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Revision of the Nearctic Moth Genus ABAGROTIS Smith with Descriptions of New Species (Lepidoptera:Noctuidae), Part 1

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REVISION OF THE NEARCTIC MOTH GENUS ABAGROTIS SMITH WITH DESCRIPTIONS OF NEW SPECIES
(Lepidoptera: Noctuidae)

PART I: INTRODUCTION, METHODS, PHYLOGENY, BIOLOGY AND ECOLOGY, ECONOMIC IMPORTANCE, DISTRIBUTION, TERMINOLOGY, GLOSSARY, HISTORICAL REVIEW, KEY TO RELATED GENERA, GENERIC DESCRIPTIONS, KEY TO SPECIES GROUPS. *

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Although adults of the genus *Abagrotis* are largely nocturnal, a few members of certain species feed diurnally in the late fall. The adults feed primarily on nectar from flowers, but a few individuals feed on plant exudates. The larvae of most species feed on a variety of plants in the Angiospermae, but one species apparently selects a member of the Gymnospermae.

Most adults of *Abagrotis* are drab in coloration, exhibiting shades of brown and gray, but a few species are brightly or contrastingly colored. At the generic level of classification, or higher, the general external features are similar. When external features plus wing maculation are considered, one finds many valuable species characters. For generic classification the male genitalia are the most diagnostic. In addition,, antennal morphology, leg morphology and wing maculation are very valuable to the systematist for specific or generic classification.

As originally conceived, *Abagrotis* Smith was based on *erratica* (Smith) which was first assigned to *Rhynchagrotis* Smith. Even though Smith placed *erratica* in *Abagrotis,* he later placed a similar species, *alcandola* (Smith) in *Rhynchagrotis.* From this, it can be seen that there was confusion as to what species were involved in his two genera. Hampson (1903) synonymized *Abagrotis* and *Rhynchagrotis* with *Triphaena* Hübner.

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* This revision is a modification of a thesis submitted in partial requirement for the degree of Master of Science. It was submitted to and accepted by the University of California, Davis, January, 1966. This paper is the first of a series of the revision.

Benjamin (1921) redefined the group, including the species of both *Abagrotis* and *Rhynchagrotis,* in Hübner's genus *Lampra.* In this case Benjamin arbitrarily lumped many genera under a European name, clearly implying that he did not believe in proposing genera based on genitalic characters by stating ". . . sexual characters should not be used to designate genera." Pertaining to this matter, the present author believes that the type species of *Lampra* (which is *fimbria* by monotypy) is far removed from both *Abagrotis* and *Rhynchagrotis.*

It is my feeling that prior classifications are unsatisfactory because no thorough studies have been conducted to relate one species to its closest relative, and therefore unnatural groupings have resulted. The arrangement used in this paper is best designed for the recognition of *Abagrotis* species as currently recognized.

As presently concieved, the genus *Abagrotis* is totally Nearctic in distribution although one species, *totonaca* (Schaus), touches on the undefinable line bounding the northern part of the Neotropical Region. It appears that *Abagrotis* along with other closely related genera are of recent origin, as is exemplified in their unstable state of evolution. This instability is evidenced by the number of closely related species. Due to the lack of fossil evidence in the noctuids, it is difficult to identify primitive versus derived characters.

A study of the type specimens of *Abagrotis* species resulted in the synonymy of one species and the selection of many lectotypes. In the present work, thirty-one species are recognized of which seven are herein described as new.

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The author would also like to extend his appreciation to many other collectors who made material available during the course of this study.

METHODS

Collection and preservation - Moths of the genus *Abagrotis* are best collected by use of a fifteen watt fluorescent "black light." I have also used a "watering method" in which water from a garden hose is sprayed over dried leaves; best results are obtained in late summer or autumn. The force of the water dislodges the dried leaves, which in turn disturbs the moths hiding beneath the leaves. Moths are then netted and

transferred to a cyanide killing jar. This method is most successful in the early part of the afternoon when the moths come to rest in leaves located at the shady side of a house, a dirt bank, or some similar shady place. Additional collecting methods used are of general use in collecting noctuids, so will be discussed only briefly here.

Another method is "sugaring", which is the use of a mixture of 3 parts stale beer, 1 part granulated brown sugar, 0.5 part thick brown molasses. Numerous other recipes are available, many of which employ fermenting fruit. The sugar bait is painted on surfaces of trees and similar objects where moths may congregate. The collector then makes trips at regular intravals at dusk or after dark to collect moths attracted to the bait.

Larvae are taken at night by beating shrubbery, although a few collectors have found specimens during the day. A more successful method of obtaining larvae is to confine a female of a known species, and obtain eggs of which the first instars can be placed on a series of host plants to determine host preference. I had very little success in obtaining eggs from *Abagrotis* females, but the method is successful in some instances with other moths.

For larval preservation I use a modification of KAAD which is made up as follows: 3 parts crude kerosene; 2 parts glacial acetic acid; 9 parts ethanol; and 5 parts sec-butyl alcohol.

Preparation of material - The preparation of adult specimens for study is relatively simple. The wings should be spread of at least a representative series of a species so that 1) relationships in size and shapes of the wings is readily discernable, 2) the surfaces of the wings, both dorsally and ventrally can be seen, and 3) the position of pertinent external parts is kept in the same perspective. The antennae should be placed in a position visible to the observer so that later adjustment, which might cause breakage, is not necessary.

