

# NFI applies new DVI software

## Software based on Bayesian networks assists in DVI following the crash of Afriqiyah Airways Flight 8U771 near Tripoli, Libya

C.J. van Dongen, C. van Kooten, A.J. Kal, K. Slooten, M. Slagter (Netherlands Forensic Institute, The Hague, the Netherlands), W. Burgers, W. Wiegerinck (SNN Adaptive Intelligence, Nijmegen, the Netherlands)

### Introduction

On May 12<sup>th</sup> 2010, Afriqiyah Airways Flight 8U771 crashed upon landing near Tripoli International Airport, Libya, claiming 103 lives and leaving a sole survivor, a young child. The majority of the victims, 70 in all, were Dutch nationals. Among the victims were a number of blood-relatives. Five days after the crash, the Netherlands Forensic Institute (NFI) was formally requested by both the Libyan authorities and the Netherlands Ministry of Foreign Affairs to assist with the Disaster Victim Identification (DVI) process. *Bonaparte DVI*, a newly developed software package based on Bayesian networks, was used in the screening and matching process.



Photo 1. Crash site in Tripoli, Libya.

### Materials (post mortem (PM) and ante mortem (AM) samples)

The NFI received:

- soft (muscle) and hard (bone and tooth) tissue samples from 149 bodies or body parts
- 25 personal items (clothes, razor blades etc) belonging to 11 missing persons (MPs)
- 195 reference samples (mostly buccal swabs) from relatives of 76 missing persons
- 16 DNA profiles of missing persons and/or relatives of 7 missing persons typed in foreign labs

In total we received reference samples from (relatives of) 84 missing persons. We received no reference samples pertaining to 19 of the 33 non-Dutch national missing persons.

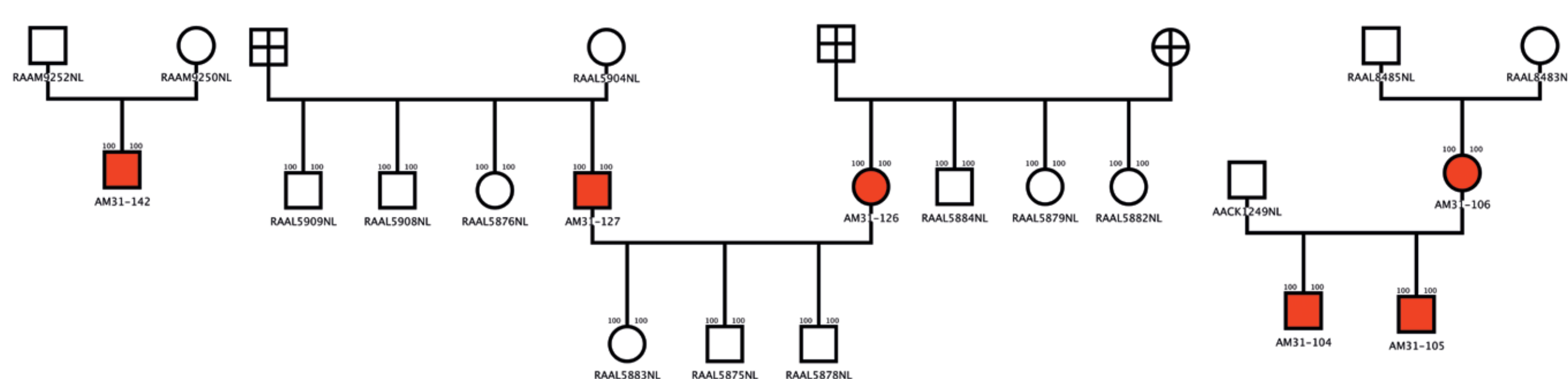


Figure 1. Examples of pedigrees with one, two and three MPs.

### Methods

For DNA typing we used the QiaAmp isolation method (Qiagen), real-time quantification (ABI) and the Identifiler kit (ABI) to obtain DNA-profiles containing 15 autosomal loci and amelogenin. The buccal swabs were processed by a robot line. Upon delivery at the NFI the samples were processed and DNA profiles obtained within a period of 3-5 days. The *Bonaparte DVI* software was used for the screening and matching. Most match reports were issued the same day.

### Software

Bonaparte DVI software:

- uses statistical graphical models, so-called Bayesian networks, to model statistical relationships of genetic material of relatives in a pedigree
- uses information from the entire pedigree (resulting in fewer false hits)
- is transparent (for example, models implemented in Bonaparte are available to users)
- is flexible (allowing to incorporate other factors such as mutation models, size bias correction, missing data etc)
- is user-friendly (automatic import of DNA-profiles, 'drag and drop' pedigree editor etc)

During the identification process Bonaparte DVI software was a reliable and time-saving tool that significantly simplified and sped up the entire investigation.

