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Source: Journal of Wildlife Diseases, 37(2) : 370-374

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-37.2.370

Journal of Wildlife Diseases, 37(2), 2001, pp. 370–374

Hematological and Plasma Biochemical Values of the Greater Glider in Australia

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ABSTRACT: Reference hematological and plasma biochemical values are presented for the greater glider (*Petauroides volans*) at Tumut (southeastern New South Wales, Australia). Nineteen animals were sampled during a capture period of 1 wk in August 1999. Values for red cell counts were significantly higher in male animals ($\bar{x} \pm$ SE; males: 5.6 ± 0.1; females: 5.2 ± 0.1). Young animals had higher white cell counts than older ones ($\bar{x} \pm$ SE; young: 4.9 ± 0.4; older: 2.8 ± 0.4). Lymphocytes were the predominant white blood cell type in this species.

Key words: Biochemistry, greater glider, hematology, *Petauroides volans*, reference values.

The greater glider (*Petauroides volans*) is a strictly nocturnal arboreal marsupial that inhabits eucalypt forests throughout eastern Australia (McKay, 1983), except Tasmania (Green, 1974). Adult *P. volans* weigh up to 1,300 g and feed almost exclusively on the leaves of *Eucalyptus* spp. trees (Kavanagh and Lambert, 1990; Comport et al., 1996). The home range of *P. volans* is about 1 to 2 ha (Henry, 1984; Comport et al., 1996) and the species is usually solitary except during the breeding season when pairs of animals are often recorded (Henry, 1984). *Petauroides volans* is a gliding species and it is capable of volplanning more than 100m (McKay, 1983).

Although the distribution of *P. volans* has been widely studied, capture and handling of animals has been infrequent as a result of their strictly arboreal habits. There have been no studies of the health status of animals, nor opportunities to collect blood samples to establish normal reference values for the species. As part of ongoing research on movement patterns and genetic variation of *P. volans* (Lindenmayer et al., 1999), animals were captured at a number of study sites at Tumut (southeastern New South Wales, Australia). In this paper we describe the results of haematological and blood chemistry analyses completed for *P. volans* and present a set of reference blood values for the species.

Our study was conducted at six sites located in the Bondo and Bungongo State Forests (148°40′E, 35°10′S) near Tumut in southern NSW during August 1999. Animals were captured between 17–23 August, in forests dominated by ribbon gum (*Eucalyptus viminalis*) and narrow-leaved peppermint (*Eucalyptus radiata*) with occasional mountain gum (*Eucalyptus dalyrmpleana*) and swamp gum (*Eucalyptus camphora*) stems (see Lindenmayer et al., 1999).

Animals were located in feed trees at night using 50W Powabeam spot lights and they were captured by shooting down the branches on which they were feeding. When the branch was dislodged, the animal glided to the ground, where it was captured and transferred to a hessian sack containing a large supply of fresh eucalypt leaves from the capture tree.

To minimise handling stress, animals were sedated with Zoletil (tiletamine hydrochloride and zolazepam hydrochloride in a 1:1 ratio by weight) (Virbac, Sydney, Australia) at a dose rate of 10 mg/kg by intramuscular injection into the quadriceps muscle. While under sedation, each animal underwent a complete physical examination, including examination of the pouch, age class determination [using a modification of a tooth wear index devel-

oped by Winter (1980) for the common brushtail possum (*Trichosurus vulpecula*)], collection of a range of morphological measurements and collection of blood from the jugular vein for hematological and biochemical analyses.

A total of 0.5 ml of blood was transferred into a pediatric (1 ml) tube containing ethylene diamine tetraacetic acid (EDTA) for hematological studies and 0.5 ml of blood transferred into a tube containing lithium heparin for biochemical analyses. A thin blood smear was made immediately from fresh blood, air-dried and fixed with methanol. This was later stained with Giemsa (Provet, Sydney, Australia) and used to complete differential white cell counts, as well as to assess white and red blood cell morphology.

Within 3 hr of collection, lithium heparin samples were centrifuged for 10 min at 3,000g force and the resulting plasma was transferred to a cryotube and frozen. Samples were sent on ice to Victorian Veterinary Pathology Services (Clayton, Victoria, Australia) and processed immediately upon arrival. Hematological analyses were completed using an automated veterinary Cell-Dyn 3500R System (Abbott Diagnostics, Lane Cove, New South Wales, Australia), which establishes unique species specific configuration files and adjusts automatically for cell size (see Whittington and Comer, 1984). Biochemistry analyses were completed using an Olympus AU 600 (Integrated Sciences, Kew Victoria, Australia) automated biochemistry analyser.

Reference blood values for *P. volans* at Tumut were determined by combining data from all animals to determine the mean and upper and lower quartiles for each parameter. Data also were examined for significant differences between the sexes and age classes using ordinary regression (Weisberg, 1985). Sex and age class were fitted as categorical variables in these analyses.

Blood was collected from 19 animals (11 females, 8 males) from six different locations spaced 3 to 5 km apart throughout the eucalypt forest in the study area. All animals appeared to be in good general health. Of the females, seven had pouch young. All females except one had mature pouch morphologies (i.e., deep pouch with everted nipples) and were assumed to be of breeding age. The mean body mass of all animals captured was 1.24 kg (range: 1.0–1.5 kg), with a mean head length (external occipital protruberance to nose tip) of 6.5 cm (6.2–6.8 cm). Testicular size (measured along the long axis of the testes minus the epididymis) varied between males from 8.3 mm to 15.2 mm, and may possibly reflect breeding condition. Animals measured on average 90 cm (83–97 cm) from nose tip to tail tip, with more than half of this length being tail ($\bar{x}$ = 50 cm).

