

Taken from "AUTHENTICITY OF A REPORT OF A RED FOX FOUND RECENTLY KILLED ON GLEN ESK RD, 1ST AUGUST 2006." - author Nick Mooney.

[Passages, images and graphs inserted by David Obendorf **in RED**.]

1. Immediate examination of the fox

The carcass body appeared very slightly warm. Taskforce staff first arriving and undertaking this examination were delivering a car stripped of field equipment so had to improvise at this stage. A deep, narrow stab wound with a knife was made to the chest and a finger inserted which showed that the body core was slightly warm. The male fox looked and felt in good physical condition and appeared to be a young adult (although the fox had neat, sharp teeth and was not overly large it had well-developed testes). There was no sign of rigor mortis in jaw nor limbs.

The fox had firm, clear and moist eyes, fresh blood and saliva in and around the mouth, pale gums, intact teeth (except for one molar missing and healed) and a small cut in the back of the mouth matching teeth in the closed jaw. A large patch of skin about 35 cm long by 10-15 cm wide was hanging off but still attached to its side (Photos 2 and 3), small speckled bruising and pin-prick bleeding suggesting the skin was torn off. The wide, ragged tear extended along the groin exposing the penis shaft and continued into a hind leg. This resulted in torn and bruised muscle being exposed. The belly was badly bruised but not ruptured although the scrotum was and one testicle appeared squashed. Exposed flesh appeared very fresh (firm, shiny and moist). There was no blood on the muzzle or elsewhere externally other than a small amount immediately adjacent to the leg muscle gash.

Mooney File Note dated 2 August states: "The testes were bare but full, rounded, tight, shiney [*sic*] and firm to touch.'

COMMENT: In my experience as a veterinary pathologist it is unusual for the testicles of an animal that had allegedly been hit by a motor vehicle to be external from the scrotal sac and yet show no obvious sign of bruising, haemorrhage, deformation or rupture. In my view this feature and the loosely reflected abdominal skin of the left flank of the fox (see below) suggest that someone has interfered with this carcass at a time after the fox died.



Figure of Cleveland fox carcass with torn left flank skin though to left hindleg; note testicles free of the scrotum (neither appears deformed, traumatised or contused).

There was a very small amount of fine soil/dust [and blood] caked about the outside gums (Photo 4) which otherwise were clean. This soil could have been part of the course of foraging for soil invertebrates or it could have been because of snapping during death throes which might explain the cut lip. The former is more likely because the teeth and adjoining gum were clean of this material (probably because of normal tongue action).

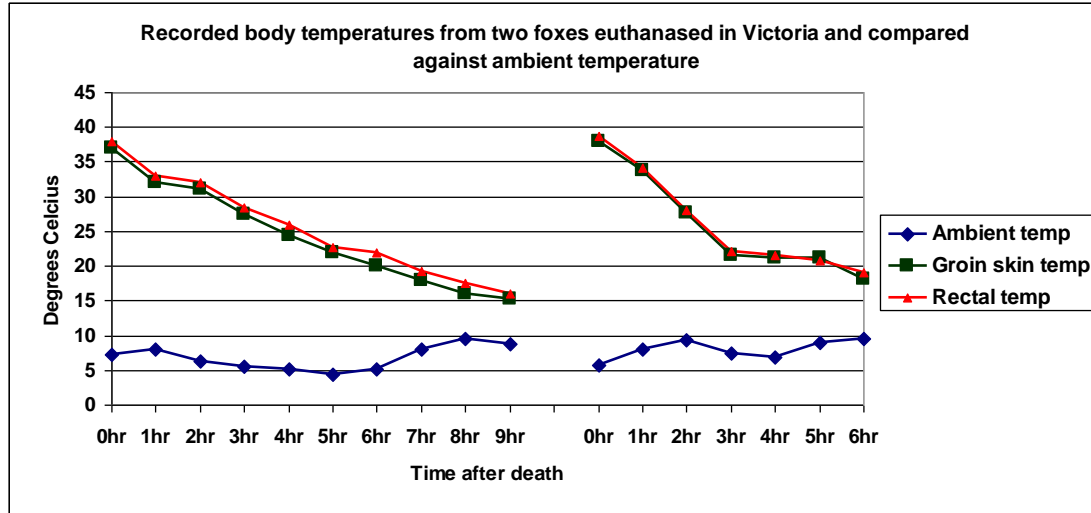
There was no smell of putrefaction (outside or in the mouth) just a slight, pungent smell typical of 'fox'. The pelt was dry and clean except for some entangled gravel. Limbs did not appear broken and the skull seemed intact. The tail had unusual hair growth from a scared area distal of mid distance.

