The Citizen Lepidopterist:

*Description of Butterflies and Moths and the Information Needs of Serious Amateurs*

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Introduction

From the earliest days of environmental conservation movements, amateur naturalists have provided vital contributions to science. On a volunteer basis, these “citizen scientists” contribute specimens to museum collections, identify and nurture the local fauna that visit their home gardens, and create datasets of sightings of particular species. Conservationist organizations have recognized the importance of data sourced from amateur naturalists, and even actively recruit the public to contribute to scientific study; notable examples include wildlife censuses like the Audubon Society’s annual Christmas Bird Count, and the crowdsourced dataset of butterfly and moth sightings maintained by Butterflies and Moths of North America. Hartel’s call for research into the information needs and behaviors associated with “serious leisure” takes on particular importance when we consider how vital citizen science is to the environmental movement. Conservationists have a vested interest in providing amateur naturalists with information resources which facilitate self-education in service of recording the high-quality data on which formal scientific institutions rely, while preserving the “pleasurable qualities” of hobbyist information activity.

This study examines how information resources have fared in facilitating the self-education and information needs of amateur lepidopterists, specifically in terms of how description of butterflies and moths is structured, articulated, and accessed. Amateur lepidopterists comprise a heterogeneous population, with the variety of social

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4 http://www.butterfliesandmoths.org/get-involved.
6 Star and Griesemer, 399.
motivations, interests, and levels of seriousness which previous studies have demonstrated to be typical of hobbyists in general. Their information behaviors have only received modest study, and then with a focus on information design and adaptation of field guides to electronic media. Description deserves special attention, however, because identification-oriented descriptions of Lepidoptera, especially in the form of field guides and butterfly-garden collection descriptions, are often a gateway to more serious amateur naturalist behaviors. Descriptive information which is both educational and accessible encourages greater participation by “citizen lepidopterists” and heavier investment in the work of environmental conservation.

By evaluating ten information resources which either directly target or seek to accommodate the information needs of amateur lepidopterists, this study provides a survey of description of butterflies and moths across institutional and commercial contexts, and provides insights for conservationists on how to create descriptive information resources which encourage the interest and participation of serious amateurs.

**Who Is a Lepidopterist?**

In order to determine how description of Lepidoptera meets the information needs of amateur lepidopterists, we must first determine the boundaries of the population being described. Much as in the “shotgun school” of early birding, amateur lepidopterists were once a fairly unified population of naturalist-collectors; in the early days of grassroots environmentalist movements, even the most reverent conservator of the natural world had no qualms about killing specimens in order to add to a personal or institutional collection, for the greater good of conservation and scientific inquiry. But collecting

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8 Lee and Trace, 625–626.
9 Chamberlain and Griffiths.
12 Stevenson et. al., PDF page 3.
14 Star and Griesemer, 401.
butterflies and moths, while far from obsolete, has been superseded by the passive observation and catch-and-release practices also familiar to modern birders. The naturalist-collector has been joined by butterfly-watchers, backyard ecologists, hand-rearers of captive live specimens, and even by pure collectors who scour antique shops and websites for already-dead specimens.

All of these populations have a fair claim to the title of “amateur lepidopterist,” and this diversity means that amateur lepidopterists will approach information resources from a variety of perspectives and information needs. The Serious Leisure Perspective draws a distinction between “amateurs” (self-taught citizen experts who conduct, for pleasure, labor analogous to that of a professional) and “hobbyists” (a population, including collectors, whose pleasure-work has no professional equivalent)\(^\text{15}\); among amateur lepidopterists, however, these distinctions are muddled by significant overlap, and the information needs of the population as a whole are heterogeneous as a result. Butterfly-gardeners and hand-rearers will require more detailed information on larval foodplants to attract or feed favored species. Field naturalists will want to be able to distinguish between similar-looking species quickly and under challenging field conditions, and to have clear information on geographic range and current conservation status. Collectors will be interested in the rarity, quality, and visual interest of a given specimen,\(^\text{16}\) with contextual knowledge an afterthought to some but of vital interest to others.\(^\text{17}\) While all of these key attributes fall under the heading of “description of \textit{Lepidoptera},” amateur lepidopterists of different stripes will naturally evaluate the informational value of this description slightly differently depending on their individual priorities.

