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ORIGINAL PAPER

A mortality survey of free range nutria (*Myocastor coypus*)

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Abstract A review of the literature revealed little information on natural occurring diseases in wild nutria. In this report, a summary of necropsies performed on free-range animals from four different geographical areas, is presented. Fifty-two percent of the nutria had trauma (mostly by predation and road kill), 15% had poisoning by different toxics, and 11% had starvation. The rest died due to infectious diseases and miscellaneous causes, while 21 individuals had no significant lesions. The occurrence of infections seems sporadic with a far lower prevalence than in the farmed animals, while the incidence of poisoning is rather high. In addition, anthrax was diagnosed in two individuals. Thus, nutria are probably subject to mortality from a number of different human-induced causes rather than natural ones. Analysis of these records may provide insight into prevention of problem and better management practices.

Keywords Wild nutria · Mortality · Post mortem examination

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Introduction

The coypus or nutria (*Myocastor coypus*) is a semiaquatic rodent native of South America, which has been introduced to many countries through meat production and fur farming. It is a capromyd, belonging to the rodent suborder Hystricomorpha (Catzeflis et al. 1995). In 1922, Argentineans began raising coypus in captivity, and this practice spread worldwidely. Unofficial census taken in 1994 revealed a total of 6,000,000 wild nutrias, mostly inhabiting the banks of waterways in the vast Buenos Aires province. Nutria is listed currently as lower risk/least concern (LR/lc) by IUCN Red List of threatened species (2004), which means effectively that it is not a threatened or endangered species. However, the animal has been traditionally hunted as a source of fur and meat (Vietmeyer 1991). Ninety-eight percent of commercial furs here come from wild populations, and yet, there is no effective control over hunting permits (Guichón and Cassini 2005). Regrettably, there is a paucity of information about the types and prevalence of diseases, which affect the wild population. The intent of this study was to identify major problems that have caused death in native populations of nutria from different areas of Argentinean territory in the last two decades.

Materials and methods

Between 1987 and 2006, a total of 312 coypus found dead were submitted to the laboratories for post mortem examination. One hundred and eighty-four came from the Buenos Aires Province (region 1), 62 from the southern Patagonia (region 2), 44 from the Ecological Reserve on the River Plate banks (region 3), and 22 from other locations (region 4). The approximate age was determined primarily on tooth-wear characteristics, skull ossification, and the appearance of organs and general weight (Willner et al. 1979). Animals were then categorized into two groups: immature (juveniles and subadults under 1 year of age) and mature (any adult animal at least 1 year of age). Cadavers were examined for skin lesions and parasites. Body condition was assessed from muscle mass and fat deposits. After a complete necropsy, observations of post mortem examinations and gross pathology were recorded. When possible, samples of clotted blood were collected from the heart cavity (n=46). After sedimentation, serum was examined by the modified direct agglutination and the microscopic agglutination tests for antibodies directed against *Toxoplasma gondii* and *Leptospira* infection, respectively. Routine histological examination was done when found necessary on particular cases (n=122) and bacteriological (n=161) or virological examinations (n=29) (Martino and Stanchi 1998). Examining microscopically Giemsa and McFadyean-stained-blood smear for identification of spores and subsequent culturing made diagnosis of anthrax. Attempts to demonstrate viral particles in tissues (i.e., lung, liver, kidney) from suspected animals were done by direct negative contrast electron microscopy (EM). For attempted virus isolation in these cases, bacteria-free filtrates of pools of viscera were inoculated onto the following cell cultures: primary chicken embryo fibroblast (CEF) cells and Vero cells. Suspected cases of being rabid (n=2) were tested by both the rabies tissue culture infection test and the mouse inoculation test with oral sample swabs. For toxicological studies on suspected cases, polychlorinated byphenils (PCBs), organochlorine pesticides (i.e., DDT, DDE, dieldrin, oxychlordane, trans-nonachlor, heptachlor), organophosphate pesticides (n=68), and rodenticide compounds (i.e., bromadiolone, warfarine) (n=11) were investigated mostly in liver, adipose tissue, and gastric content by gas chromatography/electron capture detection and mass spectrometry (Buck 1974; Foley et al. 1988). In addition, the presence of mercury and lead (n=59) was assessed by chemical analysis of the liver, gastric content, and kidney (Frank et al. 1979).

