在菲律宾开展经营活动或与菲律宾有着那样那样的联系。

人们还向委员会展示了表明气候变化与极端天气事件联系的专家证据，以及化石燃料产业游说和基于不准确信息的运动所带来的影响。

迈尔斯·艾伦是联合国政府间气候变化专门委员会（IPCC）《全球升温 1.5°C 特别报告》的作者之一，也是牛津大学大气、海洋和行星物理学系大气动力学组的教授。他向伦敦的听证会展示，研究成果表明人为影响加剧了台风“海燕”破坏性和强度。

他警告说，即便将温度上升控制在 1.5 摄氏度以内，也不足以完全

避免对人类生命财产的危害。菲律宾等国受害可能尤为严重。

艾伦说，化石燃料企业早就知道气候变化的原因和影响，但几十年前就决定不投入资金发展减缓技术。他说：“在我看来，这一产业存在另外一种行动选择。”

化石能源企业的不作为导致了多个举世瞩目的气候责任案例。罗达·维尔亨博士是一位接手过此类案件的律师，她阐释了气候变化诉讼在世界各地不断增加，法院对涉及人权诉求的案件进行审理的情况。她特别提到了自己参与的两件案子。一件是一位自家面临冰川融化带来风险的秘鲁农民如何起诉德国能源企业莱茵集团（RWE）。这个案子虽被法院驳回，但原告目前还在上诉。另一件被称为“人民气候案”，即十个来自世界各地的家庭起诉欧盟未能制定更强有力的减排目标。

维尔亨说：“我代理的都是真正面临问题的委托人。我们讨论的并非未来影响，而是历史排放，是已经发生的破坏或目前气候变化造成的风险。”

尽管证据充分表明使用化石燃料正在造成气候变化，但完全不用它们也很困难。保罗·艾金斯是英国能源研究中心联合主任，也是伦敦学院大学可持续资源研究所所长和资源与环境政策教授。他说，对化石燃料的某些投入是必需的，因为世界仍然依赖它们。但他批评了对新的开采和勘探进行投资，“我们知道有足够的储量但不能去用，发现更多只会让这些决策更加困难。”

艾金斯还说，任何明白自身所肩负的人权和社会福利义务的负责任企业都应该计划摆脱化石燃料。

“从最近的‘1.5 度’报告来看，这些企业应该迅速规划起来。”

将气候变化与人权联系起来

同一周在伦敦举办的一场关于人权与气候变化的主题沙龙上，绿色和平组织律师克里斯汀·卡斯帕将菲律宾的调查描述为“目前全球行动浪潮的一个缩影”。

斯特林大学法学讲师安娜丽莎·萨瓦勒西说，菲律宾人权委员为国内人权组织如何对气候变化这样的全球问题展开调查树立了一个重要先例。

她说，委员会的这一行动有好几个关键挑战需要面对：表明企业在整体上具有人权义务；证明某个特定企业对气候变化的贡献已经达到违反人权的程度；分配这些违反人权行为的责任。

萨瓦勒西总结说，菲律宾人权委员会已经搜集了足以应对以上关键挑战的证据。“只要委员会发现违反人权的切实企业责任可以被归到‘碳巨头’们头上，就打下了一个良好的基础。接下来什么样的进展都有可能。”

委员会 12 月将在马尼拉举行最后一场听证会。其正式报告有望于明年夏天完成。

卡博如今已经成为一位社区反煤炭活动家，她对此次调查的积极影响充满希望。她说：“我亲眼看着贫穷社区在气候变化影响面前变得越来越脆弱。我相信，通过人权委员会，人们会听到我们的故事和我们的声音。政府和企业会选择人民，而非利润。”

伊莎贝拉·卡明斯基，自由撰稿环境记者

Please listen to us: typhoon survivors appeal to fossil fuel firms

Major carbon producers are being investigated for breaching Filipinos' human rights

□ Isabella Kaminski

Survivors of devastating typhoons in the Philippines have appealed to major carbon producers to respect their human rights and act on climate change.

At an emotional hearing in London last week, the Philippines Commission on Human Rights heard personal testimonies from Filipinos who had suffered during recent extreme weather disasters. The commission also listened to expert testimony on climate change science, risk and law.

The inquiry is investigating whether the actions of 47 large coal, oil, mining and cement firms are breaching the human rights of Filipino citizens, including their rights to life, housing, health, food and self-determination, by

extracting large volumes of fossil fuels or through carbon-intensive industrial processes.

It began in 2016 following a petition by Greenpeace South Asia and other local groups to investigate the issue. The commission held four sessions in the Philippines before expanding to New York and London because it wanted to hear evidence from a broader range of people and to raise the inquiry's international profile.

Typhoon devastation

During the latest hearing at the London School of Economics, Veronica Cabe described how her Philippines home was devastated in 2009 by Typhoon Ketsana. Separated from her family, she had to wade waist-deep through floodwaters for seven hours to bring them dry clothes and pots of cooked rice and adobo. “When I finally saw them, I was happy because they were safe.”

The typhoon was devastating for the Philippines, leaving hundreds dead and causing billions of dollars worth of damage. Cabe spent the following months removing the mud that caked their home and trying to salvage anything that could still be useful. Her father caught leptospirosis and had to be treated in hospital. “I felt like part of our dignity was lost,” she said.



© Richard Atrero de Guzman/Greenpeace

The aftermath of typhoon Mangkhut in the northern Philippines

The panel also heard from a survivor of Typhoon Haiyan, the deadliest storm the country had ever seen. Marielle Bacason, who now works in London as a research nurse, described the emotional, social and physical impacts of the disaster on her family even five years later and said her priorities in life had changed. “Before, my worries were superficial, but having that experience opened my mind.”

None of the 47 companies subject to the inquiry, which include Shell, Total, BP, ExxonMobil and Chevron, have appeared at the hearings, despite being asked to present their views. However, several have challenged the inquiry's jurisdiction over them in writing and argued that climate change is not a violation of human rights.

When asked if she had a message for respondents, Cabe said: “Maybe I can still appeal to the respondents: please listen to us. Consider our suffering.”

Holding companies accountable

The commission is an independent body tasked with investigating human rights violations in the Philippines. It does not have the power to hold the companies legally responsible or to fine them. But its report could inform the development of new laws in the Philippines, and it hopes that the body of evidence it develops will be used by policymakers, lawyers and climate campaigners around the world.

At its hearings, the commission was presented with attribution studies that calculate how much individual companies have contributed to global warming. Richard Heede of the Climate Accountability Institute explained how his landmark “Carbon Majors” project shows the amount of carbon dioxide created by each of the world's biggest coal, oil, gas and cement companies since the industrial

revolution. The Philippines inquiry focuses on the publicly owned companies identified in this work, many of which operate in or have links to the country.

The commission was also shown expert evidence linking climate change with extreme weather events and information on the impact of fossil fuel industry lobbying and misinformation campaigns.

Dr Myles Allen, co-author of the IPCC's Special Report on Global Warming of 1.5°C and head of the Climate Dynamics group at the University of Oxford's department of atmospheric, oceanic and planetary physics, presented studies in London that showed human influence had increased the impact and intensity of Typhoon Haiyan.

He warned that even limiting climate change to 1.5°C would not be enough to completely avoid harm to people and property. Countries such as the Philippines are likely to suffer particularly badly.

Allen said fossil fuel companies had long been aware of the causes and impacts of climate change, but decided not to invest in mitigation technology decades ago. “In my view, there was an alternative course of action available to the industry,” he said.

The failure of fossil fuel companies to act has resulted in several high-profile climate liability cases. Dr Roda Verheyen, a lawyer who has represented such cases, explained how climate change litigation is growing around the world and courts are hearing cases involving human rights arguments. She talked in particular about two cases she is involved in. In one, a Peruvian farmer whose home is at risk from a melting glacier is suing German energy company RWE. The case was dismissed but is now under appeal. In another, called the “People's Climate Case”, ten families from across the world are taking the EU to court for not having stronger targets to reduce carbon emissions.

“I represent real clients with real problems,” said Verheyen. “We're not talking about future effects. We're talking about historic

“Maybe I can still appeal to the respondents: please listen to us. Consider our suffering.”

— Veronica Cabe, survivor of Typhoon Ketsana.

emissions. We're talking about already occurring damage or risk due to climate change today."

Despite the evidence that burning fossil fuels is driving climate change, ending their use quickly will be a challenge. Dr Paul Ekins, co-director of the UK Energy Research Centre and professor of resources and environmental policy and director of the Institute for Sustainable Resources at University College London, said some investment in fossil fuels is necessary because the world is still dependent on them. But he was critical of investment in new exploration and discovery. "We know about plenty of reserves that we can't afford to burn and discovering more of them will simply make those decisions more difficult."

Any responsible business that is aware of its commitments to human rights and social welfare should be planning to exit from fossil fuels, added Ekins. "And we know from the recent 1.5C report it should be planning that pretty fast."

Linking climate change and human rights

At an evening talk on human rights and climate change, held during the same week in London, Greenpeace lawyer Kristin Casper described the Philippines inquiry as a "microcosm of the global wave of action that is happening right now".

Dr Annalisa Savaresi, law lecturer at the University of Stirling, said the commission has set an important precedent

in investigating the global issue of climate change as a national human rights organisation.

She said there were several key challenges to doing this: showing that corporations have human rights obligations in general, that a specific corporation has contributed to climate change in a way that amounts to a human rights breach and allocating responsibility for such breaches.

Savaresi concluded that the Philippines commission had heard evidence that these could be demonstrated. "If the commission is to find that indeed corporate responsibility for human rights violations can be attributed to carbon majors that could be a primer, and who knows where we go from there."

The commission's final hearing will be held in Manila in December. It is expected to formally report on its findings by next summer.

Cabe, who is now a community anti-coal activist, remains hopeful that it will have a positive influence. "I have seen how poor communities have become ever more vulnerable to the impacts of climate change," she said. "I believe that through this commission our stories and our voices can be heard. Governments and corporations can choose people over profit." ☞

Isabella Kaminski is a freelance environmental journalist.

气候诉讼的三种类型

在人类活动如何影响天气这个问题上，我们的理解正在不断加深，并且随着这种理解的加深，法律环境也在发生着变化。

□ 斯蒂芬妮·莫尔顿

气候变化经常被称为我们这个时代面临的关键性挑战。挑战的一个方面是如何量化气候变化对特定天气事件的影响。

如今，在突破性科学发展的帮助下，我们对人类活动如何影响天气的认识迅速加深。这一点很重要，因为这一科学领域在快速发展的气候诉讼方面将发挥日益重要的作用。

“概率事件归因科学”听起来也许有些复杂，但其目的却很直接：确定人为引起的气候变化能在何种程度上改变特定天气事件的概率或强度。

尽管科学家们使用了一系列方法来去做这个研究，其主要办法还是将真实世界与一个无人为温室气体排放的虚拟环境进行对比。

比如，2016年7月武汉发生的暴雨引发严重水灾，导致237人死亡、93人失踪。洪水还造成超过220亿

美元的损失，使其成为中国历史上最为惨重的天气相关自然灾害之一。

中国的研究者们想要弄清此次事件受气候变化影响的概率究竟有多大。他们的研究发现，如此强度的极端降水在2016年的气候条件下发生的概率是28年一遇。

相比之下，类似天气事件在1961年气候下的发生概率是272年一遇。换句话说，1961年到2016年间，此类事件发生的概率几乎增加了十倍。

他们的发现也表明此类事件约60%的风险可以归因到人为气候变化。因此，气候变化可能已经大大提高了武汉所经历的这种极端降雨发生的概率。

归因科学不仅可以使我们更好地理解目前正在发生的情况，而且清晰地给出了有关未来极端天气事件风险的证据和警告。

从法律角度来看这很重要，因为在很多法律体系中，可预见性是确定关注义务的基础。以此为背景，法律格局开始改变。除了上述科学进步的因素之外，极端天气事件造成的损失越来越大也有可能是导致法律格局发生变化的原因。

我们认为这些诉讼大致可以分为三类：一是未能减缓气候变化，二是未能采取气候变化适应措施，三是未能遵守关于对气候变化进行披露和报告的法律法规。

关于未能减缓气候变化的诉讼

这类案件可能包括就公私实体（常常通过温室气体排放）的气候变化贡献导致的损失所发起的诉讼。

例如，荷兰公民最近在一场针

一家保险公司起诉芝加哥当地政府的市政当局，理由是其明知气候变化导致下暴雨的可能性在增加，却没有改进污水和雨水下水系统。尽管后来案子撤诉了，但也仍然是一个反映地方政府责任风险的有趣例子。

对荷兰政府的诉讼中获胜。海牙上诉法院判决政府因未能实现到 2020 年底至少减排 25% 温室气体的目标，违反了《欧洲人权公约》的第 2 条（生存权）和第 8 条（私人和家庭生活得到尊重的权利）。

在另一起案子中，一位秘鲁农民起诉德国最大电力生产商莱茵集团。他要筹集资金修建防洪设施来保护自己的家乡不受全球变暖造成的冰川融化的危害。这个案子还没有经过审理，但已被允许进入证据提交阶段。法庭将考虑关于莱茵集团对气候变化的贡献及其对山岳冰川影响的证据。

要提供证据表明主要是气候变化而非天气型态的正常波动造成了损失和破坏，一向是很困难的，而事件归因科学可以成为解决这一难题的关键。

关于未能采取气候变化适应措施的诉讼

针对实体或个人未能将气候变化纳入决策的诉讼可能被包含进这个类别。这不仅包含气候变化的物理侵害，也可能包含经济、声誉和法律侵害。

例如，设在波士顿的保护法基金会 2016 年就马萨诸塞州的埃弗雷特码头起诉埃克森美孚公司。该基金会认为埃克森美孚明知海平面明显上升会让码头面临威胁，但却没有采取任何行动保护公众及环境。

这类诉讼与政府关系尤其密切，特别是拥有和管理公共基础设施

和资产的部门。在很多领域，这些基础设施都需要升级，以提升对气候变化实质后果的抵抗力。如果未能跟踪气候变化科学并将其纳入决策过程，政府可能会因此面临官司。

2014 年，一家保险公司起诉芝加哥当地政府的市政当局，理由是其明知气候变化导致下暴雨的可能性在增加，却没有改进污水和雨水下水系统。尽管后来案子撤诉了，但也仍然是一个反映地方政府责任的有趣例子。

这项责任风险同样会降临到专业人士和私营企业头上。比如，工程师可能会因未能将气候风险纳入工程项目考量而面临赔偿请求。

同样的，企业老板和高管可能会因未将气候变化风险纳入考量（如未做出合理的预防以确保其供应链对气候变化具有抵御能力）而承担违反某些“关注义务”，因此而受损的股东可能会提起派生诉讼。

气候变化使得极端天气更易产生和更加频繁。而极端天气是否是可预见的？归因科学将帮助给出答案。反过来，归因科学也可能被作为一个“合理性标准”来对范围广泛的个人、企业和政府机构的决策、行动和疏忽进行评估。

关于未能遵守气候变化信息披露规则的诉讼

很多企业都被要求披露和报告风险，而且披露和报告的方式不得

产生任何误导。如果气候变化会给商业带来重大风险，这些风险就很可能被纳入现有规章制度。相应地，一旦企业未能充分披露气候变化带来的风险，就会面临法律风险。

例如，2018 年，ClientEarth 向英国金融管理局举报了三家保险公司没有在其年报中披露气候变化是影响经营的主要风险，违反了在英上市企业必须遵守的披露指导和透明度规则。

同样的，纽约州总检察长最近起诉埃克森美孚公司在气候变化影响的考量方式上误导股东。纽约州称该公司面临触犯气候变化法规的风险要比其告知投资者的要大。

对充分披露气候变化所致风险的企业来说，他们必须弄清气候变化如何影响其经营。归因科学可以让这些企业更好地理解特定极端天气事件的可预见性。那些未能利用这些知识的企业会有触犯法律的风险。

归因科学有望在方兴未艾的气候诉讼领域发挥重大作用。随着我们加深理解气候变化对天气的影响，我们会更加期待获得如何从法律层面跟踪并管理这些影响的办法。^⑤

斯蒂芬妮·莫尔顿，ClientEarth 事务所气候金融律师

How ‘attribution science’ is shifting the legal landscape

Lawyer Stephanie Morton explains three types of climate lawsuit that are threatening the future of fossil fuels

□ Stephanie Morton



The aftermath of Typhoon Yagi in the Philippines

Climate change is often described as the defining challenge of our time. One aspect of this challenge has, historically, been quantifying its impact on particular weather events.

Now, with the help of scientific developments, we are rapidly improving our understanding of how human activity

influences the weather. This area of science is important for its role in the burgeoning field of climate litigation.

"Probabilistic event attribution science" may sound complex but the aim is straightforward: to determine the extent to which human-caused climate change has altered the probability or intensity of specific weather events.

While scientists use a range of methods to do this, the main approach is to compare real world scenarios with a simulated alternative that excludes man-made greenhouse gas emissions.

Take, for example, the Chinese city of Wuhan. In July 2016, torrential rain resulted in catastrophic flooding, which killed 237 people and left 93 missing. The flooding caused over US\$22 billion in damage, making it one of the costliest weather-related natural disasters in Chinese history.

Chinese researchers wanted to understand how climate change affected the probability of this event happening. They found that extreme precipitation of that intensity was likely to occur once every 28 years, according to the climate of 2016. By contrast, in 1961, it would have been likely to occur once every 272 years. In other words, these events have become almost ten times more likely over 55 years.

Their findings suggested that around 60% of the risk of such an event occurring can be attributed to human-caused climate change. Climate change may, therefore, have substantially increased the probability of extreme rainfall such as that experienced in Wuhan.

Attribution science enables us to better understand what is happening today and produces clear evidence, and warnings, of future weather risks. This is important from a legal perspective, as foreseeability is fundamental to establishing a duty of care in many legal systems. Against this backdrop, the legal landscape is beginning to shift. This is partly due to scientific advances, but also due to the increasing losses of extreme weather events.

Litigation will fall into three main categories: i) failure to mitigate climate change, ii) failure to adapt to climate change, and iii) failure to comply with legislation or regulation around disclosing and reporting on climate change.

Event attribution science may be key to providing evidence of the extent of loss and damage that is attributable to climate change, rather than normal fluctuation in weather patterns.

Failure to tackle the root causes

Failure to mitigate climate change includes claims for losses resulting from a public or private entity's contribution to climate change, often through greenhouse gas emissions.

For example, Dutch citizens were recently successful in bringing a case against their government. The Hague Court of Appeal held that the government was acting in contravention of Articles 2 (right to life) and 8 (right to respect for private and family life) of the European Convention of Human Rights by failing to reduce greenhouse gas emissions by at least 25% by the end of 2020.

In another case, a Peruvian farmer is bringing a claim against Germany's largest electricity producer, RWE. He is seeking a contribution towards the cost of establishing flood protections to defend his hometown of Huarez against melting mountain glaciers caused by global warming. The case has not yet been tried but has been permitted to proceed to the evidential phase, where the court will consider evidence on RWE's contributions to climate change, and the impact on mountain glaciers.

Event attribution science may be key to providing evidence of the extent of loss and damage that is attributable to climate change, rather than normal fluctuation in weather patterns. This has, historically, been challenging to establish.

Failure to recognise the risks

Failure to adapt to climate change includes cases where it is alleged that an entity or individual has failed to take climate change risks into account in their decision-making. This goes beyond the physical risks of climate change and can encompass economic, reputational and legal risks.

For instance, the Boston based Conservation Law Foundation filed a suit against ExxonMobil in 2016 with regard to its Everett Terminal in Massachusetts. The Foundation alleges that ExxonMobil was aware that a significant rise in sea level would put the terminal at risk but took no action to protect the public or the environment.

This type of claim is particularly relevant to governments, especially agencies that own and manage public infrastructure

and assets. Many areas, such as infrastructure, will need to be upgraded to improve resilience to the physical consequences of climate change. By failing to monitor climate change science and integrate it into their decision-making processes governments may be exposed to litigation.

In 2014, an insurance company sued local government municipalities in Chicago for failing to improve sewer and storm water drainage systems, despite knowing that climate change was making heavy rain more likely. Although the case was withdrawn, it remains an interesting example of the liability risks facing local governments.

This liability risk applies to private professionals and companies. For instance, engineers could see professional indemnity claims for failing to account for climate risks in projects.

Likewise, company directors and officers owe certain duties of care, which could be breached by a failure to take climate change risks into account, for example by not taking reasonable precautions to ensure their supply chains are resilient to climate impacts. In turn, this could lead to derivative actions by shareholders who have suffered loss as a result.

In all such cases, attribution science is set to play a key role in establishing whether extreme weather events, made more likely or intense as a result of climate change, are foreseeable. In turn, this may be used as a standard of reasonableness to gauge the actions of a wide range of individuals, companies and government bodies.

Failure to disclose information

Many companies are already required to disclose and report on risks in a way that is not misleading. Material

risks posed by climate change are likely to be caught by existing regulations. Accordingly, a failure to adequately disclose the risks from climate change poses a legal threat for companies.

For instance, ClientEarth reported three insurance companies to the UK financial regulator in 2018 for failing to disclose climate change as a principal risk affecting the business in their annual reports. In all cases ClientEarth alleged that this failure constituted a breach of the disclosure guidance and transparency rules which apply to listed companies in the UK.

In a similar vein, New York's attorney general recently sued ExxonMobil for misleading shareholders on the manner in which the company accounts for the effects of climate change. It is alleged that the company is more exposed to climate risk regulation than investors were led to believe.

For companies to adequately disclose the risks posed by climate change, they need to understand how climate change may impact their business. Attribution science enables companies to better understand and anticipate extreme weather events. Companies that fail to take advantage of this knowledge risk breaching the law.

As we improve our understanding of the degree to which climate change is expected to impact the weather, legal expectations as to how those impacts should be monitored and managed will inevitably increase. ☞

Stephanie Morton is a climate finance lawyer at ClientEarth.

巴西新总统的对华态度引关注

雅伊尔·博尔索纳罗的特朗普式言论在巴西各界引起广泛争议。

□ 曼努埃拉·安德列奥尼

在今年巴西轰轰烈烈的总统大选期间，国际市场的注意力都被极右候选人雅伊尔·博尔索纳罗的私有化承诺所吸引，他在10月28日以明显优势战胜左翼对手费尔南多·阿达德。

在选举前，博尔索纳罗一直鼓吹计划出售100家国有企业。但就在10月大选第一轮投票3天后，这些计划被高调叫停。在接受Estadão新闻网采访时，博尔索纳罗收回了巴西电力公司私有化的诺言，这是一家国有能源企业，受到金融市场的密切关注。

他说，能源生产对巴西来说具有战略意义，还说不想让国有资产被不当处置。

“当你进行私有化时，你会让世界其他国家的资本来‘私有’它吗？”博尔索纳罗在采访中玩起了字眼：“中国不是在巴西收购，而是在收购巴西。你们想把巴西送到中国人手里吗？”

博尔索纳罗承诺的自由经济政策与其民粹主义立场之间的矛盾，引起了巴西贸易伙伴的担忧。

博尔索纳罗自称反共，并指中国投资威胁巴西主权。今年早些时候他访问了台湾，众所周知这是与“一个

“一想到巴西经济中的战略性部门掌握在外国人手中，总是会在武装部队中引发某种反应。我们仍然有一点冷战思维。”

中国”原则相违背的。他表达了与美国靠近的强烈愿望，而美国今年初对中国发起了贸易战。

退休军官博尔索纳罗赢得了总选票的55%。近年来，在拉美地区的选举中，有关中国在拉美存在的批判并不鲜见。2015年的阿根廷大选中，现任总统毛里西奥·马克里给中国政府写了一封信，说中阿之间的协议可能违宪，需要重新审议。2017年的智利大选中，塞巴斯蒂安·皮涅拉有样学样，说“中国在拉美的强大政治存在并非好事”。

两人后来都改了主意。中国在南美投资的“雪崩式”下滑和对中国贸易日益增加的依赖显然占了上风。

里约热内卢州立大学国际关系教授毛里西奥·桑托罗说：“我认为博尔

索纳罗一旦上台，其观点会更加务实。但这种情况也让中国十分关切，博尔索纳罗是一个未知数。”

常年关注国际问题的中国《环球时报》主编胡锡进也对这种反华情绪表达了自己的质疑，认为它会影响巴西的外交政策。

胡锡进在推特上说：“无论雅伊尔·博尔索纳罗在选举期间说了什么，我认为他都会采取对华友好政策。中国是巴西大豆和铁矿的最大买家，特朗普式反复无常的对华政策不符合其政府的利益。”

中国在巴西的投资

2009年以来，中国取代美国成为巴西的头号出口目的地。中国国有银行已经为巴西提供了大量资本投资。2017年，中国对巴西投资209亿美元，为7年来最高。这些投资的很大一部分都进入了能源领域，中国国家电网收购CPFL能源使其成为巴西最大的配电企业。

中国在巴西其他具有重要战略意义的经济领域也有投资。比如，有利于农产品出口的农业综合企业以及基础设施等。

这样一来，就有必要探究中国投资是否能最好地服务于巴西的地缘政治利益，巴西广告营销高等学校（ESPM）亚洲商业研究中心教授亚历山大·乌伊哈拉如是说。但上述批评对制订巴西经济政策并无建设性作用。

乌伊哈拉指出：“说‘我不喜欢中国’是很愚蠢的。中国被当成了巴西问题背后的罪魁祸首。”

1970年，巴西前总统埃内斯托·盖泽尔在其军事独裁期间与中国建交。近年来双边关系不断加强，在劳工党连续执政期间达到顶峰。中国与巴西，再加上印度、俄罗斯和南非建立了新兴经济体集团——“金砖五国”。

与两国关系拉近相伴的是巴西农业的强化。巴西已经成为大豆主要出口国，尽管面临与中国日益激烈的竞争。

挑衅

进入21世纪以来，中国对巴西重要性的迅速增强引起了该国民粹主义者的关切，尤其是博尔索纳罗身边的一群军人。

桑托罗解释说：“一想到巴西经济中的战略性部门掌握在外国人手

中，总是会在武装部队中引发某种反应。我们仍然有一点冷战思维。”

博尔索纳罗竞选期间的行为不啻给这些反应煽风点火。今年2月，他访问了台湾。

作为回应，中国驻巴西使馆给洛伦佐尼的政党发去了一封措辞严厉的信函，指出这次访问“违背了‘一个中国’政策，这是国际社会的广泛共识，也是巴西政府和国会的明确政策”。

关注与美亲近

2017年10月，博尔索纳罗在访问迈阿密时向美国国旗致敬，这引起了巴西民粹主义者的注意。

博尔索纳罗在公众演讲中说：“特朗普是我的榜样。我知道自己和特朗普差得有多远，但我打算为了巴西和美国的利益向他靠近。”

政治专家们指出这两个人将在美洲建立一个右翼同盟。巴西与美国关系的回暖对特朗普来说无异于雪中送炭，他上台后一直自绝于国际社会。

巴西已经开始从特朗普的对华贸易战中受益。今年1月到9月巴西对华大豆出口同比增加了15%。

巴西和中国此前在国际外交中也站在同一战线。两国以及南非和印度组成的“基础四国”（BASIC）是一个

反对特朗普让美国退出“巴黎协定”的发展中国家政治联盟。博尔索纳罗自身对这一协定的态度模棱两可，说他不会退出，但同时却在撕毁巴西的承诺，如保护亚马逊地区。

实用主义或占上风

尽管博尔索纳罗言辞激烈，但中巴友好关系似乎仍将继续。巴西势力强大的农业游说集团是博尔索纳罗的靠山，而它又严重依赖对华出口。与中国发生龃龉将直接影响博尔索纳罗的支持基础。

中国国家媒体《中国日报》的一篇社论强调了中国与巴西新政府建立良好关系的意愿。

社论中说：“我们真诚希望博尔索纳罗先生在接管这个世界第八大经济体时，能够用客观而理性的眼光看待中巴关系现状。”

博尔索纳罗是否以及何时能够做到这一点，还需拭目以待。^⑤

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曼努埃拉·安德列奥尼，中拉对话巴西板块编辑

Brazil's new president stokes fear of China's regional presence

Jair Bolsonaro's Trump-style rhetoric is out of step with the interests of his administration

□ Manuela Andreoni



The former army captain's nationalist stance could raise concern among Chinese trade partners

During this year's hectic Brazilian presidential campaign, international markets' ears pricked up at the privatisation promises by far-right candidate Jair Bolsonaro, who swept to a comfortable victory over leftist rival Fernando Haddad on Sunday October 28th.

Ahead of the election, Mr Bolsonaro boasted of plans to sell 100 state-owned companies. But just three days after October's first round vote, plans screeched to a halt. In an interview with news network Estadão, Mr Bolsonaro backtracked on a pledge to privatise Eletrobras, a state-

owned energy company, which was closely watched by financial markets.

Energy generation is strategic for Brazil, he said, adding that he did not want national assets to fall into the wrong hands.

“When you privatise, will you privatise to any capital in the world?” Bolsonaro asked rhetorically during the interview. “China isn’t buying in Brazil, it’s buying Brazil. Are you going to put Brazil in Chinese hands?”

The contradiction between the liberal economic policy promised by Bolsonaro and his nationalist stance has raised concern among Brazil's trade partners.

