

2016 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 26th annual report on the data collected globally during 2017 for embryo transfer (ET) activity in 2016.

There was a drop in the number of countries reporting from 50 to 44, which is disappointing. Countries not reporting this year but reported the previous year include Kenya, China, South Korea, Czech Republic, Lithuania, Colombia and Paraguay. However, ET data was received for Zimbabwe. Far fewer Australian ET practitioners provided data, accounting for the significant drop in ET activity reported; in 2016, eleven reported their ET activity while in 2017 only four provided data.

Some countries advised they are unable to collect data according to whether semen was sexed or not.

Table 1 Number and proportion of countries submitting data

Region	No countries in Region	No. Countries submitting data	% countries in region	% countries in region	
				2015	2016
Africa	57	2	3.51%	2	3.51%
Asia	53	4	7.55%	2	3.77%
Europe	45	32	71.11%	30	66.67%
North America	3	3	100.00%	3	100.00%
Oceania	23	2	8.70%	2	8.70%
South America	44	7	15.91%	5	11.36%
GLOBALLY	225	50	22.22%	44	19.56%

1.1 DATA COLLECTION

It was necessary to send several reminders during the year, encouraging various data collectors to submit embryo collection, production and transfer data. Seven countries submitted data at the last minute, giving me only days to prepare the report. Because of the short time, I decided to focus on thorough preparation of the 20 tables and 3 charts in this report and let the figures speak for themselves.

There seemed to be no confusion about using the database this year, with all the problems addressed at the annual meeting in Austin in January 2017.

1.2 BOVINE ANIMALS

Not all ET practitioners submitted data according to whether sexed semen was used. There were apparently several reasons for this, the main ones being the amount of work required to record such data, and that this was not required by their national ET association.

Tables 2 to 5 reports on regional ET activities for in-vivo derived (IVD) embryos. Globally, over the past year, flushings for collection of embryos dropped 6.87%, the number of transferrable embryos collected dropped 6.74%, and the number of IVD embryos transferred dropped 4.18%. North America accounted for over 50% of IVD embryo activities world-wide.

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	38	559	597	0	0	0	597
Asia	2426	12391	14817	2	0	2	14819
Europe	14677	4675	19352	1338	93	1431	20783
North America	17434	31288	48722	1161	25	1186	49908
Oceania	41	1358	1399	3	0	3	1402
South America	2027	4242	6269	37	0	37	6306
Grand Total	36643	54513	91156	2541	118	2659	93815

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	315	3824	4139	240	3863	4103
Asia	22933	169063	191996	13226	99372	112598
Europe	151257	43530	194787	99693	29184	128877
North America	120981	368519	489500	111575	220677	332252
Oceania	329	7375	7704	160	7332	7492
South America	17560	29771	47331	17552	29764	47316
Grand Total	313375	622082	935457	242446	390192	632638

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 2015
	2015				2016				
Africa	711	5,534	7.78	0.84%	597	4,103	6.87	0.65%	-25.86%
Asia	14,689	105,685	7.19	16.01%	14,819	112,598	7.60	17.80%	6.54%
Europe	20,497	127,980	6.24	19.38%	20,783	128,877	6.20	20.37%	0.70%
North America	53,536	360,020	6.72	54.53%	49,908	332,252	6.66	52.52%	-7.71%
Oceania	2,353	11,187	4.75	1.69%	1,402	7,492	5.34	1.18%	-33.03%
South America	8,953	49,815	5.56	7.55%	6,306	47,316	7.50	7.48%	-5.02%
Grand Total	100,739	660,221	6.55	100.00%	93,815	632,638	6.74	100.00%	-4.18%

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
	2015				2016			
Africa	1681	1735	3416	0.66%	1394	1861	3255	0.63%
Asia	24476	53066	77542	14.90%	22803	53123	75926	14.70%
Europe	46931	65375	112306	21.58%	47796	68607	116403	22.53%
North America	105496	165549	271045	52.07%	101484	167159	268643	52.00%
Oceania	5731	4847	10578	2.03%	1997	3373	5370	1.04%
South America	18834	26814	45648	8.77%	20089	26899	46988	9.10%
GRAND TOTAL	203149	317386	520535	100%	195563	321022	516585	100.00%

Table 6 and 7 summarises the in-vitro produced embryo activities in cattle over the year. Globally, OPU IVP embryo production grew by 8.73% and transfers by 11.43%. Because of lack of ET data for abattoir derived IVP embryos from Asia, where most of this type of ET activity is conducted, it is not possible to analyse the data.

