

Table 4: Organ disorders, lesions, results of post mortem examinations in *Loris* ^{15, 32}

Observed phenomenon / behaviour / symptom	Occurrence in Loridae	In other species	Situation in which the phenomenon was observed; correlated symptoms	Possible cause, health disturbance diagnosed synchronously	Further examination, diagnosis	Treatment, prevention
Respiratory system						
Pulmonary disease (no further information) ⁵¹ .	In <i>N. coucang</i> (captive), n=4 of 24 examined dead animals ⁶¹ .					
Pneumonia ¹⁰ . Diffuse interstitial pneumonia ³² .	In <i>Loris</i> (captive), n=1 ³² .	<i>Microcebus murinus</i> : in 48.8 % of animals examined postmortem, interstitial pneumonia was found, most commonly in animals who died spontaneously; permanent social stress was considered to be a common cause of death ³³ .		In <i>Loris</i> : after death with mycotic dermatitis and secondary bacterial pyoderma (n=1) ³² , minimal diffuse pneumonia in a very old animal ³² . In <i>Microcebus murinus</i> : agonal circulatory disturbance, decreased body resistance or hormonal imbalances (corticoids?) considered as causes ³³ . Interstitial pneumonia: possibly viral origin ?		
Bacterial pneumonia		Death in prosimians (unspecified) ¹⁰	In humans: fever, unusually high frequency of heartbeat and breath; shallow breathing, coughing, red-brown mucus coming up from the respiratory tract; in children vomiting, seizures and other symptoms ⁵ . A major cause of death in captive primates ³ .	Infection with <i>Pneumococci</i> , <i>Klebsiella pneumoniae</i> , <i>Pasteurella multocida</i> , <i>Haemophilus influenzae</i> ³		Quick treatment is necessary. Penicillin, broad spectrum antibiotics or sulfonamides; warmth and supportive therapy ³
Edema of the lungs ³²	In <i>Loris</i> (captive), n=3 ^{15, 32} .		Infection with <i>Staphylococcus albus</i> (n=1) ¹⁵ , severe edema after death due to a gastric bezoar (n=2) ¹⁵ , death due to kidney failure and secondary protozoan infection in an old animal ¹⁵ , old animal euthanized because of increasing weakness; findings: kidney disease , high insulin level in the blood and wasting syndrome ¹⁵ .			
Emphysema of the lungs ³²	In <i>Loris</i> (captive), n=5 ^{15, 32} .		Postmortem findings in captive <i>Loris</i> after infection with <i>Staphylococcus albus</i> (n=1) ³² , after kidney disease, infection and pneumonia ³² , after quarantine stress and diabetes ³² , one case: very old animal, death due to a trichobezoar ¹⁵ . In at least two cases probably a geriatric condition ^{15, 32} .			

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Respiratory system						
Hyperaemia (increased quantity of blood) of the lungs due to congestion ³²	In <i>Loris</i> (captive), n=2, third case difficult to judge because of putrifaction ³² .		Myocarditis (n=1) ³²			
Abundant growth of hemolytic <i>E. coli</i> in the lungs ³²	In <i>Loris</i> (captive), n=1 ³² .		Loss of weight. Cause of death in the observed case not clear ³²	Lungs infected by swallowing		Antibiotics
Hemorrhage into the pleura and pericard ¹⁵	In <i>Loris</i> (captive), n=1 ¹⁵ .		Sudden death after short hiding in a box in a healthy-looking young animal ¹⁵ .	Cause of death not clear; injury by an accident? (Intoxication mentioned as a possible cause, but no signs of disease in other animals in the same cage) ¹⁵ Trauma on stem brain?		
Pulmonary mottling (dorsal lung surface mottled pink and red)	In <i>Loris</i> (captive), n=1 ³² .			Likely due to agonal congestion ³²		
Stomach						
Gastric, stomach ulcera ³² , multiple small erosions and hemorrhages in the epithelium of the stomach ³² .	In <i>Loris</i> (captive), n=2 and 1 case with "dark brown spots" on the surface of the stomach mucosa. Possibly more cases because we postmortem reports only of few animals who died in quarantain were returned ³² .	In <i>Microcebus murinus</i> , in 20% of animals who dies spontaneously ³³ .		In <i>Loris</i> : transport / quarantain stress (n=1) ³² ; the second specimen suffered both from quarantain stress and diabetes at the time of death ¹⁵ <i>Helicobacter pylori</i> as a cause?		Minimizing environmental stress by adequate care and particularly conditions in unfamiliar environment (providing some cover, avoiding noise and disturbance); reduction of susceptibility to environmental stress by behavioural enrichment
Gas in the stomach ³² .	In <i>Loris</i> (captive), n=1 ³² .			In <i>Loris</i> , specimen autolytic ³² . In simian primates (n=24), gastric dilatation by gas production was found ³⁹ .		