Preparation of good genitalic mounts requires careful clearing, inflating of various parts and staining. The whole abdomen is generally removed because 1) the abdominal pelt may possess valuable characters, and 2) there is little possibility of losing pertinent parts of the genitalia. The initial clearing is done with 20 percent KOH (potassium hydroxide) in distilled water, the distilled water being employed because of its purity. One can heat the specimen in KOH for an hour, until the genitalia are pliable, or leave the specimen in KOH for a period of from 24 to 36 hours. The softened abdomen is placed in distilled water and the scales and hairs are brushed off. The procedure now differs for the sexes. The male genitalia are forced out the terminal end of the abdomen, the integument clipped at the base of the genitalia, and the genitalia removed. Next, the aedeagus is removed from the rest of the structure by pulling it carefully away from the juxta and anellus. The genitalia minus the aedeagus are then brushed to remove simple hairs, and are then slightly flattened so the valves are spread, which reveals their inner face. The vesical sac of the aedeagus is then everted into its

supposed natural copulatory position by inflating it with a hypodermic needle. It is first inflated with distilled water, and, after it and the remainder of the genitalia have been stained, it is again inflated, this time with 95 percent ethanol. Lignin pink (100 parts water to 1 part stain) is used. The genitalia are dipped in the stain for a maximum of 10 seconds. In the female the abdominal pelt is laterally slit up to either the seventh segment, or to the posterior apophyses, where a transverse slit (both dorsally and ventrally) removes it from the genitalic organ and its associated parts. It is then treated in the same way as the male abdominal pelt. The genitalia are then cleaned and the anal tube cut and removed. The bursa copulatrix is inflated by water from a hypodermic needle inserted into the genital pore and ductus bursae. The genitalia are then stained, placed in 95 percent ethanol, and reinflated with ethanol. The procedure is now the same for both sexes.

After fifteen or twenty minutes in 95 percent ethanol, the genitalia are placed in absolute iso-propyl alcohol where they remain for an hour. Next, they are placed in xylene for ten to fifteen minutes, and then are placed on a microscope slide in balsam. The slide is then labeled, and placed in an oven at 120° F. for one week, after which time additional balsam is added as needed.

Descriptions - The species descriptions are designed to be thorough and comparable throughout the genus. Descriptions are limited to the external features, and are supplemented by photographs. The desirability of both descriptions and photographs is because the descriptions deal mainly with hair and scale shape and color, whereas the photographs of the adults give an immediate pictorial representation. Illustrations of the genitalia therefore, are included and no verbal descriptions of the genitalic organs are given. The female genitalia alone are usually not of diagnostic value, and therefore few separate keys for the female genitalia are included. In difficult species groups, separate keys of the male genitalia are given.

The section "Material studied" was abbreviated due to the number of specimens studied. Data in this section are recorded only to the county level in the United States and by province in Canada. On the distribution maps, each dot represents a single locality within a county. The more exact data are recorded on the distribution maps. The section dealing with "Recognition characters" gives spot characters that allow for quick recognition.

Illustrations - Illustrations other than those prepared by the aforementioned artists were prepared by the author. Illustrations of the genitalia were made with a Bausch and Lomb bioscope; all were drawn to the same scale unless otherwise stated.

PHYLOGENY

The lack of adequate information concerning immature stages makes it difficult to hypothesize an ancestral type, therefore this study was confined almost entirely to the use of adult characters. My study indicated that the following characters are probably primitive: 1) heavily sclerotized genitalia: 2) large vesical cornuti; 3) bipectinate, or fasciculate antennae in males.

On this basis the *erratica* group is thought to be the most primitive with the hypothetical ancestral type having given rise to the various species groups. Within the *erratica* group, most of the salient features are quite similar except for the vesical cornutus. The huge vesical cornutus found in *alcandola* (see fig. 77) is modified in *erratica erratica* and *erratica ornatus* to a much smaller, bulbed cornutus. The ductus bursae of the female genitalia is extremely heavily sclerotized. As one proceeds from primitive to more distantly derived relationships, there is a trend toward lighter sclerotization (as shown in the illustrations). The male antennae are biserrate and fasciculate, presumably with a more complex chemoreceptive ability than those which are simple or ciliate.

The larval stage of the *erratica* group is somewhat restricted in host plant preference; *alcandola* on ash (*Fraxinus* sp.); and *erratica ornatus* on a species of willow (*Salix* sp.). There is no evidence that *alcandola* feeds on willow, though. In comparison with primitive forms, the larvae of the more distantly derived sorts may feed on two or more plant species, and some are apparently polyphagous.

The phylogenetic plan developed in this paper was based primarily on morphology of the male (table 1).

BIOLOGY AND ECOLOGY

Unfortunately, little is known concerning the biology and ecology of these insects. The larval stages are known for only 50 per cent of the species in the genus and even here the information recorded is sketchy. Apparently no data are available concerning host-parasite relationships.

Seasonal occurrence - Adults of most species within the genus occur in middle to late summer and in early autumn. An occasional specimen is collected in early March, and as late as November (see table 2). In California, peak of numbers for most species occurs during the last two weeks of August and the first two weeks of September.

