The longitudinal study of land-use at Acconia: Placing the fieldwork of the survey archaeologist in time

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This article presents the results of the longitudinal study of land-use conducted at Acconia in southern Italy between 1980 and 2007. This is the first of several articles planned on the landscape dynamics that took place there over a span of 27 years. Here we trace the sequence of the steps in the work of the Acconia Survey and the evolution in our thinking that led to the start of the longitudinal study, outline the fieldwork conducted at Acconia in 2007 and 2008, and present the changes in land-use that took place between the first mapping in 1980 and the fourth one in 2007. The final section considers some of the implications of what we have observed for the development of method and theory in survey archaeology. One of the main conclusions to emerge from the longitudinal study is that the work of the survey archaeologist should be seen as situated in time.

Keywords: survey archaeology, landscape dynamics, longitudinal study, land-use, site visibility, Acconia

Introduction

The aim of this article is to return to Acconia and the landscape dynamics that we have observed there since 1980 as part of our ongoing regional survey in the south of Italy. Every nine years from 1980 through 2007, we have returned and repeated the mapping of land-use on a field-by-field basis. Based on the four maps that are now available—for 1980, 1989, 1998 and 2007—there is the opportunity to trace the changing patterns of land-use in the Acconia area over an arc of 27 years. To our knowledge, this is the first study of its kind that covers such a long span of time (for a preliminary report on the first nine years of the study, see Ammerman 1995). Acconia is located on the west coast of Calabria, the region in the toe of southern Italy, and we conducted an intensive survey in the years between 1974 and 1980 (Ammerman 1985a) (for the patterns of Neolithic and Eneolithic settlement at Acconia, see FIG. 1). As described below, it has taken a good deal of planning and patience to carry out a longitudinal study of this length.

Another goal is to return to a question of major interest when it comes to the development of method and theory in survey archaeology: namely, the role that time plays in what happens to come to light on the surface of the landscape in any given year. The working assumption made by the person doing an archaeological survey was an optimistic one. What was found on the surface of the land was held to be independent of time. In other words, it was assumed that what one saw at a given place on the landscape in 1975 would be the same if the archaeologist went back out to the same place and took a second look in 1985 (Ammerman 1981). In effect, the work of the survey archaeologist—the search for sites or scatters of archaeological materials on the land surface—was taken to be a timeless endeavor. The survey archaeologist was living and working in a Garden of Eden (Ammerman 2004). However, based on the work of the Acconia Survey over a span of seven years (from 1974 through 1980), we began to realize that this tacit assumption had its problems. There were dynamics that were taking place on the landscape during the life of the survey, and the visibility of a given site on the landscape was in a state of flux from one year to the next (Ammerman 1981, 1985a, 1985b, 1995, 2004). This raised new questions about the very nature of survey archaeology. It is worth recalling the words from *Macbeth* that were placed at the start of "Surveys and Archaeological Research" (Ammerman 1981: 63): "Come what come may, time, and the hour, runs through the roughest day." In these few words, Shakespeare managed to capture the sense of what was coming to light on the restless landscape at Acconia.

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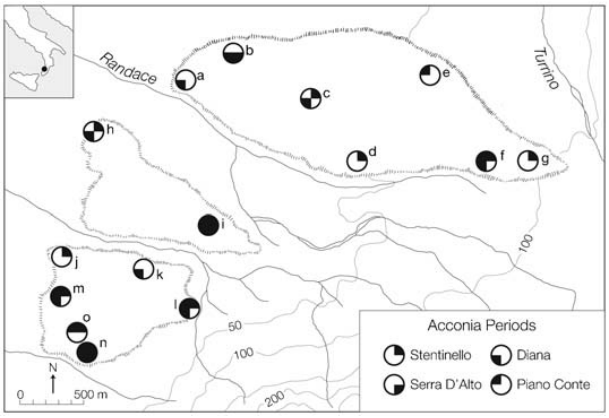

Figure 1 Map of the settlement complexes at Acconia showing the patterns of occupation for three periods in the Neolithic (Stentinello, Serra d'Alto, and Diana) and one in the Eneolithic (Piano Conte).

As part of the fourth mapping in 2007, many people who had spent their lives working on the landscape at Acconia were interviewed. The aim was to gain a better understanding of how and why land-use changes in our area; we wanted to learn more about what makes the landscape dynamics at Acconia tick. After the results of the second mapping in 1989 (Ammerman 1995) and a third mapping in 1998, it was clear that the longitudinal study was productive from the perspective of the archaeologist. The systematic mapping of land-use in a time series (in 1980, 1989, and 1998) provided good empirical evidence for the dynamic nature of the modern landscape. Now it was time to explore in greater depth the social, economic, and political factors that were behind the observed changes in land-use. Studies of this kind are normally done by the anthropologist or the geographer and not by the field archaeologist. In 2007, with the support of the Wenner Gren Foundation for Anthropology Research, we had the opportunity to return to Acconia to put three anthropologists in the field alongside the archaeologists who were doing the fourth mapping. Below more will be said about the wide range of studies that were started in 2007: for example, the identification of those who took the lead in bringing innovations to the area, the ways in which public policy and farm subsidies have shaped the changing patterns of land-use, and the interviews with older people at Acconia, which now made it possible to reconstruct what the landscape was like in the years just after the Second World War.

These studies proved to be highly productive and there is too much material to present in the space available here. Thus, only a few aspects of this work will be mentioned and we plan to write a series of complementary articles. In addition, we intend to write a monograph that will offer a full account of what we have learned about the nature of landscape dynamics at Acconia.

The aim here is to present the empirical side of the story—the changes in land-use observed between 1980 and 2007—and not to delve into the rich and parallel story of what makes land-use change. In another article, we shall move beyond the changing patterns of land-use that have been observed (the matter of primary interest for the field archaeologist) and give a fuller account of what drives the landscape dynamics.

The pathway to the longitudinal study

Why was the decision made to start the longitudinal study in 1980? The story of the Acconia Survey involves a number of innovations that fit together and make good sense in terms of where we stand today. Each of them called for innovative thinking in the 1970s. For this reason, it is useful to list four of the innovations, as each contributed to seeing the landscape at Acconia in a more dynamic way: (1) the replicated collection of site surfaces (showing the stochastic character of what is seen on the surface of a plowed site at any one time) (Ammerman and Feldman 1978), (2) the repeated coverage of the landscape (Ammerman 1985a), (3) the plow-zone experiments which again show the stochastic character of the artifacts appearing on the surface of a site (Ammerman 1985c), and (4) the new concept of "window of visibility" on the landscape (Ammerman and Bonardi 1981; Ammerman 1985a). The full account of the details concerning the innovations is documented elsewhere (http://Acconia.colgate.edu).

The invitation to start the survey came from Gianfranco Ghiara, the President of the new University of Calabria, which had just opened its doors in 1974. At the time, the first author taught at Stanford University where he worked in close collaboration with Luca Cavalli-Sforza in the Department of Genetics. Previously, there had been very few archaeological surveys in Calabria, one of the poorest regions in Italy (Douglas 1915). Ghiara encouraged us to focus on prehistoric sites, since the prehistory of the region was not well known. This would give us the chance to explore in the field some of our new ideas about the Neolithic transition in Europe (Ammerman and Cavalli-Sforza 1984). There seemed to be a paucity of Neolithic settlements in the toe of southern Italy. As part of his synthesis of the nearby region of Sicily, Luigi Bernabò Brea (1966), one of the leading figures in Italian prehistory, had recently suggested that the Neolithic had skipped over Calabria.

One of the key steps in the design of the survey project was the AMPRA (Parma) sampling game, which was created at Stanford University in the spring of 1974 (Ammerman 1985a: 3–5). Without

going into details here, it was "played" by three groups before we first went out to Calabria: professors at Stanford with an interest in statistics, graduate students taking a course in sampling methods, and a group of archaeologists in the San Francisco Bay Area. AMPRA revealed some of the basic problems of sampling a region in the case of a large, multi-period survey. Thus, we opted for the contiguous coverage of four areas of smaller size, each with a good potential for producing Neolithic sites. While all four yielded Neolithic impressed ware sites in the Stentinello tradition (ca. 6th millennium CAL B.C.) (Robb 2007) during the course of fieldwork in the autumn of 1974, Acconia was clearly the most promising area. By the end of our first field season in November of 1974, we had found a total of 24 prehistoric sites at Acconia and thought that this was a good catch.

