

2015 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 25th annual report on the data collected globally during 2016 for embryo transfer (ET) activity in 2015. There were two major features this year. The first is that fifty countries, believed to be a record and certainly a vast improvement on the 39 countries that reported in the previous year, submitted data on ET activity within their borders (Table 1). The second is that the IETS database was upgraded to enable more detailed analysis on ET activities.

Table 1 Number and proportion of countries submitting data

Region	No countries in Region	No. Countries submitting data	% countries in region	No. Countries submitting data	% countries in region
	2014			2015	
Africa	57	3	5.26%	2	3.51%
Asia	53	0	0.00%	4	7.55%
Europe	45	27	60.00%	32	71.11%
North America	3	3	100.00%	3	100.00%
Oceania	23	2	8.70%	2	8.70%
South America	44	4	9.09%	7	15.91%
GLOBALLY	225	39	17.33%	50	22.22%

1.1 DATA COLLECTION

The data submission activity continued to vary greatly between regions and countries, although it has improved considerably. Fifty of 225 (22.22%) countries submitted data to the IETS secure web-based database, a significant improvement on 39 that reported the previous year, with thanks to the hard-working data collectors. The committee welcomed new data collectors from several countries, especially from Europe and South America, and was happy to see the Asian region submitting ET data once again.

It was noted however there is some confusion about what number goes where in the database, especially in the bovine in-vivo derived (IVD) embryo collection section, the “Number of Collections” (Figure 1), which needs to be rewritten to reflect the number of ungraded embryos and ova collected after flushing.

1.2 BOVINE ANIMALS

This year is the first time bovine IVD data identified embryos fertilised with conventional semen or with sex sorted semen (Table 2). World-wide, only 4.9% of all flushes specified having used sex sorted semen to fertilise the embryo donors. The highest %'s were 6.55% in Europe and 6.31% in North America. Just over 100,000 cattle were flushed in 2015.

Beef cattle accounted for over 60% of IVD embryos collected world-wide (Table 3). The Table 3 data in the columns headed “Embryo Collections” (first three columns of numbers should be disregarded as there was obviously confusion about the type of data to enter in this section.

Table 2 Collection of bovine IVD embryos by region – embryo collections (flushes)

Region	Conventional semen			Sexed semen			Total - All flushes
	Dairy	Beef/Other	Flushes	Dairy	Beef/Other	Flushes	
Africa	67	643	710	0	1	1	711
Asia	2581	12096	14677	12	0	12	14689
Europe	15650	3505	19155	1313	29	1342	20497
North America	17567	32590	50157	2828	551	3379	53536
Oceania	468	1851	2319	27	7	34	2353
South America	1609	7181	8790	159	4	163	8953
Grand Total	37942	57866	95808	4339	592	4931	100739

Table 3 Collection of bovine IVD embryos by region - ungraded and transferrable embryos

Region	Embryo Collection			Transferrable embryos		
	Dairy	Beef/Other	Total embryo collection	Dairy	Beef/Other	Total transferrable embryos
Africa	673	6764	7437	402	5132	5534
Asia	25320	158712	184032	16057	89628	105685
Europe	148104	37560	185664	104174	23806	127980
North America	133132	375121	508253	127613	232407	360020
Oceania	556	1859	2415	2178	9009	11187
South America	7369	23094	30463	8636	41179	49815
Grand Total	315154	603110	918264	259060	401161	660221

North America recorded over 50% of global IVD embryo activity. Globally, the reported number of transferrable IVD embryos collected increased 7.45%, but this was largely due to Asia reporting 105,685 IVD embryos, whereas in the previous year, no report was received from any Asian countries. Africa, Europe, North and South America reported decreased numbers, while the Oceania reported increased numbers, largely due to improved reporting by Australia (Table 4).

Table 4 Comparison of IVD embryo ET activity

Region	BOVINE IN-VIVO DERIVED EMBRYO COLLECTION								
	Flushes	Transferrable embryos	No embryos per collection	% of global embryo production	Flushes	Transferrable embryos	No embryos per collection	% of global embryo production	% change transferrable embryos from 2014
	2014				2015				
Africa	794	5,782	7.28	0.94%	711	5,534	7.78	0.84%	-4.29%
Asia	0	0	0.00	0.00%	14,689	105,685	7.19	16.01%	0.00%
Europe	22,408	137,998	6.16	22.46%	20,497	127,980	6.24	19.38%	-7.26%
North America	58,934	397,306	6.74	64.66%	53,536	360,020	6.72	54.53%	-9.38%
Oceania	1,326	5,224	3.94	0.85%	2,353	11,187	4.75	1.69%	114.15%
South America	11,204	68,154	6.08	11.09%	8,953	49,815	5.56	7.55%	-26.91%
Grand Total	94,666	614,464	6.49	100.00%	100,739	660,221	6.55	100.00%	7.45%

There was also significant increase in IVD embryos transferred, due to Asia reporting, having not reported 2014 data (Table 5). North American ET activity for implanting fresh and frozen IVD embryos were very similar to 2014. Africa, Europe and South America reported decreased activity but the Oceania reported much higher numbers due to higher numbers of Australian ET practitioners reporting.

Table 5 Transfer of bovine IVD embryos by region

REGION	BOVINE IN-VIVO DERIVED EMBRYO TRANSFERS							
	No. fresh embryos	No. frozen embryos	Total transferred	% of global transfers	No. fresh embryos	No. frozen embryos	Total transferred	% of global transfers
	2014				2015			
Africa	4455	944	5399	1.16%	1681	1735	3416	0.66%
Asia	0	0	0	0.00%	24476	53066	77542	14.90%
Europe	59546	63434	122980	26.47%	46931	65375	112306	21.58%
North America	107700	163646	271346	58.41%	105496	165549	271045	52.07%
Oceania	2391	2180	4571	0.98%	5731	4847	10578	2.03%
South America	27868	32418	60286	12.98%	18834	26814	45648	8.77%
GRAND TOTAL	201960	262622	464582	100.00%	203149	317386	520535	100.00%

With regards to bovine in-vitro produced (IVP) ET activity, number of embryos derived from oocytes collected by ovum pick-up (OPU) grew 3.8% from 590,035 in 2014 to 612,709 in 2015 (Table 6). However, there was a greater increase (10.26%) with number transferred. This was largely due to increase in South America (12.58%) and North America (5.32%), the two regions that are by far the largest users of OPU IVP (Total 94.69%; South America 70.35% and North America 24.34%).