Mr Mooney's file contains the statement: "Possible hemp or sisal [in vacuuming from the pelt] and confirmation of these is being sought."

At **1055 hrs** during discussions while Witness 3 [Jason Powe] said he had a soil thermometer probe (used to assess planting potential) and this was immediately used to take chest (12.4°C), rectal (11.9°C) and ambient (7.9°C and rapidly rising) temperatures. This thermometer was later calibrated against others and it proved accurate.

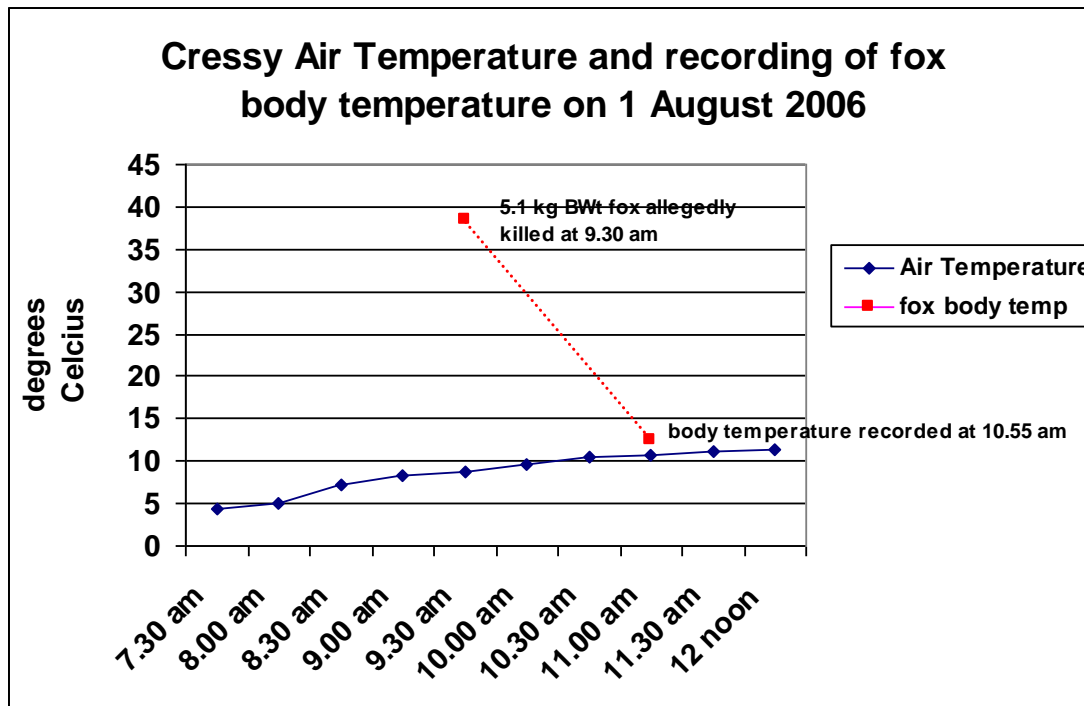
Jason Powe told *The Mercury* reporter, Nick Clark that the thermometer registered 21°C. [Based on Nick Mooney's recordings, Mr Powe's recollection and quote in *The Mercury* of 2 August is therefore erroneous.]

It is important to include here the data collected from two euthanased foxes on body temperature decline over time that Nick Mooney requested from his Victorian counterparts (see Figure below).



