Herbivores in the agro-ecosystems of Latin America

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Abstract

Ungulates, or hoofed mammals, comprise one of the most successful and diverse groups of large mammals alive today, having colonized nearly every habitat on all continents either naturally or by human introduction except Antarctica. Within ungulates ruminants comprise nearly all the species that humans use as livestock. Livestock production performs numerous functions in agricultural systems of the world. They produce meat and milk, generate cash income for rural and urban populations, provide traction and transport, and produce value-added goods that can have multiplier effects and create a need for a variety of services. Humans have relied heavily upon this order, which has provided us with many domesticated species including cattle, pigs, goats, and sheep.

In Latin America livestock shares ecosystems with wild ungulates and little attention has been devoted to their ecological importance and as protein source for local people. The overall trend across Latin America is to promote the replacement of wild ungulates by domestic and mostly European livestock. In this paper we aim to integrate in a holistic perspective the current situation of both groups of species linking livestock production with wild ungulates conservation. The onset of a new millennium sets new challenges for Latin America with a major challenge which is how to produce food and revenues to people without eroding local biodiversity. Indeed, sustainable livestock production must conserve the living mesh (grassland and wildlife) that provides ecosystem services and sustainability.

Keywords: sustainable livestock production, ungulates conservation, biodiversity and grassland, animal production in Latin America.

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INTRODUCTION

Agricultural practices determine the level of food production and, to a greater extent, the state of the global environment. Agriculturalists are the chief managers of terrestrial 'useable' lands, which we broadly define as all land that is not desert, tundra, rock or boreal. About half of global usable land is already in pastoral or intensive agriculture. A doubling in global food demand projected for the next 50 years poses huge challenges for the sustainability both of food production and of terrestrial and aquatic ecosystems and the services they provide to society. Agriculturalists are the principal managers of global useable lands and will shape, perhaps irreversibly, the surface of the Earth in the coming decades (Tillman et al 2002).

Ruminant livestock perform numerous functions in agricultural systems of the world. They produce meat and milk, generate cash income for rural and urban populations, provide traction and transport, and produce value-added goods that can have multiplier effects and create a need for a variety of services. Livestock also diversify production and income; provide year-round employment (Delgado and Hamann. 2000). From the beginning of the 1970s to the mid 1990s, consumption of meat and milk in developing countries increased by 175 million metric tons, more than twice the increase that occurred in developed countries. The market value of that increase in meat and milk consumption totalled approximately $155 billion (1990 US$), more than twice the market value of increased cereals consumption under the cereals "Green Revolution" (CIPAV 2003).

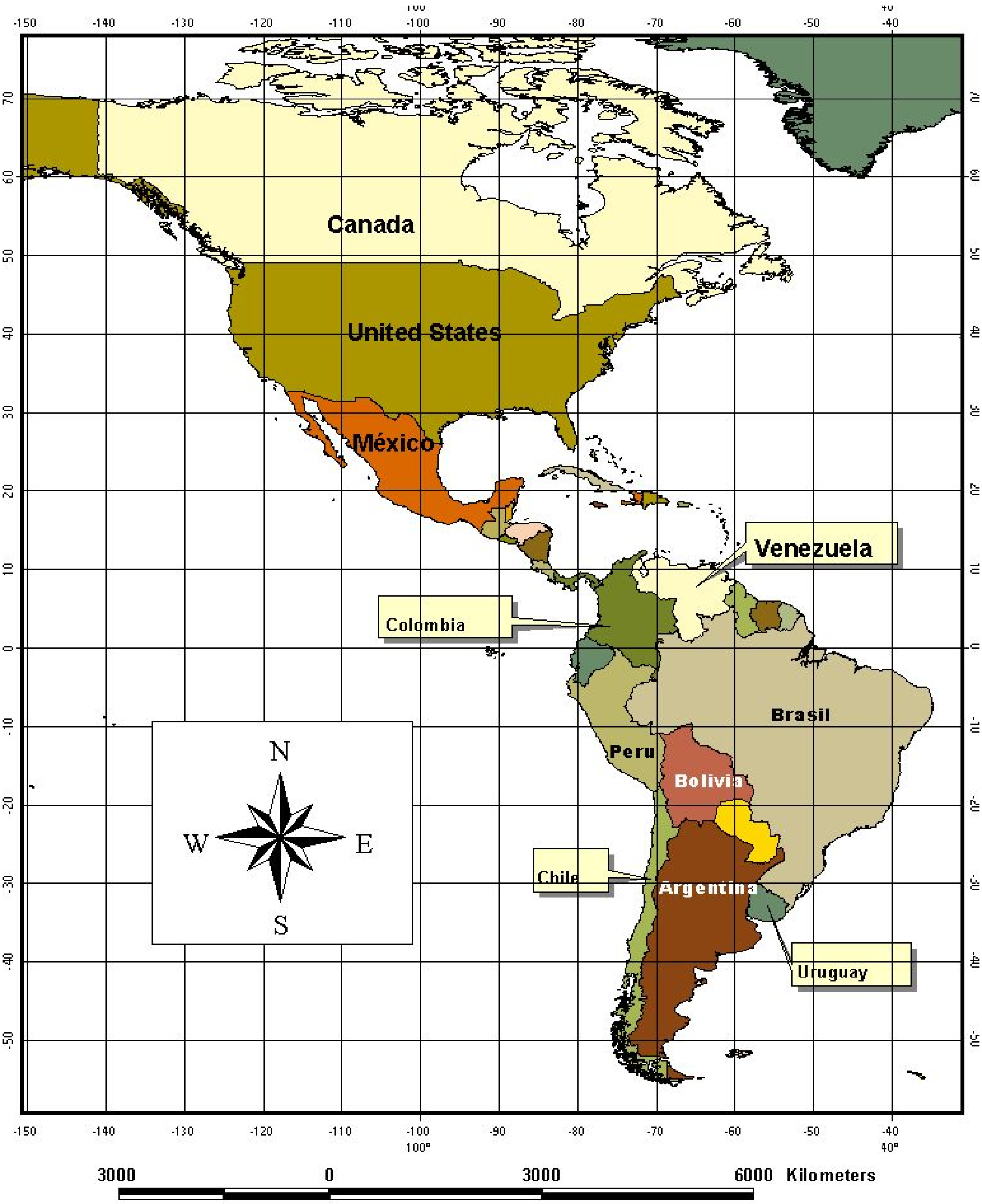
In the early 1990's, the share of the world's meat consumed by developing countries was 47 percent, and their share of the world's milk was 41 percent, up sharply from the early 1980's. Current projections to 2020 place developing countries share of world meat production at 60 percent, and their share of milk at 52 percent, indeed a "Livestock Revolution". Population growth, urbanization, and income growth that fuelled the recent increase in meat and milk consumption in developing countries are expected to continue (CIPAV 2003). By 2050, global population is projected to be 50% larger than at present and global grain demand is projected to double. This doubling will result from a projected 2.4-fold increase in per capita real income and from dietary shifts towards a higher proportion of meat (much of it grain-fed) associated with higher income (Tillman et al 2002).

