

Beitr. Ent.	Keltern	ISSN 0005 - 805X
55 (2005) 2	S. 485 - 498	27.12.2005

Myrmecology in the internet: Possibilities of information gathering

(Hymenoptera, Formicidae)

with 12 tables

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Summary

A well advanced information system about ants exists on the internet. Many myrmecologists all over the world offer useful information as text files, images or databases. A good part of the information focuses on regional faunas and biogeographic regions, with updated species checklists and geographic distribution maps. Many internet sites deal with specific ant groups or single genera and provide dichotomous and sometimes interactive identification keys, extensive information about the biology and/or geographic distribution of the species. Text information is often illustrated with images of living or dry mounted ants. Additionally, detailed pages about anatomy, mounting of ants, colony husbandry or ant conservation (red lists) can be found. In discussion forums it is possible to exchange facts and thoughts about all myrmecological facets with other interested people. A special offer for taxonomists is the increasing number of databases about museum collections and their type catalogues.

Zusammenfassung

Für Ameisen gibt es mittlerweile ein sehr gut entwickeltes Informationssystem im Internet. Weltweit bieten zahlreiche Myrmekologen brauchbare Informationen in Form von Textbeiträgen, Bildern und Datenbanken an. Ein guter Teil der Information beschäftigt sich mit regionalen Faunen bzw. biogeographischen Regionen, z.B. in Form von Artenlisten und Verbreitungskarten. Viele Internetseiten handeln auch spezielle Ameisentaxa ab, stellen dichotome oder gar interaktive Bestimmungsschlüssel vor und offerieren ausführliche Informationen zur Biologie und Verbreitung der Arten. Die Texte werden häufig durch Bilder präparierter oder lebender Ameisen ergänzt. Es lassen sich auch detaillierte Seiten über Anatomie, Präparation, Haltung und Schutz finden. Diskussionsforen bieten die Möglichkeit, sich über alle Aspekte der Myrmekologie mit Gleichgesinnten auszutauschen. Ein wichtiges Angebot speziell für taxonomisch Interessierte ist die zunehmende Zahl von Sammlungs- und Typenlisten.

Keywords

ants, Formicidae, internet based information, database, type images

Introduction

The World Wide Web is the most dynamic information source about any given topic. Performing internet searches about “ants” in different languages, the popular search engine “Google” presents close to 3.5 million records. But not all of the recorded internet sites are dealing in a reliable or useful manner with ants (BARONI URBANI & ANDRADE 2003). The aim of this publication is to give a list of major and helpful internet sites about ants within a broad spectrum of themes that, however, will be far from exhaustive.

Results

We distinguish different categories of sites, the limits, however, are often far from being sharply drawn. There are some sites that serve as kind of internet portals about ants (table 1). Beside own information, these sites offer links to other pages with many different topics. The main site in this category is “Antbase”, initiated and maintained by Donat Agosti and Norman F. Johnson. It is the pilot site of the Social Insects World Wide Web (SIWeb) and aims to give all available information about ant names (via “Hymenoptera Name Server”) and primary taxonomic literature (citations and full text copies); there are links to important other databases, a glossary about morphological terms and the directory of world’s ants taxonomists.

The main topic of another category of highly useful internet pages is taxonomy and systematics (table 2). These pages are partly integrated into the ant portals. “Antweb” initiated by Brian Fisher of the California Academy of Sciences provides superb high resolution Automontage® images of nearly all ant genera of the world. The “Hymenoptera Name Server” offers the actual taxonomic status of any given species name with its synonymies and original descriptions, often available for download in PDF file format. In this category also fits the webpage of the “Tree of Life”-project. This site deals with phylogenetic (cladistic) relationships among all taxa on earth and also gives a short description of the natural history of the requested organism, with useful links to sites with more specific information and images.