Bolsonaro has proclaimed himself anti-Communist and suggested that Chinese investments threaten Brazil’s sovereignty. Earlier this year he visited Taiwan, with whom China is locked in an ongoing diplomatic dispute about its independence. He has expressed a strong desire to draw closer to the US, which launched a trade war against China earlier this year.

Retired army captain Bolsonaro won the run-off with 55% of the total vote share. Criticism of China’s presence in the region has not been uncommon in recent elections in the region. In the 2015 campaign, current president of Argentina, Mauricio Macri, wrote a letter to Chinese authorities saying that agreements between Argentina and China might be unconstitutional and would be reviewed. In Chile in 2017, Sebastián Piñera followed suit, saying that “China’s strong political presence in Latin America [was] not good.”

Both have since backpedalled. The avalanche of Chinese investment in South America and a growing dependence on Chinese trade has taken precedence.

“I believe that once he is in office, Bolsonaro’s focus will be more pragmatic,” says Mauricio Santoro, professor

of international relations at the State University of Rio de Janeiro. “But this scenario is greatly concerning for the Chinese. Bolsonaro is an unknown.”

Hu Xijin, editor-in-chief of Chinese tabloid Global Times, which focuses on international affairs, expressed scepticism that anti-China sentiment would infuse Brazil’s foreign policy.

“No matter what Jair Bolsonaro said during his campaign, I think he will adopt a China-friendly policy. China is a top buyer of Brazilian soybean and ore. Trump-style capricious China policy will not be in line with the interests of his administration,” Hu tweeted.

Chinese investments in Brazil

Since 2009, China has been the number one destination for Brazilian exports, replacing the US. Chinese state banks have provided Brazil with huge sums of capital investment. In 2017, China invested US\$20.9 billion in Brazil, the largest amount in seven years. A large part of this investment has gone into energy assets. The purchase of CPFL Energia by China’s state-owned State Grid made the Chinese company the largest distributor of electricity in Brazil.

China invests in other areas of strategic importance to the Brazilian economy. These include agribusiness and infrastructure that expedites the export of agricultural products.

It makes sense to question whether Chinese investment is the best way to serve Brazil’s geopolitical interests, says Alexandre Uehara, professor at the Asian Business Studies Centre at the country’s Advanced School of Marketing and Advertising (ESPM). But these criticisms have not been constructive for formulating Brazilian economic policy.

“It is silly to say ‘I don’t like China’,” says Uehara. “China is presented as the villain behind Brazil’s problems.”

"No matter what Jair Bolsonaro said during his campaign, I think he will adopt China-friendly policy. China is top buyer of Brazilian soybean and ore. Trump-style capricious China policy will not be in line with the interests of his administration."

— Hu Xijin, editor-in-chief of Chinese tabloid Global Times.

Former Brazilian president Ernesto Geisel established ties with China during his military dictatorship in 1970. The relationship has strengthened in recent years. They peaked under the successive administrations of the Workers Party (PT), when Brazil and China joined India, Russia, and South Africa in creating the BRICS group of emerging economies.

Closer relations coincided with the strengthening of Brazilian agribusiness. The country has become a major exporter of soybeans, though faces increasing competition from China.

Provocation

China's importance to Brazil grew rapidly in the 2000s causing concern among Brazilian nationalists, especially the military, a group close to Bolsonaro.

"The idea that you have strategic sectors of the Brazilian economy controlled by foreigners, and especially a regime like China, which by nominally being a Communist party is a Communist government, always causes some kind of reaction in the Armed Forces," explains Mr Santoro. "We still have a bit of this Cold War view."

Bolsonaro stoked up these reactions during his campaign. In February he travelled to Taiwan. According to Onyx Lorenzoni, Bolsonaro's chief aide, the trip was to learn more about Taiwan's education system.

In response, the Chinese embassy in Brazil sent an outraged letter to Lorenzoni's party, describing the visit as a "breach of the one-China policy, a broad consensus in the international community and a policy explicitly advocated by the government and the Brazilian Congress."

Concerning US closeness

In October 2017, Bolsonaro drew the attention of Brazilian nationalists for saluting the US flag on a visit to Miami.

"Trump is an example for me," Mr Bolsonaro told a public audience. "I know how far I am from Trump, but I plan to approach him for the good of Brazil and the United States."

Political experts suggest the two could create a right-wing alliance in the region. Brazil's rapprochement with the US could benefit Trump, who has isolated himself from the international community during his presidency.

Brazil has already begun to profit from Trump's trade hostilities with China, with exports of Brazilian soybeans went up 15% from January to September this year based on the same period last year.

Brazil and China have also been allies in international diplomacy. The two countries are part of the BASIC group with South Africa and India, a political coalition of developing countries, which is against Trump's decision to withdraw the US from the Paris Agreement. But Bolsonaro himself has sent mixed signals about the Agreement, saying he would not withdraw but at the same time undermining Brazil's commitments, such as the preservation of the Amazon.

Pragmatism expected to prevail

Despite Bolsonaro's inflammatory rhetoric, it is likely that good relations between China and Brazil will continue. Bolsonaro is dependent on Brazil's powerful agribusiness lobby, which relies heavily on exports to China. A quarrel with China would directly affect his support base.

An editorial in the state-run China Daily highlighted the country's willingness to establish good relations with Brazil's new government.

"We cherish the sincere hope that when he assumes leadership of the world's eighth-largest economy, Bolsonaro will take an objective and rational look at the state of China-Brazil relations," it stated.

It remains to be seen if and when Bolsonaro will meet that. ☞

This is an edited version of an article originally published on Diálogo Chino.

Manuela Andreoni is Diálogo Chino's Brazil editor

中国游客探寻哥伦比亚 稀有动物动冠伞鸟

哥伦比亚广袤的森林吸引着勇敢的探索者，但其珍贵的生物多样性正处于危险之中。

□ 列瓦诺·安德烈斯·贝穆德斯

“我们必须安静地等待 10 分钟，只有完全不动，不发出一声声音，他才会过来。”

鸟类学家塞萨尔·阿雷东多低声说道，他的指令先是翻译成英语，随后被译成中文。一群中国摄影师们安静地坐在潮湿的森林里，面前支着三角架，上面架着体积庞大、看起来更像是望远镜的相机。

突然划过一道橙色的闪电。一只乌鸦大小、头顶半月形羽冠的小鸟停在了树枝上，片刻之后又消失了。这只行踪难寻的小鸟就是南美洲亚马逊盆地所独有的圭亚那动冠伞鸟（学名：*rupicola rupicola*）。

镜头快速旋转，试图透过浓密的树叶，聚焦在这小小的鸟儿身上。虽然四周寂静无声，摄影师们的紧张感却十分明显。“请呆在原地，它会回来的，绝对不要动。”阿雷东多说。

几分钟后，动冠伞鸟再次出现，停在了他们面前的一个树枝上。林间响起一阵快门声，仿佛一队打字员在疯狂地敲打键盘。之后的 1 个多小时里，这只原本行踪隐秘的鸟儿从这棵



动冠伞鸟

树跳到那棵树，非常上镜地在这些最新型号的佳能相机前摆着造型。用鸟类观察者的语言说，它是在“栖息”。

跨越半个地球追鸟

“为了来这里，我们花了相当多的时间和金钱，包括 18 个小时的飞

机，下飞机到这里的路上还颠簸了好几个小时。所有这些努力都是为了来这里，但看到鸟的一瞬间，这一切就都值了，”54 岁的业余摄影师刘怡（音译）说。这位来自山东济南的女士从头到脚都穿戴蓝色的迷彩服，相机的长焦镜头上都盖着褐色树叶的伪装。

过去的 23 天里，为了这场特殊的观鸟之旅，她和另外 5 位来自中国的鸟类爱好者跨越了半个哥伦比亚。他们从首都波哥大出发，走过 7 个省份，寻找剑嘴蜂鸟、多彩唐加拉雀等鸟类。最后在亚马逊丛林与安第斯山脉脚下广袤平原之间的这片郁郁葱葱的森林中结束了这次旅程。

尽管一路上遇到了 100 多种不同的鸟类，但他们的目标始终非常明确：找到现存的两种动冠伞鸟。

“感觉就像鸟儿在等我们。”43 岁、来自西安的平面设计师凌子川（音译）一边回看着自己从各个角度拍摄的数百张照片，一边说道。这次他们很幸运。两周前，他们去了卡利法拉隆国家公园附近的一个农场，但没有拍到安第斯动冠伞鸟（学名：*rupicola peruvianus*）。尽管他们在细雨中发现了其他种类的动冠伞鸟，但距离太远，他们没能找到合适的拍摄位置。在宁静的瓜维亚雷，这只做出求偶动作的雄性动冠伞鸟在清理出来的小小领地上骄傲地昂首阔步，这块地方不仅是他和其他鸟类斗技的竞技场，也是他吸引棕色羽毛的雌性动冠伞鸟的舞台。

一行人在瓜维亚雷看到的不只是动冠伞鸟。他们还在一个泻湖里看到了一只正在用嘴喂食幼鸟的麝雉；在附近的一棵树顶看到了羽毛柔滑的裸颈果鸦；在湿地偶遇了一群角叫鸭，从很远处就能听到它们刺耳的叫声。一个接着一个，他们看到了红顶须鹭、黑臀食螺鸂，看到了体态纤细的日鵂和速度飞快的白耳鸂。



刘怡（音译）查看她拍到的动冠伞鸟

无与伦比的生物多样性，前所未有的机遇

坐拥 1912 种鸟类的哥伦比亚是鸟类爱好者的天堂。尽管拥有世界上种类最多的鸟类资源、丰富多样的自然景观和生态系统，但利润丰厚的观鸟生态旅游在这个国家才刚刚起步。

2016 年哥伦比亚政府与左翼游击队队伍“哥伦比亚革命武装力量”（简称“哥武”）签订历史性的和平协议后，国内很多地区的安全状况明显改善，为旅游业的发展提供了巨大的机遇。瓜维亚雷是哥伦比亚生物多样性最为丰富的省份，也是全国最穷的省份之一。多年来有 1.3 万游击队员盘踞在这里，直到 2017 年 7 月这些人才放下武器。几十年来，瓜维亚雷一直是受暴力袭击最为严重的地区之一。

瓜维亚雷是哥伦比亚森林砍伐率最高的省份之一，且几乎不存在私营部门，但这里如今希望通过一场彻底的变革，助其在保护自然财

富的同时发展工作机会。包括观鸟在内的自然旅游正成为一个有潜力的选择。这里有 550 种不同的鸟类，占哥伦比亚全国总数的四分之一。

“自然旅游不仅正在成为造福许多家庭（拥有森林所有权的农民、司机、导游）的经济部门，也是物种保护的盟友，”阿雷东多解释说。成为鸟类学家后，阿雷东多回到自己的祖国，成立了国内首家专营自然旅游的旅行社，名字也很合适，叫“生物多样性旅行社（Biodiverso Travel）”。

这一点在瓜维亚雷省至关重要。尽管拥有刚刚荣晋为世界遗产的南美洲最大的国家公园——齐里比克特国家公园，但瓜维亚雷是全国森林砍伐率最高的省份之一。该省省会、旅游中心圣何塞市周边被认为是全国 8 个森林砍伐最为严重的热点地区之一，且面临着非法木材贸易、农业用地扩张、非法侵占土地的三重威胁，其中最严峻的要数非法侵占土地。

“尽管岩石和沙漠地区也有鸟类，但鸟类（包括数量和多样性）和森林等复杂的生态系统之间有着非常明确的联系。类似瓜维亚雷这样，当它们和平原、丘陵、湿地、洪水频发的森林、露出地面的岩石联系在一起时，情况更是如此。”保育和可持续发展基金会（Foundation for Conservation and Sustainable Development）主任罗德里戈·波特罗说，该基金会一直在记录令人目不暇接的环境破坏情况。“这类生态旅游是一种正向刺激，对维持森林的健康有着积极的意义，而健康的森林是动冠伞鸟等标志性物种的家园。”他补充道。

即便是个小规模的细分市场，“生态旅游”的影响也是双重的：为社区创造收入，激励人们改变没有树的土地更值钱的心态——这种想法在许多农业扩张地区非常普遍。

“一旦农民看到有人会花钱来看类似动冠伞鸟这样的动物，发现帮这样的人实现他们的目标具有金钱价值，他砍森林的时候就会三思而行。这种激励，加上环境教育和由此产生的地方自豪感，对一个拥有丰富的森林资源但同时森林砍伐率又如此之高的省份而言非常重要。”阿雷东多说，他利用业余时间与他人合著了瓜维亚雷第一本鸟类指南。

来自鸟类的潜在和平红利也很重要：保护战略基金（Conservation Strategy Fund）在对美国奥杜邦协会（US Audubon Society）合作伙伴进行的 2000 份调查的基础上所做的学术研究显示，《和平协定》签署后，对前往哥伦比亚“观鸟”感兴趣的游客估计可能多达 27.8 万人次，这

一旦农民看到有人会花钱来看类似动冠伞鸟这样的动物，发现帮这样的人实现他们的目标具有金钱价值，他砍森林的时候就会三思而行。

将带来约 4600 万美元的收入，提供超过 7000 个就业机会。

无论如何，取得长期成功和可持续性发展有赖于国家政府、地方当局和社区之间的统筹规划。而这在哥伦比亚仍存在很大难度。

“潜力是很大，但仅占全球旅游经济总量 5% 的生态旅游不是万灵药，单靠它养不活社区。”哈佛大学教授、专攻可持续旅游的学者之一梅根·爱普乐·伍德警告说，“必须认真考虑该地区的未来，详细预测每个发展路径的经济、社会和环境影响。最终的决定必须基于对这些选择的权衡。”

爱普乐·伍德因创作《有限行星上的可持续旅游》一书而闻名，她去年造访了瓜维亚雷，和阿雷东多一起去“观鸟”，并向当地人讲述了野生动物观赏的旅游价值。

巨大的潜在市场

大多数观鸟者都是英国和美国人，至少瓜维亚雷的情况是这样的。中国观鸟者的人数尽管不多，但他们都对这里留下了深刻的印象。

“我认为动冠伞鸟是世界上最美丽的鸟。我敢肯定，等我们旅行结束回到家里，向大家展示我们拍的照片，就会有更多中国人来这里，”来自江苏徐州的退休人员韩风（音译）

说，他第一次看到动冠伞鸟是在一本杂志上，自此便梦想能亲眼见到这种美丽的鸟。

根据官方移民数据，去年赴哥伦比亚旅游的中国游客数量仍旧不多，仅 16879 人，但自 2012 年和平谈判之后，中国游客数量迅速增长了 4 倍，去年赴哥伦比亚旅游的人数超过了拥有类似旅游资源的哥斯达黎加。

随着中国游客出境游人数屡创新高（去年全国出境游人次达 1.45 亿），消费能力不断增长（根据世界旅游组织的数据，中国游客境外消费达 2610 亿美元），他们越来越多地寻求通过摄影、动物观赏等活动来身临其境地感受自然。这群到瓜维亚雷观鸟的人许多都去过与哥伦比亚类似的地方。凌子川今年年初去了哥斯达黎加，刘怡去年去了古巴，这两个人都曾去过日本，探访毛腿鱼鸮、丹顶鹤等深受观鸟爱好者追捧的鸟类。

“哥伦比亚才刚开始开发这个巨大的市场，我们只是触及了冰山一角。多亏了大家口口相传，我们会迎来中国游客，作为一个国家，一个部门，我们必须做好准备。”生物学家克里斯托弗·卡隆杰说。卡隆杰是哥伦比亚观鸟旅行社（Colombia Birdwatch）的创始人，目前正在卡利市附近的达瓜（Dagua）修建一个

面向观鸟爱好者的生态酒店。哥伦比亚观鸟旅行社去年共接待了7个中国旅游团，成员几乎都是摄影师。

然而，这些公司必须更好地了解中国生态游客的情况。他们大多已经退休，出行喜欢坐头等舱，住5星级酒店，有中国导游随行（很多人都会说英语），往往更喜欢在中餐厅用餐。哥伦比亚也有豪华的旅游基础设施，但大多位于城市，而不是瓜维亚雷这样可以观鸟的地方。

“需要改善的地方还有很多——道路状况不佳，酒店标准有待提升。这样有助于发展当地经济。”韩风说。3周的哥伦比亚游总共花费约7万人民币。

行程结束后，韩风一行人准备前往波哥大赶回航班的航班，但他们

被困住了。17个山体滑坡接踵而至，导致整个道路被关闭，整片区域完全与外界隔离，他们不得不修改了行程。幸运的是，他们的最后一站是观察颜色鲜艳的线尾侏儒鸟，并且可以从附近的约帕尔市买机票。

如果中国游客的数量继续增长，哥伦比亚就需要克服这些挑战。目前，许多中国游客会选择哥斯达黎加，这个国家的鸟类虽不足哥伦比亚的一半，但有着多年的生态旅游经验。哥斯达黎加国土面积更小，拥有完善的旅游基础设施。此外，外界才刚刚开始改变对哥伦比亚的看法。

“很多中国人对哥伦比亚的印象还停留在好莱坞大片中，认为这是个危险的地方。我们现在知道了，这

里非常安全。”凌子川说，他还兼职教授摄影。

他很高兴可以拍到许多种类的蜂鸟采集花蜜时悬停在空中的画面。“我们中国没有这些，但这里就能看见，到处都是。鸟儿都很亲人，说明人类对它们很友好。”他一边展示自己传到朋友圈里的照片，一边说。

那么这群游客是否认为会有更多中国游客来到这里？“会的，为了这种鸟。”刘怡回答说，她展示了一张动冠伞鸟的特写，鸟儿橙色的羽冠四周散发着一圈光晕。☺

安德烈斯·贝穆德斯·列瓦诺，中拉对话拉丁美洲安第斯区域（哥伦比亚、厄瓜多尔、秘鲁、玻利维亚和委内瑞拉）记者及编辑

Chinese ecotourists in hunt for Colombia's rare cock-of-the-rock

Forests in post-peace deal Colombia attract the intrepid, but its prized biodiversity is in danger

□ Andres Bermudez Lievano

“For ten minutes we have to stay here quietly. He will only come to us if we're very still and make no noise.”

Ornithologist César Arredondo's orders, given in a low voice, are translated into English and then into Chinese. A group of Chinese photographers sit waiting obediently in the middle of a humid forest behind tripods and cameras which, owing to their size, look more like telescopes.

Suddenly, an electric orange flash appears. A small bird with a half-moon-shaped crest, about the size of a raven, rests on a branch. A moment later it disappears. It is the Guianan cock-of-the rock (*rupicola rupicola*), an elusive species that only inhabits countries in South America's Amazon Basin.

Lenses rotate quickly, desperately trying to focus through dense foliage. Although there is dead silence, the photographers' nervousness is palpable. “Please stay where you are. It will come back. Stand very still,” Arredondo begs.

A few minutes later, the cock reappears on the scene and settles on a branch in front of them. A flurry of shutters is unleashed, like an army of typewriters tapping furiously in concert. For more than an hour this typically evasive bird jumps from tree to tree, showing how photogenic it is. It is “perching” in bird watchers' language.

Half the world for a bird

“We spent a lot of money and time to come here, including an 18-hour flight and many hours on the road. All this effort to get here, but it paid off the instant we saw the bird,” says Liu Yi, a 54-year-old amateur photographer from Jinan, in China's eastern Shandong province. She is dressed from head to toe in blue military camouflage. Even her camera's telephoto lens is covered with a brown leaf camouflage pattern.

For the past 23 days, she and five other Chinese enthusiasts travelled half of Colombia on a special bird watching tour. It began in the capital Bogotá and took them through seven Colombian departments in search of birds like the sword-billed hummingbird and the multi-coloured tanager. Their journey ended in this Guaviare forest, a lush region where the jungles of the Amazon meet the vast plains at the foothills of the Andes.

Although they encountered more than a hundred different birds along the way, their objective was always very clear: to find the two existing species of the cock-of-the-rock.

“It is like the bird was waiting for us,” says Ling Zi Chuan, a 43-year-old graphic designer from Xian in northwestern Shaanxi province, as he reviews the hundreds of images he took. This time they were lucky. Two weeks



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Zhuang Qiang, 55, waits for the cock-of-the-rock

ago they visited a farm near the Farallones National Park in Cali but failed to capture the Andean cock-of-the-rock (*rupicola peruvianus*). Though they spotted the other species from afar amid the drizzle, they were never in a position to take a picture. In Guaviare, in the tranquillity of its lek, or courtship site, a male strutted proudly around the tiny boxing ring it had cleaned. It serves as an arena to fight other birds and to attract the less colourful brown-plumaged females.

The cock was not the only sighting in Guaviare. In a lagoon, they saw a skunk bird, or hoatzin, feeding its two chicks by mouth. At the top of a nearby tree, they saw the silky plumage of the bare-necked fruitcrow. In a wetland area, they came across a group of horned screamers, with their raucous, far-carrying cry that resembles that of a donkey. One after the other, they saw the scarlet-crowned barbet, the slender-billed kite, the svelte sunbittern and the fast white-eared jacamar.

Unparalleled biodiversity, unprecedented opportunities

With 1,912 bird species, Colombia is a paradise for bird enthusiasts. Despite being the country with the most birds in the world and boasting a great diversity of landscapes and ecosystems, Colombia is only beginning to take its first steps towards profitable birdwatching tourism.

With the historic peace agreement signed by the Colombian government with the Marxist guerrilla group the Revolutionary Armed Forces of Colombia (FARC) in 2016, security conditions have improved notably in many regions of the country. This is providing a strong boon for tourism. Guaviare, one of the country's most biodiverse departments, and also one of the poorest, was for years one of the operating centres of the 13,000 guerrillas who, in July 2017, laid down their weapons. It was one of the regions hardest hit by decades of violence.

“When the farmer sees that people pay for the experience of seeing animals such as the cock-of-the-rock and that helping them to achieve their goal has a monetary value, he will think twice before cutting down the forest.”

— César Arredondo, ornithologist.

With an almost non-existent private sector and one of the highest rates of deforestation in Colombia, Guaviare is hoping to undergo a sea change that will allow it to develop job opportunities while preserving its natural wealth. Nature tourism, including bird watching, is becoming a powerful alternative. There are 550 different species here, a quarter of the total within Colombia.

“Not only is it becoming an economic sector that benefits many families – forest-owning farmers, drivers, guides – but it is also the best ally for conservation,” explains Arredondo, who returned to his native country after qualifying as an ornithologist to set up the first travel agency specialising in nature tourism, aptly named Biodiverso Travel.

This is crucial in a department that has one of the highest rates of deforestation in Colombia and where the Chiribiquete Mountains, South America’s largest national park, have just been declared a World Heritage Site. The area around regional capital and tourism hub San José del Guaviare is considered to be one of eight critical deforestation hotspots. It is under threat from the illegal timber trade, the expansion of the agricultural frontier and, above all, the illegal appropriation of land.

“Although there are birds even in rocky areas and deserts, there is a very clear relationship between birds – both in number and in diversity – and complex ecosystems such as these forests. Even more so when, as in Guaviare, they are connected to plains, hills, wetlands, flood-prone forests and rocky outcrops,” says Rodrigo Botero, director of the Foundation for Conservation and Sustainable Development (FCDS), which has been documenting the dizzying pace of environmental destruction. “This type of specialised tourism is a positive stimulus in maintaining healthy forests which are home to emblematic species such as the cock,” he adds.

Even though it is a small niche, the impact of “avitourism” is two-fold: It generates income for the communities and incentives to change the mentality – prevalent in many areas where agriculture is expanding – that the land is worth more without vegetation.

“When the farmer sees that people pay for the experience of seeing animals such as the cock-of-the-rock and that helping them to achieve their goal has a monetary value, he will think twice before cutting down the forest. This incentive, and the environmental education and local pride generated, are fundamental in a department with so much jungle, but so much deforestation as well,” says Arredondo, who in his spare time co-wrote Guaviare’s first bird guide.

The potential peace dividend from birds is also significant: an academic study by the Conservation Strategy Fund based on 2,000 surveys with US Audubon Society partners, estimated that up to 278,000 tourists may be interested in “birding” in Colombia following the Peace Accord. This could generate revenues of around US\$46 million and provide more than 7,000 jobs.

In any case, long-term success and sustainability depends on joint planning between the national government, local authorities and communities. This remains precarious in Colombia.

“There is great potential, but ecotourism – which represents only 5% of the total global tourism economy – is not a panacea, it won’t sustain communities alone,” warns Megan Epler Wood, a professor at Harvard University and one of those who has most studied sustainable tourism. “There must be careful deliberation about the future in the region, with detailed projections of the economic, social and environmental impacts of each development option. A final decision must be based on a balance of these options.”

Epler Wood, well-known for authoring *Sustainable Tourism on a Finite Planet*, visited Guaviare last year and went “birding” with Arredondo. She spoke to locals about the potential of wildlife watching.

Huge potential market

The majority of bird watchers, at least in Guaviare, are British and American. Though they have been coming in smaller numbers, Chinese nevertheless are leaving impressed.

“I believe the cock-of-the-rock is the most beautiful bird in the world. I’m sure that after we go back home from our trip and show people our photos, more Chinese people will come,” says Han Feng, a retiree from Xuzhou, in the province of Jiangsu, who saw the bird for the first time in a magazine and dreamt of seeing it in real life.

Based on official migration statistics, the number of Chinese tourists visiting Colombia is still modest at 16,879 last year. But it is growing rapidly, increasing four-fold

since the country’s peace talks began in 2012, and last year surpassed Costa Rica, a country with similar attractions.

As Chinese travel abroad in record numbers (145 million trips last year), and spend their money (US\$261 billion, according to the World Tourism Organization), they are increasingly looking for immersive experiences in nature through photography and animal watching. Among those who came to Guaviare, several have already looked for destinations similar to Colombia. Ling was in Costa Rica at the beginning of the year, and Liu travelled to Cuba last year. Both have been to Japan in search of species such as Blakiston’s fish owl or the red-crowned crane, which are prized among birdwatchers.

“It is a very large market that Colombia is only beginning to take advantage of, but we are just touching the tip of the iceberg. Thanks to word of mouth, we are going to get a wave of Chinese tourists and we have to be prepared as a country, and as a sector,” says biologist Christopher Calonje, who founded the agency Colombia



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Following the cock-of-the-rock, high in the treetops

Birdwatch, and is building an eco-hotel for birdwatchers in Dagua, near Cali. Colombia Birdwatch hosted a total of seven groups of Chinese tourists in the past year, almost all of them photographers.

However, these companies must better understand the profile of Chinese avitourists. They are usually retired, prefer to travel first class and stay in five-star hotels, are accompanied by a Chinese guide (since many do not speak English), and often prefer eating in Chinese restaurants. Although there is luxury tourism infrastructure in Colombia, it is usually in the cities and not where birds are, such as Guaviare.

“There is a lot of room for improvement – roads are in bad condition and hotel standards could be much higher. It can help develop the local economy,” says Han Feng. All in all, a three-week package to Colombia costs around 70,000 yuan (US\$10,200).

In fact, Han Feng’s group got stuck at the end of the trip whilst preparing to leave for Bogotá to catch their return flights. A series of 17 landslides led to the total closure of the road, leaving the region totally cut off from the rest of the world and forcing them to modify their itineraries. Fortunately, they were going to make one last stop to look at the colourful wire-tailed manakin, and could buy plane tickets from the nearby city of Yopal.

Colombia needs to overcome such challenges if the number of Chinese tourists visiting the country is to grow. For now, many Chinese tourists choose Costa Rica, which, despite having fewer than half its bird species, has years of experience in ecotourism. It is also smaller and has a well-developed tourism infrastructure. Furthermore, foreigners are only just beginning to change their perception of Colombia.

“Many people in China still have the Hollywood idea that Colombia is a dangerous place. We now know it’s perfectly safe,” says Ling Zi Chuan, who also teaches photography.

He has been delighted by capturing dozens of species of hummingbirds doing aerial pirouettes as they extract the nectar from a flower. “We don’t have any in China. You can see them here, everywhere. The birds all come very close to people. That means people are friendly to them,” he says, while showing one of the images signed using his nickname, Mr Ling, that he uploads to his WeChat account.

Does this group think more Chinese tourists will come? “Yes, for this bird,” replies Liu Yi, showing a close-up of it, its orange crest tipped by a halo of light. 🌀

This story originally appeared on Diálogo Chino.

Andres Bermudez Lievano is Diálogo Chino's regional editor for the Andean region (Colombia, Ecuador, Peru, Bolivia and Venezuela).