At the time, the working assumption of the survey archaeologist in Italy, Greece, and elsewhere in the Mediterranean lands was that one season of coverage was enough (Ammerman 1981). A key step in the Acconia Survey was the innovation, mentioned before, of repeating the coverage of the landscape over multiple seasons. This arose quite unexpectedly from a probing question that Marcus Feldman in the Department of the Biological Sciences at Stanford asked at the end of a talk that the first author gave on the results of the first field season at Acconia. What would happen if we repeated the coverage at Acconia a second time? Would we find the same number of sites on the landscape? Or new and different ones? Repeating the coverage of the landscape was not part of the methodology of survey archaeology in 1974. On the other hand, by the early 1970s, it had become standard practice in ecology to carry out repeated trials in the field.

Now it was time to see what we would find when we took up Feldman's challenge. In the spring of 1975, we walked over several places that we had covered in the first season without coming up with any evidence for human occupation there. To our surprise, we found cultural material: scatters of prehistoric material were now visible on the surface in places where nothing was seen in the first season. What this meant was that it was time to slow down and spend several more field seasons at Acconia. We managed to find a total of 75 prehistoric sites by the end of the fourth field season in 1976 (Ammerman 1985a: fig. 3.1), when most of the area had now been covered a second time. By 1980, after further work had been done—by this time, many places within the survey area had been covered three or four times—a total of 91 prehistoric sites were identified. More new sites would continue to come in during the course of the longitudinal study (Ammerman 1995: fig. 3), although this was not its real purpose.

The next step was to focus our attention on the question of site visibility on the landscape. Now it is necessary to digress and explain this important question in the history of survey archaeology (e.g., Ammerman 1981, 1993; Ammerman and Bonardi 1981; Cherry *et al.* 1991; Terrenato and Ammerman 1996; Meyer and Schon 2003; Terrenato 2004; Thompson 2004). Today there are still a few survey archaeologists who wish that the whole matter of site visibility had never come up; it would have made all of our lives much simpler (Terrenato and Ammerman 1996: 91). To begin with, it is fair to say that few surveys in the Mediterranean took an active interest in the question of site visibility in the 1970s. The work that we were doing at Acconia was an exception. However, by 1981 the question of visibility had already been set out in the literature. It was summarized in the following words "As we have seen in survey work in Calabria, where a small area has been subjected to repeated, intensive coverage over a period of five years, what is seen on the landscape changes from year to year. The situation is one in flux. The search for sites goes on within a time frame, and time itself introduces relativity into the relationship between the observer and that which is observed. On a given day in the field, time's arrow conditions in part what we will happen to see (Ammerman 1981: 82)."

Even by the mid 1990s, there were comparatively few surveys where the decision had been made to take a more rigorous approach to recording visibility in the field and to analyzing its effects on site recovery. This is something that Terrenato and Ammerman (1996) learned when they searched the literature for other studies in Italy and Greece to compare with what was coming to light in the Cecina Valley of Tuscany. To complicate the story, one of the few surveys that did turn to the question had managed to reach an ambiguous conclusion (Cherry *et al.* 1991: 45). This was the survey on the island of Keos in the Aegean where only ground cover was taken into account and no attempt was made to consider the role of geomorphology in site visibility. When we subsequently reanalyzed the data of the Keos Survey, we found a much stronger correlation between visibility and site recovery than had been reported (Ammerman 1993; Terrenato and Ammerman 1996: fig. 9). While the Keos Survey had made the right move and decided to record visibility in the field, it then tried to sweep what it found under the carpet (Terrenato 2004: 37). In retrospect, the Keos Survey represents a missed opportunity; it is emblematic of the ambivalent attitude toward visibility that lasted well into the 1990s.

Returning to the steps leading to the idea of "windows of visibility" on the landscape, a very brief account will be given here. The soil studies done for the Acconia Survey by two specialists from the University of Amsterdam (Remmelzwaal 1985) represent its point of departure. In their work at the so-called Acconia Flats, Otto Spaargaren and Arie Remmelzwaal were able to show—based on comparing the aerial photographs of the area taken in 1954 and in 1974 (Ammerman 1985a: fig. 2.4)—that the landscape there had experienced a major change in the intervening years and that the Neolithic sites recovered on the Acconia Flats occurred in association with what they initially called "geomorphological windows," or places where the upper horizons in the soil profiles commonly seen in this area were missing due to wind erosion or human activity or some combination of the two. In other words, the artifacts occurring in the paleosol of a buried Neolithic site had managed to become visible on the surface because of an exposure that had formed in the years since 1954. Thus, the work at the Acconia Flats documented for the first time the connection between the recovery of sites and the occurrence of "windows of visibility," as they are now called. In turn, we realized that our project needed a better series of aerial photographs than the one flown in 1974 (at a scale of 1:15,000), which showed the situation on the ground at the start of our work in Acconia. What was called for was a series of aerial photographs taken closer to the time of the fourth field season done in the spring of 1976, which would allow us to map in detail all of the windows of visibility on the landscape at Acconia. The new series was flown for the project in April of 1977 at a scale ca. 1:5000 (Ammerman 1985a: 28, 1985b: 29). In January 1977, the first author moved from Stanford to the State University of New York at Binghamton. As part of a course there in spatial analysis, a group of graduate students used the new aerial photographs to map the windows of visibility (using stereo pairs and the same methods of aerial photographic interpretations as the Dutch soil scientists) over most of the survey area at Acconia (FIG. 2A). This was a blind study in the sense that the students had no prior knowledge of the spatial distribution of the sites found by the survey when they mapped the windows. When the students had the chance to compare their map with the one showing the locations of the prehistoric sites recovered by the Acconia Survey, they came up with a result of major interest (FIG. 2B). While the windows, covered only about 5% of the dune area at Acconia, three-quarters of the sites happened to fall within them (Ammerman and Bonardi 1981: fig. 27.3) (FIG. 2). Thus, the close relationship between windows of visibility and site recovery clicked together.

Previously, we had not fully appreciated the strength of this association. This meant that we now had to rethink some of our basic ideas about survey archaeology (Ammerman 1981: 82–83, 1985a: 4). The windows were the key both to site visibility and to the recovery of the dense patterns of Neolithic settlement at Acconia. In thinking more carefully about the source of the windows, we realized that many of them were linked in one way or another with human activity. In order to gain a better understanding of the formation of the windows, we had to take a closer look at the changing patterns of land-use in our area. We began the longitudinal study in 1980, and the map itself (FIG. 4) was based on the 1977 aerial photographs in combination with cadastral maps at a scale of 1:2000 (Ammerman 1985b: fig. 3.1). Without the 1977 aerial photographs, the mapping of the windows of visibility (FIG. 2) would not have been feasible. We were in the unique position to have both good reasons for doing the longitudinal study and the right tools for the field-by-field mapping of a large number of fields.

The second mapping of land-use was done in the same way in the spring of 1989. It showed that there were many changes on the landscape even over a span of just nine years (Ammerman 1995). The sequence of four photographs of a given place on the landscape taken at different points in time (FIG. 3) illustrates some of the major changes that were taking place in the years around 1989. Many fields changed to a different class of land-use between 1980 and 1989 (Ammerman 1995: fig. 2). What we see is that the pattern of change is heterogeneous in spatial terms; the dynamics are not taking place evenly or uniformly over the landscape as a whole. Two classes of land-use, in particular, showed major changes between 1980 and 1989. In the case of fruit trees, there were 54 fields in 1980; this number now rose to 102 fields in 1989. For strawberries, there was an increase as well: from 20 fields in 1980 to 31 fields in 1989. On the other hand, there was a decrease in the number of fields in three of the more traditional classes of land-use: cereals, vines, and grazing. What we found after nine years was good evidence for landscape dynamics (Ammerman 1995: table 4). Thus, there was every reason to proceed with the third mapping in 1998 and the fourth one in 2007.