Implications of the Livestock Revolution for human nutrition are especially critical. As many as 1.3 billion people presently suffer from anaemia and hundreds of millions more from other forms of micro-nutrient malnutrition - the great "silent hunger". Deficiencies in intake of iron, iodine, vitamin A, zinc and other micronutrients are needlessly condemning masses of poor people in developing countries to disease and decreased ability to live a full and productive life. While it is possible to deliver the needed nutrients through daily pills or a highly varied vegan diet, there is an increasing consensus that under the conditions of rural areas in most developing countries, only intake of at least a small amount of meat and milk can supply the necessary nutrients on a widespread sustainable daily basis in bio-available form (Delgado and Hamann. 2000). Fifty grams of meat daily for a young child will greatly improve his or her nutritional status, including the utilization of ingested foods of vegetable origin. However many developing countries are still far from reaching this level of consumption even on a national average basis, much less in the diets of the children of the poor.

Within the dominant agricultural structures in Latin America it is recognised that the principle land use is extensive cattle ranching. The socio-environmental questions directed to the ranching sector are justified by the increasingly worrying effects in particular the deterioration of the tropical ecosystems and rural societies: deforestation, concentration of ownership of the land, reduction in local food production, population migration, violence, deterioration of catchment’s areas and erosion (CIPAV 2003). Indeed livestock production will continue and increase its requirements of grassland, grain and labour in Latin America threatening natural habitats and wildlife conservation even at a greater pace than the last century. Latin American natural grasslands were naturally populated by a series of unique wild ungulates, many of them currently endangered or declining. Local aboriginal people learnt how to use in a sustainable way local species as hunters and gatherers and even domesticated some species from their wild counterparts (see this volume pages: XX-XX; Bas and Bonacic 2003).

Therefore, the aims of this paper are to describe the current situation of livestock production in Latin America. Particularly population trends for domestic species between 1993 and 2002 and land use patterns between the last 10 years in Latin America. A set of data that comprises South American countries are described in more detail in terms of population trends, production and future challenges (Figure 1). Wild ungulates current conservation status is described following the IUCN red list criteria for South American wild ungulates. Finally, future directions are suggested for a sustainable livestock production that ensures wild ungulates conservation in natural grassland ecosystems.

Figure 1. America (with the names of the countries mentioned in the text).



PEOPLE, LAND USE AND LIVESTOCK CURRENT SITUATION IN LATIN AMERICA

Human population growth is falling in Latin America from 6 children per fertile woman to less than 3 (World Resource Institute, 2003). Rural settlements are also declining in importance with less people living in farms and more concentrated in major cities. An increase of 21% of people living in cities is observed between 1990 and 2000 and a decline of 8% of people living in rural areas. The combination of population growth and emigration from rural areas accounts for the increase of human concentration in major cities. Latin America mega cities are a rule more than an exception with two of the largest cities in the world (Sao Pablo and Mexico City). Land use patterns indicates a slightly increase in grassland surface (4% increase between 1990 and 2000) probably as a consequence of deforestation and natural habitat replacement (Table 1. FAO 2003). A growing trend of deforestation and biodiversity loss is somehow less intense during the last 10 years than before and no more than a 3-4% increase in grassland area is described for the Region. However, local situation may depart from this trend with intense deforestation and habitat replacement in the Amazon basin and Central America. Total agricultural land increased by 10% between 1990 and 2000.

Table 1. Human population and land use in Latin America between 1990 and 2000 (adapted from FAO statistics, 2003).

Latin America **Total human population (000)**		**Year 1990**	**Year 2000**
Non rural		323.671	410.617
Rural		116.683	108.192
Land use			
Permanent crops (1000Ha)		18,184	20,271
Grasslands (1000Ha)		596,847	612,865
Agriculture land (1000Ha)		749,542	781,137
Non arable land (1000Ha)		1,865,087	1,849,510

The grassland biome is characterized by grasses and their relatives, and often abundant flowering annual plants. Plants are often adapted to fast, scattered fires that burn the tops of plants but leave seeds, roots or other resistant structures intact (Corn, 1993). Ecologically grassland ecosystems are classified in seven different types (White et al 2000). Five of them are present in Latin America. From North to South Desert and Xeric grasslands are predominant in Mexico, Tropical and Subtropical are frequent in Central America and North of South America and a particular large portion of the South of Brazil named *pantanal* maintains unique grassland known as Flooded Grassland. Throughout both sides of the Andes and in large highland plains (altiplano) montane grasslands are predominant (Bonacic et al 2002). A small portion of central Chile still remains with Mediterranean grassland, which is one of the most endangered ecosystems around the world (hot spots)(Primack et al 2001). Finally in the very South steppe vegetation occupy large portions of Patagonia (Franklin et al 1996). Some of these ecosystems are locally named as the llanos of Colombia and Venezuela, the *pampa* of Argentina, steppes of Patagonia in Chile and Argentina. Because these areas are often suitable for cultivation or livestock grazing we shall describe the availability of them in Latin America. Nearly 30% of the total land of Latin America is covered by grassland-like ecosystems and in major countries like Argentina (51% total area), Mexico (41%), Colombia (37%), Brasil (23%) and Venezuela (20%) grassland are highly predominant on their landscape. During the last decade no major changes were observed in terms of increase or decline of the land area classified as grassland (Table 2). Perhaps the last century trend of forest and wildlife areas replacement by grassland and cropland is slowly declining and no more habitat available for that purpose is easily obtainable. Countries like Uruguay (77%) and Paraguay (53.3%) are practically entirely grassland ecosystems.

