A Database for Egyptian Entomology

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Abstract

With the increasing ease of use of database systems and programming languages it becomes inevitable that complex ecological applications be computerised. The task of looking up ecology and distribution information for Coleoptera is one such task that can absorb enormous amounts of time in literature searches. The authors aim, in constructing the EgBugs database was to provide entomologists and palaeoentomologists working in the Egypt region with an easy to use and effective tool for assimilating such data. By extracting information from hundreds of trusted entomological sources, compiling it into one program, adding various search and reporting functions it is hoped that EgBugs will greatly reduce the amount of time its users have to spend on analogue data mining. This paper describes the EgBugs Database for Egyptian Entomology, and will hopefully incite and enthuse both present and would be entomologists and ecologists.

Introduction

The insect fauna provides an important element in both the biodiversity and agriculture of Egypt. The better known species are largely those which achieve pest status (e.g. Attia & Kamel 1965; Hammad 1961; Hammad *et al.* 1967; Hill 1975) or might be used in the control of pests (e.g. Ragab & Shanab 1991), whilst changing land use and the use of insecticides has pushed others to the edge of extinction. As yet there is no published Red Data Book, listing those species under threat in Egypt, although lists for the flora are available (el Hadidi *et al.* 1992). The history of the insect fauna has also recently begun to be studied (e.g. Panagiotakopulu & van der Veen 1997; Panagiotakopulu 2001a) and several interesting conclusions have already begun to emerge from this work (e.g. Buckland & Panagiotakopulu 2001; Panagiotakopulu 2004), but there is also a need to collate habitat and distribution data with the Holocene fossil record, largely emerging from work upon archaeological deposits. In 1998, a major research grant from the Leverhulme Trust to one of the authors (EP) allowed the development of a project, EPAS, Egyptian pests and storage, which sought to examine the history and biogeography of the synanthropic elements in the fauna by the examination of samples from archaeological deposits, both preserved in museum collections (Panagiotakopulu 1998; 2003), and from current excavations (Panagiotakopulu 1999). Much of this material is coleopterous, and as both a checklist (Alfieri 1976) and a database management system (Buckland *et al.* 1997; 2002) already existed, the present form of the database is based upon the Coleoptera, with the addition of a number of ectoparasites, which are not infrequent as identifiable fossils (Panagiotakopulu & Buckland 1999; Panagiotakopulu 2001b). Inevitably, as the original model, funded by the Leverhulme Trust (UK) and National Science Foundation (USA) as part of a project to study the faunas of the North Atlantic region, was called BUGS, the Egyptian version has been christened EGBUGS (fig.1), and this paper summarises the structure and present state of the project, which is freely available for both teaching and research purposes. It is hoped that this easily accessed collation of habitat, distribution and the fossil record will provide the basis for renewed research into the insect fauna of Egypt.

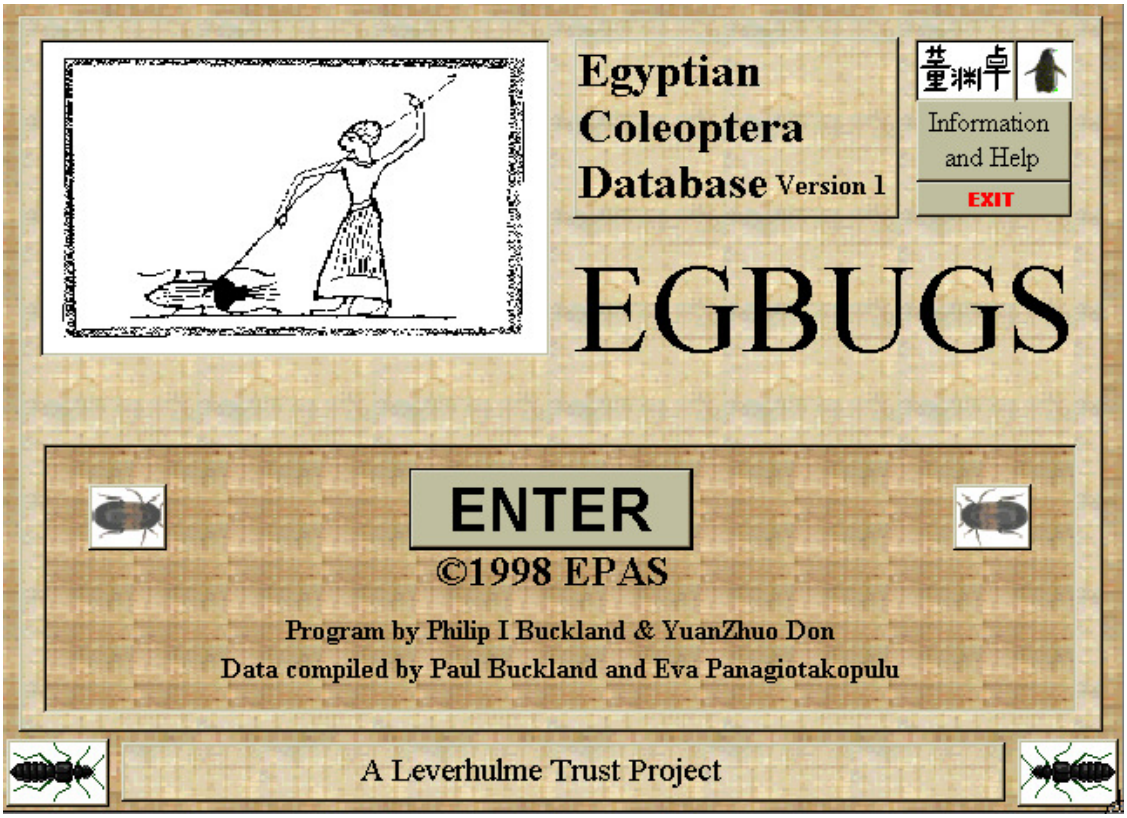

Fig. 1. The EGBUGS startup screen.

