

**FAO/OIE Reference Laboratory Contract Report  
April-June 2008**

**Foot-and-Mouth Disease**

## **Summary**

There were no outbreaks officially reported in FMD-free countries that did not practice vaccination between April and June 2008.

In the Middle East, an FMD outbreak was reported in cattle in **Bahrain** (due to serotype O) in April. Poor vaccination and uncontrolled animal movements were proposed as the cause of the outbreak. Elsewhere in Asia, an untyped FMD outbreak is reported to be spreading in townships in **Myanmar** affected by Cyclone Nargis in the Irrawaddy delta and in the Rangoon and Pegu divisions. There is no estimate of the number of affected animals or when the outbreak first occurred. There continue to be further outbreaks of FMD (Serotype Asia 1) in **China**. In **Vietnam**, new cases of FMD have been reported in June in 50 domestic animals in six communes in Trung Khanh District, the northern province of Cao Bang.

In Africa, an outbreak was reported in Gaza province, **Mozambique**, in April affecting 45 cattle although the virus has not been typed. The possible cause is legal animal movement. Further outbreaks of SAT 2 have been reported in Caprivi, **Namibia**. Movement and quarantine restrictions in concert with ring vaccination (with SAT 1-3) were employed in an attempt to control the spread of the disease.

Viruses isolated from recent samples sent to WRL from FMD outbreaks in **Nigeria** have been characterised as SAT2. In the south of the continent, the causative virus of the ongoing outbreak in **Zambia** which began in March was not typed. However, samples sent to Pirbright have been typed as SAT 1 and SAT 2. Illegal movement of animals is the possible cause of introduction

Within South America, An outbreak in **Colombia** was confirmed May 30 in a defined zone in Cucuta, Norte de Santander, close to the Venezuelan border, with 27 male cattle being fattened for slaughter testing positive after 29 cattle showed signs of lesions. FMD diagnosis was carried out by 3ABC serology. In **Venezuela**, an outbreak of serotype A has been reported in the Sifontes region with disease detected in some cattle herds from 7 farms in Tumeremo. Possible vaccination problems have been cited as the cause. An outbreak of serotype O was reported in Esmeraldas, **Ecuador**, thought to have been through introduction of live animals from an unspecified location. Large scale vaccination programmes continue to be employed in the region.

### **Additional information:**

During this reporting period WRL have received samples from Gabon for the first time, received samples from Somalia for the first time since 1983 and received samples from Nigeria for the first time since 1984-85. This is a very welcome improvement in the geographical range of samples sent to WRL and may reflect the efforts of the EUFMD in encouraging sample submission from these regions. This is a very positive move for the future with regard to obtaining regular 'real time' information on virus populations circulating in particular regions and will greatly aid informed disease management and control.

New appointment: In June Dr. Jef Hammond took over the role of Head of the Vesicular Reference Laboratories at Pirbright from Dr. David Paton. There will be a change over period of 3 months to maintain continuity of the WRL activities.

### **WRL vaccine recommendations are unchanged.**

Results from samples received at WRL (status of samples being tested) are shown in Table 1 and a complete list of clinical sample diagnostics made by the WRL between April and June 2008 is shown in annexe 1 Table A. A record of all samples received to IAH-Pirbright (April-June 2008) is shown in annexe 1 Table B.

An up-to-date list and reports of FMD viruses characterised by sequencing can be found at the following website: [http://www.wrlfmd.org/fmd\\_genotyping/2008.htm](http://www.wrlfmd.org/fmd_genotyping/2008.htm)

**Table 1: Status of sequencing of samples received recently to WRLFMD**

Batch	Country	Serotype	Number of samples	Status
WRLFMD/2008/00006	Pakistan	O	25	Completed
WRLFMD/2008/00008	Saudi Arabia	O	5	Completed
WRLFMD/2008/00009	Ethiopia	O	3	Completed
WRLFMD/2008/00009	Ethiopia	SAT1	3	Completed
WRLFMD/2008/00010	Botswana	SAT 2	6	Completed
WRLFMD/2008/00011	Zambia	SAT 1	3	Completed
WRLFMD/2008/00011	Zambia	SAT 2	1	Completed
WRLFMD/2008/00012	Iran	A	3	In progress
WRLFMD/2008/00013	Pakistan	O	6	In progress
WRLFMD/2008/00013	Pakistan	A	1	In progress
WRLFMD/2008/00014	Nigeria	O	1	In progress
WRLFMD/2008/00014	Nigeria	SAT 2	9	In progress
WRLFMD/2008/00015	Somalia	O	3	In progress
WRLFMD/2008/00016	Kenya	O	11	In progress
WRLFMD/2008/00016	Kenya	A	2	In progress
WRLFMD/2008/00016	Kenya	SAT 1	2	In progress
WRLFMD/2008/00016	Kenya	SAT 2	15	In progress
WRLFMD/2008/00018	Namibia	SAT 2	1	In progress
WRLFMD/2008/00020	Turkey	O	9	In progress
WRLFMD/2008/00020	Turkey	A	23	In progress
<b>Total</b>			<b>132</b>	

### **Middle East and Asia**

#### *Pakistan (type O)*

VP1 sequencing of 25 FMDV O viruses isolated from samples received from Pakistan during the last reporting period was completed. They represented viruses collected in 2005 (n=6), 2006 (n=11), 2007 (n=6) and 2008 (n=2). All belonged to the ME-SA toptotype and all but one to the PanAsia-2 lineage (O/PAK/68/2006 was related to PanAsia viruses isolated in Pakistan in 2005) (Annex 2, Figure 1). Those within the PanAsia-2 lineage fell on multiple sub-lineages, some which included representatives from other countries, indicating a complex epidemiological situation. One sample O/PAK/66/2007 contained two distinct PanAsia-2 viruses (labelled A and B) which were differentially amplified by the two RT-PCR primer sets used.

#### *Saudi Arabia (type O)*

VP1 sequencing was completed on five type O viruses received from Saudi Arabia during the last reporting period. All belonged to ME-SA PanAsia-2 and were closely related to Saudi Arabian viruses received earlier in the year (Annex 2, Figure 2).

#### *Turkey (types O & A)*

Ten VP1 sequences of viruses isolated in Turkey in 2008 were received from the FMD Institute-Ankara. Three type O sequences belonged to the PanAsia-2 lineage (Annex 2, Figure 3) and seven type A viruses belonged to the A-Iran-05 lineage (Annex 2, Figure 4). One type O sequence appeared most closely related to sequences of viruses from Jordan (2006) and Israel (2007), however, sequences of the VP1 gene may not contain enough resolution to give an accurate phylogeny of very closely related viruses. The seven type A virus sequences

clustered together (along with four sequences from 2007 previously sent from FMDI-Ankara) within the A-Iran-05 lineage; however, they appeared to form a new sub-lineage.

## **Africa**

### *Botswana (type SAT 2)*

Six SAT 2 viruses were isolated from cattle in Maun, Botswana in 2008. Their VP1 sequences were closely related to viruses isolated in October-November 2007 in the same place.

### *Ethiopia (types O & SAT 1)*

Six FMD viruses, three type O and three type SAT 1, were isolated from samples received from Ethiopia during the previous reporting period. The VP1 sequences of the type O viruses (O/ETH/26-28/2007, collected in December 2007) belonged to the EA-3 toptotype and were related to an earlier isolate from the same year (Annex 2, Figure 5). The three SAT 1 viruses, isolated in December 2007 from cattle, sheep and goat, were closely related to an earlier isolate originating from the same region (Koka, Bench Maji, SNNP) in November 2007 (Annex 2, Figure 6). This was the first description of SAT 1 in Ethiopia, but it is not clear if the infection originated from wildlife in nearby game parks or if it came from a neighbouring country.

### *Zambia (types SAT 1 & SAT 2)*

Three type SAT 1 viruses were isolated from samples from Zambia (Southern Region). Their VP1 sequences belonged to the North-west Zimbabwe (NWZ) toptotype and were most closely related to those of viruses previously found in Zambia in 2004-05 (various locations in the Southern Region) (Annex 2, Figure 7).

A single SAT 2 virus was closely related to viruses from Zambia (Kazungula, Southern Province, November 2007) and Namibia (Caprivi Strip, November 2007) (Annex 2, Figure 8). The nearest related virus was collected from African buffalo at Kasane, Botswana in July 2006.

## **Vaccine matching**

Five FMDV type O isolates (O SAU 1/2008; O PAK 1 and 2/2008 and O PAK 68 and 71/2007) from Saudi Arabia and Pakistan collected in 2007 and 2008 were further characterised by two dimensional virus neutralisation test (VNT: see Annex 1; TABLE C). These results showed that all of these isolates were antigenically matched with all of O1 Manisa, O IND R2/75 and O BFS 1860 vaccine strains except that isolate O PAK 71/2007 was not antigenically close to O BFS 1860 strain. These results indicated that these serotype O viruses could be covered by more than one vaccine present in many vaccine banks.

Four FMD type SAT 1 isolates (SAT1 ETH 3, 18 and 21/2007 and SAT1 ZAM 7/2008) from Ethiopia and Zambia have been characterised by two dimensional VNT and the results showed no matching with SAT1 RHO 12/78 vaccine strain (Annex 1; TABLE C).

## **Publication of data to the scientific community and the industry**

FMD papers published in the reporting period from the Pirbright Laboratory (Pirbright authors underlined):

**1:** Valarcher JF, Gloster J, Doel CA, Bankowski B, Gibson D.

Foot-and-mouth disease virus (O/UKG/2001) is poorly transmitted between sheep by the airborne route.