Table 6 Collection and transfer of bovine OPU IVP embryos by regions

REGIONS	OVUM PICK-UP FOR BOVINE IN-VITRO PRODUCED EMBRYOS									
	COLLECTION			TRANSFERS		COLLECTION			TRANSFERS	
	DONORS	OOCYTES	EMBRYOS	FRESH	FROZEN	DONORS	OOCYTES	EMBRYOS	FRESH	FROZEN
				EMBRYOS	EMBRYOS				EMBRYOS	EMBRYOS
2014					2015					
Africa	1359	20976	5081	1202	170	1113	21494	3733	162	21
Asia	0	0	0	0	0	3177	59224	9438	3250	1164
Europe	9710	83785	15693	10980	2957	9092	73397	13780	9799	4703
North America	43452	812468	206139	71263	21667	35980	683717	212046	65844	32027
Oceania	3250	30549	6486	2044	3171	1646	17533	3892	1825	2491
South America	71327	861100	356960	211177	40096	60696	1205840	369820	224066	58821
Grand Total	129098	1808878	590359	296666	68061	111704	2061205	612709	304946	99227

In 2013, Asia had accounted for 89% of all collections of abattoir derived IVP embryos and 85% of all transfers. So the impact of lack of Asian data for 2014 was very significant. In 2015, Asia had accounted for 98% of all abattoir derived IVP embryo collections and 96% of all transfers world-wide.

Interestingly, this form of ET activity is insignificant elsewhere. This is most likely due to cultural and husbandry practices common in Asia.

Table 7 Collection and transfer of bovine abattoir-derived IVP embryos by regions

REGIONS	ABATTOIR DERIVED OOCYTES FOR BOVINE IN-VITRO PRODUCED EMBRYOS									
	COLLECTION			TRANSFERS		COLLECTION			TRANSFERS	
	DONORS	OOCYTES	EMBRYOS	FRESH	FROZEN	DONORS	OOCYTES	EMBRYOS	FRESH	FROZEN
				EMBRYOS	EMBRYOS				EMBRYOS	EMBRYOS
2014					2015					
Africa	0	0	0	0	0	156	2033	235	0	0
Asia	0	0	0	0	0	35335	714783	56740	11485	11445
Europe	1335	37414	1369	0	35	65	2472	434	0	0
North America	13	258	187	193	0	5	9117	1037	273	418
Oceania	9	146	16	260	0	7	142	16	8	8
South America	118	2025	519	410	0	0	0	0	0	0
Grand Total	1475	39843	2091	863	35	35568	728547	58462	11766	11871

Once again, the United States and Canada were major exporters of bovine IVD embryos, and along with South Africa, contributed to the growing international trade in bovine IVP embryos. Australia and New Zealand were major exporters of ovine embryos (Table 8).

Table 8 Regions and countries exporting embryos

REGION	EXPORTS							
	IN-VIVO DERIVED EMBRYOS			IN-VITRO PRODUCED	IN-VIVO DERIVED EMBRYOS			
	DAIRY	BEEF	UNSORTED	BOVINE	SHEEP	GOATS	CERVIDS	SWINE
Africa	94	365	0	176	0	0	0	0
South Africa	94	365	0	176	0	0	0	0
Asia	0	0	0	0	0	0	0	0
Europe	4	0	1776	0	0	0	0	0
Belgium	0	0	146	0	0	0	0	0
Denmark	0	0	91	0	0	0	0	0
Finland	4	0	0	0	0	0	0	0
France	0	0	220	0	0	0	0	0
Hungary	0	0	10	0	0	0	0	0
Luxembourg	0	0	50	0	0	0	0	0
Netherlands	0	0	1115	0	0	0	0	0
Portugal	0	0	16	0	0	0	0	0
Spain	0	0	56	0	0	0	0	0
Switzerland	0	0	72	0	0	0	0	0
North America	15517	7478	0	542	199	0	0	395
Canada	5408	2374	0	172	0	0	0	0
Mexico	0	623	0	355	0	0	0	0
United States	10109	4481	0	15	199	0	0	395
Oceania	116	269	0	0	3013	23	213	0
Australia	0	269	0	0	1803	0	0	0
New Zealand	116	0	0	0	1210	23	213	0
South America	0	3262	0	0	0	0	0	0
Argentina	0	3262	0	0	0	0	0	0
Grand Total	15731	11374	1776	718	3212	23	213	395

1.3 OTHER ANIMAL SPECIES

Tables detailing ET activities in other livestock species are included in this report.

1.4 GENERAL COMMENTS

A significant feature is the return of Asian countries submitting ET data after a conspicuous absence the previous year. In addition, ET data was received from 50 countries and is believed this can be further improved. It is hope to receive more data from several countries over the next year and more countries will come on board.

The collection, handling, processing and transfer of livestock embryos has continued to prove to be very safe with negligible risk of disease transmission, even with fresh IVD 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.

2 INTRODUCTION

This is the 25th annual report of the IETS Data Retrieval Committee, the highlight of which is the presentation of the 2015 global data on activities related to in-vivo and in-vitro embryo collection and transfer in domestic farm animals. The data was 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 and entered on the IETS database.