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 EMBRYOS	FROZEN EMBRYOS	DONORS	OOCYTES	EMBRYOS	FRESH EMBRYOS	FROZEN EMBRYOS
	2015					2016				
Africa	1113	21494	3733	162	21	619	19062	2167	379	246
Asia	3177	59224	9438	3250	1164	0	0	0	0	0
Europe	9092	73397	13780	8115	4345	10651	94407	18879	10424	3635
North America	35980	683717	212046	65844	32027	45918	805072	260574	80825	50672
Oceania	1646	17533	3892	1825	2491	2241	21587	6304	4732	1702
South America	60696	1205840	369820	224066	58821	49739	1138302	378291	230263	65235
Grand Total	111704	2061205	612709	303262	98869	109168	2078430	666215	326623	121490

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

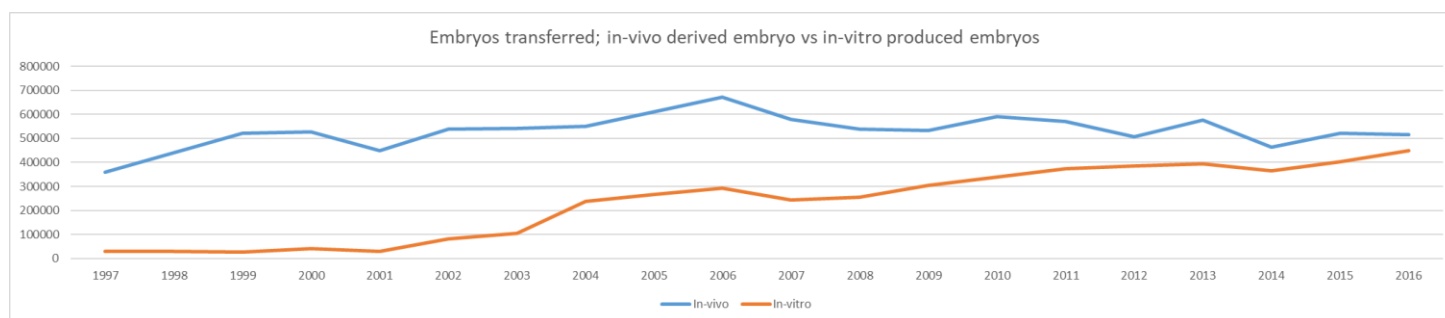
REGIONS	ABATTOIR DERIVED OOCYTES FOR BOVINE IN-VITRO PRODUCED EMBRYOS									
	COLLECTION			TRANSFERS		COLLECTION			TRANSFERS	
	DONORS	OOCYTES	EMBRYOS	FRESH EMBRYOS	FROZEN EMBRYOS	DONORS	OOCYTES	EMBRYOS	FRESH EMBRYOS	FROZEN EMBRYOS
	2015					2016				
Africa	156	2033	235	0	0	0	0	0	0	0
Asia	35335	714783	56740	10685	7831	0	0	0	0	0
Europe	65	2472	434	0	0	256	18317	1095	40	133
North America	5	9117	1037	273	418	0	0	0	0	12
Oceania	7	142	16	8	8	4	60	16	8	4
South America	0	0	0	0	0	1345	5017	1511	0	0
Grand Total	35568	728547	58462	10966	8257	1605	23394	2622	48	149

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

1.3 OTHER ANIMAL SPECIES

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

Figure 1



1.4 GENERAL COMMENTS

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. Figure 1 shows the increasing popularity of bovine IVP embryos relative to IVD embryos for the past 20 years.

Table 8 Regions and countries exporting embryos

REGION/COUNTRY	CATTLE				OTHER IN-VIVO DERIVED EMBRYOS		
	IN-VIVO DAIRY	IN-VIVO BEEF	IN-VIVO UNSORTED	OPU IVP EMBRYOS	SHEEP	GOATS	SWINE
Africa							
South Africa	202	901	0	0	0	0	0
Africa Total	202	901	0	0	0	0	0
Asia							
Asia Total	0	0	0	0	0	0	0
Europe							
Austria	35	21	0	0	0	0	0
Belgium	20	58	0	0	0	0	0
Denmark	97	0	0	0	0	0	0
Finland	67	0	0	0	0	0	0
France	1883	419	0	0	0	0	0
Spain	37	20	0	0	0	0	0
Switzerland	48	0	0	0	0	0	0
United Kingdom	0	222	0	0	1200	200	0
Europe Total	2187	740	0	0	1200	200	0
North America							
Canada	5135	3804	0	494	0	0	0
United States	7118	3640	0	4671	0	0	378
North America Total	12253	7444	0	5165	0	0	378
Oceania							
Australia	0	57	0	0	220	0	0
New Zealand	68	6	0	0	2729	656	0
Oceania Total	68	63	0	0	2949	656	0
South America							
Argentina	0	1358	0	0	0	0	0
Panama	0	26	26	0	0	0	0
South America Total	0	1358	0	0	0	0	0
Grand Total	14710	10532	26	5165	4149	856	378

2 INTRODUCTION

This is the 26th annual report of the IETS Data Retrieval Committee, the highlight of which is the presentation of the 2016 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 volunteered 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 Austin, Texas, USA on Monday 16th January 2017 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.