巴西环保主义者关注中美贸易战

为避开对美国产品征收的高额关税，中国买家正逐渐转向巴西市场。

□ 曼努埃拉·安德列奥尼

阿纳尔多·卡内罗一直主张要控制巴西的森林砍伐活动。多年来，他的这个信念从未动摇过。

卡内罗是非政府组织——全球林冠(Global Canopy)的负责人，他认为巴西大豆的进口商助长了巴西的环境破坏活动。他恳求进口商只从那些能够保证不会为了种植大豆而砍伐森林的农民处采购大豆。

该战略在欧洲取得了良好的效果。2015年，欧洲七国签署了《阿姆斯特丹宣言》，承诺支持私营部门采取的抵制供应链中森林砍伐活动的举措。

“欧洲市场在这方面有更强的意识。”卡内罗表示，“[他们]关注自己的行为对一线的影响。”

不过，如今卡内罗的愿望遭受了重挫，重新引发了人们对巴西森林现状的担忧：中美贸易战。

贸易摩擦的影响

今年3月，全球最大的两个经济体针锋相对，开始对一系列产品征收进口关税。中国对交易量大的美国大豆征收25%的反制关税。自此，中国对巴西大豆的需求骤增。

同时，贸易战也开启了大豆购买者和生产者之间的“抢凳子”大战。

为避开对美国产品征收的高额关税，中国买家正逐渐转向巴西市场。与此同时，由于失去了中国消费市场，美国大豆价格开始下跌，引得欧洲的经销商纷纷涌向美国。

一直以来，中国的大豆进口占美国大豆消费量的三分之一左右。随着购买力的增强，中国人更加注重饮食健康。由于大豆是中国猪饲料的主要成分之一，因此在食品生产中占有重要地位。

今年6月，欧洲进口的大豆中有37%来自于美国，与去年的9%相比呈爆发式增长。官方数据显示，与去年同期相比，今年1月至9月，巴西对华大豆出口增长了15%。如此高的需求量导致巴西的大豆储备几乎消耗殆尽。

所有这些因素都会显著改变国际市场致力于减少巴西森林砍伐活动的努力。

中国企业往往不太关注满足国内大豆需求所带来的环境后果。这一点让卡内罗颇为担忧。

“中国非常关注自身的粮食安全问题。”卡内罗解释说，他经常就森林砍伐相关的承诺与中国公司进行对话。“他们不太关心其他国家的环境问题。他们的底线是不要与任何违法活动沾边。”

毕竟，清除自然植被不一定违法。巴西森林与农业管理与认证研究所(IMAFLORA)表示，巴西有1.03亿公顷未受保护的自然植被，从法律角度上说在这些土地上是允许砍伐的。

过去，卡内罗的工作在于劝说欧洲人，即便巴西政府认为是合法的，也不要砍伐森林。但对中国则不同。

“增加种植面积应仅仅局限在已退化的土地上，这样就无需砍伐森林。但简单的经济学使得威胁仍旧存在，他们砍伐森林是因为这样做更划算。”

巴西植物油行业协会(ABIOVE)主席安德烈·纳萨尔解释称:“欧洲人希望我们的商品实现零森林砍伐率,而中国人则没有对我们提出更高的要求。”邦基集团和嘉吉公司等主要贸易商都是该协会成员。

尽管巴西大豆买家之间的标准不一,但一些组织正在努力缩小他们之间的差距。保尔森基金会环保项目负责人牛红卫承认欧洲和中国之间存在差异,但表示中方正在采取行动推动变革。

“在过去的三年里,一些组织(包括我们的研究所)一直在与中国的大豆贸易商合作,推动其在南美国家的贸易中采取更严格的环保要求。”牛红卫在一封电子邮件中写道,“希望在不久的将来,中国的贸易商在这方面能与欧洲商人一样出色。”

需求助推扩张

中美贸易战促使巴西生产者提高产量,以尽可能多地消化旺盛的需求。这就需要通过扩大种植面积来增加大豆的产量。因而这种压力会演化为森林砍伐的进一步恶化。

巴西即将取代美国成为世界上最大的大豆生产国。巴西的大豆种植面积约3300万公顷,相当于马来西亚的领土面积,是20年前种植面积的三倍。

该地区面临同样压力的国家不仅巴西一国。阿根廷和巴拉圭也是

大豆的主要生产国;2016年,三个国家的产量占全球大豆消费总量的一半左右。

佩德罗·恩里克斯·佩雷拉是巴西农业和畜牧业联合会(CNA)商业情报顾问,他注意到了市场对于扩大大豆产能的躁动情绪。但目前该联盟建议生产商们保持谨慎,投资需视中方的需求而定。

“市场的这一变化会带来很大的不确定性。虽然短期看需求会增长,但中长期来看,存在一定风险。一旦市场有变,大豆可能会砸在生产者的手里。”佩雷拉说道。

佩雷拉预计种植面积增幅不会太大,约为4%。但市场迹象表明会有很大的增长潜力。例如,巴西农业巨头之一SLC Agrícola宣布其下一季大豆种植面积将增长7%。

“我们主要担心的是,短时间内增加如此大的需求会导致森林砍伐和自然植被的变化。”世界自然基金会巴西粮食和农业计划协调员埃德加·德·奥利维拉·罗莎说。

种植区域的扩张在很大程度上并不会给亚马逊地区带来破坏。自2006年以来,大豆生产者和环境活动人士签订了一份名为《大豆禁令》的协议,禁止砍伐热带雨林来生产大豆。

受威胁最大的地区当属塞拉多。这是一个类似热带草原的生物群落,生物多样性丰富,对于平衡巴西的生态系统至关重要。绝大部分的大豆种植都集中在该地区。然而,自

20世纪70年代以来,由于农业生产和畜牧业的扩张,塞拉多地区已经失去了近一半的自然植被。

根据全球商品生产链监测平台Trase收集的数据,塞拉多地区大豆种植面积约350万公顷,而15年前这片土地还覆盖着原生植被。

塞拉多土地价格要比其他成熟的大豆产区(如巴西南部)便宜得多。这就是说令环保主义者担忧的不是种植大豆本身,而是大型农村业主的地产投机行为。土地所有者会利用市场的扩张进行砍伐,以备耕种,从而获得更高的价格。

卡内罗称,增加种植面积应仅仅局限在已退化的土地上,这样就无需砍伐森林。但简单的经济学使得威胁仍旧存在。“他们砍伐森林是因为这样做更划算。”他解释道。

ABIOVE主席纳萨尔对风险的预期较低。他说尽管森林砍伐问题仍然存在,但它远没有以前那么严重。ABIOVE的数据显示,因种植大豆引发的森林砍伐率从2002年至2007年的每公顷种植面积的27%下降到过去4年的7%。

“我们支持消除生产链中的森林砍伐行为。”纳萨尔解释道,“但我们也要认识到变化需要一个过程。”

曼努埃拉·安德列奥尼,中拉对话巴西板块编辑

US-China trade war raises fears of deforestation in Brazil

Chinese buyers turn to Latin America for soy following latest tariff hike

□ Manuela Andreoni



Soybeans exported from Brazil to China grew 15% from January to September this year based on the same period last year

For years, Arnaldo Carneiro stuck to his master plan to contain deforestation in Brazil.

Carneiro, who directs Global Canopy, an non-governmental organisation, demonstrated the complicity of importers of Brazilian soybeans in the degradation of the environment. He implored them to purchase only

from farmers who could guarantee they did not clear land for cultivation.

The strategy worked better in Europe. In 2015, seven European countries signed the Amsterdam Declaration committing to support private sector initiatives against deforestation in their production chains.

“Europe wants us to deliver zero deforestation in commodities. The Chinese will not ask us for more than we are delivering now.”

— André Nassar, Brazilian Association of Vegetable Oil Industries.

“Europe is a slightly more conscious market,” said Carneiro. “[They are] concerned with impacts on the front line.”

Now, however, Carneiro’s strategy has suffered a big setback that has renewed concerns for Brazilian forests: the US-China trade war.

Trade spat impacts

The world’s two largest economies began to impose tit-for-tat tariffs on a range of imports in March this year. China hit US soybeans – a heavily traded commodity – with a punitive 25% levy. Since then, Chinese demand for Brazilian soy has spiked.

The trade war has also kick-started a game of musical chairs between soybean purchasers and producers.

Chinese buyers have increasingly switched to Brazil to avoid the high tariffs imposed on US products. Meanwhile, European dealers have flocked to the US as prices slumped for their soybeans, which flooded the market after losing eager Chinese customers.

Historically, China has accounted for approximately one-third of US soybean consumption. Chinese people have increasingly stronger purchasing power and want to eat better. Soybeans play an important part in food production since they are fed to Chinese pigs.

In June this year, 37% of soy imported to Europe came from the US, an explosive increase compared to 9% last year. At the same time, the volume of soybeans exported from Brazil to China grew 15% from January to September this year compared to the same period last year, according to official figures. Demand was so high that Brazilian reserves have almost run out.

All this could significantly change how international markets push for less deforestation in Brazil.

Chinese companies tend to be less focused on the

environmental consequences of meeting their country’s soy demand. This worries Carneiro.

“China is very concerned with the food security of its population,” explains Carneiro, who regularly talks to Chinese companies about anti-deforestation commitments. “They are much less concerned with environmental problems in other countries. What they do not want is to be involved with any illegal activity.”

After all, clearing natural vegetation is not necessarily illegal. According to Brazil’s Institute of Forest and Agricultural Management and Certification (IMAFLORA), there are 103 million hectares of unprotected natural vegetation in Brazil – land that can be deforested legally.

Carneiro’s work used to involve convincing the Europeans not to deforest land even the Brazilian government considered it lawful to clear. But it is different with China.

“Europe wants us to deliver zero deforestation in commodities,” explains André Nassar, president of the Brazilian Association of Vegetable Oil Industries (ABIOVE), which includes major traders like Bunge and Cargill. “The Chinese will not ask us for more than we are delivering now.”

Though varying standards between buyers of Brazilian soy are a concern, some organisations are fighting to close the gap. Rose Niu, who leads the department of conservation at the Paulson Institute in Washington DC, acknowledges the difference between Europe and China, but says efforts are underway to drive change.

“In the past three years, several organisations (including our institute) have been working with soybean traders for China to adopt more stringent environmental requirements in trade with South American countries,” Niu wrote in an e-mail. “I hope that traders in China will do as good a job as the Europeans in the near future.”

Demand drives expansion

The trade war has encouraged Brazilian producers to increase production in order to absorb as much of the excess demand as possible. This pressure could result in further deforestation since soy yields are increased by expanding the planted area.

Brazil is about to replace the US as the largest producer of soybeans in the world. There are 33 million hectares of soybean plantations – an area equivalent to the size of Malaysia. This is almost triple the area under cultivation two decades ago.

Brazil is not the only country in the region facing pressure to produce. Argentina and Paraguay are also major producers of soybeans; in 2016, the three countries combined produced nearly half the soy consumed worldwide.

Pedro Henriques Pereira, a business intelligence adviser at the Brazilian Confederation of Agriculture and Livestock (CNA), has already detected some excitement in the market about expanding soy production. But for now, the confederation is advising a cautious approach for producers who want to invest with an eye to Chinese demand.

“This movement creates major uncertainty. It guarantees a short-term increase, but there is a risk in the medium and long term that something could happen and the producer could end up with a lot of soy on his hands,” says Pereira.

Pereira foresees a less significant increase in planted area, around 4%. But the market suggests the potential increase is greater. For example, SLC Agrícola, one of the giants of the Brazilian agricultural sector, announced a 7% expansion in its area planted with soybeans for the coming season.

“Our main concern is that creating such large demand in a short space of time can cause deforestation and conversion of natural vegetation,” says Edegar de Oliveira Rosa, coordinator of the Food and Agriculture Programme at WWF-Brazil.

For the most part, the Amazon is protected from this hunger for more planted areas. Since 2006, a pact called the Soy Moratorium between producers and environmental

activists has prevented the deforestation of tropical forests to produce soybeans.

The danger lies mostly in the Cerrado, a savanna-like biome with rich biodiversity that is essential for balancing Brazil’s ecosystem. Soy cultivation is overwhelmingly concentrated in this region. Yet since the 1970s, the Cerrado has lost nearly half of its natural vegetation to expansion of agriculture and pastures.

According to data collected by Trase, a global platform that monitors commodity production chains, an estimated 3.5 million hectares of soybeans have been planted in areas of Cerrado that were covered by native vegetation 15 years ago.

Land in the Cerrado is significantly cheaper than in other regions where the soy industry is more established, like southern Brazil. This means that it is not the planting of soybeans itself that concerns environmentalists, but also real estate speculation by large rural property owners. Landowners may try to capitalise on the expanding market to clear land and prepare it for farming, thereby obtaining higher prices.

According to Carneiro, activity should only increase on already degraded land, eliminating the need to deforest. But simple economics mean the danger remains. “They clear the forests because it is cheaper,” he explains.

ABIOVE’s Nassar plays down the risks. He says that even though deforestation is still a problem, it is much less serious than it used to be. Data from ABIOVE shows that deforestation caused by soybean farming decreased from 27% per planted hectare between 2002 and 2007 to 7% over the past four years.

“We support having no more deforestation in the chain,” explains Nassar. “But we have to see this as a process of transition.”

This article was originally published on Diálogo Chino.

Manuela Andreoni is Diálogo Chino’s Brazil editor

中国雾霾治理用错药了吗？

最新研究认为，中国治霾措施可能低估了甲醛扮演的角色。

□ 冯 灏 阚超群



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中国正在遭受空气污染之困

哈佛大学、清华大学和哈尔滨工业大学的一项最新研究称，如果北京希望能持续有效治理冬季严重雾霾，可能需要关注一种未被足够重视的污染物——甲醛，

并因此做出政策调整。

长期以来，导致雾霾的细颗粒物中的硫被认为源自硫酸盐，因此中国政府治理雾霾的措施之一是严控二氧化硫的排放。但该研究认为，

空气检测工具可能错误地把羟基甲烷磺酸盐（HMS）—— 甲醛和二氧化硫化硫化学反应的形成物 —— 与硫酸盐混淆。也就是说甲醛对雾霾的贡献被长久忽略了。

治污找错对象？

这一研究结果上月发表在《地球物理研究通讯》(Geophysical Research Letters)上。

“错误定位污染物的发现很重要，HMS 的生成需要甲醛和二氧化硫二者以特定水平存在于空气中。”研究的第一作者，哈佛大学工程与应用科学学院研究员乔纳森·M·莫赫(Jonathan M. Moch)在给中外对话的邮件中写到，“在这个化学反应中，甲醛才是制约因素，因此单纯限制二氧化硫的水平不会太大影响大气中的 HMS。”

这也部分解释了为什么中国过去多年来努力控制二氧化硫的排放，但是冬季雾霾依旧严重。直到去年冬天，当北京下大力气关闭了周边的大部分工厂并严格限制了冬季燃煤取暖，导致二氧化硫的浓度处于甲醛浓度之下以后，治理措施才显出效果。

“可是这种控制措施导致了部分地区供暖的不足，”莫赫研究员说，“因此在其他城市推广北京的高规格治理措施是困难的。”

媒体曾广泛报道去年北京冬季蓝天背后的高昂代价。政府大规模

进行煤改气，煤改电工程，却未能在计划时间内完工，导致去年多个地区的供暖出现问题。北京天津等地颁布“最严停工令”，长达数月的时间内，各类道路工程、土石方作业、房屋拆迁施工一律暂停。

空气污染是包括中国在内的低收入和中等收入国家面临的重要挑战。10月30日世界卫生组织在日内瓦举行全球空气污染与健康大会，聚焦空气污染与健康问题。大会前夕发布的新报告指出，全球约有93%的18岁以下儿童(18亿)因呼吸污染的空气造成健康问题甚至过早死亡。该报告估计，2016年有60万名儿童死于空气污染引起的急性下呼吸道感染。南京大学的研究表明，2013年中国74个主要城市的死亡约三分之一和PM2.5污染相关。

中国治理PM2.5的主要手段是控制二氧化硫(SO₂)、氮氧化物(NO_x)和挥发性有机物(VOCs)的排放量。这些物质被认为是经过化学转化形成PM2.5的主要物质。

这些措施取得了一定成效。“十二五”(2011-2015)期间，中国二氧化硫和氮氧化物的排放总量分别减少18%和18.6%。根据“十三五”规划，到2020年，二氧化硫，氮氧

化物的排放量比2015年还需下降15%。尽管在治理上做出了大量努力，中国北方的空气污染形势依旧严峻。绿色和平上月末发布的一份报告显示，新的卫星监测数据表明，在全球50个最大的二氧化氮排放地区中，有10个在中国境内。随着中国北方采暖季的来临，观察者开始担忧大规模雾霾是否将卷土重来。

新的方向

哈佛大学此项研究或将给北京带来治理雾霾新的可能性。甲醛来源于交通、化工和炼油厂。在北京和周围城市有大量产生甲醛的来源可以着手处理。

“这项科研结果表明中国需要调整政策来减轻空气污染问题，”莫赫说，“政策制定者需要更加努力减少甲醛的排放。在中国东部，这意味着更加关注汽车尾气和炼油化工厂的污染。”

冯灏，中外对话研究员

阚超群，中外对话北京编辑

Is China targeting the wrong chemical in effort to cut winter smog?

Formaldehyde's role in the formation of air pollution has been overlooked for years

□ Feng Hao Karoline Kan

If Beijing wants to tackle severe winter smog then it may have to adjust policies to account for formaldehyde, according to recent research.

Chinese policymakers have typically thought that smog-causing particulate matter came from sulphates, prompting the government to target sulphur dioxide emissions in its ongoing crack-down on air pollution.

But the new research, carried out jointly by scholars from Harvard, Tsinghua and Harbin Institute of Technology, finds air monitoring tools have confused sulphate with hydroxymethane sulphonate (HMS) – a chemical which is formed when formaldehyde and sulphur dioxide react. In other words, for years the role of formaldehyde in smog formation has been overlooked.

Tackling the wrong pollutant

“This misidentification is important because the chemistry that creates HMS is dependent on levels of both formaldehyde and sulphur dioxide in the air,” says Jonathon M Moch, an author of the report, which was published in the journal *Geophysical Research Letters* in October.

“In the Beijing area, the limiting factor [when tackling air pollution] has usually not been sulphur dioxide but rather

formaldehyde. In such situations, reducing sulphur dioxide emissions alone would not affect the levels of HMS in the atmosphere,” adds Moch.

This also partially explains why China still suffers severe smog in winter despite years of passing regulation to tighten control of sulphur dioxide emissions. Last winter, Beijing closed nearby factories and placed strict controls on the use of coal for winter heating. In 2016, authorities issued the city’s first “red alert”, when PM2.5 readings were so high they were off the scale. But closing down factories only became effective once sulphur dioxide levels fell below those of formaldehyde.

“These controls also led to heating shortages in some areas,” Moch says, “and may therefore be difficult to maintain or replicate for other urban areas”.

The high price of Beijing’s blue skies in winter last year was widely reported. Government projects to replace coal-burning for heat with natural gas or electricity ran into delays, leaving many people with heating shortages. Beijing and Tianjin were just two areas where wide-ranging directives were issued to stop certain types of heavy industrial work for months, such as road building, construction and demolition.

Air pollution is a major challenge for low and middle-

"This misidentification is important because the chemistry that creates HMS is dependent on levels of both formaldehyde and sulphur dioxide in the air."

—Jonathon M Moch, co-author of the report.

income nations, including China. On October 30 the first WHO Global Conference on Air Pollution and Health was held in Geneva, just after a new report said 93% of the world's under-18 population (1.8 billion children) are exposed to air pollution that can cause health problems or early death. The report estimated that air pollution contributed to respiratory tract infections that resulted in the deaths of 600,000 children under 15. Research from Nanjing University showed that in 2013, one third of deaths in 74 of China's major cities were linked to PM2.5 pollution.

China tackles smog primarily by controlling the release of sulphur dioxide, nitrogen oxides and volatile organic compounds. These are seen as the main substances involved in the chemical reactions which create PM2.5 pollution.


This has been somewhat successful. During the 12th Five-Year Plan (2011-2015) emissions of sulphur dioxide and nitrogen oxides dropped by 18% and 18.6%, respectively. Under the latest 13th Five-Year Plan, emissions of these two pollutants are expected to drop a further 15% on 2015 levels by 2020. But despite the huge efforts made, air pollution in northern China remains severe.

A report from Greenpeace showed that new satellite

monitoring data located ten of the world's 50 largest sources of nitrogen dioxide in China. And as the winter heating season approaches, observers are worried northern China will suffer smog again.

A new direction

The Harvard report may offer a new option. Formaldehyde emissions come predominantly from transportation, the chemical industry and oil refining. There are many such sources in Beijing and the surrounding area which could be dealt with.

"The new work from Harvard suggests that in order to reduce extreme haze in Beijing, policymakers should focus their efforts on reducing emissions of formaldehyde," said Moch. "In eastern China, this would mean focusing on cars and trucks as well as oil and chemical refineries, the major sources of formaldehyde." 

Feng Hao is a researcher at chinadialogue.

Karoline Kan is the Beijing Editor at chinadialogue.

CCUS 技术 会在中国迎来春天吗？

应对气候变化的紧迫性增加了碳捕集、利用与封存技术受到的关注度，这项具有争议的技术的应用会在中国加速吗？

□ 冯 灏

10月8日，政府间气候变化委员会（IPCC）在韩国仁川发布了《全球升温 1.5°C 特别报告》，以及报告的“决策者摘要”。根据该报告，将全球变暖限制在 1.5°C 需要社会各方进行快速、深远和前所未有的变革。

报告中，二氧化碳去除（Carbon Dioxide Removal）作为重要的技术路径被重点强调。报告认为，所有限制全球变暖在 1.5°C 以内的路径都需要去除 1000 亿–10000 亿吨数量级的二氧化碳。如此庞大的碳去除无法通过单一技术手段实现。报告评估了一系列可供选择的“负排放”技术，包括造林和再造林、土地恢复和土壤固碳、直接空气碳捕获和储存和二氧化碳捕集与储存技术（CCS）。

中外对话访问的中国专家认为，与报告列举的其他技术相比，CCS 技术相对最成熟，并将是未来全球实现大规模减排的关键技术。与此同时，该技术的高成本、长期安全性和可靠性等问题也不容忽视。



中国正积极发展碳捕集、利用与封存技术

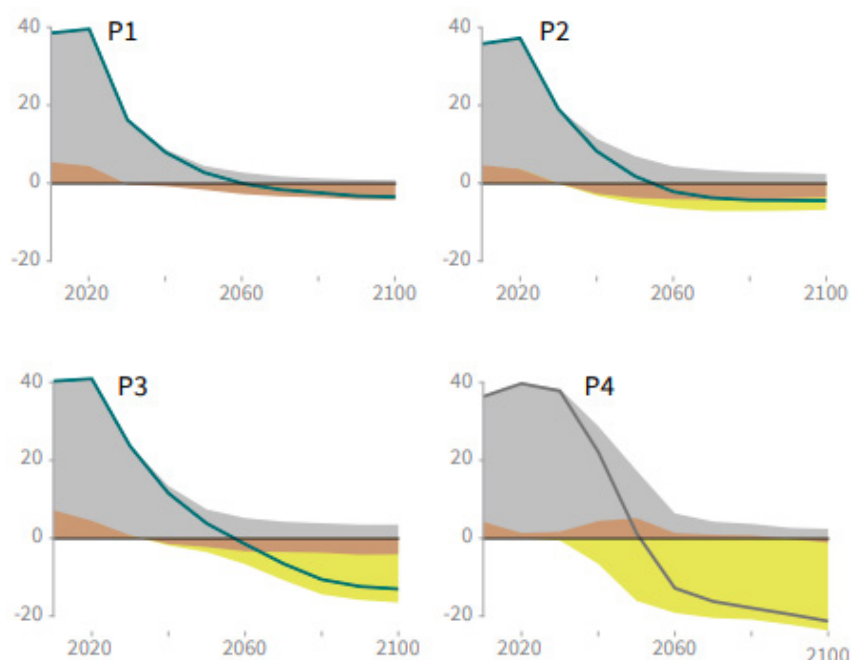
难以忽略的技术

据 IPCC 报告估计，目前人类活动已经造成的全球升温约 1.0°C。

绿色创新发展中心（iGDP）执行理事胡敏认为，报告可能是应对气候变化的一个新拐点。“我们一般认为国际气候行动的基础和目标是避免巨

灾风险（Catastrophic Risk）。IPCC 报告警示我们这一风险的现实性，应尽快达到净零排放。”

根据该报告，不依赖二氧化碳去除技术而达到全球温升控制在 1.5°C 以内的目标，意味着全球碳排放要在 2030 年之前就开始减少。以目前全球各国的碳排放强度来说，



报告给出了将升温控制在1.5°C以内的四种说明性方案，灰色为化石燃料和工业领域，棕色表示农林及其他土地利用，黄色为生物质能源+二氧化碳捕获和储存，示意不同手段在不同时段的贡献比例。后三种路径均使用到二氧化碳捕获和储存技术，并且，其贡献比例随时间推进有所增加。单位：十亿吨/年（图片来源：IPCC SR1.5 SPM-19）。

这几乎是一条不可能达到的曲线。这意味着，要通过巨量的二氧化碳去除来平衡掉各国的排放量。

中国社科院城市发展与环境研究所可持续发展经济学研究室研究员陈迎告诉中外对话，考虑到全球碳预算严重不足，IPCC报告格外强调二氧化碳去除技术，也是不得已的选择。要在全球范围实现大规模的负排放，技术、经济、国际治理等方面的挑战都是巨大的。

此次IPCC报告中评估的CDR技术（如造林、土壤固碳等）多是从大气中吸收二氧化碳的技术，唯独CCS技术与工业生产过程中的排放息息相关。工业排放中的二氧化碳浓度高、捕获相对容易。从根本上讲，CCS是一项减排技术。中国在CCS原有三个环节的基础上，增加

了二氧化碳利用（Utilization）环节，即CCUS技术，希望通过资源化利用以产生经济效益。

陈迎表示，对于中国等高度依赖化石能源的国家而言，在能源结构调整、节能等潜力挖掘之外，必须高度重视CCUS技术。目前该技术的示范多在采油、发电等能源部门，未来要与大规模的生物质利用结合，甚至要开发直接从空气捕获二氧化碳的新技术，以实现负排放，因此发展前景十分广阔。

中国押注CCUS？

IPCC报告公布前一个月，中国生态环境部和南非环境部刚刚签署了《关于气候变化领域合作的谅解备忘录》。根据《备忘录》，为共同加

强气候变化领域能力建设，双方将在CCUS等优先领域开展合作。

此前的2017年，作为中美联合气候变化声明成果的一部分，中国在陕西榆林建成了第一个大型碳捕集封存示范项目，通过从煤化工工厂捕集二氧化碳，提纯后注入油田进行驱油（CCS-EOR）和封存，该项目计划每年捕获41万吨二氧化碳。国家发改委能源研究所高级研究员姜克隽告诉中外对话，中国和南非的合作也可能采取类似示范项目的形式。

中国发改委明确提到开展CCUS试点项目的行业涉及火电、煤化工、水泥和钢铁行业。另外，中国大型国有石油企业对于该技术的兴趣也是与日俱增，两大石油巨头中国石油天然气集团公司和中国石油化工集团公司都有专门的研究院从事相关的科研工作。

经济效益几何

南非环境部长莫莱瓦早前在北京表示，“碳捕捉技术仍然非常昂贵，我们需要对这项前沿技术更多的研发”。此次IPCC报告的中国作者之一姜克隽也认为，该技术在提高捕获效率、真正降低成本方面空间还很大。

中国社会科学院能源数量经济与技术经济研究所能源研究室主任刘强认为，从经济角度出发，根本就不会产生CCS的市场，之所以有所谓的市场、形成了所谓的价格，是因为各国应有应对气候变化的压力和需求。

CCUS项目关注的重点就是对二氧化碳进行商业应用以抵消全流

程高昂的成本。目前在中国 CCUS 项目中应用最普遍的是二氧化碳强化驱油 (EOR) 和二氧化碳强化驱煤层气 (ECBM), 将用于封存的二氧化碳液体, 注入到已近开采枯竭的油气田或煤层气中, 驱赶岩缝中的原油或天然气, 以提高油田和煤层气的开采率和利用量。

根据亚洲开发银行的分析, 对于正在或者即将面临减产局面的中国国内大多数油田而言, EOR 是维持油田经济生存力的重要选择。

当然, 其经济可行性主要取决于二氧化碳购入成本与原油增产收益之间的平衡。根据该分析, 这类示范项目的前提是要具有高浓度二氧化碳排放源的大规模煤化工工艺, 二氧化碳排放量每年不少于 10 万吨, 最好接近或超过 100 万吨; 此外, 在项目整个生命期内, EOR 所增产的原油都可以提供持续的现金流, 保障进一步的二氧化碳收购价格。

环境隐忧

CCUS 技术真正的环境效益存在争议。

山东大学化学与化工学院教授朱维群曾表示, 该技术会增加 25—40% 的额外能耗, 而 EOR 所用二氧化碳大约会有 2/3 回到地表, 不宜作为长期性的封存方法。也有专家指

出, 由于这一过程中收获的化石燃料最终还是用于燃烧, 因而这种二氧化碳捕集方式不能作为气候变化的解决方案。

二氧化碳封存的长期安全性一直是此类项目的重要风险。亚行分析认为, 由于项目在环境安全方面的风险, 严格的风险响应机制和环境保护计划必不可少, 同时还必须为上述项目配备特定的监测和审核设备。如果大规模推广, 就更需要出台具体的标准来规范封存地选址、封存地分级、环境影响评价和长期可靠性评估。

另外, 碳捕集技术会增加工业冷却水的需求。而水资源短缺被认为是中国未来 10~15 年面临的最大挑战, 尤其是在煤炭项目集中的中国西北和西部地区

发展提速?