The year began with the Data Retrieval Committee meeting in Louisville, Kentucky, USA on Monday 25th January 2016 to review the previous annual ET activity report, discuss 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.

3 METHODOLOGY

The methodology is as reported for the earlier report “2013 Statistics of Embryo Collection and Transfer in Domestic Farm Animals”, available on-line at: http://www.iets.org/pdf/comm_data/December2014.pdf. However, there were several changes to the database over the past year as shown in Figures 1 and 2. Several collectors forgot that access to the database is via a special web address, and not via the IETS website. Some also lost their login and password. Fortunately, the IETS administrator and chair have a copy of the master file detailing all those with access to the database, including their login and passwords.

<http://www.iets.org/data-retrieval/> is the home page for IETS database system. That page serves as the common login page for the chair, the group heads, and the data submitters. On this page is:

Login: *Submitter's email address*

Password: *Unique password created by FASS and sent to the submitter by email.*

The Chair has full access to the whole database and grants restricted access to the group heads (data collectors). The Chair (first tier) had responsibility for creating new regional/country data collectors (second tier), using the email address provided by them for login. An email with login details are then automatically sent by FASS to the new group heads. The Chair downloads all or filtered data in csv format for auditing and analyses using Microsoft Excel®.

Second tier data collectors collecting data from one or several countries in their region have the responsibility for providing secure restricted access to third tier data submitters for their region/country. The second tier data collectors can submit/view/edit data they and their delegated (third tier) submitters provided. They can also download data in csv format for their region/country for auditing and further analysis.

When submitting data, submitters are to ensure they selected the correct “Year” and “Region/Country”. All data collectors can submit data more than once and can correct their data. Some data collectors prefer to submit data team by team, others country by country. The choice is up to the individual submitters.

There are two links (“Start New Submission” and “Return to Home Page”) in the yellow message box that appear at the top of the page after data was submitted or saved. The “Start New Submission” link clears out the previous data on the page so new data can be entered, otherwise any new data will overwrite the previous unsaved data. Also, the link in the breadcrumb bar (Data Retrieval ... Home > Submission) above the page title is available to return the user to the home page. Logging out is via a logout link at the upper right corner of the home page.

Data can be “saved” and “submitted” without filling in every field. Once “submitted”, the program automatically fills blank cells with “0”. “Saved” does not result in data being submitted, it is simply to allow the user to go back to the database and finish entering data. After clicking the “SUBMIT” button, it is necessary to wait until the page reloads and to check if there are any error messages or if submission is accepted. If there is a message in a red box, then an error has occurred and data is not saved. After correcting the problem, the “SUBMIT” button is clicked again. If the user sees a yellow box, then submission was successfully saved/accepted, and the “Start a new Submission” link is clicked to clear the data and start a new submission, or the user can return to the home page via the “Return to Home Page” link.

For those considering becoming IETS ET data collectors, Figures 1 and 2 show what the current data entry forms look like on the IETS data retrieval website.

Figure 1 IETS Database entry form for embryo collections

Number of embryo collections and collected

SPECIES	TYPE	Number of Flushes		Total No of Collections	Total No. Transferable Embryos Collected
		Conventional Semen	Sexed Semen		
BOVINE In Vivo	Dairy	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Beef & Other Breeds	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
SPECIES	TYPE	Number of OPU Sessions		No of Oocytes	No. of transferable embryos**
		Conventional Semen	Sexed Semen		
BOVINE In Vitro OPU	Dairy - non-stimulated	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Dairy - stimulated	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Beef or other - non-stimulated	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Beef or other - stimulated	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
SPECIES	TYPE	Number of Abattoir Donors		No of Oocytes	No. of transferable embryos**
		Conventional Semen	Sexed Semen		
BOVINE In Vitro Abattoir*	Dairy	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Beef	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
SPECIES	TYPE	Number of in vivo embryos		Number of in vitro embryos	
BOVINE Embryo Technologies	Number of sexed embryos (via biopsy)	<input type="text"/>		<input type="text"/>	
	Number of genotyped embryos	<input type="text"/>		<input type="text"/>	
SPECIES	TYPE	Number of Flushes		Number of Transferrable Embryos**	
WATER BUFFALO <i>Bubalis bubalis</i>	in vivo only	<input type="text"/>		<input type="text"/>	
SHEEP	in vivo only	<input type="text"/>		<input type="text"/>	
GOATS	in vivo only	<input type="text"/>		<input type="text"/>	
CERVIDS	in vivo only	<input type="text"/>		<input type="text"/>	
HORSES	in vivo only	<input type="text"/>		<input type="text"/>	
SWINE	in vivo only	<input type="text"/>		<input type="text"/>	
OTHERS	in vivo only	<input type="text"/>		<input type="text"/>	
SPECIES	TYPE	Number of OPU sessions		Number of Oocytes	Number of Transferrable Embryos**
		Conventional semen	Sexed semen		
WATER BUFFALO <i>Bubalis bubalis</i>	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
SHEEP	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
GOATS	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
CERVIDS	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
HORSES	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
SWINE	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
OTHERS	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Figure 2 IETS Database entry form for embryo transfers and exports

Number of embryos transferred and exported

SPECIES	TYPE	NUMBER OF			EXPORTS
		FRESH	FROZEN		
			DOMESTIC ORIGIN	FOREIGN ORIGIN	
BOVINE	Dairy (in vivo derived)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Beef & Other Breeds (in vivo derived)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Non-Separated* Breeds (in vivo derived)	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	in vitro produced: OPU	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	in vitro produced: Abattoir**	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
WATER BUFFALO <i>Bubalis bubalis</i>	in vivo only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
SHEEP	in vivo only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
GOATS	in vivo only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
CERVIDS	in vivo only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
HORSES	in vivo only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
SWINE	in vivo only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
OTHERS	in vivo only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
WATER BUFFALO <i>Bubalis bubalis</i>	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
SHEEP	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
GOATS	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
CERVIDS	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
HORSES	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
SWINE	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
OTHERS	in vitro only	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Non-Separated* - only record data on this line for bovine in vivo derived embryos not separated by breed.

