

Reaching a socio-ecological tipping point: Overgrazing on the Greek island of Samothraki and the role of European agricultural policies

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ABSTRACT

Livestock keeping and food production from grasslands play an important role in the Mediterranean region, where grazing has a long tradition and still is a key livelihood strategy. Yet, in many places widespread degradation (caused by overgrazing) severely threatens the natural resource base and prospects for future food security and sustainable development. On Samothraki, a Greek island, several decades of continuous increase of the local livestock population, exceeding not only the local food base by far but also the local farmers' ability to provide supplementary feed, led to a socio-ecological tipping point turning the dynamics downward. Still, in the face of very restricted marketing opportunities, we find local farmers in an economic deadlock of relying on CAP subsidies as a main source of income and on still too high animal numbers for maintaining an ecological balance of their land while lacking the labor power (due to large-scale migration to Germany in the 1950s and 60s) to apply adequate management practices. In this paper, we present a feed balance (feed-demand and supply) for sheep and goats from 1970 to 2012 and discuss causes and effects of the excessive growth in animal numbers, as well as reasons for their downturn in the last decade. We describe the island's groundcover and symptoms of soil degradation, and underline our findings by reference to a remote sensing approach. Our findings recently gained in prominence as in September 2017, a state of emergency had to be declared on the island when a major weather event triggered a series of landslides that severely damaged the main town, a number of roads and bridges and even the 700 years old Fonias Tower, a marker of Samothraki tourism.

1. Introduction

Livestock keeping and food production from grasslands is a key livelihood strategy in many parts of the world (Herrero et al., 2013), and is essential for humanity because it allows utilizing a resource – grassy biomass – that otherwise would be unusable for humans. Across the Mediterranean basin, livestock grazing is a traditional form of land use since millennia (Grove and Rackham, 2001; Papanastasis et al., 2007), with ecosystems having evolved to their current state under high grazing pressures over thousands of years (Noy-Meir, 1975). In Greece, sheep and goat farming has been a part of the national identity since prehistoric times and still constitutes the dominant land-use practice and a major source of income in many less favorable areas. On Samothraki, a small Greek island in the Aegean Sea, grazing of small ruminants (e.g. sheep and goats) is a practice that occurs unrestrictedly on all land types all year round.

The current paper is an outcome of a broader study of this island, in which the socioecological system of Samothraki is conceptualized as an interaction between cultural and natural spheres of causation (Fischer-

Kowalski and Weisz, 1999). By this definition, society's stocks (human and livestock population as well as built infrastructure) can be reproduced as long as the flows required for maintaining these stocks can be organized (Petridis and Fischer-Kowalski, 2016). When critical stocks cannot be reproduced, the system risks collapsing. Our research sought to identify pathways in which this island society could maintain its human population and the impressive biodiversity (as most of its territory is included in the Natura, 2000 network, Biel and Tan, 2013), while complementing its agriculture with a moderate amount of tourism (Petridis and Huber, 2017; Petridis et al., 2017). The ubiquitous sight of free ranging goats tourists consider one of the particular charms of this island. Not so the regular inhabitants: The first rounds of focus group interviews with the local population made clear that there existed strong tensions against farmers increasing their livestock numbers at the expense of public forests and green vegetation, private gardens, and safe walking areas (Petridis et al. 2013).

Livestock statistics seem to confirm the perspective of the locals (see Fig. 1): within four decades, the livestock population had increased almost fourfold; and at the time of the interviews, although declining,

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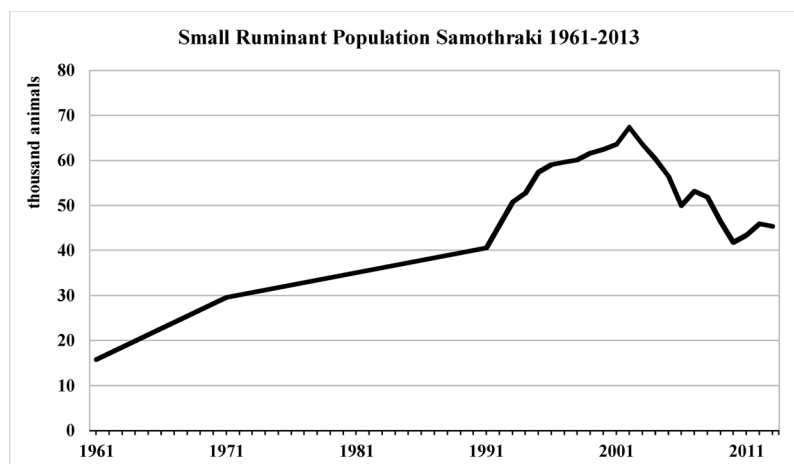


Fig. 1. Small ruminant population on Samothraki 1961–2013 (ELSTAT, 2014).

numbers still were three times as high as in the 1960s.

