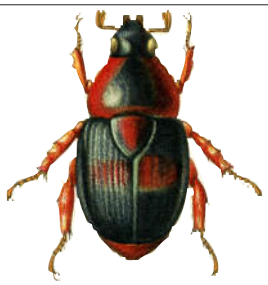
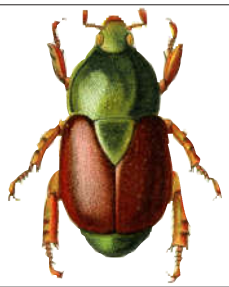


SCARABS



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Focus-Stacking Macro Photography System for Around $1,200

by Chris Moeseneder

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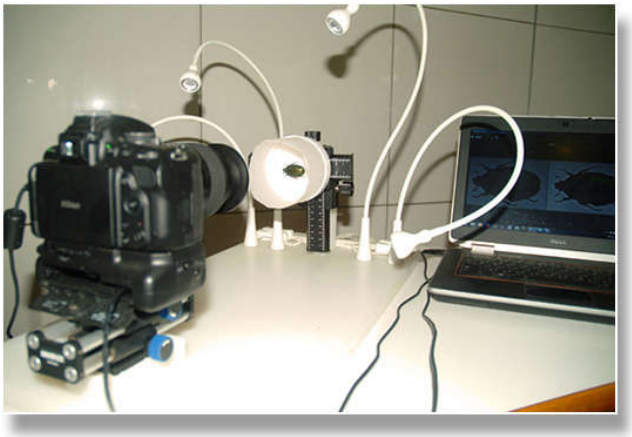
The challenge was to build a focus-stacking macrophotography system as cost-effective as possible while still ensuring that it performs well. This article presents the system which I built for this purpose, complete instructions on how to replicate and operate it, and its advantages, drawbacks and calibration. The skills required to build the system are low and tools are few but you must be able to read a technical drawing and use power tools. While this system was developed under the constraints of a private budget it is also a solution which will not blow your project budget and may just slip under the threshold of a capital investment. There are many camera, lighting, stage and software manufacturers which produce components that are as good, or even better, than those mentioned in this article. However, the combination of products presented here has been successfully assembled into a reliable, replicable, cost-effective and easy to operate system.

Figure 1: ***Ischiopsopha wallacei*****. Mostly out of focus.**



Figures 2-4: Macro photography setup.

Problems of Photography at Small Scales

In photography at small scale - the size of insects - the part of an image which is in focus is much less than at larger scale. In subjects such as landscapes, the depth of focus may be from few metres to infinity. For subjects that are few centimetres large, the sharp area in an image is usually only a few millimetres deep (Figure 1, only top of elytra is in focus). The rest of the image is out of focus. Focus-stacking is a technique in which a number of images are taken of a subject while the camera is advanced in small increments. In the resulting series of images only a certain area in each image is in focus. The series of images can then be processed by software which combines the sharp areas of each image and creates a single image in which the entire subject is in focus. Factors which have an effect on the quality of the image are the number of images, the distance travelled between images and the accuracy with which the camera advances towards the subject.

The System

A single small base plate contains all components: camera and the sled, the subject and the stage and lighting. All parts are solidly mounted since unwanted movement of any component reduces the quality of the final picture.

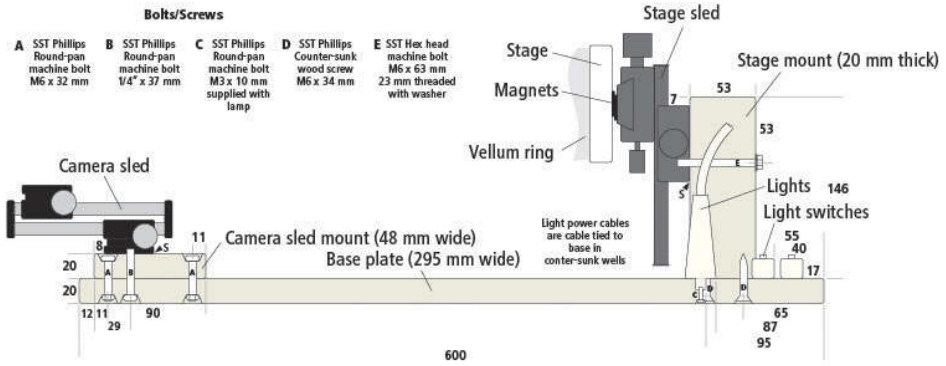


Figure 5: Technical drawing, side view. All measurements are in mm.

