

## 2013 STATISTICS OF EMBRYO COLLECTION AND TRANSFER IN DOMESTIC FARM ANIMALS

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### 1. EXECUTIVE SUMMARY

The International Embryo Transfer Society (IETS) Data Retrieval Committee presents the 23<sup>rd</sup> annual report on the data collected globally during 2014 for embryo transfer (ET) activity in 2013. A major feature of the past year was the continuing growth in the bovine ET to record levels, thanks mainly to the continuing rapid growth in the IVF technology. Further details are provided in the report below.

#### 1.1 DATA COLLECTION

The quality of the data continued to vary greatly between regions and countries. Only 40 of 225 (16.9%) countries submitted data to the IETS secure web-based database, a drop from 41 that reported the previous year. In Asia, Thailand did not report, nor did Austria, Croatia and Norway (Europe); however Moldova (Europe), Chile and the Dominican Republic (South America) began reporting this year.

**Table 1 Number and proportion of countries submitting 2013 data**

Region	No of countries in region	No countries submitting data	% countries submitting data
Africa	57	2	3.51%
Asia	53	4	7.55%
Europe	45	24	53.33%
North America	3	3	100.00%
Oceania	23	2	8.70%
South America	44	5	11.36%
<b>Globally</b>	<b>225</b>	<b>40</b>	<b>17.78%</b>

Collecting quality data continues to be problematic despite the recent development of the secure IETS Database system for the following reasons:

- Lack of trust by ET practitioners in ensuring the confidentiality of the source of the ET data collected
- The effort required by individual ET practitioners to collect ET activity data, especially those with small teams that have little contact with their national ET industry or the IETS
- The lack of interest by many countries not submitting ET data despite the evidence of the benefits.
- The ability to find national ET data collectors recognised by colleagues as being impartial
- The reluctance of some countries/regions to adapt their ET data collection procedures to suit the IETS format
- The reluctance by many to collect specific data, eg, export data, splitting cattle into dairy and beef.

#### 1.2 BOVINE ANIMALS

The bovine embryo transfer industry has recorded its highest ever number of collections and transfers globally. The number of in-vivo derived (IVD) and in-vitro fertilised (IVF) bovine embryos collected in 2013 was 1,275,874, pipping the previous highest of 1,219,111 recorded in 2006; and the number of IVD and IVF bovine embryos transferred was 986,983, higher than the previous highest of 945,211 recorded in 2011. Given the under-reporting of ET activity globally, it is considered highly likely that more than one million bovine embryos were transferred in 2013.

Table 2 (next page) summarises the global activity for **IN-VIVO DERIVED** (IVD) embryo collection and transfer according to the data submitted.

**Table 2 Collection and transfer of bovine IVD embryos by region in 2013**

Region	In-vivo embryo collection				In-vivo embryo transfers			
	Collections	Transferrable embryos	No. embryos per collection	% of global embryo prod'n	No. fresh embryos	No. frozen embryos	Total transferred	% Global transferred
Africa	1081	8461	7.83	1.16%	4098	2754	6852	1.15%
Asia	9391	105249	11.21	14.43%	27346	62844	90190	15.71%
Europe	22316	135711	6.08	18.61%	46206	73662	119868	20.89%
North America	57735	392530	6.80	53.83%	115832	161785	277617	48.31%
Oceania	2837	14525	5.12	1.99%	5488	8570	14058	2.23%
South America	12545	72770	5.80	9.98%	32666	34534	67200	11.71%
<b>GRAND TOTAL</b>	<b>105905</b>	<b>729246</b>	<b>6.89</b>	<b>100.00%</b>	<b>231636</b>	<b>344149</b>	<b>575785</b>	<b>100.00%</b>

Over the previous 12 months, global production of transferrable IVD bovine embryos increased from 699,586 in 2012 to 729,246, a rise of 4.2%. While the number of collections (flushes) increased only slightly, from 104,883 to 105,905, a rise of 1%, the number of embryos per collection increased from 6.67 in 2012 to 6.89 in 2013.

Of significance was the notable increase in number of IVD bovine embryos transferred globally, from 505,876 to 575,785 embryos, an increase of 13.5%. This is just above 571,342 IVD bovine embryos transferred in 2011, but well short of the high of 670,711 recorded for 2006, when IVF embryos was becoming increasingly popular. North America accounted for half of the global activity in IVD bovine embryos.

Regionally, the number of IVD bovine embryo collected increased in Africa (11.2%), North America (10.3%) and Asia (4.7%), remained stable in Europe (fall 0.4%) but decreased in South America (14.2%) and the Oceania (6.5%). Interestingly, the total number of embryos transferred increased dramatically in Asia (39.2%), significantly in North America (17.8%) and Europe (12.6%), and slightly in Africa (4.1%) but fell in the Oceania (14.8%) and surprisingly in South America (13.7%).

Table 3 summarises the global activity for **IN-VITRO FERTILISED (IVF)** embryo collection and transfer according to the data submitted.

