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Bureau of Land Management U.S. DEPARTMENT OF THE INTERIOR

AERIAL PHOTOGRAPHY USE FOR BLM IN ARCHEOLOGICAL SITE INVENTORY

The purpose of this paper is to provide technical advice on the use of aerial photographs in archeological and historical site inventory at the district office level. For purposes of this paper it is intended that historical sites be considered as archeological sites, for the techniques of identification or location through aerial photographs are the same. The use of aerial photos in archeological inventory is still in its infancy, even among professional archeologists, so that undoubtedly a great many techniques and methods remain to be developed. However, there has been enough work done on the use of aerial photography in archeological inventory in recent years to give us some idea of its usefulness in BLM antiquities resource inventory work.

The first thing usually looked for in aerial photos when dealing with antiquities inventory are "unnatural" shapes and designs on the ground. Man frequently makes geometric designs in his disturbances of the earth - nature seldom does. Man's structures are often rectangular in form like the pueblo ruins found in the Southwest, or round as in the case of the prehistoric pithouses of Alaska and Oregon and the tipi rings of Wyoming. Man makes linear construction like the ancient canals of Arizona, buffalo jumps in Montana, and the rock intaglios of California. Regular geometric forms, where they are consistent and in situations where man might build, are good indicators of sites when spotted on aerial photos.

Knowing where to look is almost as important as knowing what to look for. Prehistoric man, being a creature of habit and having certain needs and desires, usually placed his structures, living sites, and developments in set patterns with relation to the natural landscape. Once the pattern is learned, the job of locating the archeological sites is made easier, either on the ground or in looking at aerial photographs. As examples, most of the prehistoric pueblos in the Southeastern Utah mesa country are located on the crests of the ridges or at the heads of the canyons with springs in them. In Alaska most coastal villages are located on sandspits where the wind could blow the mosquitoes away, and access to both the sea and quiet water lagoon behind the spit were readily available.

Campsites of prehistoric man of the Folsom culture were located in New Mexico by pinpointing ancient dry lakes on aerial photos and later checking them out on the ground. (Dawson and Judge, 1969) The association of dry lakes (wet when Folsom man was there) and sand dunes was the type of location preferred by Folsom man for his hunting campsites. Settlement patterns can be learned from the archeological literature of an area, or if no literature is available, then through actual inventory and experience over a period of time until the pattern makes itself clear.

Archeological sites show up on aerial photos because of several reasons, all of them based on man's disturbance of the area and usually visible in direct proportion to the amount of disturbance. "Shadow Marks" are visible on the photographs because of the shadows cast by mounds of fallen wall and earth or by the sides of depressions. These shadow marks may not be at all visible on the ground but from the air they are apt to stand out sharply, particularly as the early morning or late afternoon sun's rays fall obliquely across the mound or depression.

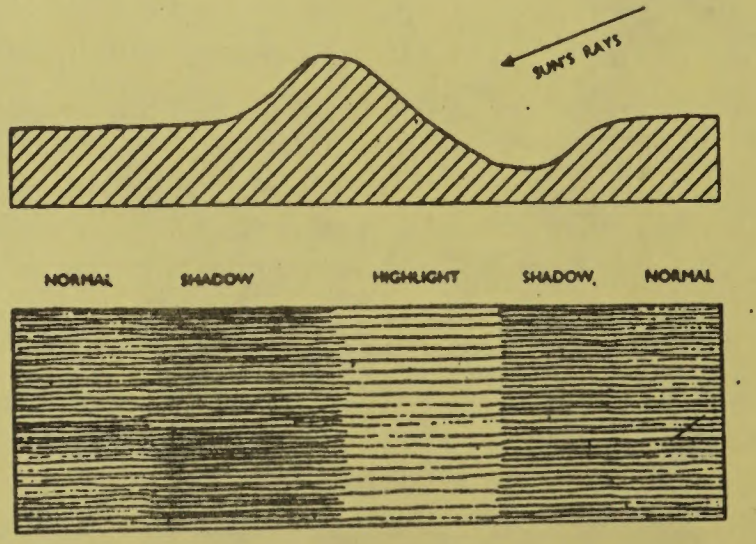

FIG. 1. Section and top views of a shadow mark made by a ditch and earth bank. The highlight is produced by the angle of the earth bank to the sun. (Reproduced by courtesy of D. N. Riley, and *The Archaeological Journal*.)

