# GM Freeze Consultation Response: Draft Guidance on the Environmental Risk Assessment of Genetically Modified Animals by the EFSA Panel on Genetically Modified Organisms (GMO)

31 August 2012

## Introduction to GM Freeze response

In 2007 The European Commission requested the GMO panel of the European Food Safety Agency (EFSA) to produce a guidance document "for the safety assessment of GM animals that would address both food and feed and environmental safety as well as animal health and welfare issues" to assist applicants wishing to gain commercial approvals for GM animals. The EFSA mandate was extended in March 2010 to cover animal health and welfare issues. A Draft Guidance document was issued by EFSA in June 2012, and the public had an opportunity to comment by the end of August 2012. This document sets out the comments on the Draft Guidance GM Freeze submitted to EFSA's consultation.

Production of the Guidance assumes there is consensus in the European Union to go ahead with the development and release of GM animals into the environment either in captive, semi-captive or non-captive condition and to allow the import and export of GM animals and products produced from them. The Guidance covers three main animal groups: GM fish, GM insects and GM mammals/birds.

Considerable pressure has been brought to bear on the European Commission to produce this document to help ensure companies and institutions working on GM insects (Oxitec, UK), GM chicken (Roslin Institute/Cambridge University, UK) and GM salmon (AquaBounty, US) have greater certainty of regulatory and market readiness as they push ahead with their respective GM animal development. GM Freeze is very concerned that members of Oxitec staff and associates[1] were involved in drafting the risk assessment Guidance as members working groups that supported the EFSA GMO panel as this could lead to bias, particularly as Oxitec staff have called for a weakening of the risk assessment requirements to facilitate the development of GM insects[i].

These comments on the Draft Guidance follow the section-by-section pattern required by EFSA's consultation procedure.

## Summary of GM Freeze main points

- A full public debate on the need, ethics and resulting acceptability of GM animals is required before any risk assessment Guidance can be issued.
- Ethical, socio-economic and animal welfare consideration should carry equal weight to the environmental risk assessment in decisions on applications to authorise GM animals, and applications for authorisation should be rejected on these grounds alone. The introduction of GM animals and cloning to the food chain would relegate animals to the status of commodities rather than treating them as sentient beings.
- The risk assessment Guidance should cover all potential GM animals and not just focus on groups where there are current developments (fish, insects, mammals/birds), or it risks being rapidly outdated and outpaced by developments. It should also cover animals genetically modified to produce pharmaceuticals.

[1] Romeo Bellini has co-authored papers with Oxitec's chief scientific officer, Luke Aphley (see www.ncbi.nlm.nih.gov/pmc/articles/PMC2946175/ ), who also provided expert evidence to the EFSA GMO panel and who has also penned an article supporting lighter regulation for GM insects (see www.ncbi.nlm.nih.gov/pmc/articles/PMC3269410/). Michael Bonsall cooperates with Aphley (see www.bbsrc.ac.uk/news/health/2012/120702-n-bbsrc-at-science-live.aspx), George Christophides of Imperial College is a colleague of Aphley's in the INFRAVEC Consortium (see www.infravec.eu/index.pl?pos=02.00&lbl=partners), John Mumford co-authored a paper produced for Mosqguide with Aphley and another Oxitec employee Camilla Beech (See www.msmbb.org.my/apjmbb/html173/173c.pdf).

