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Introduction

Hello, and welcome to the May 2014 issue of DNA Tribes® Digest. One time tested subject of interest in genetic genealogy is the search for DNA evidence of Jewish ancestors. IBD analysis can now identify a person's recent Jewish relatives in a genealogical time frame (generally limited to the past several centuries). However, DNA studies have not yet explored the more challenging question of more ancient and distant connections between Jewish and non-Jewish populations.

This month's Digest highlights Jewish related ancestral components in Europe, West Asia, the Indian Subcontinent, and Africa. The Mideastern Jewish, Sephardic-Sicilian, and Ashkenazi Jewish genomic components expressed in modern non-Jewish populations (although small in most studied cases) provide new genetic clues using unlinked SNP markers. These results are presented so that future DNA studies using segment sharing (IBD) analysis can establish the chronology of ancient "deep ancestry" links between Jewish and non-Jewish populations around the world.

Best regards,
Lucas Martin
DNA Tribes

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Beyond the River: The Search for Genetic Evidence of Jewish “Lost Tribes”

Historical Background

Even as the globally connected, technologically advanced 21st century begins, scholars debate the relationship between Biblical texts and the archaeological record of the ancient Middle East. Remarkably, the Hebrew Bible’s narrative of the Iron Age Israelite tribal confederation that split apart and was dispersed almost three thousand years ago (at a time long before the rise of the Roman Republic, when Western Europe was an unknown barbarian wilderness) continues to fascinate (and perplex) academics and the general public around the world.

According to the Hebrew *Sepher Malakhim* (“Book of Kings”), there were two related kingdoms in the ancient East Mediterranean: Southern Judah and Northern Israel. However, this political and religious union ended when the northern kingdom rebelled against the Davidic monarchy and Temple of Jerusalem. Under the political leadership of Yerevam (Jeroboam), the ten northern tribes reconstituted themselves as an independent kingdom (Samaria). However, this short lived kingdom was conquered, and its population was exiled to the far corners of the Assyrian Empire.

In exile, the northern tribes were assimilated into surrounding West Asian cultures (including Mesopotamian peoples and the Cimmerian nomads of the Assyrian frontiers). After this time, they disappeared from the view of the (Biblical) scribes that remained in Judea.

For this reason, the descendants of the once prosperous northern kingdom became known as the legendary “Lost Tribes.” Jewish and Christian historians have searched far and wide for traces of these lost relatives for centuries, without clear success. One traditional rabbinical saying is that these former nations are now located beyond the metaphorical “River of Sambation,” a type of symbolic boundary that cannot be crossed by ordinary exploration or travel.

New Evidence from Autosomal DNA

Emerging genomic technologies have provided a new source of material for researchers seeking traces of the “Lost Tribes.” Early DNA research has focused on uniparental markers, including Y-DNA lineages associated with Cohen and Levite paternal lines among the Jewish Diaspora.

However, Jewishness is traditionally inherited through the mother, not through the paternal line (although some rabbinical traditions associate patrilineal kinship structures with the former “Lost Tribes” of the northern kingdom). For this reason, autosomal studies using SNP based genomic data provide an important new source of clues for genealogists and researchers hoping to locate evidence of non-lineal Jewish ancestry.

In recent years, several studies have looked at how present day Jewish communities within the wider context of world genetic structure. The present consensus has been summarized by Behar *et. al.*, “The Genome-Wide Structure of the Jewish People” (2010):¹

¹ Available at http://www.academia.edu/3550542/The_genome-wide_structure_of_the_Jewish_people.

“Most Jewish samples form a remarkably tight subcluster that overlies Druze and Cypriot samples but not samples from other Levantine populations or paired Diaspora host populations. In contrast, Ethiopian Jews (Beta Israel) and Indian Jews (Bene Israel and Cochini) cluster with neighboring autochthonous populations in Ethiopia and western India, respectively, despite a clear paternal link between the Bene Israel and the Levant. These results cast light on the variegated genetic architecture of the Middle East, and trace the origins of most Jewish Diaspora communities to the Levant.”²

Segment sharing analysis has provided new insights about the inter-relationships between Jewish communities in different parts of the Diaspora,³ as well as information about separate gene flow from Africa to non-Jewish Middle Eastern populations (possibly one factor in the present day differences between present day Jewish and non-Jewish populations in the Middle East).⁴

Similar studies have identified signatures of ancient admixture events between European populations over the past 3,000 years.⁵ **However, no study to date has examined autosomal genomic evidence for ancient gene flow between Jewish and non-Jewish populations.**

To explore genomic evidence for ancient “Lost Tribes” described by the early Hebrew chroniclers, this month’s Digest issue will highlight Jewish related ancestral components in Europe, West Asia, the Indian Subcontinent, and Africa. These percentages (although small in most studied cases) provide genetic clues using unlinked SNP markers that future Identity-By-Descent (IBD) studies can explore using chronological segment sharing analysis.