Sites about the content of collections and type catalogues are available in growing number. Some examples are given in table 3. The homepage of the Museum of Comparative Zoology at Harvard University is a very good example because the authors provide high resolution images of deposited ant types. The German project “Digital information on ant collections in Germany and their types (FoCol)” within the GBIF-D program has the same focus (VERHAAGH & KLINGENBERG 2004). High resolution images of the ant types in German collections and any other available information such as taxonomic status and original literature will be available on the international GBIF homepage from 2006 on.

Very important and helpful are websites with ant literature (table 4). The database “Formis” has a key function in this respect; one can search for ant literature published since 1650. Weblogs have a message board character containing also links to new publications. “Notes from Underground” is an informal ant newsletter established since three years in the internet, formerly published in paper prints. It also offers a message board.

There are many websites related to regional ant faunas (table 5). A majority of pages is dealing with the North American ant fauna. The Japanese Image Database gives detailed information about the ant fauna of each Japanese island. Similar pages are available about the ant fauna of other countries and continents, but in very different completeness. Most of these pages are providing checklists, identification keys, distribution maps, images often in excellent quality, literature, glossaries, hints for specimen preparation and link lists. In a few cases information about natural history is given, too. Outstanding in this category are the web pages of John Longino about Costa Rican ants and of Steve Shattuck about Australian ants.

For several ecologically important ant groups such as leaf cutting ants or fire ants web sites with detailed information on their natural history are available (table 6). They often include images of living ants and links to related sites.

A category of ant related web sites of growing importance deals with invasive ants (table 7). In most of the presented sites those ants are not only treated as pests in the context of human activities, but also as ants which are dangerous for the native ant fauna. Identification guides are given, often illustrated with images. Geographic distribution maps on regional level are also available in some cases. Useful information on the biology of invasive species may also be found on some sites about controlling pest ants. But we made no attempt to check the very high number of websites that deal with pest ant control.

There are a few web sites about endangered ants (table 8). The IUCN red list is also linked to antbase.org. The German "Ameisenschutzware" deals mainly with *Formica* spp. and provides information about activities in red wood ant conservation and literature, and maintains a discussion forum.

Glossaries are helpful especially for beginners in myrmecology (table 9). At some of the web sites related to regional ant fauna and internet portals (e.g. "Antbase") glossaries are given. Two other sites listed here not only give a list of explained terms, but the main structures are illustrated and detailed descriptions of each structure with links to the main morphological complex are given.

URLs to images of mounted and living ants are given in table 10. To our opinion the web page of Alex Wild "myrmecos.net" shows the best images of living ants we have seen in the web. The superb pictures of mounted specimens of all ant genera at "Antweb" have already been mentioned above under the taxonomic category. The Australian Ant Image Database is actually a subsite of the Japanese Ant Image Database. Both sites provide very good images of mounted and living ants. Many other pages, especially on sites of regional ant fauna (see above) also provide images of ants in high resolution quality.

For people who like to maintain living colonies at home or under laboratory conditions useful hints are given on the sites listed in table 11. Discussion forums about ant husbandry are available, too. The ecological risks for the environment and the native fauna in the case that exotic ant species escape from captivity should be kept in mind (BUSCHINGER 2004). Serious precautions against escapement should accompany any rearing of exotic ant species that nevertheless should be restricted to responsible scientific investigations.

Discussion forums in different languages are the last category of our ant related web sites (table 12). There is more than one discussion forum in German. Links to them can be found on other sites, such as "Ameisenschutzware" or "Ameisenhaltung".

Conclusion

The links presented here are only a small subset of all available web sites which deal with ants. We have chosen these sites, because they seem to be maintained regularly and all URLs have been verified by us. Many of these sites hold links to other sites and bear more information than we have commented.

It became evident that most web sites are maintained by US-American colleagues, or at least with support of them. European or German web sites about ants with comparative quality are still quite rare.

