

Cancer prevalence and aetiology in wild and captive animals

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Abstract

Neoplasia has been recorded in the vast majority of metazoans. The frequent occurrence of cancer in multicellular organisms suggests that neoplasia, similar to pathogens/parasites, may have a significant negative impact on host fitness in the wild. This is supported by the fact that wildlife cancers have recently been shown to result in significant increased levels of mortality and concomitant reduction in fitness. By thorough searches of the available literature on the internet we provide a comprehensive and an updated list of cancer prevalence and aetiology in the wild. We were unable to find data on non-transmissible cancer prevalence in invertebrates and consequently this chapter focuses on cancer in wild vertebrates. Although single cases of cancer are frequently encountered in the wild, we were only able to retrieve robust data on cancer prevalence in 31 vertebrate species (12 fish, 3 amphibians, 2 reptiles, 2 birds and 12 mammals). Cancer prevalence among these vertebrates ranged from as low as 0.2% observed in Canada geese (*Branta canadensis*) to more than 50% recorded in Santa Catalina Island foxes (*Urocyon littoralis catalinae*) and Cape mountain zebras (*Equus zebra zebra*). The high prevalence recorded in some vertebrates strongly suggests that cancer in wildlife may indeed carry significant fitness costs. In spite of this, the low number of published comprehensive studies clearly shows that so far cancer in wildlife has received insufficient attention by biologists. We hope that this chapter will act as a catalyst for further studies focusing on the impact of cancer in wild animals. The chapter also compares cancer recorded in French zoological parks and compare these records to that obtained at other zoological parks. Finally we provide an updated list of cancer recorded as single cases in the wild as well in captive animals.

Introduction

Despite the evolution of numerous natural cancer suppressor mechanisms (DeGregori, 2011), neoplasia has been recorded in most metazoans (Leroi et al., 2003). ~~Although~~However, a few exceptional species such as the naked mole rat (*Heterocephalus glaber*) have been claimed to be resistant to cancer (Tian et al., 2013). Recent studies have however shown that even this species may develop cancer (Delaney et al., 2016) strongly suggesting that the vast majority of multicellular organisms are indeed susceptible to cancer. The frequent occurrence of cancer in metazoans suggests that neoplasia, similar to pathogens/parasites, may have a significant negative impact on host fitness in the wild (Vittecoq et al., 2013). This is supported by a recent review of wildlife cancer by (McAloose and Newton, 2009) demonstrating that high prevalence of cancer in e.g. Tasmanian devils (*Sarcophilus harrisi*) and belugas (*Delphinapterus leucas*) resulted in concomitant significant increase in levels of mortality and reduction in fitness.

Wildlife cancer statistics are, however, highly scattered in the scientific literature and hence challenging to access. Moreover, as tumours in wildlife are most commonly detected during post-mortem examination and therefore hard to confirm without using histopathology. However, even histological analyses can be inaccurate because of high levels of autolysis (organ disintegration) (McAloose and Newton, 2009). In addition, individuals harbouring tumours often display a decrease in body condition often resulting in higher levels of parasite/pathogen infections and concomitant increased levels in morbidity and mortality (Vittecoq et al., 2013). The combination of the negative effects of cancer and/or pathogen/parasite infections has also been shown to result in increased levels of predation (Vittecoq et al., 2013). In our view, the combination of the problems involved in accurately recording wildlife cancer, the increased risk of succumbing to pathogens/parasites and/or predation has often led to a somewhat erroneous assumption that although cancer is common in domestic animals, it remains rare in the wild. If, as we suggest, cancer may be a significant determinant of animal fitness it is therefore crucial to determine cancer prevalence in the wild.

As the aetiology and prevalence of transmissible cancers are presented and discussed in chapter 14, the present chapter will therefore focus on the prevalence and aetiology of non-transmissible cancers.

By thorough searches of the available literature on the internet we provide a comprehensive and an updated list of cancer prevalence in wild animals ranging from fish to whales (Table 1). We also provide a list of cancer recorded in captive animals from French zoological parks and compare our findings to that recorded at other zoological parks (Table 2-4). Finally we provide an updated a list of cancers recorded as single cases in the wild as well in captive animals to show that cancer occurs in nearly every taxonomic orders of the animal kingdom (Table 5).

Cancer prevalence and aetiology in wild vertebrates

Although cancers are frequently encountered in wild animals, we were only be able to

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retrieve robust data on cancer prevalence of 31 wild vertebrates. We were unable to find data on non-transmissible cancer prevalence in wild invertebrates consequently this chapter focuses on cancer in wild vertebrates ranging from fish to mammals. Below we provide a summary of cancer aetiology and prevalence in each of the five vertebrate groups.

Fish

In 2010 FAO (FAO, 2010) fisheries and aquaculture department published a report that showed that the mean contribution of fish to global diets was 17 kg per person/year, supplying over three billion people with 15 percent of their animal protein intake. About 45% of the fish consumed were farmed but the remaining 65% of fish were caught in the wild clearly demonstrating the importance of wild fish in the human diet. In spite of that cancers such as plasmacytoid leukemia have been shown to result in up to 50% mortality in commercially important taxa such as chinook salmon (*Oncorhynchus tshawytscha*; (Eaton et al., 1994) and neurofibromatosis-like tumours have been shown to result in 100% mortality in bicour damselfish (*Stegastes partitus*; (Coffee et al., 2013)) we have only been able find information on cancer prevalence of 12 wild fish taxa.

Substantial seasonal variation in lymphosarcoma prevalence was observed in northern pike but the underlying aetiology is unknown (Papas et al., 1976). In walleye and Atlantic salmon (*Salmo salar*) retroviruses have been found to initiate cancer development (Coffee et al., 2013). In bicour damselfish the neurofibromatosis-like tumours are most likely caused by an "extrachromosomal DNA virus-like agent" (Coffee et al., 2013) whereas in European

smelt (*Osmerus eperlanus*) cancer development is most likely caused by a “herpesvirus like agent” (Coffee et al., 2013) and a corona virus has been suggest to be the cause for the development of lymphsarcoma in the northern pike (Papas et al., 1976). In brown bullhead (*Ameiurus nebulosus*), however, the higher levels of liver neoplasms (15%) recorded on one of the lakes investigated have been suggest to be caused by pollution (Baumann et al., 2008). A study of English sole (*Parophrys vetulus*) revealed that up to 24% of the fish had developed liver neoplasms which aetiology could be traced to have been caused by pollution/chemical carcinogens (Malins et al., 1987).

Cancer prevalence as high as 20% have been observed in several species such as gizzard shad (*Dorosoma cepedianum*), northern pike (*Esox lucius*), walleye (*Sander vitreus*) and bicolor damselfish and in white sucker (*Catostomus commersoni*) cancer may affect 59% of the fish (Coffee et al., 2013). However, the epidermal papilloma recorded in the latter taxon appears to result in low mortality (Coffee et al., 2013). Apart from the studies conducted on Chinook salmon and bicolour damselfish, the remaining studies do not provide any data on cancer prevalence and mortality. In spite of this we find it reasonable to suggest that the high tumour frequency observed in several species may have a significant negative impact on fish fitness. Considering the importance of fish in the human diet the high cancer prevalence, and associated increase in mortality recorded in some fish taxa, clearly demonstrate the need of a substantial increase in research on the effect of cancer on both marine and fresh water fishes.

Amphibians

Although cancer has been reported in numerous amphibians (Balls and Clothier, 1974) we have only been able to find three studies that incorporated data on cancer prevalence in the wild. In the North American leopard frog (*Rana pipiens*) (McKinnel, 1965) found that up to 9% of the frogs were diagnosed with renal adenocarcinoma. However, no information about tumour aetiology or its possible effects on the frogs was provided. Interestingly, in later study (McKinnell and Martin, 1979) observed a gradual temporal decline in tumour prevalence and in 1978 and 1978 no tumours were observed in 1216 dissected frogs. (McKinnell and Martin, 1979) suggested that the decline in cancer prevalence was caused by a significant reduction in frog numbers and a concomitant reduction in the release of oncogenic viruses into the breeding ponds. However, the authors could not rule out that a

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gradual reduction of carcinogenic pollutants into the breeding could have caused the decline in tumour prevalence.

(Asashima et al., 1982) studied the occurrence of spontaneous skin papillomas in Japanese newts (*Cynops pyrrhogaster*) in Northern Japan. The prevalence of papillomas showed a seasonal variation being highest in autumn, ranging from 1.93 to 5.45% whereas during the rest of the year the prevalence ranged between 0.16 to 0.50%. Also a spatial difference in cancer prevalence was recorded and newts collected from the northern, seaside prefectures had higher papilloma rates (1.00 to 5.45%) than did newts from the southern, Pacific Ocean prefectures (0 to 0.27%). No inter-sexual difference in tumour prevalence was recorded. Virus-like bodies, resembling herpes-type virus, were found in the cytoplasm of the epitheliomas suggesting that tumour may have been caused by a viral agent. Unfortunately the study does not provide any information of the underpinning(s) of what could be causing the temporal and spatial variation in tumour prevalence or whether the tumours affected newt mortality.

In a recent study skin tumour prevalence was investigated in the monteseny brook newt (*Calotriton arnoldi*) in Spain (Martinez-Silvestre et al., 2011). The range of newts is restricted to a small geographic area < 40 km² of the North Eastern Iberian Peninsula. Similar to the Japanese newt a profound spatial population difference in tumour prevalence was observed ranging from 0%, 2% to 29%. The tumours were only observed in adult newts which led the authors to suggest that the tumours may be caused by increased UV-B exposure. Yet again no data is provided whether the tumours may affect newt mortality.

Although our sample is small it shows that cancer prevalence may affect a substantial proportion of wild amphibians and considering the dramatic decline in amphibians caused by the chytrid fungus, *Batrachochytrium dendrobatidis* (Daszak et al., 1999) makes it even more important to further investigate the possible negative effects of cancer in this group of vertebrates.

Reptiles

The only reptile taxa for which we have been able to retrieve data on cancer prevalence in the wild are restricted to marine turtles. Although fibropapillomatosis (FP) mainly affects green turtles it has also been documented in loggerheads (*Caretta caretta*; (Aguirre et al., 1999b)). The former has been subjected to numerous and extensive research projects and below we summarize the major findings from some of these studies. FP in green turtles results in tumour growth on eyes, oral cavity, skin, carapace, plastron and/or internal organs (Santos et al., 2010). Consequently the disease may significantly reduce turtle foraging efficiency. FP shows significant geographic variation not only in prevalence (ranging from 0 to 92%) but also in severity (Santos et al., 2010). Moreover, in Brazil the disease is absent in juvenile green turtles but increases in prevalence in older turtles (Santos et al., 2010). In contrast in Hawaii, FP affects mainly juvenile turtles (Balazs et al., 1990, Work and Balazs, 1999). However, the reason(s) for the age-specific increase in FP prevalence in Brazil and the age-specific difference in cancer development in Brazil and Hawaii is not known. Interestingly, (Chaloupka et al., 2009) reported on cases where FP had regressed and even completely disappeared in some green turtles in Hawaii and that the diseases since the mid 90's has showed a significant decline in prevalence.

Although we have not been able to find data on how FP affects green turtle mortality rates, the disease results in high parasite load, immune suppression, increased physiological cost (Work and Balazs, 1999, Work et al., 2005, Work et al., 2001) and is the most common cost of green turtle stranding on Hawaii (Chaloupka et al., 2008, Chaloupka et al., 2009). Consequently, we find it highly likely that FP may impose considerable mortality cost on green turtles in the wild. In spite of FP's high prevalence in some areas and its possible severe effects on green turtle fitness the aetiology of FP is still not known. Some studies have found an association between herpes viruses and FP (e.g. (Greenblatt et al., 2005)) whereas others have implicated pollution and habitat quality may be major component explaining the presence of FP (Herbst and Klein, 1995).

Considering the detrimental impact of cancer on marine turtles and the emergence of a novel fungal disease in squamate reptiles (Guthrie et al., 2015) warrants increased research efforts to investigate how cancer might affect the demography of reptiles in the wild.

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Birds

We find it remarkable that although birds are often abundant in both urban and rural habitats we have only been able to find very few studies that have recorded cancer prevalence in wild birds. (Jennings, 1968) Jennings (1968) estimated that the prevalence of neoplasia in wild birds in Great Britain to be between 0.1 and 1.0%. Similar low cancer prevalence was recorded by (Gates et al., 1992) in Canada geese (*Branta canadensis interior*; 2 out 1272 birds 0.2%). Both birds were young and emaciated and microscopical analyses suggested that the tumours “had the typical appearance of spindle cell sarcomas” (Gates et al., 1992). Similar results on low cancer prevalence in wild birds was published by (Siegfried, 1983) who only found tumours in 9 out of more than 18,000 birds examined (0.05%). Although based on significantly smaller samples sizes 3 out 13 (23%) ruffed grouse (*Bonasa umbellus*) were diagnosed having tumours (Howerth et al., 1986). One bird was diagnosed having a lipoma, the second bird a fibroma, and the third bird had developed a renal carcinoma metastatic to the liver (Howerth et al., 1986). The high prevalence recorded in ruffed grouse should, however, be interpreted with caution as all three birds were delivered for examination because they all suffered from obvious lesions. (Reece, 1992) reported on 383 cases of cancer from a collection of more than 10,000 birds (3.8%) submitted for necroscopy in Victoria, Australia from 1977 to 1987. As the birds examined consisted of both wild and captive birds and no data is provided about the actual number of birds in each of the two groups, again the data on cancer prevalence should be interpreted with caution.

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The only publication we have found showing that cancer prevalence in birds may reach similar levels as that found among other vertebrates is a study by (Daoust et al., 1991) who reported that out of 30 wild white-fronted goose (*Anser albifrons*) killed by hunters seven were diagnosed as having developed multicentric mesenchymal tumours (23%). (Daoust et al., 1991) suggested that high prevalence could have been caused by “a genetically influenced susceptibility to the disease”. Unfortunately, however, no data is provided to support this statement.

In their review of wildlife cancer (McAloose and Newton, 2009) listed the endangered North American Attwater's prairie chicken (*Tympanicus cupido attwateri*) as an example of a species being further threatened by extinction due to cancer. Although reticuloendotheliosis

virus may infect up to 50% of the captive birds we have not been able to find any publication that relate this high infection levels to concomitant mortality in the wild.

The few publications that we have been able to retrieve suggest that cancer prevalence in birds in general appears to be low. Although the samples size in some of the studies were very high, they were often restricted to larger and long-lived birds such as geese. In order to make in any robust generalization of cancer prevalence among wild birds future research should incorporate birds representing a significantly more diverse taxonomic range.

Mammals

Cancer prevalence and its effect on some wild mammal population such as California sea lions (*Zalophus californianus*) and belugas (*Delphinapterus leucas*) have been subjected to intensive research (Gulland et al., 1996, Martineau et al., 2002). Between 1979 and 1994 the prevalence of a metastatic carcinoma of urogenital origin in stranded California sea lions was reported to be 18% (Gulland et al., 1996). However, between 1998 and 2012 the prevalence of this cancer had increased to 26% (Browning et al., 2015). This metastatic carcinoma appears to result ~~in s~~-100% mortality as all animals died during rehabilitation (Gulland et al., 1996). The actual prevalence of this cancer is most likely lower as only sick animals are likely to strand but in spite of this the cancer represents ~~s~~ a significant cause of death in this species (Browning et al., 2015). Recent studies have found that the aetiology of the cancer is associated with individual genotype, persistent organic pollutants and a herpesvirus (Browning et al., 2015). Similar high cancer prevalence has been recorded in an isolated beluga population living in the St. Lawrence estuary (Martineau et al., 2002). Although the major primary causes of death were respiratory and gastrointestinal infections with metazoan parasites observed in 22% of the belugas, cancer was the second most common cause of death across all age groups and observed in 18% of the stranded belugas (Martineau et al., 2002). The cancer prevalence in adults was even higher (27%) and (Martineau et al., 2002) estimated the annual rate of all cancer types in belugas to 163 out of 100,000 animals a rate significantly higher than that reported for any other ~~cetacean~~ populations ~~s of cetacean~~ and similar to that of recorded in humans. The habitat of the belugas in St. Lawrence estuary is highly contaminated by polycyclic aromatic hydrocarbons (PAHs) produced by the local

aluminium smelters strongly suggesting that PAHs are a major cause of the high cancer prevalence recorded in this population of belugas (Martineau et al., 2002).