In addition, this month’s Digest analysis will provide a “sneak preview” of the new **DNA Tribes SNP update** that will feature a new and more detailed cluster analysis of world populations, including three Jewish related clusters.

Jewish Related SNP Components in Eurasia and Africa

The genetic analysis in this month’s Digest issue will highlight Jewish related ancestral components in several populations of Europe, West Asia, the Indian Subcontinent, and Africa. This will be compared with chronological information from previous IBD (segment sharing) studies that identified potentially related admixture events, to highlight some potential historical contexts for early Jewish related ancestry in each of these populations.

² Behar’s analysis was performed before the publication of new tree models of Eurasian population history incorporating ancient genomes, which have identified an Early European Farmer (EEF) ancestral component that is well represented by present day Sicilian, Maltese, and European Jewish populations. However, the antiquity of these relationships will require further ancient DNA evidence to confirm. For more discussion of EEF ancestry in Europe and the Middle East, see <http://dnatribes.com/dnatribes-digest-2014-04-02.pdf>.

³ For instance, see “North African Jewish and non-Jewish Populations Form Distinctive, Orthogonal Clusters” by Campbell *et. al.*, at <http://www.pnas.org/content/early/2012/07/31/1204840109.abstract>.

⁴ See “A genetic atlas of human admixture history” by Hellenthal *et. al.*, available at <http://www.sciencemag.org/content/343/6172/747.abstract>.

⁵ See “The Geography of Recent Genetic Ancestry across Europe” by Ralph and Coop, at <http://www.plosbiology.org/article/info%3Adoi%2F10.1371%2Fjournal.pbio.1001555>.

Jewish Related Clusters in World Genetic Structure

The upcoming *DNA Tribes SNP* update (to be announced this Spring) will include a more detailed comparison to genetic clusters around the world, including several Jewish related ancestral clusters: Mideastern Jewish, Sephardic-Sicilian, and Ashkenazi Jewish.

These three clusters are part of the more general West Eurasian (European and Middle Eastern) family of related populations, with the closest genetic relatives in Mediterranean Europe and West Asia.⁶ In addition to these general relationships, each Jewish related cluster has its own genomic characteristics, reflecting local community histories, in part shaped by genetic drift and in some cases admixture in each part of the Jewish Diaspora.

Past studies have discussed evidence for admixture from non-Jewish populations in present day Jewish communities. However, no study to date has assessed the possible role of ancient and historical Jewish source populations in shaping West Eurasian genetic structure. For this reason, this article highlights non-Jewish populations in several parts of the world in which Jewish related ancestral components are expressed.

These updated DNA Tribes® SNP admixture percentages are based on unlinked autosomal SNP markers and can express ancient relationships (not limited to recent genealogy); however, future studies can expand on this analysis using linked SNP segments to identify whether any of these relationships can be associated with particular historical or archaeological periods.

Section One: Mideastern Jewish Components in Western Asia

The Mideastern Jewish cluster (*available soon with the upcoming DNA Tribes® SNP update to be announced this Spring*) includes sampled genomes from Azerbaijani, Georgian, Iranian, Iraqi, Kurdish, and Uzbek Jewish communities.

However, Mideastern Jewish percentages are also expressed for several non-Jewish populations in Western Asia (highlighted in **Table 1**), including: Assyrian (10.6%), Armenian (*Sample 1*; 8.1%), Azerbaijan (7.6%), Iran (7.5%), Imer (7.2%), and several others. To provide a possible context for historical admixture between Jewish and non-Jewish populations in this part of the world, **Table 2** lists periods of admixture identified by a separate segment (IBD) study, “A genetic atlas of human admixture history” by Hellenthal *et. al.*⁷

Although Middle Eastern Jewish populations were not included in the analysis, results in **Table 2** identify three admixture dates in West Asia during the 10th – 11th centuries CE. Notably, these periods coincide with two factors that shaped medieval cultures in this part of the world. First, the Turko-Mongol expansions in Persia, which displaced populations and created new unified states that increased contacts between South Asian, East Asian, and Middle Eastern populations. A second potentially related factor was the emergence of medieval dynasties in the Transcaucasus (Armenia and Georgia), each claiming Davidic (Jewish related) descent for their royal family.