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Intestine						
Dysbacteriosis, intestinal dysbacteria (unusual amounts of certain species of normal intestinal bacteria and fungi)	In <i>Loris</i> after wrong, too abundant feeding ¹⁵ , in a potto ⁴⁶ .	In many species ²	In <i>Loris</i> : loss of weight, abnormal hunger (due to resorption problems), kidney lesions which may be a result of dysbacteriosis ¹⁵ (see also table 7, mycoses, under <i>Candida</i>).	Some possible causes: diabetes, too abundant and high calorie diet ¹⁵ ; lack of hygiene or wrong use of antibiotics ⁵ ; in humans, simian primates and rats: environmental stress ³⁸ ; in simian primates: <i>Clostridium perfringens</i> (animals probably infected via food containing <i>Clostridium</i>) ³⁹ ; secondary disease following <i>Shigella</i> infections (in higher and lower primates, n=237) ⁴⁰	Examination of fecal samples, identification in culture. Additional urine dipstick tests for diabetes and kidney problems recommended	Adequate, not too abundant feeding In <i>Loris</i> : <i>Inulin</i> powder, 0.5 g per kg body weight was added to the milk formula daily for two weeks, then 1 g per kg body weight for two weeks ⁶⁴ ; in addition, bacterial biopreparations (<i>Bird Bene-Bac</i> , <i>E. coli</i> filled into insects) were given for replacing normal intestinal flora ^{64, 38, 40} . After this treatment, in 12 of 14 animals with former dysbacteriosis intestinal flora was rather normal again. Lifelong supply of the animals with 0.5 g <i>Inulin</i> per kg body weight was recommended ⁶⁴ . In a potto: explained as a consequence of lactose intolerance, lactose-free diet led to improvement of the animal's condition ⁴⁶ .
Flatulence; intestine filled with gas ¹⁵	In <i>Loris</i> (captive), n=4 ^{15, 32} (in one case specimen autolytic)	In <i>Microcebus murinus</i> , n=2 and 2 cases of severe distention of the caecum ³³ .	Only diagnosed in dead specimens. Live animals quietly hanging under the ceiling of cage, occasionally with a facial expression of unwellbeing, might have a similar problem (see also above under "dysbacteriosis") or suffer from pain caused by a gastric bezoar or gall stones.	Abundant gas production in the intestine, for instance by <i>Clostridium</i> , after wrong diet might be an explanation; see also under "dysbacteriosis" (in table 7, "mycoses" under <i>Candida</i>). See also under "diabetes" ¹⁵ .		
(Hemosiderosis: excess iron storage, recognizable by blackish colour of the tissue, particularly in the small intestine ^{37, 58} .	No evidence found in <i>Loris</i> ¹⁵ .	Found in adult captive Malagasy lemurs, in all species examined.) ^{37, 58}				Caution with feeding excess iron in connection with ascorbic acid; tannin in the food may reduce the amount of iron adsorbed ⁵⁸ .

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Intestine						
Blood in the gut	In <i>Loris</i> (captive), n=1, amount: 2 b cont ³²	In <i>Microcebus murinus</i> two cases of intestinal hemorrhage ³³ .		Probably blood from gastric ulcera, after death in quarantain. Environmental distress ³² . Severe enteritis.		
Parasites, see tables 9, 10 and 11						
Cystic dilatation of some of the glands in the mucosa (no inflammation detected) ¹⁵ .	In <i>Loris</i> (captive), n=1 ¹⁵ .		Old animal suffering from kidney disease, increased insulin level in the blood, wasting syndrome ¹⁵ .			
Trichobezoar problems						
Trichobezoar formation in the stomach or the small intestine, consisting of hair and a small amount of plant material ^{15, 60}	In <i>Loris</i> (captive, old animals), n=2 ¹⁵ . Trichobezoars were also reported from two slow lorises and one angwantibo ¹⁰ .	In <i>Galago</i> and lemurs ¹⁰ .	In one case, reduced food consumption, occasional "coughing" (apparently a sort of vomiting) and subsequent chewing on something were observed; in one, no evident behavioural changes were noticed before the animal suddenly died. Both slender lorises who died of a trichobezoar showed a severe edema of the lungs, which might be secondary and rather a consequence of dying than of the bezoar itself. ^{15, 32} .	In both cases, the trichobezoar led to occlusion of the pylorus / jejunum and led to rather sudden death ^{15, 60} . Animals groom their fur with the toothcomb; the hair is then swallowed. Faeces contain some hair, and faeces of normal size consisting almost merely of hair are found. This is a normal behaviour; no overgrooming was observed in the animals concerned ¹⁵ .		Paraffin oil (Ribjer, pers. comm.) or special substances against trichobezoars (<i>Miturat catlax</i> for cats), added to the food, may at least reduce further increase of size; removal of bezoars already existing with chemotherapy impossible? In a young female showing reduced food consumption, after adding of paraffin oil to the food a partly chewed trichobezoar was found on the feeding place ¹⁵ . For humans, surgical removal ¹ or dissolving of bezoars by using a teledyne water pick jet stream through a gastroscope was recommended ³² .