Abattoir** - only record the number of embryos transferred in commerce. Do not include embryos transferred for research purposes.

The data collectors are those as listed in Table 9 on the next page. There were a few changes from the previous year.

The Data Retrieval Committee is extremely grateful for all the data submitted and appreciates the efforts of those who made considerable effort to improve the quantity and quality of data submitted.

Table 9 List of Data Collectors by Region and Country

REGION/COUNTRY	Collector	REGION/COUNTRY	Collector
AFRICA		EUROPE	
Kenya	Morne de la Rey	AETE	Marja Mikkola (Finland)
Namibia	Morne de la Rey		
Rep South Africa	Morne de la Rey	Austria	Friedrich Führer
ASIA		Belgium	Peter Vercauteren, Isabelle Donnay
China	J Hepburn, Simon Bell	Bosnia & Herzegovina	Teodor Markovic
India	Aditya Misra	Croatia	Mario Matkovic
Israel	Amir Shiffman	Czech Republic	Pavel Bucek
Japan	Osamu Dochi	Denmark	Henrik Callesen
Kazakistan	Victor Madison	Estonia	Jevgeni Kurykin
Korea	Sang-Rae Cho	Finland	Seija Vahtiala
Taiwan	S N Lee	France	Serge Lacaze
Thailand	Rangsun Parnpai	Germany	Hubert Cramer
NORTH AMERICA		Greece	Foteini Samartzi
Canada	Reuben Mapletoft/CETA	Hungary	Ferenc Flink
Mexico	Salvador Romo	Ireland	Patrick Lonergan
United States	Daniela Demetrio/AETA	Italy	Giovanna Lazzari
SOUTH AMERICA		Latvia	Vita Anatane
Argentina (bovine)	Gabriel Bo	Lithuania	G Palubinskas, V Ziliatis, J Kutras
Argentina (equine)	Luis Losinno	Luxembourg	Mariiane Vaeseen
Brazil (equine)	M Alvarenga	Macedonia, Rep of	Toni Dovenski
Brazil (bovine)	Joao Henrique Moreira Viana	Netherlands	Helga Flapper
Colombia	Canadian Embryo Transfer Assoc	Norway	Eiliv Kummen
Dominican Rep	Luis Nasser	Poland	Jedrzez Jaskowski
Ecuador	Michael Wehrman	Portugal	Joao Nestor das Chagas e Silva
Panama	Luis Nasser	Russia	Denis Knurow
Paraguay	John Hepburn	Serbia	-
Peru	Roberto Diaz Navarro, W Vivanco	Slovakia	Dalibor Polak
Uruguay	Pedro Bañales	Slovenia	Janko Mrkun
St Martinique	Michael Wehrman	Spain	Santiago Fuentes Ibanez
OCEANIA		Sweden	Renee Båge
Australia	Rob Pashen; George Perry	Switzerland	Rainer Saner
New Zealand	John Hepburn	Turkey	Ebru Emsen
		United Kingdom	Ian Kippax
		Ukraine	Victor Madison

4 RESULTS

4.1 IN-VIVO DERIVED BOVINE EMBRYOS

Bovine IVD embryo collected and transferred

Table 10 shows that more bovine IVD embryos are being transferred frozen in all regions except the Oceania while Table 11 and 12 show the number of bovine IVD embryos collected and transferred by region and country.

Table 10 Frozen bovine IVD embryos transferred as a % of all IVD embryos transferred.

REGION	BOVINE IN-VIVO DERIVED EMBRYO TRANSFERS							
	No. fresh embryos	No. frozen embryos	Total transferred	% frozen	No. fresh embryos	No. frozen embryos	Total transferred	% frozen
	2014				2015			
Africa	4455	944	5399	17.48%	1681	1735	3416	50.79%
Asia	0	0	0		24476	53066	77542	68.44%
Europe	59546	63434	122980	51.58%	46931	65375	114348	57.17%
North America	107700	163646	271346	60.31%	105496	165549	271045	61.08%
Oceania	2391	2180	4571	47.69%	5731	4847	10578	45.82%
South America	27868	32418	60286	53.77%	18834	26814	45648	58.74%
GRAND TOTAL	201960	262622	464582	56.53%	203149	317386	520535	60.97%