Attempts were made to categorize all the deaths by their primary cause. Judgements as to what factors were primary and what were contributory were based mainly on the necropsy findings, but other factors were also taken into account. The lack of adequate ante mortem data and the delay between death and laboratory examination sometimes limited interpretation of findings. The cases were sorted into six categories: (1) Trauma: included coypus showing serious external indications (lacerations, amputations, or extensive wounds) and those fatal cases possibly savaged by predators (mostly with penetrating injuries suggesting an attack), hunter killed, or hit by automobiles (specimens typically flattened and badly destroyed by traffic). Internal evidence included massive hemorrhage in the body cavities, subcutaneous extravasation, fractures, and rupture of the liver; (2) Starvation: recorded those animals presenting with loss of weight, signs of dehydration, depleted body fat, and with no gastrointestinal contents; (3) Infectious diseases group (ID): included losses attributed to localized bacterial infections; meanwhile, septicemia was incriminated when a microorganism was isolated in pure culture from all samples cultured; cases of *Toxoplasma* infection were also recorded in this group; (4) Poisoning: included those intoxications due to aquatic biotoxins, crude oil, pesticides, or rodenticide; (5) Miscellanea: contemplated losses due to different causes such as neoplasia and adverse environmental factors, and (6) No significant lesions (NSL): included nutria that on post mortem examination could not be ascribed to any of the above groups because they were free of obvious lesions.

The chi square test was performed to evaluate temporal differences, using p <0.05 as the level of significance.

Results

Table 1 presents the occurrence of nutria mortality by age, sex, and geographical location. Mature coypus were significantly identified in 73% of the necropsies (p<0.05); meanwhile, there was no difference between sexes (p>0.05). Region 1 provided the highest number of casualties (59%, p<0.05), followed by the patagonian region 2 (20%).

No seasonal distribution pattern was noted among the casualties except for the highest overall seasonal mortality rate in Trauma group during the spring and summer months, which was only moderately significant (p=0.02). The age–sex distribution was similar among the death categories, with only the highest incidence in adult females of the Trauma group and in young males of the Poisoning group (p<0.05).

Trauma

The most common casualties were due by carnivore predation (n=95) followed by those cases hit by cars (n=39) mainly on the highway–national roads of region 1. Other animals that met violent death were those shot in the head and flanks (n=20), coypus clubbed by local people (n=7), and three animals with amputations (probably caught in fox sets and then escaped).

Starvation

These deaths (n=33) included animals commonly in poor condition. Some of them had evidence of renal disease (n=3) and dental problems such as overgrown or shattered teeth (n=14).

Table 1 Occurrence of nutria mortality by age, sex, and geographical location

Regions	Categories						Age		Sex		Total %
	T[a]	St[b]	ID[c]	Poi[d]	Misc[e]	NSL[f]	1 year	<1 year	♂	♀	
Region 1	126	12	10	13	9	14	131	53	101	83	184 58.9
Region 2	23	3	2	19	9	6	35	27	25	37	62 19.8
Region 3	2	17	9	11	4	1	40	4	11	33	44 14.1
Region 4	13	1	2	4	2	-	15	7	1	21	22 7.0
Total	164	33	23	47	24	21	221	91	138	174	312
Percent (%)	52.6	10.6	7.4	15.1	7.7	6.7	70.8	29.2	44.2	55.8	100

[a] Trauma
[b] Starvation
[c] Infectious diseases
[d] Poisoning
[e] Miscellanea
[f] No significant lesions

ID group

Major causes were *Streptococcus zooepidemicus* pleuropneumonia (*n*=5, two of them associated with *Klebsiella pneumoniae* and *Staphylococcus aureus*), *Yersinia pseudotuberculosis* infection (*n*=4), enteritis by *Escherichia coli*, *Clostridium perfringens*, or *Salmonella* spp (*n*=5), anthrax (*n*=2), and nephritis (*n*=3). Renal culture in these last cases yielded *Leptospira* sp. and *Pseudomonas aeruginosa*; meanwhile, serological titers were ≥1:100 for *Leptospira interrogans* serovars *canicola* and *copenhageni*. The rest of the ID group were single cases *of Pasteurella multocida* septicaemia, peritonitis by *Actinomyces pyogenes* due to a perforated colonic ulcer, myocarditis by *E. coli*, and purulent meningoencephalitis by *Staphylococcus aureus*. Three animals of this category also had concurrent cerebral and hepatic toxoplasmosis (serological titers were ≥1:64). EM revealed no virus particles from suspected samples screened, and attempts at virus isolation were also unsuccessful.

Poisoning

The second most common diagnosis (*n*=47) included: organochlorine intoxication (*n*=21) (with significant levels of dieldrin and DDE: >1.25 µg/g of liver dry matter) and 16 cases with suggested lesions of poisoning (i.e., fatty livers and hemorrhagic gastric ulcers) in which residues of mercury (0.02–1.4 µg/g), lead (<45 µg/g), or PCBs (<1.4 ppm) were present at low concentrations. There was also crude oil intoxication (*n*=3) in cadavers collected from the surroundings of perforations in region 3 (some of them appeared typically coated with petroleum) and anticoagulant rodenticide intoxication (*n*=3) (with high concentrations of warfarin: >22 µg/g found in the livers). These animals (all from region 1) presented characteristic massive hemorrhages and died in areas where rodenticides are commonly spread. Although the toxins could not be demonstrated, four deaths in region 2 were attributed to aquatic biotoxins, as water discoloration by blue-green algae, high temperature, and some unusual bird mortality were observed.