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- Experimental releases of GM insects in very large numbers should be covered by a comprehensive environmental risk assessment because the risks involved are similar to a commercial release.
- The statistical power of experiments to investigate the environmental impacts of GM animals needs to be sufficient to detect small but significant ecological changes that could cumulate over a number of years and bring about a significant long-term change to the ecosystems into which the GM animal has been released or escaped.
- Experience of escapes and releases of introduced animal species in the UK illustrates the difficulties in removing GM animals from ecosystems to which they are or have become well adapted (for example the American mink, the Signal crayfish and the freshwater fish the Zander). This is not adequately dealt with by the Draft Guidance.
- Post Market Environmental Monitoring must not be used to fill data gaps in the risk assessment or resolve scientific uncertainties in the risk analysis.
- Where there are significant data gaps and unresolved scientific uncertainty the precautionary principle should apply, as required by Directive 2001/18, and the application should be rejected.
- All biogeographical regions where GM animals are likely to be released or survive should be included in the risk assessment and not just those selected by applicants.
- As some GM animal product facilities will be located outside the EU the legal powers of the EU to include such facilities in environmental risk assessment needs to be clarified.
- Difficulties in selecting reliable comparators or surrogate species for GM animals to study the environmental consequences of a release and/or escape are very significant and should result in approval being rejected until risk assessment techniques become more reliable.
- Genetic modification of honeybees to tolerate insecticides is not acceptable because it could reduce genetic diversity at a time when the full gene pool may be needed to overcome other problems and the use of insecticides, such as nicotinoids, could also damage other pollinators and non-target insects.
- Environmental risk assessment of GM animals should not be used to assess environmental benefits of GM insects, as suggested in the Draft Guidance. Instead this should part of a wider assessment of ethics and socio-economic impacts that would inform any authorisation process.

## GM Freeze consultation response

### Abstract

Lines 7-21

The abstract should acknowledge that the Environmental Risk Assessment (ERA) is but one part of the assessment of GM animals and that ethical, socio-economic and welfare considerations also form an equal part of the overall assessment and should lead to the outright rejection of the genetic modification of the animals in the EU for any purpose.

### Summary

Line 48 suggests that the scope of the risk assessment Guidance is limited to GM insects, fish, mammals and bird. This should be reviewed in the light of recent experimental projects and patents for GM arthropods and other phylum such as *Mollusca* and *Amphibia*.

### Background

Lines 164-193

It is very unclear why EFSA has been asked to embark on developing risk assessment Guidance for GM animals at a time when there seems to be very little prospect of them finding a market in the EU because of the widespread public opposition to GM technology in crops and the cloning of animals in the EU. The only credible explanation is that industry has pressed for this to demonstrate GM animal research and development is not a blind alley in the hope of satisfying existing investors and staying in business long enough to encourage new ones.

Line 187

The genetic modification of animals raises new ethical and moral issues that should result in the

rejection of the technology in the EU. The Draft Guidance is therefore premature as it should follow a wide-ranging debate across the EU as to whether GM animals are acceptable. Issues such as the treatment of animals as commodities rather than sentient beings would feature strongly in such a debate. GM Freeze believes that this document must follow such a debate rather than preceding, and possibly pre-empting, it.

**Assessment**
Line 229
It is unclear why the Guidance document excludes GM animals to produce pharmaceuticals when these will pose a potential threat to the environment as well as clearly raising additional safety issues because of the presence of biologically active GM products. GM Freeze believes that GM animals producing pharmaceuticals should therefore be covered by this Guidance in addition to the usual pharmaceutical safety assessments.

Lines 248-252
The Guidance document fails to make a clear distinction between experimental and commercial releases. In the case of GM insects experimental releases will often be designed to demonstrate commercial viability and therefore involve the releases of millions of GM insects (as was the cases with Oxitec's recent releases of GM mosquitoes in the Cayman islands, Malaysia and Brazil). The need for a rigorous risk assessment is as great for such trials as for full commercial releases. EFSA should address this point in the final Guidance document.

Lines 283-285
The document highlights the release of non-captive GM animals, such as insects and rabbits modified to control problem wild populations, into "specific environments". GM Freeze suggests that this should refer to "the environment" because the possibility of GM animals being confined to a specific environment is extremely unlikely in most cases and damage to ecosystems they inhabit could be significant.

**2. Strategies for ERA of GM animals**
Lines 286-325
GM freeze has concerns about the lack of attention payed by the Draft Guidance to ensuring that baseline data on ecosystems into which GM animals are to be released is fully available and understood. This will be needed to enable the complex interrelationships of the food webs above and below ground to be fully understood and increase the chances of being able to design trials or models to test hypothesis as to the possible impacts of a GM animal. Baseline data should extend to all seasons and abiotic conditions to ensure that all possible interactions between resident species and the existing ecosystems are understood, enabling the possible impact of the accidental or deliberate introduction of a GM animal to be assessed.