Table 11

Bovine in-vivo derived embryo collection by region and countries

REGION	BOVINE IN-VIVO DERIVED EMBRYO COLLECTION											
	COLLECTIONS - FLUSHES						UNGRADED EMBRYOS COLLECTED			TRANSFERRABLE EMBRYOS COLLECTED		
	CONVENTIONAL SEMEN			SEXED SEMEN								
	DAIRY	BEEF	TOTAL	DAIRY	BEEF	TOTAL	DAIRY	BEEF	TOTAL	DAIRY	BEEF	TOTAL
Africa	67	643	710	0	1	1	673	6764	7437	402	5132	5534
Kenya	30	0	30	0	0	0	319	0	319	167	0	167
South Africa	37	643	680	0	1	1	354	6764	7118	235	5132	5367
Asia	2581	12096	14677	12	0	12	25320	158712	184032	16057	89628	105685
Israel	37	2	39	2	0	2	39	2	41	190	10	200
Japan	2527	11308	13835	0	0	0	25215	156361	181576	15815	88057	103872
Korea (South)	17	786	803	10	0	10	66	2349	2415	52	1561	1613
Europe	15650	3505	19155	1313	29	1342	148104	37560	185664	104174	23806	127980
Austria	120	118	238	15	4	19	1310	1478	2788	955	1077	2032
Belgium	241	904	1145	10	0	10	2037	5657	7694	1258	4659	5917
Bosnia & Herzegovina	0	0	0	0	0	0	0	0	0	0	0	0
Croatia (Hrvatska)	0	0	0	0	0	0	0	0	0	0	0	0
Czech Republic	0	8	8	0	0	0	0	105	105	0	41	41
Denmark	526	67	593	0	0	0	5177	824	6001	3827	508	4335
Estonia	0	0	0	0	0	0	0	0	0	0	0	0
Finland	293	0	293	40	0	40	3300	0	3300	2139	0	2139
France	4735	1257	5992	913	21	934	50176	14772	64948	32076	8056	40132
Germany	2231	780	3011	0	0	0	19340	11231	30571	12704	7048	19752
Greece	3	0	3	0	0	0	22	0	22	15	0	15
Hungary	15	58	73	0	0	0	128	646	774	101	442	543
Ireland	420	0	420	0	0	0	4032	0	4032	2562	0	2562
Italy	1967	45	2012	0	0	0	22227	419	22646	15933	293	16226
Latvia	0	0	0	0	0	0	0	0	0	0	0	0
Lithuania	69	11	80	0	0	0	509	54	563	383	37	420
Luxembourg	173	5	178	41	0	41	2540	80	2620	1499	30	1529
Macedonia, Rep. of	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	3519	0	3519	0	0	0	20505	0	20505	20365	0	20365
Norway	6	10	16	0	0	0	40	78	118	32	54	86
Poland	142	0	142	20	0	20	1407	0	1407	1037	0	1037
Portugal	80	0	80	8	0	8	925	0	925	544	0	544
Russian Federation	225	158	383	64	0	64	3217	1158	4375	1606	940	2546
Serbia	0	0	0	0	0	0	0	0	0	0	0	0
Slovakia	0	0	0	0	0	0	0	0	0	0	0	0
Slovenia	7	0	7	0	0	0	21	0	21	12	0	12
Spain	309	57	366	126	0	126	4315	622	4937	2519	350	2869
Sweden	193	4	197	1	0	1	1586	43	1629	1071	26	1097
Switzerland	376	18	394	75	4	79	5290	375	5665	3536	233	3769
Turkey	0	0	0	0	0	0	0	0	0	0	0	0
Ukraine	0	5	5	0	0	0	0	18	18	0	12	12
United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0
North America	17567	32590	50157	2828	551	3379	133132	375121	508253	127613	232407	360020
Canada	7227	2355	9582	541	5	546	7768	2360	10128	51374	16148	67522
Mexico	0	1462	1462	0	0	0	0	1462	1462	0	9011	9011
United States	10340	28773	39113	2287	546	2833	125364	371299	496663	76239	207248	283487
Oceania	468	1851	2319	27	7	34	556	1859	2415	2178	9009	11187
Australia	468	1851	2319	27	7	34	495	1858	2353	2014	8967	10981
New Zealand	0	0	0	0	0	0	61	1	62	164	42	206
South America	1609	7181	8790	159	4	163	7369	23094	30463	8636	41179	49815
Argentina	420	4326	4746	153	4	157	573	4330	4903	2406	24566	26972
Brazil	1162	2820	3982	0	0	0	6763	18729	25492	5931	16424	22355
Colombia	0	0	0	0	0	0	0	0	0	0	0	0
Paraguay	0	0	0	0	0	0	0	0	0	0	0	0
Peru	27	35	62	6	0	6	33	35	68	299	189	488
Grand Total	37942	57866	95808	4339	592	4931	315154	603110	918264	259060	401161	660221