Vet J. 2008 Sep;177(3):425-8. Epub 2007 Jul 12.

**2:** Muller JD, McEachern JA, Bossart KN, Hansson E, Yu M, Clavijo A, Hammond JM, Wang LF.

Serotype-independent detection of foot-and-mouth disease virus.

J Virol Methods. 2008 Jul;151(1):146-53. Epub 2008 Apr 25.

**3:** Parida S, Fleming L, Oh Y, Mahapatra M, Hamblin P, Gloster J, Paton DJ.

Emergency vaccination of sheep against foot-and-mouth disease: Significance and

detection of subsequent sub-clinical infection.  
Vaccine. 2008 Jun 25;26(27-28):3469-79. Epub 2008 May 2.

**4:** Bronsvoort BM, Parida S, Handel I, McFarland S, Fleming L, Hamblin P, Kock R. Serological survey for foot-and-mouth disease virus in wildlife in eastern Africa and estimation of test parameters of a nonstructural protein enzyme-linked immunosorbent assay for buffalo.  
Clin Vaccine Immunol. 2008 Jun;15(6):1003-11. Epub 2008 Apr 2.

**5:** Dekker A, Sammin D, Greiner M, Bergmann I, Paton D, Grazioli S, de Clercq K, Brocchi E. Use of continuous results to compare ELISAs for the detection of antibodies to non-structural proteins of foot-and-mouth disease virus.  
Vaccine. 2008 May 23;26(22):2723-32. Epub 2008 Apr 11.

**6:** Li Y, Stirling CM, Denyer MS, Hamblin P, Hutchings G, Takamatsu HH, Barnett PV. Dramatic improvement in FMD DNA vaccine efficacy and cross-serotype antibody induction in pigs following a protein boost.  
Vaccine. 2008 May 19;26(21):2647-56. Epub 2008 Feb 12.

**7:** Cottam EM, Wadsworth J, Shaw AE, Rowlands RJ, Goatley L, Maan S, Maan NS, Mertens PP, Ebert K, Li Y, Ryan ED, Juleff N, Ferris NP, Wilesmith JW, Haydon DT, King DP, Paton DJ, Knowles NJ. Transmission pathways of foot-and-mouth disease virus in the United Kingdom in 2007.  
PLoS Pathog. 2008 Apr 18;4(4):e1000050.

**8:** Hollister JR, Vagnozzi A, Knowles NJ, Rieder E. Molecular and phylogenetic analyses of bovine rhinovirus type 2 shows it is closely related to foot-and-mouth disease virus.  
Virology. 2008 Apr 10;373(2):411-25. Epub 2008 Jan 16.

**9:** Fowler VL, Paton DJ, Rieder E, Barnett PV. Chimeric foot-and-mouth disease viruses: evaluation of their efficacy as potential marker vaccines in cattle.  
Vaccine. 2008 Apr 7;26(16):1982-9. Epub 2008 Feb 22.

**10:** Schumann KR, Knowles NJ, Davies PR, Midgley RJ, Valarcher JF, Raoufi AQ, McKenna TS, Hurtle W, Burans JP, Martin BM, Rodriguez LL, Beckham TR. Genetic characterization and molecular epidemiology of foot-and-mouth disease viruses isolated from Afghanistan in 2003-2005.  
Virus Genes. 2008 Apr;36(2):401-13. Epub 2008 Feb 16.

#### In Press

1. Ryan, E., Gloster, J., Reid, S. M., Li, Y, Ferris, N. P., Waters, R., Juleff, N., Charleston, B., Bankowskia, B., Gubbins, S., Wilesmith, J., King, D. P., Paton D. J. Clinical investigations of the foot-and-mouth disease epidemic in the United Kingdom in 2007 Veterinary Record

**Annex 1.**

**Table A:** Summary of clinical sample diagnostics made by the WRL between April and June 2008

Country	WRL for FMD Sample Identification	Animal	Date of Collection	Results		
				VI/ELISA	RT-PCR	Final report
BOTSWANA	BOT 6/2008	Cattle	NK	SAT 2	Positive	SAT 2
	BOT 7/2008	Cattle	NK	SAT 2	Positive	SAT 2
	BOT 8/2008	Cattle	NK	SAT 2	Positive	SAT 2
	BOT 9/2008	Cattle	NK	SAT 2	Positive	SAT 2
	BOT 10/2008	Cattle	NK	SAT 2	Positive	SAT 2
	BOT 11/2008	Cattle	NK	SAT 2	Positive	SAT 2
GABON	GAB 1/2008	NK	NK	NVD	Negative	NVD
	GAB 2/2008	NK	NK	NVD	Negative	NVD
	GAB 3/2008	NK	NK	NVD	Negative	NVD
	GAB 4/2008	NK	NK	NVD	Negative	NVD
	GAB 5/2008	NK	NK	NVD	Negative	NVD
	GAB 6/2008	NK	NK	NVD	Negative	NVD
	GAB 7/2008	NK	NK	NVD	Negative	NVD
	GAB 8/2008	NK	NK	NVD	Negative	NVD
	GAB 9/2008	NK	NK	NVD	Negative	NVD
	GAB 10/2008	NK	NK	NVD	Negative	NVD
	GAB 11/2008	NK	NK	NVD	Negative	NVD
	GAB 12/2008	NK	NK	NVD	Negative	NVD
IRAN	IRN 1/2008	NK	NK	A	Positive	A
	IRN 2/2008	NK	NK	NVD	Negative	NVD
	IRN 3/2008	NK	NK	NVD	Positive	FMDV GD
	IRN 4/2008	NK	NK	A	Positive	A
	IRN 5/2008	NK	NK	A	Positive	A
	IRN 6/2008	NK	NK	NVD	Negative	NVD
KENYA	KEN 11/2006	Cattle	02.06.06	SAT 1	Positive	SAT 1
	KEN 12/2006	Cattle	29.05.06	NVD	Positive	FMDV GD
	KEN 13/2006	Cattle	20.06.06	NVD	Negative	NVD
	KEN 14/2006	Cattle	05.07.06	SAT 1	Positive	SAT 1
	KEN 1/2007	Cattle	02.03.07	NVD	Positive	FMDV GD
	KEN 2/2007	Cattle	16.04.07	SAT 2	Positive	SAT 2
	KEN 3/2007	Cattle	18.06.07	O	Positive	O
	KEN 4/2007	Cattle	25.06.07	SAT 2	Positive	SAT 2
	KEN 5/2007	Cattle	26.06.07	SAT 2	Positive	SAT 2
	KEN 6/2007	Cattle	28.06.07	NVD	Negative	NVD
	KEN 7/2007	Cattle	01.07.07	SAT 2	Positive	SAT 2
	KEN 8/2007	Cattle	09.07.07	SAT 2	Positive	SAT 2
	KEN 9/2007	Cattle	10.07.07	SAT 2	Positive	SAT 2
	KEN 10/2007	Cattle	16.07.07	SAT 2	Positive	SAT 2
	KEN 11/2007	Cattle	23.07.07	SAT 2	Positive	SAT 2
	KEN 12/2007	Cattle	23.07.07	O	Positive	O
KEN 13/2007	Cattle	25.07.07	SAT 2	Positive	SAT 2	
KEN 14/2007	Cattle	31.07.07	SAT 2	Positive	SAT 2	
KEN 15/2007	Cattle	03.08.07	NVD	Positive	FMDV GD	
KEN 16/2007	Cattle	00.08.07	SAT 2	Positive	SAT 2	

	KEN 17/2007	Cattle	30.08.07	O	Positive	O
	KEN 18/2007	Cattle	17.09.07	NVD	Positive	FMDV GD
	KEN 19/2007	Cattle	26.09.07	SAT 2	Positive	SAT 2
	KEN 20/2007	Cattle	01.10.07	O	Positive	O
	KEN 21/2007	Cattle	03.10.07	NVD	Positive	FMDV GD
	KEN 22/2007	Cattle	09.10.07	SAT 2	Positive	SAT 2
	KEN 23/2007	Cattle	13.11.07	SAT 2	Positive	SAT 2
	KEN 24/2007	Cattle	15.11.07	NVD	Positive	FMDV GD
	KEN 25/2007	Cattle	03.12.07	NVD	Positive	FMDV GD
	KEN 1/2008	Cattle	08.01.08	O	Positive	O
	KEN 2/2008	Cattle	08.01.08	SAT 2	Positive	SAT 2
	KEN 3/2008	Cattle	23.01.08	O	Positive	O
	KEN 4/2008	Cattle	06.02.08	O	Negative	O
	KEN 5/2008	Cattle	07.02.08	NVD	Negative	NVD
	KEN 6/2008	Cattle	07.02.08	NVD	Negative	NVD
	KEN 7/2008	Cattle	09.02.08	A	Positive	A
	KEN 8/2008	Cattle	19.02.08	A	Positive	A
	KEN 9/2008	Cattle	20.02.08	O	Positive	O
	KEN 10/2008	Cattle	22.02.08	O	Positive	O
	KEN 11/2008	Cattle	07.03.08	NVD	Positive	FMDV GD
	KEN 12/2008	Cattle	19.03.08	NVD	Positive	FMDV GD
	KEN 13/2008	Cattle	11.04.08	NVD	Positive	FMDV GD
	KEN 14/2008	Cattle	05.05.08	O	Positive	O
	KEN 15/2008	Cattle	00.05.08	O	Positive	O
	KEN 16/2008	Cattle	06.05.08	NVD	Positive	FMDV GD
NAMIBIA	NMB 1/2008	Cattle	00.00.08	SAT 2	Positive	SAT 2
NIGERIA	NIG 1/2007	Cattle	00.09.07	O	Positive	O
	NIG 2/2007	Cattle	00.09.07	SAT 2	Positive	SAT 2
	NIG 1/2008	Cattle	00.01.08	SAT 2	Positive	SAT 2
	NIG 2/2008	Cattle	00.01.08	SAT 2	Positive	SAT 2
	NIG 3/2008	Cattle	00.01.08	SAT 2	Positive	SAT 2
	NIG 4/2008	Cattle	00.01.08	SAT 2	Positive	SAT 2
	NIG 5/2008	Cattle	00.00.08	SAT 2	Positive	SAT 2
	NIG 6/2008	Cattle	00.00.08	SAT 2	Positive	SAT 2
	NIG 7/2008	Cattle	00.00.08	SAT 2	Positive	SAT 2
	NIG 8/2008	Cattle	00.02.08	SAT 2	Positive	SAT 2
	NIG 9/2008	Cattle	00.00.08	NVD	Negative	NVD
	NIG 10/2008	Cattle	00.00.08	NVD	Negative	NVD
PAKISTAN	PAK 68/2007	Buffalo	03.12.07	O	Positive	O
	PAK 69/2007	Buffalo	07.12.07	O	Positive	O
	PAK 70/2007	Buffalo	07.12.07	O	Positive	O
	PAK 71/2007	Cattle	08.12.07	O	Positive	O
	PAK 72/2007	Cattle	08.12.07	NVD	Negative	NVD
	PAK 73/2007	Cattle	08.12.07	A	Negative	A
	PAK 3/2008	Cattle	08.01.08	O	Positive	O
	PAK 4/2008	Cattle	21.01.08	NVD	Negative	NVD
	PAK 5/2008	Cattle	21.01.08	NVD	Negative	NVD
	PAK 6/2008	NK	24.01.08	O	Positive	O
SOMALIA	SOM 1/2007	Cattle	22.12.07	O	Positive	O
	SOM 2/2007	Cattle	23.12.07	O	Positive	O
	SOM 3/2007	Cattle	24.12.07	NVD	Positive	FMDV GD