Lines 555-559
GM Freeze would like to emphasise that Post Market Environmental Monitoring (PMEM) must not be used to fill knowledge gaps or to clarify uncertainties that have not been addressed by the risk assessment for GM animals. The history of the deliberate or accidental release of animals into new environments shows that the results can be unpredictable and may take many decades to fully develop. For example Pacific salmon, which migrated from Russian rivers feeding the White Sea in the 1960s, have only recently started to appear in Scottish rivers (eg, the Tweed, see Association of Salmon Fishery Boards 2011 www.asfb.org.uk/pacific-salmon-species-caught-in-tweed-district/). The consequences of such arrivals on native fish stocks are not yet clear and may not be obvious for a number of years because, for instance, they may be dependent on the alien species adapting to local conditions or reaching critical population thresholds. Removing GM animals from ecosystems to which they are or have become well adapted could prove to be very difficult, as it has with many previous escapes or introductions (see for instance the case of the Zander – Linfield RSJ, undated. "The impact of Zander (*Stizostedion lucioperca (l.)* in the United Kingdom and the future management of affected fisheries in the Anglian Region", FAO www.fao.org/docrep/009/ae997b/AE997B09.htm#TopOfPage).

**3. Cross-cutting considerations**

**3.1 Receiving environments**

Lines 639-646

The production of GM animals and their accidental or deliberate release in the EU can occur across a range of biogeographical regions in which the environmental conditions are very different. The current application by AquaBounty to commercially release GM salmon in the US involves the use of two production facilities outside the US that are located in two vastly different biogeographical zones (Price Edward Island in Canada for egg and fry production and Panama for growing captive salmon). This illustrates the need for the Guidance to make it clear that risk assessments must include receiving environments for all phases of production including the possibility of escapes in transit. This also raises the question whether the EU can demand that applicant assess risks for production facilities located outside the EU. This issue has not been addressed by the current draft, and the EU should not only assess the risks within EU boundaries when significant negative impacts outside the EU could occur, meaning European-based risk assessment could fail to deliver the level of environmental protection required.

Lines 729-734

In view of the need to assess every possible receiving environment the sentence, “However in practice it will not be feasible to study all the receiving environments of a GM animal so that in many cases applicants will have to select specific study sites,” should be deleted, along with subsequent text and Table 3 (Lines 730-754).

**3.2 Experimental environment**

Lines 792-852

GM Freeze believes this section underlines the scientific and technical difficulties in carrying out an ERA for GM animals that are intended to be released into the environment (eg, GM insects) or might escape (eg, GM fish). Whatever the choice of experimental design it will not replicate the environment into which the GM animal is intended to be released. This brings into question the wisdom of even contemplating the release of GM animals commercially, and we would therefore suggest that a prohibition on their development would be more appropriate.

In cases where GM animals are designed to limit the populations of pest species or disease vectors, it would be impossible to design an experiment that could mimic the full-scale release of the GM animals. This would be the case particularly with GM animals which, if successful, could result in a huge reduction in the target population that could, in turn, result in a significant change in the ecosystem. This would be impossible to meaningfully replicate in an experimental environment, especially in the entirely foreseeable circumstances where the reaction to other species in the ecosystem (or ones that moved into it from outside) was delayed well beyond the duration of the experiment. Moving from a satisfactory experiment to full-scale commercial release would place unacceptable reliance of PMEM with unpredictable and damaging consequences. Reversing such changes could prove to be impossible, and, therefore we conclude no approvals to release GM animals should be granted.

**3.3 Choice of comparators**

Lines 853-1051

GM Freeze is extremely concerned about the proposals relating to the selection of comparators for GM animals. The Draft Guidance recognises the difficulties in finding a non-GM equivalent for the GM animals, especially if the species is absent from the proposed receiving environment, and the clear limitations on experimenting with the GM animal in the environment.

