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**Annex 1**

**JOINT NATURE CONSERVATION COMMITTEE**
**Position Statement on Genetically Modified Organisms**
**October 2001**

1. Biodiversity has resulted from four billion years of evolution. The development of GMOs is more than a greatly accelerated form of microbial, plant or animal breeding. It can effectively create novel life forms by transferring genes from one species into another species, including animal genes into plants[BN1]. GM technology has given breeders the potential to effect these changes at rates unparalleled in the Earth's history. Conventional breeding also produces new strains of organism, some of which may affect native wildlife. However, the use of transgenic techniques, incorporating new combinations of genes into crops and other commercially valuable organisms, may pose additional risks to our natural heritage due to potential impacts on ecological food webs. In addition, there is potential for GMOs to enable changes in agricultural, forestry and fisheries management, which could be detrimental to wildlife.

2. The UK has international obligations to safeguard its native biodiversity, in particular through the EU Habitats Directive, the EU Birds Directive, and the Convention for Biological Diversity. In the UK, much of our biodiversity is closely associated with agricultural systems and activity, and with managed forests and aquatic habitats. The biodiversity associated with agricultural systems is already being affected significantly by intensification, with many species of farmland birds, butterflies and plants having declined very substantially over the past 50 years[BN2]. While genetically modified (GM) crops have not contributed to agricultural intensification to date, using certain types of GM crops has the potential to reduce biodiversity further by increasing such intensification. There are also potential risks to biodiversity arising from gene flow and toxicity from some GM crops. The JNCC believes there should be careful assessment of the implications for biodiversity, and for the environment generally, before decisions are made on the commercial release of genetically modified organisms (GMOs).

3. The JNCC recognises that the use of some GM crops may have potential benefits for farmland wildlife, especially if their use results in better targeted agrochemicals with a lower impact on biodiversity[BN3].

4. This position statement represents the combined views of the three British statutory nature conservation agencies of which JNCC is a joint committee. The agencies are statutory consultees in the process by which applications for release of GMOs into the environment are considered, and also have a general duty to advise government on conservation policies. We are solely concerned with potential impacts of GMO releases on the living environment and on sustainable use of our natural resources, including protected sites and the wider countryside. We have no locus on matters of public health and safety. The agencies, working through the JNCC, advocate using the precautionary principle where commercial releases are proposed, and consider that the release and use of GMOs is appropriate only when all of the following criteria are satisfied:

i. Rigorous risk analysis is undertaken for potential releases of GMOs, including analysis of the risks to biodiversity of changes in husbandry, agricultural practices, soil processes and other land and water use, which may result from the adoption of GM technology[BN4].

ii. Meaningful public consultations are undertaken within a timetable that is reasonable. Additionally, the JNCC recommends that public notice should be at least one month in advance of release.

iii. Risks to the conservation of native biodiversity are shown by comprehensive analysis of evidence to be acceptably low. Risks may include direct toxicity of transgenic organisms to wildlife, competitive displacement of native species by transgenic organisms or hybrids with wild species, and effects on soil and aquatic ecosystems.

iv. It is demonstrated that the use of GMOs in agriculture, forestry or aquaculture does not lead to changes in land and water use and management which are detrimental to the wildlife that use farmland, woodland, freshwater or the seas. The use of GMOs should not lead to changes in patterns of agrochemical or veterinary pharmaceutical use that may have adverse effects on wildlife. The use of GMOs should not promote agricultural or forestry intensification on land of nature conservation value[BN5], and should not inhibit the widespread adoption of more environmentally sustainable methods of agriculture, forestry and fisheries.

v. It is demonstrated that crops developed to be resistant to insect, bacterial and fungal attack do not jeopardise the survival of native species, including beneficial insects, which rely upon such organisms within food webs[BN6].

vi. There are adequate safeguards against gene flow between GMOs and native organisms. Such safeguards should be built into the genomes of GMOs themselves[BN7]. Best practice techniques (such as those described by the Advisory Committee on Releases to the Environment (ACRE) in its report *Guidance on Best Practice in the Design of Genetically Modified Crops* should be used in the construction of transgenic organisms.

