

Work with Arthropods

Introduction

Arthropods are a wide ranging group of invertebrate organisms which include insects, arachnids, or aquatic arthropods eg crabs and lobsters. The University has recently seen a significant and increasing amount of work with insects (e.g. *Drosophila melanogaster*) and other arthropods. There are specific hazards associated with each type of arthropod and it is vital that the hazards of each are fully understood by the researchers. The hazards can vary depending on the organisms and may include:

- Bites and stings from bees and some arachnids;
- Exposure to any potential zoonotic infections (examples of organisms that can survive in *Drosophila* URL: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3956501/>)
- Potential release of genetically modified organisms (GMOs) into the environment;
- Exposure to potentially allergenic materials (see URL: http://flystocks.bio.indiana.edu/Fly_Work/culturing.htm <http://www.sciencedirect.com/science/article/pii/S0091674986903313>)
- Physical defences (eg from marine arthropods like crabs)

To ensure the safety of laboratory workers as well as other staff and students at the University and to prevent possible harmful environmental effects of the work, it is important to have proportionate control measures in place which are relevant to the type of arthropod that researchers are using.

The control measures used to eliminate or minimise risks will vary depending on the type of organism. Thus the controls for *Drosophila* will vary from that used for marine arthropods like crabs and lobsters. It is therefore vital that workers understand what risks are associated with the particular organism.

Risks Associated with Arthropods

It is a legal requirement that an appropriate risk assessment is undertaken for all procedures which may have a significant risk to humans or the environment. All work with arthropods, which includes insects, arachnids and marine arthropods should identify any hazard these organisms pose and what control measures are required to eliminate or minimise the risks these organisms pose. All such risk assessments must be approved by the Supervisor of the project and also all the workers undertaking the activities.

Arthropods are a very large and wide-ranging phyla of arthropods ranging from very small insects and arachnids to much larger aquatic arthropods like crabs and lobsters. The risks could include issues like:

- Stings and bites from some smaller insects eg bees, ticks, mites and scorpions;
- Much more serious venomous arthropods like tarantulas;
- Nips and pinches from larger aquatic decapods eg crabs and lobsters
- Allergic reactions to the arthropod or its sting
- Arthropods acting as a vector for a human pathogenic micro-organism

Risk assessments should clearly identify the hazards associated with this type of work, who may be harmed, the risks associated with the work and what control measures need to be implemented to minimise the risks associated with the work. This must include details of how the arthropods will be euthanized and how they are to be made safe for disposal. Guidance on risk assessing research with animals including arthropods can be found in the following Health and Safety Executive documents:

- Working Safely with Research Animals: Management of Infection Risk (see URL: <http://www.hse.gov.uk/pubs/priced/animal-research.pdf>);
- Biological Agents: managing the Risks in Laboratories and Healthcare Premises (see URL: <http://www.hse.gov.uk/biosafety/biologagents.pdf>)

The risk assessment should also include details of specific hazards which may affect other workers at the University.

All chemical control measures which are used, e.g. disinfectants, must include some detail about the effectiveness of the chemicals (for low risk work, this can be the manufacturers information).

Work with genetically modified arthropods will come under the Genetically Modified Organisms (Contained Use) Regulations 2014. Such work with genetically modified arthropods (eg *Drosophila spp* or other insects or arachnids) must be approved by the University Chemical and Biological Hazards Management Group (see form at URL: <http://www.st-andrews.ac.uk/media/environmental-health-and-safety-services/health-and-safety/chemical-and-biological-safety/Notification%20of%20Genetic%20Modification%20Project.rtf>). Where the genetically modified arthropods which are more hazardous than the parent strain will then also have to be approved by the HSE which can take up to 45 days from submission.

It is therefore a requirement of the legislation to ensure there is adequate containment which is proportionate to the risk of the organisms to human health and the environment. Every effort must be undertaken to ensure there is no release of the genetically modified organism into the environment no matter how little risk is perceived from the organism.

Where an arthropod may act as a vector for a pathogenic micro-organism (eg mosquitos infected with *Plasmodium falciparum* thus may cause malaria), an assessment of the potential risk to workers and the public must be undertaken. This will include details of the genetically modified arthropod vector or pathogen or both. If there is a potential risk, then appropriate control measures must be put in place to avoid potential infection of workers and/or the public.

ISTR has produced guidance on working with arthropod vectors for human pathogens at URL: <http://www.istr.org.uk/docs/guidance%20on%20the%20containment%20of%20infected%20arthropods%20%20V1%20August%202017.pdf> .