The fieldwork conducted in 2007 and 2008

As mentioned above, a wide range of studies was done at the time of the fourth mapping, including those by three anthropologists, Pamela Ballinger,

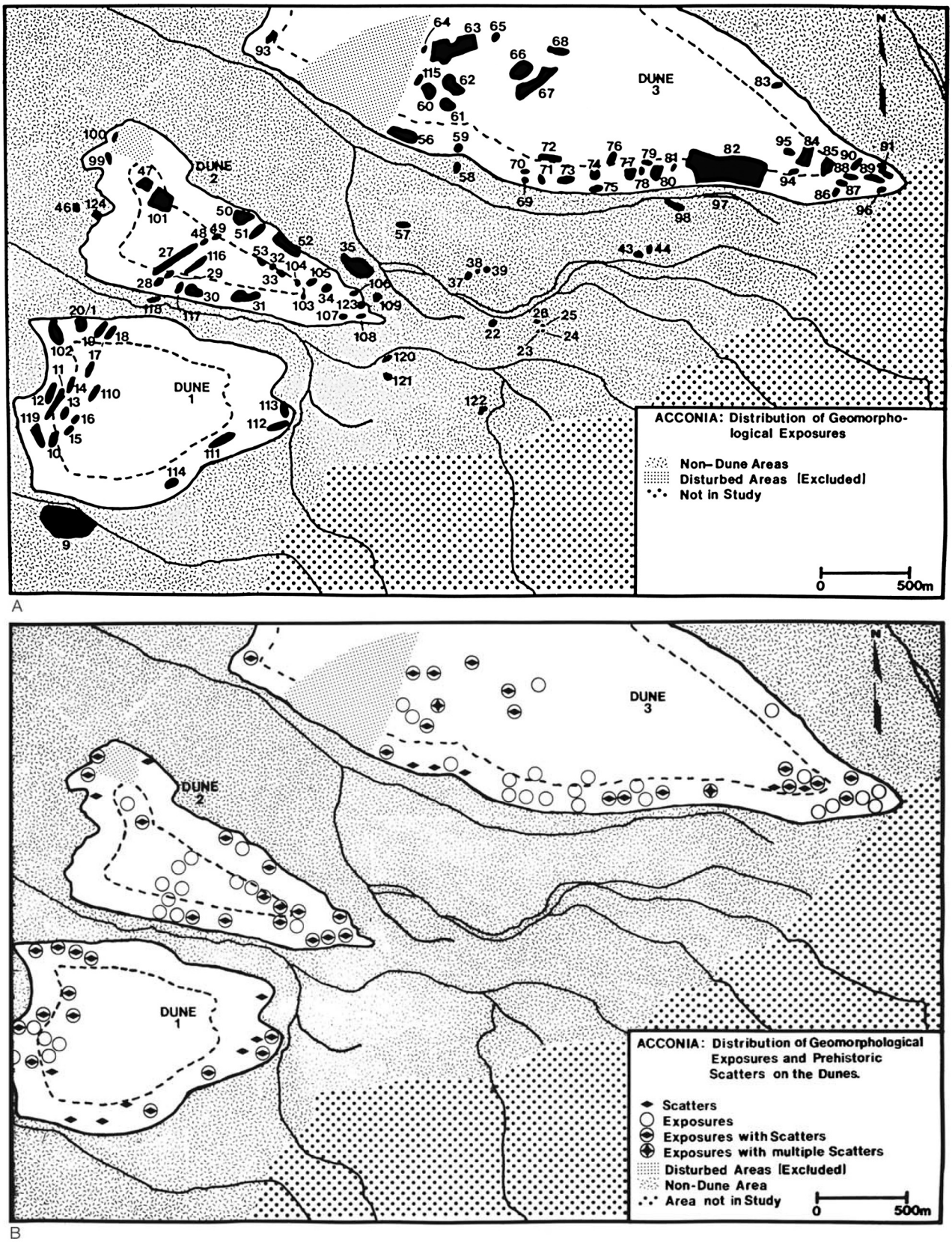

Figure 2 This pair of maps shows the relationship between geomorphological windows on the landscape and the recovery of prehistoric sites on the three dunes at Acconia. The upper map gives the spatial distribution of all of the geomorphological windows (on and off the sand dunes). Below is a map that shows the association between scatters of prehistoric material on the landscape and the geomorphological windows on the dunes (after Ammerman and Bonardi 1981: fig. 27.3).

Isabella Caneva, and Harold Koster, who collected information along economic, social, and historical lines in an attempt to explain the landscape dynamics. A fuller account of what we learned on the anthropological, economic, and historical sides of the research will be presented elsewhere. Previously,

Figure 3 Photographs taken from the southeast showing the landscape around the settlement of Piana di Curinga (complex *i* in FIG. 1) that were taken at four different times: April 1980, July 1984, June 1992, and June 1998. Here the landscape was completely transformed by the early 1990s when large groves of citrus trees were planted.

when we had done fieldwork at Acconia from 1974 through 1998, the local economy had been on an upward trend. Each year there were more fields of strawberries, and the once poor and isolated village of Acconia had grown to the point where it was now a prosperous small town. What we encountered in 2007 was an economic downturn that stemmed from weak market prices (for strawberries, citrus, and olive oil) and rising labor costs. Many of the farmers in our area were finding the year to be a bad one during our interviews with them. As recently as 2006, the agricultural sector at Acconia was reasonably healthy. What was now in the air was an economic crisis. In brief, we realized that it might be a good idea to study the response of individual farm operations to the downturn, and so we made the decision to return to Acconia in 2008, when we would again map all of the fields that were in strawberries and intensive horticulture and conduct further interviews with the farmers in order to learn more about how they were adapting. As we would learn by the end of 2008, the 31 operations producing strawberries tried to deal with the problem in various ways. Some of the smaller producers decided to stop growing strawberries, many of the middle-sized operations chose to reduce their area in strawberries and diversify by turning to less labor-demanding forms of horticulture (zucchini and peppers), and others made few changes and continued on as before in hopes of an economic recovery.

Among the anthropological studies, priority was given to interviewing the older people in the community so that we could reconstruct what the landscape was like in the 1940s. We had the chance to speak with several people who worked in the area at the time and who provided vivid accounts of the rough living conditions in those years. In fact, most of the area was uninhabited in the years just after World War II when efforts were still being made to eradicate malaria on the coastal plain. The interviews in combination with the study of old maps and aerial photographs made it possible to piece together a picture of the landscape in the late 1940s. It was a completely different place from the one where the survey was done in the l970s. In turn, this has allowed us to compare what one would find if one were to conduct the same basic survey at Acconia in three different years (1947, 1977, and 2007). The results obtained for each of these three times would be quite different.

At this point, it is worth mentioning briefly five major contrasts Acconia if we compare 1947 and