Table 2. Grassland area in Latin America (1000 ha). Adapted from FAO statistics (2003).

Latin America land use	*Total area (1000Ha)*	Grassland area Year		Variation
		1993	2001	
Latin America	2,058,063	604,559	614,575	1.7%
Antigua y Barbuda	44	4	4	0.0%
Antillas Neerlandesas	80			
Argentina	278,040	142,000	142,000	0.0%
Aruba	19			
Bahamas	1,388	2	2	0.0%
Barbados	43	2	2	0.0%
Belice	2,296	49	50	2.0%
Bolivia	109,858	33,835	33,830	0.0%
Brasil	854,740	189,463	197,000	4.0%
Caimán, Islas	26	2	2	0.0%
Chile	75,663	12,900	12,935	0.3%
Colombia	113,891	40,083	41,800	4.3%
Costa Rica	5,110	2,340	2,340	0.0%
Cuba	11,086	2,600	2,200	-15.4%
Dominica	75	2	2	0.0%
Dominicana, República	4,873	2,090	2,100	0.5%
Ecuador	28,356	5,001	5,090	1.8%
El Salvador	2,104	680	794	16.8%
Granada	34	1	1	0.0%
Guadalupe	171	23	23	0.0%
Guatemala	10,889	2,602	2,602	0.0%
Guayana Francesa	9,000	10	7	-30.0%
Guyana	21,497	1,230	1,230	0.0%
Haití	2,775	495	490	-1.0%
Honduras	11,209	1,533	1,508	-1.6%
Jamaica	1,099	229	229	0.0%
Malvinas (Falkland), Is	1,217	1,201	1,130	-5.9%
Martinica	110	14	12	-14.3%
Montserrat	10	1	1	0.0%
México	195,820	79,000	80,000	1.3%
Nicaragua	13,000	4,815	4,815	0.0%
Panamá	7,552	1,490	1,535	3.0%
Paraguay	40,675	21,700	21,700	0.0%
Perú	128,522	27,120	27,100	-0.1%
Puerto Rico	895	232	210	-9.5%
Saint Kitts y Nevis	36	2	2	0.0%
San Vicente	39	2	2	0.0%
Santa Lucía	62	3	2	-33.3%
Suriname	16,327	21	21	0.0%
Trinidad y Tabago	513	11	11	0.0%
Turcas y Caicos, Islas	43			
Uruguay	17,622	13,520	13,543	0.2%
Venezuela	91,205	18,241	18,240	0.0%
Vírgenes Británicas, Is	15	5	5	0.0%
Vírgenes E.U, Islas	34	5	5	0.0%

LIVESTOCK PRODUCTION IN LATIN AMERICA

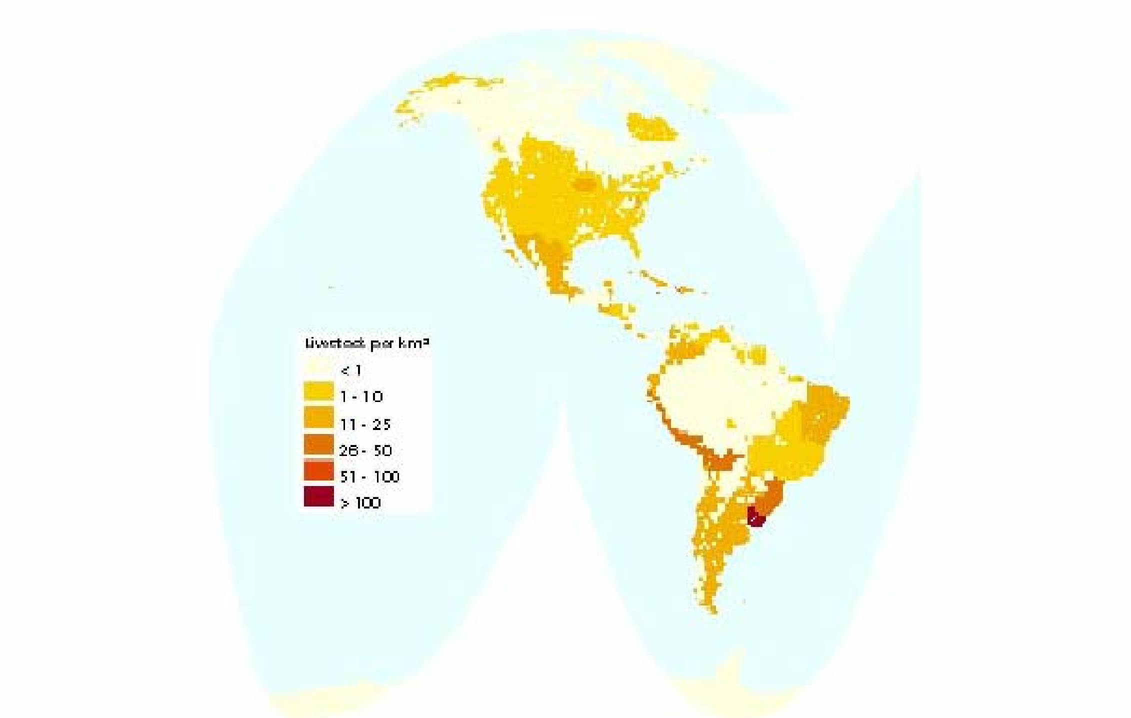
Livestock production is becoming an industrial-scale process in which several thousand cattle or pigs, or 100,000 or more chickens, are fed grains and produced in a single facility in the world. Latin American countries are following a global trend towards modern animal production. However, large areas and millions of animal are still under extensive management practices. There are 514 million domestic livestock in South America and nearly 70% of them are cows. Sheep, Goats, Equines (Horse, Ass and Mule), Buffaloes and Camelids accounts for the remaining heads. Overall a slight increase of 2% between 1993 and 2002 is observed for the total number of livestock present in South America. Total number of cows increased 7.1% in a decade and also a dramatic fall in the total number of Bufalloes (24.8%) and Sheep (17.3%) is observed. Brazil significantly increased the total number of cows from 155 to 176 millions (13% increase) in a decade. Argentina, the second largest cow's population showed a small population decline (-4%) between 1993 (52 million) and 2002 (50 million). A fall of 20% from 1.4 million to 1.2 million Buffaloes were observed within a decade in Brazil which accounts for nearly 97% of the total number of Buffaloes in South America. Scattered and small herds of Buffaloes are present in tropical grassland of South America particularly in Surinam where they decline from 570,000 to 395,000 animals. The second largest herds are composed by Sheep which are also declining during the last decade. Nearly in all countries Sheep herds were falling and particularly in Uruguay (largest population in 1993). A total population of 23 million in 1993 declined to 11 million by 2002 which is a 52% decline. Argentina and Brazil have large numbers of Sheep and also showed a decline of -24% and -17%, respectively. Latin America shows an increase in total production of meat and milk within the last decade and a dramatic decline in wool production (Table 3).