Table 12 Bovine in-vivo derived embryo transferred by region and countries

REGION / COUNTRY	BOVINE IN-VIVO DERIVED EMBRYOS															
	FRESH EMBRYOS				FROZEN DOMESTIC EMBRYOS				FROZEN IMPORTED EMBRYOS				EMBRYOS EXPORTED			
	DAIRY	BEEF	UNSORTED	TOTAL	DAIRY	BEEF	UNSORTED	TOTAL	DAIRY	BEEF	UNSORTED	TOTAL	DAIRY	BEEF	UNSORTED	TOTAL
Africa	208	1473	0	1681	157	1009	0	1166	33	536	0	569	94	365	0	459
Kenya	54	0	0	54	13	0	0	13	33	0	0	33	0	0	0	0
South Africa	154	1473	0	1627	144	1009	0	1153	0	536	0	536	94	365	0	459
Asia	2536	21785	155	24476	6253	45620	16	51889	1099	71	7	1177	0	0	0	0
Israel	0	0	155	155	0	0	16	16	0	0	7	7	0	0	0	0
Japan	2531	21314	0	23845	6231	44564	0	50795	1070	57	0	1127	0	0	0	0
Korea (South)	5	471	0	476	22	1056	0	1078	29	14	0	43	0	0	0	0
Europe	9499	0	37432	46931	14840	0	46308	61148	496	0	3731	4227	4	0	1776	1780
Austria	0	0	456	456	0	0	759	759	0	0	28	28	0	0	0	0
Belgium	0	0	1275	1275	0	0	3869	3869	0	0	1007	1007	0	0	146	146
Czech Republic	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0
Denmark	0	0	2238	2238	0	0	1007	1007	0	0	0	0	0	0	91	91
Finland	762	0	0	762	1544	0	0	1544	496	0	0	496	4	0	0	4
France	0	0	18837	18837	0	0	17200	17200	0	0	1042	1042	0	0	220	220
Germany	8017	0	0	8017	12546	0	0	12546	0	0	0	0	0	0	0	0
Greece	0	0	5	5	0	0	0	0	0	0	25	25	0	0	0	0
Hungary	0	0	289	289	0	0	212	212	0	0	106	106	0	0	10	10
Ireland	720	0	0	720	750	0	0	750	0	0	0	0	0	0	0	0
Italy	0	0	6003	6003	0	0	0	0	0	0	0	0	0	0	0	0
Lithuania	0	0	54	54	0	0	36	36	0	0	0	0	0	0	0	0
Luxembourg	0	0	736	736	0	0	791	791	0	0	0	0	0	0	50	50
Netherlands	0	0	4072	4072	0	0	16406	16406	0	0	0	0	0	0	1115	1115
Norway	0	0	22	22	0	0	45	45	0	0	55	55	0	0	0	0
Poland	0	0	608	608	0	0	588	588	0	0	0	0	0	0	0	0
Portugal	0	0	124	124	0	0	450	450	0	0	35	35	0	0	16	16
Russian Federation	0	0	104	104	0	0	1510	1510	0	0	482	482	0	0	0	0
Slovenia	0	0	10	10	0	0	2	2	0	0	2	2	0	0	0	0
Spain	0	0	869	869	0	0	1130	1130	0	0	138	138	0	0	56	56
Sweden	0	0	768	768	0	0	329	329	0	0	263	263	0	0	0	0
Switzerland	0	0	950	950	0	0	1969	1969	0	0	523	523	0	0	72	72
Ukraine	0	0	12	12	0	0	0	0	0	0	25	25	0	0	0	0
North America	50439	55057	0	105496	46522	118291	0	164813	58	678	0	736	15517	7478	0	22995
Canada	16855	2380	0	19235	20985	6382	0	27367	58	173	0	231	5408	2374	0	7782
Mexico	0	5825	0	5825	0	1992	0	1992	0	505	0	505	0	623	0	623
United States	33584	46852	0	80436	25537	109917	0	135454	0	0	0	0	10109	4481	0	14590
Oceania	1043	4688	0	5731	1005	2881	0	3886	263	698	0	961	116	269	0	385
Australia	1028	4688	0	5716	919	2876	0	3795	258	698	0	956	0	269	0	269
New Zealand	15	0	0	15	86	5	0	91	5	0	0	5	116	0	0	116
South America	3640	15194	0	18834	5245	21053	0	26298	145	371	0	516	0	3262	0	3262
Argentina	831	7758	0	8589	1850	11888	0	13738	133	371	0	504	0	3262	0	3262
Brazil	2793	7411	0	10204	3138	9001	0	12139	0	0	0	0	0	0	0	0
Peru	16	25	0	41	257	164	0	421	12	0	0	12	0	0	0	0
Grand Total	67365	98197	37587	203149	74022	188854	46324	309200	2094	2354	3738	8186	15731	11374	1776	28881

Table 13 Bovine OPU IVP embryo collection by region and country

REGION / COUNTRY	BOVINE OVUM PICK-UP EMBRYOS																							
	DONOR PREPARATION												OOCYTES						TRANSFERRABLE EMBRYOS					
	CONVENTIONAL SEMEN						SEX SORTED SEMEN						NON-STIMULATED			STIMULATED			NON-STIMULATED			STIMULATED		
	NON-STIMULATED			STIMULATED			NON-STIMULATED			STIMULATED			NON-STIMULATED			STIMULATED			NON-STIMULATED			STIMULATED		
	DAIRY	BEEF	TOTAL	DAIRY	BEEF	TOTAL	DAIRY	BEEF	TOTAL	DAIRY	BEEF	TOTAL	DAIRY	BEEF	TOTAL	DAIRY	BEEF	TOTAL	DAIRY	BEEF	TOTAL	DAIRY	BEEF	TOTAL
Africa	0	278	278	0	815	815	0	0	0	0	20	20	0	2326	2326	0	19168	19168	0	415	415	0	3318	3318
South Africa	0	278	278	0	815	815	0	0	0	0	20	20	0	2326	2326	0	19168	19168	0	415	415	0	3318	3318
Asia	450	2727	3177	0	0	0	0	0	0	0	0	0	8166	51058	59224	0	0	0	1162	8276	9438	0	0	0
Japan	-	-	2453	0	0	0	0	0	0	0	0	0	-	-	45368	0	0	0	-	-	6456	0	0	0
Korea (South)	0	724	724	0	0	0	0	0	0	0	0	0	0	13856	13856	0	0	0	0	2982	2982	0	0	0
Europe	8286	207	8493	145	52	197	324	1	325	75	2	77	67487	3013	70500	2297	600	2897	12275	689	12964	565	251	816
Austria	0	0	0	8	0	8	0	0	0	0	0	0	0	0	0	80	0	80	0	0	0	17	0	17
Finland	148	0	148	0	0	0	0	0	0	0	0	0	1084	0	1084	0	0	0	235	0	235	0	0	0
France	44	0	44	137	30	167	0	0	0	43	2	45	238	0	238	1769	434	2203	62	0	62	503	213	716
Germany	1609	22	1631	0	0	0	0	0	0	0	0	0	12253	410	12663	0	0	0	2209	35	2244	0	0	0
Italy	400	185	585	0	0	0	145	0	145	0	0	0	6709	2549	9258	0	0	0	847	634	1481	0	0	0
Netherlands	5818	0	5818	0	0	0	0	0	0	0	0	0	45395	0	45395	0	0	0	8727	0	8727	0	0	0
Russian Fed'n	267	0	267	0	0	0	179	0	179	0	0	0	1808	0	1808	0	0	0	195	0	195	0	0	0
Spain	0	0	0	0	22	22	0	1	1	32	0	32	0	54	54	448	166	614	0	20	20	45	38	83
North America	17348	16372	33720	1540	33	1573	3	0	3	666	18	684	315278	346725	662003	21330	384	21714	96359	106703	203062	8839	145	8984
Canada	19	0	19	1540	33	1573	3	0	3	666	18	684	194	0	194	21330	384	21714	54	0	54	8839	145	8984
Mexico	0	1065	1065	0	0	0	0	0	0	0	0	0	0	11299	11299	0	0	0	0	5050	5050	0	0	0
United States	17329	15307	32636	0	0	0	0	0	0	0	0	0	315084	335426	650510	0	0	0	96305	101653	197958	0	0	0
Oceania	1646	0	1646	0	0	0	0	0	0	0	0	0	17533	0	17533	0	0	0	3892	0	3892	0	0	0
New Zealand	1646	0	1646	0	0	0	0	0	0	0	0	0	17533	0	17533	0	0	0	3892	0	3892	0	0	0
South America	5510	19538	25048	8	0	8	35532	5	35537	103	0	103	726119	478829	1204948	892	0	892	208468	161068	369536	284	0	284
Argentina	37	1581	1618	8	0	8	298	5	303	103	0	103	2421	36901	39322	892	0	892	396	6526	6922	284	0	284
Brazil	0	17280	17280	0	0	0	33700	0	33700	0	0	0	674450	432014	1106464	0	0	0	202334	151205	353539	0	0	0
Dominican Rep	0	281	281	0	0	0	188	0	188	0	0	0	2790	4183	6973	0	0	0	837	1254	2091	0	0	0
Panama	0	396	396	0	0	0	265	0	265	0	0	0	3820	5731	9551	0	0	0	1389	2083	3472	0	0	0
Peru	5473	0	5473	0	0	0	1081	0	1081	0	0	0	42638	0	42638	0	0	0	3512	0	3512	0	0	0
Grand Total	33240	39122	72362	1693	900	2593	35859	6	35865	844	40	884	1134583	881951	2016534	24519	20152	44671	322156	277151	599307	9688	3714	13402