The system is usable for specimens from 6 mm to 80 mm length. When using a macro lenses other than 105 mm focal length these parameters will change. Two sleds were used. The camera sled moves the camera back and forth in relationship to the subject. This sled must be of very high quality. For proper stacking several images are needed for each millimetre that the camera travels towards the subject. I found sleds from Novoflex and Manfrotto to be suitable for this purpose. The stage sled is used to position the specimen up/down and left/right. It does not need to move very accurately or to be of high quality since it does not participate in the focus-stacking movement. It is for convenience since it is difficult to position the subject by any other means (Velcro and blue tack are unsuitable). I should mention that initially I bought two identical sleds from China to use as a stage sled which turned out to be badly manufactured and broken. I did not receive a refund so this is the only non-recoverable development cost ($80). The four IKEA lamps are sufficient for lighting since slow exposure is used. They do not have replaceable bulbs and when they burn out they must be replaced as a whole. IKEA quotes a life of 20,000 hours which is probably more time than you will ever spend taking insect images.

Equipment Selection

Some parts were purchased on Ebay and some of these were used. It is up to you to ensure that you are getting products that work well and that you buy from trustable suppliers. If you want guaranteed new and from local suppliers you will double the price. If you are worried about quality then by buy the original Nikon 5100 power supply for $110 rather than a Chinese copy for $34 (which works just as well in my opinion). Not included in this setup is a PC or laptop. Any computer which runs Microsoft Windows suitable for the Camera Shooting software and Helicon focus versions you purchase. I use the Helicon Focus software even though it is not free since I was not able to find freeware which performed well. Running costs are $30/year for renewal of Helicon Focus software.

Price	Supplier	Condition	Item
$325	Camera Sky website	New	Nikon 5100
$154	Ebay, seller: Photo Koeberl, Austria	Used demo	Noxoflex Castel Mini
$54	Plastic supplier	New	White 20 mm thick HDPE (high-density polyethylene)
$31	IKEA	New	4 Jansö lights
$15	Your local hardware store	New	Cable ties, 90 mm inside diameter drain pipe cap, magnets, epoxy
$23/year	Helicon Soft website	New	Helicon Focus software
$72	Amazon www.amazon.com	Used	Nikon Camera Control Pro 2
$23	Bolt supplier	New	Stainless steel screws and bolts
$18	Ebay, seller: kameradapter	New	EH-5A/EP-5A Power supply for Nikon 5100, Chinese copy
$31	Ebay, seller: hohfashion	New	4 Way Macro Focusing Rail Slider
$462	Ebay	Used	Micro Nikkor 105mm lens
	Office store	New	A3 Vellum paper
$1,208	**Total**		

The Build

The skill level and tools required for this build are low. You must be able to drill precise holes by hand or with aid of a drill press and you will have to sand plastic parts.

Technical Comments

Each final image requires several dozen separate images, so the camera's battery is drained very quickly. A permanent 240V power supply prevents this and you can then remove batteries entirely. Do not set the f-stop (the aperture, or internal opening of the lens) to a value larger than f/11 (ie f/13, f/15 …) since washout occurs. I position the lamps in such a way that they do not produce much glare on the subject (my beetles are often shiny and glabrous). This can mean moving the light far from the vellum ring, turning it almost parallel to the axis of view or draping an A4 sheet of vellum over the gap between the lens and the camera. Creating proper lighting is the greatest challenge with any such setup. The base board hold all components (sled/camera, specimen, lighting) solidly in place. HDPE is solid enough not to move but soft enough to drill easily. Its white color does not introduce a dark reflection on the subject.