Table 9 lists the national data collectors who assisted in the collection of the ET data.

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

4 RESULTS

4.1 BOVINE IN-VIVO DERIVED EMBRYOS

Tables 11 and 12 details the bovine IVD embryo collection and transfers country by 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
	2015				2016			
Africa	1681	1735	3416	50.79%	1394	1861	3255	57.17%
Asia	24476	53066	77542	68.44%	22803	53123	75926	69.97%
Europe	46931	65375	112306	58.21%	47796	68607	116403	58.94%
North America	105496	165549	271045	61.08%	101484	167159	268643	62.22%
Oceania	5731	4847	10578	45.82%	1997	3373	5370	62.81%
South America	18834	26814	45648	58.74%	20089	26899	46988	57.25%
GRAND TOTAL	203149	317386	520535	60.97%	195563	321022	516585	62.14%

Table 11 Bovine in-vivo derived embryo collection by region and countries

REGION / COUNTRY	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	38	559	597	0	0	0	315	3824	4139	240	3863	4103
South Africa	38	553	591	0	0	0	315	3784	4099	240	3850	4090
Zimbabwe	0	6	6	0	0	0	0	40	40	0	13	13
Asia	2426	12391	14817	2	0	2	22933	169063	191996	13226	99372	112598
Israel	38	2	40	2	0	2	265	10	275	182	10	192
Japan	2388	12389	14777	0	0	0	22668	169053	191721	13044	99362	112406
Europe	14677	4675	19352	1338	93	1431	151257	43530	194787	99693	29184	128877
Austria	168	64	232	26	1	27	1836	890	2726	1397	641	2038
Belgium	155	971	1126	8	1	9	1150	6073	7223	694	5059	5753
Denmark	635	44	679	0	0	0	6092	630	6722	4194	399	4593
Finland	314	0	314	15	0	15	3325	0	3325	2090	0	2090
France	4473	1254	5727	463	70	533	42755	14284	57039	27254	7642	34896
Germany	2919	282	3201	0	0	0	29544	2849	32393	19472	1839	21311
Hungary	19	90	109	0	2	2	175	1195	1370	128	789	917
Ireland	171	686	857	0	0	0	1868	7472	9340	1203	4810	6013
Italy	1900	75	1975	0	0	0	22000	695	22695	15000	487	15487
Luxembourg	160	20	180	0	0	0	0	0	0	1104	138	1242
Netherlands	1836	0	1836	0	0	0	16340	0	16340	11370	0	11370
Norway	35	25	60	0	0	0	0	0	0	203	158	361
Poland	151	0	151	41	0	41	1712	0	1712	1215	0	1215
Portugal	77	15	92	39	0	39	1413	186	1599	649	71	720
Russian Federation	142	708	850	448	0	448	6677	4803	11480	3495	4527	8022
Serbia	9	0	9	2	0	2	56	0	56	35	0	35
Slovenia	7	0	7	2	0	2	27	0	27	14	0	14
Spain	244	199	443	150	17	167	3729	2186	5915	2284	1340	3624
Sweden	192	7	199	5	0	5	1441	51	1492	967	27	994
Switzerland	323	24	347	137	1	138	4813	303	5116	3240	150	3390
Ukraine	2	0	2	0	0	0	7	0	7	6	0	6
United Kingdom	745	211	956	2	1	3	6297	1913	8210	3679	1107	4786
North America	17434	31288	48722	1161	25	1186	120981	368519	489500	111575	220677	332252
Canada	5838	2468	8306	1161	10	1171	6999	2478	9477	45947	18360	64307
Mexico	0	2096	2096	0	15	15	0	17943	17943	0	13289	13289
United States	11596	26724	38320	0	0	0	113982	348098	462080	65628	189028	254656
Oceania	41	1358	1399	3	0	3	329	7375	7704	160	7332	7492
Australia	0	1349	1349	3	0	3	46	7359	7405	24	7326	7350
New Zealand	41	9	50	0	0	0	283	16	299	136	6	142
South America	2024	4227	6251	35	0	35	17532	29737	47269	17532	29737	47269
Argentina	164	2536	2700	35	0	35	934	14652	15586	934	14652	15586
Brazil	1860	1691	3551	0	0	0	16598	15085	31683	16598	15085	31683
Panama	3	15	18	2	0	2	28	34	62	20	27	47
Grand Total	36643	54513	91156	2541	118	2659	313375	622082	935457	242446	390192	632638