The Database

The original BUGS project began with a DOS-based program in DBaseIII/Clipper (Sadler *et al*. 1992), but it soon became apparent that a more versatile system, which operated under Microsoft Windows © was required, and the program was redrafted in Microsoft Access v2 © with linked Excel © spreadsheets by Yuan Zhou Don, then an MSc student at the University of Sheffield, and PIB. It runs on subsequent versions of Microsoft Access (95, 97 and 2000,) after conversion, which is performed by Access on request, after opening the database. Implementation in Access XP has not been tested, and will be delayed until the release of the new European Bugs in late 2005.

Taxonomic Codes

The basic articulation of the program requires a coded checklist in taxonomic order, and this was developed by PCB, based on that already available for the Coleoptera of Central Europe (Lucht 1987). It was important, because of the overlap in species, that codes for Egypt and the European fauna were discrete, and this has caused some problems in construction. In addition, for many genera, the detailed taxonomic position is uncertain, and as in the contemporary British Coleoptera checklist (Kloet & Hincks 1977), Egyptian species are listed in alphabetic order within each genus; recoding into taxonomic order, however, will be no problem where this is agreed in that all data are pendant to the species code.

Family	Genus	Species
93.	131	0010
(Example)		
Curculionidae	Sitophilus	(granarius L.)

(= 93.1310010)

Table 1 : Species coding within EGBUGS

The basic taxonomic code format uses the first two digits, before the point for the family (table 1), the next three for the genus, a further three for the species, and a final digit in reserve for flexibility. All species are entered with their respective authors, abbreviated where appropriate (e.g. L. = Linnaeus, F. = Fabricius). These follow normal usage as indicated in Joy (1932), although a key to authors will be included in later versions. Whilst the basic assignment into families follows (Lawrence & Newton 1995), adapting the Central European list caused a number of problems in that some families present in Egypt, such as the Prionoceridae and Pedilidae, and absent in Europe were not easily accommodated. This was resolved by using the first digit of the genus for the additional family, such that the code for the in Egypt monotypic family Prionoderidae, with its single species *Idgia particularicornis* Pic, becomes 28.501001, where 28.5 represents the family. At the generic and species level, this problem clearly becomes more complex, and the facility to incorporate additional species and identifications to the generic level only (sp. and spp.), by use of a fourth digit in the species code, has had to be occasionally varied from the tripartite convention. The taxonomic order currently adopted for genera not present in Central Europe follows that of Alfieri (1976), and this causes particular problems with the Tenebrionidae (Family 83.xxxxxxx), where more than fifty genera precede the first genus (*Blaps*) common to Central Europe. Thus, Alfieri's (1976) first genus and species in the Tenebrionidae, *Arthrodeis cruciatus* Solier, has been ascribed the code 83.0000101, and other taxa have been allocated sequentially. Whilst the checklist is based primarily around Alfieri (1976), a number of taxa principally secondary pest species, such as several Cryptophagidae, not currently recorded from Egypt are included, since it is probable that some will eventually be found. In any case, copying of data over from the European BUGS database is facilitated by the uniqueness of species codes. To avoid problems with the database, occasioned by unauthorized editing, the system is passworded and the species code is only visible after this is entered. The structure of the database would allow for the entire taxonomic code to be relatively easily replaced, should a more universal checklist be available in the future.

Biology and Distribution Data

Articulated around the coded checklist is the main form, which contains the basic information on the species. Figure 2 shows the screen view for a common storage pest, the grain weevil *Sitophilus granarius* (L.). Arrows to the right of the species name allow navigation through the database in taxonomic order, in the case of *S. granarius*, *Gronops* sp. backwards, and its congener *S. oryzae* (L.) forwards. The button [**GOTO**] allows search at the generic level. The main area of the screen is then divided into two, the upper part being the biology of the species, and the lower the distribution. Only the first nine lines of the entry is displayed, but clicking the mouse within the field activates a scroll bar on the right which can be used to peruse the remaining data. As a convention, synonyms for the species are entered on the first line (in this case "=*Calandra*" and incl. subsp *granarius* L. and *africanus* Zacher (described from Egypt {Alfieri 1976}), followed where necessary by size range, brief taxonomic and identification notes. A further convention has been to separate Egyptian habitat data, where

available, from that from Europe, which provides an immediate indication of species biogeography. Data have been extracted, usually in summary form, from a wide range of sources, and these have been directly ascribed to their respective authors. The first entry for *S. granarius* therefore reads, "{Attia & Kamel 1965} in mills and granaries on farinaceous foodstuffs, flour, etc." The use of the brackets {} is linked to the button labelled [**Bibliography**] on the top right of the screen, and depression of this immediately lists all primary sources, any one of which can then be displayed by pressing the adjacent button, labelled [**...**], for the full bibliographic reference (fig. 3). (Note that the updated file structure of new European Bugs has removed the necessity of these brackets, and improved the handling of synonyms).