In the cases known, larvae occur in the spring, after emerging from overwintering eggs. Field observations indicate that the females oviposit in the late fall and the eggs remain in position until the following

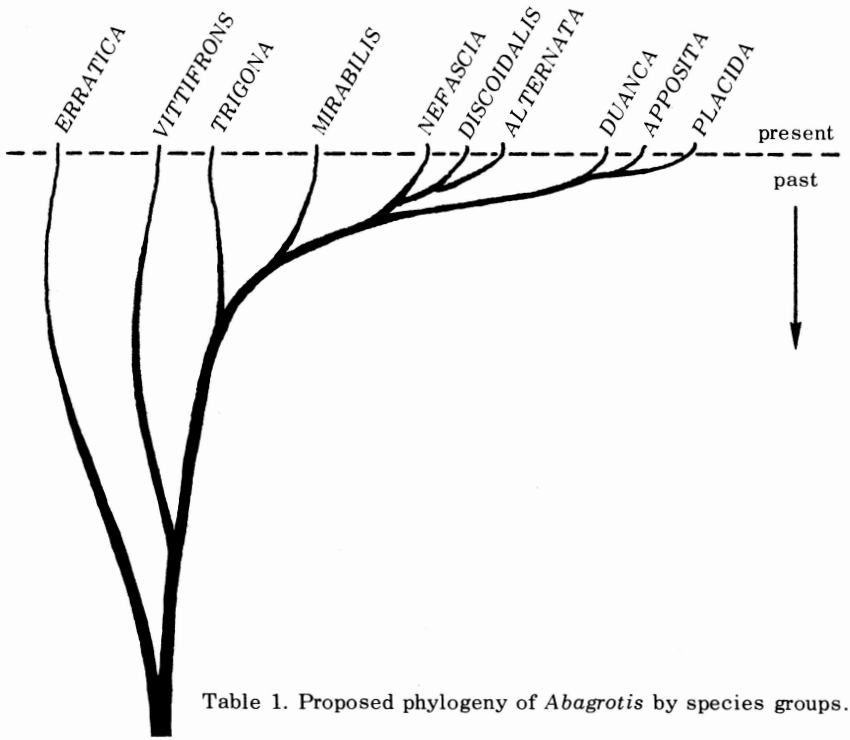

Table 1. Proposed phylogeny of *Abagrotis* by species groups.

spring. It is also possible that some larvae emerge in the fall and overwinter as early instars. The early larval instars of known species feed on young leaves or shoots. With the exception of a species, which feeds on juniper, the other species with known larval stages select deciduous shrubs or trees or annual plants. Since juniper is an evergreen, larvae emerging in the autumn would possibly have a food source available until hibernation. Published data on larval biology and ecology have been contributed by only a few authors: Blackmore (1925), Crumb (1932, 1956), and Forbes (1954). Personal notes of authors (Henne, and McFarland) are available also.

Daily periodicity and activity - Adults are largely inactive during the day, but at high elevations where the ordinary nocturnal temperatures are too low to permit flight, adults may feed on blossoms of some plant species (e.g., *Chrysothamnus spp.*) diurnally. In addition, the adults move about diurnally to locate protective situations away from wind, sunlight, precipitation, and predators. The adults feed and copulate and carry out most of their activities nocturnally during a span of an hour after sunset to an hour before sunrise. The larvae of known species are active at night only, but may be beaten from host plants diurnally.

Food sources - Adults feed on nectar from many sources including blossoms of buckeye, *Aesculus californicus* (Spach) Nuttall, and *Chry-*

sothamnus spp. In addition, adults have been collected at sugar solution bait, and at fermenting fruit.

The larvae feed on a number of plant species, and table 3 illustrates the diversity. Future work will undoubtedly expand our knowledge of larvae-host plant relationships.

Natural enemies - Common enemies of *Abagrotis* adults are predaceous insects, spiders, solpugids, mites, and shrews. These predators and parasites have all been personally observed feeding on *Abagrotis* adults. Larval erythraeoid mites are very abundant on moths of the various species of *Abagrotis* taken in the southern part of their ranges.

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
erratica erratica							●	●	●	●		
erratica ornatus							●	●	●			
kirkwoodi									●	●		
alcandola								●	●			
vittifrons				●		●	●	●	●	●	●	
totonaca								●				
bimarginalis						●	●	●	●			
trigona			●	●	●	●	●	●	●	●		
mirabilis						●	●	●	●	●	●	
rubricundis						●		●	●			
striata						●	●					
glenni								●				
hennei						●	●		●			
nefascia					●	●	●	●	●			
alampeta					●	●	●		●			
denticulata					●	●	●	●	●			
baueri						●	●	●				
barnesi					●	●	●	●	●	●		
alternata						●	●	●	●	●		
turbulenta						●	●	●	●			
crumbi crumbi					●	●	●	●	●			
crumbi benjamini							●	●				
variata					●	●	●	●	●	●	●	
scopeops						●	●	●	●	●		
tecatensis							●					
discoidalis						●	●	●	●	●		
pulchrata							●	●	●	●		
apposita						●	●	●	●	●		
nanalis							●	●	●	●		
duanca					●	●	●	●	●	●		
reedi				●	●	●	●	●	●	●		
placida							●	●	●			
dodi							●	●	●			

Table 2. Flight periods of *Abagrotis* species.

