



## **The Global Trade in Amphibians: Summary Interim Report of a CCM Study**

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The global trade in amphibians comprises live amphibians and amphibian parts and products supplied for human consumption, for the laboratory animal trade, for the pet trade and for zoos. In this report, we outline results from the first two years of a multi-year study by the Consortium for Conservation Medicine gathering data to identify the volume of these trades.

### **Summary of Findings:**

- **Over the past two decades, the production and international trade of farmed amphibians for human consumption has developed into a globalized trade.**
- **Data from the USA suggest that the trade in amphibians for human consumption and pets are the two most important forms of trade in amphibians respectively.**
- **Our study has demonstrated the presence of the emerging pathogen of amphibians, *Batrachochytrium dendrobatidis*, and the ranaviral agent FV3 in live amphibians directly imported from Asia to major US cities**

### **Detailed interim report:**

#### **1) The trade in amphibians for human consumption**

There has been a recent global expansion of production and trade in ranid frogs for human consumption (Table 1). Although toads (*Bufo* spp.) are consumed in some countries (e.g. China – Daszak *pers. obs.*), the ranid frogs, and especially the bullfrog

(*Rana catesbeiana*) and the Indian or tiger bullfrog (*Rana tigrina*) are the most commonly bred species for consumption. This expanding trade represents the partial domestication of these species, which are bred in large, often outdoor, ponds and usually fed processed fish pellets. They are usually exported live, but in some countries frozen frog legs are traded internationally (Teixeira et al. 2001).

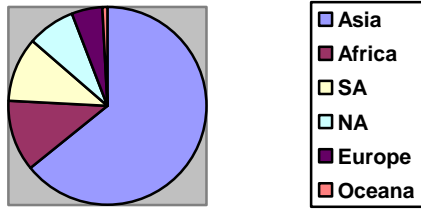
Table 1: Production (in tonnes) of ranid frogs for human consumption, broken down by country. Source: (Teixeira et al. 2001).

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Argentina	0	0	0	0	0	0	50	50	50	50	50	50
Bangladesh	2318	2824	2685	739	318	771	700	700	0	0	0	0
Brazil	10	29	40	60	90	120	140	165	304	415	522	570
Cuba	224	235	203	137	96	73	52	52	62	69	46	28
India	0	13	15	29	-	-	-	-	-	-	-	-
Indonesia	689	1582	1342	1590	1957	2666	2411	2111	2194	1793	1390	1330
Mexico	1327	1007	461	868	309	350	352	350	547	414	2063	1229
Romania	29	0	0	0	0	2	0	0	0	0	0	41
Taiwan PC	-	-	327	134	188	784	2052	1132	1378	1259	730	1700
Thailand	20	20	6	5	18	131	321	353	137	1600	1570	1600
Turkey	-	-	-	-	1321	648	750	851	864	740	160	100
Uruguay	0	1	0	-	-	-	-	-	15	3	3	3
USA	1	4	1	0	9	18	20	17	5	2	9	6
<b>TOTAL</b>	<b>4618</b>	<b>5715</b>	<b>5080</b>	<b>3562</b>	<b>4306</b>	<b>5563</b>	<b>6848</b>	<b>5781</b>	<b>5556</b>	<b>6345</b>	<b>6543</b>	<b>6657</b>

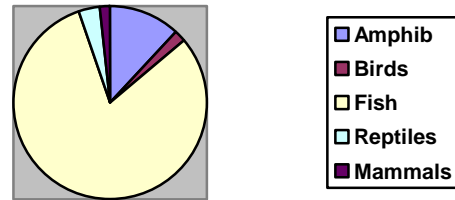
It is important to note that these data are incomplete. For example, China and Ecuador are major producers of frogs for consumption (see data on imports into the USA, below), but these data are not listed above. Amphibians produced for this trade are often traded internationally. For example, between 1998 and 2002 inclusive, the U.S.A. imported 14.7 million wild-caught, whole amphibians and 5.2 million kg of wild-caught amphibians. Approximately 4 million of these were for food (Schlaepfer et al. 2005). Asia is the second largest market for frog leg consumption in the world, but the data are far less complete. The United States is the world's third top importer of frog legs, receiving 19.43% of exports from Asia (Parker and Lilly 2004).

*New York Port Study:* To examine the pet trade into the USA, we used data from the Law Enforcement Management Information System (LEMIS) division of the U.S. Fish and Wildlife Service (USFWS) on all U.S. wildlife imports and exports at designated ports throughout the U.S. This data is freely available for educational and research purposes under the Freedom of Information Act (FOIA). For the Port of New York alone, a total of 37,457 consignments of wildlife were imported during the years 2000-2003 representing 462 genera or mammals, birds, amphibians, reptiles and fish. Fish constituted a large percentage of all wildlife imports, whereas mammals comprised less than 1% of all imports. Sixty-six percent of all shipments originated from Asia, 47% of which contained fish. Additionally, 59% of all imports into New York were wild-caught specimens (see figures below).