High cancer prevalence has also been recorded in other marine mammals such Pacific walrus (*Odobenus rosmarus divergens*) and Baltic gray seal (*Halichoerus grypus*). In the former 18 neoplasms were found during examination of tissues from 107 carcasses (17%) from Alaskan subsistence hunting over a 10-year period (Fleetwood et al., 2005). However, no data regarding cancer aetiology or pathogenesis of the walruses examined is presented. Between 1975 and 1997 53 female Baltic gray seals aged between 15 and 40 years were found dead along the Baltic coast of Sweden of which 34 (64%) were diagnosed having developed uterine leiomyomas (Bäcklin et al., 2003). Although little is known about the aetiology and pathogenesis of leiomyoma in Baltic gray seals (Bäcklin et al., 2003) tentatively suggest an association between cancer prevalence and pollutants such as organochlorines. However as mentioned above, the actual prevalence of uterine leiomyomas in female Baltic gray seals is most likely lower as only sick animals are likely to strand but in spite of this, similar to the California sea lion, this cancer may constitute a significant cause of death in this species.

In contrast to the four marine species mentioned above, neoplasia in northern sea otters (*Enhydra lutris*) appears to be rare and (Williams and Pulley, 1981) only found tumours in two females out of 112 otters examined (1.8%). Similar to the female Baltic grey seals the tumours of the female otters were diagnosed as uterine leiomyomas (Williams and Pulley, 1981).

Our review of the literature also revealed significant geographical species-specific difference in cancer prevalence. For example, of 42 roe deer (*Capreolus capreolus*) carcasses examined in Hungary 14 (33%) showed macroscopic lesions consistent with skin fibropapillomatosis (Erdélyi et al., 2009) whereas out of 985 carcasses examined in Sweden only 19 were diagnosed having neoplasia (2%) and only one of the 19 having developed fibropapillomatosis (Aguirre et al., 1999a). Moreover, even in the Hungarian study neoplasia was confined to certain geographical areas (Erdélyi et al., 2009). As fibropapillomatosis is caused by the infection of papillomavirus (CcPV1) this led (Erdélyi et al., 2009) to suggest that genetic factors may underpin roe deer susceptibility to fibropapillomatosis.

In humans increased cancer prevalence have been shown to be associated with reduced

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genetic diversity (Rudan et al., 2003, Assié et al., 2008). It is therefore interesting to note that some of the highest cancer prevalence observed in wild mammals (> 50%) have been recorded in species/populations with low genetic diversity such as the Santa Catalina Island foxes (*Urocyon littoralis catalinae* (Funk et al., 2016, Vickers et al., 2015)) and the South African Cape mountain zebra (*Equus zebra zebra*; (Marais and Page, 2011, Sasidharan et al., 2011, Marais et al., 2007)). (Vickers et al., 2015) suggested that the high prevalence of ceruminous gland tumours (carcinomas and adenomas) observed in the Santa Catalina Island foxes may have a genetic basis. Similarly, the high cancer prevalence observed in one of the South African Cape mountain zebra populations has also been suggested to be associated with concomitant low genetic diversity (Sasidharan et al., 2011, Marais et al., 2007). Interestingly, as mentioned above, the high prevalence of cancer in Californian seal lions may also, at least partly, have a genetic basis (Browning et al., 2015). The possible association between reduced genetic diversity and cancer prevalence is further supported by the high prevalence of cancer observed in both captive and wild western barred bandicoot (*Perameles bougainville*), a highly endangered Australian marsupial that was once widespread across western and southern Australia but now restricted to two small island off the Western Australian coast (Woolford et al., 2008, Woolford et al., 2009). Captive breeding of this species hasve been severely hampered by debilitating cutaneous and muco-cutaneous papillomatosis and carcinomatosis, associated with infection of papillomatosis carcinomatosis virus type 1 (BPCV1) (Woolford et al., 2009, Woolford et al., 2008).

Low genetic diversity in the wild has been found to result in increased risk of inbreeding depression and concomitant increased risk of extinctions (Madsen et al., 1999, Madsen et al., 1996, Madsen et al., 2004). If low genetic diversity results in an increased risk of cancer, as suggested by the examples mentioned above, this may further imperil the long-term survival of the numerous wild organisms presently suffering from low genetic diversity.

Cancer aetiology and prevalence in French zoological parks

Although conditions (and hence associated cancer risks) in zoological parks are often significantly different from those experienced in nature (e.g. altered levels of activity and food and abnormal breeding frequency; (Vittecoq et al., 2013)), cancer studies in captive

animals are facilitated by the absence of masking variables such as predation. In addition, because of curative and preventive improvements in veterinary medicine, diseases of captive animals are closely monitored and necropsies are performed in routine using microscopy analysis (Hubbard et al., 1983, Lombard and Witte, 1959).

Materials and Methods

The study was conducted from September 2013 to February 2015. Thirty zoological parks were contacted through a partnership with two French animal histopathology laboratories (ONIRIS in Nantes, VetDiagnostic in Lyon) and the French Association of Zoological Park Veterinarians (AFVPZ). Data collection consisted of 1) consultation of veterinarian archives in the zoological parks; 2) analysis of centralized data by veterinarian histopathology laboratories.

Accurate cancer diagnosis relies on histopathological examination of samples from biopsies, resection or autopsy/necropsy (Martineau et al., 2002). We therefore only entered tumour type (benign or malignant) into our database when they had been confirmed by histological analyses. We also recorded animal age and sex, the necropsy and histological reports, the organs affected, and, if any, the presence and the location of metastases. In order to facilitate data presentation, we classified the tumours into 12 anatomical systems (see Table 3).

Results

The database consisted of 341 tumour references, including 271 cases of cancer in mammals, 46 in birds and 26 in reptiles representing 27 different orders (Table 2).

Anatomical distribution by class

Our analyses of tumour frequencies based on three vertebrate classes revealed remarkable similarities. High frequencies of digestive, hematopoietic and skin tumors were observed across the three classes whereas tumors in the remaining 9 anatomical systems occurred in similar low frequencies (Table 3).

Benign and malignant tumours recorded in Mammalia, Aves and Reptilia

We observed a significant difference in the number of benign and malignant tumours in Reptilia relative that observed in Mammalia and Aves ($\chi^2 = 6.14$, $p = 0.046$, $df = 3$). That is, in Reptilia significantly more malignant tumours were observed relative that in Aves and

Mammalia whereas no difference was observed among Aves and Mammalia ($\chi^2 = 1.63$, $p = 0.20$, $df = 2$; Table 4).

Discussion

The results from the present study show that the highest tumour prevalence was observed in the order Carnivora (42.1% 114 of 271). Similar high cancer prevalence in this order of mammals has been observed by (Lombard and Witte, 1959) and (Effron et al., 1977). This group of vertebrates includes the families Felidae and Canidae. Members of the latter two families include domestic cats and domestic dogs which both have been shown to be subjected to high prevalence of tumours (Merlo et al., 2008, Zambelli, 2015). However, we have not been able to find any information explaining the high prevalence in this group of mammals.

Our study also revealed some different results from those obtained in previous studies of tumour prevalence in mammals (Mammalia) kept at zoological parks. For example (Effron et al., 1977) found that pulmonary tumours were the most prevalent cancer recorded in mammals (14%) and (Lombard and Witte, 1959) also found a high prevalence of such tumours (16%) whereas in our study tumours in the digestive system had the highest prevalence (18.4%) and pulmonary tumours were only found in 6.4% of the animal investigated i.e. the 7th of the 12 anatomical systems. Similar to our results (Lombard and Witte, 1959) found that tumours in the digestive system of mammals had the highest prevalence (20%). However, the second most common tumours observed in mammals by (Effron et al., 1977) was hematopoietic /lymphosarcoma (8.9%) followed by skin tumours (8.7%). Our results thus show a remarkable similarity with the results obtained by (Effron et al., 1977) as we also found hematopoietic and skin tumours being the second and third most common tumours recorded (17.6% and 14.2% respectively). In contrast (Lombard and Witte, 1959) found that the second most prevalent tumours was confined to the endocrine system (18.4%) whereas in our study endocrine tumours were only found in 7.9% of mammals.

Comparing our results of tumour prevalence in birds (Aves) with those obtained by (Effron et al., 1977) revealed additional striking similarities. In both studies hematopoietic /lymphosarcoma were the most prevalent tumours recorded (27.9% and 32.4% respectively). In both the study by (Effron et al., 1977) and (Lombard and Witte, 1959) as well as in our

study the second most prevalent cancers confined to the gastric/digestive system (20.9%, 22.2% and 12.6%, respectively). In all three studies the third most prevalent tumours were fibrosarcoma/skin tumours (18.6%, 11.1% and 9.9%, respectively). The second most common tumours recorded by (Lombard and Witte, 1959) was confined to genital system (20.2%) whereas these tumours were the fourth most common tumours recorded by (Effron et al., 1977) (9.9%) and the 6th most common tumours in the present study (4.6%).

The most common cancers recorded by (Effron et al., 1977) in reptiles (Reptilia) were lymphosarcoma (25%) followed by tumours in the intrahepatic biliary/digestive system (21%). Again our results are quite similar to that recorded by (Effron et al., 1977) although the order of the two cancer types were reversed, that is our results showed a highest prevalence in the digestive system (34.8%) followed by the hematopoietic system (21.7%).

The high prevalence of cancers affecting the digestive, hematopoietic and skin system recorded across the three vertebrate classes is remarkable and certainly warrants further studies to investigate whether these high prevalence also occur at other zoological parks. As these animals are kept under quite different conditions i.e. most mammals and birds are kept in outdoor cages whereas reptiles are mostly kept indoors we presently have no explanation for the similarities in tumours prevalence among these three groups of vertebrates.

The results from the present study suggest that malignant tumours in reptiles were more prevalent than that observed in mammals and birds. However, this is not supported by the study of (Effron et al., 1977) that did not find any significant difference in malignant tumours among the three vertebrate classes. As our data on tumour prevalence in reptiles is based on fairly small number of individuals we therefore suggest that our results should be interpreted with caution.

Although many of the results from the present study are similar to that observed by (Effron et al., 1977) and (Lombard and Witte, 1959) we do emphasize that the cancer aetiology and prevalence were all obtained from animals kept in captive conditions. Cancer in captive animals has been shown develop predominantly in older age cohorts or even only in post-reproductive ages. For example, although cancer prevalence in captive black-footed ferrets (*Mustela nigripes*) has been shown to affect 55% of the ferrets, the cancer almost exclusively affected post reproductive ferrets questioning its impact in wild ferret populations (Lair et al.,

2002). The high cancer prevalence recorded in captive animals is often restricted to older age cohorts suggesting that the significance of cancers recorded, similar to black-footed ferrets, may have limited or in some cases no fitness effects in the wild. In spite this cancer statistics recorded in captive animals remain an important source of information for studies in comparative oncology as well as providing data on cancer aetiology.

Acknowledgements

We acknowledge the French zoological parks who welcomed us into their premises and provided data on their animals: Safari de Peaugres, Réserve Africaine de Sigean, Zoo de la Barben, Zoo La Palmyre, Montpellier Parc Zoologique, Réserve de la Haute-Touche, ZooParc de Beauval, Zoo de La Boissière-du-Doré, Planète sauvage, Bioparc Zoo de Doué, Zoo de Lyon, La Ménagerie, le zoo du Jardin des Plantes, Zoo/Fauverie du Mont Faron. This work was supported by the ANR (Blanc project EVOCAN), the CNRS (INEE), the French-Australian Science Innovation Collaboration Program Early Career Fellowship, and an International Associated Laboratory Project France/Australia.

Table 1. Cancer prevalence in wild animals.

Species	Neoplasia	Prevalence	Reference
Fish			
Atlantic salmon (<i>Salmo salar</i>)	leiomyosarcoma	4.60%	(Coffee et al., 2013)
Bicolor damselfish (<i>Stegastes partitus</i>)	neurofibromatosis-like disease	23%	(Coffee et al., 2013)
Brown bullhead (<i>Ameiurus nebulosus</i>)	liver neoplasms	5-15%	(Baumann et al., 2008)
Chinook salmon (<i>Oncorhynchus tshawytscha</i>)	plasmacytoid leukemia	6%	(Eaton et al., 1994)
Dab (<i>Limanda limanda</i>)	epidermal papilloma	1-7%	(Dethlefsen et al., 2000)
English sole (<i>Parophrys vetulus</i>)	carcinomas, adenomas, hepatic mesenchymal neoplasms	up to 24%	(Malins et al., 1987)
European smelt (<i>Osmerus eperlanus</i>)	spawning papillomatosis	5.50%	(Coffee et al., 2013)
Gizzard shad (<i>Dorosoma cepedianum</i>)	spindle-cell neoplasms	20%	(Geter et al., 1998)
Northern pike (<i>Esox lucius</i>)	lymphosarcoma	21%	(Papas et al., 1976)
Roach (<i>Rutilus rutilus</i>)	epidermal papillomatosis	3-31%	(Korkea-aho et al., 2006)
Walleye (<i>Sander vitreus</i>)	dermal sarcoma	20-30%	(Coffee et al., 2013)
Walleye (<i>Sander vitreus</i>)	epidermal hyperplasia	up to 20%	(Coffee et al., 2013)
White sucker (<i>Catostomus commersoni</i>)	epidermal papilloma	59%	(Coffee et al., 2013)
Amphibians			
Japanese fire belly newt (<i>Cynops pyrrhogaster</i>)	skin papilloma	5.50%	(Asashima et al., 1982)
Leopard frog (<i>Rana pipiens</i>)	renal adenocarcinoma	9%	(McKinnel, 1965)
Montesney brook newt (<i>Calotriton arnoldi</i>)	chromatophoroma melanocytoma	27%	(Martinez-Silvestre et al., 2011)
Reptiles			
Green turtle (<i>Chelonia mydas</i>)	fibropapillomatosis	23%	(Foley et al., 2005)
Green turtle (<i>Chelonia mydas</i>)	fibropapillomatosis	22%	(Adnyana et al., 1997)
Green turtle (<i>Chelonia mydas</i>)	fibropapillomatosis	*	(Chaloupka et al., 2009)
Green turtle (<i>Chelonia mydas</i>)	fibropapillomatosis	58%	(dos Santos et al., 2010)
Green turtle (<i>Chelonia mydas</i>)	fibropapillomatosis	16%	(Aguirre et al., 1999b)
Loggerhead turtle (<i>Caretta caretta</i>)	fibropapillomatosis	6%	(Aguirre et al., 1999b)
Birds			
Canada geese (<i>Branta canadensis</i>)	spindle cell sarcomas	0.2%	(Gates et al., 1992)
With-fronted geese (<i>Anser albifrons</i>)	multicentric intramuscular lipomatosis/fibromatosis	23%	(Daoust et al., 1991)
Mammals			

Baltic gray seal (<i>Halichoerus grypus</i>)	uterine leiomyomas	64%	(Bäcklin et al., 2003)
Beluga (<i>Delphinapterus leucas</i>)	adenocarcinoma, squamous cell carcinoma, dysgerminoma, lymphosarcoma	18%	(Martineau et al., 2002)
Brown hare (<i>Lepus europaeus occidentalis</i>)	ovarian tumors	5.60%	(Flux, 1965)
California sea lions (<i>Zalophus californianus</i>)	metastatic carcinoma, spindle cell sarcoma, adenocarcinoma, adrenocortical adenoma	18% - 26%	(Gulland et al., 1996)
Cape mountain zebra (<i>Equus zebra zebra</i>)	equine sarcoid	53%	(Marais et al., 2007)
Gray squirrels (<i>Sciurus carolinensis</i>)	fibromatosis	**	(Terrell et al., 2002)
Northern sea otters (<i>Enhydra lutris</i>)	uterine leiomyomas	2%	(Williams and Pulley, 1981)
Pacific walrus (<i>Odobenus rosmarus divergens</i>)	uterine leiomyomas, ovarian leiomyoma, mesenteric leiomyoma, gastric gastrointestinal stromal tumors, ovarian dysgerminomas, intestinal hemangioma, hepatic hemangioma, mammary adenoma,	17%	(Fleetwood et al., 2005)
Roe deer (<i>Capreolus capreolus</i>)	fibropapillomas	33%	(Erdélyi et al., 2009)
Roe deer (<i>Capreolus capreolus</i>)	adenoma, brain tumors, bileduct carcinoma, hemangiosarcoma, lymphoma, osteosarcoma, rhabdomyosarcoma	2%	(Aguirre et al., 1999a)
Santa Catalina Island foxes (<i>Urocyon littoralis catalinae</i>)	ceruminous gland tumors	52%	(Vickers et al., 2015)
Sea otter (<i>Enhydra lutris</i>)	leiomyoma	1.80%	(Williams and Pulley, 1981)
Western barred bandicoot (<i>Perameles bougainville</i>)	cutaneous papillomatosis and carcinomatosis	***	(Woolford et al., 2008)

* significant temporal decrease in prevalence

** epizootic, no data provided on exact prevalence

*** high, no data provided on exact prevalence

Table 2. Number of tumours recorded among 27 vertebrate orders in French Zoological Parks.