However, another factor might be underlying ancestral components shared by both Jewish and non-Jewish populations in West Asia that are better preserved in Jewish communities and other local populations (such as Assyrians and Armenians) due to historical endogamy since the Muslim conquests.

⁶ Possibly related to shared Hebraic or ancient Jewish population origins around the East Mediterranean. For more detailed discussion, see <http://dnatribes.com/dnatribes-digest-2012-09-01.pdf>.

⁷ <http://www.sciencemag.org/content/343/6172/747.abstract>; <http://admixturemap.paintmychromosomes.com/>.

Population	Red Sea Yemen-Egypt	Bedouin-Gulf Arabs	Lebanese Cyprus	Mid-eastern Jewish	Sephardic- Sicilian	Ashkenazi Jewish	Aegean Balkan Italian	Pontic-West Caucasus	Daghestan- North Caucasus	Azeri Kurdish Persian Turkey	Kalash-Balochi	Punjab Sindhi	Burusho	Other
Assyrian	2.9%	3.8%	22.5%	10.6%	8.0%	3.8%	0.7%	7.2%	8.2%	27.9%	1.9%	0.1%	2.2%	
Armenian Sample 1	1.6%	1.8%	13.8%	8.1%	7.2%	3.2%	5.9%	18.7%	4.9%	30.9%	1.8%	0.0%	2.3%	
Azerbaijan	4.5%	0.5%	7.6%	7.6%	5.6%	1.4%	5.4%	14.4%	5.1%	26.7%	4.0%	4.4%	13.0%	
Iran	6.6%	3.9%	9.5%	7.5%	3.2%	1.6%	0.7%	7.4%	4.3%	29.6%	11.0%	4.0%	10.8%	
Imer Georgia	0.1%	0.1%	2.6%	7.2%	3.5%	1.4%	0.6%	53.9%	5.4%	24.5%	0.1%	0.0%	0.7%	
Armenian Sample 2	3.0%	2.4%	19.3%	6.9%	8.2%	2.4%	3.7%	17.3%	5.4%	27.2%	1.6%	0.2%	2.5%	
Persian Qatar	7.5%	5.0%	8.8%	6.5%	4.4%	1.3%	0.4%	2.5%	6.9%	20.9%	8.4%	9.4%	18.0%	
Kurdish Sample 1	5.9%	1.8%	10.2%	6.2%	2.8%	1.7%	2.3%	7.3%	6.9%	34.9%	9.4%	5.2%	5.6%	
Adyghe North Caucasus	0.0%	0.7%	2.3%	5.6%	1.9%	2.2%	4.3%	41.1%	10.5%	9.1%	2.6%	1.5%	18.1%	
Turkey Sample 2	3.7%	1.6%	16.7%	5.1%	6.0%	2.7%	4.2%	12.8%	5.7%	23.0%	1.5%	1.1%	15.9%	
Kurdish Sample 2	2.2%	1.7%	12.6%	4.8%	2.8%	2.2%	1.0%	13.6%	6.4%	37.3%	7.1%	1.9%	6.5%	
Abkhazian	0.7%	1.3%	7.0%	4.7%	3.3%	2.8%	0.8%	53.1%	8.2%	12.6%	1.3%	0.0%	4.2%	

Table 1: Mid-eastern Jewish SNP components in selected West Asian populations.

Admixed Population	Study	Admixture Source 1	Admixture Source 2	Approx. Date(s)	Possible Historical/Archaeological Context
Iranian (2nd event)	Hellenthal	Indian Subcontinent; SE Asia	Mid-east and Mediterranean	1,306 CE	Turko-Mongol expansions in Persia (Mongol Ilkhanate). South Asian, East Asian (Mongol), and Middle Eastern populations.
Armenian	Hellenthal	Bulgarian (Caucasus and European)	Turkish (West Asian)	970 CE	Medieval Armenia (Bagratuni Dynasty). Possible Davidic and/or Orontid origins: Eruand, cf. Yerevan). Byzantine and Anatolian (Cilician) populations.
Georgian	Hellenthal	Adygei	Turkish	1,082 CE	Medieval Georgia (Bagrationi Dynasty; tradition of Davidic lineage).

