How are animal care guidelines applied to invertebrates?

The "Guidelines for the treatment of animals in behavioral research and teaching"[1] used by editors of various journals in assessing submitted manuscripts appears to apply across the board to all taxa of animals. But should the same standards really apply to a sponge as to a chimpanzee? or to an urchin larva vs. a mouse? Our recent experiences suggest that these would be fruitful topics for discussion.

We recently investigated autotomy in porcelain crabs - small abundant intertidal creatures well known for their propensity to shed limbs. We were interested in examining the anti-predatory benefits to autotomy, and how they may differ with condition and context. Autotomy is not a predator avoidance strategy; it is a phenomenon that occurs only after capture. Therefore, it would have been impossible to study in a natural field setting. Instead, we used staged encounters in laboratory enclosures. This enabled us to closely track the events that occurred following capture of porcelain crabs. We initially attempted to watch predation encounters by standing over the enclosure, but found this to be ineffective because both predator and prey seemed more intimidated by us than interested in each other. Furthermore, predation often occurred after more than an hour of nothing happening, and when it did, interactions were too quick to be objectively assessed by real-time human observation. We therefore videotaped trials, which solved both problems. We carried out about 200 such trials to replicate various combinations of predator and prey species, sizes and genders; in about half of these trials, the porcelain crab was eaten by the predatory crab.

We submitted a manuscript based on this work – demonstrating an anti-predatory benefit to autotomy in porcelain crabs – to the journal Animal Behavior. It was rejected after 8 months, without having undergone peer review, based on animal care concerns. This came as a surprise to us, since neither of our universities regulate the use of invertebrates for research. The reason given for rejection without review by Animal Behavior was that we should have more conservatively adhered to the recommended "Guidelines"[1]. In particular, they were concerned about the large sample size. This was perhaps larger than needed to demonstrate an anti-predatory benefit, but as we explained to the editor, it was necessary for examining condition- and context-dependence of the phenomenon, the subject of a second manuscript. The committee was also concerned that we allowed the porcelain crabs to get eaten following autotomy. However, because we remotely videotaped trials, we had been unable to rescue the prey immediately following autotomy. While unfortunate for the crabs, this also yielded useful information: we discovered that prey that escape by autotomy invariably are eaten in repeat attacks, while prey that escape by fighting often can indefinitely avoid being eaten. After a fruitless attempt at rebutting the animal care concerns, we submitted the manuscript to the journal Behavioral Ecology. The editorial staff at Behavioral Ecology explicitly considered animal care concerns raised by the manuscript, and opted to continue with the review process and eventually accepted the paper for publication[2].

This story illustrates that the criteria for animal care are subject to considerable interpretation. Perhaps the time has come for a forum to discuss animal care standards for invertebrates, so that both researchers and editors can adhere to more objective, explicit criteria. The "Guidelines"[1] indicate that "*an investigator must always weigh the potential gain in knowledge against any adverse consequences for the animals and populations under study*". For the first part – consequences to the animals

– it might make sense to take into account the sophistication of the animal's nervous system. Complex, well-developed brains are likely associated with greater suffering (experience of pain, fear, sadness, etc.) than are tiny, simple brains. We made this case to Animal Behavior, suggesting that the death of 100 tiny crustaceans (average size < 1 cm) at the hands (claws, actually) of predators was justified by what we had learned about the benefits of autotomy. The mention of size drew scorn from the corresponding editor, who claimed that it was irrelevant to animal care concerns. Clearly this is a difficult ethical issue that merits further discussion! Our sense, in any case, is that the amount of gained knowledge needed to justify cutting up a sponge or overheating zooplankton on microscope slides, say, is much lower than what is required to justify hurting a monkey or a dolphin. Certainly this has been an unstated rule of thumb: embryologists routinely kill thousands of urchin embryos, for instance, while no primate researcher would consider killing even one baby gorilla. But without some sort of metric of levels of acceptable suffering, such views are completely subjective.

For the second part of the recommendation in the "Guidelines"[1] regarding adverse consequences to populations, a similar sliding scale might be useful. In this case, the focus is on population traits, not pain, and the discussion should probably be expanded to include organisms other than animals. For instance, from a conservation standpoint, killing a large redwood might be much worse than killing a laboratory-bred mouse (even though the reverse would be true from the point of view of sensation of pain). Likewise from a conservation standpoint, harming a rare salamander would be worse than a guinea pig, even though the latter has a more sophisticated nervous system. Mortality rates in nature might also be considered – a higher bar of justification might be required for killing something that is likely to have lived a long time without intervention than something that has an expected lifespan of hours, days, or weeks. Community consequences of removing the individual could also be discussed. Again, most researchers apply common sense rules of thumb that encompass these points, causing what they consider inconsequential harm to populations even for small studies, class projects, etc., and only carrying out more substantial harm to populations when they feel it is strongly justified by the importance of the scientific question.

Perhaps it is time to hold an open forum on these issues, and to develop more explicit criteria that will provide clarity to researchers and editors alike. Our suggestion would be that the level of knowledge required to justify harm to organisms with simple nervous systems or those with abundant, short-lived individuals should be lower than that required to justify harm to organisms with complex nervous systems or those with rare or long-lived individuals. However, there will inevitably be a difficult gray area between these extremes. In any case, discussion of such issues should make the process more transparent and fair to all involved. Once developed, the criteria should be applied evenly to similar species across studies, whether they are target organisms or food sources. We suspect, for instance, that if we had carried out a study of Dungeness crabs and had mentioned in the methods section that we provided them five porcelain crabs a day as food, the welfare of the porcelain crabs would not have been subject to strong scrutiny, even though the suffering by the crabs would have been the same, with similar predation, autotomy, and death rates. If animal care committees of journals decide to regulate invertebrates, they should do so fairly across the board, including food species used for larger predators.

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References

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2. Wasson K, Lyon BE, & Knope M. *In press*. Hair-trigger autotomy in porcelain crabs is a highly effective escape strategy. *Behavioral Ecology*