

STATISTICS COMMITTEE REPORT - AETA 2019 (2018 DATA)

In 2017, for the first time in the International Embryo Technology Society (IETS) records, the number of bovine *in vitro* fertilized (IVF) embryos produced and transferred worldwide was greater than the *in vivo* produced (49% increase from the previous year). The main factor driving this change was the growth of IVF in North America (especially in the USA) and Europe (Viana, 2018). In 2018, there was an increase of 4% in the number of bovine embryo transfers (ET) performed in the USA, and IVF continued to increase (+11% total, +9% dairy and +15% beef) while *in vivo* produced ETs decreased (-14% total, -5% dairy and -7% beef).

We have been trying to adapt the survey to the different scenarios of the USA IVF market to make sure that our final summary is accurate (oocytes are shipped to labs, embryos are shipped back or not, private labs perform the whole cycle, some practitioners only transfer, etc). If you have any suggestions, or if you would like to serve the Statistics Committee, please contact us. There is a lot of work involved and we really need your help!

Survey data is only as good as the quality and integrity of the data submitted by people. Before submitting your survey, please take a second look and make sure everything is correct. There are a lot of minor errors that can probably be fixed without us having to contact you for clarification. Thank you for taking the time to submit your data. A special thanks to non-certified members and non-AETA members that voluntarily submitted data.

Sincerely,

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2019 SURVEY SUMMARY (2018 DATA)

The submitted data from 206 embryo practitioners (25 non-members), 145 ETBs (Embryo Transfer Businesses), 119 AETA certified, is summarized below.

- Embryo transfer work is the main business of 85 ETBs (considered >75% ET work);
- 142 ETBs transferred embryos;
- 128 ETBs flushed cows;
- 55 ETBs performed OPU's;
- 18 IVF labs (fertilized oocytes and cultured IVF embryos *in vitro*) reported data (some companies have several labs in different States but were reported as one).