Table 2: Admixture events in non-Jewish West Asian populations identified by segment sharing (IBD) studies.⁸

⁸ See “A genetic atlas of human admixture history” by Hellenthal *et. al.*, available at <http://www.sciencemag.org/content/343/6172/747.abstract> and <http://admixturemap.paintmychromosomes.com/>.

Section Two: Sephardic-Sicilian Components in Balkan and Atlantic Europe

The Sephardic-Sicilian cluster (*available soon with the upcoming DNA Tribes® SNP update to be announced this Spring*) includes sampled genomes from Jewish communities of Algeria, Bulgaria, Italy, Libya, Morocco, Tunisia, and Turkey, as well as sampled genomes from non-Jewish populations of Sicily and Southern Italy.

However, Sephardic-Sicilian percentages are also expressed for several non-Jewish populations in the Balkan Peninsula and Atlantic Europe (highlighted in **Table 3**), including: Romania (7.9%), Bulgaria (7.2%), Andalusia, Spain (6.3%), Spain (*Sample 1*; 5.5%), and Galicia, Spain (5.4%). Additionally, Sephardic-Sicilian percentages appear in Sardinia and as in locations as distant as France (2.3-3.5%) and Ireland (2.6%).

Population	Berber-North African	Lebanese Cyprus	Mideastern Jewish	Sephardic-Sicilian	Ashkenazi Jewish	Aegean Balkan Italian	Basque-Iberian	NW European	Slavic Baltic	Tatar Chuvash	Pontic-West Caucasus	Daghestan-North Caucasus	Azeri Kurdish Persian Turkey	Other
Sardinia	4.0%	5.7%	1.1%	11.8%	2.7%	34.5%	38.3%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	1.3%
Romania	0.3%	6.0%	1.5%	7.9%	2.5%	27.5%	8.8%	6.3%	24.0%	1.3%	2.2%	3.5%	4.1%	4.0%
Bulgaria	0.4%	5.4%	1.2%	7.2%	2.9%	22.5%	8.3%	12.8%	26.7%	0.3%	4.3%	1.7%	1.5%	5.0%
Andalusia Spain	4.5%	0.6%	0.7%	6.3%	2.9%	18.9%	36.9%	16.1%	5.2%	0.8%	1.3%	0.0%	1.4%	4.3%
Spain Sample 1	5.5%	2.0%	0.4%	5.5%	2.2%	24.7%	31.5%	16.4%	6.6%	1.3%	0.2%	0.3%	0.3%	3.2%
Galicia Spain	7.3%	1.1%	0.4%	5.4%	2.1%	23.2%	28.8%	22.1%	5.8%	0.5%	0.7%	0.1%	0.3%	2.2%
Croatia	0.3%	2.1%	1.3%	5.2%	1.9%	20.6%	7.6%	14.7%	40.4%	0.1%	0.8%	2.1%	0.2%	2.7%
Spain Sample 2	2.3%	2.5%	1.0%	4.4%	1.7%	25.4%	33.4%	17.9%	6.0%	0.1%	0.5%	0.8%	0.0%	4.1%
Slovenia	0.0%	0.2%	0.2%	4.1%	1.9%	16.7%	8.1%	17.5%	43.8%	0.5%	1.0%	1.9%	0.6%	3.5%
France 2	0.3%	2.2%	0.8%	3.5%	1.5%	31.6%	18.4%	24.9%	12.8%	1.7%	1.3%	0.0%	0.0%	1.1%
Portugal	5.7%	0.7%	0.0%	2.6%	4.5%	26.0%	22.1%	22.2%	5.5%	2.6%	3.3%	0.1%	0.2%	4.6%
Ireland	0.0%	0.0%	0.4%	2.6%	0.8%	4.9%	12.9%	52.3%	19.4%	1.4%	0.6%	1.8%	0.0%	3.0%
Moldavia	0.0%	1.2%	0.5%	2.4%	0.7%	14.6%	3.5%	11.6%	53.9%	1.1%	1.6%	2.0%	0.0%	6.9%
France	1.0%	0.4%	0.5%	2.3%	2.6%	24.3%	15.7%	33.0%	13.9%	1.8%	0.5%	0.9%	0.7%	2.5%

Table 3: Sephardic-Sicilian SNP components in selected European populations.