	SOM 4/2007	Cattle	25.12.07	O	Positive	O
TURKEY	TUR 31/2007	Cattle	26.12.07	O	Positive	O
	TUR 1/2008	Cattle	10.01.08	A	Positive	A
	TUR 2/2008	Cattle	11.01.08	A	Positive	A
	TUR 3/2008	Cattle	14.01.08	A	Positive	A
	TUR 4/2008	Cattle	14.01.08	O	Positive	O
	TUR 5/2008	Cattle	15.01.08	O	Positive	O
	TUR 6/2008	Cattle	21.01.08	A	Positive	A
	TUR 7/2008	Cattle	31.01.08	A	Positive	A
	TUR 8/2008	Cattle	08.02.08	A	Positive	A
	TUR 9/2008	Cattle	08.02.08	O	Positive	O
	TUR 10/2008	Cattle	08.02.08	O	Positive	O
	TUR 11/2008	Cattle	16.02.08	A	Positive	A
	TUR 12/2008	Cattle	19.02.08	A	Positive	A
	TUR 13/2008	Cattle	19.02.08	A	Positive	A
	TUR 14/2008	Cattle	28.02.08	A	Positive	A
	TUR 15/2008	Cattle	02.03.08	NVD	Negative	NVD
	TUR 16/2008	Cattle	02.03.08	O	Positive	O
	TUR 17/2008	Cattle	04.03.08	A	Positive	A
	TUR 18/2008	Cattle	10.03.08	A	Positive	A
	TUR 19/2008	Cattle	11.03.08	A	Positive	A
	TUR 20/2008	Cattle	16.03.08	A	Positive	A
	TUR 21/2008	Cattle	20.02.08	A	Positive	A
	TUR 22/2008	Cattle	25.03.08	A	Positive	A
	TUR 23/2008	Cattle	27.03.08	A	Positive	A
	TUR 24/2008	Cattle	28.03.08	A	Positive	A
	TUR 25/2008	Cattle	04.04.08	O	Positive	O
	TUR 26/2008	Cattle	08.04.08	O	Positive	O
	TUR 27/2008	Cattle	10.04.08	A	Positive	A
	TUR 28/2008	Cattle	10.04.08	A	Positive	A
	TUR 29/2008	Cattle	14.04.08	A	Positive	A
	TUR 30/2008	Cattle	18.04.08	O	Positive	O
	TUR 31/2008	Cattle	06.05.08	NVD	Positive	FMDV GD
	TUR 32/2008	Cattle	06.06.08	A	Positive	A
	TUR 33/2008	Cattle	12.06.08	A	Positive	A
ZAMBIA	ZAM 1/2008	Cattle	NK	NVD	Negative	NVD
	ZAM 2/2008	Cattle	NK	NVD	Positive	FMDV GD
	ZAM 3/2008	Cattle	NK	NVD	Negative	NVD
	ZAM 4/2008	Cattle	NK	NVD	Positive	FMDV GD
	ZAM 5/2008	Cattle	NK	SAT 1	Positive	SAT 1
	ZAM 6/2008	Cattle	NK	SAT 1	Positive	SAT 1
	ZAM 7/2008	Cattle	NK	SAT 1	Positive	SAT 1
	ZAM 8/2008	Cattle	NK	SAT 2	Positive	SAT 2

**TOTAL: 138**

\* Institute for Animal Health, Pirbright Laboratory, Woking, Surrey GU24 0NF  
FMD(V) foot-and-mouth disease (virus)  
GD genome detected  
VI/ELISA FMDV serotype identified following virus isolation in cell culture and antigen ELISA  
RT-PCR reverse transcription polymerase chain reaction on epithelial suspension for FMD viral genome  
NVD no foot-and-mouth disease, swine vesicular disease or vesicular stomatitis virus detected  
NK not known



**TABLE B: Summary of samples collected and received to IAH-Pirbright (April-June 2008)**

Country	No. of samples	Virus isolation in cell culture/ELISA								SVD virus	NVD	RT-PCR for FMD (or SVD) virus (where appropriate)	
		FMD virus serotypes				Asia						Positive	Negative
		O	A	C	SAT 1	SAT 2	SAT 3	SAT 1					
BOTSWANA	6	-	-	-	-	6	-	-	-	-	6	-	
GABON	12	-	-	-	-	-	-	-	-	12	-	12	
IRAN	6	-	3	-	-	-	-	-	-	3	4	2	
KENYA	45	11	2	-	2	15	-	-	-	15	40	5	
NAMIBIA	1	-	-	-	-	1	-	-	-	-	1	-	
NIGERIA	12	1	-	-	-	9	-	-	-	2	10	2	
PAKISTAN	10	6	1	-	-	-	-	-	-	3	6	4	
SOMALIA	4	3	-	-	-	-	-	-	-	1	4	-	
TURKEY	34	9	23	-	-	-	-	-	-	2	33	1	
ZAMBIA	8	-	-	-	3	1	-	-	-	4	6	2	
<b>TOTAL</b>	<b>138</b>	<b>30</b>	<b>29</b>	<b>-</b>	<b>5</b>	<b>32</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>42</b>	<b>110</b>	<b>28</b>	

\* Institute for Animal Health, Pirbright Laboratory, Woking, Surrey GU24 0NF  
 VI/ELISA FMD (or SVD) virus serotype identified following virus isolation in cell culture and antigen detection ELISA  
 FMD foot-and-mouth disease  
 SVD swine vesicular disease  
 NVD no FMD, SVD or vesicular stomatitis virus detected  
 RT-PCR reverse transcription polymerase chain reaction for FMD (or SVD) viral genome

**TABLE C: Antigenic characterisation of FMD field isolates by matching with vaccine strains by VNT – r1 value data from 1<sup>st</sup> April to 30<sup>th</sup> June 2008**

Field isolates	TEST	r1 values for type O vaccine strains		
		O Manisa	BFS1860	O Ind R2/75
O Sau 1/2008	VNT	0.50	0.40	>0.80
O Pak 1/2008	VNT	0.67	0.73	>1.0
O Pak 2/2008	VNT	0.84	0.41	>1.0
O Pak 68/2007	VNT	0.55	0.40	0.66
O Pak 71/2007	VNT	0.39	0.18	0.49

Field isolates	TEST	r1 values for type SAT 1 vaccine strains
		Sat1 Rho 12/78
Sat1 Eth 3/2007	VNT	0.15
Sat1 Eth 18/2007	VNT	0.13
Sat1 Eth 21/2007	VNT	0.25
Sat1 Zam 7/2008	VNT	0.11

## **Interpretation of $r_1$ values**

### In the case of VNT:

$r_1 = \geq 0.3$ . Suggests that there is a close relationship between field isolate and vaccine strain. A potent vaccine containing the vaccine strain is likely to confer protection.

$r_1 = < 0.3$ . Suggests that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect

### In the case of ELISA:

$r_1 = 0.4-1.0$ . Suggests that there is a close relationship between field isolate and vaccine strain. A potent vaccine containing the vaccine strain is likely to confer protection.

$r_1 = 0.2-0.39$ , Suggests that the field isolate is antigenically related to the vaccine strain. The vaccine strain might be suitable for use if no closer match can be found provided that a potent vaccine is used and animals are preferably immunised more than once.