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Liver						
Fatty liver degeneration with liver necroses. Liver enlarged, pale. Microscopic result in one case: the whole of the examined piece of liver (1 cm) was very heavily infiltrated by fat. All of the hepatocytes were involved and some were so severely distended that they were beginning to undergo actual necrosis. There was, however, very little inflammation within the parenchyma and around the portal area. ³²	In <i>Loris</i> : n=4 ^{32, 20, 45, 51} .			All cases during quarantain stress after transports to zoos, within 4-6 weeks ³² . abnormal storage of triglycerids during increased adrenalin level ³³ . "No signs of infection explaining the liver problem, but the vast majority of cases of fatty liver are normally secondary to some other condition and not a primary liver disease. Fatty liver syndrome as a primary condition has been identified in a number of species now, but the most common cause includes starvation, anorexia, diabetes mellitus etc." ³²		
"Spotted liver" ³²	In <i>Loris</i> : n=1 ³² .			Transport / quarantain stress and <i>Staphylococcus</i> infection (n=3) ³² .		
Liver swollen, with ochre-coloured marmoraceous spots (necroses) ³² Hyperaemia (increased quantity of blood) of the liver, necroses, necrobioses due to stasis / congestion ³²	In <i>Loris</i> : n=1 ³² . In <i>Loris</i> : n=1 ³² .			Necroses due to <i>Listeria</i> infection (n=3) ³² Myocarditis (can be caused by shock) ³²		
Two moderately large areas with adenoid proliferation of the gallvessels and moderate lymphatic infiltration ⁶⁰ .	In <i>Loris</i> : n=1 (very old animal) ³² .		In a 15-years-old male	Gallvessel proliferation is an unspecific response to a stimulating event		
Multiple regenerative nodes in part with fibrosis; histologically, both local fibrosis and proliferation of the gall ducts were present ⁶⁰ .	In <i>Loris</i> : n=1 ³² .		In a 9-years-old male	Noxes of the liver induce regeneration		
Generalized edema		In <i>Microcebus murinus</i> ³³ .		Possible causes: hypoxic steatosis; blood circulation disturbances, lack of lipotropic factors, hormonal imbalance (corticoids?) ³³ .		
Liver						

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<p>Mild, multifocal-scattered, lobular collapse and multiple small foci of hepatocytes with moderately roughly bordered, cytoplasmic vacuolation and central nuclei. Large, discrete vacuoles are also scattered throughout the parenchyma. The majority of hepatocytes have small amounts of yellow brown cytoplasmic pigments and there is mild, periportal, biliary hyperplasia. Morphologic diagnosis: mild to moderate multifocal hepatic lipidosis / hydropic degeneration and mild to moderate intrahepatocellular bile stasis. The hepatic changes are not severe, although the bile pigment deposition (presumptive) and biliary hyperplasia do suggest partial hepatic compromise.</p>	<p>In <i>Loris</i>: n=1 ³².</p>		<p>Very old animal</p>	<p>Many of the lesions, especially the mild ones, are common lesions of geriatric animals and considered incidental ³².</p>		

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Gall bladder						
Gall bladder filled either with one large or multiple small gallstones, all consisting of 100% cholesterol ^{32, 59, 60} .	In <i>Loris</i> : n=5 ^{15, 32} .		Icterus in 2 of 3 specimens ¹⁵ . In one animal euthanized because of declining health, there were no significant findings with the exception of a pea-sized gall stone ³² . An old female euthanized because of increasing weakness and emaciation was occasionally sitting with an expression interpreted as a possible sign of unwellbeing or pain, but usually showed a normal and vivid behaviour ¹⁵ . Painful in humans	Usually two tablespoons of milk formula seem to provide a sufficient supply with liquid to prevent gallstone development. The four animals from Bochum in whom gallstones were found got a diet without milk formula for some time because of signs of diabetes / kidney disease; they did not drink water, fennel tea or fruit juice instead. Since then, milk turned out to be readily accepted.		Supply with about two tablespoons of some liquid accepted by he animals (formula, milk), see also under "possible cause".
Gall bladder with multiple, < 1 mm, pale mural nodes	In <i>Loris</i> : n=1 (very old animal) ³² .		Kidney disease, old age	Cause of gall bladder change is unknown but may represent areas of mucosal hyperplasia ³² .		
Pancreas Post mortem conservation of pancreas tissue in most specimens was not sufficient for satisfactory judgement.						
Slight edematous desintegration and enlargement of the Langerhans islets. Lymph nodes of about 1 mm size in the pancreas; concrement in some ducts and a cyst containing some concrement in one duct ¹⁵ .	In <i>Loris</i> : n=1 (euthanized because of increasing weakness) ¹⁵ .		Old animal with kidney disease and wasting disease. Insulin level increased ¹⁵ .			See under "diabetes", further below:
Rare ducts are mild to moderately ectatic	In <i>Loris</i> : n=1 (old animal) ³² .					
Diabetes or other diseases with similar symptoms: see table 13, blood and body fluids						

