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The Dynamics of Modern Land Use and the Acconia Survey

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Abstract

At a time when surface visibility is one of the key issues for archaeological surveys in the Mediterranean world, it is of interest to look more closely at the character of modern land use. In this case study of the Acconia area in southern Italy, the mapping of land use on a field-by-field basis was carried out in two different years (1980 and 1989). As part of the analysis, use is made of a transition matrix to summarize the patterns of continuity and change in the exploitation of fields between the two dates. The longitudinal study of land use at Acconia reveals the growing importance of groves of fruit trees at the expense of other forms of land use. The installation of a new grove commonly involves sub-surface intervention (the levelling of the ground, the digging of holes for planting the trees, the excavation of trenches for the irrigation system) which increases the chances that archaeological material at a buried site will be brought to the land surface, thus making it possible for the survey to discover a new site. In retrospect, much of the success of the Acconia Survey in recovering a dense pattern of Neolithic settlement is now to be linked with the dynamics of modern land use. In a final section, some of the broader implications of the case study for survey work in the Mediterranean are discussed briefly.

Introduction

If it is difficult to imagine what Mediterranean archaeology would be like today without surveys, this was not always the case. Only 25 years ago, the survey was still by-and-large a novelty in countries such as Greece, Italy and Spain. Major strides in the development of this kind of fieldwork have thus taken place over a comparatively short span of time. However, we can now see in retrospect that, in the rush to carry out more seasons of survey work each year, certain basic aspects of survey methodology may not have received the full attention that they should have done. One of these is the dynamics of modern land use. The aim of this article is to present the first longitudinal study of modern land use, taking the Acconia Survey in southern Italy as a case study (Ammerman 1985a; see the inset in Figure 3 for the location of Acconia), and to discuss some of its implications for the conduct and planning of survey work elsewhere in the Mediterranean.

It is now common practice for the archaeologist to make observations on how the land is currently being exploited as part of a survey in the Mediterranean region. This is usually done at the time that a given field is covered But it is almost never the

case for observations to be made at a given field in time series over a number of years in order to see whether or not there are directional trends in how the land is being utilized. For one reason or another (a shortage of time, a scarcity of available resources or a lack of awareness of the problem), no real attempt is made to document the changes that are taking place on the landscape — the immediate context for the recovery of sites — during the lifetime of the survey itself. Instead, the working assumption is tacitly made that land use today does not experience change. This means, in other words, that the archaeologist is treating patterns of modern land use as if they were static in character. Such a treatment however, is clearly at odds with what we can see happening on the contemporary landscape in many parts of the Mediterranean. With considerable variation from one place to the next, old crops and past strategies of exploitation are being replaced by new ones; traditional practices of land use are often witnessing transformation before our very eyes. Thus, there is a clear tension between the static assumption commonly made on the part of the survey archaeologist and the way the world actually behaves.

The main aim here is to show how a more realistic treatment of the question can be implemented. What is called for, as mentioned above, is a longitudinal approach to the study of land use. In the case of the Acconia Survey, this will involve taking a given field and comparing how it was utilized at two different times (for example, in 1980 and 1989). When such comparisons are made systematically for a large set of fields in the area, it is possible to produce a transition matrix which summarizes the main trends of change in land use currently taking place at Acconia. As a next step, once such trends are established, it is possible to examine the links between certain types of land use (such as fruit trees in the present case) and their growing importance over time and the recovery of prehistoric sites on the landscape. Indeed, it will now be possible to see that much of the success of the Acconia Survey in the discovery of Neolithic sites is to be explained in terms of the dynamics of modern land use.

With this report, I return to a subject that I considered 10 years ago in a contribution called 'Modern land use versus the past' (Ammerman 1985b). As mentioned in the opening section then, there were two main motivations for the initial study of modern land use at Acconia. One was to develop a critical evaluation of the method of site catchment analysis (Vita-Finzi and Higgs 1970; Barker 1975; Jarman and Webley 1975), which was still in general favour in the early 1980s. Since that time, with a few notable exceptions (Gilman and Thornes 1985; Hunt 1992), the interest in site catchment analysis has fallen off, as its limitations have become better understood. The other motivation, mentioned only briefly in passing at the time (Ammerman 1985b: 27), had to do with the question of site visibility on the landscape and my growing sense of awareness that modern land use probably played a major role in this story. Subsequently, as a part of the Cecina Valley Survey in Tuscany, it was possible to begin in 1988 a more controlled study of the relationship between conditions of surface visibility and site recovery during the course of a survey (Terrenato and Ammerman 1996). The treatment of visibility in the Cecina study, which is based on a sample of 25 squares each measuring 1 km on a side, includes aspects

of both geomorphology and ground cover. Without going into the details here, the results at Cecina show a strong positive association between visibility and site recovery. In addition, our recent re-examination of published data from a survey on the Greek island of Keos (Cherry *et al.* 1991) reveals a clear relationship between conditions of visibility on the land surface and the recovery of sites (Ammerman 1993; Terrenato and Ammerman 1996: fig. 9).