**Origin of wildlife imported into New York 2000-3**

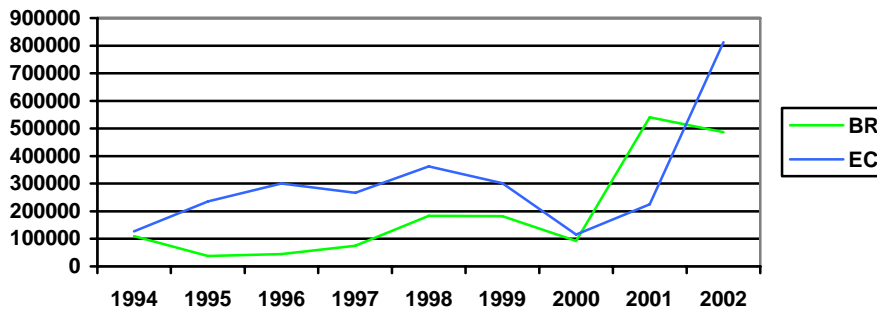


**Major groups of animals imported into New York 2000-3 from Asia**



A large percentage of amphibians imported into the Port of New York are from South America and Asia (Schlaepfer et al. 2005). Through collaborator Dr. Jon Paul Rodriguez of Provita, Venezuela, we obtained amphibian trade data between South America and the United States for the years 1993-2002. We collated and analyzed data for all ranid species, which are used almost entirely for human consumption, and constitute mainly the bullfrog (*Rana catesbeiana*). The top 2 countries exporting amphibians to the U.S.A. are Brazil and Ecuador. Export data from these countries clearly demonstrate a growing international trade from these countries to the USA:

**Total Ranid Exports from Brazil and Ecuador**



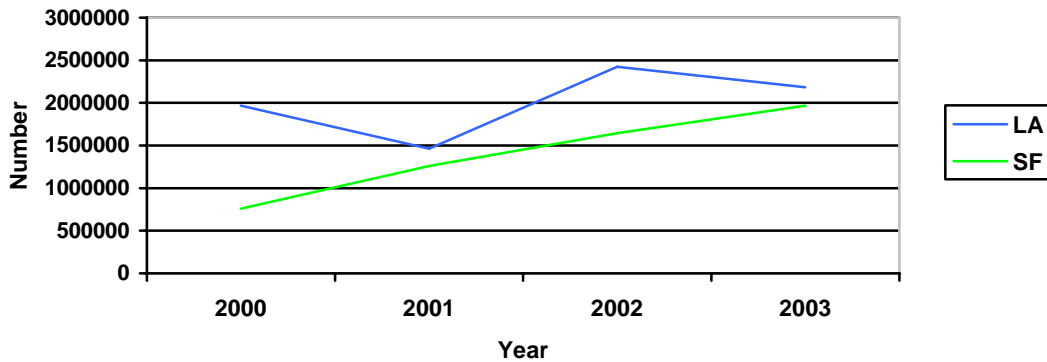
We have now obtained data on amphibian imports into New York between 2000-2004 and found that during this 4-year period 2,457,698 individuals and 39,000 kilograms of live amphibians were imported into New York from Brazil alone.

*Study of trade from Asia to USA:* To analyze the amphibian trade between the United States and Asia, we selected the top three busiest ports in the western U.S.A. and submitted a FOIA request for all trade data between the years of 2000 and 2004. The ports were Anchorage, San Francisco and Los Angeles (graph below and table 2). While Anchorage was the third busiest port for wildlife in 2004, with large numbers of shipments coming in from Asia, it does not appear to be a significant port of entry for amphibians. A total of 549 amphibians were imported into Anchorage between 2000-2004.

Importation data for *Xenopus laevis* was also collated, because this host may have played a part in the global spread of chytridiomycosis in the past (Weldon et al. 2004). From

2000-2004, there was a total of 9 shipments (1437 individuals) of *Xenopus* imported into LA and 1 shipment (65 individuals) of *Xenopus* imported into SF.

