

Data Retrieval Committee Annual Report

STABILIZATION OF NUMBERS OF IN VIVO COLLECTED EMBRYOS IN CATTLE BUT SIGNIFICANT INCREASES OF IN VITRO BOVINE PRODUCED EMBRYOS IN SOME PARTS OF THE WORLD.

By Professor Michel THIBIER – Chairperson.

Summary

The committee met once again in early 2004 at the IETS venue at Portland (Ore. USA). The results from the survey of the previous year were discussed. In that discussion an emphasis was put on the effort that was to be made for those countries, including Russia, India and others, where there is difficulty finding a national collector able to report. Posting of this yearly report on the IETS web site in such a manner that it is accessible to all including non-members was strongly suggested to the Board. Regarding the results from the bovine ET activity, the number of *in vivo* collected embryos has declined a little this year and amounts to a total of close to 480,000. However, there was a considerable lack of response from two countries in Oceania, which underestimated those results. By contrast, *in vitro* produced embryos in cattle increased considerably in two parts of the world: Asia and South America. The total number of IVF embryos transferred worldwide was 106,220, reaching for the first time more than 100,000. The efficiency of retrieving data from small ruminants has been somewhat irregular this year, however many thousands of sheep and goat embryos are being transferred both domestically and internationally. The Cervids are also subject to some ET activity as are buffaloes, as reported by Vietnam, and even rabbits. The number of equine embryos transferred, which were almost exclusively fresh, has also slightly increased to more than 11,000 in 2003. Finally, the swine industry has been involved in ET as well, although essentially on an experimental basis. In any case more than 20,000 embryos have been transferred in this species, some being either cloned or even transgenic, particularly in Asia.

Introduction

For the 13th year in a row, this Committee is in a position to report to the IETS members and the world, where the Embryo Transfer industry stands in terms of numbers and of activity. It has met at the onset of the year 2004 at the IETS annual conference venue in Portland (Ore. USA). As usual, the members who attended, participated actively in the discussion of both the numbers reported the previous year and the means and tools to use or develop to make this report even better. Among the items that were screened, the first referred to countries where it is difficult to find a national collector able to retrieve data from the country. This is particularly the case for Russia, India but also others like Indonesia. It was noted that thanks to the international exchanges of embryos between various parts of the world and the People Republic of China, there was some idea available of the numbers of embryos shipped to and transferred in this country.

Regarding the idea of weighting the numbers from one given country according to the percentage of teams responding, it was confirmed like the previous years, that if there was interest in reporting of the percentage of teams responding as a piece of information. However, it was determined that the real numbers should be collated and reported so that the report does not “drift” as some kinds of non-scientific surveys do providing figures that are difficult to determine what they represent and mean.

Another item discussed was the best way to make this report known to the whole world. The Chairman indicated that he had many requests from all around the world. There are surely tools now available to make these figures available in an easy manner. The Brazilian member advocated that the tables could be pulled from the IETS data retrieval report and posted on the IETS homepage in such a manner that it is accessible to anyone not only to members. The Chair reported this point to the Board of Governors of IETS. Another point discussed at large was that to determine how the Internet and

other electronic methods of communication could help in retrieving data. It was decided that each member would think about this issue and it would be put on the agenda of the Committee's next meeting at the IETS Conference venue. The Chair was asked to carry on, for 2004, his work of collecting data from 2003 in the same way that has been used for more than 10 years. That method is to keep the idea that data retrieval should not be a survey of a given sample of the ET teams of some countries but the collection of real numbers from each ET team from each country where the ET industry exists. These teams should provide their gross data in an anonymous manner, as always. And so it was done and this is the report of this study.

We were happy this year to receive data from different countries such as Thailand Vietnam, Columbia, Uruguay, Kenya, Namibia, Sudan and Zimbabwe in addition to those, which regularly report. The Committee profoundly thanks very much all those involved in this collection of data.

