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WHAT AUSTRALIA OFFERS AS A SOURCE OF WORLD LEADING GENETICS AND GENETIC TECHNOLOGIES

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1. Background

In 2011 the world's population exceeded 7 billion people. This is predicted to increase further to 9 billion in 2050. Population growth in virtually all developing countries and rising income in a number of these countries will create a dramatic increase in demand for animal protein. This will be provided as chicken, pork, beef and milk. The quantum of this huge market opportunity that is captured by beef and dairy depends on the capacity of those industries to plan globally rather than domestically.

Many developing countries already have underutilized pasture resources or have the capacity to increase pasture production on land with limited alternative uses. It follows that there is a strong demand for dairy and beef heifers for building national herds in developing countries in parallel with imports of beef, milk products and cattle for slaughter.

Australia has decades of experience in developing the infrastructure and protocols for export of live animals. For example, live cattle exports of between 700,000 and 1 million head take place each year. The main destinations in recent years have been Indonesia, China, Turkey, the Philippines, the Russian Federations and Israel. The majority of these exports are for slaughter in importing countries or value adding through a period of feedlot finishing, as is the case for a large percentage of the feeder steer exports to Indonesia.

Australia also exports around 3 million head of live sheep per year. Most of these sheep go to the Middle East where they are destined for slaughter.

For over two decades the authors have advocated that Australia has the capacity to become a major exporter of cattle, semen and embryo for breeding purposes (2, 7, 8, 9, 10, 11, 12).

Export of cattle for breeding can use much of the infrastructure developed for exporting cattle for slaughter (particularly quarantine, transport and feeding facilities). However, a number of the markets for breeding cattle require an extra level of quality assurance that relates to type inspection and pedigree background. As a result of funding provided by the Australian Government's Department of Agriculture, Fisheries and Forestry (DAFF), Export Certification procedures have been developed for dairy cattle (in 2005) and beef cattle (in 2008). The procedures for beef cattle will be detailed in the presentation that follows given by Mr Christian Duff. The use of these quality assurance procedures has greatly increased the confidence of overseas buyers of live cattle for breeding and a strong increase in exports has followed.

It needs to be acknowledged that the international demand for cattle genetics is much greater than can be met by any one country. The USA, Canada, Britain and Holland are countries which have developed very good infrastructures for export of cattle genetics and whose cattle breeders have been richly rewarded by the success of these national export initiatives.

2. What Australia offers as a source of high quality cattle genetics

While being somewhat of a late starter, there are many good reasons for Australia now becoming a major player in the export of cattle genetics. These include:

- Australia already has infrastructure and expertise to be major exporter of breeding cattle – over 700,000 live cattle have been exported annually for slaughter in recent years.
- Australia is free of most of the serious infection diseases of cattle.
- Cattle are available from a range of climates to meet requirements of many markets.
- Cattle of many breeds are available – tropical breeds, British breeds, European breeds and Holsteins are all in large numbers.
- Many cattle are from large herds where effective selection is practised.
- Our genetics is backed by world leading science (Beef and Dairy CRCs) and genetic evaluation systems (BREEDPLAN for beef and ADHIS for dairy cattle).
- All major breeds of cattle are backed by world-leading pedigree systems from ABRI.
- Independent quality assurance system is in place for both dairy and beef exports for breeding.
- Technical support is available to importing countries.

To maximize sales, Australia needs to look at providing packages of products/services that are customized to the requirements of individual clients. These packages may include combinations of:

- Live cattle for breeding:
    - true-to-type commercial females
    - pedigree cattle in various categories
- Semen
- Embryos
- Technical advice on how to use the genetics
- Recording & genetic evaluation systems with link to data from exporting countries.

Thus we need a range of competent players collaborating in a very focused way. Exporters play a key role in the success of our initiatives. This includes close liaison with importers to understand their requirements and concurrently with Australia's suppliers of genetics and genetic services to see that market requirements are met. There has been rapid progress in this area in recent times.

3. What is the potential benefit to the Australian economy

For some time the authors have advised that the export of Australian genetics and related services can become a major industry. Our current estimate is that Australia has the potential to achieve the following levels of export in the next few years.

Item	Annual Value
180,000 live cattle for breeding	$306M FOB
Semen and embryos	$ 10M
Various technical services	$ 10M
TOTAL	$326M

In 2011, Australia achieved about 60% of the target of live cattle exports for breeding with Russia, Kazakhstan, China, Turkey and Indonesia being the main markets.

We still have some way to go to reach $10Mpa in sale of semen and embryos. However, Section 5 identifies target breeds and markets for export.