The information resources evaluated here are not held to an impossible standard of providing pertinent descriptions for all subpopulations of amateur lepidopterist. Rather, their descriptive practices are analyzed to determine which populations are targeted by each particular resource, and the resource is then evaluated by four metrics (abstraction level, access points, descriptive attributes, and descriptive style) in order to

\(^{15}\) Hartel, 3267–3269.  
\(^{16}\) Lee and Trace, 626–627.  
\(^{17}\) Lee and Trace, 628.
determine whether it is successful.

**Case Studies**

A total of ten information resources were analyzed for this study, spanning a variety of institutions, functions, funding contexts, and formats. The resources fell into six broad categories:

1) One **online species guide and dataset**, Butterflies and Moths of North America (BAMONA). Originally a project of the United States Geological Survey, BAMONA is now independent and advertising-supported, and it bills itself as both a species guide for amateur lepidopterists and an open-access, crowdsourced dataset for scientific study. Under the oversight of professional entomologists, BAMONA allows registered users to submit time-stamped and geocoded data points for sightings of butterfly and moth specimens in the wild. BAMONA’s massive dataset is integrated into its regional checklists, with maps of recent sightings appearing in the records for individual species.

2) One **print-format field guide**, The Audubon Society Field Guide to North American Butterflies (1981). In keeping with the standard definition of a field guide, this book is physically compact enough to fit in a coat pocket, reflecting its intended use as a quick reference for butterfly-watchers out in the field.

3) Two **print-format desk references** featuring natural histories, life cycle information, and larval food plants as well as species guides: The Moth Book (1904) and The Butterflies of North America: A Natural History and Field Guide (1986). While the latter refers to itself as a “field guide,” both books are so large and heavy that they are clearly not suitable (or intended) for use in the field; they are thus categorized as desk references and not as true field guides. The difference between early and later information resources is clear in the two references’ writing styles and assumed audiences.

4) One **online natural history museum specimen database**, from the Smithsonian

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18 For case study citations, please see Appendix A.
20 Peterson, 22.
National Museum of Natural History. The SMNH Entomology Collection features insect and arachnid specimens from around the globe, some of which have been digitally photographed and made visible online. The Smithsonian allows users to search museum records for specimens through the Specimen Inventory, Species Inventory, General Search, and Boolean Keyword Search; each of these interfaces is slightly different and in some cases yield very different records for identical queries.

5) Three **butterfly garden exhibition materials**. Two are pamphlets which are given to visitors at butterfly gardens: “Watching Butterflies: A Take Home Guide” from the Museum of Science, Boston, and “Tropical Butterfly House Identification Guide” from the Pacific Science Center, Seattle. The third resource is an online guide to the butterfly collection at the Sophia M. Sachs Butterfly House at the Missouri Botanical Garden. As butterfly gardens are an entry-point for amateur lepidopterists, and as they are especially popular among children, these exhibition materials are required to provide information to a wider array of reading levels than the other resources studied here.

6) Two **commercial websites** which sell specimens and equipment to amateur lepidopterists. One resource, Butterflies & Things, sells unmounted specimens of butterflies and moths to collectors; the other, Butterflies Etc., sells life-cycle kits which include live caterpillars. As this study will demonstrate, the difference between populations served is reflected in each website’s manner of description.

One notable omission among the information resources studied is mobile digital references, such as the Audubon Society’s paid-service mobile application for butterfly identification.\(^\text{21}\) The author was unable to find any free applications of equal quality and wide geographic coverage. There are likely to be differences between traditional print-format field guides and mobile field guide applications, and this is a worthy avenue for future investigation.

