

Flying-fox Paralysis Syndrome (FFPS): Interim case definition, sample collection & treatment advice

Flying Fox Paralysis Syndrome Working Group

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Background

Since December 2020, unusual clusters of flaccid paralysis have been identified in flying foxes in South East Queensland and North East NSW, particularly over the summer months. To date, black flying foxes (BFF, *Pteropus alecto*), grey-headed flying foxes (GHFF, *P. poliocephalus*) and little red flying foxes (LRFF, *P. scapulatus*) have been affected. Anecdotally, cases appear to be correlated with periods of heavy rain.

Preliminary investigations have ruled out known causes of paralysis, and in lieu of a diagnosis the syndrome has been named Flying Fox Paralysis Syndrome (FFPS). Investigations into the cause of FFPS are ongoing, and further cases are anticipated in the 2022/2023 summer. A description of the syndrome, sample collection protocols, and advice for vets and flying fox rehabilitators is provided below.

Cases can be difficult to distinguish clinically from Australian Bat Lyssavirus (ABLV), and ABLV should always be considered as a possible cause of any neurological symptoms in bats. **Only people who are trained, wearing appropriate personal protective equipment (PPE) and appropriately vaccinated with ongoing immunity should handle bats.** Information on PPE for handling bats is available at wildlifehealthaustralia.com.au/ProgramsProjects/BatHealthFocusGroup.aspx

Members of the community who find an injured or sick bat should contact a wildlife care organisation or local veterinarian.

Flying-fox Paralysis Syndrome Clinical Description

Progressive flaccid paralysis of unknown cause.

Body condition is variable, ranging from poor condition to very good condition.

Absence of ticks, tick attachment sites, or other clinical signs or history which suggest trauma, electrocution or other differential diagnosis.

Clinical signs include impaired mobility, and may also include the other manifestations described below. More severely affected individuals are expected to demonstrate all four manifestations.

1. **impaired mobility**, ranging from bilateral hind limb paresis or weakness with poor grip, through to complete flaccid paralysis with no deep pain response. Individuals may be able to fly but not gain height, or unable to fly but may be able to crawl along ground. Sequelae from the latter may include excoriations on wrists / ventral aspect of wings due to dragging along the ground.
2. **impaired swallowing** and tongue control, with potential sequelae of secondary dehydration, poor body condition, aspiration pneumonia
3. **impaired blinking**, with secondary eye weeping, corneal oedema, ulceration
4. **impaired respiration**, including open mouth or laboured breathing, with possible establishment of pneumonia from aspiration.

Progression over the four identified stages of severity in Table 1 may occur acutely over a period of hours or more chronically over days to weeks. **End stage** individuals are moribund, show extreme weakness, extensive paralysis, severe dehydration, hypoglycemia, hypothermia and respiratory signs likely all sequelae of paralysis and secondary effects, including shock, tremors and/or convulsions.

Other differential diagnoses (e.g. Australian bat lyssavirus ABLV) must be considered.

Case definition: outbreak investigation classifications

The descriptions below identify features that must be met for an individual flying fox to be considered a suspect, probable or confirmed case of FFPS. These definitions aim to assist with both prioritising individuals for further diagnostic testing and for subsequent epidemiological investigations.

1. Suspect case:
 - Consistent with the clinical description (presenting live or dead),
Note that flying foxes that are dead on presentation to a veterinarian, bat rehabilitator or similarly qualified person can meet the clinical description based on a history of signs prior to death reported by a member of the public
 - OR,
 - Dead on presentation with no clinical history AND occurrence is spatio-temporally consistent with probable cases (particularly between December – March, anecdotally during periods of high rainfall)
2. Probable case:
 - Consistent with the clinical description (presenting live or dead), AND
 - Other differential diagnoses have been ruled out via diagnostic testing (as a minimum, ABLV testing and a full histopathological workup which encompasses CNS (brain and spine), and preferably peripheral nerve and skeletal muscle)
 - May or may not be spatio-temporally consistent with other probable cases.
3. Confirmed case:
 - Definition not yet possible until a cause is identified.