Laboratories where work with arthropods is performed must have appropriate procedures for the storage and disposal of these organisms e.g. <http://www.flyfacility.gen.cam.ac.uk/Flylab/houserules>

Containment and Control Requirements

Other than during fieldwork or work in an apiary, all work with arthropods must be in specified laboratories, insectaries or aquaria. The door to these laboratories must display a Code of Practice or Standard Operating Procedure (SOPs) for those entering and working within the laboratory. Cleaning staff and trades staff should be warned of the hazards in these areas prior to starting work.

All work with genetically modified arthropods must be undertaken in controlled conditions which restrict the potential for escape. This is a requirement for genetically modified arthropods under the Genetically Modified Organisms (Contained Use) Regulations 2014. Further guidance on containment of arthropods which act as vectors for human/environmental pathogens can be found at URL: <http://www.istr.org.uk/docs/guidance%20on%20the%20containment%20of%20infected%20arthropods%20%20V1%20August%202017.pdf>

Each laboratory must have suitable and sufficient containment procedures in place which prevent escape of laboratory arthropods to the environment. The Health and Safety Executive guidance on working with arthropods is given in the document entitled: ‘ Working Safely with Research Animals; Management of Infection Risks (see URL: <http://www.hse.gov.uk/pUbns/priced/animal-research.pdf>).

Laboratories using terrestrial (ie those that crawl, jump or fly) arthropods should have the following control measures (or the equivalent):

- rooms should be insect-proof;
- ventilation inlets and outlets should be screened;
- consideration should be given to placing ‘insectocutors’ outside the laboratory – see Working safely with research animals: Management of infection risks (URL: <http://www.hse.gov.uk/pUbns/priced/animal-research.pdf>)

- measures should be taken to enable escaped arthropods to be easily detected and recaptured or destroyed;
- a laboratory sink should be provided with an adequate trap for waste; if there is a possibility that arthropods could escape through the trap, liquid waste should be treated before disposal (preferably by heat - see below);
- solid waste is most effectively treated by heat because it may harbour arthropods that may not be killed by chemical disinfectants or fumigants;
- insecticidal sprays may be necessary in an emergency;
- arthropods may be chilled to reduce their activity and minimise the risk of escape;
- for ticks and mites, containers should be kept over trays of oil;
- flying insects infected with agents in Hazard Groups 2, 3 or 4 should be kept in double cages (for example, a sleeved netting cage inside a clear substantial plastic bag) and both enclosures should be labelled;
- experimental cages/containers should be numbered and labelled or otherwise documented to indicate the hazard;
- at Containment Levels 3 and 4, flying or crawling arthropods should be kept in identified lots and each lot accounted for; they should also be handled in an appropriate containment device;
- laboratories receiving potentially infected arthropods for identification or examination, where the specimens are not known to be dead, should ensure that containers are opened in an appropriate safety cabinet or other safe form of enclosure;
- where practicable, a record should be made of the number of individual arthropods at the earliest practicable time, and each invertebrate should be accounted for as the work proceeds through to final fixation or disposal;
- where identification of flying or crawling arthropods alone is required, the container may be frozen at -20°C, or lower as necessary as some arthropods can withstand prolonged freezing, for 2 hours to kill them..

Please note that additional precautions may be necessary for genetically modified organisms, whether recommended by the Chemical and Biological Hazards Management Group, or imposed as a condition by a government agency. Guidance on what constitutes a GMO, how to assess risks of working with GMOs and good practices for containment of GMOs are available here:

<http://www.hse.gov.uk/biosafety/gmo/acgm/acgmcomp/part5.pdf>

Please note that additional precautions are necessary for work that involves species that pose a direct risk to public health and/or agriculture. Laboratories working at genetically modified arthropods at Hazard Levels greater than 1 will be required to obtain HSE approval prior to work commencing. Guidance on what arthropods meet these criteria are available here:

<http://www.hse.gov.uk/biosafety/gmo/acgm/acgmcomp/>

<http://www.hse.gov.uk/pubns/priced/129.pdf>

<http://www.who.int/csr/resources/publications/biosafety/en/Biosafety7.pdf>

Where there is a proposal to work with deliberately released genetically modified arthropods into the environment, the requirements of the Genetically Modified Organisms (Deliberate Release) (Scotland) Regulations 2002 will need to be complied with. It is vital that any such application is made in due to time to obtain permission. It is vital that contact is made with the Chemical and Biological Hazards Management group as soon as practicable. It is vital that all practicable controls with regard to the potential harm of such organisms is contained in the risk assessment for the work.