Correcting Tracking

I was concerned about movement of the camera sled away from an exact perpendicular from the plane of the specimen. Previously I have taken focus-stacked images in which some areas, such as where a leg lies close to the body, an area remains fuzzy and parts of the specimen seem to float in the final image. I used the following procedure to ensure that the camera sled tracks perpendicular to the specimen:

1. Stick a size 1 insect pin in the specimen mount.
2. Move the camera back as far as possible.
3. Center the pin head in the image (using the camera shooting software's grid option and zoom).
4. Turn off autofocus.Focus the lens on the pin head.
5. Move the camera sled as far forward as possible but only so far that the pin head is still in sharp focus.
6. Unless you are very lucky, the pin head will have moved from the center. The further the pin head is from the center of the image the worse the alignment of the camera travel is from the perpendicular of the specimen plane.
7. Adjust the angle between 1) the camera sled and the camera sled mount, and 2) the stage sled and the stage mount by inserting small rectangles of A4 80 g paper.
8. Check how far the pin head has moved towards the center and repeat these instructions from point 7.

Problems

Some of the more common problems encountered with the setup (and these are present in all macrophotography setups):

1) The pin. Figure 6 shows the pin as a fuzzy area (underneath center of image). If possible it is best to remove the pin and fill the resulting void with clones of the surrounding area in Photoshop. Another way to deal with it is to increase the travel of the sled to include the pinhead which makes the pin sharp and seem less out of place

2) Reflections. Figure 9 shows a reflection of the vellum collar on the thorax. This can be reduced by moving the light further away but that also leads to a slightly underexposed area. Without spending another $100 for a high quality head (ie Manfrotto), in order to remove the camera the sled must be moved fully rearward so the camera attachment screw can be accessed. The adjustment of the top rail of the Novoflex rail is slightly cumbersome since it is too close to the body. A spacer would fix this.

Figure 6: *Lensoma fulgens*. Focus-stacked image assembled from 35 separate images. Specimen body length: 15 mm. No retouching in Photoshop was performed on these pictures except a slight lightening. The 35 images were taken at a 4 mm depth which equates to 9 images per mm.

Figures 7-8: *Lensoma fulgens*. Focus-stacked image assembled from 35 separate images.

Figure 9: *Neorrhina punctatum*. Focus-stacked image, assembled from 44 separate images. Specimen body length: 13 mm. No retouching in Photoshop was performed on these pictures except a slight lightening. The 44 images were taken at a 6 mm depth which equates to 7 images per mm.

Taking Pictures

Camera settings for Nikon D100:

- d4 Exposure delay mode: ON
- Image quality: JPEG fine
- Image size: Large
- Release mode: Single frame
- ISO: 100
- Flash: OFF
- Mode: Manual
- F stop: 11
- Speed: 1.2 – 1/5 sec. (for cetoniines)
- Use the Nikon Control Pro software to set the white balance by choosing menu point "Camera/Measure White balance" and follow the instructions.

My procedure for taking images:

1. Pick a specimen that has been set nicely or reset it.
2. Degrease in Acetone if necessary and/or clean it in an ultrasonic bath.
3. For a dorsal image remove the pin and mount on small foam length with super glue (makes the underside unusable since it removes the hairs).
4. Brush all remaining dirt from specimen.
5. Pin on stage.
6. Move camera as close as possible so that specimen fills entire screen or as much as possible.
7. Ensure you can cover the entire travel. Turn off autofocus. Focus on lowest part (tarsi) then go up to highest.
8. Take a test image and adjust only the shutter speed to

produce a well-lit image. It is better to underexpose than to overexpose since the former will preserve details better and exposure can be increased later in Adobe Photoshop.

