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Potential of kite aerial photography for peatland investigations with examples from Estonia

Leijailmakuvausmenetelmän käyttömahdollisuudet soiden kartoituksessa — esimerkkejä Viron soilta

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Kite aerial photography (KAP) involves the use of large kites to lift camera rigs 50–150 m above the ground. Various types of radio-controlled, single- and dual-camera systems may be employed to acquire images in visible and near-infrared portions of the spectrum. KAP has many advantages for peatland research, including: high portability, rapid setup and operation, small crew, range of suitable weather and site conditions, high-resolution images, and low cost of equipment and operation. On this basis, KAP could be utilized for multitemporal imagery throughout the growing season and from year to year to document study sites. Kite aerial photography at Endla Nature Reserve in Estonia demonstrates the potential of this method for acquiring useful images in vertical and oblique orientations. Sun glint in oblique views (toward the sun) can highlight the presence of water bodies regardless of water depth or turbidity. Color-infrared KAP would be especially useful for separating different types of vegetation cover and water bodies in peat bogs. Kite aerial photography could represent one level of observation in a multistage and multitemporal approach that involves ground study, conventional aerial photographs, and satellite imagery.

Key words: Estonia, kite aerial photography, peatland, remote sensing.

INTRODUCTION

Peat bogs and mires cover substantial portions of northern Eurasia and North America. For environmental and economical reasons, peat deposits are subjects of much scientific research in many northern countries. The scale of peat research ranges from national and international assessments to detailed, local site investigations. Within this wide range of scales, many different techniques have been utilized to collect, compile, analyze, and synthesize data. In recent years, traditional ground mapping methods have been supplemented with the use of geographic information systems (GIS) and remote sensing techniques for wetland research (Jensen et al. 1993; Juvonen et al. 1997; Ahvenniemi et al. 1998; Barrette et al. 2000). In this article, we explore the potential of kite aerial photography as a method for acquiring low-height, high-resolution imagery for studies of peat bogs and mires.

Kite aerial photography (KAP) involves the use of large kites to lift camera rigs 50–150 m above the ground. Kite aerial photography was popular in the late 1800s and early 1900s, before it was largely displaced by photography from

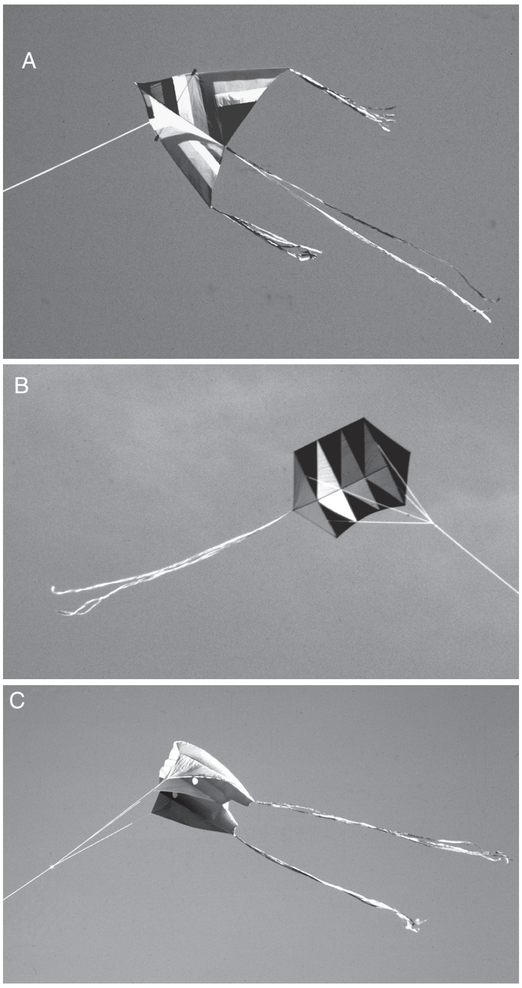

Fig. 1. Examples of types of kites used for lifting camera rigs for aerial photography. A – delta, surface area = 2.8 m^2; B – rokkaku, surface area = 3.3 m^2; C – soft airfoil, surface area = 1.5 m^2. For each example, the tail is 4½ m long.

Kuva 1. Esimerkkejä erilaisista ilmavalokuvaukseen käytettävistä leijatyypeistä. Leijojen pinta-alat: A – 2.8 m^2, B – 3.3 m^2, C 1.5 m^2. Häntä on kaikissa 4,5 m. pitkä.

manned airplanes. In recent years, KAP has experienced a rebirth based on high-performance kites and kite handling equipment, small cameras of high quality, and the need for near-surface photographs. KAP has the capability to produce large-scale images of surface features at low cost. Scientific applications for KAP are many and varied. Kite aerial photography has proven

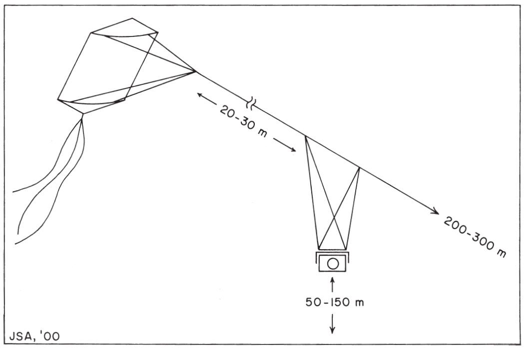

Fig. 2. Cartoon showing the arrangement of camera rig for kite aerial photography. Representative distances are indicated; not to scale.