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																
South Africa	115	1267	0	1382	35	638	0	673	453	735	0	1188	202	901	0	1103
Zimbabwe	0	12	0	12	0	0	0	0	0	0	0	0	0	0	0	0
Africa Total	115	1279	0	1394	35	638	0	673	453	735	0	1188	202	901	0	1103
Asia																
Israel	161	0	0	161	16	0	0	16	0	10	0	10	0	0	0	0
Japan	2318	20324	0	22642	7288	44526	0	51814	1283	0	0	1283	0	0	0	0
Asia Total	2479	20324	0	22803	7304	44526	0	51830	1283	10	0	1293	0	0	0	0
Europe																
Austria	396	242	0	638	773	269	0	1042	40	12	0	52	35	21	0	56
Belgium	189	1006	0	1195	440	3030	0	3470	1426	34	0	1460	20	58	0	78
Denmark	2498	54	0	2552	966	124	0	1090	0	0	0	0	97	0	0	97
Estonia	0	0	0	0	0	0	0	0	0	6	6	12	0	0	0	0
Finland	892	0	0	892	1415	0	0	1415	252	0	0	252	67	0	0	67
France	15590	1729	48	17367	14321	6588	36	20945	1134	190	0	1324	1883	419	0	2302
Germany	7781	0	350	8131	11215	0	972	12187	0	0	0	0	0	0	0	0
Hungary	28	124	0	152	79	232	0	311	0	0	38	38	0	0	0	0
Ireland	573	2294	0	2867	629	2517	0	3146	0	0	0	0	0	0	0	0
Italy	6000	300	0	6300	0	0	0	0	0	0	0	0	0	0	0	0
Luxembourg	0	0	600	600	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	2522	0	0	2522	9519	0	0	9519	0	0	0	0	0	0	0	0
Norway	0	0	0	0	0	0	0	0	70	0	0	70	0	0	0	0
Poland	611	0	0	611	524	0	0	524	0	3	0	3	0	0	0	0
Portugal	120	10	0	130	434	9	0	443	4	63	0	67	0	0	0	0
Russian Federation	717	22	0	739	1290	4466	0	5756	82	143	0	225	0	0	0	0
Serbia	12	0	0	12	23	0	0	23	0	0	0	0	0	0	0	0
Slovenia	10	0	0	10	6	0	0	6	4	6	0	10	0	0	0	0
Spain	988	736	0	1724	752	408	0	1160	50	58	0	108	37	20	0	57
Sweden	0	0	78	78	0	0	744	744	0	0	181	181	0	0	0	0
Switzerland	859	21	0	880	1657	29	0	1686	374	16	0	390	48	0	0	48
Ukraine	0	0	0	0	0	0	0	0	35	0	0	35	0	0	0	0
United Kingdom	70	326	0	396	173	585	0	758	1	154	0	155	0	222	0	222
Europe Total	39856	6864	1076	47796	44216	18257	1752	64225	3472	685	225	4382	2187	740	0	2927
North America																
Canada	14762	2642	0	17404	18807	7821	0	26628	18	373	0	391	5135	3804	0	8939
Mexico	0	8031	0	8031	0	4022	0	4022	0	1486	0	1486	0	0	0	0
United States	29759	46290	0	76049	26457	108175	0	134632	0	0	0	0	7118	3640	0	10758
North America Total	44521	56963	0	101484	45264	120018	0	165282	18	1859	0	1877	12253	7444	0	19697
Oceania																
Australia	0	1982	0	1982	0	2583	0	2583	0	643	0	643	0	57	0	57
New Zealand	15	0	0	15	114	21	0	135	0	12	0	12	68	6	0	74
Oceania Total	15	1982	0	1997	114	2604	0	2718	0	655	0	655	68	63	0	131
South America																
Argentina	295	6637	0	6932	524	7595	0	8119	65	0	0	65	0	1358	0	1358
Brazil	6712	6365	0	13077	9886	8720	0	18606	0	0	0	0	0	0	0	0
Dominican Republic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Panama	20	20	40	80	7	15	29	51	12	17	29	58	0	26	26	52
Peru	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South America Total	7027	13022	40	20089	10417	16330	29	26776	77	17	29	123	0	1384	26	1410
Grand Total	94013	100434	1116	195563	107350	202373	1781	311504	5303	3961	254	9518	14710	10532	26	25268