In the Victorian experiment the body temperature declined in the first 1.5 hrs from 38 to 32C during an ambient temperature declining from 7.3 to 6.3C [fox 1]; and 38.7 to 25C over an ambient temperature ascending from 5.8 to approx. 8C [fox 2].

For fox 1 this is a loss of 6C at an average air temperature of 6.8C; for fox 2 this is a loss of 13.7C at an average air temperature of 7C.



By construction only assuming an incident “very close to 9.30 am¹”, in the Glen Esk case the body temperature was have declined from 38.5 (normal fox body temperature) at 9.30 am to 12.4C at approximately 11.00 am (when Mooney took the temperature) over an ambient temperature range from approx. 5 to 7.9C; i.e. a loss of 26.1C at an average air temperature of ~6.5C.

This interpreted loss of body temperature under ambient temperature conditions are inconsistent with those shown for the two Victoria foxes although contact with a cold substrate such as a road surface may cause the body

¹ DPIW Press Release - 3 August 2006 - “Driver who hit fox identifies himself.”

temperature to decline more rapidly. Neither was the hair coat of the fox wet, another factor that may increase the rate of temperature decline.

1. Formal post mortem examination of the fox

The findings on cause of death are best summarised as: "Based on the distribution and type of injuries sustained by the fox, it suggests a crushing type injury". Death appeared to be very quick but bruising suggests not instantaneous. Expert opinion is that death would have been probably been in a few minutes and the animal may have been in extreme shock. There was no putrefaction and no evidence of freezing. The mouth became very difficult to open (an early sign of rigor mortis) and rigor mortis proper commenced as the formal post mortem examination progressed. The abdominal cavity was effectively crushed and 'jellied' but not ruptured creating a huge sinus with much clotted blood free in the abdominal and to a lesser extent thoracic cavities. The abdominal muscles were markedly bruised.

Beyond pathology samples, the following were retrieved and sent for expert comment.

- Gravel combed from the soil and soil/dust scraped from the gums
- Pollen and detritus vacuumed from the fur (a new vacuum cleaner was used)
- A canine tooth for ageing
- Gut content from stomach to rectum (the rectum was examined and hair from there included and there was no material between stomach and mouth).

The eyes had begun to soften and dry by the time of this examination (at 1330 hrs).

COMMENT:

With respect to those concerned, the various digital images of the carcass at Mt Pleasant Laboratories are more informative than the descriptions given in the pathology report (06/2128).

The presence of roundworms or nematodes (not identified) in the intestine of this fox is noteworthy. Apparently these were ascarid nematodes; most probably *Toxocara canis*.

The pathology report makes a diagnosis of 'extensive haemorrhage (blunt trauma)'. Rather than 'rigor mortis commencing', it is more likely rigor mortis was nearly complete and hence the limbs and trunk of the fox carcass were 'relatively flaccid'.

Description in the Pathology Report (06/2128) to explain the final diagnosis of the 'extensive haemorrhage' is limited. The report notes rupture to the liver and one kidney; bruising to exposed abdominal muscles and 'haemorrhagic' right brachial plexus region. The digital images show an extensive haematoma in the ventral abdominal region. Clinical veterinarian, Kim Barrett [who X-rayed the carcass prior to the necropsy] notes: 'abdominal herniation from a penetrating wound to the posterior abdominal wall....'.