**Table 3 Collection and transfer of bovine IVF embryos by region in 2013**

Region	Ovum pick up					Abattoir				
	Collection			Transfers		Collection			Transfers	
	Donors	Oocytes	Embryos	Fresh embryo	Frozen embryo	Donors	Oocytes	Embryos	Fresh embryo	Frozen embryo
Africa	1384	20097	5012	3048	1552	0	0	0	53	10
Asia	1827	30441	4171	0	0	1832	751749	25896	8571	6422
Europe	7506	60315	13722	9236	2804	1449	19881	1050	45	29
North America	24707	444312	112300	53836	12766	355	7403	2093	2076	355
Oceania	2730	27114	5923	2417	3038	2	52	2	9	3
South America	47684	949330	376459	289903	15025	0	0	0	0	0
<b>Global</b>	<b>85838</b>	<b>1531609</b>	<b>517587</b>	<b>358440</b>	<b>35185</b>	<b>3638</b>	<b>779085</b>	<b>29041</b>	<b>10754</b>	<b>6819</b>

Globally, production of IVF embryos, both ovum-pick-up (OPU) and abattoir derived, resulted in 546,628 transferrable embryos collected and 411,198 transferred. Production of OPU transferrable embryos grew significantly from 443533 embryos to 517587 embryos, an increase of 16.7% and the first time over 500,000 bovine IVF OPU embryos collected and over 400,000 transferred in one year. Africa and Oceania did not report their IVF embryo activity the previous year, but provided ET data activity this year. All regions except Asia reported significantly increased OPU IVF transferrable embryo production. Asia had a slight drop in OPU IVF bovine embryo production from 5294 to 4171 but this was more than offset by the doubling of abattoir derived IVF bovine embryos from 12584 embryos to 25896 embryos.

South America accounted for 72.7% of OPU IVF bovine embryo production while Asia accounted for 89.2% of the abattoir-derived IVF bovine embryo production.

### 1.3 OTHER LIVESTOCK SPECIES

**Buffalo** – no IVD or IVF activity reported this year.

**Sheep** – eleven countries reported on sheep embryo collection and transfers, with Australia and South Africa being the major producers, followed by Mexico, New Zealand and the United States . Globally 6704 IVD embryos were collected and 3928 transferred in 2013. This is in contrast to 13633 embryos collected and 12244 transferred in 2012. The drop is largely due to under-reporting from Australia.

**Goats** – four countries (South Africa, New Zealand, Mexico and the United States) reported data for caprine ET activity indicate significantly reduced activity in 2013 with only 1185 embryos collected and 881 transferred.

**Deer** – Canada was the only country reporting cervine ET activity with 226 embryos collected and 157 transferred

**Horses** – Globally the ET activity was significantly reduced due to the non-reporting of equine ET activity from Argentina, a major producer of equine embryos. Brazil, another major producer, reported 19680 embryos collected and transferred in 2013, 17% higher than the 16800 embryos collected and transferred reported in 2012. Brazil and Argentina are the only countries that report significant ET activities in horses.

### 1.4 GENERAL COMMENTS

A major concern is the lack of ET data for exports from most European and Asian countries. As shown in Table 4, only seven of 38 countries that provided ET activity data in 2013 also provided their export data.

The collection, handling, processing and transfer of livestock embryos has, over the past 30 plus years of commercial ET activity, has consistently proved to be very safe and to have negligible risk of disease transmission. The risk is negligible even with fresh embryos, often washed only up to three times and collected from animals of unknown health status before transfer to other animals within the same country.

It is clear that given the very high level of safety of embryo transfer in livestock, conditions for international trade in livestock embryos should be one of trust rather than mistrust, as currently evidenced by the onerous and unnecessary biosecurity conditions imposed by many countries for importation of livestock embryos. The time is rapidly coming when countries will need to be prepared for international trade in fresh or chilled micro-manipulated (DNA tested) IVF embryos. Such trade will require a high level of trust in the ET industry as evidence by a streamlined and rapid border post processing of the imported consignments to ensure the survival of such embryos at the time of transfer to recipients.

**Table 4 Countries known to export embryos**

Animal spp	Country	Exported
Bovine IVD	South Africa	659
	Canada	12758
	United States	15896
	Australia	2426
	New Zealand	28
	Argentina	2946
Bovine IVF OPU	Canada	122
	Dominican Republic	590
Sheep IVD	New Zealand	214
	South Africa	399
Goats IVD	New Zealand	171
	South Africa	552
Swine IVD	Canada	118

## 2 INTRODUCTION

This is the 23<sup>rd</sup> annual report of the IETS Data Retrieval Committee, the highlight of which is the presentation of the 2013 global data on activities related to in-vivo and in-vitro embryo collection and transfer in domestic farm animals. The data is collected by national data collectors who volunteer to collect the information from the embryo transfer (ET) practitioners within their country, either directly from these practitioners or indirectly via the national ET association.

The year began with the Data Retrieval Committee meeting in Reno, USA, on 13<sup>th</sup> January 2014 to review the previous annual ET activity report, the development of the new IETS Database for collecting and storing

numbers of in-vivo and in-vitro domestic farm animal embryo collections and transfers globally and the availability of national ET data collectors. Sixteen attended the meeting.