9. Take images using the camera shooting software and advance sled in smallest possible steps. Do not knock setup or table.
10. Assemble images in Helicon Focus. I use method "C."
11. Adjust exposure, increase sharpness, adjust color balance and remove dust specks in Adobe Photoshop.

Next

Stepping the camera sled by hand requires time. I intend to automate this using a servo attached to the knob of the camera sled and writing a Python program to control the servo.

I would like to know if anyone replicates this system and if they have found ways to improve it. If the readership is interested, I can post a YouTube video in which I explain the construction and demonstrate the system by taking images of specimens and focus-stacking them.

Figure 10: *Dilochrosis balteata*. Specimen body length: 39 mm. After Photoshop processing.

Figure 11: *Dilochrosis balteata*, detail. After Photoshop processing.

Collecting the Planet's Largest Dung Beetles: Genus *Heliocopris* Hope, 1837 (Coleoptera: Scarabaeidae: Scarabaeinae)

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Introduction

The first author has had the opportunity to collect *Heliocopris* in both South Africa and Asia. These spectacular coprophagous insects are very large, generally from 30 to 50 mm. The most impressive specimens often measure nearly 70 mm, making them the world's biggest dung beetles. The largest species are *Heliocopris andersoni*, *H. colossus*, *H. dilloni*, *H. dominus*, *H. gigas* and *H. tyrannus*. While some of these dung beetles are closely associated with recycling the excrement of the large pachyderms and wild and domesticated ruminants, smaller forest-dwelling species feed mostly on monkey droppings. These insects are often found on elephant, rhinoceros and hippopotamus feces, while others feed exclusively on cattle dung. Some articles mention that certain species may have already vanished or could disappear from locations where elephants are no longer found. The United Nations recently published a study showing that the African elephant population shrank by 30% between 2007 and 2014! Many species of these large dung beetles may be able to adapt and shift from elephant feces to those of other herbivores, but the fact remains that some of them are no longer, or very rarely, found outside the national parks protecting these large mammals. Two species (*Heliocopris faunus* and *H. japetus*) are now listed as protected on the IUCN list, although they are not identified as vulnerable or endangered.

***Heliocopris midas*, Pakistan.**

Biology, Taxonomy and Geographic Distribution

Most *Heliocopris* are quite large. There is pronounced sexual dimorphism within the genus, with males usually sporting horns or protrusions of different sizes on their head or thorax. These beetles are frequently black or dark brown, with a leathery appearance. Females lay eggs nearly 5 mm in size, the largest among the Scarabeidae. Eggs are laid one at a time in a tunnel dug directly beneath the dung, containing some of the dung to feed the larva. Males use their horns, which may be more or less elaborate, to fight over females. In 2009, the superb work by Pokorny, Zidek and Werner (see *Scarabs*, No. 45:10) mentioned over 50 valid species. Since then, Moretto & Minetti (2013) have described a new species in Kenya, *Heliocopris karlwerneri*, and Philippe Moretto (2014) has described two new species, *Heliocopris stroehlei* and *H. maou*, and better defined the geographic distribution of other taxa. P. Moretto just published in 2017 a new species (*Heliocopris smithi*) and two new subspecies *Heliocopris eryx tridentatus* and *H. eryx ikelenge*. Out of the 54 currently known species, 48 are in sub-Saharan Africa and just 4 (*H. bucephalus*, *H. dominus*, *H. midas*, *H. tyrannus*) in Asia. *Heliocopris gigas*, for its part, is found in the arid northeastern region of Africa and the Arabian Peninsula.

***Heliocopris felschei*, Tanzania.**

***Heliocopris hamadryas*, South Africa.**

***Heliocopris neptunus*, South Africa.**

***Heliocopris dominus*, Thailand.**

***Heliocopris pirmal*, South Africa.**

Photo courtesy Brian J.McMorrow.

In Asia, *Heliocopris* are found in India, Iran, Pakistan and southern China, as well as in Southeast Asia as far as western Indonesia.

