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IETS statement on worldwide ET statistics for 2010

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Abstract

For the twentieth consecutive year, the Data Retrieval Committee of the International Embryo Transfer Society (IETS) can report global embryo transfer (ET) statistics. The number of bovine *in vivo*-derived (IVD) embryos collected/flushed worldwide in 2010 increased to 732,000, a 4% increase from 2009. Consequently, the number of bovine IVD embryos transferred is up by 11% to 591,000 in 2010. All continents, with the exception of Africa, reported significant increases in the number of IVD embryos transferred. The number of frozen IVD embryos transferred into recipients outnumbered fresh transfers by 60,000 (328,000 frozen and 263,000 fresh). The total number of transferrable bovine *in vitro* produced (IVP) embryos worldwide increased to 451,000 in 2010, a 20% increase in IVP production. South America (mainly Brazil) again leads the global field of *in vitro* embryo production and transfers. The total number of IVP embryos transferred worldwide in 2010 was 339,685, an 11% increase from 2009.

Global equine ET activity also increased in 2010. The number of reported flushes (41,652) was up by 4,681 (+13%). The number of transfers (28,824) was also up (+4,354). Brazil and Argentina led the way in mares flushed with 15,200 and 12,655 respectively. Small ruminant ET activity was down by about 7% from 2009. Again, Australia was the leader in ovine embryo production and transfers. There was no swine ET activity reported and only a few cervid embryo transfers for 2010. The volume of ET activity reported from all the committee's regional data collectors indicates that the embryo transfer industry is doing well. It is important to note that this report does not include every country's statistics, and very few, if any, country has 100% of its activity represented; however, it is the best worldwide report available about the commercial embryo transfer business.

Keywords: embryo transfer, IETS, *in vitro*, *in vivo*, statistics.

Introduction

For the twentieth consecutive year, the Data Retrieval Committee of the International Embryo Transfer Society (IETS) can report global embryo transfer (ET) statistics (Stroud, 2011). The goal of the IETS Statistics and Data Retrieval Committee is to collect complete *in vivo* and *in vitro* bovine, equine, swine and small ruminant embryo collection and transfer statistics from every ET practitioner in every geographical area of the world. Collecting data is a great challenge each year for everyone involved including the ET practitioners who have to dig into their last year's files and assimilate the requested information. Although, not all the ET activity performed worldwide is included in this report, it is the best report available and gives good indication about the trends and directions of the activity in different parts of the world.

Countries that are members of regional ET societies or associations, i.e. the American Embryo Transfer Association (AETA), the European Embryo Transfer Association (AETE), the Canadian Embryo Transfer Association (CETA) and the Society of Brazilian Embryo Technology (SBTE), to name a few, are well-organized and have established collection protocols that make reporting consistent from year-to-year. However, many countries do not belong to associations, and data collectors in those countries must call on the ET practitioners that they know personally to provide them with data. This requires a tremendous amount of effort on behalf of the regional data collectors, and in many cases not all practitioners are contacted. Certainly, much of the ET that is performed worldwide is not included in this report. However, efforts are ongoing to improve the system of collecting ET data to provide the industry and everyone else with more complete and accurate numbers.

Report of bovine *in vivo* derived embryos in 2010

For the first time in four years the reported number of flushes/collections and the number of IVD embryos transferred into recipients increased (Table 1). Although the number of bovine embryo collections was up less than 1%, the number of embryos transferred was up by over 10%. That is a substantial increase in one year. Frozen embryo transfers (+13%) made up most of that difference. One notable trend, with the exception of Africa, is that growth appears to be equally distributed across all continents with respect to the number of embryos transferred.

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Table 1. Bovine *in vivo* derived embryo activity in 2010.