vii. GMOs are constructed using genes found only in natural organisms. We believe that the environmental effects of artificially constructed genes will be even harder to predict than those that occur naturally[BN8]. We are especially concerned that transgenic traits designed for industrial and pharmaceutical use should not adversely affect native species.

viii. In environmental clean-up work, GMOs are only used where there is a demonstrable advantage over conventional methods. All clean-up techniques are less desirable than pollution prevention[B]

ix. Plans and resources have been put in place to ensure there is adequate monitoring of the use and possible spread of GMOs in the environment following their commercial and experimental release, with specific work to detect effects on different habitats and species[BN10]. Alongside the monitoring required by the EC Directive 2001/18, there should be adequate monitoring of both gene stacking in commercial transgenic organisms, and multiple gene transfer to wild species.

5. The JNCC considers that future research and development effort on GMOs must ensure that there is adequate regulation of commercially-orientated and experimental releases into the environment, and that detrimental effects of releases on wildlife are properly assessed. We will therefore:

i. Continue to press for changes in the regulatory system to take account of, and minimise, potential ecological effects when assessing the risks of releasing GMOs.

ii. Continue to press for more research on the impact and extent of gene flow from GMOs to native terrestrial and aquatic species, and also on the ecological effects (including those in the soil) of crop management changes resulting from the use of GMOs.

iii. Recognise the need for field-scale studies on the effects on biodiversity of growing GM herbicide-tolerant crops, compared to other types of agriculture. The statutory agencies will continue to scrutinise the scientific rigour of the Department for Environment, Food and Rural Affairs (Defra) research through their membership of the scientific steering committee.

iv. Urge Government and industry to ensure that there is effective monitoring of possible ecological effects from GMO releases.

v. Continue to provide objective advice both to Government and to industry over potential effects of the release of GMOs on terrestrial and aquatic wildlife. The statutory agencies will continue to act as assessors to ACRE.

vi. Continue to recommend that commercial releases of GMOs, including herbicide-tolerant and insect-resistant crops, are not undertaken until sufficient research has been completed and evaluated, appropriate risk assessments have been carried out to provide public assurance that risks to the environment are acceptably small, and appropriate public consultation has taken place.

vii. Continue to advise Government on the impact on biodiversity of international agreements relating to trade and global environmental issues, especially those agreements involving GMOs.

**JNCC Position Statement on GMOs**

**Annex A. Background Notes**

BN1 Genetic (transgenic) engineering is a more radical form of plant and animal breeding, by which genes from other species (or even phyla) are inserted into the recipient genome. These genes have never been, and in many cases could never naturally be, part of the recipient species' gene pool. It is impossible, therefore, to predict accurately their behaviour if they should out-cross to native species. It is likely that some genes are inherently more risky than others. For example, genes conferring resistance to insects, viruses and fungi in GM crops such as oilseed rape, if transferred to native species, have the potential to increase fitness of the resulting hybrids. These could then become ecological weeds, with the potential to invade native ecosystems.

BN2 Recent research and survey has revealed severe declines in UK farmland bird populations, especially in those species associated with lowland arable and mixed farmland. Because of these declines, farmland bird populations have been included as one of the Government's 'Quality of Life Counts' headline indicators of sustainable development. Long-term research in southern England has identified increased pesticide efficacy as a major factor contributing to declines of skylarks, partridges and corn buntings. Herbicide efficacy is very important in determining the breeding success of these species; low breeding success is strongly associated with highly efficient weed control programmes. One of the factors involved in this effect is the reduction in invertebrate density caused by lack of weeds in arable fields. It has been demonstrated that bird chicks fail to thrive when invertebrate densities are low.

BN3 There is little doubt that biotechnology has great potential to be able to alleviate some of the problems associated with conventional intensive agriculture, especially if out-crossing from GM crops to native species can be prevented. Reductions in, or even elimination of, pesticides by using pest- and disease-resistant varieties, coupled with the prospect of nitrogen fixation and perennial crops, are attractive goals for genetic engineering. They could contribute towards more sustainable agriculture, as long as there were no reductions in biodiversity by diminishing invertebrate food sources, or through toxin transfer through the food chain. Present trends in GM crop engineering are, however, in the opposite direction, with herbicide tolerance being widely used to increase herbicide efficacy, exacerbating the adverse effects of agricultural intensification.