Birds (n = 46)		Mammals (n = 276)	
Order	n	Order	n
Accipitriformes e.g. birds of prey	2	Afrosoricida tenrecs and golden moles	2
Anseriformes e.g. ducks and geese	5	Carnivora e.g. cats and wolves	114
Bucerotiformes e.g. hornbills and hoopoes	3	Cetartiodactyla e.g. pigs and deer	49
Ciconiiformes storks	1	Chiroptera bats and flying foxes	4
Columbiformes e.g. pigeons and doves	3	Cingulata armadillos	2
Galliformes e.g. turkeys and chickens	2	Diprodontia e.g. kangaroos and koalas	7
Gruiformes e.g. cranes, coots and rails	2	Lagomorpha e.g. hares and rabbits	1
Pelecaniformes e.g. pelicans and cormorants	8	Perissodactyla e.g. zebras and rhinoceros	14
Phoenicopteriformes flamingoes	2	Pilosa anteaters	2
Psittaciformes parrots and parakeets	10	Primates monkeys and apes	70
Rheiformes rhea	2	Rodentia e.g. rats and capybaras	6
Sphenisciformes penguins	3		
Strigiformes owls	4		
Reptiles (n = 26)			
Order	n		
Crocodylia e.g. crocodiles and alligators	1		
Squamata snakes and lizards	23		
Testudines turtles and tortoises	2		

Table 3. Anatomical percentage distribution of tumours in three vertebrate classes in French Zoological Parks.

	Birds	Mammals	Reptiles
	(n=46)	(n = 271)	(n = 26)
mammary	N/A	4.9	N/A
cardiovascular	4.6	5.6	4.4
digestive	20.9	18.4	34.8
endocrine	2.3	7.9	4.4
genital	4.6	7.1	4.4
hematopoietic	27.9	17.6	21.7
musculoskeletal	7.0	6.7	4.4
neural	0.0	1.9	0.0
oral cavity	0.0	3.4	4.4
pulmonary	4.6	6.4	0.0
skin	18.6	14.2	17.4
urinary tract	9.3	6.0	4.4

Table 4. Number of benign and malignant tumours in three vertebrate classes in French Zoological parks.

Class	Number of benign tumours	Number of malignant tumours
Aves	10	25
Mammalia	94	142
Reptilia	4	20

Table 5. Examples of neoplasia across the ~~the~~ animal kingdom*

Latin name	Common name	Neoplasia (including benign and malignant abnormal cell growths)	Reference
Invertebrates			
Hydrozoa			
<i>Pelmatohydra robusta</i>	Hydra	undetermined neoplasia	(Domazet-Lošo et al., 2014)
Mollusca			
<i>Arctica islandica</i>	Ocean quahog	germinoma	(Peters et al., 1994)
<i>Argopecten irradians</i>	Atlantic bay scallop	gonadal neoplasia or germinoma	(Carballal et al., 2015, Peters et al., 1994)
<i>Cerastoderma edule</i>	Common cockle	disseminated neoplasia of unknown origin, gonadal neoplasia or germinoma	(Barber, 2004, Carballal et al., 2015, Peters et al., 1994)
<i>Crassostrea gigas</i>	Pacific oyster	fibroma or myofibroma, gonadal neoplasia, gonadoblastoma, disseminated neoplasia of unknown origin	(Carballal et al., 2015, Peters et al., 1994)
<i>Crassostrea virginica</i>	Eastern oyster	germinoma, gonadoblastoma, disseminated neoplasia of unknown origin	(Carballal et al., 2015, Peters et al., 1994)
<i>Ensis magnus (=arcuatus)</i>	Razor clam	gonadal neoplasia or germinoma	(Carballal et al., 2015)
<i>Ensis siliqua</i>	Pod razor	gonadal neoplasia or germinoma	(Carballal et al., 2015)
<i>Macoma balthica</i>	Baltic macoma	disseminated neoplasia of unknown origin	(Carballal et al., 2015)
<i>Macoma calcarea</i>	Chalky macoma	germinoma, haemic neoplasia	(Peters et al., 1994)
<i>Mercenaria campechiensis</i>	Southern quahog	gonadal neoplasia or germinoma	(Carballal et al., 2015)
<i>Mercenaria campechiensis x Mercenaria mercenaria hybrid</i>	Quahog hybrid	gonadal neoplasia or germinoma	(Carballal et al., 2015, Peters et al., 1994)
<i>Mercenaria mercenaria</i>	Hard-shell clam, quahog	germinoma	(Carballal et al., 2015, Peters et al., 1994)
<i>Mya arenaria</i>	Soft-shell clams	disseminated neoplasia of unknown origin, gonadal neoplasia or germinoma, haemic neoplasia	(Metzger et al., 2015, Carballal et al., 2015)
<i>Mytilus edulis</i>	Blue mussel	focal polypoid hyperplasia of germinal epithelium, germinoma , disseminated neoplasia of unknown origin	(Carballal et al., 2015, Peters et al., 1994)
<i>Mytilus edulis (trossulus/ galloprovincialis hybrid)</i>	Blue mussel hybrid	myxomas in vesicular connective tissue	(Peters et al., 1994)
<i>Mytilus galloprovincialis</i>	Mediterranean mussel	gonadal neoplasia or germinoma	(Carballal et al., 2015, Peters et al., 1994)
<i>Mytilus trossulus</i>	Bay mussel	disseminated neoplasia of unknown origin	(Carballal et al., 2015, Peters et al., 1994, Ciocan and Sunila, 2005, Ciocan et al., 2006)
<i>Ostrea edulis</i>	European flat oyster	disseminated neoplasia of unknown origin	(Barber, 2004)

<i>Tiostrea chilensis</i>	Dredge oyster	germinoma, haemic neoplasia	(Peters et al., 1994)
<i>Venerupis aurea</i>	Golden carpet-shell	disseminated neoplasia of unknown origin	(Carballal et al., 2015)
<i>Xenostrobus securis</i>	Small brown mussel	gonadal neoplasia or germinoma	(Carballal et al., 2015)
Crustacea			
<i>Lithodes aequispinus</i>	Golden king crab	probable tegmental gland adenocarcinoma	(Morado et al., 2014)
<i>Paralithodes camtschaticus</i>	Red king crab	midgut tumour, probable tegmental gland adenocarcinoma	(Morado et al., 2014)
<i>Paralithodes platypus</i>	Blue king crab	anaplastic cells on the surface of the antennal gland, probable tegmental gland adenocarcinoma	(Morado et al., 2014)
Insecta			
<i>Drosophila melanogaster</i>	Frutifly	gut and testis tumours	(Salomon and Jackson, 2008)
Vertebrate			
Fish			
<i>Agonus cataphractus</i>	Armed bullhead	dermal fibromas, fibrosarcomas	(Groff, 2004)
<i>Amia calva</i>	Bowfin	granuloplastic leukemia	(Groff, 2004)
<i>Anguilla japonica</i>	Japanese eel	nephroblastoma	(Groff, 2004)
<i>Astronotus ocellatus</i>	Oscar	adenocarcinomas	(Groff, 2004)
<i>Barbus barbus plebejus</i>	Italian barbel	osteoblastic osteosarcoma	(Groff, 2004)
<i>Carassius auratus</i>	Goldfish	fibrosarcoma, pigment cell neoplasm, neurofibromas, schwannomas, focal or multifocal cutaneous erythrophoromas	(Groff, 2004)
<i>Carassius auratus x Cyprinus carpio</i>	Goldfish hybrid	gonadal neoplasms	(Groff, 2004)
<i>Carcharhinus brachyurus</i>	Bronze whaler shark	proliferative, possibly neoplastic, lesions	(Robbins et al., 2014)
<i>Carcharhinus leucas</i>	Bull shark	cutaneous neoplasms	(Robbins et al., 2014)
<i>Carcharias taurus rafinesque</i>	Grey nurse shark	odontogenic, oral and gingival neoplasms	(Robbins et al., 2014)
<i>Carcharodon carcharias</i>	Great white shark	proliferative, possibly neoplastic, lesions	(Robbins et al., 2014)
<i>Catostomus commersoni</i>	White sucker	cutaneous papillomas	(Groff, 2004)
<i>Chaetodon multicinctus & C. miliaris</i>	Butterflyfish hybrids	pigment cell neoplasms	(Groff, 2004)
<i>Cholegaster agassizi</i>	Spring cavefish	spontaneous retinoblastomas	(Groff, 2004)
<i>Corydoras spp.</i>	Cory catfish	pigment cell neoplasms	(Groff, 2004)
<i>Cyprinus carpio</i>	Common carp	gonadal neoplasms, erythrophoromas	(Groff, 2004)
<i>Danio rerio</i>	Zebrafish	malignant neoplasms of the intestine	(Groff, 2004)
<i>Esox lucius</i>	Northern pike	lymphomas, undifferentiated sarcoma of the integument	(Groff, 2004)

<i>Esox masquinongy</i>	Muskellunge	lymphoma	(Groff, 2004)
<i>Fundulus heteroclitus</i>	Mummichog	hepatoblastoma	(Groff, 2004)
<i>Gadus spp.</i>	Alaska pollock	pseudobranchial adenomas	(Groff, 2004)
<i>Galeocerdo cuvier</i>	Tiger shark	cutaneous neoplasms	(Robbins et al., 2014)
<i>Ginglymostoma cirratum</i>	Nurse shark	melanoma	(Robbins et al., 2014)
<i>Hemichromis bimaculatus</i>	African jewelfish	osteochondroma	(Groff, 2004)
<i>Hippocampus abdominalis</i>	Pot-bellied sea horse	reticuloendothelial hyperplasia	(LePage et al., 2012)
<i>Hippocampus erectus</i>	Lined sea horse	fibrosarcoma of the brood pouch	(LePage et al., 2012)
<i>Hippocampus kuda</i>	Yellow sea horse	renal adenoma, renal round cell tumor, exocrine pancreatic carcinoma, intestinal carcinoma	(LePage et al., 2012)
<i>Hippocampus kuda</i> & <i>Phyllopteryx taeniolatus</i>	Seahorse hybrids	cardiac rhabdomyosarcoma, renal adenocarcinoma, renal adenoma, lymphomas, exocrine pancreatic carcinoma, intestinal carcinoma	(LePage et al., 2012)
<i>Ictalurus nebulosus</i>	Brown bullhead	hepatobiliary neoplasms	(Groff, 2004)
<i>Ictalurus punctatus</i>	Channel catfish	osteosarcoma	(Groff, 2004)
<i>Kryptolebias marmoratus</i>	Mangrove rivulus	chondrosarcomas, hemangiomas, hemangioendotheliomas, hemangioendotheliosarcomas	(Groff, 2004)
<i>Lepomis sp.</i>	Sunfish	cutaneous carcinoma	(Groff, 2004)
<i>Limanda limanda</i>	Common dab	papillomas	(Groff, 2004)
<i>Microgadus tomcod</i>	Atlantic tomcod	hepatic neoplasm	(Groff, 2004)
<i>Morone saxatilis</i>	Striped Bass	nephroblastomas	(Groff, 2004)
<i>Mustelus canis</i>	Smooth dogfish	cutaneous neoplasms	(Groff, 2004)
<i>Nebrius ferrugineus</i>	Tawny nurse shark	cutaneous osteoma	(Groff, 2004)
<i>Oncorhynchus kisutch</i>	Coho salmon	plasmacytoid leukemia (marine anemia), lymphomas	(Groff, 2004)
<i>Oncorhynchus mykiss</i>	Rainbow trout	hepatobiliary neoplasms, nephroblastoma, adenopapillomas, lymphomas	(Groff, 2004)
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	plasmacytoid leukemia (marine anemia)	(Groff, 2004)
<i>Oryzias latipes</i>	Medaka	lymphohematopoietic neoplasms, cutaneous lymphoma, adenomas, adenocarcinomas, retinoblastomas, teratoid medulloepitheliomas, medulloepitheliomas, neoplasms of embryonal origin or teratomas	(Groff, 2004)
<i>Osmerus eperlanus</i>	European smelt	papillomas and squamous cell carcinomas	(Groff, 2004)

<i>Osmerus mordax</i>	Rainbow smelt	papillomas, and squamous cell carcinomas	(Groff, 2004)
<i>Pagrus major</i>	Japanese seabream	leukemia	(Groff, 2004)
<i>Perca flavescens</i>	Yellow perch	ovarian and testicular leiomyomas and fibroleiomyomas	(Groff, 2004)
<i>Phyllopteryx taeniolatus</i>	Weedy sea dragon	rhabdomyosarcoma	(LePage et al., 2012)
<i>Plecoglossus altivelis</i>	Ayu	rhabdomyoma	(Groff, 2004)
<i>Plectropomus leopardus</i>	Coral trout	melanomas	(Sweet et al., 2012)
<i>Poecilia formosa</i>	Amazon molly	pigment cell neoplasms (or chromatophoromas)	(Groff, 2004)
<i>Poecilia reticulata</i>	Guppy	epidermal cystadenoma, adenomas, adenocarcinomas, neoplasms of embryonal origin or teratomas	(Groff, 2004)
<i>Pomacentrus partitus</i>	Bicolor damselfish	neurofibromas, schwannomas	(Groff, 2004)
<i>Prionace glauca</i>	Blue shark	cholangiocarcinoma, testicular mesothelioma, odontogenic, oral and gingival neoplasms	(Groff, 2004, Robbins et al., 2014)
<i>Pseudopleuronectes obscurus</i>	Flatfish	papillomas (wild)	(Groff, 2004)
<i>Pterophyllum scalare</i>	Angelfish	labial fibromas (odontomas)	(Groff, 2004)
<i>Salmo salar</i>	Atlantic salmon	fibrosarcomas of the swimbladder, cutaneous papillomas, sarcomas	(Groff, 2004)
<i>Sparus aurata</i>	Gilt-head bream	osteochondroma	(Groff, 2004)
<i>Stizostedion vitreum</i>	Walleye	dermal sarcomas	(Groff, 2004)
<i>Tilapia spp.</i>	Tilapia	adenocarcinomas, lymphomas	(Groff, 2004)
<i>Xiphophorus maculatus</i>	Southern platyfish	melanoma, neoplasms of embryonal origin or teratomas	(Groff, 2004)
<i>Xiphophorus maculatus X helleri</i>	Platyfish and swordtail hybrid	pigment cell neoplasms	(Groff, 2004)
Amphibians			
<i>Ambystoma tigrinum</i>	Tiger salamander	tumorous growths, type not specified	(Rose, 1976, Rose and Harshbarger, 1977)
<i>Bufo japonicus x Bufo raddei hybrids</i>	Toad hybrids	renal cell carcinomas	(Masahito et al., 2003)
<i>Calotriton arnoldi</i>	Montseny brook newt	pigmented skin tumors, melanophoroma, chromatophoromas	(Martinez-Silvestre et al., 2011)
<i>Litoria aurea</i>	Green and golden bell frog	nephroblastoma, carcinoma	(Ladds, 2009)