A difference to printed information is that web sites are more or less always under construction and sometimes not available (there are also many “dead” links). The contributions are not peer-reviewed – except for information copied from peer-reviewed texts. Thus, one should be ready to read really silly ideas like “Preventive measures [against ants]: Destroy all Hymenoptera’s nests around your home” (from the site “Poisonous animals and plants – Ants”; http://library.thinkquest.org/C007974/2_4ant.htm) Internet sites offer today only a small part of all the information available on ants. They cannot replace traditional information sources as already stated by BARONI URBANI & ANDRADE (2003) but can complement them to growing extent.

Acknowledgement

We thank Jochen Bihn for critical reading of the manuscript and the hint to the link “Poisonous animals and plants”.

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- After submission of our paper the following publication appeared which offers few additional web resources about ants: NASH, D. R. 2005: Web resources for myrmecologists. - Myrmecologische Nachrichten 7: 95-102.

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Tab. 1: Internet portals and general information on ants

URL	site title	content
http://antbase.org	Antbase	Is the pilot site of the Social Insects World Wide Web (SIWeb) and aims to give all available information about ant names (via Hymenoptera Name Server) and primary taxonomic literature (citations and full text copies); links included to ground living ant database, to a distribution database, to red lists and the extensive literature database FORMIS; contents a term glossary and the directory of world's ants taxonomists.
http://www.mymecology.info/portal/news.php	Myrmecology Portal	Provides links to the main web pages about ants and is directly linked to the Hymenoptera Name Server; ant discussion forum; books about ants available at Amazon and other book sellers. Search engine "ant dig". For full access to register.
http://ant.edb.miyakyo-u.ac.jp/	Japanese Ant Image Database and World Ant Link	Since 1995 online. Introduction to myrmecology, gives a world distribution map of ant genera, links to Australian ant image database, Hymenoptera Name Server, FORMIS literature database, Australian ants online etc.
http://www.discoverlife.org/nh/rx/Insecta/Hymenoptera/Formicidae/	Discover Life	Gives check lists of world ant genera and species lists of a number of countries in America, Asia and Africa; interactive identification guides for a number of countries, information about invasive ants and leafcutter ants with geographic distribution maps; ant images with Automontage® software.

Tab. 2: Ant taxonomy and systematics

URL	site title	content
http://iris.biosci.ohio-state.edu/hymenoptera/hym_db_form.html	Hymenoptera Online Database	Gives information about ant taxa and other Hymenoptera taxa including their "parent" and "children" taxa, provides literature, images, maps and links to other databases if available.
http://atbi.biosci.ohio-state.edu/	Hymenoptera Name Server	Gives all information about taxonomy and systematics about ants, with synonyms, links to original descriptions with pdf-documents for download. Is directly linked with the Hymenoptera Online Database.
http://tolweb.org/tree?group=Formicidae&contgroup=Vespoidea	Tree of Life	Presents phylogenetic relationships between ants themselves and other insects groups. Images of living ants and references are given.
http://www.cs.unc.edu/~hedlund/ants/catalog/BoltonUpdates.html	Update to Boltons Ant Catalog	Taxonomic updates to Bolton, B. (1995): A new general catalogue of the ants of the world - Harvard University Press.
http://www.antweb.org/index.jsp	Antweb	Provides high resolution Automontage® images of all ant genera of the world.