ECONOMIC IMPORTANCE

Larvae of *Abagrotis* species have been recorded on economic crops to which they have incurred considerable damage. In New York considering *Abagrotis barnesi,* Forbes (1954) stated, "Larva hatching in the fall, feeding up in the spring, when it is often an injurious climbing cutworm on apple and grape." Concerning *Abagrotis alternata,* he stated, "Caterpillar. . .reported injurious to cherry, oak, hickory, etc." The larva of *alternata* has the common name of "Mottled Gray Cut-Worm". Regarding the "Red Cut-Worm", *Abagrotis placida,* Forbes mentioned that it had been reported as an injurious pest in Michigan.

	erratica ornata	*alcandola*	*trigona*	*hennei*	*nefascia*	*barnesi*	*alternata*	*crumbi crumbi*	*variata*	*discoidalis*	*pulchrata*	*apposita*	*nanalis*	*duanca*	*reedi*	*placida*
Acer negundo L.						●									●	
Alnus spp.									●							
Amelanchier spp.					●	●		●	●			●				
Artemisia spp.													●	●		
Carya sp.							●									
Crataegus sp.								●								
Fragaria sp.							●									
Fraxinus sp.		●														
Holodiscus sp.															●	
Juglans sp.							●									
Juniperus californica Carr.				●												
Malus sp.						●		●								●
Populus sp.						●		●							●	●
Prunus spp.						●	●		●							
Quercus sp.							●									
Ribes aureum Pursh.								●								
Ribes sp.						●										
Rubus sp.											●					
Salix scouleriana Barr.			●													
Salix sp.	●		?						●						●	
Sarcobatus vermiculatus (Hook.)								●		●						●
Verbascum thapsus L.									●							
Vitus sp.						●		●								●

Table 3. Known larval host-plant associations of *Abagrotis*.

Leaves and buds of plants are consumed. The Mottled Gray Cut-Worm is recorded as feeding on "Buds of apple, hickory, oak and walnut, and strawberry plants", by Crumb (1956). Crumb also states of *Abagrotis barnesi* in relation to foodplant preference "Apple, peach, cherry, cottonwood (*Populus*), serviceberry (*Amelanchier*), and introduced box-elder (*Acer negundo*)." The primary crop plant species attacked by members of the genus are apple, peach, walnut, strawberry and cherry.

Judging by the huge population buildup of the adults, usually during late summer, it seems logical to expect these species to be of considerable potential as an economic pest to our western fruit trees. As can be seen by the distribution maps, many species of *Abagrotis* occur sympatrically with our fruit and vegetable producing areas.

Thus far the larvae of only 12 species of *Abagrotis* have been described, leaving a total of 21 yet undescribed. It is quite possible that some, or even many of the larvae identified as "cutworms" may belong to the genus *Abagrotis*. It is hoped that future work will produce biological information of species in the group as well as thorough larval descriptions.

DISTRIBUTION

The genus *Abagrotis* is distributed widely throughout the Nearctic Region. Little information is available concerning the distribution of any member of the genus in Nearctic Mexico, although many species have been collected less than one mile north of the United States-Mexican border.

The species occur from sea level to above 10,000 feet elevation, the greatest numbers being found between elevations of 1,000 and 8,000 feet. The northernmost known record for any species is 60° north latitude, at Northwest Territories, Canada (*A. placida*). The southernmost known record is the type locality of *A. totonaca* in Jalapa, Veracruz, Mexico, at 19° north latitude. Members of the genus are strong fliers, and therefore it is not too surprising to find species in nearly all the life zones. About half of the total number of species in the genus are widespread. Of greater interest are the species confined to particular regions. There are four confined to the Pacific Coast Ranges, five to the Great Basin, two species occur at higher elevations, and five at lower elevations. Four of the lower elevation species are also coastal. Members of the genus are excluded from the Neotropical Region and from the more northern parts of the Nearctic Region (e.g. Alaska).

As with most animals, *Abagrotis* species are susceptible to low temperatures which might induce death by freezing. At higher elevations (10,000 feet elevation, or above) where the summer is shorter, and the temperatures are rather low, fewer species are represented. On the contrary, *Abagrotis* species are, with few exceptions, not susceptible to higher temperatures as long as there is adequate means of protection from direct rays of the sun.

TERMINOLOGY

With modifications, I have used the terminology of Forbes (1954). Labeled illustrations of pertinent external anatomy of a representative moth and the genitalia in both sexes have been prepared (see figs. 25 through 40). Inasmuch as confusion exists in terminology I am defining terms used in this paper as follows:

accessory lobe - The lobe or duct in the female genitalia connecting the bursa copulatrix to the spermatheca; it may be large as in *A. vittifrons,* or small as in other species.

ampulla (ae) - The membranous sensory projection from the inner face of the valve (see fig. 37).

basal area - That area on the dorsal surface of the primaries which extends from the base of the forewing distally to the basal line, and from the costa to the inner margin (unless a basal half-line is present).

basal half-line - A line from the base of the wing distally to the transverse anterior line; usually longitudinally bisecting the basal area.

basal line - That line defining the distal part of the basal area and the basal part of the transverse anterior area; may be geminate.

biserrate - The shape of the flagellar segments of the male antennae in some species of the genus (best viewed dorsally, fig. 28).