In the United States, the average number of animals per livestock operation increased 1.6-fold for cattle over 14 years. Large-scale facilities are economically competitive because of production efficiencies, but have health and environmental costs that must be better quantified to assess their potential role in sustainable agriculture. The evidence on recent technological change in world livestock production suggests that the developing countries are catching up in both pigs and poultry, and falling further behind in beef cattle, dairy and small ruminant species. The biotechnological revolution has not escaped the notice of large-scale producers in Brazil, who are beginning to use transgenic feed and forage crops, recombinant derived proteins (ST), steroid growth promoters, molecular markers, cloning, transgenic rumen microorganisms and DNA vaccines. Much of this has occurred through private sector research and the transfer and adaptation of technologies from the North. On the other hand, relatively little has been invested world-wide in improving the health, feed, and genetic technologies that would allow small-scale operators to continue to play a role in a more integrated livestock production and marketing chain (Pinto per com). Often the benefits of such technologies and the extension that must go with them are not obtainable by a single private actor; they need to be treated as public goods.

Table 3. Livestock production in Latin America.

Production (Mt)	Year		Variation
	1993	2002	
Meat	22,854,660	33,924,497	33%
Cows skins	1,372,655	1,681,754	18%
Wool	263,399	167,115	-58%
Sheep skins with wool	21,126	18,609	-14%
Milk (fresh and processed)	46,650,161	59,981,271	22%
Milk (fresh)	46,259,287	59,590,344	22%

Figure 2. Livestock density in Latin America. Modified from The World Resource Institute 2000.



Note:

Uruguay, Southern Brazil and highlands of Bolivia, Peru and subtropical grassland areas of Colombia concentrates the highest livestock density in Latin America.

Figure 3. Livestock population in Latin America. Total number of cows per year (1992-2002).

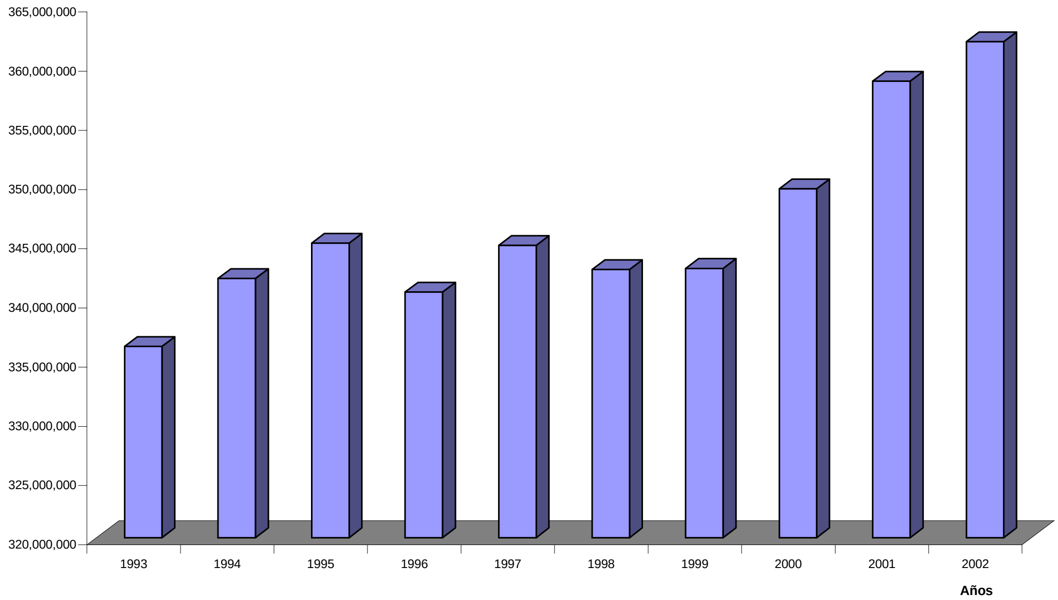
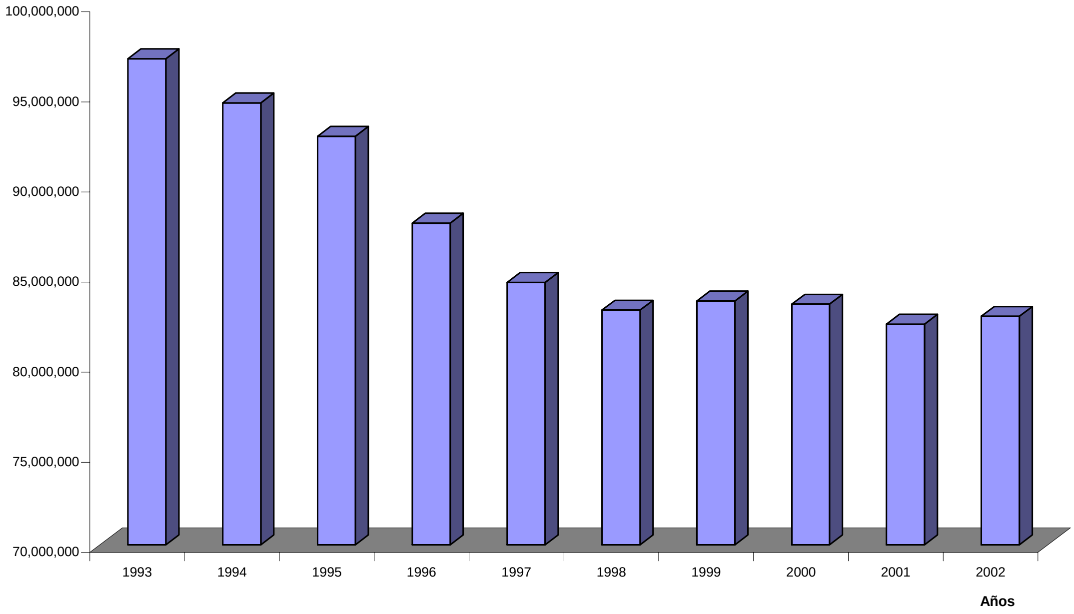