Such a long-term increase in livestock numbers is an unusual finding for the Mediterranean: according to Hadjigeorgiou (2011), in the 1990s, the period of strongest growth of livestock numbers in Greece, numbers increased by one third in Crete and by 20% in East Macedonia and Thrace, while in most other Greek regions they showed even a slight decline.

At this point, a first research question needs to be answered: Why did such an unusually persistent increase of livestock numbers occur on Samothraki?

From this follows a second research question: Did this lead to a rise in grazing pressure that constitutes a serious threat to the vegetation cover, to the degree that it impacts biodiversity and touristic attractiveness of the island? And finally: what happened in 2002 and the subsequent years to make livestock numbers decline?

High grazing pressure and negative impacts on the resource base have been reported widely across the Mediterranean region (Hill et al., 1998; Lorent et al., 2008; Kizos et al., 2013). Grazing at sustainable levels can be beneficial for the conservation of cultural landscapes, the preservation of soil loss or the enhancement of primary productivity, and can provide an essential livelihood strategy in remote areas (Herrero et al., 2009). Unsustainable grazing practices, on the other hand, can have grave environmental and socio-economic consequences. Overgrazing may trigger devastating feedback cycles such as a loss of species diversity, changes in species composition, an increase in unpalatable species (e.g. weeds) or woody plants, a decline of primary production and plant cover, a reduction of grazing capacity and finally soil degradation (Coughenour et al., 1990; Milchunas and Lauenroth, 1993; FAO, 1999; Asner et al., 2004). The risk for soil degradation is further exacerbated by a factor of up to 2.5 in mountainous regions, due to steep slopes (Barbayiannis et al., 2011).

Has the vegetation cover on Samothraki come under large scale threat? Has possibly an ecological tipping point been reached? We will address these research questions in due sequence, after explaining the study area and the methods applied.

2. The study area

Samothraki is an example of a “marginal” mountainous Mediterranean island and belongs to the East Macedonia and Thrace regional unit in North-Eastern Greece. Its area is 178 km² and it is located 42 km off the northern Greek coast in the Aegean Sea. The dominant climate type is eastern Mediterranean with an average annual temperature of 17.5 °C and precipitation of 651 mm (Year 2015; Meteo Greece, 2016). The dominant mountainous character of the island with its highest peak reaching up to 1611 m above sea level causes a strong

north-south gradient in precipitation. According to the CORINE land cover data product (Copernicus Programme, 2014; EEA, 2011), 18% of the total land area is agricultural land, which is mostly located in the south-western part of the island where the majority of the inhabitants reside. Agricultural land includes arable areas and complex cultivation patterns such as a mix of permanent and annual crops, gardens, pastures, and fallow land (EIONET, 2016), land principally used for agriculture (e.g. cropland or pastures interspersed by natural vegetation) and olive groves. Mediterranean shrub land (maquis and its degraded forms garigüe and phrygrana) and principally agricultural land make up for 38% of the total area, natural grasslands for 39%, 4% is natural forest remnants (mainly oak forests consisting of Quercion frainetto; Biel and Tan, 2013), and the remainder is made up of bare rock.

After a decline in the first post-War period, the island population stabilized somewhat below 3000 inhabitants (ELSTAT, 2014). Currently, among the economically active population (37% of total population), 22% are employed in the primary sector, mainly practicing sheep and goat farming and olive cultivation. Their numbers have shrunk from more than 400 to 200 persons between 2001 and 2011, but this refers more to their formal status than to their economic activity: The transparency database for agricultural subsidies still registers more than 500 recipients in 2015 (<https://transpay.opekepe.gr>). The secondary sector (e.g. dairy, concrete and asphalt production) employs 12% of the labor force, while the tertiary sector (e.g. tourism and public services) makes up for 66% of the total working population.

3. Methods

As explained in the introduction, this study was part of a longer-term research on the socio-ecological system of the island that began in 2008. Thus, we could build upon previous efforts like the in-depth work of Fuchs (2015) who intensively collaborated with six farmers (2013/14) to explore their practices in dealing with their livestock. Equally, we could build upon information from focus group interviews with farmers and farm advisors throughout the study period and capture changes in convictions and beliefs (Petridis and Fischer-Kowalski, 2016).

3.1. Estimating the feed balance

Total feed demand for sheep and goats was estimated using information on livestock numbers from public statistics (see Fig. 1) and on feed demand from the literature. Due to a lack of information we do not consider changes in feed demand during pregnancy or lactation periods and apply average values necessary to maintain a good healthy status of livestock from the work of Fuchs (2015); Evlagon et al., 2010

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