**Chrysomya bezziana** in pet dogs in Hong Kong: a potential threat to Australia

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The Old World Screwworm fly (Chrysomya bezziana) has recently been causing aggressive myiasis in pet dogs in Hong Kong, and the Agriculture, Fisheries and Conservation Department of Hong Kong has confirmed the presence of *Chrysomya bezziana* in the territory. This report describes screwworm infestation in pet dogs presented for treatment at our clinic in the past year. Screwworm fly larvae were found in typically punched out round wounds or embedded in exposed or neglected wounds. Infested wounds had a characteristic strong offensive smell and oozed a sero-sanguineous exudate or frank blood. Removal of the larvae, wound treatment, continuous monitoring for re-infestation, application of insect repellants and protective housing were essential for successful treatment. Because Hong Kong is a source of pet migration or a transit point to Australia, the fly could threaten Australia.

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<table>
<thead>
<tr>
<th>SWF</th>
<th>Screwworm fly</th>
</tr>
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<tbody>
<tr>
<td>OW</td>
<td>Old World</td>
</tr>
<tr>
<td>sid</td>
<td>Once daily</td>
</tr>
<tr>
<td>bid</td>
<td>Twice daily</td>
</tr>
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</table>

The OWSWF was first confirmed in Hong Kong in the year 2000. Myiasis was first detected in the United States in 1983, and SWF has been identified as a potential hazard to Australia. *Chrysomya bezziana* is endemic to and is widely distributed in tropical parts of Africa and Asia, occurring as far as Southern China and eastwards to Papua New Guinea. Outbreaks of the fly have also been reported in the Middle East. There are two types of SWF, the Old World SWF (*Chrysomya bezziana*) and the New World SWF (*Choiomyia hominivorax*). Both are obligate parasites that attack healthy tissue of living animals. *Chrysomya bezziana* is distinct from other *Chrysomya* sp in that its larvae will only survive in live animals. Other *Chrysomya* sp are considered to be carrion inhabitants, blowflies or scavengers. *Chrysomya albiopa* can be a beneficial biological agent in reducing populations of myiasis-causing flies of man and animals.

The larvae of SWF may be found anywhere in exposed or neglected wounds. As the tissue breaks down and liquefies, it becomes attractive to other flies, and in some cases the initial larval infestation modifies the habitat to attract a second or third species. The female SWF oviposits around wounds (even small abrasions or tick bites) or on soft skin contaminated by blood or body fluids. Eggs hatch in 12 to 20 hours at 25 to 30°C; the first stage larvae enter the wound and burrow into underlying tissue to feed on blood. Larval development is completed in 6 to 7 days after which the larvae drop off the host, usually at night, and penetrate the soil to pupate. Adult flies emerge in about a week and have a life span of 16 to 51 days. Under ideal conditions the lifecycle can be completed in 20 days. Not all SWF infestations are obvious; sometimes all that appears is a swelling in a part of the body with little or no sign of larvae, exudates or discharge.

While currently free from the SWF, international trade and pet migration from endemic areas means the risk of importation of the SWF into Australia exists. The OWSWF is considered to pose the most direct threat to Australia's livestock, wildlife and human population. A simulation model study to predict the spread of SWF found a high probability of establishment year round in tropical regions of Australia. Stringent Australian quarantine regulations for imported animals have largely prevented establishment of SWF in Australia thus far, however, since travellers could also introduce SWF from endemic areas, Hong Kong presents a risk, being a major source of travellers, and, to a certain extent, pets, arriving in Australia. International travel of pets has been reported to be responsible for the introduction of exotic pathogens in non-endemic regions.

Previously published reports on SWF mainly refer to livestock and humans. This is the first report of OWSWF in pet dogs in Hong Kong.

**Case reports**

**Case 1** — A 6-year-old 3.6 kg male entire Maltese with a 2-year history of stomatitis and halitosis that intermittently responded to antibiotics and steroids, was presented for what the owner regarded as a recurrence of these problems. The dog was inappetent, dehydrated, had a temperature of 39.3°C, and was drooling blood-tinged saliva. Examination of the mouth revealed SWF larvae in the left upper gingiva involving the incisivum and maxilla (Figure 1). The buccal, oral and gingival mucosae were inflamed, had a purulent exudate and were covered with pseudomembranes. A tentative diagnosis of necrotic stomatitis and *Chrysomya* sp myiasis was made. The dog was hospitalised and 5% dextrose in lactated Ringer's injection was administered intravenously for 24 hours. Enrofloxacin (18 mg), amoxicillin/clavulinate (54 mg) and carprofen (14.4 mg) were administered by subcutaneous injection. General anaesthesia was induced with diazepam (0.72 mg) and ketamine (18 mg) intravenously, and maintained with 3% halothane in oxygen. Clusters of SWF larvae anchored in the gingival mucosa were easily removed, exposing the underlying bone. All teeth except the canines were extracted. Larvae in the incisivum were removed leaving a large defect (Figure 2). The dog started eating the day after surgery and was sent home 4 days later on oral spiramycin (46.9 mg)/metronidazole (25 mg) two tablets sid for 10 days. The dog had recovered fully by the 10th day of medication.

