

## Flight over the future motorway. Airphotos in Polish rescue archaeology

Agnieszka Dolatowska<sup>1</sup> and Andrzej Prinke<sup>2</sup>

<sup>1</sup>Adam Mickiewicz University,  
Poznań, Poland  
agadola@amu.edu.pl

<sup>2</sup>Poznań Archaeological Museum,  
Poznań, Poland  
[aprinke@man.poznan.pl](mailto:aprinke@man.poznan.pl)

**Abstract.** Air reconnaissance as an indispensable part of a major archaeological rescue project has not gained wide recognition in Poland yet. One of the first opportunities to apply it on a wider scale was the extensive motorway construction project (ca 2500 km of motorways to be built within the next 10-15 years). A pilot project for systematic air photo taking and interpretation in order to locate possibly all endangered sites was executed in Mid-western Poland (Poznań area) in 1999-2000 on a fragment of the planned motorway ca 100 km long. After taking over 1000 air photos during two helicopter flights they were analyzed, rectified and inserted into a GIS module of regional SMR, based on the *MapInfo* system. Finally, a description of the applied research procedures was published as a slide presentation on the WWW page *Archaeology in Poland* in order to make the method wider known.

In recent years the region of Greater Poland (Mid-Western part of the country) has been flourishing with the investment boom that includes the great undertakings of international scope, i.e. a section of the Yamal Peninsula (Siberia) – Western Europe gas pipeline and the A2 motorway section from Frankfurt/Oder through Poznań to Warsaw (Fig. 1; Mazurowski and Zapaśnik 2002).



**Fig. 1.** The planned Polish motorway network and the route of the Yamal Peninsula (Siberia) – Western Europe gas pipeline (Polish section).

These large-scale construction undertakings created the highest threat to the whole environment and particularly to archaeological heritage. According to the Polish legislation, they should – and have been – preceded by thorough field survey in order to localize and evaluate all existing archaeological sites. The thorough list of sites which was compiled during such reconnaissance serves as a basis to formulate a program of further rescue activities, mainly - excavations of all endangered and valuable sites. The rich experience of traditional field walking gathered during the execution of a long-term project of Polish Archaeological

Survey (which started in 1975) proves that this method alone does not bring satisfactory results and should be controlled by other methods. One of them could be air reconnaissance which proved to be very efficient in several European countries (Bewley and Rączkowski 2002, Nowakowski and Rączkowski 2000). What follows is a short case study of an introductory stage of a major archaeological rescue project. As we shall try to prove, already from the start reconnaissance could be intensified by using some computer applications and procedures.

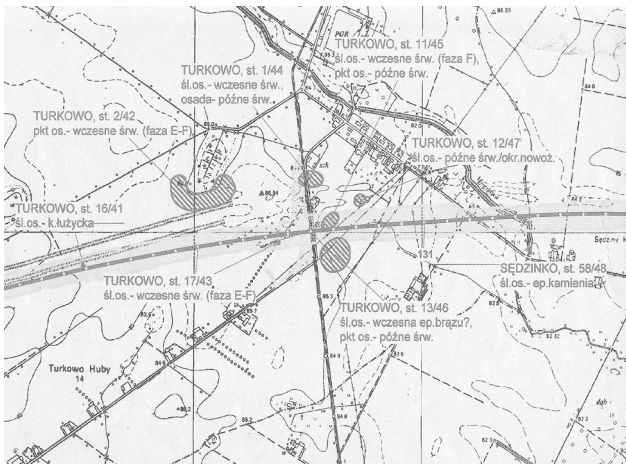
Although the tradition of applying air photos for documentary aims in Polish archaeology dates back to the 1920s, the method of air reconnaissance as an indispensable part of the early stage of the archaeological rescue project has not gained general recognition yet. One of the first opportunities to apply it on a wider scale was the intensive archaeological survey along a section of the planned motorway in Mid-Western Poland (a part of the all-Polish motorway construction project - ca 2500 km long, to be built within the next 10-15 years; fig. 1).