BN4 We believe that there is insufficient consideration of biodiversity issues in the risk assessment procedure currently used by the regulation system in the UK and in other parts of Europe. The last Government extended the remit of the main regulatory committee, ACRE, to include such issues, but it is not yet clear how ACRE is to achieve this, especially given the paucity of scientific data on the effects on biodiversity of GM crops and their management systems. Field-scale trials started in 1999 will help to supply data on the biodiversity effects of growing GM herbicide-tolerant crops, but there needs to be an increase in the quantity and quality of ecological data supplied with risk assessments before the regulatory system can properly address the risks to biodiversity of introducing GMOs commercially.

BN5 Besides the need to demonstrate that any changes in land use and management associated with the use of individual GMOs are at least benign and preferably beneficial to wildlife, there is a need to promote better strategic thinking about the effects of agricultural biotechnology within government as a whole. Transformations allowing pharmaceuticals, biomass, industrial raw materials and tolerances to be incorporated into crops may lead to greater pressure on land currently marginal for arable production, and especially land of conservation value. There needs to be more strategic thinking throughout both Government and industry about the desirability of incorporating future transgenic crops into UK agriculture. We are hopeful that the Agriculture and Environment Biotechnology Commission will be able to fulfil this role.

BN6 Pest and disease resistances are currently being engineered into a wide range of crops. Insect resistance has been achieved mainly by incorporating various types of toxic proteins (the so-called Bt proteins and the lectins) into the GM plant. Recent research has shown that these can have adverse effects on non-target species, although no comparison has yet been made with conventional pesticide use. There could also be potential effects on the soil decomposer ecosystem, and this needs to be researched.

BN7 Recent research has shown that gene flow from some GM crops to native plants and to non-GM crops is inevitable, but there is little research on the impact of such crossbreeding on the genetic fitness of any resulting hybrids. Risks associated with gene flow can be minimised in experimental plots, but may increase if GM crops are grown commercially. The JNCC is especially concerned about the transfer of insect, fungal and viral resistance to native plant populations, causing possible disruption to the population dynamics of the plants themselves and their parasites and predators. The technology for preventing gene transfer (by male sterility, pollen incompatibility and changing flowering times) already exists, but has not yet been incorporated into GM crops. A sub-group of ACRE has published on the ACRE web site (www.defra.gov.uk/environment/acre/bestprac/guidance/index.htm) a report on best practice for minimising gene transfer.

BN8 Constructing ‘designer’ genes is now routine in medical biotechnology and may be an attractive option for the farming industry when more advanced GM crops are formulated. There is already considerable interest and research into inserting genes coding for industrial raw materials, pharmaceuticals and nutrient supplements (‘nutraceutical’ crops) into various crop plants, some of which are capable of out-crossing to native species. We believe that this could have serious effects on ecosystems if such genes were to become incorporated into native plants.

BN9 Genetically modified bacteria and fungi are already being used experimentally to deal with oil spills and heavy metal contamination. There is considerable potential in extending this to other types of bioremediation, dealing with other types of pollution and contamination. Generally speaking, the risks to biodiversity from such GMOs are relatively low, but we are concerned that the existence of these GMOs should not reduce pressure to prevent pollution.

BN10 There is currently no legal requirement for monitoring for biodiversity effects after a GMO is released commercially. This will change with implementation of the revised EC Directive governing the release of GMOs (2001/18/EC), which includes an obligation to monitor both experimental and commercial releases. Member States have until August 2002 to revise their domestic legislation accordingly.

**Annex 2**

**JOINT NATURE CONSERVATION COMMITTEE**
**Position Statement on Genetically Modified Organisms**

**DRAFT UPDATE 1, JULY 2003**

1. Biodiversity has resulted from four billion years of evolution. The development of GMOs is more than a greatly accelerated form of microbial, plant or animal breeding. It can effectively create novel life forms by transferring genes from one species into another species, including animal genes into plants[BN1]. GM technology has given breeders the potential to effect these changes at rates unparalleled in the Earth's history. Conventional breeding also produces new strains of organism, some of which may affect native wildlife. However, the use of transgenic techniques, incorporating new combinations of genes into crops and other commercially valuable organisms, may pose additional and different risks to our natural heritage due to potential impacts on ecological systems. There is also potential for GMOs to enable changes in agricultural, forestry and fisheries management, which could be either beneficial or detrimental to wildlife.