<i>Litoria caerulea</i>	Green tree frog	renal adenocarcinoma, cutaneous papilloma and fibropapilloma of the maxillary region and upper lip, hepatoma, metastatic pancreatic adenocarcinoma, coelomic adenoma	(Ladds, 2009)
<i>Litoria infrafrenata</i>	Giant (white lipped) tree frog	lymphoma, renal tubular adenoma, squamous cell carcinoma, papilloma, sebaceous gland carcinoma	(Ladds, 2009)
<i>Litoria lesueuri</i>	Lesuer's frog	melanoma	(Ladds, 2009)
<i>Paramesotriton hongkongensis</i>	Hong Kong warty newt	seminoma	(Chu et al., 2012a)
<i>Xenopus laevis</i>	African Clawed Frog	various types the most common being hepatomas, ovarian tumours and teratomas	(Balls and Clothier, 1974, Robert et al., 2009, Hardwick and Philpott, 2015)
Reptiles			
<i>Acanthophis antarticus</i>	Death adder	leukemic lymphoma, melanoma	(Ladds, 2009, Mader, 1996)
<i>Acrantophis madagascariensis</i>	Madagascar boa	squamous cell carcinoma, biphasic neoplasm	(Bera et al., 2008, Steeil et al., 2013)
<i>Acrochordus javanicus</i>	Elephant trunk snake	fibroma	(Mader, 1996)
<i>Agkistrodon contortrix</i>	Southern copperhead	myeloid leukemia, cholangiocarcinoma, hemangiosarcoma	(Catão-Dias and Nichols, 1999)
<i>Agkistrodon halys brevicaudus</i>	Korean mamushi	adenocarcinoma, neurofibrosarcoma	(Mader, 1996)
<i>Agkistrodon piscivorus</i>	Cottonmouth	squamous cell carcinoma, sarcoma, fibroma	(Mader, 1996)
<i>Alligator mississippiensis</i>	American alligator	papilloma, seminoma, fibrosarcoma	(Mader, 1996, Elsey et al., 2013)
<i>Anolis caroliensis</i>	Carolina anole	reticulum sarcoma	(Hernandez-Divers and Garner, 2003)
<i>Apalone ferox</i>	Florida softshell turtle	lymphoreticular neoplasia	(Hernandez-Divers and Garner, 2003)
<i>Arizona elegans occidentalis</i>	California glossy snake	pheochromocytoma	(Mader, 1996)
<i>Aspidites melanocephalus</i>	Black-headed python	gastric adenocarcinoma, angiolioma	(Ladds, 2009, Dietz et al., 2016)
<i>Aspidites ramsayi</i>	Woma	lymphoma, colonic adenocarcinoma	(Ladds, 2009)
<i>Basiliscus plumifrons</i>	Green basilisk	fibrosarcoma	(Hernandez-Divers and Garner, 2003)
<i>Bitis arietans</i>	Puff adder	leukemic lymphoma, adenoma	(Mader, 1996)
<i>Bitis gabonica</i>	Gaboon viper	transitional cell carcinoma, carcinoma, adenocarcinoma, fibrosarcoma, lymphoma, squamous cell carcinoma	(Mader, 1996) (Catão-Dias and Nichols, 1999)
<i>Bitis nasicornis</i>	Rhinoceros viper	lymphoma, leukemic lymphoma, leukemia	(Mader, 1996)

<i>Boa constrictor</i>	Boa constrictor	fibrosarcoma, malignant peripheral nerve sheath tumour, malignant perivascular wall tumour, squamous cell carcinoma, fibrosarcoma, melanoma, hemangiosarcoma, lipoma, leukemia, adenocarcinoma, carcinoma, rhabdomyosarcoma	(Mader, 1996, Dietz et al., 2016)
<i>Boa cookii</i>	Cook's tree boa	hemangiosarcoma	(Mader, 1996)
<i>Boiga dendrophila</i>	Mangrove snake	fibrosarcoma	(Mader, 1996)
<i>Bothrops atrox</i>	Common lancehead	adenocarcinoma	(Mader, 1996)
<i>Caretta caretta</i>	Loggerheads	fibropapilloma, lymphoblastic lymphoma	(Ladds, 2009)
<i>Chalcides ocellatus</i>	Brown forest skink	lymphoma	(Chu et al., 2012a)
<i>Chamaeleo dilepis</i>	Flap-necked chameleon	hepatoma	(Hernandez-Divers and Garner, 2003)
<i>Chelonia mydas</i>	Green sea turtle	papillomas, fibromas, fibropapillomas, fibroma, fibroadenoma, carcinoma, myxofibroma, leiomyoma, papilloma of the gall bladder	(Mader, 1996, Brill et al., 1995, Reichenbach-Klinke, 1963, Ladds, 2009)
<i>Chilabothrus inornatus</i>	Yellow tree boa	squamous cell carcinoma, hepatoma, leiomyosarcoma	(Mader, 1996)
<i>Chondropython viridis</i>	Green tree python	lymphoid leukemia, fibrosarcoma, chromatophoroma (small intestine), thymoma, myeloid leukemia, lymphoma	(Catão-Dias and Nichols, 1999)
<i>Clelia clelia</i>	Mussurana	hepatoma	(Mader, 1996)
<i>Cnemidophorus uniparens</i>	Golden pheasant	teratoma	(Hernandez-Divers and Garner, 2003)
<i>Coleonyx mitratus</i>	Central American banded gecko	coelom	(Hernandez-Divers and Garner, 2003)
<i>Corallus caninus</i>	Emerald tree boa	leiomyosarcoma, lymphoma, adenocarcinoma, malignant peripheral nerve sheath tumour	(Catão-Dias and Nichols, 1999, Dietz et al., 2016)
<i>Cordylus polyzonus</i>	Karoo girdled lizard	adenoma	(Hernandez-Divers and Garner, 2003)
<i>Crocodylus acutus</i>	American crocodile	lipoma	(Mader, 1996)
<i>Crocodylus porosus</i>	Saltwater crocodile	lymphoma, papilloma, cancer of the cerebellum, squamous cell carcinoma	(Reichenbach-Klinke, 1963, Hill et al., 2016)
<i>Crocodylus siamensis</i>	Siamese crocodile	fibrosarcoma	(Hernandez-Divers and Garner, 2003)
<i>Crotalus atrox</i>	Western diamondback rattlesnake	fibrosarcoma	(Mader, 1996)
<i>Crotalus horridus</i>	Timber rattlesnake	adenoma, adenocarcinoma, fibrosarcoma, leukemia, mesothelioma, hemangioma	(Mader, 1996)

<i>Crotalus mitchellii pyrrhus</i>	Southwestern speckled rattlesnake	adenocarcinoma	(Mader, 1996)
<i>Crotalus ruber</i>	Red diamond rattlesnake	sarcoma	(Mader, 1996)
<i>Crotalus viridis helleri</i>	Prairie rattlesnake	hemangioma	(Mader, 1996)
<i>Crotalus viridis viridis</i>	Prairie rattlesnake	fibrosarcoma	(Mader, 1996)
<i>Cyclura cornuta</i>	Rhinoceros iguana	chondro-osteofibroma	(Hernandez-Divers and Garner, 2003)
<i>Cyclura ricordi</i>	Hispaniolan ground iguana	biliary adenoma	(Hernandez-Divers and Garner, 2003)
<i>Dipsosaurus dorsalis</i>	Desert iguana	adenoma, adenocarcinoma	(Hernandez-Divers and Garner, 2003)
<i>Dispholidus typhus</i>	Boomslang	adenoma	(Mader, 1996)
<i>Drymarchon corais</i>	Eastern indigo snake	melanophoroma	(Mader, 1996)
<i>Drymarchon couperi</i>	Eastern indigo snake	adenocarcinoma	(Mader, 1996)
<i>Drymarchon melanurus erebennus</i>	Texas indigo snake	leiomyosarcoma	(Mader, 1996)
<i>Echis carinatus</i>	Saw-scaled viper	hepatocarcinoma	(Catão-Dias and Nichols, 1999)
<i>Elaphe guttata guttata</i>	Corn snake	lymphoma, carcinoma, lymphoma, chondrosarcoma, renal cell carcinoma, adenocarcinoma, myeloid leukemia, leiomyosarcoma	(Mader, 1996, Catão-Dias and Nichols, 1999)
<i>Elaphe obsoleta</i>	Western ratsnake	adenocarcinoma, adenoma, fibrosarcoma, rhabdomyosarcoma	(Mader, 1996, Catão-Dias and Nichols, 1999)
<i>Elaphe obsoleta rossalleni</i>	Everglades ratsnake	melanoma	(Mader, 1996)
<i>Elaphe obsoleta quadrivittata</i>	Yellow ratsnake	transitional cell carcinoma	(Mader, 1996)
<i>Elaphe taeniura</i>	Beauty snake	hepatocarcinoma	(Catão-Dias and Nichols, 1999)
<i>Elaphe taeniura friesei</i>	Taiwan beauty rat snake	malignant chromatophoroma	(Chu et al., 2012b)
<i>Elaphe vulpina</i>	Fox snake	adenocarcinoma	(Mader, 1996)
<i>Emys orbicularis</i>	European pond turtle	squamous cell carcinoma, fibroadenoma	(Mader, 1996)
<i>Epicrates cenchria</i>	Rainbow boa	histiocytoma, lymphoma, adenoma, myelomonocytic leukemia, squamous cell carcinoma	(Catão-Dias and Nichols, 1999)
<i>Epicrates cenchria cenchria</i>	Rainbow boa	lymphoma, adenoma of the pancreas, myelomonocytic leukemia, squamous cell carcinoma	(Catão-Dias and Nichols, 1999)
<i>Epicrates subflavus</i>	Jamaican boa	malignant peripheral nerve sheath tumour, malignant perivascular wall tumour	(Dietz et al., 2016)
<i>Eryx conicus</i>	Common sand boa	squamous cell carcinoma, mixed cell tumour	(Mader, 1996)
<i>Eublepharis macularis</i>	Leopard gecko	cholangiocarcinoma	(Hernandez-Divers and Garner, 2003)
<i>Eumeces fasciatus</i>	Five-lined skink	hepatocarcinoma	(Hernandez-Divers and Garner, 2003)

			2003)
<i>Eunectes murinus</i>	Green anaconda	lymphoma, fibrosarcoma, granulosa cell tumour	(Mader, 1996)
<i>Eunectes notaeus</i>	Yellow anaconda	cystadenoma	(Catão-Dias and Nichols, 1999)
<i>Geochelona carbonaria</i>	Redfoot tortoise	adenoma	(Mader, 1996)
<i>Gopherus agassizi</i>	Mohave desert tortoise	adenoma, interstitial tumour	(Mader, 1996)
<i>Gopherus trijuga</i>	Ceylon terrapin	carcinoma, squamous cell carcinoma	(Mader, 1996)
<i>Heloderma suspectum</i>	Gila monster	squamous cell carcinoma, melanoma	(Hernandez-Divers and Garner, 2003)
<i>Heterodon nasicus</i>	Western hognose snake	sarcoma, lymphoma	(Mader, 1996)
<i>Hydrosaurus amboinensis</i>	Amboina sailfin lizard	lymphoma, plasma cell tumour	(Hernandez-Divers and Garner, 2003)
<i>Iguana iguana</i>	Green iguana	lymphoma, hepatoma, cholangioma, adenocarcinoma, ovarian teratoma, adenoma	(Hernandez-Divers and Garner, 2003)
<i>Lacerta agilis</i>	Sand lizard	papilloma, squamous cell carcinoma	(Hernandez-Divers and Garner, 2003, Reichenbach-Klinke, 1963)
<i>Lacerta lepida</i>	Ocellated lizard	papilloma	(Reichenbach-Klinke, 1963)
<i>Lacerta viridis</i>	Green lizard	papilloma, osteosarcoma	(Hernandez-Divers and Garner, 2003, Reichenbach-Klinke, 1963)
<i>Lamprohis fuliginosus</i>	African house snake	malignant peripheral nerve sheath tumour	(Dietz et al., 2016)
<i>Lampropeltis getulus californiae</i>	Eastern kingsnake	adenoma, carcinoma, lymphoma, squamous cell carcinoma, cholangiocarcinoma, melanoma, malignant peripheral nerve sheath tumour	(Mader, 1996, Dietz et al., 2016)
<i>Lampropeltis getulus getulus</i>	Eastern kingsnake	tubular adenoma	(Catão-Dias and Nichols, 1999)
<i>Lampropeltis getulus holbrooki</i>	Speckled kingsnake	adenoma	(Mader, 1996)
<i>Lampropeltis triangulum annulata</i>	Mexican milk snake	sarcoma	(Mader, 1996)
<i>Lampropeltis triangulum sinaloae</i>	Sinaloan milk snake	myxosarcoma, sarcoma, hepatoma	(Mader, 1996, Catão-Dias and Nichols, 1999)
<i>Lampropeltis triangulum triangulum</i>	Eastern milk snake	adenocarcinoma, adenoma	(Catão-Dias and Nichols, 1999)
<i>Morelia spilota</i>	Carpet python	multicentric lymphoma, soft tissue sarcoma, fibrosarcoma, cholangiocarcinoma, coelomic carcinoma	(Ladds, 2009)
<i>Morelia spilota spilota</i>	Dimond python	myxosarcoma, monocytic leukemia of azurophilic type, lymphoid leukemia	(Ladds, 2009)
<i>Morelia spilotes variegata</i>	Darwin carpet python	cholangiocarcinoma	(Mader, 1996)
<i>Morelia viridis</i>	Green tree python	ossifying fibrosarcoma	(Ladds, 2009, Mader, 1996)

<i>Naja naja</i>	Indian cobra	leiomyosarcoma, adenocarcinoma, adenoma, lymphoma, hepatocarcinoma	(Mader, 1996, Catão-Dias and Nichols, 1999)
<i>Naja nigricollis</i>	Black-necked spitting cobra	adenoma, lymphoma	(Mader, 1996)
<i>Naja nivea</i>	Cape cobra	adenocarcinoma	(Mader, 1996)
<i>Natrix natrix</i>	Grass snake	pancreatic adenocarcinoma, malignant peripheral nerve sheath tumour	(Reichenbach-Klinke, 1963, Dietz et al., 2016)
<i>Ophiophagus hannah</i>	King cobra	tubular adenoma	(Catão-Dias and Nichols, 1999)
<i>Pantherophis alleghaniensi</i>	Black rat snake	ameloblastoma	(Comolli et al., 2015)
<i>Pantherophis guttatus</i>	Corn snake	lipoma, fibrosarcoma, malignant peripheral nerve sheath tumour, rhabdomyosarcoma	(Dietz et al., 2016)
<i>Pelomedusa subrufa</i>	African helmeted turtle	leukemia	(Mader, 1996)
<i>Pelusios subniger</i>	East African black mud turtle	carcinoma	(Mader, 1996)
<i>Pituophis melanoleucus</i>	Pine snake	adenocarcinoma, malignant chromatophoroma, carcinoma, adenoma	(Mader, 1996)
<i>Pituophis melanoleucus musitus</i>	Florida pine snake	rhabdomyosarcoma, adenoma, adenocarcinoma, melanoma	(Mader, 1996)
<i>Pituophis melanoleucus sayi</i>	Bullsnake	papilloma, adenocarcinoma, malignant melanoma	(Reichenbach-Klinke, 1963, Mader, 1996)
<i>Podarcis muralis</i>	Common wall lizard	papilloma	(Hernandez-Divers and Garner, 2003)
<i>Pogona vitticeps</i>	Bearded dragon	adenocarcinoma of the liver, disseminated myelogenous leukemia, monocytic leukemia, malignant nerve sheath tumour	(Hernandez-Divers and Garner, 2003, Ladds, 2009)
<i>Pardalis sicula</i>	Italian wall lizard	lymphoma, fibrosarcoma, undifferentiated mesenchymal tumour	(Hernandez-Divers and Garner, 2003)
<i>Pseudechis porphyriacus</i>	Red-bellied black snake	cutaneous papillomas, adenomatous proliferation, adenoma of the bile duct	(Ladds, 2009, Mader, 1996)
<i>Pseudemys elegans</i>	Red-eared Slider	leukemia	(Mader, 1996)
<i>Pseudonaja affinis</i>	Dugite	melanoma	(Ladds, 2009)
<i>Pseudonaja nuchalis</i>	Western brown snake	leukaemic lymphoma	(Ladds, 2009)
<i>Python molurus</i>	Indian rock python	ameloblastoma, fibroma	(Mader, 1996)
<i>Python molurus bivittatus</i>	Burmese python	carcinoma, adenocarcinoma, interstitial cell tumour, osteosarcoma	(Mader, 1996)
<i>Python molurus molurus</i>	Indian python	sarcoma, lymphoma, leukemia	(Mader, 1996)
<i>Python regius</i>	Ball python	fibrosarcoma	(Mader, 1996)