A pilot project for systematic air photo taking and interpretation in order to locate sites endangered by the planned motorways was executed in Mid-western Poland (Poznań area) in 1999-2000 by the Poznań Archaeological Museum. It covered a fragment of the future motorway ca 100 km long. The project included:

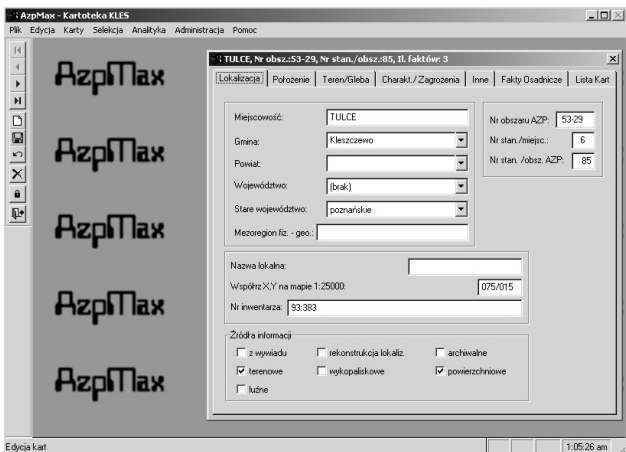
- a/ two helicopter flights over a chosen fragment of the motorway,
- b/ taking photos of three categories of objects:
  - known archaeological sites,
  - all traces that might be archaeologically meaningful (i.e. crop marks and soil marks),
  - areas under excavation
- c/ analysis of the photos by archaeologist trained as air photo interpreter,
- d/ rectification of the oblique photos,
- e/ insertion of the photos with identified archaeological features into a digitized topographic map of *MapInfo* system (wherever possible),
- f/ publication of the description of the applied research procedures and results in the form of electronic presentation on

the WWW page *Archaeology in Poland* in order to make the method wider known and used.

The starting point was to prepare a map with all known archaeological sites, situated within the threat zone of the planned motorway (fig. 2).



**Fig. 2.** Fragment of archaeological map of the planned motorway launched by GIS module of regional SMR.



**Fig. 3.** Regional SMR database for region of Greater Poland (Poznań area); text module.

It could be automatized with the use of the computerized Sites & Monuments Record for the region of Greater Poland, which has been systematically built up since 1986 at the Poznań Archaeological Museum (fig. 3; Prinke 1997a, 1997b). The system includes a simple GIS module based upon *MapInfo* GIS system (Prinke 1999).

The flights were executed with the Soviet MI-2 helicopter. Navigation was carried out with GPS and 1:50 000 scale topographic maps. Two persons were taking pictures with the following cameras: Canon EOS 500N and Pentax MZ50 (24x36 format) and Pentacon six TL (6x6 format). Both color and black-and-white photos, as well as color slides (Kodak films) were used. As a result of the flights, over 1000 oblique air photos were taken. All of them are kept in the archive of Poznan Archaeological Museum, Department for Protection of Archaeological Heritage. A database archive to contain the photos together with their archaeological interpretation (both graphical and text) as well as GIS attributes is now in preparation. It is planned to integrate it with the general SMR database for the region of Greater Poland (Wielkopolska).

Eventually, it should become a module of a multiaspectual Information System on Archaeological Sites, integrating data gathered during air reconnaissance with information derived from other sources.

Their analysis and interpretation, executed by Dr. Włodzimierz Rączkowski (Institute of Prehistory, Adam Mickiewicz University, Poznań) disclosed probable traces of archaeological relics on over 130 photos. The conclusions are based mainly upon the presence of anomalies in vegetation (crop marks), disclosing the differences of humidity and structure of the soil. Below is a choice of the results of this interpretation:

**Gluchowo, comm. of Komorniki, site 24 (fig. 4)**

Near a small lake the are clear crop marks. The majority of them display circular shapes of similar sizes, unevenly distributed in space. It may partly be due to diversified crops (a good example of how different plants may disclose or hide archaeological objects).