Lines 995-6 suggest that Rainbow and Brown Trout might be suitable comparators if the Brown Trout is present in the local environment. However there is good evidence showing that the two species behave quite differently in the same environment, for instance Brown Trout are more active at night and Rainbow Trout have larger ranges (Young MK, et al, 1997. “Contrasting behaviour of large Brown Trout and Rainbow Trout in Silver Creek, Idaho”. *Great Basin Naturalist*, 57: 238-244). The potential impact of a released or escaped GM fish on related or unrelated species in accessible ecosystems which could be proposed as suitable comparators (eg, in

competition for food, resting sites or breeding sites), also makes the choice very difficult if not impossible. Without adequate comparators the risk assessments will be invalid, and therefore no GM animals should be approved.

**3.4 The use of non-GM surrogates**
Lines 1052-1107
The use of non-GM surrogates as comparators in ERAs is not recommended by GM Freeze. For example GM insects with the female lethality gene and insects with radiation-induced sterility would not be directly comparable as the former results in fertile eggs being laid and hatching but failing to mature to adulthood, while the latter does not produce any offspring. Each system has a different failure rate, and in the case of Oxitec's GM mosquito developed to control Dengue Fever the lethality gene can be switched off by the presence of the chemical trigger in the environment (in this case the antibiotic tetracycline). In sterile insect technology, the sterility cannot be reversed once it is achieved, although fertile individuals can still be produced.

In the case of AquaBounty's fast growing salmon, which is currently undergoing regulatory approval in the US, no obvious surrogate stands out. The GM fish cannot be released into the wild without the possibility of interference with native populations and irreversible damage. The use of completely different species is fraught with difficulties, as illustrated by the behaviour differences between Rainbow and Brown Trout above. The introduction of any new species into an aquatic ecosystem can alter the behaviour of native stock, for instance research has shown that wild juvenile Brown Trout responded to the presence of predatory adult Brown Trout by seeking refuges more often. However this behaviour was not observed in second generation hatchery fish, which were far less responsive to predation (Alvarez D and Nicieza AG, 2003. "Predator avoidance behaviour in wild and hatchery-reared brown trout: the role of experience and domestication". *Journal of Fish Biology* 63: 1565–1577). This only serves to illustrate the difficulties in trying to model in "controlled" conditions the short-term and long-term consequences of a GM fish escape into the wild.

In our view knowledge gaps relating to the interactions of GM animals in the natural environment will be significant because of the difficulties of conducting controlled experiments, and therefore the Guidance should explicitly state that the precautionary principle should apply where such gaps exist and applications should not be approved.

**3.6 Long-term effects**
Lines 1498-1505:

> *"Long-term effects of category II, by definition, cannot be investigated through an initial experimental phase of testing, as none of the possible experimental design can provide the range of complexity experienced after full commercial release. For example, it is likely to be difficult to mimic, with a confined experimental set up, all conditions occurring in the receiving environments in order to assess possible interactions of a GM animal with other animal species. Category II effects can only be investigated by reference to possible existing examples and case studies that provide evidence of rates and magnitudes of environmental impact due to change in production systems (eg, intensive grazing) or external (e.g. climate change) factors."*

As is clear from this extract from the Draft Guidance, experimental design to test if the releases of GM animals are likely to result in significant ecological changes to the receiving ecosystem are very difficult to design and carry out. Experiments should be powerful enough to detect such differences, especially those which are cumulative in nature and could be missed by shorter, less powerful experiments. In a 25-year field study of food supply for farmland birds in the UK, difference in weed abundance (weed seed is an important food source) detected difference of 13% ($P < 0.001$) and were ecological significant (Ewald JA and Aebischer NJ, 1999. "Pesticide use, avian food resources and bird densities in Sussex", *Joint Nature Conservation Committee Report No 296*; page 70). This emphasises how easy it would be to miss such differences in GM animal experiments that are poorly designed or are too limited in their power.