"Crop marks" are formed where vegetation is affected by man's disturbance. Any digging into the native soil, making of mounds of disturbed soil, or leaving holes in it can set up situations that are conducive to a relatively more rapid and healthier growth of the plant life on the disturbance, than that on the surrounding undisturbed soil. Depressions and holes accumulate fine silt and hold water to provide ideal growing conditions while even simple overturning of the soil aerates and loosens it to help produce better vegetation. The digging may also have been into previously impermiable areas so that soil useable to the plant is increased in volume and value.

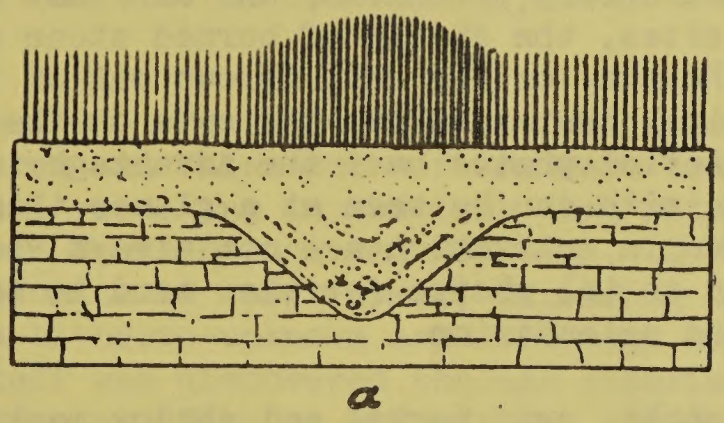

FIG. 2. *a*, section view through a positive crop mark. Vegetation growth has been enriched by the ditch filling. *b*, section view through a negative crop mark, a rare feature. Vegetation growth has been reduced by a subsurface feature, such as a buried wall foundation. (Reproduced by courtesy of D. N. Riley, and *The Archaeological Journal*.)

Conversely, where objects like walls and rubble have been covered over with a thin layer of soil, the plant life on this soil will, many times, be less healthy or thrifty than the surrounding plants. Compaction of the soil through long human use can affect plant life similarly. This difference in the condition of the plants which is frequently reflected in density, size, and color of them, is particularly visible from the air and photographs well enough, at times, to provide information as to the location of archeological sites.

In a similar vein, certain plants tend to grow on archeological sites, either because man brought them to the site or because they are more tolerant of conditions there. They, too, may indicate the presence of a site on aerial photos if they tend to photograph differently than the surrounding vegetation. For example, in the coastal mangrove swamps in Florida the Gumbo Limbo tree is an indicator of prehistoric sites, for the ancient inhabitants used Gumbo Limbo for living fences around their villages and the tree still grows on the old sites.

"Soil marks" are the differences in soil color or composition that give clues to the location of archeological sites. The cluster of broken and chipped stone, potsherds, and ash that make up the surface of Southwestern sites, the circle of burned stone and ash that locates a mescal pit in Nevada, or the soil thrown out of the prehistoric ditch in Arizona are clues that identify the site on the ground and through aerial photos. Aerial photos have the advantage in that much more of the extent of the site can be seen at a glance than on the ground. Subtle differences in coloration are not always readily apparent on the ground but are on aerial photos for they tend to be accentuated because of their shape and orientation.

Of course, soil marks, crop marks, and shadow marks may appear on photos by themselves or in any combination. Where stereographic pairs of aerial photos are used, these marks emphasize the slight difference in elevation that may be there and further aid in finding sites.