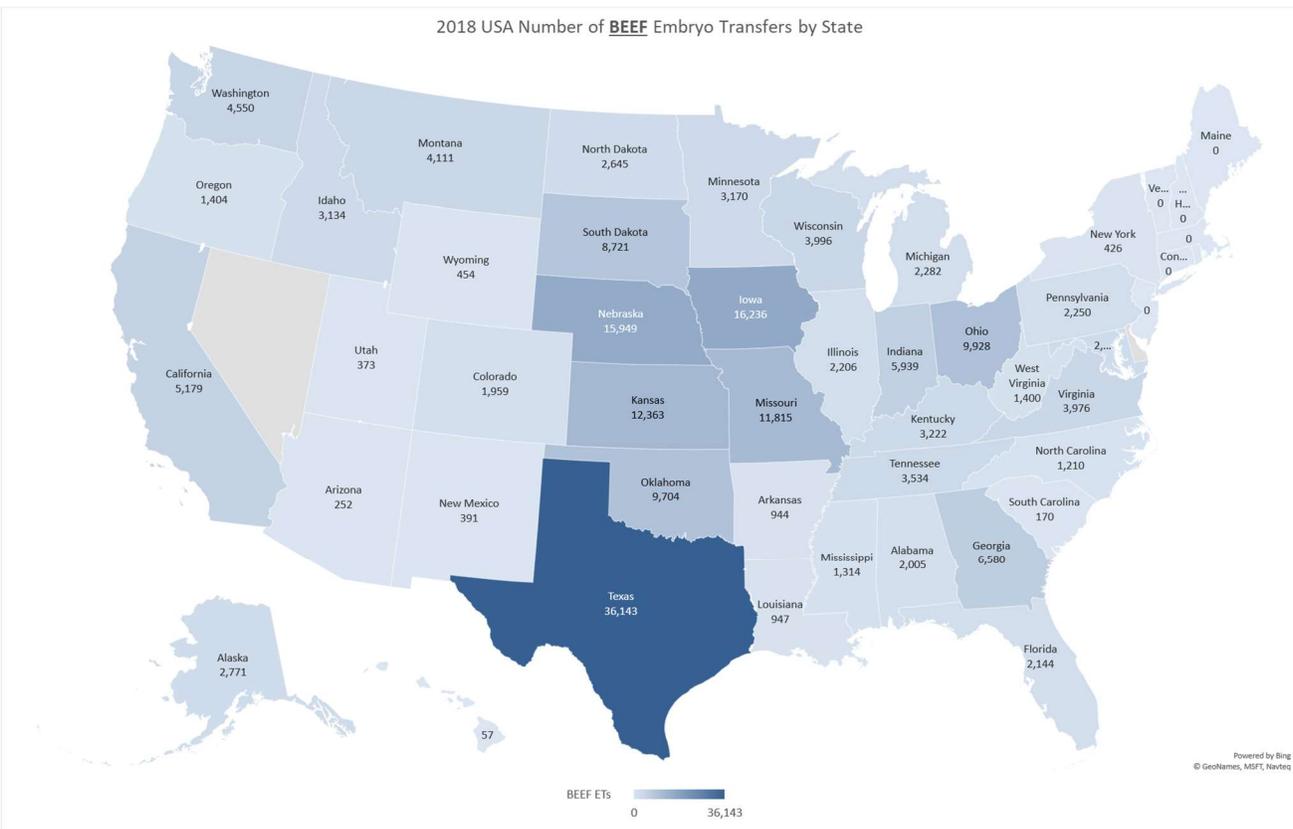
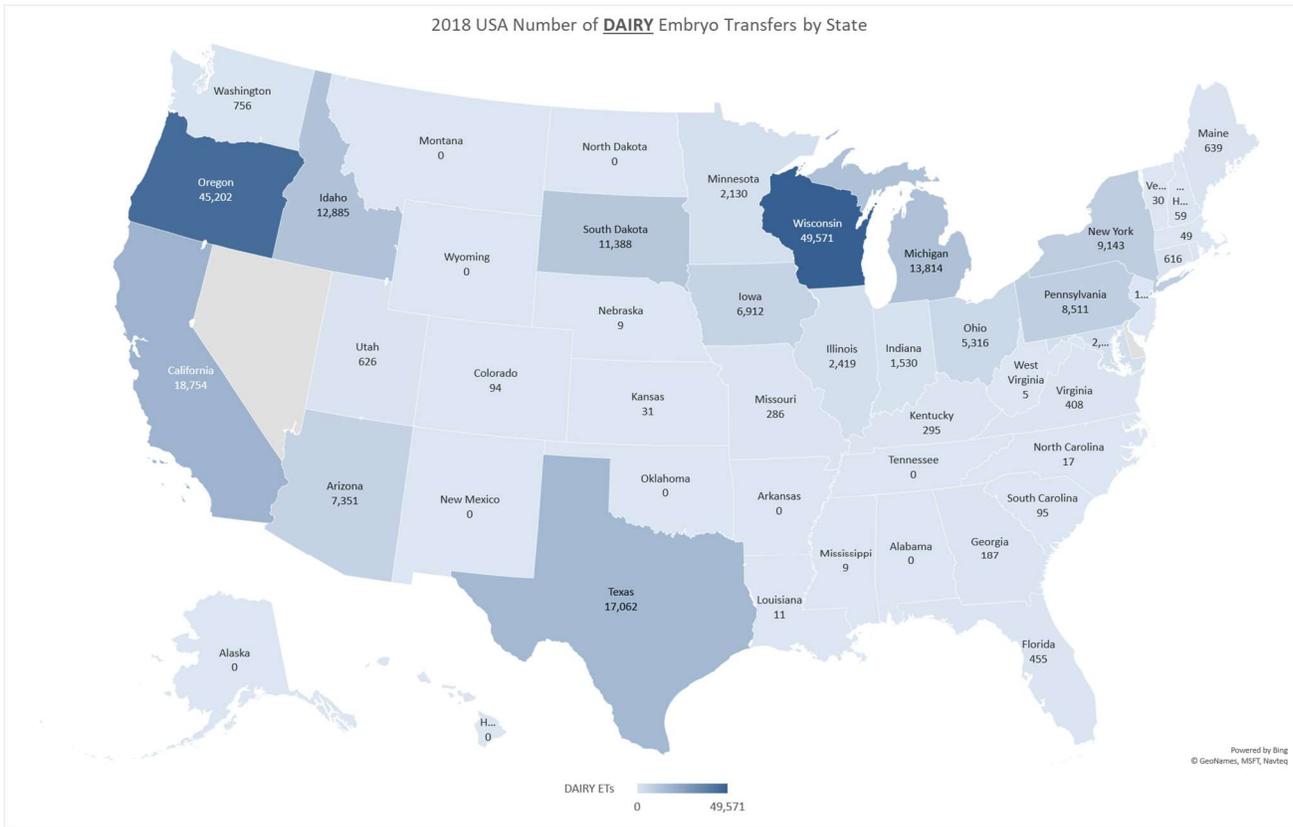
2018 USA BOVINE EMBRYO TRANSFERS