姜克隽认为, 减缓温室效应将是一件越来越急迫的事情, CCUS 技术也会被赋予越来越多的市场价值。英国地质调查局也指出, 该技术在全球范围内的经济可行性在很大程度上取决于政府和民众对于环境和生态系统的估值。

但目前, 国际层面和中国国家层面的政策 (包括碳价格信号) 仍然有待明确。

理论上, 将二氧化碳作为工业原料、用来强化驱油, 或出售碳排放权都可以为项目带来额外收益, 克服整体投资和成本的增加。

但迄今为止, 中国的碳市场还处于萌芽阶段, 也未形成足以影响排放行为的碳价。这意味着任何二氧化碳供应方与使用方之间的商务合作都需要单独谈判。姜克隽认为, 对于早期示范项目, 政府需要提供必要的财政和融资支持, 来克服商业可行性不足的问题。

不过, 受访的中国专家均认同, CCUS 或许是全球减排不得已的选项, 但不应被视为能源转型的替代, “哪怕是对于中国和南非这样以煤炭为主的国家而言, 效果最好、成本最低、空间最大的还应该是各环节的节能。” 刘强指出。

胡敏认为, 全球的减排潜力还可以从非二氧化碳温室气体来挖掘, 包括 HFC 和甲烷等。加速制冷剂替代, 减少食品浪费, 甚至调整饮食习惯等也需要得到重视, “不深刻改变生活方式而达到碳中性的未来, 基本不可能。”

冯灏, 中外对话研究员

Costs, risks and benefits: can carbon sequestration take off?

After the IPCC's urgent warning on climate change, will China speed up development of controversial carbon capture technologies?

□ Feng Hao

The UN Intergovernmental Panel on Climate Change (IPCC) issued its starkest warning yet on the urgency of tackling global warming in its “Special Report on Global Warming of 1.5C,” saying that only 12 years remain to keep warming within that limit.

“Warming greater than the global annual average is being experienced in many land regions and seasons,” the report said. Average global temperatures are already 1C above pre-industrial levels, with impacts that “will persist for centuries to millennia.”

The IPCC forecast, with “high confidence”, that 1.5C would be reached between 2030 and 2052.

However, it could get much worse. Rapid, far-reaching and unprecedented changes to all aspects of society are needed if global warming is to be limited to 1.5C, according to the report's summary for policymakers.

“We usually think the aim of international action on climate change is to avoid catastrophic risk. The IPCC's report warns of how real that risk is, and that we should get

to zero net emissions as soon as possible,” says Hu Min, executive director of the Innovative Green Development Program (iGDP), an NGO.

Halting higher emissions

Global emissions must start to decline before 2030 to keep warming within 1.5C without reliance on carbon dioxide removal. However, current carbon intensity data indicates this is almost impossible, so large-scale removal of carbon dioxide will be needed to balance out emissions.

The report says it will be necessary to remove 100 to 1,000 gigatonnes of carbon dioxide from the atmosphere during the 21st century to keep warming within the 1.5C target. No single approach to carbon dioxide removal (CDR) can do this. The options include afforestation and reforestation, land restoration, soil carbon sequestration and carbon capture and storage (CCS).

The IPCC's report emphasised CDR as there is no

“Warming greater than the global annual average is being experienced in many land regions and seasons,” the report said. Average global temperatures are already 1C above preindustrial levels, with impacts that “will persist for centuries to millennia.”

—IPCC Special Report on Global Warming of 1.5 C.

other choice, according to Chen Ying, a researcher at the Sustainable Development Economics Laboratory, part of the Chinese Academy of Social Sciences (CASS) Institute for Urban and Environmental Studies, speaking to *chinadialogue*.

The report provides four illustrative pathways to the 1.5C target, indicating the different contributions from sources of carbon emissions or carbon capture over time.

Nature versus technology

CDR (such as afforestation and soil carbon sequestration) mainly involves ways of absorbing carbon from the atmosphere. But carbon capture and storage technologies (CCS) work differently. They capture carbon from industrial emissions, especially where there are higher concentrations of carbon dioxide to make the complex process easier.

CCS is essentially an emissions reduction technology. In China, CCS developers have added an extra step – utilisation – to this emerging technology, known by the

acronym CCUS. The aim is to turn carbon into a resource that enhances profitability.

CCUS trials are mostly in the energy sector, for instance, in oil extraction and power generation. The hope is that in future CCUS could be combined with bioenergy, or that technologies capable of removing carbon dioxide directly from the atmosphere can be developed.

Will China bet on CCUS?

CCUS remains a trial technology. China built its first large-scale demonstration plant in 2017 in Yulin, Shaanxi province, in the country's northwest, as one of the outcomes of the China-US Joint Statement on Climate Change.

The project will capture 410,000 tonnes of carbon a year. It combines CCS with enhanced oil recovery (EOR), a system in which carbon dioxide is captured from a coal-fired power plant and injected into oil fields to boost levels of oil recovery. The gas is stored underground and thereby removed from the atmosphere.

Table of large-scale CCS projects in China

Facility name	Province	CO2 capture capacity (Mtpa)	Operation date	Primary storage type
CNPC Jilin Oil Field CO2 EOR	Jilin Province	0.6	2018	Enhanced oil recovery
Sinopec Qilu Petrochemical CCS	Shandong Province	0.4	2019	Enhanced oil recovery
Yanchang Integrated Carbon Capture and Storage Demonstration	Shaanxi Province	0.41	2020	Enhanced oil recovery
Sinopec Eastern China CCS	Jiangsu Province	0.5	2020-2021	Enhanced oil recovery
China Resources Power (Haifeng) Integrated Carbon Capture and Sequestration Demonstration	Guangdong Province	1.0	2020's	Dedicated geological storage - offshore deep saline formations
Huaneng GreenGen IGCC Project (Phase 3)	Tianjin	2.0	2020's	Enhanced oil recovery, dedicated geological storage options under review
Shanxi International Energy Group CCUS	Shanxi Province	2.0	2020's	Under evaluation
Shenhua Ningxia CTL	Ningxia Hui Autonomous Region	2.0	2020's	Under evaluation
Sinopec Shengli Power Plant CCS	Shandong Province	1.0	2020's	Enhanced oil recovery

Data from the Global CCS Institute

The National Development and Reform Commission (NDRC) has identified the thermal power generation, coal-chemical, concrete and steel sectors as suitable for CCUS trials. And China's state-owned oil giants are getting more interested – CNPC and Sinopec both have dedicated research bodies looking at the possibilities.

In September, China's Ministry of Ecological and Environmental Protection and its South African counterpart signed a memorandum of understanding on cooperation in the climate change sector, under which the two countries will partner on the construction of climate-friendly energy projects, with priority given to CCUS.

Jiang Kejuan, a senior researcher with the NDRC's Energy Research Institute and contributor to the IPCC report, said that the China-South Africa partnership might build demonstration projects similar to the one at Yulin.

During her visit to Beijing, South Africa's then Minister of Environmental Affairs, Edna Molewa, said that "carbon capture is hugely expensive and we need more research and development into this cutting-edge technology".

Jiang says there is huge potential to increase efficiency and reduce costs.

Liu Qiang, head of the energy research office at the CASS Institute of Quantitative and Technical Economics, says that in economic terms there is no market for CCS, and that any market created or price paid will arise from policy efforts to tackle climate change.

CCUS projects focus on finding commercial uses for carbon dioxide to offset the huge costs of carbon capture.

The most common approaches used in China's CCUS projects are enhanced oil recovery (EOR), and enhanced coal bed methane recovery (ECBM). The gas is liquified and injected into oil or methane reservoirs exhausted by conventional extraction. The carbon dioxide drives residual

oil or methane to the surface, increasing extraction rates, then remains sequestered underground.

According to the Asia Development Bank, EOR could be a good option for many Chinese oil fields, which are already seeing or will soon see falling output.

However, the economic feasibility of EOR depends upon the cost of the carbon dioxide and the selling price of the recovered oil. The ADB's analysis found that demonstration projects would need to have a large-scale coal-chemical plant nearby producing high concentrations of carbon dioxide – at least 100,000 tonnes a year, and ideally 1,000,000 tonnes. It suggests the extra oil produced by EOR can provide cashflow for ongoing purchase of carbon dioxide.

Costs, and few benefits?

Analysts disagree over whether CCUS has any environmental benefits. Some have pointed out that as the extra fossil fuels obtained will ultimately be burned, CCUS cannot be seen as a solution to climate change.

Zhu Weiqun, a professor at Shandong University's School of Chemistry and Chemical Engineering, has said that CCUS will increase energy consumption by 25-40% and about two thirds of the carbon dioxide used in EOR will return to the surface, making it unsuitable for long-term sequestration.

Long-term security of sequestered carbon has always been a risk. According to the ADB, rigorous environmental impact assessments (EIAs) and environmental protection plans are essential, along with monitoring and verification equipment. If CCUS is to be implemented more widely, standards will need to be developed for site selection, site grading, environmental impact assessments and long-term stability (China is earthquake prone).

"Carbon capture is hugely expensive and we need more research and development into this cutting-edge technology."

— Edna Molewa, former Minister of Environmental Affairs in South Africa.

CCUS projects also require water for industrial cooling, but water shortages are already set to be one of China's biggest challenges over the next 10-15 years – particularly in the west and north-west, where the coal industry is concentrated.

Speeding up?

Jiang thinks urgency over mitigating the greenhouse effect will mean CCUS technologies will be given more market value (depending on policy measures and carbon pricing). The British Geological Survey has pointed out that the viability of CCS globally is dependent on the value and price placed by people and governments on the environment and ecosystems.

In theory, profits could be made from captured carbon dioxide by using it for EOR, or by selling emission rights, thus cancelling out the initial investment and running costs.

But China's carbon markets remain in their infancy and carbon prices are too low to effect emissions behaviour, so cooperation between carbon suppliers and carbon consumers will require individual negotiations.

Jiang thinks the government will need to supply funding and support to early demonstration projects to ensure eventual commercial viability.

Clean energy

However, all the Chinese experts we spoke to agree that an energy transition is more effective than CCUS in terms of tackling global warming, even if the technology is an essential choice in the near term. "Even in coal-powered countries, like China and South Africa, the most effective, cheapest and impactful option remains widespread energy saving," says Liu.

According to Hu, there is also still potential to reduce warming from other greenhouse gases, such as hydrofluorocarbons and methane through giving serious attention by replacing refrigerants, cutting food consumption and even changing eating habits.

"It's not possible to achieve a carbon neutral future without major changes to our lifestyles," she says. ☞

Feng Hao is a researcher at chinadialogue.

中国外卖巨头向塑料垃圾宣战

面对公众压力，中国最大的网上订餐平台美团外卖和饿了么，正在努力寻找减少垃圾产生的方案。

□ 王晨



© thomas yuan

每天百万份的外卖被送到客人手里的同时，产生数百万的塑料包装垃圾

拿出手机，点击一个外卖平台APP，在手机上选好餐厅和餐食，过不了几分钟，骑着电动自行车的送餐员就会把还热烘烘的饭菜送到你手中。

外卖平台兴起不过短短几年，这个场景就成了中国很多城市消费者的日常现实。但外卖“骑手”们送来的不只是可口的饭菜。包装一份外卖所需要的塑料袋、塑料餐盒

和餐具正成为一个棘手的环境问题。

2018年上半年，中国三大外卖平台美团外卖、饿了么和百度外卖每天送出约3390万个外卖。这意味着每天至少同等数量的餐盒餐具被

丢弃。而根据饿了么于2017年发布的《中国外卖消费大数据洞察》，中国O2O外卖市场规模预计将从2016年的1000多亿元（约146亿美元）爆发性增长到2020年的7000亿元（约1021亿美元）。外卖垃圾可能随着行业规模扩大而迅速恶化。

作为外卖产业链条中的关键环节，中国外卖平台正在公众压力下寻求外卖垃圾问题的解决之道。

外卖垃圾困局

一单典型的外卖包括两到三个塑料餐盒、一到两层塑料餐袋、一次性筷子、塑料汤匙、塑料汤杯等，有时还包括软饮的纸盒或塑料瓶。清华大学循环经济产业研究中心主任温宗国介绍说，目前外卖交易中的餐盒包括PP餐盒、PS餐盒、纸质餐盒、铝箔餐盒等。其中使用最为广泛的PP餐盒、PS餐盒等塑料制品在北京市的外卖包装中占比近七成，而它们在自然条件下均不可降解。

2017年9月，外卖垃圾被推上了舆论的风口浪尖。民间环保组织重庆市绿色志愿者联合会起诉外卖订餐平台百度外卖、饿了么、美团外卖，认为被告方默认配送一次性餐具造成巨大的资源浪费和生态破坏，要求平台允许消费者选择“是否需要一次性餐袋、餐具”，并对一次性餐盒餐具收费。据重庆市绿联会透露，截止发稿前，本案尚未开庭审理。

压力之下的外卖平台

尽管法律程序尚未启动，但舆论压力之下，美团外卖和饿了么先

后发布“青山计划”与“蓝色星球计划”，承诺努力减少垃圾产生。

作为对公众压力的直接回应，2017年9月后，美团外卖和饿了么都开始提供“不需要一次性餐具”的选项，饿了么还为选择这一选项的用户提供了积分奖励，用户可使用积分兑换环保购物袋、认领荒漠造林等。但包括羊城晚报、三秦都市报等媒体发现，即使勾选了“不需要一次性餐具”，很多商家仍会在外卖中提供。餐厅出于节省时间和用户满意度的考虑，往往选择给所有外卖配套餐具。

外卖平台的运营模式与Uber、Airbnb等网上平台类似，是直接连通商家和消费者的网络中间环节。消费者通过网络平台挑选商家与餐食，但平台本身并不拥有或经营这些餐厅，这为其控制餐厅的物料使用（如包装）带来了一定的挑战。

为了解决商户无视用户“无需餐具”选项的问题，饿了么与近20000家平台签署了“无需餐具承诺书”，要求商家尊重并落实用户的环保选择，并通过支付宝接口鼓励用户选择“无需餐具。”

8月31日，美团外卖举办发布会，介绍其垃圾减量计划。与上游和下游商家的合作成为计划的重点。在发布会上，美团宣布与上游的100多家包装提供商合作，通过技术和

设计改善外卖包装。而下游的100多家“循环经济合作伙伴”则会为一次性外卖餐盒找到循环再生的出路。同时美团外卖将联合平台上超过10万多家商家使用更为环保优质的包装。

环保餐具？

“塑料餐盒轻便、防水、便宜，很多替代材料仅是密封性这一条就无法满足顾客的需求。”温宗国表示，现有的替代材料几乎都达不到塑料的优越性能，而“牺牲消费体验，消费者不买账，商家也不乐于使用其他的替代材料餐盒。”

今年6月，美团外卖、饿了么、百度外卖联合上海市食品接触材料协会共同在上海的三个区试点外卖餐盒的行业推荐标准，提倡使用淋膜纸碗代替塑料餐盒。淋膜纸碗是在纸质餐盒上覆盖一层塑料类的薄膜，在保证防水、防油等要求时可减少75%以上的塑料使用。该标准没有法律约束力，但设计了激励机制。如果平台上的餐饮提供商被发现不遵守标准，将被扣除积分。积分过低的餐厅最高面临关店整顿的惩罚。

然而标准执行不尽如人意。劳动报报道称，试点区域使用纸碗配送的商家不足五成。成本是商家不得不考虑的问题。据北京日报报道，

“
外卖垃圾问题仅靠外卖平台也难以彻底解决。
消费主义盛行之下，消费者不愿牺牲消费体验，对外卖包装要求较高，而商家为了迎合需求只能将环保因素作为次要考虑。
”

环保纸质餐盒比塑料餐盒贵 0.2 元（约 0.03 美元）左右，是塑料餐盒成本的 3 倍左右。

针对这些问题，美团外卖和饿了么均表示将免费投放纸碗和送餐袋供商户试用。而行业推荐标准的未来修订也将考虑新的包装产品和技术。

中外对话也了解到，饿了么正在和国内取得了环保局微生物应用许可的供应商合作，推进可降解餐盒在部分外卖中的试点。目前材料测试已通过，试点已排上日程。

一家专门提供垃圾回收解决方案的社会企业 R 立方创始人张淼认为，即便是以可降解塑料作为替代，通常也需要较为严苛的工业堆肥条件才能促使材料实现降解。而以中国目前的垃圾混合收集和处理方式（焚烧或填埋），可降解塑料难以体现出环保优势。

针对这个问题，饿了么为可降解餐盒配套了后端堆肥项目，并将在饿了么公司内部落地。

循环再生

对于已经产生的外卖垃圾，收集和循环利用也不容易。

外卖垃圾高度的分散性产生了收集上的困难，而中餐本身多油多汤，餐盒的清洁处理也是难点。据张淼介绍，现在市面上很少有人愿意回收外卖餐盒，一方面因为餐盒的油污难以清洗；另一方面，废塑料回收一般按照重量计算价值，外卖餐盒重量过轻而体积不小，因此并不受到回收业者青睐。

美团外卖在本次发布会上展示了一辆摩拜单车，装配有添加了外卖餐盒回收材料的挡泥板，作为塑料餐盒的可能循环利用方式之一。摩拜单车是美团的首批“循环经济合作伙伴”之一。

饿了么则选择与联合办公巨头 WeWork 合作，在其中国区旗舰店内回收外卖颗粒，并将其清理和再处理为回收塑料颗粒，用以制作小花盆等产品。通过这一试点获得的数据将被用于后续项目的开展。

但这些合作伙伴是否有能力消化每天数以千万计的塑料垃圾，还要打上问号。

外卖垃圾何解？

联合国环境署关于一次性塑料问题的研究报告显示，一次性塑料

禁令或强制收费制度是全面的垃圾减量政策的先行步骤。而要实现问题的实质改善，还需要公众意识的提升作为助推剂。

目前看来，外卖行业产生的塑料垃圾暂时还未进入政府政策视野。“外卖垃圾产生的废旧塑料其实在生活垃圾中占比还很低”，温宗国介绍，生活垃圾中的废旧塑料里仅有 4% 来自外卖垃圾。张淼也认为，这一现实使得政策制定者不得不将治理重点首先放在更好解决且量更大的塑料垃圾问题上，比如塑料饮料瓶和塑料袋等。针对一次性塑料袋的“限塑令”政策已执行十年。

但外卖垃圾问题仅靠外卖平台也难以彻底解决。消费主义盛行之下，消费者不愿牺牲消费体验，对外卖包装要求较高，而商家为了迎合需求只能将环保因素作为次要考虑。循环经济协会副主席赵凯表示，要解决外卖垃圾问题，一方面要更加大力推广绿色消费观念，另一方面则需要加快推进新技术的发展以促进外卖行业形成循环经济的闭环。

王晨，中外对话编辑助理

Food delivery apps skewered for creating plastic waste

Services like Meituan and Ele Me are under increasing pressure to cut packaging waste

□ Wang Chen

Pull out your phone, tap on a food delivery app, choose your restaurant and dishes and relax! Because in several minutes you can expect a delivery of piping hot food, delivered to your door by someone on an electric bicycle.

But it's not just food that gets delivered – the plastic bags, boxes and cutlery that come with it are creating an environmental mess that requires consumers, restaurants and the delivery apps themselves to work together to clear it up.

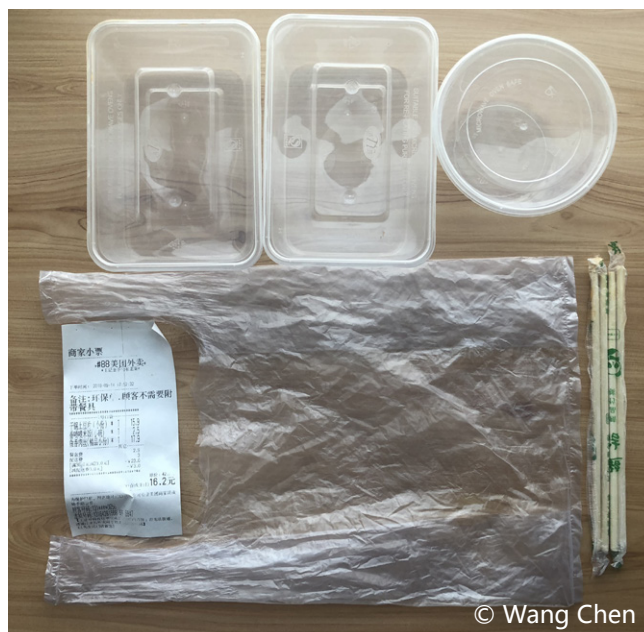
Fast food, fast disposal

In the first half of 2018 China's three biggest online food delivery platforms – Meituan, Ele Me and Baidu Takeout – made 33.9 million deliveries on average every day.

A typical order will include two or three plastic boxes, carried in one or two plastic bags; with an assortment of disposable chopsticks, plastic spoons and plastic soup containers; and possibly drink cartons or cans.

Wen Zongguo, head of the Tsinghua Centre for the Circular Economy, explains that boxes used in food deliveries are usually made of plastics such as polypropylene and polystyrene, or paper and aluminium foil. The plastic containers aren't biodegradable, yet in Beijing they are used in 70% of deliveries.

And the problem is expected to get worse. A 2017 report from Ele Me, which hopes to profit from the sector's growth,



© Wang Chen

The plastic packaging and disposable cutlery that comes with a typical food delivery

estimates that online takeaway food orders will rocket from 100 billion yuan a year in 2016 to 700 billion yuan in 2020 (US\$14.6 billion to US\$70 billion) – a 700% increase.

Side order of plastic

Increasingly, China's food delivery apps are bearing the brunt of consumer frustration with the amount of waste produced by the sector.

In September 2017, Chongqing Green Volunteers' Union sued Baidu Takeout, Ele Me and Meituan for permitting consumers to order so much disposable food packaging and cutlery. The group demanded that the phone apps allow customers to opt-in to using disposable bags and packaging, for which they would be charged. As of the time of writing this case has not been heard in court.

Responding to pressure, Meituan and Ele Me have both promised to cut waste through their respective Green Hills and Blue Planet waste strategies.

The companies have added options to their apps allowing users to opt-out of unnecessary disposable items. Ele Me incentivises customers to do so by giving them points that can be exchanged for environmentally-friendly shopping bags or to plant trees. It has also signed agreements with restaurants to honour the choice of consumers.

But media reports in the Yangcheng Evening News and the Sanqindu Times have found that restaurants, which are keen to save time and ensure customers are satisfied, are often adding disposable items to orders regardless.

This is an issue for the food delivery platforms because they neither own nor operate the restaurants they connect customers to through their phones. But that's not to say the problem is out of their hands.

In late August, Meituan announced a new plan to cut waste that will see it cooperate with packaging providers and over 100 "circular economy partners" to improve design and recyclability. Meanwhile, over 100,000 restaurants on the Meituan app have agreed to shift to greener packaging.

Green food packaging?

"Plastic food boxes are light, waterproof and cheap – a lot of the alternatives fail to meet customer needs even on

permeability," explains Wen Zongguo. So alternatives aren't as good as plastics and "consumers won't accept them, meaning restaurants aren't happy to use them instead of plastic".

But delivery apps are pushing ahead with trials for different types of packaging. In June this year Meituan, Ele Me and Baidu Takeout trialled bowls made of paper coated with a layer of plastic to make them impermeable to oil and water. They require 75% less plastic than an equivalent plastic box.

The trial was in cooperation with the Shanghai Association of Food Contact Materials, which has created an industry standard for food delivery containers. It's not mandatory, but measures have been designed to encourage its adoption. For example, restaurants will lose points on the delivery apps if they do not use the bowls, which can eventually result in them being kicked off the platforms.

But implementation of the standard has left some disappointed. The Laodong Daily reported that less than half of restaurants in the trial area were using the paper bowls. One reason is the cost. The Beijing Daily reported that restaurants face an extra 0.20 yuan (US\$0.03) per delivery when using the paper bowls. This can quickly add up for restaurants sending out thousands of orders a month.

In response, both Meituan and Ele Me said they would provide restaurants with paper bowls and bags to use during the trial, and that the standard could be revised in the future to take account of new products and technologies.

chinadialogue also learned that Ele Me is working with a certified supplier of biodegradable materials and that it will soon start packaging trials with restaurants.

But Zhang Miao, founder of Rcubic, a social enterprise specialising in waste recycling solutions, says that replacements for plastic that are biodegradable often need to be composted using a particular industrial process. But

"Plastic food boxes are light, waterproof and cheap – a lot of the alternatives fail to meet customer needs even on permeability."

—Wen Zongguo, head of the Tsinghua Centre for the Circular Economy.

as waste is often buried or burned, the advantages of these materials are lost.

In response to these concerns, Ele Me has set up a composting project to handle the biodegradable containers.

Recycling

Collecting and recycling waste materials from food deliveries is problematic because the waste is created in small quantities over a wide area, making collection difficult. And as Chinese food tends to be wet and oily, the used containers are contaminated.

Zhang Miao says that few recyclers are willing to buy such waste because it's hard to remove the oil, and because the waste is lightweight and bulky. This is important because waste plastic is sold by weight.

A report from the United Nations Environment Programme on single-use plastics argues that an outright ban is the best way to reduce use, or the introduction of compulsory fees to make consumers think again about using them.

However, it's unlikely that the Chinese government is going to act on the issue soon, explains Wen Zongguo. "The waste plastic from food deliveries is actually only a very small part of domestic waste overall," he says – it accounts for only 4% of all domestic plastic waste.

Zhang Miao says this means policy-makers have little choice but to focus on other problems, such as plastic bottles or bags that are easier-to-handle and are found in larger quantities. A ban on free plastic bags in shops, for example, has been in place since 2008.

So for the time being it's likely that the food delivery apps and restaurants will have to sort the waste issue out among themselves. At the very least, it's unlikely that they'll do anything to inconvenience their customers, which have high expectations for how food is packaged.

Zhao Kai, deputy chair of the China Association of the Circular Economy, says that the development of new packaging and better recycling will help, but consumers also need to back a more environmental approach. 

Wang Chen is one of our junior researchers on our Beijing editorial team.

