

Missing Migrant DNA Database (MMDD) Project

Elizabeth Wood
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Missing Persons

- Individual Cases
- Mass Fatalities

Yugoslav Wars 1991-2001

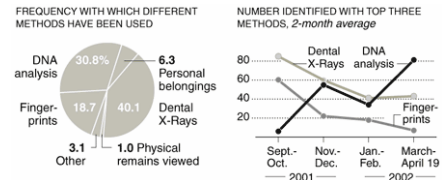
- Series of violent conflicts in the territory of the former Socialist Federal Republic of Yugoslavia
- 40,000 missing following the cessation of conflicts
- Identifications made by the International Commission on Missing Persons (ICMP)
- 13,455 individuals using DNA



Source: International Commission on Missing Persons

WTC Disaster - 9/11 Attacks

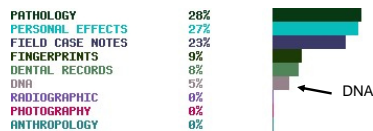
- ~3,000 Victims
- 972 (34.4%) identified
- Identifications made by NYC Office of the Chief Medical Examiner



Source: Office of Chief Medical Examiner
http://www.september11victims.com/september11victims/wtc_statistics.htm

Hurricane Katrina

- Storm formed on August 23, 2005
- ~1,800 died
- ~60 individuals identified using DNA
- 205 DNA samples examined by the ICMP



Source: Louisiana Department of Health and Hospitals
<http://www.dhh.louisiana.gov/offices/page.asp?ID=303&Detail=7048>
Source: International Commission on Missing Persons

Indian Ocean Earthquake

- December 26, 2004
- >200,000 Individuals died
- ~1,700 bone samples
- 902 identified using DNA
- International Commission on Missing Persons (ICMP) performed the identification



Source: International Commission on Missing Persons

Holocaust Victims



- DNA Shoah Project
 - DNA profile victims including mass graves unearthed
 - Match to surviving family members
 - Develop multi-level, science-based curricula for teaching about the Holocaust
- Laboratory: University of Arizona GATC



The Missing Migrant DNA Database (MMDD) Project

- Background
- Missing persons / Undocumented Border Crossers (UBCs)
- Markers
- Missing Migrant DNA Database
- University of North Texas Center for Human Identification (UNTCHI)

Arizona-Sonora Border in 1853

- The Treaty of Guadalupe Hidalgo (1848) incorporated the states of CA, NV, UT, AZ and parts of WY, CO, NM
- The Gadsden Purchase 1853 incorporated the region including Pima County into the US, to allow for the construction of a southern transcontinental railway.



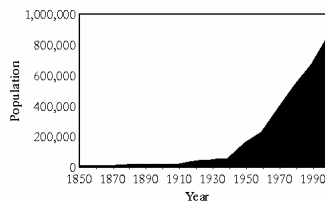
Migration

- In 1880, the Southern Pacific Railway reaches Tucson allowing for greater migration into the area
- The University of Arizona was founded in 1885
- Arizona becomes a state in 1912



Population Growth in Pima County

- In 1880, the population was ~8,000
- In 2006, the population is estimated to be ~950,000



http://ag.arizona.edu/AZWATER/publications/sustainability/report.html/full_img/ch2_05.gif

US attempts to reduce migration coming from Mexico

- In the mid-1990s, the US government implement a program of "prevention through deterrence" to curb immigration
- Resulted in
 - the militarization of the border through border barriers, fortified checkpoints, high-tech forms of surveillance, and additional Border Patrol agents
 - a 5-fold increase in border enforcement expenditures



Border Fences

- 70 miles (60 in Arizona) of new fence was completed in Sept 2007
- fence is 15 ft high and more than 5 ft below ground
- costs \$3 million per mile or \$210 million dollars for the newest portion
- to date, the total fence length across US Mexico Border is 145 miles



Source: East Valley Tribune, Phoenix, 9/27/2007

The “Funnel Effect”



- The closure of major urban points along the US-Mexico border has funneled hundreds of thousands of unauthorized migrants through southern Arizona's remote and inhospitable deserts
- The “Funnel Effect” has resulted in a significant increase in the number of individuals who die in the deserts along the border
- The University of Arizona Binational Migration Institute sought to quantify the increase in deaths of undocumented border crossers (UBC) in Pima County