$r_1 = < 0.2$ . Suggests that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect

## Annex 2: Phylogenetic analysis of characterised FMDV isolates

Fig 1: FMD serotype O viruses characterised from Pakistan

Comparison of FMD type O viruses isolated from Pakistan between 2002 and 2008 (all viruses belong to the ME-SA topotype)

Software: MEGA 4.0  
 No. of Taxa : 120  
 Data File : n:\evd\meg\db\fmdv\o\PAKusman3.meg  
 Data Type : Nucleotide (Coding)  
 Analysis : Phylogeny reconstruction  
 Tree Inference : -----  
 ->Method : Neighbor-Joining  
 ->Phylogeny Test and options : Bootstrap (1000 replicates; seed=64238)  
 Include Sites : -----  
 ->Gaps/Missing Data : Pairwise Deletion  
 ->Codon Positions : 1st+2nd+3rd+Noncoding  
 Substitution Model : -----  
 ->Model : Nucleotide: Kimura 2-parameter  
 ->Substitutions to Include : d: Transitions + Transversions  
 ->Pattern among Lineages : Same (Homogeneous)  
 ->Rates among sites : Uniform rates  
 No. of Sites : 639  
 No Of Bootstrap Reps = 1000

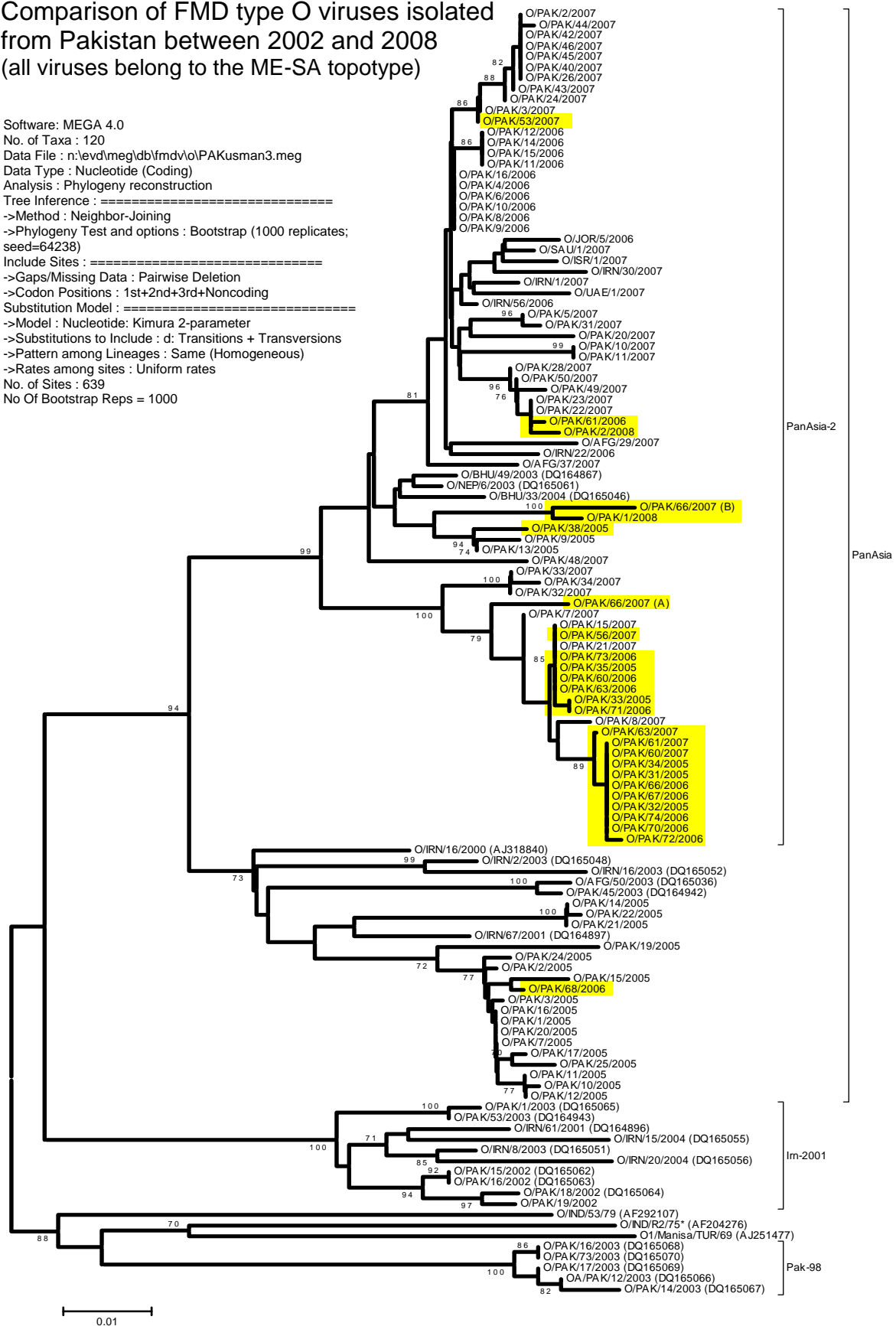


Fig 2: FMD serotype O viruses characterised from Saudi Arabia

Report on FMD type O viruses from Saudi Arabia in 2008

Software: MEGA 4.0  
 No. of Taxa : 166  
 Data File : n:\evd\meg\db\fmv\o\SAU2008b.meg  
 Data Title : Saudi Arabia 2008  
 Data Type : Nucleotide (Coding)  
 Analysis : Phylogeny reconstruction  
 Tree Inference : =====  
 ->Method : Neighbor-Joining  
 ->Phylogeny Test and options : Bootstrap (1000 replicates; seed=64843)  
 Include Sites : =====  
 ->Gaps/Missing Data : Pairwise Deletion  
 ->Codon Positions : 1st+2nd+3rd+Noncoding  
 Substitution Model : =====  
 ->Model : Nucleotide: Kimura 2-parameter  
 ->Substitutions to Include : d: Transitions + Transversions  
 ->Pattern among Lineages : Same (Homogeneous)  
 ->Rates among sites : Uniform rates  
 No. of Sites : 639  
 No Of Bootstrap Reps = 1000  
 Only bootstrap values of 70% and less are shown

\* , not a WRLFMD Ref. No.