“隐形污染”：中国环境治理下一站？

被雾霾、黑臭河所困扰的中国，是否准备好了应对那些看不见的化学品“隐形杀手”？

□ 马天杰 冯 灏



中国已急速成长为全球最大的化学品生产国，对于市场上流通使用的数万千种化学品，无论监管者还是普通民众都知之甚少

海水蔚蓝，沙滩细软。人们悠闲地涂抹防晒霜，享受日光浴，并不时下水嬉戏。

这幅美好画面的背面却让人不寒而栗：奇形怪状的畸形鱼类胚胎。这是香港浸会大学的一份最新研究展示的画面。该研究发表在权威的《环境科学与技术》上。科学家认为，造成这些鱼类胚胎变异的，正是海水中的防晒霜成分。

二苯甲酮3(BP-3)、乙基己基甲氧基肉桂酸酯(EHMC)和八氯乙烯(OC)，这些普通人闻所未闻的化学品被作为紫外线吸收剂使用在防晒霜中。在人类皮肤表面，它们阻止紫外线的伤害，可一旦进入水中，它们却会导致斑马鱼的后代畸形，并通过食物链累积，最终可能回到人类体内。研究者呼吁对此类化学品进行监管。

与困扰中国的雾霾、黑臭河等显性的环境问题相比，这种隐藏在日用品中的污染看不见摸不着，其危害也不会立时显现。但中国已急速成长为全球最大的化学品生产国，对于市场上流通使用的数万千种化学品，无论监管者还是普通民众都知之甚少。与“隐形污染”有关的环境健康问题也已呈上升之势。专家认为，以“显性”污染和安全事故

为着眼点的管理体系并不适应对“隐形污染”的风险管理，改善化学品监管已刻不容缓。

显性 vs. 隐性

在过去数年中，中国一定程度上扭转了一度极为严重的雾霾问题，让人看到其不断增强的环境监管体系的威力。被 2015 年新版《环境保护法》和中央高层“生态文明”理念赋予更大权力的环境监管者可以对污染企业课以重罚，限制乃至关闭其生产，甚至将违法者关进监狱。2017 年的北京，空气中的 PM2.5 水平比 2013 年下降了约 35%，完成了被认为是极其困难的三年行动计划。

显性的污染得到了控制，隐性的污染却还总体上处于监管空白状态。

中国市场上已知正在流通的化学物质超过 45000 种(实际存在的化学物质可能远高于这个数字)，但受到一定程度监管的只有约 3000 种。这些受监管的化学品种大多属于易燃、易爆和剧毒的化学品种，具有明确的显性危害性。而根据环保组织绿色和平的统计，45000 多种化学物质中，约 50% 具有潜在的危害性，可能对人体或环境造成长期负面影响。

“中国目前化学品管理的重点在于具有确定危害、且主要是急性危害的危险化学品。”绿色和平项目主任王衍表示，“对于具有慢性环境和健康危害的化学品的监管较弱，尤

其是在流通、加工使用和环境排放环节。”王衍介绍，长期以来，中国化学品管理侧重于劳动生产过程安全和化学事故防范，较少考虑人类健康和生态环境安全。

防晒霜中的 BP-3，早已在 2012 年就被丹麦认定为一种潜在的内分泌干扰物，在个人护理用品中的使用受到欧盟法规限制。但是，和很多类似的化学品一样，它并没有进入中国法规的监管视野。

北京大学环境科学与工程学院副教授刘建国曾撰文指出，一些高污染、高风险的落后化学品生产或使用工艺正逐步从发达国家转移到中国等化学品技术和管理水平相对落后的发展中国家。化学品环境管理形势严峻。

监管盲区

中外对话访问的专家均认为，对化学品潜在危害的监管同时处于两个监管“盲区”：在环境监管中，重心在治理雾霾、黑臭水体这样显性的污染问题上，管理隐性污染的动力和优先级都不高。而在化学品监管中，因为传统上中国化学品管理的出发点在职业安全防范，因此重视的是易燃、易爆和剧毒等“急性”危害，对隐蔽的、长期性的环境健康风险重视不足。

公众环境研究中心(IPE)主任马军指出：“目前化学品环境监管存

在的‘空白’，一方面是相对隐性，另一方面是环境执法部门面对多重挑战但资源有限。”

目前中国还没有制定国家层面的化学品管理专门法律。最高位阶的化学品管理法规是 2011 年修订的，由原国家安监总局(现应急管理部)牵头的《危险化学品安全管理条例》，对列入“危险化学品目录”的约 3000 种化学品进行规管。该条例脱胎于 1987 年的《化学危险物品安全管理条例》，此前已执行 20 多年，监管的化学品范围主要以易燃易爆和剧毒品为主。

2011 年的修订首次将“对环境有害”列入“危险化学品”定义中，给化学品的环境管理开启了一定的空间。环保部在这一修订的基础上，于 2012 年推出《危险化学品环境管理登记办法(试行)》，尝试对大约 84 种具有环境危害的化学品进行额外监管，要求企业上报这些化学品的生产和使用数据。

遗憾的是，由于该法规层级很低(部门规章)，执行乏力，已于 2016 年被废止，成为中国环境监管史上较罕见的一次“折戟”。行业媒体 REACH24h 在报道这一变化时透露：“环保部曾多次举办研讨会及相关培训，极力推进法规实施，但因缺乏相关配套文件及行业抵制等原因”导致法规“难以为继。”

王衍认为：“中国化学品环境管理无论在整个化学品管理体系中，

与困扰中国的雾霾、黑臭河等显性的环境问题相比，这种隐藏在日用品中的污染看不见摸不着，其危害也不会立时显现。

还是在环保系统内部，目前都比较边缘化。”

环境健康危机

监管滞后之时，环境健康危机却若隐若现。

中国国家癌症中心今年发布的中国癌症负担显示，乳腺癌位居女性癌症发病率首位。数据同时显示，在2000年到2013年之间，中国乳腺癌的年平均增长率约为3.5%，在世界范围内增速位列首位。北京、上海、广州等城市的乳腺癌发病率已接近欧美发达国家水平。

在世界卫生组织和联合国环境署最近的一次对内分泌干扰物质（EDC）的科学评估报告中，将世界范围内某些疾病的发病率上升部分归因于一些“尚未识别的环境因素”。这些疾病包括一些内分泌系统癌症（如乳腺癌和睾丸癌）以及生殖系统疾病和不孕不育等。而该研究也注意到：“工业化地区的人们所接触的一些化学品能够干扰激素的生成、运作和新陈代谢。”

曲折前行的监管

中国的环境监管者一直有意将化学品的环境管理纳入其管理体系。不幸夭折的《危险化学品环境管理办

法(试行)》可以说是一次“带着镣铐的舞蹈”，在有限的授权范围内，它尽可能地搭建了一个化学品环境管理机制的雏形，包括一个动态筛选和更新的“重点环境管理危险化学品名录”，考虑了持久性和生物累积性等“隐性”危害；要求生产和使用这些化学品的企业向主管部门登记，并每年填报重点化学品的释放和转移申报表。

其中最后一点被普遍认为是对于化学品环境管理意义重大的PRTR制度的雏形，对于促进企业减少乃至替代这些化学品具有激励作用。无论是美国的TRI制度还是欧盟的PRTR制度均被认为对有毒有害化学品的管理起到了促进作用。

马军认为：“从国际经验来看，PRTR制度不但能够让媒体、环保组织和公众利用公开信息施压高排放企业减排；而且能协助政府更加全面和精准地掌握企业有害化学品排放与转移情况。”

该法规废止之后，化学品环境管理的政策制定者一度调低了目标，不再追求一步到位地建立整个化学品环境管理体系。一位接近政策制定的人士曾表示：“将化学品的管理融入到水、土壤、大气的治理中，是当前比较现实的方向。”

2017年，环保部发布“优先控制化学品名录（第一批）”，就是借助国务院的《水污染防治行动计划》（简

称“水十条”）的授权而制订的。该名录包括了22种持久性有机污染物和内分泌干扰物质等“隐形污染物”，并要求将其纳入废水的排污许可证进行管理，限制这些化学物质在产品中的使用并鼓励将其替代。

今年6月，中共中央明确了土壤污染防治的方向，指出应“评估有毒有害化学品在生态环境中的风险状况，严格限制高风险化学品生产、使用、进出口，并逐步淘汰、替代。”这一新的授权无疑将增加化学品环境管理的监管动力。

但业内人士认为，将化学品环境管理分散在大气、水、土壤等领域中只是短期权宜之计。“这会增加监管的难度，也让公众的监督更加困难。”马军认为。

从刚刚结束的一次化学品环境风险防控专委会年会上传出的消息显示，今年三月新成立的生态环境部仍在积极研究制订化学品环境风险管理专项法规，酝酿中的该法规将“以风险防范和源头控制为根本原则”，形成以“危害筛查、风险评估、分级管理（禁止、限制、优先控制等）的制度体系。”^⑤

马天杰，中外对话运营副主编

冯灏，中外对话研究员

China's next environmental challenge is hard to see

The slow, harmful effects of unregulated chemicals are a growing risk to public health

□ Ma Tianjie Feng Hao

Public health campaigns have been telling people for years to apply a generous layer of sunscreen when they go to the beach, and to make sure they're fully protected before getting into the water. But recent research from Hong Kong Baptist University finds that sunscreens are also having a shocking effect under the surface by causing deformities in fish embryos.

Few people have heard of chemicals commonly used in sunscreens, such as benzophenone-3 (BP-3), ethylhexyl methoxycinnamate (EHMC) and octocrylene (OC). When they are applied to the skin they block ultraviolet radiation, but in the water they also cause abnormalities in the young of zebrafish, and accumulate in the food chain where they can ultimately reach the human body.

The authors of the paper, which was published in the journal *Environmental Science & Technology*, have called for regulations to cover the use of such chemicals in personal care products.

Pollutants concealed in everyday products are not as noticeable as smog or foul-smelling waterways and the damage they cause is not immediately visible. But China is already the world's largest manufacturer of chemicals and neither regulators nor the public know much about the tens of thousands of different substances being transported and used around the country.

Meanwhile, the use of the chemicals is causing a rise in environmental health issues. Experts say that systems

designed to deal with visible pollution and accidental releases aren't well-suited for managing hidden pollution, and urgent changes are needed to address this.

Seeing the danger

In recent years, China has strengthened its system of environmental management and seen some impressive results. PM2.5 levels in Beijing in 2017 were 35% lower than in 2013 following a three-year action plan that was initially regarded as next to impossible to achieve. The 2015 Environmental Protection Law and the Party leadership's focus on "ecological civilization" have also empowered regulators to impose heavy fines on polluting firms and even shut down factories and jail offenders.

Visible pollution is being brought under control, but hidden pollution is still mostly unregulated.

There are about 45,000 chemicals known to be in circulation on the Chinese market (the actual number may be much larger), but fewer than 3,000 are regulated. These include substances that present clear risks because they are explosive, flammable or highly toxic. However, Greenpeace has calculated that about half of the 45,000 chemicals could cause long-term harm to the environment or human health.

"China's management of chemicals focuses on those which are dangerous and present definite and immediate risks," explains Wang Yan, toxics campaigner at



© Wu Hao / Greenpeace

The aftermath of the 2015 chemical warehouse explosion in Tianjin. Management of chemicals in China has long focused on preventing incidents like this, with less attention paid to public health and the environment

Greenpeace. “Management of chemicals which have slower harmful effects on health and the environment is weaker, particularly when it comes to transportation, processing and use, and release into the environment.”

Wang added that China’s emphasis is on workplace safety and the prevention of accidents, with less thought given to people’s health and protection of the environment. For example, the BP-3 found in sunscreen was identified as a potential endocrine disruptor as early as 2012. Its use in cosmetic products is restricted by EU regulation. But BP-3, like many other similar chemicals, is not regulated in China.

Liu Jianguo, associate professor at Peking University’s College of Environmental Sciences and Engineering, has written that dangerous and polluting production methods and use of chemicals have shifted from developed to developing nations, such as China, where technology and regulations are less developed.

Regulatory blind spots

Experts interviewed by *chinadialogue* said that China faces a growing challenge to manage chemical risks in an environmentally safe way and that current measures are inadequate. One problem is that environmental regulators are focused on more visible issues, such as smog and water pollution, and give little priority to hidden risks.

Ma Jun, director of the Institute for Public and Environmental Affairs, adds that “environmental law enforcement agencies are facing multiple challenges with limited resources”.

China has no national law on the management of chemicals. The highest-level relevant rules are the Regulations on the Safety Administration of Dangerous Chemicals, revised in 2011 by the State Administration of Work Safety (now the Ministry of Emergency Management). These regulate about 3,000 substances,

which are included on a register of dangerous chemicals. The regulations were developed from a 1987 set which had been in place for 20 years and covered mainly explosive, flammable and highly toxic substances.

The 2011 revision added “harmful to the environment” to the definition of dangerous chemicals, which allowed the regulation of chemicals for environmental reasons. The Ministry of Environmental Protection then published a trial method for registering chemicals hazardous to the environment in 2012, including those representing persistent and bioaccumulative risks. It included extra regulations for 84 environmentally-harmful substances and required firms manufacturing and using the chemicals to register and submit annual reports of releases and transfers.

Unfortunately, these departmental regulations were not enforced properly, and in 2016 they were annulled – a rare surrender for China’s environmental regulators. Industry media outlet REACH24h said at the time that “the Ministry of Environmental Protection held a number of seminars and training sessions to encourage implementation, but with industry resistance and a lack of supporting documents, the regulations could not be maintained”.

Wang Yan said that “environmental management of chemicals is marginalised, both within the environmental regulatory system and that for chemicals”.

A worsening health crisis

With effective regulation still not in place, environmental health issues are becoming more apparent. A report from the China National Cancer Centre, China’s Cancer Burden, published this year, shows that the most common cancer among women is breast cancer; incidences between 2000 and 2013 grew by 3.5% annually – the

highest rate of growth globally. Rates in cities such as Beijing, Shanghai and Guangzhou are approaching those in the developed world.

In the most recent evaluation of endocrine-disrupting chemicals from the World Health Organisation and UN Environment Programme, a worldwide increase in incidence of some diseases is attributed partially to “unidentified environmental factors”. These include cancers of the endocrine system, such as breast and testicular cancer, reproductive diseases and infertility. The report also noted that “chemicals to which all humans in industrialized areas are exposed have been shown to interfere with hormone synthesis, action or metabolism”.

A different regulatory approach

China’s environmental regulators have wanted to bring chemicals under their jurisdiction for a long time. The first attempt to establish an actively maintained list of chemicals, including those representing persistent and bioaccumulative risks, and require those manufacturing and using the chemicals to register and submit annual reports of releases and transfers, resulted in failure. However, it was regarded as an embryonic form of a pollutant release and transfer registry, a key part of any system for managing environmentally-harmful chemicals and encouraging firms to use less or opt for alternatives. The US Toxic Release Inventory and the EU’s Pollutant Release and Transfer Register (PRTR) both improved the management of toxic and harmful chemicals in those jurisdictions.

According to Ma Jun, “International experience shows that a PRTR system allows the media, environmental groups and the public to use openly available information to pressure firms into cutting emissions, and can give the government

“Environmental management of chemicals is marginalised, both within the environmental regulatory system and that for chemicals.”

—Wang Yan, toxics campaigner at Greenpeace.

a more comprehensive and accurate grasp of how firms are releasing and transferring harmful chemicals”.


After the above mentioned regulation was abandoned, policy-makers lowered their ambition and no longer aimed to create a complete regulatory system all at once. A source close to policy-makers said that “merging regulation of chemicals with governance of water, soil and air is a more realistic direction at the moment”.

In 2017 the then Ministry of Environmental Protection published an initial list of chemicals to be prioritised for regulation that included 22 persistent organic pollutants and endocrine-disrupting chemicals. The change resulted from powers granted by a State Council action plan on water pollution, and required licenses to release the substances in waste water, limits on their use in products, and encouragement to switch to alternatives.

In June the Communist Party Central Committee clarified the direction on soil pollution, saying that the risks associated with harmful chemicals in the environment should be assessed, with strict restrictions on

the manufacture, use and import of high-risk chemicals, which should be gradually eliminated and replaced. This new authority will be a further boost to management of environmentally-harmful chemicals.

But industry insiders say that dividing management across air, water and soil is only a short term measure. “This will make both regulation and public oversight more difficult,” says Ma Jun.

The creation in March of a Ministry of Ecology and Environment from the old Ministry of Environmental Protection is cause for optimism though. According to leaked reports, the ministry is actively working on a new set of regulations based on the principles of “risk prevention and control at the source”. They will classify harms, assess risks and manage chemicals by banning, restricting or controlling their use. 

Ma Tianjie is chinadialogue managing editor in Beijing.

Feng Hao is a researcher at chinadialogue.

废旧电子设备资源再生渐成热点

对电子设备中的金属进行回收的“城市采矿”，正在成为科技和商业创新的热点。

□ 凯瑟琳·厄尔利



中国的电子废弃物总量预计到2030年达到2840吨，成为比美国或欧盟更大的电子废弃“产地”

如今的世界高科技化程度越来越高，而一个重大的环境问题也日益凸显。我们的旧手机、旧笔记本电脑和旧电视常常被直接填埋或者得不到正规的回收处理，导致有毒物质渗出，造成大气、土壤和水质污染。同时，开采初级原材料来生产新的电子设备又会产生更多的污染，排放更多的二氧化碳。

全球电子废弃物监察（GEM）是一项由联合国大学、国际电信联盟和国际固体废弃物协会联合参与的项目。来自该项目的统计显示，仅2016年一年，全球就产生了近4500万吨的电子废弃物。

由于消费者频繁更换产品，所以电子废弃物总量也在持续增加，而且全球有越来越多的人开始有机会使用

电子设备。到2021年，电子废弃物年增总量预计将达到5220万吨。

同时，这些电子废弃物大多得不到回收再利用。全球电子废弃物监察（Global E-Waste Monitor，简称GEM）表示，全球三分之二的人口都受到电子废弃物管理相关法律的约束，但实际上只有20%的电子废弃物得到了合理的回收再利用。大

约有 4% 都被直接丢进了垃圾桶，另外 76% 要么不知所踪，要么回收条件恶劣，会给环境和人类健康带来非常不利的影响。

但是，电子废弃物作为资源的价值正在逐渐显现。现代电子产品中含有各种贵金属，包括金、铜、铂和各种稀土元素（比如钕和钽）。据全球电子废弃物监察（GEM）预计，2016 年电子废弃物中所有原材料的总价值大约为 550 亿欧元（约 4400 亿元人民币）。

爱丁堡大学化学教授杰森·拉夫表示：“所有的电子产品都含有大量的有价金属，所以我们应该对其进行回收，因为将它们从地下开采出来并从其他材料中分离出来都要耗费相当大的人力物力。”

回收再利用面临的挑战

在欧洲，电子废弃物受《报废电子电气设备（Waste Electrical and Electronic Equipment，简称 WEEE）

指令》监管。该指令中包括一系列提高电子产品使用寿命结束后对其进行收集、处理和回收的措施。

贸易机构 Tech UK 环境与合规负责人苏珊娜·贝克表示，从消费者手中回收电子废弃物仍然是一项艰巨的挑战。她说：“很多小电子设备最终都被丢进了垃圾桶。缺少促使消费者把这些电子垃圾送到市政回收设施的措施。”

清华大学环境学院副教授曾现来是城市采矿和电子废弃物管理方面的专家。他认为，电子废弃物回收是发达国家和发展中国家共同面临的一个重大障碍。他指出，想要提高零售商和制造商的电子废弃物回收比率，补贴至关重要。

中国的电子废弃物总量预计会从 2020 年的 1500 吨增加到 2030 年的 2840 吨，使其成为比美国或欧盟更大的电子废弃“产地”。但曾现来认为，中国也正在成为电子废弃物城市采矿的领军国家。

城市采矿的前沿阵地

目前，中国政府已经通过补贴来推动电子废弃物及其有价材料的收集和提取。比如，从一台阴极射线管（CRT）电视中回收金属能获得约 13 美元（约 90 元人民币）。曾现来认为这对提高城市采矿对中国商家的吸引力来说非常重要。

补贴政策意味着在中国城市采矿比原始采矿成本更低。曾现来教授与清华大学的李金辉教授和澳大利亚麦考瑞大学的约翰·马修共同进行的研究预计，通过原始采矿获得一台阴极射线管电视所需的金属比通过城市采矿提取这些金属的成本要高 13 倍还多。研究还显示，对于印制电路板（PCB）来说，原始采矿的成本是城市采矿的 7 倍多。

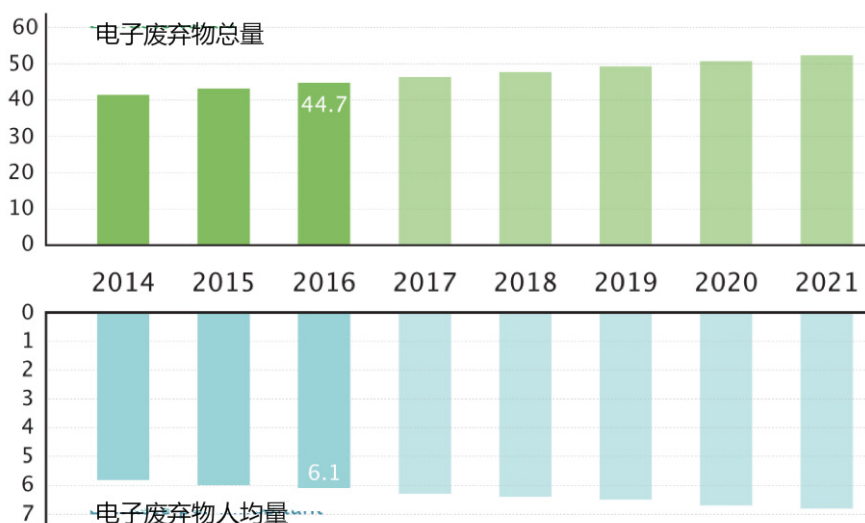
目前，电子废弃物回收主要通过工业冶炼厂完成。比如将笔记本电脑的印制电路板压碎并运输到冶炼厂，然后提取出其中的铜、金和银。拉夫表示，冶炼厂属于高耗能产业，高温可达 2000 摄氏度，会产生大量的二氧化碳气体。

从电子废弃物中提取金属的难度在于，电子设备使用的材料非常复杂，可能包含不同的金属、玻璃、塑料和焊接金属。因此，工厂必须在进行冶炼提取前先对电子设备进行物理拆解，拉夫补充道。

制造商发现市场潜力

一些国际电子产品制造商已经开始关注城市采矿业。科技巨头戴尔公司就在新电脑主板中使用了从旧电脑主板上回收的黄金。此外，戴尔还与一位珠宝设计师合作，用回

全球电子废弃物总量（单位：百万吨）



注：2017—2021 的数据为估值。来源：Global E-Waste Monitor

收提取的黄金制造耳环和袖扣。分析机构 Trucost 的研究显示,回收提取的黄金比传统开采黄金的环境影响要低 99%。戴尔公司已经承诺,2020 年前其产品中的回收成分总重量将达到 1 亿磅(约 4536 万公斤)。

与此同时,苹果公司也开发了一款专门负责拆解 iPhone 手机的机器人。其中,最新版本的 Daisy 机器人每小时可拆解 200 部 iPhone,并会对可回收利用部分进行拆除和归类。苹果公司的目标是在产品制造过程中彻底告别原始开采材料。

学者们也正在努力开发新的城市采矿流程。比如,爱丁堡大学的一群化学家们就开发了一种新的化合物,可将黄金与手机中的其他元素分离。

黄金是手机中最有价值的金属。一吨黄金矿石中大约含有 1 到 5 克黄金,但是一吨手机中的黄金含量则超过 300 克。其实,全球流通的黄金中,有大约 7% 都存在于电子设备(比如电路板的键触点)中。

下一阶段的研究就是与一位地质科学家合作。后者有兴趣开发一种通过细菌溶解金属的生物学方法,

这种方法能与拉夫的化学分离法相结合。此外,拉夫还希望与工程师合作开发一个商业化的分离流程。

他表示:“我们希望让这个过程更环保,取代传统的冶炼过程。”

此外,人们也在努力降低金属和稀土元素数据的获取难度。行业、研究机构、以及地质调查机构目前联合创建了一个城市采矿数据库。这个叫做 ProSUM 的项目标明了几种具体材料的最大库存,用户可以通过该数据库了解欧盟范围内电子废弃物存量的实时变化。比如,这个项目会显示哪些金属的使用量在增加,而哪些的使用量在减少。换言之,这个系统的目标是为决策者提供立法相关的事实依据,帮助学界确定研究的重点和原材料再生的创新机会。

同时,爱尔兰考克大学也在开展一个名叫“RecEOL”的项目,希望找到一种方法让城市采矿更加“有利可图”。该项目的目标是将电子废弃物的金属回收率从 70%-80%,提高到 95%。研究人员称,这也是首个回收关键和特殊金属(例如从印制电路板和液晶显示屏中回收铟和钽)

的技术。这个研究通过一家试点工厂证明,这种方法要比现有回收提取方法更加经济可行,也更加环保。

学界与业界的多家机构共同参与了这个国际项目,其中包括弗莱堡矿冶工业大学(德国),以及废塑料加工商 Coolrec BV(比利时)、穆德赫弗顿回收再利用与环境技术股份有限公司(德国)和 Alumisel SAU(西班牙)等该技术的工业用户企业。

Tech UK 的贝克表示:“针对城市采矿的学术研究已经有不少了,但是大多数还停留在实验室阶段,没有进入试点。”

她表示:“我们清楚城市矿山蕴藏的资源,只是需要更多的创新,帮助我们把资源‘开采’出来。需要克服的挑战就是找到一种与现有原材料开采相比具有成本竞争力的方法,同时还能获得稳定与充足的资源开采量,确保整个流程具备可营利性和可预测性。这就是下一个前沿领域了。”

凯瑟琳·厄尔利,自由撰稿记者,《环境学家》前主编

The treasure hidden in our gadgets

Recovering metals from old electronics could save money and the environment

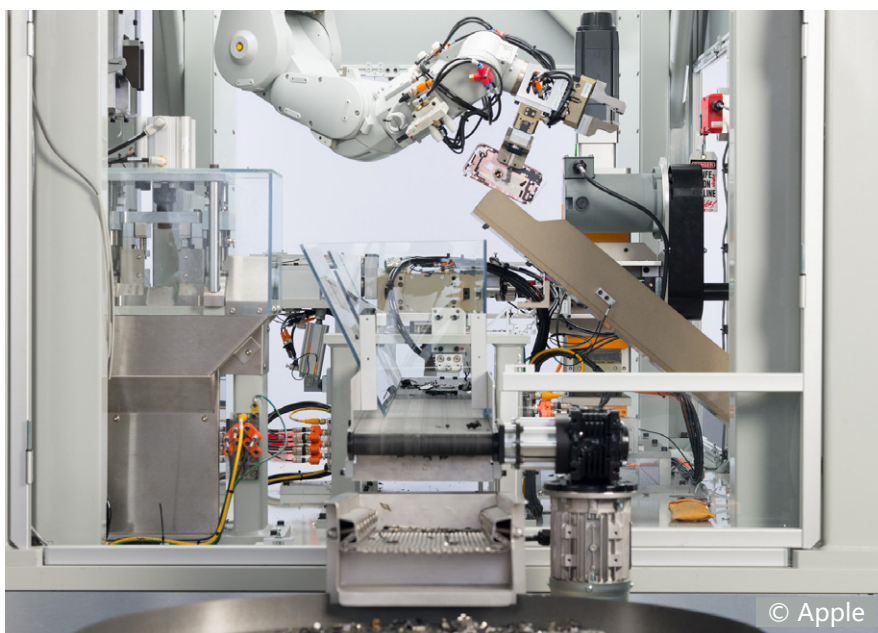
□ Catherine Early

Gold is the most valuable metal in a phone. One tonne of gold ore contains around 1-5 grams of pure gold – but a tonne of mobile phones contains upwards of 300 grams, explains Professor Jason Love. In fact, an estimated 7% of gold in circulation around the world is contained in the circuitry of electronic devices, he points out.

Love is head of inorganic chemistry at the University of Edinburgh, Scotland. His focus is on using chemistry to recover valuable and toxic metals from old technology. The digital junk people throw away offers a huge and valuable resource if the metals can be recovered and recycled through what's known as "urban mining". This can also avoid the extraction of new materials.

The professor's team is developing a new compound that can be used to separate gold from other elements in a mobile phone.

"All electronics contain lots of valuable metals, and we really should be recycling them because it takes a lot of effort and energy to get them out of the ground and separate them from other materials," says Love.



Daisy the robot can disassemble 200 iPhones every hour and doesn't require rest breaks

The team is aiming to make a process that is more environmentally friendly than smelting, which is the most common way of recycling phones, but which is very energy intensive, he adds.

The next stage of the research is to team up with a geoscientist who is interested in developing a biological method using bacteria to dissolve metals, which could be combined with the chemical method.

As the world becomes increasingly high-tech, a huge

environmental problem is piling up. Our old phones, laptops and TVs often end up in landfills or in unregulated reprocessing, polluting air, soil and water as toxic materials seep out. Meanwhile, mining virgin materials to replace discarded products generates more pollution and carbon dioxide emissions.

But the value of e-waste as a resource is growing. Modern electronics contain a variety of precious metals including gold, copper, platinum, and rare earth elements, such as neodymium and tantalum.

The Global E-Waste Monitor (GEM), a project involving the United Nations University, International Telecommunications Union and the International Solid Waste Association, estimated the total value of all raw materials present in e-waste in 2016 at approximately 55 billion euros.

The GEM also estimated that nearly 45 million tonnes of e-waste was generated globally in 2016, which is expected to grow to 52.2 million tonnes by 2021.

The problem is that the vast majority of e-waste is not recycled. Two-thirds of the world's population is covered by laws governing e-waste, but only 20% is recycled properly, according to GEM. Around 4% is thrown in the bin, while 76% is unknown, or recycled under poor conditions for environmental and human health. Companies lack the incentive to collect and process e-waste as the cost of sourcing raw materials is often cheaper.

Challenges

China's e-waste waste is expected to grow from 15 million tonnes in 2020 to 28.4 million tonnes by 2030 – making it a larger generator of e-waste than the United States or the European Union.

However, it has also emerged as a leader in urban mining, says Xianlai Zeng, associate professor at the School of Environment at Tsinghua University, who specialises in urban mining and e-waste management.

Collecting e-waste is the main obstacle for both developed and developing countries, adds Zeng.

In Europe, e-waste is regulated by the Waste Electrical and Electronic Equipment (WEEE) Directive, which

contains measures to improve collection, treatment and recycling of electronics at the end of their life.

There, collecting e-waste from consumers is still a major challenge. "A lot of small electronics end up in the bin. There's nothing to compel the consumer to take them to a civic amenity site," says Susanne Baker, head of environment and compliance at trade body Tech UK.

The Chinese government has promoted collection and extraction of valuable materials from e-waste through subsidies. For example, metal recovered from one cathode ray tube (CRT) television earns US\$13, which Zeng says has been vital to the attractiveness of urban mining in China.

The subsidy has meant that urban mining is cheaper than virgin mining in China. A study by Zeng, together with professor Jinhui Li from Tsinghua University and professor John Mathews from Macquarie University in Australia, estimated that virgin mining for the metals in a CRT TV was around 13 times more expensive than extracting the metals through urban mining. For PCBs, the materials were seven times more expensive through virgin mining, it found.

How is it done?

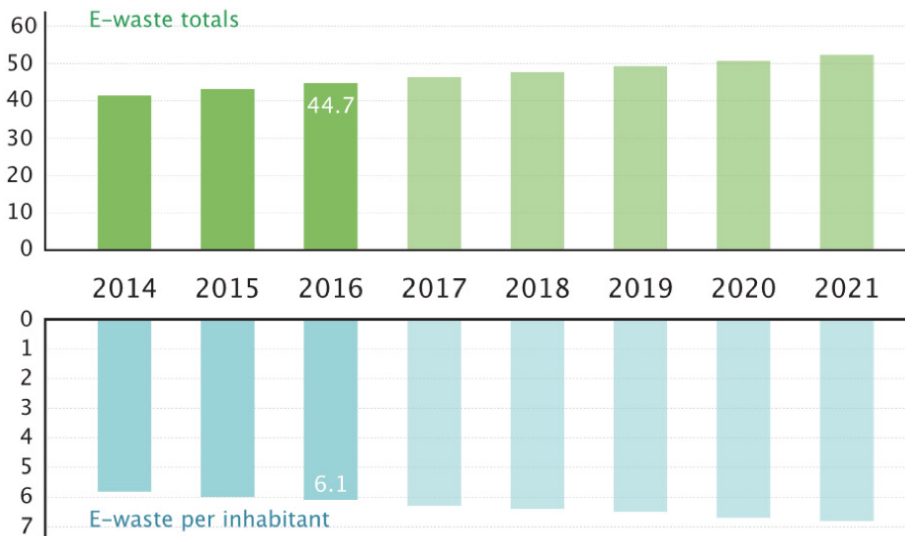
Of the e-waste that is currently recycled, most is carried out by industrial smelters. Printed circuit boards from laptops are crushed and transported to these facilities, which can then remove copper, gold and silver. Smelters are energy intensive, heating up to 2000 degrees Celsius, which produces a large amount of carbon dioxide.