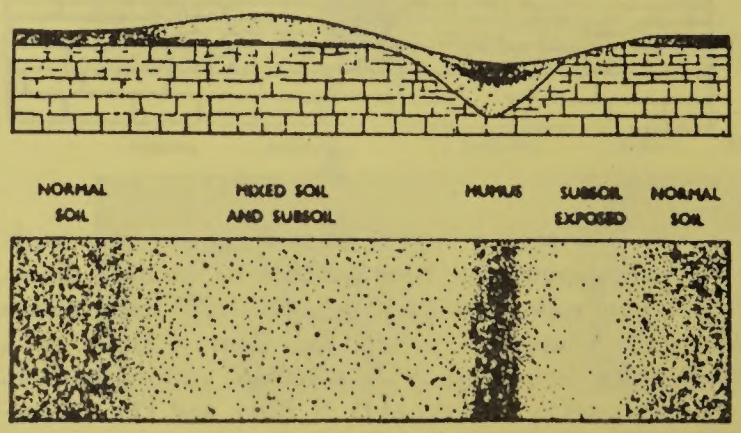

FIG. 3. Section and top views illustrating the formation of a soil mark resulting from the excavation of a ditch. The normal soil has been cut into and disturbed. Humus has collected in the ditch as subsequent fill. (Reproduced by courtesy of D. N. Riley, and *The Archaeological Journal*.)

A recent study by the Itek Corporation (1965) recommends that the best vertical aerial photography for archeological inventory can be most rapidly and economically done at a scale of 1:10,000 exposed through a minus blue filter (No. 12) on panchromatic black-and-white film. Larger scales of 1:5000 and 1:3,000 will bring out finer details and may be necessary in areas where sites are small and difficult to see but the cost of the larger scale is more. Indications are that color photography is particularly valuable in certain areas, particularly the desert, where soil color differences are not readily detectable in black-and-white. Use of color would probably be justifiable only where several needs can be served at one time or in remote, poorly accessible areas, for it is expensive.

Other remote sensing methods are relatively new and untried in archeological inventory. Infrared and false-color films were tried by Itek with little additional detail resulting in the test area which was the lush Missouri River valley in South Dakota and Nebraska. However, these sensing methods hold further promise in other areas, depending on future experimentation. Recently a hitherto-unknown archeological site in the volcanic ash area around Flagstaff was discovered through experimentation with an infrared scanning radiometer (Schaber & Gumerman, 1969). The site was an agricultural one where volcanic ash was used to mulch plants but it was undetectable on the ground.

However, even the 1:20,000 and 1:15,000 scale aerial photos that are most readily available to BLM provide a certain amount of information on the archeological resources for inventory. This is particularly true with larger sites and the use of high quality film and camera systems.

At this stage in the art, aerial photographs can best serve in making emergency rapid surveys of areas that are unknown but where some action can affect the antiquities values is about to take place. Full advantage should be taken of reading photos stereoscopically for complete analysis.

Aerial photos can also well serve to validate historical sites found through literature search and located by informants. Old roads, trenches and gun pits, building sites, railroads, trails, graveyards, and other works of contemporary man show up frequently in detail on aerial photos. In dealing with any historical site, full use of the aerial photos should be made for it is seldom that documents, records and maps fully show the extent and character of the site.

The best aerial photo coverage available should be used as a matter of course in conjunction with on-the-ground inventory so that more rapid systems of inventory can be developed. Consideration should be given to archeological inventory needs in making any new aerial photo coverage for combined needs may justify more detailed or sophisticated type

coverage. As different types of sites are determined from ground observation and aerial photos, photo interpretation keys to the sites should be compiled in a manual for the use of future photo interpreters. These can be made simply by cutting the photo of the site out and pasting it in a loose-leaf notebook along with a short paragraph identifying the type of site and its photographic properties that will help identify others like it for the photo interpreter.

Instructions for obtaining BLM aerial photography are found in BLM Manual 9163. To find out if an area has been photographed and by whom and when, contact: Map Information Service, Federal Board of Surveys and Maps, North Interior Department Building, Washington, D. C.

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* Copies available from Denver Service Center D-370

** Copies available from Clearinghouse, U. S. Dept. of Commerce, Springfield, Va., 22151 at $3.00 each in Xerox printing.

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