bulbed cornutus - Found in the male genitalia when the vesical cornutus exhibits a swollen base (as in figs. 75, 81, 107).

cell - See discal cell.

claviform - An elongate spot (found on the primaries) extending distally from the transverse anterior line into the median area.

costal band - The band which traverses the area from the base of the forewing and distally succeeding the transverse posterior line; found in the *vittifrons* group.

discal cell - The large median cell extending from the base of the forewing to and including the reniform.

discal dot - The dot or mark centrally located on the secondaries, usually faint, and sometimes absent.

divided collar - A situation where the thoracic collar is incomplete medially, non-contiguous.

exterior line - That line on the secondaries which is frequently a faint broad band paralleling the outer margin.

fringes - The terminal scales on the outer margin of both primaries and secondaries; not always useful since they may be rubbed off during the life of the moth.

geminate - "doubled", herein used to describe the form of some of the transverse lines of the primaries.

"hairs" - simple - a hair with no modification, as in fig. 31.

elongate - a simple hair, but much longer than a typical simple hair, as in fig. 32.

flattened - a hair similar in length to a simple hair but flattened, as in fig. 33.

median area - That area on the primaries that distally succeeds the transverse anterior line and preceding the transverse posterior line, and from the costa to the inner margin. This area contains the median shade, claviform, orbicular and reniform.

median shade - That shade appearing within the central part of the median area in some species.

orbicular spot - A round or oval mark appearing in the discal cell within the median area.

ordinary cross lines - The transverse lines of the primaries, including the basal, transverse anterior, transverse posterior, subterminal, and terminal lines.

preapical tooth - A modification of the valves of the male genitalia in which an abrupt projection, or "tooth" is found.

reniform mark - An oblong, or kidney shaped mark at the distal end of the discal cell on the primaries, within the median area.

"scales" - simple - a scale that is gradually tapered from base to apex, as in fig. 34.

spatulate - a scale which is narrow for basal one-half, and then broadened to apex, as in fig. 35.

elongate - a scale which is gradually tapered, but more elongate than a simple scale, as in fig. 36.

setose-ciliate - Found on the antennal flagellomeres in which some of the segments are both setose and ciliate.

spined sclerotized band - A sclerotized band or plate of the vesica in which a number of small spicules, or small spines are present.

subbasal-transverse anterior dash - The dash (below the discal cell) on the primaries which traverses the area from the base of the wing into or through the median area; found in the *mirabilis* group (see figs. 172 through 177).

subterminal area - That area on the dorsal surface of the primaries which succeeds the transverse posterior line and distally defined by the subterminal line, and from the costa to the inner margin.

subterminal line - That line on the primaries which distally succeeds the subterminal space and preceeds the terminal space; may be geminate.

terminal area - That area on the primaries distally succeeding the subterminal line and preceding the terminal line.

terminal line - Not a true line, usually represented preceding the fringes as a series of lunules, spots or discs between or on the veins.

transverse anterior area - That area distally succeeding the basal area and preceding the transverse anterior line, and from the costa to the inner margin.

transverse anterior line - That line on the primaries defining the distal part of the transverse anterior area and the basal part of the median area; it may be geminate.

transverse posterior line - That line on the dorsal surface of the primaries which distally defines the median area and basally defining the subterminal area; may be geminate.

valva (ae) - Herein, the valves are considered to be the huge arms which apparently give rise to the ampulae and preapical tooth (see fig. 37).

vesical sac - That membranous sac which everts through the terminal portion of the aedeagus; frequently possessing the salient taxonomic characters.

HISTORICAL REVIEW

The first species of *Abagrotis* J. Smith were described by Grote in 1864, at a time when there were only twelve North American species of noctuids named in North American collections! Virtually all the descriptive work to date on these noctuids has been done in the past one hundred years, and there are now approximately 2,800 described North American species. Those now assigned to *Abagrotis* have been placed in many different genera in the past, including *Noctua* Guenee, *Agrotis* Ochsenheimer, *Triphaena* Hübner, *Rhynchagrotis* J. Smith, *Lampra* Benjamin, *Cerastis* Ochsenheimer, *Amathes* Hübner, *Adelphagrotis* J. Smith, *Eurois* Hübner, *Matuta* Grote, *Lycophotia* Hübner, and *Caradrina* Ochsenheimer.

One of the earliest pioneers in the study of North American noctuids, Augustus R. Grote, is responsible for the descriptions of more *Abagrotis* than any other author and he is followed by John B. Smith. Most descriptive activity took place during a ten year period from 1875 to 1885, when ten species were described of which seven are still valid.

1864 - Two species were described and assigned to *Noctua: alternata* (Grote), and *vittifrons* (Grote).

1868 - Two species described in 1864 assigned to *Agrotis* by Grote.

1874 - *A. alternata* assigned to *Cerastis* by Grote.

- *A. alternata* once again assigned to *Agrotis* by Grote.

1876–1883 - Ten species described and assigned to *Agrotis: discoidalis* (Grote), *placida* (Grote), *variata* (Grote), *varix* (Grote), *orbis* (Grote), *apposita* (Grote), *minimalis* (Grote), *mirabilis* (Grote), *nanalis* (Grote), *bimarginalis* (Grote).