1. A small decline in the numbers of *in vivo* collected bovine embryos.

As seen in Table 1, the total number of embryos collected *in vivo* and transferred is less this year than the year before. In particular, there were less than the half million embryos transferred that were regularly reported in the last few years. It is impossible to distinguish if this is due to decreased real ET activity and what is due to the decreased efficiency of data retrieval this year. But this last point is probably the major explanation for such a decline in numbers. This fact poses the problem of the significance of such figures when some countries refuse to provide incentives for their ET teams to respond or at least are unable to retrieve those data. This year has been worse in this regard as no data was sent to the Chair from India or from Russia for example. In addition, some countries, more specifically, Australia and New Zealand were unable to get reports from more than 10 % of their teams, which make the numbers collected hardly meaningful. This is unfortunate for two main reasons, first it gives a bad and underestimated picture of the reality of our industry and gives the impression of the reduction (maybe an extinction, like I once heard) of the industry, which might not be true. Secondly, as seen often in other circumstances in the world, it is unfair to all the colleagues who report very regularly and professionally to their national society, to their national collector or to the Chair of this Committee so as to make sure that their numbers are taken into account. There are so many cases like this that it is disappointing to see such ET teams not bothering to take this seriously and not responding to their national collector, especially when there is one person who is willing to do this and tries his or her best.

Table 1. Overall Activity of *In Vivo*-Derived Bovine Embryos in 2003.

CONTINENTS	FLUSHES	TRANSFERABLE EMBRYOS	NUMBER OF TRANSFERRED EMBRYOS		
			FRESH	FROZEN	TOTAL
AFRICA	1,565	10,064	3,658	2,796	6,454 (1.4%)
N. AMERICA	47,638	280,432	101,237	112,674	213,911 (44.7%)
S. AMERICA	21,212	126,385	87,877	10,890	98,767 (20.6%)
ASIA	18,717	162,640	50,975	67,778	118,753 (11.8%)
EUROPE (*)	17,503	104,726	41,289	53,328(**)	94,617 (19.8%)
OCEANIA(***)	1,531	9,540	5,531	2,762	8,293 (1.7%)
TOTAL	108,166	693,787	290,567	250,228	540,795

(*) Those European data are derived from the statistics of AETE, 2004.

(**) One country did not split the figures between fresh and frozen (Total 4,109). By convention, they were all included in the frozen column so as to take them into account in the gross total.

(***) due to lack of responses from many ET teams from this continent, this line is highly underestimated.

Percentage wise from the various continents, obviously Oceania has dropped considerably so that North America has now close to 45% of the total *in vivo* collected embryos transferred in cattle. South America is second and ahead of Europe for the second year in a row (both around 20% of the total). As compared to the figures of the previous year, one can see that the industry has increased in North America by more than 10%. So has Europe with a more modest increase of 5% approximately. By contrast, the number of bovine *in vivo* collected embryos both in South America and Asia has declined by more than 15%. This of course will have to be put in perspective and compared with the dramatic increase of the *in vitro* produced embryos in this species.

Regarding the percentage of fresh and frozen embryos, 54% of the *in vivo* collected embryos were transferred fresh in cattle, this is significantly higher than a 50:50 ratio but numerically not very much above that distribution. This, like the previous years, shows that the two systems have their own advantages and according to circumstances, one or the other may be performed.

From the overall figures, one can also see that the mean number of transferable embryos per flush is 6.0, a little less than that of last year (6.2) but still reasonable. Several features from North America are interesting to note. If Mexico has retained about the same activity, the US has increased their numbers. This may be related, to some extent, to the fact that 81 certified ET businesses have responded this year plus 23 non-certified ET businesses, which is slightly more than the previous year. The national collector should certainly be commended for achieving such a high percentage of responses. Close to the two-thirds of embryos collected were from beef cattle (64%). Of these embryos, 46% were transferred fresh and the remainder (54%) as frozen-thawed embryos. The Canadians, as usual, have made an extensive report not only on their domestic activity but also on the activity reported from Canadian teams working overseas in places such as the People Republic of China. As opposed to what was described for the USA, 80% of the cows flushed were dairy breeds. From the total number of embryos collected, 63% were frozen. Among the fresh embryos transferred, almost 10% were previously sexed prior to transfer; almost all of these were of dairy breeds. There were also close to 2,000 frozen-sexed embryos of which 90% were also of dairy breeds. A total number of 26,000 embryos were subjected to direct transfer. As far as international movements were concerned to and from Canada, 8,187 embryos were exported and 437 imported.