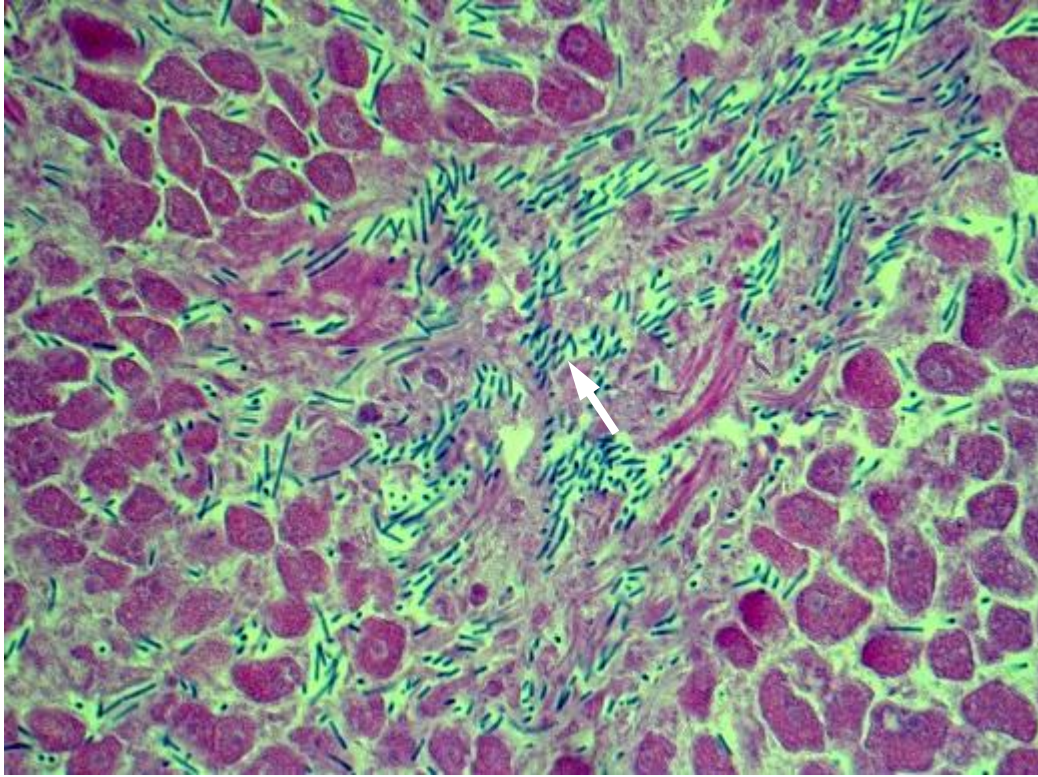
In the totality of this pathology case, it is my opinion that these injuries are not entirely consistent with a spontaneous impact with a motor vehicle - even as stated in this report "a heavy-duty tyre being the only point of impact".

The pathology report estimates the time of death was **5-10 hours** prior to the commencement of the necropsy examination at **1330 hrs**, placing the TOD between 330 and 830 hrs on 1 August.

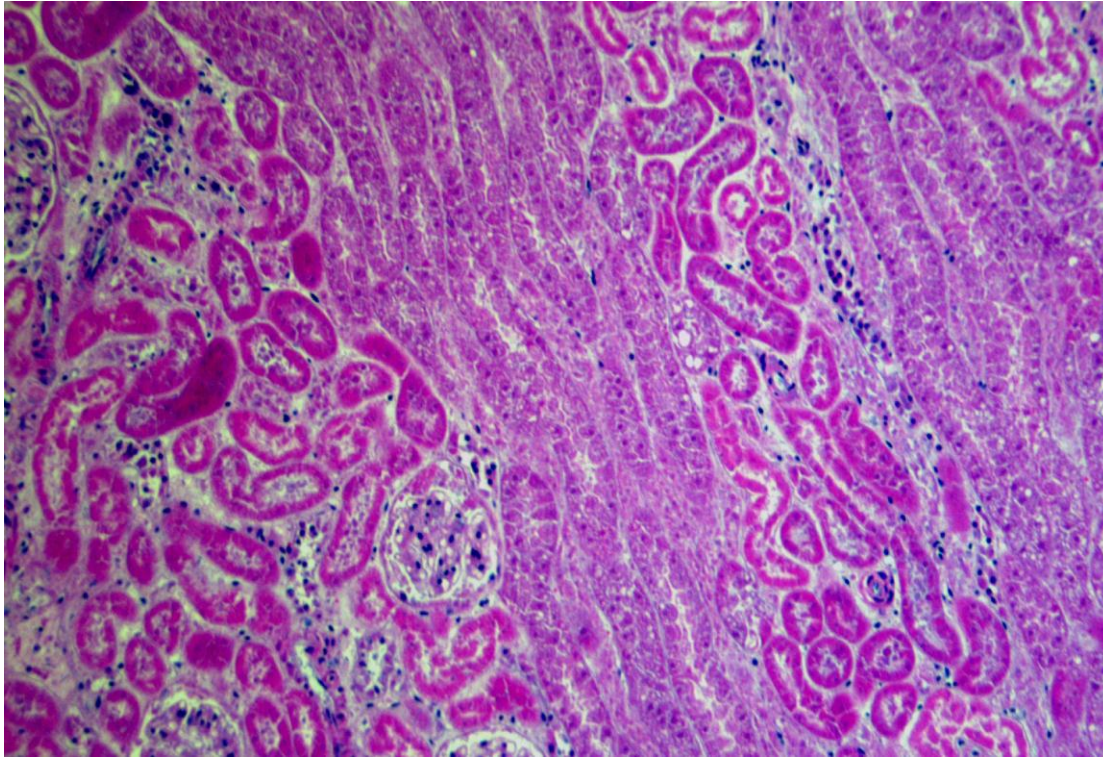
Prior to seeing the microscope slides from this case I estimated a TOD closer to 12-14 hrs prior to the necropsy - i.e. 2330 hrs on 31 July and 130 hrs on 1 August. I requested and subsequently received the histological sections prepared from various tissues preserved from this animal during the necropsy. I examined these tissues and provided the slides to two other pathologists for their assessments.