Kuva 2. Kaaviokuva kameran kiinnityksestä leijaan.

especially useful in those situations where conventional airphotos would be either impractical, dangerous, or prohibitively expensive to acquire (Perkins 2000).

Kite aerial photography is one type of small-format aerial photography (Warner et al. 1996). Recent examples of the scientific use of kite aerial photography include a penguin study in Antarctica (Carlson 1997) and archeologic investigations on Novaya Zemlya (Gawronski & Boyarsky 1997). Bigras (1997) employed KAP for detailed study of buried fossil forest beds on Axel Heiberg Island in Arctic Canada. He developed a stereo-camera KAP rig for accurate mapping of tree stumps and litter beds that are currently undergoing erosion in the tundra environment. Marzolff & Ries (pers. com. 2000) are using KAP to document patterns of erosion in semiarid land of Burkina Faso, western Africa. Warner (1996) coined the term *kiteography*, which is the use of KAP in making accurate topographic maps based on photogrammetric principles. Aber et al. (1999) and Aber & Galazka (2000) have employed KAP for geomorphic and forestry applications in the United States and Poland.

KAP EQUIPMENT

The choice of kite depends on wind conditions and the weight of camera rig for a particular situation. Soft airfoil kites and rigid kites can be uti-

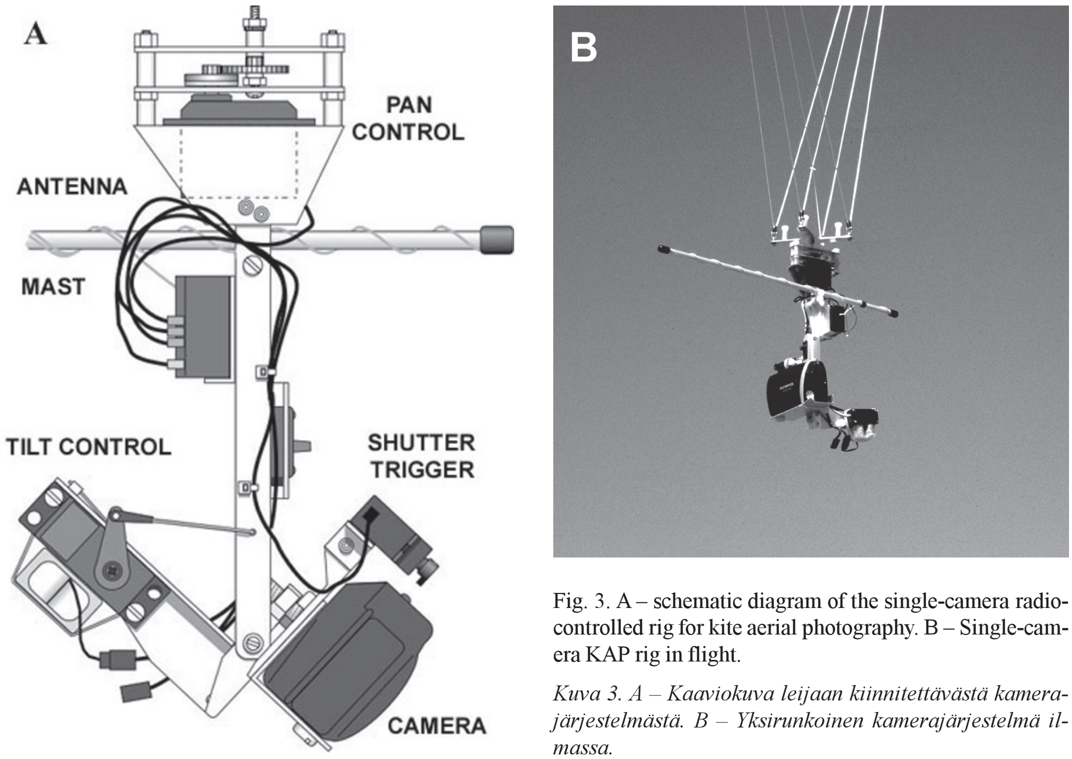

Fig. 3. A – schematic diagram of the single-camera radio-controlled rig for kite aerial photography. B – Single-camera KAP rig in flight.

Kuva 3. A – Kaaviokuva leijaan kiinnitettävästä kamerajärjestelmästä. B – Yksirunkoinen kamerajärjestelmä ilmassa.

lized (Fig. 1). In our experience, we prefer large rigid kites (2½ to 3½ m^2) of the delta or rokkaku style for light to moderate wind (10–20 km h^{-1}). For stronger wind (20–30 km h^{-1}), we normally employ a smaller airfoil kite (1½ m^2). The camera rig is secured to the kite line usually 20 to 30 m below the kite (Fig. 2). This position helps to protect the camera from sudden movements of the kite. The camera platform involves a cable-and-pulley arrangement called a *Picavet* suspension, which keeps the platform level regardless of the angle of the kite line and protects the camera from vibration of the kite line. For flying a single kite, we normally put out 300 m of braided dracon line with a breaking strength of 110 kg. In conditions of light wind, we sometimes fly two kites in a series to generate more lift for the camera. The usual flying height for kite and camera rig is 50–150 m depending on wind conditions.