Line 1521
Meta-analysis is recommended when there is a lack of sufficient data or conclusive data in any study. Meta-analysis is based on combining the results of several different studies. However this approach is not without its problems (eg, bias caused by applicants selecting studies showing favourable, rather than unfavourable, results or the selection of inappropriate studies included because there are so few appropriate ones available). In the case of GM animals meta-analysis is most likely based on studies of comparators or appropriate surrogates to the GM animal. GM Freeze is concerned that this could result in reliance on inappropriate studies given the difficulties outlined above concerning the selection of comparators or surrogates. This adds weight to the argument that the approval of GM animals is premature, and taken with other factors such as ethics and socio-economic factors it should mean a ban.

**3.7 Uncertainty analysis**
Lines 1549-1720
This section of the Draft recommends various techniques and approaches to deal with uncertainty in the risk assessment for GM animals. While all the proposed methods are valid, none provides an adequate approach if data on the GM animal is absent or inadequate to use in any of the techniques. What is lacking in this section is any guidance as to what applicants or regulators should do if the uncertainty analyses do not provide sufficient certainty or even adds to the uncertainty. The absence of any guidance as to when and how the precautionary principle should be applied in this section, or indeed the entire document, is therefore a major oversight or omission. Given that the precautionary principle underpins Directive 2001/18, this is unacceptable.

**3.7.3 Interplay between ERA conclusions and PMEM**
Lines 1721 -1737
The drafting of this section leaves a lot to be desired:

> *"The ERA is often constrained/restricted by the available knowledge and experience of the GM animal and it can be difficult to predict and consider all potential future applications, production systems and receiving environments of the GM animal. Thus large-scale and long-term use of a GM animal could result in some effects which were not predictable at the time of the ERA or consent. Therefore, according to Directive 2001/18/EC (EC, 2001), applicants are required to conduct general surveillance (GS) to detect unanticipated adverse effects on the environment."*

This gives applicants the option to rely on post market environmental monitoring (PMEM) to file gaps in data. We reject this approach in favour of one based upon the precautionary principle, under which environmental protection would take precedence over premature approval of a GM animal where data on its impacts were inadequate.

**3.8 Aspects of animal welfare**
Lines 1738-1823
GM Freeze considers that the welfare of animals should be a high priority. The Draft Guidance correctly indicates that animal welfare has been the subject of legislation in the EU. This should apply to all GM animals, and welfare should be used as a reason for refusing any application to produce, release or market GM animals. We believe that the introduction of a Draft Guidance for the risk assessment of GM animals is premature and should not be progressed until there has been a full and wide-ranging debate on GM animals across the EU, including examining the necessity of such a development.

**3.8.1 Health and welfare aspects for GM mammals and birds**
Lines 1769 -1797
GM Freeze emphasises that animal welfare is of paramount importance. The Draft Guidance rightly points out that existing breeding of birds and mammals has increased welfare problems in many groups such as dairy and beef cattle, broiler chickens, turkeys and dogs. Genetic modification could exacerbate existing conditions or introduce new problems. The cloning of GM

mammals and birds would add to welfare problems, as the record in cloned farm animals is very poor in this respect. GM Freeze therefore believes that issuing a risk assessment Guidance is unwelcome as it will only serve to encourage developments of GM animals in the absence of any need, demand or convincing means to adequately assess their impact.

**3.8.2 Health and welfare of GM fish**
Lines 1798 – 1817
GM fish are most likely to be produced for intensive production facilities, which already form the basis for aquaculture in the EU. These involve keeping fish at naturally high densities and carry a high risk of increased disease and parasites, all of which increase the use of antibiotics and subsequent waste discharge into surrounding ecosystems and resulting damage. Genetically modified fish are likely to exacerbate these problems, as it is likely to reduce the genetic base of farmed stock. GM animals so far proposed include fast growing Atlantic salmon from the US company AquaBounty. GM fast-growing fish could be to subject to fitness and behaviour problems, as has been the case in other groups such as broiler chickens (which have also been selectively bred to grow quickly), and where lameness and heart problems are subsequently common (see Compassion in World Farming
www.ciwf.org.uk/farm_animals/poultry/meat_chickens/welfare_issues.aspx).

