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Geographic context of the Green Pistachio of Bronte, a protected designation of origin product

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ABSTRACT

The Green Pistachio of Bronte is an Italian protected designation of origin (PDO) product that was officially recognized by the European Union in 2010. These pistachios are grown on Mt Etna's western slope in a specific area of thin volcanic soils and rugged terrain that inhibits the use of mechanized agriculture. Bronte pistachios are known for their distinct flavor, bright green color, and unique organoleptic properties that are intimately linked to their place of origin. They are highly prized in the food industry and can sell for more than double the price of other pistachios on the global market. Mapping landscapes that give rise to specialty food products like the Green Pistachio of Bronte facilitate understanding of the connections between food, culture, and environment within a specific geographic context. Mt Etna's powerful presence in the landscape adds to the unique characteristics of this product and its place of origin.

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Pistachio; Bronte; Mt Etna; Sicily; protected designation of origin

1. Introduction

Italy ranks first among European Union (EU) member states with the highest number of agricultural and specialty food products recognized with protected designation of origin (PDO), protected geographical indication (PGI), or traditional specialty guaranteed (TSG) status. These designations are designed to promote and protect product authenticity, to improve economic conditions for producers in affected areas, and to provide consumers with information about product origins and production methods (Council Regulation, 2006). As of November 2017, 294 Italian products registered as PDO, PGI, or TSG were included in the EU's Database of Origin and Registration; France ranked second with 245 products.

The Green Pistachio of Bronte [Pistacchio Verde di Bronte] was officially registered as an Italian PDO product in 2010. These pistachios are grown in a specific area of thin volcanic soils and rugged terrain on the western slope of Mt Etna in Sicily near the city of Bronte. Unique characteristics of Bronte pistachios include their bright green color, high chlorophyll a to b ratio, elongated shape, high fatty acid content, and unique organoleptic properties that are intimately linked to their place of origin through both environmental and cultural influences (Bellomo & Fallico, 2007; Commission Regulation, 2010; D'Evoli, Lucarini,

Gabrielli, Aguzzi, & Lombardi-Boccia, 2015; Petino, 2010). Given their unique characteristics, limited production, and reputation for high quality, Bronte pistachios can sell for more than double the price of other pistachios on the global market. They are highly prized in the pastry, ice cream, and processed meat industries (Avanzato & Vassallo, 2008; Vitale et al., 2013). Laboratory tests using near-infrared spectroscopy, chemometric classification, and nuclear magnetic resonance indicate that Bronte pistachios can be differentiated from others grown in Iran, Turkey, the US, India, and Syria with a high level of accuracy (Bellomo & Fallico, 2007; Sciubba, Capuani, Di Cocco, Avanzato, & Delfini, 2014; Vitale et al., 2013).

The Bronte pistachio is both a commodity and a cultural manifestation resulting from a long history of interactions between specific environmental and cultural agencies (Petino, 2010). While the PDO designation is recent, Parfitt, Kallsen, and Maranto (1995) suggested that European consumers identified pistachios from Sicily as among the best tasting since at least the nineteenth century. The Bronte pistachio is now an important part of the regional economy and, as with other specialty food products, contributes to the local sense of place and cultural identity (Cianflone & Cardile, 2014; Petino, 2010; Stone, 2013). For example, pistachios are common in many local sweet and savory recipes, Bronte holds a pistachio festival

each fall [Sagra del Pistacchio di Bronte], and the city has adopted the tag line ‘City of the Pistachio’ on official signage. Lombardo (2015) also noted that a significant number of the region’s inhabitants participate in the biennial harvest that is still done mainly by hand.

Local environmental conditions can interact with cultural forces to create food products with unique characteristics that distinctly set them apart from others (Feagan, 2007). Mapping landscapes associated with specialty food products like the Green Pistachio of Bronte facilitates understanding of the connections between food, culture, and environment in a specific geographic context. While no official maps of the Green Pistachio of Bronte PDO have been published, this brief paper and the accompanying maps attempt to contribute insight into the connections between place and product using written descriptions of the PDO published in official documents, publicly accessible map and image resources, and local expert knowledge.

2. Background

The history and current status of pistachio cultivation in Italy and its relationships to other production areas around the world have been well documented (e.g. Barone & Marra, 2005; Fabbri & Valenti, 1998; Hormaza, Dollo, & Polito, 1994; Petino, 2010). The earliest references suggest pistachios were first brought to Italy around 30 CE (Casas-Agustench, Salas-Huetos, & Salas-Salvadó, 2011). Advancement of pistachio cultivation in Sicily during the Middle Ages has been attributed as one of the many agricultural innovations brought about during Arab occupation of the island from the ninth to eleventh centuries (Barbera, 2013). Petino (2010) described the development of pistachio cultivation around Bronte as revealed through historic texts and maps, and analyzed recent economic and cultural trends associated with the development the pistachio industry in the region. This research suggests that pistachios became widespread across Sicily during the thirteenth century, eventually becoming geographically concentrated and attaining a level of economic importance around Bronte by the mid-nineteenth century.

