

IMPORT RISK ANALYSIS

**IMPORTATION OF WEED SPECIES BY LIVE ANIMALS AND UNPROCESSED
FIBRE OF SHEEP AND GOATS**

May 1999

**John Randall
Regulatory Authority
Ministry of Agriculture and Forestry
Wellington
NEW ZEALAND**

Import Risk Analysis: Importation of Weed Species by Live Animals and Unprocessed Fibre of Sheep and Goats

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
INTRODUCTION	2
Scope	2
Background	2
Contamination situations considered in the risk analysis	2
Risk analysis methodology	3
Hazard identification	3
Risk Assessment	3
Risk Management	4
SUMMARY OF RECOMMENDED SAFEGUARDS	5
Live Animal Imports	5
Unprocessed Fibre of Sheep and Goats	5
RISK ANALYSIS (MONOCOTYLEDONS)	6
<i>Cenchrus incertis</i>	6
<i>Cenchrus longispinus</i>	6
<i>Cyperus aromaticus</i>	6
<i>Homeria flaccida</i>	7
<i>Nassella trichotoma</i>	7
<i>Pennisetum macrourum</i>	7
<i>Pennisetum villosum</i>	8
<i>Sagittaria montevidensis</i>	8
<i>Sorghum x almum</i>	8
<i>Sorghum halepense</i>	9
<i>Sporobolus africanus</i>	9
<i>Stipa caudata</i> and <i>S. brachychaeta</i>	9
RISK ANALYSIS (DICOTYLEDONS)	10
<i>Acanthospermum hispidum</i>	10
<i>Adonis microcarpa</i>	10
<i>Alternanthera pungens</i>	10
<i>Ambrosia confertiflora</i>	11
<i>Ambrosia psilostachya</i>	11
<i>Amsinckia</i> species	11
<i>Chondrilla juncea</i>	12
<i>Chrysanthemoides monilifera</i>	12
<i>Cuscuta</i> species	12
<i>Dittrichia graveolens</i>	13
<i>Gmelina asiatica</i>	13
<i>Gorteria personata</i>	13
<i>Heliotropium amplexicaule</i>	14
<i>Heliotropium europaeum</i>	14
<i>Hyptis capitata</i>	14
<i>Hyptis suaveolens</i>	15
<i>Ibicella lutea</i> and <i>Proboscidea louisianica</i>	15
<i>Malvella leprosa</i>	15
<i>Martynia annua</i>	16
<i>Parkinsonia aculeata</i>	16

<i>Physalis viscosa</i>	16
<i>Reseda lutea</i>	17
<i>Sclerolaena muricata</i>	17
<i>Sida rhombifolia</i>	17
<i>Solanum elaeagnifolium</i>	18
<i>Solanum rostratum</i>	18
<i>Stevia eupatoria</i>	18
<i>Tribulus terrestris</i>	19
<i>Verbesina encelioides</i>	19
<i>Xanthium occidentale</i> , and <i>X. orientale</i>	19
<i>Xanthium spinosum</i>	20
LIVE ANIMAL IMPORTS - RISK ASSESSMENT AND RISK MANAGEMENT	21
UNPROCESSED FIBRE OF SHEEP AND GOATS - RISK ASSESSMENT AND RISK MANAGEMENT	24
REFERENCES	25

1 EXECUTIVE SUMMARY

This document is a non-quantitative analysis of the biosecurity risks posed by the importation of live animals and fibre of sheep and goats into New Zealand. It is in part an addendum to the disease import risk analysis on unprocessed fibre of sheep and goats prepared by Howard J Pharo, Regulatory Authority, Ministry of Agriculture and Forestry, Wellington, New Zealand, in November 1998, and has been prepared following a similar format.

The risks to the New Zealand environment are analysed using a sample of plant species known to have weedy characteristics and have dispersal mechanisms that utilize animals and animal fibre. Fruits and seeds are the primary means by which angiosperms are dispersed. The chief agents of dispersal are wind, water and animals. Animals disperse fruits and seed either by ingesting and subsequently excreting them or by passively transporting them once they have adhered to an external part of the body, such as the fur.

Because of the large number of plant species present in the world it was not possible to assess every potential weedy species in this risk analysis. A sample of the many species present in the world that could potentially be spread by animals have been examined as a means of illustrating the potential hazards and impacts that may result from the importation of potentially weedy plant species.