Tab. 3: Ant collections and type catalogues

URL	site title	content
http://mcz-28168.oeb.harvard.edu/mcz/FMP?db=Species.fim&lay=web&format=search.htm&c=view	Museum of Comparative Zoology, Type Database	Provides Automontage® images of type specimens deposited at the Museum of Comparative Zoology Harvard.
http://ant.edb.miyakyo-u.ac.jp/E/GUIDE/TYPES.HTM	Type specimen of Japanese ants	Links to type specimen of Japanese ants in the MCZ of Harvard University and the Smith Collection in the Natural History Museum London.
http://www.calacademy.org/research/entomology/types/insecta/hymenop/formicid.htm	California Academy of Sciences, Formicidae type collection	Provides a list of ant types deposited at California Academy of Sciences.
http://iris.biosci.ohio-state.edu/types/hyms/formicid.html	Ohio State University, primary types of Formicidae	Provides a list of ant types deposited at Ohio State University.
http://insects.ummz.lsa.umich.edu/species_lists/Formicidae.html	University of Michigan, Formicidae in the UMMZ insect division	Provides a list of ant species deposited at University of Michigan.
http://www.zsm.mwn.de/hym/ressources.htm	Zoologische Staatssammlung München Online Ressourcen der Sektion Hymenoptera	Provides a list of ant species and ant types deposited at Zoologische Staatssammlung München.
http://www.gbif.org/	GBIF	Provides taxonomic information about organisms in zoological and botanical institutions, often with images.

Tab. 4: Literature on ants

URL	site title	content
http://cmave.usda.uffl.edu/~formis/	Formis	Extensive ant bibliography data base with last update 2003. Literature data base is for download and can be opened with Endnote.
http://www.oegef.at/	Myrmecological News/Österreichische Gesellschaft für Entomofaunistik	Registered Online-Journal about myrmecology. Paper reprints available.
http://www.notesfromunderground.org/	Notes from Underground	Online-Journal about myrmecology, but no ISSN. Message board.
http://pogonomyrmex.blogspot.com/	Ant News	Weblog, different kind of ant notes, often with links to research articles.

Tab. 5: Information on regional ant faunas

URL	region	check-list	identification key/taxonomy	distribution maps	literature	natural history	images	glossary morphology	collection guide/specimen preparation	links	observations
http://www.antweb.org/	USA (Arizona, California, Florida, Louisiana), Mexico (Baja California), Madagascar	+		+			+(Auto-monotage)				combines distribution maps with Google Earth
http://www.antdata.org/	USA	+								+	
http://www.cs.unc.edu/~hedlund/ants/catalog/index.html	USA	+		+	+	+	+				
http://www.desertants.org/	USA		+			+		+			still under construction
http://www.tightloop.com/ants/	USA (Arizona)	+				+	+			+	

URL	region	check-list	identification key/laxonomy	distribution maps	literature	natural history	images	glossary morphology	collection guide/specimen preparation	links	observations
http://www.msstate.edu/org/mississippiantmuseum/Researchtaxapages/Foromicidachome.html	USA (Mississippi and Alabama)	+	+				+	+		+	Discover Lifeimages
http://www.acad.carleton.edu/Arboretum&McKnightPrairie	USA (Cowling Arboretum & McKnight Prairie)	+	+	+	+		+		+	+	
http://insects.umz.lsa.umich.edu/fauna/MICHANTS.html	USA (Michigan)	+									
http://www.sunfoundation.org/prod/Reference/antsSunFoundation.asp	USA (Sun Foundation, Illinois)	+			+	+	+	(REM pictures)			
http://www.npwrc.usgs.gov/resource/1999/ants/ants.htm	USA (Tallgrass Prairie)	+	+		+	+					
http://www.utep.edu/leb/antgenera.htm	North, Central and South America		+	+	+		+	(in the keys)		+	keys in MS Word format for download
http://faculty-staff.ou.edu/K/Michael.E.Kaspari-1/K/Michael.E.Kaspari-1/bcnm_ants_home.htm	North and Central America (Barro Colorado, Panama)	+					+			+	

URL	region	check-list	identification key/taxonomy	distribution maps	literature	natural history	images	glossary morphology	collection guide/specimen preparation	links	observations
http://www.natural-sciences.be/cb/ants/projects/ibisca_ants.htm	Panama				+	+	+ (videos)				Ibica-project site about insect diversity in Panamanian rain forest
http://www.evergreen.edu/ants/AntsofCostaRica.html	Costa Rica	+	+		+	+	+		+	+	
http://www.bdt.fat.org.br/zoologia/formiga/index.html	Brazil				+				+	+	still under construction
http://antbase.org/ants/africa/	Africa	+	+	+	+		+				
http://www.museum.org.za/bio/ants/#Classification	South-Africa		+								
http://www.ento.csiro.au/science/ants/default.htm	Australia	+	+	+	+	+	+ (REM-images)	+	+		
http://ant.edb.miyakyo-u.ac.jp/AZ/index.html	Australia	+			+		+				
http://ant.edb.miyakyo-u.ac.jp/E/index.html	Japan	+	+	+	+	+	+	+		+	
http://www.hormigas.org/	Spain	+	+		+	+		+		+	