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		TOTAL		NON-STIMULATED		STIMULATED		TOTAL		NON-STIMULATED	STIMULATED		TOTAL		NON-STIMULATED	STIMULATED		TOTAL		NON-STIMULATED	STIMULATED		TOTAL
DAIRY	BEEF	TOTAL	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																										
South Africa	0	299	299	0	278	278	0	36	36	0	6	6	0	2931	2931	0	16131	16131	0	658	658	0	1509	1509		
Africa Total	0	299	299	0	278	278	0	36	36	0	6	6	0	2931	2931	0	16131	16131	0	658	658	0	1509	1509		
Asia																										
Asia Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Europe																										
Austria	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	7	0	7	0	0	0	1	0	1		
Finland	103	0	103	111	0	111	0	0	0	0	0	0	687	0	687	790	0	790	142	0	142	320	0	320		
France	0	0	0	524	29	553	0	0	0	58	0	58	0	0	0	4813	518	5331	0	0	0	1370	258	1628		
Germany	1311	41	1352	0	0	0	0	0	0	0	0	0	11496	1009	12505	0	0	0	1843	76	1919	0	0	0		
Italy	294	219	513	0	0	0	68	0	68	0	0	0	4202	2995	7197	0	0	0	495	1015	1510	0	0	0		
Netherlands	0	0	0	4726	0	4726	0	0	0	0	0	0	0	0	0	45662	0	45662	0	0	0	8385	0	8385		
Poland	9	0	9	4	0	4	0	0	0	0	0	0	47	0	47	17	0	17	24	0	24	10	0	10		
Russian Federation	0	0	0	0	0	0	1519	0	1519	0	0	0	6076	0	6076	0	0	0	911	0	911	0	0	0		
Serbia	6	0	6	8	0	8	0	0	0	0	0	0	24	0	24	56	0	56	11	0	11	24	0	24		
Spain	137	102	239	25	31	56	329	5	334	86	19	105	6569	1052	7621	1816	455	2271	1472	381	1853	543	183	726		
United Kingdom	53	277	330	238	217	455	15	1	16	85	0	85	697	2298	2995	1826	1295	3121	127	583	710	457	248	705		
Europe Total	1913	639	2552	5637	277	5914	1931	6	1937	229	19	248	29798	7354	37152	54987	2268	57255	5025	2055	7080	11110	689	11799		
North America																										
Canada	0	0	0	2629	171	2800	0	0	0	994	41	1035	0	0	0	35352	2309	37661	0	0	0	14887	1158	16045		
Mexico	0	1170	1170	0	0	0	0	5	5	0	0	0	0	12450	12450	0	0	0	0	5700	5700	0	0	0		
United States	22823	18085	40908	0	0	0	0	0	0	0	0	0	392273	362688	754961	0	0	0	121317	117512	238829	0	0	0		
North America Total	22823	19255	42078	2629	171	2800	0	5	5	994	41	1035	392273	375138	767411	35352	2309	37661	121317	123212	244529	14887	1158	16045		
Oceania																										
Australia	0	566	566	0	0	0	0	272	272	0	0	0	0	10055	10055	0	0	0	0	3584	3584	0	0	0		
New Zealand	906	140	1046	0	0	0	23	291	314	0	43	43	7262	3786	11048	0	484	484	1940	684	2624	0	96	96		
Oceania Total	906	706	1612	0	0	0	23	563	586	0	43	43	7262	13841	21103	0	484	484	1940	4268	6208	0	96	96		
South America																										
Argentina	8	3042	3050	0	0	0	12	27	39	0	0	0	925	67071	67996	0	0	0	341	19893	20234	0	0	0		
Brazil	20958	17947	38905	0	0	0	0	0	0	0	0	0	533800	457106	990906	0	0	0	186830	159987	346817	0	0	0		
Dominican Republic	0	268	268	0	0	0	468	0	468	0	0	0	8966	7335	16301	0	0	0	2359	2215	4574	0	0	0		
Panama	0	371	371	0	0	0	470	0	470	0	0	0	7049	6612	13661	0	0	0	1581	1986	3567	0	0	0		
Peru	4711	319	5030	0	0	0	1121	17	1138	0	0	0	46703	2735	49438	0	0	0	2852	247	3099	0	0	0		
South America Total	25677	21947	47624	0	0	0	2071	44	2115	0	0	0	597443	540859	1138302	0	0	0	193963	184328	378291	0	0	0		
Grand Total	51319	41110	92429	8266	726	8992	4025	377	4402	1223	109	1332	1026776	917618	1944394	90339	21192	111531	322245	305237	627482	25997	3452	29449		

4.2 BOVINE IN-VITRO PRODUCED EMBRYOS

Tables 13 and 14 details the IVP OPU bovine embryo production and transfers.

Table 15 details the abattoir-derived IVP embryo production and transfers country by country, wherever ET data was collected and recorded.

Table 16 summarises the growing popularity of frozen bovine IVP embryos as technological advances overcomes problems with safe freezing of IVP embryos, with the proportion of embryos transferred fresh slowly dropping.