<i>Python reticulatus</i>	Reticulated python	carcinoma, melanoma, lymphoma	(Mader, 1996)
<i>Python sebae</i>	African rock python	adenoma	(Mader, 1996)
<i>Rhamphiophis oxyrhynchus</i>	Rufous beaked snake	hemangiosarcoma, lymphoma, fibrosarcoma	(Catão-Dias and Nichols, 1999)
<i>Sistrurus catenatus</i>	Massasauga	adenoma, hemangioma, carcinoma	(Mader, 1996)
<i>Spilotes pullatus</i>	Yellow rat snake	adenocarcinoma	(Mader, 1996)
<i>Strophurus spinigerus</i>	Spiny-tailed gecko	neuroblastoma	(Ladds, 2009)
<i>Terrapene carolina</i>	Common box turtle	adenocarcinoma	(Mader, 1996)
<i>Testudo graeca</i>	Spur-thighed tortoise	adenoma	(Mader, 1996)
<i>Testudo hermanni</i>	Hermann's tortoise	lymphoma, neurilemmoma	(Mader, 1996)
<i>Testudo horsfieldi</i>	Afghan Tortoise	fibroma, fibroadenoma	(Mader, 1996)
<i>Thamnophis sauritus</i>	Ribbon snake	lipoma	(Dietz et al., 2016)
<i>Thamnophis sirtalis</i>	Common garter snake	squamous cell carcinoma, cholangioma, granulosa cell tumour, Sertoli cell tumour, malignant perivascular wall tumour, malignant peripheral nerve sheath tumour	(Mader, 1996, Dietz et al., 2016)
<i>Thamnophis elegans terrestris</i>	Coast garter snake	malignant chromatophoroma	(Mader, 1996)
<i>Tiliqua rugosa</i>	Bobtail lizard	subcutaneous osteoma, liposarcoma	(Ladds, 2009)
<i>Trachemys scripta elegans</i>	Red-eared slider	carcinoma	(Mader, 1996)
<i>Trachydosaurus rugosus</i>	Shingle-back lizard	liposarcoma	(Hernandez-Divers and Garner, 2003)
<i>Tupinambis nigropunctatus</i>	Tegu	squamous cell carcinoma,	(Hernandez-Divers and Garner, 2003)
<i>Tupinambis rufescens</i>	Argentine red tegu	hepatoma	(Hernandez-Divers and Garner, 2003)
<i>Tupinambis teguixin</i>	Golden tegu	squamous cell carcinoma	(Hernandez-Divers and Garner, 2003)
<i>Uromastix acathinura</i>	Bell's dabb lizard	lymphoma	(Hernandez-Divers and Garner, 2003)
<i>Uromastix aegyptia</i>	Egyptian mastigure	lymphoid neoplasia	(Gyimesi et al., 2005)
<i>Varanus bengalensis</i>	Bengal monitor	leukemia, osteochondroma, enchondroma	(Hernandez-Divers and Garner, 2003)
<i>Varanus exanthematicus</i>	Savannah monitor	lymphoma	(Hernandez-Divers and Garner, 2003)
<i>Varanus komodoensis</i>	Komodo dragon	carcinoma, adenoma, islet cell tumour, pheochromocytoma, Interstitial cell tumour	(Hernandez-Divers and Garner, 2003)
<i>Varanus niloticus</i>	Nile monitor	plasma cell tumour	(Hernandez-Divers and Garner, 2003)
<i>Varanus salvator</i>	Water monitor	lymphoma	(Hernandez-Divers and Garner, 2003)

<i>Vipera ammodytes</i>	Horned viper	adenocarcinoma	(Mader, 1996)
<i>Vipera palestine</i>	Palestine viper	adenocarcinoma	(Mader, 1996)
<i>Vipera russelli</i>	Russell's viper	fibrosarcoma, leukemia, myofibroma	(Mader, 1996)
<i>Walterinnesia aegyptia</i>	Desert cobra	pheochromocytoma	(Mader, 1996)
Birds			
<i>Acanthagenys rufogularis</i>	Spiny-cheeked honeyeater	nephroblastoma	(Ladds, 2009)
<i>Agapomis liliana</i>	Nyasa lovebird	fibromas and fibrosarcomas of integument and/or skeletal muscle, Sertoli cell tumours	(Ladds, 2009, Reece, 1992)
<i>Agapomis roseicollis</i>	Peach-faced lovebird	fibromas and fibrosarcomas of the integument and/or skeletal muscle, visceral fibromas and fibrosarcomas, subcutaneous lipomas, intra-abdominal lipomas, lymphoblastic lymphomas, lymphocytic lymphomas and mixed-cell lymphomas, hepatocarcinomas, neurilemmoma	(Ladds, 2009, Reece, 1992)
<i>Ailuroedus crassirostris</i>	Green catbird	myelocytomas	(Ladds, 2009, Reece, 1992)
<i>Aix sponsa</i>	North American wood duck	malignant melanoma	(Chu et al., 2012a)
<i>Alectoris gracea</i>	Chukar partridge	liposarcomas, cholangiomas	(Ladds, 2009, Reece, 1992)
<i>Alisterus scapularis</i>	Australian king parrot	plasma cell tumours	(Ladds, 2009, Reece, 1992)
<i>Anas castanea</i>	Chestnut teal	lymphocytic lymphomas and mixed-cell lymphomas, metastatic abdominal adenocarcinomas	(Ladds, 2009, Reece, 1992)
<i>Anas cyanoptera</i>	Cinnamon teal	adenocarcinoma	(Snyder and Ratcliffe, 1966)
<i>Anas novaehollandiae</i>	New Zealand scaup	dermal squamous cell carcinomas	(Ladds, 2009, Reece, 1992)
<i>Anas platyrhynchos</i>	Mallard, domestic duck	intra-abdominal lipomas, chondromas, osteomas, lymphoblastic lymphomas, seminomas, metastatic abdominal adenocarcinomas, astrocytoma	(Ladds, 2009, Reece, 1992)
<i>Anas platyrhynchos</i>	Mallard duck	seminoma	(Chu et al., 2012a)
<i>Anas superciliosa</i>	Pacific black duck	myxomas and myxofibromas, malignant melanomas	(Ladds, 2009, Reece, 1992)
<i>Anhinga novaehollandiae</i>	Darter	hemangiomas	(Ladds, 2009, Reece, 1992)
<i>Anser anser</i>	Greylag goose	chondromas	(Ladds, 2009, Reece, 1992)
<i>Anser domesticus</i>	Domestic goose	fibrosarcoma	(Ratcliffe, 1933)
<i>Aprosmictus scapularis</i>	King parrot	fibrosarcoma	(Ratcliffe, 1933)
<i>Ara militaris</i>	Military macaw	squamous cell carcinoma	(Ratcliffe, 1933)
<i>Bamardius bamardii</i>	Mallee ring-neck	lymphoblastic lymphomas	(Ladds, 2009, Reece, 1992)
<i>Bamardius zonarius</i>	Port Lincoln parrot	plasma cell tumours	(Ladds, 2009, Reece, 1992)

<i>Barnardius zonarius semitorquatus</i>	Twenty eight parrot	plasma cell tumours	(Ladds, 2009)
<i>Brotogeris tirica</i>	Plain Parakeet	fibrosarcoma	(Ratcliffe, 1933)
<i>Bubo virginianus</i>	Great horned owl	myelogenous leukemia	(Wiley et al., 2009)
<i>Cacatua galerita</i>	Sulphur-crested cockatoo	visceral fibromas and fibrosarcomas, subcutaneous lipomas, intra-abdominal lipomas, osteosarcomas, lymphoblastic lymphomas, lymphocytic lymphomas, and mixed-cell lymphomas, granulosa cell tumours, squamous cell carcinoma	(Ladds, 2009, Reece, 1992)
<i>Cacatua galerita</i>	Sulphur-crested cockatoo	adenocarcinoma	(Ratcliffe, 1933)
<i>Cacatua leadbeateri</i>	Pink cockatoo	dermal squamous cell carcinomas	(Ladds, 2009, Reece, 1992)
<i>Cacatua moluccensis</i>	Gang-gang cockatoo	lymphomas	(Ratcliffe, 1933)
<i>Cacatua roseicapilla</i>	Galah	subcutaneous lipomas, intra-abdominal lipomas, granulosa cell tumours	(Ladds, 2009, Reece, 1992)
<i>Cacatua sanguined</i>	Little corella	intra-abdominal lipomas, lymphoblastic lymphomas	(Ladds, 2009, Reece, 1992)
<i>Callocephalon fimbriatum</i>	Gang-gang cockatoo	visceral fibromas and fibrosarcomas, osteosarcomas, plasma cell tumours	(Ladds, 2009, Reece, 1992)
<i>Calyptorhynchus baudinii</i>	White-tailed black cockatoo	myeloblastomas	(Ladds, 2009, Reece, 1992)
<i>Casuarius casarius johnsonii</i>	Southern cassowary	papilliform mesotheliomas, gastro-intestinal adenocarcinomas	(Ladds, 2009, Reece, 1992)
<i>Centropus phasianinus</i>	Coucal pheasant	hepatoma, hepatocarcinoma, cholangioma	(Ladds, 2009)
<i>Cereopsis novaehollandiae</i>	Cape barren goose	plasma cell tumours	(Ladds, 2009, Reece, 1992)
<i>Chalcophaps indica</i>	Emerald dove	pinealoma	(Ladds, 2009, Reece, 1992)
<i>Chloephaga leucoptera</i>	Upland goose	adenocarcinoma	(Snyder and Ratcliffe, 1966)
<i>Chrysolophus pictus</i>	Golden pheasant	adenocarcinoma, adenoma	(Ratcliffe, 1933)
<i>Columba livia</i>	Domestic pigeon	fibromas and fibrosarcomas of integument and/or skeletal muscle, visceral fibromas and fibrosarcomas, subcutaneous lipomas, intra-abdominal lipomas, liposarcomas, rhabdomyoma, leiomyomas and leiomyofibromas, myelocytomas, lymphoblastic lymphomas, lymphocytic lymphomas and mixed-cell lymphomas, plasma cell tumours, basal cell tumours, crop carcinoma, cholangiomas, renal adenocarcinomas, metastatic abdominal adenocarcinomas, seminomas, thyroid adenomas	(Ladds, 2009, Reece, 1992, Shimonohara et al., 2013)

<i>Columba pulchricollis</i>	Ashy wood pigeon	cholangioma	(Chu et al., 2012a)
<i>Conurus holochlorus</i>	Green parakeet	carcinomatoid embryoma	(Ratcliffe, 1933)
<i>Coscoroba coscoroba</i>	Coscoroba swan	cholangiocarcinoma, renal cell carcinoma	(Chu et al., 2012a)
<i>Coturnix australis</i>	Brown quail	subcutaneous lipomas	(Ladds, 2009, Reece, 1992)
<i>Coturnix chinensis</i>	King quail	fibromas and fibrosarcomas of integument and/or skeletal muscle, hepatocarcinomas, seminomas, metastatic abdominal adenocarcinomas	(Ladds, 2009, Reece, 1992)
<i>Coturnix coturnix japonica</i>	Japanese quail	fibromas and fibrosarcomas of integument and/or skeletal muscle, visceral fibromas and fibrosarcomas, osteosarcomas, hemangiomas, lymphocytic lymphomas and mixed-cell lymphomas, cholangiomas	(Ladds, 2009, Reece, 1992)
<i>Cyanoramphus novaeseelandiae</i>	Red-fronted parakeet	intra-abdominal lipomas	(Ladds, 2009, Reece, 1992)
<i>Cygnus atratus</i>	Black swan	myxomas and myxofibromas, osteosarcoma	(Ladds, 2009, Reece, 1992, Chu et al., 2012a)
<i>Cygnus olor</i>	Mute swan	myxomas and myxofibromas	(Ladds, 2009, Reece, 1992)
<i>Dacelo novaeguineae</i>	Laughing kookaburra	intra-abdominal lipomas, cholangiomas	(Ladds, 2009, Reece, 1992)
<i>Dendrocygna autumnalis</i>	Red-billed tree duck	adenocarcinoma	(Snyder and Ratcliffe, 1966)
<i>Dromaius novaehollandiae</i>	Emu	pancreatic adenocarcinomas	(Ladds, 2009, Reece, 1992)
<i>Dryonastes berthemyi</i>	Buffy laughingthrush	fibrosarcoma	(Ratcliffe, 1933)
<i>Egretta novaehollandiae</i>	White-faced heron	lymphoma	(Ladds, 2009)
<i>Emberiza icterica</i>	Red-headed Bunting	lipoma	(Ratcliffe, 1933)
<i>Emblema temporalis</i>	Red-browed firetail	oesophageal papilloma	(Ladds, 2009, Reece, 1992)
<i>Eolophus roseicapill</i>	Galah	lipomas	(Ratcliffe, 1933)
<i>Erythrura gouldiae</i>	Gouldian finch	adrenocortical adenomas	(Ladds, 2009, Reece, 1992)
<i>Erythrura trichroa</i>	Blue-faced parrot finch	renal adenoma, adenocarcinoma	(Ladds, 2009)
<i>Eudyptula minor</i>	Little penguin	lymphocytic lymphomas and mixed-cell lymphomas, fibroma, fibrosarcoma, cutaneous papillomas	(Ladds, 2009, Reece, 1992)
<i>Falco naumanni</i>	Lesser kestrel	malignant intracranial teratoma	(Lopez and Murcia, 2008)
<i>Gennaues nycthemerus</i>	Silver pheasant	adenocarcinoma	(Ratcliffe, 1933)
<i>Gennaues nycthemerus</i>	Silver pheasant	adenocarcinoma	(Snyder and Ratcliffe, 1966)
<i>Geopelia cuneata</i>	Diamond dove	leiomyomas and leiomyofibromas	(Ladds, 2009, Reece, 1992)
<i>Geopelia humeralis</i>	Bar-shouldered dove	osteosarcomas	(Ladds, 2009, Reece, 1992)

<i>Geopelia placida</i>	Peaceful dove	leiomyomas and leiomyofibromas	(Ladds, 2009, Reece, 1992)
<i>Ginnaeus swinhoi</i>	Swinhoe's pheasant	visceral fibromas and fibrosarcomas	(Ladds, 2009, Reece, 1992)
<i>Gracula religiosa</i>	Greater hill mynah	chondrosarcoma	(Chu et al., 2012a)
<i>Gymnorhina tibicen</i>	Australian magpie	fibromas and fibrosarcomas of the integument and/or skeletal muscle, myeloblastomas, lymphocytic lymphomas and mixed-cell lymphomas	(Ladds, 2009, Reece, 1992)
<i>Indotestudo elongate</i>	Yellow-headed tortoise	leukemia	(Chu et al., 2012a)
<i>Larus novaehollandiae</i>	Silver gull	lymphocytic lymphomas and mixed-cell lymphomas	(Ladds, 2009, Reece, 1992)
<i>Larus pacificus</i>	Pacific gull	chondromas, myelocytomas	(Ladds, 2009, Reece, 1992)
<i>Leipoa ocellata</i>	Mallee fowl	lymphomas	(Ladds, 2009)
<i>Leptolophus hollandicus</i>	Cockatiel	lipomas	(Ratcliffe, 1933)
<i>Lonchura castaneolhorax</i>	Chestnut-breasted mannikin	lymphocytic lymphomas and mixed-cell lymphomas	(Ladds, 2009, Reece, 1992)
<i>Lopholaimus antarcticus</i>	Topknot pigeon	lymphomas	(Ladds, 2009)
<i>Macropygia amboinensis</i>	Cuckoo-dove	gastro-intestinal adenocarcinomas	(Ladds, 2009)
<i>Malurus cyaneus</i>	Superb fairy-wren	lymphocytic lymphomas and mixed-cell lymphomas	(Ladds, 2009, Reece, 1992)
<i>Mareca sibilatrix</i>	Chiloe widgeon	adenocarcinoma	(Snyder and Ratcliffe, 1966)
<i>Megaquiscalus major</i>	Boat-tailed grackle	adenocarcinoma	(Ratcliffe, 1933)
<i>Meleagris gallopavo</i>	Wild turkey	adenocarcinoma	(Ratcliffe, 1933)