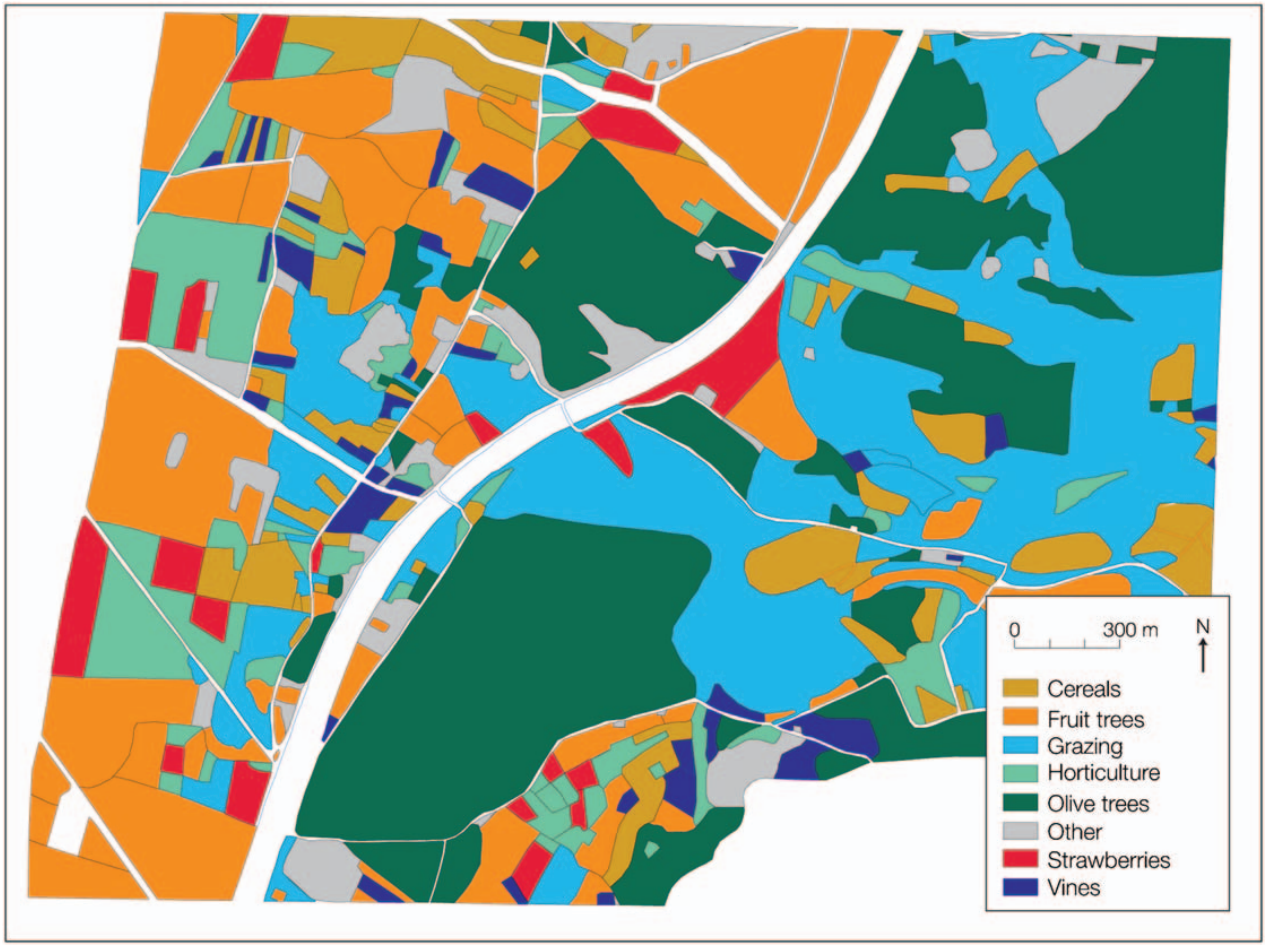

Figure 4 Map of land-use at Acconia in 1980, a new ArcGIS version of the original map drawn by hand (see Ammerman 1985b: fig. 3.1, 1995: fig. 1).

2007. Acconia had gone from being a marginal place with malaria outbreaks to an area that was now covered with a large number of gleaming greenhouses, which came into use for the production of strawberries in the 1990s. Furthermore, it had also gone from being a landscape with very few houses—those who grazed animals seasonally in our area in the 1940s usually slept in what the old-timers called a *pollaio* (that is, a chicken coop or a simple shelter made of reeds)—to one dotted with strawberry mansions. In addition, Acconia had witnessed the change from emigration to immigration. In the 1950s, many young men left Acconia to find work in Germany and Switzerland, and in 2007 immigrants were coming from Romania and Bulgaria to work in the strawberry fields. Another major change was the one from *colono* (tenant farmer) to agro-entrepreneur; for example, the father of the Gianpà brothers had spent most of his life as a *mezzadro,* a sharecropper, and now his four sons were running a large agro-business operation. Finally, there was the shift from low-cost labor to high-cost labor. In the 1950s, almost all of the land in the area was still owned by a few old families; there was a shortage of work at the time and people were prepared to work for very little pay. By 2007, the cost of putting a farmhand in the field could run as high as 70 U.S. dollars per day.

In the 1940s, there was no village of Acconia. Called modestly the "Villaggio Agricolo di Curinga" (the Agricultural Village of Curinga) on maps at the time, it was the brainchild of planners in Rome in the mid 1930s. In 1949, there were very few houses in the place where the small town stands today. At the time of the Second World War, there were still wetlands and wild areas all along the coast of the Golfo di Sant'Eufemia (or Maida Vale). With the arrival of the allies and DDT as the war advanced through southern Italy, there was the chance to eradicate malaria. Paved roads arrived on the coastal plain during the mid 1950s. For traffic moving north and south along the Tyrrhenian coast, the only paved road previously was a slow and winding one at the foot of the hills in the interior. In 1950, almost no one lived on a permanent basis in the Acconia area, particularly on the west side of the railway line. Electricity made its first appearance only in the mid 1950s, and olive groves had yet to be planted on the central and southern dunes at Acconia. In the 1950s, a new and more effective chemical treatment was developed for the *mosche olearia*, the name for the

flies that damaged the olives and led to the poor quality olive oil, which brought in little income. In the eyes of the old landowning families, the coastal plain—where malaria had been endemic for centuries and where even the production of olive oil had long been precarious—was still seen as an unpromising place for agriculture in the 1950s. Instead, it was viewed by the nobility as a no-man's-land, to be used for hunting—recreation and not production. It was only in 1962 that the wife of Natale Gitto, a nurseryman with a pioneering spirit who had moved from Mazzarà San Andrea in Sicily in 1954, raised the first experimental plots of strawberries at Acconia.

Methods

By the time of the mapping in 2007, satellite imagery with software that makes it possible to produce geometrically corrected and georeferenced maps had been available for several years at a reasonably low cost. We asked Digital Globe to cover our area, and we had the good fortune to obtain excellent imagery with a ground sample distance of 60 cm. Taken on April 7, 2007, the imagery had no cloud cover. Peter Scull, a geographer at Colgate University with a specialization in GIS then helped us to produce hard copies of the QuickBird image maps at a scale of 1:2000 (the same scale as the cadastral maps of our area). These maps were soon put to use in the field during the last week of April—the peak of the strawberry season at Acconia—when the first author mapped on the ground all of the fields currently being used for the production of strawberries, horticulture, and cereals. The mapping of other classes of land-use such as olive groves and citrus groves was done in July.

As part of the work in the field, the first author made a short visit to Acconia in February 2007 when he took a series of photographs from the high road on the east side of the area to document what was growing on the land at the start of year. In July 2007, with the assistance of Elizabeth Wolfram, he carried out the fourth mapping. A team of five then began to conduct interviews with local informants. Since July is a slow month for agriculture at Acconia, it was a good time of the year to talk with the farmers. At this point we also made contact with the local agricultural cooperative known as *Torrevecchia*. For a number of it members, it provided us with monthly production figures for the various crops grown by each farmer as well as the average price per month paid for a given crop. This information led to a much better understanding of the economics of the farming operations in our area. Additionally, we collected information in the field on the 31 operations in the mapped area that produced strawberries in 2007. Data were gathered on the size and character of that work force, whether the strawberries were raised in open fields or in *serre* (greenhouses), and on how and where the fruit was sent to market. In addition, we discussed with the operators their economic strategy over the years and how they saw the future. The two ArcGIS maps of land-use presented in this article (FIG. 4 for 1980; FIG. 5 for 2007) were prepared by E. Pfenning, who also took part in the mapping at Acconia in May 2008.

Changes in land-use between 1980 and 2007

We turn now to comparing the patterns in the first map with those seen on the fourth map. The changes in land-use that took place between the first two maps (1980 and 1989) have previously been described in some detail (Ammerman 1995). If we compare the first map (FIG. 4) with the fourth one (FIG. 5), the spatial patterning as a whole becomes more fine-grained. There has been a marked trend toward the reduction in the size of fields over ca. 27 years, which is consistent with the ongoing intensification of land-use at Acconia. The map for 1980 has a total of 368 fields, while the number of fields in 2007 increased to 644 (TABLE 1). In particular, there are fewer of the very large fields on the east side in 2007—land that was formerly in the hands of a few noble families and that has subsequently been either divided among heirs or else sold to smaller holders. There is also a major decline in the number of fields in both cereals and vines over a span of 27 years (TABLE 1). On the other hand, there is increasing use of land for fruit trees, strawberries, and horticulture. We draw special

Table 1 This table compares the land-use at Acconia in 1980 and 2007. Figures 3 and 5 give maps of land-use at Acconia for the respective times.