Hassall and Associates have estimated that there is a multiplier effect of 2.125 to the Australian economy from the export of live cattle. When applied to the above forecasts, the value to the Australian economy of a vibrant genetic export trade is estimated to reach $850M as shown below:

Estimated value of exports	$326M
Multiplier	2.125
Value to Australian Economy	$693M

Australia's cattle producers, the MLA, LiveCorp, Australian Livestock Exporters Council, live exporters, the Australian Cattle Genetics Export Agency, ABRI, breed societies, artificial breeding companies and AQIS all have key roles to play to bring this dream to reality. But it is entirely achievable with a focused approach. Perhaps we could get some inspiration from George Bernard Shaw who said *"If your dreams don't frighten you they're not big enough."*

4. What is the progress with exports of breeding cattle

The export of dairy heifers for breeding has flourished under the export certification scheme introduced in 2005. Around 75,000 dairy heifers are exported per year from Australia of which 50,000 are certified.

The certification procedures for beef cattle for breeding were introduced in 2008 and are now well regarded by both importers and exporters as an effective mechanism for quality control. The numbers of certified exports have been:

Year	No. Certified Cattle exported
2007	2,720
2008	5,453
2009	3,010
2010	5,380
2011	24,769

The five-fold increase in certified exports of beef cattle for breeding in 2011 has been very encouraging. In addition to the certified exports to markets that require some pedigree background, there are around 10,000 good quality commercial heifers exported per year for breeding mainly Brahmans. The majority of these are required by importers to pass an inspection for type.

In summary, the export of live cattle for breeding has been a great success in recent years.

5. Opportunities for Export of beef breed semen and embryos from Australia

5.1 Semen

Today's global trade in frozen bovine semen and bovine embryos is significant in the size and dynamics of exports and imports between different countries. Some countries have put great emphasis into export development (USA, Canada and UK), others have largely been importers (Brazil) while others are trying to change the emphasis from net importer to net exporter (Australia and Argentina).

5.2 Global Semen Trade

While global statistics around trade appear not to be kept on an annual basis by any individual entity the following statistics from the USA will give readers some idea of the size of the trade (Table 5.1).

Table 5.1: Value and volume of export semen sales from USA to the world (units of semen and dollar value) in 2010	
Dairy semen exports - units	14,924,802
Dairy semen exports – dollar value	$117,260,668
Beef semen exports - units	1,670,556
Beef semen exports – dollar value	$6,674,982

Source: NAAB (2012)

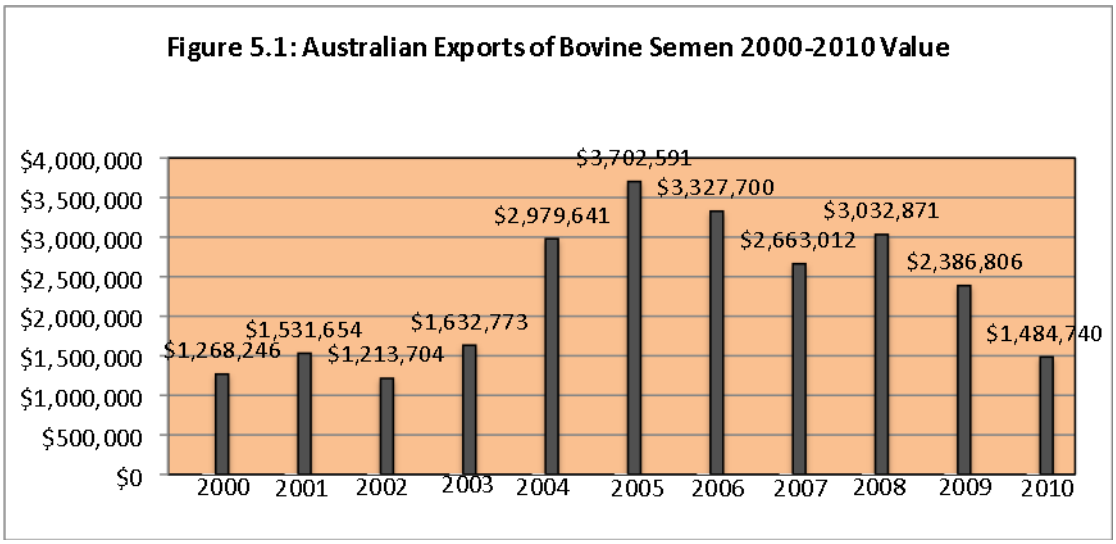
Exports of dairy semen around the world are significant but it is interesting to note the increased interest in exports of beef semen in recent years. In USA the growth rate of beef semen for export has been much greater than for domestic sales. The number of units of beef semen exported surpassed the numbers of units sold domestically for the first time in 2008 and again in 2009 (Johnson and Dhuyvetter 2011).

Domestic USA beef semen sales in 2010 showed 1,229,798 units while beef semen export sales showed 1,669,686 units (NAAB 2012). In contrast beef semen imports into USA in 2010 showed only 2,940 units with 996 being Angus.