<i>Melopsittacus undulatus</i>	Budgerigar	adenoma, adenocarcinoma, carcinomas, fibromas and fibrosarcomas of integument and/or skeletal muscle, visceral fibromas and fibrosarcomas, myxomas and myxofibromas, subcutaneous lipomas, intra-abdominal lipomas, osteomas, leiomyomas and leiomyofibromas, hemangiomas, myelocytomas, reticulum cell sarcoma, lymphoblastic lymphomas, lymphocytic lymphomas and mixed-cell lymphomas, plasma cell tumours, dermal squamous cell carcinomas, feather folliculomas, uropygial adenomas, proventricular adenocarcinomas, cholangiomas, renal adenocarcinomas, seminomas, Sertoli cell tumours, Leydig cell tumour, ovarian adenocarcinoma, granulosa cell tumours, oviduct adenomas, metastatic abdominal adenocarcinomas, adrenocortical adenomas, thyroid adenomas, thyroid mixed-cell tumour, neurofibroma, nephroblastoma, lipomas, glioma, lymphoma, teratoma	(Ratcliffe, 1933, Ladds, 2009, Reece, 1992)
<i>Neochmia ruficauda</i>	Star finch	myxomas and myxofibromas	(Ladds, 2009, Reece, 1992)
<i>Neophema pulchella</i>	Turquoise parrot	lymphocytic lymphomas and mixed-cell lymphomas	(Ladds, 2009, Reece, 1992)
<i>Neopsephotus bourkii</i>	Bourke's parrot	plasma cell tumours	(Ladds, 2009, Reece, 1992)
<i>Northiella haematogaster</i>	Blue bonnet	plasma cell tumours	(Ladds, 2009, Reece, 1992)
<i>Nycticorax caledonicus</i>	Rufous night heron	myelocytomas	(Ladds, 2009, Reece, 1992)
<i>Nymphicus hollandicus</i>	Cockatiel	liposarcomas, renal adenocarcinomas, fibroma, fibrosarcoma	(Ladds, 2009, Reece, 1992)
<i>Nyroca americana</i>	Redhead duck	adenocarcinoma	(Snyder and Ratcliffe, 1966)
<i>Oxyura australis</i>	Blue-billed duck	cholangiomas, hepatoma, hepatocarcinoma	(Ladds, 2009, Reece, 1992)
<i>Padda oryzivora</i>	Java sparrow	lymphocytic lymphomas and mixed-cell lymphomas, metastatic abdominal adenocarcinomas	(Ladds, 2009, Reece, 1992)
<i>Palaeornis cyanocephala</i>	Burmese Parrakeet	adenoma	(Ratcliffe, 1933)
<i>Palaeornis eupatrius</i>	Alexandrine Parrakeet	teratoma	(Ratcliffe, 1933)
<i>Paroaria cucullata</i>	Red Crested Cardinal	myxosarcoma	(Ratcliffe, 1933)
<i>Passer domesticus</i>	House sparrow	lymphocytic lymphomas and mixed-cell lymphomas	(Ladds, 2009, Reece, 1992)
<i>Pavo cristatus</i>	Common peafowl	esophageal papilloma	(Chu et al., 2012a)

<i>Pelgadis falcinellus</i>	Glossy ibis	intracutaneous keratoacanthomas	(Ladds, 2009, Reece, 1992)
<i>Phalacrocorax carbo</i>	Great cormorant	melanoma	(Kusewitt and Ley, 1996)
<i>Phaps chalchoptera</i>	Common-bronze-wing	dermal squamous cell carcinomas	(Ladds, 2009, Reece, 1992)
<i>Phasianus colchicus</i>	Ring-necked pheasant	lymphoblastic lymphomas, lymphocytic lymphomas and mixed-cell lymphomas, renal adenocarcinomas, cholangioma, pulmonary carcinoma, renal cell carcinoma, thyroid adenoma, fibroma	(Ladds, 2009, Reece, 1992, Chu et al., 2012a)
<i>Phasianus versicolor</i>	Green Pheasant	fibrosarcoma, lymphomas	(Ratcliffe, 1933)
<i>Phylidonyris novaehollandiae</i>	New Holland honeyeater	cutaneous papillomas	(Ladds, 2009)
<i>Planesticus m. migratorius</i>	Three-Legged Robin	nephroblastoma or renal carcinoma	(Ratcliffe, 1933)
<i>Platycercus elegans</i>	Crimson rosella	lymphocytic lymphomas and mixed-cell lymphomas, plasma cell tumours	(Ladds, 2009, Reece, 1992)
<i>Platycercus eximius</i>	Eastern rosella	lymphocytic lymphomas and mixed-cell lymphomas	(Ladds, 2009, Reece, 1992)
<i>Plectorhyncha lanceolata</i>	Striped honeyeater	nephroblastoma	(Ladds, 2009)
<i>Plectropterus gambensis</i>	Spur-winged goose	fibrosarcoma	(Ratcliffe, 1933)
<i>Podargus strigoides</i>	Tawny frogmouth	intra-abdominal lipomas	(Ladds, 2009, Reece, 1992)
<i>Polytelis swainsonii</i>	Superb parrot	lymphoma, plasma cell tumours	(Ladds, 2009, Reece, 1992)
<i>Prunella collaris</i>	Alpine accentor	hepatoma	(Chu et al., 2012a)
<i>Psephotus dissimilis</i>	Hooded parrot	fibroma, fibrosarcoma	(Ladds, 2009)
<i>Psephotus varius</i>	Mulga parrot	fibromas and fibrosarcomas of integument and/or skeletal muscle	(Ladds, 2009, Reece, 1992)
<i>Quelea quelea</i>	Red-billed quelea	teratoma	(Ratcliffe, 1933)
<i>Serinus canaria</i>	Canary	fibromas and fibrosarcomas of integument and/or skeletal muscle, visceral fibromas and fibrosarcomas, myxomas and myxofibromas, chondromas, leiomyomas and leiomyofibromas, lymphoblastic lymphomas, lymphocytic lymphomas and mixed-cell lymphomas, plasma cell tumours, dermal squamous cell carcinomas, intracutaneous keratoacanthomas, feather folliculomas, uropygial adenomas, proventricular adenocarcinomas, hepatocarcinomas, adrenocortical adenomas, pituitary adenoma	(Ratcliffe, 1933, Ladds, 2009, Reece, 1992)
<i>Sicalis flaveola</i>	Saffron finch	adenocarcinoma	(Ratcliffe, 1933)
<i>Spatula clypeata</i>	Shoveler duck	adenocarcinoma	(Snyder and Ratcliffe, 1966)

<i>Strepera spp.</i>	Currawong	lymphocytic lymphomas and mixed-cell lymphomas	(Ladds, 2009, Reece, 1992)
<i>Struthidea cinerea</i>	Apostlebird	plasma cell tumours	(Ladds, 2009, Reece, 1992)
<i>Struthio camelus</i>	Ostrich	papilliform mesotheliomas	(Ladds, 2009, Reece, 1992)
<i>Tadoma radjah</i>	Radjah shelduck	oviduct adenomas, nephroblastoma	(Ladds, 2009, Reece, 1992)
<i>Tadoma variegata</i>	Paradise shelduck	plasma cell tumours	(Ladds, 2009, Reece, 1992)
<i>Taeniopygia bichenovii</i>	Double-barred finch	fibroma, fibrosarcoma	(Ladds, 2009)
<i>Taeniopygia castanotis</i>	Zebra finch	adenocarcinoma, teratoma	(Ratcliffe, 1933)
<i>Thraupis palmarum</i>	Palm Tanager	lipoma	(Ratcliffe, 1933)
<i>Torgos tracheliotus</i>	African eared vulture	adenocarcinoma	(Snyder and Ratcliffe, 1966)
<i>Trichoglossus chloroepidotus</i>	Scaley-breasted lorikeet	pancreatic adenocarcinomas	(Ladds, 2009, Reece, 1992)
<i>Trichoglossus rubritorquis</i>	Red-collared lorikeet	intra-abdominal lipomas, hepatocarcinomas, metastatic abdominal adenocarcinomas	(Ladds, 2009, Reece, 1992)
<i>Turdoides terricolor</i>	Jungle babbler	adenoma	(Ratcliffe, 1933)
<i>Turdus merula</i>	Blakbird	nephroblastoma or renal carcinoma (hypernephroma)	(Ratcliffe, 1933)
<i>Turnix melangaster</i>	Black-breasted quail	metastatic abdominal adenocarcinomas	(Ladds, 2009, Reece, 1992)
<i>Vanellus miles</i>	Masked lapwing	lymphoma	(Ladds, 2009)
Mammals			
<i>Acinonyx jubatus</i>	Cheetah	myometrial leiomyomas, uterine fibroleiomyoma	(Munson et al., 1999, Walzer et al., 2003)
<i>Acrobates pygmaeus</i>	Feathertail glider	biliary adenocarcinoma	(Ladds, 2009)
<i>Addax nasomaculatus</i>	Addax	intestinal tubulopapillary carcinoma	(Chu et al., 2012a)
<i>Aepyprymnus rufescens</i>	Rufous rat-kangaroo	thyroid adenoma, lymphoma, hemangiomas, carcinoma	(Ladds, 2009)
<i>Ammotragus lervia</i>	Barbary sheep	lymphoma	(Chu et al., 2012a)
<i>Antechinus stuartii</i>	Brown antechinus	squamous cell carcinoma, trichoepithelioma	(Canfield et al., 1990)
<i>Antechinomys laniger spenceri</i>	Kultarr	pulmonary adenomatosis	(Attwood and Woolley, 1973)
<i>Antechinus minimus</i>	Swamp antechinus	renal pelvic transitional cell proliferation	(Canfield et al., 1990)
<i>Arctictis binturong</i>	Binturong	hepatocarcinoma	(Chu et al., 2012a)
<i>Arctocephalus forsteri</i>	New Zealand fur seal	renal adenocarcinoma, papilloma, basal cell carcinoma, osteosarcoma, anaplastic renal adenocarcinoma, neuroblastoma	(Ladds, 2009)

<i>Arctocephalus pusillus</i>	Afro-Australian Fur Seal	hepatoma, hepatocarcinoma, uterine and intestinal leiomyomas, thyroid adenoma, lymphoma, ovarian granulosa cell tumour, adenocarcinoma, malignant melanoma	(Newman and Smith, 2006, Ladds, 2009)
<i>Atelerix albiventris</i>	Four-toed hedgehog	epithelial tumors, round cell tumors, mesenchymal or spindle cell tumors, endometrial stromal sarcomas, leiomyosarcoma, adenoleiomyoma, adenocarcinoma, lymphoma, oral squamous cell carcinoma, schwannoma or neurofibrosarcoma, plasma cell tumour, hemangiosarcoma, fibrosarcoma, osteosarcoma, undifferentiated or poorly differentiated sarcomas, mammary gland tumors, mast cell tumors, sebaceous carcinoma, lipoma	(Heatley et al., 2005, Mikaelian et al., 2004)
<i>Atherurus macrourus</i>	Brush-tailed porcupine	inflammatory myofibroblastic tumor	(Chu et al., 2012a)
<i>Balaena mysticetus</i>	Bowhead whale	lipoma	(Newman and Smith, 2006)
<i>Balaenoptera borealis</i>	Sei whale	melanocytoma (possibly hamartoma)	(Newman and Smith, 2006)
<i>Balaenoptera musculus</i>	Blue whale	mediastinal ganglioneuroma, mucinous cystadenoma, granulosa cell tumour, gastric lipoma, fibroma of the pleura	(Newman and Smith, 2006, Ladds, 2009)
<i>Balaenoptera physalus</i>	Fin whale	neurofibroma of the cerebellum, Hodgkin's-like lymphoma, fibromas of the tongue, of the pleura, of the subcutis and skin, granulosa cell tumour, ovarian carcinoma, osteoma, lipoma	(Newman and Smith, 2006, Ladds, 2009)
<i>Bassariscus astutus</i>	Ringtail cat	basal cell carcinoma	(Ratcliffe, 1933)
<i>Bison bison</i>	Bison	adenocarcinoma	(Ratcliffe, 1933)
<i>Bos bubalis</i>	Buffalo	adenoma	(Ratcliffe, 1933)
<i>Bos taurus</i>	Domestic cattle	esophageal papilloma, cutaneous squamous cell carcinoma	(Chu et al., 2012a)
<i>Boselaphus tragocamelus</i>	Nilgai	fibroma	(Ratcliffe, 1933)
<i>Buteo jamaicensis</i>	Red-tailed hawk	cholangiocarcinoma	(Hartup et al., 1995)
<i>Callimico goeldii</i>	Goeldi's marmoset	myelolipoma	(Porter et al., 2004)
<i>Callithrix jacchus</i>	Common marmoset	myelolipoma	(Porter et al., 2004)

<i>Callorhinus ursinus</i>	Northern fur seal	granulosa cell tumor, lymphoma, lipoma, fibrosarcoma, squamous cell carcinoma, ganglioneuroblastoma, rhabdomyosarcoma	(Newman and Smith, 2006)
<i>Camelus bactrianus</i>	Bactrian camel	hemangioma	(Ratcliffe, 1933)
<i>Canis anthus</i>	Senegalese wolf	medullary carcinoma	(Ratcliffe, 1933)
<i>Canis latrans</i>	Coyote	chondrosarcoma	(Ratcliffe, 1933)
<i>Canis lupus baileyi</i>	Mexican wolf	basal cell carcinoma, squamous cell carcinoma, nephroblastoma, adenocarcinoma	(Ratcliffe, 1933)
<i>Canis lupus dingo</i>	Dingo	lymphoma, thymoma, lipoma of subcutis, fibromatous epulis, perianal adenoma, sebaceous adenoma, squamous cell carcinoma, bronchial adenoma	(Ladds, 2009)
<i>Canis mesomelas</i>	Black-backed jackal	osteoma, hemangiosarcoma	(Chu et al., 2012a)
<i>Canis rufus</i>	Red wolf	adenocarcinoma, carcinomas	(Snyder and Ratcliffe, 1966, Seeley et al., 2016)
<i>Capra hircus</i>	Domestic goat	lymphoma	(Ratcliffe, 1933)
<i>Cebus albifrons</i>	White-fronted capuchin	cholangiocarcinoma	(Porter et al., 2004)
<i>Cebus apella fatuellus</i>	Tufted capuchin	adenoma	(Ratcliffe, 1933)
<i>Cercocebus atys</i>	Sooty mangabey	hepatocarcinoma	(Porter et al., 2004)
<i>Cercocebus atys lunulatus</i>	White-naped mangabey	hepatocarcinoma	(Porter et al., 2004)
<i>Cercopithecus aethiops</i>	African green monkey	hepatoma, mixed hepatocellular and cholangiocellular carcinoma, uterine leiomyoma	(Porter et al., 2004, Chu et al., 2012a)
<i>Cercopithecus diana</i>	Diana monkey	cholangiocarcinoma	(Porter et al., 2004)
<i>Cercopithecus mitis</i>	Blue monkey	biliary adenoma/cystadenoma	(Porter et al., 2004)
<i>Cercopithecus mitis ssp. albogularis</i>	White-throated Guenon	biliary adenoma/cystadenoma	(Porter et al., 2004)
<i>Cercopithecus mona</i>	Mona monkey	biliary adenoma/cystadenoma	(Porter et al., 2004)
<i>Chalinolobus gouldii</i>	Gould's wattled bat	cutaneous papilloma of the wing	(Ladds, 2009)
<i>Chlorocebus sabaeus</i>	Green monkey	adenocarcinoma	(Ratcliffe, 1933)
<i>Connochaetes gnou</i>	Black wildebeest	squamous cell carcinoma	(Ratcliffe, 1933)
<i>Cuniculus paca</i>	Lowland paca	lymphoma	(Ratcliffe, 1933)