	[1980]			[2007]		
	N fields	Total area (ha)	Area (%)	N fields	Total area (ha)	Area (%)
Fruit trees	54	150	21.3	125	205.2	28.8
Olive trees	35	196.3	27.8	93	213	30
Vines	44	18.2	2.6	17	4.8	0.7
Horticulture	57	54.6	7.7	107	63.9	9
Strawberries	20	28.3	4	62	33.8	4.7
Cereals	68	56.5	8	45	34.1	4.8
Grazing	39	157.3	22.3	42	42.6	6
Other	51	44.4	6.3	144	78.7	11
Unused	0	0	0	9	35.8	5
Total	368	705.6	100	644	711.9	100

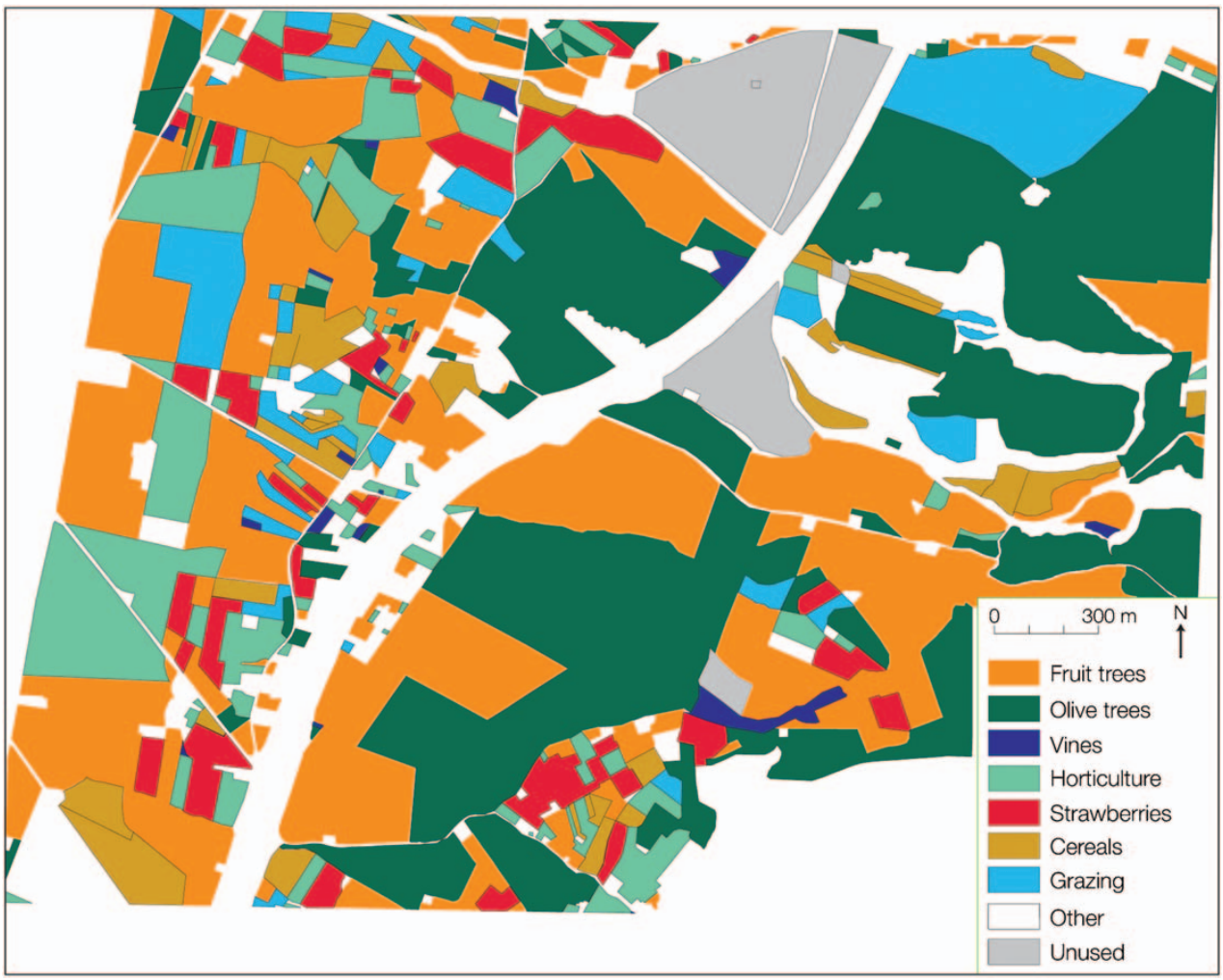

Figure 5 Map of land-use at Acconia in 2007.

attention to the progressive increase in the number of fields used for the production of strawberries (FIG. 6; TABLE 2). Here the numbers have risen from 20 fields in 1980 to 62 fields in 2007, a threefold increase over the span of essentially one human generation. This is not surprising since strawberries have been the driving force of the local economy for the last 40 years. Indeed, a strawberry festival is held each year at Acconia. We can gain a better sense of the long term impact on the landscape by looking at the combined map of strawberry fields for 1980, 1989, 1998, and 2007 (FIG 7.). It shows that there are only six fields (identified as union) where strawberries were grown in the same field in all four years. These two figures offer a good picture of the restless dynamics of strawberry production, which requires that the ground be leveled and a watering system installed each time a new field is put in. Even in the case of Figure 7, there is the chance to see the spatial pattern for only four of the 27 years between 1980 and 2007. If we were able to show all of the fields where strawberries were grown in the other 23 years, Figure 7 would show even more red fields.

The three classes of land-use that show clear patterns of decline are cereals, vines, and grazing (TABLE 1). In the case of cereal production, there were 68 fields in 1980; this number then fell to 39 in 1989, and it rose slightly to 45 fields in 2007. The percentage of the Acconia area covered by this class in 1980 was 8.0%; it fell to 4.5% in 2007. By this time, the small cereal fields, which had once been grown on the dunes for subsistence purposes in 1980, had vanished from the scene (Ammerman 1985b: table 3.2). Cereals are now a minor component of land-use at Acconia. The decline is even more marked in the case of vines. In 1980, there were 44 fields in this class (covering 2.6% of the land). By 1989, the number had fallen to 30 fields. In 2007, there were only 17 fields in vines, and they covered just 0.7% of the land. Most of the fields in vines at both times (1980 and 2007) were small in size, and the grapes were used for making table wines consumed by the farming households. With the exception of the Apostoliti vineyard, the production of grapes has ceased. In the case of grazing, the numbers of fields appear to be similar over time: 39 fields in 1980 versus 42 fields in 2007. However, by area, the percentage fall steeply from

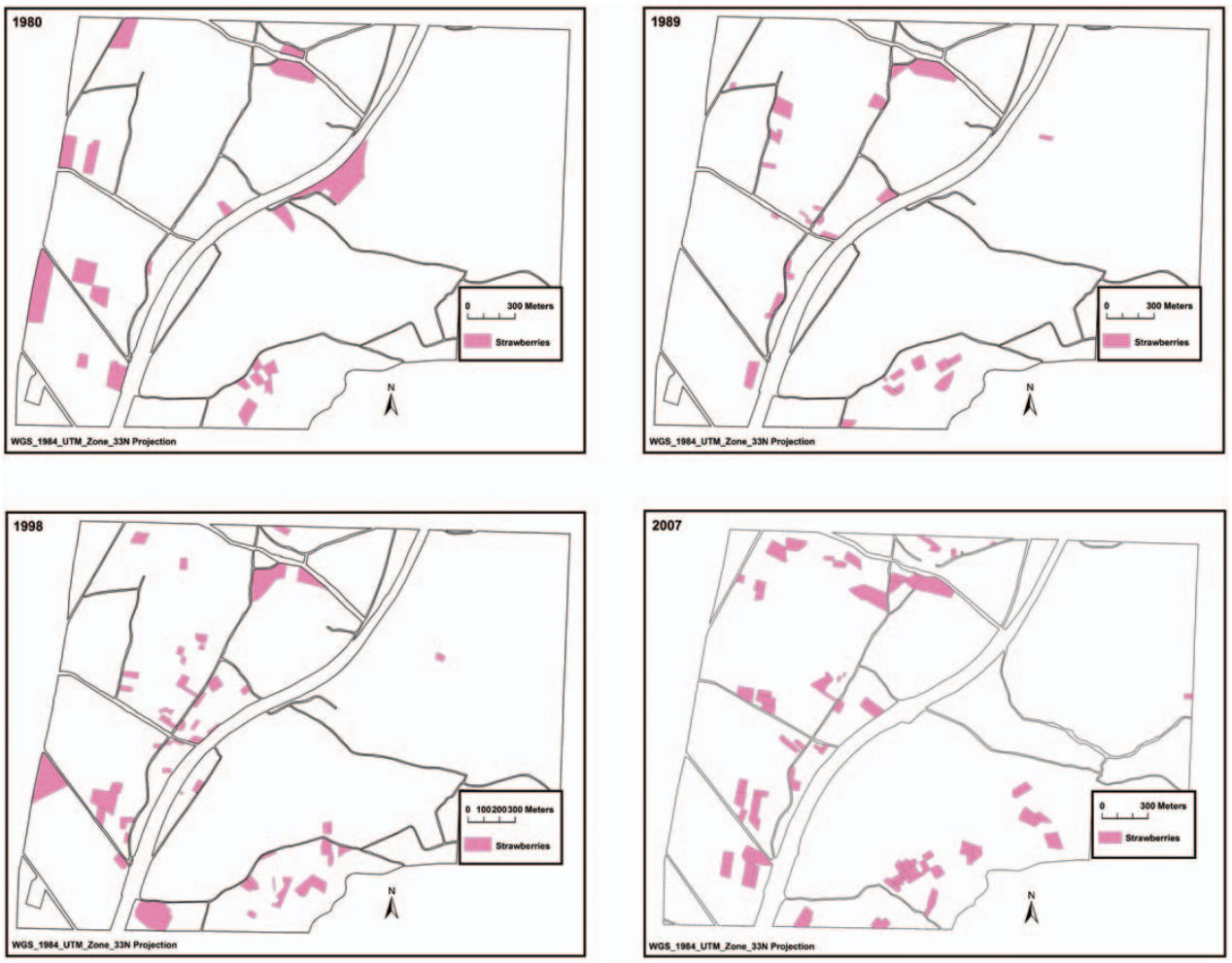

Figure 6 Maps showing the fields where strawberries were grown in 1980, 1989, 1998, and 2007.