Based on those examinations and discussions with colleagues I estimate a TOD to be well in excess of this time period (up to 4 days if the carcass had been keep cool to cold).

The major organs - liver, spleen, kidneys, heart and lung - all show signs of advanced autolysis and varying degrees of loss of normal differential staining of the cellular cytoplasm and nucleus. There is evidence of gas formation within the tissues and the presence of large numbers of large rod-shaped bacteria in the liver, lungs and blood vessels. The lungs show loss of the bronchial epithelium. It is unusual for such lung decomposition to be evident in a traumatized carcass where body tissues are preserved within 12 hours of death.



High power figure of liver tissue (06/2128): Note breakdown of cellular junctions between hepatocytes, loss of basophilic staining to cell nuclei and extensive bacterial proliferation (arrow).



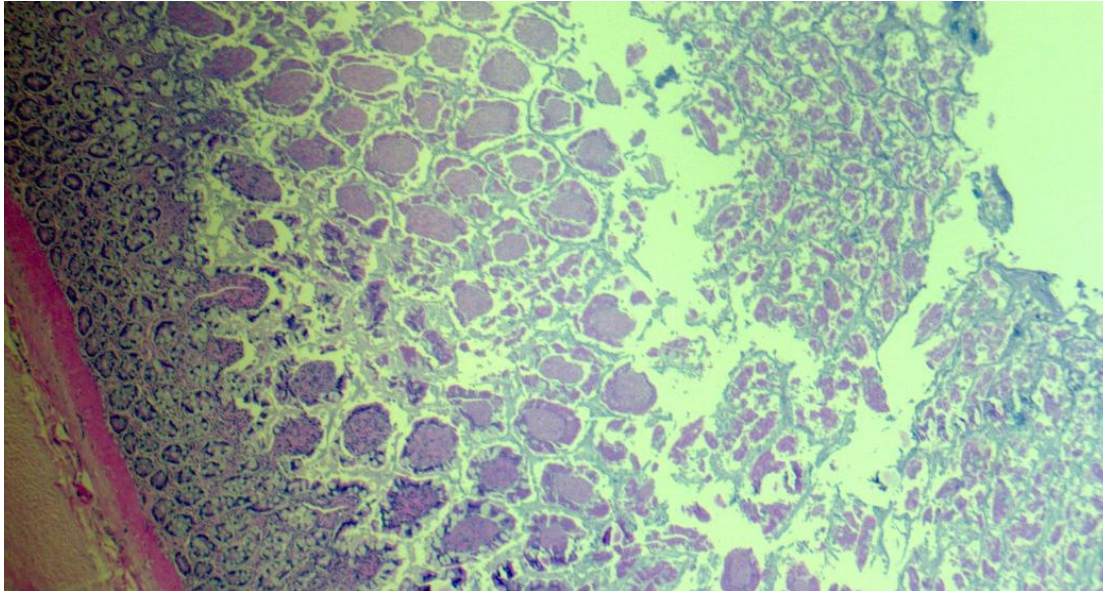
High power figure of the kidney (06/2128) showing renal autolysis in cortex.