<i>Cynomys ludovicianus</i>	Black-tailed prairie dogs	hepatocarcinoma, hepatoma, biliary cystadenoma, cholangiocarcinoma, odontoma (elodontoma), lingual squamous cell carcinoma, salivary gland adenocarcinoma, gingival squamous cell carcinoma, Intestinal leiomyoma, multicentric lymphoma, malignant round cell tumour, high grade lymphoma of liver and gall bladder, cutaneous lymphoma, malignant thymoma, atrial hemangiosarcoma, splenic hemangioma, thoracic lipoma, thyroid adenocarcinoma, pancreatic adenocarcinoma, cystadenocarcinoma, adenocarcinoma probably mammary, basal cell tumour, squamous cell carcinoma, bronchiolo-alveolar carcinoma	(Thas and Garner, 2012)
<i>Dasyercus cristicauda</i>	Mulgara	prostatic carcinoma	(Canfield et al., 1990)
<i>Dasykaluta rosamondae</i>	Little red kaluta	splenic myeloid hyperplasia	(Canfield et al., 1990)
<i>Dasyprocta albida</i>	Agouti	uterine fibroleiomyoma	(Chu et al., 2012a)
<i>Dasyprocta azarae</i>	Azara's agouti	squamous cell carcinoma	(Ratcliffe, 1933)
<i>Dasyuroides byrnei</i>	Kowari	pulmonary adenoma, splenic haematopoietic hyperplasia, trichoeplithelioma, dermal mastocytoma metastatic to spleen, squamous cell carcinoma, metastatic adenocarcinoma of unknown origin, spindle cell tumour of scapula, multiple hepatomas, schwannoma, apocrine gland cystadenoma, splenic and thoracic fibrosarcoma, squamous cell carcinoma, cerebellar medulloblastoma, schwannoma	(Canfield et al., 1990, Attwood and Woolley, 1973) (Ladds, 2009)
<i>Dasyurus geoffroii</i>	Western quoll	metastatic facial fibrosarcoma	(Canfield et al., 1990)
<i>Dasyurus hallucatus</i>	Northern quoll	lymphoma, squamous cell carcinoma of teat, lymphocytic leukemia, histiocytoma	(Canfield et al., 1990, Ladds, 2009)
<i>Dasyurus maculatus</i>	Tiger quoll	pulmonary carcinoma, mesothelioma of peritoneum, squamous cell carcinoma, renal adenoma, abdominal lipoma, splenic haemangiosarcoma, adrenal adenocarcinoma, adenocarcinoma of the small gut, ovarian hemangioma	(Canfield et al., 1990, Attwood and Woolley, 1973) (Ratcliffe, 1933, Ladds, 2009)
<i>Dasyurus maculatus</i>	Eastern quoll	cutaneous lipoma	(Chu et al., 2012a)

<i>Dasyurus viverrinus</i>	Eastern quoll	adrenal cortical nodular hyperplasia, multiple hepatomas, papillomas, metastatic squamous cell carcinoma to lung, trichoepithelioma, splenic leiomyosarcoma, mammary adenocarcinoma, ganglioneuroma of liver, metastatic mammary adenocarcinoma, splenic hemangioma, ovarian adenocarcinoma, dermal spindle cell tumour, sebaceous hyperplasia, papillomas of head and feet, carcinoma of the rectum, medullary carcinoma	(Canfield et al., 1990, Ratcliffe, 1933, Ladds, 2009, Attwood and Woolley, 1973)
<i>Delphinus delphinus ponticus</i>	Short-beaked common dolphin	fibroma of the epididymis, Leydig cell tumour, testicular neoplasia	(Ladds, 2009, Newman and Smith, 2006, Diaz-Delgado et al., 2012)
<i>Dendrolagus bennettianus</i>	Bennett's Tree kangaroos	generalised sarcoma	(Ladds, 2009)
<i>Didelphis marsupialis</i>	Common opossum	squamous cell carcinoma	(Snyder and Ratcliffe, 1966)
<i>Didelphis virginiana</i>	Virginia opossum	transitional cell carcinoma of the bladder, pulmonary adenomatosis, lymphoma	(Canfield et al., 1990, Higbie et al., 2015, Attwood and Woolley, 1973, Marrow et al., 2010)
<i>Dorcopsis muelleri</i>	Brown forest wallaby	pulmonary metastasis of carcinoma	(Ladds, 2009)
<i>Dydelphys marsupialis</i>	Common opossum	adenocarcinoma	(Ratcliffe, 1933)
<i>Elaphurus davidianus</i>	Pere David's deer	cutaneous squamous cell carcinoma	(Chu et al., 2012a)
<i>Elephas maximus</i>	Asian elephant	cutaneous fibrosarcoma, uterine leiomyoma	(Chu et al., 2012a)
<i>Enhydra lutris nereis</i>	Southern sea otter	osteosarcoma, osteoma	(Rodriguez-Ramos Fernandez et al., 2012)
<i>Equus asinus</i>	Donkey	renal hemangiosarcoma	(Chu et al., 2012a)
<i>Equus ferus przewalski</i>	Przewalski's wild horse	uterine adenocarcinoma	(Thompson et al., 2014)
<i>Equus quagga</i>	Common zebra	fibrosarcoma	(Ratcliffe, 1933)
<i>Equus zebra zebra</i>	Mountain zebra	sarcoid tumours	(Sasidharan, 2006, Sasidharan et al., 2011)
<i>Erethizon dorsatum</i>	North American porcupine	chorionepithelioma	(Ratcliffe, 1933)
<i>Erinaceus europaeus</i>	Hedgehog	adenocarcinoma, uterine leiomyoma	(Chu et al., 2012a)
<i>Eulemur fulvus</i>	Common brown lemur	hepatocarcinoma	(Porter et al., 2004)
<i>Eulemur macaco</i>	Black lemur	biliary adenoma/cystadenoma, hepatocarcinoma	(Porter et al., 2004)
<i>Eulemur mongoz</i>	Mongoose lemur	adenoma	(Ratcliffe, 1933)
<i>Eumatopias jubatus</i>	Steller's sea lion	fibroleiomyoma, adenocarcinoma	(Newman and Smith, 2006)
<i>Felis caracal</i>	Caracal	osteochondroma	(Ratcliffe, 1933)
<i>Felis concolor</i>	Mountain lion	fibrosarcoma, thyroid carcinoma	(Chu et al., 2012a)

<i>Felis leo</i>	Lion	adenocarcinoma, leiomyoma, scirrhus carcinoma	(Ratcliffe, 1933)
<i>Felis nebulosa</i>	Clouded leopard	pleural mesothelioma	(Snyder and Ratcliffe, 1966)
<i>Felis onca</i>	Jaguar	mammary fibroadenoma, lymphangioma	(Ratcliffe, 1933)
<i>Felis tigris</i>	Tiger	squamous cell carcinoma	(Ratcliffe, 1933)
<i>Felis wiedii</i>	Margay	cholangiocarcinoma, vaginal leiomyoma	(McClure et al., 1977)
<i>Felis pardus</i>	Leopard	lymphangioma	(Ratcliffe, 1933)
<i>Galago crassicaudatus</i>	Greater galago	hepatocarcinoma, uterine leiomyoma	(Chu et al., 2012a)
<i>Galagoides demidovii</i>	Demidoff's dwarf galago	cholangiocarcinoma	(Porter et al., 2004)
<i>Gazella dorcas</i>	Dorcas gazella	osteoma	(Ratcliffe, 1933)
<i>Gazella thomsonii</i>	Thomson's gazelle	hepatocarcinoma	(Chu et al., 2012a)
<i>Genetta genetta</i>	Common genet	basal cell carcinoma	(Ratcliffe, 1933)
<i>Gerbilliscus robustus</i>	Muridae	fibrosarcoma, squamous cell carcinoma	(Ratcliffe, 1933)
<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	granulosa cell tumour	(Newman and Smith, 2006)
<i>Globicephala melaena</i>	Long-finned Pilot whale	fibroleiomyomas, leiomyoma	(Newman and Smith, 2006)
<i>Gorilla gorilla gorilla</i>	Lowland gorilla	uterine adenocarcinoma, squamous cell carcinoma vulva, cervix and uterus	(Stringer et al., 2010)
<i>Herpestes urva</i>	Carb-eating mongoose	uterine leiomyoma	(Chu et al., 2012a)
<i>Heterocephalus glaber</i>	Naked mole-rat	adenocarcinoma possibly of mammary or salivary origin, neuroendocrine carcinoma	(Delaney et al., 2016)
<i>Hyaena brunnea</i>	Brown hyaena	mammary gland adenocarcinoma	(Chu et al., 2012a)
<i>Hyaena hyaena</i>	striped hyaena	lymphoma, bronchiole-alveolar carcinoma	(Chu et al., 2012a)
<i>Hydromys chrysogaster</i>	Water-rat	mediastinal lymphoma, adenoma, pheochromocytoma	(Ladds, 2009)
<i>Hydrurga leptonyx</i>	Leopard seal	fibromatous epulis	(Ladds, 2009)
<i>Hystrix brachyura longicauda</i>	Malayan porcupine	scirrhus carcinoma	(Ratcliffe, 1933)
<i>Hystrix cristata</i>	Crested porcupine	uterine leiomyosarcoma	(Chu et al., 2012a)
<i>Inia geoffrensis</i>	Amazon river dolphin	squamous cell carcinoma	(Newman and Smith, 2006)
<i>Isodon auratus</i>	Golden bandicoot	unidentified cloacal neoplasia	(Canfield et al., 1990, Marrow et al., 2010)
<i>Jaculus jaculus</i>	Lesser Egyptian jerboa	angiolipoma	(Ratcliffe, 1933)
<i>Lagenorhynchus obliquidens</i>	Pacific white-sided dolphin	squamous cell carcinoma, eosinophilic leukemia, lymphoma, teratoma, fibroma	(Newman and Smith, 2006)
<i>Lagenorhynchus obscurus</i>	Dusky dolphin	dysgerminoma, uterine leiomyomas, fibroleiomyomas	(Newman and Smith, 2006, Ladds, 2009)

<i>Lagenorhynchus acutus</i>	Atlantic White-sided dolphin	fibropapilloma, adenoma, leiomyoma	(Newman and Smith, 2006)
<i>Lama glama</i>	Llama	gastric squamous cell carcinoma	(Chu et al., 2012a)
<i>Lemur catta</i>	Ring-tailed lemur	cholangiocarcinoma, biliary adenoma/cystadenoma, mammary gland adenoma	(Porter et al., 2004, Chu et al., 2012a)
<i>Leopardus pardalis</i>	Ocelot	hepatocarcinoma	(Miranda et al., 2015)
<i>Leporillus conditor</i>	Greater stick-nest rat	sarcoma, mediastinal thymoma, adenocarcinoma	(Ladds, 2009)
<i>Lutra canadensis</i>	North American otter	squamous cell carcinoma	(Snyder and Ratcliffe, 1966)
<i>Lycaon pictus</i>	African wild dog	hemangioma	(Ratcliffe, 1933)
<i>Macaca fascicularis</i>	Crab-eating macaque	hepatocarcinoma, mixed hepatocellular and cholangiocellular carcinoma	(Porter et al., 2004)
<i>Macaca fuscata</i>	Japanese macaque	biliary adenoma/cystadenoma, hepatocarcinoma, squamous cell carcinoma, adenoma	(Porter et al., 2004, Ratcliffe, 1933)
<i>Macaca sinica</i>	Toque macaque	papilloma	(Ratcliffe, 1933)
<i>Macropus agilis</i>	Agile wallaby	focal hepatobiliary proliferation, biliary adenoma	(Ladds, 2009)
<i>Macropus giganteus</i>	Eastern grey kangaroo	dermal lymphoma, metastatic hemangiosarcoma, hepatoma, trichoepithelioma, bronchiolo-alveolar carcinoma, bronchial carcinoma	(Ladds, 2009, Chu et al., 2012a)
<i>Macropus parma</i>	Parma wallaby	osteochondromatous proliferation, squamous cell carcinoma of the cervix and vagina	(Canfield et al., 1990, Marrow et al., 2010, Ladds, 2009)
<i>Macropus parryi</i>	Whiptail wallaby	lymphoblastic lymphoma	(Ladds, 2009)
<i>Macropus robustus</i>	Common wallaroo	hepatic vascular proliferation, hamartoma, biliary adenoma	(Ladds, 2009)
<i>Macropus rufogriseus</i>	Bennett's wallaby	oral melanoma, oral adenocarcinoma, lymphoma, bile duct proliferation	(Brust, Ladds, 2009)
<i>Macropus rufus</i>	Red kangaroo	adenocarcinoma, lymphoma, squamous cell carcinoma, basal cell carcinoma of the pouch, squamous cell carcinoma of the oral cavity, gastric carcinoma, pulmonary carcinoma	(Ratcliffe, 1933, Brust, Ladds, 2009)
<i>Macrotis lagotis</i>	Greater bilby	fibrosarcoma of skin and lung, osteosarcoma, hemangioma of pancreas, hemangiosarcoma, histiocytoma, basal cell carcinoma, pulmonary sclerosing squamous cell carcinoma and adenocarcinoma, pulmonary adenomatosis, lymphoma	(Ratcliffe, 1933, Ladds, 2009)
<i>Manis pentadactyla</i>	Pangolin	hepatocarcinoma, hepatoma	(Chu et al., 2012a)

<i>Marmota monax</i>	Groundhog	adenoma	(Ratcliffe, 1933)
<i>Megaptera novaeangliae</i>	Humpback whale	lipoma, fibroma	(Newman and Smith, 2006)
<i>Melomys burtoni</i>	Grassland mosaic-tailed rat	fibrosarcoma, hepatoma, adenocarcinoma, carcinoma	(Ladds, 2009)
<i>Mephitis mephitis</i>	Striped skunk	biliary cystadenoma, renal cell carcinoma, adenocarcinoma	(Chu et al., 2012a, Snyder and Ratcliffe, 1966)
<i>Mesembriomys gouldii</i>	Black-footed tree-rat	thymic lymphoma, hepatoma	(Ladds, 2009)
<i>Mesoplodon densirostris</i>	Blainville's beaked whale	vaginal fibromas	(Newman and Smith, 2006, Ladds, 2009)
<i>Microcebus murinus</i>	Gray mouse lemur	hepatocarcinoma	(Porter et al., 2004)
<i>Mirounga leonina</i>	Southern elephant seals	adrenocortical adenoma, malignant granulosa cell tumour	(Ladds, 2009)
<i>Mus musculus molissinus</i>	Japanese waltzing mice	adenocarcinoma, fibroadenoma	(Ratcliffe, 1933)
<i>Mustela putorius furo</i>	Ferret	sebaceous carcinoma, adrenocortical carcinoma	(Chu et al., 2012a)
<i>Mustela vison</i>	American mink	cutaneous squamous cell carcinoma, hepatocarcinoma, adrenocortical carcinoma, lymphoma, hemangiosarcoma, hepatoma	(Chu et al., 2012a)
<i>Myocastor coypus</i>	Nutria	adenocarcinoma, fibroma	(Ratcliffe, 1933)
<i>Myrmecophaga tridactyla</i>	Giant anteater	multicentric lymphoma	(Sanches et al., 2013)
<i>Nasua nasua</i>	South American coati	squamous cell carcinoma	(Ratcliffe, 1933)
<i>Neofelis nebulosa</i>	Clouded leopard	pheochromocytoma, uterine leiomyoma, mesothelioma, hemangioma	(Chu et al., 2012a, Snyder and Ratcliffe, 1966)
<i>Neophocaena phocaenoides</i>	Indo-Pacific finless porpoise	fibroma	(Newman and Smith, 2006)
<i>Notomys alexis</i>	Spinifex hopping mouse	fibroma, lipoma, rhabdomyosarcoma, cavernous hemangioma, thymic lymphoma, multicentric lymphoma	(Ladds, 2009)
<i>Notomys alexis</i>	Spinifex hopping-mouse	melanoma	(Old and Price, 2016)
<i>Nyctereutes procyonoides</i>	Raccoon dog	adenocarcinoma	(Ratcliffe, 1933)
<i>Nycticebus coucang</i>	Slow loris	cholangioma, adrenocortical adenoma, myeloid leukemia	(Chu et al., 2012a)
<i>Nyctophilus geoffroyi</i>	Lesser long-eared bat	fibrosarcoma of the abdomen	(Ladds, 2009)
<i>Odocoileus hemionus</i>	Mule Deer	intracerebral malignant plasma cell tumour	(Clancy et al., 2016)
<i>Odocoileus virginianus</i>	White-tailed deer	fibroadenoma, oligodendrogliomas	(Ratcliffe, 1933, Gottdenker et al., 2012)