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	379	77	169	625	0
South Africa	379	77	169	625	0
Asia	0	0	0	0	0
Europe	10424	3343	292	14059	0
Finland	61	226	0	287	0
France	526	543	2	1071	0
Germany	1556	265	0	1821	0
Italy	479	372	0	851	0
Luxembourg	0	0	50	50	0
Netherlands	6448	1242	0	7690	0
Poland	17	10	0	27	0
Russian Federation	81	47	0	128	0
Serbia	5	30	0	35	0
Spain	1196	413	149	1758	0
Switzerland	0	0	91	91	0
United Kingdom	55	195	0	250	0
North America	80825	50672	0	131497	5165
Canada	6375	1824	0	8199	494
Mexico	5250	315	0	5565	0
United States	69200	48533	0	117733	4671
Oceania	1334	1516	0	2850	0
Australia	3398	263	0	3661	0
New Zealand	1334	1439	0	2773	0
South America	230263	65235	0	295498	0
Argentina	9531	3120	0	12651	0
Brazil	215195	60723	0	275918	0
Dominican Republic	1241	0	0	1241	0
Panama	2222	367	0	2589	0
Peru	2074	1025	0	3099	0
Grand Total	326623	121029	461	448113	5165

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	DAIRY	BEEF
Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Europe	111	144	255	1	0	1	9972	8345	18317	543	552	1095	40	133	173		
France	1	0	1	0	0	0	17	0	17	10	0	10	8	2	10		
Italy	4	4	8	0	0	0	117	185	302	13	57	70	0	20	20		
Netherlands	61	0	61	0	0	0	8998	0	8998	141	0	141	23	111	134		
Portugal	0	0	0	1	0	1	20	720	740	9	34	43	9	0	9		
Spain	45	20	65	0	0	0	820	240	1060	370	101	471	0	0	0		
United Kingdom	0	120	120	0	0	0	0	7200	7200	0	360	360	0	0	0		
North America	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12		
Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12		
Oceania	4	0	4	0	0	0	60	0	60	16	0	16	8	4	12		
New Zealand	4	0	4	0	0	0	60	0	60	16	0	16	8	4	12		
South America	298	965	1263	82	0	82	1376	3641	5017	394	1117	1511	0	0	0		
Argentina	298	965	1263	82	0	82	1376	3641	5017	394	1117	1511	0	0	0		
Grand Total	413	1109	1522	83	0	83	11408	11986	23394	953	1669	2622	48	149	197		

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

REGION	% IVP EMBRYO TRANSFERRED FRESH			
	2013	2014	2016	2015
Africa	66.5%	87.6%	88.5%	60.6%
Asia	57.2%	-	50.1%	-
Europe	76.6%	78.8%	65.1%	73.5%
North America	81.0%	76.7%	67.1%	61.5%
Oceania	44.4%	39.2%	42.3%	73.5%
South America	95.1%	84.0%	79.2%	77.9%
GRAND TOTAL	89.8%	81.3%	74.0%	72.9%

Table 17 shows details of sexing and/or genotyping embryos. This is the second 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	1772	964	0	964
France	2688	0	1595	0
Germany	966	0	416	0
Netherlands	0	0	381	0
New Zealand	0	42	0	100
United States	0	0	56	0
Grand Total	5426	1006	2448	1064

4.3 OTHER LIVESTOCK SPECIES

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

5. DISCUSSION AND CONCLUSION

In conclusion, the year 2016 resulted in a slightly less successful outcome of embryo transfer activity than previously, with seven countries that reported last year not reporting this year but one new country, Zimbabwe reported. Overall, the ET data collected provides 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 is resulting in clearer guidelines for managing the disease risks, encouraging more research in this area. Australia has recently completed an import risk analysis which enable the development of import conditions for frozen bovine IVP embryos from specified countries. The IETS continues to provide 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.

Tables 19 and 20 (next pages) shows the growing popularity of ET activity over the past 20 years, with over one million bovine embryos being collected each year for the previous 14 years and over 900,000 transferred each year for the past 4 years. Had all countries contributed ET activity data, there is no doubt that over one million bovine embryos are being transferred yearly.

The format of the 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.

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.

The Chairman advises he is standing down this year. The new chairman is Dr Joao Henrique Moreira Viana (henrique.viana@embrapa.br) of the Brazilian Agricultural Research Corporation (EMBRAPA). I thank him for his willingness in taking over this task and I also thank the IETS for the opportunity it has given me to improve the collection, analysis, and reporting of the ET data.

Table 18a Sheep and goats – in-vivo derived embryo collections, in-vitro produced embryos and transfers

