Non-native species Trichocera maculipennis (Diptera) eradication from Arctowski Polish Antarctic Station, Western Shore of Admiralty Bay, King George Island, South Shetland Islands – update 2020/2021

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**An Information Paper submitted by Poland**

***Summary***

The paper presents the recent status and eradication strategies of the non-native species *Trichocera maculipennis* (Diptera) from Arctowski Polish Antarctic Station, Western Shore of Admiralty Bay, King George Island, South Shetland Islands.

***Background***

Until recently, the Antarctic terrestrial environment has been little impacted by non-native species in comparison to other regions of the Earth. This environment is characterised by the simplicity of the food network, which only encompasses a few species. Antarctic land animals (those that spend their entire lives on land) present on King George Island are predominantly micro-invertebrates. As a result of its simplicity, this environment is likely to have free niches that can be easily occupied by alien and invasive species (Hughes & Convey 2012). Increased human activity contributed to the introduction of alien species in the Antarctic region (Hughes et al., 2019). Non-native species are characterised by having possible negative effects on the native environment, and therefore constant monitoring and eradication of identified invasive species is necessary (Mack et al., 2000). The first report documenting the presence of the boreal trichocerid fly (*Trichocera maculipennis*) took place at the Uruguayan Base Científica Antártica Artigas in 2006 (Volonterio et al., 2013). Subsequently, there have been reports of the fly recorded within or in the surroundings of the following stations on King George Island: Artigas, Arctowski, Escudero, Frei, Fildes, and King Sejong. This species has established itself in natural areas, as well as within buildings such as sewage treatment plants, scientific research stations, military bases, and hydroponic installations (Hughes et al., 2005, Volonterio et al., 2013).

*T. maculipennis* is a species that is primarily known from the northern hemisphere, inhabiting the Boreal Zone (also found in Europe in caves or mines), as well as the sub-Arctic and Arctic Zones - Greenland, sub-Arctic islands, and Scandinavia (Petrašiūnas & Weber, 2013). In the Boreal Zone, these insects reproduce twice a year, whereas in the Arctic Zone they reproduce only once a year, during the summer season. *T. maculipennis* has four larval stages, where pupation usually lasts only a few hours, and adults can even emerge through the snow layer (Hågvar & Krzemińska, 2008). It is believed that they were brought to Antarctica with the supplies for science stations or with tourists. *T. maculipennis* flies are perfectly adapted to low temperatures, which allows them to spread in high latitudes. They mainly occur in the vicinity of human aggregates, preying on dead organic matter, including sewage systems (Carlsson, 1962). Adults are active at low temperatures, although no longer fly at temperatures below -10°C. The development of eggs and the pupation of larvae is possible in the temperature range -1.5°C to 18.0°C, and larvae are able to survive when frozen in ice (Dahl, 1969, 1970; Platcher, 1983). Its larvae have been detected in nutrient rich substrates, such as decomposing plant matter, excrement, or as pests in stored vegetables (Volonterio et al., 2013).

The CEP Non-native Species Manual recommends, as a key guiding principle, that ‘*to be effective, responses to introductions should be undertaken as a priority, to prevent an increase in the species’ distribution range and to make eradication simpler, cost effective and more likely to succeed*’. Therefore, we believe that the successful management of non-native species, including those within station buildings, should be a priority.

This work aims to report non-native *T. maculipennis* fly found at the Arctowski Station, and to present actions taken to remove them and protect the station against the influx of new individuals. In accordance with Annex II of the Protocol on Environmental Protection to the Antarctic Treaty, as well as the CEP non-native species manual, measures to eradicate *T. maculipennis* from the Arctowski Station were taken.

***Non-native fly* T. maculipennis *at Arctowski Polish Antarctic Station***

The non-native fly *T. maculipennis* was accidentally introduced at the Polish Antarctic Arctowski Station, with alive larvae and adult individuals initially recorded in large numbers in the sewage system in October 2017 (Potocka & Krzemieńska, 2018). Only a few adult individuals were noticed outside the facility, at a distance of less than 50 cm from the septic tank (Potocka et al., 2020). Routine inspections in previous years had not revealed their presence (Przepiórka, 2016, unpublished data). However, since their discovery, their presence has been recorded on a regular basis. Imago individuals of *T. maculipensis* are recorded at Arctowski Station throughout the year. Live individuals, numbering up to a dozen flies, can be found in the main building of the station, most often in the kitchen or pantry. The second permanent location where flies can be found is a cold store with food, where the temperature is kept at 4°C. The third location, that has already been mentioned above, is the septic tank. After the initiation of several control measures, the number of recorded alive individuals dropped significantly, with less than 10 individuals being observed during the summer season 2019/2020. In the current 2020/2021 season, no flies to date have been found in the Arctowski Station septic tank nor in the buildings. This result can be considered a success, evidencing the effectiveness of the measures taken to eradicate the flies. The total number of individuals found has decreased significantly since 2017. However, further actions are necessary to maintain this state.

***Eradication of*****T. maculipennis *from Arctowski Polish Antarctic Station***

Since their first discovery, systematic monitoring and control measures have been carried out at the Arctowski Station to eradicate the invasive species. As the septic tank is considered to be the main breading location, it is regularly emptied. Opening of the septic tank lid is accompanied by alcohol spraying to immobilize any individuals, which if present, are collected before the tank is emptied. Subsequently, the tank is cleaned using fresh water, then washed with a solution of hydrochloric acid at a concentration of approximately 2-3%. The internal walls of the protective box, lid, and available parts of the tank, are sprayed with an insecticide containing lambda-cyhalothrin, e.g. Oxyfly or Solfac. Spraying is carried out according to the manufacturer’s instructions. Food stored at the station is regularly reviewed, with the storage rooms being cleaned frequently and any developmental stages of the flies present are removed. In places where flies are found, adhesive traps are installed to identify population trends throughout the year. Traps are regularly checked and changed. In addition, there are ferrone traps at the Arctowski Station, in support of the Uruguayan Monitoring Plan to Manage the Non-Native Flies in King George Island, South Shetland Islands. The use of UV lamps in the rooms was abandoned because of the presence of fresh food, which began to sprout after exposure to the light. Molecular analyses of collected specimens were performed to assess population origin and structure (Potocka et al., 2020). Extra measures are taken during each new food transport to the station, with imported food being carefully screened to avoid the influx of new individuals of invasive species.

The eradication of the invasive *T. maculipennis* from the Arctowski Polish Antarctic Station on King George Island, is necessary to maintain species stability in the natural Antarctic environment, as well as being required by the Protocol on Environmental Protection. The eradication procedure will have no more than minor or temporary impact on the environment. The applied means are used only within the sewage system, and chemical substances having an active period of up to 12 weeks, which subsequently decomposed into non-hazardous substances. Selected insecticides have a local effect, and will not affect other components of nature, except for intended treatment of the invasive species. The eradication procedure is carried out by trained personnel to avoid possible emergency situations. The application of a procedure consisting of several methods allows the elimination all life stages of the invasive insects - washing and disinfecting agents eliminate eggs and insect larvae, whereas contact insecticides affect adults and larvae. As the controlling of non-native insect species colonizing the sewage systems is extremely difficult, only a comprehensive eradication plan, with several different methods targeting different life stages, is likely to be effective. As the existing measures that have been undertaken give satisfactory results, it is planned to continue them in the coming years.

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