### **3 METHODOLOGY**

Table 5 (next page) lists the data collectors who volunteered to collect embryo transfer data from their region/country. Embryo transfer associations in several countries, in particular, Canada (Canadian Embryo Transfer Association CETA), United States (American Embryo Transfer Association AETA), Mexico (Mexican Embryo Transfer Society META), Brazil (Sociedade Brasileira de Tecnologia de Embriões SBTE), Argentina (Sociedad Argentina de Tecnologías Embrionarias SATE) and Member States of the European Union and other European countries (European Embryo Transfer Association EETA or Association Européenne de Transfert Embryonnaire AETE), collected data from their members, collated and pooled the data and provided, via designated data collectors, the IETS Data Retrieval Committee with a country by country summary for inclusion in this report.

Data collectors from remaining countries rely largely on the goodwill of individual embryo transfer practices to volunteer their data. These collectors were usually chosen as being recognised by their colleagues as being impartial and respectful of the commercial sensitivities of their ET data. Those involved in international trade are more likely to submit data as they realise potential importers and veterinary authorities of importing and exporting countries may refer to these annual reports for information on the livestock embryo transfer industry in the exporting and/or importing countries.

Australia, New Zealand and Panama embryo transfer practitioners submitted data individually either to the Chair or directly to the IETS database. The data collector for South Africa submitted data practice by practice, while other countries provided pooled data. Collection of data from Australia and New Zealand and other Asian, African and South American countries remained problematic with many practitioners reluctant to provide data. It hoped the new report format with greater details about each country will encourage practitioners to provide data to demonstrate the scale of the embryo transfer industry within their own country, thus reducing under-reporting.

Best quality data come from countries that require ET practitioners to submit data as part of their annual registration requirements according to the IETS format. Canada, via the Canadian Embryo Transfer Association, has consistently provided the best data in recent years, with United States, Brazil, Argentina all providing good data. The Europe data, collected by the AETE, is more difficult because of the languages and of the different data format that doesn't separate beef and dairy cattle or record exports.

Despite the various issues, the Data Retrieval Committee is extremely grateful for all the data submitted. It is hoped this will improve.

**Table 5 List of Data Collectors by Region / Country**

REGION/COUNTRY	Collector	REGION/COUNTRY	Collector
<b>AFRICA</b>		<b>EUROPE</b>	
Kenya	Morne de la Rey	AETE	Hiemke Knijn
Namibia	Morne de la Rey		
Rep South Africa	Morne de la Rey	Austria	Gabi Wetchy
<b>ASIA</b>		Belgium	Peter Vercauteren
India	Aditya Misra	Bosnia & Herzegovina	Teodor Markovic
Israel	Amir Shiffman	Croatia	Mario Matkovic
Japan	Takashi Nagai	Czech Republic	Pavel Bucek
Kazakistan	Victor Madison	Denmark	Henrik Callesen
Korea	Sang Rae Cho	Estonia	Jevgeni Kurykin
Taiwan	Tzong-faa Shiao	Finland	Marja Mikkola
Thailand	Rangsun Parnpai	France	Clair Ponsart
<b>NORTH AMERICA</b>		Germany	Hubert Cramer
Canada	Reuben Mapletoft	Greece	Samartzi Foteini
Mexico	Salvador Romo	Hungary	F Flink
United States	Michael Wehrman	Ireland	Pat Lonergan
<b>SOUTH AMERICA</b>		Italy	Giovanna Lazzari
Argentina (bovine)	Gabriel Bo	Luxembourg	J Westphal
Argentina (equine)	Luis Losinno	Netherlands	Jan Derksen
Brazil (equine)	M Alvarenga	Norway	Eiliv Kummen
Brazil (bovine)	Joao Henrique Moreira Viana	Poland	Jedrzej Jaskowski
Chile	Marcelo del Campo	Portugal	Joao Nestor das Chagas e Silva
Dominican Rep	Luis Nasser	Russia	Victor Madison
Ecuador	Michael Wehrman	Spain	Julio de la Fuente
Panama	Luis Nasser	Sweden	A Tidstrom
Peru	Edwin Mellisho	Switzerland	Rainer Saner
Uruguay	Pedro Bañales	Turkey	Ebru Emsen
St Martinique	Michael Wehrman	United Kingdom	Ian Kippax
<b>OCEANIA</b>		Ukraine	Victor Madison
Australia	Rob Pashen; George Perry		
New Zealand	Grant Clarke		

## 4. RESULTS

### 4.1 IN-VIVO DERIVED BOVINE EMBRYOS

#### IVD bovine embryo collected

Table 7 shows the numbers of the bovine IVD transferrable embryos collected in 2013.

Globally, 729,246 IVD bovine embryos were collected in 2013. This is an increase of 4.2% from 699,586 transferrable embryos collected in 2012 but is well short of the peak in 2005 when 789,972 transferrable IVD bovine embryos were collected, a difference of 60,726 embryos. The difference is accounted for by the growing popularity of in-vitro fertilised (IVF) embryos replacing IVD embryos in some parts of the world, especially in the *Bos indicus* breeds where it has found greater acceptance. The United States (301,671) was the world's largest producer of IVD bovine embryos, followed by Japan (102,880), Canada (84,940) and Brazil (50,455). In Europe, France produced the most IVD embryos (38,244), followed by The Netherlands (26,670) and Germany (17624).