**Fig. 4.** Gluchowo, comm. of Komorniki, site 24.

**Mała Górka, comm. of Nekla, site 12 (fig. 5)**

The photograph documents a hill, where the grain shows crop marks informing about the structures under the humus. In this case an irregular area of anomalies in grain colour may be observed. The whole area should be rather linked to geomorphological structures. The presence of a very few regular “objects” suggests that there may also be archaeological sites there.

**Poznań-Nowe Miasto, site 29 (fig. 6)**

Between the railway line and the road there is a distinct sphere of crop marks. Against the oval background of ripe grain (dark brown in colour) at least four oval patches can be seen. It is quite probable that they signal a group of large archaeological objects (dug-outs?).



**Fig. 5.** *Mala Górka, comm. of Nekla, site 12.*



**Fig. 6.** *Poznań-Nowe Miasto, site 29.*

**Sędzinko, comm. of Duszniki, site 44, 58 (fig. 7)**

Close to a farmhouse there is a small enclave with crop marks. A wide oval object can be seen in its centre. The remaining elements are much smaller. It is possible that archaeological objects occur here.



**Fig. 7.** *Sędzinko, comm. of Duszniki, site 44, 58.*

The results of the analysis were then used during the execution of further stages of the rescue project, mainly during the excavation of the endangered sites.

After a powerful new tool known as GIS became available, it diversified the way air photos are applied by archaeologists as it became possible to integrate the end products of this method with some others, i.e. results of surface surveys (field walking) and geophysical examinations on the background of

topographical map (e.g. Murray 2002, Rączkowski 2002). The advances which have been made in the last few years in the methods of inventorying and documentation of archaeological sites have taken place mainly due to advances in computer technology. This exceptionally dynamically developing field has supplied exceptional applications of a universal character, and thus of use to the archaeological profession, and especially to the heritage management service. Its everyday professional activities include the rapid selection of data from huge resources of archives and documentation created by the long term programme called the Polish Archaeological Record. For this reason, all archaeologically valid photos from the described project have been rectified and inserted into a topographical 1:10 000 scale digital map in order to precisely locate the archaeological features identified from the air. It was done by use of the shareware software *AirPhoto*([www.home.t-online.de/home/gcarver/Airphoto.htm](http://www.home.t-online.de/home/gcarver/Airphoto.htm)). The inevitable condition for the photo to be processed this way is the sufficient number of control points it contains

Already the use of textual databases meant a great advance over the use of traditional paper records and allowed the automation of the process of creation, updating, and search. After mastering the new tool, users rapidly came to appreciate its many advantages, such as:

- the possibility of establishing and maintaining precise data standards,
- the rapid identification of mistakes and missing information,
- the possibility of automation of part of the work connected to the completion of data and correction of mistakes,
- the possibility of rapid and cheap creation of an unlimited quantity of copies of data in order to safeguard them or disseminate them, or allow their synthesis.

An important argument for the introduction of digital maps in the everyday work of the archaeological conservation services, apart from the time it would save and the increased precision of the obtained results, is also the fact that for some time these tools have been increasingly commonly used by our professional partners, who make use of archaeological data, that is planners, officials of the state and local government as well as several specialised public and communal services. In such situation it seemed justifiable to introduce a systematic solution, the creation of maps of archaeological sites as one of the layers of multiaspectual spatial planning maps. For the archaeological conservation services – apart from any other advantages - this would have an important strategic value, since it would allow the elimination of the frequent procedure of ignoring of the problem of preservation of archaeological heritage in the decision-making process involved in local government, planning of redevelopment, administrative processes etc.