**Case 2** — An 8-year-old 25.4 kg outdoor mixed breed entire male dog was presented with 3-day-old multiple dogfight wounds involving the right upper gingiva and maxillary mucosa. The owner regarded this as a recurrence of these problems. The dog was afebrile, alert and had a temperature of 38.8°C. Examination of the mouth revealed *Chrysomya* sp larvae in the gingiva of the right upper maxilla. The dog was hospitalised and 5% dextrose in lactated Ringer's injection was administered intravenously for 24 hours. Enrofloxacin (18 mg), amoxicillin/clavulinate (54 mg) and carprofen (14.4 mg) were administered by subcutaneous injection. General anaesthesia was induced with diazepam (0.72 mg) and ketamine (18 mg) intravenously, and maintained with 3% halothane in oxygen. Clusters of SWF larvae anchored in the gingival mucosa were easily removed, exposing the underlying bone. All teeth except the canines were extracted. Larvae in the incisivum were removed leaving a large defect (Figure 2). The dog started eating the day after surgery and was sent home 4 days later on oral spiramycin (46.9 mg)/metronidazole (25 mg) two tablets sid for 10 days. The dog had recovered fully by the 10th day of medication.

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wounds on the left neck and mandibular region and a tear on the lower lid of the left eye. The dog was lethargic, dehydrated and inappetent, with a rectal temperature of 40°C. There was a serosanguineous, dark, foul-smelling discharge from the wounds. There were clusters of SWF larvae embedded in the wounds and left ear canal (Figures 3 and 4), though none in the eyelid wound. The dog was given intravenous lactated Ringer's solution over a period of 10 hours to correct dehydration. Visible and easily extractable larvae were removed from the wounds and external ear canal. The external ear canal was flushed with 0.9% saline and the wounds with diluted hibitane solution. An insecticide (Baygon®, Bayer China Co Ltd, containing cyfluthrin, transfluthrin, propane and butane) was sprayed on the wounds. Some larvae wriggled out soon after the spray and died. Ivermectin (10.16 mg) was administered by subcutaneous injection once. After intravenous fluids, the dog was willing to eat and was sent home on oral amoxicillin-clavulanate (15 mg/kg bid), cefadroxil (30 mg/kg bid) for 14 days and topical dilute hibitane to be used on the wounds twice daily. The wounds were left to granulate during this period. The owner was advised to keep the dog indoors to prevent re-infestation and to apply insect repellant around the wounds. Chloramphenicol eye drops and ear drops containing gentamycin, thiabendazole and dexamethasone, were dispensed for application twice daily into the left eye and ear respectively. No larvae were evident by the second day of treatment. Fourteen days later, healthy granulation tissue was growing in the wounds. The wound margins were freshened and the defects were closed surgically. The left lower eyelid defect was also repaired surgically and the dog was neutered.
### Table 1. Management of *Chrysomya bezziana* infestation in ten of the twelve dogs presented for treatment at a veterinary clinic in Hong Kong.