4.2 IN-VITRO FERTILISED BOVINE EMBRYOS

IVP bovine embryo produced and transferred

Tables 13 and 14 details the IVP OPU bovine embryo production and transfers and Table 15 shows the abattoir-derived IVP embryo production and transfers.

IVP bovine embryo production has stabilised somewhat with 612,709 transferrable embryos produced by OPU and 58,402 produced from abattoir derived oocytes to give a total of 671,111 bovine IVP embryos available for transfers, exceeding the 660,221 bovine IVD embryos collected, the first time this has happened.

However, 520,535 bovine IVD embryos were transferred during 2015, significantly more than the 404,173 bovine IVP embryos transferred, resulting in 924,708 bovine embryos transferred during that year. In 2014, a total of 830,207 bovine embryos consisting of 464,582 bovine IVD embryos and 365,625 bovine IVP embryos were transferred.

Table 14 Bovine OPU IVP embryo transfer by region and country

REGION / COUNTRY	BOVINE OPU IVP EMBRYO TRANSFER				
	FRESH	FROZEN		TOTAL	EXPORTED
		DOMESTIC	FOREIGN		
Africa	162	21	0	183	176
South Africa	162	21	0	183	176
Asia	3250	1164	0	4414	0
Japan	800	1164	0	1964	0
Korea (South)	2450	0	0	2450	0
Europe	9799	3065	1638	14502	0
Austria	12	5	0	17	0
Finland	66	43	0	109	0
France	251	297	0	548	0
Germany	1684	358	0	2042	0
Italy	328	1337	0	1665	0
Luxembourg	0	45	0	45	0
Netherlands	7287	899	0	8186	0
Russian Federation	0	5	1630	1635	0
Spain	171	76	8	255	0
North America	65844	32027	0	97871	542
Canada	4309	1844	0	6153	172
Mexico	2956	0	0	2956	355
United States	58579	30183	0	88762	15
Oceania	1825	2491	0	4316	0
Australia	55	126	0	181	0
New Zealand	1770	2365	0	4135	0
South America	224066	58821	0	282887	0
Argentina	5318	842	0	6160	0
Brazil	214886	54467	0	269353	0
Dominican Republic	1140	0	0	1140	0
Panama	2722	0	0	2722	0
Peru	0	3512	0	3512	0
Grand Total	304946	97589	1638	404173	718

Table 15 Bovine abattoir derived IVP embryo production and transfer

REGION / COUNTRY	BOVINE ABATTOIR DERIVED IVP EMBRYOS														
	IN-VITRO PRODUCTION									EMBRYO TRANSFER					
	SEMEN						OOCYTES			EMBRYOS			FRESH	FROZEN	ALL
	CONVENTIONAL SEMEN			SEX SORTED SEMEN			DAIRY	BEEF	TOTAL	DAIRY	BEEF	TOTAL	DAIRY	BEEF	TOTAL
Africa	0	156	156	0	0	0	0	2033	2033	0	235	235	0	0	0
South Africa	0	156	156	0	0	0	0	2033	2033	0	235	235	0	0	0
Asia	-	-	35335	0	0	0	-	-	714783	-	-	56740	-	-	18516
Japan	-	-	34677	0	0	0	-	-	703149	-	-	54235	-	-	16487
Korea (South)	0	658	658	0	0	0	0	11634	11634	0	2505	2505	1525	504	2029
Europe	65	0	65	0	0	0	2472	0	2472	434	0	434	0	0	0
Germany	24	0	24	0	0	0	889	0	889	165	0	165	0	0	0
Italy	10	0	10	0	0	0	428	0	428	108	0	108	0	0	0
Lithuania	3	0	3	0	0	0	9	0	9	0	0	0	0	0	0
Netherlands	28	0	28	0	0	0	1146	0	1146	161	0	161	0	0	0
North America	0	5	5	0	0	0	9072	45	9117	987	50	1037	273	418	691
Canada	0	0	0	0	0	0	9072	0	9072	362	0	362	0	22	22
Mexico	0	5	5	0	0	0	0	45	45	0	15	15	9	0	9
United States	0	0	0	0	0	0	0	0	0	625	35	660	264	396	660
Oceania	7	0	7	0	0	0	142	0	142	16	0	16	8	8	16
New Zealand	7	0	7	0	0	0	142	0	142	16	0	16	8	8	16
Grand Total	-	-	35568	0	0	0	-	-	728547	-	-	58462	-	-	19223

Table 16 shows that % of IVP embryos transferred fresh is decreasing, indicative of the improved freezing technology being adopted commercially.