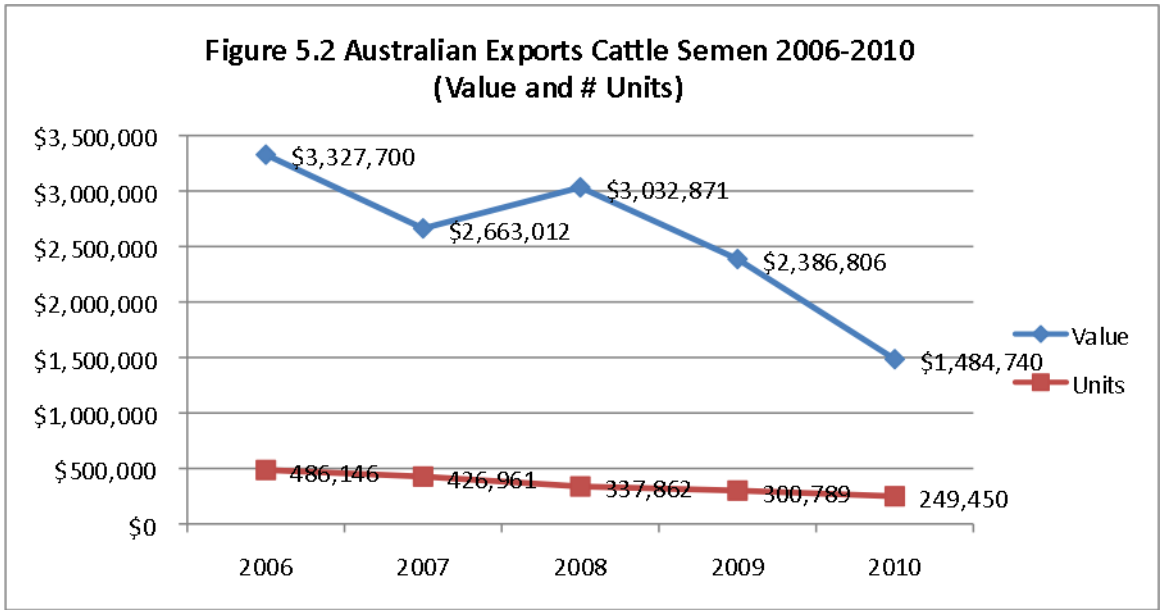
From a breed perspective, in 2010 domestic US sales of semen showed seventy-three (73) percent Angus, eight (8) percent Simmental, and Red Angus six (6) percent. For export sales Angus showed fifty-nine (59) percent, Red Angus fifteen (15) percent, Red Brahman seven (7) percent, Brahman four (4) percent and Brangus three (3) percent.

5.3 Australia – Semen Exports

In 1992, Nicol suggested "when it comes to marketing beef seedstock and genetics, Australia is way behind the rest of the world" (Nicol 1992). Export activity in terms of beef semen has not improved in that time. Between 2000 and 2005 (Figure 5.1) export of beef and dairy semen exports rose in value from $1,268,246 to $3,702,501 however by 2010 the sales had dropped considerably. The current trend is downwards (Figure 5.2) and it will take significant collaborative effort to turn this trend around.



Source: ABS 2011 (DEEDI pers. comm.)



Source: ABS 2011 (DEEDI pers. comm.)

Australia exported beef and dairy semen to thirty-two countries in 2009 (Table 5.2). While the statistics do not differentiate whether beef or dairy one would surmise that the majority of semen exports are dairy with perhaps the exception of Brazil and Argentina where beef exports probably dominate.

Table 5.2 Bovine Semen (Dairy and Beef) Exports from Australia 2009		
Country	Number of Units	Percentage
Canada	55,361	18.19%
South Africa	48,310	15.88%
Brazil	38,578	12.68%
USA	26,184	8.61%
United Kingdom	21,657	7.12%
Argentina	18,205	5.98%
New Zealand	15,383	5.06%
Spain	11,389	3.74%
Uruguay	9,150	3.01%
Japan	6,299	2.07%
Thailand	5,500	1.81%
Fiji	5,280	1.74%
20 other countries	42,990	14.11
Total	304,286	100%

Source: AQIS Canberra (C Millar pers. com. 2012).

It should be noted that there are differences in the number of units exported in 2009 reported from the different sources above. The need for standardized annual collection and publication of import and export statistics for beef and dairy genetic materials is a critical KPI for the industry, yet despite many attempts the appropriate authorities have been unable to deliver.

5.4 Semen Imports

Table 5.3 shows the semen imports to Australia in 2009. Again there is no differentiation between beef and dairy but it shows that Australia is still a long way from being a net exporter of semen.