| | | <i>IN VIVO</i> | | | <i>IN VITRO</i> | | | <i>TOTAL</i> | | |
|--------------|--------------|----------------|---------------|----------------|-----------------|---------------|----------------|----------------|----------------|----------------|
| | | <i>FRESH</i> | <i>FROZEN</i> | <i>TOTAL</i> | <i>FRESH</i> | <i>FROZEN</i> | <i>TOTAL</i> | <i>FRESH</i> | <i>FROZEN</i> | <i>TOTAL</i> |
| DAIRY | TOTAL | 20,842 | 18,549 | 39,391 | 148,148 | 32,151 | 180,299 | 168,990 | 50,700 | 219,690 |
| | % | 53% | 47% | 18% | 82% | 18% | 82% | 77% | 23% | 53% |
| BEEF | TOTAL | 37,616 | 81,149 | 118,765 | 31,933 | 47,961 | 79,894 | 69,549 | 129,110 | 198,659 |
| | % | 32% | 68% | 60% | 40% | 60% | 40% | 35% | 65% | 47% |
| TOTAL | TOTAL | 58,458 | 99,698 | 158,156 | 180,081 | 80,112 | 260,193 | 238,539 | 179,810 | 418,349 |
| | % | 37% | 63% | 38% | 69% | 31% | 62% | 57% | 43% | |