Table 16 Fresh bovine IVP embryos transferred as % of all IVP embryos transferred

REGION	% IVP EMBRYO TRANSFERRED FRESH		
	2013	2014	2015
Africa	66.5%	87.6%	88.5%
Asia	57.2%	-	50.1%
Europe	76.6%	78.8%	65.1%
North America	81.0%	76.7%	67.1%
Oceania	44.4%	39.2%	42.3%
South America	95.1%	84.0%	79.2%
GRAND TOTAL	89.8%	81.3%	74.0%

Table 17 shows details of sexing and/or genotyping embryos. This is the first time data was collected and presented as part of the annual report.

Table 17 Micro-manipulation of bovine embryos for sexing and/or genotyping

COUNTRIES	BOVINE EMBRYO TECHNOLOGIES			
	SEXED		GENOTYPED	
	IN-VIVO	IN-VITRO	IN-VIVO	IN-VITRO
Canada	1218	337	0	337
France	984	0	634	0
Germany	865	154	371	38
Hungary	24	0	0	0
Japan	1968	6999	0	0
Korea (South)	0	50	0	0
Netherlands	0	0	90	0
United States	271	0	0	0
Grand Total	5330	7540	1095	375

4.3 OTHER LIVESTOCK SPECIES

Tables 18 and 19 details the ET activity for both IVD and IVP embryos in species other than cattle.

Table 18 Other livestock species – in-vivo derived embryo collections and transfers

COUNTRY	IN-VIVO DERIVED EMBRYOS					
	EMBRYO COLLECTION		EMBRYO TRANSFERS			
	COLLECTIONS / FLUSHES	TRANSFERRABLE EMBRYOS	FRESH EMBRYOS	FROZEN DOMESTIC	FROZEN FOREIGN	EXPORTS
SHEEP						
Australia	2046	15256	12357	1208	700	1803
Canada	14	69	0	0	0	0
China	1658	10142	6421	0	0	0
Colombia	4	9	9	0	0	0
Greece	3	18	18	0	0	0
Hungary	3	12	9	0	0	0
New Zealand	257	1362	0	1695	0	1210
Norway	0	0	0	0	250	0
Paraguay	0	0	0	0	207	0
Peru	0	0	0	0	605	0
Spain	7	41	39	9	0	0
Sweden	0	0	0	0	125	0
Turkey	6	90	0	90	0	0
United Kingdom	504	4691	4258	147	0	0
United States	94	444	364	60	0	199
Grand Total	4596	32134	23475	3209	1887	3212
GOATS						
Australia	1916	10338	9992	346	0	0
Colombia	14	41	33	0	0	0
New Zealand	16	33	0	0	15	23
Turkey	9	72	72	0	0	0
United States	124	750	648	57	0	0
Grand Total	2079	11234	10745	403	15	23
CERVIDS						
Canada	14	80	80	0	0	0
New Zealand	120	897	684	98	0	213
United States	450	1696	1446	0	0	0
Grand Total	584	2673	2210	98	0	213
HORSES						
Argentina	1505	1321	1765	30	0	0
Brazil	26238	18362	18362	0	0	0
Canada	34	18	18	1	0	0
France	845	510	510	0	0	0
Hungary	7	4	4	0	0	0
Mexico	6	6	6	0	0	0
Poland	25	21	21	0	0	0
South Africa	17	10	0	0	0	0
Sweden	28	16	16	0	0	0
Switzerland	81	43	16	0	0	0
United States	865	613	603	7	0	0
Grand Total	29651	20924	21321	38	0	0
SWINE						
Canada	0	0	395	0	0	0
United States	39	395	46	0	0	395
Grand Total	39	395	441	0	0	395
ALPACAS						
Peru	186	158	0	0	0	0
Grand Total	186	158	0	0	0	0

Table 19 Other livestock species – in-vitro produced embryo collections and transfers

COUNTRY	IN-VITRO PRODUCED EMBRYOS					
	EMBRYO COLLECTION		EMBRYO TRANSFERS			
	COLLECTIONS	TRANSFERRABLE EMBRYOS	FRESH EMBRYOS	FROZEN DOMESTIC	FROZEN FOREIGN	EXPORTS
SHEEP						
Australia	327	1069	1069	0	0	0
HORSES						
Brazil	0	32	32	0	0	0
Italy	6273	551	29	121	0	0

5. DISCUSSION AND CONCLUSION

In conclusion, the year 2015 resulted in a more successful outcome of embryo transfer activity than previously, providing a valuable resource for detailed analysis of ET activity in farm animals world-wide. With regards to data collection, it is essential that the IETS Data Collection committee continue to:

- encourage countries to report their ET data by appointing national data collectors acceptable to colleagues
- encourage ET practitioners, including small teams, to provide their ET data accurately and in the current IETS format now that a secure web-based database is available.

The improved database format and reporting together with good security should encourage more ET practitioners to submit their data.

The growing interest in international trade in bovine IVP embryos should result in clearer guidelines for managing the disease risks, encouraging more research in this area. Industry demands are forcing several countries to address this issue and the IETS is providing leadership in this area, updating its Manual and, through its Health and Safety Advisory Committee, and advising the World Animal Health Organisation (OIE) on updates to the Terrestrial Animal Health Code.

6. ACKNOWLEDGMENTS

While the written part of the report is brief, the formatting of some tables were further improved to better reflect the data being collected. The format of other more complex tables remained the same to allow direct comparison of some data with the previous year's tables.

Those wishing to use tables for their reports can contact the author for a copy of the Excel spreadsheet used in the tabulation and analyses of ET data.

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.