N.J. Knowles, J. Wadsworth & K. Ebert, 12 June 2008

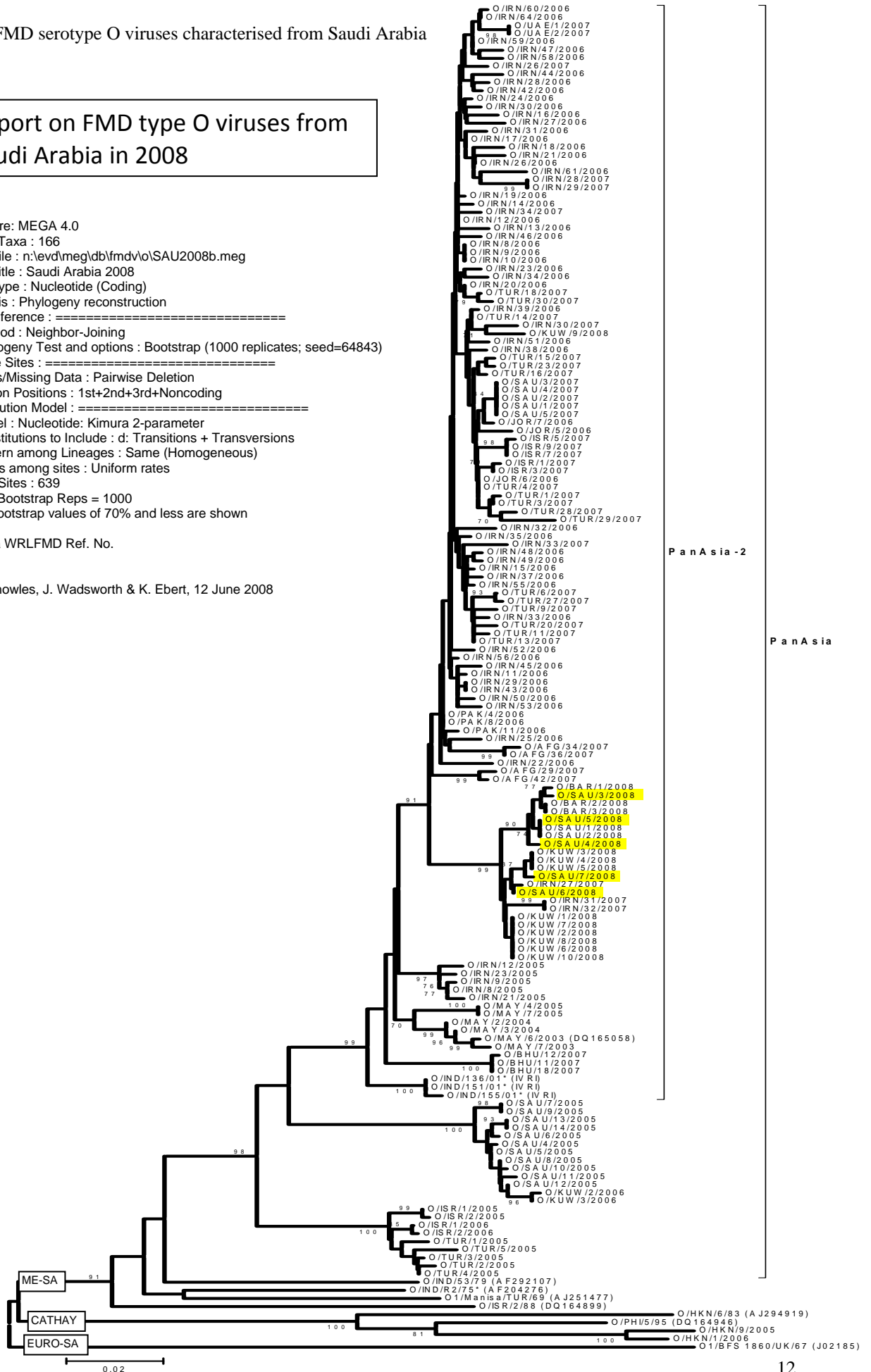


Fig 3: Recent serotype O viruses characterised from Turkey

**Report on FMD type O virus sequences from FMDI-Ankara received 26 June 2008**

No. of Taxa : 206  
 Data File : n:\evd\meg\db\fmdv\oTUR2008a.meg  
 Data Title : Turkey 2008 (FMDI-Ankara)  
 Data Type : Nucleotide (Coding)  
 Analysis : Phylogeny reconstruction  
 Tree Inference : =====  
 ->Method : Neighbor-Joining  
 ->Phylogeny Test and options : Bootstrap (1000 replicates; seed=64238)  
 Include Sites : =====  
 ->Gaps/Missing Data : Pairwise Deletion  
 ->Codon Positions : 1st+2nd+3rd+Noncoding  
 Substitution Model : =====  
 ->Model : Nucleotide: Kimura 2-parameter  
 ->Substitutions to Include : d: Transitions + Transversions  
 ->Pattern among Lineages : Same (Homogeneous)  
 ->Rates among sites : Uniform rates  
 No. of Sites : 639  
 No Of Bootstrap Reps = 1000  
 Only bootstrap values of 70% and less are shown

\* , not a WRLFMD Ref. No.

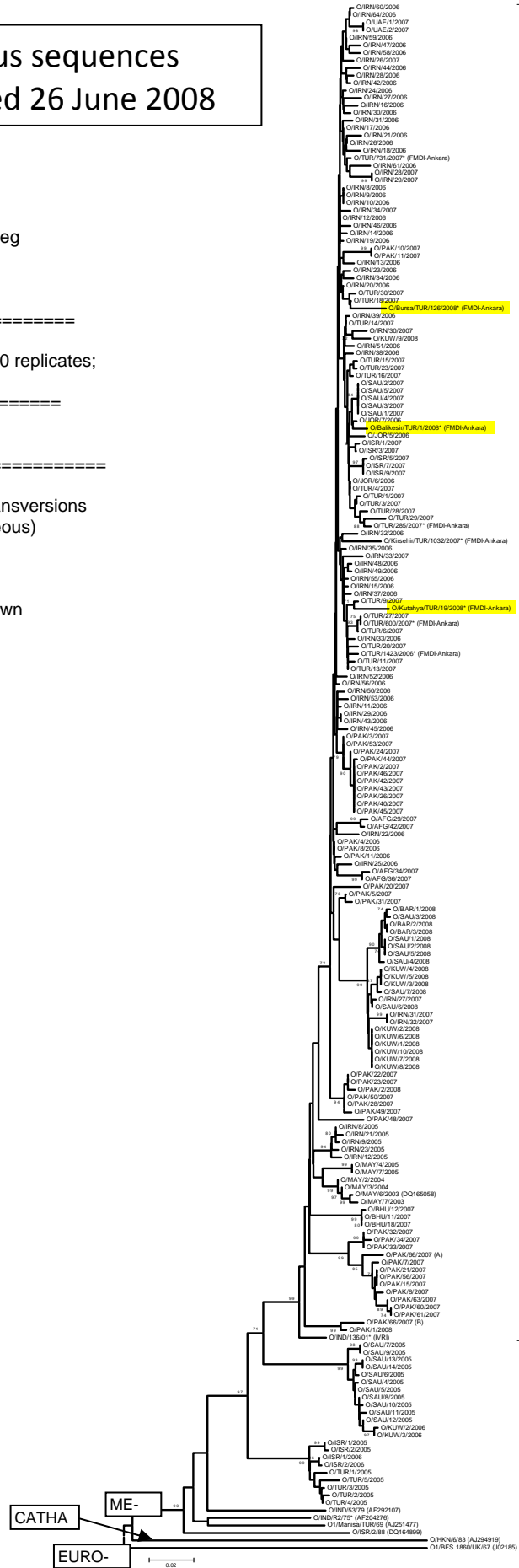


Fig 4: Recent FMD serotype A viruses characterised from Turkey

**Report on FMDV type A VP1 sequences from FMDI-Ankara, received 26 June 2008**

No. of Taxa : 153  
 Data File : n:\evd\meg\db\fmdv\A\tur2008a.meg  
 Data Title : Turkey (FMDI-Ankara)  
 Data Type : Nucleotide (Coding)  
 Analysis : Phylogeny reconstruction  
 Tree Inference : =====  
 ->Method : Neighbor-Joining  
 ->Phylogeny Test and options : Bootstrap (1000 replicates; seed=69104)  
 Include Sites : =====  
 ->Gaps/Missing Data : Pairwise Deletion  
 ->Codon Positions : 1st+2nd+3rd+Noncoding  
 Substitution Model : =====  
 ->Model : Nucleotide: Kimura 2-parameter  
 ->Substitutions to Include : d: Transitions + Transversions  
 ->Pattern among Lineages : Same (Homogeneous)  
 ->Rates among sites : Uniform rates  
 No. of Sites : 645  
 No Of Bootstrap Reps = 1000  
 Only bootstrap values of 70% and above are shown