Publicly available data from the Italian National Institute of Statistics (ISTAT – <http://www.istat.it/it/>) indicate that the total area devoted to pistachio cultivation in the province of Catania, which is essentially geographically synonymous with the Bronte pistachio area, has remained stable from 1999 through 2010 at about 3100 hectares. The total area devoted to pistachio cultivation in Italy as a whole remained at about 3500 hectares over the same period. Thus, the Bronte area accounts for nearly all of Italy’s production and land use devoted to pistachio cultivation. Smaller pockets

of pistachio cultivation in Sicily can still be found in the provinces of Agrigento, Caltanissetta and, to a lesser extent, Palermo (Avanzato & Vassallo, 2008). ISTAT reported a total production of 28,500 quintals from the province of Catania in 2009, and previous harvests have exceeded 30,000 quintals with a total value in excess of 20 million euros. Given the high quality associated with the Bronte pistachio, much of the crop is processed for use in the food industry and for export. The high costs associated with traditional cultivation and harvesting methods, along with the limited production and biennial harvest cycle combine to create a situation in which pistachios must be imported to meet local and national market demands (Petino, 2010).

In addition, to be grown within a specific geographic area, pistachios must be of the species *Pistacia vera* L., cultivar *Napoletana* (also known as *Nostrale* or *Bianca*) to be officially certified as a Green Pistachio of Bronte PDO product. The plants are grafted almost exclusively on *P. terebinthus* rootstock (see Figure 1(a)), known locally as ‘spaccasassi’ (stone breaker) in reference to the strong and deep roots that can penetrate the rocky lava soils. Fields are terraced in some areas, but the rugged terrain on which the pistachios are grown generally inhibits mechanized agriculture (e.g. see Figure 1(b)). In addition to the subtropical Mediterranean climate, the prevailing west wind and orographic lifting caused by the topography of Mt Etna contribute to natural pollination of the pistachio groves. Cultivation and harvesting are still done primarily by hand, making it a labor-intensive crop. Biennial harvesting in odd-numbered years results from natural cycles of the pistachio plant as well as management practices, including pruning and removal of the few blossoms that do occur in non-harvest years. This practice is intended to increase both yield and quality during harvest years and to control the spread of *Chaetoptelius vestitus* (the pistachio bark beetle) (Avanzato & Vassallo, 2008).

3. Methods

No official maps of the Green Pistachio of Bronte’s PDO boundaries have been published to our knowledge, though at least two written descriptions are available in official publications. A description of the PDO boundary published in the *Official Journal of the European Union* specifies the area located within ‘the municipalities of Bronte, Adrano and Biancavilla in the Province of Catania between 400 m and 900 meters above sea level’ (Commission Regulation, 2010, p. 17). Mapping the area encompassed by these administrative and elevation boundaries (hatched area in Main Map supplement) provides a general overview of the region. The 400- and 900-meter contours depicted were created from a 2-meter resolution digital