The difficulty with removing metals from e-waste is that the materials used in electronics are very complex, for example, different metals, glasses, plastics, and solder connectors. They need to be physically disassembled before anything can be done with them, adds Prof Love.

Manufacturers see the potential

Some global electronics manufacturers have begun to look into incorporating urban mining into their supply chains.

Estimate of global e-waste (million tonnes)



Note: 2017-2021 are estimates

Source: Global E-Waste Monitor

Technology giant DELL is using gold recovered from computer motherboards in new ones, and has also partnered with a jewellery designer to create earrings and cufflinks from the metal.

Gold from this reclaimed process has an environmental impact 99% lower than conventionally mined gold, according to a report last year by analysts Trucost. The company has pledged to recycle 100 million pounds of recycled content into its product portfolio by 2020.

Meanwhile, Apple has developed a robot to disassemble its iPhone. The latest incarnation, Daisy, can take 200 iPhones apart every hour, and removes and sorts the components for recycling. The tech firm has a goal to completely eliminate virgin materials from its product manufacturing.

The value chain


Efforts have also been made to make data on metals and rare earth elements more accessible. An urban mine database has been developed by a collaboration involving research

institutes, geological surveys and industry.

The so-called ProSUM project identifies the largest stocks of specific materials, and allows users to see the changing makeup of e-waste over time across the EU. For example, it reveals those metals that are increasing in use and those that are decreasing. It aims to provide a factual basis for policy makers to design legislation, and for academia to define research priorities and innovation opportunities in recovering raw materials.

Meanwhile, University College Cork is working on a project to make urban mining more lucrative. The RecEOL project aims to increase the amount of metals reclaimed from e-waste recycling from 70-80%, to up to 95%.

The process will also be the first recycling technology of its kind to capture critical and special metals, such as indium and tantalum from PCBs and LCDs, according to the researchers, which aim to show the process is economically viable and environmentally better than current methods through a pilot plant.

“We know what’s in the urban mine, we just need more innovation in the sector to be able to extract it. The challenge to crack is to extract the metals at a cost that can compete with virgin materials, and to get steady and sufficient quantities of that material so that there’s bankable, predictable process. That’s the next frontier,” says Tech UK’s Baker. 

Catherine Early is a freelance journalist and the former deputy editor of the environmentalist.

新一代电池的无限可能

新的化学物质纷纷加入未来手机的电源行列，但锂离子电池仍然会存在一段时间

□ 阿比盖尔·贝尔

不管是笔记本电脑还是手机，你每天总要用到好几个锂离子电池。自从上世纪 90 年代上市以来，这些可充电电池让我们的电脑和电子设备变成可移动的，如今就连汽车都电动了。

但锂离子电池并非十全十美。世界上的锂供应量是有限的，企业和消费者对电池的安全性、寿命、容量的需求不断提升，而且电动汽车和电网蓄能等新的电池用途也在迅速涌现。

为了满足这些需求，新一代电池的开发将成为竞争焦点，但它们会是什么样子、会比现在的电池有哪些改进，都还是未知数。

能源日新月异

一个负极、一个正极和一些电解质就构成了最简单的电池。带负电荷的电子通过电解质从负极流向正极，就形成了电流。

负极通常使用锂金属氧化物制造，带有这种负极的就被称为锂离子电池。锂离子电池之所以最常用，是因为它们能量容纳率最高，能够放进像你的手机这么小的空间里。在充电

和放电时，锂离子电池的能量密度是传统可充电电池的 3 倍。

大多数锂离子电池由石墨正极和液态有机电解质构成。为了避免电池中正负极接触发生短路，两极之间以一小片薄薄的可渗透聚丙烯（一种塑料）加以阻隔。如果这一屏障裂开或蚀坏，正负电极就会接触，电池会极速发热。电池中还充满了会在发热时起火的可燃电解质，只要一次短路就能轻易将其激发。如果封堵被揭开，液态电解质还会泄漏。

改进电解质

为了解决上述问题，研究者们正在寻找固态电解质作为替代。

“目前的局限在于液态电解质。”德州大学奥斯汀分校的机械工程与材料科学教授约翰·班宁斯特·古迪纳夫如是说。

他说，电解质限制了电池充电和放电的次数，以及电池的充电速度和能量储存。

新一代电池还是锂离子的，但会使用不同的电解质。比如，它们可能会用固态电解质代替液态的。

对电解质的要求是很高的。它

必须能导电、耐高压而且在长时间内保持电化学和热学上的稳定性状。这就是为什么开发固态电解质如此困难的原因。

去年，瑞士联邦材料科学与技术实验室的研究者们开发出一种固态电解质，其效率可以与通常的液态电解质媲美。它在室温下的导电率与液态电解质相当，而且在 150 摄氏度高温之下仍能保持稳定。相比之下，液态电解质在如此高的温度下就会出现安全风险。

2016 年丰田公司的研究者发表一篇论文，阐述了一种可以在短短 7 分钟内完成充电的固态锂离子电池。

锂硫电池是另一种很有前途的电池，使用的化学物质截然不同。从理论上说，这种电池的容量很大，且所用的硫储量丰富。

成本更低、寿命更长

随着电动汽车和电网蓄能等用途的涌现，电池需求的增加，近年来电池成本已经明显下降。但为了让电动汽车价格更合理、行驶里程更长，电池还必须进一步降低生产成本、延长使用寿命。

2014 年，专注于可持续技术的英国庄信万丰公司收购了常州的一家电池研究机构，为的就是提高汽车的电池效率。该公司表示，汽车所用电池的日历寿命需要很快与车辆的寿命看齐，可能达到 10 至 15 年。这意味着电池寿命将不再是顾客拒绝购买电动汽车的理由。目前，大多数制造商可以保证电池的寿命为 8 年左右，或者 10 万英里。

美国阿尔贡国家实验室能量存储与材料科学联合研究中心的程雷（音）说，锂离子电池的最大缺点之一是容量会随着时间的推移而减小。“这是由充电、放电以及电池静置时不必要的化学反应造成的。”这个问题在高温下会更加严重。

此外，由于使用了钴和锂等金属以及缺乏经济的回收手段，锂离子电池仍然相当昂贵。这是促使人们寻找替代化学物质的另一个原因。

大规格电池的最佳选择是用无有序晶体结构的固态电解质代替液态电解质。古迪纳夫说：“电解质是现成的，但开发使用它的电池则有待获得许可协议。”

电网蓄能

除了电动汽车，电网蓄能也是一个大规格电池作用日益重要的领域。太阳能和风能是间歇性能源，其在特定时间的可再生电力发电量受天气左右。电池则可以通过有效存储能量帮助稳定电网。

程雷说：“在电网蓄能市场上，硫离子电池可以成为锂离子电池的经济替代品。”硫离子电池的工作方式与锂离子相似，但所使用的硫的供应则要稳定得多。

华威大学的艾玛·肯德里克博士也看好硫离子电池。她说：“这是锂离子电池的低成本替代品，尽管还方兴未艾，但该技术有可能进入工艺性和耐久性研究。”

程雷补充说：“液流电池也是一种很好的选择，因为它们的储能规模很容易扩大。液流电池包含了两种化合物，中间被一层薄膜隔开。这两种化合物可以穿过薄膜产生化学能，但也能回到原位给电池充电。”

除以上之外还有很多其他的选择。今年 2 月，加州大学尔湾分校的

科学家们造出了可以充电数百次的金纳米线电池，这是其他电池所无法比拟的。该团队希望有一天能够制造出可以无限次充电的电池。

石墨烯未来也可能成为电池的组成部分。西班牙的 Grabat 公司说，他们的石墨烯电池单次充电可供电动汽车行驶 500 英里。相比之下，特斯拉 3 型充一次电只能跑 215 英里。

尽管没人可以确切预言新一代电池会是什么样子，但有很多人在努力解决这一问题。

从液流电池到硫离子电池的众多新选择都还在开发阶段，锂离子电池仍要用上相当一段时间。“未来五年仍然是锂离子电池的天下。”剑桥大学的刘涛（音）博士如是说。

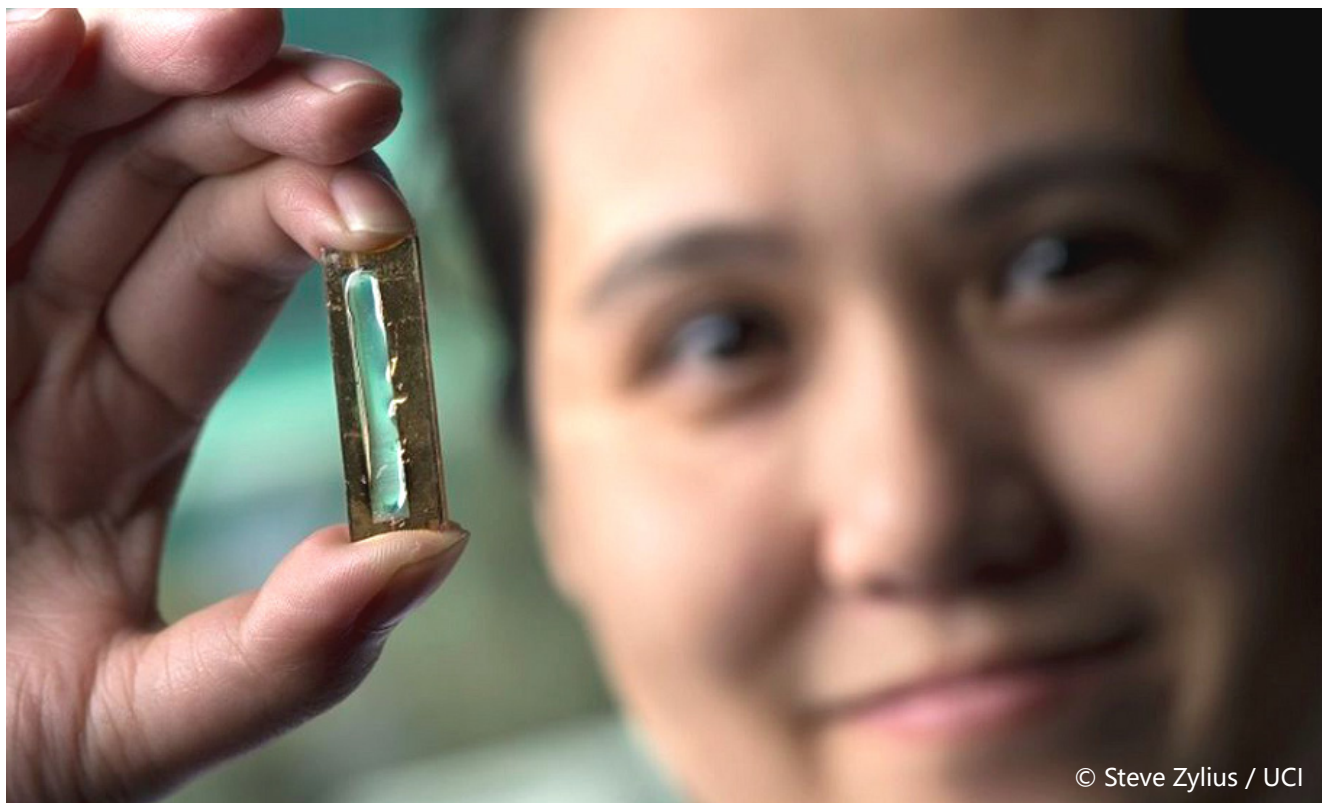
与此同时，科学家们也在努力探索锂离子电池的回收方法。这会减少锂矿开采的环境影响，而锂矿开采也是一个成本高昂的工序。⑤

阿比盖尔·贝尔，英国利兹自由撰稿人

The race to develop the next generation battery

A revolution in electric vehicles is spurring a new wave of chemistries

□ Abigail Beall



Mya Le Thai's nanowire technology allows lithium-ion batteries to be recharged hundreds of thousands of times

Whether in a laptop or a smartphone, there's a good chance that you're using several lithium-ion batteries every day. Since they hit the market in the 1990s, these rechargeable batteries have helped make our computers and devices portable and, increasingly, our vehicles too.

But lithium-ion batteries are not without shortcomings.

The world's supply of lithium is limited, and companies and consumers are constantly demanding batteries that are safer, last longer and pack more energy. Meanwhile, new uses for batteries are rapidly emerging, including electric vehicles and grid storage, adding to the demand for better batteries.

To meet these needs, the race is on to develop the next generation of batteries, although what they will look like, and how they will improve upon current ones, is still unknown.

Energy on the go

In its simplest terms, a battery is made up of a cathode, anode and an electrolyte. The lithium ions flows through the electrolyte from the negatively-charged anode to the positively-charged cathode.

Cathodes are usually made out of a lithium metal oxide, so batteries with this type of cathode are called lithium-ion batteries. These are the most popular kind because they most efficiently pack lots of energy into a small space like your mobile phone. When it comes to charging and discharging, lithium can provide three times the energy density of conventional rechargeable batteries.

Most lithium-ion batteries are made up of a graphite anode and liquid organic electrolyte. Inside the battery, the main barrier against short-circuiting is a thin and porous slip of polypropylene (a type of plastic) that stops the cathode and the anode from touching each other. If the separator breaks or erodes then the electrodes can come in contact and the battery will heat up extremely quickly. Batteries are filled with a flammable electrolyte, which can combust when it heats up – something that can easily be triggered by a short circuit. And to cap it off, liquid electrolytes can also leak.

Better electrolytes

To overcome these problems researchers are investigating solid-state alternatives.

“Current limitations are associated with the liquid

electrolyte,” says John B Goodenough, professor of mechanical engineering and materials science at the University of Texas at Austin.

The electrolyte limits how many times the battery can be charged and discharged, he says, along with how quickly the battery can be recharged and how much energy it can store.

The new generation of batteries will be lithium-ion but will use different electrolytes. For example, they may have a solid-state electrolyte instead of liquid.

The requirements placed on an electrolyte are high. It must conduct electricity, withstand high voltages, and remain electrochemically and thermally stable over a long period of time. This is why developing a solid-state alternative is so challenging.

In 2017, researchers at the Swiss Federal Laboratories for Materials Science and Technology developed a solid-state electrolyte that competes with the usual liquid electrolytes in terms of efficiency. It has a conductivity comparable to a liquid electrolyte at room temperature, and is stable at temperatures of up to 150 °C. In contrast, liquid electrolytes pose a safety risk at such high temperatures.

In 2016, researchers at Toyota published a paper looking into a solid-state lithium ion battery that can fully charge in just seven minutes.

Lithium sulphur batteries, which are based on a completely different chemistry, are another promising future battery. Theoretically, they can store a large charge and use sulphur, which is abundant.

Cheaper and longer-lasting

Battery costs have fallen significantly in recent years as demand has increased and more uses have emerged, such

“Sodium-ion batteries could be an inexpensive alternative to lithium-ion in the grid storage market.”

—Lei Cheng, scientist at the Joint Center for Energy Storage Research and Materials Science Division at Argonne National Laboratory.

as in electric vehicles and grid storage. But to make electric vehicles affordable and practical for driving long distances, batteries need to become even cheaper to produce, and their life cycle extended.

In 2014, Johnson Matthey, a British company specialising in sustainable technologies, acquired a battery research facility in Changzhou, southern China, to improve battery efficiency in cars. It says the lifespan of batteries for use in autonomous cars will need to match that of the vehicle, possibly up to 10 to 15 years. This means customers will not be put-off from buying an electric car because of the limited lifetime of the battery. At the moment, most manufacturers offer guarantees that batteries will last around eight years, or 100,000 miles.

One of the biggest drawbacks of lithium-ion batteries is that their capacity fades over time, says Lei Cheng, a scientist at the Joint Center for Energy Storage Research and Materials Science Division at Argonne National Laboratory in the US. "This is caused by undesired chemical reactions that happen during charge/discharge, as well as while the battery is resting." The problem is even worse when the temperature is high.

In addition, the lithium-ion battery is still quite expensive because it uses metals such as cobalt and lithium, and there is a lack of economic recycling methods. This is another driver for finding alternative chemistries.

The best option for a large-scale battery is to replace a liquid electrolyte with a solid-state electrolyte with no ordered crystal structure. "This electrolyte is available, but battery development with it awaits licensing agreements" says Goodenough.

Grid storage

Alongside electric cars, grid storage is another area where large-scale batteries will play an increasingly important role. The amount of renewable power from solar and wind at any given time depends on the weather, which makes it intermittent. Batteries can help stabilise grids by storing energy efficiently.

"Sodium-ion batteries could be an inexpensive alternative

to lithium-ion in the grid storage market," says Cheng. Sodium-ion batteries work in a similar way to lithium-ion but use sodium instead, which is more readily available.

Dr Emma Kendrick, a materials chemist at the University of Warwick, is looking into the sodium-ion battery. "This is a low-cost alternative to lithium-ion batteries," she says. "It is still in its infancy but there are opportunities to perform research into the manufacturability and durability of the technology."

Flow batteries are another alternative.

"Flow batteries are also attractive options since they can be easily scaled up to provide high capacity," says Ms Cheng, adding: "They contain two chemical compounds that are separated by a membrane. The compounds can flow through the membrane, creating chemical energy, but they can also move back to where they started, which recharges the battery."

There are many other options. In February this year, scientists at the University of California Irvine created gold nanowire batteries that can withstand more recharging than ever before, hundreds of times within their lifetime. The team hopes this will one day lead to batteries that can last indefinitely.

Graphene may also be a component of the battery of the future. A Spanish company called Grabat says their graphene batteries can provide power for an electric vehicle to travel 500 miles on a single charge. For comparison, Tesla's Model 3 can travel 215 miles on one charge.

While nobody can predict exactly what the next generation of batteries is going to look like, there is a huge amount of work going into solving the problem.

The various options for new batteries – from flow batteries to sodium-ion – are in development stages, but lithium-ion will be around for a while yet. "In the next five years, lithium-ion batteries [will] still dominate," says Dr Tao Liu, a research associate at the University of Cambridge.

In the meantime, scientists are trying to develop better ways to recycle lithium-ion batteries. This will reduce the environmental impact of extracting more lithium – another costly process. ☺

Abigail Beall is a freelance journalist based in Leeds, UK.

瓢虫作为大自然的“杀虫剂” 可助棉民增加收益

如果田里的瓢虫数量翻倍，棉农每年将增收 3 亿美元。

□ 张巍



一只瓢虫每天可以杀死50只蚜虫，一生大约可以杀死5000只蚜虫

许多国家都有这样的传说：每当你看到一只瓢虫，你都应该把它放进钱包里，因为它象征着好运气。

这些老话的背后总是不乏真理。华北平原棉田里的每一只瓢虫至少能为农民带来 0.05 元（约合 0.01 美元）的经济效益。

这可能听起来有些微不足道，但是如果将中国三分之二棉田中的瓢虫密度增加一倍，那么每年就能为农民带来 3 亿美元（约 20 亿人民币）的收入。

蚜虫对棉田作物的危害极大，而瓢虫正是它们的天敌。在中国，棉农通常使用化学杀虫剂来消灭蚜虫。

长期以来，这也被认为是最简单、最经济实惠的害虫防治方法，并在全球得到大规模使用。

自然解决方案

但是，化学杀虫剂的使用会抑制大自然提供的免费杀虫“服务”。

对于蚜虫来说，漂亮而又惹人喜爱的红黑色瓢虫就是恶毒的捕食者。据估计，一只瓢虫每天可以杀死 50 只蚜虫，一生大约可以杀死 5000 只蚜虫。

结合昆虫取样和家庭调查后，我们的研究发现，瓢虫(主要包括异色瓢虫、龟纹瓢虫和七星瓢虫)能够带来相当可观的经济效益。我们计算发现，即便在同时使用大量杀虫剂的情况下，每只成年瓢虫每年仍然可以提供价值 0.05 元的“杀虫服务”。

但是大多数农民并不知道这个情况。

中国每公顷棉田大约有 1.35 万只瓢虫。如果将这些“农田卫士”的平均密度增加一倍，那么每公顷棉田就可增收 664 元(约合 93.67 美元)。如果将此举推广到全中国三分之二的棉田，则每年可增加经济效益近 20 亿元(约合 2.908 亿美元)。

好处多多

推广瓢虫治虫法可以解决的远远不止消灭蚜虫一个问题。如果能够减少化学杀虫剂的使用，对农民和整个社会的健康与环境都能带来不少好处。

中国农民过量使用化学杀虫剂，导致化学制剂渗入食物、水和生态系统，从而带来了不小的环境损失。

同样，接触杀虫剂还会对农场工人、消费者、居民和牲畜带来负面的健康影响。

过量使用农药还会破坏害虫的自然防治机制，在消灭害虫的同时，也杀死了瓢虫等重要的益虫，同时还会由于害虫产生耐药性而引发虫害频繁爆发的恶性循环。

农药还会影响农场的收益。使用杀虫剂不仅成本很高，而且会让农民对杀虫剂产生“依赖”，从而放弃了其他解决办法。长远来看，减少杀虫剂用量对中国的农民是有利的。

不断升级的收益

我们的研究显示，农民使用的杀虫剂越少，瓢虫消灭蚜虫的作用就发挥得越充分。

如果我们能将现在每公顷 22.35 公斤的杀虫剂超标用量削减四分之三，那么瓢虫的边际价值就能从每公顷 48 元(约合 6.98 美元)上升到 118 元(约合 17.6 美元)，相当于增加了 2.5 倍多。

一旦这种生物防控机制——这里指的就是瓢虫的棉田杀虫作用——开始发挥作用，农民就有可能进一步减少杀虫剂的用量，尽管我们可能还需要进一步采取激励措施，但是，瓢虫和其他害虫天敌的价值就会得到提升，从而形成可持续农业迫切需要的良性循环。

这些发现从经济、健康、环境等方面为相关政策提供了强有力的证据，从而有助于通过政策减少化学物质使用、加大农民扶持力度，以降低有害生物风险。

但是，农民和政策制定者往往缺乏这方面的知识。我们该如何改变这种现状呢？首先，我们需要量化虫害生物防治机制的潜在价值，并让更多的人认识到这一价值。应该把这类信息的传播当作首要任务，例如通过农业推广服务，而且还可以通过这种服务分享有关农业化学品的健康风险以及负面环境影响的信息。

但是，仅仅共享信息还不够。

其他非经济层面的障碍仍然存在。(至少从短期来看)，自然虫害防治机制的风险和不确定性似乎比杀虫剂更高。这类问题我们可以通过保险计划、农业种植策略培训等方式来加以解决。通过培训和宣传也有助于农民树立信心，放弃杀虫剂，选择害虫的自然防治机制。

所以，下次你再看到瓢虫时，不要只顾着许愿。要感谢它为我们经济做出的贡献。珍视瓢虫和其他昆虫、动物的作用，这对于我们做出最佳决策，有效管理我们的食物系统、商业活动和生活环境都至关重要。☺

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张巍，国际粮食政策研究所(IFPRI)以及国际农业研究协商小组(CGIAR)水、土地和生态系统(WLE)研究计划的研究员

Swapping pesticides for beetles could put money in farmers' pockets

Doubling the number of ladybirds in their fields could give cotton growers an extra US\$300 million a year

□ Zhang Wei

Every time you see a ladybird beetle, you should tuck the bug in your wallet as they are prosperity-bringing lucky charms, according to folklore in many countries.

There's a grain of truth in the old stories. Every ladybird in a cotton field in the North China Plain provides an economic benefit to farmers of at least 0.05 yuan (US\$ 0.01).

This may not sound like much, but doubling the current ladybird density in two-thirds of Chinese cotton fields could bring farmers around US\$300 million per year.

Ladybirds eat aphids that destroy cotton plants. Chinese farmers generally kill aphids using chemical insecticides. Long seen as the easiest and most affordable pest control method, insecticides are used on a mass scale worldwide.

Natural solutions

But chemical insecticide use suppresses the services nature offers for free. For aphids, the pretty and popular red and black beetles are vicious predators. Unleashed onto a field, it is estimated that one ladybird can kill 50 aphids per day, or some 5,000 in its lifetime.

Combining insect sampling and household surveys our research found significant economic benefits arising from ladybird beetles (for insect geeks: it's mainly *harmonia*

axyridis, *propylea japonica*, and *coccinella septempunctata*). We've calculated that each adult bug provides services worth 0.05 yuan per year, even alongside substantial insecticide use.

But most farmers don't know this.

Chinese fields host about 13,500 ladybirds per hectare. Doubling the average density of our spotted friends could potentially increase farmers' income by 644 yuan (US\$93.67) per hectare. Spread across two-thirds of cotton acreage in China, and that's nearly two billion yuan (US\$290.8 million) pumped into the economy per year.

Wide benefits

Proliferation of ladybird beetles could address more than the aphid problem. There are health and environmental benefits to farmers and society if chemical insecticide use is reduced.

Excessive use of insecticides by Chinese farmers carries environmental costs as the chemicals infiltrate food, water and ecosystems.

Insecticide exposure can cause negative health effects to farm workers, consumers, residents and livestock.

Excessive pesticide use also disrupts natural pest suppression systems by killing not only pests but other

Five facts about ladybirds

- Ladybugs are not in fact bugs, but beetles
- The lady in the name ladybird refers to the Virgin Mary. In the Middle Ages, farmers whose crops were plagued by the beetles would pray to the Blessed Lady for deliverance
- Ladybirds are cannibals
- The properties of ladybird wings are currently being researched for robotics, mechanics and aerospace engineering (for their storage qualities and strength)
- Ladybirds release noxious compounds from their knees when threatened

farmers may reduce insecticide use even further, though additional incentives may be needed. However, the value of ladybird beetles and other natural predators could rise, creating the

important organisms, such as ladybirds, feeding into a vicious cycle of increasingly frequent pest outbreaks due to pesticide resistance.

Pesticides can also undermine the profitability of farms. Insecticide use is expensive and can put farmers on a “pesticide treadmill” where they forgo other solutions. China’s farmers could bolster their long-term bottom line by purchasing less insecticide.

Escalating gains

Our research shows that the less pesticides farmers use, the more ladybirds can expand their aphid-killing services.

If we cut current, excessive insecticide use of 22.35 kilogrammes per hectare to one quarter of this amount, the marginal value of the ladybirds would rise from more than two and a half times, from 48 yuan (US\$6.98) to 118 yuan (US\$17.6) per hectare.

Once the biological control services – in this case ladybird services in cotton fields – begin to flourish,

virtuous cycle that sustainable agriculture urgently needs.

The findings provide a strong economic, health and environmental case for policies that move away from chemicals and provide more support to farmers to reduce pest risks.