Thus, there is now increasing evidence that conditions of visibility affect what one will find during the course of a survey. At Cecina, the effects of ground cover are found to be a major factor. Since the state of ground cover at any one time in a given field is influenced by the form of land use there, there is an intimate connection between land use and surface visibility, and in turn, between land use and site recovery. In other words, if the chances of finding a site at a given place on the landscape are determined in part by ground cover, and if changes in modern land use modify the conditions of ground cover in that place, then such changes may well affect what will be found by a survey there. Hence, at a time when visibility has become one of the key issues for survey archaeology, the dynamics of modern land use is a topic of critical importance; it is at the very heart of survey methodology.

It is worth adding at this point that the second mapping of land use at Acconia, which was done in 1989, was carried out at the same time as the second year of the Cecina study (1988–91), when the importance of visibility was becoming increasingly evident. In fact, there are plans to repeat the mapping of land use at Acconia again in 1998. By having information for three points in a time series over a span of 18 years (1980, 1989 and 1998), one will be able to explore the trends in the dynamics of modern land use in much greater depth. This means that the present report is put forward as an interim communication — one that intends to illustrate, as mentioned above, how a longitudinal approach can be implemented. Rather than waiting another four or five years, when the results of the third mapping will be available, the reason for writing this preliminary report at the present time is so that others doing surveys will also have the chance to initiate work of this kind. Since years may be needed in order to conduct such a longitudinal study, the sooner that one can start the better.

The Longitudinal Study of Modern Land Use

Let us begin by reviewing some of the main results of the original study of land use done at Acconia in the spring of 1980 (Ammerman 1985b). To start with, we had access to good resources for purposes of mapping in the field. One of these was a series of aerial photographs in colour and at a scale of 1:5000, which had been flown for the project in 1977. Resolution is such on the photographs that field boundaries and even small, individual trees and vine rows can be clearly recognized. There was also a series of cadastral maps covering the area at a scale of 1:2000. Maps of this kind show the ownership of fields or land parcels (each parcel is given an identification number and its boundaries are defined by lines) and they thus provide an independent source of information on field boundaries. One part of the original study, which will not be presented here, involved the linking of the individual fields with lists of their respective owners in

order to examine the relationship between different types of owners (for example, families with large holdings, who have traditionally held the land at Acconia, as against those with small holdings, who have obtained their parcels through land reform after the second world war) and patterns of land use. The first mapping was done systematically on a field-by-field basis; it covered an area of some 7 km^2 at Acconia. As shown in Figure 1, seven main classes of land use were distinguished. The first three — fruit trees, olive trees and vines — are all crops of a more permanent character in the sense that there is no rotation from one year to the next; the same thing is produced in a field for a number of years. The most important class of the three in economic terms is fruit trees with citrus groves being the most common. Irrigation is required for this form of land use and it is only in the last 30 years or so that an active interest has been taken in the production of oranges and other citrus fruits at Acconia. It will be recalled that through the time of the Second World War malaria was common on the coastal plain at Acconia; the area was a backward one with few paved roads and an emphasis on less intensive forms of production (Ammerman 1985a: 4–5). It is only with the introduction of DDT after the war and opportunities for irrigation in subsequent years that life began to change at Acconia. Olive groves represent a more traditional form of land use in the area; some of the largest fields in Figure 1 are those devoted to this form of production. Such fields are usually owned by families that have had large holdings in the area for generations. While there are a fair number of fields that are planted in vines, most of them are quite small in size. Most of the wine produced is intended for consumption at the local level; many of those with small holdings try to produce their own wine. This would be in contrast with the first two classes where most of the production enters regional and national markets. Taken together (see Table 1), these three classes accounted for about one half of the land in use for agricultural purposes at Acconia in 1980.

Horticulture, the fourth class, includes the cultivation of strawberries and a wide range of vegetables (peas, green beans, peppers, fennel, zucchini and so forth). Substantial inputs of labour and capital are required for the production of strawberries. In a successful year, strawberries represent perhaps the most remunerative cash crop that can be raised on the sand dunes of Acconia. By 1980, strawberry fields had reached 20 in number and they are shown as a separate subdivision of horticulture on the map for this reason (see Figure 1). It is worth noting that the production of strawberries (if not all of the other vegetables in horticulture) calls for irrigation. The fifth and sixth classes, cereals and grazing, are again more traditional ones. Together the fields belonging to these two classes comprise only about one-third of the mapped area for 1980. The seventh class includes all land that is not directly used for agricultural purposes: that is, sand and gravel quarries, roads and residences. The broad white band that runs from north to south on the left side of Figure 1 is land occupied by the *autostada* (built in the late 1960s and early 1970s) and the railway which runs just next to it.

Figure 1 Map of land use at Acconia in 1980.