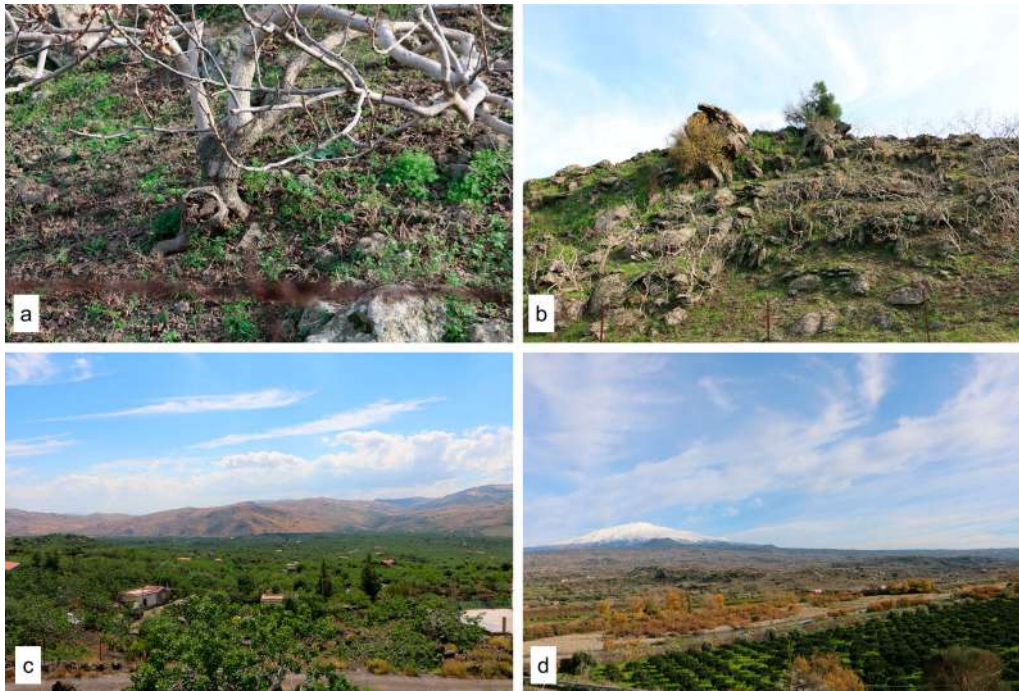


Figure 1. (a) *Pistacia vera* L. grafted on *P. terebinthus* rootstock. (b) Typical rugged landscape on which Bronte pistachios are cultivated. (c) June 2016 photo (37.758380N, 14.815963E) showing green pistachio groves on volcanic soils in the foreground contrasting with the dry vegetation on sandstone and clay hills west of the Simeto River in the background. Photo looks west from a location about three kilometers south of Bronte. (d) December 2016 photo (37.729207N, 14.782497E) looking east towards Mt Etna with citrus groves and the Simeto River in the foreground. The pistachio groves (without leaves at this time of year) on the lower slopes of the volcano appear in brownish tones below the dark green forests on Etna's upper slopes and the snowcapped summit.

elevation model accessible from the Sicilian Regional Territorial Information System (<http://www.sitr.regione.sicilia.it>). It should be noted for clarity that the cities labeled on the map share the same name as the municipalities in which they occur.

While the description in the *Official Journal of the European Union* provides a general indication of the PDO location, it is important to note that cultivation of the quintessential Bronte pistachios is limited to thin volcanic soils on rugged terrain east of the Simeto River and to the south of the city of Bronte. Taken literally, the boundaries described in the *Official Journal of the European Union* incorrectly imply that cultivation extends into areas where soils are formed on sedimentary and, to a lesser extent, alluvial parent materials.

A more detailed written description of the PDO boundary was published in the *Official Journal of the Italian Republic* (2010). A translation of this description is as follows:

The production area of the Green Pistachio of Bronte falls in the territory of the communes of Bronte, Adrano, and Biancavilla (Province of Catania). In particular, the boundaries are identified as: BRONTE – west along the Simeto River, east to the height of 900 a.s.l., south to the Commune of Adrano and north along the road from Bronte to Cesarò; ADRANO – north to the border of the Commune of Bronte, south to the town center and the State Road 121 (SS 121), east with the Lava Grande of 1595 and

with the Commune of Biancavilla, west along the Simeto river to the SS 121; BIANCAVILLA - north along the border of Adrano, south to the town center and the SS 121, east to the municipal boundary of Santa Maria Licodia, west to the border of the Commune of Adrano.

The production area must be between 400 and 900 meters in elevation. (translated from the *Official Journal of the Italian Republic*, 2010, p. 34)

Despite the discrepancies between the two published written descriptions, both mention the importance of volcanic soils as a key variable that gives Bronte pistachios their unique characteristics. For example, in the 2009 application for PDO status published in the *Official Journal of the European Union*, the Bronte pistachio's link to its environment is described as follows:

The production area has volcanic soils and enjoys a semi-arid, subtropical Mediterranean climate, with long, dry summers, rains concentrated in the autumn and winter and significant changes in temperature between the day and night. These pedological and climatic factors, together with the use of terebinth (*Pistacia terebinthus*), introduced by man, give the fruit particular qualities ... that are hard to achieve in other production areas or elsewhere in the Etna massif. This particular combination of pedological, climatic and human factors gives 'Pistachio Verde di Bronte' PDO specific qualities that make this a unique product. (Council Regulation, 2009, p. 17)

Given the importance of volcanic soils in the cultivation of Bronte pistachios, pedologic and geologic maps of Mt Etna by Bellotti, Branca, and Groppelli (2010) and Branca, Coltelli, Groppelli, and Lentini (2011) were consulted when attempting to transcribe the written description of the PDO published in the *Official Journal of the Italian Republic*. The region of Mt Etna referred to by Branca, Coltelli, and Groppelli (2011) as the stratovolcano supersynthem includes a broad area affected by eruptions beginning about 57,000 years ago. This was a period of significant volcanic activity that resulted in Mt Etna's current stratovolcano form that significantly impacted the terrain around Bronte where the pistachios are now grown. The delineation of the Green Pistachio of Bronte PDO derived from interpretation of the written description in the *Official Journal of the Italian Republic* is depicted in the [Main Map](#) supplement with a red outline and more closely matches the extent of volcanic terrain when compared to the description in the *Official Journal of the European Union*.