We routinely utilize two single-camera rigs. The smaller rig is based on an *Olympus Stylus* point-and-shoot camera (Fig. 3). This camera has a fixed-focus 35-mm lens and automatic light settings. The larger rig has a *Canon Rebel* SLR camera with full manual or automatic functionality. The zoom lens (35 to 80 mm) can be mounted with various filters. This camera can take either color-visible or color-infrared photographs. Both rigs have radio control of camera position (pan and tilt) and shutter release while in flight. The smaller rig weighs about 570 g (incl. film and batteries); weight of the larger rig is just over one kg. In addition, we have begun to experiment with a digital-camera rig, based on the *Canon Digital Elph* (*Digital Ixus* in Europe), a miniture camera with a 1200x1600 CCD pixel array. It likewise has full radio control of pan, tilt, and shutter release; total weight of this camera and rig is about 625 g (incl. battteries).

We also have two dual-camera rigs. The first is for stereo photography (Fig. 4). It includes two *Olympus Stylus* cameras mounted on a boom 93½ cm apart. Position of the cameras and boom is set manually for each flight, and the shutters are triggered by radio control. Designed for extreme lightness, this rig weighs only 870 g, including

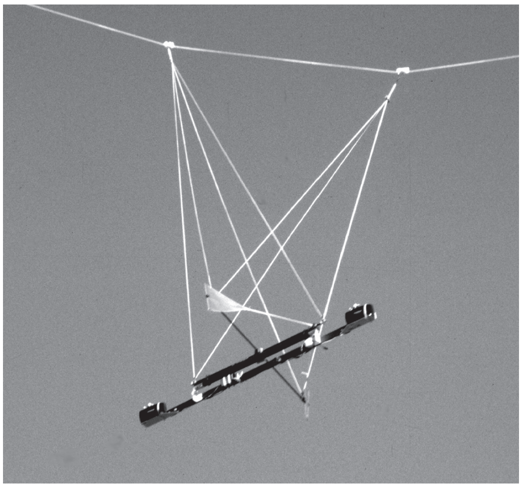

Fig. 4. Flight picture of the stereo-camera rig for kite aerial photography. The small dihedral wings help to maintain stable position of the camera boom, parallel to the kite line. Overall length of the rig is about 1 m.

Kuva 4. Lentokuva leijaan kiinnitetystä stereokamerasta. Pienet siivet kameran sivuilla auttavat pitämään kameran suorassa, suhteessa leijan naruun. Kameratelineen pituus on n. 1 m.

two cameras, batteries and film. The cameras take simultaneous photographs of the same area on the ground. When these photo pairs are viewed through a stereoscope, dramatic depth perception is evident. The second dual-camera rig employs two *Canon Rebel* SLR cameras mounted side by side. One camera takes normal color pictures, and the other uses color-infrared film with a yellow filter. Camera settings (shutter speed and *f*-stop) along with camera position (pan and tilt) are set prior to each flight, and the shutters are triggered simultaneously by radio control. This heavy rig weighs 1½ kg.

ADVANTAGES OF KAP FOR PEATLAND RESEARCH

The special advantages of kite aerial photography (KAP) for research on peat bogs and mires are summarized in the following categories.

Portability — By its operating requirements, KAP equipment is light in weight and small in volume. It can be transported to the field efficiently by vehicle, boat, or aircraft. On the ground, two people can carry easily the necessary equipment to reach inaccessible sites in bog interiors.

Setup time — Given suitable conditions, KAP equipment can be set up, photographs taken, and equipment put away in about one hour (or less), depending on the types of cameras/films and number of pictures to be taken at a site. On this basis, several sites can be photographed in a day. Images could be acquired at mire study plots several times during the growing season.

Crew — A crew of two is usually sufficient— one to handle and fly the kite and the other to operate radio controls for the camera. In order to position the camera over a specific site on the ground, a spotter can direct the kite flyer via a small radio. No special training is necessary, and flight permission is not required as long as the kite does not exceed 150 m above the ground.

Weather — The open nature of large bogs favors consistent, near-surface wind. Nominal wind speed 10 to 30 km h^{-1} and bright sunshine are optimum conditions; sun at least 30° above the horizon to minimize shadows. Air temperatures above 35°C may damage color film (but not b/w film). Below 5°C, small batteries begin to lose power, and kite flyers must be protected well from wind chill. This range of suitable weather conditions occurs frequently throughout the growing season of temperate and boreal environments.

Site — The interiors of bogs and fens offer excellent KAP locations either from the ground or from a small boat in a lake or stream. The ground site should be free from obstacles (power lines, towers, tall trees, etc.) and should pose no risk to people or structures in the event of a kite crash. Ground markers can be laid throughout the study site and surveyed with differential GPS equipment.

Imagery — All types of black-and-white, color-visible, and color-infrared film as well as various filters may be utilized in conventional cameras. Digital and video cameras are also possible. Views can be taken in all orientations relative to the horizon, sun position, shadows, and ground targets. Special lighting effects in oblique views, such as sun glint, can aid in recognition of small water bodies, which are common in many bogs.