Compared with 2012 data, IVD embryo collection increased in South Africa (12%), Israel (35%), South Korea (240%), Japan (4.1%), Czech Republic (538%), Denmark (33%), Finland (16%), France (16%), Germany (7%), Hungary (3%), Ireland (77%), Italy (10%), Luxembourg (20%), Russian Federation (210%), United States (17%) and Australia (30%). However, collection of IVD bovine embryos fell in Kazakhstan (18%), Belgium (7.7%),

Netherlands (16%), Poland (6%), Portugal (32%), Spain (6%), Sweden (39%), Switzerland (21%), Ukraine (84%), Canada (7.5%), New Zealand (97%), Argentina (34%) and Brazil (1%).

### IVD bovine embryo transferred

Table 8 shows the numbers of the bovine IVD embryos transferred in 2013.

According to the ET data, 573,970 bovine IVD embryos were transferred, 13.5% higher than 505,876 transferred in 2012 but well short of the high of 670,711 IVD bovine embryos transferred in 2006, before being overtaken by the rapidly growing acceptance of the IVF embryos.

Compared with the 2012 data, IVD fresh and frozen embryo transfer increased in South Africa, Israel, Japan, South Korea, Belgium, Czech Republic, Denmark, France, Germany, Italy, Netherlands, United States and Australia. However, collection of IVD bovine embryos fell in Finland, Hungary, Kazakhstan, Poland, Portugal, Russian Federation, Spain, Sweden, Switzerland, Ukraine, Canada, New Zealand, Argentina and Brazil.

Of interest is the difference in directions of IVD and IVF embryos in different regions. South America with its high *Bos indicus* populations prefer IVF embryos to IVD embryos because of its economics and suitability for the breeds, and the number of IVD embryo collection (72770 in 2013) and transfer (67200 in 2013) have continued to be in decline since the peak of 150434 IVD bovine embryos collected and 125,250 IVD bovine embryos transferred in 2005. In the *Bos taurus* breeds, IVF OPU bovine embryos generally find favour with dairy heifers.

Also of interest is the regional/country preferences for transferring fresh or frozen IVD embryos. Globally, almost 60% of IVD bovine embryos were transferred frozen, the remainder transferred fresh (Table 6). The variations between countries were very high, depending on the size of the ET industry and the structure of cattle enterprises within each country.

**Table 6 - Frozen IVD bovine embryos transferred as % of all IVD embryos transferred**

Region	% frozen transferred
Africa	40.2%
Asia	69.7%
Europe	61.5%
North America	58.3%
Oceania	61.0%
South America	51.4%
<b>GRAND TOTAL</b>	<b>59.8%</b>

**Table 7 Bovine IVD embryo collection by region and country**

Region / Country	In-vivo Embryo collection					
	Collections			Transferrable embryos collected		
	Dairy	Beef	Total	Dairy	Beef	Total
<b>AFRICA</b>						
Namibia	0	0	0	0	0	0
South Africa	40	1041	1081	350	8111	8461
<b>ASIA</b>						
Israel	96	0	96	439	0	439
Japan	1997	6587	8584	12630	90250	102880
Kazakhstan	353	0	353	254	0	254
Korea (South)	15	343	358	81	1595	1676
<b>EUROPE</b>						
Belgium	926	0	926	4599	0	4599
Bosnia and Herzegovina	1	0	1	10	0	10
Czech Republic	241	0	241	1314	0	1314
Denmark	622	0	622	4572	0	4572
Estonia	2	0	2	8	0	8
Finland	425	0	425	3037	0	3037
France	7205	0	7205	38244	0	38244
Germany	2573	0	2573	17624	0	17624
Greece	1	0	1	5	0	5
Hungary	104	0	104	901	0	901
Ireland	840	0	840	4739	0	4739
Italy	2025	42	2067	15045	260	15305
Luxembourg	185	0	185	1347	0	1347
Moldova	4	0	4	2	0	2
Netherlands	4308	0	4308	26670	0	26670
Poland	139	0	139	859	0	859
Portugal	108	0	108	661	0	661
Russian Federation	157	0	157	766	0	766
Spain	547	0	547	2958	0	2958
Sweden	20	0	20	69	0	69
Switzerland	362	0	362	2791	0	2791
Turkey	0	0	0	0	0	0
Ukraine	9	0	9	39	0	39
United Kingdom	1470	0	1470	9191	0	9191
<b>NORTH AMERICA</b>						
Canada	9952	2112	12064	68215	16725	84940
Mexico	76	910	986	483	5436	5919
United States	16252	28433	44685	100479	201192	301671
<b>OCEANIA</b>						
Australia	212	2598	2810	889	13566	14455
New Zealand	26	1	27	65	5	70
<b>SOUTH AMERICA</b>						
Argentina	622	3663	4285	3478	18835	22313
Brazil	2706	5553	8259	17153	33302	50455
Chile	1	0	1	2	0	2
Dominican Republic	0	0	0	0	0	0
Panama	0	0	0	0	0	0
<b>GRAND TOTAL</b>	<b>54622</b>	<b>51283</b>	<b>105905</b>	<b>339969</b>	<b>389277</b>	<b>729246</b>