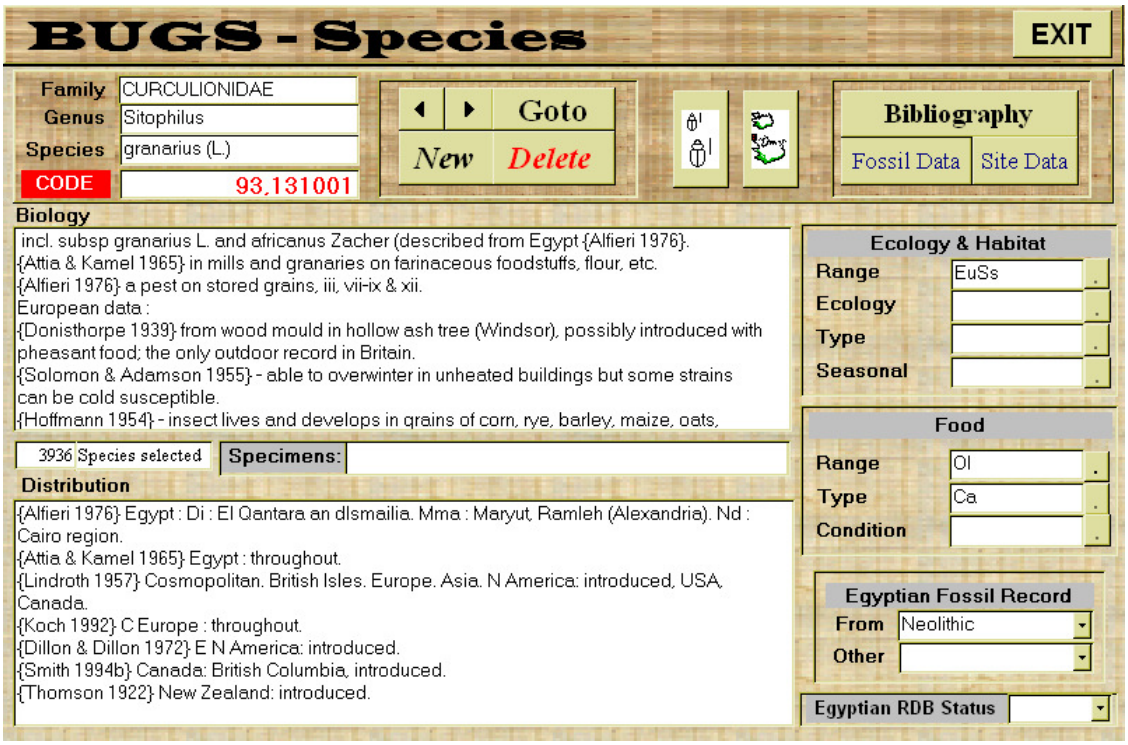

Fig. 2. Main screen with information on the ecology and distribution of *Sitophilus granarius* (L.)

A small field on the right between Biology and Distribution lists the location of specimens. Currently this largely consists of data on the location of rare, often unique types and the Carnieri Collection in the Goulandri Museum of Natural History in Athens, with the number of individuals, but other data will be added progressively to facilitate work upon the fauna. The scroll button on the right allows access to other data in the field, where collections have been entered in alphabetic order.

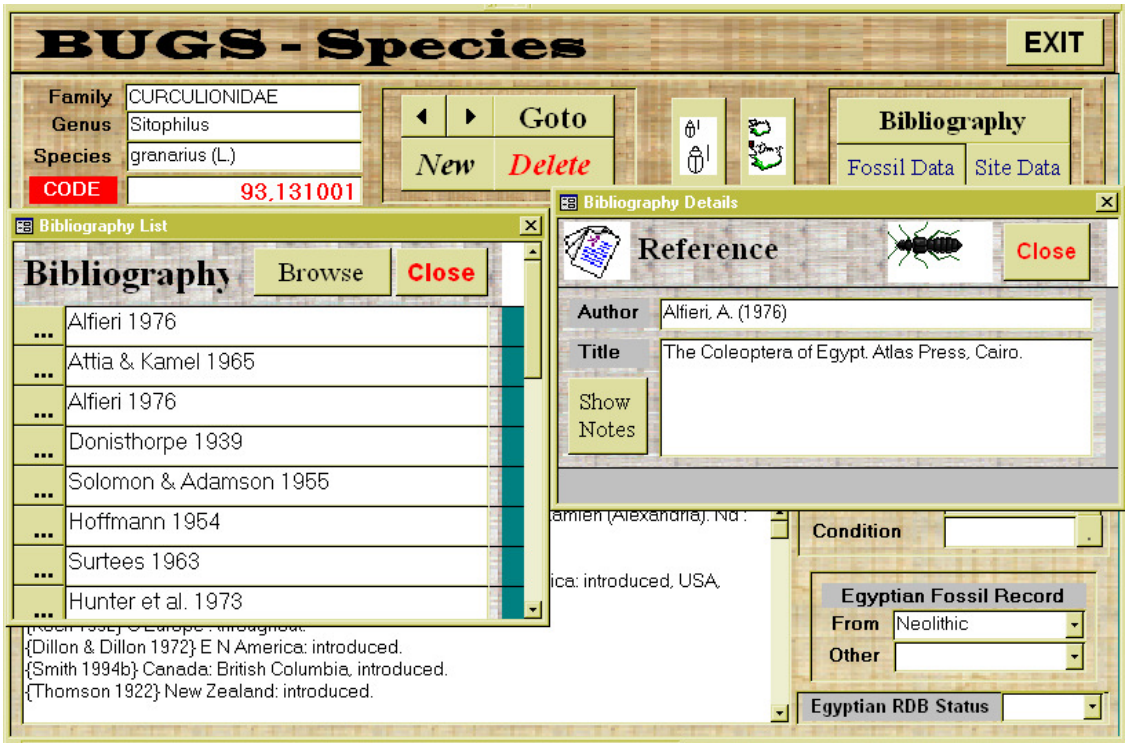

Fig. 3. Bibliography for *Sitophilus granarius* (L.) with details of Alfieri (1976).

Distribution data are listed in order with Egyptian records, primarily from Alfieri (1976), listed first with other records below. For a now cosmopolitan pest, like *S. granarius*, records within the various regions of Egypt, based upon the same biogeographic regions, which have also been employed in phytogeography (e.g. el Hadidi 1993, fig. 3.2), are largely a reflection of where collecting has taken place, but other species belong to both African and Sindian elements of the fauna, and the data provide a rough indication of distribution within Egypt. The remaining information provides some indication of distribution outside of Egypt. This collation of data occasionally throws up some interesting combinations. Whilst Zacher (1934) hypothesised that *S. granarius* probably originated in acorns in India, Stroyan (1948) notes that it is very rare as a pest there, and the fossil record (see below) also shows the species to be present in both Egypt (Levinson & Levinson 1994) and Europe by the Neolithic (Büchner & Wolf 1997).

Mma	Mediterranean coastal zone (W)
Mp	Mediterranean coastal zone (E)
Dl	Libyan Desert
Dn	Nubian Desert
Di	Isthmic Desert
Dg	Galala Desert
Da	Arabian Desert
Nd	Nile Delta
Nv	Nile Valley
Ne	Nubian Nile Valley
Nf	Fayum
O	Oases
S	Sinai
Ge	Gebel Alba

Table 2. Biogeographical regions of Egypt (after Alfieri 1976).