Table 1: Clinical signs: severity matrix

Stage	Impaired mobility	Impaired swallowing ¹	Impaired blinking	Impaired respiration	Other
Stage 1	Mild generalised weakness. Cannot fly but can climb.	Able to swallow. May have uncoordinated tongue movement	Weepy eyes	Normal respiratory rate and effort.	Dehydration ²
Stage 2	Moderate generalised weakness. May use thumbs to support hanging. Unable to hold wings against body.	Impaired swallow reflex. Likely to have uncoordinated tongue movement, with tongue often protruding ³	Reduced ability to close eyelids, dry eyes, may have corneal ulcers forming ⁴ .	Some respiratory difficulty. May be open-mouth breathing, without teeth showing	Dehydration
Stage 3	Severe, generalised weakness. May be hanging or found on ground. Unable to hold wings against body. May be able to move legs.	Unable to swallow, no gag reflex. Uncoordinated tongue movement, with tongue protruding.	Unable to close eyelids. Sunken eyes, may have severe corneal ulcers.	Obvious, severe respiratory distress. Open mouth breathing, with gaping and teeth showing.	Severe dehydration. May have abrasions due to struggling on the ground.
Stage 4	Unable to move. May be hanging or found on ground. Unable to hold wings against body. Unable to regrip.	Unable to swallow, no gag reflex. Uncoordinated tongue movement, with tongue protruding. May have clear, bubbly nasal discharge.	Unable to close eyelids. Sunken eyes, may have severe corneal ulcers and corneal swelling	Ineffective breathing (shallow, abdominal) with high respiration rate.	Severe dehydration. In shock or starting to go into shock. Cyanotic (pale, blue-grey gums). May have secondary neurological signs such as seizures / shivering, anisocoria. May be in poor body condition ⁵ . May have abrasions due to struggling on the ground

¹ Swallowing is a more consistent indicator of stage than tongue control.

² LRFF less likely to show dehydration than GHFF/BFF

³ LRFF more likely to have tongue protruding than GHFF/BFF

⁴ LRFF less likely to have ulcers than GHFF/BFF

⁵ Body condition is variable across all species, however LRFF less likely to show loss of body condition than BFF/GHFF

Prognosis

- Stage 1 - Recover well with supportive care (see First Aid sections below).
- Stage 2 - Require more aggressive treatment to survive. Nil by mouth. (see First Aid sections below)
- Stage 3 - Euthanasia recommended.
- Stage 4 - Euthanasia recommended.

Stage 1



Stage 2



Stage 3



Images: J Vink.

Differential diagnoses and laboratory criteria for diagnosis

No definitive laboratory criteria have currently been identified.

Clinical pathology associated with sequelae such as dehydration and shock may be expected and should be monitored for animals undergoing treatment/care.

The differential diagnoses listed below should be considered and excluded where possible. Differential diagnoses marked with * are of higher priority to investigate and/or exclude.

1. Infectious

- a. *Australian bat lyssavirus (ABLV) or other novel lyssavirus
- b. Toxoplasmosis
- c. Other viral, bacterial, parasitic or protozoal infection

2. Toxicological

- a. *Plant toxin, and plants high in soluble oxalates
- b. *Botulism
- c. *Tick Paralysis
- d. *Algal toxins
- e. *Organophosphates and other pesticides/herbicides, including neonicotinoids
- f. Fungal neurotoxin
- g. Insect neurotoxin
- h. Heavy metals, including lead

3. Parasitic

- a. *Angiostrongyliasis

4. Trauma

- a. *Spinal damage, concussion
- b. *Electrocution

5. Metabolic

- a. Liver disease
- b. Kidney disease
- c. **Hypocalcaemia secondary to soluble oxalate poisoning or other plant poisoning