Past segment sharing (IBD) studies have omitted Jewish populations as potential source populations. However, IBD studies by Hellenthal *et. al.* and Ralph and Coop have identified multiple periods in which Central and East Mediterranean related (Italian and Greek) admixture took place in the Balkan Peninsula and Atlantic Europe (listed in **Table 4**).

These IBD results suggest a complex history of interactions between Mediterranean populations (possibly including early Jewish related populations) and more distant parts of Europe. Some of these date to the second millennium BCE and might relate to the **Urnfield culture** (probably predating the formation of the United Monarchy of Ancient Israel), as well as later **Thrac-**

Cimmerian, Hallstatt C, and La Tène cultures (post-dating the Assyrian conquest and exile of the northern Kingdom of Israel described in Iron Age Hebrew chronologies).

Future IBD studies can confirm whether these admixture events might have involved specifically Jewish populations, providing new insights about the Mediterranean dispersions of the Israelite peoples.

Admixed Population	Study	Admixture Source 1	Admixture Source 2	Approx. Date(s)	Possible Historical/Archaeological Context
Romania and Bulgaria	Ralph and Coop	IT (Italy)	R-B (Romania and Bulgaria)	Wave c. 1,700 - 500 BCE	Tumulus, Urnfield, and Hallstatt Cultures.
Romania and Bulgaria	Ralph and Coop	IT (Italy)	R-B (Romania and Bulgaria)	Spikes c. 1,200 and 600 BCE	Early Urnfield; Thraco-Cimmerian Migrations.
Serbia and Croatia	Ralph and Coop	IT (Italy)	S-C (Serbia and Croatia)	Long wave c. 4,000+ BCE - 200 BCE	Various ongoing regional contacts.
Serbia and Croatia	Ralph and Coop	IT (Italy)	S-C (Serbia and Croatia)	Spikes c. 1,200 BCE; 500 BCE; 250 BCE; 1,000 CE	Various cultural expansions.
Spain and Portugal	Ralph and Coop	IT (Italy)	Iber (Spain and Portugal)	Wave c. 1,700 - 600 BCE	Tumulus, Urnfield, and Hallstatt Cultures. Castro culture in NW Spain and Portugal.
France	Ralph and Coop	IT (Italy)	FR (France)	Wave c. 1,500 - 500 BCE	Urnfield Culture; Hallstatt Culture.
Ireland	Hellenthal et. al.	Mediterranean (Greek) and East European.	Northwest European	No strong evidence of admixture (ancient?)	Terminal Atlantic Bronze Age or Hallstatt.
Ireland	Ralph and Coop	IT (Italy)	IE (Ireland)	Wave c. 1,500 - 700 BCE, peaking c. 1,000 BCE)	Urnfield Culture.
Ireland	Ralph and Coop	IT (Italy)	IE (Ireland)	Spikes c. 700 BCE and 1,200 BCE	Atlantic Bronze Age (beginning and terminal) and Hallstatt Culture.

Table 4: Admixture events in non-Jewish Balkan Peninsula and Atlantic European populations identified by segment sharing (IBD) studies^{9,10}

⁹ Hellenthal *et. al.*, “A genetic atlas of human admixture history” at <http://www.sciencemag.org/content/343/6172/747.abstract> and <http://admixturemap.paintmychromosomes.com/>.

¹⁰ Ralph and Coop, “The Geography of Recent Genetic Ancestry across Europe” at <http://www.plosbiology.org/article/info%3Adoi%2F10.1371%2Fjournal.pbio.1001555>.

Section Three: Ashkenazi Jewish Components in the Caucasus and Indian Subcontinent

The Ashkenazi Jewish cluster (*available soon with the upcoming DNA Tribes® SNP update to be announced this Spring*) includes sampled genomes from Jewish communities living in Western and Central Europe during the medieval and modern periods.