URL	region	check-list	identi-fication key/taxonomy	distribu-tion maps	litera-ture	natu-ral his-tory	images	glossary morpho-logy	collection guide/speci-men prepa-ration	links	observations
http://www.agr.hr/hed/hrv/ento/inventar/formica.htm	Croatia	+	(gene- ra)		+						
http://www.antnest.co.uk/	United Kingdom	+	+			+	+	+		+	with in-troduc-tion to myr-mecology
http://www.anthill.org.uk/index.htm	United Kingdom					+	+			+	with in-troduc-tion to myr-mecology
http://perso.wanadoo.fr/jean-yves.bichaton/ecran.htm	France	+		+	+	+					
http://www.antba.se.de/	Germany, Borneo, Malaysia, Mongolia	+			+		+				

Tab. 6: Special ant groups

URL	ant group	content
http://entomology.ucdavis.edu/faculty/ward/pseudo.html	Subfamily Pseudomyrmecinae	Taxonomy, identification guides, Automontage® images, phylogeny, natural history.
http://www.blueboard.com/leafcutters/	Leafcutter ants (Attini)	Natural history, image gallery, related publications for download as pdf, link to Attini researchers.
http://www.armyants.org/	New World army ants (Ecitoninae)	Identification key, images, taxonomy, distribution maps, natural history.
http://www.projectlinks.org/ants/	Carpenter ants (<i>Camponotus</i>)	Link list to <i>Camponotus</i> web pages.

URL	ant group	content
http://www.allabouthome.com/tips/pests/carpenter_ants.html#Anchor-Reinfestation-59546	Carpenter ants (<i>Camponotus</i>)	Commercial website about <i>Camponotus</i> , treating these ants only like house invading ants and pest.
http://fireant.tamu.edu/index.html	Fire ants (<i>Solenopsis</i>)	Natural history, identification, habitat and impact of fire ants, distribution maps.
http://fireant.ifas.ufl.edu/	Fire ants (<i>Solenopsis</i>)	Site of the US-Department of Agriculture in Florida reporting on projects for areawide fire ant suppression.
http://msa.ars.usda.gov/ms/stoneville/bcpru/bcpruhome_001.htm	Fire ants (<i>Solenopsis</i>)	Natural history, link to research institutions.
http://www.ento.okstate.edu/fireants/fireants.html	Fire ants (<i>Solenopsis</i>)	Site offers links to recent research projects at the Oklahoma State University, gives general information about fire ants, image gallery, links to related web sites.
http://ipmworld.umn.edu/chapters/lockley.htm	Fire ants (<i>Solenopsis</i>)	Offers information about history, biology and control.
http://www.bluesquaregroup.de/projekte/ameisen/index.html	Red wood ants (<i>Formica</i>)	Experiments to investigate strength of wood ants.
http://www.natur-lexikon.com/Texte/MZ/001/00071-Ameise/MZ00071-Waldameise.html	Red wood ants (<i>Formica</i>)	Image gallery with information about natural history.
http://www.wald.gr.ch/download/ameise.pdf	Red wood ants (<i>Formica</i>)	Downloadable newsletter about <i>Formica</i> .
http://www.bursztyn.px.pl/b_systematyka/formicidae.html	Ants in amber	Image gallery and identification guide.