Collecting Specimens

In South Africa, we collected specimens from hippopotamus and rhinoceros dung. A day after these pachyderms had passed by, their fresh pats were full of dung beetles. *Heliocopris* are most often found under the dung or in tunnels they have dug, unlike *Scarabaeus*, which quickly roll away a ball of some size. In our many collections, we never found large numbers of *Heliocopris*, unlike other dung-eating insects. In most instances, we collected three to seven specimens. In Thailand, we found *Heliocopris dominus* in elephant excrement the day after they had been by, but once again never in large numbers. A box of latex gloves, a shovel, a few twigs and alcohol jars are the tools needed for harvesting these large, showy dung beetles. Note that some of them are also attracted to light.

For any scarab beetle collector, the first time one catches a full-grown male *Heliocopris andersoni* or *Heliocopris dominus* is a memorable occasion.

Ethnoentomology

The Mofu tribe in Cameroon, Africa has great respect for dung beetle larvae and adults. They are called “magurgweleng” and seen as fertilizers of the soil –

said to "cook the soil." *Heliocopris hamadryas* is called "mabodo golom zay" and plays an important role in Mofu culture. In South Africa, dung-eaters are recognized as having an important role, and even mentioned on traffic signs: driving over these insects is prohibited in national parks. People in Thailand eat some 150 insect species, mainly in the north, including *Heliocopris bucephalus*.

Acknowledgments

The authors wish to thank Philippe Moretto, in particular, for his latest publication, for re-reading short articles and providing information on this topic. We also wish to acknowledge those who provided us with photographs: Denis Blaquière, Georges Brossard, Brian J. McMorrow and the late Jacques de Tonnancour. The following individuals have provided us with interesting material for many years now, and we wish to acknowledge their contribution: P. Moretto, R. Minetti, C. Di Gennaro, H. Mtemela and the late C. Phimphisarn and M. Chantraine. In closing, we would like to thank Barney Streit and Olivier Décobert for their constant collaboration and for correcting and printing these articles in *Scarabs*.

References

FAO, 2010/02. Edible Forest Insects. Humans Bite Back!!, Food and Agriculture Organization of the United Nations, 232 p.

MORETTO P., 2014. "Description de deux nouveaux *Heliocopris* Hope, 1837, d'Afrique tropicale (Coleoptera: Scarabaeidae)." *Catharsius* La Revue, 2014, No. 09: 1-9.

MORETTO P. and R. MINETTI, 2013. "Description d'une nouvelle espèce d'*Heliocopris* du Kenya." *Besoiro* 23: 7-9.

MORETTO P. (2017) «*Heliocopris eryx* (Fabricius, 1801) et ses formes. Description d'une espèce et de 2 sous-espèces nouvelles» *Catharsius* La Revue no 14: 23-40.

POKORNY S., J. ZIDEK and K. WERNER, 2009. Giant dung beetles of the genus *Heliocopris*. Taita publishers. 134 p.

Caution sign in South Africa.

Feces, South Africa.

Introduction

Le premier auteur a eu la chance de récolter des *Heliocopris* tant en Afrique du Sud qu'en Asie. Ces spectaculaires coprophages sont de très grande taille, généralement entre 30 et 50 mm. Les plus impressionnants approchent souvent les 70 mm et sont de ce fait les plus gros bousiers du monde. Notons les espèces suivantes qui sont les plus imposantes:

Hippopotamus feces in South Africa.