Further insight into the area of pistachio cultivation is provided in the Land Use Map of the Sicilian Region (Sicilian Region Department of Land and Environment, 2007). This 1:10,000 scale vector layer identifies biotopes in Sicily based on air photo interpretation and a land use classification system that is compatible, but more thematically detailed than the Coordination of Information on the Environment (CORINE) dataset. Only 1 of the nearly 7000 polygons covering the Sicilian Region is coded as pistachio groves. This core area of cultivation (shown with a green on the [Main Map](#) supplement) occurs near the center of the PDO, just south of the city of Bronte and extends into the northern section of the commune of Adrano.

The core area of cultivation has a distinct visual appearance that is apparent when traversing the landscape in the field or visualizing it from satellite or aerial imagery (see [Main Map](#) supplement). Two major lava flows make up the primary surface geology of this region. The Mt Ruvolo flow is associated with a flank eruption dated to approximately 100 CE. This flow partially overlaps the older Mt Minardo lava field produced by a flank eruption dated to approximately 160 BCE (Bellotti et al., 2010; Branca, Condomines, & Tanguy, 2015).

The photographs in [Figure 1\(c,d\)](#) provide additional insight into the Bronte pistachio's geographic setting. [Figure 1\(c\)](#) was taken in June 2016 looking directly westward from a location approximately three kilometers south-southwest of the city of Bronte. The green vegetation in the foreground is comprised almost exclusively of pistachio groves that contrast with the dry, brown herbaceous vegetation on the sandstones and clay hills west of the Simeto River in the background.

Flat and gently sloping areas within the region that are covered by alluvial soils are more easily accessible to mechanized farming and more likely to be planted

with crops in symmetrical rows: mainly olives and citrus, with some vineyards and other fruits, nuts, and vegetables (Martelli & Longhitano, 1987). Conversely, the topographically rugged areas characterized by thin and rocky volcanic soils are cultivated almost exclusively with pistachios, sometimes on terraces and interspersed with prickly pear, among the only economically viable crops that can grow on this terrain.

The [Main Map](#) supplement was designed at a scale of 1:75,000. A Landsat 8 Operational Land Imager (OLI) image collected on 15 February 2014 was used as the primary backdrop. The 30-meter resolution multispectral image was sharpened using the OLI 15-meter panchromatic channel (band 8) and displayed using an RGB 4-3-2 true-color composite that highlights the distinct color and texture of the core cultivation area at a time of year when the deciduous pistachio plants were without leaves.

The map was offset to show the juxtaposition of the PDO in relation to the summit of Mt Etna, a powerful presence in this landscape that is intimately linked to the unique properties of the Bronte pistachio. On the date the satellite image was acquired, the Italian National Institute of Geophysics and Volcanology (INGV) reported Strombolian activity, active lava flows, and explosions near Mt Etna's snow-covered summit (INGV, 2014).

4. Discussion

Developing a large-scale map of the Green Pistachio of Bronte PDO based on the two official written descriptions and supporting cartographic data was challenging given the discontinuities and ambiguities in the publicly available source material describing the PDO boundaries. Cartographic interpretations of the two written descriptions are presented simultaneously in the [Main Map](#) supplement and inset to facilitate comparison of their similarities and differences.

Transcribing the abbreviated written description of the PDO published in the *Official Journal of the European Union* into map form (hatched area) was technically straightforward because it relied on easily discernable municipal boundaries and elevation contours. However, when taken literally, this description extends the PDO into areas of soils formed on sandstones, clays, and alluvial deposits where pistachios are not typically grown. Even if pistachios were grown in these areas, it is unlikely they would exhibit the same organoleptic properties as those grown on the thin, rocky volcanic soils of Mt Etna that produces the quintessential PDO product. The EU description could be improved with the addition of a few short phrases indicating the zone of production is limited to volcanic soils east of the Simeto River (which forms a boundary between volcanic and sedimentary soils) and to the south of the city of Bronte. Combined

with the municipal and elevation boundaries already included in the EU description, these additions would more precisely define the relevant area.