Continents	Flushes	Transferrable embryos	Number of transferred embryos			
			Fresh	Frozen	Total	Percentage
Africa	1,515	9,738	4,685	3,730	8,415	1%
Asia	12,986	131,718	34,148	53,590	87,738	15%
Europe	17,694	117,813	48,555	60,859	109,414	19%
North America	51,735	338,540	106,400	147,271	253,671	43%
South America	12,263	77,643	47,353	24,205	71,558	12%
Oceania	8,458	56,775	21,895	37,870	59,765	10%
Total 2010	104,651	732,227	263,036	327,525	590,561	100%
2009 totals	103,851	702,358	243,495	290,605	534,100	
Change 09-10	+1%	+4%	+8%	+13%	+11%	

Africa's bovine flush numbers (collector: de la Ray) were up from 1,446 in 2009 to 1,515 in 2010. However, there was a decline of almost 600 IVD embryos transferred in 2010. Otherwise, ET data from Africa was stable compared to a year ago. As in previous years, the majority of Africa's ET data is generated from the Republic of South Africa.

Although all of the Asian data generated in 2009 came exclusively from Japan (collector: Dochi), several other countries in Asia have reported data for the 2010 calendar year. For the first time Sun-Ho Choi has reported ET activity from Korea with 67 dairy flushes and 679 beef flushes. Almost 9,000 IVD bovine embryos were transferred in Korea in 2010. Rangsun Parnpai reported 126 flushes (41 dairy and 85 beef) in Thailand, resulting in 706 transferrable embryos. A total of 728 embryos, fresh plus frozen, were transferred in Thailand in 2010. R. Mapletoft from Canada has reported that Canadian practitioners flushed 57 dairy donors (166 embryos) in 2010 and transferred 113 fresh embryos in China. He also reported 40 beef and 40 dairy donor collections in Russia with a total of 304 transferrable embryos collected and 289 embryos transferred. Japan still dominates Asia in the amount of bovine ET performed in that continent and showed a healthy increase of 700 flushes from 2009 (10,924) to 2010 (11,611). Based on reported data, Asia is responsible for transferring about 15% of the world's *in vivo* derived embryos. The committee still feels that ET activities are ongoing in countries inside Asia, but are not being reported. As of now there are only five countries with designated data collectors in Asia; Dochi from Japan, Nguyen from Vietnam, R. Parnpai from Thailand, Sun-Ho from Korea plus S.N. Lee from Taiwan. Again, the committee urges anyone from an Asian country reading this report to volunteer their time as a data collector or point to someone who would be a good candidate.

Europe (collector: Knijn), a continent of 47 countries, had 21 countries (24 in 2009) that reported data for 2010. As always, they are very thorough and prompt with their data reporting. The number of flushes in 2010 (17,694) was up 838 from 2009 (16,856). Annually, Europe is responsible for transferring about 18% of the world's IVD embryos. Table 2 illustrates a few shifts among countries in Europe relative to the volume of embryos transferred. Some of the countries in Europe do not provide breed information, so comparing dairy and beef is not possible. France and The Netherlands continue to be the top two European countries reporting ET data. Overall, European ET data had a healthy increase in 2010 compared to 2009.

Table 2. The top twelve European countries ranked by number of *in vivo* derived embryos transferred in 2010.

Country	Number of flushes	Number of embryos transferred	Change 2009-2010
France	5,714	29,155	→
Netherlands	3,499	20,808	↗
UK	2,527	14,959	↗
Germany	2,245	15,553	↗
Italy	2,039	11,625	↗
Belgium	1,174	7,222	↗
Spain	577	2,314	↗
Finland	486	3,809	↘
Switzerland	467	3,011	↗
Ireland	360	1,612	↘
Denmark	347	2,054	↘
Czech	229	1,213	↘

Overall, the 2010 North American bovine ET data remained relatively constant, but there were some notable differences reported in 2010. In 2009 Mexico (collector: Romo) reported 1,875 flushes and 8,215 IVD embryos transferred, but only 197 flushes and 4,041 transfers in 2010. Canada (collector: Mapletoft) was down from 2009 (13,348) to 2010 (12,956) by only about 300 flushes. Canadian transfer data were up slightly from 53,410 in 2009 to 55,136 in 2010. The US (collector: Wehrman) was up slightly in the number of flushes reported in 2010. In 2009 a total of 37,655 beef and dairy flushes combined were reported as compared to 38,552 in 2010. Likewise the number of transfers was up from 187,660 in 2009 to 194,794 in 2010. North America (Canada, Mexico and US) continues to dominate the percentage (43%) of global bovine IVD embryos transferred.