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Breed</th>
<th>Age (Years)</th>
<th>Sex</th>
<th>Body weight (kg)</th>
<th>History and clinical signs</th>
<th>Treatment</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Mixed</td>
<td>7</td>
<td>M</td>
<td>27</td>
<td>Recent restlessness, tail chasing, two discharging puncture wounds in the peri-anal area and one on the ventral tail base.</td>
<td>Surgical ablation, oral cefadroxil (30 mg/kg bid), metronidazole (15 mg/kg bid) and carprofen (2.2 mg/kg/day)</td>
<td>Ten days later the wound had healed well</td>
</tr>
<tr>
<td>4</td>
<td>Chow Chow</td>
<td>2.5</td>
<td>M</td>
<td>18</td>
<td>Inability to urinate for 1 day, licking of the prepuce, and a wound on the dorsal aspect of the preputial orifice infected with several SWF larvae.</td>
<td>Surgical ablation, extraction of larvae, ivermectin (400mg/kg s/c single injection), oral amoxicillin-clavulanate (15 mg/kg bid), carprofen (2.2 mg/kg/day).</td>
<td>Passed urine soon after extraction of larvae; 7 days later the wound had healed</td>
</tr>
<tr>
<td>5</td>
<td>Schnauzer</td>
<td>4 (M)</td>
<td>19.4</td>
<td>1.6</td>
<td>Multiple dog bite wounds on the left lateral scapula region, left elbow, left oral commissure and medial inter-digital web of the left hind limb all with SWF larvae.</td>
<td>Surgical ablation, extraction of larvae, oral cefadroxil (30 mg/kg bid), carprofen (2.2 mg/kg/day), insecticidal spray* (once only), and once weekly topical maldison wash.</td>
<td>Treated as in-patient for 1 day. Three days later three larvae were recovered from the foot lesion. Dog had recovered fully by the 10th day after surgery.</td>
</tr>
<tr>
<td>6</td>
<td>Great Dane</td>
<td>3</td>
<td>M</td>
<td>60</td>
<td>Recent restlessness, tail chasing, two discharging puncture wounds in the peri-anal area and one on the ventral tail base.</td>
<td>Extraction of larvae, diluted hibitane flush oral cefadroxil (15 mg/kg bid), carprofen (2.2 mg/kg/day), insecticidal spray* (once only).</td>
<td>No larvae were detectable by the second day of treatment. Fully healed after 10 days.</td>
</tr>
<tr>
<td>7</td>
<td>Mixed</td>
<td>4</td>
<td>M</td>
<td>21.7</td>
<td>Extensive granulomatous discharging wound of an unknown duration over the right lateral scapula region. Dog was lethargic and pyrexic (39.8°C).</td>
<td>Surgical ablation, oral cefadroxil (30 mg/kg bid), amoxicillinclavulanate (15 mg/kg bid) and carprofen (2.2 mg/kg/day) for 7 days.</td>
<td>Had recovered uneventfully by 10th day after surgery.</td>
</tr>
<tr>
<td>8</td>
<td>Sharpei Cross</td>
<td>6 (N)</td>
<td>29.5</td>
<td>2.2</td>
<td>Chronic otitis externa, demodicosis, large circular discharging wound with clusters of SWF larvae on the left dorso-frontal forehead noticed 2 days earlier.</td>
<td>Surgical ablation, oral amoxicillin-clavulanate (15 mg/kg bid), enrofloxacine (5 mg/kg sid), ivermectin (400mg/kg), carprofen (2.2 mg/kg/day) and weekly amitraz (1:250) wash.</td>
<td>It took 10 days for complete recovery from SWF infestation. Demodicosis was still being treated with weekly amitraz wash.</td>
</tr>
<tr>
<td>9</td>
<td>Terrier cross</td>
<td>3</td>
<td>M</td>
<td>5</td>
<td>Neglected otitis externa, matted hair, and SWF larva in the left ear canal.</td>
<td>Extraction of the larvae, single insecticidal spray* and daily ear drops* for 7 days.</td>
<td>Ear canal was clear of SWF larvae by the 2nd day of treatment.</td>
</tr>
<tr>
<td>10</td>
<td>Cocker Spaniel</td>
<td>8</td>
<td>M</td>
<td>18</td>
<td>Ongoing bilateral otitis externa and atopic dermatitis, multiple round wounds with SWF larvae on the inner surface of the pinna of the left ear and the external ear canal.</td>
<td>Extraction of the larvae, insecticidal spray* (once) and daily ear drops* for 7 days.</td>
<td>Dog lived close by the clinic and treatment was monitored daily. Recovered after 7 days.</td>
</tr>
<tr>
<td>11</td>
<td>Cocker Spaniel</td>
<td>10</td>
<td>F</td>
<td>11.3</td>
<td>On-going periodontal disease, pyrexia (39.6°C). Puncture wound on the right rostral mandible lobe with an unknown number of SWF larvae noticed a day earlier.</td>
<td>Extraction of larvae, insecticide spray*, enrofloxacine (5 mg/kg sid), metronidazole and spiramycin (Stomorgyl® 1.25 tabs sid) for 7 days.</td>
<td>The wound caused by SWF infestation healed by granulation</td>
</tr>
<tr>
<td>12</td>
<td>Rough Collie</td>
<td>10</td>
<td>M</td>
<td>23.2</td>
<td>Two neatly punched out wounds on left rump near tail base with an unknown number of SWF larvae noticed a day earlier.</td>
<td>Extraction of larvae, oral cefadroxil (30 mg/kg bid), dilute hibitane flush, insecticidal spray*</td>
<td>Dog recovered within a week of treatment.</td>
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</tbody>
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*Baygon® (Bayer China Co Ltd), contains cyfluthrin, transfluthrin, propane and butane.*

*Maldison 200 g/L (Malatroy®, Troy Laboratories Pty Ltd, Smithfield, NSW), diluted at 15 mL/L water to be used weekly.*