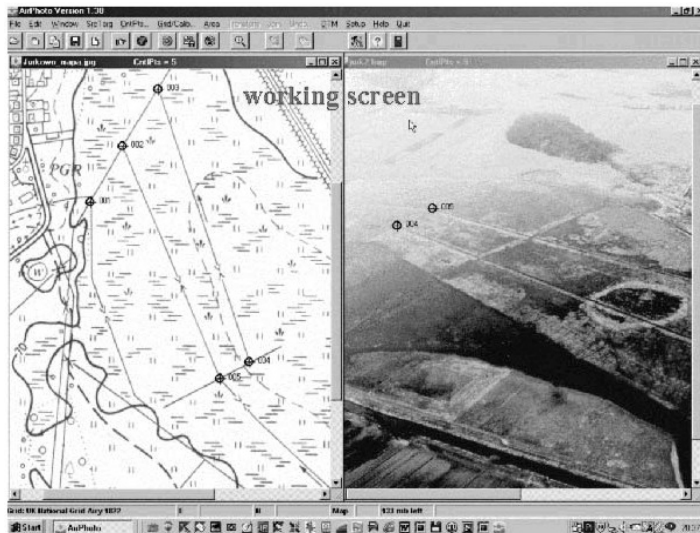
After finishing the project described above we found it useful to prepare an Internet presentation, showing the applied research procedures and to publish it on our WWW page *Archaeology in Poland* (fig. 9) to make the method wider known and used ([www.muzarp.poznan.pl/muzeum/muz\\_eng/archairframe.html](http://www.muzarp.poznan.pl/muzeum/muz_eng/archairframe.html)). which is one of the products of European project *ArchTerra. Extending the European Archaeology Web over Bulgaria, Romania, and Poland*, carried out by Poznań

Archaeological Museum in 1999-2001 under the INCO Copernicus programme (Van Leusen and Prinke 2002).

What remains to be done is (1) a "spade test" to check the results of the possibly all photo interpretations by method of sondages and drilling, (2) an attempt to define the outline of the regional "crop mark typology" for Mid-western Poland, according to its specific conditions (soil, climate, moisture, farming, technologies).

RĄCZKOWSKI, W., 2002. *Archeologia Lotnicza – Metoda Wobec Teorii (Aerial Archaeology – Method in the Face of Theory)*, Poznań UAM Wydawnictwo Naukowe.

VAN LEUSEN, M., PRINKE, A., 2001. The ArchTerra Project: Extending the European Archaeology Web over Bulgaria, Romania, and Poland. In Stančić, Z. and Veljanovski, T. (eds.), *Computer Archaeology for Understanding the Past CAA2000, Proceedings of the 28th Conference*, Ljubljana, April 2000, Oxford ArchaeoPress (BAR International Series 931).



**Fig. 8.** Internet presentation, showing the applied proceeding of air photos, published on WWW page *Archaeology in Poland*.

## References

BEWLEY, R.H. and RĄCZKOWSKI, W., 2002. *Aerial Archaeology. Developing Future Practice*, NATO Science Series, Series I: Life and Behavioural Sciences 337. Amsterdam IOS Press.

MAZUROWSKI, R., ZAPAŚNIK, T., 2002. The Construction of Roads and Motorways As a Source of Knowledge About the Remotest Past of Poland's Territories, Routes/Roads (in press). Paris, World Road Association.

MURRAY, D., 2002. The integration of data sources. In Garcia Sanjuan, L. and Wheatley, D.W. (eds.), *Mapping the Future of the Past. Managing the Spatial Dimension of the European Archaeological Resource*, Sevilla, Universidad de Sevilla.

NOWAKOWSKI, J. and RĄCZKOWSKI, W., 2000. Refutation of the Myth: New Fortified Settlement from Late Bronze Age / Early Iron Age in Wielkopolska Region (Poland), *Antiquity* 74.

PRINKE, A., 1997a. AZP\_Fox, rel. 1.8. A Computer Database Management System on Archaeological Sites. User's Guide, Poznań Muzeum Archeologiczne w Poznaniu (Poznańskie Zeszyty Archeologiczno-Konserwatorskie 4).

PRINKE, A., 1997b. MuzArP, rel. 1.5. A Computer System of Integrated Archaeological Information (Sites - Research - Finds). User's Guide, Poznań Muzeum Archeologiczne w Poznaniu (Poznańskie Zeszyty Archeologiczno-Konserwatorskie 9).

PRINKE A., 1999. Can Developing Countries Afford National Archaeological Records? The Polish Answer. In Hansen, H.J. and Quine, G. (eds.), *Our Fragile Heritage. Documenting the Past for the Future*, Copenhagen Nationalmuseet.