A summary of the number of fields belonging to each class and the relative proportion of the mapped area covered by each class in 1980 is given in Table 1. On the whole, the exploitation of the land seems to be a reasonably diversified one. No one crop dominates the picture. The three classes with the most fields in terms of number are horticulture, cereals and fruit trees. On the other hand, the first three classes with regard to area are respectively olive trees, grazing and fruit trees. It is worth noting that while vineyards are fairly numerous (a total of 44 fields in all), they cover only 4 per cent of the land.

It is instructive to consider the production of cereals in somewhat greater detail, since it represents one of the most interesting findings of the original study — one with significant implications for the evaluation of a method such as site catchment analysis, as mentioned earlier. Specifically, it was observed in 1980 that cereal crops are occasionally grown on the dune soils at Acconia. These fields are usually small in size and their yields tend to be modest by modern standards. Irrigation does not seem to be required in order to grow such cereal crops on the sandy dune soils. In Table 2, the number of fields raised on the dunes and the number on

Class	*No. of Fields*	*% of Area*
Fruit Trees	54	16
Olive Trees	35	26
Vines	44	4
Horticulture	77	13
Cereals	68	10
Grazing	39	22
Other	–	9

Table 1 Summary of land use at Acconia in 1980.

other soils (mainly the clayey soils of Pleistocene alluvial terraces) are tabulated by size. Six out of eight of the cereal fields on the dune had a size of 0.4 ha or less and none was larger than 1.4 ha. In comparison, not only are there more cereal fields off the dunes, as one might expect, but they are also larger in size (45 per cent had an area of 0.5 ha or more and five fields in this case each covered more than 2.5 ha). It is worth adding that the crops planted on the dunes are grown essentially for household consumption, which helps to explain their small size. Such fields demonstrate that, if one is not particularly worried about a high yield (as in the case of a farmer with a small holding and a subsistence orientation), the dune soils do not present an environmental impediment to growing cereals. On the other hand, the dune soils are really not suitable if one is interested in the market-oriented production of cereals. The moral here for the archaeologist is that it is not possible to classify a soil in fixed, *a priori* terms; classification is only meaningful in relation to a specific economic system or strategy.

Let us now turn to the situation in the same area nine years later. Again the mapping of land use in the spring of 1989 was done on a field-by-field basis. With a few minor exceptions (for example, fields now enclosed by fences), essentially the same area at Acconia was covered. As we shall see in the transition analysis below, it was possible to record in 1989 the state for 290 out of the original 317 fields where observations were made (in 1980). What changes in land use have taken place over the last nine years? What degree of continuity over time is observed among the different classes of land use? Which classes show increasing importance between the two dates? And which forms of production are in decline? These are some of the main questions that we want to answer.

The results of the longitudinal study are presented in Figure 2 and in Tables 3 through 5. Before turning to them in detail, some comment is called for here on the difference between directional forms of change and those that involve the rotation of crops. The former would consist of shifts in land use that mark a clear break in what is being produced. A good example would be the case where a field formerly used for cereals was converted to a grove of fruit trees. The change is directional in the sense that the field is now likely to remain in fruit trees for some time; there is a low chance that its use will cycle back to cereals over the span of the next few years. Directional change is comparatively easy to document when the shift involves three of the classes of land use at Acconia: fruit

	≤0.4	*0.5–1.4*	*1.5–2.4*	*≥2.5*	*Total*
On Dune	6	2	0	0	8
Off Dune	23	19	3	5	60

Table 2 The size distribution (in hectares) of cereal fields on and off the dune soils at Acconia in 1980.

trees, olive trees and vines. This holds both in the case of a field being converted to any one of them and in the case of movement in the opposite direction (for example, a field in vines that is converted to horticulture). In contrast, rotational change involves short-term cycling in the state of a field. For example, a field in cereals one year may be used for grazing the next two years and then back in cereals for a fourth year.

Both forms of change occur on the landscape at Acconia today. The one that will be of particular interest to us — both because it entails less ambiguity in terms interpretation and because it has more important implications for the Acconia Survey — is directional change. Figure 2 shows only those fields where there is a difference in land use between the two dates; the new state in 1989 is displayed on the map. Those places where change has occurred are widely distributed over the map. In Table 3, a comparison is made between the two years in terms of the number of fields that belong to the seven classes of land use. The third column gives the change in number with reference to 1980. Thus, for fruit trees, there were 54 fields in 1980 and this number has

