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Reef Aerial Photography from a Kite

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Summary. The construction and operation of a mechanism for taking aerial photographs from a kite are described. The apparatus is inexpensive, light and robust and is operated by two people. This method of low level aerial photography, vertical or oblique from an altitude of 50 to 200 m, is ideal for surveys of reef flats and islands where winds of 7 to 25 knots are encountered.

Introduction

There are numerous occasions when conducting a photographic survey of reef flats or reef islands when one wishes the camera could be held 10 m or 100 m above the ground to obtain a good plan view. On some coral islands it is possible to charter an aeroplane or helicopter to fly over the sites of interest for photography. On remote reefs a technique that can be used is that of aerial photography from a light-gas balloon (Rützler 1978). Each of these methods has drawbacks. Chartering aircraft and helicopters is expensive and normally time-specific. Helium is not readily obtainable and is also costly, and there is a risk element in using hydrogen. Further, balloons are difficult to fly in winds in excess of 5 knots. Another alternative is to use a kite equipped for aerial photography.

Aerial photo-reconnaissance by kite has been used by the military for many years, and more recently for the survey of archaeological sites (Allen 1980), but the technique has not been exploited for reef studies. Kites have certain advantages over other forms of aerial photography: they are inexpensive, they are light and easily transportable, and they operate well in light to fresh breezes from 7 to 25 knots, conditions often found on coral reefs.

Methods

Construction

This apparatus consists of a nylon kite; a reel of cord; a box carrying a camera, autowind and radio receiver; and a single channel radio transmitter.

Kite

The kite used was made of nylon fabric which in the wind filled with air forming an aerofoil shape. A small drogue was connected to the centre of the trailing edge (Fig. 1). There are no struts and the kite folds into a small cylindrical bundle 20 cm long weighing 1 kg. The specific type used was Stratascoop III, supplied by Greens of Burnley, England. 350 m cord (terylene, 150 kg breaking strain) is coiled on a reel held on a frame that can hang from the neck on the chest (Fig. 1). About 40 m from the kite end of the cord, two metal rings are attached to the cord for connection to the camera housing (Fig. 1).

Camera Attachment and Control

A light automatic-exposure 35-mm camera (Pentax ME super) was used for photography. A box with an optical glass window and a waterproof sealing lid was built to house the camera and the autowind mechanism, which was wired to a small radio receiver (Fig. 1). Connected to the outside of the box was a ball-and-socket joint on a bar which was suspended from a swivel on another bar (Fig. 1). The ball-and-socket joint always hung vertically below the bar attached to the kite cord and the box containing the camera could be oriented to give vertical or oblique photographs by means of the ball-and-socket joint (Fig. 1). During operation the camera housing was connected to two metal rings attached to the kite cord by means of quick-connect clips (as used on dog leads).

Operation

Two people are needed to launch and fly the kite and to operate the radio transmitter. First it is necessary to prepare the camera in its housing and to switch on the radio transmitter, receive and autowind. The camera is set at infinity and the lens is set to a wide aperture so that on automatic exposure a fast shutter speed is used. One photograph was taken by radio control with the camera on the ground to confirm correct operation of radio, shutter and wind-on mechanisms which can be heard through the box. This first photograph could usefully be of a card indicating location and date. The kite is launched without the camera box. About 30 m of cord is laid out on as smooth a ground surface as is available. One person (the anchor man) holds the cord reel on his neck and secures the cord with a couple of turns round the bar in front of the reel (Fig. 1). The other person (the controller) holds the kite attached to the end of the cord so that the wind flows into it and billows it into shape. The kite is held high by the tail and released into flight. The kite climbs and is held by the anchor man. The controller, who should be wearing strong gloves, takes hold of the cord firmly while the anchor man undoes the turns on the reel bar and, walking away, lets out a further 30 or 40 m of cord. The end of the line is again secured on the reel bar with several turns on itself. The controller walks to the anchor man letting out the cord by hand and the

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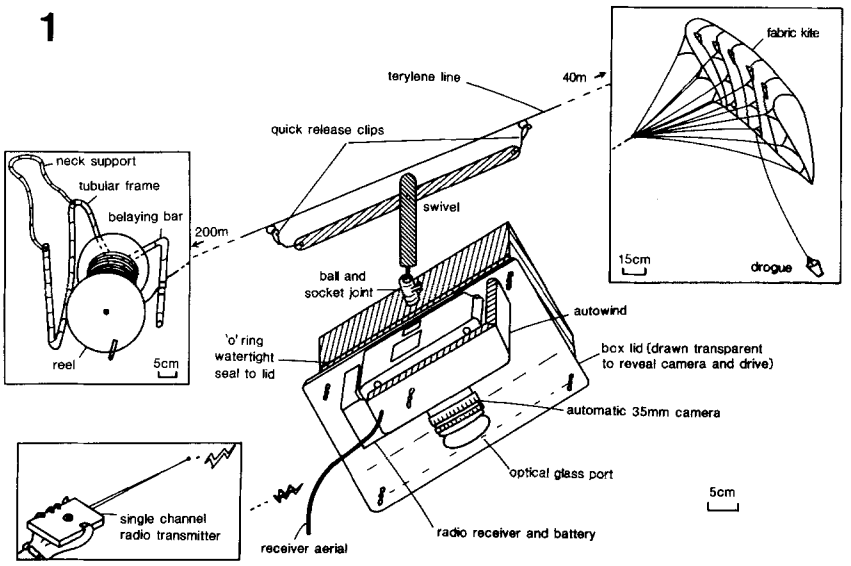