Hazard identification has been undertaken for each of the species represented but the risk assessment and risk management component of the analysis has been consolidated to provide a generic assessment.

2 INTRODUCTION

2.1 Scope

2.1.1 Background

Mechanisms for Seed Dispersal⁽¹⁾

Fruits and seeds are the primary means by which angiosperms are dispersed. The chief agents of dispersal are wind, water and animals. Animals disperse fruits and seed either by ingesting and subsequently excreting them or by passively transporting them once they have adhered to an external part of the body, such as the fur.

The evolution of fleshy fruits and seeds exemplifies the coevolution of plants and their animal agents of dispersal. An animal diet often consists solely of fruits and seeds that are designed to be eaten and dispersed, and in many cases these seeds require full or partial digestion to stimulate germination.

Most fruits with a fleshy pericarp are eaten whole by vertebrates, including the stony endocarp or the stony seed coat. The seeds are then either regurgitated by the animal or pass through the alimentary canal and are excreted, often some distance from the original site.

Many mammals eat and disperse seeds and fruits. Furry terrestrial mammals are the agents most frequently involved in epizoochory, the inadvertent carrying by animals, of dispersal units. Burr like seed and fruits, or those diaspores provided with spines, hooks, claws, bristles, grapples and prickles, cling tenaciously to their carriers. Seeds of some species, such as *Medicago* species, are highly resistant to damage from hot water and certain chemicals such as dyes, and have achieved wide global distribution through the wool trade.

Because of the large number of plant species present in the world it was not possible to assess every potential weedy species in this risk analysis. The weedy plant species detailed in section 4 are a sample of the many species present in the world that could potentially be spread by animals.

2.1.2 Contamination situations considered in the risk analysis

This risk analysis looks at the potential for introduction of weedy plant species of concern to New Zealand via the importation of live animals and fibre of sheep and goats. For live animal imports there are two pathways for contamination, fruits and seeds passing through the digestive tract or attached to wool or fur/hide. For fibre from sheep and goats the risk analysis looks at the direct contamination of the fibre.

2.2 Risk analysis methodology

As this risk analysis is in part an addendum to the disease import risk analysis on unprocessed fibre of sheep and goats prepared by Howard J Pharo, Regulatory Authority, Ministry of Agriculture and Forestry, Wellington, New Zealand, in November 1998, a similar methodology has been adopted.

The steps in the risk analysis process are:

- hazard identification
- risk assessment
 - release assessment
 - exposure assessment
 - consequence assessment
 - risk estimation
- risk management

2.2.1 Hazard identification

Hazard identification involves identifying the risk-producing agents and the conditions under which they potentially produce consequences. If a hazard is not identified, a risk assessment cannot be conducted and risk mitigation measures cannot be formulated.

This hazard identification examines the weed characteristics and properties of a sample of plant species recorded as having animals involved as dispersal agents, to determine whether animals and imported fibre could be considered as vectors for the introduction of weedy plant species into New Zealand.

2.2.2 Risk Assessment

The risk assessment comprises four distinct steps:

a) Release assessment

This is the process of describing the potential for a risk source, in this case live animals and fibre of sheep and goats, to introduce weedy plant species of concern to New Zealand.

b) Exposure assessment

This step describes the possible sources of introduction of fruits and seeds into the New Zealand environment.

c) Consequence assessment

This is the process of describing the economic and environmental consequence associated with the introduction of weedy plant species of concern to New Zealand.

d) Risk estimation

This is the step which integrates the results from the release assessment, exposure assessment, and consequence assessment. This step is a summarisation of the preceding three steps and involves a decision as to whether safeguards are necessary.

2.2.3 Risk Management

Risk management is the formulation of risk mitigating measures (safeguards) which are considered appropriate for the identified hazards.

3 SUMMARY OF RECOMMENDED SAFEGUARDS

3.1 Live Animal Imports

The risk of introducing weedy plant species of concern to New Zealand via the importation of live animals will be dependant on a number of time dependant factors. Initially there will need to be exposure to reproductive plant material at an optimum period of maturity and viability. An optimum transport time that will allow material to be introduced into the New Zealand environment is also critical. The fruits or seeds will then have to be able to survive the new environment, become established and continue to propagate.

There is potential for introduction in this pathway, but the risks rapidly decrease as each of the factors is combined.