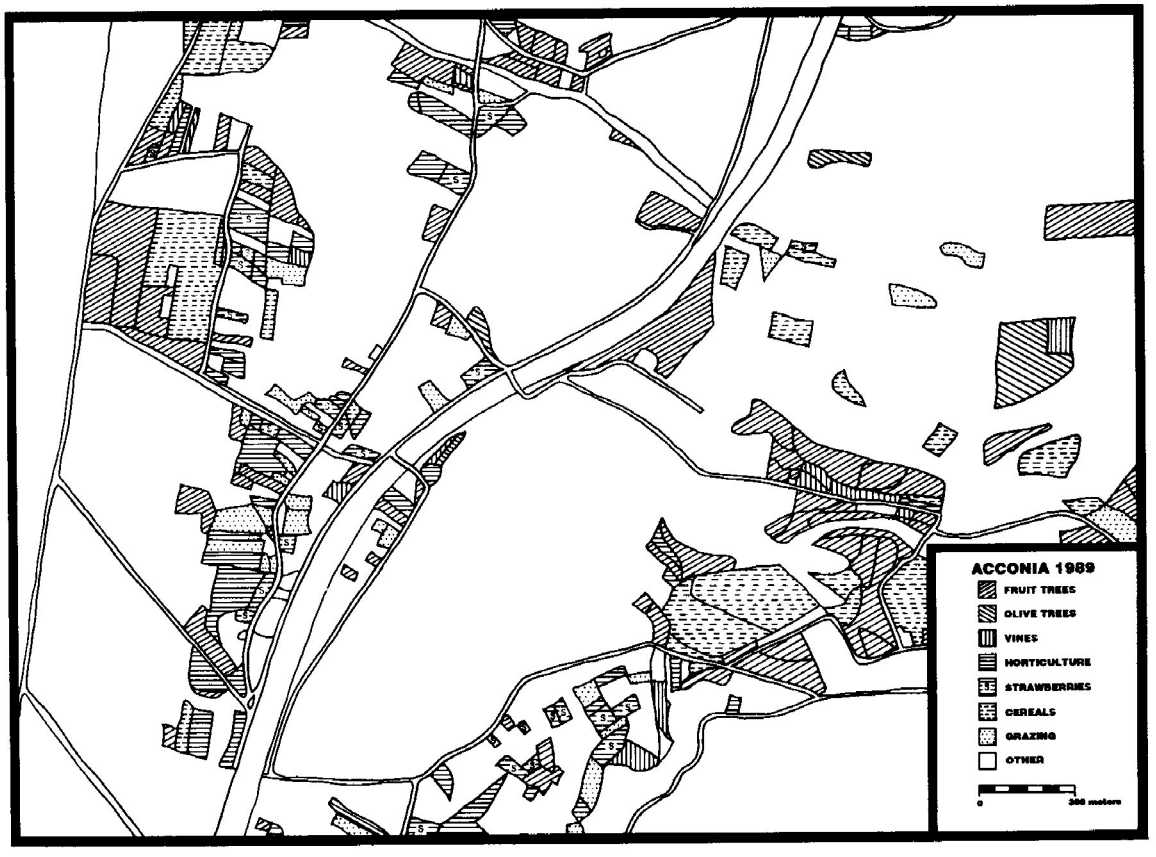

Figure 2 Map showing those fields at Acconia where a change has taken place in land use between 1980 and 1989.

Class	*1980*	*1989*	*Change*
Fruit Trees	54	102	+48
Horticulture	57	67	+10
Strawberry	20	31	+11
Cereal	68	39	−29
Grazing	39	41	+2
Vines	44	30	−14
Olive	35	30	−5

Table 3 Comparison of the number of fields in different classes of land use at Acconia in 1980 and 1989. The third column gives the change in the number of fields between the two dates.

increased to 102 fields in 1989, which means a positive change of 48 fields. The other class with a major increase is strawberries (up from 20 fields in 1980 to 31 fields in 1989). On the other hand, there are fewer fields in cereals in 1989 than there were in 1980 and the same holds for vines. Already we can begin to gain a sense of the changes at work with regard to the exploitation of the landscape at Acconia.

A more refined analysis of the dynamics of change is offered by the transition matrices in Tables 4 and 5. Here the seven classes of land use are arrayed as a symmetrical matrix with 1980 for the rows and 1989 for the columns. By taking each of the original fields and comparing its state then (in 1980) with its state nine years later (in 1989) and tabulating the results for all of the cases where a comparison can be made, we obtain the values in the transition matrix. For those less familiar with this standard tool of analysis in economics and the social sciences, some further words on how a transition matrix works may be helpful at this point. Perhaps the easiest way to do this (in terms that are not too formal) is to review a classical example of its use in the literature, Sen's analysis of the occupational classes that were hardest hit by the Great Bengal Famine of 1943. In order to reveal the dynamics of the famine, Sen (1981: 84–85, tables 6.9 and 6.10) decides to compare the pattern of change in jobs in rural Bengal for the time just before the famine broke out with that during the time of the famine itself. In order to establish the pattern for a given time period, Sen arrays the 13 occupations as a symmetrical table: that is, with the rows (the start of the period) and the columns (the end of it) having the same 13 classes listed in the same order. He then tabulates the data: for each individual, a comparison is made between the job held at the beginning and the end of the period and the totals for the population are added up for all of the combination of classes. The numbers are converted to percentages for each row in order to make the table easier to read (as done in Table 5). The values along the diagonal of the matrix give the measure of continuity for a given class (that is, the percentage of those who held the same job at the start and end of the period). The other entries in the table indicate the values for change from any one occupation to another. The table as a whole thus summarizes the dynamics of occupational change for a given period. In Sen's case, two such transition matrices are constructed and he is then able to compare and contrast the movement in jobs just before and during the famine. For example, he finds that while only 1.6% of those engaged in fishing moved into destitution in the time prior to the famine, 9.6% became destitute once the famine broke out. The three classes found to be hardest hit by the famine are fishermen, transport workers and farm labourers (those not owning or renting their own land but

working for others). In contrast, those engaged in agriculture who worked their own land showed a high degree of continuity in occupation and fewer moved into destitution (0.7% before the famine as against only 1.3% once it broke out).