COUNTRY	IN-VIVO DERIVED EMBRYOS						IN-VITRO PRODUCED EMBRYOS								
	EMBRYO COLLECTION		EMBRYO TRANSFERS				DONORS		OOCYTES	EMBRYOS	EMBRYO TRANSFERS				
	COLLECTIONS / FLUSHES	TRANSFERRABLE EMBRYOS	FRESH EMBRYOS	FROZEN DOMESTIC	FROZEN FOREIGN	EXPORTS	CONVENTIONAL SEMEN	SEXED SEMEN			FRESH EMBRYOS	FROZEN DOMESTIC	FROZEN FOREIGN	EXPORTS	
SHEEP															
Australia	1107	5377	4025	362	0	220	0	0	0	0	0	0	0	0	0
Canada	105	1011	0	0	0	0	0	0	0	0	0	0	0	0	0
France	20	64	0	0	0	0	0	0	0	0	0	0	0	0	0
Hungary	6	24	20	0	96	0	0	0	0	0	0	0	0	0	0
Mexico	12	64	50	14	0	0	0	0	0	0	0	0	0	0	0
New Zealand	580	3390	250	0	0	2729	0	0	0	0	0	0	0	0	0
Norway	0	0	0	0	250	0	0	0	0	0	0	0	0	0	0
Peru	4	17	17	0	0	0	0	0	0	0	0	0	0	0	0
South Africa	33	1455	100	656	0	0	0	0	0	0	0	0	0	0	0
Sweden	0	0	0	0	465	0	0	0	0	0	0	0	0	0	0
Turkey	29	151	117	34	0	0	0	0	0	0	0	0	0	0	0
United Kingdom	2902	15499	0	300	0	1200	3319	453	11	0	0	0	0	0	0
United States	153	342	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	4951	27394	4579	1366	811	4149	3319	453	11	0	0	0	0	0	0
GOATS															
Australia	6	66	0	0	0	0	0	0	0	0	0	0	0	0	0
Canada	9	110	72	0	0	0	0	0	0	0	0	0	0	0	0
France	17	73	0	0	0	0	0	0	0	0	0	0	0	0	0
New Zealand	129	873	23	0	0	656	0	0	0	0	0	0	0	0	0
South Africa	1	107	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	20	42	0	42	0	0	0	0	0	0	0	0	0	0	0
Turkey	5	43	43	0	0	0	0	0	0	0	0	0	0	0	0
United Kingdom	25	200	0	0	0	200	0	0	0	0	0	0	0	0	0
United States	253	1586	1151	0	0	0	60	0	947	207	98	0	0	0	0
Grand Total	465	3100	1289	42	0	856	60	0	947	207	98	0	0	0	0

Table 18b Other livestock species – in-vivo derived embryo collections, in-vitro produced embryos and transfers

COUNTRY	IN-VIVO DERIVED EMBRYOS						IN-VIVO DERIVED EMBRYOS								
	EMBRYO COLLECTION		EMBRYO TRANSFERS				DONORS		OOCYTES	EMBRYOS	EMBRYO TRANSFERS				
	COLLECTIONS / FLUSHES	TRANSFERRABLE EMBRYOS	FRESH EMBRYOS	FROZEN DOMESTIC	FROZEN FOREIGN	EXPORTS	CONVENTIONAL SEMEN	SEXED SEMEN			FRESH EMBRYOS	FROZEN DOMESTIC	FROZEN FOREIGN	EXPORTS	
CERVIDS															
United States	47	160	31	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	47	160	31	0	0	0	0	0	0	0	0	0	0	0	0
HORSES															
Argentina	39	0	31	0	0	0	0	0	0	0	0	0	0	0	0
Canada	20	10	9	0	9	0	0	0	0	0	0	0	0	0	0
France	983	529	0	0	0	0	0	0	0	0	0	0	0	0	0
Italy	0	0	0	0	0	0	965	0	11056	800	61	229	0	0	0
Poland	17	17	11	0	0	0	0	0	0	0	0	0	0	0	0
Spain	594	300	203	10	0	0	0	0	0	0	0	0	0	0	0
Sweden	22	14	14	0	0	0	0	0	0	0	0	0	0	0	0
United States	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	1677	870	268	10	9	0	965	0	11056	800	61	229	0	0	0
SWINE															
Canada	0	0	378	0	0	0	0	0	0	0	0	0	0	0	0
United States	15	413	19	0	0	378	0	0	0	0	0	0	0	0	0
Grand Total	15	413	397	0	0	378	0	0	0	0	0	0	0	0	0
OTHER (ALPACAS)															
Peru	49	94	64	30	0	0	0	0	0	0	0	0	0	0	0
Grand Total	49	94	64	30	0	0	0	0	0	0	0	0	0	0	0

Table 19 Total of bovine IVD and IVF embryos collected

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
AFRICA	17452	995	10426	8024	6018	13091	14896	15349	12995	13660	13459	13537	10528	9738	9401	7609	13473	10863	9267	6306
ASIA	101088	127460	211562	186074	173227	198150	391263	241299	272186	226479	212036	173160	193558	248332	186780	105852	109420	0	115123	191996
EUROPE	162102	160922	169451	151555	122729	114080	116897	213117	115126	108032	112116	123176	114148	124968	116746	144009	149433	153691	141760	214761
N AMERICA	178818	250615	300564	289201	315628	285553	307845	323293	421475	549758	562011	437593	367921	381598	411255	430108	504830	603445	572066	750074
OCEANIA	14005	12710	92655	100426	17402	37873	14890	2650	4487	17086	13039	17026	71525	71787	68615	15538	20448	11710	15079	14024
S AMERICA	24425	61012	92492	69312	54278	141635	189726	214923	294350	304096	285387	312711	323126	345953	393536	440003	449229	425114	419635	427133
Grand Total	497890	613714	877150	804592	689282	790382	1035517	1010631	1120619	1219111	1198048	1077203	1080806	1182376	1186333	1143119	1246833	1204823	1272930	1604294

