

A CONTRASTED YEAR FOR THE WORLD ACTIVITY OF THE ANIMAL EMBRYO TRANSFER INDUSTRY

-A report from the IETS Data Retrieval Committee

By Professor Michel THIBIER – Chairperson.

SUMMARY

The Committee met in early 2002 at the IETS 2002 venue at Foz do Iguacu (Brazil). It discussed the report of the previous year and mainly the means to make its network even more efficient. The results presented here show that this goal has only been partially achieved. Some countries in which it is known that ET activity occurred did not report. One major finding of the Committee this year, is a decline in the number of bovine in vivo derived embryo being collected and transferred. The total number was 450,000, which was a decrease of ~12%. Failure to retrieve some of the data, the economic crisis and major outbreaks of infectious diseases, all contributed to this observation. Similarly, the in vitro production of bovine embryos has also declined by some 25%. However, the situation is not uniform as there has been some significant increases of these activities in some parts of the world, notably in Asia, and a stable situation in other regions, such as in North America. The network has been quite efficient for the equine species and the total number of equine embryos transferred is now in the magnitude of ~7,000. The data concerning small ruminants are only partial but sheep, goats and cervids continue to have several thousand embryos collected and transferred. In swine, several thousand transferable embryos have been collected and transferred, although mainly for experimental purposes. It is the responsibility of all IETS members to help this Committee to further improve its efficiency in retrieving and transmitting the data set. As always, the data are collated anonymously.

INTRODUCTION: A REACTION FROM THE PRACTITIONERS OF THE EMBRYO TRANSFER IS NEEDED IN ORDER TO FURTHER IMPROVE THE IETS DATA RETRIEVAL NETWORK.

For the 11th year in a row, the IETS Data Retrieval Committee has been able to gather information on the numbers of embryos collected, handled and transferred in most of the species of farm animals. Although operational for more than 10 years now, this Committee still has a lot to progress to make. It met at the 2002 venue of the IETS Conference in Foz do Iguacu (Brazil) where 16 members from the various regions of the world attended. In addition to the comments made in the previous report, published a few weeks before in the IETS Newsletter, most of the debate touched on the difficulty IETS has had collecting data from some countries. This continuing problem in Australia and New Zealand was again discussed, although no representative of New Zealand attended this years meeting. It was suggested to take advantage of the next venue of the IETS Conference to Auckland (NZ) to hold a friendly meeting with the practitioners of these countries. The goal of such a meeting will be to try to show and convince them of all the benefits the world can realize from a reliable data collection network: **“so little for the practitioners, so much to the world”** as stated the Chairman. There were indeed points of satisfaction in the quality of the retrieval, particularly in North America, South Africa, where the effort was commended, and in Europe.

The weak point is in West Asia. There is still no collector clearly identified and able to put the data together in countries such as India, Pakistan, and to some extent China and others. The absence of knowledge of what is going on in the Middle East, most notably in Israel and the Arabic countries (for any species, including camels) is another gap in this network. For the Western Asia, the Committee has benefited from some help from AB Technology™ in estimating the magnitude of activity but the Committee’s aim is to get accurate figures even if incomplete at a country by country basis.

For the “other species” items, some improvements were noticed and new members have joined the Committee particularly from South America and members interested in horses. It had indeed been recognized that the “horse ET world” is somewhat different and has no formal communication with the ET world of ruminants. It was also debated whether to add the human ET statistics, but after a long discussion, it was decided to focus on animals and target all efforts on improving significantly the current network.

In summary of this meeting, the system in place for over 10 years is a good one, most useful and should be continued. It is anonymous, simple and makes the data easy to collect. Further, the charts are now fine-tuned and remain the same one-year to the next. This makes the summaries easier to prepare at the end of the year. However, the system does need some improvements in identifying reliable and willing people to collecting the data. We also need to further commitments and responses from IETS members in all parts of the world. This is the only way to make sure that the figures from

our industry are channeled to the Committee. These figures must reflect properly and accurately the real activity of ET and new technologies around the world. This Committee had previously identified this problem the year before and clearly there has been no improvement in the past year. The next Committee meeting in Auckland (January 13, 2003, 8:00h) should try to take some action, in conjunction with the Board of Governors, to try to improve this situation. The Canadian system has already been recognized as a very good example, there might be other systems in operation that could also be used elsewhere. This is something to reflect on before the next IETS Conference in New Zealand. Similarly some reflection should be made to try to identify good data collectors in those countries where there are commercial contacts and knowledge of the people involved.