22.3% in 1980 to only 6.0% in 2007. The grazing of animals, which was once the main activity at Acconia in the 1940s, is now reduced to a few small areas scattered on the landscape. Not much of the land in the current era of agribusiness is dedicated to this activity. There are now fewer shepherds than there were in 1980, and only older men in the community were doing this kind of work in 2007. In 1980, whole families (including women and children) had once engaged in the herding of sheep. As a consequence, the flocks have declined in size: only one flock in 2007 contained 100 head. More commonly a flock today is half that size. In contrast, there were several households in 1980 that once had 200 head or more. Taken together, these three traditional classes of land-use—cereals, vines, and grazing—covered just 12% of the land in 2007.

There are four major players in the agricultural economy at Acconia today: fruit trees, olive groves, strawberries, and horticulture. Commonly one finds some degree of rotation between strawberries and other intensive forms of horticulture (zucchinis, peppers, and green beans). In the case of fruit trees (mainly citrus groves), the number in 1980 was 58 fields; it then rose to 102 fields in 1989. In 1988, there was a joint Italian-European Union program to promote the production of citrus in southern Italy, and it fostered major changes on the landscape such as the one shown in Figure 3. In 2007, the citrus trees were growing in 125 fields. The percentage of land in this class increased from 21.3% in 1980 to 28.8% in 2007, which means that more than one-quarter of the land in the surveyed area now has fruit trees standing on it. In the early 1960s, there were almost no citrus groves at Acconia. The fields with olive trees are as follows: 35 in 1980, 30 in 1989, and 93 in 2007. Most of the new fields in 2007 are very small ones; they often constitute tiny clusters of olive trees planted next to a house built in recent years. In fact, the total area covered by olive trees has barely changed over the last 27 years: from 27.8% in 1980 to 30.0% in 2007. It is important to recall that there were few olive groves on the central and southern dunes at Acconia even as late as the mid 1950s. Together olive trees and fruit trees cover almost 60% of the land today. The problem is that the markets for both olives and oranges have weakened in Italy in recent years. Today, somewhat paradoxically, the farmers who engage in these two forms of production have to rely on European Union subsidies to survive.

Before we turn to strawberries and horticulture, a few words should be said about the two classes of land-use called ''other'' and ''unused'' in Table 1. ''Other'' indicates those spaces on the map—a residence, a warehouse, a road, or the railway line—not used for agricultural production. Counts are not given for the individual spaces, since they are not agricultural fields. As a result of the growth of the local economy, the percentage of land in this class rose from 6.3% in 1980 to 11.0% in 2007. At the time of the first mapping, there were no parcels of agricultural land that did not have some form of actual use. In 2007, we observed several fields that were in a state of limbo; they were neither abandoned nor were they currently being used for agricultural production. In all nine fields fell in this class of land-use, and they covered 5.0 % of the area in 2007. Examples of such fields include the block of greenhouses of a strawberry operation that had recently failed, a large rundown citrus grove that had passed into the hands of a bank, and a large tract of land that the state had taken over for legal reasons.

This brings us to the heart of the story: strawberries and intensive horticulture. For the latter, there were 57 fields (7.7% of the area) in 1980 and 107 fields (9.0%) in 2007. In 1989, there were 67 fields in horticulture. In the case of strawberries, there are (TABLE 2; FIG. 6): 20 fields in 1980, 31 in 1989, 48 in 1998, and 62 in 2007. The growth in the number of strawberry fields between 1980 and 1989 was quite modest due in large part to the Chernobyl disaster in 1986. In fact, for a number of the smaller strawberry operations, this was a very bad year, and some farmers chose to shift to the production of vegetables. In terms of the percentage of the area covered by strawberries, the numbers appear to be much the same: 4.0% in 1980 versus 4.7% in 2007. But these figures are misleading in many respects. Between 1980 and 2007, there were major changes in how strawberries were produced, which led to higher yields per unit area. In 1980, all strawberries were raised in open fields. Indeed, at that time, a few of the producers unwisely attempted to grow strawberries on a large scale, and because of the rising labor costs, two of them failed (see the two large fields just on the east side of the *autostrada* [motorway] in the center of the 1980 map) (FIG. 6).

Table 2 The number of strawberry fields and their total area in 1980, 1989, 1998, and 2007.

Year	N fields	Total area (ha)
1980	20	25.50
1989	31	13.26
1998	48	25.30
2007	62	33.80

In contrast, most of the strawberries were raised in greenhouses in 2007. Since the early 1990s, the use of greenhouses has meant that there is greater control over inputs as well as higher levels of production. Over a span of 27 years, the Acconia area has witnessed a steady intensification of strawberry production, as farmers have tried to cope with rising labor costs by increasing their yields.

The best illustration of the human ability to create windows of visibility on the landscape is given by Figure 7, which shows the combined spatial distribution of the strawberry fields for all four of the mapped years. Moreover, as mentioned before, there would be much more red on this map if we had the data to plot the strawberry fields for all of the years between 1980 and 2007. If we turn to the archaeological side of the story, as it relates to Figure 7, we now know that the years when many of the Neolithic sites first came to light on the land surface were those between the mid 1960s (when strawberries made their first appearance) and the early 1990s (when most of the greenhouses were put in). During this period of time, the production of strawberries in combination with intensive horticulture set in motion more active landscape dynamics and, in turn, the formation of many new windows of visibility. By looking closely at Figure 7, one can see that the strawberry fields tend to cluster in some places (e.g., on the west side of the autostrada and in the southeast corner of the mapped area), while there are fewer strawberry fields on the east side of the map. In survey archaeology, one would ideally like to make the working assumption that human agency and windows of visibility, in particular, are taking place more or less evenly or homogeneously over the landscape as a whole (Terrenato and Ammerman 1996: 107). This would simplify the task of interpreting the spatial distributions of the sites recovered by a survey. Unfortunately, the longitudinal study at Acconia provides no support for such an optimistic assumption. As shown by the combined pattern for strawberry fields (FIG. 7), human agency is heterogeneous in space, and this adds a further degree of difficulty when it comes to the interpretation of settlement patterns that date to different periods of time. Since the settlement patterns associated with the respective periods are not the same, but vary in terms of their spatial distributions, the landscape dynamics are acting on each settlement pattern in a different way.