Processing — Scanned photographs or original digital images can be imported into image-processing or GIS software. Vertical, stereo images can be rectified, based on ground survey markers, and form the basis for accurate photo mosaics and cartographic products (Warner et al. 1996). Final image ground resolution is in the range 10–20 cm (pixel size) with locational accuracy of ± 1 m (Aber et al. 1999).

Cost — Basic cost for equipment is on the order of $1000 to $1500, depending on types of camera, kites, radio control, and related articles. Cost can be reduced by building the camera rig and kite. Equipment costs increase with additional camera rigs, various kites, and accessories. A complete set of KAP equipment could cost in the range $3000 to $5000. Operational expenses include film, photo processing, and travel to KAP sites, which varies widely depending on location.

Aerial photographs taken from a kite are, in principle, no different from small-format air photos (SFAP) taken from other manned or unmanned platforms (Warner et al. 1996). All forms of SFAP have similar goals, namely acquisition of low-height, large-scale imagery for land resources and management applications. SFAP may be subjected to standard photogrammetric and image-processing techniques, including radiometric and geometric corrections, and may be employed as one layer in geographic datasets.

Small-format aerial photography has been conducted from many types of unmanned platforms, such as radio-controlled model airplanes (Quilter & Anderson 2000), tethered hot-air blimp (Marzolff & Ries 1997), and helium balloons (Table 1). These platforms share the advantages of flexibility for SFAP operations, relatively quick setup in the field, and low-tech components. Each has certain strengths and weaknesses, but kites combine low cost with high portability, which is desirable for working in large and relatively inaccessible peatland environments.

Table 1. Comparison of unmanned platforms for small-format aerial photography (SFAP). Based on Marzolff & Ries (1997), Quilter & Anderson (2000), and other sources.

Taulukko 1. Erilaisten miehittämättömien pienimuotoisten ilmakuvausmenetelmien vertailua. Perustuu lähteisiin Marzolff & Ries (1997) ja Quilter & Anderson (2000), ym.

Platform	Advantages	Disadvantages	Costs *
Kite (tethered)	Minimum crew of 2 Excellent portability Wind range 10–30 km h^{-1}	Ground hazards Platform motion Light payload	Equipment $1000 Operation = low
Model Airplane (free flying)	Minimum crew of 2 Overfly ground hazards Fair portability	Wind under 10 km h^{-1} Experienced pilot Platform vibration	Equipment $1000 Operation = low to moderate
Helium Balloon (tethered)	Minimum crew of 2 Stability in flight Positioning control	Wind under 5 km h^{-1} Ground hazards Poor portability	Equipment $1200 Operation = low to moderate
Hot-air Blimp (tethered)	Stability in flight Positioning control Heavy payload	Wind under 5 km h^{-1} Minimum crew of 4 Poor portability Ground hazards	Equipment $14,000 Operation = high

* Minimum costs of equipment include a basic platform, radio controls, and camera. Operating costs are relative estimates based on fuel, gas (He), maintanence, transportation, etc. – *Laitteiden minimikustannukset sisältävät jalustan, radio-ohjausyksikön ja kameran. Käyttökustannukset ovat suhteellisia estimaatteja perustuen polttoaineeseen kaasuun, ylläpitoon, kuljetukseen jne.*