South America (collector: Bo) has four new countries reporting data for 2010: Colombia, Ecuador, Peru and Panama. The other South American country collectors are J. Viana from Brazil, L. Nasser from Panama, R. Mancheno from Peru, P. Bañalas and S. Kmaid from Uruguay. For the South American continent G. Bo reported a modest increase in the number of flushes from 2009 (11,634) to 2010 (12,263), but a substantial 21% increase in the number of IVD embryos transferred into recipients (from 59,032 in 2009 to 71,558 in 2010). Those numbers mean that South America transfers over 12% of the world's *in vivo*-derived embryos. As for the number of IVD embryos transferred the reporting South American countries are ranked in order from first to last for data reported in 2010: (1) Brazil = 38,975, (2) Argentina = 24,263, (3) Uruguay = 3,402, (4) Colombia = 2,890, (5) Ecuador = 675 and (6) Peru = 108. Panama only reported *in vitro* produced embryo data.

Oceania (collectors: Pashen/Australia and Forsyth/New Zealand) reported decreases in the number of flushes from 10,070 in 2009 to 8,454 in 2010. However, the number of embryos transferred increased substantially from 46,095 in 2009 to 59,765 in 2010. As in last year's report it is worth mentioning that these numbers are greatly underreported for both countries. Australia is not well organized between the veterinarians and non-veterinarians, which makes it extremely difficult to gather data from the latter group. Forsyth reported only 1 of 7 known team's data for 2010. It is unclear why the other six teams failed to report their ET numbers.

Globally, more frozen *in vivo* derived embryos were transferred in 2010 than fresh embryos (327,525 and 263,036, respectively). That statistic held true for every continent except South America where two times as many fresh embryos were transferred than frozen. The large number of available recipients throughout Brazil and Argentina is a likely reason for that.

The top five countries (Table 3) outside North America and Europe have not changed in the last year.

Table 3. The top five countries outside Europe and North America in 2010 (based on number of bovine *in vivo* embryos transferred).

Country	Number of flushes	Number bovine embryos transferred
Japan	11,611	77,568
Australia	8,138	59,600
Brazil	5,996	38,975
Argentina	5014	24,263
South Africa	1,240	7,521

Report of bovine *in vitro* produced embryos in 2010

Globally, the number of *in vitro* produced (IVP) embryos was up by 74,000 (26%) from a year ago (Table 4). South America was responsible for 268,000 (59%) of the IVP production compared to 68% in 2009. Brazil, the clear global leader in IVP embryos, produced 264,263 embryos. Brazilian ET practitioners transferred 252,048 fresh IVP embryos and 12,214 frozen in 2010. Panama was also active in producing 2,905 IVP embryos in 2010, which was their first year to report IVP embryos. Uruguay was the third leading South American country with 850 IVP embryos, and Argentina reported 292 embryos. Asia reported 117,000 IVP embryos (25% of world total). Japan was responsible for 68,000 of those embryos, but Korea is close behind reporting over 48,000 IVP embryos produced in 2010. Thailand showed some IVP activity producing 59 embryos. North America made 43,000 IVP embryos. The US reported 35,000 embryos (80%) of the North American total. Canada reported 7,600 IVP embryos and Mexico 481. That placed North America in third place worldwide with 10% of the global production. The number of *in vitro* produced embryos transferred worldwide also showed a healthy 11% increase from 306,000 in 2009 to 340,000 in 2010.

Table 4. Bovine *in vitro* produced embryos in 2010.