6. Immune mediated

- a. Acquired myasthenia gravis or unknown aetiology

Case investigation and Treatment

Only people who are trained, wearing appropriate personal protective equipment (PPE) and appropriately vaccinated with ongoing immunity should handle bats. Information on PPE for handling bats is available at wildlifehealthaustralia.com.au/ProgramsProjects/BatHealthFocusGroup.aspx

Metadata collection

- Species / location
- Sex
- Age
- Forearm length
- Weight
- Body condition score (out of 5, from 1= emaciated, with concave muscle mass, pronounced sternum, to 3 = convex, moderate muscle either side of sternum, and 5 = protruding muscle mass above sternum apex)

Triage and primary first aid

- Euthanasia is recommended for individuals with Stage 3 or 4 clinical signs
- Nothing should be provided orally unless controlled swallowing is confirmed. Assess ability to swallow once hydrated and alert. Tilt bat down and observe ability to lap and swallow fluid from a syringe. This ensures fluid drains from the mouth if they are unable to swallow to reduce aspiration risk.
- Warmth. Take bats temperature and adjust humidicrib to treat shock as normal.
- Glucose gel or paste on gums (if safe to do so). Tilt bat down to drain excess saliva to avoid aspiration.
- Lubricant eye gel or drops in eyes - thickest available
- For all bats, initially administer 10% of body weight as warmed sub cutaneous fluids (50/50 hartmanns and 2.5% glucose)
- If available, administer oxygen via oxygen concentrator
- Organise vet appointment for full assessment and prescription medications
- Monitor bats for respiratory deterioration and immediately seek euthanasia if they descend to Stage 3

General notes

- Paralysis syndrome is not contagious to other bats in care
- Bats can take months to fully recover, some cannot hang full time for upwards of 2-3 weeks
- Bats in care will require ongoing sub cutaneous fluids until they are swallowing strongly and able to maintain their own hydration
- Nutripet (or equivalent) should be fed to bats only able to take small amounts orally before transitioning to a high protein smoothie with Calcium Sandos or Troy syrup (2mL/100mL of smoothie; do not give calcium powder)
- Do not give fruit to a bat suffering paralysis syndrome until they are hanging and able to swallow normally

Veterinary first aid

- General anaesthesia via mask +/- nasal O2 if possible
- Fluorescein stain eyes and treat as warranted, e.g. topical ophthalmic NSAID
- Blood glucose - supplement as needed
- SC or IV fluids as warranted. IV therapy recommended for Stage 2. Stick to conservative rates to avoid cardiorespiratory overload.
- Correct any electrolyte abnormalities

- For pneumonia (if suspected based on radiography and clinical signs):
 - SC or oral amoxicillin clavulanate as a first choice for established aspiration pneumonia
 - IV antibiotics e.g. penicillin or cephalosporin, or Ceftazidime for more generalised, severe pneumonia (at the first sign of radiological evidence)
 - Nebulise with 1:5 enrofloxacin:saline 20 mins BID, or with F10, to aid antibiotic treatment or if aspiration suspected
- Administer pain relief as required. Avoid NSAIDs until hydration improves (topical ophthalmic NSAIDs are an exception).
- Start oral supplementation once bright and gag reflex has been determined to be strong.
- Calcium supplementation (see general notes) if demonstrated hypocalcaemia from blood test with normal albumin
- Note response to warmth, glucose and supportive treatment and any deterioration / improvement in signs seen post treatment. Repeat in-house bloods to monitor improvement.
- Consider referral if available

Note: Stage 2 cases require more aggressive treatment to survive - preferably IV fluids, correction of any electrolyte abnormalities, ophthalmic treatment and antibiotics as required +/- nebulisation.

Sample collection and pathological investigations in dead bats

All dead bats that present with clinical signs consistent with ABLV (i.e. often overlapping with signs shown by FFPS) should be submitted to State Government Laboratories for ABLV screening. If you are interested in submitting samples for diagnostic investigation, contact your State/Territory WHA Coordinator to discuss whether further diagnostic screening is appropriate at wildlifehealthaustralia.com.au/AboutUs/ContactDetails.aspx