Heliocopris andersoni, *H. colossus*, *H. dilloni*, *H. dominus*, *H. gigas*, et *H. tyrannus*. Si une partie de ces bousiers est étroitement associée au recyclage des excréments des grands pachydermes et ruminants sauvages ou domestiques, les espèces forestières, plus petites, exploitent surtout les déjections des singes. On en retrouve souvent sur les fèces d'éléphants, de rhinocéros et d'hippopotames alors que d'autres se nourrissent plus particulièrement de bouses de bovidés. Des articles mentionnent que certaines espèces auraient disparu ou pourraient disparaitre des endroits où les éléphants n'existent plus. Le Programme des Nations Unies publiait récemment une étude montrant que la population des éléphants d'Afrique a diminué de 30% entre 2007 et 2014 ! Plusieurs espèces de ces grands bousiers seraient en mesure de s'adapter et pourraient passer des fèces d'éléphants à celles d'autres herbivores mais force est de constater que certaines d'entre elles ne se trouvent plus, ou très rarement, en dehors des Parcs Nationaux abritant les grands mammifères. Deux espèces (*Heliocopris faunus* et *H. japetus*) sont mentionnées dans la liste de l'UICN comme protégées bien qu'elles ne soient pas données comme vulnérables ou en voie de disparition.

Biologie, Taxonomie et Distribution Géographique

Les *Heliocopris* sont majoritairement de bonne taille. Il existe dans ce genre un fort

dimorphisme sexuel et les mâles portent en général des cornes ou des saillies, plus ou moins prononcées sur la tête et/ou le thorax. La coloration est souvent noire ou brun foncé et l'aspect est celui du cuir. Les femelles pondent des œufs de près de 5 mm ce qui correspond à un maximum chez les Scarabéides. Un seul œuf est pondu dans une galerie creusée directement sous la bouse et qui contiendra la matière fécale pour le développement de la larve. Les mâles utilisent leurs cornes céphaliques plus ou moins élaborées pour lutter contre des concurrents pour la possession des femelles. En 2009, le très beau travail de Pokorny, Zidek et Werner (voir *Scarabs* N°45:10) mentionnait plus de 50 espèces valides. Depuis cet ouvrage, Moretto & Minetti (2013) ont publié la description d'une nouvelle espèce du Kenya, *Heliocopris karlwerneri*, puis Philippe Moretto (2014) en a décrit deux autres, *Heliocopris stroehlei* et *H. maou*, et précisé la distribution géographique de certains taxons. Ce dernier auteur en a ajouté une troisième en 2017 avec *Heliocopris smithi* et a aussi décrit deux nouvelles sous-espèces: *Heliocopris eryx tridentatus* et *H. eryx ikelenge*. Sur les 54 espèces actuellement connues, 48 occupent l'Afrique sub-saharienne alors que 4 seulement (*H. bucephalus*, *H. dominus*, *H. midas*, *H. tyrannus*) sont présentes en Asie. *Heliocopris gigas*, quant à lui, est présent sur la partie Nord-Est aride de l'Afrique et la Péninsule Arabique.

Herd of elephants in Kenya.

En Asie, on retrouve des *Heliocopris* en Inde, en Iran, au Pakistan et dans le Sud de la Chine ainsi qu'en Asie du Sud-Est jusque dans la partie Ouest de l'Indonésie.

Récolte de Spécimens

En Afrique du Sud, nous avons récolté des spécimens dans des fèces d'hippopotames et de rhinocéros. Le lendemain, après le passage de ces pachydermes, les bouses encore fraiches étaient remplies de bousiers. On retrouve le plus souvent les *Heliocopris* sous la bouse ou en cherchant dans les tunnels qu'ils ont creusés contrairement aux *Scarabaeus* qui s'éloignent rapidement avec une boule plus ou moins grande. Lors de nos nombreuses récoltes, nous n'avons jamais trouvé abondamment les *Heliocopris* contrairement aux autres coprophages. En général de 3 à 7 spécimens ont été prélevés. En Thaïlande, des *Heliocopris dominus* ont été trouvés dans des excréments d'éléphants le lendemain de leur passage,

Rhinoceros in Kenya.

mais là encore jamais en grande quantité. Une boite de gants de latex, une pelle, quelques morceaux de bois ainsi que des pots avec de l'alcool sont des outils indispensables pour la récolte de ces grands et spectaculaires bousiers. À noter que certains d'entre eux sont aussi attirés par la lumière.