Continents	Transferrable embryos	Number of transferred embryos			
		Fresh	Frozen	Total	Percentage
Africa	0	0	0	0	0%
Asia	116,614	15,993	6,510	22,503	7%
Europe	7,155	3,412	2,249	5,661	2%
North America	43,058	25,778	2,322	28,100	8%
South America	268,310	256,888	12,235	269,123	79%
Oceania	15,012	13,644	654	14,298	4%
Total 2010	450,549	315,715	23,970	339,685	100%
2009 Totals	376,576	283,188	22,761	305,949	
Change 09-10	+20%	+12%	+5%	+11%	

Figure 1 compares the number of IVD to the number of IVP produced embryos transferred annually over the past decade. The lines are beginning to converge. However, much of the *in vitro* production is coming from South America, mainly Brazil (Figure 2). The figure clearly shows that other continents are stable with the activity of IVP embryos, and the number of transfers is much lower in those regions of the world. North America did show a small bump upwards in 2010. Time will tell if the rest of the world will follow Brazil in producing and transferring mostly IVP embryos.

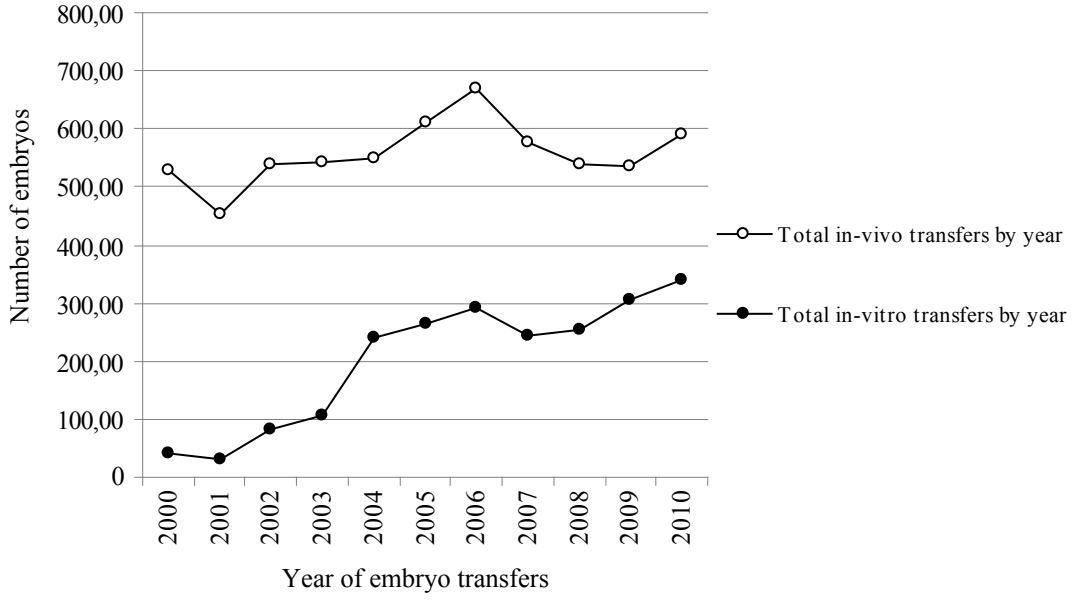

Figure 1. Comparison of the number of *in vivo* and *in vitro* embryos transferred annually for the past decade.

So far, the majority of the IVP embryos transferred have been fresh, not frozen. Data from Table 4 indicates that worldwide only 7% of the IVP embryos transferred in 2010 were frozen. However, that data varies with different regions of the world.