Table 5.3 Bovine Semen (Dairy and Beef) Imports to Australia Jan – Dec 2009		
Country	Number of Units	Percentage
USA	410,052	39%
Canada	244,535	23%
New Zealand	138,373	13%
United Kingdom	93,119	8%
Netherlands	54,595	5%
France	51,487	4%
Germany	22,900	2%
Italy	7,978	0.8%
Sweden	7,900	0.7%
Denmark	6,010	0.6%
Ireland	3,460	0.3%
Norway	2,587	0.2%
Total	1,043,396	100%

Source: AQIS Canberra (C Millar pers. com. 2012).

5.5 Imports versus exports

For beef semen, Australia in the past has been an importing country rather than an exporting country. In 1990, Australia imported CAN$ 3.8 million worth of dairy and beef semen from Canada (Nicol 1992). In Australia, as in the USA, the Angus breed is the most important breed for beef semen sales. Seventy percent (70%) of the registered Australian Angus AI calves in 1990 were by ten sires, 9 of which were North American in origin.

In contrast, by 2010, 6 of the top 10 sires based on progeny registered with Angus Australia were Australian; one was from New Zealand and 3 from USA. Of the top 50 sires in that year 27 were Australian (Angus Australia 2012).

Table 5.2: Percent registered Angus calves [1] in Australia by AI and ET			
	2008	2009	2010
Percent calves by AI	34%	38%	36%
Percent calves by ET	8%	7%	7%
Percent calves by USA Sires (AI + ET)	16%	22%	16%
Percent calves by Canadian Sires (AI + ET)	1%	2%	1%
Percent calves by NZ Sires (AI + ET)	1%	1%	5% [2]
Percent calves by Australian Sires (AI + ET)	19%	21%	23%

[1] All Angus registers: HBR, APR, ACR. Source: Angus Australia (pers. comm.)
[2] Mainly one very popular sire

AI use in recent years in the registered Angus breed in Australia shows a new and growing trend in the use of semen from local sires rather than imported sires (Table 5.2). Today's top Australian Angus sires have multi-trait excellence and can compete on a global basis.

Based on their genetic merit there are numbers of Angus bulls that could be exported globally. A short-term challenge that needs to be remembered is that if a bull is unrelated to the animals in the importing breeds' genetic evaluation database, the EBV performance of the bull will be regressed down to the base performance in the early years after first import.

5.6 Embryos

The global production of transferrable bovine embryos in 2010 was 1,183,000 units taking into consideration fresh and frozen *in vivo* derived (IVD) embryos and fresh and frozen *in vitro* produced (IVP) embryos worldwide (Stroud 2011).

Worldwide there were 61,000 beef donors flushed and 43,000 dairy flushes however European bovine ET data isn't separated into beef and dairy meaning the actual numbers may be slightly different for the beef and dairy relativity.

From those global production figures 56,775 embryos are reported for Australia and New Zealand in 2010, though the numbers for these two countries are greatly underreported. Australia is not well organised between the veterinarians and non-veterinarians, which Stroud (2011) suggests it makes it extremely difficult to gather stats from the latter groups. Only one of seven known ET teams in New Zealand reported data for 2010.

5.7 Embryo Exports

Worldwide there were 19,878 dairy and 16,819 beef embryos exported in 2010 (Stroud 2011).

Table 5.3: The exports of beef embryos by major country for 2010 (units)		
	Country	Frozen bovine embryos exported
1	Canada	4894
2	Australia	4500 [1]
3	USA	3938
4	Argentina	2446
5	South Africa	753
6	Uruguay	128

[1] Mainly beef and significant numbers of Wagyu embryos R. Pashen (pers.comm.)

In relative numbers exported Australia seems to perform quite credibly. In beef embryo terms Australia is already a net exporter because the majority of imported embryos are of dairy genetics.

The numbers for Australia are based mainly on exports of embryos from the Japanese Black Wagyu breed to China and other countries and, Braford and Brahman embryos to South America.

In recent years Argentina has put strong effort into the export of semen and embryos to other Mercosur countries. They have been quite aggressive in sales of Brangus and other tropical beef breed embryos to Brazil, Paraguay and Bolivia and more recently to Colombia. Interestingly Argentina has also exported embryos to Canada in 2011.

5.8 Embryo Imports

Imports of embryos are shown in table 5.4. The majority of these are dairy embryos (C Millar pers. com. 2012) but without a breakdown by beef or dairy and by breed little can be said about the statistics.

Table 5.4 Bovine Embryo Imports into Australia 2009	
Country of Origin	# Embryos
Canada	1,741
USA	1,494
South Africa	833
New Zealand	222
Netherlands	81
France	73
Denmark	36
Total	4480

Source: AQIS Canberra (C Millar pers. com. 2012).
N.B. Ambiguous statistic for Italy omitted.

5.9 Brazil: a case study of a beef semen and embryo importing country

Statistics for beef semen importation over time and embryo production in South America allows for an analysis of Brazil as a potential export target for Australian exporters.