The written description of the PDO published in the *Official Journal of the Italian Republic* constrains the PDO to a smaller area, but it is only when interpreting this description while consulting geologic and soil maps of the area that the relevant extent is most clearly defined. Despite close correspondence between portions of the *Official Journal of the Italian Republic* PDO description and the geologic and soil maps, seemingly illogical discrepancies still remain. For example, the SS 121 (state road) is mentioned as forming part of the boundaries within the communes of Adrano and Biancavilla. However, this road occurs below the 400-meter contour throughout the region. This conflicts with later parts of the written description that state the zone of production as limited between 400 and 900 meters in elevation. However, two areas of volcanic terrain depicted on geologic and soils maps of the area extend below the 400-meter contour from the town centers of Adrano and Biancavilla and terminate at the SS 121 (see inset on [Main Map](#) supplement).

A further complication that contributes uncertainty in delineating the Green Pistachio of Bronte PDO boundary arises from criteria used for PDO certification. The entire production process associated with PDO products, from cultivation to final product, must occur within a specific geographic area. In contrast, PGI products must have distinct characteristics that are uniquely associated with a particular place, but only one stage of production must be associated with a specific geographic area. Thus, in the case of the Green Pistachio of Bronte PDO, processing facilities that are not necessarily located on the volcanic terrain where the pistachio plants are cultivated may be located nearby and the description of the PDO may be extended to ensure these facilities are included within the boundary to comply with the certification criteria.

5. Conclusions

Geographical origin is often associated with quality in agricultural and other products, thus geographical labels have long been used to both inform consumers and as tools for marketing (Lombardo, 2015; Menapace, Colson, Grebitus, & Facendola, 2009). Allaire, Casabianca, and Thévenod-Mottet (2011, p. 1) used the term ‘origin products’ to describe this phenomenon. The legislation of the EU’s PDO, PGI, and TSG systems is partially reflective of ancient traditions of associating goods with specific places of origin, but it is also more than that. Modern geographically delimited products codify both a specific area and a set of physical, biological, and cultural practices. In so doing they seek to both guarantee authenticity to the consumer and preserve production methods and

lifestyles that result in distinct products. Because these systems are recognized and enforced at international levels, they have the potential to protect both producers and consumers from lower priced and lower quality imitations. Purchasing PDO, PGI, or TSG goods not only can be seen as ‘buying into the farmers,’ but it is also a choice to purchase a particular product with unique characteristics, produced in an exacting way, and under legally sanctioned specifications.

Products such as the Bronte pistachio also have symbolic content, but consumer’s recognition of geographical labels depends on context. For example, Vecchio and Annunziata (2011) concluded from a survey of 400 Italian consumers that, while PDO and PGI logos can be a motivation for purchasing among consumers who are knowledgeable about the products and the meaning of the labels, consumers who are not aware of these designations are more motivated by price and perception of quality. Consumers who recognize the precise origin of a product and understand the symbolic content may have close connections to the product’s region of origin. For example, Metro-Roland (2013) demonstrated products such as the Bronte pistachio mediate relationships between homelands and those living in the diaspora in important ways.

While the published metes and bounds descriptions of the Bronte pistachio PDO and other specialty products may present challenges to cartographers, we see the sort of maps developed for this paper as important steps toward better understanding these economically and culturally important regions and products. As noted by Feagan (2007, p. 23), ‘there is a strong argument for emplacing our food systems, while simultaneously calling for careful circumspection and greater clarity regarding how we delineate and understand the “local”.’ Depicting these areas in maps provides considerable insight into the uniqueness and complexity that they encompass.

Software

Map design was conducted using ArcGIS, v. 10.5.1. Quantum GIS v. 2.18.1 was used to retrieve GIS data from OpenStreetMap and the Territorial Information System of the Sicilian Region websites, and to create contour lines and hill shade images from the digital elevation data. ERDAS Imagine, v. 2016 was used for panchromatic sharpening and color balancing of the satellite image backdrop in the [Main Map](#).