**3.8.3 Health and welfare of GM insects**
Lines 1818-1822
This section acknowledges the need for a risk assessment of GM honeybees. While GM Freeze agrees that the welfare of honeybees is vitally important, we would oppose the use of genetic modification to address any of the serious problems which are currently harming their populations across the EU, which include disease, parasites and exposure to pesticides (eg, nicotinoids), nor are we convinced such impacts are restricted to honeybees alone among pollinators. Rather than addressing the welfare implications of GM honeybees, there is an overriding need to improve the welfare of existing populations of all pollinators. With regard to honeybees, this should include the potential role that inbreeding of new strains of honeybees has played in the susceptibility of honeybees to diseases, parasites and other threats and the effectiveness of biosecurity measures to prevent the arrival on new diseases or parasites, or new strains of the same. The genetic modification of bees could reduce apian genetic diversity at a time when a larger gene pool may be required to regenerate more robust colonies. GM Freeze rejects the idea of genetically modifying honeybees to be tolerant insecticide because it completely ignores the threat this would pose to other wild pollinators that will not carry this GM trait from continued use of harmful insecticides.

**4.1 Specific areas of risk for the ERA of GM fish**
Lines 1848-2935
A major omission from this section of the Draft Guidance is consideration of GM fish specifically modified for purposes of biological control of pests and invasive fish species, similar to the approach proposed by Oxitec for controlling insect disease vectors and pests. One example already being cited in scientific literature is the control of scarp in Australian rivers (Nowak R, 2012. “Gene warfare to be waged on invasive fish”. *New Scientist* online 8 May See www.newscientist.com) by introducing a “Trojan horse gene” into wild populations via GM males that would in theory weaken offspring and eliminate them from the ecosystem.

Such a removal of a species (if successful) could have significant knock-on effects on the ecosystem by severely disturbing an established food web and potentially also have abiotic impacts. Modelling the impact of such a change would require a comprehensive understanding of the existing ecosystems where the pest species was present. The risk assessment required would also need to take into account the possibility that some GM fish may not pass on the gene and a small population of the pest species could survive and potentially recolonise river systems.

**4.2 Specific areas of risk for the ERA of GM insects**
Lines 2937-4367
In this section (and others) the Draft Guidance refers to a likely use of GM in insects as being **“**induced sterility or lethality in target species progeny for suppression or prevention that could

reduce the negative effects of the target species" (lines 2981-2982, and similarly in lines 3047-3048). It is important to distinguish between different approaches that do not produce any offspring and those that produce eggs and larvae which die before reaching sexual maturity due to the presence of a lethality gene. These different approaches could produce different outcomes and would therefore require different risk assessments.

Overall this section of the Guidance (lines 2937-4367) illustrate the massive difficulties in assessing the environmental impact of the mass release of GM insects without carrying out mass experimental releases to assess this and to test efficacy of the genetic modification, as was the case with Oxitec's recent releases of GM mosquitoes in The Cayman Islands, Malaysia and Brazil as part of their development programme. Large-scale experimental releases of insects are equivalent to a commercial release, and therefore carry the same risk to the environment and human health. Even if such releases are permitted, their value would be very limited unless there was a considerable amount of good quality baseline data on the receiving ecosystems. The duration of such experimental releases would be of limited value in assessing the impact of the GM insects in the long-term, maybe following multiple releases in the same area. The experimental mass release of GM insects requires a full environmental risk assessment, which applicants may be reluctant to undertake given doubts about the efficacy of the approach.

Our conclusion from this section is that any commercial approval of a GM insect would take place with very significant data gaps and scientific uncertainty and therefore be very heavily dependent on PMEM to establish the safety (or not) of the GM insect and any mitigation measures. We reject this approach and submit that this should immediately lead to a reassessment of the need for GM insects.

**4.2.5 Environmental impact of the specific techniques used for the management of GM insects**

Lines 4091-4093

The draft guidance includes the following sentence in relation to the management of GM insects:

> "*Alteration to management practices might provide both environmental benefits as well as harm so that the net environmental impact of the overall production system needs to be considered."*

It is unclear why an analysis of "benefits" is included because the assessment of environmental benefits is not covered by the mandate to EFSA provide by the European Commission on 13 February 2007 and 25 March 2010. Neither are environmental benefits mentioned in Directive 2001/18 and it annexes. Other sections of the Draft Guidance on GM fish and animals do not include any reference to environmental benefits.