To ensure minimal risk of introducing weed species of concern to New Zealand, animals could be held, pre-shipment, in areas free of weed species and fed on clean pasture or high quality feed. During transport, provision of high quality feed with little or no weed species contamination or feed that has been treated in such a way as to render seeds non-viable will mitigate the risks associated with the importation of live animals.

Dung produced during transport should be safely disposed of, either enroute or on arrival in New Zealand.

Where animals are held in quarantine in New Zealand, sites may need to be monitored over several years if the original importation indicated that there was a higher risk of weed seeds of species of concern being introduced.

3.2 Unprocessed Fibre of Sheep and Goats

The risk of introducing weedy plant species of concern to New Zealand via the importation of unprocessed fibre of sheep and goats, into a situation that would result in establishment is likely to be very low.

Buyers should be encouraged to purchase clean, weed free fibre. Plant and seed material removed from fibre during carding, scouring or testing should be collected and waste material either incinerated or deep buried in a commercial rubbish tip.

4 RISK ANALYSIS (MONOCOTYLEDONS) ^(2,3,4)

4.1 *Cenchrus incertis*

4.1.1 Hazard identification

An erect annual grass forming loose tussocks and characterised by large spiny burrs and occurring in humid and subhumid tropical lowlands, growing on sandy or other light soils. This grass is a native of tropical America, extending from the southern United States through the Caribbean region and Central America to Colombia, Brazil, Argentina and Chile.

It is a serious weed of maize and pastures and grows readily in moist conditions, producing thick clumps which compete with the crop for light, moisture and nutrients, often smothering low-growing plants.

The plant produces spiny seed containing burrs which fall from the plant when mature and adhere to wool and fur.

4.2 *Cenchrus longispinus*

4.2.1 Hazard identification

An erect or spreading annual grass reproducing by seed. This grass originated in North and Central America and occurs in temperate subhumid and semi-arid regions where it grows in low fertility, sandy, well drained soils. It occupies open dry sandy situations and is a pioneer plant of disturbed sandy soils.

Seeds are contained within a burr that has barbed spines. The burrs easily detach from the plant when mature and adhere to wool and fur.

4.3 *Cyperus aromaticus*

4.3.1 Hazard identification

An aggressive perennial sedge reproducing by seed and rhizomes, native to tropical Africa, Madagascar, Mauritius and Seychelles. It is extremely aggressive and unpalatable plant, capable of smothering many tropical pasture species, thereby reducing pasture production.

Long distance spread is principally by seeds passing through the digestive tract of animal and birds, or carried in mud attached to hooves and pelts.

4.4 *Homeria flaccida*

4.4.1 Hazard identification

An erect perennial herb with annual leaves and flowers reproducing from corms and seed, occurring in semi-arid and subhumid subtropical scrubland on a wide range of soil types. Originating in South Africa, it is considered troublesome because it is poisonous to cattle, sheep and goats, all parts of the plant being toxic whether green or dry.

When seeds are ingested by animals they remain viable after passing through stock. Seeds also adhere to wool.

4.5 *Nassella trichotoma*

4.5.1 Hazard identification

A perennial tussock forming grass occurring in subhumid and warm-temperate regions as a weed in open pastures and lightly timbered areas. This tussock is a native of Argentina, Chile, Peru and Uruguay and can heavily reduce pasture carrying capacity. Because of a high fibre content and low protein level animals are unable to digest the plant, sometimes resulting in fibre balls lodging in the intestines, causing loss of condition.

The roughened coat of the seed and tufts of hair at the base allow the seed to cling to wool.

4.6 *Pennisetum macrourum*

4.6.1 Hazard identification

An erect perennial grass, commonly 1 to 1.8 metres high, reproducing by seed and rhizomes. It is a native of South Africa. The coarse leaves of mature plants are of low palatability and not grazed by stock except when there is an extreme shortage of other feed. The plant can be a prolific seed producer.

Seeds have bristles that cling to wool and hair of animals.

4.7 *Pennisetum villosum*

4.7.1 Hazard identification

An erect densely tussock forming perennial grass up to 70 cm high of moister semi-arid or arid subtropics, native to North Africa and the Arabian Peninsula. Mature plants are unpalatable and rarely grazed by stock. Dense clumps can be formed that tend to dominate infested pasture.

Some seed held within involucre bristles can adhere to wool and fur.