However, Ashkenazi Jewish percentages are also expressed for several non-Jewish populations in the Caucasus and the Indian Subcontinent (highlighted in **Table 5**), including: Kabardin (5.8%), Armenian (*Sample 1*; 3.2%), Abkhazian (2.8%), Tabasaran (2.8%), Pashtun (1.6%), Makrani (1.3%), and the Persian subset (West/South Asian related) of sampled genomes from Qatar (1.3%). In addition, Ashkenazi Jewish percentages are expressed for two Jewish communities of India: Bene Israel (3.6%) and Cochin Jewish (1.0% Ashkenazi Jewish; with an additional 2.5% Sephardic-Sicilian component).

Population	Yemen-Egypt Red Se	Lebanese Cyprus	Mideastern Jewish	Sephardic-Sicilian	Ashkenazi Jewish	Aegean Balkan Italian	Pontic-West Caucasus	Daghestan-North Caucasus	Azeri Kurdish Persian Turkey	Kalash-Balochi	Burusho Punjab Sindhi	Gangetic North Central India	Dravidian South India	Other
Kabardin	1.6%	11.8%	0.0%	0.3%	5.8%	2.2%	33.0%	11.6%	8.2%	1.1%	0.1%	4.0%	0.0%	20.5%
Bene Israel India	5.2%	8.1%	3.7%	0.8%	3.6%	0.0%	2.1%	3.1%	6.0%	7.7%	10.0%	14.7%	24.7%	10.3%
Armenian Sample 1	1.6%	13.8%	8.1%	7.2%	3.2%	5.9%	18.7%	4.9%	30.9%	1.8%	0.0%	0.3%	0.1%	3.7%
Abkhazian	0.7%	7.0%	4.7%	3.3%	2.8%	0.8%	53.1%	8.2%	12.6%	1.3%	0.0%	0.6%	0.0%	4.8%
Tabasaran	4.1%	4.0%	1.0%	0.7%	2.8%	0.1%	9.2%	33.9%	13.0%	2.5%	5.2%	2.0%	0.0%	21.6%
Pashtun Afghanistan	0.0%	0.3%	3.0%	0.6%	1.6%	2.4%	5.6%	9.5%	3.3%	14.2%	22.4%	12.6%	0.9%	23.6%
Makrani Pakistan	1.5%	3.0%	3.4%	0.6%	1.3%	0.1%	2.8%	2.6%	14.5%	32.0%	16.1%	9.2%	1.5%	11.5%
Cochin Jewish India	1.8%	2.6%	3.1%	2.5%	1.0%	0.0%	1.0%	1.8%	0.0%	6.4%	13.9%	29.9%	26.6%	9.4%
Persian Qatar	7.5%	8.8%	6.5%	4.4%	1.3%	0.4%	2.5%	6.9%	20.9%	8.4%	9.4%	4.7%	1.9%	16.4%

Table 5: Ashkenazi Jewish SNP components in selected West Asian and Indian Subcontinent populations.

Somewhat similar to IBD results discussed in the Mideastern Jewish section earlier in this article, the segment sharing results published in Hellenthal *et. al.* include several admixture events in West Asia that generally coincide with the foundations of traditionally Davidic related royal dynasties in Armenia and Georgia, as well as the Turko-Mongol expansions that displaced Central Eurasian populations during the medieval period (listed in **Table 6**).

Intriguingly, Hellenthal *et. al.* identify an admixture event that affected their India Jewish population approximately 1,362 CE. This involved mixture between an Iranian-like (Mediterranean and West Asian related) population and a Sindhi-like (South and Southeast Asian related) population. The date for this event coincides with the general period of Turko-Mongol expansions in the Indian Subcontinent, which might have provided an historical context for resettlement and admixture involving early Jewish populations in South Asia.

Future studies are needed to confirm whether specifically Jewish populations were involved in these admixture events in the Caucasus and Indian Subcontinent; however, admixture results suggest the possibility of geographically complex relationships linking now distant populations during this tumultuous period of history that displaced cultures throughout Central Eurasia.

