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# Methods

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the invaded area contains only a minor fraction of the species-groups, all of which are found in the area of origin (see also Extra-territorial Affinities, above).

The Dryocoetini consist of several elements, most of which are of south Asian origin. Exceptions include *Dryocoetes* (sensu strictu) and *Lymantor*, which invaded northern North America recently, and *Dendrocranulus*, which recently invaded southern North America from South America, and *Thamnurgus*, *Xylocleptes*, *Triotemnus*, and possibly *Tiarophorus* of Eurasia and Africa. The origin of these latter groups evidently predates the separation of Africa and South America sufficiently that ancestral *Dendrocranulus*, which is almost congeneric with *Xylocleptes*, could disperse into South America.

The Cryphalini appear to have subdivided early into the *Cryphalus* group of genera that radiated out from southern Asia and reached northern North America rather recently and the *Hypothenemus* group of genera that radiated out from the African-South American land mass. A large number of genera and species are involved and cannot be adequately analyzed without a thorough taxonomic study.

## METHODS

Several departures from normal procedure were followed in this study. Those relating to the examination of specimens include: (1) Early in this study it was learned that the published records of distribution and host could not be relied upon as being authentic. Consequently, virtually every record cited in this work was based upon my personal examination of voucher specimens and types. Exceptions are clearly indicated. Almost all existing primary types, including the types of genera, have been examined by me and compared directly in detail to material from the same or a nearby locality. All type comparisons are cited. Due to misidentification, numerous published distribution and host records are not cited because they do not pertain to the species mentioned in the literature. Numerous collections were visited during the course of this study to obtain data and to examine type and other material.

These included the National Museum of Natural History (Smithsonian Institution), American Museum of Natural History, Museum of Comparative Zoology, Illinois Natural History Survey Collection, Ohio State University Collection, State University of New York, Syracuse, Oregon State University, University of California at Berkeley, Colorado State University, California Academy of Sciences, the USDA Forest Service Collections (at Corvallis, Oregon; Berkeley, California; Albuquerque, New Mexico; and Fort Collins, Colorado), Canadian National Collection of Insects at Ottawa, British Museum (Natural History) at London, Museum National d'Histoire Naturelle at Paris, Universitates Zoologiska Museum at Helsinki, Zoological Institute of the USSR at Moscow, Forest Research Institute at Dehra Dun (India), and the Karl E. Schedl Collection at Lienz, Austria. Type and other material was sent by mail for my examination from numerous institutions and private individuals. Because many of these asked to remain anonymous, none are mentioned here. In all, more than 187,000 North and Central American specimens were examined during the course of the study.

(2) Measurements of the length of specimens depart from the usual method in that the head was not included for any species (other workers have included the head for Hylesininae and Scolytini). In general, measurements of the body, pronotum, and elytra were made from a position perpendicular to the dorsal (discal) surface at a position near the middle of the object being measured.

(3) All proportions were standardized; that is, the width was always divided into the length of the body, pronotum, or elytra (others have divided the shorter into the longer measurement regardless of the result).

(4) Insofar as practical, the descriptions were standardized to make comparisons easier and to avoid the illusion of describing differences when, in fact, none exist.

(5) Distributions are presented just in a brief summary that outlines the most distantly separated limits of range. This is then followed by a listing of political subdivisions from north to south beginning with Alaska (listed as though it were a separate country, due to its geographical position) to Panama.

Subdivisions of these political areas are listed alphabetically. When 10 or fewer collection records are known the full data are given; when 10 to 100 collection sites are known the towns or other localities are listed by states, estados, or provinces; when more than 100 sites are known only the names of the states, estados, or provinces are listed.

(6) The authenticity of the data depends on the accuracy of locality, host identification, and labeling by the original collector; on the correctness of labeling in the laboratory; and on the absence of remounting errors and other accidents that can happen in the curation of collections. Many errors have been published in the literature; a few of these were detected and eliminated or pointed out in this study.

All my studies were made with a stereoscopic American Optical Company microscope at magnifications of 10, 40, 80, and 160X, equipped with an ocular grid, using an American Optical Company illuminator Model 350, except at Moscow and Helsinki, where local museum equipment was used. Measurements were made in millimeters using the ocular grid, only at 10X magnification, because distortion affected measurements at higher magnifications. Measurements of proportions not requiring conversion to millimeters were made at other magnifications also.

When this study commenced it was intended that a complete listing of all known references to each species would be included. However, midway through the project financial support for this activity was withdrawn and the literature review was discontinued. It is hoped that future events will permit the publication of this important omission. Only the original validation of each nominate species and the citation of new synonymy were included.

My usage of the terms "interspace" and "interstriae" are not synonymous, as is the case with many coleopterists. Interspace here is a generic (general) term referring to a space between two objects, such as the space between any two punctures on the frons, pronotum, or elytra. Interstriae is restricted to the space on the elytra between two stria rows. Because the space referred to can exist only between *two* striae, only the plural form

of this term is valid. An interstriae is an interspace, but only one restricted usage of interspace is an interstriae. To avoid confusion in this work, an interstriae is never referred to as an interspace.

## SYSTEMATIC SECTION

### FAMILY SCOLYTIDAE

SCOLYTARI Latreille, 1807, *Genera crustaceorum et insectorum* . . . 2:273 (Type-genus: *Scolytus* Geoffroy, 1762, see China 1962).

The first noteworthy attempt to summarize the known information about the Scolytidae of North America was that of LeConte (1868), who treated 17 genera and 94 species. In a later summary he (LeConte 1876) included 26 genera and 123 species. Both reviews treated only the fauna of Canada and the United States. In his treatment of the fauna of Mexico and Central America, Blandford (1895-1906) recognized 4 tribes, 45 genera, and 270 species. Swaine (1918) treated the fauna of Canada and part of the United States, listing 4 subfamilies, 52 genera, and 226 species. In an uncritical summary of previous work, Chamberlin (1939) listed 5 subfamilies, 71 genera, and 571 species from Alaska, Canada, and the United States. Bright (1976) recognized 3 subfamilies, 45 genera, and 214 species in Alaska and Canada. The present study is the first attempt to treat the Scolytidae of all of North America, including Central America; 2 subfamilies, 20 tribes, 94 genera, and about 1430 species are listed. This represents an estimated 23 percent of the known world fauna.

Speculation as to the apparent degree of completeness of our knowledge of the scolytid fauna of this area might be of interest in view of the experience that has resulted from the preparation of this work. It is supposed that 95-97 percent of the species in Alaska, Canada, and the United States are known. Those awaiting discovery will probably be sibling (cryptic) species that can be detected only through intensive biological studies or host specific species that breed in rare or unstudied hosts. Perhaps no more than 80-85 percent of the Mexican fauna is known; most undiscovered species there should be found in nonconiferous hosts. It is doubtful that as