Discussion

Here we consider six points that emerge from the longitudinal study. The focus is on the more

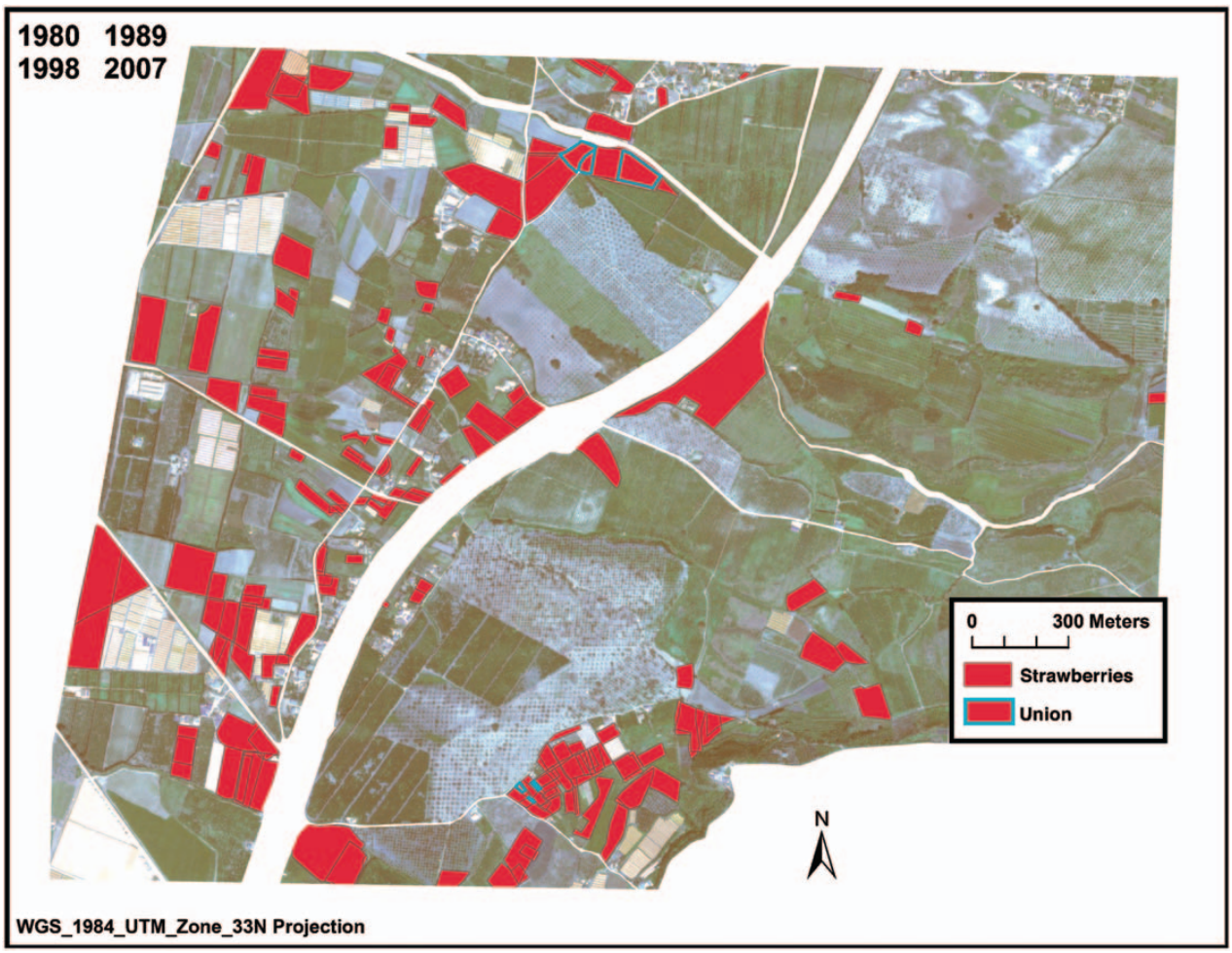

Figure 7 This map brings together all of the strawberry fields raised at the times of the four mappings (1980, 1989, 1998, and 2007); the term "union" indicates a field that was used to produce strawberries in all four years.

immediate implications of the case study for the field archaeologist. In two articles that we plan to write in the future, the scope of the discussion will widen. One of them, as mentioned in the opening section, the plan is to work on an article that will explore the social, economic and political conditions and developments that gave rise to the changes in land-use observed at Acconia. We will also engage in a broader discussion of the current state of survey archaeology and, more specifically, to consider the critical juncture that this field of study has now reached. Here, we argue that there is good evidence for major and ongoing changes in land-use over a period of 27 years. The landscape at Acconia is an even more restless place than we had imagined. Previously, there was no study of this kind in the survey literature, so there were no guidelines in terms of what to expect. Now that the fourth mapping has been completed, it is clear that "time and the hour" do run through the landscape at Acconia. Thus, the proposition that time is a factor in survey visibility is no longer just an idea or a working hypothesis, but one that is well documented. We also need to consider that the work of the survey archaeologist takes place on a landscape that is changing during the lifetime of the archaeologists. The assumption that a survey is carried out in a context that is free or independent of time is no longer tenable. Time is no less important in archaeology than it is in other fields of scientific investigation (Shapin 2010). To put it another way, the archaeologist who does a survey is not Adam toiling in a timeless Garden of Eden (Ammerman 2004).

This brings us to the second point. Not only are the landscape dynamics unfolding over time, but they are also heterogeneous in space. As shown in Figure 7, some places on the landscape have witnessed more active changes in land-use than others. For example, the fields located within 500 m of the west side of the railway line (running on a north-south line through Figure 4) as well as in the southeast corner of the map are more dynamic than those located in other parts of the area. This is notably so when it comes to the fields on the eastern side of the map where the explanation for the change is a social one. There, for years, the land has been in the hands of a few old families with large holdings, and they have been content to follow more traditional and extensive strategies of land-use. Thus, there is no support for the idea that the dynamics observed at Acconia are

taking place evenly or uniformly over the landscape as a whole. In fact, if we look back on the spatial patterns obtained by the Acconia Survey, we find that we are dealing with an autocorrelation between the intensity of human agency on the landscape (that is, places were windows of visibility are more actively created as fields move from one class to another) and the recovery of sites on the land surface. The spatial patterns recovered by the survey are, in part, artifacts of what human beings are doing on the landscape in our own time.

The third point is the need for more studies of this kind to be carried out in other places in the Mediterranean and elsewhere in the world. By making similar longitudinal studies in other areas, it will be possible to develop a repertoire of the various forms that landscape dynamics take under local conditions. Ideally, the case studies should be done in a wide range of environmental contexts. In Italy, there are areas of marginal land in the Apennines where the trend in land-use runs in the opposite direction to the one observed on the coastal plain at Acconia (Ammerman 2004). Instead of moving toward the intensification of agriculture, most upland areas are no longer under active cultivation. In some places, many of the fields are now in a state of abandonment. The landscape does not simply sit still; it continues to evolve due to processes of ecological secession. Alternatively, there are survey areas such as the one at Metaponto in Basilicata with fertile soils on the coastal plain where the production of cereals and other crops has been maintained at a high level for more than 40 years based on deep plowing (Carter and Prieto 2011). At Metaponto, the archaeological materials that occur in the plow zone have become increasingly dispersed over the years (Thompson 2004). The size distribution of the ceramics found on the surface—due to breakage and damage from plowing—is smaller today than it was in 1981 when the Metaponto survey began. In some cases, a classical site that could readily be dated in the 1980s is now reduced to such a poor state that it is no longer possible to date it to a specific time (Prieto 2011). Part of the motivation for the Metaponto survey was to respond to the impact of modern agriculture on the archaeological record (Thompson 2004: 72; Prieto 2011: 72).

The challenge for the survey archaeologist is obviously that of finding the time to do a longitudinal study. The decision to conduct such a long term project calls for a major commitment. In practical terms, most survey projects have neither the resources nor the time to carry out a longitudinal study of land-use. In effect, this constitutes a bottleneck in the development of method and theory in survey archaeology today. Until other studies of this kind are done, it is premature to say whether the active landscape dynamics observed at Acconia are exceptional or whether they are common. In general, one would expect to see a range of variation in what will be found in the other case studies. The implication here (assuming that a fair range of variation is eventually documented) is that each survey will have to know where it stands on this spectrum. In addition, given such a mixed picture, it will be difficult to make meaningful comparisons between surveys done in different areas. At the same time, it needs to be underscored that one cannot take shortcuts in conducting a proper longitudinal study of land-use. The mapping of land-use has to be done at a fairly high level of spatial resolution: ideally, on a field-by-field basis. The study should have a reasonable time depth: that is, a series of three or four maps (made at a regular time interval) over a span of 20 to 30 years. It will be recalled that the alternative example in Greece put forward by Davis and Sutton (1995) has major limitations in both respects. In other words, it does not meet the standards of a longitudinal study. On a more positive note, satellite imagery that is available today provides an excellent tool for mapping land-use. Indeed, high-resolution imagery has become much less expensive in recent years. When we began the longitudinal study in 1980, the best resource for mapping that was available at the time was aerial photographs.

