

# Shenzhen

*Shenzhen, a former fishing village, is something of a miracle in China's scientific development. It has become a dominant force in genomics, proteomics and bioinformatics, and is now heading for new frontiers.*

**ARTICLE COUNT (AC): 107**  
**FRACTIONAL COUNT (FC): 35**  
**WEIGHTED FRACTIONAL COUNT (WFC): 35**

Until recently, Shenzhen was best known for factories in which cheap labour churned out counterfeit goods. The city has repositioned itself as one of the world's leading centres for genetics research. Shenzhen is home to BGI Shenzhen (formerly the Beijing Genomics Institute, now known as BGI), a prolific gene-sequencing organization that accounts for 50% of global sequencing capacity. In 2013, BGI acquired Complete Genomics, a US-based bioinformatics company and its closest rival — a move that will further secure BGI's dominance in the 'omics' realm.

However, BGI's success is only one aspect of Shenzhen's transformative journey. In 2011, the Shenzhen Municipal People's Government set out its twelfth 'five-year plan' to support research and innovation within six strategic emerging industries: biotechnology, internet, renewable energy, advanced materials, cultural creativity and information technology. It is hoped that by 2015, the total output value of these industrial sectors will be US\$49 billion — which equates to 20% of the city's current GDP. For comparison, the current output value of BGI is approximately US\$16 billion.

For now, Shenzhen's research strength is still predominantly in the life sciences. The city has grown its output in chemistry, although

the Nature Index shows that its WFC for this subject is still 15% below the national average.

BGI remains the largest contributing institution, with 51 articles (WFC = 15.3) in the Nature Index, accounting for 44% of the city's WFC. Included in these are seven in *Nature* and *Science* (WFC = 1.8), representing nearly 12% of its output. This means that the gene-sequencing organization has the second highest percentage WFC in *Nature* and *Science* of all Chinese research institutions, topped only by the Institute of Vertebrate Paleontology and Paleoanthropology, of the Chinese Academy of Sciences (CAS, page S56).

Jun Wang, the founder and director of BGI, led most of these publications. Last year, he contributed to 35 articles (WFC = 11.7), the most notable of which were on the genomes of bread wheat, bats and the rock pigeon. "Comparative analysis of bat genomes provides insight into the evolution of flight and immunity" published in *Science* was listed as one of China's most influential papers of 2013.

The next two major contributors from BGI are Xu Xu and Guojie Zhang, with three articles each. Xu's three (WFC = 1) were on the genomes of domestic goats, Chinese pears and upland rice; Zhang's (WFC = 0.9) were on the genomes of soft-shell turtles, green-shell turtles and one comparing the genomes

of modern domestic horses to that of a horse from the late Pleistocene.

The remainder of Shenzhen's output in the index comes mostly from the Shenzhen Institutes of Advanced Technology (SIAT) and Shenzhen University (SZU), accounting for 32% and 14% of the city's WFC, respectively.

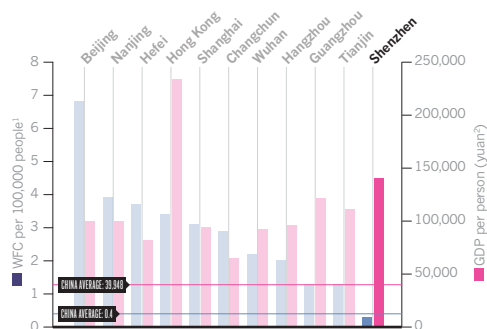
The Nature Index shows that all of SIAT's output is in chemistry. The CAS institute published 13 articles (WFC = 11.4), accounting for more than three-quarters of the city's total chemistry WFC. Most of these articles were led by analytical chemist Chunyang Zhang, who last year contributed to ten articles (WFC = 9.5) on quantum dots and amplification binding assays — tools for detecting transcription factors, enzymes and microRNAs.

Established only 31 years ago, SZU is Shenzhen's leading institution in the physical sciences. In 2013 it published seven articles in these fields (WFC = 3), most of which were in *Applied Physics Letters*. Xiacong Yuan is SZU's largest contributor, having published three articles (WFC = 0.7) on optical tweezers. "We are the first to use surface plasmon polaritons in the confinement of metal nanoparticles," says Yuan. The experiment has important implications for Raman spectroscopy, a surface imaging technique widely used in chemistry and solid-state physics. ■

## SHENZHEN ANALYSIS

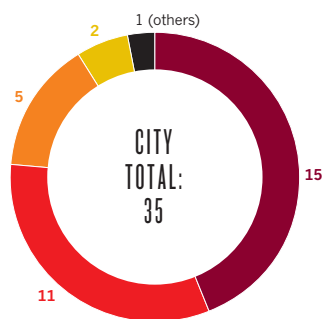
### Shenzhen data

Shenzhen is the second most prosperous city after Hong Kong but lacks a comparable research base.



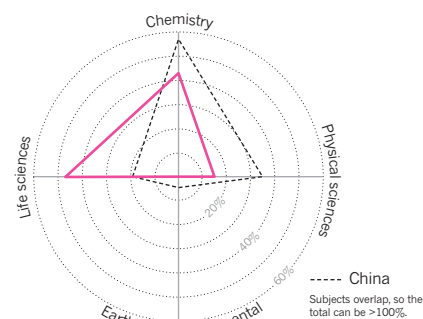
### City WFC breakdown

BGI and CAS institute SIAT contribute most of the city's WFC.



### City subject spread

BGI's influence means that life-science research is a substantial part of Shenzhen's WFC.



■ BGI ■ Shenzhen Institutes of Advanced Technology\* ■ Shenzhen University ■ South University of Science and Technology of China

\*CAS institute; 1. 360doc.com; 2. cnpop.org; yuan = US\$0.16