Admixed Population	Study	Admixture Source 1	Admixture Source 2	Approx. Date(s)	Possible Historical/Archaeological Context
India Jewish (1st event)	Hellenthal	Iranian-like (Mediterranean and West Asian)	Sindhi-like (South and Southeast Asian)	1,362 CE	Turko-Mongol expansions in Indian Subcontinent (Timurid Empire). West and South Asian populations.
Armenian	Hellenthal	Bulgarian (Caucasus and European)	Turkish (West Asian)	970 CE	Medieval Armenia (Bagratuni Dynasty. Possible Davidic and/or Orontid origins: Eruand, cf. Yerevan). Byzantine and Anatolian (Cilician) populations.
Georgian	Hellenthal	Adygei	Turkish	1,082 CE	Medieval Georgia (Bagrationi Dynasty; tradition of Davidic lineage).
Pathan (2nd event)	Hellenthal	European	South Asian	1,362 CE; 2,530 BCE.	Turko-Mongol expansions in Indian Subcontinent (Timurid Empire). Remnant of pre-Turkic Central Asian populations?
Iranian (2nd event)	Hellenthal	South and Southeast Asian	Mideast and Mediterranean	1,306 CE	Turko-Mongol expansions in Persia (Mongol Ilkhanate). South Asian, East Asian (Mongol), and Middle Eastern populations.

Table 6: Admixture events in West Asian and Indian Subcontinent populations identified by segment sharing (IBD) studies.¹¹

Section Four: Mideastern Jewish and Sephardic-Sicilian Components in Ethiopia

Finally, small Mideastern Jewish and Sephardic-Sicilian components are expressed in Ethiopia. This is particularly notable, since some Ethiopian communities trace their origins to early contacts related to the Biblical story of Solomon and Sheba (during the United Monarchy of Ancient Israel and prior to the general dispersions of ancient Israel and later Judah).

Past research using segment sharing (IBD) analysis (published in Pickrell *et. al.*) has identified Mediterranean and Middle Eastern admixture in Ethiopians and several other African populations.¹² For Ethiopians, this admixture dates to approximately 1,000 BCE, possibly coinciding with the ancient D'mt culture (involving contacts between the Horn of Africa and South Arabia) and the emergence of the Ethiosemitic languages (listed in **Table 8**).

The new *DNA Tribes*® SNP update includes a Horn of Africa cluster that includes sampled Ethiopian genomes. This cluster itself reflects this general regional mixture between Sub-Saharan

¹¹ Hellenthal *et. al.*, "A genetic atlas of human admixture history" at <http://www.sciencemag.org/content/343/6172/747.abstract> and <http://admixturemap.paintmychromosomes.com/>.

¹² See Pickrell *et. al.*, "Ancient West Eurasian Ancestry in Southern and Eastern Africa" at <http://www.pnas.org/content/early/2014/01/29/1313787111.abstract>.

African and Middle Eastern populations.¹³ One sampled Ethiopian population stands out as expressing somewhat larger percentages of Mideastern Jewish and Sephardic-Sicilian components: Notably, this is not the sample of Ethiopian Jewish (Beta Israel) genomes, but instead the sampled **Ethiopian Afar (also known as Qafar or Danakil), who speak a more ancient Cushitic language** (highlighted in Table 7).

Nevertheless, all sampled Ethiopians (including Ethiopian Beta Israel genomes) also express the Horn of Africa component, which is partly Middle Eastern. For this reason, results do not necessarily exclude a more fundamental underlying relationship between ancestral Hebraic (Jewish) populations or other ancient East Mediterraneans and Ethiopian Jewish populations.

Future studies using segment sharing (IBD) analysis can resolve whether any ancient Middle Eastern or Mediterranean related admixture events in Africa might have involved ancestral Jewish populations. However, results suggest that affected populations might include not only traditionally Jewish communities, but possibly other non-Jewish and non-Ethiosemitic speaking cultures in the Horn of Africa.

Population	Khoisan	Omotic Ari Ethiopia	Nilotic	Horn of Africa	Berber-North African	Red Sea Yemen-Egypt	Bedouin-Gulf Arabs	Lebanese Cyprus	Mideastern Jewish	Sephardic-Sicilian	Askenazi Jewish	Other
Somalia	0.4%	1.9%	16.5%	78.6%	0.8%	0.0%	0.7%	0.1%	0.0%	0.0%	0.0%	1.0%
Afar Ethiopia	0.2%	2.5%	6.9%	76.2%	1.9%	2.7%	5.0%	0.7%	1.1%	1.2%	0.3%	1.6%
Somali Ethiopia	0.0%	5.3%	17.5%	71.7%	2.2%	0.8%	0.8%	0.0%	0.0%	0.1%	0.0%	1.8%
Tigray Ethiopia	0.1%	4.7%	3.3%	69.5%	3.4%	10.0%	6.2%	1.2%	0.1%	0.1%	0.0%	1.4%
Jewish Ethiopia	0.3%	5.5%	8.7%	67.7%	4.2%	5.5%	4.6%	0.7%	0.1%	0.4%	0.7%	1.8%
Amhara Ethiopia	0.6%	7.0%	4.2%	66.3%	2.7%	7.1%	6.9%	1.0%	0.9%	0.5%	0.5%	2.4%
Oromo Ethiopia	1.1%	11.9%	15.6%	59.9%	1.5%	2.7%	4.8%	0.1%	0.0%	0.0%	0.5%	1.9%
Wolayta Ethiopia	2.9%	24.9%	9.2%	55.3%	0.0%	2.4%	1.8%	0.0%	0.1%	0.0%	0.0%	3.4%