1889 - *A. variata* and *varix* (in part), were synonymized under *Amathes phyllophora* (Grote) by Butler. *A. placida* (Grote) was synonymized under *Amathes velata* (Walker) by Butler.

1890 - The species *erratica* (J. Smith) was described and assigned to *Agrotis*.

The genus *Rhynchagrotis* J. Smith was described and the following species previously under *Agrotis* were assigned to it: *vit-*

tifrons, bimarginalis, mirabilis, alternata, variata, discoidalis, placida, minimalis.

- *A. apposita* (Grote) was removed from *Agrotis* and assigned to *Adelphagrotis* J. Smith, by J. Smith.
- The genus *Abagrotis* J. Smith was described with *erratica* (J. Smith) being removed from *Agrotis* and designated type species of the new genus.

1893 - *A. trigona* (J. Smith) was described and assigned to *Rhynchagrotis.*

1894 - Two species were described: *totonaca* (Schaus) from Mexico, which was assigned to *Noctua; mantalini* (J. Smith) which was assigned to *Caradrina* Ochsenheimer.

1903 - One species was described, *ornatus* J. Smith, and assigned to *Abagrotis.*

- Hampson considered the species herein concerned and described up until 1903, to belong to the genus *Triphaena* Hübner. *A. apposita* was removed from *Adelphagrotis* and assigned to *Eurois* Hübner. *A. nanalis* was removed from *Agrotis* and assigned to *Lycophotia* Hübner.

1904 - One species was described and assigned to ***Rhynchagrotis:*** *scopeops* (Dyar).

1908 - Four species were described and assigned to ***Rhynchagrotis:*** *alcandola* (J. Smith), *duanca* (J. Smith), *nefascia* (J. Smith), *sambo* (J. Smith).

1912 - One species was described, *tristis* Barnes and McDunnough and assigned to *Abagrotis.*

1916 - Three species were described and assigned to *Rhynchagrotis: orbitis* (Strand), *alternatella* (Strand), *uniformis* (Strand).

1917 - *A. apposita* was removed from *Eurois* and assigned to *Matuta* Grote, by Barnes and McDunnough in their check list.

1921 - The genus *Lampra* Benjamin was described and the following species presently placed as *Abagrotis* were assigned to it, with two species being new: *erratica, ornata, alcandola,* (with *tristis* as synonym), *bimarginalis, vittifrons, trigona, sambo, mirabilis, discoidalis, placida* (with abberation *minimalis*), *barnesi* (Benjamin), *forbesi* (Benjamin), *duanca, nefascia, variata, scopeops, alternata.*

1925 - One species was described, *pulchrata* (Blackmore), and assigned to *Lampra.*

1927 - McDunnough removed all the species listed under the "1921" citation of *Lampra,* and included them in *Abagrotis.* He also indicated *nanalis* belonged with *Abagrotis.*

- Two species were described and assigned to *Abagrotis: turbulenta* McDunnough, and *dodi* McDunnough.

1928 - McDunnough in his "A Generic Revision of North American Agrotid Moths" made a clear distinction between *Abagrotis* and *Rhynchagrotis,* including in the former mentioned genus all the spe-

cies listed under "1921" plus *pulchrata, turbulenta* and *dodi; apposita* is also included with *Abagrotis*.

1932 - Crumb described the larvae of *A. placida, barnesi,* and *alternata.*

1938 - McDunnough, in his "checklist" listed the known *Abagrotis* to date at the time and indicated relationships within the genus.

1946 - One species was described, *denticulata* McDunnough.

1949 - One species was described, *baueri* McDunnough.

1954 - Forbes considered *placida, barnesi,* and *alternata* to belong to *Noctua,* along with many other agrotid genera in his "Lepidoptera of New York and Neighboring States."

1955 - One species was described, *crumbi* Franclemont, with a race *benjamini* Franclemont.

1956 - Crumb described the larvae of *alternata, alcandola, trigona* var. *sambo, erratica, ornata, duanca, nanalis, "forbesi", discoidalis, "nefascia", variata, barnesi, apposita* and *Abagrotis* n. sp. (= *crumbi crumbi).*

1967 - One species was described, *alampeta* Franclemont.

KEY TO *ABAGROTIS* AND RELATED GENERA

1. Primaries with reniform mark very large, quadrate in appearance, slightly constricted medially, 2 mm broad at broadest point; antennae ciliate; foretibia much longer than tarsae I; possessing well divided prothoracic and metathoracic dorsal tufts; aedeagus with juxta conical, basal portion acutely convex; uncus thin; vesical sac possessing spined sclerotized band . . . . . .*Hemigraphiphora* McDunnough.