4.8 *Sagittaria montevidensis*

4.8.1 Hazard identification

An emergent perennial aquatic herb occurring in marsh soils. It is a native of North and South America that can produce dense infestations, blocking channels and drainage ditches.

While seed spread is primarily through waterways, it can also occur in mud sticking to hooves and fur.

4.9 *Sorghum x almum*

4.9.1 Hazard identification

A vigorous short-lived, late maturing, summer growing, coarse perennial grass, 1 to 3.5 metres high, reproducing by seed and rhizomes and occurring in subtropical, semi-arid high fertility soils. This cross is believed to have originated in Argentina and was widely cultivated. Seedlings readily establish on disturbed soils and has the potential to harbour diseases and insect pests of sorghum and maize, contaminate grain sorghum seed and poison stock.

Seeds, when awned, stick to wool and fur of animals.

4.10 *Sorghum halepense*

4.10.1 Hazard identification

An erect perennial grass, 0.5 to 2 metres high, reproducing by seed and rhizomes and occurring in temperate, subtropical and tropical regions and can invade cultivated and irrigated paddocks. This species is native to the Indo-European region. This is a C₄ plant and is considered one of the ten worst weeds in the world. It causes severe crop losses as a result of direct competition. Seedlings readily establish on disturbed soils and has the potential to harbour diseases and insect pests of sorghum and maize, contaminate grain sorghum seed and poison stock.

Seeds can stick to wool and fur of animals and pass relatively unharmed through animal digestive tracts.

4.11 *Sporobolus africanus*

4.11.1 Hazard identification

A tough unpalatable perennial tussock grass reproducing by seed and occurring in moister areas of southern semi-arid to subhumid subtropics, as a weed in disturbed soils. It is able to invade degraded pastures, particularly in wet or swampy areas. A native of South Africa, this species is also a C₄ plant that is particularly aggressive in wet swampy soils, but can become dominant in open sunny situations and seriously reduce pasture production.

At maturity, seeds become sticky when damp and when expressed from the spikelet, stick to the outer surface of the glumes where they can readily attach to animal fur.

4.12 *Stipa caudata* and *S. brachychaeta*

4.12.1 Hazard identification

Tussock forming perennial grasses without rhizomes and producing by seed, that occur in temperate grasslands. They are native to South America and can reduce yields, particularly in lucerne. Once established they are hard to eradicate.

Fine hairs on the awn and callus allow the seed to readily stick to wool.

5 RISK ANALYSIS (DICOTYLEDONS) ^(2,3,4,5)

5.1 *Acanthospermum hispidum*

5.1.1 Hazard identification

An erect annual herb covered by stiff hairs and reproducing by seed, from humid and subhumid tropics. This is a native of South America that seriously competes with several crops for water and nutrients. It also impedes harvesting.

Hooked spines on the seed make this species an important contaminant of wool and fur of animals.

5.2 *Adonis microcarpa*

5.2.1 Hazard identification

An erect, much branched, annual herb, native to the Mediterranean region and occurring in warm-temperate regions. This species can compete strongly in cereal crops and medic pastures. It is also toxic with the principle poison being the adonidin group of glycosides, especially adonin.

The seed readily adheres to wool and fur.

5.3 *Alternanthera pungens*

5.3.1 Hazard identification

A prostrate creeping perennial herb, reproducing by seed, roots and stems taking root at nodes, occurring in tropical and sub tropical regions, mainly on light soils in areas with high temperature. A native of tropical America, it colonises bare or disturbed areas. The heads contribute to vegetable fault in wool.

Part of dispersal occurs when the prickly burrs attach to animals.

5.4 *Ambrosia confertiflora*

5.4.1 Hazard identification

An erect perennial herb forming large colonies from creeping roots, occurring in dry plains of temperate regions and native to the semi-arid plains of the southern United States and Mexico. This plant is an extremely competitive plant, readily suppressing pasture species. Its burrs contaminate wool and, because of hooked spines, are not easily removed during scouring. This adds to the cost of manufacture because acid carbonising must be used for removal.

5.5 *Ambrosia psilostachya*

5.5.1 Hazard identification

An erect robust perennial herb that forms dense colonies and has a strong rootstock and creeping roots occurring in semi arid grassland, principally on sandy soils. This species grows extensively in North America and is strongly competitive, often resulting productivity reductions in crops and pasture. Aerial growths are allelopathic and the pollen causes allergic inflammations.

The fruit of this species is able to tangle in wool and stick to furred animals.