IVP embryo production is growing geographically throughout the world. Africa was the only continent that failed to report any embryos produced *in vitro*. Japan, Korea and Thailand all reported IVP embryos from Asia. In Europe, five of the twenty-one countries reporting, produced IVP embryos. The Netherlands led with 2,863 embryos produced followed by Germany with 2,148. Portugal followed with 1,007. Italy was fourth with 681 embryos produced, then France with 315. As for the number of IVP embryos transferred into recipients in Europe seven countries reported data. The Netherlands topped the 2010 list by transferring 2,593 embryos. Germany was second with 1,481. Italy was a close third having transferred 1,255 IVP embryos. From fourth through seventh in order was: France (311), Portugal (129), Estonia (17) and Switzerland (5). In North America all three countries reported IVP embryo production and transfers. The US produced 34,969 IVP embryos and 26,742 transfers. Canada reported 7,608 IVP embryos produced. They also transferred 850 IVP embryos in 2010. From South America, Argentina, Brazil, Panama, and Uruguay all reported IVP activity in 2010 as mentioned before. In Oceania, Australia reported 12,000 IVP embryos and New Zealand 3,012. New Zealand

reported four times more IVP embryos than IVD. product of OPU with 6,876 (in 2009: 4,885) OPU sessions yielding 109,615 oocytes and 34,969 transferrable embryos for an efficiency rate of almost 32%. One ET group in Mexico reported 191 OPU procedures resulting in 481 transferrable embryos.

As previously stated Brazil is the major IVP player in South America, but it should be noted that Argentina reported 151 OPU sessions producing 292

All of the US *in vitro* produced embryos were a embryos. Uruguay reported 96 OPU sessions producing 850 embryos. Panama was busy with 1,030 OPU sessions yielding 13,180 oocytes and 2,905 embryos.

The reported total number of bovine *in vivo* derived and *in vitro* produced embryos transferred in 2010 worldwide was 930,993 which was an increase of 87,131 transfers from the 2009 total of 843,862. That is a solid 10% increase overall.