Worker Safety

It is vital that the risk assessment for any work with arthropods also includes the safety of the workers. For example any work with marine arthropods on the coast line must take into account the risks to workers due to tide changes, access to the coastline etc.

If there is use of CO₂ for anaesthetisation for specific types of arthropods eg *Drosophila*, then this work must be carried out in a well ventilated area. If there is any restriction in the ventilation in this area, or if the size of the largest CO₂ cylinder would create a hazardous atmosphere in the event of a leak, then a CO₂ level or O₂ level electronic detection system must be installed.

Workers can become allergic to arthropod and/or the media used to maintain them as well as to their bites and stings

Any worker who shows the following symptoms:

- itchy eyes;
- sneezing, running or blocked nose;
- chest tightness with wheezing;
- itchy skin rash;
- swelling of lips, sometimes swelling of tongue

should notify their supervisor immediately and contact Occupational Health for medical advice.

Fieldwork

A suitable risk assessment needs to be done on fieldwork with arthropods. This will include any risks associated with getting to the relevant organisms (eg marine arthropods) as well as working on wild organisms (eg bees). Work with wild organisms should also take into account the possibility of injury due to the organism or injury due to stings/bites. Such work may not be close to emergency services thus consideration of medical / first aid requirements should be considered in the risk assessment. This is especially important when working with marine arthropods which are a significant distance from the coast. It is therefore vital that detailed assessment is undertaken where all relevant risks are considered and suitable control measures are implemented.

Where it is proposed to undertake work with deliberately released genetically modified organisms, then researchers will need to undertake a risk assessed under the Genetically Modified Organisms (Deliberate Release) (Scotland) Regulations 2002 (see URL: <http://www.legislation.gov.uk/ssi/2002/541/contents/made>). All such applications should be made to the University Chemical and Biological Hazards Management Group prior to any submission to the Scottish Government for approval. It should be noted that approval for such work can take a significant amount of time and thus any application must be made as early as possible.

Training

It is expected that researchers behave in a professional manner when using arthropods in their research. There are no legal restrictions on the use of arthropods at this time. It is, however, recommended that, morally, laboratories should have a culture of respect for all animal life, including arthropods. This includes using the most appropriate means of euthanizing the arthropod. This will vary depending on the organism, for example use of CO₂ for use with *Drosophila* but may be chilling certain aquatic arthropod species. It is recommended that individual laboratories train staff to minimize the number of organisms sacrificed during experiments and that all arthropods are dispatched in an appropriate manner. This should be part of the Standard Operating Procedures (SOP) for the work.

All staff who handle arthropods must be competent to do so and must have received appropriate training as well as must receiving suitable supervision. It is therefore a requirement that workers receive appropriate training in:

- SOP for work with arthropods,
- the handling of such arthropods,
- the best practice for anaesthetising arthropods,
- the appropriate systems for disposal of euthanized arthropods.
- procedures for working with arthropods that may cause physical harm (e.g. bees or tarantulas)
- what to do if significant numbers of arthropods escape
- where the arthropod may act as a vector for a pathogenic organisms, what disease these agents may possibly cause;
- potential injury due to nips and pinches from arthropods;

- how to report any medical conditions which may develop eg allergies

This training must be recorded for all workers.

Specific training in the handling of terrestrial arthropods during fieldwork should be required where appropriate. For example, workers handling bees in an apiary or during fieldwork should have received suitable training eg attending a beekeeping course or tuition from an experienced beekeeper. All training should be recorded in writing.

Transport of Arthropods

Transport must be inside containers with at least 2 layers of physical containment which can withstand an approximate 2 metre drop or as appropriate according to the species.

Stocks of *Drosophila*

It is recommended that whenever reasonably practicable, all new stocks of terrestrial arthropods are quarantined appropriately for the relevant species eg. *Drosophila* should be kept in quarantine for 2 generations to ensure there is no inherent infection which will affect the colony with mites or micro-organisms. It is also recommended that stocks of arthropods are disposed of before adults become old. Older cultures have an increased risk of becoming infected with mites or mould (see URL: <http://www.flyfacility.gen.cam.ac.uk/Flylab/houserules>).

Disposal of insects or other arthropods and growth media

Terrestrial arthropods can be anaesthetised or killed with CO₂ in specific apiary gas tight containers or by freezing to -20°C for 24 hours. Anaesthetisation with CO₂ should be undertaken in well ventilated laboratories in case of a leak of CO₂. See Worker Safety above.

It is then necessary to autoclave all biological material waste materials from the experiments including growth media. All such waste materials should be autoclaved at 120°C at 15psi for 30 minutes. Following autoclaving, biological material and growth media can be disposed through appropriate routes for waste disposal.