GM Freeze believes it is outside EFSA's remit to consider benefits as the aim of the environmental risk assessment is "for the safety assessment of GM animals that would address both food and feed and environmental safety as well as animal health and welfare issues" (lines 167-168).

The assessment of environmental benefits should be undertaken in a separate process, as with ethics and socio-economic impacts of the GM animal.

**4.3 Specific areas of risk for the ERA of GM mammals and birds**

Line 4368-6387

The Draft Guidance document distinguishes between captive, semi-captive and non-captive GM animals. It is worth reiterating that there is a well-documented history of captive animals and birds escaping into the wild either as a result of carelessness, neglect or deliberate intervention by third parties. Species that have escaped and become established in the UK are numerous and include:

- Mammals (eg, American mink, coypu, muskrat, three species of deer, edible dormouse and red necked wallaby), reptiles (eg, the European Pond terrapin).
- Birds (eg, ruddy duck, eagle owl, ringed neck parakeet and Canada Goose).

- Amphibians (eg, American bull frog, marsh frog and European tree frog).
- Molluscs (eg, zebra mussel and slipper limpet).
- Crustaceans (eg, signal crayfish).

The means of escape or release of these species are largely known, but this does not necessarily lead to greater biosecurity aimed at preventing future releases. Some species (eg, coypu, muskrat and ruddy duck) have been successfully eliminated or controlled by culling programmes, but others (eg, American mink, Canada geese and Muncjac deer) continue to thrive. The environmental and economic impacts of introduced species are also highly variable, from very serious in the case of North America mink or fish farms and fisheries, to none known in the case of the European Pond Terrapin (see Introduced Species into the UK website www.introduced-species.co.uk/index.htm).

The success of escaped or released GM animals will depend on how well they are adapted, or adapt to, local conditions as they disperse. The difficulties in establishing this prior to approval are huge and ultimately will depend of the quality and quantity of the data collected.

The Draft Guidance document puts forward four case studies. Two of these are said to be "in an advanced stage of development" – the Enviropig and flu resistant chicken (lines 4375-4377). However development of the former has now ended (see www.huffingtonpost.ca/2012/06/21/enviropigs-university-of-guelph_n_1617140.html), so it is hardly a good example. Other cases studies are either dependent on further development (avian flu resistant chickens) or are theoretical (the sterile rabbit and the growth enhanced cat).

Neither of the case study animals cited as examples was used systematically to demonstrate the approach to risk assessment proposed in the Guidance, so it is not clear what value the case studies provide. The use of some detailed cases studies may provide greater clarity about the complexity of what is involved in assessing the risks of any GM animal. The case of the sterile rabbit being used to control wild rabbit populations could be usefully employed to do this and to illustrate the far-reaching consequences such an application of GM technology might have. These would include indirect effects (such the potential loss/reduction of rabbit grazing on sensitive grassland habitats), the impacts of reduced food availability on wild predators and their other prey species (including carrion eaters) and the economic impacts of the widespread reduction in rabbit populations.

**5. Post-Market Environmental Monitoring plan**
Lines 6389 -6547
The Guidance sets out the wording in Directive 2001/18 on Case-Specific Monitoring (CSM) and General Surveillance (GS) to identify the occurrence of adverse effects of the GMO or its use on human health or the environment that were not anticipated in the ERA. This sets out what PMEM is intended to achieve: to confirm that the risk assessment was correct and to detect unanticipated consequences of the release of a GM animal.

PMEM is therefore not intended to fill data gaps that should have been provided in the risk assessment. If it proves impossible to provide adequate data without first releasing the GM animal into the environment, then the correct course of action under the precautionary principle is to reject an authorisation to release until the gaps are adequately filled and scientific uncertainties resolved.

[i] Aphley L and Beech C, 2012. "Appropriate Regulation of Insects". *PLoS Neglected Tropical Diseases* 6: www.ncbi.nlm.nih.gov/pmc/articles/PMC3269410/pdf/pntd.0001496.pdf