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Kidneys						
Renal disease in general:	Renal disease contributed to 20 % of deaths in 24 examined <i>N. coucang</i> led to the death of 1 of 9 <i>N. pygmaeus</i> ⁶¹ .		In <i>Microcebus murinus</i> : starting with changes of tubular adsorption mechanisms. Initial symptoms: proteinuria, intermittent glycosuria, no other symptoms; during terminal period: polydipsia, polyuria, hematuria, death of renal failure ³³ . In <i>Loris</i> : similar symptoms ¹⁵ .	In <i>Microcebus</i> , renal damage is progressing with length of captivity, but occurs too early to be a normal consequence of ageing. Possible causes: chronic circulatory disturbances, hormonal imbalances? Disease may be induced by glucocorticoid overload (direct effect and via hypertension or hyperglycaemia; hyperglycaemia and subsequent renal damage may also be a consequence of diabetes) ³³ .		Renal function should always be evaluated, particularly when examining older animals ⁶¹ .
Focal area of interstitial lymphocytes, histiocytes, and fibrosis with thickening of nearby glomerular capsules. Kidneys pale and the cortex is very distinct on cut surface ³² .	In <i>Loris</i> (n=1) ³²		After sudden loss of weight and death for unknown reason	Focal interstitial nephritis regarded as incidental ³²		
Kidney macroscopically: no signs of disease; in the area where cortex and medulla meet hollow space is clearly extended (starting from blood vessels?) ³² .	In <i>Loris</i> (n=1) ³²		Young specimen	After death due to diabetes / quarantain stress		
Enlarged pale kidneys	In <i>Loris</i> (n=1) ³²		Found after death in quarantain	Cause of death: probably transport / quarantain stress		
Chronic interstitial nephritis	In <i>Loris</i> (n=1) ⁶¹ , in <i>N. coucang</i> (n=1) ⁶¹ ,			Regularly found in old animals		

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<p>Kidneys</p> <p>Polycystic nephropathy: mild to extreme dilatation of distal tubuli; macroscopically a wavy, nodular surface of the kidney and mostly miliary, unilocular, fluid-filled cysts (size up to 4 mm) on the surface and on the cortex part of the sections. Cystic tubules (mild to extreme dilatation) lined with cuboidal to flattened epithelium, and occasionally filled with proteinaceous material. Some of the tubules lined with deeply basophilic, low cuboidal cells (regenerative). More "normal" groups of tubules are lined with highly vacuolated to granular, tall columnar epithelium. Described in one case: significant sclerosis and fibrosis in combination with moderately severe infiltrates of lymphocytes and histiocytes in the remaining tissue between the cysts, only few areas of functional active parenchyma remained. The remaining glomeruli in part revealed mild to completely obliterating fibrosis or proliferation of the mesangial matrix / cells and local proliferation to totally obliterating fibrosis or homogenic sclerosis of the glomerulum ^{32, 59, 60}.</p>	<p>In <i>Loris</i> (n=9): observed in one neonate and 8 adult to very old animals ^{32, 59, 60}.</p>	<p>In <i>Microcebus murinus</i>: more than 80 % of animals affected ³³.</p>	<p>In <i>Loris</i>: uremia in at least two animals ¹⁵. Progress of the disease in <i>Microcebus</i>: 0: bowman´s capsule thin, no tubular dilatation 1: bowman´s capsule enlarged, glomerulus filled with serous fluid, expanded capillary loop, slight and focal dilatation of tubules in the cortex. 2: glomerulus with thickened basal membranes, foci of large tubular dilatations generally lying in groups. 3: glomeruli severely enlarged, filled with serous fluid; dilatated capillaries, thickened basal membranes. Numerous small tubuar dilatations through the entire renal cortex. Inter-stitium: areas of sclerosis. 4: progressive destruction of vascular loop, contraction of glomeruli appearing as sclerosed nodules. Formation of cortical cysts, tubules lined by flattened epithelial cells. Interstitium: fibrous tissue replacing normal structures ³³</p>	<p>Disease found in captive lorises developing a wasting syndrome after changes of diet. Nutritional causes or stress due to a primary disease caused by nutrition? The severe cystic changes in the renal tubules resulted in compression / obliteration of functional nephrons leading to the clinically observed renal failure. The interstitial nephritis (with glomerular sclerosis) was likely secondary to the cystic change, and much less likely a separate process. Such extensive tubule ecstasia usually results from a defect in basement membrane function, which in humans and some domestic mouse strains is genetically influenced. In one case, a possible relation to advanced age was mentioned ^{32, 63}. In <i>Microcebus</i>, social stress leading to changes in renal blood supply is discussed as a cause ³³. In rats, the disease has been caused by poison ⁶³.</p>		