Figure 4. Total number of Sheep in Latin America.



LIVESTOCK PRODUCTION AND THE ENVIRONMENT

Grasslands, which cover 40 percent of the earth's surface, are home to almost a billion people, half of them living in susceptible arid lands. The world's grasslands have declined in their extent and condition as a consequence of overgrazing, as well as their ability to support human, plant, and animal life. Agriculture and urbanization are also transforming grasslands. For some North American prairies, conversion is already nearly 100 percent. Road-building and human-induced fires also are changing the extent, composition, and structure of grasslands. All of the major food grains -- corn, wheat, oats, rice, barley, millet, rye, and sorghum -- originated in grasslands. Wild strains of grasses can provide genetic material to improve food crops and to help keep cultivated varieties resistant to disease. Grasslands are also important ecosystems for a diverse number of birds and other wild species.

Implications of the Livestock Revolution for environmental sustainability are worrisome, in both the North and the South. Livestock currently use just under half the world's arable area (26 percent directly, 21 percent indirectly for feed grain). The production of 1 kg of meat can require between 3 and 10 kg of grain. During the past 40 years, global per capita meat production has increased more than 60%, a trend driven by increasing global per capita incomes. Seventy percent of the projected increase in world meat production through 2020 is projected to come from non-ruminant sources. The primary associated pollution problems are nutrient loading and greenhouse gases from manure handling. These - as in the case of ruminants - can be successfully addressed by a combination of policy changes and technology development, but greater attention needs to be devoted to the interaction of the two instruments. Improved policy can capture the externalities inherent in point-source pollution, for example through the creation of markets for tradable property rights for carbon sequestration and improved enforcement of regulatory control. Technologies can both lower the amount of waste and improve its utilization for purposes such as bio-gas.

The increasing concentrations of veterinary pharmaceuticals in both edible livestock products and residues are another major issue. In the North such drugs now account for roughly half of chemical input costs to livestock production. Food safety issues have also become more prominent with the rise in trade of meat and milk, and it will be critical to distinguish between vital food safety concerns and non-transparent use of health regulations for protectionist purposes. Evidence also suggests that the resolution of food safety and protection issues in developing countries can also have a major impact on the scale of livestock production units, and thus on how the growth of production affects poor rural people in developing countries.

Unlike most crop technologies which often can be adopted by some, but not others in a given location, sanitary measures for livestock such as control of Foot-and-Mouth disease need to be implemented on a national basis. Chile is a successful example of livestock disease control, particularly Foot-and-Mouth disease which was eliminated from the country 30 years ago. A rigorous and permanent surveillance system aimed to detect any product or risk of transmission from neighbour countries was set 30 years ago and now is paying back with an exploding demand of Chilean meat from developed countries (Rojas per com). Similarly, introduction of HACCP standards in the handling of perishable produce under tropical conditions cannot allow a lower technological standard to be part of the same chain. To make matters worse, partial trade liberalization, such as GATT-related Minimum Access Guarantees for feed grains in specific markets, creates the possibility of better-connected large-scale actors garnering lower cost inputs than the mass of small-scale producers, if they can capture the right to pay a lower tariff on their feed grain imports.

The dominant model of accelerated transformation of the natural ecosystems and traditional agro-ecosystems is the largest challenge for countries like Colombia, where extensive cattle ranching occupies nearly 90% of man-affected landscape (40 millions ha), but only contributes to 4.3% of the national GDP, 22% of agricultural GDP and 60% of livestock GDP. (CIPAV 2003). New incentives and policies for ensuring the sustainability of agriculture and ecosystem services will be crucial if we are to meet the demands of improving yields without compromising environmental integrity or public health (Tillman et al 2002).