Brazil's use of semen in its cattle industries has evolved from 2,597,668 straws or ampoules in 1991 with a 300% increase to 10,415,050 straws sold in the country in 2010 (ASBIA 2010). Of the total used in 2010, 6,074,534 straws (58.32%) was national semen and 4,340,516 straws (41.68%) were imported.

Of the 2010 total, 6,025,214 straws (57.85%) were beef breed semen and 4,389,863 (42.15%) was dairy breed semen, a different ratio to most other importing countries where dairy semen predominates (ASBIA 2010).

South America transfers over 12% of the world's IVD embryos with the following numbers reported for 2010: 1) Brazil/38,975; 2) Argentina/24,263; 3) Uruguay/3402; 4) Colombia/2890 showing in part, the indications for these countries as export targets.

Brazil accounted, in 2008, for 26.9% of the embryos produced in the world, but for 30.6% of the embryos transferred (Viana et al 2010). Brazil's production of IVD embryos in that year showed 9.3% of the world total but 66.6% of the global production of IVP embryos

As a potential target country for Australian seedstock producers and artificial breeding companies, Table 5.5 shows some interesting trends between 2006 and 2010.

It is important to note that 2,676,336 straws of Nellore semen was used in 2010 which is a significant part of the beef total, Nellore being by far the most popular breed in Brazil. It is unlikely that importation of Nellore semen to Brazil will ever be significant in number terms.

Table 5.5: Beef breed semen utilisation in Brazil between 2006-2010 by source of semen.										
Breed	Nationally produced semen (doses)					Imported semen (doses)				
	2006	2007	2008	2009	2010	2006	2007	2008	2009	2010
Angus	100,633	154,808	234,825	321,619	353,476	156,024	216,766	370,884	639,823	854,859
Red Angus	260.896	376,927	264,326	273,598	253,336	95,853	119,683	177,419	217,773	331,825
Brahman	168,206	173,177	182,301	214,178	240,404	19,192	10,798	9,848	31,041	15,348
Simmental	83,438	72,394	59,793	87,040	72,739	16,427	16,858	17,783	14,851	21,470
Senepol	35,720	36,861	38,113	54,653	72,271	20,891	12,858	5,554	14,414	21,145
Brangus	23,115	36,270	46,272	37,032	43,297	5,355	4,229	12,102	43,303	29,131
Bonsmara	29,380	26,298	28,666	18,526	21,921	804	856	278	-	-
Red Brangus	62,044	52,813	65,338	49,379	48,669	1,759	539	3,850	4,485	12,948
Hereford Poll	35,601	14,326	30,646	38,750	45,596	16,070	22,271	28,467	29,497	31,853
Braford	36,861	63,544	71,829	70,209	108,657	6,566	8,529	8,258	26,089	10,134
Santa Gertrudis	16,338	25,296	6,764	3,182	18,950	406	510	865	372	90
Hereford	490	20,836	9,131	9,377	8,148	4,120	14,668	12,929	40,091	10,616
Nelore	1,917,879	1,646,589	1,815,178	2,290,455	2,676,336	-	-	-	570	

Source: ASBIA 2010

Angus in 2006 showed 256,657 straws used (national plus imported) and Red Angus with 356,749 (Table 5.5). By 2010 the position has changed significantly with Black Angus semen showing 1,207,335 units used and Red Angus 585,161 units. The growing use of AI and ET is boosting genetic improvement in the importing breeds and together with increasing use of breed genetic evaluation programs means the collection of semen from national sires of high genetic merit is increasingly substituting for imports in some breeds and Australian exporters need to be aware of this.

For Australian black Angus breeders the trend in semen imports to Brazil suggests a major potential market for exports. Imported Angus semen showed 854,859 for 2010 with every prospect it could surpass a million units soon.

Crossbreeding Angus semen with Nellore cows is the most popular cross in the country at present (Pohler *et al* 2011) and the trend from red to black has most likely developed in parallel to the growth of feedlots in Brazil, black Angus perceived to have the better carcase traits.

For Angus, Red Angus and Brahman in Brazil it can be seen that national semen production is increasing solidly while imports are static or decreasing, (Table 5.5). For Brahman, national production has grown from 168,206 doses in 2006 to 240,404 doses in 2010. Imports in that period have remained relatively constant.

Two relatively new breeds introduced to Brazil show interesting trends: Senepol and Bonsmara.

For Senepol, from 2006 to 2010 imports remained relatively constant, while national production has more than doubled. For the Bonsmara breed originally from South Africa, national semen production has remained static or declined but imported semen has never grown and breeders are now relying totally on the national product.

However it is with two numerically small breeds in Australia, the Brangus (3/8 Brahman content) and Braford breeds we can see a major new trend developing in Brazil as measured by semen sales.