\* , not a WRLFMD Reference Number

N.J. Knowles, J. Wadsworth and K. Ebert, 26 June 2008

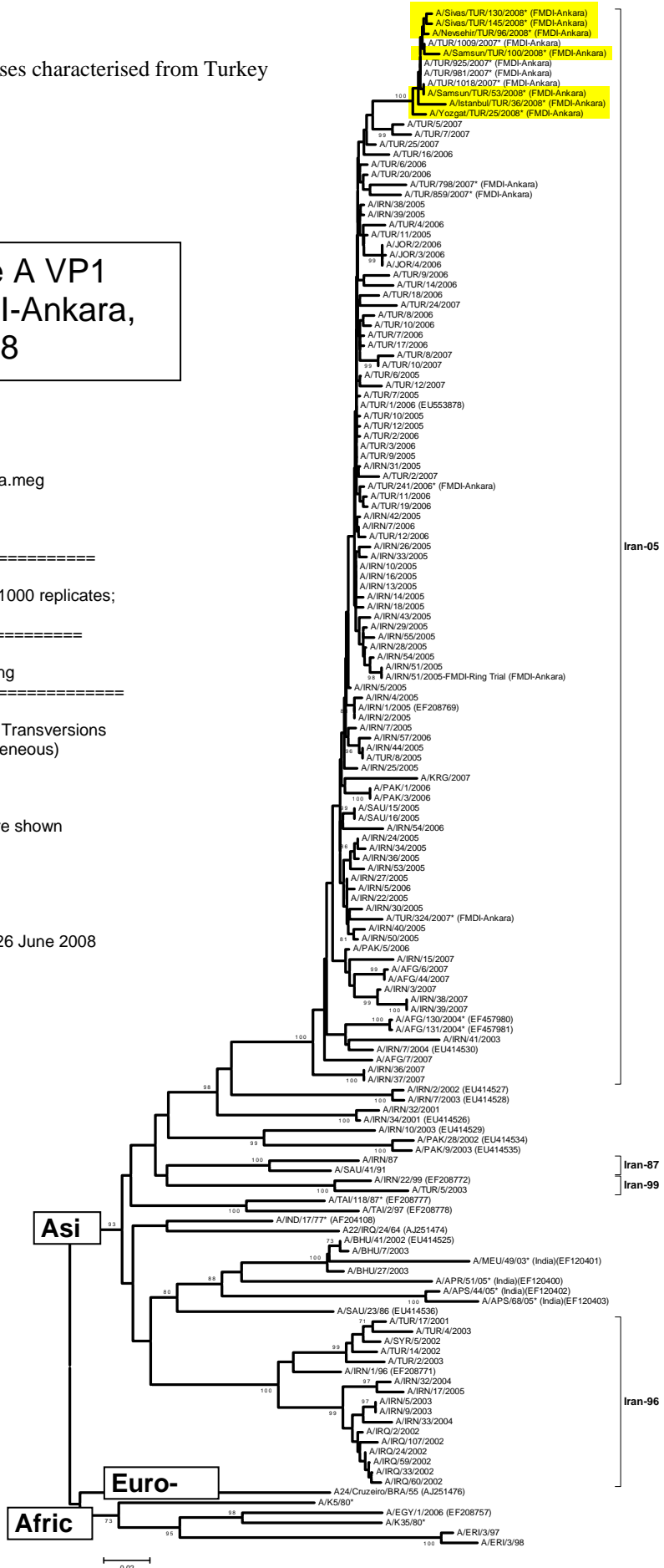


Fig 5: Recent FMDV serotype O viruses characterised from Ethiopia

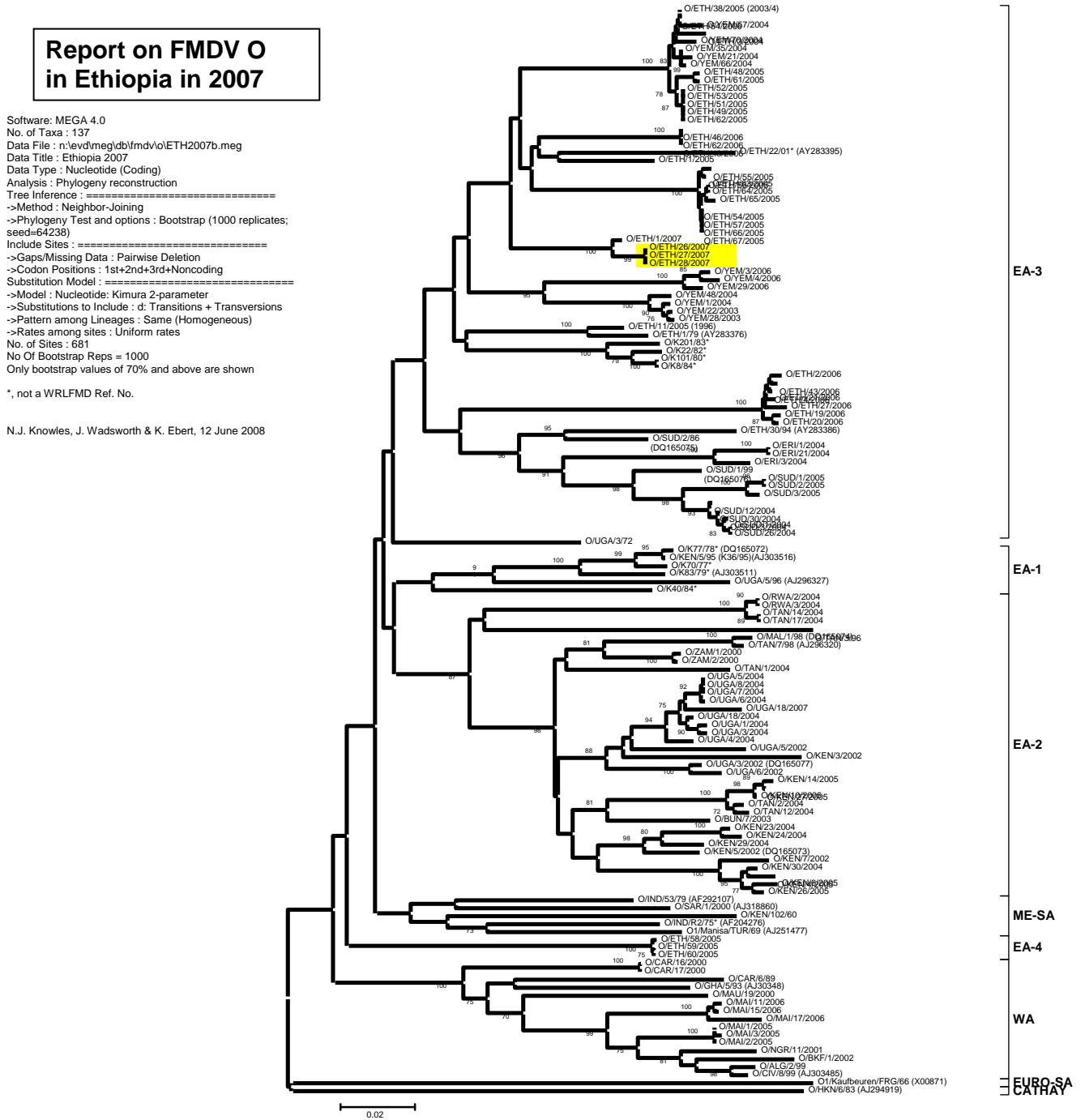


Fig 6: Recent FMD serotype SAT1 viruses characterised from Ethiopia

## Report on FMDV SAT 1 from Ethiopia in 2007

No. of Taxa : 107  
 Data File : n:\evd\meg\db\fmv\sat1\ETH2007b.meg  
 Data Title : SAT1 Ethiopia 2007  
 Data Type : Nucleotide (Coding)  
 Analysis : Phylogeny reconstruction  
 Tree Inference : =====  
 ->Method : Neighbor-Joining  
 ->Phylogeny Test and options : Bootstrap (1000 replicates;  
 seed=64238)  
 Include Sites : =====  
 ->Gaps/Missing Data : Pairwise Deletion  
 ->Codon Positions : 1st+2nd+3rd+Noncoding  
 Substitution Model : =====  
 ->Model : Nucleotide: Kimura 2-parameter  
 ->Substitutions to Include : d: Transitions + Transversions  
 ->Pattern among Lineages : Same (Homogeneous)  
 ->Rates among sites : Uniform rates  
 No. of Sites : 663  
 No Of Bootstrap Reps = 1000  
 Only bootstrap values of 70% and above are shown

\*, not a WRLFMD Ref. No.