But too often, farmers and policymakers lack this knowledge. How can we change this? First, we need to quantify and disseminate the hidden values of biological pest controls. Communicating these should be prioritised, for example, through the agricultural extension service, which can also share information on health risks and adverse environmental effects of agrochemicals. ☞

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中国海洋保护区命运迎来拐点？

生态领域的强力改革，能否扭转中国近海生态保护与开发之间屡败屡战的局面？

□ 张 春

1963年，中国在位于渤海湾、不足一平方公里的大连蛇岛建立了第一个海洋保护区，保护生存在这里和附近海域的上万条蝮蛇；1980年，蛇岛和附近的大连老铁山一起被批准国务院批准为国家级自然保护区。

此后的近40年，中国近海海洋保护区建设开始了与经济快速发展的漫长赛跑。沿着中国1.8万公里的海岸线，各种大大小小的保护区被建立起来。截至2017年，中国海洋保护区面积近12.4万平方公里，占中国管辖海域面积的4.1%。

但各地热火朝天的围填海和沿海开发不断蚕食着保护的成果。几乎与保护区建设同步发生的是，上世纪后50年内，中国损失了53%的温带滨海湿地、73%的红树林和80%的珊瑚礁；中国沿海的河口、海湾、滩涂湿地，因污染排放导致的水体富营养化、重金属污染等，多数处于亚健康状态。保护在多数情况下输给了开发。

随着中国领导层近年来提出“生态文明”等顶层设计理念，并推行大部制改革和生态红线政策，中国近海环境保护是否有望重复中国在

气候变化和空气污染等问题上的故事，迎来“拐点”？这个问题的答案事关未来中国渔业捕捞、水产养殖和沿海开发的走向。

从无到有

中国海洋保护区建设的历史几乎与中国环境保护的历史同步。1980年蛇岛建成第一个国家级海洋保护区之后三年，中国将“环境保

护”确立为一项基本国策。1982年《中华人民共和国海洋环境保护法》（简称《海洋法》）通过，海洋保护区建设有了明确的法律依据。1990年，负责制定和执行海洋保护相关法规的国家海洋局，设立了其管理的首批5个国家级海洋自然保护区。由国务院制定的专门管理海洋保护区的《海洋自然保护区管理办法》也于1995年应运而生。

中国主要的海洋自然保护区，



大连的蛇岛是中国的首个海洋保护区。来源：百度地图

大多在《海洋法》通过后的 20 年间建立。例如位于渤海湾的辽宁大连斑海豹国家级自然保护区，于 1992 年建立，1997 年升级为国家级自然保护区，是中国面积最大的自然保护区之一，也是为数不多的海洋哺乳类动物保护区。

2000 年以后，国家海洋局开始将重心放在“海洋特别保护区”的建设上。相比海洋自然保护区，海洋特别保护区的概念更宽泛。除了“海洋生态系统敏感脆弱和具有重要生态服务功能的区域”，它还可以用来保护历史文化遗迹，甚至那些适合进行未来产业发展的预留区域。国家海洋局海洋环境监测中心湿地中心副主任廖国祥表示，海洋特别保护区其实是在有效保护和科学利用之间寻找平衡的尝试。

2002 年，福建建立了中国第一个地方政府批准的海洋特别保护区。由海洋局制定的、专门管理海洋特别保护区的《海洋特别保护区管理办法》于 2010 年颁布。相比起需要国务院批准才能设立的国家级海洋自然保护区，海洋特别保护区的设立只需获得国家海洋局批准，审批级别相对较低。截至 2016 年，中国已经有了近 80 个国家级海洋特别保护区，包括各类海洋公园、重要的海岛和油气资源开发预留区域等。

在经历了近 40 年的建设，特别是近几年的积极发展后，中国近海形成了 12.4 万平方公里的海洋自然保护区和特别保护区网络，相当于英国国土面积的一半。2012-2017 年 5 年期间，中国海洋保护区占中国管辖海域面积的比例，就从 1.2% 提升到了 4.1%。中国似乎迎来了海洋保护区建设的高潮。

不过相比世界各国管辖海域内平均 14.4% 的保护率，这个数据还很低；比起 2010 年国际生物多样性公约缔约方大会达成的在 2020 年将各国 10% 管辖海域纳入保护的目标，也还有不小距离。

参差的保护效果

和全球其他国家的海洋保护区一样，虽然名为“保护区”，但不同的海洋保护区保护力度不同。有研究认为，要取得理想的保护效果，一个海洋保护区需做到禁渔、监管得力、建立时间长(大于 10 年)、面积足够大(大于 100 平方公里)以及有天然屏障阻隔人类活动。至少要有其中三个要素，才能实现有效保护。

如果按照上述标准，中国只有早期建立的部分国家级自然保护区符合要求。几乎近十年才开始大规模建设的海洋特别保护区，因为在设计中就或多或少允许一定程度的开发，其保护效果要打上折扣。

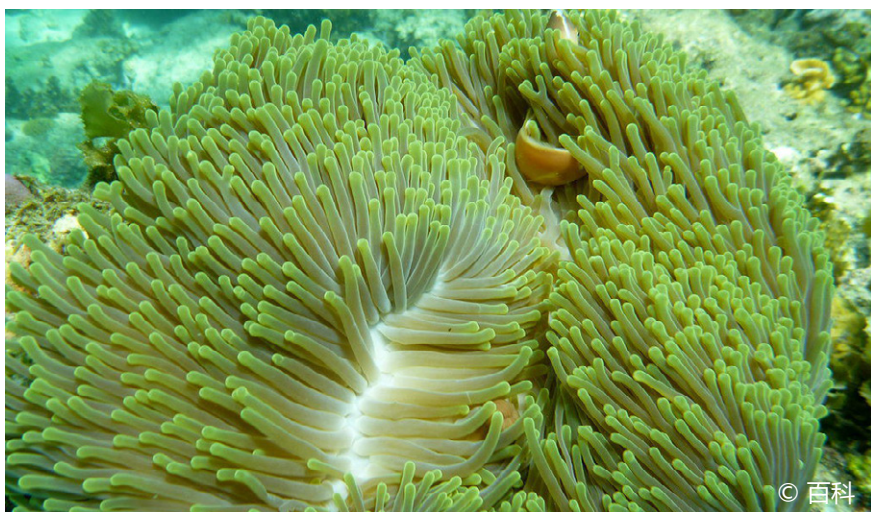
世界自然保护联盟(IUCN)中国代表处代表张琰说，中国的海洋

特别保护区试图平衡开发和保护功能，通常只能对应到 IUCN 第五类保护区——同时满足保护和游憩需要的景观保护区，距离高等级的保护区尚有距离。而海洋特别保护区中的“潜在矿产、油气开发区”的保护等级甚至更低。

当然，保护效果打折，也与中国保护区多部门管理力量分散、以及监督力量不足有关。

国家级自然保护区因为由国务院统一批复，且多数有专门管理机构，管理层级较高，保护效果相对较好。国家级海洋特别保护区则全部由海洋局批准管理。除此之外，各种层级更低的保护区则由许多部门批准和监管，如农业部门管理“水产种质资源保护区”，林业部门管理的“湿地保护区”，以及环保部门参与管理的多种类型保护区等。

这种分割管理模式，不仅导致单个部门想要申请大型保护区并不容易，也使得部门间争相划定保护区，同一区域可能有多部门管理。如江苏盐城珍禽(丹顶鹤)国家级自然保护区，归环保部门管理；与这个保



徐闻国家级珊瑚礁自然保护区

近十年才开始大规模建设的海洋特别保护区，因为在设计中就或多或少允许一定程度的开发，其保护效果要打上折扣。

保护区重叠的还有一个国家级麋鹿保护区，归林业部门管理。一些海洋特别保护区，也同时挂了风景名胜区的牌子，同时接受海洋局和旅游管理部门的监管以及资金支持。

“中国海洋保护区管理是比较乱的，在（2018年3月大部制）改革之前，涉及海洋保护区管理的部委非常多，包括国家海洋局、国家林业局、农业部、环保部、国土资源部等。”廖国祥说。

世界自然保护联盟（IUCN）报告认为，由于海域环境的使用由数量繁多的社会群体分享，最理想的情况是由一个政府部门管理一个保护区内所有的活动，并在保护区的设计阶段充分纳入多个当地利益相关方的意见。

保护和开发并进

部门分割还不是中国海洋保护区面临的最大威胁。中国过去四十年大规模的经济开发对中国近海环境保护的努力带来了最直接的冲击。

上个世纪，中国沿海共有过三轮大规模填海，包括建国初期的围海场建设，上世纪六七十年代的围海造田，以及上世纪八九十年代的围海养殖潮。

进入新世纪后，沿海经济发展加速，大型沿海港口、临海工业园、

沿海经济带开发纷纷向海要地，掀起了第四轮围填海潮。

改革开放带来的生产力解放也激发了中国近海渔业的大发展，从1995年开始近海捕捞总量就在每年1000万吨以上，大大超过渔业专家建议800万-900万吨的最大可捕捞量。

保护和开发，就像在赛跑。原本应当受到保护的区域被开发的情况屡见不鲜。仅2005—2012年间，就有辽宁蛇岛老铁山国家级自然保护区、江苏盐城湿地珍禽国家级自然保护区等9个沿海、海洋自然保护区的面积被调减，调减面积达5756.77平方公里。

2018年7月25日，国务院发布《国务院关于加强滨海湿地保护严格管控围填海的通知》，试图给激进的沿海开发和围填海踩刹车。

国家海洋二局研究员曾江宁在文章中提到：“自然岸线的大量消退、滩涂成块连片的快速消失和浅海高强度的渔业捕捞活动造成近海生物多样性的下降。”

海洋生态红线

从2012年起，在国务院监督之下，渤海湾三省一市（辽宁、山东、河北、天津）开始了“海洋生态红线”的试点。海洋保护区建设似乎出现了转机。

在试点基础上，2016年，国家海洋局出台了《关于全面实施海洋生态红线制度的意见》，标志着全国海洋生态红线划定工作全面启动。

中国政府早在2011年就提出“生态保护红线”概念，但直到2017年2月，中共中央和国务院共同发布《关于划定并严守生态保护红线的若干意见》，明确提出地方各级党委和政府是严守生态保护红线的责任主体，生态红线作为一项环境政策才慢慢展现出它的约束力。

全国生态红线制度给乱象纷呈的海洋开发带上了新的“紧箍咒”，其中一条红线就是海洋生态红线区面积占沿海各省（区、市）管理海域总面积的比例不低于30%。

这个目标给创造更大的海洋保护区提供了想象空间。山东大学威海分校海洋学院教授王亚民认为，海洋生态红线的设立是为了抢救性地保护一些生态系统。“一个国家级海洋自然保护区的建设，大约需要10年的时间”，他说，“等待建立保护区太慢了。”

红线区域分为禁止开发区和限制开发区。按照红线划定准则，所有的海洋自然保护区都属于禁止开发范围之内，而限制开发区域，主要是一些尚未纳入保护范围但有保护价值的区域，如重要渔业水域、滨海湿地，珍稀濒危动物集中分布区等。

“如果把所有的红线保护区算进来，中国受保护的海域面积将大大增加。”廖国祥说。

虽然廖国祥和王亚民都看好海洋生态红线的保护作用，但到目前为止，海洋生态红线的划定尚无法律依据，“限制开发”这样的模糊规定恐怕也难以保障红线区域的保护效果和力度。

近海生态管理格局巨变？

2018年3月，中国公布国务院大部制改革方案，将国家海洋局、国土资源部、水利部、农业部等下辖的自然保护区，风景名胜区、自然遗产、地质公园等统一归入自然资源部下新组建的国家林业草原局管理。

那就意味着，由多部门分散管理多年的各类海洋保护区，终于有望归入一家了。此前因为部门分割、陆海分治造成的海洋保护区管理问题，在中央政府强力推进生态文明建设的背景下，出现了改善的曙光。

但大部制改革只是开始。一些工作的落实还要等待各部委下属职能机

构设置完全后确定，而这些后续改革会影响到保护区的保护效果。

例如，在改革之前，环保部每年会对全国所有的自然保护区进行视察，并出具年度环境公报。现在自然保护区全部归入自然资源部管理。自然资源部是否还会延续环保部此前对保护区的环境监督手段，尚没有定论。

此外，各类海洋保护区快速增加带来的管理挑战，以及如何整合原来分散在各部门的管理法规，都是近期要面对的问题。

“一些类型的海洋保护区，如渔业保护区，已经（建设了）几十年了，积累了一些好的管理经验。（改革后）

渔业部门会把所有的经验都交给一个原来以陆地保护为主的部门吗？”

上海交通大学凯原法学院教授，海洋法专家薛桂芳表示。

但薛桂芳教授同时认为，改革过渡期虽会涉及到许多部门利益的调整和纠缠，但是中国加强海洋保护的趋势是明确的。^⑤

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张春，中外对话高级研究员

How ‘viper island’ started a wave of coastal conservation

Environmental reforms promise stronger safeguards for China's coastline

□ Zhang Chun



© Xinhua / Alamy Stock Photo

White cranes fly over the Melmeg Wetland in northeast China's Jilin Province

Shedao island is only small but it's home to thousands of pit vipers, a snake that wraps itself around tree branches so that it can ambush small migrating birds.

The island, which lies about 10 kilometres south-west of China's Liaoning peninsular is less than one square kilometre in size. It became China's first marine reserve in 1963 to protect the vipers.

The State Council then expanded it in 1980 to include Laotieshan, a forested mountain area on the nearby mainland that supports egrets, cranes and Mandarin ducks,

thereby covering the pit vipers' entire known habitat. In doing so, the government created a national nature reserve – just the first of several that were approved in the early 1980s.

But the successful protection of the pit viper is not typical. Despite the creation of reserves, conservation in China's coastal areas has mostly lost out to development. This has resulted in the rapid and severe degradation of ecosystems, even in areas that have some protections in place.

This may be about to change. The new Ministry of Natural Resources, which emerged from the government

restructuring in March, has taken on and unified some of the powers from other government bodies. This should address the problem of weak and competing oversight that has hampered conservation.

Pollute first, conserve later

By 2017, China had designated marine reserves of 124,000 square kilometres – 4.1% of all coastal waters along the country's 18,000-kilometre coastline. The area is equivalent to half the total land area of the United Kingdom.

Nonetheless, 4.1% is low by international standards. The average for countries that have placed national waters under protection is 14.4%. China is also far from the target set by signatories to the Convention on Biological Diversity in 2010. This called for 10% of national waters to be protected by 2020.

And marine reserves do not guarantee complete protection. Within China's reserve boundaries, economic development and human activity is restricted and controlled but land reclamation and coastal development have limited the effectiveness of reserves even as they were being created. By 2000, China had lost 53% of its temperate coastal wetlands, 73% of its mangrove forests and 80% of the coral reefs it had in 1950.

Among other causes, such losses have resulted from run-off of agricultural fertilisers and seepage of heavy metals that have fouled many river mouths, bays and wetlands.

The future of China's fishing and aquaculture industries and the direction of its coastal development rests with the new ministry and its ability to deploy effective oversight. In particular, this means using the system of "ecological red lines" that set strict limits on pollution, and which fall under the concept of "ecological civilization".

Legal changes

As China has adopted wider and more stringent environmental policies, it has protected more areas.

Three years after Shedao was made a national nature reserve in 1980, environmental protection became a basic national policy. A national environmental protection conference marked the turning point.

The 1982 Marine Environmental Protection Law provided a legal basis for establishing marine reserves and spurred a wave of new ones over the following 20 years.

In 1990, the State Oceanic Administration (SOA), which is responsible for defining rules on marine conservation, established the first five national marine nature reserves. In 1995, the State Council introduced regulations on the management of marine nature reserves.

China's largest marine reserve protects spotted seals in the Bohai Sea. It was established in 1992 and given national marine reserve status in 1997.

Between 2012 and 2017 the percentage of China's waters covered by reserves grew from 1.2% to 4.1%.

Balancing economic growth and conservation

Since 2000, the SOA has focused on creating marine special reserves (MSR). These permit limited economic development and are broadly defined to include areas of natural, historical or cultural importance.

Liao Guoxiang, deputy head of the Wetlands Centre at the SOA's National Marine Environmental Monitoring Centre said marine special reserves permit some economic development in an attempt to balance protection and reasonable use. They can be used in areas earmarked for development.

Three years after Shedao was made a national nature reserve in 1980, environmental protection became a basic national policy. A national environmental protection conference marked the turning point.



National Coral Protected Area at Xuwen, Guangdong province

The first MSR to be set up by a local government was in south-west China's Fujian province in 2000. SOA, which approves marine special reserves released management regulations in 2010. In contrast, State Council approval is needed for national marine nature reserves, which tend to be larger, more ecologically valuable and have more robust protection.

By 2016, there were around 80 marine special reserves, including marine parks, islands, and oil and gas exploration sites, and 35 national marine nature reserves.

Weak, competitive, divided

According to research published in *Nature* in 2014, the most effective marine reserves ban fishing, strictly enforce rules, occupy a minimum of 100 square kilometres, have been in existence for at least a decade, and have natural barriers to human activity. At least three of these factors need to be in place for protection to work.

But only a few of China's national marine reserves meet that standard. China has focused on creating marine special reserves since 2000 but these are less likely to provide sufficient protections because they permit development.

The International Union for Conservation of Nature

has six protected area categories based on different management objectives. China's marine special reserves generally rank in the lower categories, according to Zhang Yan, the IUCN's representative in China. Many are Category V, defined as "seascape areas with both tourism and protection functions". Category VI includes reserves where oil, gas or mineral extraction is permitted.

National marine nature reserves tend to be better managed and protected than MSRs, with more robust rules and a dedicated management body. This is because they are approved by the State Council, a higher authority than the SOA.

However, the weak protection for China's marine reserves is also partly due to divided management and oversight because they are split across different government departments.

There are lower categories of reserves approved and overseen by many other agencies, such as the Ministry of Agriculture's "marine product genetic resource reserves"; the forestry authorities wetland reserves; and those run by the Ministry of Ecology and Environment.

This makes it harder for a single department to establish a large reserve and leads to competition between departments and a proliferation of managers. For example, the Yancheng Red-crowned Crane Nature Reserve in Jiangsu province is managed by the environmental authorities but overlaps with a deer reserve managed by the forestry authorities.

Some marine special reserves hold special scenic area status and are overseen and funded by both the marine and tourism authorities.

"Management of reserves in China is a bit confused,"

Liao explains, listing the departments involved in running marine reserves prior to the March 2018 reforms as the State Oceanic Administration; the State Forestry Administration; the Ministry of Agriculture; the Ministry of Ecology and Environment; and the Ministry of Land and Resources.

The IUCN favours having one government body to manage all activity within a single reserve and conduct consultations with local stakeholders when a reserve is planned.

Economic challenges

Economic development in China over the past four decades has brought huge changes that have wreaked havoc on coastal environments, while weak management of marine reserves exacerbated their impact.

Since 1949, there have been three waves of land reclamation: to build large salt evaporation ponds in the early years of the People's Republic; to create farmland in the 1960s and 1970s; and to expand aquaculture and in the '1980s and '1890s.

Coastal fisheries expanded from the 1980s: commercial fishing was widely permitted and demand increased. Annual catches reached 10 million tonnes or more in 1995, outstripping the eight or nine million tonnes that experts viewed as sustainable.

Economic growth moved even faster from 2000, driven by foreign investment in export industries; more coastal lands were reclaimed for ports and industrial and economic zones.

Development and protection were in competition. From 2005 to 2012 nine coastal or marine reserves shrunk by a total of 5,756.77 square kilometres – including the Shedao and Laotieshan national reserve and Yancheng national reserve.

To rein in excessive coastal development, the State Council published a notice on July 25, 2018 on stricter management of reserves and controls on land reclamation.

“The rapid loss of large stretches of natural coastline and shallows and intense fishing in shallow waters have reduced coastal biodiversity,” says Zeng Jiangning, a researcher with the SOA's No.2 Ocean Institute.

Seeing red

A new approach based on “red lining” sensitive areas promises to improve environmental protection. Marine ecological red lines have been trialled since 2012 under State Council supervision in Liaoning, Shandong, Hebei and Tianjin, which all border the Bohai Sea.

In 2016, the SOA built on those trails with a document on the full implementation of the red line system that will roll them out nationwide.

Ecological red lines were first proposed in 2011 but it was not until February 2017 that the Central Committee and State Council published enforcement guidelines. By making local party committees and government responsible for observing the red lines, it finally became a policy with binding force.

National red lines brought the chaos of marine development under control by making larger marine reserves possible. One red line mandated each coastal province to classify at least 30% of its coastline a marine ecological red line area.

Creating marine red lines rescued certain ecosystems, according to Wang Yamin, a professor at the Marine College at Shandong University's Weihai campus. “It takes 10 years to get a national marine reserve set up,” he says. “That would be too late.”

“It takes 10 years to get a national marine reserve set up. That would be too late.”

— Wang Yamin, professor at the Marine College at Shandong University's Weihai campus.

Red line areas can ban or limit development. Marine reserves will ban development; areas which are not yet protected but are worth protecting will see development limited –

for example key fishing grounds, coastal wetlands, or areas supporting rare animals.

Liao Guoxiang says that the area of China's waters under protection "is set to increase significantly", if all the red line areas are taken into account.

However, there is still no legislative basis for how red lines should be set. And vague language such as "limiting development" may not provide effective protection.

Unified management at last

Unified management is on the way. Reforms to China's ministerial structure published in March 2018 will see the National Forestry and Grasslands Bureau within the new Ministry of Natural Resources take over running nature reserves, scenic areas, natural heritage sites and geoparks that are currently divided between the SOA, Ministry of Land and Resources, Ministry of Water Resources and the Ministry of Agriculture.

It will solve a major long-running problem as part of the drive for "ecological civilisation".

But ministerial reforms are only the beginning. Some tasks will have to wait until sub-ministerial functions and structures have been finalised, and those follow-up changes will also impact on how effective China's nature reserves are.

For example, prior to the reforms the Ministry of Environmental Protection would carry out annual checks on all nature reserves nationwide and publish a report on its findings. Now, all reserves are managed by the Ministry of Natural Resources – and it is not yet known if it will continue this practice.

Future challenges

The rapid increase in the number of marine reserves also presents challenges, as does consolidating different local rules on management of reserves into a single system.

"Some types of marine reserves, such as fishery reserves, have been in place for decades and a lot of experience has been accumulated. Are the fishery authorities going to pass all that accumulated experience onto a body that previously only managed reserves on land?" asks Xue Guifang, a professor to the University of Shanghai's Koguan School of Law and an expert on marine law.

Xue believes conflicts will arise as ministerial powers shift during the transition period, but the trend toward tougher marine protection is clear. ☞

Our thanks to the Crossborder Environment Concern Association for their assistance with this article.

Zhang Chun is a senior researcher at chinadialogue.

公海生物多样性谈判 需解决机制性问题

各国期望达成管理公海生物多样性的国际条约，
但谈判需要解决全球条约与现有区域和行业机制之间关系的问题。

□ 陈冀俚

在刚刚过去的9月，全球各国政府代表在纽约联合国总部进行了公海生物多样性条约（BBNJ）的第一次政府间谈判。如何在公海现有的行业 and 区域机构基础上，建立全球海洋保护区设立程序和制度，是谈判的4个重要组成部分之一。

BBNJ 谈判旨在保护公海生物多样性、保障生物资源可持续利用，其历程可以追溯到2004年联合国建立公海生物多样性研究小组，不过直到2017年才定下政府间正式谈判的计划。因为谈判涉及的区域面积占全球总面积的45%，其结果的生态影响巨大而深远，堪比气候领域的“巴黎协定”。

人们期待谈判中的法律文书，能够支持在公海建立保护区系统，以此终结公海中各种区域和行业组织“碎片化”管理，为公海的生物多样性的利用和养护提供综合全面的制度安排。但谈判需要解决一些根本的机制问题。

不损害现有机制

说到海洋保护区，现有的行业 and 区域性机构很多已经开展了海洋保护区选划的工作。这些机构包括但不限于：管理海底矿产开发的国际海底管理局（ISA）、保护区域性自然文化遗产的联合国教科文组织（UNESCO）、管理农林渔业的联合国粮农组织（FAO）、促进航运安全的国际海事组织（IMO），以及旨在保育全球生物多样性、促进可持续利用的生物多样性公约（CBD）等。

这些机构或条约下已经设立或建议划定的保护区保护力度各不相同。例如CBD进程下划定的生态或生物重要区域（EBSAs），只是识别出来的优先区域，并无实际保护行动；区域渔业组织（RFMOs）所设立的临时禁渔区，海事组织设立的排放控制区等，则不仅识别了区域，而且确定了边界和相应的管理措施。

“不损害现有机制”是BBNJ条约谈判的重要原则，也是各国的基本共识。一方面，现有的机制对于自己管辖范围内的活动已经形成了一



挪威卑尔根市某三文鱼海洋牧场

套运行中的管理机制，新的条约没有必要推翻重来；另一方面，现有的机制也不愿意失去自己的地位，被新的协定替代或者成为其附属。现有区域和行业组织如何与 BBNJ 的海洋保护区进程相协调，是协议谈判中的关键问题之一。

前车之鉴

现有的一些国际公约就存在与区域/行业组织机制协调的问题。《奥斯陆巴黎保护东北大西洋海洋环境公约》(OSPAR) 的缔约方大会于 2010 年通过了建立海洋保护区网络的决定，迄今已经建立了 7 个公海保护区。但 OSPAR 自身没有相应海域的管理权限，遂通过缔约方国家在其所在的区域组织内合作，促使区域组织采纳相应的安排。

实践中，有些区域组织，如东北大西洋渔业组织就采纳了 OSPAR 的安排，将其管理权限区域内的相应区域设为禁渔区。但也有一些组织，如国际海底管理局和国际海事组织，至今仍未作出相应决定。OSPAR 在实践中出现的困难体现出了区域/行业组织对于来自外来影响力的抵触。这也是“不损害现有机制”原则的现实根源。

新的 BBNJ 协定是否要超越这种模式，代表全人类对区域/行业组织起到监督和指导的作用，是谈判的焦点之一。如果 BBNJ 条约的缔约方大会可以直接要求区域/行业组织执行关于保护区的决定，一方

面将有可能动摇“不损害现有机制”的原则，另一方面也带来了保护区外国家的决定权与区域组织成员国决定权的权重问题。区域外的国家有权决定区域内国家如何使用相应海域吗？是否可以赋予域内国家一票否决权？这些问题都需要谈判来解决。

各执己见

在 BBNJ 的海洋保护区讨论中，已经形成“全球模式”、“区域模式”及“混合模式”三种管理机制的选项。三种模式的关键区别在于谁掌握最终决策权。

全球模式主张建立一个全球机构，进行统一管理和决策。区域模式强调区域主体的决策权，不建立全球层面的监管，而是发挥区域组织的作用并利用其已有经验。混合模式主张强化区域保护机制，但同时提供国际统一的指导和监督。

在刚刚结束这轮谈判中，环保组织和发展中国家普遍支持的是全球模式，希望等级更高的国际条约能够有力地敦促行业和区域组织加大力度建设保护区。区域和行业组织原本在结构上优先对自己的成员利益负责，而 BBNJ 条约一旦缔结，原则上这些机构就需要回应来自于条约所代表的“全人类”的保护需要。

区域模式的支持者较少，其代表是俄罗斯。事实上，俄罗斯一直反对 BBNJ 条约的谈判，认为现有机制已经足以解决公海生物多样性的问题。

混合模式的支持方主要是发达国家，其中有一些是传统的海洋强国。采取这种立场的原因可能一方面是要保持自己原来在区域组织内的优势，另一方面需要 BBNJ 条约为自己将来在区域组织内的议程提供支持。例如，新西兰是个渔业强国，也很注重渔业资源的养护，BBNJ 条约的保护区建议可能可以支持其在区域组织中关于设立禁渔区的诉求。

中国在发言中没有明确表态支持哪个模式。但从之前的谈判发言来看，中国认为“新的国际文书在多数情况下不会与现有文书或机构所规定的海洋保护区措施发生重叠”，因此 BBNJ 协定不会对现有区域和行业运行机制进行干预。不同于俄罗斯的是，中国支持通过 BBNJ 条约的缔约方大会来做出设立保护区的决定。

谈判下一步

按照 BBNJ 谈判计划，在 2020 年结束之前还有 3 次谈判。这 3 次谈判将对今年 9 月会议上收集的建议进行选择、合并和精简，最终形成条约的文本。是否能够达成一致，不仅取决于条约与各种机构组织、国家之间利益的平衡，也取决于各方对保护区潜在价值的认识。

就像《科学进展》八月号的社论结尾所说的，公海制度的建立“将考验我们的人性、合作能力以及我们对未来的集体想象”。^⑤

陈冀浪，创绿研究院海洋治理项目研究员

Governments thrash out treaty to save the high seas

Talks must overcome a web of vested interests before a biodiversity charter can be agreed

□ Chen Jiliang

The first round of talks to establish a new treaty to protect marine life and biodiversity in the high seas took place at the United Nations in New York in September, with the goal of finalising a treaty in 2020.

The intergovernmental talks to protect biodiversity beyond national jurisdictions (BBNJ) lasted two weeks and covered four key topics, with the aim of ensuring all nations can share equally and sustainably in the benefits and resources – biological and mineral – of the high seas, which cover 45% of the planet's surface and are home to 90% of marine life.

The over-arching question of what powers a new treaty will have, and who will wield them, was among the most complex the delegates discussed. Resolving it will be crucial to the outcome. But we do know that establishing reserves to protect marine genetic resources touches on two of the core goals set for the talks.

Multiple stakeholders

There are multiple intergovernmental organisations and regional agreements that have vested interests in how the deep sea is run. An effective treaty must put in place governance arrangements that end the fragmentation of the deep sea. Yet success will depend upon the consent of these organisations, and many governments, in order to put

mechanisms in place for conservation and utilisation of marine biodiversity.

Conference president Rena Lee of Singapore referred to this dilemma in her closing remarks.

“It will not always be smooth sailing. We will not always paddle in the same direction. But, if we continue in co-operative, flexible and committed mode, we will reach our destination one day,” she said.

Upsetting the status quo

At least 16 regional and sectoral organisations are already involved in marine reserves. They include the International Seabed Authority (ISA), which oversees mineral extraction from the seabed; the Food and Agricultural Organisation (FAO); the International Maritime Organisation (IMO), which promotes maritime safety; the Convention on Biological Diversity; and UNESCO, which deals with natural and cultural heritage.

However, marine reserves do not provide a uniform level of protection. For example, the Convention on Biological Diversity's Ecologically or Biologically Significant Marine Areas offer no conservation whatsoever; it merely recognise an area's importance. Regional fishery management organisations impose temporary fishing bans in certain areas, while the IMO designates emissions control areas –

in both cases identifying boundaries and putting appropriate measures in place.

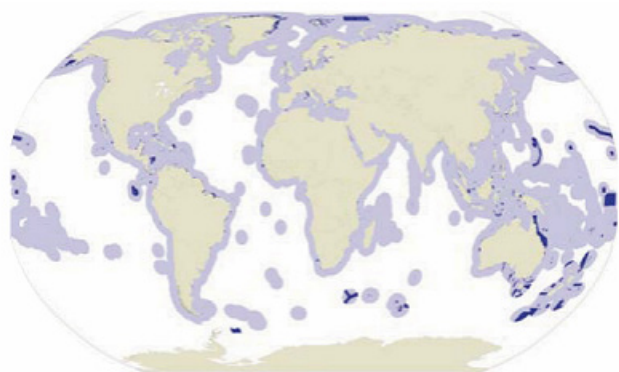
There was consensus at the BBNJ talks that such mechanisms should not be undermined by a new high seas treaty. So the question remains: how will new BBNJ marine reserves coexist and interact with systems that are up and running within their jurisdictions.

Implementation risks

In fact, there are already examples of co-ordination problems between international treaties and regional and sectoral organisations.