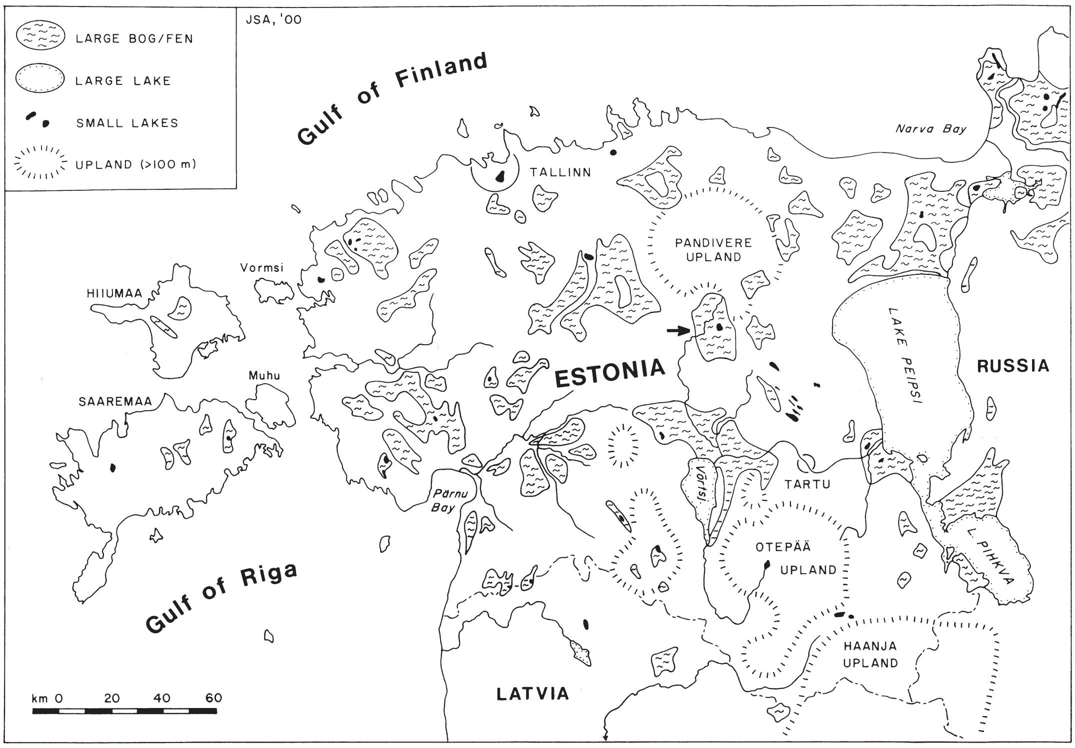

Fig. 5. Generalized distribution of large mire complexes in Estonia and adjacent territories. The location of Endla Nature Reserve is marked by the arrow. Based primarily on Orru et al. (1993).

Kuva 5. Viron suoalueet (Orru 1993). Endlan luonnonsuojelualue on merkitty nuolella.

KAP AT ENDLA NATURE RESERVE, ESTONIA

We have conducted kite aerial photography at the Endla Nature Reserve. The present reserve was created in 1985 as an expansion of the previous smaller Endla-Oostriku mire reserve. It is located immediately south of the Pandivere Upland in east-central Estonia (Fig. 5). The Endla mire complex grew up in the depression of former Great Endla Lake (Allikvee & Masing 1988). Several remnants of this lake still survive, notably Endla Lake and Sinijärv (Blue Lake). These lakes were subjected to several episodes of draining (1872, 1949, 1950) and were reflooded in 1968. The Endla mire complex contains seven bogs separated by narrow rivers, and several significant springs rise in the western part of the complex (Fig. 6). The lakes, bogs, and springs are important sources of recharge for the Põltsamaa River. Among the bogs, Männikjärve bog has been investigated intensively since the early 1900s. A small meteorological station is located in the bog. An elevated, wooden walkway allows visitors to travel across the bog without disturbing the surface and without sinking into the peat and mud (Aaviksoo et al. 1997).

Our KAP ground site was the wooden platform at the meteorological station in Männikjärve bog. We utilized the small single-camera rig for color-visible (film) photographs on two occasions in September and October, 2000. Wind and sun conditions were excellent for the September session, although some cloud shadows did appear in the area around the bog. In October, the atmosphere was smoky from widespread agricultural burning. This smoke rendered a hazy appearance to many of the photographs. Our intention was to demonstrate the potential of KAP for peatland research, so we did not undertake any

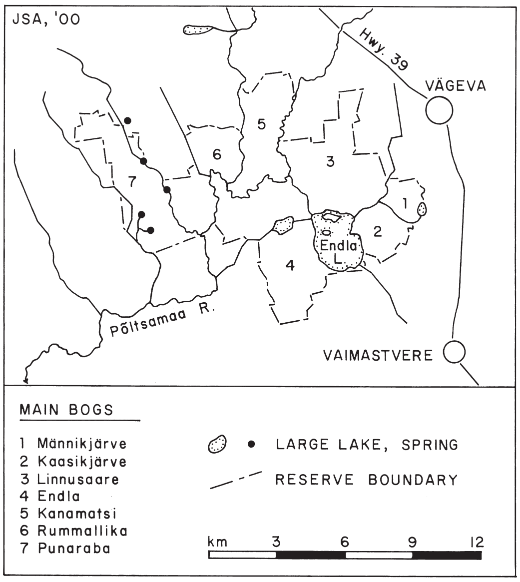

Fig. 6. Sketch map of the Endla Nature Reserve in east-central Estonia. Kite aerial photography was conducted at Männikjärve bog (1) at the eastern end of the reserve.

Kuva 6. Kartta Endlan luonnonsuojelualueesta itäisessä Keski-Virossa. Leijailmakuvausmenetelmää testattiin Männikjärven suolla suojelualueen itäosassa.

type of accuracy or error assessment.

Oblique views across the bog display overall patterns of hummock ridges, dwarf pines, hollows, and water-filled pools (Fig. 7). In closeup oblique and vertical views, it is possible to identify individual small trees, moss hummocks, faint trails, small potholes, and other structures (Fig. 8). Varieties of peat moss are distinct in their coloration—bright red, reddish orange, and greenish yellow. In oblique views in the solar plane, sun glint from pools highlights standing water clearly. Small, shallow pools are, conversely, difficult to see in vertical views, as they blend in with the underlying and surrounding mud.

A representative vertical view was selected to examine image resolution (Fig. 9). The original 35-mm film was scanned at 680 dpi (dots per inch). Based on known width of the boardwalk, pixel size could be calculated. In this case, the pixel resolution is 12½ cm, which means that each pixel represents a ground cell 12½ by 12½ cm in area. There is an inverse linear relationship between scanning resolution and resulting pixel resolution. For this example, increasing the scanning resolution to 850 dpi would reduce pixel resolution to 10 cm; a pixel size of 5 cm could be achieved by scanning the film at 1700 dpi. Given this range of resolutions, it would be feasible to map the complicated microrelief of bog structures using single or stereo photos.