1. A CLEAR DECLINE OF THE NUMBER OF BOVINE IN VIVO DERIVED EMBRYO TRANSFERRED: A TOTAL OF 450, 000.

This year and for the first time in over 5 years, one notices a clear decline in the number of in vivo derived bovine embryos that were transferred. On the whole, this decline is in the order of magnitude of ~12% with an absolute figure of less than 500,000 bovine in vivo derived embryos: 450,000 of such embryos were reported as transferred in 2001 (Table 1). This is mainly due to the reduction of activity in South America, Europe and Oceania and to a lesser extent to Africa. Two major so-called “intrinsic” factors explain this decline: the first set is related to economic reasons and the crisis that has affected South America is a good example of this constraint. The second source of this reduction is related to the major outbreaks of diseases that occurred in the course of 2001. This holds true in some parts of South America and also in Europe with the occurrence of Foot and Mouth Disease, particularly in the United Kingdom, which has been superimposed on the “BSE context” of this country. In addition, some failure in retrieving data by this Committee also explains part of this reduction. This is true in Oceania where it has been very difficult to gather data from the practitioners of that area. It is also true in Asia, even though an increase has been noticed, thanks to the very active ET industry in Japan and Korea. However, on this continent no data was been collected at all from India, Pakistan or the Republic of China, which underestimates notably the ET activity of this region. As compared to Africa, South America, Europe and Oceania, it is interesting to note that the number of cows flushed and of embryos transferred has remained almost identical in North America and has increased by approximately 12% in Asia. Roughly speaking the number of transferable embryos per female flushed remained equal to that ratio observed the previous year with a mean of 5.9 embryos. This is encouraging showing that even with a reduction of activity the technical performances remain quite stable. One can also notice that the ratio of fresh and frozen embryos remain equal as in previous years. This importance of fresh embryos should be underlined as it had been speculated that frozen embryos were the way to go due to their increased flexibility between donors and recipients. However, the field data show that this is far from being the case.

Table 1. Overall Activity of *In Vivo*-Derived Bovine Embryos in 2001.

CONTINENTS	FLUSHES	TRANSFERABLE EMBRYOS	NUMBER OF TRANSFERRED EMBRYOS		
			FRESH	FROZEN	TOTAL
AFRICA	929	5,218	2,284	2,142	4,426 (1 %)
N. AMERICA	55,981	315,628	110,619	111,082	221,701 (49 %)
S. AMERICA	11,007	53,610	47,655	10,034	57,689 (12.8 %)
ASIA	10,440	80,521	14,703	39,574	54,277 (12.0 %)
EUROPE (*)	19,594	109,698	44,890	49,713	98,000(**) (21.6 %)
OCEANIA(***)	3,340	15,402	7,927	8,523	16,450 (3.6 %)
TOTAL	101,291	580,077	228,078	221,068	452,546 (**)

(*) Those European data are derived from the statistics of AETE ,2001 ,

(**) UK gave only one figure for all transferred embryos, it was inferred that 10% were from in vitro produced and in addition the 3 400 left could not be distributed between fresh and frozen, they were then added in bulk in the total; this explains why the total is 3 400 more than the sum of fresh to frozen, this will be also found in the gross total.

(***) due to the low number of teams that responded in New Zealand, in accord with the national collector, we have extrapolated the data from those of last year with a mean increase of 5%