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Urinary tract, urine						
In the bladder few inclusion bodies in the cytoplasm (possibly caused by viruses?) ¹⁵	In <i>Loris</i> (n=1) ¹⁵		Slight signs of an infection of the urinary tract, no glucose in the urine ¹⁵			
Bladder: mild to moderate intramucosal eosiniphils.	In <i>Loris</i> (n=1, very old animal) ¹⁵		Urine almost clear (sp. gr. 1.014; dipstick: glucose 100 mg/dl, protein 2+, rest within normal limits). Glucose in the urine suggests the possibility of diabetes although reportedly the serum chemistries did not suggest this.	Dead from old age / kidney disease		
Urine scald; urinary incontinence was suspected but not proven	In <i>N. coucang</i> (n=1), a similar condition has been seen in <i>N. pygmaeus</i> specimens ⁶¹					
Urethral calculi as a cause of death ⁶¹	In <i>N. pygmaeus</i> (n=1) ⁶¹					
Gonads, reproductive tract						
Seminoma in the testes ⁶⁰			Found in a male more than 15 years old ⁶⁰			
One testes reduced to the size of a rice corn, fibrotic in histology, with no spermiogenesis; other testes normal, fertile ⁶⁰			Found in a male more than 16 years old ⁶⁰			
Ovars both with unilocular fluid-filled cysts up to 7 mm diameter ⁶⁰			In a nine-years-old female; the specimen showed male behaviour (mounting) towards an unrelated adult female			
Testis: moderate, diffuse, eosinophilic to suppurative, seminal vesicular gland adenitis. One group of epididymal tubules have moderately severe vacuolation at the base of the cells below the nuclei. Some of the vacuoles contain faint yellow brown pigment. Accessory sex glands: there are moderate numbers of eosinophils and neutrophils within the lumen and throughout the epithelium and stroma.	In <i>Loris</i> : n=1 (very old animal) ³² .		Death due to old age; kidney disease	Why the accessory sex glands (presumptive seminal vesicles) have such a high number of infiltrating eosinophils is not known but would suggest parasitism or an immune mediated process.		
Papillary adenoma and other disorders of the uterus, some indicating sexual dysfunction		In <i>Microcebus murinus</i> ³³ .		Specimens died after lasting social stress ³³ .		

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Adrenal glands						
Mild hyperplasia of the zona reticularis and fasciculata with moderate, multifocal, medullary fibrosis. There is mild variation in nuclear and cell size of the cortical parenchyma. The capsule has numerous, dilated, vascular channels. Morphologic diagnosis: mild, diffuse adrenocortical hyperplasia and medullary fibrosis. Adrenals are yellow, otherwise grossly normal ³² . Adrenals dark red Captive individuals with larger adrenal than wild-caught animals, animals which spontaneously died in captivity had the largest one; corticoadrenal necrosis.	In <i>Loris</i> : n=1 (very old animal) ³² . In <i>Loris</i> : n=1 ³² . In <i>Loris</i> : n=1 (very old animal) ¹⁵ .	In <i>Microcebus murinus</i> ³³ .	Sudden loss of weight for unknown reason, death ³² . Kidney disease, old age, wasting syndrome	No cause of death was found ³² . Conclusions: corticoadrenals: hypercorticism similar to Cushing's disease; adrenal medulla: hyperactivity		
Thyroid						
Small numbers of follicles mildly cystic. Morphologic diagnosis: mild, cystic thyroids ³² .	In <i>Loris</i> : n=1 ³² .		Very old animal	Older animals also have a higher degree of cystic changes with thyroid involvement, a common occurrence		
Megakaryocytes, hypertrophy and congestion. Hypothyroidism progressing with length of captivity ³² .		In <i>Microcebus murinus</i> : low incidence (29.3 %) ³³ .				
Spleen						
Hemopoiesis. Moderate hemopoiesis in the red pulp; only few follicles were noticed in general in the spleen of the specimen ⁶⁰ , small numbers of hematopoietic aggregates scattered throughout and moderate numbers of macrophages which have phagocytized erythrocytes ³² . Spleen mildly depleted, with a moderate population of hematopoietic cells; primarily erythroid with occasional megakaryocytes. There is moderate extramedullary erythroid hematopoiesis in the spleen ³² .	In <i>Loris</i> : n=3 ³² .			The significance of this is difficult to determine without a CBC; anemia can also be associated with vitamin E deficiency in mammals ³² .		