   Primaries with reniform mark not as in preceding, never exceeding 1.5 mm at broadest point; antennae may be simple, ciliate, fasiculate, setose, setose-ciliate, or biserrate; foretibia longer than tarsal segment I; dorsal thoracic tufting sometimes present; aedeagus with juxta variable, if conical, then basal portion not convex; uncus variable; aedeagus with vesical sac armed or unarmed. 2

2. Antennae ciliate; thorax lacking dorsal tufts; male genitalia with juxta weak, conical, basal portion not convex; uncus with broadened mediolateral flanges; aedeagus with vesical sac unarmed. . . . . .*Protolampra* McDunnough (excluding *bruneicollis*)

   Antennae variable; thoracic tufting variable; male genitalia with juxta polymorphic, not conical; uncus lacking broadened mediolateral flanges of preceding genus; aedeagus with vesical sac armed. . .3

3. Antennae of male bipectinate, fasciculate, ciliate, setose-ciliate, serrate, biserrate; of female setose, ciliate, setose-ciliate; "ampulae" of valves in male genitalia non-sclerotized, weakly developed. . . . . .*Abagrotis* J. Smith

Antennae of male simple, ciliate, never fasciculate or bipectinate; or female as in *Abagrotis* "ampulae" of valves in male genitalia well developed, heavily sclerotized. . . . . .*Rhynchagrotis* J. Smith

Related genera considered to be closely related to *Abagrotis* J. Smith include: *Rhynchagrotis* J. Smith, *Hemigraphiphora* McDunnough, and *Protolampra* McDunnough. Generic differences of these genera are based almost exclusively on the male genitalia. In part, Crumb (1956) supplemented these generic descriptions of the adults with larval characteristics. Apparently Crumb considered *Protolampra, Abagrotis,* and *Rhynchagrotis* to be congeneric as far as larval classification is concerned, as he included them under a single couplet in his key to genera, and discussed them as a unit. In addition it is interesting to note that one of the closely related genera, namely *Hemigraphiphora,* is represented only by a single species.

In this paper, the closely related genera are tentatively accepted not because they are thought to represent valid taxa as presently defined, but rather because of customary usage. I do not consider *brunneicollis* (Grote) to be a typical *Protolampra,* and I am unfamiliar with *Protolampra hero* (Morrison).

ABAGROTIS SMITH.

Abagrotis J. Smith, 1890. Bull. U.S. Natl. Mus. No. 38: 9,49. Type species: *Rhynchagrotis erratica* J. Smith, by original designation.

Diagnosis – Head with antennae polymorphic, may be simple, ciliate, fasciculate, setose, setose-ciliate, or biserrate; labial palpi with terminal segment short, stubby, less than one-half the length of preceding segment; vestiture of frons and vertex largely composed of scales, but may be equally clothed with simple or flattened hairs. Thorax with collar divided or continuous, composed primarily of scales, but may be equally clothed with simple and flattened hairs; prothoracic and metathoracic dorsal tufts present or absent; disc and tegulae with vestiture same as in collar; ventrally clothed in fine elongate simple hairs; legs with mesothoracic and metathoracic tibiae spined; prothoracic tibiae longer than first tarsal segment; tarsal segments with three longitudinal rows of spines; ungues simple or bifurcate; primaries and secondaries with venation as in figures 26 and 27. Abdomen dorsally clothed in simple hairs; ventrally clothed in simple hairs and scales.

Male genitalia – Coxopodite of ninth segment simple; saccus pointed or rounded; vinculum and tegumen not greatly modified. Valves (= harpegones, or exites of ninth segment) with sacculus generally somewhat swollen; medial portion of valves broadened, or narrower than sacculus; ampullae membranous, small, possessing small setae terminally; terminal part of valve (= cucullus) generally attenuated or narrowed in comparison to basal part, may be modified; juxta polymorphic (see figures of

male genitalia). Uncus narrow, or somewhat broadened, lanceolate or truncate terminally. Aedeagus lightly to heavily sclerotized; vesical sac armed with spined-sclerotized band, cornutae, or combinations of these; cornutae may be minute, large, elongate, bulbed or polydentate.

Female genitalia – Ovipositor lobes lightly to moderately sclerotized; apically evenly rounded, or truncate; interolaterally longitudinally concave. Anterior and posterior apophysis well developed but not greatly broadened. Genital pore lightly, or heavily sclerotized; ductus bursae simple or modified, may be heavily sclerotized; bursa copulatrix variable in size, possessing signa or not; accessory lobe variable.

Distribution – Nearctic North America, except Alaska and extreme northern Canada.

KEY TO SPECIES GROUPS OF *ABAGROTIS*

1. Antennae of male serrate, biserrate-fasciculate (if ciliate, then primaries with a cream-colored costal band, as in figures 157, 158); of female setose, or setose-ciliate; primaries tan, pinkish to brown, or with light costal band; male genitalia with sacculus greatly broadened, or costal part of valves serrate (if different from this, then as in figs. 44, 47). 2

   Antennae of male simple, ciliate to setose-ciliate, fasciculate; primaries lacking cream colored costal band; male genitalia with sacculus not as in preceding, highly variable; ductus bursae of female genitalia not as heavily sclerotized as in preceding. 4
2. Antennae of male biserrate, fasciculate (as in fig. 4); of female setose, or setose-ciliate; primaries trigonate, to subtrigonate, light tan, pinkish, brownish, or blackish, may be banded, but lacking cream colored to orange costal band. 3

   Antennae of male biserrate, fasciculate, or ciliate basally, apically setose-ciliate; of female weakly setose or ciliate; thorax with divided collar; primaries not trigonate, dark brown, costally with prominent light colored band (as in figs. 157 through 161); aedeagus with vesical sac armed with single cornutus plus a sclerotized plate. . . . . .*vittifrons* group
3. Antennae of male biserrate, fasciculate; of female setose; thorax with undivided collar; primaries subtrigonate (as in figs. 147 through 156), light tan, pinkish, luteous gray to brownish, not banded; male genitalia with sacculus greatly broadened; valves apically blunt, or modified; aedeagus with large vesical spine (as in figs. 75, 76, 77); female genitalia with ductus bursae heavily sclerotized (as in figs. 116, 117, 120) bursa copulatrix possessing two signa. . . . . .*erratica* group