2. The UK has international obligations to safeguard its native biodiversity, in particular through the EU Habitats Directive, the EU Birds Directive, and the Convention for Biological Diversity. In the UK, much of our biodiversity is closely associated with agricultural systems and activity, and with managed forests and aquatic habitats. The biodiversity associated with agricultural systems is already being affected significantly by intensification, with many species of farmland birds, butterflies and plants having declined very substantially over the past 50 years[BN2]. Using certain types of GM crops has the potential to reduce biodiversity further by increasing such intensification. There are also potential risks to biodiversity arising from gene flow and toxicity from some GM crops. The JNCC believes there should be careful assessment of the implications for biodiversity, and for the environment generally, before decisions are made on the commercial release of genetically modified organisms (GMOs).

3. The JNCC recognises that the use of some GM crops may have potential benefits for farmland wildlife, especially if their use results in management practices having a reduced impact on the environment[BN3].

4. This position statement represents the combined views of the three British statutory nature conservation agencies of which JNCC is a joint committee. The agencies are statutory consultees in the process by which applications for release of GMOs into the environment are considered, and also have a general duty to advise government on conservation policies. We are solely concerned with potential impacts of GMO releases on the living environment and on sustainable use of our natural resources, including protected sites and the wider countryside. We have no locus on matters of public health and safety. The agencies, working through the JNCC, advocate using the precautionary principle where commercial releases are proposed, and consider that the release and use of GMOs is appropriate only when all of the following criteria are satisfied:

i. Rigorous environmental risk analysis is undertaken for potential releases of GMOs, including analysis of the risks to biodiversity of changes in husbandry, agricultural practices, soil processes and other land and water use, which may result from the adoption of GM technology.

ii. Risks to the conservation of native biodiversity are shown by comprehensive analysis of evidence to be acceptably low. Direct risks from GMOs may include toxicity of transgenic organisms to wildlife, competitive displacement of native species by transgenic organisms or hybrids with wild species, and effects on soil and aquatic ecosystems. Indirect risks include changes in land and water use and management that are detrimental to the wildlife that use farmland, woodland, freshwater or the seas. The use of GMOs should not promote agricultural or forestry intensification on land of nature conservation value[BN4] and should not inhibit the widespread continuation or adoption of more environmentally sustainable methods of agriculture, forestry and fisheries.

iii. Meaningful public consultations are undertaken within a timetable that is reasonable.

iv. Weed and pest resistance are monitored in areas where crops tolerant to herbicides and insects are grown. Resistance management strategies should be implemented and enforced.

v. It is demonstrated that crops and trees developed to be resistant to insect, bacterial and fungal attack will not have significant adverse effects on native species, including beneficial insects, which rely upon such organisms within food webs, in comparison to the impacts of current systems of agriculture and forestry[BN5].

vi. There are adequate safeguards against gene flow between GMOs and native organisms where transgenes are likely to affect fitness, decrease genetic diversity or increase toxicity. The preferred method should be to avoid releasing transgenic organisms with sexually compatible wild relatives in the UK. Applicants wishing to release transgenic native species into the environment should consider incorporating genetic isolation mechanisms into the genomes of the GMOs themselves[BN6]. Best practice techniques (such as those described by the Advisory Committee on Releases to the Environment (ACRE) in its report *Guidance on Best Practice in the Design of Genetically Modified Crops* should be used in the construction of transgenic organisms.

vii. Crops engineered to express industrial or pharmaceutical compounds, that are able to outcross with food crops or wild plants in the UK, should not be grown in open fields unless and until it is demonstrated that they will not have adverse impacts on the environment. Incorporating genetic isolation mechanisms may be a method of limiting the risks to the environment if such mechanisms can be demonstrated to be reliable. Otherwise such crops should be grown in containment. We believe that the environmental effects of

artificially constructed genes will be even harder to predict than those that occur naturally[BN7].