From Europe, 23 countries reported their numbers. From Table 2, it can be seen that France and the Netherlands remain the major countries in terms of both the number of cows flushed and the number of *in vivo* collected embryos transferred in cattle. Germany who was in the second position two years ago has again reduced its activity. This reduction relates to the problems this country faces in using superovulatory treatments. The ranking within Europe in terms of embryos transferred does not change much, however Sweden and Spain are now back in the top twelve in place of Ireland and Slovakia. The situation from one year to another according to countries with the exception of Germany does not change much, some increase slightly such as France, Belgium or Hungary, while some countries decrease such as Italy and the Czech Republic. Other countries remain stable such as the Netherlands, Denmark or Switzerland. In its report, the AETE (2004) indicates that the percentage of frozen embryos for all countries together is slightly higher than 50% (actually 54.6%).

Table 2. The Top Twelve European Countries Ranked According to Numbers of *In Vivo*-Derived Embryos Transferred in 2003 (AETE, 2004).

COUNTRIES	NUMBER OF FLUSHES	NUMBER OF EMBRYOS TRANSFERRED
FRANCE	5,665	33,491 ↗
NETHERLANDS	3,119	15,352 ≡
GERMANY	2,687	9,955 ↘
ITALY	1,002	6,042 ↘
CZECH Republic	1,073	5,808 ↘
BELGIUM	1,146	4,640 ↗
DENMARK	605	4,583 ≡
UNITED KINGDOM(*)	n.d.	4,109 ↗
FINLAND	500	2,301 ↗
SWITZERLAND	243	1,707 ≡
SPAIN	303	1,355 ≡
SWEDEN	270	1,322 ↗

(*)This is the only data available for this country this year.

↗↘ evolution as compared to the previous year

Table 3 reports the data for the top five countries outside Europe and North America. One can see that Brazil has the lead among those countries although this number is a little less than that reported last year. This is probably related to the fact that not as many teams seem to have responded to the collector this year. Nevertheless, it is of note that more than 95 % of those embryos collected derive from beef cows, mostly zebu cows. It is also noted that 90% of such embryos are transferred fresh and a little more than 3,200 embryos have been transferred frozen-thawed including several hundred imported embryos. Japan is again very active and in fact has increased its activity with more than 55,000 embryos transferred. Those are mainly (87%) from beef origin. In the dairy breeds, 25% of the embryos are transferred as fresh whereas in the beef breed, one-third or more are transferred as fresh embryos. This higher percentage perhaps is related to the value of each embryo collected and transferred.

Table 3. The Top Five Countries Outside Europe and North America in 2003.

COUNTRIES	NO. FLUSHES	NUMBER OF EMBRYOS TRANSFERRED		
		FRESH	FROZEN	TOTAL
BRAZIL	17,505	84,451	3,281	87,732 ↘
JAPAN	9,672	16,931	39,569	56,500 ↗
P R CHINA	8,540	33,306	27,825	61,131 ↗
ARGENTINA	2,504	3,528	6,938	10,466 ↗
SOUTH AFRICA	1,393	3,550	2,707	6,257 ↘

Thanks to the collector from China numbers have been provided to the committee, which has summarized the figures for this huge country. The numbers result in more than 60,000 embryos reported transferred. Probably close to 20,000 embryos have been exported to and transferred in China. In addition, many collections have taken place mainly from dairy cattle, with an output of 44,408 transferable embryos recorded. Of these embryos, 33,306 were transferred as fresh and 27,825 reported as transferred frozen-thawed (including some imported embryos). It should be kept in mind that for dairy breeds, it seems easier to get numbers recorded. There were also some transfers in beef cattle but these were harder to identify and to record.

Like in Brazil, Argentina has an activity mostly dedicated to the beef cows as more than 90% of the 14,000 embryos collected were of beef breed origin. However, the two-thirds of the embryos transferred including the 858 of foreign origin were frozen-thawed. Only 36% of those embryos from domestic origin were transferred fresh. Finally, the Republic of South Africa, still very much in the top five countries in this category, has seen a decline in its number but has still transferred more than 6,000 embryos. More than the two-thirds of them are from beef origin. It is of note that more than 5,000 embryos (n = 5,570), mostly from beef breeds have been exported from South Africa to various parts of the world.

2. A significant increase in the numbers of bovine *in vitro* produced embryos: for the first time more than 100,000 of such embryos have been transferred.