LATIN AMERICAN HERBIVORES CONSERVATION

The even-toed ungulates are currently the most successful group of large herbivores, being native to every continent with the exception of Antarctica, inhabiting virtually all latitudes and altitudes. In addition to their native ranges, many artiodactyl species have been introduced into non-native areas and have survived to produce feral (wild) populations. An incredible diversity is seen in the approximately 210 members of this order, which includes swine, hippopotami, camels, chevrotains, musk deer, giraffes, deer, pronghorns and bovids. Table 4 summarises main biological features of Latin American ungulates. Sizes vary dramatically - from the tiny chevrotains which may weigh less than a kilogram when fully grown to the immense river hippopotamus, weighing up to 4,500 kg (Macdonald 2001). Humans have relied heavily upon this order, which has provided us with many domesticated species including cattle, pigs, goats, and sheep. The primary distinguishing feature of this order is the limb structure, in which the symmetry of the foot passes between the two middle digits (III and IV).

The nasal bones of the artiodactyls are not expanded caudally, nor is there an alisphenoid canal. Teeth are variable, but the upper incisors are always reduced or absent. Canines are usually small or not present at all, although in some species they are greatly enlarged into tusks (Novak 1991). Two main types of molars are recognized - the brachyodont (low-crowned) teeth of the pigs, peccaries, and hippos, and the hypsodont (high-crowned) teeth of the camels and some ruminants. A postorbital bar is present in all species.

Latin American wild ungulates are scarce compared to Africa; however a unique biodiversity is present. Distinctive ungulates that occupies key ecosystem of Latin America are listed below (also see Table 6 for biological traits):

- Tayassuidae Catagonus: (Chacoan Peccary).
- Tayassuidae Tayassu: (Collared and White-lipped Peccaries, or Javelinas).
- Camelidae Lama: (Guanaco, Llama, and Alpaca).
- Camelidae Vicugna: (Vicuña).
- Cervidae Odocoileus: (White-tailed Deer and Mule Deer).
- Cervidae Blastocerus: (Marsh Deer).
- Cervidae Ozotoceros: (Pampas Deer).
- Cervidae Hippocamelus: (Guemals, or Huemuls).
- Cervidae Mazama: (Brocket Deer).
- Cervidae Pudu: (Pudus).

SUBORDER Suiformes (adpated from Webb 2000 and Macdonald 2001)

Tayassuidae; peccaries

Restricted to the New World, the peccaries are pig-like in form, but much smaller than members of the Suidae. The feet of the Tayassuidae are slender, with four toes on the forefeet but only two (*Catagonus*) or three (*Tayassu*, *Pecari*) toes on the hindfeet. The upper canines are equipped with a sharp cutting edge and point downwards. The dental formula for all species is I 2/3, C1/1, P 3/3, M 3/3 x 2 = 38.

SUBORDER Tylopoda

Camelidae; camels, llamas

The neck is long and thin and the palette is cleft. Unique among mammals, the red blood cells are oval in shape. The feet have only two digits (III and IV), which sit almost flat on the ground as part of a wide pad; the foot posture is thus digitigrade. The hooves are reduced, growing only on the upper surface of the distal phalanges. The foot bones (metapodials) are fused to form a "cannon bone". Camelids ruminate (regurgitate and re-chew their food), and have a three-chambered stomach. The dental formula is I 1/3, C 1/1, P 2-3/1-2, M 3/3 x 2 = 30-34.

SUBORDER Ruminantia

The ruminants (suborder Ruminantia) are considered to be the most advanced artiodactyls. The stomach has four (sometimes three) chambers which allow for the proliferation of microorganisms which are able to digest tough vegetation which would otherwise be unavailable to the animal. The dental formula is generally I 0/3, C 0/1, P 3/3, M 3/3 x 2 = 32, although in members of the Tragulidae, Moschidae and some Cervidae the upper canine may be present (total teeth 34). The bones in the feet (metapodials) are fused to form a cannon bone, although in *Hyemoschus* (Tragulidae) this does not occur until after maturity. Only the third and fourth digits are well developed; the second and fifth are vestigial or absent.

Cervidae; deer

Deer are found world-wide with the exception of most of Africa and Australia (where they have been introduced). Branching antlers are present in the males of all but one species (*Hydropotes inermis*), and are never borne by females with the exception of *Rangifer tarandus*. These antlers are formed of bone, and are usually shed and regrown annually. Males of a few species possess enlarged, tusk-like upper canines (*Hydropotes*, *Muntiacus*, *Elaphodus*). In other species the upper canines are either vestigial or absent. There are usually two lacrimal canals. There is no gall bladder.

Antilocapridae; pronghorn

The single living species is found only in western North America. The feet have two digits. The 'horns' are unique, consisting of a bony core covered with a keratinized sheath which is shed annually.

Bovidae; antelope, cattle, sheep, goats

All males - and females of some genera - possess un-branched horns attached to the frontal bones of the skull. The horns are composed of a bone core and are covered with a keratin sheath which is never shed. *Tetracerus* is unique in that males regularly bear four horns (two pairs); all other genera (with the exception of some domestic sheep) have only one pair. The upper canines are always absent. A single lacrimal canal is usually present.

Many different models have been proposed to explain or predict the impacts of livestock on bio-diversity and particularly on wild ungulates, but their success in enriching management decisions has been mixed. In part this is because of the complexities of the interactions, and the large disparities in the scales at which impacts and management occur. Livestock production may contribute either directly or indirectly to the decline of wild herbivores as follows (Landsberg et al 1999):

Livestock grazing inevitably impacts on bio-diversity in natural ecosystems that have not previously been grazed by livestock. The nature and extent of the impact is hugely variable, however.

The impact is most extreme when natural ecosystems are converted to fertilized, exotic pastures to support livestock. The impacts of ancillary activities such as water provision, fencing, fire management, and pest control also lead to major shifts in the abundance and distribution of many native biota.

At bio-regional scales, concepts that relate grazing impacts to their evolutionary context have proven helpful for understanding the constraints under which different systems operate: why some ecosystems tolerate or even benefit from livestock grazing, while others are more sensitive.