Red blood cell morphology in all animals was normocytic and normochromic, with mild anisocytosis and mild polychromasia often recorded. Occasional Howell-Jolly bodies were detected in all blood smears. White blood cell morphology was normal and no remarkable features were noted. Lymphocytes were the predominant blood cell type in *P. volans.* Only two animals (a young male and an older female with advanced pouch young) had higher absolute neutrophil counts than lymphocyte counts which may have been due to physiological changes associated with stress and/or sedation. A predominance of lymphocytes has been reported for numerous other native mammals in Australia, such as the koala (*Phascolarctos cinereus*) and southern hairy nosed wombat (*Lasiorhinus latifrons*) (Parsons et al., 1971); agile antechinus (*Antechinus agilis*) (Cheal et al., 1976); platypus (*Ornithorhinchus anatinus*) (Whittington and Grant, 1983; Connolly et al., 1999), red-tailed phascogale (*Phascogale calura*) (Bradley, 1990), and the common brushtail possum (*T. vulpecula*) (Parsons et al., 1971; Presidente and Correa, 1981).

Red cell counts were significantly higher (P = 0.02) in males ($\bar{x} \pm$ SE; 5.6 ± 0.1)

TABLE 1. Reference blood values for the greater glider (*Petauroides volans*) from Tumut (southeastern Australia).

Parameter		Mean	Range	Lower quartile	Upper quartile
Hemoglobin (g/L)		121	108–135	116	128
Packed cell volume (%)		0.36	0.33–0.41	0.35	0.37
Red cell count ($\times 10^{12}$/l)	all	5.41	4.59–6.21	5.11	5.66
	male	5.6 (SE = 0.1)			
	female	5.2 (SE = 0.1)			
Mean corpuscular hemoglobin concentration (g/l)		334	319–369	331	356
Mean corpuscular volume (fl)		67.2	59–73	66	69
Mean corpuscular hemoglobin (pg)		22.5	21–24	22	23
White cell count ($\times 10^{9}$/l)	all	3.7	1.3–6.6	2.4	5.3
	age class 2–4	4.9 (SE = 0.4)			
	age class 5–7	2.8 (SE = 0.4)			
Neutrophils		1.0	0.4–2.0	0.7	1.4
Lymphocytes		2.6	0.4–5.5	1.3	3.8
Monocytes		0.06	0–0.3	0	0.1
Eosinophils		0.05	0–0.1	0	0.1
Urea (mmol/l)		4.0	1.3–8.4	2.6	5.2
Creatinine (mmol/l)		0.05	0.04–0.06	0.05	0.06
Protein (g/l)		67.5	62–72	65	70
Albumin (g/l)		41	34–50	39	42
Globulin (g/l)		26.4	22–30	25	27
Bilirubin (μmol/l)		<5	N/A	N/A	N/A
Alanine aminotransferase (IU/l)		70	36–140	52	78
Gamma glutamyltransferase (IU/l)		7	5–11	6	8
Alkaline phosphatase (IU/l)		414	252–664	340	440
Calcium (mmol/l)		2.24	1.78–2.5	2.15	2.34
Phosphorus (mmol/l)		1.69	0.8–2.69	1.37	1.95

N/A = not applicable.

than females (5.2 ± 0.1). Higher values for red cell counts in males have been reported for other Australian species, including the mountain brushtail possum (*Trichosurus caninus*) (Barnett et al., 1979; Viggers and Lindenmayer, 1996) and platypus (Connolly et al., 1999). A significant difference ($P = 0.003$) was detected between age groups for white cell count, with younger animals (age class 2–4) having significantly higher counts ($\bar{x}$ ± SE; 4.9 ± 0.4) than older animals (age class 5–7; 2.8 ± 0.4).

Reference hematological and biochemical values are given in Table 1. Mean, range and upper and lower quartiles for each blood parameter are shown. Other than those described above, no significant differences between sexes or age groups were detected. Red cell values were similar to other herbivores such as the koala (Canfield et al., 1989) and common wombat (*Vombatus ursinus*) (Booth, 1999), but were lower than those reported for platypus (Connolly et al. 1999) and carnivorous marsupials such as the eastern quoll (*Dasyurus viverrinus*) (Melrose et al., 1987) and agile antechinus (*Antechinus agilis*) (Cheal et al., 1976). White cell counts in greater gliders were also lower than for platypus (Whittington and Grant, 1983; Connolly et al., 1999), but were similar to values reported for koalas (Canfield et al., 1989) and eastern quolls (Melrose et al., 1987).

Alanine aminotransferase (ALT) and alkaline phosphatase (ALP) levels in greater gliders were similar to those of the common wombat (Booth, 1999). In some other species of Australian mammals such as

platypus (Connolly et al., 1999) and koala (Canfield et al. 1989), ALP levels were lower than in greater gliders. Levels of urea in greater gliders were low in comparison with platypus (Connolly et al., 1999), but were similar to common wombats (Booth, 1999).

Financial and logistical support for work at Tumut was by the Land and Water Resources Research and Development Corporation, Environment Australia, The Australian Research Council, Rural Industries Research and Development Corporation, New South Wales Department of Land and Water Conservation, Visy Industries (Pratt Foundation), CSR Ltd, State Forests of New South Wales, New South Wales National Parks and Wildlife Service and a private donation from J. Atkinson. M. Pope, C. Tribolet, A. Taylor, P. Sannucks and C. MacGregor assisted with the capture of animals. We thank Victorian Veterinary Pathology Services for prompt and professional analysis of very small volume blood samples. R. Cunningham and C. Donnelly of the Statistical Consulting Unit of the Australian National University, provided expertise with analysis of data. The Tumut District Hospital allowed occasional use of their centrifuge.

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Received for publication 8 February 2000.