5.6 *Amsinckia* species

5.6.1 Hazard identification

Erect annual herbs originating in North and South America and occurring in temperate regions on a wide range of soils in moderately warm, unshaded situations. This species is very competitive with cereal crops, causes impurities in wool and is potentially toxic to stock.

A bristly calyx facilitates dispersal on wool, fur and hair of animals. Seeds are also believed to pass through the intestines of sheep in a viable condition.

5.7 *Chondrilla juncea*

5.7.1 Hazard identification

An erect, much branched perennial herb that occurs in temperate, subhumid and semi-arid open scrubland in dry, well drained, sandy to moderately textured soils. This species originated in an area from the former southern Soviet Union and Asia Minor west to the Mediterranean. It is of little importance as a weed in most of these areas but has become a major weed in Australia, especially in cereal crops.

The plant produces small seed with a large pappus, scales and toothlike projections that can attach to wool. Contamination of wool has been an important dispersal mechanism in Australia.

5.8 *Chrysanthemoides monilifera*

5.8.1 Hazard identification

A perennial shrub to 3 metres high occurring in subtropical and sub humid scrubland preferring sandy or medium textured soils and disturbed areas, particularly near the sea where it tolerates saline conditions. It is native to the southern and south eastern coastal areas of South Africa. While not usually detrimental in agricultural areas it has capable of invading areas of native vegetation and coastal vegetation systems.

The fleshy fruit can be eaten by cattle and other animals and birds. Seeds remain viable after passing through the digestive tract.

5.9 *Cuscuta* species

5.9.1 Hazard identification

Parasitic weeds which affect a wide range of broad-leaved plants and can grow over a wide range of environmental conditions. Many species originate from the Americas.

Seed can pass through animals in a viable state.

5.10 *Dittrichia graveolens*

5.10.1 Hazard identification

An erect, much branched, strongly aromatic annual herb up to 1 metre high that occurs in warm-temperate and subtropical regions on shady or light textured soils. It is a native of the Mediterranean region. When mature the plant is not very palatable. Flower heads, when eaten by sheep can cause irritation and puncturing of the stomach, intestine and bowel lining by the barbed pappus hairs. Aromatic oils are also produced by glandular hairs which can discolour wool. This discolouration is, however, removed during the scouring process.

The seed is hairy with barbs on the pappus hairs that allow it to readily attach to wool and skin.

5.11 *Gmelina asiatica*

5.11.1 Hazard identification

A highly variable thorny shrub or small tree, 2 to 4 metres high, widely distributed throughout Asia in open deciduous or wet scrubby forests of subtropical areas. It is an aggressive thorny shrub that tends to form dense thickets.

Spread is mainly by animals and birds voiding viable seed in their droppings.

5.12 *Gorteria personata*

5.12.1 Hazard identification

A stiff herbaceous to woody annual herb occurring mainly in dry, sandy or gravelly soils in undisturbed sub-tropical and warm-temperate open woodlands. It is a native of south-western Africa. It has spiny burrs that tangle in wool, providing potential vegetable fault. Contaminated wool would need to be treated by the carbonising process, thus reducing its commercial value.

Spread is wholly through the movement of the spiny burr which is well adapted to tangle in wool and other fibrous material.

5.13 *Heliotropium amplexicaule*

5.13.1 Hazard identification

A hairy prostrate perennial herb, native to South America and occurring in warm-temperate and subtropical regions. It is commonly a weed of roadsides, waste places, fallows and degraded pastures and often forms clumps free of other species.

Seeds are contained in wrinkled and tuberculate nutlets that readily stick to wool and animal fur. Seeds also pass unharmed through the alimentary tracts of most animals.

5.14 *Heliotropium europaeum*

5.14.1 Hazard identification

A hairy, summer-growing annual herb, native to central Europe, western Asia and northern Africa and occurring in temperate regions on a wide range of soils. Its main economic importance is its toxicity to sheep, cattle and horses.

A hairy inflorescence and rough surface of its nutlets allow seeds to adhere to wool and fur. Seeds usually pass through the digestive tracts of animals unharmed.

5.15 *Hyptis capitata*

5.15.1 Hazard identification

An erect aromatic perennial herb with several branching stems, native to Central America from Mexico to Panama, occurring in the humid tropics and subtropics on heavy soils retaining above average moisture. Because of its peculiar odour and bitter taste it is not readily eaten by stock, resulting in more palatable species being grazed and allowing further spread of this species.