It is also worth noting that, while order *Lepidoptera* encompasses moths as well as butterflies, moths are underrepresented in the information resources studied. Nine of ten resources included information on butterflies, while only six included information on moths—and three of those included information only on a few token, visually-striking

species, generally the Madagascar Sunset moth (Missouri Botanical Garden; Butterflies & Things) or the Luna moth (Butterflies & Things; Museum of Science, Boston). The “charisma” of certain taxa has been noted as a key factor in driving interest among amateur naturalists, and the sharp disparity between information resources on moths and butterflies indicates that butterflies fall among the more charismatic taxa, while moths—unless they are particularly colorful—generally do not. As the analysis below will demonstrate, the charisma gulf between butterflies and their less-loved cousins is echoed in the differences between how butterflies and moths are described, in which contexts, and for which subpopulations of amateur lepidopterists.

**Comparative Analysis**

*Level of abstraction.*—Just as there is variation among levels of abstraction in bibliographic records, records of *Lepidoptera* vary considerably in what exactly is being described. A record titled “Monarch Butterfly” might refer to a particular mounted specimen in a museum collection, a brood of similar live specimens in a zoo, or to Monarch butterflies in general—the last which, as Bowker points out, really means that the record refers to the abstract ideal of a “Monarch butterfly” based on the aggregation of specimens and observations. Different levels of abstraction with regard to what constitutes the butterfly (or the moth) are appropriate to different information purposes, but the distinctions must be articulated to avoid confusion.

Based on the principles of IFLA’s entity abstraction hierarchy, I propose a hierarchy of species abstraction for *Lepidoptera* records. The uppermost level of abstraction is **model** , for records describing the species at large from scientific consensus as to the species’ attributes, behaviors, and boundaries with other species. The intermediate level of abstraction is the **aggregation**, or a collection of (usually, but not always, living) discrete individuals who belong to the same species model. The most concrete level is the **specimen**—the individual, alive or dead, which is deemed to

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represent the species model within the collection. As the level of abstraction grows more concrete, descriptive attributes become more specific. For instance, Pacific Science Center describes its *aggregation* of Monarch butterflies as originating in a non-migratory population native to a tropical climate, and Butterflies & Things specifies the sex and preservation condition of each *specimen*. The Smithsonian database features exclusively specimen-level information, including attributes for date and location of capture and whether the specimen is pinned or papered (stored unmounted in a glassine envelope).

Field guides, desk references, and similar identification-oriented resources favor the *model* level of abstraction, describing the species according to the scientifically-constructed ideal of appearance and behavior. This can lead to confusion with certain polytypic species—for instance, the White Admiral/Red-Spotted Purple (*Limenitis arthemis*), a species whose variation in appearance is so wide that it was initially believed to be two separate species altogether. Field guides deal with such individual variation by providing visual description of variants, but in doing so they must draw from the collective specimen history of the species, in order to identify trends and create abstractions from those trends.

BAMONA is an interesting case in that it transparently treats its model-level species records as abstractions from individual specimens. In lieu of the traditional range map, which depicts population areas as a contiguous “cloud,” BAMONA’s species records feature maps with discrete data points for individual specimen sightings. The records also contain user-submitted specimen photographs, which, in the case of *Limenitis arthemis*, ends up highlighting not only the discrete “variants” common to field guides, but the intermediate specimens which are born when variants mate. BAMONA’s approach to the model-level record allows for an unusual amount of ambiguity—which is accurately reflective of what is found in nature, at the boundaries of what strict hierarchical taxonomy purports to describe.

*Access points.*—All but two of the ten cases structure the discovery of individual records to some degree by offering points of access by taxonomic family, yielding to the
hierarchical classification structure common to modern field guides across disciplines.\textsuperscript{25} In the case of the two desk references, taxonomic hierarchy was the sole point of entry for an individual species record besides the index. The two printed butterfly-house pamphlets are intended to be browsed visually by matching live specimens to illustrations, but their illustrations and textual supplements are spatially grouped and labeled by taxonomic family. Even Butterflies & Things, a commercial website selling specimens to collectors and emphasizing specimen-quality information over scientific, allowed records to be narrowed to members of a specific family.

The two exceptions were the Missouri Botanical Garden digital butterfly garden guide, and Butterflies Etc., which sells life-cycle kits and live butterflies. The Missouri Botanical Garden features a collection guide which appears not to be in any particular order at all (the Madagascar Sunset moth appears between two records for butterflies), but which is small enough that the designer might reasonably have expected users to prefer to browse it visually. However, as the collection list is broken up into five pages, a visual organizational structure may not have gone amiss even if the scientific hierarchy system was not deemed necessary.