Searching for and Exporting Species Information

Both Biology and Distribution fields may be interrogated by use of the search function, which is accessed via the [Search] item, and then [Biology, Distribution and Red Data Book] subitem from the top menu bar. This action opens a form, labelled "Information Retrieval" (fig. 4), which acts as a search interface for the bulk of the database. Thus, entering "Ne :" in the Distribution field will retrieve a subset of data consisting of all species recorded from the now largely drowned Nubian segment of the Nile valley, the number of species (134) being displayed in the small field labelled "Species selected" on the left between the Biology and Distribution panels. Similarly entering "shouna" in the Biology field produces a list of 45 species recorded from these grain stores throughout Egypt. Combining the two, incidentally provides a list of only five species, all tenebrionids, of which only *Alphitobius laevigatus* (F.), originally described from New Zealand (Blair 1914), would perhaps be regarded as a pest, although it is probably a predator and scavenger in this situation. The Information Retrieval form also allows a search of the field in the bottom right hand corner of the main screen, labelled "Egyptian RDB Status". Whilst this has yet to be published, the program may help in its compilation, and the facility may eventually prove useful in site survey and classification, allowing a list of Red Data Book species to be rapidly extracted. The right hand button attached to the RDB field on the main form provides a dictionary of RDB terms (table 3), adapted from that used in Europe (e.g. Hyman 1992). Highlighting any one of these allows it to be written to the record for the species currently shown. The logical functions AND/OR can be applied between all of the search fields on the Information Retrieval form, and standard wild card characters ("?" and "*") can be used in all fields, allowing for more complex search criteria. In addition, the standard Access search function is available in most fields by pressing the key combination <CTRL> + <F>.

[**Report**] on the menu at the top of the screen allows the output of all the information on a particular species, a printed version of the full checklist, or the results of a search, with codes, or the dictionaries of terms used in the definition of habitat and food source. The second item on the Report menu, [All

selected Species] leads to a submenu with the options [Just the Names] and [Full Details], which are self explanatory. These reporting functions are particularly useful when one wishes to see/print out a list of the species returned by a search, and can be a valuable aid when collecting in the field.

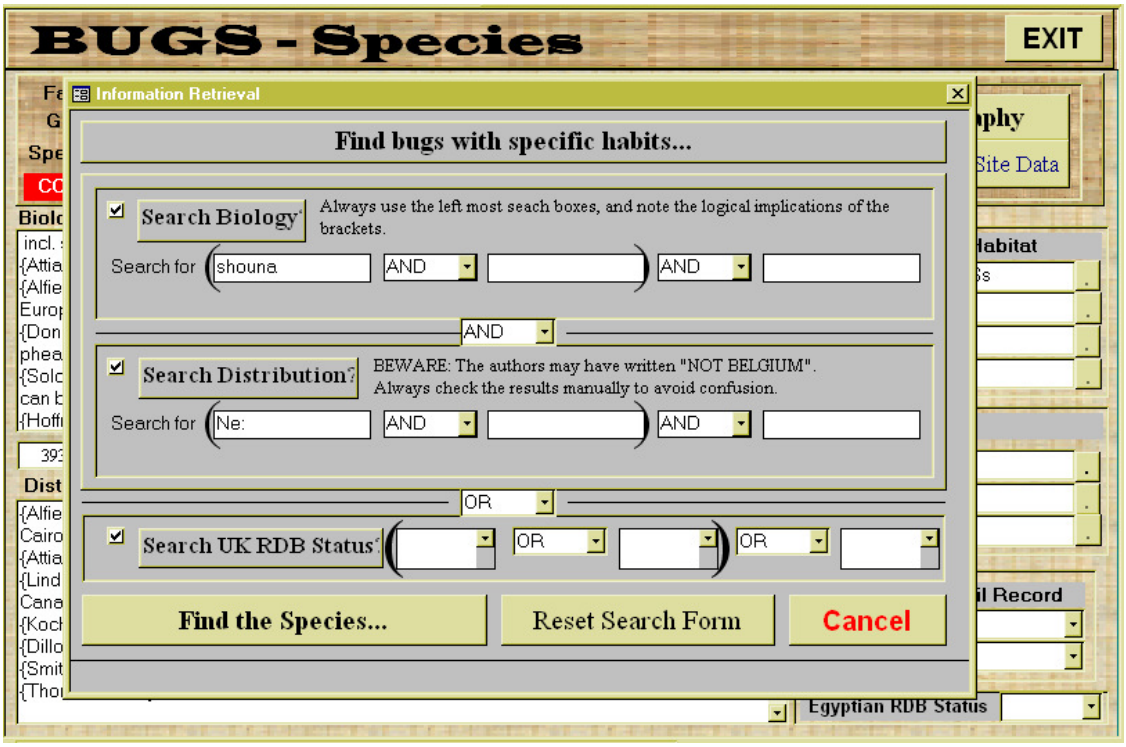

Fig. 4. The EGBUGS search interface.

N	Notable
Na	"Notable A"
Nb	"Notable B"
RDB3	Rare
RDB2	Vulnerable
RDB1	Endangered
X	Extinct in Egypt
RDBI	Status indeterminate
RDBK	Insufficiently known

Table 3. Red Data Book terms (Note : these still require full definition in the Egyptian context.)

Ecological Classification and Codes

The buttons beside the other categories on the right hand side of the screen (fig. 2) are similarly used to activate dictionaries for their respective fields. Clicking any of these opens the appropriate dictionary form, and the relevant definitions are marked by ticked boxes. The four panels beneath "Ecology and Habitat" are derived largely from a classification devised by Koch (1989a & b; 1992) for the Central

European fauna, although "Seasonal" has been modified to indicate months of activity of the imagines, as suggested primarily by Alfieri's (1976) Egyptian collecting data, suitably modified in the light of more recent information; data are stored in the form of a simple two letter code indicating the month. A number of months may be entered, or simply the code Tt, indicating throughout the year. "Range" utilises a series of standard terms to classify the basic habitat range for each species, the dictionary providing a brief explanation of the two letter code (table 4).