Figure 2 Total of bovine IVD and IVF embryos collected

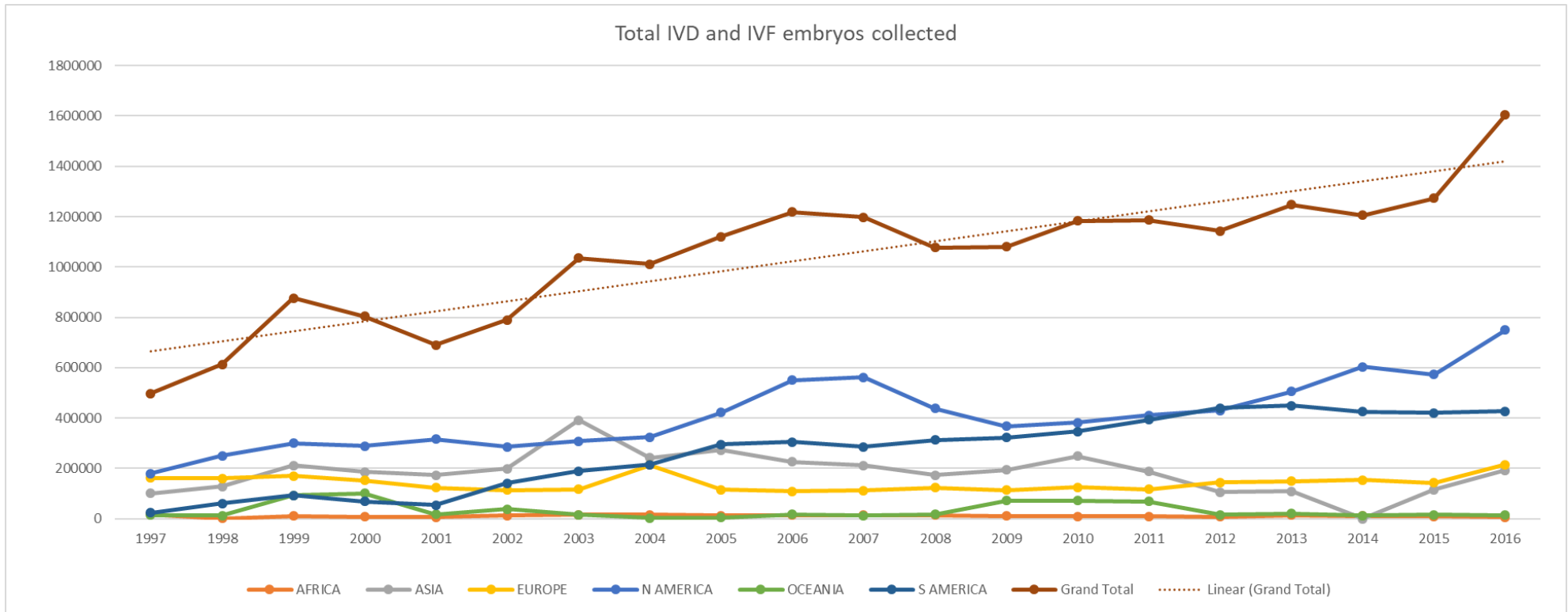


Table 20 Total of bovine IVD and IVF embryos transferred

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
AFRICA	8766	3311	5763	6785	4592	14443	6597	7153	6684	5181	7416	9047	9165	8415	6525	6347	11452	6771	3599	3880
ASIA	60284	59300	60374	71335	72958	115239	150312	268654	243054	266232	128195	75526	89817	110241	86508	65435	90190	0	81956	75926
EUROPE	145830	134473	143168	119771	103915	101514	103027	94184	91193	94686	103799	95501	100881	115075	121874	114099	131908	136917	126808	130635
N AMERICA	124953	201633	200185	226366	222277	189618	216064	218738	278215	296914	311234	297085	267362	281771	269395	275890	344219	364276	368916	400152
OCEANIA	16138	9802	44753	48926	17578	33039	9084	3600	4455	14491	9662	15663	57444	74063	74745	15208	19513	9786	14894	11816
S AMERICA	35254	64103	93421	97048	58090	167788	161931	196273	254658	285052	262828	301575	315380	340681	386164	413896	372128	311559	328535	342486
Grand Total	391225	472622	547664	570231	479410	621641	647015	788602	878259	962556	823134	794397	840049	930246	945211	890875	969410	829309	924708	964895

Figure 3 Total of bovine IVD and IVF embryos transferred