An understanding of the impacts of livestock grazing on bio-diversity should take cognizance of differences among systems, not only in the capacities and sensitivities of natural systems, but also in the cultures, expectations, and needs of their managers.

The introduction of domestic livestock into a new grassland ecosystem immediately generates hunting and wild ungulates displacement from their habitat. Usually this follows predator control because the lack of natural prey and the abundance of poorly managed domestic livestock create the scenario for predation over domestic animals. Overall the final consequence is biodiversity loss.

The IUCN set conservation categories as a guideline about the state of biodiversity worldwide. A universal classification for every taxa around the world is described below:

Table 5. IUCN Red List (2003).

EXTINCT (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)
A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)
A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)
A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)
A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)
A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)
A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

Latin American ungulates are endangered or with conservation problems in every main grassland. The IUCN list classifies 10 species with enough information to be able to assess their conservation status. Half of them present serious conservation threats being already included in the red list as endangered or vulnerable. The five remaining are in lower risk but conservation dependent. Indeed this is a global challenge for the Region, wild ungulates are facing a dramatic decline and little is known about their future under the current approach that separates livestock production and human wellbeing from wildlife conservation. A new sustainable approach should include both in a partnership ensuring livestock production while maintaining biodiversity and ecosystem processes.

Powel et al (1999) suggests that a more integrated research, extension, and education activities in partnership with farmers, agribusiness, and policy makers aimed at achieving crop, livestock, and land management systems that enhance profitability would reduce environmental impacts of livestock production and contribute to rural development. Conservationist should also be part of a multidisciplinary team aiming to manage grassland ecosystems. Conservationists and wildlife managers would contribute to more sustainable strategies for livestock production and ensure biodiversity conservation. Also wildlife manager can promote multiple species herds with a more stable rural economy based on diversification. Canada, particularly Alberta is promoting the use of wild ungulates enhancing the amount of land used with more than cattle (Hudson, per com). This model could improve grassland sustainability in Latin America helping to reduce poverty. A unique and leading example of wild ungulates sustainable use exists now in four countries of South America. The sustainable use of the vicuna (*Vicugna vicugna*) by capturing wild herds for shearing is proving to be a new economic alternative for a marginal ecosystem where local indigenous people lives under harsh conditions (See Bonacic et al 2001; Bas and Bonacic in this volume).

FINAL CONSIDERATIONS

Latin America has relatively few alternatives for sustainable livelihoods, it is imperative to investigate more fully the options for using a combination of policy and technology to include rather than exclude them from the Livestock Revolution. Multidisciplinary policy making and research is essential to illustrate the costs and benefits of various courses of action with respect to the Livestock Revolution in developing countries and the need of proper wild ungulates conservation. Health and environmental threats will not respect national boundaries and extinction processes are more linked to the distribution of natural ecosystems than political borders. Increasingly global livestock markets will ensure that price outcomes will eventually impact on everyone. Increased transparency in our understanding of the economic, policy and technological forces currently driving the rapid industrialization of livestock production will benefit the vast majority of producers and consumers in both the North and the South. However, globalisation could become a threat rather than a solution for many people if local knowledge and traditional practices are not also protected. It would be illusionary for producers and consumers of the North to think that what actually transpires in the South will not eventually have a big impact on what they in the North earn, eat, and spend. Grassland ecosystems and its biodiversity got a value beyond the cost of replacing wildlife for beef or dairy cattle. Nowadays conservation and livestock production seem to become inextricable linked in a world that faces global change and critical environmental problems.

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Table 4. Latin American wild ungulates taxonomy and distribution (adapted from Macdonald 2001).

Order	Suborder	Family	Specie		Distribution
Perissodactyla	Ceratomorpha	Tapiridae	Brazilian Tapir	*tapirus terrestris*	E of Andes from N Colombia to S Brazil; N Argentina and Paraguay incluiding Amazonia and Orinoco forest basins lowland rain forest, sea level to 1,700m
			Mountain Tapir	*tapirus pinchaque*	Andes mountains in Colombia, Ecuador, extreme NW Peru, Mid- and high- elevation 1,400-4,700m
			Baird`s Tapir	*tapirus bairdii*	S Mexico through C America and S to Gulf of Guaya-quil, lowland forests, swamps, flooded meadows, lower to middle- elevation mountain forests

Table 4. Continuation

Artiodactyla	Suina	Suidae	Wild Boar	*sus scrofa*	Introduced into America, feral domestic pigs in Australia, New Zealand, N and S America
		Tayassuidae	Collared Peccary	*tayassu tajacu*	SW USA to N Argentina, wet and tropical forest
			White-lipped Peccary	*tayassu pecari*	SE Veracruz state, Mexico to N Argentina wet tropical forest, tropical wooded, savanna, thorn scrub
			Chacoan Peccary	*catagonus wagneri*	Gran Chaco (N Argentina, SE Bolivia, W Paraguay)
	Tylopoda	Camelidae	Llama	*lama glama*	Andes of C Peru, W Bolivia, NE Chile, NW Argentina Alpine puna grassland at 3,700 - 4,800m
			Alpaca	*lama pacos*	Andes of C Peru to W Bolivia Alpine grassland, meadows, and marshes at 4,400 - 4,800m
			Guanaco	*lama guanicoe*	Andean foothills of Peru, Chile, Argentina and Patagonia; desert grassland, savanna, shrubland and ocassional forest up to 4,250m
			Vicuña	*vicugna vicugna*	High Andes of C Peru, W Bolivia, NE Chile, NW Argentina. Alpine puna grassland at 3,700 - 4,800m
	Ruminantia	Cervidae			
			Falow deer	*dama dama*	Introduced into America
			White-tailed deer	*odocoileos virginianus*	N and C America, northern parts of S America. In S America valleys near water in dry season, higher in rainy season

