The blue morpho butterfly lives in the neotropics, where insect data are severely lacking.

Edited by **Jennifer Sills**

Invest in insects

In her News Feature "Where have all the insects gone?" (12 May, p. 576), G. Vogel reports that data from amateur entomologists in Germany point to a massive loss in insect numbers. The story correctly emphasizes the lack of large-scale and long-term monitoring data of insect abundances. It is time to fund long-term entomological institutions to gather comprehensive data on insect species, populations, and trends before it is too late.

Despite the substantial ecological consequences of the insect crisis, the News story's alarming data come from amateurs rather than from professional scientists working in universities or museums. One likely explanation is that research grants are usually provided for only 2 to 5 years and therefore not suitable for documenting long-term ecological trends. Meanwhile, the number of naturalists working on insects is quite low and steadily decreasing (*1*, *2*). And although amateur entomologists are present in northwestern Europe and North America, they are scarce in the Mediterranean and more or less absent in most tropical countries (*3*). Data for these species-rich regions are severely lacking.

To test whether the patterns observed in Germany are also true in other regions, researchers would need to be willing to repeat inventories of insect populations from decades ago, which have often been published in local journals or grey literature [e.g., (*4*)], and compare them to today's numbers. More important, we urgently need data on the status of insects from tropical and subtropical countries, many of which have exceptionally small geographic ranges and thus a high extinction risk. Information on the population trends of insects is necessary to reach Aichi Target 12 of the Convention on Biological Diversity, which aims to halt biodiversity loss by 2020 (*5*). This requires long-term investment rather than short-term projects. Enhancing entomological education, building taxonomic capacity in tropical countries, increasing funds for field biological research, and establishing large centers for invertebrate conservation would be great steps in this direction (*6*–*8*).

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Chile unprepared for Ph.D. influx

In 2009, the Chilean government implemented a scholarship system with the goal of increasing the number of highly specialized scientists in the country. Each year, the Becas Chile program, funded by the National Commission for Scientific and Technological Research (CONICYT) (*1*) provides hundreds of scholarships to Chileans aiming to pursue a master's or a doctorate degree in overseas top-ranked universities. Recipients are required to sign a commitment letter stating that they will return to Chile after finishing their studies and stay in the country for the same length of time as their graduate program, or double that time if they plan to stay in Chile's metropolitan region of Santiago. In addition, an endorsement letter signed by a guarantor is needed to secure the return of the scholarship fellow to the country (*1*). The goal was to produce a critical mass of researchers that would establish a highly qualified research community and help move Chile toward the status of a developed nation.

It was a good idea, but the policy is flawed. Chilean educational and research institutions were not prepared for the sudden influx of newly graduated researchers. In the period from 2010 to 2015, the CONICYT international scholarship produced 1090 new Ph.D.s, and its parallel national program produced another 1968 (*2*). This implies that the 59 Chilean universities would have to provide 3058 new positions just to accommodate the recipients from these programs. However, for this period, only 2353 academic permanent positions for Ph.D.s were created (*3*). These academic positions are also sought by an increasing number of international scholars and by the hundreds of Ph.D.s graduating each year who are not funded by CONICYT. A recent survey showed that more than 40% of graduated Ph.D.s have problems finding jobs in Chile, and 12% cannot find a job within 3 years of graduating (*4*).

The CONICYT postdoctoral program (*5*), which could help to integrate the new researchers, has been expanded from 80 to 300 scholarships per year. However, this growth is not enough, considering that in Chile there are more than 5200 enrolled Ph.D. students (*3*) and that postdoctoral positions are open to applicants from other countries as well (*6*). The private sector could also help integrate highly skilled professionals. Unfortunately, Chile's private sector is not prepared or incentivized to hire highly trained scientists.

Despite opportunities elsewhere in the world, even those that would allow collaboration with Chilean institutions, Chile's government insists that scholarship recipients must uphold their contract. When recipients have broken the contract by leaving Chile, CONICYT has billed them for reimbursement or banned them from applying for future funding (*6*, *7*).

It is time for the Chilean government to put in place a complementary strategy to help returning researchers reintegrate into the labor market. Recipients should have the option to collaborate from abroad, and the private sector should be given incentives to hire scientists. The government must also adjust the requirements for those who are currently trapped in Chile with no job opportunities. Strategies based only on scholarship programs are not enough to promote scientific development.