N. M. K... J. Mad... B. K. E... 24 April 2008

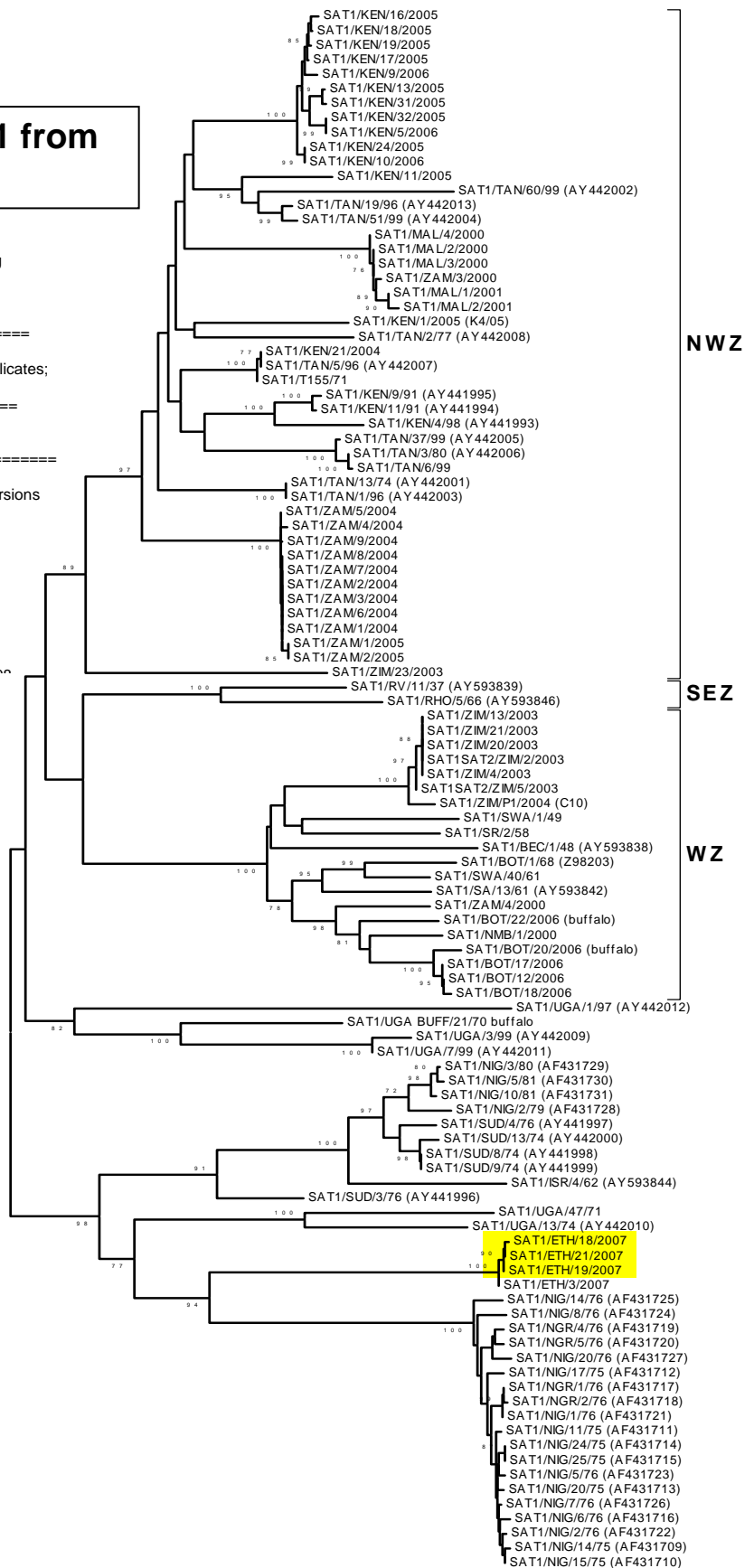




Fig 7: Recent SAT 1 viruses characterised from Zambia

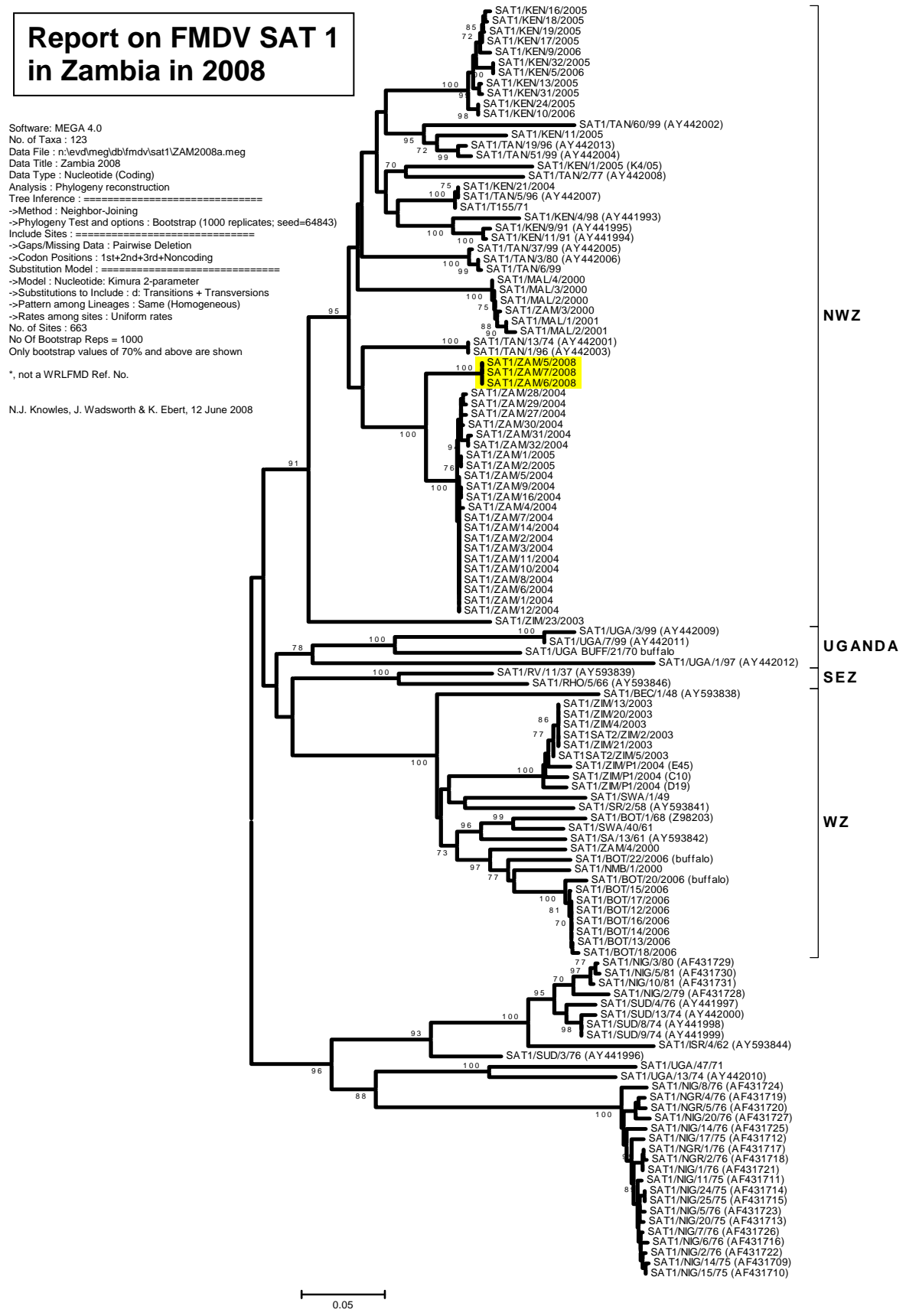


Fig 8: Recent serotype SAT2 virus characterised from Zambia

## Report on FMDV SAT2 in Zambia in 2008

Software: MEGA 4.0  
 No. of Taxa : 159  
 Data File : n:\evd\meg\db\fmdv\sat2\ZAM2008a.meg  
 Data Title : Zambia 2008  
 Data Type : Nucleotide (Coding)  
 Analysis : Phylogeny reconstruction  
 Tree Inference : =====  
 ->Method : Neighbor-Joining  
 ->Phylogeny Test and options : Bootstrap (1000 replicates; seed=84007)  
 Include Sites : =====  
 ->Gaps/Missing Data : Pairwise Deletion  
 ->Codon Positions : 1st+2nd+3rd+Noncoding  
 Substitution Model : =====  
 ->Model : Nucleotide: Kimura 2-parameter  
 ->Substitutions to Include : d: Transitions + Transversions  
 ->Pattern among Lineages : Same (Homogeneous)  
 ->Rates among sites : Uniform rates  
 No. of Sites : 648  
 No Of Bootstrap Reps = 1000  
 Only bootstrap values of 70% and above are shown

\* , not a WRLFMD reference number

N.J. Knowles, J. Wadsworth & K. Ebert, 12 June 2008



### Annex 3. Recent FMD Publications cited by PubMed

- 1: Valarcher JF, Gloster J, Doel CA, Bankowski B, Gibson D. Foot-and-mouth disease virus (O/UKG/2001) is poorly transmitted between sheep by the airborne route. *Vet J.* 2008 Sep;177(3):425-8. Epub 2007 Jul 12.
- 2: Martínez-López B, Perez AM, De la Torre A, Rodriguez JM. Quantitative risk assessment of foot-and-mouth disease introduction into Spain via importation of live animals. *Prev Vet Med.* 2008 Aug 15;86(1-2):43-56. Epub 2008 Apr 21.
- 3: Choudary S, Ravikumar P, Ashok Kumar C, Suryanarayana VV, Reddy GR. Enhanced immune response of DNA vaccine (VP1-pCDNA) adsorbed on cationic PLG for foot and mouth disease in guinea pigs. *Virus Genes.* 2008 Aug;37(1):81-7. Epub 2008 May 31.
- 4: Rana SK, Bagchi T. Partial sequence analysis of VP1 of Indian isolates of foot-and-mouth disease virus type Asia-1. *Virus Genes.* 2008 Aug;37(1):60-8. Epub 2008 May 30.
- 5: Kim SM, Lee KN, Park JY, Ko YJ, Joo YS, Kim HS, Park JH. Therapeutic application of RNA interference against foot-and-mouth disease virus in vitro and in vivo. *Antiviral Res.* 2008 Jul 1. [Epub ahead of print]
- 6: Perez AM, König G, Späth E, Thurmond MC. Variation in the VP1 gene of Foot-and-mouth disease virus serotype A associated with epidemiological characteristics of outbreaks in the 2001 epizootic in Argentina. *J Vet Diagn Invest.* 2008 Jul;20(4):433-9.
- 7: Harwood LJ, Gerber H, Sobrino F, Summerfield A, McCullough KC. Dendritic cell internalization of foot-and-mouth disease virus: influence of heparan sulfate binding on virus uptake and induction of the immune response. *J Virol.* 2008 Jul;82(13):6379-94. Epub 2008 Apr 30.
- 8: Cubillos C, de la Torre BG, Jakab A, Clementi G, Borrás E, Bárcena J, Andreu D, Sobrino F, Blanco E. Enhanced mucosal immunoglobulin A response and solid protection against foot-and-mouth disease virus challenge induced by a novel dendrimeric peptide. *J Virol.* 2008 Jul;82(14):7223-30. Epub 2008 Apr 30.
- 9: Muller JD, McEachern JA, Bossart KN, Hansson E, Yu M, Clavijo A, Hammond JM, Wang LF. Serotype-independent detection of foot-and-mouth disease virus. *J Virol Methods.* 2008 Jul;151(1):146-53. Epub 2008 Apr 25.
- 10: Muthukrishnan M, Singanallur NB, Ralla K, Villuppanoor SA. Evaluation of FTA((R)) cards as a laboratory and field sampling device for the detection of foot-and-mouth disease virus and serotyping by RT-PCR and real-time RT-PCR. *J Virol Methods.* 2008 Jun 25. [Epub ahead of print]
- 11: Yang M, Holland H, Clavijo A. Production of monoclonal antibodies against whole virus particles of foot-and-mouth disease virus serotype O and A and their potential use in quantification of intact virus for vaccine manufacture. *Vaccine.* 2008 Jun 25;26(27-28):3377-82. Epub 2008 May 15.
- 12: Parida S, Fleming L, Oh Y, Mahapatra M, Hamblin P, Gloster J, Paton DJ. Emergency vaccination of sheep against foot-and-mouth disease: Significance and detection of subsequent sub-clinical infection. *Vaccine.* 2008 Jun 25;26(27-28):3469-79. Epub 2008 May 2.
- 13: Lin G, Cai Z, Wu J, Wan XF, Xu L, Goebel R. Identifying a few foot-and-mouth disease virus signature nucleotide strings for computational genotyping. *BMC Bioinformatics.* 2008 Jun 13;9:279.
- 14: Fan ZC, Bird RC. Generation and characterization of an N(pro)-disrupted marker bovine viral diarrhoea virus derived from a BAC cDNA. *J Virol Methods.* 2008 Jun 12. [Epub ahead of print]
- 15: Bronsvort BM, Parida S, Handel I, McFarland S, Fleming L, Hamblin P, Kock R. Serological survey for foot-and-mouth disease virus in wildlife in eastern Africa and estimation of test parameters of a nonstructural protein enzyme-linked immunosorbent assay for buffalo. *Clin Vaccine Immunol.* 2008 Jun;15(6):1003-11. Epub 2008 Apr 2.