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Spleen						
Swollen spleen	In <i>Loris</i> : n=2 ³² .			Cause of death: infection with <i>Staphylococcus aureus</i> during quarantain stress ³² ; infection with <i>Listeria</i> ³² .		
Spleen very small without clear follicles ³² ; very few follicles present (normal?) ¹⁵ .	In <i>Loris</i> : n=2 ^{15, 32} .		In a young <i>Loris</i> after death, probably due to diabetes and / or quarantain stress ¹⁵ , in an old specimen			
Megakaryocytes, hypertrophy and congestion ³³ .		In <i>Microcebus murinus</i> (low incidence, 29.3 %) ³³ .		In <i>Microcebus</i> : possible causes: lack of B factors, defense reaction, chronic circulatory disturbance, respiratory insufficiency? ³³ .		
Heart, circulatory system						
Atherosclerosis in the thoracic part of the aorta, especially in the areas where intervertebrate arteries branched off ⁶⁰			In a more than 15 years old male			
Thickening (slight) of the left atrioventricular valves and the semilunar valves by nodular connective tissue. Artery with lymphatic perivasculitis, vacuole-like loosening of the media and karyopyknosis, ⁶⁰			In an old animal with kidney disease, increased insulin level in the blood and wasting disease ¹⁵ .	Cause unknown ¹⁵ .		
Multiple mild areas of lymphocytes, neutrophils and histiocytes in the myocardium often around vessels. Morphologic diagnosis: mild multifocal, pyogranulomatous myocarditis and vasculitis.	In <i>Loris</i> (captive), n=1 ³² .			The mild, often perivascular inflammation in the heart may be due to uremic induced vasculitis.		
Myocarditis (inflammation of the heart muscle), slight, punctual cellular infiltrations with degeneration of heart muscle fibres and forming of microthromboses; no pus (n=1) ¹⁵ ; multiple small yellow areas of myocardial infarcts were found ⁶⁰	In <i>Loris</i> (captive), n=1 ¹⁵ .		In the first case: subsequent acute stowing of blood in the lungs (medium intensity); liver: severe acute stowing of blood, lines of stowing with necroses. Bladder: inclosures in some cells, probably caused by viruses. No pathogenous changes of other organs. No parasites ¹⁵ .	Myocarditis may be caused by viral and other infections ⁵ . Myocardial lesions are also regular consequences of psychic stress ³³ . (In the first case observed in <i>Loris</i> , no stress related to environmental change preceded the death of the animal, but social stress, unrecognized by the then keeper, might have occurred ¹⁵ .		
Mild separation of myocardial fibers (edema) ³² .			In a younger <i>Loris</i> showing sudden loss of weight before death ³² .	The myocardial edema is not severe and likely an agonal event ³² .		
Hemorrhage into the pleura and pericard ¹⁵	In <i>Loris</i> (captive), n=1 ¹⁵ .		Sudden death after short hiding in a box in a healthy-looking young animal ¹⁵ .	Cause of death not clear; injury by an accident? (Intoxication mentioned as a possible cause, but no signs of disease in other animals in the same cage) ¹⁵		

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Heart, circulatory system						
Section of the ileal veins just distal to the bifurcation is composed of a plexus of numerous small vessels	In <i>Loris</i> (captive), n=2 ³² .			. This is likely a normal structure for the species as it was present in a previous submission		
Chronic heart failure as a cause of death	In <i>N. coucang</i> , n=2 of 24 examined animals ⁶¹ .					
Cardiac disorders; most common: myocardial necrosis and / or fibrosis, most frequently on the left ventricular wall		In <i>Microcebus murinus</i> , in 33.3 % of 147 examined hearts ³³ .		Possible causes: nutritional imbalances (lipotropic factors, proteins), hydromineral imbalances (Na), hormonal overloading? ³³ .		
Nervous system						
Mild amounts of widely scattered vacuoles (demyelination) are in the white matter of the brain. Many of the neurons also contain small, cytoplasmic deposits of light brown granular pigments (lipofuscin). Morphologic diagnosis: mild, multifocal demyelination ³² .	In <i>Loris</i> (captive, very old animal), n=1 ³² .		Old age, kidney disease			
Subdural hematoma, fatal ⁶¹ .	In <i>Loris</i> (captive), n=1 ⁶¹ .			Hematoma presumed to have been caused by a fall from the top of the enclosure ⁶¹ .		
Purulent focal encephalitis ³² .	In <i>Loris</i> (captive), n=1 ³² .			Infection with <i>Listeria</i> ³² .		
Thrombosis of the basal artery of the brain ⁶¹ .	In <i>N. pygmaeus</i> (captive), n=2 ⁶¹ .		During late term gestation. Sudden-onset seizures in one animal, posterior paresis prior to parturition, which resolved post-partum, in the other one ⁶¹ .			

