Forest carbon offsets include co-benefits and co-detriments

Anderson *et al.* (2017) asserted that forest offsets can help mitigate climate change by increasing the carbon sequestered by forests, while simultaneously yielding some conservation co-benefits. Missing from their review was any discussion of the equally important co-detriments of forest offsets that persist in towns like Richmond, California, where more than one-third of residents in neighborhoods surrounding the Chevron petroleum refinery (Figure 1) live two times below the Federal Poverty Level (Contra Costa Health Services 2014). When Chevron purchases carbon credits from outsourced forest offset projects, it is buying permission to continue to pollute in Richmond. Had Chevron instead reduced its on-site carbon pollution, it would have also reduced the emission of many physical and chemical pollutants that are associated with a raft of negative health outcomes (Driscoll *et al.* 2015). At the very least, it could purchase forest offsets from conservation projects near the source of the pollution, so that those breathing the toxicants might also enjoy the health benefits associated with a walk in the woods.

The potential for exacerbating social inequities is increasingly influencing the policy debate about the future of California's carbon offset trading program, and recent amendments to the program are beginning to address these concerns. The policy debate notwithstanding, ecologists are too often unaware of this side of the discussion. We submit this letter to help round out Anderson *et al.*'s review of the indirect consequences of forest carbon offsets and to describe some of the related policy changes that will affect future offset programs.

Exactly how much harm is done to disadvantaged communities by the cap-and-trade program has been debated (eg Richardson *et al.* 2012), but the linkage between forest offsets and pollution in poor neighborhoods is clear. Polluting industries are disproportionately located near disadvantaged residents who bear the worst brunt of emissions (Morello-Frosch *et al.* 2002; Cushing *et al.* 2016). Currently, 808 regulated companies in California may meet their state-mandated emissions reductions by purchasing up to 8% of their total carbon credits from environmental improvement projects, which can be located anywhere in the US. Consequently, carbon trading is commonly criticized as a way to "outsource pollution" (Farber 2012). Anderson *et al.* (2017) admitted that the current limit might allow ongoing on-site emissions, but they emphasized that purchases so far constitute just 2% of credits. While 2% may seem unthreatening, Weisberg (2017) estimated that at the current rate, $4.86 billion will be spent on offsets in California from 2017 through 2030, which could yield immense local benefits if spent on reducing on-site emissions or conserving and improving forests to serve nearby disadvantaged communities.

Like on-site emissions reductions, carbon offsets purchased off-site using improved forest management, reforestation, and avoided conversion projects may indeed contribute to global carbon reclamation and thus help mitigate climate change. The question is whether Chevron should meet its obligations to reduce carbon pollution at its refinery site in Richmond, or purchase credits from a conservation nonprofit or other distant landowners who own large forest tracts and can shoulder the legal and long-term monitoring costs associated with offsets. Indeed, the average size of an offset project reviewed by Anderson *et al.* (2017) was >8950 ha. Of course, there may be instances where the combined direct benefits and co-benefits associated with forest offset projects are a sensible trade-off with the co-detriments associated with local exposure to fossil-fuel pollution. To be clear, we are vociferous advocates for forest conservation. We simply want to ensure that there is a full accounting of all the relevant consequences. And we believe that land protection for forest carbon and the myriad other values can and should occur, but without jeopardizing the health of the communities in the polluter's backyard.

Every offset credit purchased from a far-off forest management project is a lost opportunity to reduce pollution in cities like Richmond. State legislators have been addressing this issue incre-

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Figure 1. Chevron purchases forest offsets to help meet CO_2 reduction requirements for its refinery in Richmond, CA (pictured here in 2017).

mentally since the implementation of cap-and-trade via AB 32 in 2006 (California Legislature 2006). Advocates of environmental justice in California criticized the bill from the start for inadequately prioritizing polluted communities. As a response, in 2012, SB 535 required that at least one-quarter of carbon credit auction proceeds be allocated to projects that benefit underserved communities (California Senate 2012), which may lessen the inequities associated with auctioning of offsets by creating more direct alignment between the policies and beneficiaries. AB 398 (California Legislature 2017a) has begun to respond to persistent environmental justice concerns by announcing that as of 2021, one-half of all offset purchases must come from projects within California's boundaries. The new bill also reduces the allowable offset purchase rates to 4%. In addition, AB 617 (California Legislature 2017b) will launch a community-scale air pollution monitoring program that detects areas in most need of remediation projects, pushing for community participation along the way. With these new policy modifications, future offset research will need to merge elements of ecology, public health, and social justice in order to document the health and other co-benefits of climate-change mitigation close to the source of the pollution. Soon, Chevron could be purchasing offset credits from a remediation project in Wildcat Canyon, just three miles away from the poorest neighborhoods of Richmond.

Acknowledgements

This research was supported by the US National Science Foundation (Grants No. NSF-DEB 12-37491 and NSF-DEB-13-38809). We thank R García of the City Project for inspiring this letter and S Meyer for a helpful review.

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Environmental justice concerns in the use of offsets

We share the opinion expressed by Hastings *et al.* that environmental justice concerns are central to the ethics and efficacy of forest offset programs. In fact, we published a follow-up study last year analyzing the environmental justice implications of California's offset program (Anderson *et al.* 2018). A second article on the topic was also published in that same year (Cushing *et al.* 2018).

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