Table 7: Mideastern Jewish and Sephardic-Sicilian SNP components in Ethiopian populations.

Admixed Populations	Study	Admixture Source 1	Admixture Source 2	Approx. Date(s)	Possible Historical/Archaeological Context
Ethiopians	Pickrell	Mediterranean and Mideast	Sub-Saharan African	c. 1,000 BCE	D'mt culture (South Arabian contacts); Ethiosemitic languages.

Table 8: Admixture events in Ethiopian populations identified by segment sharing (IBD) studies.¹⁴

¹³ For more discussion, see <http://dnatribes.com/dnatribes-digest-2014-03-01.pdf>.

¹⁴ See Pickrell *et. al.*, "Ancient West Eurasian Ancestry in Southern and Eastern Africa" at <http://www.pnas.org/content/early/2014/01/29/1313787111.abstract>.

Conclusion

DNA technologies provide new opportunities to reconstruct the chronology of ancient population relationships. In particular, genomic admixture and segment sharing (IBD) analysis provide new data that can be compared against archaeological evidence to produce a new, clearer and more complete picture of prehistory. In some cases, DNA analysis can help resolve longstanding scholarly debates about early cultures and answer questions that have fascinated generations of historians.

The DNA results discussed in this month's Digest article express percentages of Mideastern Jewish, Sephardic-Sicilian, and Ashkenazi Jewish components in several non-Jewish populations of Eurasia and Africa using unlinked autosomal SNP markers. Future studies using linked chromosomal segment (IBD) analysis can potentially confirm whether early admixture events involved ancestral Jewish populations and if so, the time periods coinciding with these contacts.

However, results suggest that it might not be sufficient to limit IBD to present day geographical neighbors due to complex history of population movements and resettlements. For instance, the Jewish related SNP components expressed in the Caucasus and Indian Subcontinent include percentages of Ashkenazi Jewish and Sephardic-Sicilian clusters associated with populations living in Europe during the medieval and modern periods.

For this reason, a comprehensive sampling (including both proximate and distant, Jewish and non-Jewish populations) is needed to detect genetic traces of some early admixture events that predate the formation of present day ethnic groups in the medieval and modern periods.



DNA Tribes® Announcements for May 2014

Mother's Day Sale for 22 Marker and 26 Marker Kit STR Tests

DNA Tribes® is pleased to offer 22 Marker Kit and 26 Marker Kit tests at great prices. Each 22 and 26 Marker Kit tests includes your Autosomal STR Profile for industry standard markers used in DNA fingerprinting around the world.

Both kits options feature the most detailed and comprehensive comparison of your autosomal DNA to world populations available anywhere. Your genetic ancestry report will include DNA Tribes® Native Population Match, Global Population Match, and World Region Match analysis.

DNA Tribes® 22 Marker Kits (Sale Price: \$119.99) test the following autosomal STR markers:

Amelogenin, CSF1PO, D13S317, D16S539, D18S51, D21S11, D3S1358, D5S818, D7S820, D8S1179, FGA, Penta D, Penta E, TH01, TPOX, vWA, D19S433, D2S1338, D10S1248, D12S391, D1S1656, D22S1045, and D2S441.

DNA Tribes® 26 Marker Kits (Sale Price: \$139.99) test the following autosomal STR markers:

Amelogenin, CSF1PO, D13S317, D16S539, D18S51, D21S11, D3S1358, D5S818, D7S820, D8S1179, FGA, Penta D, Penta E, TH01, TPOX, vWA, D19S433, D2S1338, D10S1248, D12S391, D1S1656, D22S1045, D2S441, F13A1, F13B, FES/FPS, and LPL.

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