There is generalised tubular necrosis (renal autolysis) in the cortical and medulla of the kidney; this would be consistent with a considerable delay between the death of the animal and the preservation of these tissues. Cellular degeneration is evident in the glomeruli, proximal convoluted tubules and loops of Henle and to a lesser extent the distal convoluted tubules. The bladder shows complete slough of the transitional lining epithelium. This feature is seen when a body is undergoing post mortem decomposition and is usually accentuated when there is a prolonged delay in preservation of these tissues.

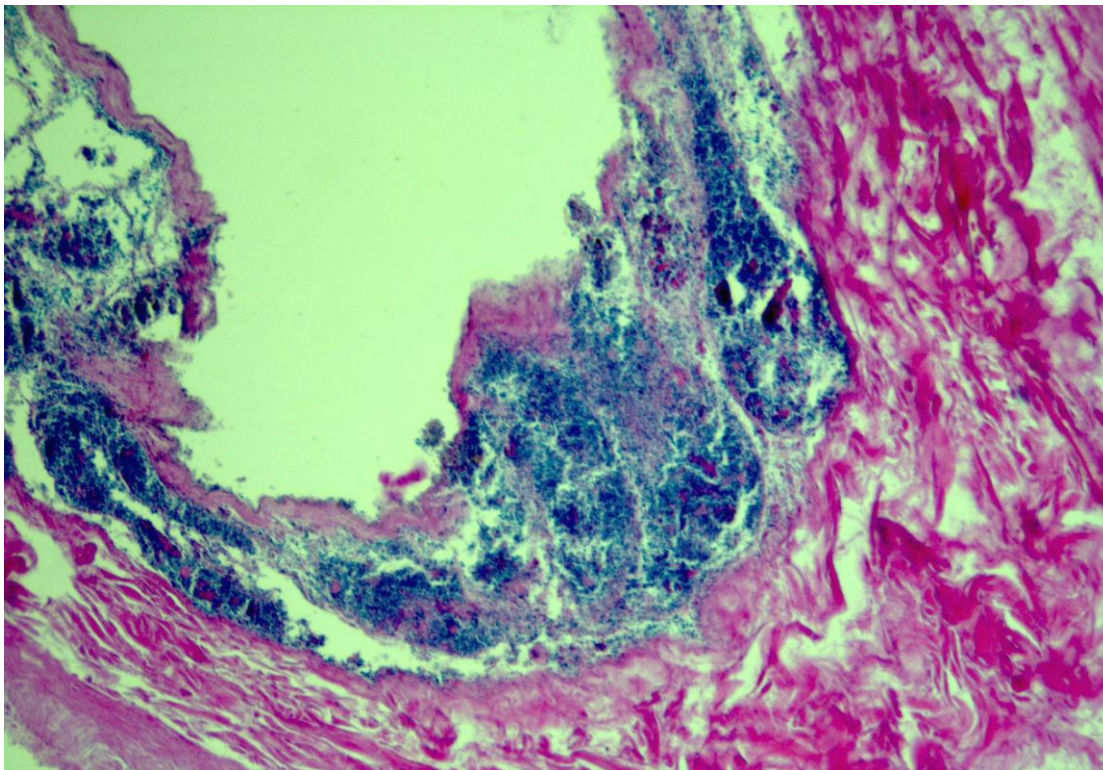
Several muscle sections show evidence of muscle decomposition - pale nuclei and muscle fibre degeneration - consistent with post mortem autolysis.

There is no mention of obvious gut rupture in the post mortem report for 06/2128, however, the haemorrhagic omentum contains bacteria and other foreign debris that could suggest that gut perforation may have occurred.