			Marsh deer	*blastoceros dichotomus*	C Brazil to N Argentina.
					Marshes, flood plains,savannas, south of Amazonia
			Pampas deer	*ozotoceros bezoarticus*	Brazil, Argentina, Paraguay, Bolivia
					Open grassy plains
			Chilean Huemul	*hippocamelus bisulcus*	Chile, Argentina, High Andes
			Peruvian Huemul	*hippocamelus antisensis*	Peru, Ecuador, Bolivia, N Argentina high Andes
			Red Brocket	*mazama americana*	C and S America, from Mexico to Argentina
					Dense mountain thickets
			Brown Brocket	*mezama guazoupira*	C and S America, fron Mexico to Argentina
					mountains thickets, but more open than red brocket
			Little red brocket	*mazama rufina*	N Venezuela, Ecuador, SE Brazil
					forest thickets
			Dwarf brocket	*mazama chunyi*	N Bolivia and Peru, Andes up to 3,000m
				mazama bricenii	Cordillera Mérida, Venezuela
			Southern pudu	*pudu pudu*	Lower Andes of Chile and Argentina
					deep forest
			Northern pudu	*pudu mephistophiles*	Lower Andes of Ecuador, Peru, Colombia
					deep forest, sightly larger than southern pudu

Tabla 6. Latin American wild ungulates distribution, body parameters and gestation.

Specie		Distribution	Head-body length	Tail length	Shoulder height	Weight	Antler length	Gestation
Brazilian Tapir	*tapirus terrestris*	E of Andes from N Colombia to S Brazil; N Argentina and Paraguay incluiding Amazonia and Orinoco forest basins lowland rain forest, sea level to 1,700m						390 - 400 days
Mountain Tapir	*tapirus pinchaque*	Andes mountains in Colombia, Ecuador, extreme NW Peru, Mid- and high- elevation 1,400-4,700m	180 - 250cm	0cm	75 - 120cm	150 - 300kg		393 days
Baird`s Tapir	*tapirus bairdii*	S Mexico through C America and S to Gulf of Guaya-quil, lowland forests, swamps, flooded meadows, lower to middle- elevation mountain forests						13 months
Wild Boar	*sus scrofa*	Introduced into America, feral domestic pigs in Austra-lia, New Zealand, N and S America	90 -180cm	30 - 40cm		50 - 200kg		115 days
Collared Peccary	*tayassu tajacu*	SW USA to N Argentina, wet and tropical forest	78 - 100cm	2 - 6cm	40 - 49cm	16 - 35kg		145 days
White-lipped Peccary	*tayassu pecari*	SE Veracruz state, Mexico to N Argentina wet tropical forest, tropical wooded, savanna, thorn	90 - 135cm	3 - 6cm	56cm	27 - 40kg		158 days

		Scrub						
Chacoan Peccary	*catagonus wagneri*	Gran Chaco (N Argentina, SE Bolivia, W Paraguay)	93 - 106cm	3 - 10cm	52 - 69cm	30 - 43kg		5 months
Llama	*lama glama*	Andes of C Peru, W Bolivia, NE Chile, NW Argentina Alpine puna grassland at 3,700 - 4,800m	120 - 225cm		109 - 119cm	130 - 155kg		348 - 368 days
Alpaca	*lama pacos*	Andes of C Peru to W Bolivia Alpine grassland, meadows, and marshes at 4,400 - 4,800m	120 - 225cm		94 - 104cm	121 - 143kg		342 - 345 days
Guanaco	*lama guanicoe*	Andean foothills of Peru, Chile, Argentina and Patago- nia; desert grassland, savanna, shrubland and ocassio- nal forest up to 4,250m			110 - 115cm	100 - 120kg		345 - 360 days
Vicuña	*vicugna vicugna*	High Andes of C Peru, W Bolivia, NE Chile, NW Argen- tina. Alpine puna grassland at 3,700 - 4,800m	125 - 190cm		86 - 96cm	45 - 55kg		330 - 350 days
Falow deer	*dama dama*	Introduced into America			78 - 91cm	29 - 103kg	71cm	229 - 240 days
White-tailed deer	*odocoileos virginianus*	N and C America, northern parts of S America. In S America valleys near water in dry season, higher in rainy season			81 - 102cm	118 - 136kg		204 days

Marsh deer	*blastoceros dichotomus*	C Brazil to N Argentina.				70 - 110kg	60cm	225 - 271 days
		Marshes, flood plains,savannas, south of Amazonia						
Pampas deer	*ozotoceros bezoarticus*	Brazil, Argentina, Paraguay, Bolivia			69cm	33 - 40kg		
		Open grassy plains						
Chilean Huemul	*hippocamelus bisulcus*	Chile, Argentina, High Andes			81 - 90cm	50 - 65kg	20 - 25cm	240 days
Peruvian Huemul	*hippocamelus antisensis*	Peru, Ecuador, Bolivia, N Argentina high Andes			69 - 77cm	45kg	22 - 27cm	240 days
Red Brocket	*mazama americana*	C and S America, from Mexico to Argentina			71cm	20 - 55kg	10 - 13cm	220 days
		Dense mountain thickets						
Brown Brocket	*mezama guazoupira*	C and S America, fron Mexico to Argentina			35 - 61cm	17kg	10 - 13cm	206 days
		mountains thickets, but more open than red brocket						
Little red brocket	*mazama rufina*	N Venezuela, Ecuador, SE Brazil			35cm		7cm	
		forest thickets						
Dwarf brocket	*mazama chunyi*	N Bolivia and Peru, Andes up to 3,000m			35cm		3,5cm	
	mazama bricenii	Cordillera Mérida, Venezuela					5cm	
Southern pudu	*pudu pudu*	Lower Andes of Chile and Argentina			35 - 38cm	6 - 8kg	7 - 10cm	210 days
		deep forest						

Northern pudu	*pudu mephistophiles*	Lower Andes of Ecuador, Peru, Colombia				3,3 - 6kg	6cm	202 - 223 days
		deep forest, sightly larger than southern pudu						