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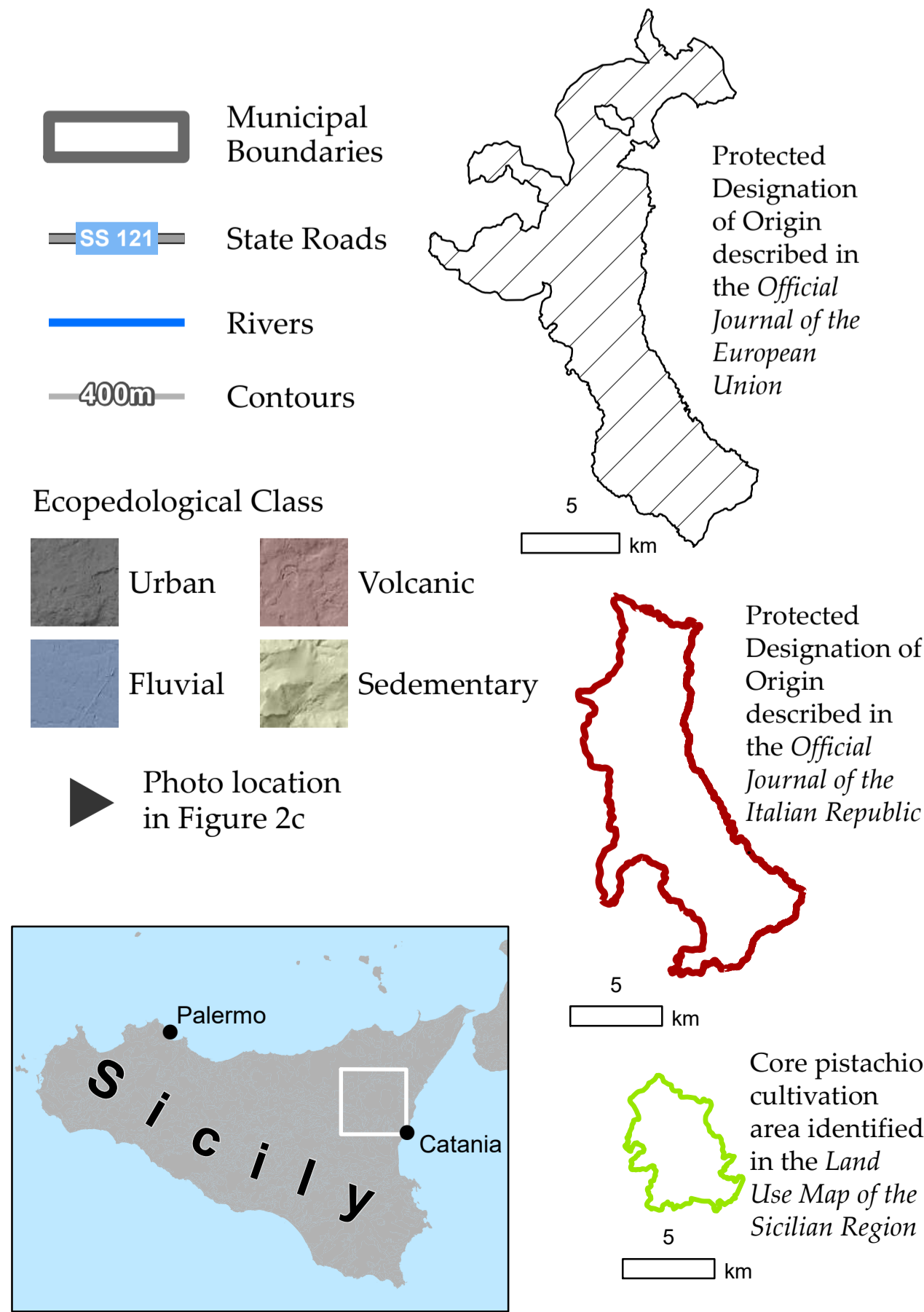
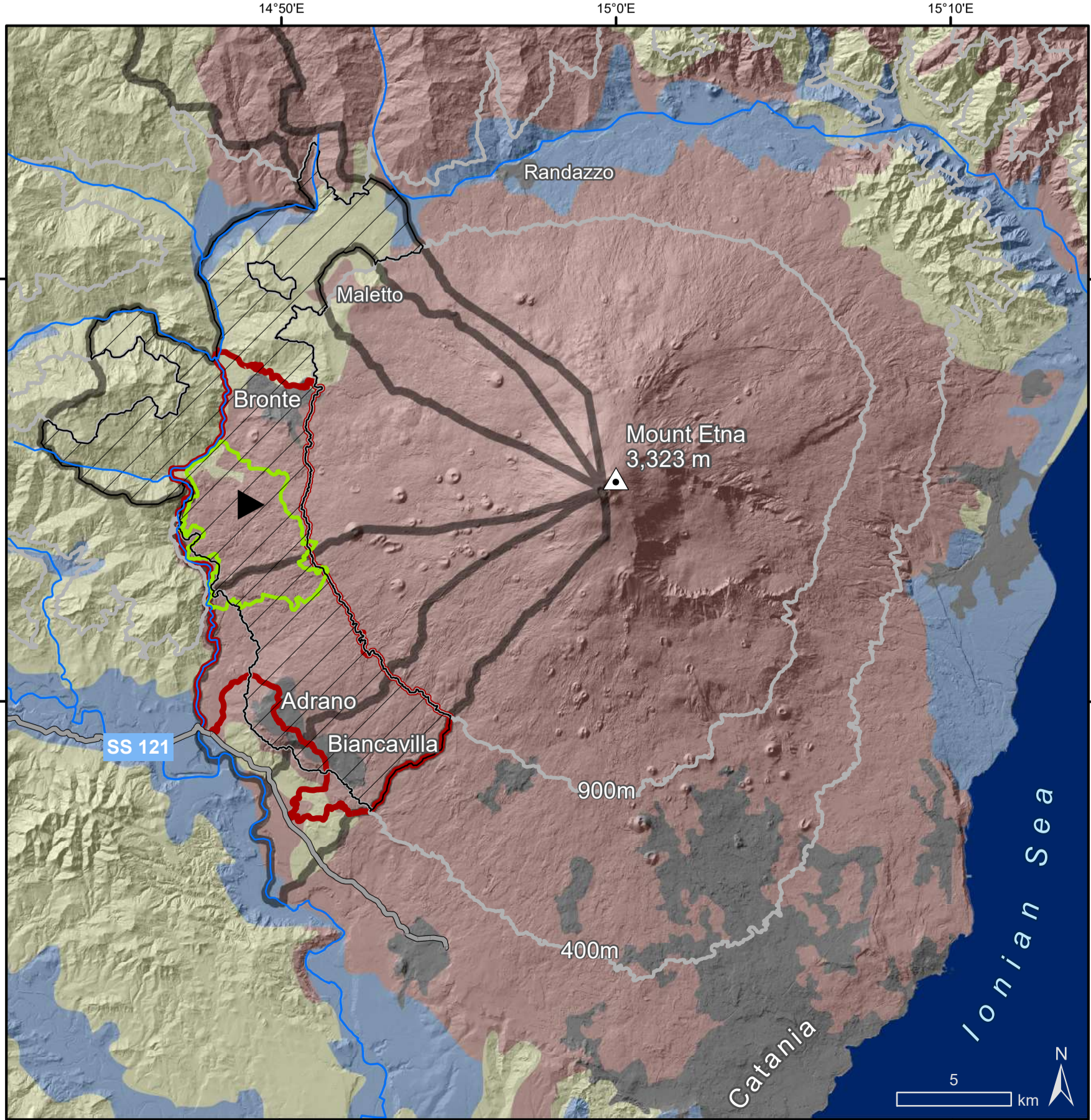