viii. It can be satisfactorily demonstrated that deliberate or unintentional crossing of the GMO with other GM products that are present in the UK environment will not lead to stacked-gene organisms with increased fitness or capacity to cause harm to non-target species. We do not consider that voluntary codes of practice alone will be able to prevent transgene stacking occurring in crops or wild relatives, so risk assessments for commercial releases of transgenic outcrossing species should consider stacking to be inevitable.

ix. Reliable mechanisms are set up to enable coexistence between different types of farming systems, including GM, 'conventional' and organic systems, in advance of the commercial growing of GM crops. Coexistence mechanisms should not prejudice the ability of farmers to manage their land for the benefit of biodiversity or natural resources, for example by requiring increased use of herbicides to control volunteers or by reducing farmers' choice of rotations, management practices or entry into agri-environment schemes.

x. Effective legislation is put in place to minimise the occurrence of adventitious GM material in both non-GM and GM seed. Thresholds should be set at the minimum detectable level and regularly revised to reflect improvements in analytical technologies. Regulation of adventitious presence should be based on minimising risks to the environment and not solely on food labelling standards.

xi. Legislation is put in place to establish liability for environmental harm caused by the deliberate release of GMOs.

xii. In environmental clean-up work, GMOs are only used where there is a demonstrable advantage over conventional methods. All clean-up techniques are less desirable than pollution prevention[BN8].

xiii. Plans and resources have been put in place to ensure there is adequate monitoring of the use and possible spread of GMOs in the environment following their commercial and experimental release, with specific work to detect effects on different habitats and species. This will require a publicly accessible database containing accurate information on the location of all GMO releases that will enable any environmental changes identified in general surveillance and monitoring work to be analysed for possible correlation.

5. The JNCC considers that future research and development effort on GMOs must ensure that there is adequate regulation of commercially-orientated and experimental releases into the environment, and that detrimental effects of releases on wildlife are properly assessed. We will therefore:

i. Continue to press for changes in the regulatory system to take account of, and

minimise, potential ecological effects when assessing the risks of releasing GMOs.

ii. Continue to press for more research on the impact and extent of gene flow from GMOs to native terrestrial and aquatic species, and also on the ecological effects (including those in the soil) of crop management changes resulting from the use of GMOs.

iii. Recognise the need for field-scale studies on the effects on biodiversity of growing GM crops that require or enable changes in management practices, compared to other types of agriculture – for example, herbicide-tolerant and insect-resistant crops.

iv. Continue to urge Government and industry to ensure that there is effective monitoring of possible ecological effects from GMO releases.

v. Continue to provide objective advice both to Government and to industry over potential effects of the release of GMOs on terrestrial and aquatic wildlife. The statutory agencies will continue to act as assessors to ACRE.

vi.

vi. Continue to recommend that commercial releases of GMOs, including herbicide-tolerant and insect-resistant crops, are not undertaken until sufficient research has been completed and evaluated, appropriate risk assessments have been carried out to provide public assurance that risks to the environment are acceptably small, and appropriate public consultation has taken place.

vii. Press for the development of legislation to set and enforce standards of seed purity that ensure adequate protection of the environment, and to establish reliable and practicable coexistence measures and clear lines of liability for environmental harm caused by GMO releases.

viii. Continue to advise Government on the impact on biodiversity of international agreements relating to trade and global environmental issues, especially those agreements involving GMOs.

**JNCC Position Statement on GMOs**

**Annex A. Background Notes**

BN1 Genetic (transgenic) engineering is a more radical form of plant and animal breeding, by which genes from other species (or even phyla) can be inserted into the recipient genome. These genes have never been, and in many cases could never naturally be, part of the recipient species' gene pool. Due to the often subtle nature of interactions between transgenes and native genes, it is impossible to predict accurately their behaviour if they should out-cross to native species without carrying out detailed studies of fitness parameters in a range of environments. It is likely that some genes are inherently more risky than others. For example, genes conferring resistance to insects, viruses and fungi in GM crops such as oilseed rape, if transferred to native species, have the potential to increase fitness of the resulting hybrids. These could then become ecological weeds, with the potential to invade native ecosystems and cause adverse impacts on biodiversity.