**Table 8 IVD bovine embryo transfers and exports by regions and countries.**

Region / Country	In-vivo embryo transfers											
	No. fresh embryos transferred			No. frozen domestic embryos			No. frozen imported embryos			No. embryos exported		
	Dairy	Beef	Total	Dairy	Beef	Total	Dairy	Beef	Total	Dairy	Beef	Total
<b>AFRICA</b>												
Namibia	0	0	0	0	0	0	0	51	51	0	0	0
South Africa	174	3924	4098	78	2421	2499	1	203	204	0	659	659
<b>GRAND TOTAL</b>	<b>174</b>	<b>3924</b>	<b>4098</b>	<b>78</b>	<b>2421</b>	<b>2499</b>	<b>1</b>	<b>254</b>	<b>255</b>	<b>0</b>	<b>659</b>	<b>659</b>
<b>ASIA</b>												
Israel	212	0	212	146	0	146	0	0	0	0	0	0
Japan	2432	24026	26458	7840	52711	60551	1171	34	1205	0	0	0
Kazakhstan	44	0	44	210	0	210	0	0	0	0	0	0
Korea (South)	42	590	632	0	649	649	83	0	83	0	0	0
<b>GRAND TOTAL</b>	<b>2730</b>	<b>24616</b>	<b>27346</b>	<b>8196</b>	<b>53360</b>	<b>61556</b>	<b>1254</b>	<b>34</b>	<b>1288</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>EUROPE</b>												
Belgium	962	0	962	3914	0	3914	0	0	0	0	0	0
Bosnia and Herzegovina	10	0	10	0	0	0	0	0	0	0	0	0
Czech Republic	729	0	729	658	0	658	0	0	0	0	0	0
Denmark	2420	0	2420	1161	0	1161	0	0	0	0	0	0
Estonia	0	0	0	11	0	11	0	0	0	0	0	0
Finland	710	0	710	2263	0	2263	0	0	0	0	0	0
France	17833	0	17833	16684	0	16684	0	0	0	0	0	0
Germany	6639	0	6639	11326	0	11326	0	0	0	0	0	0
Greece	2	0	2	4	0	4	0	0	0	0	0	0
Hungary	184	0	184	465	0	465	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0	0	0	0
Italy	5510	0	5510	0	0	0	0	0	0	0	0	0
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0
Moldova	0	0	0	2	0	2	0	0	0	0	0	0
Netherlands	5770	0	5770	26318	0	26318	0	0	0	0	0	0
Poland	222	0	222	727	0	727	0	0	0	0	0	0
Portugal	192	0	192	410	0	410	0	0	0	0	0	0
Russian Federation	105	0	105	491	0	491	0	0	0	0	0	0
Spain	895	0	895	1426	0	1426	0	0	0	0	0	0
Sweden	28	0	28	45	0	45	0	0	0	0	0	0
Switzerland	645	0	645	1565	0	1565	0	0	0	0	0	0
Turkey	0	0	0	0	0	0	0	0	0	0	0	0
Ukraine	0	0	0	115	0	115	0	0	0	0	0	0
United Kingdom	3350	0	3350	6077	0	6077	0	0	0	0	0	0
<b>GRAND TOTAL</b>	<b>46206</b>	<b>0</b>	<b>46206</b>	<b>73662</b>	<b>0</b>	<b>73662</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>NORTH AMERICA</b>												
Canada	22910	2248	25158	25374	5245	30619	56	202	258	8244	4514	12758
Mexico	292	4506	4798	25	873	898	105	112	217	0	0	0
United States	42771	43105	85876	32968	96825	129793	0	0	0	10993	4903	15896
<b>GRAND TOTAL</b>	<b>65973</b>	<b>49859</b>	<b>115832</b>	<b>58367</b>	<b>102943</b>	<b>161310</b>	<b>161</b>	<b>314</b>	<b>475</b>	<b>19237</b>	<b>9417</b>	<b>28654</b>
<b>OCEANIA</b>												
Australia	674	4804	5478	371	6687	7058	125	1243	1368	178	2248	2426
New Zealand	10	0	10	10	103	113	31	0	31	22	6	28
<b>GRAND TOTAL</b>	<b>684</b>	<b>4804</b>	<b>5488</b>	<b>381</b>	<b>6790</b>	<b>7171</b>	<b>156</b>	<b>1243</b>	<b>1399</b>	<b>200</b>	<b>2254</b>	<b>2454</b>
<b>SOUTH AMERICA</b>												
Argentina	1058	5945	7003	1516	8483	9999	357	0	357	0	2946	2946
Brazil	7505	18158	25663	9177	14999	24176	0	0	0	0	0	0
Chile	0	0	0	2	0	2	0	0	0	0	0	0
Dominican Republic	0	0	0	0	0	0	0	0	0	0	0	0
Panama	0	0	0	0	0	0	0	0	0	0	0	0
<b>GRAND TOTAL</b>	<b>8563</b>	<b>24103</b>	<b>32666</b>	<b>10695</b>	<b>23482</b>	<b>34177</b>	<b>357</b>	<b>0</b>	<b>357</b>	<b>0</b>	<b>2946</b>	<b>2946</b>