2018 USA BOVINE EMBRYO TRANSFERS AND ETBS BY STATE

| STATE | DAIRY ETs | | | BEEF ETs | | | TOTAL ETs | |
|----------------|----------------|--------|------|----------------|--------|------|----------------|--------|
| | TOTAL | % | ETBs | TOTAL | % | ETBs | TOTAL | % |
| Alabama | 0 | 0.00% | 0 | 2,005 | 1.01% | 7 | 2,005 | 0.48% |
| Alaska | 0 | 0.00% | 0 | 2,771 | 1.39% | 1 | 2,771 | 0.66% |
| Arizona | 7,351 | 3.35% | 2 | 252 | 0.13% | 2 | 7,603 | 1.82% |
| Arkansas | 0 | 0.00% | 0 | 944 | 0.48% | 6 | 944 | 0.23% |
| California | 18,754 | 8.54% | 8 | 5,179 | 2.61% | 10 | 23,933 | 5.72% |
| Colorado | 94 | 0.04% | 1 | 1,959 | 0.99% | 4 | 2,053 | 0.49% |
| Connecticut | 616 | 0.28% | 4 | 0 | 0.00% | 0 | 616 | 0.15% |
| Florida | 455 | 0.21% | 3 | 2,144 | 1.08% | 8 | 2,599 | 0.62% |
| Georgia | 187 | 0.09% | 1 | 6,580 | 3.31% | 5 | 6,767 | 1.62% |
| Hawaii | 0 | 0.00% | 0 | 57 | 0.03% | 1 | 57 | 0.01% |
| Idaho | 12,885 | 5.87% | 6 | 3,134 | 1.58% | 7 | 16,019 | 3.83% |
| Illinois | 2,419 | 1.10% | 5 | 2,206 | 1.11% | 10 | 4,625 | 1.11% |
| Indiana | 1,530 | 0.70% | 4 | 5,939 | 2.99% | 11 | 7,469 | 1.79% |
| Iowa | 6,912 | 3.15% | 6 | 16,236 | 8.17% | 12 | 23,148 | 5.53% |
| Kansas | 31 | 0.01% | 1 | 12,363 | 6.22% | 10 | 12,394 | 2.96% |
| Kentucky | 295 | 0.13% | 2 | 3,222 | 1.62% | 5 | 3,517 | 0.84% |
| Louisiana | 11 | 0.01% | 1 | 947 | 0.48% | 2 | 958 | 0.23% |
| Maine | 639 | 0.29% | 2 | 0 | 0.00% | 0 | 639 | 0.15% |
| Maryland | 2,768 | 1.26% | 4 | 2,805 | 1.41% | 3 | 5,573 | 1.33% |
| Massachusetts | 49 | 0.02% | 1 | 0 | 0.00% | 0 | 49 | 0.01% |
| Michigan | 13,814 | 6.29% | 6 | 2,282 | 1.15% | 5 | 16,096 | 3.85% |
| Minnesota | 2,130 | 0.97% | 4 | 3,170 | 1.60% | 4 | 5,300 | 1.27% |
| Mississippi | 9 | 0.00% | 1 | 1,314 | 0.66% | 3 | 1,323 | 0.32% |
| Missouri | 286 | 0.13% | 3 | 11,815 | 5.95% | 8 | 12,101 | 2.89% |
| Montana | 0 | 0.00% | 0 | 4,111 | 2.07% | 6 | 4,111 | 0.98% |
| Nebraska | 9 | 0.00% | 1 | 15,949 | 8.03% | 13 | 15,958 | 3.81% |
| New Hampshire | 59 | 0.03% | 1 | 0 | 0.00% | 0 | 59 | 0.01% |
| New Jersey | 150 | 0.07% | 1 | 0 | 0.00% | 0 | 150 | 0.04% |
| New Mexico | 0 | 0.00% | 0 | 391 | 0.20% | 3 | 391 | 0.09% |
| New York | 9,143 | 4.16% | 10 | 426 | 0.21% | 4 | 9,569 | 2.29% |
| North Carolina | 17 | 0.01% | 1 | 1,210 | 0.61% | 6 | 1,227 | 0.29% |
| North Dakota | 0 | 0.00% | 0 | 2,645 | 1.33% | 4 | 2,645 | 0.63% |
| Ohio | 5,316 | 2.42% | 7 | 9,928 | 5.00% | 11 | 15,244 | 3.64% |
| Oklahoma | 0 | 0.00% | 0 | 9,704 | 4.88% | 9 | 9,704 | 2.32% |
| Oregon | 45,202 | 20.58% | 4 | 1,404 | 0.71% | 8 | 46,606 | 11.14% |
| Pennsylvania | 8,511 | 3.87% | 13 | 2,250 | 1.13% | 10 | 10,761 | 2.57% |
| Rhode Island | 107 | 0.05% | 1 | 0 | 0.00% | 0 | 107 | 0.03% |
| South Carolina | 95 | 0.04% | 1 | 170 | 0.09% | 2 | 265 | 0.06% |
| South Dakota | 11,388 | 5.18% | 1 | 8,721 | 4.39% | 6 | 20,109 | 4.81% |
| Tennessee | 0 | 0.00% | 0 | 3,534 | 1.78% | 7 | 3,534 | 0.84% |
| Texas | 17,062 | 7.77% | 4 | 36,143 | 18.19% | 15 | 53,205 | 12.72% |
| Utah | 626 | 0.28% | 2 | 373 | 0.19% | 4 | 999 | 0.24% |
| Vermont | 30 | 0.01% | 1 | 0 | 0.00% | 0 | 30 | 0.01% |
| Virginia | 408 | 0.19% | 4 | 3,976 | 2.00% | 9 | 4,384 | 1.05% |
| Washington | 756 | 0.34% | 3 | 4,550 | 2.29% | 5 | 5,306 | 1.27% |
| West Virginia | 5 | 0.00% | 1 | 1,400 | 0.70% | 5 | 1,405 | 0.34% |
| Wisconsin | 49,571 | 22.56% | 25 | 3,996 | 2.01% | 17 | 53,567 | 12.80% |
| Wyoming | 0 | 0.00% | 0 | 454 | 0.23% | 2 | 454 | 0.11% |
| TOTAL | 219,690 | | | 198,659 | | | 418,349 | |

Embryo transfer numbers per State were calculated based on the % of work provided by members on the survey. The 3 highest numbers per State in each category are highlighted.