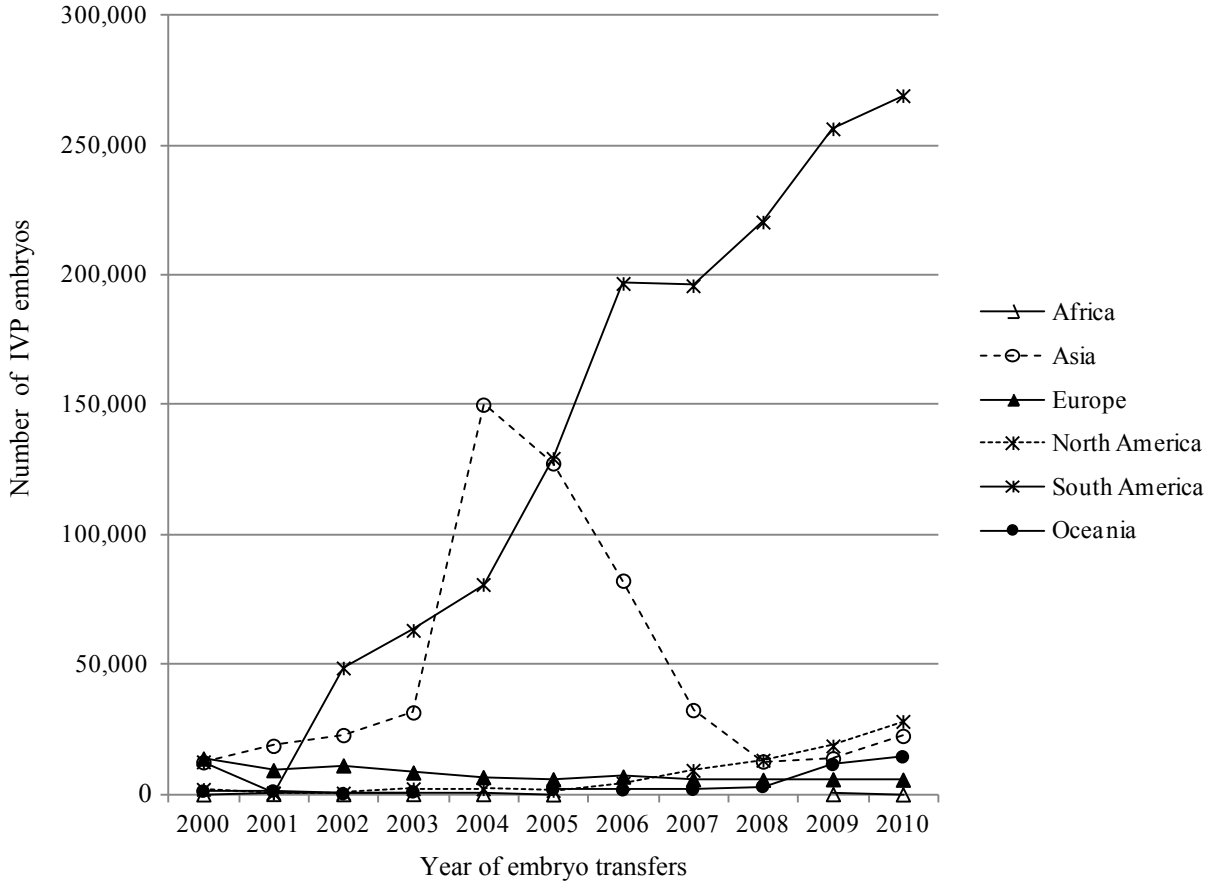

Figure 2. Trends by continents of transferred in-vitro produced embryos since 2000.

The overall activity of ET in other species in 2010

In this report, statistics are recorded for three species of small ruminants: sheep, goats and deer. The reported number of viable sheep embryos flushed in 2010 was almost identical to the 2009 data (32,768 in 2009 and 32,614 in 2010; see Table 5). Although many were transferred in 2009, Australia did not report the number of sheep embryo transfers last year. In 2010 they reported 24,170 transfers, most of those being fresh. The Republic of South Africa followed Australia in sheep embryo production with transfer of 3,392 ovine embryos. For the second consecutive year Mexico was third with 1,505 transfers. In 2010 the European countries of Turkey, Hungary and the Czech Republic combined transferred 446 ovine embryos compared to 143 in 2009. R. Mapletoft of Canada reported 68 ovine flushes producing 335 embryos in Canada. He reported only 83 transfers for 2010. He also reported work done in Mongolia by a Canadian ET practitioner where 590 ovine embryos were transferred. Mapletoft also reported ovine ET performed in Sweden by a Canadian team in a project that transferred 125 embryos. Uruguay also reported transferring 544 sheep embryos in 2010. Lastly, New Zealand reported 109 ovine embryo transfers.

Caprine ET activity was most likely underreported for the 2010 year. Only 539 total goat embryos were reported as collected worldwide. Australia reported the most transfers (1,200). That was followed by 290 transfers in Mexico, 200 in the West Indies (Mapletoft reported a Canadian team performing that work), 155 in South Africa, 93 in Mexico (Mapletoft/Canadian), 14 goat transfers in Mongolia (Mapletoft/Canadian), and 10 goat embryo transfers in

the US in 2010. Caprine ET work in the US is grossly underreported.

Table 5. Small ruminant global ET activity in 2010.

Species	Transferrable embryos	Number of transferred embryos		
		Fresh	Frozen	Totals
Sheep total	32,614	26,480	2,598	29,078
Goat total	539	1,619	14	1,633
Cervids total	0	0	84	84
Total 2010	33,153	28,099	2,696	30,711
2009 totals	35,697	2,473	355	2,828
Change 09-10	-8%	ND	ND	ND

ND = Not determined.

Only 84 cervid embryos were reported being transferred in 2010 worldwide. Mapletoft reported that one of his teams from Canada transferred 84 embryos in Mexico. The rest of the world had no deer ET activity to report.