St	stenotopic	only in the specified biotope.
Sh	stenothermic	only in a narrow temperature range.
Sm	stenohygric	only in a narrow moisture range.
Eu	eurytopic	in many varied biotopes.
Eh	eurythermal	tolerates a wide range of temperatures.
Em	euryhygric	tolerates a wide range of moisture conditions.
Ub	ubiquitous	occurs everywhere.
Sy	Synanthropic	living in close association with Man.
Sf	Facultative Sy	synanthropic, but not restrictedly so.
Ss	Strongly Sy	strongly, often obligate synanthrope.
Sn	Typically Sy	typical, but non-obligate synanthrope.

Table 4. Terms used in the Habitat Range field.

As a species might be, for example, both synanthropic and stenothermal in its requirements, several pairs of unique letter are permitted sequentially. The "Ecology" field gives a simple two letter indication of the usual habitat requirements of the species. Again, these are chosen from an attached dictionary (table 5), and multiple entry is again possible by ticking several codes.

ag	agaricolous	on agaric fungi
ak		in tree tops
ab	arboricolous	on trees
ar	arenicolous	on sand
ap	arundicolous	in reeds
av	arvicolous	in arable fields
bo	boleticolous	in boletiform fungi
ca	cadavericolous	in cadavers (corpses)
cp	campicolous	in fields
cv	cavernicolous	in caves
co	corticolous	under bark
de	deserticolous	in desert regions
fu	fungicolous	in fungi
fl	floricolous	on flowers
he	herbicolous	on herbs
hu	humicolous	in the humus layer
li	lignicolous	in wood
lm	limnicolous	in inland waters
lc	Limicolous	in mud

mi	microcavernicolous	in galleries, nests, etc. of rodents
mu	muscicolous	in moss
ni	Nidicolous	in bird nests
nv	Nivicolous	by snow patches
pa	paludicolous	in swamps
pe	petricolous	among and under stones
ph	phyllicolous	on leaves
py	phyllodetriticolous	in leaf debris (litter)
pt	phytodetriticolous	in plant debris (litter)
pl	planticolous	on growing shoots
po	polyporicolous	on polypore fungi
pr	praticolous	in meadows
ri	ripicolous	on river banks
si	silvicolous	in woodland
sp	sphagnicolous	in *Sphagnum*
st	steppicolous	in steppe environments
sk	stercoricolous	in dung
su	succicolous	at sap runs on trees, etc.
te	terricolous	subterranean, in the earth
to	torrenticolous	by waterfalls
xy	xylodetriticolous	in wood debris
aq	Aquatic	in water
ps	Parasitic	tied to a particular host animal
gr	graminicolous	on grasses
rh	rhizicolous	on roots
zo	zoodetriticolous	in animal debris
p-	Pest	pest of stored products

Table 5. Terms used in the Ecology field with their definitions.

Habitat "Type" allows a narrowing of the definition of a species' requirements, and in form this is similar to the preceding categories (table 6). Additionally, the seasonality of the insect's occurrence can be highlighted by selecting terms from the "Seasonal" dictionary (table 7).

ac	acidophilous	prefers acid conditions.
ch	chromophilous	attracted to colour
co	coprophilous	in dung
ha	halophilous	in salty environments
he	heliophilous	attracted to light
hy	hygrophilous	prefers moisture
hl	hylophilous	in wood
kr	krenophilous	at water sources, springs, etc.
my	mycetophilous	in fungi
mm	myrmecophilous	associated with ants
ne	necrophilous	associated with carrion.
os	osmophilous	attracted to smells
pe	petrophilous	among stones
ph	pholeophilous	prefers shade
ps	psammophilous	in sand
rh	rheophilous	associated with flowing water.
sa	saprophilous	in rotting materials.
si	silicophilous	on gravel
th	thermophilous	prefers warm localities
ka	cold stenotherm	prefers cold conditions
tr	trogophilous	in caves
ty	tyrphobiont	in bogs
xe	xerophilous	prefers dry places
ht	halotolerant	tolerant of saline habitats
am	amylophilous	attracted to amyls in wood
zo	zoophilous	associated with mammals
in	indoors	associated with houses or crop storage

Table 6. Definitions of terms used in the Habitat "Type" field.

m.	monorophic	occurring almost only in one layer, e.g. a straw layer.
a.	allaxorophic	varies the layer for a specified time.
x.	xerophic	synchonously living in various layers.
mo	monochorous	living almost only in specified places of one layer.
Al	allaxochorous	changes locality temporarily.
Xe	xerochorous	living in many places in one layer.
h.	homotopic	completes development in one biotope type.
He	heterotopic	development in two or more biotopes.

Table 7. Seasonality definitions for insect activity.

The three categories listed under "Food" provide some idea of the principal sustenance taken by the insect. The "Range" provides definition of how restrictive the insect is in its choice of food type (table 8).

Mo	monophagous	specialises on a specific plant or animal species.
Ol	oligophagous	on a narrow range of often closely related plant or animal species.
Po	polyphagous	on a wide variety of various plant or animal species.
Om	omnivorous	on living or dead plant and animal materials.
Xe	xenophagous	developing on a rare plant or animal host.
Xn	xenophilous	prefers a foodstuff originating from abroad.
Me	merotopic	feeds on plant structural parts.
En	endophagous	feeds on the plant's inner parts.
Ek	ectophagous	feeds on the plant's outer parts.
Zo	Zoophagous	feeds exclusively on animal matter

Table 8. Definitions of terms used in the Food "Range" field.

The "Nourishment Source" field provides more detail of the animal's requirements (table 9); the short category "Condition" lists the nature of the food consumed (table 10).