The fruit readily adheres to wool and fur.

5.16 *Hyptis suaveolens*

5.16.1 Hazard identification

An erect branched woody-based annual herb with a characteristic odour when crushed, native to tropical America and occurring in fertile coarse textured soils in the subhumid or semi-arid tropics, in areas not subject to waterlogging. It is not palatable to stock and poses a problem in improved pastures. As stock avoid grazing it, more palatable species are overgrazed. It can form dense thickets.

The seed remains in its spined burr which catch on wool and fur.

5.17 *Ibicella lutea* and *Proboscidea louisianica*

5.17.1 Hazard identification

Erect low-growing annual herbs originating throughout the Americas and occurring in humid, temperate to tropical regions on high fertility soils. It is weedy on disturbed sites and can be strongly competitive with summer crops. It produces hard woody, clawed fruit that can injure stock when the claws work into an animal body or become attached to the feet or mouth.

The hooked claws of the fruit allow it to readily attach to animals, particularly sheep.

5.18 *Malvella leprosa*

5.18.1 Hazard identification

A semi-erect perennial herb originating in western North America, occurring on channel banks and irrigated annual pastures, principally on alkaline soils in arid and semi-arid warm-temperate regions. It is a deep rooted perennial that competes strongly with pastures species. It is encouraged by irrigation.

The plant can produce abundant seeds which can be spread while still in their capsules that can become caught in wool.

5.19 *Martynia annua*

5.19.1 Hazard identification

An erect rank-growing squash-like annual herb growing up to 2 metres, native to Mexico and occurring in subhumid to semi-arid scrub and steppe. It is a fast growing plant which has an offensive, slimy discharge that discourages grazing.

Seed remains in its seed pod which has dorsal spines and hooked claws that can catch on to animals.

5.20 *Parkinsonia aculeata*

5.20.1 Hazard identification

A branching spiny glabrous shrub or small tree, from 2 to 8 metres high, often forming thickets, native to southern United States, the Caribbean, Mexico and northern South America. It occurs in semi-arid to subhumid tropics and subtropics on a wide range of soil types. It is an extremely hardy shrub which can form dense thickets especially along creeks and rivers.

The main method of seed dispersal seems to be by birds and animals eating the seed and voiding it, often with enhanced germination capacity.

5.21 *Physalis viscosa*

5.21.1 Hazard identification

An erect perennial herb originating in both North and South America and occurring in warm-temperate regions. When well established this species competes with other vegetation for moisture and nutrients. It has an extensive root system often more than 1 metre deep which makes control difficult. It is hardy and withstands drought, shading and trampling.

The fruit can be eaten by stock and it seems that germination is enhanced after seeds pass through animals.

5.22 *Reseda lutea*

5.22.1 Hazard identification

A biennial or short-lived perennial herb with a woody base and deep taproot, native to the limestone or chalk soils of Europe that occurs in the temperate regions, preferably with warm dry summers. It competes with pastures and crops for light and nutrients but is mainly a weed of waste ground or where it encroaches onto regenerating pastures and crops.

Some seed is dispersed when eaten by animals and later excreted. Germination capability is usually much reduced, but sufficient survive to establish new colonies.

5.23 *Sclerolaena muricata*

5.23.1 Hazard identification

An erect bushy rounded semi-shrub, native to semi-arid areas of eastern Australia, occurring on a wide range of soils.

Burrs contaminate wool but their spines are not hooked and are therefore not as troublesome as the *Xanthium* species.

5.24 *Sida rhombifolia*

5.24.1 Hazard identification

An erect or ascending, much branched, perennial sub-shrub up to 1 metre high, that appears to be endemic throughout the tropics. It occurs in tropical to warm-temperate savanna, tolerating a wide range of soils and is principally a weed in moist disturbed areas. It is a serious competitor for light and nutrients in both crops and pastures in the warmer regions.

It has seed with finely barbed awns that catch on wool and fur.

5.25 *Solanum elaeagnifolium*

5.25.1 Hazard identification

An erect summer growing perennial herb with a native range from central and south-western North America to temperate South America, occurring in warm-temperate regions. This species competes directly with summer growing crops and pastures, and reduces production of winter crops such as cereals. It is a difficult weed to control.

Seed from fruit eaten by animals are voided in a viable condition.