POTENTIAL OF INFRARED KAP OF PEAT BOGS

Peat bogs display great variation in their types of vegetation, soils, and water bodies. Photosynthetically active green plants strongly absorb red (0.6 to 0.7 µm) light and strongly reflect near-infrared (0.7 to 1.0 µm) energy (Colwell 1974; Tucker 1979). Active vegetation is the only land-cover material with these spectral characteristics, which forms the basis for recognizing vegetation in color-infrared photographs and multispectral digital imagery. Note: the spectral limit of sensitivity for photographic film is 0.9 µm, which excludes longer mid- and thermal-infrared wavelengths. Peat moss (*Sphagnum* sp.) has a considerably lower near-infrared reflectivity compared to trees and grass, so it is quite distinct in color-infrared photographs. Furthermore, the seasonal peak of near-infrared reflectivity for moss occurs in late summer, whereas most trees and grass have their peak in late spring and early summer (Peterson & Aunap 1998).

For color-infrared KAP, *Kodak Ektachrome* EIR film is available in 35-mm format. This film carries no ISO speed rating, and camera light meters do not measure near-infrared radiation. We have developed empirical light settings for our equipment that produce proper exposure under conditions of full sun and active ground vegetation. Infrared KAP has proven to have excellent potential for detailed studies of forest and prairie vegetation (Aber et al. 2001). Color-infrared photography is also quite effective for depicting open water, regardless of water depth or turbidity. On this basis, it seems evident that multitemporal, color-infrared kite aerial photography could be especially useful for separating different types of vegetation cover and water bodies in peat bogs.

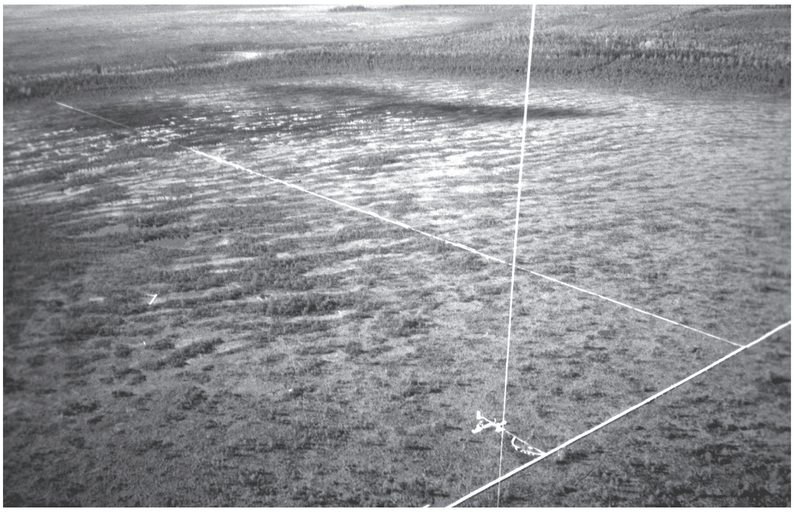

Fig. 7. Low oblique view toward northwest across Männikjärve bog. Center of the bog is in the left background. Kite flyers are working from the small meteorologic station in the lower part of view. Black-and-white picture derived from original color photograph. September, 2000.

Kuva 7. Kalteva näkymä luoteeseen Männikjärven suolla. Suon keskiosa näkyy kuvassa takavasemmalla. Oikealla alhaalla näkyy pieni sääasema, josta leijoja ohjataan. Kuva on otettu syyskuussa 2000 ja on alunperin värikuva.

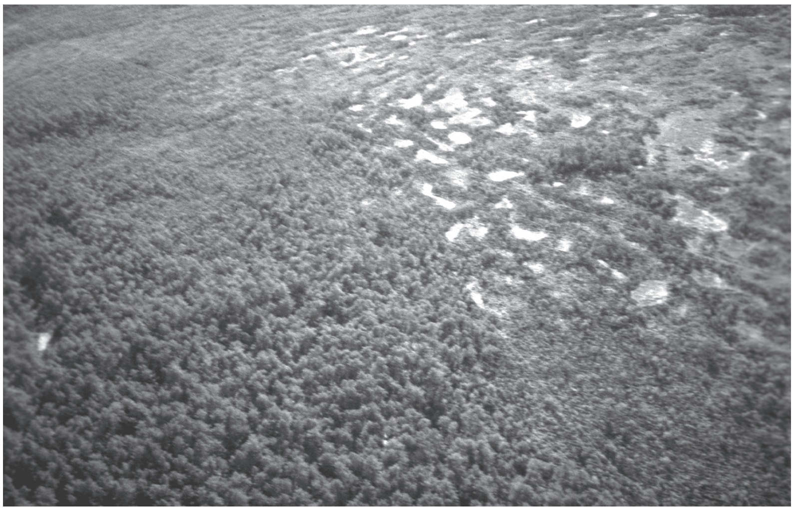

Fig. 8. Closeup low-oblique view toward the southwest of the eastern bog margin and adjacent forest. Sun glint (white) highlights water pools in hollows, and a faint trail can be seen toward the upper right corner of the scene. Black-and-white picture derived from original color photograph. September, 2000.

Kuva 8. Kalteva lähikuva lounaaseen kohti suon itäistä reunaa ja viereistä metsäaluetta. Auringon valo heijastuu vesialtaista tuoden ne selkeästi esiin. Oikeassa reunassa voidaan nähdä suolla kulkeva polku. Alunperin värikuva, syyskuu 2000.