Due to the situational changes (data report, economy and disease outbreaks) and evolution of the industry from 2000 to 2001, North America now represents close to 50 % of the world activity, Europe remains on the order of 21%, South America has 12% of the total (as opposed to 16% last year) and Asia also with 12% of the total (up 4 percentage points from last year). Oceania has dropped to 4% as compared to 9% last year and Africa remains in the same order of 1% due essentially to the activity in South Africa. However, Kenya, Namibia and Zimbabwe have also had some activity, although more modest. Several features from North America are interesting to report. Mexico, which has improved its data retrieval, thanks to the collector, has reported close to 10,000 transferable embryos collected. A full two-thirds of these were from beef breeds. In this country, more than 6,700 embryos were transferred as fresh and nearly 2,000 frozen and stored. In the US, close to 40,000 females were flushed of which, only 38% were from dairy breeds. The distribution here between fresh and frozen is almost equal (80,000 fresh vs. 86,000 frozen). Canada as usual gave an exhaustive report. They should be commended for this effort. Three-quarters of the 14,350 flushed females were of dairy breeds. This is in contrast with what was observed in the USA. A mean of 6.4 transferable embryos per donor was reported, slightly higher than the world average. The percentage of fresh and frozen embryos was 50% each and the pregnancy rates reported were 60.8% and 59.7 %, respectively for fresh and frozen embryos. Ninety-five percent of the frozen embryos are directly transferred and the mean pregnancy rate of such direct transfers is 58.9%. The Canadian practitioners also sexed their embryos, from the 2,511 such fresh embryos, the pregnancy rate was 59.3% and from the 1,180 frozen embryos, 679 pregnancies were observed (a 57.5 % pregnancy rate). More than 300 embryos were split, which resulted in a 52.7 % pregnancy rate. Canada reports having exported 13,845 embryos and imported 437, an indication of the polarity of the flux of the genetics at stake. From the USA, 16,348 embryos were exported to 31 countries on all continents but Africa. Fifty-two per cent were from beef breeds conversely to what has been seen in the past.

In Europe, and thanks to the European collectors, a large set of data is available. From Table 2, it can be seen that France, Germany and the Netherlands remain the major countries in terms of numbers of cows flushed or embryos transferred. It is of interest to note that Finland and Slovakia have joined the top twelve countries. Those last two countries with Denmark are the only ones that have shown an increase in their activity. By contrast the three major countries as well as the others also have seen their activity decline, particularly in the case of Germany (-50%) and the Netherlands (-33%). In Germany, the regulation in effect governing the use of stimulating hormones poses a difficult case and is one major factor explaining this decrease. Although real in the other countries, the decrease is smaller as compared to the activity of last year and is in the magnitude of 10%. Table 3 illustrates well the contrasting situation among other countries in different parts of the world. Japan is still increasing its activity by more than 10%; Australia is also increasing although here a slightly better retrieval of the data might partly explain this observation. By contrast, Argentina, Brazil and the Republic of South Africa have declined in their ET activity in relation, as stated above, to the economical difficulties of some of these countries.

Table 2. The Top Twelve European Countries Ranked According to Numbers of *In Vivo*-Derived Embryos Transferred In 2001 (AETE,2002).

COUNTRIES	NUMBER OF FLUSHES	NUMBER OF EMBRYOS TRANSFERRED	
FRANCE	6,680	32,922	↘
GERMANY	3,229	11,977	↘
NETHERLANDS	2,330	12,602	↘
ITALY	1,086	7,245	↘
BELGIUM	1,150	7,112	↘
CZECH Republic	1,036	4,738	≡
DENMARK	784	4,125	↗
UNITED KINGDOM(*)		3,400	
IRELAND	742	3,107	↘
SWITZERLAND	264	1,989	↘
FINLAND	308	1,598	↗
SLOVAKIA	403	1,590	↗

(*)This is the only data available for this country this year and no data last year.

↘ ↗ evolution as compared to the previous year

Table 3. The Top Five Countries Outside Europe and North America in 2001 (*).

COUNTRIES	NO. FLUSHES	NUMBER OF EMBRYOS TRANSFERRED		
		FRESH	FROZEN	TOTAL
JAPAN	10,100	14,287	39,223	53,510 ↗
BRAZIL	9,225	42,813	3,488	46,301 ↘
AUSTRALIA	2,775	6,237	7,773	14,010 ↗
ARGENTINA	1,782	4,842	6,546	11,388 ↘
SOUTH AFRICA	830	1,980	2,121	4,101 ↘

(*). Because of the insufficient accuracy of the data originating from New Zealand, this country could not be included in the present table.