5.26 *Solanum rostratum*

5.26.1 Hazard identification

An erect annual herb with a native range that includes Mexico and the southern United States. It occurs in semi-arid and subhumid warm-temperate regions. This species is poisonous and also bears numerous prickles.

The plant produces burrs that can stick to wool and also contribute to vegetable faults.

5.27 *Stevia eupatoria*

5.27.1 Hazard identification

A perennial herb native to Mexico, occurring in subtropical to temperate mountainous woodland or grassland above 500 metres. It is unpalatable and produces dense infestations limiting grazing and pasture production.

Most dispersal is by seed, which are adapted for spread by wind and animals, when seed lodges in wool and fur.

5.28 *Tribulus terrestris*

5.28.1 Hazard identification

A prostrate summer growing annual herb with a large native range. This species occurs in almost all temperate areas of the world and is troublesome in most. Spines on the fruit damage the feet of animals, and is a nuisance in environmental and recreational areas.

Fruit can become entangled and embedded in the fleece of sheep and much of this species spread throughout the world may have been as a contaminant of wool.

5.29 *Verbesina encelioides*

5.29.1 Hazard identification

An erect branching summer-growing annual herb native to Mexico and the southern United States that occurs in temperate to subtropical open scrubland in lighter soil types. This species can potentially affect some cereal crop production and is extremely toxic.

Seeds have wings and fine bristles that can attach to wool and fur.

5.30 *Xanthium occidentale*, and *X. orientale*

5.30.1 Hazard identification

Erect annual herbs up to 2.5 metre high with two growth forms (erect single-stemmed plants; much branched spreading plants) that appear to originate in North America. It occurs in unshaded, warm situations in temperate regions, usually on fertile soils.

The burrs of these species become entangled in wool and are a problem to shearers when they work into the fleece and are struck by the shearing combs. They often completely mat the wool, particularly under the neck and on the belly. The burrs can seriously damage carding machines. Burrs cannot be removed mechanically and the wool must be carbonised with acid.

5.31 *Xanthium spinosum*

5.31.1 Hazard identification

An erect much branched annual herb up to 1 metre high, native to South America and occurring in exposed, moderately warm situations in temperate regions on high fertility disturbed soils. Dense growth reduces pasture productivity.

Burrs have hooked spines that cling firmly to wool or fur of animals. While the burrs are not as difficult to remove as those of *X. occidentale* and *X. orientale*, additional treatments are necessary.

6 LIVE ANIMAL IMPORTS - RISK ASSESSMENT AND RISK MANAGEMENT

6.1 Risk Assessment

6.1.1 Release assessment

Prior to export, the majority of domestic grazing animals will have primarily been exposed to either pastures, green-feed, grain or dry-feed (hay, silage, commercial feed). Animals on pasture or green-feed would need to be exposed to weed species at a time when plants were producing viable, mature seed and the seeds where from a species capable of surviving passage through the digestive tract or were able to attach themselves to the wool or fur of the animal. Grain or dry-fed animals would need to be exposed to feed that was already contaminated with seeds of weedy plant species that were still viable.

Transport time to New Zealand will also be a factor in the potential risk of introducing weed species that have been ingested. If weed seeds, from a species that can pass through the digestive tract, have been ingested, they will either be voided prior to departure (dependant on the pre-shipment holding period), enroute or on arrival in New Zealand. The longer the period between ingestion and arrival, the less risk there will be of seeds being voided in New Zealand.

The quality of feed during transport and where it is sourced will influence the risks of introducing weed species. If contaminated feed is provided then the risk of introduction of weed species could increase as the period between ingestion and arrival diminishes.

6.1.2 Exposure assessment

Once animals have been introduced to New Zealand the risk of populations of weed species establishing will vary depending on a number of factors, such as:

- whether or not they have been exposed to seeds at an appropriate time;
- the seeds coming from a plant species that is of concern to New Zealand;
- the period of time between ingestion of seed and arrival in New Zealand (timing of seeds being voided);

- seeds adhering to wool or fur becoming dislodged in an environment suitable to allow seedlings to germinate, grow, and produce propagative material;
- being voided into a suitable environment that will allow seedlings to germinate, grow, and produce propagative material; and
- viability of the seeds.