Ph	Phytophagous	plant materials.
Al	algophagous	feeds on algae
Bl	blastophagous	on buds
Ca	Carpophilous	on seeds
Cu	caulophagous	on stalks.
Ce	cecidophagous	in plant galls
Co	Cortivorous	on bark
Fr	Fructivorous	on fruits
Zo	Zoophagous	on animal materials
Ap	aphidophagous	eats aphids
Cp	Coprophilous	eats dung
En	entomophagous	eats insects
He	helminthophagous	eats worms
Li	lichenophagous	consumes lichens
My	mycetophagous	on fungi
Py	phyllophagous	feeds on leaves
Pn	pollenophagous	feeds on pollen
Rh	Rhizophagous	feeds on roots
Sa	saprophagous	in rotting materials.
Sp	sporophagous	on spores.
Xy	Xylophagous	feeds on wood
Kr	Kreophagous	on living animals (parasitic).
Mu	molluscophagous	feeds on molluscs
Fo	myrmecophagous	eats ants (Formicidae)
Ne	necrophagous	on dead animals

Oo	Oophagous	eats eggs of other arthropods
Mi	-	eats mites
Di	-	eats Dipterous larvae
Pp	phloeophagous	eats phloem layer on trees
Px	Xylomycetophagous	eats fungi in wood
St	-	feeds on stored products.
Ms	musciphagous	feeds on mosses (Bryophytes)

Table 9. Dictionary of food types.

Ol	oligoprobic	beginning to rot.
Me	mesoprobic	distinct traces of rot in the whole substrate.
Ho	holoprobic	slimey dissolved consistency.

Table 10. Decay condition of food sources.

Whilst these small coded fields may be seen as a duplication of the data entered into the Biology field, the longer term objective is to provide a means by which the codes can be statistically summarised across species to obtain a summary of the habitat of a particular site, including the number of RDB species recorded from it. This facility will be used in conjunction with the Site Data sheets available via the [**Site data**] button in the top right on the display, and is primarily designed with conservation and biodiversity survey applications in mind, although it has proven extremely useful when reconstructing prehistoric environments.

Images and Maps

Two other buttons, top centre, have also been added with a view to future developments. The left hand one with an outline of a beetle (fig. 2) opens a form titled "Species Images - Main Screen", from which one can access the [**Photo**] and [**Detail**] windows. These allow the storage of pictures of identified insects, as well as supplementary labelled drawings to assist in identification work. Currently a number of photographs of tenebrionids from Kaszab's (1979, 1982) *Fauna of Saudi Arabia* have been entered by way of example, but as keys to the Egyptian fauna are further developed and access to high quality digital technology becomes more widespread, new images will be added. Separate "Notes" fields are associated with both the "Detail" and "Photo" windows, and the original author's often inadequate description of the species will be progressively entered into the former. The right hand button on the main screen with a small map on it (fig. 2) is intended to link into a GIS (Geographic Information System), wherein species distribution data, both modern and fossil will be displayed; currently it is linked to a field which allows the storage of distribution maps as bitmap image files. Image file size within Access, however, imposes serious limitations and these facilities are likely to be developed within a different system.

The Fossil Record

The two remaining fields, bottom right, titled "Egyptian Fossil Record" relate to Quaternary fossil data. Some of the earliest studies of fossil insects from archaeological deposits concerned Egyptian material, and these have recently been reviewed (Panagiotakopulu, 2001a). In addition, the Leverhulme Trust funded project, EPAS, Egyptian Pests and Storage, has added a significant number of new records (e.g. Panagiotakopulu 1998; 1999; Panagiotakopulu & Buckland 1999), pushing back the earliest evidence for some synanthropic associations by several thousand years and also occasionally altering biogeographic preconceptions (Buckland & Sadler 1989; Buckland & Panagiotakopulu, 2001; Panagiotakopulu 2001b; 2004). "From" is intended to provide a brief note of the earliest record of a species in Egypt. For *S. granarius*, for example (fig. 2), this is "Old Kingdom", whilst "Other" provides the earliest fossil record elsewhere in the World. In the case given, this is "Neolithic". The fields are again supported by dictionaries, and the form of this follows the European database BUGS, with period divisions more relevant to Egypt appended (table 11). The subdivision of the Quaternary will be revised to use Marine Isotope Stages, rather than Stage names (*cf.* Lowe & Walker 1997), but currently the only published records from Egypt come from mid- to Late Holocene archaeological contexts.

Pliocene
Late-Pliocene – Pleistocene
Early Pleistocene
Middle Pleistocene
Pre-Elster Interglacial
Elster (Anglian)
Holstein (Hoxnian)
Saale (?Wolstonian)
Eemian (Ipswichian)
Weichselian (Devensian)
Early Weichselian
Mid-Weichselian
Late Weichselian
Lateglacial
Lateglacial Interstadial
Lateglacial Stadial
Holocene
Early Holocene
Mid-Holocene
Late Holocene
Neolithic
Bronze Age
Iron Age
Roman
Medieval
Post-medieval

Modern
Unknown
Pre-Dynastic
Old Kingdom
Middle Kingdom
New Kingdom
Ptolemaic
Byzantine
Early Arabic

Table 11. Period classification dictionary used with the Fossil Record files.

The details of the fossil record for any species are obtained by depressing the [**Fossil Data**] button on the top right of the screen. This provides a summary chart of all known fossils of each particular taxon; that for *S. granarius* is presented in figure 5. Entries are listed by country, beginning with those from Egypt, and then in approximate chronological order. Each entry lists the location, date and published reference, the latter available in the same form as on the main screen when the [**Species Bibliography**] button on the pop-up window is depressed. A scroll bar down the right hand edge of the text box allows other entries to be viewed. The full EGBUGS bibliography can be accessed by pressing the [**Browse Bibliography**] button, and this also still contains many references which have been carried over from the European version of the program.