Source: BMI Report “The Funnel Effect” & Recovered Bodies, Rubio-Goldsmith et al. 2006

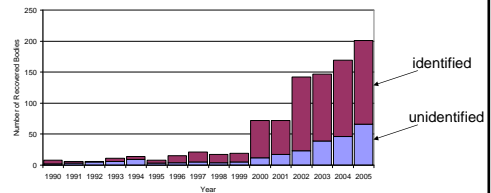
Deaths of UBCs in Pima County

- In 1990, 8 recorded UBC deaths
- In 2005, 201 recorded UBC deaths
- These numbers are believed to be underestimates because many bodies still remain in the desert



Unidentified UBCs in Pima County

- As the number of deaths rise, the number of bodies whose identity is unknown has also risen
- Since 2000, the number of unknown UBC has risen 42%
- Assuming the current rate of increase, there will be over 750 unknown UBCs in the year 2012



Location of Deaths in Arizona



Causes of Death

1. exposure to the elements (including hyperthermia, hypothermia, complications from dehydration and drowning)
2. natural causes (e.g. heart attack)
3. “undetermined” whereby the skeletal remains were in such an advanced state of decomposition that the cause of death could not be determined
4. motor vehicles accidents (most likely victims are children)
5. homicide

Political Implications

- The rise in deaths of UBCs has been deemed a human rights crisis
- Senate Majority Leader Bill Frist (R-TN) referred to it as a “humanitarian crisis.”
- Researchers at the Centers for Disease Control and Prevention (CDC) have concluded that it is “emerging as a major public health issue”

Political Implications

- Professor Wayne Cornelius, a leading scholar of immigration issues at the UCSD, estimates that the bodies of 2,978 unauthorized border crossers were recovered on U.S. soil from 1995-2004.
- Cornelius: “To put this death toll in perspective, the fortified US border with Mexico has been more than 10 times deadlier to migrants from Mexico during the past nine years than the Berlin Wall was to East Germans throughout its 28-year existence.”

Discovery of Remains

- Bodies are handled by law enforcement officials
 - Sheriff's Offices of Pima, Pinal, Santa Cruz Counties
 - Tohono O'Odham & Tucson Police Departments
 - US Border Patrol
 - BORSTAR (Border Patrol Search, Trauma, Rescue) Team
- Bodies are then transported to the Pima County Morgue



Return or Burial

- PCMEO typically stores bodies 6 months – 1 year, sometimes longer
- If identified, the remains are flown home
 - Cost (\$2,300) covered by family or government of country of origin
- If all identification attempts fail, the remains are cremated
 - Cost (\$1,800: burial or \$475: cremation) covered by the State of Arizona
- Between 2000-2005, PCMEO successfully identified and repatriated ~755 (75%) of recovered UBCs

Identification Methods

- Information about the individual is released to the PCMEO
 - Personal effects (e.g. ID card, photos, a list of phone numbers)
 - Information provided by traveling companions
- PCMEO designates an individual as a migrant based on a multitude of factors (e.g. location of the body, physical features, personal effects)



Mexican Voter ID Card

Traditional Identification Methods

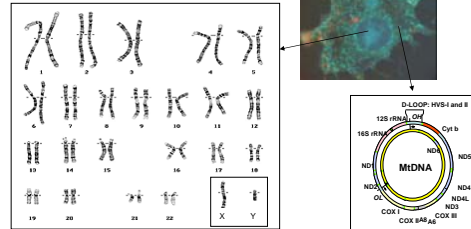
- After an autopsy, the Tucson Mexican Consulate is notified
- Mexican Consulates office takes photos of the remains and the belongings
 - Tattoos, scars, birth marks, dental work
 - Clothes, bags, backpacks, other objects
- Most common method is visual recognition
- If facial features are unrecognizable, fingerprints are obtained if the hands are intact
- If the individual is believed to be a Mexican citizen, all information is uploaded into the System for Identification of Remains and Localization of Individuals (SIRLI) Database
- When these methods fail, DNA testing is sometimes performed