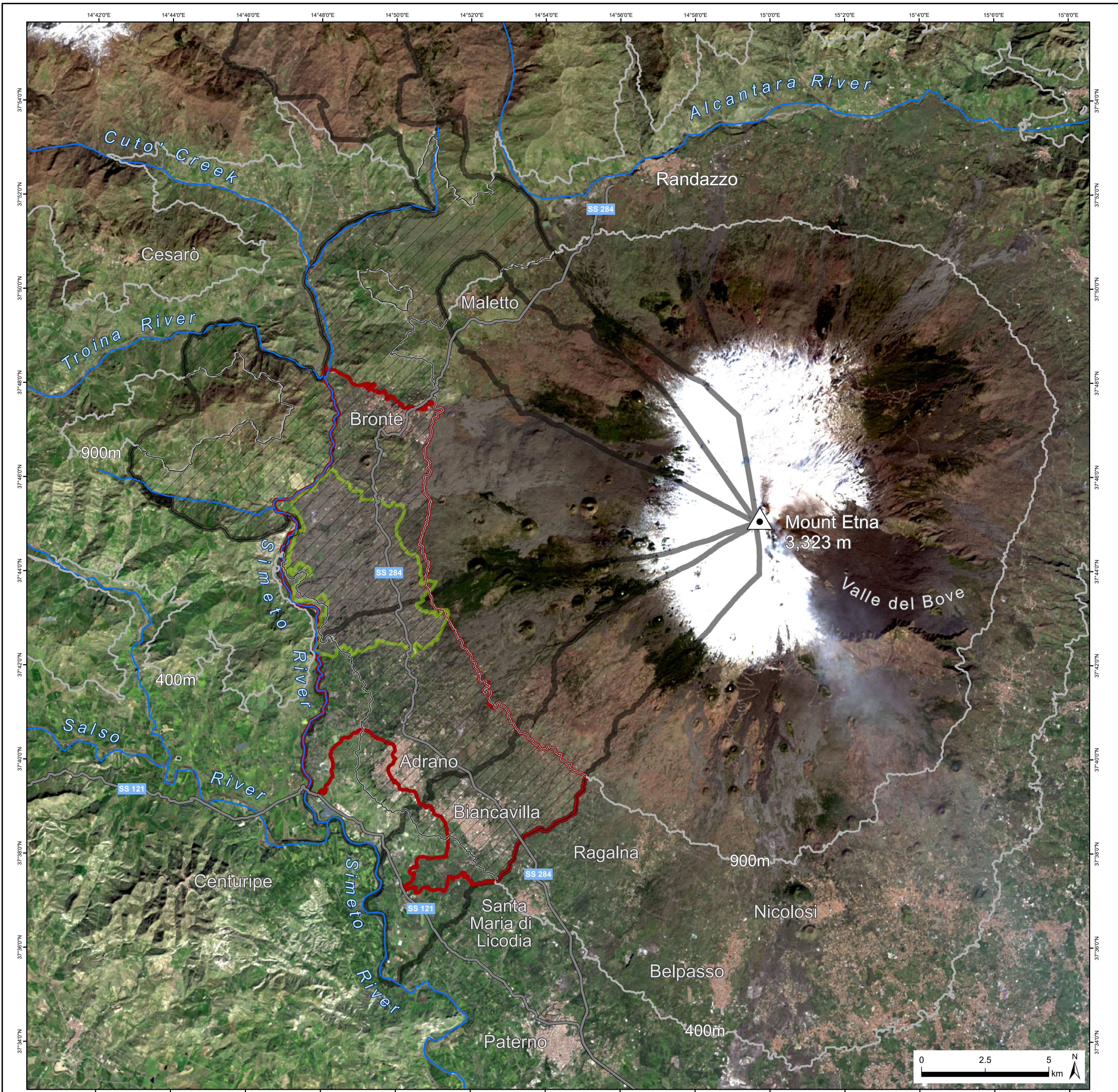
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The Green Pistachio of Bronte