On the other hand, Butterflies Etc. features a radically different access-point structure than any other resource, and it suits the website’s focus on a particularly nurturing clientele. Records for butterfly species can only be accessed by geographical range, with species sorted by U.S. state. The butterflies on this site are intended to be raised to healthy adulthood and then released into the wild, and the website makes it impossible for the user to access records for species which cannot thrive in the environment where they are to be released. Butterflies Etc. earns its unorthodox access-point structure by its commercial rather than educational focus, and by the fact that the \textit{Lepidoptera} it describes are live specimens requiring active and conscientious care from the user.

While BAMONA offers access by taxonomic family (as well as facilitating Boolean keyword searches), it offers a similar geographic narrowing feature in the form of its Regional Checklist generator. Users are invited to create a checklist of \textit{Lepidoptera}

(they can choose moths, butterflies, or both) whose geographic range includes the user’s location in North America; the list generated is then structured by taxonomic family. The regional checklist can act as a field guide, but its primary function—and one more suited to it—is to facilitate the confirmation of species sightings to contribute to BAMONA’s dataset. BAMONA’s access points assume a certain level of expertise among its users in terms of familiarity with taxonomic structure and even individual species; there is no way to sort results by identifying features (e.g. color or foodplant), and photographs are only available in individual species records. BAMONA’s stated ideal user is already a citizen scientist; serendipitous discovery is better facilitated by resources which do not yet expect users to actively contribute data.

Despite being a print resource, the Audubon field guide offers a faceted access-point system which both incorporates hierarchical taxonomy and facilitates access to even the greenest of amateurs. While users can still access species records by taxonomic family as in other resources, the Audubon guide features a comprehensive visual index which is sorted by wing shape and then by color. Illustrations are then crosslisted to the textual record, which is nested under the traditional taxonomic hierarchy. This is in keeping with Stevenson et. al.’s access-point recommendations for the creation of amateur-friendly electronic field guides, all the more impressive because it was achieved within the spatial and structural limitations of a printed pocket field guide. While the Audubon guide is not a perfect solution (some of the distinctions between wing shapes are very fine), its access points maintain the balance between ease of use and educational value necessary for an information resource for amateur naturalists.

The Smithsonian entomological collection database features faceted browsing in a digital interface, but its accessibility suffers from the unclear differences between its interfaces for Specimen Inventory and Species Inventory. Only the latter database yields records which include information on species range; records in the Specimen Inventory are considered on such an immutably concrete level of abstraction that their sole geographic information is the site of capture. Specimens are searched geographically by geopolitical location of capture, while species are searched by biome; cross-references between the two types of record are unclear. Identical queries to each database yield far

26 Stevenson et. al., PDF page 5.
more extensive results for species than for specimen, and the reasons for this disparity are not immediately clear. Far more than assuming a certain level of domain expertise in the user, the Smithsonian database assumes a level of familiarity with the collection and its classification practices. Its collection data—while extensive and rich—is thus fairly difficult for prospective citizen scientists to access.

_Attributes._—All ten information resources featured some degree of geographic range information and offered the species’ Latin name as a descriptive attribute, and it is here that generalizations across resources end. “Common names” were nearly universal, but 1904’s _The Moth Book_ lacks them entirely. This may be due to the date of its publication and its author’s presumption of a certain level of Latin language familiarity in his audience, but may also stem from the fact that moths—absent the charisma of their butterfly brethren—often have no common name at all.27 (As Bowker notes, the general population is only inclined to bestow names on the species that it likes.28) Rather than include an attribute which many of his subjects would lack, Holland seems to have foregotten it altogether.

By and large, information resources choose descriptive attributes which are tailored to their specific purposes. Butterflies Etc.—whose entire business model is predicated on the successful completion of its butterflies’ life cycle—featured extensive information on not only which plants larvae eat, but how much of the plant a single caterpillar will need to eat in order to successfully metamorphose. Identification guides (e.g. the desk references, Audubon field guide, and BAMONA) featured descriptions of when a species flies and in how many broods, as well as detailed narrative descriptions of the wings, antennae, and (in some cases) manner of flight. The Audubon guide, in keeping with its users’ need to distinguish between similar-looking species out in the field, featured an attribute explaining the differences between the species of record and the butterflies it resembled and might be mistaken for.