2018 USA BOVINE IN VIVO EMBRYO PRODUCTION (SUPERVOVULATION/FLUSH)

| | COLLECTIONS | TOTAL OVA | | VIABLE EMBRYOS | | | FRESH ETs | | FROZEN | |
|--------------|---------------|----------------|-------------|----------------|------------|------------|---------------|------------|----------------|------------|
| | # | # | Average | # | Average | % | # | % | # | % |
| DAIRY | 10,293 | 95,213 | 9.3 | 54,821 | 5.3 | 58% | 20,842 | 38% | 33,979 | 62% |
| BEEF | 21,510 | 270,421 | 12.6 | 150,624 | 7.0 | 56% | 37,616 | 25% | 113,008 | 75% |
| TOTAL | 31,803 | 365,634 | 11.5 | 205,445 | 6.5 | 56% | 58,458 | 28% | 146,987 | 72% |

2018 USA BOVINE IN VITRO EMBRYO PRODUCTION (IVF)

| <i>All ETBs that performed OPU</i> | DAIRY | | | BEEF | | | TOTAL | | |
|--|-------------|----------|-----------|-------------|----------|---------|-------------|-----------|-----------|
| | WITHOUT FSH | WITH FSH | TOTAL | WITHOUT FSH | WITH FSH | TOTAL | WITHOUT FSH | WITH FSH | TOTAL |
| Total OPUs | 54,551 | 37,542 | 92,093 | 4,771 | 22,545 | 27,316 | 59,322 | 60,087 | 119,409 |
| Total Oocytes Recovered | 838,718 | 590,372 | 1,429,090 | 94,463 | 489,749 | 584,212 | 933,181 | 1,080,121 | 2,013,302 |
| Recovered Oocytes per OPU | 15.4 | 15.7 | 15.5 | 19.8 | 21.7 | 21.4 | 15.7 | 18.0 | 16.9 |
| <i>ETBs with IVF labs only</i> | DAIRY | | | BEEF | | | TOTAL | | |
| | WITHOUT FSH | WITH FSH | TOTAL | WITHOUT FSH | WITH FSH | TOTAL | WITHOUT FSH | WITH FSH | TOTAL |
| Total OPUs | 54,515 | 30,290 | 84,805 | 3,789 | 20,233 | 24,022 | 58,304 | 50,523 | 108,827 |
| Total Oocytes Recovered | 838,355 | 494,063 | 1,332,418 | 78,203 | 452,361 | 530,564 | 916,558 | 946,424 | 1,862,982 |
| Oocytes per OPU | 15.4 | 16.3 | 15.7 | 20.6 | 22.4 | 22.1 | 15.7 | 18.7 | 17.1 |
| Fertilized Oocytes | 664,511 | 462,881 | 1,127,392 | 56,383 | 430,254 | 486,637 | 720,894 | 893,135 | 1,614,029 |
| Fertilized Oocytes per OPU | 12.2 | 15.3 | 13.3 | 14.9 | 21.3 | 20.3 | 12.4 | 17.7 | 14.8 |
| Total Viable Embryos | 117,237 | 163,647 | 280,884 | 20,675 | 144,469 | 165,144 | 137,912 | 308,116 | 446,028 |
| Viable Embryos per OPU | 2.2 | 5.4 | 3.3 | 5.5 | 7.1 | 6.9 | 2.4 | 6.1 | 4.1 |
| % Viable Embryos (Viable/Recovered) | 14% | 33% | 21% | 26% | 32% | 31% | 15% | 33% | 24% |
| % Viable Embryos (Viable/Fertilized) | 18% | 35% | 25% | 37% | 34% | 34% | 19% | 34% | 28% |
| Total Frozen (in the production lab) | 21,832 | 65,213 | 87,045 | 12,622 | 99,639 | 112,261 | 34,454 | 164,852 | 199,306 |
| % Frozen | 19% | 40% | 31% | 61% | 69% | 68% | 25% | 54% | 45% |
| Total Transferred Fresh or Discarded | 95,405 | 98,434 | 193,839 | 8,053 | 44,830 | 52,883 | 103,458 | 143,264 | 246,722 |
| % Transferred Fresh or Discarded | 81% | 60% | 69% | 39% | 31% | 32% | 75% | 46% | 55% |
| <i>Commercial Abattoir Embryo Production</i> | DAIRY | | | BEEF | | | TOTAL | | |
| Total Oocytes Recovered | 999 | | | 15,900 | | | 16,899 | | |
| Total Viable Embryos | 326 | | | 5,307 | | | 5,633 | | |
| % Viable Embryos | 33% | | | 33% | | | 33% | | |