Pour tout collectionneur de scarabées, la première capture d'un mâle majeur d'*Heliocopris andersoni* ou d'*Heliocopris dominus* est mémorable.

Ethnoentomologie

La tribu des Mofu en Afrique (Cameroun) considère avec respect les larves de bousiers et les adultes. Elles sont nommées «magurgweleng» et considérées comme des agents de fertilisation du sol. Pour les Mofu, les larves et les adultes «cuisinent le sol». Ces grands scarabées sont donc perçus très positivement. *Heliocopris hamadryas* se nomme «mabodo golom zay» et joue un rôle important pour les cultures de ces peuples. En Afrique du Sud, on reconnait le rôle important des coprophages et des panneaux de signalisation pour les véhicules en font mention. Il est interdit d'écraser les bousiers dans les parcs nationaux. En Thaïlande, plus de 150 espèces d'insectes sont consommées dont une cinquantaine dans le Nord. *Heliocopris bucephalus* est l'une d'entre elles.

Remerciements

Les auteurs tiennent à remercier particulièrement M. Philippe Moretto pour sa plus récente publication, la relecture de courts articles et ses informations sur le sujet. Merci aussi à ceux qui nous ont fourni quelques photographies: Denis Blaquière, Georges Brossard, Brian J. Mc Morrow et le regretté Jacques de Tonnancour. Les personnes suivantes nous ont fourni du matériel intéressant depuis plusieurs années, qu'elles en soient ici remerciées: P. Moretto, R. Minetti, C. Di Gennaro, H. Mtemela et les regrettés C. Phimphisarn et M. Chantraine. Pour terminer un remerciement à Barney Streit et Olivier Décobert pour leur continuelle collaboration aussi bien pour la correction que pour l'édition de ces articles dans la revue «*Scarabs*».

Sliding Down the V: A Low Cost and Efficient Flight Intercept Trap

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I wish I could say I came up with the basic concept of a V-shaped smooth flight intercept trap (FIT), but that was actually an ingenious Oklahoma rancher named Epps that patented a large contraption with two narrow FITs with black fabric targets between and around them to attract and catch horse flies that were bothering his cattle. Years ago I had an research and development project to commercialize Epp's patent with my former employer, and was surprised at how many insects (including several *Phanaeus* and other scarabs) went into the trap in just a couple hours after we set it up in his Oklahoma pasture. His original design used glass panes; Plexiglas did not work as well because the acrylic polymer it is made of reflects UV light visible to insects, but which we cannot see. Obviously glass would not work for cost, shipping and durability, so I came up with a system to use polyethylene sheeting instead, solving the durability, shipping hazard & cost issues. (Poly sheeting looks milky to us but insects do not seem to see it.)

The thought of using that technique (45° angled poly FIT) modified to a more "collector friendly" format has been rattling about in my noggin for years, and I have discussed the design with a few friends during that time, because unlike vertical netting FITs, insects cannot land on the smooth angle and simply "slide" or ricochet down into the catching fluid, so taxa that normal FITs do not catch well (like cerambycids that land on the netting or tiny beetles that

could go through netting) will be caught by this technique. The modified design also forms its own rain shield, and is somewhat wind resistant because the film can move in the wind and the central tensioning rod simply roles back to the center when a wind gust ends. It took Editor Rich Cunningham's putting the design into practice in his yard, bagging several inquiline aphodiines and histerids (a group I also collect) in hours to get me off my butt and actually put some together.

I apologize in advance to readers outside of the U.S., but local equivalents will no doubt be available to the U.S. parts described below. The entire construction requires just a hack saw, a pair of scissors (or cutting blade) and a screwdriver. The trap in the pictures is based on optimizing costs for using 10-foot lengths of half inch electrical conduit. Other sizes and heights can be made, and the poly sheeting can be hung from a rope wrapped around two trees if you need to pack light for a trip to the tropics!