6.1.3 Consequence assessment

The number of known invasive weeds has grown steadily since the 1960's, as new species have naturalised (some of which become invasive)⁽⁶⁾. Much of the introduction of new species in the past has been associated with the importation of seed and nursery stock for gardening and horticultural purposes. Currently there are approximately 20,000 introduced plant species present in New Zealand, with the potential of thousands of taxa worldwide that could establish in New Zealand⁽⁷⁾. Of these approximately 2,000 have become established in the wild.

Weedy species new to New Zealand have the potential to cause production losses and threaten New Zealand's natural heritage if they become established and able to maintain invasive populations. However, the impacts in New Zealand are not always easily predicted from their behaviour in their native range.

6.1.4 Risk estimation

The risk of introducing weedy plant species of concern to New Zealand via the importation of live animals will be dependant on a number of time dependant factors. Initially there will need to be exposure to reproductive plant material at an optimum period of maturity and viability. An optimum transport time that will allow material to be introduced into the New Zealand environment is also critical. The fruits or seeds will then have to be able to survive the new environment, become established and continue to propagate.

There is potential for introduction in this pathway, but the risks rapidly decrease as each of the factors is combined.

6.2 Risk Management

To ensure minimal risk of introducing weed species of concern to New Zealand, animals could be held, pre-shipment, in areas free of weed species and fed on clean pasture or high quality feed. During transport, provision of high quality feed with little or no weed species contamination or feed that has been treated in such a way as to render seeds non-viable will mitigate the risks associated with the importation of live animals.

Dung produced during transport should be safely disposed of, either enroute or on arrival in New Zealand.

Where animals are held in quarantine in New Zealand, sites may need to be monitored over several years if the original importation indicated that there was a higher risk of weed seeds of species of concern being introduced. Animals would need to have been exposed to weed species that were of concern to New Zealand (either new to New Zealand; were a risk species; or subject to official control).

7 UNPROCESSED FIBRE OF SHEEP AND GOATS - RISK ASSESSMENT AND RISK MANAGEMENT

7.1 Risk Assessment

7.1.1 Release assessment

Prior to shearing, sheep or goats would need to be exposed to weed species of concern to New Zealand at a time when plants were producing viable, mature seed and that the fruits or seeds themselves became attached to the animal. During the shearing process, fruits and seeds would need to remain attached to the fleece.

Pelts would also need to be accepted for purchase and export to New Zealand by the buyer and be acceptable to the importer.

7.1.2 Exposure assessment

Fibre imported for scouring, further processing, home spinning or testing is unlikely to result in release of fruits and seeds into a suitable environment for establishment, depending on the method of disposal of waste material. Plant and seed material removed from fibre during carding, scouring or testing would be collected as waste material. Dumping of this material may pose some risk of viable seed material being introduced into the environment, however, most commercial activities would result in the material being incinerated or deep buried in a commercial rubbish tip.

7.1.3 Consequence assessment

See section 6.1.3 above.

7.1.4 Risk estimation

The risk of introducing weedy plant species of concern to New Zealand via the importation of unprocessed fibre of sheep and goats, into a situation that would result in establishment is likely to be very low.

7.2 Risk Management

Buyers should be encouraged to purchase clean, weed free fibre. Plant and seed material removed from fibre during carding, scouring or testing should be collected and waste material either incinerated or deep buried in a commercial rubbish tip.

8 REFERENCES

1 Encyclopaedia Britannica (1996)

2 Parsons, W.T. and Cuthbertson, E.G. (1992). *Noxious Weeds of Australia*. Inkata Press

3 Holm, L., Doll, J., Holm, E., Pancho, J., and Herberger, J. (1997). *World Weeds: Natural Histories and Distribution*. John Wiley & Sons, Inc.

4 Holm, L.G., Plucknett, D.L., Pancho, J.V., and Herberger, J.P. (1977). *The World Worst Weeds*. University Press of Hawaii.

5 Webb, C.J., Sykes, W.R. and Garnock-Jones, P.J. (1988). *Flora of New Zealand, Volume IV, Naturalised Pteridophytes, Gymnosperms, Dicotyledons*. Botany Division, D.S.I.R., Christchurch, New Zealand

6 Owen, S.J. (October 1998). *Department of Conservation Strategic Plan for Managing Invasive Weeds*. Department of Conservation, Wellington, New Zealand. pp. 12

7 Nicol, E. (1997). Vascular plant species recommended for “Entry Prohibited” status. Unpublished report to MAF Regulatory Authority. Landcare Research.