**Table 8 IVF bovine embryo collections, transfers and exports by regions and countries.**

Region / Country	Ovum pick up						Abattoir				
	Collection			Transfers			Collection			Transfers	
	Donors	Oocytes	Embryos	Fresh embryo	Frozen domestic	Exports	Donors	Oocytes	Embryos	Fresh embryo	Frozen
South Africa	1384	20097	5012	3048	1552	0	0	0	0	53	10
<b>AFRICA TOTAL</b>	<b>1384</b>	<b>20097</b>	<b>5012</b>	<b>3048</b>	<b>1552</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>53</b>	<b>10</b>
Japan	1823	30390	4165	0	0	0	0	655157	13979	5531	6379
Korea (South)	4	51	6	0	0	0	1832	96592	11917	3040	43
<b>ASIA TOTAL</b>	<b>1827</b>	<b>30441</b>	<b>4171</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1832</b>	<b>751749</b>	<b>25896</b>	<b>8571</b>	<b>6422</b>
Bosnia and Herzeg	1	20	10	0	0	0	0	0	0	0	0
Czech Republic	1	20	10	0	14	0	0	0	0	0	0
France	234	1882	688	173	515	0	2	65	14	0	0
Germany	1638	5036	3480	2566	970	0	0	0	0	0	0
Italy	51	101	170	100	386	0	19	845	67	0	0
Netherlands	4391	37328	5094	4173	703	0	60	2661	358	0	0
Portugal	0	0	0	0	0	0	1368	16310	611	45	29
Russian Federation	925	12722	3565	1503	49	0	0	0	0	0	0
Spain	265	3206	705	721	167	0	0	0	0	0	0
<b>EUROPE TOTAL</b>	<b>7506</b>	<b>60315</b>	<b>13722</b>	<b>9236</b>	<b>2804</b>	<b>0</b>	<b>1449</b>	<b>19881</b>	<b>1050</b>	<b>45</b>	<b>29</b>
Canada	2286	20650	8298	3111	456	122	0	300	15	0	5
Mexico	375	7500	2500	2880	0	0	355	7103	1881	1879	350
United States	22046	416162	101502	47845	12310	0	0	0	197	197	0
<b>NTH AMERICA TOTAL</b>	<b>24707</b>	<b>444312</b>	<b>112300</b>	<b>53836</b>	<b>12766</b>	<b>122</b>	<b>355</b>	<b>7403</b>	<b>2093</b>	<b>2076</b>	<b>355</b>
Australia	0	0	0	124	205	0	0	0	0	0	0
New Zealand	2730	27114	5923	2293	2833	0	2	52	2	9	3
<b>OCEANIA TOTAL</b>	<b>2730</b>	<b>27114</b>	<b>5923</b>	<b>2417</b>	<b>3038</b>	<b>0</b>	<b>2</b>	<b>52</b>	<b>2</b>	<b>9</b>	<b>3</b>
Argentina	1048	17891	4852	2786	0	0	0	0	0	0	0
Brazil	45742	914843	366517	286527	15025	0	0	0	0	0	0
Dominican Republic	52	1428	529	590	0	590	0	0	0	0	0
Panama	842	15168	4561	0	0	0	0	0	0	0	0
<b>STH AMERICA TOTAL</b>	<b>47684</b>	<b>949330</b>	<b>376459</b>	<b>289903</b>	<b>15025</b>	<b>590</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>GLOBAL TOTAL</b>	<b>85838</b>	<b>1531609</b>	<b>517587</b>	<b>358440</b>	<b>35185</b>	<b>712</b>	<b>3638</b>	<b>779085</b>	<b>29041</b>	<b>10754</b>	<b>6819</b>

## 4.2 IN-VITRO FERTILISED BOVINE EMBRYOS

### IVF bovine embryo production

For the first time, the global production of bovine IVF embryos exceeded the half-million mark with a total of 546,628 IVF embryos produced, 517,587 by ovum pick-up (OPU) method and 29,041 by collection of ovaries at abattoirs. This is a significant jump of 19.5% from the previous high of 457,455 in 2012 and is indicative of the rapidly growing popularity of bovine IVF embryos world-wide. Its use continues to grow in popularity in South America, particularly in Brazil which produced 70.8% of the IVF OPU bovine embryos in the world.

Production of OPU transferrable embryos grew significantly from 443,533 embryos to 517,587 embryos, a significant increase of 16.7%. Africa and Oceania did not report their IVF embryo activity the previous year, but provided IVF ET data activity this year. All regions except Asia reported significantly increased OPU IVF transferrable embryo production (Europe (56%), North America (48%) and South America (6%). On the other hand, Asia reported a doubling of abattoir-derived IVF embryos produced, from 12,584 in 2012 to 25,896 in 2013, while elsewhere production of abattoir-derived IVF embryos decreased or was non-existent. Japan (13,979) and South Korea (11,917) leads the world in production of abattoir-derived IVF embryos, producing 48.1% and 41.0% of the global production of this type of embryo.

Surprisingly, Europe (14,772) did not produce significant quantity of IVF bovine embryos in comparison with South America (376,459), North America (114,393) and Asia (30,067), especially given the amount of research into IVF embryo production in Europe. Of the European countries, the three producing the most IVF OPU bovine embryos were The Netherlands (5094), Russia (3565) and Germany (3480) and the three producing the most IVF abattoir-derived bovine embryos were Portugal (611), The Netherlands (358) and Italy (67). IVF laboratories exist in Australia and New Zealand, though only NZ reported IVF data, recording 5,923 IVF embryos produced, higher than any of the European countries.