<i>Orcinus orca</i>	Killer whale	Hodgkins-like lymphoma, papilloma	(Newman and Smith, 2006, Ladds, 2009)
<i>Ornithorhynchus anatinus</i>	Duck-billed platypus	papilloma, hepatoma, adrenocortical adenoma	(Ladds, 2009)
<i>Oryx gazella gazelle</i>	Gemsbok	adrenocortical adenoma	(Chu et al., 2012a)
<i>Otolemur crassicaudatus</i>	Brown greater galago	cholangiocarcinoma, hepatoma	(Porter et al., 2004)
<i>Otospermophilus beecheyi</i>	California ground squirrel	osteoma	(Ratcliffe, 1933)
<i>Pan troglodytes</i>	Chimpanzee	hepatocarcinoma, hepatoma, reproductive neoplasia, uterine leiomyomas	(Stringer et al., 2010)
<i>Panthera leo</i>	Lion	gallbladder adenocarcinomas, mammary gland adenocarcinoma, uterine leiomyoma, hepatocarcinoma, biliary cystadenoma, malignant histiocytosis	(Sakai et al., 2003, Chu et al., 2012a)
<i>Panthera onca</i>	Jaguar	adrenocortical carcinoma, pancreatic islet cell carcinoma, metastatic leiomyosarcoma, leiomyoma	(Chu et al., 2012a, Port et al., 1981)
<i>Panthera pardus</i>	Black leopard	hepatoma, parathyroid carcinoma, mammary gland adenocarcinoma, cholangiocarcinoma	(Chu et al., 2012a, Sakai et al., 2003)
<i>Panthera tigris</i>	Bengal tiger	mammary gland adenocarcinoma, adenomatous polyps	(Chu et al., 2012a)
<i>Panthera tigris bengalensis</i>	Bengal tiger	endometrial adenocarcinoma	(Linnehan et al., 1991)
<i>Papio cynocephalus</i>	Yellow baboon	adenocarcinoma, fibroadenoma	(Ratcliffe, 1933)
<i>Papio cynocephalus anubis</i>	Anubis baboon	cutaneous squamous cell carcinoma, trichofolliculoma	(Chu et al., 2012a)
<i>Papio hamadrya</i>	Hamadryas baboon	gall bladder adenocarcinoma, biliary adenoma/cystadenoma	(Ratcliffe, 1933, Porter et al., 2004)
<i>Papio papio</i>	Guinea baboon	gall bladder adenocarcinoma	(Porter et al., 2004)
<i>Papio sphinx</i>	Mandrill	uterine leiomyosarcoma, cutaneous lipoma	(Chu et al., 2012a)
<i>Papio ursinus</i>	Chacma baboon	gall bladder cystadenocarcinoma, fibrosarcoma	(Porter et al., 2004, Ratcliffe, 1933)
<i>Paradoxurus hermaphroditus</i>	Asian palm civet	adenocarcinoma	(Ratcliffe, 1933)
<i>Parantechinus apicalis</i>	Dibbler	lymphoma (leukaemic)	(Canfield et al., 1990)
<i>Perameles bougainville</i>	Western barred bandicoot	pulmonary carcinoma, prostatic carcinoma, cutaneous papillomatosis and carcinomatosis	(Ladds, 2009)

<i>Perameles gunnii</i>	Eastern barred bandicoot	colonic leiomyosarcoma and leiomyoma, leiomyosarcoma of skin and lymph nodes, fibrohistiocytoma, cutaneous histiocytoma, mast cell tumour, basal cell tumour of the larynx	(Canfield et al., 1990, Marrow et al., 2010, Ladds, 2009)
<i>Perodicticus potto</i>	Potto	cholangiocarcinoma	(Porter et al., 2004)
<i>Perodipus richardsoni</i>	Kangaroo rat	fibrosarcoma, lymphoma	(Ratcliffe, 1933)
<i>Peromyscus leucopus</i>	White-footed mouse	fibrosarcoma, adenocarcinoma	(Ratcliffe, 1933)
<i>Petaurus breviceps</i>	Sugar glider	subcutaneous fibroma, histiocytoma, sebaceous carcinoma, lymphoma, leukemia, fibrosarcoma, myxosarcoma, adenocarcinomas and carcinomas of the adrenals, intestines, liver and mammary glands, transitional cell carcinoma of the urinary bladder	(Marrow et al., 2010, Brust, Ladds, 2009)
<i>Phalanger gymnotis</i>	Ground cuscus	cutaneous lymphoma	(Goodnight et al., 2008)
<i>Phascogale tapoatafa</i>	Brush-tailed phascogale	hemangiopericytoma, trichoepithelioma, fibrosarcoma, lymphoma, hemangioma, hemangiosarcoma, basal cell tumour, squamous cell carcinoma, hepatocarcinoma, melanoma	(Canfield et al., 1990, Ladds, 2009)
<i>Phascolarctos cinereus</i>	Koala	lymphoma, meothelioma, tumours of the cartilaginous or osseous tissues of the craniofacial region, testicular teratoma, myeloid leukemia, rhabdomyosarcoma, myxofibroma of the subcutis, leiomyoma of the intestine, oral fibrosarcoma, biliary adenoma, hepatoma, ovarian tumour, adenoma of fimbria, mammary adenocarcinoma, cutaneous papilloma and squamous cell carcinoma, pilomatricoma, chromophobe adenoma, adenoma of the frontal sinus, serosal adenocarcinoma	(Ladds, 2009)
<i>Phocoena phocoena</i>	Harbour porpoise	papilloma, adenocarcinoma	(Newman and Smith, 2006)
<i>Physeter macrocephalus</i>	Sperm whale	uterine leiomyoma, fibroleiomyoma, fibroleiomyosarcoma, hemangioma, fibromas of the jaw and skin, penile papillomatosis	(Ladds, 2009, Newman and Smith, 2006)
<i>Planigale maculata</i>	Common planigale	dermal spindle cell tumour, uterine adenocarcinoma, squamous cell carcinoma	(Canfield et al., 1990)
<i>Pongo pygmaeus</i>	Bornean orangutan	malignant granulosa cell tumor	(Stringer et al., 2010)

<i>Presbytis entellus</i>	Gray langur	hepatoma	(Porter et al., 2004)
<i>Procyon cancrivorus</i>	Crab-eating raccoon	adenocarcinoma	(Ratcliffe, 1933)
<i>Procyon lotor</i>	Raccoon	adenoma, adenocarcinoma, pancreatic exocrine adenocarcinoma, hepatocarcinoma, mammary gland adenocarcinoma, sweat gland adenocarcinoma	(Chu et al., 2012a, Ratcliffe, 1933)
<i>Proteles cristatus</i>	Aardwolf	peritoneal mesothelioma	(Chu et al., 2012a)
<i>Pseudantechinus bilarni</i>	Sandstone antechinus	lymphoma or splenic erythroid hyperplasia (ce n'est pas une tumeur à supprimer), sebaceous adenoma	(Canfield et al., 1990)
<i>Pseudoantechinus macdonellensis</i>	False antechinus	lymphoma (leukaemic)	(Canfield et al., 1990)
<i>Pseudocheirus peregrinus</i>	Common ringtail possum	lymphoma, metastatic adenocarcinoma	(Ladds, 2009)
<i>Pseudomys albocinereus</i>	Ash-gray mouse	liposarcoma, lymphoma	(Ladds, 2009)
<i>Pseudomys australis</i>	Plains rat	hemangiosarcoma, adenocarcinoma, carcinoma	(Ladds, 2009)
<i>Pteropus d. dasymallus</i>	Flying fox	hepatocarcinoma, chondrosarcoma, uterine adenocarcinoma	(Chu et al., 2012a)
<i>Pteropus poliocephalus</i>	Grey-headed flying fox	metastatic carcinoma, fibropapilloma, subcutaneous fibrosarcoma, rhabdomyoma	(Ladds, 2009)
<i>Rangifer tarandus tarandus</i>	Reindeer	lymphoma	(Jarplid and Rehinder, 1995)
<i>Rattus norvegicus</i>	Rat	mammary gland fibroadenoma	(Chu et al., 2012a)
<i>Rattus tunneyi</i>	Pale field rat	adenocarcinoma	(Ladds, 2009)
<i>Saguinus oedipus</i>	Cotton-top tamarin	intestinal adenocarcinoma	(Chu et al., 2012a)
<i>Saimiri boliviensis</i>	Black-headed squirrel monkey	hepatocarcinoma	(Porter et al., 2004)
<i>Saimiri sciureus</i>	Squirrel monkey	cutaneous lipoma, adenocarcinoma of vaginal wall, hepatocarcinoma	(Chu et al., 2012a, Porter et al., 2004)

<i>Sarcophilus harrisii</i>	Tasmanian devil	papillomas, splenic erythroid hyperplasia), adrenocortical nodular hyperplasia (pas tumeur donc à supprimer), keratoacanthoma, mammary cystadenoma, metastatic squamous cell carcinoma to lung, trichoeplthelioma, fibrosarcoma of lung, squamous cell carcinoma, sebaceous and apocrine hyperplasia; adrenal dermal lymphosarcoma, hemangioma, smooth muscle hyperplasia of oesophagus, sebaceous hyperplasia or adenoma of pouch, metastatic squamous cell carcinoma to lung, apocrine and mammary gland hyperplasia, pyloric leiomyoma, hepatoma, Tasmanian devil facial tumour disease	(Canfield et al., 1990, Attwood and Woolley, 1973, Ratcliffe, 1933, Ladds, 2009)
<i>Sciurua niger</i>	Fox squirrel	adenocarcinoma and adenoma of the kidney	(Ratcliffe, 1933)
<i>Sciurus carolinensis pennsylvanicus</i>	Northern gray squirrel	hypernephroma	(Ratcliffe, 1933)
<i>Setonix brachyurus</i>	Quokka	liposarcoma, papilloma	(Ladds, 2009)
<i>Sminthopsis crassicaudata</i>	Fat-tailed dunnart	dermal spindle cell tumour, splenic lymphoma, squamous cell carcinoma, round cell sarcoma of the upper forelimb	(Canfield et al., 1990)
<i>Stenella coeruleoalba</i>	Striped dolphin	myelogenous leukemia, squamous cell carcinoma	(Newman and Smith, 2006)
<i>Suricata suricatta</i>	Meerkat	rhabdomyosarcoma	(Chu et al., 2012a)
<i>Sus barbatus</i>	Black small-eared pig	uterine adenocarcinoma, uterine leiomyoma	(Chu et al., 2012a)
<i>Sus scrofa</i>	Pig	adenocarcinoma	(Ratcliffe, 1933)
<i>Tachyglossus aculeatus</i>	Short-beaked echidna	lymphoma of spleen, fibroma of subcutis, leiomyoma of the cloaca, pericloal leiomyosarcoma, fibroma of the beak, myocardial lymphom, lymphoma with leukemia, cystic adenoma of the thyroid	(Ladds, 2009)
<i>Taurotragus oryx</i>	Common eland	cutaneous lymphoma	(Chu et al., 2012a)
<i>Taxidea taxus</i>	American badger	peritoneal epithelioid leiomyosarcoma, undetermined adenocarcinomas	(Chu et al., 2012a)
<i>Thylacomyis lagotis</i>	Rabbit-eared bandicoot	squamous cell carcinoma	(Snyder and Ratcliffe, 1966)
<i>Thylogale billardieri</i>	Tasmanian pademelon	squamous tumour of the stomach, melanoma	(Kusewitt and Ley, 1996, Ladds, 2009)
<i>Tragelaphus eurycerus isaaci</i>	Bongo	uterine leiomyomas	(Napier et al., 2005)
<i>Tragelaphus strepsiceros</i>	Greater kudu	renal cell carcinoma	(Chu et al., 2012a)

<i>Trichosurus vulpecula</i>	Common brushtail possum	thoracic chondrosarcoma	(Ladds, 2009)
<i>Tupaia belangeri</i>	Northern treeshrew	hepatocarcinoma	(Porter et al., 2004)
<i>Tursiops truncatus</i>	Common bottlenose dolphin	lymphoma, myeloma, malignant seminoma, hepatic and thyroid adenoma, pancreatic carcinoma, reticuloendotheliosis of lung, liver, lymphoma of spleen, myelogenous leukemia, immunoblastic lymphoma, lymphadenopathy, splenomegaly, plasmacytoid neoplastic cells, sublingual squamous cell carcinoma, uterine adenocarcinoma, renal adenoma, teratoma	(Newman and Smith, 2006, Ladds, 2009)
<i>Urocyon cinereoargenteus</i>	Gray fox	adenoma, splenic myelolipoma, cutaneous squamous cell carcinoma, sweat gland adenoma of eyelid, lymphoma	(Chu et al., 2012a, Ratcliffe, 1933)
<i>Ursus americanus</i>	American black bear	medullary carcinoma, basal cell carcinoma	(Ratcliffe, 1933)
<i>Ursus arctos</i>	Brown bear	bronchial adenoma, cholangiocarcinoma, hypernephroma	(Chu et al., 2012a, Ratcliffe, 1933)
<i>Ursus maritimus</i>	Polar bear	cutaneous lymphoma, adenocarcinoma	(Chu et al., 2012a, Ratcliffe, 1933)
<i>Ursus thibetanus</i>	Asiatic black bear	biliary cystadenoma	(Chu et al., 2012a)
<i>Ursus thibetanus formosanus</i>	Formosan black bear	bronchiolo-alveolar carcinoma	(Chu et al., 2012a)
<i>Varecia variegata</i>	Black-and-white ruffed lemur	hepatocarcinoma, biliary adenoma/cystadenoma	(Porter et al., 2004)
<i>Vicugna pacos</i>	Alpaca	medullary carcinoma	(Ratcliffe, 1933)
<i>Viverra zibetha</i>	Malayan civet	adenocarcinoma, squamous cell carcinoma	(Ratcliffe, 1933, Snyder and Ratcliffe, 1966)
<i>Viverra zibetha</i>	Large Indian civet	adenocarcinoma	(Ratcliffe, 1933)
<i>Vombatus ursinus</i>	Coarse-haired wombat	fibropapilloma, lymphoma, leukemia, adenocarcinoma	(Ladds, 2009)
<i>Vulpes corsac</i>	Corsac fox	adenoma	(Ratcliffe, 1933)
<i>Vulpes v. pennsylvanicus</i>	American red fox	adenoma	(Ratcliffe, 1933)
<i>Zalophus californianus</i>	California sea lion	adenocarcinoma, hypernephroma, squamous-cell carcinoma, leiomyoma, fibroma, carcinoma, adenoma, ovarian granulosa cell tumor, lymphoma, islet cell adenoma or carcinoma, transitional cell carcinoma, adenoma, duct adenoma, hepatocarcinoma, lipoma, nephroblastoma, sarcoma, neuroendocrine tumour, fibrosarcoma, myosarcoma, melanoma, mesenchymoma, multicentric neurofibromatosis	(Newman and Smith, 2006, Rush et al., 2012)

*We tried to provide a comprehensive list of examples of neoplasia in wild and captive animals, but understandably the list cannot be complete due to limited space. Review articles were used primarily due to restricted space for citations.

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