Let us now return to Acconia and the class of fruit trees, the first row in our transition matrix. In Table 4, we find that out of a total of 54 fields in this class in 1980 (see the row total), 53 fields remained in fruit trees and only one changed to vines. As noted above, the matrix is easier to read when the values for each row are given as percentages. Taking the case of fruit trees again, we see in Table 5 that 98.1% of the original fields stayed in the same state, while only 1.9% had changed to vines by 1989. By examining the values along the diagonal of Table 5, we learn which classes of land use show the strongest degree of continuity over the span of nine years (that is, the high values — respectively, fruit trees at 98.1%, olive trees at 84.8% and vines at 59%) and which exhibited the least (the low ones — strawberries at 30%, cereal fields at 36.7% and horticulture at 45.8%).

In order to see the gains that a given class of land use made between 1980 and 1989, let us look at the values in the columns. Thus, we observe a series of positive percentages for fruit trees (note that the values for a column do not sum to 100%) ranging from 24.5% in the case of horticulture to 9% in the case of vines. This means that while almost no field already in fruit trees in 1980 moved to another state, all other classes of land use had fields that did change their state to fruit trees in the years between 1980 and 1989. In other words, there was a clear shift toward fruit trees as the preferred form of agricultural production at Acconia. In contrast, we can see that the situation with regard to fields with olive groves was more conservative. With the exception of the movement toward fruit trees (10.6%), there was very little change from olive trees to other classes (see the values along the row for olives) or from other classes to this class (see the column for olive trees, where the largest value is only 3.1% for horticulture). The lack of dynamics for olive trees is due in large measure to their ownership by old families with major holdings who practice a conservative strategy of land use. Note that the matrix is intentionally arranged so as to display the more dynamic classes at the top and the more stationary ones in the lowest rows. Before taking a closer look at some of the other classes, the further comment should be made that at the time the mapping was

		1989								
		Fruit	*Hort*	*Straw*	*Cereal*	*Graze*	*Vine*	*Olive*	*Other*	*Total*
	Fruit	53.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	54
	Hort	11.75	22.00	2.25	5.25	2.50	2.25	1.50	0.50	48
	Straw	4.00	6.00	6.00	1.50	2.00	0.00	0.00	0.50	20
1980	*Cereal*	12.83	11.67	3.00	22.00	8.67	0.83	1.00	0.00	60
	Graze	6.17	3.17	3.33	2.83	18.00	1.50	0.00	1.00	36
	Vine	3.50	2.50	3.00	2.50	3.00	23.00	0.50	1.00	39
	Olive	3.50	0.00	0.00	0.00	0.00	0.50	28.00	1.00	33

Table 4 Transition matrix for land use at Acconia between 1980 and 1989. The values in the table are the counts of field here (see Table 5 where they are transformed to percentages).

		1989							
		Fruit	*Hort*	*Straw*	*Cereal*	*Graze*	*Vine*	*Olive*	*Other*
		%	%	%	%	%	%	%	%
1980	*Fruit*	98.1	0.0	0.0	0.0	0.0	1.9	0.0	0.0
	Hort	24.5	45.8	4.7	10.9	5.2	4.7	3.1	1.0
	Straw	20.0	30.0	30.0	7.5	10.0	0.0	0.0	2.5
	Cereal	21.4	19.5	5.0	36.7	14.5	1.4	1.7	0.0
	Graze	17.1	8.8	9.3	7.9	50.0	4.2	0.0	2.8
	Vine	9.0	6.4	7.7	6.4	7.7	59.0	1.3	2.6
	Olive	10.6	0.0	0.0	0.0	0.0	1.5	84.8	3.0

Table 5 Transition matrix for land use at Acconia between 1980 and 1989.

done in the spring of 1989 several large fields in olive trees on the south side of the area (near site *n* in Figure 3) were being cleared of their trees and by the summer had been planted with citrus trees. These fields were still considered to be olive groves at the time of recording, since olive trees were still standing in them then. If such fields had been treated as ones in fruit trees, the matrix would show an even more pronounced shift to fruit trees and a lesser degree of continuity for olive trees.