The year 2003 again will have seen the production of *in vitro* embryos in cattle increase its performance with more than 100,000 of such embryos recorded for the first time (see Table 4). This increase results from higher numbers in all the continents except Europe where this activity seems to have stabilized. However, the major impact of this technology appears to have occurred in Asia and in South America. In Asia, Japan has produced 34,000 transferable embryos and close to 10,000 were transferred, half of them as frozen-thawed. But it is in the People’s Republic of China that this technology has been the most actively put into the field with more than 130,000 embryos imported and transferred. Further, some hundreds of embryos have been produced after ovum pick-up operations inside the country. In addition to those two countries, increased activity has been seen in Taiwan, in Thailand and in Korea. More than 60,000 transferable embryos were produced, mostly collected from abattoirs, and greater than 20,000 embryos were transferred, a quarter being transferred after freezing and thawing. Vietnam produced also close to 2,000 transferable embryos from which half were transferred, mainly as fresh embryos. South America and particularly Brazil has been also very active in this area with more than 60,000 transferable embryos produced and transferred as fresh. The Brazilian collector reports than 267,000 oocytes were collected by OPU (more than 11,000 operations) from zebu cows who seem to deliver, a considerable amount of oocytes (a mean of ~25) from each operation.

Table 4. The Number of Bovine *In Vitro*-Produced Embryos Transferred in 2003.

	TRANSFERABLE			
	EMBRYOS COLLECTED	TRANSFERRED EMBRYOS		
		FRESH	FROZEN	TOTAL
AFRICA	4,832	4	139	143 ↗
ASIA	228,623	22,297	9,262	31,559 ↗
N. AMERICA (*)	27,431	1,798	355	2,153 ↗
S. AMERICA	63,341	63,164		63,164 ↗
EUROPE	12,171	3,635	4,775	8,410 ↘
OCEANIA (*)	5,350	474	317	791 ↗
TOTAL	330,848	91,372	14,848	106,220 ↗

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

Other areas in the world are also involved in this technology. Canada reports a total number of 953 transferable embryos produced from OPU and 24,012 from abattoir collections. Most of Canadian embryos are from dairy breeds and the majority of them have been frozen. However, most of them have been exported and only a few hundreds are reported to be transferred domestically, the majority of which are transferred as fresh. The Canadian collector also reports the transfer of 90 split embryos and 66 cloned embryos. In Europe, this activity has somewhat declined and a total number of 8,419 *in vitro*-produced embryos have been transferred, 57% were previously deep-frozen, mainly from the Italian team. As an example, the European AETE (2004) reports that 563 oocyte donors were used for 3,108 OPU sessions and produced 3,683 transferable embryos. Simultaneously, 8,498 transferable embryos were produced from abattoir-collected ovaries. On the whole and when the indications permitted such a calculation, 85% of the embryos derived from oocytes were collected from abattoirs. This poses a major problem that is being dealt with by the IETS HASAC Committee, namely the risk analysis of associating pathogens with such collections.

3. Embryo transfers from other species: some progress still needed to retrieve those data.

As far as the small ruminants are concerned, this year the data retrieval has not been very successful and the numbers reported in Table 5 are highly underestimated. Some data have been obtained from various parts of the world but in particular in Oceania are only partial. The majority of the sheep ET business derives from the Republic of South Africa and Australia but Europe (notably Greece, Portugal and Romania), Canada, New Zealand and the USA have also reported several hundred embryo transfers mostly as fresh with the notable exception of Australia with a third being transferred as frozen.

Table 5. Small Ruminant E T Activity in 2003.

SPECIES	TRANSFERABLE EMBRYOS	TRANSFERRED EMBRYOS	
		FRESH	FROZEN
SHEEP	7,648	6,674	2,907
GOAT	4,533	3,997	757
CERVIDS	696	632	34

In goats, Canada has reported more than 1,500 embryos collected and transferred almost exclusively as fresh. The USA, Taiwan, Europe (including Romania), New Zealand and South Africa have also reported hundreds of embryos collected and transferred. The Cervids do not seem to have been the subject of as many embryo transfers this year. Canada, New Zealand and the USA have reported some data with an interesting set from Canada indicating that domestically, 163 embryos were transferred (20 frozen) and that 157 as fresh and 14 as frozen were so transferred in New Zealand by Canadian teams.