BN2 Recent research and survey has revealed severe declines in UK farmland bird populations, especially in those species associated with lowland arable and mixed farmland. Because of these declines, farmland bird populations have been included as one of the Government's 'Quality of Life Counts' headline indicators of sustainable development. Long-term research in southern England has identified increased pesticide efficacy as a major factor contributing to declines of skylarks, partridges and corn buntings. Herbicide efficacy is very important in determining the breeding success of these species; low breeding success is strongly associated with highly efficient weed control programmes. One of the factors involved in this effect is the reduction in invertebrate density caused by lack of weeds in arable fields. It has been demonstrated that bird chicks fail to thrive when invertebrate densities are low.

BN3 There is little doubt that biotechnology has great potential to be able to alleviate some of the problems associated with conventional intensive agriculture, especially if out-crossing from GM crops to native species can be prevented. Reductions in, or even elimination of, pesticides by using pest- and disease-resistant varieties, coupled with the prospect of nitrogen fixation and perennial crops, are attractive goals for genetic engineering. They could contribute towards more sustainable agriculture, as long as there were no reductions in biodiversity by diminishing invertebrate food sources, or through toxin transfer through the food chain. Present trends in GM crop engineering are, however, in the opposite direction, with herbicide tolerance being widely used to increase herbicide efficacy, exacerbating the adverse effects of agricultural intensification.

BN4 Besides the need to demonstrate that any changes in land use and management associated with the use of individual GMOs are at least benign and preferably beneficial to wildlife, there is a need for strategic thinking within government as a whole about the likely impacts of biotechnology on agricultural sustainability in the UK and worldwide. We value the continuing role of the Agriculture and Environment Biotechnology Commission in promoting strategic thinking and debate on these issues.

BN5 Pest and disease resistances are currently being engineered into a wide range of crops, although none are currently close to commercial growing in the UK. Insect resistance has been achieved mainly by expressing various types of toxic proteins (for example, Bt proteins and lectins) into GM plants. Although some instances of toxicity to non-target invertebrates have been demonstrated in the laboratory, the limited amount of fieldwork that has been carried out so far (mainly in the USA) suggests that these impacts are not translated into significant population-level effects when compared to using pesticides on conventionally-grown crops. Pest- and disease-resistant crops could also potentially have effects on soil ecosystems, and we recommend further research in this area.

BN6 Recent research has shown that gene flow from some GM crops to native plants and to non-GM crops is inevitable, but there is little research on the impact of such crossbreeding on the genetic fitness of any resulting hybrids. Risks associated with gene flow can be minimised in experimental plots, but may increase if GM crops are grown commercially. The JNCC is especially concerned about the transfer of insect, fungal and viral resistance to native plant populations, causing possible disruption to the population dynamics of the plants themselves and their parasites and predators. However, transgenes that increase fitness of crops or wild relatives in agricultural environments may also pose risks to biodiversity. For example, the presence of one or more herbicide tolerance genes in volunteer oilseed rape plants could cause farmers to instigate changes in weed management that have an adverse impact on arable plant communities in crops and field margins. The technology for preventing gene transfer (by male sterility, pollen incompatibility and changing flowering times) already exists, but has not yet been incorporated into commercially-available GM crops. The ACRE report on best practice in the design of GM crops outlines these technologies in more detail (www.defra.gov.uk/environment/acre/bestprac/guidance/index.htm).

BN7 Constructing ‘designer’ genes is now routine in medical biotechnology and may be an attractive option for the farming industry when more advanced GM crops are formulated. There is already considerable interest and research into inserting genes coding for industrial raw materials, pharmaceuticals and nutrient supplements (‘nutraceutical’ crops) into various crop plants, some of which are capable of out-crossing to native species. We believe that this could have serious effects on ecosystems if such genes were to become incorporated into native plants.

BN8 Genetically modified bacteria and fungi are already being used experimentally to deal with oil spills and heavy metal contamination. There is considerable potential in extending this to other types of bioremediation, dealing with other types of pollution and contamination. Even if the risks to biodiversity from such GMOs are demonstrated to be relatively low, we are concerned that the existence of these GMOs should not reduce pressure to prevent pollution.