For instance, a 2010 conference of Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) agreed to set up a network of marine reserves, with seven already in place in international waters. But OSPAR does not have the right to manage activity in those reserves, and relies on the convention's signatories to encourage regional bodies they are members of to put in place measures.

The results are uneven and undermine conservation. The North East Atlantic Fisheries Commission has banned fishing in the areas suggested by the OSPAR Convention. But the ISA and IMO have not done the same. This shows how regional and sectoral bodies can resist external pressure. Such resistance is likely to be a major hurdle facing the BBNJ talks.



Marine protected areas of the world = 5,878 sites. The purple shading shows an approximation of areas of potential national jurisdiction (200 nautical miles from all coasts). Source: IUCN

A key question is whether a new BBNJ deal should go beyond the existing model and provide oversight and guidance for regional and sectoral bodies. But requiring signatories to such a deal to ensure regional and sectoral bodies implement BBNJ decisions on reserves challenges the principle of not undermining existing mechanisms. It also raises questions on how the powers of countries within regional bodies are balanced with those that are not.

Do countries outside the region have the right to decide how those within the region use international waters? Should countries in the region have a veto? The talks will have to address these questions.

Three options

Three possible models for BBNJ nature reserves are under discussion:

- a global model, with a single body to manage these reserves worldwide;
- a regional model, relying on existing regional organisations and their expertise;
- a combined model emphasising regional conservation mechanisms, but adding an international body for oversight and guidance.

In the September talks, the global model emerged as the most popular with environmental groups and developing nations, which believe that a higher-ranking international body would exert pressure on regional and sectoral organisations to create reserves.

It was viewed as the best chance of counteracting the tendency of regional and sectoral bodies to put their members' interests first, as a BBNJ treaty would in principle require them to respond to the needs of "humanity as a whole".

The regional model had fewer supporters and is being pushed by Russia, which has consistently opposed talks on a BBNJ treaty, arguing that existing mechanisms are adequate.

The combined model gained most support among developed nations, including some traditional seagoing powers. They want to maintain their existing membership benefits within regional bodies and use

the additional powers of a BBNJ treaty to address key interests and concerns.

For example, as a major fishing nation New Zealand is concerned about conservation of fish stocks, so sees a treaty providing support for its calls to ban fishing in regional fishery management organisations (RFMOs).


China's negotiators did not express a preference during the talks, though the country has previously stressed its support for existing regional bodies.

On September 7 Ma Xinmin, head of the Chinese delegation to the BBNJ negotiation, says: "The new international instrument in most cases will not overlap with the MPA measures under existing instrument or bodies." However, unlike Russia, China supports a treaty with the power to set up BBNJ marine reserves.

Xinmin also stressed that agreements should be reached by consensus, as majority voting can produce decisions that lack sufficient support.

Two years to make it work

Three further rounds of negotiations are due to take place, with the next one tentatively scheduled for March 25 2019. Success will depend not just on how the treaty balances organisational and national interests, but also the value the various parties place on the potential BBNJ reserves.

As an editorial in August's Science Advances magazine rightly concluded: "The high seas, like everything on Earth, are a limited resource. How we choose to protect and use its precious resources will test our humanity, our cooperation, and our collective vision for the future." 

Chen Jiliang is a researcher at Greenovation Hub, a non-governmental organisation based in Beijing.

“幽灵渔具”之忧

废弃的渔网在海洋塑料垃圾中占很大比例，海洋生物和渔民都将为此付出巨大代价。

□ 伊丽莎白·霍根

自从清理海洋塑料成为全球优先事项以来，各种解决方案纷纷涌现，比如一次性塑料产品的替代品、可重复使用的购物袋、金属咖啡杯和水壶、禁用饮料吸管、以及采用其他形式的包装等。

虽然这些选择都很必要，收到的反响也不错，但海洋塑料中还有很大一部分是丢失和废弃的渔具，这个问题的处理更具挑战性。

一段时间以来海洋塑料备受关

注，但丢弃的渔网（也称“幽灵渔具”）受到的注意却少得多。2009 年联合国粮食及农业组织（FAO）估计，每年进入海洋的塑料中有 10% 是幽灵渔具，相当于每年 64 万公吨，到 2018 年达到 80 万公吨。

现在看来，实际数字可能远高于此。海洋清理（The Ocean Cleanup）的新研究表明，漂浮在太平洋环流表面的塑料垃圾中有 46% 是幽灵渔具。

一些塑料比其他的更糟

当我们谈论海洋塑料问题时，着眼的往往是如何解决其“量”的问题，很少会考虑其影响，例如，哪种类型的塑料的危害最大？

所有的海洋塑料并非“生而平等”。而渔具，即便是被丢弃后，也会继续履行自己的职责：困住并杀死海洋中的野生动物，包括鱼类、海龟、海鸟以及鲸鱼、海豚、海豹、海狮等海洋哺乳动物。一张渔网就足以杀死一片珊瑚礁，破坏整个生态系统。幽灵渔具对生物多样性、食品安全、渔民生计、物种保育、以及海洋健康都构成了危害。

这种破坏的影响是难以衡量的。幽灵渔具导致商业鱼类种群的损失，并加剧了非法和过度捕捞本就深重的影响。被幽灵渔具困住的鱼永远不会被出售、食用或繁衍后代——没有人能从中受益。

在波罗的海，一张丢弃的刺网能够破坏价值 2 万美元的海产品。幽灵渔网每年给英国刺网捕鱼船队造成 42 万欧元的损失。在美国，切萨皮克湾寻回了 3.2 万只丢失的蟹笼，困在其中的 125 万只蓝蟹意味



© Scott Leonard

美国马萨诸塞州南塔开特岛上，一只被渔网缠住的灰海豹在挣扎求生

着渔民损失了 40 万美元。而在路易斯安那州，蟹农平均每年丢失 250 个蟹笼，损失利润 400 万美元。阿曼湾每年丢失超过 1.5 万个蟹笼，损失总计 260 万美元以上。

幽灵渔具对鱼类种群的影响也对食品安全产生了巨大影响，尤其是对居住在海边、靠海而生的人。世界上 40% 的人口生活在距离海边 100 公里以内的地区，10% 的人口依靠渔业为生。贫困人口受到的打击最为严重；渔获减少意味着价格上涨，这是贫困人口所无法承受的。

除了渔民的经济损失和粮食供应的损失，幽灵渔具对其他海洋野生动物也构成了重大威胁。据估计，每年有 13.6 万头鲸、海豚、海豹和海狮死于幽灵渔具，更不用说这些动物死前遭受的漫长痛苦。

幽灵渔具造成的伤口极为骇人，会给动物带来巨大的痛苦，让其无法进食、交配以及移动。动物一旦被幽灵渔具缠住，就很难挣脱。

塑料的耐用性对渔业而言具有很大的吸引力。从原则上来说，其他材料制成的渔具虽然也有其亮点，但在实践中可能难以推广。相比有机纤维制成的绳索和渔网，塑料渔网更能抵御恶劣的天气和岩石表面的摩擦。替代材料制成的渔具价格高昂，更不用说重新下网耗时过长的问题了。许多技术替代品，如遥控浮标，可以消除垂直线导致大型鲸类被纠缠的危险，但仍过于昂贵，无法广泛使用。

政府有许多选择

要想解决幽灵渔具带来的种种影响，有一条路就是借助联合国可持续发展目标（SDGs）。几个不同的可持续发展目标针对的都是受到幽灵渔具影响的问题，例如增强食品安全、清洁水、海洋废弃物、回收部门以及生物多样性这些全球目标。联合国成员国也可以根据自身承诺，针对每个问题制定国家行动计划，以解决幽灵渔具的问题。

今年 7 月粮农组织渔业委员会（COFI）采取重大行动，通过了关于渔具标记的技术准则，要求确定所有形式的渔具，但这些准则都不是强制性的。那些严肃应对海洋塑料问题，尤其是幽灵渔具的有害影响的国家可以通过国家行动计划，让这些技术准则成为渔业部门的强制性规定，并采取行动推进执法。

这不仅能够帮助负责任的渔业公司预防损失，还有助于制止非法捕捞（非法、不报告和不受管制的捕捞活动，简称 IUU 捕捞活动），此类活动会故意丢弃渔具（通常丢在海上以躲避侦查）。IUU 捕捞活动每年给全球造成 200 亿美元的经济损失。标记渔具有助于当局追踪非法捕鱼活动，并帮助司法部门提起诉讼。

各国政府也可以效仿巴拿马。该国和全球幽灵渔具倡议（Global Ghost Gear Initiative，简称 GGGI）合作，主办了一个由 8 个国家参加的通过潜水回收幽灵渔具的地

区研讨会。此次研讨会建立了一个覆盖整个中美洲和加勒比海的跨境区域网络。该网络可以合作建立数据和报告系统，从而积极回收丢弃的渔具。

海产品行业也可以发挥作用。法律法规的出台往往是一个漫长的过程，企业部门则不同。他们可以迅速采纳渔具管理政策（例如全球幽灵渔具倡议提出的最佳实践框架），并要求整条供应链采用特定的渔具管理标准。大型的海产品公司买家也可以对供应商提出这样的要求。

消费者也可以发挥自己的作用，比如选择认证产品。认证方可以将渔具管理作为海产品公司获得可持续海产品标签的必要条件，让公众有机会通过选择“无幽灵渔具”的海产品来表达自己的偏好。

支持回收行业可能是防止幽灵渔具最简单的方法。数百种由回收海洋塑料制成的产品已经商业化，并且有了不错的消费者基础。建立这一部门发展所需的物流能将幽灵渔具从废弃物变成有价值的商品。

成千上万的海洋哺乳动物、海鸟、海龟的死亡和痛苦遭遇、鱼类种群的丧失、渔民的生计福祉、以及海洋的健康，都有赖于我们果断采取行动，解决幽灵渔具的问题。只要我们愿意，能用的方法有很多。🔄

伊丽莎白·霍根是美国世界动物保护组织海洋与野生动物的项目经理

Ghost gear, a grave threat to ocean life

Governments must act to rid the seas of abandoned fishing nets

□ Elizabeth Hogan

Since the world has begun to prioritise cleaning up ocean plastic, many alternatives to single-use consumer products have emerged: reusable shopping bags, metal coffee mugs and bottles, and biodegradable forms of packaging.

While these options are welcome, a major component of the problem of ocean plastic has proved more challenging to address – that of lost and abandoned fishing gear.

Lost fishing nets, known as “ghost gear”, have received less attention than other forms of plastic pollution, despite accounting for an estimated 10% of plastic entering the ocean each year, according to the UN Food and Agriculture Organization. This is equivalent to 640,000 metric tonnes per year; and is expected to reach 800,000 metric tonnes in 2018.

The true number is probably higher. Research from The Ocean Cleanup has revealed that 46% of the surface plastic in the North Pacific Gyre is comprised of ghost gear.

Some plastics are worse than others

When discussing the issue of ocean plastic, solutions typically attempt to address volume. Impact is rarely



A Stellar sea lion is left with a painful wound after being rescued from lost fishing gear

considered. That is, which types of plastic cause the greatest harm.

Not all ocean plastic is created equal and fishing gear, when lost, continues to do exactly what it is designed to do: trap and kill ocean wildlife. This includes fish, sea turtles, seabirds, and marine mammals such as whales, dolphins, seals and sea lions. A single lost net can easily smother a coral reef, destroying an entire ecosystem. Ghost gear presents a hazard to biodiversity, food security, fisher livelihoods, conservation and ocean health.

The impacts of this destruction are difficult to measure.

Ghost gear causes the loss of commercially valuable fish stocks; a fish lost to ghost gear is a fish that will never breed, be sold or eaten. This adds to the impacts of illegal and overfishing.

In the Baltic Sea, a single lost gillnet can destroy US\$20,000 worth of seafood. Ghost fishing costs the United Kingdom's fishing sector €420,000 on average a year (based on lost catch, gear replacement and lost time spent resetting gear).

In Chesapeake Bay, an estuary in the US states of Maryland and Virginia, the retrieval of 32,000 lost crab pots (containing 1.25 million blue crabs) represents a loss of income of US\$400,000 to fisheries a year.

Meanwhile in Louisiana, crab fishers lose an average 250 traps annually, costing US\$4 million in profits a year on average. In the Gulf of Oman, over 15,000 traps are lost every year, adding up to losses over US\$2.6 million.

The impact of ghost gear on fish stocks bears a tremendous impact on food security, particularly for populations that live close to the sea and rely on it for their income.

Forty percent of the world's population lives within 100 kilometres of the coast, and 10% depend on fisheries for their livelihoods. Poor populations are hit the hardest, as smaller harvests mean increased prices that they cannot afford.

In addition to the economic losses to fishermen and destabilised food supplies, ghost gear poses a significant threat to wider ocean wildlife. An estimated 136,000 whales, dolphins, seals and sea lions die from ghost gear every year; many enduring prolonged suffering before death.

Wounds from ghost gear are horrific. They cause tremendous pain and prevent animals from feeding, mating or migrating. Once entangled in a net, an animal is unlikely to ever be freed.

Using biodegradable materials for fishing gear is a good idea in principle, but difficult to promote in practice as the durability of plastic is what makes it so attractive to the industry. Plastic lines can better withstand bad weather and rocky surfaces than ropes and nets made of organic fibre.

It is extremely expensive to replace gear, not to mention time consuming. Many technological alternatives, such as remote controlled buoys, which eliminate the dangerous vertical lines prone to entangling large whales, are still too expensive to attract widespread use.



US law enforcement and the IWC rescue a beleaguered humpback whale off the coast of Maui, in Hawaii in the United States

Governments have plenty of options

One path for addressing the myriad impacts of ghost gear is via the United Nations Sustainable Development Goals (SDGs). The SDGs have already established global goals to protect food security, clean water, marine debris, recycling and biodiversity. UN member states can address ghost gear within the national action plans they have already committed to on these issues.

A major step was taken this July, when the FAO Committee on Fisheries passed technical guidelines on the marking of fishing gear, which calls for all forms of gear to be identified by the fishery.

However, these guidelines are voluntary. Governments that are serious about addressing ocean plastic – and the harmful effects of ghost gear, in particular – should make these technical guidelines mandatory throughout their fishing sector, and take steps to require enforcement.

This would not only result in loss prevention by responsible fisheries, it would also help stop illegal fishing (IUU), which accounts for intentionally discarded gear (typically abandoned at sea to avoid detection). IUU fishing costs the global economy US\$20 billion annually. Marked gear would help authorities track illegal fishing activity and bring criminals to justice.

Governments can also follow the example of countries like Panama, which joined with the Global Ghost Gear Initiative (GGGI) to host an eight-country regional

workshop on dive removal for ghost gear, creating a transboundary regional network across Central America and the Caribbean. This network works together to establish data and reporting systems to proactively recover lost gear.

The seafood industry can also play a part. Passing laws and regulations is often a slow process, but the private sector could quickly adopt gear management policies, such as the Best Practice Framework put forth by the Global Ghost Gear Initiative, to require standards of gear management throughout their supply chain. Large corporate buyers of seafood could also demand more of their suppliers.

Additional assistance can come from consumers. Certifiers can include gear management in their requirements for awarding sustainable seafood labels to seafood companies, allowing the general public an opportunity to declare a preference for ghost gear-free seafood.

Perhaps the most accessible means of preventing ghost gear is by supporting the recycling industry. Hundreds of products featuring recycled ocean plastic are already commercially available and have found an eager consumer base. Developing the logistics required to boost this sector will turn ghost gear from debris into a valuable commodity, inspiring recovering efforts.

The suffering and death of hundreds of thousands of marine mammals, birds, and sea turtles; the loss of fish stocks; the wellbeing of fisher livelihoods; and the health of our oceans rests on taking decisive action to address ghost fishing gear. There are multiple tools at our disposal, if only we had the will to put them into place. ☹

Elizabeth Hogan is the program manager for Oceans and Wildlife with World Animal Protection in the United States.

海洋牧场如何确保“生态优先”？

海洋牧场的建设并非易事，快速大规模推广所蕴含的风险也需要纳入考量

□ 张钰晨 康宁

8月的一个普通的傍晚，七艘渔船排队从吕泗渔港出发，驶向临近的吕泗渔场进行捕捞作业。与此同时，从不同省市赶来的冷链运输车正挤在渔场附近的路上，等待着下一批渔获上岸。

吕泗渔场是中国著名渔场，也是重要经济鱼类大黄鱼的产卵地。过去几十年的过度捕捞让大黄鱼资源几近枯竭，渔场生态严重退化。不过近几年，吕泗渔场的光景似乎触底反弹。

本地渔民庞裕昌说，2017年年末，他的一位老乡一网就打上来约莫价值四五十万元的渔获。“到了周末，很多上海人来这里买海鲜，住酒店都得提早订，”他笑称。

渔业的再度红火似乎证明江苏省渔业部门对近海渔业资源的养护取得了一定成效。除了休渔时间从2个月延长到三个半月，渔业管理者已连续9年在休渔期内向吕泗渔场放流了共计约3000万尾大黄鱼鱼苗。

另一项引人注目的新措施则是从2015年开始的，以人工鱼礁投放为标志的“海洋牧场”建设。不仅仅是在吕泗渔场，这种人为营造海底生物栖息地的海洋资源养护措施，正在中国的海岸边迅速发展。

海洋牧场来了

海洋牧场是上世纪70年代兴起的一种渔业形式。最初的海洋牧场主要通过向海底投放废船、人造水泥鱼礁等，改变海底水流状态，便于藻类繁殖，以此吸引海底生物聚集和停留。现在，鱼苗放流和海草、海藻养殖也是“投礁型”牧场建设的重要组成部分。而在深海建设大型装备养殖高经济鱼类的“装备型”牧场，在中国还比较少见。

在近海渔业的管控方面，近年来中国沿袭限制产能的思路，以渔船数量的控制、休渔期的增长和燃油补贴的减量为主。

“投放人工鱼礁、增殖放流，甚至网箱养殖等经常被简单等同于海洋牧场建设，近海养殖和海洋牧场建设概念混淆，导致中国海洋牧场遍地开花。”

但近一两年，更为激进的近海渔业资源养护方案显得紧迫起来。传统式的增殖放流只是增加了鱼苗量，无法从根本上改变人类活动侵扰带来的海底生态环境的退化，不能从根本上逆转海洋生物资源衰退的困境。要让海里源源不断“长出”更多的鱼，就必须为鱼群的生息繁衍营造合适的空间。

有利可图

根据农业部数据，中国目前已建成的200多个海洋牧场，显示出良好的盈利能力。相比建设这些海洋牧场花费的56亿元，每年它们产生的直接经济效益则高达319亿元。另外，它们还成为旅游和海钓的好去处，每年接纳游客超过1600万人次。

因此，2017年10月，农业部发布了一份远期规划，计划至2025年将中国沿海的国家级海洋牧场示范区从42个增加到178个，将海洋牧场覆盖海域的面积从850平方公里增加至2700平方公里。为了实现这些目标，需要投放约5000万空立方米的人工鱼礁。

据农业部的“保守估计”，这些

海洋牧场全部建成后，每年带来的经济效益将超过 150 亿元。

当然，人工渔礁预计能增加的渔获量未必百分百准确。“计划实施的过程中可能还会出现一些不确定性，但是（建设海洋牧场）的效果会是明显的，”大连海洋大学研究渔港问题的桂劲松教授表示。

过热的风险

不过，一些专家告诉中外对话，海洋牧场的建设并非易事，快速大规模推广所蕴含的风险也需要纳入考量。

中国科学院海洋研究所副所长杨红生博士指出，除了管理、规划和建设中可能出现的问题之外，对于从北到南海环境差异极大的中国，海洋牧场建设面临的最大难点正是选址。事实上，目前中国已经建成的海洋牧场集中于黄海及其周边，位于南海的海洋牧场示范区仅有 9 个，并且没有一个位于热带。

根据美国安全与环境执法局（Bureau of Safety and Environmental Enforcement, BSEE）对于人工礁石的指导意见，人工礁石需要避开多种自然生境，并且其建设方式也需要避免对自然生境的完整性构成威胁。这些受保护的天然生境包括珊瑚礁、海草床、长有贝类的礁石等。

杨红生指出，海洋牧场计划因而面临着一个两难处境。一方面，科学的选址需要对海底环境进行全面的评估，因而具有相当的难度；另一方面，海洋牧场又不能太小或太破碎，一般而言一万公顷以下的海洋牧场无论在生态上还是经济上都不会表现太好。

让情况更加复杂的是，中国至今没有对海洋牧场的建设做出具体

的规定，或是出台统一的国家标准。杨红生曾在接受《中国科学报》采访时表示：“在我国海洋牧场的建设实践中，海洋牧场的含义过于宽泛。”他指出，“投放人工鱼礁、增殖放流，甚至网箱养殖等经常被简单等同于海洋牧场建设，近海养殖和海洋牧场建设概念混淆，导致中国海洋牧场遍地开花。”

但是，由于国家计划在海洋牧场建设上投入总计 191 亿元人民币的高额资金，很多地方政府和企业很可能会为了争取投资而蜂拥进入海洋牧场领域，甚至可能会出现为了申请上国家示范项目而罔顾海洋生态专家的意见。

生态影响

此外，尽管农业部认为中国目前存在的海洋牧场具有包括固碳、净化海水在内的良好的生态影响，但这些现存的海洋牧场规模不大，时间不长，更大规模地人为干预海底环境会对生态系统带来什么样的干扰，仍然是个问题。

如何预防、限制这种干扰因而显得格外重要。而目前，一个海洋牧场项目如果有七八成的把握，就可以投入建设，海南大学专门研究南海海域海洋牧场的许强教授坦承。

此外，中国当前大部分海洋牧场的设计还是以增加高经济价值的海产品产量为主要目的，很少有海洋牧场会把红树林、海草床、牡蛎礁和珊瑚礁等多种海洋生态系统综合考虑进去，而野生渔业种质资源的基因多样性也没有受到足够的关注。

海洋牧场建设中若一味追求单一物种的繁殖，即使能够实现增产，

也会对生态系统的稳定性和可持续性带来负面影响，杨红生指出。

此外，从生态角度来说，一旦人工增殖放流的种群与野生种群发生交配，那么野生种群的基因结构和多样性可能会受到严重的影响，他补充道。

事实上，有些地方可以依靠修复，增殖，养护就完成生境恢复和生产，而不需要为了争取政府资金支持而投入渔礁。人工渔礁的热度反而可能导致对这些措施的投资不足。

“生态优先”必须在未来的海洋牧场建设中得到体现，杨红生强调。

“要实现生态优先，海洋牧场的建设主体就必须尊重海洋和大自然。关于海洋生态系统的技术和知识的迅速转移也至关重要。”许强表示，“仅有资金的投入并不能保证海洋牧场建设的成功。”

渔船陆续出港后，笼罩在夕阳余晖里的吕四渔港回归了平静。就在港口船闸不远处，一艘载满人工鱼礁的货船停靠在岸边。当地海洋渔业部门计划，至 2018 年底，向嵌于吕泗渔场内的那片海洋牧场新投放一批人工鱼礁，将现在海洋牧场区再扩大一倍。

“海洋牧场听起来蛮好。”庞裕昌边说着，眼睛望向远方，露出一副若有所思的神情。“对我们来讲，只要有鱼可捕，吕四渔港就会越来越好。”

张钰晨，自由撰稿人，曾供职于《中国日报》和中央电视台英语频道

康宁，澎湃新闻记者

Marine ranching: Can China put the environment first?

As China quadruples the number of sea farming pilot projects, experts warn of the ecological risks of rapid expansion

□ Alice Zhang Kang Ning

On an ordinary August evening, seven fishing vessels leave Lusi harbour for nearby fishing grounds while articulated lorries cram the surrounding roads as they wait for the next catch to land.

The fishing grounds off the coast of Lusi, in Jiangsu province, eastern China, are a spawning ground for the large yellow croaker, a species of important commercial value. The stocks of yellow croaker were left exhausted by decades of overfishing and fishing grounds badly damaged, but in recent years their numbers have bounced back.

In late 2017, one man brought up a catch worth 400,000-500,000 yuan (US\$60,000-\$75,000) in a single haul, says local fisherman Pang Yuchang – such is the return of abundance.

“These days, lots of people come from Shanghai at the weekends to buy fresh fish,” he says. “You even have to book your hotel in advance.”

The resurgence of the fishing industry suggests that the management policies implemented by the Jiangsu provincial

government have had some success. In 2017, it extended the two-month closed fishing season to three months to give juvenile yellow croaker more time to reach maturity.

The placement of artificial reefs – used since 2015 as part of a “marine ranching” approach (also known as sea farming or mariculture) – can also be credited with the species’ resurgence along the Chinese coastline.

The rise of marine ranching

Marine ranching was developed in the 1970s. It’s a type of aquaculture involving the cultivation of marine organisms for food and other products in open sea or in an enclosed section of ocean.

Early attempts involved sinking old boats and using manufactured reefs to change seabed currents and encourage algae to grow, which in turn attracted other marine species. Today the approach involves placing artificial reefs on the seabed, releasing juvenile fish, and encouraging the growth of kelp forests. There are more equipment-intensive approaches to marine ranching, which are used to raise high-value fish species, but these are less common in China.

Historically, China’s approach to the sustainable management of coastal fisheries has been to reduce capacity: cut the number of fishing boats, extend the closed

The approach involves placing artificial reefs on the seabed, releasing juvenile fish, and encouraging the growth of kelp forests.



The Ailun Bay marine ranching area in Shandong province, China

season, and reduce fuel subsidies. But in the last few years, the pace has quickened on more production focused and technical approaches.

Profit to be made

China's 200 existing marine ranches are also popular destinations for tourism and leisure fishing, attracting 16 million visitors per year. So while each ranch costs on average 5.6 billion yuan (US\$820 million) to create, the industry can generate as much as 31.9 billion yuan (US\$4.7 billion) in revenue each year, according to the national pilot plan.

The Ministry of Agriculture is planning to increase the number of national marine ranching pilot projects from 42 to 178, and the amount of sea area covered from 850 to 2,700 square kilometres, by 2025. To achieve this goal, 50 million cubic metres of artificial reefs will be created, generating 15 billion yuan (US\$2.2 billion) a year in fishing and tourism revenues, according to "conservative estimates" from the Ministry of Agriculture.

The risks of overexpansion

But creating marine ranches is complicated and the risks of rapid overexpansion must be considered.

Dr Yang Hongsheng, deputy head of the Institute of Oceanology at the Chinese Academy of Sciences, told chinadialogue that problems can arise during the management, planning and construction of marine ranches. He says that the variety of marine environments along the north-south coastline makes the selection of locations a challenge. Examples of the environmental risks include damage to the seabed from marine infrastructure, disruption to the food chain, and pollution from intensive agriculture and tourism.

Ownership and management of the ranches is split between local government and aquaculture companies.

China's marine ranches are currently concentrated in the Bohai and Yellow Sea and its surrounding area. There are only nine pilots in the South China Sea. There are none in the tropical regions.

China does not yet have any specific regulations on the

construction of marine ranches. But according to guidelines from the United States' Bureau of Safety and Environmental Enforcement, artificial reefs should not be created in a way that might damage natural habitats; and should not be placed on coral reefs or beds of aquatic grasses, microalgae or shellfish.

In China, locations should be chosen following a scientific survey of the seabed (under the purview of the Ministry of Agriculture and Rural Affairs), says Yang. They must also meet a minimum surface area – marine ranches of less than 10,000 hectares are of little environmental or economic benefit, he adds.

“The definition of a marine ranch used in China is too broad,” Yang told China Science Daily. “Placing artificial reefs, the release of juvenile fish and even the use of cages are all defined as marine ranching. There’s also confusion between coastal fish farming and marine ranching, leading to a proliferation of marine ranches.”

With 19.1 billion yuan of state investment planned, local governments and businesses are expected to be drawn to the sector – and possibly be willing to ignore expert advice for the sake of being awarded a national pilot project.

Environmental impact

Marine ranches are relatively new in China. It is not yet known how these larger-scale human interventions will affect the marine environment. Deciding how to prevent and minimise these impacts is crucial. There is concern

is that marine ranching is taking place without a full understanding of the impacts, says Xu Qiang, a professor at Hainan University and specialist on ranching in the South China Sea.

The majority of China’s marine ranches have been designed to increase the output of “economically-valuable” marine life. Disruption to marine ecosystems such as mangrove forests, kelp beds, and oyster and coral reefs are rarely taken into consideration, nor is the genetic diversity of wild fish populations.

Ranches designed solely to increase the population of a single species reduce the stability and sustainability of the ecosystem, says Yang. Meanwhile, the release of farmed juvenile fish affects the genetic structure and diversity of wild populations.

In some places, the release of juvenile fish, coupled with remediation and better protection, may be enough to restore ecosystems without the need for artificial reefs.

“If the environment is to be put first, the builders of marine ranches need to respect the oceans and nature,” says Xu. “The rapid transfer of marine environmental technologies and expertise will be crucial. Investment alone won’t ensure marine ranches are a success.”

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江苏省启东市吕四镇水产路的一家海产店工人正在整理运上岸的梭子蟹
Workers in a seafood market sort crab



爱伦湾海洋牧场渔业作业码头
A terminal for marine ranching operations at Ailuanwei marine ranch



游客从海洋牧场码头乘船前往海上平台
Tourists take a boat to an offshore platform



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CHINA'S CHEMICAL CHALLENGES

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