### IVF bovine embryo transfer

As regards IVF OPU embryos transfers, there was a very small global increase (2.2%) in the total number of IVF embryos (both OPU and abattoir-derived) transferred in 2013 was 411,198, 3.5% increase on 397,246 IVF embryos produced in 2012. Records indicate this is the first time over 400,000 IVF bovine embryos were transferred in the one year.

OPU embryos transferred increased 2.2% from 2012 (384,999) to 2013 (393,625), with Oceania and Africa reporting IVF data in 2013, not in 2012. There was a highly significant increase in Europe (46%) and North America (57%), and surprisingly a significant fall in South America (9%).

Interestingly, unlike IVD embryos, almost 90% of IVF bovine embryos were transferred fresh (Table 9). This is largely due to the development of oocyte and embryo portable incubation technology allowing transportation of maturing oocytes from the field laboratory to central laboratories for fertilisation and preparation for in-vitro culture, then transportation of embryos undergoing in-vitro culture to the farms for transfer to recipient cows and heifers.

South America (304,928) lead the way with transfer of IVF bovine embryos in 2013, followed by North America (69,032), Asia (14,993) and Europe (12,114). Interestingly, New Zealand (5,455) reported transferring more IVF bovine embryos than any of the European countries. The Netherlands reported 4,876 transfers, followed by Germany (3,536) and Russia (1,552). Of interest was Portugal which reported 611 IVF bovine embryos produced, but only 74 transferred.

The main reason for the growing popularity of the IVF OPU embryos is due to the significant technological advances being made with collection, handling, processing, storage, transport and transfer of IVF embryos. Also advances in genomics (the branch of molecular biology concerned with the structure, function, evolution, and mapping of genomes) resulting in the improved breeding value of embryos is having an impact on breed improvement programs.

### 4.3 OTHER LIVESTOCK SPECIES

**Buffalo** – no IVD or IVF embryo production or transfers reported this year.

**Sheep** – Globally 6,704 IVD embryos were collected and 3,893 transferred in 2013. This is in contrast to 13,633 embryos collected and 12,244 transferred in 2012. Much of this is due to gross under-reporting from Australia, (2012 – Australia reported 7,135 IVD embryos collected and 6,888 transferred but in 2013, only 2732 embryos collected and none transferred). Only one of at least ten major ovine ET teams reported ET activity in sheep in 2013. It is believed that 25000 embryos being collected and transferred is a very conservative estimate of ovine ET activity in Australia. South Africa reported collecting less embryos but transferring similar numbers in 2013. They collected 2958 IVD embryos and transferred 2615 embryos in 2013 as compared to collecting 4116 embryos and transferring 2713 embryos in 2012. Chile reported their ovine ET activity for the first time in 2013.

**Table 9 - Fresh IVF bovine embryos transferred as % of all IVF embryos transferred**

Region	% IVF embryos transferred fresh
Africa	66.5%
Asia	57.2%
Europe	76.6%
North America	81.0%
Oceania	44.4%
South America	95.1%
Global	89.8%

#### 4.3 EMBRYOS OF OTHER LIVESTOCK SPECIES

**Table 10 IVF bovine embryo collections, transfers and exports by regions and countries.**

Country	Collection		Transfers			
	Collection	Embryos	Fresh embryos	Frozen domestic	Frozen Imported	Exports
<b>SHEEP</b>						
Argentina	8	56	53	0	0	0
Australia	329	2732	0	0	0	0
Canada	11	78	78	0	0	0
Chile	2	21	21	0	0	0
Czech Republic	0	0	13	0	0	0
Ireland	0	16	0	0	0	0
Mexico	108	606	606	0	35	0
South Africa	3657	2958	2032	583	0	397
Turkey	0	0	250	0	0	0
United States	53	237	214	43	0	0
<b>Grand Total</b>	<b>4168</b>	<b>6704</b>	<b>3267</b>	<b>626</b>	<b>35</b>	<b>397</b>
<b>GOATS</b>						
Mexico	23	143	143	0	0	0
New Zealand	34	156	0	13	0	171
South Africa	307	116	37	0	0	552
United States	100	770	682	6	0	0
<b>Grand Total</b>	<b>464</b>	<b>1185</b>	<b>862</b>	<b>19</b>	<b>0</b>	<b>723</b>
<b>CERVIDS</b>						
Canada	49	226	157	0	0	0
<b>Grand Total</b>	<b>49</b>	<b>226</b>	<b>157</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>HORSES (IN-VIVO)</b>						
Brazil	24880	19680	19680	0	0	0
Canada	71	49	49	0	0	0
Ireland	0	35	0	0	0	0
Italy	0	40	0	0	0	0
Mexico	20	15	15	0	0	0
Poland	0	0	4	0	0	0
Portugal	0	0	6	0	0	0
United States	601	353	337	9	0	0
<b>Grand Total</b>	<b>25572</b>	<b>20172</b>	<b>20091</b>	<b>9</b>	<b>0</b>	<b>0</b>
<b>HORSES (IN-VITRO)</b>						
Italy	0	74	0	0	0	0
<b>Grand Total</b>	<b>0</b>	<b>74</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>SWINE</b>						
Canada	12	118	279	0	0	118
France	15	279	118	0	118	0
<b>Grand Total</b>	<b>27</b>	<b>397</b>	<b>397</b>	<b>0</b>	<b>118</b>	<b>118</b>

