

## Cases for Teaching Responsible Communication of Science

### Monarchs in the corn: Issues brief

I. When is a project ready for publication? What features of a paper are relevant to the decision whether it is ready for publication? Is it a significant objection to point out that a study does not answer all the relevant questions it raises?

(1) The paper under consideration here was criticized because it showed the existence of a hazard without analyzing the correlate risk. In risk analysis, ‘hazard identification’ is only the first step: One must then characterize the effects and exposure, to gain a better understanding of the probability that harm will actually occur. Risk is a measured by the “badness” of the harm multiplied by the probability that harm will take place. Is it a weakness in this study that it characterizes a hazard without more fully analyzing the risk?

(2) Other concerns raised involve the experimental design: The Cornell researchers did not precisely measure the pollen levels, used an unidentified variety of maize as the source for the control, did not investigate whether caterpillars avoid pollen coated leaves, and did not investigate the way monarch larvae respond to varying levels of pollen. Once again, it is worth asking whether these gaps are weaknesses in the existing study, or whether the critics are identifying other useful studies that might also be undertaken.

It is noteworthy that subsequent studies, done after the publication of Losey et. al. 1999, did investigate dose response and caterpillar choice, and analyzed the risk to larvae by considering the probability that larvae would consume a harmful or fatal dose of Bt pollen. Many of those interviewed noted that the risk posed to monarch larvae by Bt pollen may be quite low. A more serious risk may be that imposed when farmers use herbicide to kill weeds, including milkweed plants. As it turns out, Roundup-Ready™ crops may be more hazardous to butterfly populations than Bt crops. But would these more extensive studies have been undertaken if Losey (1999) had not been published when it was?

(3) The charge that the study is un-reproducible is a serious charge, but it is worth questioning whether it is literally true. No papers describe the experimental design with full details. The question is whether there is enough detail that other researchers could do a meaningfully similar experiment to verify or disconfirm the results. Does this study describe the procedure with enough detail to permit others to reproduce and test the results?

II. Is it appropriate for scientists or reviewers to take possible public response into account when deciding how to present research findings in print? To what extent, if any, should the potential for public misunderstanding be taken into account?

(1) Many critics argued that this paper would be systematically misunderstood by the public, and that it would be used as ammunition by activist groups interested to cherry pick scientific results that support their cause. This concern was justified: activist groups have indeed used these results to argue for regulation or elimination of transgenic crops. There is evidence that many of these groups did not understand the difference between hazard and risk, and that the results were misinterpreted in the service of partisan causes.

This raises an important issue in the ethics of science communication: To what extent, if any, can researchers be held responsible when their results are misused or misinterpreted? Perhaps there is

good reason to do what one can to prevent avoidable misinterpretation. But would a requirement that scientific papers should be framed to prevent misinterpretation simply be too strong?

(2) The title of the paper has sometimes been picked out for special criticism: “Transgenic pollen harms monarch larvae.” In one sense, this title states exactly what the paper shows: When monarch larvae are exposed to Bt pollen, they are harmed. The term “harm” is regularly used in this way in risk analysis and in toxicology studies. But does this title, as written, imply that actual larvae are being harmed in the field? The paper does not show that larvae in actual cornfields are being harmed: further investigation would be necessary to show such a result. Would it be better for the title to state the conclusion with some qualification? For example the authors might have written “Transgenic pollen may harm monarch larvae.”

Once again, this points to an important issue for ethical science communication: are researchers responsible to take steps to prevent misunderstanding? Should scientists use special care when using terms like “harm,” which are understood in one way by scientifically informed readers, and in quite a different way by most non-scientist readers?

III. What pressures, if any, may appropriately be applied in an effort to influence scientific publications? What consequences should authors take into account? How should authors respond to pressures?

(1) It is one thing to argue that researchers should adjust their experimental design, or that they should frame their report to avoid misinterpretation. But it is quite another to urge that experimental results should be left unpublished because publication would harm company profits, or that publication would have unfortunate economic consequences.

In the long version of this case study, the bullying reviewer report from Group 3 urges that the paper should not be published because Bt corn is a valuable crop and its use should be encouraged, not undermined. Scientists interviewed for this study had different views about the relevance of such considerations. No one urged that valuable research should be suppressed when publishing it might diminish the profits of a company. But some did urge that researchers should make a serious effort to insure that the economic consequences of publication are not the result of misinterpretation. Others urged that such considerations should have no influence at all on the decision whether to publish, or on the way research is represented. Is all such influence inappropriate, or are there ways that responsible researchers might take non-scientific consequences into account?

(2) There is reason to believe that some of the researchers involved in this study were pressured not to publish, and were even threatened. How should one respond if a powerful organization urges one not to publish? What if they threaten to cut off funding if one publishes research that might be damaging to the organization? No one argued that researchers should give in to such pressures. However, some people urged that there are extra reasons to publish if inappropriate pressures have been applied. One went so far as to suggest that one had to publish under those circumstances, since failure to do so would indicate that one had given in to inappropriate pressure. Others argued that such pressures should simply be ignored, and should not enter authors’ decisions at all.

IV. What ethical standards should apply to the peer review process? What should reviewers do who have interests in a publication that go beyond their responsibilities as a reviewer?

(1) Scientists who review papers for journal publication are usually expert in the field of study covered in the publication under review, and may sometimes be pursuing closely related research. This creates an immediate potential for conflict of interest: some scientists view work that is similar to their own as ‘competition,’ and may see their own interests as being in opposition with the interests of the authors of the papers they may review. While there is wide agreement that such interests should not influence the review process, is it possible for reviewers to set aside their interests in such a case?