My original vision was to heat seal tube-like hems on the sides of the poly sheet (not that easy to do without a big bar sealer), similar to the Epps Trap design my former company used to sell. Rich greatly improved on that "armchair design overthink" by simply using some clips he had laying around to attach the plastic to the frame. After he told me about that, I found large binder clips from the office supply store worked surprisingly well and were very easy to adjust. Getting the angle of the film to exactly 45° does not seem to matter too much (e.g. the design in the pictures has the "V" a bit acute). This is good, because the relatively loose fit between the rebar stake and the conduit lumen generates some play, as does the stake placement. I am thinking of using a conduit bender to make the uprights by bending a single 10' length of conduit into a flat-bottomed "U" for quicker set-up and greater stability. The conduit "U-bottom" could then be staked into the substrate to keep the whole thing stable in higher winds. Both designs need corners, which the elbows shown here are a practical and low cost way to form them.

The plastic sheet is 6 mil polyethylene drop cloth material, and a standard 10' x 25' roll can be cut to make 8 traps. To adjust the sheet tension just squeeze the binder clip and pull down on the

ITEM	unit	price/unit	amount	extended	vendor	use in trap
1/2" EMT metallic conduit 10'	each	$ 2.45	2.500	$ 6.13	Lowes	frame & center weight
1/2" EMT elbow	each	$ 1.53	4.000	$ 6.12	Lowes	frame
0.375" steeel rebar, 10'	each	$ 3.75	0.400	$ 1.50	Lowes	stakes
6 mil clear poly sheet 10'x25'	each	$ 24.98	0.125	$ 3.12	Lowes	film intercept V
large binder clips	12 pk	$ 3.79	0.500	$ 1.90	Staples	attacment for film
half size AL steam table pans	30 pk	$ 5.98	0.133	$ 0.80	Sams Club	catchment
				$ 19.56		

free end of the sheet. The bottom of the sheet "V" should be just barely above the surface of the pans, but not resting on them. I am using more conduit here to weight the center of the "V", but rebar or other narrow/heavier cylindrical material (a garden stake?) would work well too. To eliminate the "glare" on the plastic sheet (which may improve or undermine effectiveness depending upon taxon), you can simply put a sheet of black plastic (e.g. a black plastic garbage bag) stretched over the top and use the same binder clips to attach it as an extra layer—I added a couple extra (e.g. used 5/side)—to make sure tension does not slip. The shade renders the plastic nearly clear.

Similarly, some may prefer standard FIT alternatives to the metal trays which may not be good (or may actually act as an attractant) for some taxa. That said, the trays are inexpensive—30 for $6.00 at Sam's club. You can use black trays, fluorescent yellow trays, a garbage bag covered ditch in the soil, etc., for the catch trough depending upon your preferences.

The fluid I am using here (about a half inch deep) is soapy water; some people add salt to the water as well to make a hypertonic solution; this helps preserve the bugs a day or two longer. For longer term, I prefer using a 50% or so propylene glycol solution; but, if you are checking every 2-3 days, the soapy/salty water works fine.

The costed Bill of Materials above is exclusive of tax, labor, amortization on the hacksaw and other tools, and the fluid used to catch the bugs. (Add about 40 cents for a large black garbage bag if you want a top shade.) If you are checking the trap every 2-3 days, the salty water with a few drops of liquid dish soap works fine (and obviously is just "rounding error" cost-wise); but if you are using propylene glycol you might have $10-20 invested in the fluid…

My revered editorial assistant for this submission to *Scarabs*, the beautiful Hani.

which is reusable though does very slowly evaporate in dry conditions.

Now get out there and trap all those glorious scarabs! (And you will need to get rid of those offensive histerids that are also trapped, so send them to me!!).

Thanks go to Editor Rich for inspiring me to write this article, and to Hani, part of the ever-growing editorial staff of *Scarabs*. Her suggestions and layout expertise were truly invaluable. I found it much more pleasurable dealing with Hani than Editor Barney!