Tab. 7: Invasive ants and control

URL	region	content
http://home.sandiego.edu/~tmcglynn/exotic.htm	worldwide	Distribution maps, natural history, information about native locality and non-native habitats.
http://www.extento.hawaii.edu/kbase/urban/type/antsmenu.htm	USA (Hawaii) and worldwide	Information about natural history, damage and control.
http://www.hear.org/AlienSpecies/InHawaii/ants/index.html	USA (Hawaii)	Image gallery, distribution, control and identification key.

URL	region	content
http://www.forestandbird.org.nz/biosecurity/argentineants.asp	New Zealand	Information about <i>Linepithema humile</i> (argentine ant) in New Zealand.
http://ohioline.osu.edu/hyg-fact/2000/2064.html	USA	Description of the most common invasive ants.
http://lancaster.unl.edu/enviro/pest/factsheets/003-97.htm	USA	Description of (invasive) pest ants and control.
http://doyourownpestcontrol.com/antask.htm	USA	Commercial site about (invasive) ant control.
http://www.pestproducts.com/antindex.htm	USA	(Invasive) ant lists, description of damage and control.

Tab. 8: Red lists and protection of ants

URL	content
http://www.redlist.org	International red list of the IUCN.
http://www.naturschutz-planung.de/html/tiere/391ameisen.html	Ants as possible bioindicators in German environment projects.
http://www.ameisenschutzwaarte.de/	German web page about ant protection, especially <i>Formica</i> ants, with links to related pages.

Tab. 9: Glossaries of ant morphology

URL	content
http://antbase.org/databases/glossary_files/glossary_A.htm	A glossary of entomological terms based on Torre Bueno's Glossary, from which all terms relevant to ants, wasps, bees and termites were extracted.
http://ffrec.ifas.ufl.edu/entomo/ants/ant_anatomy.htm	Ant anatomy illustrated with photographs.
http://jlibsch.web.wesleyan.edu/Ant/Morphology/index.html	Ant anatomy illustrated with photographs.

Tab. 10: Ant images

URL	content
http://www.myrmecos.net/	Fabulous images of living ants.
http://www.antweb.org/index.jsp	Provides excellent high resolution Automontage® images of all ant genera of the world.
http://ant.edb.miyakyo-u.ac.jp/E/index.html	Japanese ant image database with much other information.
http://ant.edb.miyakyo-u.ac.jp/AZ/index.html	Australian ant image database, with checklists and bibliography.

Tab. 11: Ant husbandry

URL	content
http://www.zooscape.com/cgi-bin/maitred/ZooRide?fountainhead=yellow&zooride=ant+farm&r=01	Commercial site for ant farms and related toys.
http://www.antcolony.org/index.htm	Rearing and exhibiton of ants, casts of ant nests, many links to other parts of myrmecology.
http://www.antnest.co.uk/index.html	Instructions for ant keeping and ant colony dietary, images.
http://home.tiscalinet.ch/tao/Gipsnest.htm	Instruction for building artificial plaster ant nests and maintaining the colonies.
http://www.sasionline.org/antsfiles/pages/dino/dinobio.html	Husbandry of <i>Dinoponera</i> ants.
http://www.ameisenhaltung.de/	Information and German discussion forum about ant husbandry.
http://www.fourmis.org/	French web site about ant husbandry.
http://www.antsalive.com	Living harvester ants and supply for ant keeping.
http://shop.apocrita.de/	Living ant colonies and supply for ant keeping.
http://www.antsstore.net	Living ant colonies and supply for ant keeping.
http://www.antsnature.de/catalog/	Living ant colonies and supply for ant keeping.

Tab. 12: Ant forums

URL	language
http://www.lamarabunta.org/	Spanish
http://www.ameisenforum.de	German
http://www.ameisenschutzwaite.de/forum/index.php	German
http://www.ameisenhaltung.de/forum	German
http://groups.yahoo.com/group/antcolonies/messages	English
http://rufaman.proboards15.com/index.cgi	English
http://p211.ezboard.com/bantfarm	English