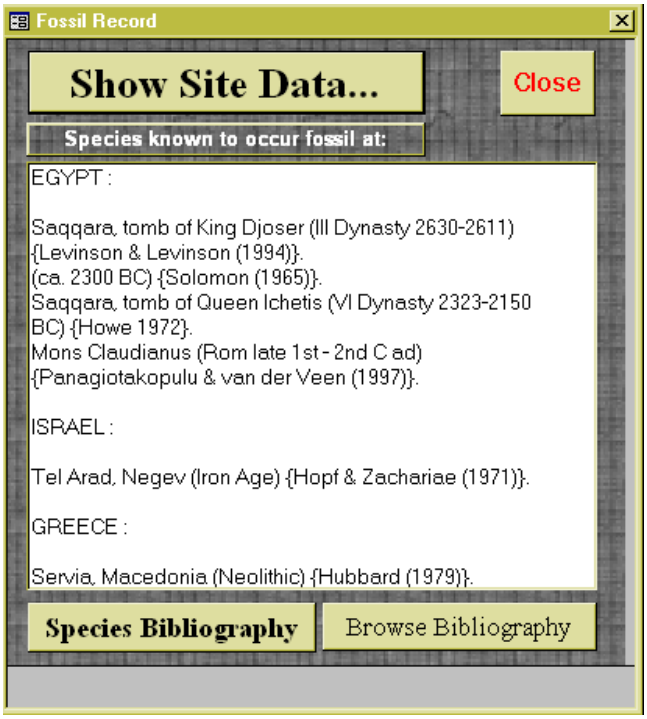

Fig. 5. Details of the fossil record for *S. granarius*

Site Details and Species Lists

One of the more tedious chores in entomology is the preparation of lists in taxonomic order, each species with its correct author. Increasingly such lists are attached to spreadsheets for statistical

manipulation of the data. One of the briefs therefore in the construction of both BUGS (Buckland *et al.* 1997, 2002) and EGBUGS was the facilitation of this work. Both the button [**Site Data**] on the main screen and the [**Show Site Data...**] button on the fossil record pop-up lead directly into a new screen labelled "Bugs - Site Information". [**Goto Site**] provides search to a particular site, and the list from Panagiotakopulu's fossil work at Amarna (Panagiotakopulu 1999; in prep.) is used as an example in this paper. Site name, region and country are listed at the top left of the screen (fig. 6), with latitude, longitude and altitude adjacent. The box labelled NGR is used for those countries, such as the United Kingdom, which have a grid system independent of latitude and longitude. [**Bibliography**] again allows the primary references, detailed beneath (Panagiotakopulu 1999) to be looked up, and [**Browse the Bibliography**] functions in the same manner as on other screens. The small field labelled "Interpretation" provides space for a short site description, and "Dates" reflects the program's original design for work with fossil insect assemblages and is intended for the input of relevant radiocarbon dates; it could equally be used for the recording of the dates of fieldwork, for example, in a pitfall trapping exercise. As identifications may need to be revised at a later date, a field labelled "Specimens are at" is provided for the insertion of the present location of material, in this case in the Site Magazine at Amarna, Minya Province. Depression of the [**Enter Species**] button brings up two pop-up windows (fig. 7), which allow the input of taxa to either an existing list or a new list. Entry can be in any order and [***Goto***] searches through the taxonomic list at the generic level; <PageUp> and <PageDown> allows movement through the list of species for larger genera. Species selection is by highlighting the square to the left of the required taxon using the mouse pointer, and addition to the list is by depressing [**ADD**] on the left of the species list. Wrong entries may be corrected by the same technique, and species may be deleted using the [**DEL**] button on the right of the list. On completion of the species list, in any order, depression of [**DONE**] reorders the list taxonomically and creates an Excel © spreadsheet for the site. Site names currently must contain eight or less characters, for the sake of backward compatibility with older operating systems. The spreadsheet is accessed from the "BUGS - Site Information" screen by double clicking within the spreadsheet area, and editing, entering of sample numbers, numbers of individuals, column widths, etc. can be carried out in Excel (note that the characters "gs" in cell A1 are necessary for EGBUGS to identify the spreadsheet as being in the BUGS format). The EGBUGS site information screen provides a snapshot of the spreadsheet. The [**Insert Spreadsheet**] routine allows incorporation of species lists produced within Excel ©, provided the taxonomy matches that within EGBUGS, and that cell A1 contains "gs".

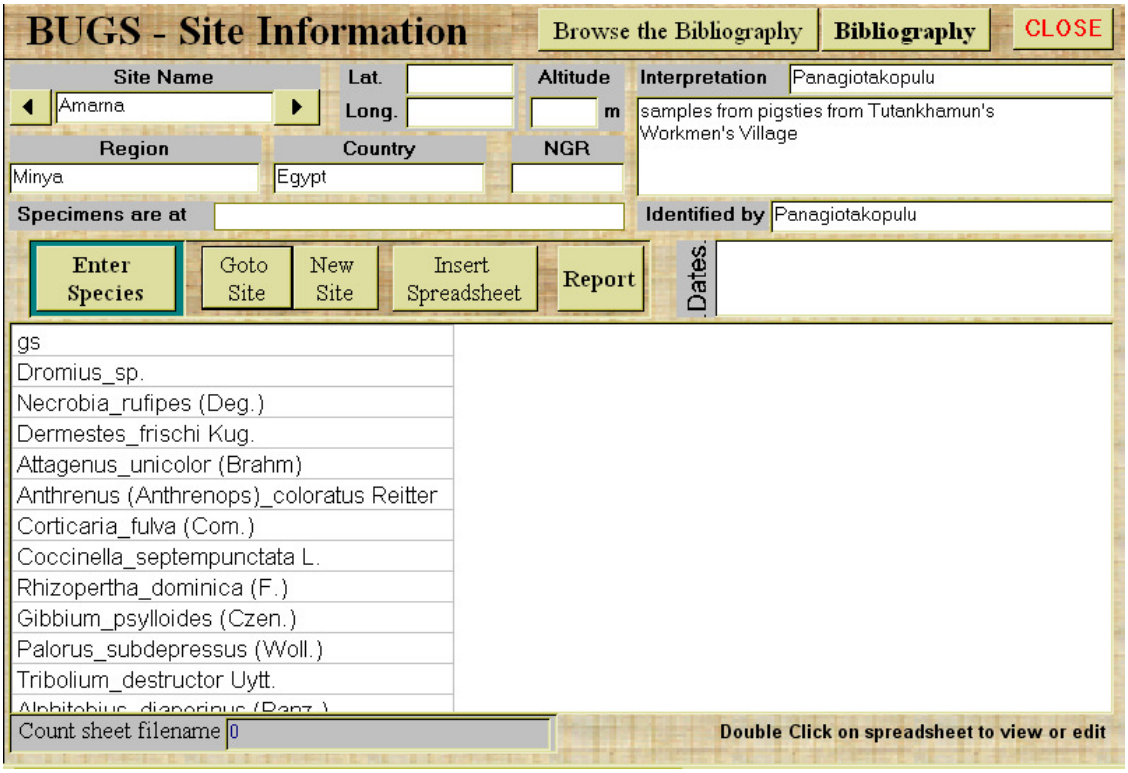

Fig. 6. Site data and species list from the pigsties at Amarna.