DNA Identification Methods

- Biological sample of deceased is obtained
 - Usually a 2 x 2 inch sample of the femur
- Currently, there are 260 unknown UBC samples stored at the PCMEO (in addition to the ~300 bodies)
- From 2003-2007, Baylor University examined bone samples from Pima County using mtDNA technology
 - Priority is given to those individuals who have a name association

Nuclear and MtDNA

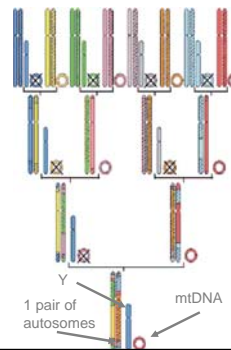
- Nuclear DNA
 - Autosomes
 - Sex chromosomes (X and Y)
- mtDNA



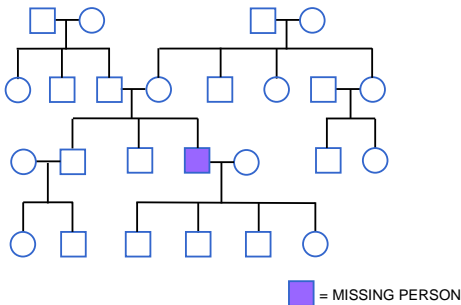
Patterns of Inheritance

- Mitochondrial DNA (mtDNA): *maternally* inherited
- Nuclear DNA
 - Autosomes
 - Sex Chromosomes
 - Y Chromosome: *paternally* inherited
 - X Chromosome (Mom always donates an X and Dad donates an X or a Y)

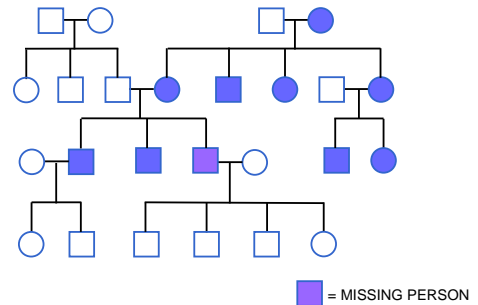
Patterns of Inheritance



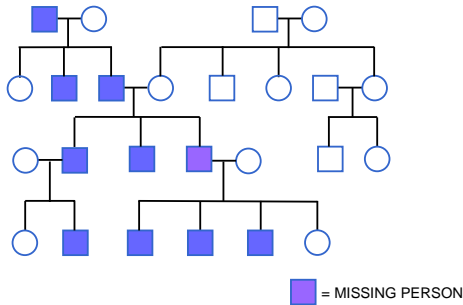
Pedigree



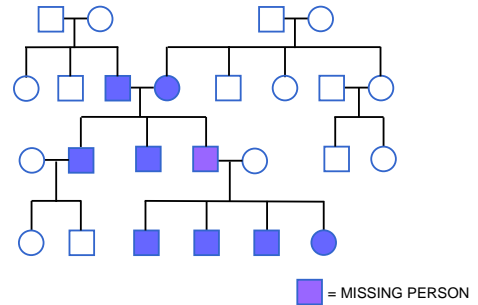
Sharing of mtDNA



Sharing of Y chromosome



Closest sharing of autosomal STRs



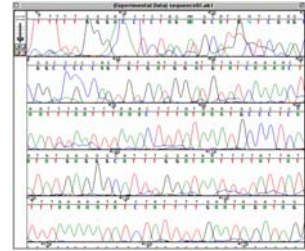
mtDNA Inheritance

- Why is mtDNA only inherited through the mother?
 - The egg carries the vast majority of the mitochondria when an egg and sperm unite.