The data for this table were divided in 2 categories: companies that predominantly use FSH for OPU cows (WITH FSH) or don't (WITHOUT FSH). Fertilized oocytes – oocytes that went to fertilization or cleaved – we will need to change this for next year's survey to have homogenous data. Viable embryos – Day 6 embryos sent from the lab to a practitioner (not necessarily will be transferred or frozen on day 7) and/or Day 7 embryos transferred fresh, frozen or discarded. There is a large amount of IVF abattoir embryos being commercialized but we were not able to collect the data from the main companies.

2018 USA EMBRYOS EXPORTED BY BREED

| BREED | IN VIVO | IN VITRO | TOTAL |
|--------------------|---------------|--------------|---------------|
| Brown Swiss | 221 | 1 | 222 |
| Crossbred | | 13 | 13 |
| Guernsey | 4 | 12 | 16 |
| Holstein | 10,767 | 2,941 | 13,708 |
| Jersey | 543 | 94 | 637 |
| TOTAL DAIRY | 11,535 | 3,061 | 14,596 |

| BREED | IN VIVO | IN VITRO | TOTAL |
|-------------------|--------------|------------|--------------|
| Akaushi | 406 | | 406 |
| American Bucking | 6 | | 6 |
| Angus | 609 | 207 | 816 |
| Brangus | 22 | | 22 |
| Charolais | 10 | 3 | 13 |
| Crossbred | 161 | | 161 |
| Hereford | 190 | 67 | 257 |
| Highland | 10 | | 10 |
| Limousin | 10 | | 10 |
| Red Angus | 27 | 33 | 60 |
| Red Devon | 20 | | 20 |
| Santa Gertrudis | 14 | 28 | 42 |
| Senepol | 20 | | 20 |
| Shorthorn | 5 | | 5 |
| Simmental | 661 | 25 | 686 |
| Wagyu | 948 | 79 | 1,027 |
| TOTAL BEEF | 3,119 | 442 | 3,561 |

The highest number in each category is highlighted.

2018 USA EMBRYOS EXPORTED BY COUNTRY

| COUNTRY | IN VIVO | | IN VITRO | | TOTAL |
|----------------------|---------------|--------------|--------------|------------|---------------|
| | DAIRY | BEEF | DAIRY | BEEF | |
| Australia | 1,164 | 541 | 86 | | 1,791 |
| Brazil | 43 | | | | 43 |
| Canada | 371 | 144 | 202 | 244 | 961 |
| Chile | 109 | 84 | | | 193 |
| China | 1,504 | 680 | 7 | | 2,191 |
| Colombia | | 83 | | | 83 |
| Costa Rica | | 14 | | | 14 |
| Czech Republic | 36 | | | | 36 |
| Denmark | | | 4 | 13 | 17 |
| Dominican Republic | 170 | | | | 170 |
| Finland | | 15 | | | 15 |
| France | 99 | 86 | 51 | 22 | 258 |
| Germany | 1,258 | 373 | 344 | 57 | 2,032 |
| Greece | 10 | | | | 10 |
| India | 349 | | 100 | | 449 |
| Indonesia | 509 | | | | 509 |
| Italy | 51 | | 9 | | 60 |
| Japan | 2,471 | | | | 2,471 |
| Kazakhstan | | | 873 | | 873 |
| Kosovo | 35 | | | | 35 |
| Mali | | | 13 | | 13 |
| Mexico | | 32 | | | 32 |
| Netherlands | 554 | 2 | 937 | | 1,493 |
| New Zealand | 14 | | | | 14 |
| Paraguay | | | | 28 | 28 |
| Peru | 49 | 30 | | | 79 |
| Poland | 11 | | 37 | | 48 |
| Portugal | 12 | | 14 | 66 | 92 |
| South Africa | | 555 | | | 555 |
| South Korea | 205 | | | | 205 |
| Spain | | 19 | | | 19 |
| Sweden | 11 | | | | 11 |
| Switzerland | 156 | 12 | 95 | | 263 |
| Turkey | 70 | | | | 70 |
| United Arab Emirates | 834 | | | | 834 |
| United Kingdom | 600 | 378 | 289 | 12 | 1,279 |
| Uruguay | | 71 | | | 71 |
| Vietnam | 840 | | | | 840 |
| TOTAL | 11,535 | 3,119 | 3,061 | 442 | 18,157 |