The total number of equine flushes increased from 36,955 in 2009 to 41,652 in 2010, which is a 13% increase (Table 6). Based on embryos transferred the top three countries performing equine ET are Brazil, Argentina and the US in that order. In 2010 Brazil equine ET practitioners transferred 14,422 embryos, which represented 43% of world's activity. Argentina reported 8,226 embryos transferred. That equates to 29% of global activity. The United States was third again with 18% of the equine workload. It's worth noting that two years ago worldwide 24,000 mares were flushed. It appears that equine ET is back on track in 2010. Brazil increased its flush numbers by about 1,100 in 2010, and Argentina by about 1,800. The US equine ET data was actually estimated for the 2010 year due to an unfortunate fire that occurred at the Colorado State University (CSU) Equine Reproductive Center. P. McCue, the Director of that facility, is the US equine data retrieval representative for this committee. Unfortunately, he was too involved with organizing the CSU breeding centers after effects of the fire to do an accurate survey for the 2010 ET season. So, his 2010 data was estimated to be identical to the 2009 data. Canada was up from 26 mares flushed in 2009 to 42 in 2010. Europe reported 1,024 flushes in 2009, but only 385 in 2010. That's a significant drop of 639. Europe reported 1,216 flushes two years ago (2008). The Czech Republic, Hungary, Italy and Portugal are the countries in Europe that reported Equine ET activity in 2010. For the second consecutive year there was no equine activity reported from Asia. The Republic of South Africa was the only country reporting equine flushes in 2010 from the African continent. They did 127 flushes in 2010, which are seven more than in 2009. Australia, reported a huge increase in the number of equine flushes (3,300 in 2010) compared to 910 in 2009. Perhaps the most notable bit of data from Australia is that ET practitioners transferred as many frozen equine embryos as fresh (1,230 of each).

Unfortunately, there was no swine ET activity reported from any continent or country in 2010. In 2008 the US reported 134 flushes, but only 9 flushes for 2009. It is unclear if swine ET activity is actually down or the data is not being reported. This committee is in desperate need of regional data collectors of swine ET data.

Table 6. Equine ET activity in 2010.

Countries	Flushes	Transferrable embryos	Number of transferred embryos			
			Fresh	Frozen	Total	Percentage
Argentina	12,655	8,480	8,226	0	8,226	29%
Brazil	15,200	12,400	12,400	22	12,422	43%
Uruguay	10	5	5	0	5	0.02%
Canada	42	32	32	0	32	0.1%
Europe	385	289	123	0	123	0.4%
South Africa	127	95	95	0	95	0.3%
Australia	3,300	1,230	1,230	1,230	2,460	9%
USA	9,933	4,966	4,966	495	5,461	19%
Total 2010	41,652	27,497	27,077	1,747	28,824	100%
2009 totals	36,955	24,515	24,455	5	24,470	
Change 09-10	+13%	+12%	+11%	ND	+18%	

ND = Not determined.

Conclusions

The volume of ET activity reported from all the committee's regional data collectors indicates that the embryo transfer industry is doing well worldwide. As always some country's data are up and others are down,

but fortunately most are up from a year ago. Anyone does not include every country's statistics, and very few, if any, country has 100% of its activity represented. Guessing what percent of the world's actual ET is represented in this document would be unprofessional at best, so no attempt will be made to do so; however, it is the best worldwide report available about the commercial embryo transfer business.

To make it easier for ET practitioners to collect data, the number of total ova collected is no longer requested by the committee. Also, the number of stored embryos is no longer a part of the survey. This should liminate a significant amount of time for each ET team to gather and report their stats each year.

For any questions about submitting data, please contact www.iets.org or brad@stroudet.com.

Acknowledgments

The authors would like to publically thank all reading this report should take into consideration that it the regional and country collectors that spend a considerable portion of their personal time each summer or winter (depending on the hemisphere) calling and emailing their fellow practitioners for all their data. Their names are listed at www.iets.org. For 20 consecutive years the data has been gathered, assimilated and published for the world to see. For as many man-hours that it takes to prepare the report, a great deal of gratitude should be given to those involved. Lastly, we would like to thank Dr. Michel Thibier for his help editing this report for accuracy and completeness.

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