In 2006 black Brangus showed 28,470 doses usage in Brazil. By 2010 that figure had more than doubled to 72,436. For red Brangus in 2006; 63,803 straws were used. By 2010 the usage of red Brangus had dropped to 61,617 doses. Again we see a trend to the black variant of a breed in Brazil. This trend is likely to continue because a large percentage of the Nellore females in the country are mated to black Angus semen and the top end of these F1 females in many cases will start a Brangus herd development.

A success story in Brazil is the growth of the Braford breed and associated semen usage. In 2006, 51,671 straws were used and by 2010, 118,791 doses were used. Imports have grown during the period from 6,566 to 26,089 in 2009 and 10,134 in 2010.

Imported Braford semen comes from Australia, Argentina and United States mainly. A trend in the Braford breed in Brazil is to start from a F1 Hereford-Nellore female. Semen from Brafords developed from a Brahman base are preferred in many herds in South America and beef conformation, colour pattern and eye pigmentation have been important considerations in importations from Australia to date.

In parallel with the Braford trend we also see an increase in national production of Poll Hereford semen and an almost doubling of imports from 2006 (16,070) to 2010 (31,853). Much of this

semen will be mated to Nellore females with many of the F1 females potentially entering the growth of the Braford herd in Brazil.

Interest in performance recording and genetic evaluation of carcase traits by scanning, adaptation traits, e.g. tick resistance and temperament is increasing in Brazil for the Brangus and Braford breeds (Natura 2011; Conexao Delta G 2011) with Sire Summaries becoming an important tool. As elsewhere in the beef research world development of DNA marker traits within these breeds is underway.

If Australian exporters of beef semen to Brazil are to escape the fate of Senepol and Bonsmara imports to Brazil a greater commitment to multi-trait genetic evaluation of their export stock will be required, especially for carcase traits.

Brazil Export Conclusions:

Analysis of available import numbers suggest strong export opportunities for the following breeds from Australia; Angus, Red Angus, black and red Brangus (3/8 Brahman content), Braford, Red and Grey Brahman and Polled Hereford. For the Tropical breeds, semen from tested, homozygous-polled bulls using the CRC Poll DNA test, now commercially available in Australia, will add an important sales point of difference.

5.10 Challenges for increases in beef semen and embryo exports

5.10.1 AB Centres and semen re-sellers

There is little potential to increase beef semen exports unless there is an increase in the level of beef AI leading to increased sales of semen, and the number of beef bulls standing for longer periods at artificial breeding centres such that they can be qualified for a number of overseas countries and build up significant inventories of frozen semen. Previously there were few beef breed bulls standing at AB centres because local demand was not there. Fixed-time artificial insemination (FTAI) if it is extended well in the beef industry may be a catalyst. FTAI will be covered elsewhere in this conference but it is clear that an increase in FTAI is the key to increased beef semen utilization with potentially the spin-off effects to exports outlined above.

For an individual breeder to put up an inventory of 20,000 straws qualified globally on a bull would cost c. $50,000. Without the assistance of a global re-seller network not many beef seedstock producers would take the gamble.

Another major factor is that for beef semen there has been few Australian-owned, artificial breeding centres that have focused on beef exports. Most of the bigger re-seller companies in this country are branches of overseas-owned, global AI corporations who import overseas-produced company semen as part of their global sales strategy.

Thankfully some of these Global entities are now recognizing Australia's beef genetic pool and are exporting Australia semen into their global networks e.g. South America, and this augurs well for future exports. In each state there is now at least one AB Centre focused on semen exports and again this augurs well for the future of export sales.

An increase in embryo exports will take significant effort in marketing and promotion and country visits as first steps. Another factor is there are only a few export-accredited embryologists; most embryologist concentrating on domestic work rather that export because of

the lower demand and the challenges around frequently changing health protocols and importing country restrictions.

5.10.2 Attitudes of breeders

For a long time the suffix (IMP) after a bull's name conferred some superiority in the Australian beef marketplace and this mitigated against an export approach in some seedstock breeders' minds and plans. Today however for a number of breeds Australia has beef breed bulls with potentially superior breeding values on the global stage.

In the US beef seedstock producers regard having a bull standing at an AB centre for world-wide collection with a great degree of pride and prestige but this does not seem to be as evident here. However a few individual breeders are building global sales for their top bulls.

There are also bulls in Australia from rare breeds that could contribute to global populations by contributing outcross genetics.

5.10.3 Cooperativism

Australian beef breeders (farmers?) are rarely collaborative or cooperative when it comes to marketing and exporting; in fact sometimes the opposite. It is difficult to imagine in Australia the formation of an export group like The British Livestock Genetics Consortium (BLG) or the Canadian Livestock Genetics Association (CLGA) made up of livestock genetics exporters and service providers. These organizations have done so much to deliver cattle and genetics exports for UK and Canada in spite of outbreaks of FMD & BSE in the past few decades.