2018 USA EMBRYOS EXPORTED BY CONTINENT

| CONTINENT | IN VIVO | | IN VITRO | | TOTAL | |
|---------------|---------------|--------------|--------------|------------|---------------|-------|
| | DAIRY | BEEF | DAIRY | BEEF | TOTAL | % |
| AFRICA | | 555 | 13 | | 568 | 3.1% |
| ASIA | 6,782 | 680 | 107 | | 7,569 | 41.7% |
| AUSTRALIA | 1,178 | 541 | 86 | | 1,805 | 9.9% |
| EUROPE | 2,833 | 885 | 2,653 | 170 | 6,541 | 36.0% |
| NORTH AMERICA | 541 | 190 | 202 | 244 | 1,177 | 6.5% |
| SOUTH AMERICA | 201 | 268 | | 28 | 497 | 2.7% |
| TOTAL | 11,535 | 3,119 | 3,061 | 442 | 18,157 | |

| 2018 USA Equine Embryo Transfer / In-Vitro Embryo Production | |
|--|------|
| 1. Embryo recovery from mares via uterine flush | |
| A. Number of recovery procedures performed | 1816 |
| B. Number of recovered embryos | 1105 |
| Average | 0.6 |
| 2. Transfer of IN-VIVO RECOVERED embryos to recipient mares | |
| A. Number of FRESH embryos (recovered at your facility or shipped to you by others) transferred to recipient mares at your facility | 1952 |
| B. Number of CRYOPRESERVED / warmed embryos (recovered at your facility or shipped to you by others) transferred to recipient mares at your facility | 591 |
| 3. Oocyte recovery procedures (TVA, OPU, flank) for in vitro embryo production | |
| A. Number of oocyte recovery procedures performed | 505 |
| B. Number of immature oocytes recovered (oocytes recovered from diestrus/subordinate follicles) | 3285 |
| C. Number of in vivo-matured oocytes recovered (recovered from the stimulated dominant follicle) | 211 |
| 4. Embryo production via ICSI at your facility | |
| A. Number of cases on which ICSI was performed | 751 |
| B. Number of oocytes on which ICSI was performed | 519 |
| C. Number of transferrable IVP blastocysts produced via ICSI | 519 |
| 5. Transfer of IVP embryos at your facility | |
| A. Number of FRESH IVP blastocysts transferred to the uteri of recipient mares at your facility (including fresh shipped IVP blastocysts) | 444 |
| B. Number of CRYOPRESERVED /warmed IVP blastocysts transferred to the uteri of recipient mares at your facility (including shipped cryopreserved IVP blastocysts) | 109 |

Thanks to Dr Katrin Hinrichs (Texas A&M University, College Station, TX) and Dr Robert Foss (Equine Medical Services, Colombia, MO), we were able to collect detailed equine embryo transfer data from practitioners that are not associated to the AETA. They created the questionnaire above and distributed to equine practitioners around the country.

2018 USA SMALL RUMINANT EMBRYO PRODUCTION

| Species | Collection data | | | | | | Transfer Data | | | |
|----------------|-----------------|-----------|--------|---------|------------|----------|---------------|-------|--------|-------|
| | Collections | Total Ova | Viable | Ave Ova | Ave Viable | % Viable | Frozen | Fresh | Frozen | Total |
| Ovine | 193 | 1,353 | 911 | 7.0 | 4.7 | 67.3% | 334 | 577 | 9 | 586 |
| Caprine | 1,052 | 12,629 | 7,541 | 12.0 | 7.2 | 59.7% | 1,869 | 5,672 | 1,172 | 6844 |

We've tried to contact several commercial small ruminant companies that are not associated with the AETA, but only a few submitted data, so the number above is probably underestimated.

There was no data reported for any other species other than equine, ovine and caprine.

Seven ETBs reported to have manipulated 279 embryos (791 biopsied for sexing, 373 biopsied for genomics and 123 bisected).