**Goats** – Global data for caprine ET activity indicate significantly reduced activity in 2013 with only 1185 embryos collected and 862 transferred. This is in contrast to 1805 embryos collected and 1013 transferred in 2012. Canada and France did not report any caprine ET activity this year after having reported some activity in 2012. New Zealand, which didn't report in 2012, reported collecting 156 embryos collected and 13 transferred in 2013. South Africa (116 collected and 37 transferred in 2013), Mexico (143 collected and transferred in 2013) and the United States (770 collected and 682 transferred in 2013) remained to be the main producers. Interestingly, most of the caprine embryos collected in New Zealand (171) and South Africa (552) were exported.

**Deer** – In 2012, only New Zealand reported cervine ET activity with 292 embryos collected and 337 transferred. In 2013, Canada was the only country reporting cervine ET activity with 226 embryos collected and 157 transferred

**Horses** – Globally the ET activity was significantly reduced due to the non-reporting of equine ET activity from Argentina, a major producer of equine embryos. Brazil, another major producer, reported 19680 embryos collected and transferred in 2013, 17% higher than the 16800 embryos collected and transferred in 2012. Brazil and Argentina are the only countries that report significant numbers, but it is believed that over 10000 equine embryo were collected and transferred in USA. Argentina, Finland and Switzerland reported equine ET activity in 2012 but not in 2013, while Ireland and Portugal reported equine ET activity in 2013 but not in 2012.

**Swine** – only two countries (Canada and France) reported ET activity. It is believed ET activity is much higher but as most major piggeries are owned by large companies, most are secretive with the ET activity and data.

## 5. DISCUSSION AND CONCLUSION

In conclusion, the year 2013 resulted in another successful outcome of embryo transfer activity world-wide. With regards to data collection, much progress need to be made to

- encourage countries to start reporting their ET data by appointing national data collectors acceptable to colleagues
- encourage ET practitioners, including small teams, to be willing to provide their ET data accurately and in the current IETS format.

Many ET practitioners desire to remain secretive with their data for commercial reasons; but those generous with their data have continued to supply the required information without any apparent adverse effects to the businesses.

The new IETS ET database addresses much of the anonymity and security concerns of ET practitioners and provides for the central ongoing storage of ET data. Efforts were made to make the website multi-lingual thus enhancing its use world-wide, but not one person responded to the proposal. The previous report available at [http://www.iets.org/pdf/comm\\_data/December2013.pdf](http://www.iets.org/pdf/comm_data/December2013.pdf) contains information about how to use the new database.

Export data remains very problematic, with very little reporting, especially from Europe. According to the data received, United States and Canada are the major exporters, each exporting over 10,000 bovine IVD embryos each year. They are followed by Australia and Argentina. It is expected South America, Africa and to some extent Asia export only limited amounts of embryos, mainly because of concerns with risk of transmission of exotic diseases. It is not known if the EU member states keep any record of intra-EU trade or trade with third countries but the AETE have been approached to see if this can be addressed. It is believed Japan does not permit export of bovine embryos in order to protect their Wagyu industry. As yet, there is very little international trade in IVF embryos and many countries are reluctant to commit resources to developing import protocols for IVF embryos, especially from South America.

The ongoing success and rapid growth of the livestock ET industry over the past 30 plus years clearly shows it is extremely safe and risks of disease transmission via embryo collection and transfer is extremely low if not

negligible, even when using donors of unknown health status, as is the case with the vast majority of domestic collections and transfers, especially with fresh IVF embryos undergoing incubation while in transit between farms and IVF laboratories. It is becoming increasingly clear that much of the international trade restrictions applied by many countries are unnecessary and should be removed.

The genetic information being unlocked by advances in genomic and high throughput technologies is rapidly revolutionizing our understanding of developmental processes in bovine species. This involves micromanipulation of embryos to collect genetic material for evaluation of their production potential. Thus it is expected that there will soon be a demand for international trade in micro-manipulated fresh or chilled IVF embryos. There will be a need for greater collaboration between the ET industry and the national veterinary authorities to map a way for the rapid transfer of embryos between countries to maximise the survival of such embryos for transfer to recipient animals.

## **6. ACKNOWLEDGMENTS**

It is the Chairperson's privilege to gratefully acknowledge the valuable efforts of all the national data collectors who participated in the data retrieval process. I also gratefully acknowledge all the ET practitioners who provided with the data either to their national data collectors or directly to the database.

I apologise the report is rather brief but I was busy with other activities. I did not realise I had such a short time to prepare the report until I was advised recently of the report's deadline for publication while I was overseas. I had no access to my computer and the IETS database until two days before the report was due. I had no time to ask others to review and edit this document and I must also apologise for denying them the privilege of this important task.

Special Note: This is the second version of the Annual Report, brought about by the addition of data from Japan and Mexico. The data from Japan had an impact on data analysis, significant enough to warrant a revision of the original report.