The BLG have eight operational strategies (BLG 2012):-

- To build on existing specialties and identify new opportunities.
- To capitalise on Britain's established leading role as a supplier of quality livestock genetics.
- To work with individual companies in identifying new customers and supporting existing customers.
- To collect and disseminate market information and sales leads.
- To use our expertise, knowledge and contacts in key countries to communicate the benefits of British livestock and genetics through public relations, shows and other marketing activities.
- To work with DEFRA, Trade Partners UK and other authorities at home and abroad to promote British genetics and to gain access to markets where the UK has no access due to lack of health certification or the removal of political barriers.
- To strengthen links with overseas organisations (companies, breed societies, Governments).
- To work with Government departments in identifying priority markets, to help establish workable export protocols and to gain market access.

5.11 Export Costs and industry support and organization.

The relative costs of exporting semen and embryos from Australia are higher than USA and the costs are rising each year at levels that are impacting on the competitive ability of genetic exporters.

Exporters (and importers) are generally dissatisfied by the performance and resources provided by federal government services in respect of the export of semen and embryos. At each step exporters have to deal singly in problem- solving with federal and state government agencies. The challenges for individual exporters in understanding the steps and procedures for export of genetic materials are considerable. The steps are not written down in one place such that potential exporters can gain knowledge and plan accordingly.

The only departure from this has been the Ruminant Genetics Trade Advisory Group (RGTAG) that has been set up three years ago by Biosecurity Australia (BA) and the Australian Quarantine Inspection Service (AQIS) to facilitate communications between BA/AQIS and the ruminant genetics industry.

The artificial breeding industry in Australia is largely unregulated which may be useful in terms of little 'red tape' but the downside is little coordination and industry organization from a beef perspective. However there is little evidence of national organisations that are active in representation for cattle genetics exporters and service providers in the artificial breeding sector.

Australia has no equivalent to the National Association of Animal Breeders (NAAB) in USA formed in 1946 that has the goal "...to unite those individuals and organizations engaged in the artificial insemination of cattle and other livestock into an affiliated federation operating under self-imposed standards of performance and to conduct and promote the mutual interest and ideals of its members."

The General Manager of the National Herd Improvement Association of Australia Inc. (NHIA), currently acts as the RGTAG meeting coordinator for the seedstock industry and professional service providers interested in the import/export of semen and embryos. RGTAG urgently needs a greater and wider support from beef genetic exporters and service providers if it is to fully represent the issues and needs. The organizers of RGTAG should consider canvassing the wider genetics industry for their involvement and look at more efficient communications so that a national involvement is enabled. Regional meetings or national teleconferences are warranted.

NHIA is a member-financed dairy group that promotes artificial insemination training and herd improvement mainly in the Australian dairy industry by providing a range of services to its membership. Beef is not excluded and in the absence of a group being developed to meet the needs raised in these last paragraphs, beef exporters and service providers should consider membership of NHIA.

There should also be recognition of the coordinating role that trade officers from DEEDI in Queensland have given tropical breed exports in recent years.

If Australia is to reach the potential for semen and embryo exports indicated in this paper, the authors believe a critical first step is a national meeting of all interested parties to map out a way forward. Failure to move in that direction will lead to continuation of the trend downwards for semen exports and stagnation of embryo export sales and lost opportunities. In 2001 the MLA Beef Genetics Plan had the Australian beef cattle industry as a net exporter of genetic material by 2006, so perhaps their role could be to sponsor and facilitate the first meeting.

6. Export of Genetic Technologies

The cattle seedstock industry is rapidly gravitating to a global approach as individual breeders seek to identify the best genetics for their herds and be part of international genetic evaluation services.

The Agricultural Business Research Institute (ABRI) has for two decades been developing its services on an international basis. It has three products that are now used widely:

ILR2 breed registry system
BREEDPLAN® genetic evaluation
HerdMASTER on-farm herd management system.

ILR2 is an advanced breed registry system that has the potential to be used by around 150 breed associations across a number of countries. ILR2 holds pedigree, performance and genomic data on over 40 million animals. This means that ABRI is able to offer users considerable economies of scale in terms of development, implementation and support. The Angus breed provides a practical example. The breed associations in Australia, New Zealand, Canada and the United Kingdom all use ILR2. This allows them to exchange data simply (it's all in the same format). Australia and New Zealand combine data for genetic evaluation and all 4 associations use the GeneProb software for calculating frequencies of genetic defects.

BREEDPLAN® is an advanced beef cattle genetic evaluation system developed initially for use in Australia. It is now used in 15 countries by a total of 45 breeds. BREEDPLAN® assists in the globalization of the beef breeding industry. It means that an Estimated Breeding Value for an animal in one country can be used with greater confidence by breeders in another country. In fact, many of the countries using BREEDPLAN combine data for evaluation. The most outstanding example of this is the Pan America evaluation for Hereford combining data for Herefords in the USA, Canada, Argentina and Uruguay.