In the case of vines, a class where it is also easy to trace directional change, we see that although there is a fair level of continuity (59% of the fields originally in vines still had the same state in 1989), movement is away from this form of land use. The shift is a broad one that includes a loss of fields not only to fruit trees but also to horticulture, strawberries, cereals, grazing and even olive trees. On the other hand, the movement from other classes to vines is quite modest (see the column values where the highest one is 4.7% for horticulture). One explanation for the trends here — a combination of broad losses and very few gains — has to do with a decline of interest in the production of wine for one's own table as farmers (even those with small holdings) have become more prosperous and can now buy their wine (often of better quality than that produced locally) on the market. Their efforts are becoming more focused on the production of cash crops rather than economizing with regard to subsistence.

The class that shows the lowest level of continuity, as mentioned above, is strawberries, a major cash crop. Less than one-third of the fields in 1980 are still in this same form of production in 1989. The main losses are to horticulture, fruit trees, grazing and cereals in that order. But the gains are even more active (recall the net increase of 11 fields in Table 3). They are obtained by shifts across a broad spectrum: from grazing, vines, cereals and horticulture (but not from fruit trees or olive trees). The implication is a fairly rapid rate of turnover in fields used for this purpose (perhaps due to the demands on soil fertility placed by this intensive form of production) and the recruitment of new fields from other classes with lower cash yields. Since levelling of the land surface is often required on the dunes at Acconia in order to create a new strawberry field, this high turnover means that many different places on the landscape at Acconia will be the object of artificial modification over the course of time.

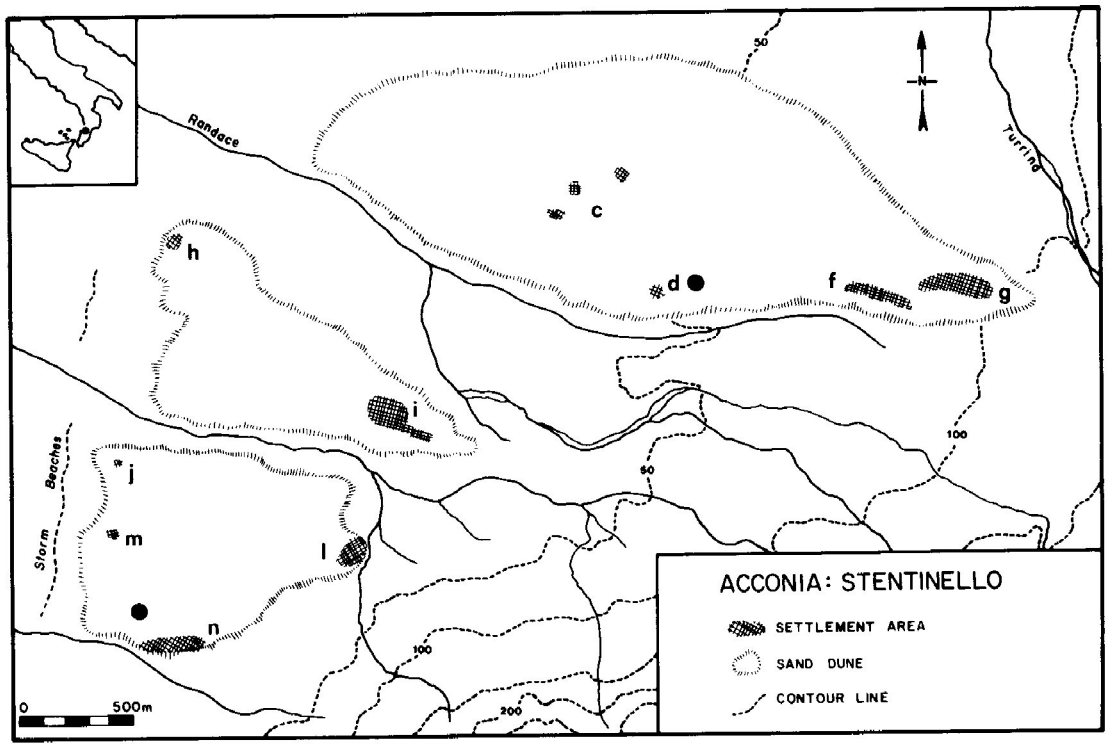

Figure 3 Map of Neolithic settlements with Stentinello pottery. The two new sites identified during the course of the second mapping of land use in 1989 are represented by circular symbols (one near d and the other just above n). After Ammerman *et al.* 1988: fig. 1.

Modern Land Use and the Acconia Survey

It is time to return to the key question of the relationship between the dynamics of modern land use and the results of the archaeological survey at Acconia. To begin with, it is no longer appropriate — at least in the case of the Acconia Survey — to think in terms of doing survey work under the simplifying assumption that modern land use is something fixed or stationary. As we have just seen, important changes are taking place on the contemporary landscape, the framework for site recovery during the life of the survey. For some time, I have realized that there seems to be a close connection between what is happening on the modern landscape and the recovery of sites in the Acconia survey (Ammerman 1981: 82; Ammerman and Bonardi 1981: 341–42; Ammerman 1985a: 4). But until now, it was not possible to go beyond this general impression — that is, to specify how land use is actually changing and to formulate in concrete terms how such changes affect the recovery of sites. In light of the results of the longitudinal study, there is a chance to look more

closely at the problem. Already there is good evidence (which the third mapping in 1998 may further strengthen) for what some of the more important developments are — notably those with regard to fruit trees and strawberry fields, two changes fully in keeping with wider trends toward the modernization of agricultural production in southern Italy over the last 30 years.