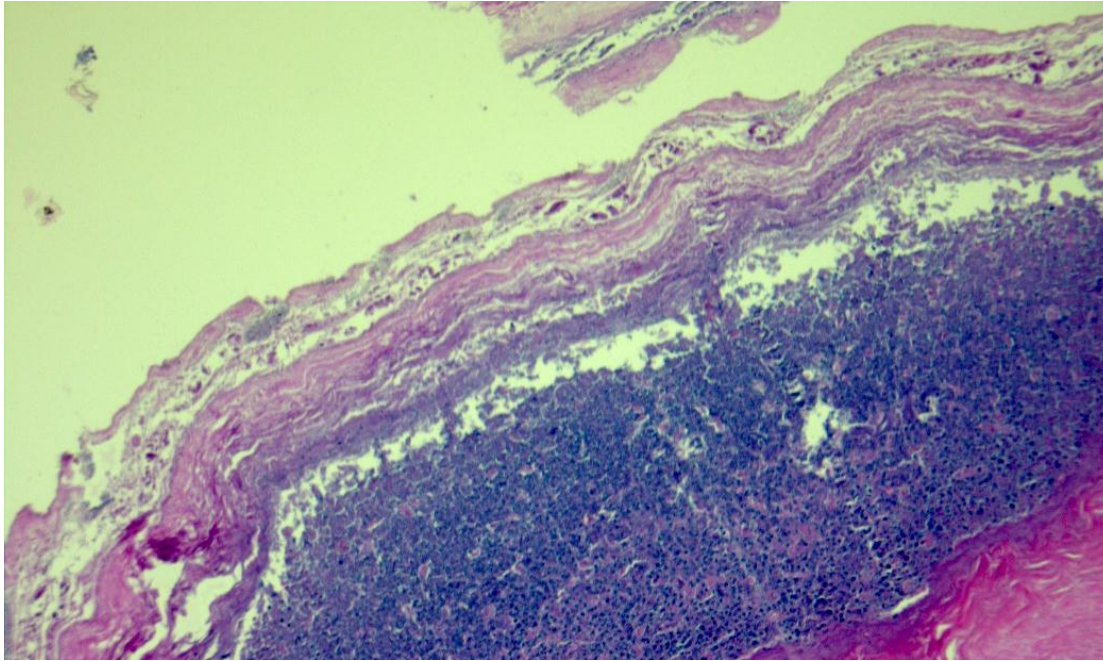
The gastro-intestinal tract contains a number of tissue types that are known to be amongst the first tissues to undergo autolytic changes after death. In this case there is evidence of advanced autolytic changes at all levels of the gut and this is particularly pronounced in the small and large intestine. Extensive masses of bacteria that have proliferated in these autolyzed tissues are evident (see Figures). Gas formation, haemolysis and evidence of post mortem coagulation necrosis or putrefaction are also evident. The pale staining quality and significant loss of nuclear staining in particular is a feature of these grossly autolyzed tissues. The mucosal and submucosal tissues show evidence of post mortem bacterial invasion and autolytic changes in many tissues and cell types. Even the deeper submucosal structures like the Peyer's patches and the muscle layers are showing autolytic changes.



Low power view of small intestine showing generalised villous atrophy and poor staining quality.



Lower power of image of large intestine (06/2128) showing extensive bacterial proliferation in remnant of the mucosa and submucosa with autolyzed muscles layers.



Lower power image of a large intestine Peyer's patch with extensive autolysis in the submucosa, connective tissue and muscle layers and decompositional changes in the lymphoid aggregate; note the absence of any epithelium.

The trachea shows extensive epithelial slough - i.e. loss of the lining epithelium - another feature of advanced tissue autolysis and carcass decomposition.

In the brain sections there are extensive vacuolar changes in the neuropile with axonal swelling and generalised white matter spongiosis; changes consistent with central nervous system autolysis. There is also a loss of epithelial lining to the internal ventricles. In the absence of significant head trauma in this animal, these features would be considered as post mortem degenerative changes consistent with an extended period of time between the animal's death and the preservation of the brain. In some suggestions there are coccoid bodies that may also be bacteria.