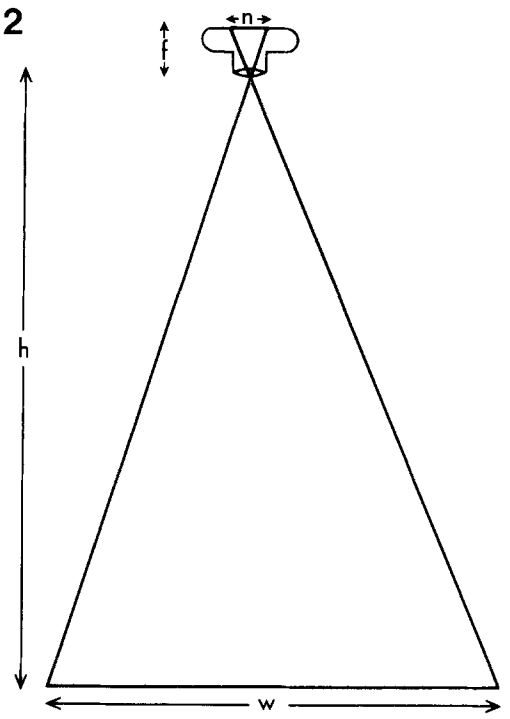

Fig. 1. Schematic diagram of apparatus. The camera housing is drawn with a transparent lid to reveal the internal components

Fig. 2. Calculation of width of field: $w = n \times h/f$. w, width of field; n, width of negative; f, focal length of lens; h, height of camera above ground. A standard 35-mm photograph (actual negative size 24×36 mm) taken with 28-mm lens 100 m above ground covers an area of approximately 85×128 m

Fig. 3. Vertical aerial photograph of part of northern shoreline of Anchorage Island, Suwarrow Atoll showing partially eroded beach rock

kite flies higher. When the two metal rings are reached a few more metres are let out. The cord is held by the controller and he attaches the camera housing by clips to the rings on the line below the flying kite (Fig. 1). When he releases the line the camera housing is lifted up. The kite and camera are allowed to ascend by repeating this process of letting out increments of line until sufficient height is obtained. This apparently cumbersome procedure avoids the possibility of friction burns, cuts or other injuries, which might result if the reel were allowed to run free. The reel must always be firmly under the control of the anchor man. When at the desired height the anchor man positions himself so that the camera is above the area to be surveyed. The controller takes photographs by pressing the button on the radio transmitter when the camera appears to be stable in the sky. The autowind will take 35 photographs on a 36 exposure film. The width of the area contained in each negative (w) can be worked out simply by similar triangles (Fig. 2) from the focal length of the lens (f), the vertical height above the ground of the camera (h), and the width of a negative frame (n). From this figure w one determines how many paces to walk between consecutive photos so as to obtain a satisfactory overlap. (It was found advisable to take two photos at each location for although the kite remains stable in a steady wind, the camera may swing a little on gusting).

The camera and kite are lowered by reversing the handling process. With the anchor man taking the strain, the controller draws down about 40 m of line and then holds the flying kite securely while the anchor man winds in the slack line so that the line on the reel is not under great tension. The anchor man makes two turns on the reel bar and takes the strain while the controller repeats the operation until the camera is within reach and can be unclipped. The kite can then be drawn down into the hand. The transmitting and receiving power are switched off and the kite folded away.

Results and Conclusions

Because the kite and camera can easily ascend or descend or swing left or right a little during slight fluctuations in the wind, the resulting photographs are difficult to match precisely for a perfect photo-mosaic. Nevertheless, maps of reef flat and island zonations were easy to draft from a series of overlapping photographs. A good width of view (with 28 mm wide-angle lens) and good resolution of typical reefal ecological and structural features can be obtained at about 100 m. Figure 3 shows the northern shoreline of Anchorage Island on Suwarrow Atoll in the Cook Islands from this height; the style of erosion of the beachrock can be picked out well. Large scale (commonly roughly linear) features which were not known to occur from ground studies were shown especially well from an altitude of about 100 m. In Britain the whole apparatus (excluding the automatic camera and autowind) costs about £140. It can be used anywhere where there are breezes from 7 to 25 knots and a launching area of relatively flat ground 20–40 m long. Once the kite is in the air the apparatus is easily walked to many positions on the reef and the required amount of line let out so that the camera is over the subject. Even wooded islands and submerged lagoon reefs present no problems as long as a launch site can be found and the length of line and wind direction allow the kite when elevated to be over the subject. If it is impossible to position the camera for vertical shots, then one has to rely on obliques. A polaroid filter can be used on the camera to cut down reflection off water. The apparatus is inexpensive, light and robust and could become standard equipment for the survey of reefs in remote places.

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