2. THE NUMBERS OF IN VITRO PRODUCED BOVINE EMBRYOS TRANSFERRED HAS ALSO DECLINED.

Again this year, data on in vitro produced embryos was collected as extensively as possible. However, the total number of transferable embryos produced and transferred has decreased by about 25% compared to last year. The total number of embryos produced (Table 4) is not comparable to that of in vivo derived embryos. The total number of in vitro produced embryos transferred was around 30,000, which was equivalent to ~6% of the in vivo derived embryos in this species. There is however, a clear underestimation of the data unfortunately, Brazil and the US have not contributed to those figures and Australia and New Zealand, contributed only partially. It is reasonable to assume that in vitro produced embryos represent about 10% or even slightly more of the total of bovine embryos transferred. This percentage would correspond to approximately 50,000 in vitro produced bovine embryos transferred.

Table 4. The Number of Bovine *In Vitro*-Produced Embryos Transferred in 2001.

	TRANSFERABLE EMBRYOS COLLECTED	TRANSFERRED EMBRYOS		
		FRESH	FROZEN	TOTAL
AFRICA	800	10	156	166 ↗
ASIA	92,706	9,216	9,465	18,681 ↗
N.AMERICA(*)	n.d	498	78	576 ↘
S.AMERICA	668	199	202	401 ↘
EUROPE	13,031	4,482	4,830	9,312 ↘
OCEANIA	2,000	974	150	1,124 ≡
TOTAL	109,205	15,379	14,881	30,260 ↘

(*). only one country from this region has reported those figures

As seen in Table 4, there is also a contrasting situation in the in vitro bovine embryo production. Asia continues to be the continent, which has the more active production due in particular to the activity in Japan and Korea including some cloned embryos produced in Korea, Japan and Taiwan Province of China. In Asia as in Europe, half of such embryos are transferred as frozen. In Europe however, with a total number about half of those seen in Asia, there are large differences according to country. For example, Italy continues to maintain its activity using essentially their technique allowing them to transfer frozen embryos (97%). The Netherlands and France have a ratio of approximately 50- 50% whereas in Germany all in vitro produced embryos transferred are reported as fresh. The European collector reports an interesting feature

regarding this production. Out of 13,000 embryos produced, 10,000 (76%) were derived from OPU as opposed to 3,000 from the abattoir. From OPU, it is recorded that there has been 1,138 donors used with the number of sessions at 4,479. This means that there was mean of about 4 sessions per donor. This has resulted in 10,065 blastocysts produced, which equals 8.8 blastocysts per session. On the whole, clearly the most striking feature of this set of data is the fact that about half of the in vitro produced embryos are being transferred frozen.

3. EMBRYO TRANSFERS IN THE OTHER SPECIES: STILL SOME PROGRESS NEEDS TO BE MADE TO RETRIEVE THE DATA.

Here also, the practitioner members of the IETS need to react strongly in the next year. The data relative to these other species, which was forwarded to the Chairman of this Committee, have been scarce and mostly only partial data was obtained for any given country. The one exception is the data regarding horses was relatively complete thanks to the reporting of individuals involved in this species. In small ruminants (Table 5), both sheep and goats, figures have been reported for in vivo derived embryos, which were much less than last year. However, a number of countries have not reported their data. In addition, because of some outbreaks of contagious diseases, a ban has been imposed on some international movements of embryos thus limiting exchanges and reducing the activity. This is particularly true in the Republic of South Africa as already noted at the end of the previous year. The Canadians report some pregnancy rates of 54.9% and 57.6% respectively for fresh and frozen embryos (several hundreds transfers recorded). The cervids continue to have some embryos transferred, mostly as fresh. Some three hundred of those have been reported. The Canadians obtained a pregnancy rate of 70% for fresh (227 transfers) and 60% for frozen (18 transfers) cervid embryos. The equine species seem to be much better monitored in terms of numbers by contrast to what has been seen above. The number of flushes is more than 12,000 (Table 6) with 7,000 transferable embryos. This is 0.6 embryo collected per flush. Seven thousand of these embryos were transferred fresh, mainly in Brazil and the USA. Those two countries accounted for 85% of the total activity according to the records collected by this Committee. Argentina, Europe and Mexico follow far behind those two countries with only a few hundred of such embryos transferred. In Europe, those countries contributing to this technology according to the AETE are Austria, the Czech Republic, Finland, France and Italy. The number of frozen embryos is still very limited and does not exceed 200. The pregnancy rate for fresh equine embryos was 80% in Canada.