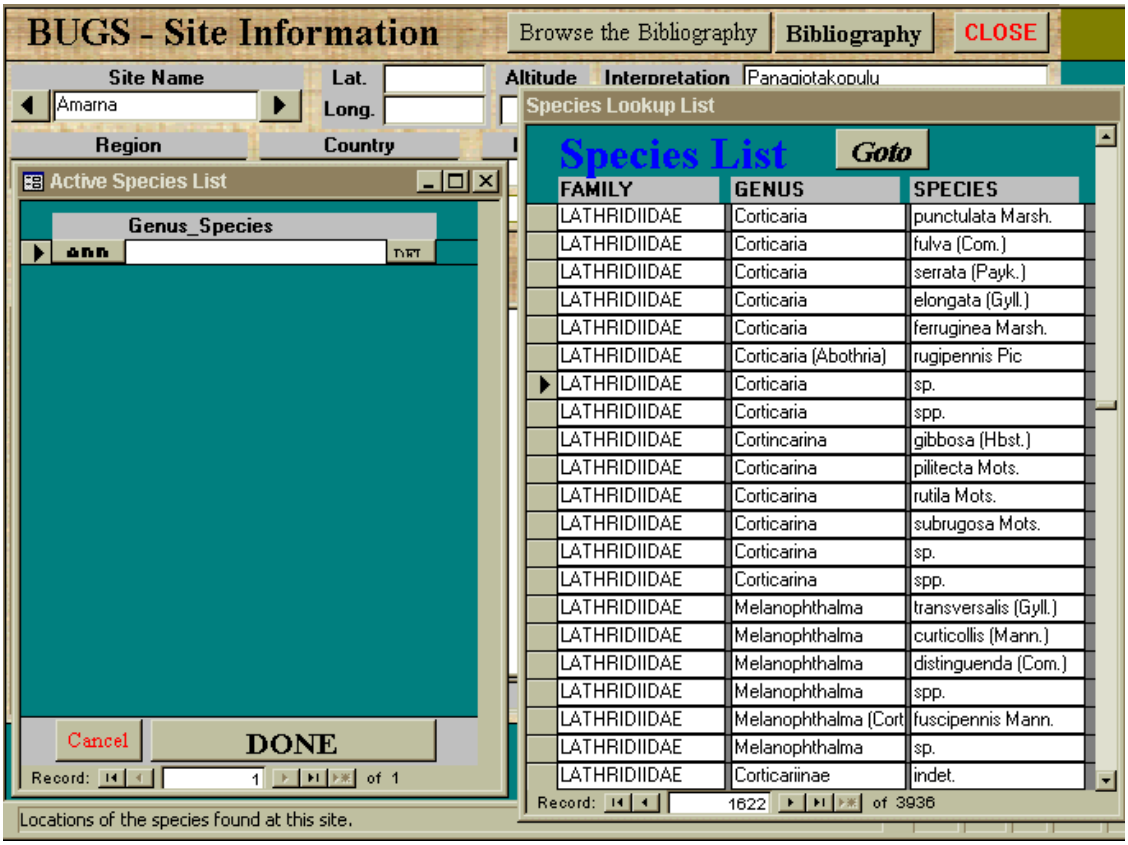

Fig. 7. Entering species found at the Amarna site.

Site Reports

The [**Report**] button links a species list with all its habitat and distribution data in the database, and this can be output either directly to a printer from Access or as an .RTF file for subsequent editing with a word processing program. In this way an overview of the ecological and distribution implications of a fauna can be rapidly generated. Whilst EGBUGS is essentially a research tool, it can also be used in teaching field entomology. Students can be set to identify a fauna, perhaps from a pitfall trapping exercise, look up individual species in the database, and then use the report function to output all the available information on the identified fauna for subsequent work in writing up the results.

Summary

EGBUGS, the Egyptian incarnation of the BUGS Coleopteran Ecology Package is a simple yet highly valuable aid to research and education in the fields of entomology and palaeoentomology. The ability to rapidly look up species habitat and distribution data compiled from various sources in itself saves hours of library and internet searching. Added to this is the ability to query habitat data and produce ecologically defined subsets of the EGBUGS dataset, and rapidly summarise the ecology of species found at a particular site, which again are tasks that would take hours to perform manually. It is hoped that the system will greatly benefit those working in the aforementioned fields, and even inspire others to engage in similar activities. The program can be freely downloaded from the BUGS2000 WWW site at http://www.bugs2000.org, and the authors would be grateful for comments, revisions and new data for entry.

Future developments

Initially it was intended that the BUGS system be designed to run on a machine with minimum specifications, and the layout and functionality of EGBUGS reflects that aim. In further developing the European BUGS system, which was initially run on the same engine as EGBUGS, it was desirable to expand the functionality considerably, and thus the EGBUGS format was dropped in favour of a more comprehensive, yet demanding system. BUGS is now entering its seventh generation, and the latest version of the European system, is planned for release in the second half of 2005. An update of EGBUGS will follow in 2007, time and funding permitting. Updates of BUGS, and development news can be found on the BUGS website at http://www.bugs2000.org. Comments and advice are, of course always welcome, and it is hoped that the publication of this article will stimulate international cooperation and the further development of the database. Contact details can be found on the website.

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