Butterfly garden identification guides differed significantly from field guides, for two likely reasons. The first is that butterfly gardens appeal to families, and thus their guides are written at a reading level which is comparatively accessible to children. The

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27 Chamberlain and Griffiths, Section 3.3.
28 Bowker, 658.
second reason is that all three butterfly garden guides were designed to be browsed visually while viewing the collection. Unlike field naturalists—who must contend with not only the massive biodiversity of the natural world, but the fact that species tend to evolve to mimic each other when one develops an evolutionary advantage—visitors to butterfly gardens are offered a curated array of species which are easily distinguished from each other. Identification information is thus minimal. What is provided instead is description of species behavior: flight movements, eating habits, and whether the individuals in the collection are likely to sit calmly while being held or photographed. Both field guides and butterfly garden guides describe live *Lepidoptera*, but context and user needs shape each information resource in distinct directions.

**Descriptive style.**—In general, authoritative sources on species identification—BAMONA, *The Butterflies of North America*, the Audubon guide—adopt a style of written description which is familiar from other seats of popular scientific authority. Information is rendered efficiently, in fragments or short sentences. This is an understandable adaptation among pocket field guides, which much conserve space while conveying extensive information, but the effect in an information resource whose spatial bounds are much looser (or, in the case of BAMONA, nonexistent) serves to convey conventional authority rather than to conserve space.

As Dunlap’s comparative history of field guides notes, this precise and impersonal tone was not always present in species-identification information resources; early field guides extensively personified animals (e.g. referring to the male of the species *T. migratorius* as “Mr. Robin”), and conveyed information about common behavior in the form of narrative stories rather than authoritative expository statements.29 These narrative descriptions had significant practical weaknesses, not least of which was their ability to devour page space.30 But the move from narratives to concise expository description was an evolutionary process, and the “superiority” of the expository descriptive model was not obvious to the writers of early field guides.

Traces of the narrative instinct are still found in butterfly garden identification guides, which by design are both more accessible and more invested in fostering

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29 Dunlap, 110–111.
30 Peterson, 25.
enjoyment than purely scientific field guides. Butterfly garden guides readily personify their subjects where a field guide would never dare; collection specimens may “love” a certain food, or sit “happily” or “calmly” for photographs, whereas a scientific guide would refer to the same behaviors as “feeding” and “basking” without any assumption of human-like motivation.

While it is tempting to attribute this difference to varying levels of scientific rigor, *The Moth Book*, written well before the distinction arose, demonstrates that scientific rigor and stylistic flourishes are not mutually exclusive. The author, W. J. Holland, was a highly regarded entomologist, and the taxonomic access structure and exhaustive ecological survey speak to the academic rigor of the project. But the book is written in a very different style from the structurally and functionally similar *The Butterflies of North America*. Species records include anecdotes about field excursions, verbose examples of the damage caused by pest species, and, in several cases, even poetry excerpts which the author felt were evocative or illustrative. One particularly charming example is found beneath the species record for *Eurycyttarus confederata*, a modest and unremarkable little brown moth common in the author’s hometown of Pittsburgh. By way of the adjacent poem—originally written, unsurprisingly, about a butterfly—the moth becomes by association a “little wanderer” and a “tiny soul,” worthy of more esteem and consideration than its humble appearance and taxonomic specifics might otherwise demand.31

Beyond even the expected information on identification and geographic range, *The Moth Book*, through its more subjective flourishes, conveys an entirely different kind of information than most of the other resources studied. More than simply learning about moths, *The Moth Book* wants the amateur lepidopterist to like them.

