Issue Brief[1]

Issue Title	**Development of engineered gene drives to control vector-borne diseases and invasive species**
Description	Engineered gene drives are engineered molecular mechanisms that are transmitted to progeny at super-Mendelian (>50%) frequencies. There are various types of engineered gene drives, but many utilize CRISPR-Cas. Other mechanisms can include toxin-antidote systems and endonucleases, among others. Applications of engineered gene drives can be designed to suppress vectors of human and animal disease and to control invasive species. These are designed as alternative vector-control measures to conventional insecticide or rodenticide applications. Specific applications include: • Living modified *Anopheles gambiae* containing an engineered gene drive designed to target *doublesex* to reduce malaria transmission • Living modified *Aedes aegyptii* to reduce malaria transmission • Living modified *Culex sp.* mosquitoes to control West Nile virus transmission • Engineered gene drive rodents to control invasive rodents on islands
Timeline (<5 years, 5-10 years, >10 years) to environmental release	Field trials within 5 years, or between 5 and 10 years. Releases for vector control suggested to be within 3 to 5 years, and within 5 to 10 years for controlling invasive species.

[1] Information gathered from the members of the multidisciplinary Ad Hoc Technical Expert Group on Synthetic Biology. Descriptions complemented with publications published by the Secretariat of the Convention on Biological Diversity.

Potential impacts on the objectives of the Convention	Potential positive impacts could include: • Controlling invasive species (reduced damage to native biodiversity) • Reduced disease transmission, particularly for vulnerable, disproportionately affected communities • Increased access to resources and opportunities through a reduction in disease burden Potential negative impacts could include: • Disruption of ecosystems (e.g., food webs) due to removal or suppression of a species from the environment • Elimination of an endogenous species if the living modified organism containing an engineered gene drive spreads to native range of the host organism • Elimination or suppression of non-target organisms due to gene flow • Unintended persistence in the environment • Off-target impacts within host organism • Transboundary movements • Reduction in genetic diversity (e.g., potential increased disease susceptibility, decreased ability of target organism to adapt to environment) • Niche replacement could bring new pathogens Potential points of consideration that may lead to a high level of uncertainty for the risk assessment of these applications: • Complexity of ecological systems, particularly when released into unmanaged or wild environments • Spatio-temporal scale of release of engineered gene (e.g., reproduction rate, genotypic replacement, design to spread)

	• Long term stability and evolution of the molecular system (e.g., mutation rate) • Evolutionary response to deployment of engineered gene drive • Host-pathogen response • Next-generation effects • Unforeseen impacts • Potential extrapolation error of experimental data to environmental conditions in models
Other considerations	• Precautionary principle • Monitoring for the potential emergence of unintended consequences • Access to and sharing the benefits of the technology • Improved human sustainable development and quality of life through a reduction in disease and economic burden • Changes to local economies due to reduced presence of an invasive pest or disease vector • Reduction in economic loss due to pest outbreaks • Intellectual property of the technology and access to its use • Concentration of the market to few biotechnological organizations • Free, prior and informed consent of indigenous peoples and local communities • Potential changes to traditional methods and communities managing biological resources • Impacts to traditional knowledge and spiritual beliefs of indigenous peoples and local communities • Ethics related to human intervention in nature • Public outreach, engagement and inclusion • Transparency in research, development and decision-making, including declarations of conflict of interest

	• Consideration of alternative interventions • Precautionary approach • Need for effective regulation and risk assessment • Potential lack of available risk management and containment measures (e.g., potential irreversibility of release) • Need for monitoring • Improved capacity-building for the regulation and potential use of the technology • Technology transfer • Transboundary movements and the likely need for international cooperation • Dual-use potential • Consideration of the social, political and commercial determinant of disease with respect to the potential costs and benefits