At this point, I want to consider how these dynamics influence what is found by the survey at Acconia. The heart of the matter, as mentioned earlier, concerns how such dynamics affect the visibility of sites on the land surface. In the case of the Acconia Survey, the connection between the two, the dynamics observed and the sites recovered, is often quite straightforward. When a new grove of fruit trees is installed, for example, it usually requires the levelling or terracing of the ground, the digging of a series of holes so that the trees can be planted, and the excavation of a network of trenches so that irrigation pipes can be laid. All of these interventions, which go with the change in state of the field, contribute positively to the chance that archaeological material at a buried site will be brought to the land surface and exposed there to view so that a new site can be recognized. Similar kinds of intervention are often involved when a new strawberry field is put in at Acconia. In effect, whenever the change in a field's form of production calls for interventions of these kinds, the dynamics of modern land use act as a means of sub-surface sampling (e.g., Kintigh 1988). The more changes in land use along these lines that occur, the more different places on the landscape are 'tested' in this way and accordingly the greater are the chances, on the whole, that a new archaeological site will come to light. In the absence of such dynamics, on the other hand, the opportunity for the discovery of buried sites with low surface visibility will remain poor.

Thus, in retrospect, it is evident (without going into all of the ramifications with regard to surface visibility and site recovery at Acconia in this interim report) that much of the success of the Acconia Survey in the discovery of Neolithic sites was due to the dynamics of modern land use. At the time when the fieldwork was carried out (1974 through 1980), much the same changes in patterns of land use, as documented here, were already in motion. As a direct consequence of the repeated, intensive coverage of the Acconia area, it was often possible for us to identify a new site in a field just at the time of its change in land use. This was, for example, how site 63 in the Acconia Survey was first recognized (Ammerman 1985a: fig. 6.2). Moreover, the positive relationship between the dynamics of modern land use, the visibility of archaeological material on the land surface, and the discovery of sites in the survey was confirmed in a rather unexpected way during the course of the mapping in 1989. The main focus of attention at the time was only on the recording of modern land use; there was no real intention to identify new sites. However, in two of the fields where a change in state had recently taken place or was actually in progress (one of the olive groves being converted to fruit trees mentioned earlier) — places on the landscape incidentally that we had examined several times before and observed no signs of archaeological remains — it was possible to see impressed-ware Neolithic pottery in the Stentinello tradition newly exposed on the ground. The locations of these two new sites are

shown in Figure 3. In short, the dense pattern of Neolithic settlement previously identified by survey coverage at Acconia (for the most recent pattern in the literature, see Ammerman *et al.* 1988: fig.1) now became even richer as a consequence of the dynamics of modern land use.

Discussion

A few brief comments will be made in this closing section on what the present study means for surveys in the Mediterranean world in broader terms. The first point is that more studies of this kind need to be carried out in other parts of the Mediterranean. We have to develop a broad base of experience with regard to the dynamics of modern land use. The results from Acconia cannot simply be borrowed by another survey and applied in a literal fashion to a situation that may be quite different. For example, in upland areas with much marginal land and demographic trends toward depopulation, there may well be dynamics but ones that operate in the opposite direction to those observed at Acconia (that is, toward the less intensive use of land and even its abandonment for agricultural purposes; such changes may operate to increase ground cover and thus to decrease site visibility). There may even be those surveys where both trends (intensification and falling into disuse) are locally in operation in different zones to be investigated by the same survey. Ideally, if time and resources are available, each survey should conduct some work on the longitudinal study of modern land use in order to monitor the situation in its own case. Eventually, when a fair body of experience is at hand, certain rules of thumb may emerge for application in a given situation, so that the archaeologist can work with well based expectations from the start of a survey project.

The implementation of a longitudinal study is not really all that demanding. The two things that are called for are good maps and time. For the mapping of individual fields, one needs either small-scale maps or good aerial photographs that show field boundaries in a clear way. The availability of cadastral maps will also prove to be of considerable help, since the land parcels that they show often match closely to fields and how they are used. In some cases, where fields are of consistently large size, it may be possible to employ various methods of remote sensing for the mapping of land use. However, the currently available systems of remote sensing do not offer a resolution that is good enough to define unambiguously many of the smaller fields in an area such as Acconia. Given the annual cycle of many crops, the timing of mapping is also of some importance and direct field observation yields data of higher quality in this regard as well. At Acconia, for example, the spring offers the best time of year to observe the full suite of crops grown in the area. And even if the crop in a given field has already been harvested, one can by means of direct field observation recognize on the ground signs of what is being produced there (something not possible with either remote sensing or the interpretation of aerial photographs). In terms of the labour involved, the second mapping at Acconia was done by one person over the course of three days. Thus, it does not take all that much work to do the field-by-field recording of land use as recommended here. The real challenge, of course, is to have enough time available so that one can trace patterns of change over a span of years. What is required in order to

implement such a study is, above all, long-ranging planning and patience. Once the recordings on different dates are completed, the analysis of the data collected is reasonably straightforward. It can even be done by hand — for those still not all that comfortable at doing this kind of work on a computer (or for those not yet quite ready to take advantage of the means of Geographic Information Systems to facilitate the comparison of different maps) — in a matter of only a few days. The point to stress here is that a longitudinal study of the kind undertaken at Acconia is well within the means of many survey projects.