**Total number of ranid frogs imported into the USA from Asia through Los Angeles and San Francisco**



For purposes in analyzing overall trends in ranid spp., shipment sizes in kilograms, pounds and gallons were converted to give the likely number of individuals based on the average weights of amphibians sampled in the SF and LA markets. The average weight of each individual at each shop was calculated by dividing the total cost by the cost per pound to yield the total number of pounds weight. That number was then divided by the number of individuals purchased at that shop to yield the average weight per individual in pounds. To obtain the average weight in kg, pounds were divided by 2.2 (2.2 pounds is equal to 1 kg). For example, the cost for ten frogs at SF shop1 was \$31.68 at \$3.29/lb: Total cost / Cost per pound / number of individuals = Average weight per individual  
 $31.68 / 3.29 / 10 = 0.9629179$  pounds  
 $0.9629179 / 2.2 = 0.44$  kg

Gallons were converted into kg and then into numbers using the following conversion: 1 US gallon = 3785.41 ml = 3785.41 g = 3.79 kg. The total average weight for amphibians collected in San Francisco and LA was found to be 1.288095 lbs or 0.4 kg. If a shipment was recorded as 2000kg, for instance, 2000 divided by 0.4 yields the number of individuals as 5000.

Table 2: Most important exporters of amphibians (*R. catesbeiana* and other ranid frogs) imported into Los Angeles and San Francisco.

Top Countries of Export 2000-2004			
Los Angeles			
Rana Catesbeiana (RACA)		All ranid frogs (RANA)	
Taiwan	54.25%	Taiwan	45.79%
China	35.67%	China	26.86%
Vietnam	8.93%	Vietnam	13.46%
San Francisco			

Rana Catesbeiana (RACA)		All ranid frogs (RANA)	
Taiwan	89.06%	Taiwan	93.88%
China	10.94%	China	4.71%
Vietnam	1.67%	Myanmar	1.39%

According to the LEMIS database, the countries which export the most amphibians to the U.S. include Taiwan, China, Vietnam and Myanmar.

## 2) Evidence of *Batrachochytrium dendrobatidis* and ranaviral disease in amphibians traded for human consumption

*Trade from South America to the USA:* Researchers from the CCM visited four bullfrog farms within the vicinity of Sao Paulo, Brazil – swabbing a total of 350 animals. Analyses of the swabs are pending. However, we analysed the mouthparts of tadpoles on these farms and found evidence of ‘missing mouthparts’ (a common sign of infection by *Batrachochytrium dendrobatidis*) in approximately 50% of individuals.

*Analysis of frogs sold in US outlets for human consumption after importation from South America or Asia:* We located four shops in the Chinatown section of Manhattan. A total of 304 swabs and 297 liver sections were collected from these shops between December, 2005 and May 2006. The swabs were then analyzed for chytridiomycosis infection and the liver for ranavirus infection. To date, we have analyzed 204 of the 304 swabs collected for *B. dendrobatidis* infection by PCR. Of these, 45% (93/204) were positive for *B. dendrobatidis*, 14% (29/204) indeterminate and 40% (82/204) negative. (Table 3).

Of the 297 liver sections collected, 277 have been analyzed by PCR. Of these 2.1% (6/277) were positive. (Table 3). Gene sequencing revealed that the animals were infected with an FV3-like ranavirus. All of the six infected animals had identical sequences and we plan to use the genetic composition to locate the origin of the ranavirus strain. In May, 2005, researchers traveled to the Chinatown sections of Brooklyn, Elmhurst and Flushing, locating an additional 14 shops with live amphibians for sale. To date we have collected a total of 118 swabs and 101 liver sections from 6 of these shops. Analysis of these samples is pending.

Table 3: Results to date of cutaneous swabs tested by PCR for *Batrachochytrium dendrobatidis*

Date/Shop	Positive	Indeterminate	Negative
<b>Jul 05</b>			
SF1	6	4	0
SF2	0	1	5
LA1	2	0	18
<b>Dec 05</b>			
NY1	0	0	20
NY2	22	3	0

<b>Jan 06</b>			
NY3	11	5	3
NY4	7	7	10
<b>Feb 06</b>			
NY1			
NY2			
SF3	3	2	15
SF2	13	2	5
SF4	15	3	2
LA1	14	2	4
<b>Total</b>	<b>93</b>	<b>29</b>	<b>82</b>

(SF= San Francisco; LA= Los Angeles; NY= New York)

#### Ranavirus results to date:

Date/Shop	Positive	Indeterminate	Negative
<b>Dec 05</b>			
NY1	0	0	20
NY2	0	0	25
<b>Jan 06</b>			
NY3	0	0	20
NY4	1	0	23
<b>Feb 06</b>			
NY1	1	0	7
NY2	0	0	20
SF3	0	0	20
SF2	0	0	20
SF4	0	0	20
LA1	0	0	20
<b>Mar 06</b>			
NY3	2	0	18
NY4	0	0	20
<b>Apr 06</b>			
NY2	2	0	18
NY3	0	0	20
<b>Total</b>	<b>6</b>	<b>0</b>	<b>271</b>

(SF= San Francisco; LA= Los Angeles; NY= New York)

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