mtDNA Identification Methods

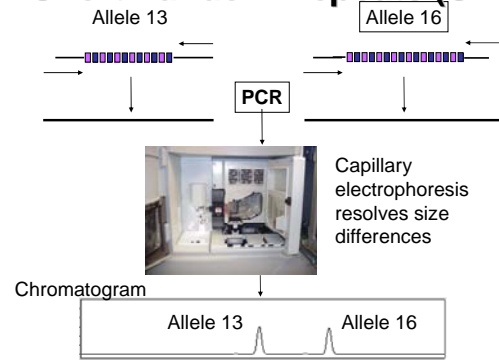
- Previous attempts to identify missing migrants used only the mtDNA-HVR1 region



mtDNA Identification Methods

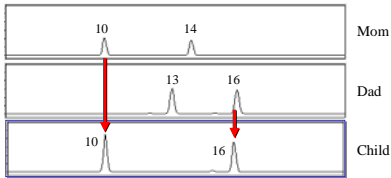
- If the mtDNA sequence of the deceased matches that of a maternal relative there is an "association"
- If traditional methods further suggest the identity is correct, the "association" designation is changed to a "match"
- Remains are returned to the family members
- 31 / 230 individuals have been identified using this method

Short Tandem Repeats (STRs)



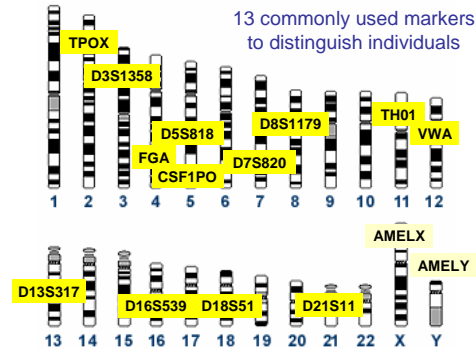
Autosomal STRs

- Each individual has two autosomal STR copies, 1 copy inherited from each parent



CODIS Markers

13 commonly used markers to distinguish individuals



Advantages / Disadvantages

- mtDNA
 - Many copies per cell so easier to extract high quality DNA
 - mtDNA was the 1st region where population variation was examined in detail
 - Hypervariable Regions (HVR) contain high allelic variability
 - Maternally inherited
 - Low discriminating capacity
- Y chromosome
 - Male specific
 - Y chromosome was the 2nd region where population variation was examined in detail
 - Can have high discriminating capacity depending on markers used
- Autosomes
 - High discriminating capacity
 - More intense computation needed

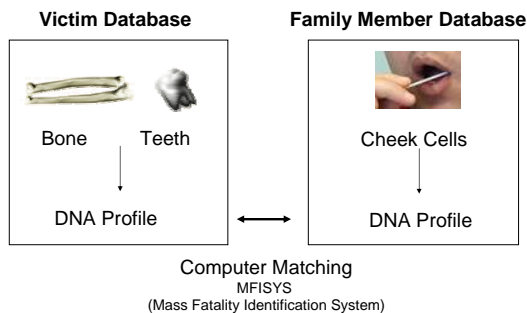


Genomic Analysis
and
Technology Core
ARL - Division of Biotechnology
University of Arizona

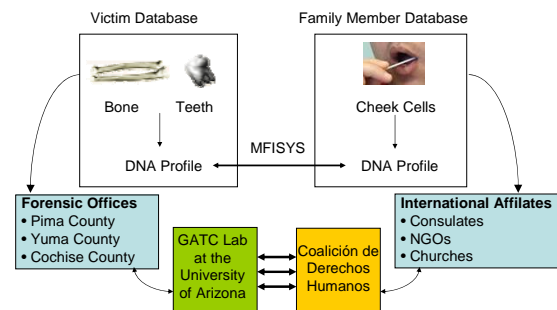
Missing Migrant DNA Database

- The goal of the MMDD Project is to make "blind" matches where there is no name association
- Collaborative effort between University of Arizona, Pima County Medical Examiner's Office, Pima County Board of Supervisors, Tucson Mexican Consulate, Ministry of Foreign Affairs in Mexico City, Coalición de Derechos Humanos

MMDD Project Aims to Construct Two DNA Databases



MMDD Project: A Collaborative Effort



University of North Texas' Center for Human Identification (UNTCHI)

- DNA laboratory supported by the National Institute of Justice (NIJ)
 - Handles forensic and missing persons cases
- Samples must be submitted through US governmental agency (police department or ME)
- Examine CODIS markers and mtDNA
- DNA profiles housed in the FBI's CODIS + MITO database
 - the missing persons database does directly interface with the Criminal Database CODIS
- Will assure anonymity for participants through the use of pseudonyms

MMDD Project

- The ultimate goal is to return individuals to their families.