### Results

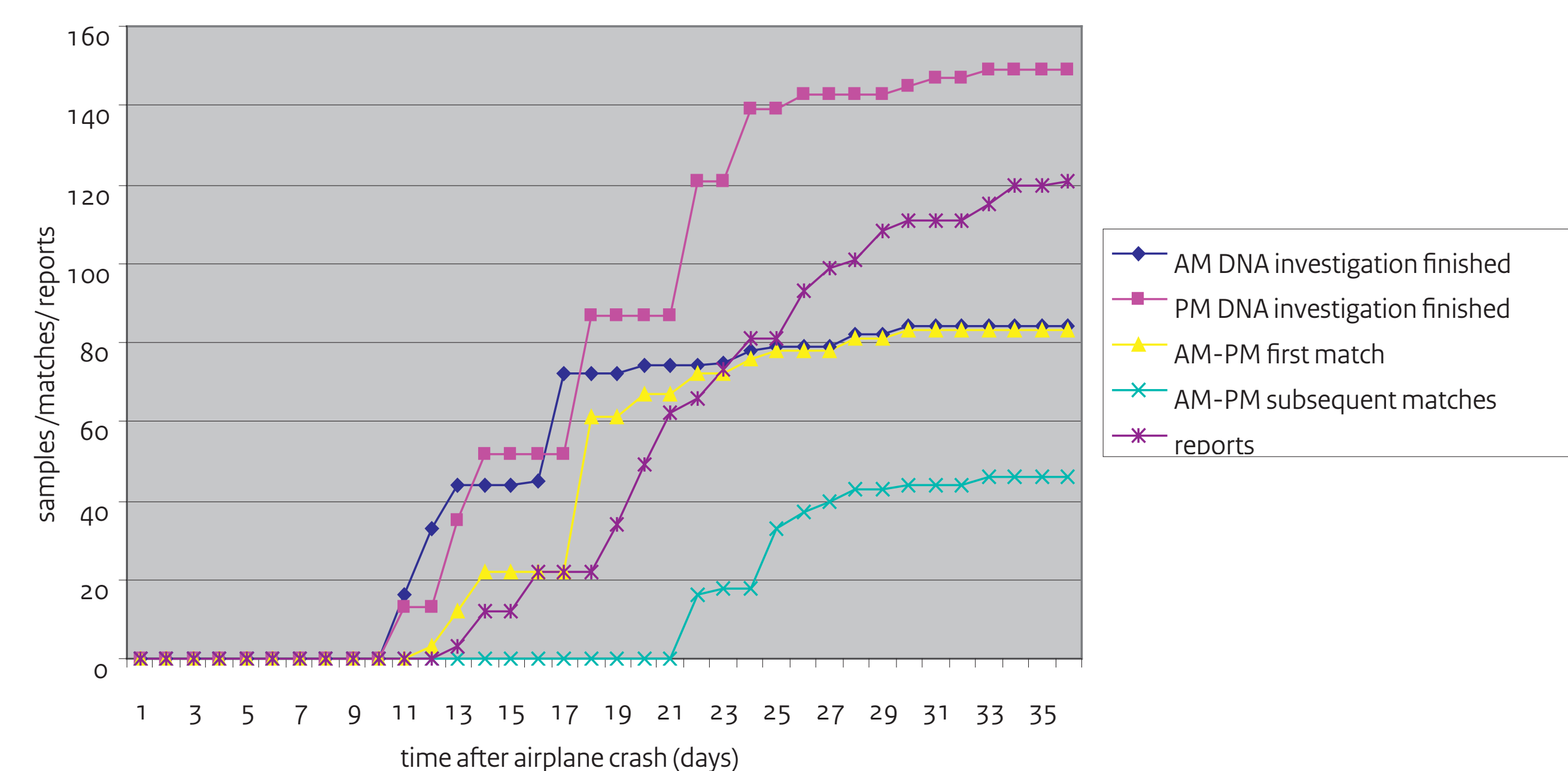


Figure 2. Results in chronological order following the crash.

Table 1. Results of the DVI process.

	number of pedigrees	total number of FMs	lowest number of FMs per pedigree	highest number of FMs per pedigree	average number FMs per pedigree	FMs/MP	lowest LR found with pedigrees <sup>a</sup>	highest LR found with pedigrees	median LR found with pedigrees	Number of PEs used for matching <sup>b</sup>
1 MP per pedigree	37	77	0	7	2.1	2.1	$2.3 \cdot 10^1$	$7.0 \cdot 10^{20}$	$3.1 \cdot 10^{11}$	8 (6) <sup>c</sup>
2 MPs per pedigree	15	101	1	13	6.7	3.4	$4.4 \cdot 10^5$	$8.4 \cdot 10^{20}$	$6.4 \cdot 10^{14}$	2
3 MPs per pedigree	3	11	3	5	3.7	1.2	$1.4 \cdot 10^5$	$8.3 \cdot 10^{18}$	-	3
4 MPs per pedigree	2	6	2	4	3.0	0.8	$9.7 \cdot 10^4$	$1.4 \cdot 10^{14}$	-	3
<b>total</b>	<b>57</b>	<b>195</b>	-	-	<b>3.4</b>	<b>2.3</b>	-	-	-	<b>16</b>

a: A Dutch reference database was used for the calculations of the LR

b: All PEs matched with PM material

c: DNA profiles of PEs typed in foreign labs.

### Conclusion

The total identification process took 26 days, 129 bodies or body parts were matched to a missing person using the Bonaparte DVI software. The point in time at which the AM and PM samples were received by the NFI caused a slight delay in the DNA identification process as a whole.

More information about Bonaparte DVI: [www.dnadvi.nl](http://www.dnadvi.nl)