The Green Pistachio of Bronte is an Italian Protected Designation of Origin (PDO) product officially registered with the European Union. Bronte pistachios are grown on the western slope of Mt. Etna (Europe's most active volcano) in a specific area of thin, rocky volcanic soils. The rugged terrain on which the pistachios are grown inhibits the use of mechanized agriculture, thus cultivation and harvesting are still done mainly by hand.

Bronte pistachios are known for their unique flavor, bright green color, and organoleptic properties that are intimately linked to their place of origin. The quality of Bronte pistachios combined with their limited area of cultivation and biennial harvest cycle creates high demand. Their price can be more than double that of other pistachios sold on the global market.

The core area of cultivation identified in the *Land Use Map of the Sicilian Region* is almost completely covered with pistachio groves (green outline on maps). Written metes and bounds descriptions of the PDO boundaries published in the *Official Journal of the Italian Republic* (red outline) and the *Official Journal of the European Union* (hatched area) present discrepancies when transcribed into map form, but both identify the zone of production as occurring between 400 and 900 meters in elevation within the communes of Bronte, Adrano and Biancavilla.

The entire production process associated with PDO certified goods must occur within a specific geographic area in order to meet certification criteria. Thus, processing facilities that are not necessarily located on the rugged volcanic terrain where the pistachios are grown may be located nearby and the PDO boundaries may be extended to ensure these facilities are included for compliance with the official certification criteria.

<p>Main Map (top)</p> <p>Scale: 1:75,000 Projection: UTM Zone 33N Datum: WGS 1984 Easting: 500,000, Northing: 0.0 Central Meridian: 15.0 Satellite image: Landsat 8, 5 February 2014 (RGB 4,3,2) Vector Overlays: OpenStreetMap, Territorial Information System of the Sicilian Region</p>	<p>Inset Map (far left)</p> <p>Scale: 1:300,000 Projection: UTM Zone 33N Datum: WGS 1984 Easting: 500,000, Northing: 0.0 Central Meridian: 15.0 Ecopedological Layer: Italian National Geoport Shaded Relief: Territorial Information System of the Sicilian Region</p>
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In riferimento alla pubblicazione dal titolo “Geographic context of the Green Pistachio of Bronte, a protected designation of origin product”, co-autorata con J.S. Wilson e D.C. Knudsen, nonostante sia frutto di un lavoro collettivo, si dichiara la seguente divisione delle parti:

a D.C. Knudsen sono ascrivibili i punti 1 e 5;

a J.S. Wilson è ascrivibile il punto 3 e l'apparato cartografico;

a G. Petino sono ascrivibili i punti 2 e 4.