Table 5. Small Ruminants E T Activity in 2001.

CONTINENTS	FLUSHES	TRANSFERABLE EMBRYOS	NUMBER OF EMBRYOS TRANSFERRED			
			FRESH	FROZEN	STORAGE	EXPORT
SHEEP						
AUSTRALIA	300	2,686	2,686	82 (foreign)		
CANADA	123(*)		565	373	289	
EUROPE		613	441			
SOUTH AFRICA	528	3,554	396	2,920	558	300
TOTAL	941	6 853	3,598	3,375	847	300
GOAT						
CANADA (**)						
EUROPE		198	103			
KOREA	241					
TAIWAN	18	174	68	42	88	
TOTAL	259	372	171	42	88	
CERVIDS						
AUSTRALIA	12	57	57	20 (foreign)		
NEW ZEALAND	N d					
CANADA	69	281	227	18		
TOTAL	81	338	284	38		

(*) much underestimated (from the collector's comment)

(**) the numbers in this country include both sheep and goats and they have been reported in the section of sheep here above. According to the collector, it would be 75% sheep and 25% goats, hence a few tens flushes in this latter species could be added.

Table 6 - Equine E T Activity in 2001.

CONTINENTS	FLUSHES	TRANSFERABLE EMBRYOS	NUMBER OF EMBRYOS TRANSFERRED		
			FRESH	FROZEN	STORAGE EXPORT
ARGENTINA	1,100	705	705		
BRAZIL	4,400	3,050	3,050	40	40
CANADA	175	122	91	22	16
EUROPE	522	309	260		
MEXICO	370	140	140		
SOUTH AFRICA	31	27	27		
USA	7,200	3,200	3,500	125	
TOTAL	12,798	7,553	7,773	187	56

Finally, the porcine (Table 7) is interesting to consider even if most of those collections and transfers reported are still in the experimental area. More than four hundred flushes have been recorded in 2001 and 700 transfers have been performed. This is more than what was reported last year. According to the Canadians, the pregnancy rate for fresh embryos (2,120 recorded) was 80%. From the 18 frozen embryo transfers performed in Canada, 11 resulted in a pregnancy (61%). Finally, it should be emphasized the substantial effort made by Korean researchers on cloned and transgenic swine embryos with more than 65,000 such embryos produced and transferred to close to 200 sows (up to 300 embryos per recipient). It could also be noticed that Korea has reported having an active involvement in ET in dogs and cats according to the collector of this country.

Table 7 - Swine E T Activity in 2001.

CONTINENTS	FLUSHES	TRANSFERABLE EMBRYOS	NUMBER OF RECIPIENT FEMALES
CANADA	111	2,120 (18 frozen)	
	105	1,156	210
KOREA	In vitro produced	1,200	15
	Clone and transgenic	67,750	166
EUROPE		6,125(*)	245
	253(**)	3,702	57
TAIWAN		504	21
USA			25
TOTAL	469	82,557	739

(*) from AETE statistics

(**) in addition to the AETE data.

In **conclusion**, the year 2001 has shown quite a contrast in the statistics according to the regions. A part of this is due to some difficulties in retrieving data either because no data was been recovered in some parts of the world, although it is known that there is some activity, or because only partial data was reported in other regions. Clearly a big effort has to be made for 2002 and this will be discussed at our next at large Committee meeting in New Zealand in January 2003. However, it is also evident that there are some economic factors that have influenced the ET industry. Further, despite these problems, some countries continue to see their activity growing not only in cattle but also in horses and to some extent in swine, although still largely on an experimental basis. Worldwide, the magnitude bovine in vivo derived embryos collected and transferred was

half a million. A part of them (approximately 10%) were exchanged internationally. This benefits farmers as they have easy access to the genetics of their choice with no risk of disease if the current regulations in place are effectively applied. It is also important to note that in vitro produced embryos have not yet quite achieved their full and due place in this industry although they do have quite a number of advantages.

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