COMPARISON TO CONVENTIONAL AIRPHOTOS AND SATELLITE IMAGERY

Conventional airphotos are medium-scale, panchromatic, large-format (23 cm), vertical views. Such airphotos are indispensible for regional mapping and assessment for all manner of environmental conditions—soils, geology, water resources, vegetation, etc. Aerial photographs of this type are available in principle for most northern countries in which peatlands are conspicuous; however, the age, quality and cost of such airphotos varies greatly. At a nominal scale of 1:25,000, a vertical airphoto covers approximately 25 km^2 ground area, and 0.1 mm on the airphoto represents 2.5 m on the ground. The usual resolution limit for conventional airphotos is 1–2 m; smaller objects cannot be discerned unless they have high contrast with the surroundings. Furthermore, the panchromatic (black-and-white) nature of conventional airphotos limits their use for interpreting and classifying vegetation cover. Color-visible or color-infrared aerial photographs are available for selected areas in only a few countries. On this basis, conventional airphotos are best suited for meso-scale investigations of peatland conditions at infrequent intervals.

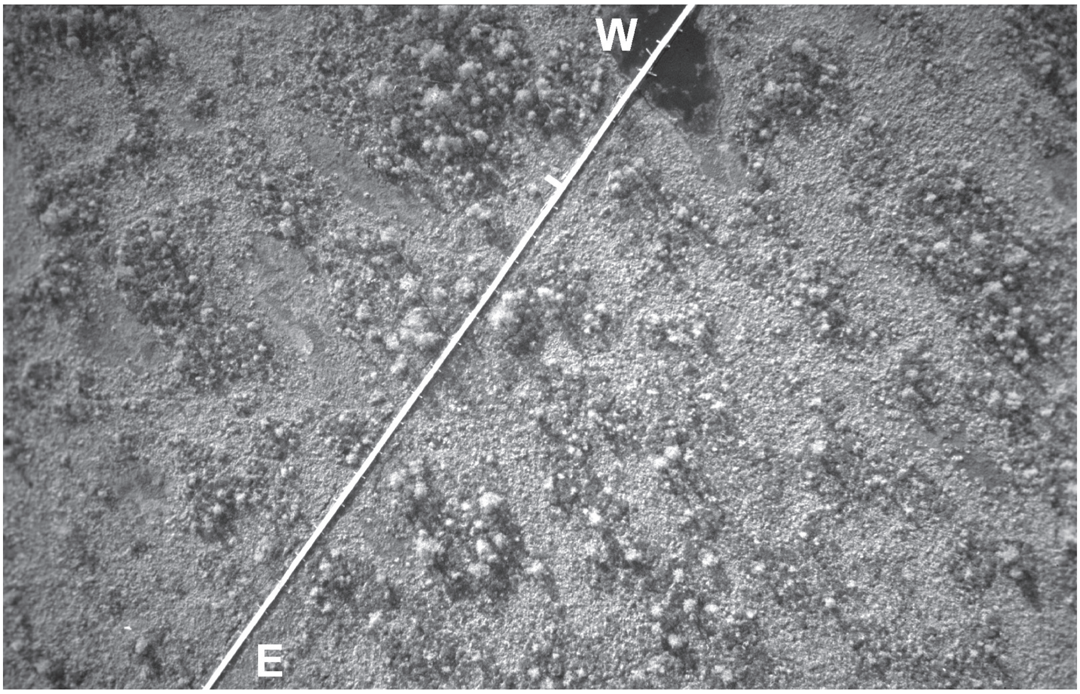

Fig. 9. Vertical view near the center of Männikjärve bog. The boardwalk is approximately 60 cm (2 feet) wide and trends E–W. A water-filled hollow is present at top of view. Dry hollows have smooth texture, and dwarf pines occupy peat hummocks. Black-and-white picture derived from original color photograph. October, 2000.

Kuva 9. Kohtisuoraan alaspäin otettu kuva Männikjärven suon keskustasta. Pitkospuiden leveys on n. 60 cm ja ne ovat itä-länsi -suunnassa. Kuvan yläkulmassa näkyy veden täyttämä kulju. Kuvassa tasaisena näkyvät pinnat ovat kuivahkoja painanteita mäntyvaltaisten mättäiden välissä. Alunperin värikuva, lokakuu 2000.

Satellite imagery represents a means to acquire uniform datasets over large regions of the Earth's surface. Most current satellite imagery is moderate resolution (pixel size 15 to 30 m). Landsat Thematic Mapper (TM) datasets more than 10 years old as well as new Landsat 7 Enhanced Thematic Mapper Plus (ETM+) datasets are available to the public at modest cost ($425 to $600 per scene). The new IKONOS satellite provides high-resolution panchromatic (1 m) and multispectral (4 m) datasets that rival conventional airphotos in detail. Image acquisition can be scheduled for a particular time of year and conditions. However, these datasets are sold at commercial prices; minimum order for Europe is currently $3000. The multispectral capability of satellite systems adds an important dimension for vegetation classification and mapping. However, issues of cost and resolution place limits on applications of satellite imagery for peatland investigations.