**Evaluation and Conclusions**

A comparative analysis across *Lepidoptera*-related information resources reveals a diversity of descriptive structures and styles, tailored to suit each resource’s institutional aims, informational goals, and targeted subpopulation among amateur lepidopterists. While there was variation in the level of user expertise each resource

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31 *The Moth Book*, 363.
assumed, the greatest differences across resources appeared to be shaped by abstraction level and institutional context. An illustrative example of this variation can be seen in the differences between BAMONA and the Smithsonian database. While both of these resources comprise datasets which are suitable for scientific use, BAMONA’s species records lie at the model level of abstraction, albeit with the species model being derived from specimen-level crowdsourced data regarding individual sightings; the Smithsonian, on the other hand, maintains centralized institutional authority over its data, and yields records which are strictly pertinent to the specimen abstraction level. The different scholarly and institutional character of each resource, and the difference in abstraction level between the entities each resource describes, accounts for the descriptive differences between them to a far greater degree than any disparity in expertise between their target audiences.

We can, however, note a disparity in assumed expertise level between those resources which convey information on moths and those which do not. Omitting those resources which include only the most charismatically butterfly-like moths in their records, we are left with a century-old desk reference, the Smithsonian collection database, and BAMONA. All three of these resources assume a level of existing expertise in the amateur lepidopterist; The Moth Book’s classification organization and BAMONA’s regional checklists assume some intermediate familiarity with Lepidoptera taxonomy, and the Smithsonian adds to this a requirement for some familiarity and comfort with the workings of the museum’s database. Nowhere do we see an analog to the Audubon field guide, or (aside from the inclusion of the Luna and Madagascar Sunset moths in two of the butterfly gardens) anything like a “moth garden” to introduce moths to children and curious members of the general public. Entry-level information resources on moths—with simple descriptions, faceted access points, and extensive visual references—are simply not available to the same degree that such resources exist for butterflies. In order to develop into a citizen scientist who specializes in moths, the amateur lepidopterist must, it seems, arrive at the specialty by cultivating an enthusiasm for butterflies first.

Whether caused by this dearth of gateway information resources or simply by moths’ status as a less charismatic taxa, the consequences for the disparity are real. While
an empirical study would be required to confirm, the author’s preliminary survey of BAMONA species records yielded fewer sighting data points and user-submitted photographs for moth species relative to butterfly species of similar plenitude and geographic range. Additionally, there appeared to be a higher frequency of incomplete metadata among moth species records. Given that conservationists of biodiversity rely on citizen scientists to provide population data, further research is necessary to determine how to incentivize amateur interest in less-loved species. One wonders whether moths would fare better in the public eye if their species records were still accompanied by behavioral anecdotes and the occasional poem.

Each of the information resources studied here deserves detailed study on its own, preferably buttressed by future empirical research into the information requirements of hobbyists and amateurs.\textsuperscript{32} BAMONA, in particular, also deserves to be evaluated for the quality and usefulness of its scientific dataset. It is unique among the resources studied in its unity between facilitating the autodidacticism of citizen lepidopterists and the aggregation of their observations for scientific purposes, and it deserves a thorough analysis of its holistic success.

While this study makes no attempt to render such qualitative judgments on these information resources, it does begin to articulate the information needs of amateur lepidopterists, and it offers examples of how these needs have shaped description of \textit{Lepidoptera} in a variety of contexts. Descriptive practices are generally successful in conveying the practical information necessary for amateur lepidopterists’ concrete activities and practices—identifying, photographing, collecting, nurturing. And at times, whether through a clever and informative faceted access-point system or through an unusual descriptive style, these resources convey a less tangible form of information. By providing intuitive hierarchies and idiosyncratic records, information resources for amateur lepidopterists can do the vitally important work of making the hobby of “citizen science” not only informative and scientifically rigorous, but enjoyable, as well.

\textsuperscript{32} Hartel, 3271–3272.
Appendix A: Case Studies

Coverage: butterflies (many), moths (several)

Coverage: butterflies (comprehensive), moths (comprehensive)

Coverage: moths (comprehensive)

Coverage: butterflies (many), moths (token)

Coverage: butterflies (several), moths (token)

Coverage: butterflies (many)

Coverage: butterflies (comprehensive)

Coverage: butterflies (comprehensive)

Coverage: butterflies (many)

Coverage: butterflies (comprehensive), moths (comprehensive)
Bibliography