*Dexoryl® (Virbac Laboratories 06516 Carros, France), contains gentamycin, thiabendazole and dexamethason.*

*MN Neutered male.*

*Stomorgyl® 10 (Merial), spiramycin (46.9 mg) / metronidazole (25 mg) 2 tablets sid for 10 days.*

In all, 12 cases of OWSWF infestation in dogs of various sizes and breeds were presented for treatment at our clinic in Hong Kong. The signalment, history, treatment and outcome for cases 3 to 12 are presented in Table 1. Of the 11 male dogs, nine were entire. Eleven dogs had cutaneous SWF lesions and one dog had lesions in the oral cavity. Dogs with older and easily accessible lesions were treated by manually extracting the larvae. Dogs in which larva had under-run the skin, and the one with oral infestation, were anaesthetised and treated by surgical ablation of the lesions, and extraction of the larvae, respectively. Broad-spectrum systemic antibiotics and anti-inflammatory medications were used as part of the treatment in all dogs. Two dogs (Cases 1 and 5) were initially treated as in-patients, while the others were treated as outpatients.
The wounds had a very characteristic strong, offensive smell and oozed a sero-sanguineous fluid or frank blood. Larvae were embedded in punched out round lesions and only posterior spiracles were visible. Healing was rapidly achieved once the larvae were dead or had been removed from the lesion(s) and all 12 dogs recovered uneventfully. Ivermectin was administered to only three dogs whose heartworm status was known to be negative. Fly larvae were submitted to Idexx Veterinary Services, Inc. (CVD) 2825, Kov Drive, West Sacramento CA, USA for identification and Chrysomya bezziana myiasis was confirmed.

**Discussion**

In Hong Kong, the dogs presented for treatment were all from the New Territories, a well-wooded, moist and shaded area, providing a suitable environment for the adult fly. Dogs in more urbanised areas were probably less likely to become infested due to the lack of adequate vegetation and fewer stray dogs.

The number of SWF that an area can support depends on the availability of wounded animals. Some Hong Kong households have been known to keep several dozen dogs, increasing the risk of SWF infestation in dogfight wounds and reducing the likelihood of early detection and treatment.

It is not known how many stray dogs live in Hong Kong, but they could number in the tens of thousands. This large population of stray dogs, and freely roaming un-owned cattle, especially in the New Territories, could result in SWF infestation reaching epidemic proportions, making control of the fly difficult. Crowded human households are also a public health concern, although at the time of writing this report, the Hong Kong Department of Health had registered no human infestations. Inter-dog aggression, territorial behaviour and fights causing wounds, with subsequent SWF infestation, could have been the main epidemiological factors in 7 of 12 dogs treated. Neutering of male dogs is recommended to reduce these causes.

Two dogs were likely to have been predisposed to fly infestation due to neglected otitis externa, with flies probably attracted to the smell associated with ear infection. It is also probable that dogs that live outdoors are more likely to be infested, in the presence of predisposing factors, as was the case with most of the dogs presented here.

Screwworm fly infestation may occur in all parts of the body and careful examination of animals is crucial, as infestations can be missed. Predisposing factors such as previous SWF infestation, concurrent diseases, such as otitis externa, and weeping skin wounds’ should heighten suspicion for the possibility of SWF infestation.

In this report, dogs recovered rapidly after treatment. Currently, there is no single product registered for the treatment of SWF infestation in companion animals. The insecticide spray Baygon®, which contains synthetic pyrethrins, is not registered for use on animals, however, it was considered easy for owners to apply to unco-operative dogs. No adverse reactions were detected with the use of the spray, and in this albeit limited number of individuals, the topical preparation appeared to be both safe and efficacious. The removal of all larvae, wound treatment, continued close monitoring for 3 or more days for newly hatched larvae, and the application of an insect repellent to prevent re-infestation, were essential for successful treatment. Affected dogs should be housed in a screened and fly free environment.

While the risk of SWF entering Australia by legally imported dogs is minimal, meticulous clinical examination for health certification in Hong Kong (preferably by Australian accredited veterinarians) should be done in the hours preceding export of pets destined for Australia. Attention should be paid to natural orifices and oral health, especially those of older animals. SWF infestation in the mouth can easily be missed or dismissed as on-going periodontal disease. Animals may also be infested on the airport tarmac as they wait in their cages to be loaded into the aircraft. Using fly-proof cages would be useful in this case.

The mandatory immediate quarantine in Australia for imported pets should be upheld with an added vigilance for pets from Hong Kong. Weeping skin sores in imported pet animals should be examined for SWF. The use of efficacious systemic insecticides should be investigated. These could be administered as a prophylactic measure against SWF infestation for migrating pets in addition to existing measures that mainly target ticks and fleas.

**References**