Let us also mention here that some embryo transfers have been performed from buffaloes, particularly in Vietnam and also in rabbits as mentioned in the report from Taiwan (645 embryos transferred as fresh).

The figures of the equine ET activity are reported on Table 6. On the whole, one can see that the activity has only slightly increased in terms of flushes and number of transferable embryos collected. However, the number of embryos that have been effectively transferred (mostly as fresh) has increased a little to the extent of more than 11,000 (an increase of 7%). The vast majority of these transfers originate from Brazil and the USA. Europe with a total number of 344 embryos transferred comes in far behind these two countries. Europe has reported activity from Austria, the Czech Republic, Finland, France, Hungary, Italy, Poland and Sweden, so that even if the numbers are still low, an increased number of countries are getting involved in this technology for this species.

Table 6 - Equine ET Activity in 2003.

COUNTRIES	FLUSHES	TRANSFERABLE EMBRYOS	EMBRYOS TRANSFERRED	
			FRESH	FROZEN
ARGENTINA	14	14		
BRAZIL	5,500	3,650	3,650	
CANADA	149	113	90	14
EUROPE	750	443		344
SOUTH AFRICA	55	55		
USA	12,500	7,500	7,400	
TOTAL	18,968	11,775	11,484	14

For the fourth year in a row, this Committee has attempted to collect some information about the ET industry in swine. This is a real challenge as obviously, this is still very much experimental in most cases and the private companies are reluctant, to say the least, to provide their data even on an anonymous basis. Nevertheless, the Chair has received some information, which is summarized in Table 7. To further complicate the matter, a number of teams, particularly in Asia are involved in experiments with cloned or transgenic pigs. Finally, despite our attempts, not all criteria used are in accordance and it is difficult to assemble logically and accurately all this information. Table 7 tries to give as real a picture as possible on ET technology in swine. More than 300 flushes have been reported around the world and more than 30,000 transferable embryos have been collected. This is quite a significant number. Out of these, a little more than 20,000 embryos have been transferred (450 as frozen). The number of embryos per recipient varies tremendously, it is difficult to give any indication on the numbers of sows used as recipients, however the numbers reported are here given as an indication. The main countries both involved and reporting are Canada, Korea, Taiwan and Europe including the Czech Republic, Hungary, France, the Netherlands, Romania and Switzerland. Clearly a lot of activity occurs in the swine industry but few yet on an economical basis.

In conclusion, this year has been somewhat difficult to retrieve some of the data of the ET industry (there is no need here to report on the numbers of e-mails and telephone calls but it is more than significant. . .). Some countries have not report even though some ET activity is taking place. Next year, a real effort must be made in this area so as to have a more accurate picture of what is going on in the field. More disappointing is the fact that in some countries, particularly in Oceania, many teams do not pay any attention to the requests from their national collector and just do not respond. The Committee has tried hard to keep the data requested to as little as possible and to as simple as possible. Clearly any business does have such data and a particular effort has to be made to get these data reported. The Committee had thought at some time that the anonymity could pose a problem but everyone agrees that never in more than 10 years time, this has been a problem. Anonymity has always been maintained. The Committee will likely have to create some new systems in order to retrieve such data, maybe through the Internet system that could make reporting even easier. This will be discussed at our next meeting in Copenhagen. I encourage everyone that is interested to attend and assure them that they are more than welcome. In any case, this Committee has again (and for more than 10 years) been able to provide a good picture of the bulk of the ET industry in numerous domestic species in which ET is effective and beneficial to the agriculture.

Table 7 - Swine E T Activity in 2003.

COUNTRIES	FLUSHES	EMBRYOS	TRANSFERRED EMBRYOS		RECIPIENT FEMALES
			FRESH	FROZEN	
CANADA	23	456	1,603		
KOREA (1)	97	1,586	34		1
(2)		10,594	1,500		10
(3)		1,900	1,900		20
(4)		8,439	8,439		95
EUROPE (5)	70	1,221	816		27
(6)	19	3,630	3,180	450	121
TAIWAN	72	1,259	1,259		
USA	64	1,457	1,457		
TOTAL	345	30,542	20,188	450	254

- (1) in vivo collected
- (2) in vitro produced
- (3) cloned embryos
- (4) genes transferred
- (5) from AETE statistics
- (6) in addition to the AETE data.

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