Kite aerial photographs can be taken in all possible orientations—vertical, low- and high-oblique, and in all directions relative to the ground target and sun position. This gives KAP the capability to acquire images quite different from conventional airphotos, and so increases the potential for recognizing ground-cover conditions. Vertical KAP images typically depict ground areas about 1 hectare (2½ acres) in area and have scanned pixel resolution in the range 10–15 cm (or less). Thus, KAP is ideally suited for large-scale, detailed investigations of relatively small sites. Kite aerial photography can be repeated at frequent intervals, because of its low cost, high portability, and rapid field acquisition. Multitemporal imagery during the growing season and from year to year would allow for small changes in ground cover to be detected quickly and analyzed while the changes are in progress. In this regard, kite aerial photography provides a means for highly focused investigations of specific sites in peat bogs and mires.

Masing (1998) envisioned a multilevel approach in mire research and mapping that ranges in scale from 1:10 (most detailed) to 1:10,000,000 (most generalized). Conventional airphotos span the scale range 1:1000 to 1:100,000, and satellite imagery can be utilized for map scales of 1:100,000 and smaller. Kite aerial photography fills the micro-scale range 1:100 to 1:1000, and thus bridges the gap between ground surveys and conventional aerial photography. This level of scale and resolution is best suited for permanent peatland study plots and control sites. KAP could form one level of data acquisition in a multistage approach that includes ground observations, conventional airphotos, and satellite images (Table 2). Kite aerial photography represents a low-cost means of remote sensing that should be considered for inclusion in the operational methods for resource and environmental surveys of peatlands.

CONCLUSIONS

Kite aerial photography (KAP) is a technique for collecting low-height, large-scale, high-resolution imagery of peatlands in visible and near-infrared portions of the spectrum. We have conducted KAP at Endla Nature Reserve in Estonia as a means to demonstrate the potential of this method for bog investigations. Variable viewing directions, frequent acquisition of photographs, low cost, and high portability combine to make KAP a useful field method for detailed investigations of control sites in peat bogs and mires. Kite aerial photography cannot replace the regional coverage provided by conventional airphotos or satellite images. Rather, KAP could form another data level within a multistage and multitemporal approach that involves ground observations, conventional aerial photography, and satellite imagery.

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Table 2. Comparison of kite aerial photography (KAP) with other methods of remote sensing applied to peatland research.
Taulukko 2. Leijailmakuvausmenetelmän vertailua muihin soiden tutkimuksessa käytettäviin etäkartoitusmenetelmiin.

Method *Menetelmä*	Height *Korkeus*	Area[1] *Pinta-ala*	Pixel size[2] *Pikselikoko*	Spectral range *Spektrialue*	Scale[3] *Mittakaava*
KAP	50–150 meters	< 1 hectare	10–20 cm	visible; near infrared	microscale
Conventional Air Photos	500–10,000 meters	10s hectares to 10s km^2	1–2 m	visible; near infrared	mesoscale
IKONOS Satellite	ca. 700 km	10s km^2	1–4 m	visible; near infrared	mesoscale
Landsat ETM+ Satellite	ca. 700 km	100s km^2	15–60 m	visible; near, mid, & thermal infrared	macroscale

1. Areal coverage given for single, near-vertical image – *Pinta-alapeittävyys yhdelle vertikaalikuvalle.*
2. Linear resolution for pixel in digital imagery – *Lineaarinen resoluutio digitaalikuvassa.*
3. Based – *Perustuen* – on Masing (1998).

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TIIVISTELMÄ

Leijailmakuvausmenetelmän käyttömahdollisuudet soiden kartoituksessa — esimerkkejä Viron soilta

Leijailmakuvauksessa (KAP=kite aerial photography) suurehkoja leijoja käytetään nostamaan valokuvauskamera 50–100 metriä maanpinnan yläpuolelle. Menetelmä mahdollistaa erilaisten radio-ohjattujen, yksi- tai kaksirunkoisten kamerajärjestelmien käytön tavallisten valokuvien tai lähi-infrakuvien ottamiseksi. Leijamenetelmän etuja erityisesti soiden kartoituksessa ovat keveys ja kannettavuus, nopea käyttöönotto, pieni työvoiman tarve, mahdollisuus kuvaukseen monenlaisissa sää- ja maastoolosuhteissa, korkean resoluution omaavat valokuvat ja vähäiset hankinta- ja käyttökustannukset. Leijamenetelmä soveltuukin hyvin kasvukausien aikaisiin ja vuosien välisiin seurantatutkimuksiin.

Leijailmakuvausmenetelmän käyttökelpoisuutta testattiin Endlan luonnonsuojelualueella Virossa. Vastavaloon otetut kuvat erottelivat vesialtaat hyvin riippumatta niiden syvyydestä tai veden liikkeistä. Väri-infrakuvat voivat olla hyödyllisiä erilaisten kasvillisuus- ja vesipintojen erottelussa. Leijailmakuvaus ei voi yksinään korvata perinteisiä soiden kartoitukseen käytettyjä menetelmiä, kuten tavallisia ilma- ja satelliittikuvia ja maastomittauksia, mutta sitä voitaisiin käyttää näiden menetelmien täydentäjänä, varsinkin usein toistuvissa mittauksissa.

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