If the decision is made to do such a study, it may well be of interest to explore in greater depth the reasons why certain fields are changing and others are not. For instance, this may involve the study of patterns of land ownership on the basis of cadastral records as we have done at Acconia (Ammerman 1985b). Work of this kind might also follow in the tradition of the study of recent land use on the Greek island of Melos, where attention is drawn, for example, to the decline in the number of farm holdings between 1961 and 1971 as well as to the presence of an active land market (Wagstaff and Augustson 1982: 107–108). Not only will the investigation of the various economic and social factors in operation behind the scenes lead to a more satisfying explanation of what is happening locally on the modern landscape but it will also serve in heuristic terms to give the archaeologist a better understanding of how change and strategies for coping with change (e.g. Forbes 1989) may once have worked in earlier times (one of the common themes of surveys in the Mediterranean).

As the findings of more studies of this kind become available, they should also make a positive contribution to the planning and design of surveys. For example, if one can identify those areas of a region where the abandonment of fields is on the rise, then public policy may want to give priority to the coverage of such places, since the conditions of the land surface in terms of ground cover are likely to be only less conducive to the visibility of sites as time passes. In such a case, it may be appropriate to allocate a major part of sampling coverage to those fields where changes in state toward disusage are most likely to occur. This will be one way to act against the effective 'loss' in the near future of this part of the archaeological record. On the other hand, as we have just seen at Acconia, in those cases where the trend is toward the intensification of land use, the archaeologist may also want to give more attention to those fields in transition (in particular, to those places where sub-surface intervention is most active). The archaeological material brought to the surface will be in its best condition just after a field has experienced a change in state of this kind. In addition, this would be the best time — before further damage and dispersal occur — to determine whether or not an excavation is in order at the site and where it should be done.

The results of the case study at Acconia have major implications for the issue of surface visibility in survey work. As shown by our recent study at Cecina and also by the re-analysis of survey data from Keos (Terrenato and Ammerman 1996), factors such as ground cover and local geomorphology play a significant role in surface visibility and, in turn, the recovery of sites during a survey. What we now learn at Acconia is that changes in the conditions of visibility due to the dynamics of modern land use are taking place even during the

lifetime of the survey itself. As noted above, the framework for the recovery of sites in a survey can no longer be treated as if it were fixed or stationary. This calls for the rethinking of recovery theory as it relates to the survey. Greater emphasis will have to be placed in surveys on monitoring the effects of surface conditions on the recovery of sites and off-sites and on tracing the pathways by which changes in land use affect their visibility on the land surface. With regard to the interpretation of settlement patterns, there is no longer justification for making the naive working assumption that the distribution of sites which a survey happens to recover corresponds with the full distribution of sites that once occurred there. If such a position is to be adopted by a survey project, it will now have to be supported by controlled studies of surface visibility. What this means with regard to those surveys already in the literature (where it is probably not possible to reconstruct the surface conditions that were present at the time of the fieldwork) is that we will have to be more cautious about many of the claims that are made.

Moreover, it is important to add that one cannot solve the problem of visibility by simply making the more realistic assumption that visibility is at work in a given survey (as a sort of masking filter) but that the problem can be circumvented by focusing on the comparison of distribution maps (each partially filtered) between time periods. The idea behind such an approach would be that the effects of visibility operate *evenly* over the various distribution maps for different periods. But the difficulty here, as shown by the study at Cecina (Terrenato and Ammerman 1996), is that visibility itself is heterogenous in spatial terms. Some parts of the Cecina Valley offer good visibility, while others do not. Since settlement patterns themselves also exhibit differences in spatial terms from one period to the next, visibility does not affect site recovery evenly or in the same way for distribution maps representing different periods. In other words, the interaction between visibility and site recovery is different for different time periods. The tacit assumption behind such a comparative approach (as a solution to the problem of visibility) is thus not acceptable upon close inspection. In short, there appears to be no easy way around the problem of visibility for surveys. It is now a fundamental concern that we should try to face squarely. Survey work in the Mediterranean is indeed no simple matter. But this is not the point in time, as we begin to develop a better appreciation of the complexity of surveys, for the survey archaeologist to throw up his or her hands in dismay. Once we start to think more clearly in terms of visibility and its effects on the survey, there is the realization that the dynamics of modern land use may offer just the window on the problem that we need in order to bring it under control.

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