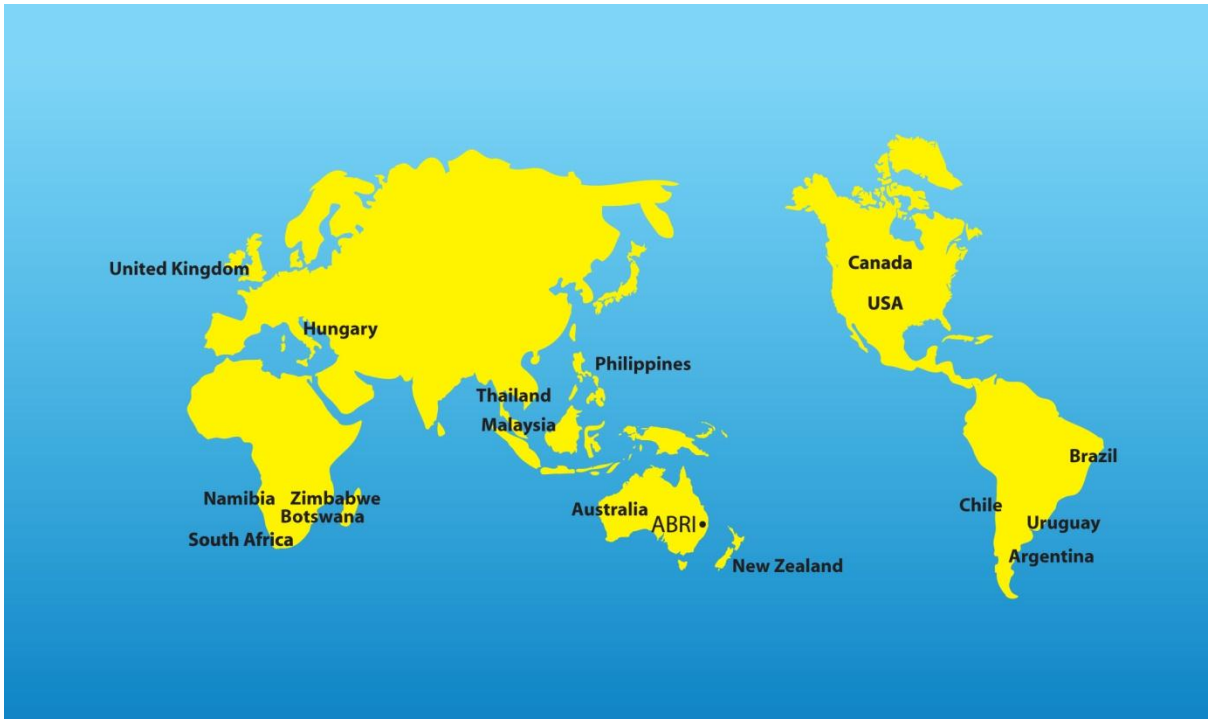
BREEDPLAN® will assist in the development of international trade of genetics. For example, Kazakhstan could import pedigreed Hereford cattle from both Australia and the USA and then undertake equivalency of the BREEDPLAN EBVs from both countries to form a platform for performance recording in Kazakhstan.

HerdMASTER is an advanced PC-based herd management system that allows individual producers or producer co-operatives to record on-farm data and send it electronically to a central database. It provides an efficient form of data capture for both ILR2 and BREEDPLAN and is used by breeders across 10 countries.

A number of other PC-based herd management systems are also available from Australian companies such as Practical System's StockBook and Sapien Technology's Kool Collect and Kool Perform.

In various combinations the three technologies developed by ABRI to support beef breeding programs are now used in 17 countries as shown below.

Countries Using ABRI's Systems – 2012



Beef Genomic tools:

Australia has invested major research funding for R&D into genomic tools for temperate and tropical beef breeds. The Co-operative Research Centre for Beef Genetic Technologies that ends in June 2012 after around 21 years of funding. It plans to deliver a number of DNA-based genomic tools that it believes will ramp up genetic gains for beef breeds (tropical breeds, temperate breeds and tropical composites), especially for 'difficult- to -measure' traits. A marker test for the Poll gene in tropical and some temperate breeds has already been released (Henshall 2011). The Angus breed in Australia has already validated and integrated molecular breeding values offered by Pfizer Animal Genetics into a number of existing Angus BREEDPLAN EBV traits. The Brahman breed was the first to integrate DNA markers for meat tenderness into an EBV. There is clearly some potential for Australia to become an exporter of beef genomics tools but it is still a little premature to predict the likely portfolio of products and the target markets.

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