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NIH's ineffective funding policies

On 2 May, National Institutes of Health (NIH) Director Francis Collins announced a new policy to limit the amount of research grant funding per investigator (*1*). The policy was warranted and long overdue (*2*), but was abandoned by 8 June (*3*). However, the problems that triggered the policy remain in place and need to be addressed.

Director Collins pointed out, as have others, that funding is allocated disproportionately to a minority of investigators and that their productivity falls once they exceed a certain amount of support (*1*, *2*, *4*). By capping awards to very well-funded investigators, the NIH would be able to reduce waste and sponsor a greater number of more modest, more productive grants. This would increase the number of funded investigators and harness a greater diversity of tools, perspectives, and creative ideas.

The need for such changes is supported by a plethora of data that quantify diminishing marginal returns on taxpayers' investments in research [see references in (*1*)]. For example, National Institute of General Medical Sciences (NIGMS) Director Jon Lorsch reported that funding for a first R01 grant ($200,000 direct costs) to an investigator would produce, on average, about five scientific publications during the funding period (*4*). However, the same amount of funding for a third R01 grant would yield only about one additional publication (*4*). As another example, the NIH gives half of all research project grant dollars to about 3% of funded institutions (*5*), even though investigators at lower-funded institutions can be far more productive per dollar of support than those at very well-funded institutions (*6*).

The abandoned policy would have capped the number of grants (not dollars) per investigator. However, the cutoff was far beyond the point at which productivity is degraded (*7*). Furthermore, of the investigators who receive more than $1 million of annual funding, only about one in five has more than three grants (*5*). The majority of investigators who receive more than $1 million per year would have been protected from the caps. For these reasons, the policy would have been ineffective at trimming the waste caused by the heavily skewed distributions of funding. Its replacement, which will earmark a pool of money for researchers who just miss out on winning a grant, has no provisions for trimming waste (*3*).

A more effective, evidence-based approach would be guided by empirical data on amounts of funding at which diminishing marginal returns kick in. It would impose caps based on total dollars of research funding from all sources (*2*). In addition to trimming more waste, this methodology would fund more investigators than those of the NIH policies.

Director Collins indicated that the first policy would "free up about 1600 new awards to broaden the pool of investigators conducting research" (*1*). When that policy was abandoned, he announced a plan that would, after 5 years, fund about 2000 grants (*3*). Those numbers might seem impressive, but are actually a miniscule improvement when one considers that the NIH supports almost 50,000 competitive grants to researchers. In contrast, a funding cap of $1 million per investigator per year—a generous amount of funding that is well into the range of diminishing returns—would free up enough money to support about 10,000 new awards (assuming an average of $350,000 annual costs per new award) (*8*). Neither approach can solve the anemic NIH budget or abysmally low investigator funding rates (wasted scientific talent and capacity), but the latter approach would be much more effective at expanding the investigator pool.

Lastly, the NIH's plans do not address proximate causes of the heavily skewed distributions of funding, such as vast disparities in grant application success rates and award sizes of investigators grouped by race (*9*), institution (*10*), and state (*11*). If the NIH were to effectively treat these causes, there would be less need to address the consequences.

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TECHNICAL COMMENT ABSTRACTS

Comment on "Xist recruits the X chromosome to the nuclear lamina to enable chromosome-wide silencing"

Chen-Yu Wang, John E. Froberg, Roy Blum, Yesu Jeon, Jeannie T. Lee

Chen *et al*. (Reports, 28 October 2016, p. 468) proposed that an interaction between Xist RNA and Lamin B receptor (LBR) is necessary and sufficient for Xist spreading during X-chromosome inactivation. We reanalyzed their data and found that reported genotypes of mutants are not supported by the sequencing data. These inconsistencies preclude assessment of the role of LBR in Xist spreading.

Full text: dx.doi.org/10.1126/science.aal4976

Response to Comment on "Xist recruits the X chromosome to the nuclear lamina to enable chromosome-wide silencing"

Chun-Kan Chen, Amy Chow, Mason Lai, Mitchell Guttman

Wang *et al*. question whether Lamin B receptor is required for Xist-mediated silencing because they claim that our cells contain an inversion rather than a deletion. We present evidence that these cells contain a proper deletion and that the confusion is caused by DNA probes used in the experiment. Accordingly, the points raised have no effect on the conclusions in our paper.

Full text: dx.doi.org/10.1126/science.aam5439

ERRATA

Erratum for the Report "Mobile MUTE specifies subsidiary cells to build physiologically improved grass stomata" by M. T. Raissig *et al*., *Science* **356**, eaan3164 (2017). Published online 7 April 2017; 10.1126/science.aan3164

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