Antennae of male with ventral part of flagellum basally fasciculate, apically becoming setose; of female setose-ciliate; thorax with divided collar; primaries trigonate, light tan to blackish, may be banded (as in figs. 162 through 166); male genitalia with sacculus not greatly broadened (as in fig. 47); valves simple, not modified apically; aedeagus possessing a single small bulbed cornutus (as in fig. 81), plus a spined sclerotized band; female genitalia with ductus bursae lightly sclerotized (as in fig. 121); bursa copulatrix lacking signa . . . . . *trigona* group

4. Primaries with cell conspicuously black, may possess black sub-basal-transverse anterior dash (as in figs. 171 through 177 and 213 through 217); orbicular spot (when present) and reniform mark outstanding, ochreous, orangish, to olivaceous (as in figs. 167 through 177); male genitalia with vesical sac possessing a single elongate cornutus only, a cornutus plus a sclerotized plate (as in figs. 82, 83, 85, 107, 108), or possessing a small to medium sized cornutus (as in figs. 84, 86); female genitalia with ductus bursae moderately sclerotized; bursa copulatrix possessing one or two signa. 5

Primaries lacking conspicuously blackened cell (cell only blackish when primaries blackish), lacking sub-basal-transverse anterior dash; orbicular spot and reniform mark not as in preceding. 6

5. Primaries olivaceous, cell blackened, lacking sub-basal-transverse anterior dash; orbicular spot and reniform mark present, olivaceous or orangish, male genitalia with vesical sac of aedeagus possessing small or medium sized cornutus (as in figs. 107, 108); female genitalia with ductus bursae moderately sclerotized; bursa copulatrix possessing one or two signa. . . . . *discoidalis* group

Primaries tan, brownish, brick red, to blackish; orbicular (when present) and reniform mark yellowish to ochreous, large, or minute; male genitalia with aedeagus possessing a single elongate vesical cornutus or a cornutus plus a sclerotized plate (as in figs. 82 through 86). . . . . *mirabilis* group

6. Primaries with ground color brick red to brownish (pattern as in figs. 218 through 223); aedeagus of male genitalia possessing a sclerotized spined band, lacking cornuti; valves sublanceolate (as in figs. 69, 70); ampullae prominent, uncus pointed; female genitalia with bursa copulatrix possessing two signa. . . . . *apposita* group

Primaries variable; male genitalia with aedeagus possessing vesical cornutus (-i); valves may possess preapical tooth (as in figs. 53, 54), not as in preceding; uncus variable; bursa copulatrix possessing one or two signa. 7

7. Primaries brown to dark brown (collar may be lighter, contrasting with remainder of moth); greatest expanse of forewing 13 mm to 16 mm; male genitalia with valves apically attenuated (as in figs. 111, 112) plus a spined sclerotized band; uncus apically truncate; female genitalia with ductus bursae moderately sclerotized; bursa

copulatrix with one signum. . . . . .*duanca* group

Primaries variable, collar not contrasting with remainder of moth; male genitalia with valves not as in figs. 71, 72, but may possess preapical tooth; uncus variable; female genitalia with ductus bursae variable; bursa copulatrix with one or two signa. 8

8. Primaries with uniform ground color (with the exception of the terminal area), tan to dark brown, rarely brick red (pattern as in figs. 178 through 192); male genitalia with vesical band simple, sclerotized, but not spined; female genitalia with ductus bursae modified into a rectangular structure (as in figs. 130, 131), or simple (as in figs. 127, 128, 129); bursa copulatrix with one or two signa. . . . . .*nefascia* group

Primaries with ground color very rarely uniform, variable, tan, brick red, olivaceous, to dark brown, maculation almost always clearly discernable; male genitalia with a single vesical cornutus or two cornuti, if vesical sclerotized band present, then spined; female genitalia with ductus bursae never modified into rectangular structure, lightly, or heavily sclerotized (as in figs. 132 through 138, 143, 146); bursa copulatrix with one large signum, or two signa. .9

9. Primaries variable, may be tan to brick red, olivaceous, dark brown; terminal area may be silvery, contrasting with remainder of wing, or may be lighter than ground color; male genitalia with uncus not abruptly pointed, but gradually so; aedeagus with vesical sac possessing one or two cornuti; ovipositor lobes truncate (as in figs. 132 through 138); ductus bursae lightly, to heavily sclerotized; greatest expanse of forewing varies, 13 mm to 19 mm. . . . . .*alternata* group

Primaries variable, from tan to red-brown, to gray-black; terminal area often contrasting with remainder of wing; male genitalia with aedeagus possessing a single cornutus, may or may not possess additional sclerotized band (as in figs. 113, 114, 115); uncus truncate, or bluntly pointed; female genitalia with ovipositor lobes subtruncate (as in figs. 143, 146); ductus bursae moderately to heavily sclerotized; greatest expanse of forewing varies from 12 mm to 16 mm. . . . . .*placida* group