(2) Some reviews are strictly partisan and interest driven—perhaps the fictional reviewer report written by the ‘Industry Representative’ in this case study is a case in point. What steps can be taken to guard against the inappropriate influence of non-scientific reasons in the review process?

Central Arguments

This section provides a list of arguments for and against publication. Its inclusion is not intended to imply that the decision whether to publish is the only communication-ethics issue at stake in the case under consideration.

**Reasons against publication**

I. Concerns about scientific methodology.

- Lack of proper control: an unidentified corn variety was sourced for pollen in control group. This makes it more difficult to reproduce the experiment precisely as it was done.
  - Response: the researchers used a widely used and untransformed maize variety. The study can usefully be reproduced with any corn variety that fits this description.
- Vague description of pollen dose: The study lacks precise information on what dose of pollen was used in the study, and does not investigate the response of larvae at varying doses. This once again make it difficult to reproduce the experiment, and renders the study incomplete.
  - Response: Pollen density, as reported, was visually similar to that seen in the field. While a more precise measure might have been used, this is sufficiently determinate to allow others to reproduce the process, and is permissible for a preliminary study like this one. More precise studies were in fact done later, partly spurred by the publication of this paper.
  - Response: While it would be valuable to gain dose-response data, that would be a different experiment. The fact that there is more to do does not imply that this work was badly done.
- Lack of choice: researchers did not discover whether monarch larvae simply avoid leaves that are pollen-covered. The larvae in this study had no alternative. This renders the laboratory conditions significantly different from in situ field conditions.
  - Response: Once again, this would be a different study. The fact that there are further studies worth pursuing does not imply that this study was badly done.

## II. Concerns that the data will be misunderstood or misrepresented.

- **Public Misinterpretation:** There is a serious potential that these results will be misrepresented in the popular press, and misunderstood by the public. “Further study should be done before airing this issue.”
  - **Response:** This is a scientific journal, not a public journal. Articles in this venue can be written for scientists and need not be adjusted for the public.
- **Inflammatory Title:** The title will be predictably misinterpreted by the public, since the non-scientific public does not distinguish between ‘harm’ and ‘risk.’
  - **Responses:** (i) The title reports precisely what the study found, and (ii) this is a professional journal, so it can appropriately be aimed at a scientifically sophisticated audience.

## III. Concerns about economic and social effects of publication.

- **Impugns Valuable Technology:** This study impugns a valuable and effective technology without providing any evidence that this technology is risky or unsafe.
  - **Responses:** (i) If the science is good, this possible effect should be regarded as irrelevant. (Should it? Not all will agree.) (ii) Our confidence that this technology is valuable and effective is unjustified unless studies like this one are pursued.
- **Economic effects:** The bad press generated by this study will needlessly undermine company profits and farm revenue. This product is necessary to maintain U.S. agricultural production, and should not be needlessly disparaged.
  - **Responses:** As above, if the science is good, then this isn’t “needlessly” undermining profit and revenue. If agricultural production of this kind causes environmental damage, we need to know.
- **Setting back research:** Articles that question the value of transgenic technologies may set back research and undermine funding for this valuable area of innovation.
  - **Response:** This study may also motivate research on non-target effects and environmental risk.
- **Potential for misuse:** This article provides ammunition for irresponsible anti-GMO activists who will mis-use the results of this study to raise broad and irresponsible fears and concerns.
  - **Response:** Authors cannot be responsible for all possible ways in which their work may be misunderstood, misinterpreted, and misused. If the study is clear and does not invite misinterpretation or invite misuse, then the authors have discharged their responsibility.

## **Reasons in support of publication**

### I. Scientific methodology.

- **All studies are incomplete:** While the study is incomplete in many respects, all scientific studies are incomplete in one respect or another. Incompleteness can never be a reason not to publish significant findings.
  - **Response:** Critics urge that this study is incomplete in key respects.
- **Responsible study with modest claims:** The scientific work described in the study was responsibly done, and the results are not overstated. This is a solid, if limited study: the science is good, the stated results are fully supported by the methodology used.

- Response: Critics raise concerns about whether the study was appropriately designed and whether it employed an appropriate methodology.
- The study is reproducible: Critics who urge that the reported methodology is unreproducible are just wrong: anyone can go through the procedure just as we describe it and can check our results for themselves.
  - Response: Vagueness and imprecision in the experimental design make reproduction of the experiment more challenging. This leaves open the possibility that different results could be explained away by possible differences that are still consistent with the description of the experimental design given in the paper.

## II. Importance of the topic.

- Relevant for evaluation of Bt Corn: The topic is important and the results of this study are relevant for the evaluation of the environmental impact of Bt corn.
  - Response: Vagueness and imprecision in the experimental design undermine the importance and relevance of the study.
- Inadequate testing so far: This product (Bt corn) was introduced into the market with inadequate testing of implications for the environment and for non-target species. In this context, it is justifiable to publish research that will bring public notice to this problem.
  - Response: This gives reason for complete, not incomplete environmental risk analysis of Bt corn. An incomplete study does not fill the gap described.

## III. Need for further research, and the hope that this study will instigate this research.

- Inspiring more research: This paper should prompt more research investigating the effects of Bt crops on non-target species, and more generally research on the environmental impact of new crops. Such research is needed.
  - Response: Other research was already underway—research that more precisely mirrored field conditions, and evaluated the risk.

## IV. Response to inappropriate industry pressure.

- Giving in to inappropriate pressures? Industry groups put pressure on the research team not to publish. In this context, if Nature were to fail to publish the results, this would be giving in to inappropriate industry pressures.
  - Response: To publish just because of pressure not to do so is to introduce non-scientific considerations where they don't belong. In this respect, it's inappropriate in just the same way that it's inappropriate to give in to inappropriate pressures. The decision should be dispassionate and based on reasons of science, not unscientific pressures.