The Blood Harvest of Horseshoe Crabs is a Moral Fiasco

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Imagine animals, held in brackets side by side, each connected to receptacles (e.g., bottles) that catch their blue colored blood as it's slowly drained from their bodies. This is not a scene from a contemporary horror film but an image that is becoming increasingly common as more media stories cover the use of horseshoe crabs in testing (Fox, 2020).

Their blood contains cells (ameboctyes) that are particularly sensitive to endotoxins which are produced by certain bacteria and fungi and can endanger human health. Drugs, vaccines, and some mechanical devices are tested using a product (limulus amebocyte lysate, or LAL) which is derived from the hemocyanin-based horseshoe crab blood (Krisfalusi-Gannon et al, 2018).

This makes horseshoe crab blood a hot commodity in toxicological circles. It's also regarded as a renewable resource in the "West" (Atlantic States Marine Fisheries Commission, 2020), as the Atlantic horseshoe crabs used in the "blood harvest" are not drained of all of their blood, nor are they all deliberately killed (Asian horseshoe crabs are not as "fortunate").

Instead, after extracting roughly 30 percent of their blood volume, many of these animals are released back into the ocean (Chesler, 2016). This talk of renewability belies the number of Atlantic horseshoe crabs dying as a result of the blood harvest: between 10 and 30 percent (Krisfalusi-Gannon et al, 2018: 3), or perhaps as many 140,000, of these animals die each year depending on the number caught. (This percentage probably excludes deaths resulting from capture and transport or Atlantic horseshoe crabs sold for bait after harvest.) Though numbers can vary considerably, over 460,000 can be harvested for this purpose in a year (Atlantic States Marine Fisheries Commission, 2020) and very little is known of their survival after release (Krisfalusi-Gannon et al, 2018).

Animal bioethics can help frame several issues that arise from this animal use. If these animals are sentient, and one of us (LM) thinks that they are, there are two clear welfare issues: the first is associated with how their blood is procured, and the second with how they fare when released back to the ocean (Chesler 2016). Though perhaps unlikely, the welfare impacts of reuse may also be an issue.

Also, there are two clear value issues: the first concerns an entitlement to use these animals in this way, and the second concerns decisions to use them even though an alternative may be available. The second of these two value issues – where these animals are held in sufficiently low-regard that an adequate alternative to their use can be ignored or rejected – intersects with a pressing issue in the scientific use of animals: replacement (Maloney, Phelan, Simmons, 2018).

Beyond the question of the sentience of these animals, negatively impacting their populations is likely to have detrimental impacts on animals whose sentience is uncontested, like the migratory shorebirds who rely on the fatty eggs of Atlantic horseshoe crabs for fuel on their migrations (Krisfalusi-Gannon et al, 2018).

Replacement intersects two considerations in animal bioethics: the 3Rs and a common moral commitment to avoid unnecessary harm (nonmaleficence) (Ferdowsian et al 2020). Animal use in science is increasingly governed by what has become known as the 3Rs: replacement, reduction, and refinement. Originally conceived as a way to minimize the inhumane scientific use of sentient animals, they each emphasize different ways of minimizing harm. **Replacement** favors the use of non-sentient "material" over the use of sentient animals; it is also commonly understood to favor the use of sentient animals who are vulnerable to fewer harms than others.

When it is decided that sentient animals will be used, **reduction** favors using a reduced number of animals than would otherwise be the case; it is also commonly understood to favor the minimal number of sentient animals needed to yield sought-after scientific results. Once the proposed numbers of sentient animals to be used has been reduced, the experiments must be **refined** to minimize or eliminate scientifically unnecessary stress or distress (Fenton, 2019). Though replacement is the "R" most neglected of the three (Franco, Sandoe, and Olsson, 2018), the reliance on horseshoe crab blood is an example of its application. Up until the discovery of the usefulness of horseshoe crab blood, rabbits were routinely used to detect endotoxins (Maloney, Phelan, Simmons, 2018).

The 3Rs are not without their critics. We ourselves think that they are an insufficient ethical framework to govern the scientific use of animals. After all, the 3Rs are not designed to assess the general legitimacy of using sentient animals in harmful scientific activities which benefit humans, and they prioritize pursuing science in such a way that they sanction the use of sentient animals even when it causes significant harm if replacements aren't available. But if, for the sake of argument, the 3Rs are understood as minimal ethical constraints, the procurement of horseshoe crab blood mentioned above is an example of an ethical inconsistency and moral failure. An adequate alternative appears to exist (Maloney, Phelan, Simmons, 2018), so the use of horseshoe crabs may be unnecessary.

A defense of their use can arise out of a denial that they are sentient. After all, if they are not sentient, there are no clear welfare issues to concern scientists and the 3Rs simply don't apply to their use (i.e., they can't be treated inhumanely). There are two possible counter-responses: one can defend the view that horseshoe crabs are sentient/possibly sentient or that replacement can still apply, albeit in an unorthodox way.

That one of us thinks that horseshoe crabs are sentient arises from their possession of a central nervous system. On such a view, a brain – or something analogous – is sufficient for sentience (Marino, 2020).

The unorthodox application of replacement, where replacement will benefit sentient members of a species other than the one replaced, arises from the original motivation for the 3Rs. Remember, the 3Rs were conceived to minimize the inhumane use of sentient animals in science. As we mentioned earlier, this evidences a sensitivity to animal harm that reflects a commitment to nonmaleficence. It is this commitment to nonmaleficence that can foreground and morally proscribe the collateral welfare impacts (such as the impact on migratory shorebirds) of ignoring an alternative to LAL and adding to factors like habitat loss and over-fishing that dangerously deplete horseshoe crab populations.

Horseshoe crabs are not charismatic animals like cats, dogs or orcas. As arthropods, they will rank quite low on the scale of moral worth for many. Even conservation efforts may be more informed by their toxicological utility than their status as a keystone species (Charles River, 2020; Krisfalusi-Gannon et al, 2018). But ethics at its best requires us to move beyond charisma, convenience, or utility and respond to what ethically matters.

In this case ethical considerations are indeed being ignored in the service of convenience or utility and that is a moral failure.

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