2. Estimates of time of death of the fox

- Formal post mortem examination

The post mortem report gives many caveats on estimating time of death on the basis of body temperature and onset of rigour mortis but it is suggested as 5-10hrs before commencement of the examination – ie, **between 0330 and 0830 hrs on 1st August 2006.**

- Comparative data specifically collected

To allow other estimates of time of death for the Cleveland Fox (5.1kg), in the following weeks several large (3.5 kg) brown hares *Lepus lepus* and a large feral cat *Felis catus* (5.2 kg) were shot in Tasmania and two red foxes (6.5 and 7 kg) shot in Victoria at a time and place attempting to simulate ambient temperatures at Cleveland on the 1st August. Hare and cat were chosen because they approximate foxes in size, build (shape and mass/surface area) and fur length/density. Eye firmness, onset of rigour mortis and body temperature were progressively taken. The main problems were trying to approximate the particular injuries of the Cleveland Fox knowing nothing of the fox's activities before death (muscle use effects onset of rigour mortis) and in getting sufficiently low ambient temperatures; these aspects were only partially achieved.

- Temperatures *tentatively* suggest death before 1st measurement as about 6-7 hours (hares), 6-9 hours (cat and fox) – ie, about 0300-0600 hrs on 1st August. All ambient temperatures were higher than prevailed at Cleveland so the above estimates might be too long.
- Onset of rigour mortis (all species) suggest death at 2-6 hours before first onset (at about 1230 hrs) - ie, about 0630-1030 hrs.

- Softening and drying of eyes (foxes and cat) suggest death at 3-4 hours before onset (at about 1230 hrs) - ie, about 0830-0930 hrs.

- Expert veterinary opinion

Three clinical vets independent of the Taskforce and very experienced in 'small animal practices' were asked about estimates of time of death given the facts (size of animal, injuries, onset of rigour mortis and body temperature of ambient and eye firmness). All stated that death could have been from 1-12 hours before 1st measurements- ie between 2200 hrs on 31st July and 1000 hrs on 1st August, with an accent on earlier rather than later. All gave the opinion that temperature falls can be both rapid and drastic in such small animals suffering extreme trauma.

COMMENT: Before examining the histology of this case it was my considered opinion that this animal sustained its fatal injuries to its lumbar spine and abdomen **prior to** its recovery from the roadway at Glen Esk Road. Having now examined the microscopic appearance of the tissues and organs from this fox and considering the time of year (winter) I consider that this fox had been dead for several days (up to 4 days) prior to the preservation of these tissues for histology. The absence of predation to the eyes or carcass generally (particularly by ravens) and the absence of dramatic drying of the carcass suggests that the body had not lain *in situ* on Glen Esk Road for a more extended period of several days.

The injuries to the fox in the form of haemorrhage, fracture/subluxation of a lumbar vertebra and the acute musculoskeletal trauma are consistent with squashing pressure causing rupture to some abdominal organs and extensive haemorrhage.

The onset and loss of *rigor mortis* can vary with the physiological condition of the animal at the time of death and also with the prevailing ambient weather conditions (particularly temperature). Under the cool to mild ambient temperatures *rigor mortis* can establish in 2-6 hours after death and can remain present in the carcass for several days, if the body is not physically manipulated and is maintained under similar cool temperatures.

Based on the histology and the description of the carcass given, it is my professional view that the observed features in this fox carcass are more consistent with a cadaver that has undergone *rigor mortis* rather than one just entering this state of *rigor*. The advanced autolysis in various body tissues and organs would lend support that conclusion. The occurrence of this incident in the winter time and the presence of bacterial invasion and proliferation in various body tissues with evidence of gas production, putrefaction and generalised autolysis is consistent the body of this fox being dead greatly in excess of the time period suggested.

These additional findings support earlier assessments and therefore calls into question the conclusions made by the Nick Mooney as to the time of death, the location at which this fox died and the precise cause of death.

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