Miscellanea

Common miscellaneous cases were: drowning in fishing tackle (*n*=8), freezing to death (*n*=5), neoplasias (*n*=2, lymphosarcoma and hepatic carcinoma) and two charred corpses of coypus killed by fire. The rest were single episodes of renal lithiasis, hepatic fasciolasis and coccidiosis, aseptic pyometra, trichobezoar, intestinal torsion, and nephrosis. Some of these animals had lesser pathological conditions as well (i.e., sarcoptic mange and gastric ulcers).

NSL

Twenty-one coypus were ascribed to this category.

Strongyloides myopotami, *Tricostrongillus retortaeformis*, and *Trichuris myocastoris* were the most common gastrointestinal parasites observed, although no severe burdens appeared to occur, and therefore, they did not indicate parasitic disease. In addition, some females (*n* = 21) showed signs of gestation at different stages; meanwhile several coypus had minor scars or cutaneous papillomatosis.

Discussion

These data were collected over a long period and in a number sufficient to give an accurate picture of the type of losses sustained on wild nutria by reason of accident and disease. Nevertheless, diagnosis was sometimes difficult to prove, as it was based on circumstantial evidence, history, post mortem examinations, and a lack of any other explanation. The finding of more than twice as many deaths in mature coypus as in immature ones was highly significant ($p<0.01$), but the samples are probably not representative of the population. This is difficult to explain and our data cannot be matched because of the lack of similar reports. Young cubs are liable to stray soon after they emerge from the den and are probably the most susceptible to predators (dogs, hawks, puma), and consequently, to disappear. Although our figures by sex do not differ significantly from a 1:1 ratio, they show, in fact, a trend towards males. Yet in nature, the ratio is usually very close to 1:1 for nutria (Norris 1967). Similarly, no major conclusions can be extracted from the age–sex distribution among the death categories, as available medical and management information were not sufficient to explain the observed differences. Most of the casualties came from the Buenos Aires province; by far the most densely populated by nutria, characterized as a temperate grassland, which became prime areas for sustained agriculture.

The leading causes of mortality were trauma and poisoning, accounting altogether for the 68% of the total. Soccini and Ferri (2004) incriminated either the accidental (road accidents or poisoning) or deliberate (hunting) anthropogenic action as the main threats for nutria. Predation is a serious problem for nutria in those areas with the presence of stray dogs, like regions 1 and 3; meanwhile coypus road kill is clearly another threat, as traffic on most roads moves as fast as 70 miles/h. Nevertheless, our figures for road kills seems to be high based on the restricted use of space by coypus, which are rarely observed more than 10 m from the water's edge (Guichon et al. 2003). Apparently, debilitated coypus are prone to be attacked by carnivores or to miscellanea trauma. The clustering of deaths caused by trauma over the warmer season may be due to an increase in the sexual activity of the nutria during that period. Animals killed by hunters were reported here in low figures, but they are clearly underrepresented, as hunting is a common practice here. It has recently confirmed that nutria distribution is negatively related to local human perturbation, mainly hunting pressure and carnivore predation (Guichon and Cassini 2005). Overexploitation of coypus populations by hunting resulted in the listing of the nutria as a species that requires management programs for sustainable exploitation in Argentina (Guichon and Cassini 2005). Poisoning frequency was high in this report and it may be assumed that nutria is susceptible to a wide range of environmental toxics. This topic is poorly documented in coypus (Jeantet et al. 1991), and the lack of knowledge of effects of heavy metals or pesticides in this species, allows very limited speculation. Nevertheless, pesticides should be regarded as serious adverse environmental factor for nutria (Foley et al. 1988; Jeantet et al. 1991). ID were not common entities in this survey; meanwhile, pneumonia and yersiniosis were the most prevalent among them (Howerth et al. 1994; Martino and Stanchi 1994; Bollo et al. 2003). Infections have long been known as a major factor among captive nutrias (Köhler et al. 1988; Vietmeyer 1991), and they are probably underrepresented here. The submitted animals sometimes had pronounced cadaveriosis, which in many individuals limited the isolation of agents. European populations are recorded as suffering substantial mortalities during cold winters (Doncaster and Micol 1990), but winters in Argentina, in contrast, are not severe enough to increase nutria mortality through direct effects of low temperature or food scarcity (Guichon et al. 2003).

In conclusion, nutria population in the surveyed areas appears to be mainly affected by human activities (i.e., road kill, predation, or poisoning) rather than by other factors such as food supply, adverse climatic conditions, or infectious diseases (Vietmeyer 1991).

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