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Adipose tissue						
Adipose tissue yellow	In <i>Loris</i> ³²		Described in one animal which died after quarantain stress and <i>Staphylococcus</i> infection ³²			
Mildly hypercellular (collapsed) fat which has similarities to brown fat common in rodents and hibernating mammals, but also to compressed depleted fat. Fatty tissue with eosinophilic granular cytoplasm with irregular vacuoles, multifocal, mild to moderately severe accumulations of histiocytes and lymphocytes. Fibrosis in the ventral pelvic skin section within the adipose indicating chronicity ³²	In <i>Loris</i> (n=1) ³²		In a formerly rather adipose animal which died after weight loss from uncertain cause over a period of eight months, but which still was in fair to good nutritional condition ³²	Marked weight loss supports the evidence that the observed phenomenon is compressed depleted fat ³² .		
Tumours, cancer						
Basalioma on the tip of one toe. Thickened, reddened tip of toe, first mistaken for an inflammation ¹⁵ .	In <i>Loris</i> (captive), n=1 ¹⁵ .					The whole toe was amputated ¹⁵
Lymphosarcoma	In <i>N. coucang</i> (captive: n=2) ⁶¹ , in <i>N. pygmaeus</i> (n=1) ⁶¹ .		In one adult male which died with severe gastric parasitism. Lymphosarcoma associated with a herpes virus has also been reported in a slow loris (⁶⁵ , quoted in ⁶¹)			
Hepatoma, islet cell tumor, parathyroid adenoma, follicular adenoma of the thyroid, basal cell tumor and multiple eccrine gland tumors ⁶¹ .			Diagnosed postmortem. Animals with the above neoplasms ranged in age from 11.5 to 14 years old ⁶¹ .			
Papillary adenoma, ovarian thecoma; 1 pheochromocytoma, 1 fibrosarcoma ³³ .		In <i>Microcebus murinus</i> ³³ .		Possible causes: gonadotropin disturbance? ³³		
Sweat gland carcinoma: see under skin changes: multiple dermal masses	In <i>N. coucang</i> ⁶¹ .					
Neoplasia (uncontrolled growth of new tissue) as a cause of death ⁶¹ .	In <i>N. pygmaeus</i> (n=1 of 9 dead animals); in <i>N. coucang</i> (n=2 of 24 dead animals) ⁶¹ .					

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Skeleton, bones						
Osteomalacia, demineralized bones, rickets ⁶⁰	In <i>Loris</i> (captive), n=2 ^{15, 79} .		Deformation of limb bones, pain, locomotor problems ⁷⁹ ; Bones of gum-like flexibility were found postmortem in a juvenile female who, for unknown reasons, developed a severe diabetes during weaning period and died shortly afterwards ⁶⁰ .	In a captive loris after a diet without milk; apparently due to lack of calcium in the diet ⁷⁹ ; Unfortunately, the parathyreoid gland of the specimen was not preserved for investigation since head and neck were missing. Postmortem consequence of preservation? Wrong nutrition most possibly was not involved in the disease in this specimen; all other animals in the colony were healthy ⁶⁰ .		
Traces of a healed series of fractures of the ribs ⁶⁰ .	In <i>Loris</i> (captive), n=1 ¹⁵ .		Found in an 11-years-old female ⁶⁰ .	Location of the healed rib fractures indicated that the animal had probably fallen down on a sharp edge.		
Degenerative changes of lumbar vertebrae; chondroid degeneration of the vertebrae was noted histologically at necropsy ⁶¹ .	In <i>N. coucang</i> (captive), n=1 ⁶¹ .		Posterior paresis ⁶¹ .			
Teeth						
Dental disease (general, unspecified)	In <i>N. pygmaeus</i> (captive), n=2 ⁶¹ .					A thorough oral evaluation and dental prophylaxis should be performed each time a loris is examined ⁶¹ .
Loose or missing teeth. In old animals; especially the teeth forming the tooth comb may get lost ¹⁵	In <i>Loris</i> (captive), n=2 ¹⁵ .					
Dental stone (German: Zahnstein)	In <i>Loris</i> (captive), common in old animals ^{15, 32} .					Addition of some food items cleaning teeth; feeding with locusts and other insects with hard cuticula ¹⁵ .
Alveolar periostitis	In <i>Loris</i> (captive), n=1 ¹⁵ .			Infection ⁵		
Facial abscessation associated with dental disease ⁶¹ .	In <i>N. pygmaeus</i> (captive), n=1, problem occurring twice ⁶¹ .					
Osteomyelitis of the zygomatic arch in connection with dental disease	In <i>N. coucang</i> (captive), n=1 ⁶¹ .					
Facial swellings as a sign of dental disease	In <i>N. coucang</i> (captive), "common" ⁶¹ .					