- 16: Grubman MJ, Moraes MP, Diaz-San Segundo F, Pena L, de los Santos T. Evading the host immune response: how foot-and-mouth disease virus has become an effective pathogen. *FEMS Immunol Med Microbiol.* 2008 Jun;53(1):8-17. Epub 2008 Apr 8.
- 17: Li Z, Yi Y, Yin X, Zhang Z, Liu J. Expression of foot-and-mouth disease virus capsid proteins in silkworm-baculovirus expression system and its utilization as a subunit vaccine. *PLoS ONE.* 2008 May 28;3(5):e2273.
- 18: Dekker A, Sammin D, Greiner M, Bergmann I, Paton D, Grazioli S, de Clercq K, Brocchi E. Use of continuous results to compare ELISAs for the detection of antibodies to non-structural proteins of foot-and-mouth disease virus. *Vaccine.* 2008 May 23;26(22):2723-32. Epub 2008 Apr 11.
- 19: Greenwood DL, Dynon K, Kalkanidis M, Xiang S, Plebanski M, Scheerlinck JP. Vaccination against foot-and-mouth disease virus using peptides conjugated to nano-beads. *Vaccine.* 2008 May 23;26(22):2706-13. Epub 2008 Apr 3.
- 20: Li X, Liu R, Tang H, Jin M, Chen H, Qian P. Induction of protective immunity in swine by immunization with live attenuated recombinant pseudorabies virus expressing the capsid precursor encoding regions of foot-and-mouth disease virus. *Vaccine.* 2008 May 23;26(22):2714-22. Epub 2008 Apr 1.
- 21: Fosgate GT, Tavornpanich S, Hunter D, Pugh R, Sterle JA, Schumann KR, Eberling AJ, Beckham TR, Martin BM, Clarke NP, Adams LG. Diagnostic specificity of a real-time RT-PCR in cattle for foot-and-mouth disease and swine for foot-and-mouth disease and classical swine fever based on non-invasive specimen collection. *Vet Microbiol.* 2008 May 20. [Epub ahead of print]
- 22: Mohan MS, Gajendragad MR, Gopalakrishna S, Singh N. Comparative study of experimental Foot-and-Mouth Disease in cattle (*Bos indicus*) and buffaloes (*Bubalis bubalus*). *Vet Res Commun.* 2008 May 20. [Epub ahead of print]
- 23: Li Y, Stirling CM, Denyer MS, Hamblin P, Hutchings G, Takamatsu HH, Barnett PV. Dramatic improvement in FMD DNA vaccine efficacy and cross-serotype antibody induction in pigs following a protein boost. *Vaccine.* 2008 May 19;26(21):2647-56. Epub 2008 Feb 12.
- 24: Martín-Acebes MA, González-Magaldi M, Rosas MF, Borrego B, Brocchi E, Armas-Portela R, Sobrino F. Subcellular distribution of swine vesicular disease virus proteins and alterations induced in infected cells: a comparative study with foot-and-mouth disease virus and vesicular stomatitis virus. *Virology.* 2008 May 10;374(2):432-43. Epub 2008 Feb 14.
- 25: Wang X, Zhang X, Kang Y, Jin H, Du X, Zhao G, Yu Y, Li J, Su B, Huang C, Wang B. Interleukin-15 enhance DNA vaccine elicited mucosal and systemic immunity against foot and mouth disease virus. *Vaccine.* 2008 May 5. [Epub ahead of print]
- 26: Oem JK, Yeh MT, McKenna TS, Hayes JR, Rieder E, Giuffre AC, Robida JM, Lee KN, Cho IS, Fang X, Joo YS, Park JH. Pathogenic characteristics of the Korean 2002 isolate of foot-and-mouth disease virus serotype O in pigs and cattle. *J Comp Pathol.* 2008 May;138(4):204-14. Epub 2008 Apr 1.
- 27: Mayer C, Neubauer D, Nchinda AT, Cencic R, Trompf K, Skern T. Residue L143 of the foot-and-mouth disease virus leader proteinase is a determinant of cleavage specificity. *J Virol.* 2008 May;82(9):4656-9. Epub 2008 Feb 27.
- 28: Harmsen MM, Fijten HP, Dekker A, Eblé PL. Passive immunization of pigs with bispecific llama single-domain antibody fragments against foot-and-mouth disease and porcine immunoglobulin. *Vet Microbiol.* 2008 Apr 30. [Epub ahead of print]
- 29: Klein J, Hussain M, Ahmad M, Afzal M, Alexandersen S. Epidemiology of foot-and-mouth disease in Landhi Dairy Colony, Pakistan, the world largest Buffalo colony. *Virol J.* 2008 Apr 29;5:53.
- 30: Du Y, Dai J, Li Y, Li C, Qi J, Duan S, Jiang P. Immune responses of recombinant adenovirus co-expressing VP1 of foot-and-mouth disease virus and porcine interferon alpha in mice and guinea pigs. *Vet Immunol Immunopathol.* 2008 Apr 22. [Epub ahead of print]

- 31: Thongyoo P, Roqué-Rosell N, Leatherbarrow RJ, Tate EW. Chemical and biomimetic total syntheses of natural and engineered MCoTI cyclotides. *Org Biomol Chem*. 2008 Apr 21;6(8):1462-70. Epub 2008 Mar 6.
- 32: Su B, Wang J, Wang X, Jin H, Zhao G, Ding Z, Kang Y, Wang B. The effects of IL-6 and TNF-alpha as molecular adjuvants on immune responses to FMDV and maturation of dendritic cells by DNA vaccination. *Vaccine*. 2008 Apr 21. [Epub ahead of print]
- 33: Cottam EM, Wadsworth J, Shaw AE, Rowlands RJ, Goatley L, Maan S, Maan NS, Mertens PP, Ebert K, Li Y, Ryan ED, Juleff N, Ferris NP, Wilesmith JW, Haydon DT, King DP, Paton DJ, Knowles NJ. Transmission pathways of foot-and-mouth disease virus in the United Kingdom in 2007. *PLoS Pathog*. 2008 Apr 18;4(4):e1000050.
- 34: Rana SK, Bagchi T. Development and characterization of monoclonal antibodies against FMD virus type Asia-1 and determination of antigenic variations in the field strains. *Vet Immunol Immunopathol*. 2008 Apr 15;122(3-4):241-9. Epub 2008 Jan 16.
- 35: Yao Q, Huang Q, Cao Y, Qian P, Chen H. Porcine interferon-gamma protects swine from foot-and-mouth disease virus (FMDV). *Vet Immunol Immunopathol*. 2008 Apr 15;122(3-4):309-11. Epub 2007 Oct 2.
- 36: Hollister JR, Vagnozzi A, Knowles NJ, Rieder E. Molecular and phylogenetic analyses of bovine rhinovirus type 2 shows it is closely related to foot-and-mouth disease virus. *Virology*. 2008 Apr 10;373(2):411-25. Epub 2008 Jan 16.
- 37: Fowler VL, Paton DJ, Rieder E, Barnett PV. Chimeric foot-and-mouth disease viruses: evaluation of their efficacy as potential marker vaccines in cattle. *Vaccine*. 2008 Apr 7;26(16):1982-9. Epub 2008 Feb 22.
- 38: Du Y, Li Y, He H, Qi J, Jiang W, Wang X, Tang B, Cao J, Wang X, Jiang P. Enhanced immunogenicity of multiple-epitopes of foot-and-mouth disease virus fused with porcine interferon alpha in mice and protective efficacy in guinea pigs and swine. *J Virol Methods*. 2008 Apr;149(1):144-52. Epub 2008 Feb 21.
- 39: Rhyan J, Deng M, Wang H, Ward G, Gidlewski T, McCollum M, Metwally S, McKenna T, Wainwright S, Ramirez A, Mebus C, Salman M. Foot-and-mouth disease in North American bison (*Bison bison*) and elk (*Cervus elaphus nelsoni*): susceptibility, intra- and interspecies transmission, clinical signs, and lesions. *J Wildl Dis*. 2008 Apr;44(2):269-79.
- 40: Tenzin, Dekker A, Vernooij H, Bouma A, Stegeman A. Rate of foot-and-mouth disease virus transmission by carriers quantified from experimental data. *Risk Anal*. 2008 Apr;28(2):303-9.
- 41: Chénard G, Selman P, Dekker A. Cedivac-FMD can be used according to a marker vaccine principle. *Vet Microbiol*. 2008 Apr 1;128(1-2):65-71. Epub 2007 Oct 16.
- 42: Schumann KR, Knowles NJ, Davies PR, Midgley RJ, Valarcher JF, Raoufi AQ, McKenna TS, Hurtle W, Burans JP, Martin BM, Rodriguez LL, Beckham TR. Genetic characterization and molecular epidemiology of foot-and-mouth disease viruses isolated from Afghanistan in 2003-2005. *Virus Genes*. 2008 Apr;36(2):401-13. Epub 2008 Feb 16.
- 43: He Y, Qian P, Zhang K, Yao Q, Wang D, Xu Z, Wu B, Jin M, Xiao S, Chen H. Construction and immune response characterization of a recombinant pseudorabies virus co-expressing capsid precursor protein (P1) and a multiepitope peptide of foot-and-mouth disease virus in swine. *Virus Genes*. 2008 Apr;36(2):393-400. Epub 2008 Feb 2.
- 44: DU JZ, Gao SD, Chang HY, Cong GZ, Lin T, Shao JJ, Liu XT, Cai XP. [Gene cloning of ligand binding domain of porcine beta3 as FMDV receptor and preparation of its polyclonal antibody.] *Xi Bao Yu Fen Zi Mian Yi Xue Za Zhi*. 2008 Apr;24(4):358-61. Chinese.

## Annex 4. RECOMMENDATIONS FROM THE WRL ON FMD VIRUS STRAINS TO BE INCLUDED IN FMDV ANTIGEN BANKS – December 2007

### High Priority

O Manisa (*covers panasian topotype*)  
O BFS or Campos  
A24 Cruzeiro  
Asia 1 Shamir  
A Iran '96  
A22 Iraq  
SAT 2 Saudi Arabia (*or equivalent*)  
(not in order of importance)

### Medium Priority

A Eritrea  
SAT 2 Zimbabwe  
A Iran 87 or A Saudi Arabia 23/86 (*or equivalent*)  
SAT 1 South Africa  
A Malaysia 97 (*or Thai equivalent such as A/NPT/TAI/86*)  
A Argentina 2001  
O Taiwan 97 (*pig-adapted strain or Philippine equivalent*)  
A Iran '99 (not in order of importance)

### Low Priority

A15 Bangkok related strain  
A87 Argentina related strain  
C Noville  
SAT 2 Kenya  
SAT 1 Kenya  
SAT 3 Zimbabwe  
A Kenya (not in order of importance)