Fourthly, we have to widen our range of vision. What happens if we try to compare the Neolithic settlement patterns produced by the Acconia Survey with those recovered by surveys in other parts of Calabria? This is exemplified by settlement patterns of Stentinello age that surveys in four other areas have found. At the present time, there are five areas in the region where intensive surveys have been carried out and where the spatial distributions of impressed-ware Neolithic sites in the Stentinello tradition have been reported: Acconia (Ammerman 1985a, 1995) (FIG. 1), Nicotera (Ammerman 1985a: fig. 7.4), Stilo (Hodder and Malone 1984), Crotone (Morter and Robb 2010), and Bova Marina, which is also called Umbro and Penitenzeria (Robb 2004, 2007). For various reasons, it is difficult to make detailed comparisons among the five areas, especially in light of the landscape dynamics documented at Acconia. The area with the richest pattern of settlement is still the one at Acconia. For our present purposes, we shall speak about settlements or site complexes rather than "sites," since the term "site" can be used in different ways (even for one of the local scatters found at a given settlement) in the survey literature (Ammerman 1985a: 82–92). As shown in Figure 1, all of the scatters with Stentinello ceramics that were recovered from various points at a given location have been gathered

together in what is called a "site complex" or settlement. In all, there are 11 settlements with Stentinello ceramics (c, d, f, g, h, i, j, l, m, n, and o) within an area of 10 sq km. The largest settlements have lengths in a range of 200 to 300 m (see the settlements identified as f, g, i, l, and n in Ammerman 1995: fig. 3; the same of letters are used for the respective settlements in FIG. 1). However, this result is just what one would expect to find: the richer pattern at Acconia stems from the repeated coverage of the landscape. Even the current settlement pattern for the Stentinello period has to be viewed as incomplete, since there are some places on the landscape that have had few windows of visibility over the years. While a number of Stentinello settlements were identified during the survey of a much larger area at Crotone (Morter and Robb 2010: fig. 11.1), the overall spatial distribution does not come close to the density found at Acconia. This is because most of the survey at Crotone involved the use of sampling squares measuring 1 km on a side. In contrast with Acconia, what is lacking at Crotone is a large contiguous area of survey coverage. In the one place where this is available (near the settlement of Capo Alfiere where the contiguous area comes to a total of 8 sq km), only four Stentinello settlements were identified. At Stilo, even fewer settlements of this age were identified by the survey (Hodder and Malone 1984); in all likelihood, the observed distribution of settlements dating to the Stentinello period is an incomplete one. On the other hand, the results of the survey near Bova Marina have not yet been published in enough detail to allow a proper comparison. Accordingly, if we are looking for a good match with Acconia, the best comparison is with the pattern at Nicotera. Both surveys involve dune areas, and the same basic field methods were used in both cases. At Nicotera, five site complexes with Stentinello material were identified within an area of about 6 sq km. In other words, there was the recovery of approximately one settlement per sq km (similar to Acconia). While this may look quite promising on the face of things, it is important to note that no attempt was made to repeat the coverage of the landscape at Nicotera. It is possible that the Stentinello settlement pattern there is actually denser than the one at Acconia. Identifying differences in the degree and the character of incompleteness among the respective surveys is at the heart of making comparisons between two or more surveys. Much like cultural analysis in the field of the anthropology (Geertz 1973: 29), the work of the survey archaeologist is intrinsically incomplete.

Fifthly, although a fair amount of attention has been given to attempting to understand why large, multi-period surveys commonly have recovered so few prehistoric sites (Bintliff *et al.* 1999), less interest has been taken in the question of how many different time periods are actually represented at any one prehistoric site or settlement. In short, the survey is thought to be doing a good job if it manages to recover prehistoric sites at all. Emphasis is not placed on the recognition of the full range of time periods at a given settlement. However, this is a matter that has major implications for the inferences that the archaeologist will make when it comes to continuity or breaks in the history of habitation in an area. Figure 1 shows that several different time periods are commonly represented at a given site complex. However, if we had stopped after the first two field seasons at Acconia, the patterns would have looked quite different. Not only would the map have had far fewer site complexes, it would show only a single period of occupation at nearly all of the settlements. In short, the early version of the map would appear to provide good evidence for discontinuity or "breaks" over time in the settlement patterns at Acconia. Now it is just such breaks in spatial distributions that those who are interested in landscape archaeology have used in reconstructing the long term history of a region (e.g., Cherry *et al.* 1991). In other words, when a discontinuity is encountered, the natural impulse is often to come up with a social or economic explanation for it. At Acconia, it took the repeated coverage of the landscape in order to build up more ample patterns of continuity. Thus, when it comes to a single-coverage survey, it is likely that some of the breaks seen in the data may not be breaks at all. Instead, they are "artifacts" of the way in which the survey was done. The spatial distributions obtained by a survey may not be what they appear to be on the surface of things. A survey based on a single coverage of the landscape will tend to underestimate continuity in settlement over the course of time.

Lastly, what would happen if we were to carry out the Acconia Survey in basically the same way at three different times with an interval of 30 years between them? Suppose that we take the following three years: 1947, 1977, and 2007. Does one expect to find the same pattern of sites all three times? Or different patterns each time? On the basis of the interviews and other studies that we conducted, we now have a fairly good picture of what the landscape at Acconia looked like in 1947. At that time, it was a rough place used for the seasonal grazing of animals and for hunting. Much of the area was still covered by large tracts of scrubland, and there would have been few windows of visibility on the landscape. In short, the chance of recovering a large number of Neolithic sites at that time would have been quite low, and the possibility of

contracting malaria was real. On the other hand, the situation was equally problematic in 2007, but the reasons for this were quite different. Because of the enclosure of the landscape and the large blocks of greenhouses, it would be difficult to gain access to many of the fields in the survey area. While the sites were still sitting there on the land surface (as they had been in 1977), it was no longer possible in practical terms to carry out the kind of survey that we had conducted in the 1970s. In theory, one can imagine the archaeologist spending much time and effort in trying to figure out a way to visit the 31 blocks of greenhouses with strawberries and in developing a research design to work inside them. However, in the real world (Shapin 2010), it is more likely that the survey archaeologist would decide to look for a better place to conduct a survey. When the three surveys at Acconia are situated in time, it is clear that there are problems with the assumptions behind what is called side-by-side survey (Alcock and Cherry 2004). As seen in this thought exercise, it is entirely possible that a survey at Acconia cannot stand alongside itself over a span of 30 years. In retrospect, one of the main reasons for the success of the Acconia Survey was the time when it was done, something that we did not fully appreciate in the 1970s when the fieldwork was carried out. Thus, even over 30 years, a comparatively short span of time, it is possible to make the argument that the Acconia Survey is not in a good position to reproduce itself. This exercise highlights in a clear and tangible way the active role that time plays in the work of the survey archaeologist.

In closing, it is our view that survey archaeology is now approaching a crossroads in its history. There are in the Mediterranean lands quite different schools of thought at the present time. One takes the position that the large, multi-period surveys done in countries such as Greece and Italy have been highly productive over the years. While surveys of this kind may have their problems or limitations, they are held to be "not overwhelming" (e.g., Cherry *et al.* 1991: 45). This school of thought has a higher ambition: it believes in the comparative study of surveys (Alcock and Cherry 2004). On the other hand, there are others, including ourselves, who see the survey as a valuable tool for archaeological research, especially if it is used in a problem-oriented way, but who take the position that it has far more limitations than are commonly acknowledged. When the work of the survey is situated in time, the archaeologist will have to rise to the challenge of sorting out the relationships between the operation of time in a given survey and the nature of that survey's incompleteness. This will encourage practitioners to rethink recovery theory in survey archaeology and to come up with new approaches to the interpretation of the spatial distributions produced by a survey.

Survey archaeology in its earlier years was too optimistic in its outlook as well as in the assumptions that it made. The survey archaeologist was in a rush to cover a large area and to find many new sites. Not enough attention was paid to basics. As those who have read Shapin (2010) may recognize, this is in keeping with the ambitions of archaeology in the 1970s and 1980s. There was clearly the need for survey archaeology to slow down and become more patient. More recently, things have begun to change. Thus, surveys in Italy, Greece, Turkey, and other Mediterranean countries have moved over the years in the direction of becoming smaller in size, more problem-oriented, more intensive in their coverage of the land, and more proactive when it comes to the question of site visibility (Terrenato 2004; Runnels *et al.* 2005). There is still the notion that the landscape itself is somehow a static and stationary place. Instead, as we now know at Acconia, the landscape should be seen as a dynamic place, one that is in a state of flux even during the lifetime of the survey archaeologist. This was proposed some 30 years ago "The degree of flux will, of course, vary with the kinds and quality of the information that we are trying to collect and from one region to the next depending upon local conditions. There is some irony in the fact that in going back to basics we are likely to discover things about survey archaeology that we may not want to know." (Ammerman 1981: 82). Facing the limitations of survey archaeology more squarely will be a sign of the field's growing maturity.

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