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Teeth						
Purulent ocular discharge over 3 years in a loris with a history of dental disease ⁶¹ .	In <i>N. coucang</i> (captive), n=1 ⁶¹ .			Eye problem probably secondary to dental disease. Several types of bacteria were cultured on different occasions ⁶¹ .		
Chronic periodontal disease and open root canals ⁶¹ .						Chronic periodontal disease and open root canals can be a source for disseminating bacterial infections. Diet consisting primarily of soft food items should be avoided; some sort of biscuit or pellets should be included to promote dental hygiene.
Eyes						
Cataract: increasing opacity of the eyes, behaviour of the animals indicates blindness ¹⁵	In <i>Loris</i> (captive), n=6 ¹⁵ .		Five animals were more than 10 years old; 4 cases of blinding occurred in younger animals ^{15, 32} . In one case, opacity of the cornea for unknown reasons was noticed in a 19 months-old female ³²	Possible causes: trauma, infectious and metabolic derangements such as diabetes mellitus; old age ³² .		Blind animals at Ruhr-University moved quickly after learning the pathways in their cage, but were more susceptible to stress by unfamiliar noise. In their cages, over all branches a free zone without sharp edges dangerous for head and eyes, altitude at least 15 cm, is provided
Thickened cornea in both eyes with moderate folding of the component fibers. Moderate numbers of macrophages, many containing prignments, are among the ciliary folds and residual anterior chamber. Morphologic diagnosis: Phtisis bulbi (O.S.) with mild granulomatous uveitis and mild, irregular corneal thickening (O.D.). ³² .	In <i>Loris</i> (captive, very old animal), n=1 ³² .		In a very old animal with kidney lesions. In connection with cataract (corneal, anterior chamber opacity)	Ocular lesions likely indicative of or related to advanced age. The primary cause cannot be determined in such an advanced stage but possibilities include trauma, infectious and metabolic derangements. ³² .		

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Detached iris in one eye.	In <i>Loris</i> (n=1, very old animal) ³² . In <i>N. pygmaeus</i> (n=1) ⁶¹ .		<i>Loris</i> : in a very old blind animal with cataract and other eye lesions	<i>Loris</i> : detachment of the iris may at least be partially due to sectioning artifacts ³² . <i>N. pygmaeus</i> : no cause for the detachment could be found on funduscopic or slit lamp examination. Since this was a confiscated animal, trauma was proposed as a likely etiology ⁶¹ .		
Occasionally small eye(s), ocular discharge / lachrymal secretion	In <i>Loris</i> ¹⁵ , n=1; in <i>N. coucang</i> , n=1 ⁶¹ .		See table 2: externally visible changes. See also under "teeth" in this table			

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Other inner problems / diseases						
Abdominal abscess ⁶¹ .	In <i>N. coucang</i> (n=1) ⁶¹ .		Diagnosed at necropsy in a loris treated for abnormal behaviour and weight loss ⁶¹ .			
Peritonitis ⁶¹ .	In <i>N. pygmaeus</i> (n=1) ⁶¹ .					
Chronic sinusitis as a cause of death	In <i>N. coucang</i> (n=1) ⁶¹ .					
Generalized amyloidosis (storage of amylois = protein fibres in tissue) ³³ .		In <i>Microcebus murinus</i> ³³ .		May lead to failure of concerned organs (heart, kidney) ³³ .		
Birth problems, stillbirths	In <i>Loris</i> ¹⁵ .		Stillbirth or babies found dead after birth, several cases. One baby had died and putrified inside the mother few days before birth; after attempts of the mother to give birth to the carcass, it could be removed from outside by a veterinarian ¹⁵ .	Cause unknown		
Inherited malformations	In <i>Loris</i> ¹⁵ .		One case: dysmelia in a neonate. Crippled hands, thumbs missing. Arms looking normal. The baby was euthanized ¹⁵ .	In humans, dysmelia may be caused by chemicals or oxygen deficiency in the 29th to 46th day of pregnancy. Oxygen deficiency might be a cause ⁵ , the mother was transferred to an unfamiliar environment during pregnancy and showed signs of stress ¹⁵ .		