# Taxonomic Recognition of Variation in Opiliones

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HOW much variation should be allowed within a single species is a matter of major concern to the systematist. Such has not always been the case. Not too many years ago the main problem was simply that of naming the animals within one's sphere of interest. A new species was not a rarity, and the worker's chief task was that of defining these unknown forms. He was but little concerned with the problems of variation and evolution. Our present task is much more difficult. The modern worker has not only the problem of recognizing new species, but also that of evaluating the old and new ones and fitting them into a scheme which will show their interrelationships. To do this adequately, he must recognize the significance of the findings of evolution, genetics, and ecology for the interpretation of his problems.

Though most taxonomists are fully aware of these facts, many have failed to incorporate the knowledge into their work. While acknowledging evolution, their descriptions of numerous species seem more to verify the theory of special creation and the fixity of species!

In the study of a taxonomic group, the systematist must begin with an extension and, if possible, a verification of earlier investigations. More often than not, it soon becomes apparent that the first descriptions were made with complete disregard of possible variations, and that the apparent order is really disorder. Even though the higher categories may be correctly delineated, the generic and specific definitions may require a complete revision. As greater numbers of specimens become available for study, it is possible to determine how much variation may occur within a single breeding population. As these variations are studied, it becomes clear that each genus or even species must be investigated individually; for, while the principles of evolution, genetics, and ecological variation are universally true, their details vary within each group.

The end result of such a study is often a drastic reduction in the number of recognized genera and species. This is particularly true for animals exhibiting a high degree of variability which have been intensively investigated by early workers. This is a far different achievement from that usually attributed to systematists by scientists not engaged in taxonomic work. Too often these latter have believed that the sole aim of the systematist was that of immortalizing his name by placing it behind numerous specific names.

In most groups, the problem of the present-day taxonomist is essentially an integrative one. To do his work adequately, he must assemble large collections, study the animals individually, investigate their ecology, and then define his species in the light of our present dynamic concepts of speciation. Frequently, as pointed out above, the result is a drastic reduction, rather than multiplication of the total number of recognized species and genera. While this method of study greatly increases the difficulty of the taxonomist's task, it does make his contribution much more valuable to the general biologist. Taxonomic data then become an integral part of our advancing knowledge of biological phenomena.

To the present writers, these problems are particularly pertinent, for the opiliones have been a favored group for uncritical study.

*The Order Opiliones*

The order Opiliones is one of the numerous orders of the class Arachnida. The members of this order are quite varied in general appearance, size, and structural details. They have been divided into three suborders: the Cyphophthalmi, Laniatores, and Palpatores.

Of these, the cyphophthalmids are the least numerous. They are mite-like forms of secretive habit whose distribution and ecology are but poorly known. They are most numerous in the Mediterranean area, Africa, southeast Asia, and New Zealand. Of the New World species, two are known from the Pacific Northwest (Oregon and Washington), one from Florida, and three from South America. Cyphophthalmids are characterized by paired elevations which bear the scent glands, and by the absence of a genital operculum.

The laniatores are widely distributed throughout the subtropical and tropical regions of the world. In the neotropical region they are the most abundant representatives of this order and may be encountered in nearly all types of habitats. However, only a few species range northward into the United States. Several families have been erected within this group. In the New World, these include the families Cosmetidae, Phalangodidae, Triaenonychidae, and Gonyleptidae. The members of this suborder are characterized by the presence of a genital operculum, a heavy palpus with a well-developed claw, and the tarsi of the third and fourth legs either with double claws or with single ones bearing lateral projections.

The third suborder, the Palpatores, is abundant throughout the world. It includes the commonest species encountered in the United States and Europe. These opiliones are characterized by the presence of a genital operculum, small palpi which are without a claw or with only a small one, and the tarsi of the third and fourth legs with single claws without lateral projections.

So abundant are the long-legged palpatores in late summer that they were recognized by the European peasants as being distinct from spiders. Their scientific classification began with Linnaeus's recognition of certain common European species. Once explorations had begun in the New World, the handsome, large tropical species were eagerly collected by the early travelers and sent back to interested scientists in Europe. Many different arachnologists participated in the rapidly enlarging knowledge of this abundant group. In 1923, Roewer published *Die Weberknechte der Erde,* in which he summarized the knowledge acquired up to that time.

While the fine work done by many of these earlier workers cannot be discounted, they were all handicapped by the fact that they invariably had only a few specimens of each form, usually from only one locality. Furthermore, few had the opportunity to study the tropical species in the field and to combine their museum studies with observation of the living animal in its environment.

As a consequence of this lack of adequate material, a great number of species and genera have been erected. Both species and genera have been defined on the basis of color pattern, dorsal spination, leg spination, tarsal numbers, and various structural details. Studies in the field and analyses of large populations have indicated that all these characters are subject to considerable variation. Thus, while species and even genera may be based on these characters, each form must be studied and analyzed in much larger numbers from many populations. In almost every case where this has been done, the result has been to reduce a number of species into population variants and subspecific groups.

Field investigations have demonstrated that the majority of these opiliones are vigorous, wide-ranging forms, and it is reasonable that much variation should be encountered and that many species should be divisible into subspecific groups or races. While these observations apply to

the majority of species, there are still some small forms which have narrow ranges. These are usually found in mountain valleys or tops, caves, or other specialized and isolated habitats. It is among this group that new species are still to be found in some numbers.

Only by extensive collections and field studies can the range of a particular species be determined. As is to be expected, most of the better-known species are of the vigorous, wide-ranging type. It is among these that the variations have been uncritically used to set up numerous species and monotypic genera.

In our recent study of the opiliones of Chiapas, Mexico, and adjacent areas, we were able to demonstrate that the above conclusions did have a basis of fact. It was clearly shown that the generic and specific definitions as determined by earlier workers were based on inadequate understanding of variations. By careful study of long series of phalangodids, we reduced the number of recognized genera in Mexico and nearby areas of Central America from approximately fifty to eight. Even more astonishing were the results of such analysis with the cosmetids. Three well-defined genera adequately contained an assemblage of 64 ill-defined ones.

Some highly variable species were definitely shown to have been described numerous times under several different generic and specific names. *Cynorta clavotibialis* (Cambridge), for example, has been known under at least five specific and three generic names.

### *Observed Variations*

As mentioned above, minor variations in color pattern, palpal spination, dorsal spination, leg spination, number of tarsal segments, and other structural details have all been used to define species and even genera among the opiliones. A brief consideration of some of these characters will provide some information as to their relative importance.

*Color variation.* In some instances, intensity of color has been used to separate supposedly different species. The difference in degree of color may involve the entire body or perhaps only the appendages. Enough studies have now been made of these color variations to demonstrate conclusively that this character cannot be relied upon to define species. More nearly adequate collections have, in all cases studied, indicated that the darker individuals were melanistic phases or members of melanistic races. With sufficiently extensive collections, all degrees of intermediates are demonstrable.

*Homolophus biceps* (Thorell), for example, shows an interesting series of body colorations, varying from light to dark. This species ranges along the Rocky Mountains from southern Canada to Arizona and New Mexico. Among the northern forms, the entire animal, especially the palpi, is quite light; among the southern ones, the body and palpi are much darker. When the extremes are contrasted, the difference is striking, but specimens collected from intermediate areas show varying degrees of this melanistic tendency. With sufficient material, a cline can be clearly demonstrated.

Among the phalangodids of the species *Bishopella laciniosa* (Crosby and Bishop), specimens from Tennessee, Alabama, and Georgia are light reddish-brown in color; however, the specimens from northern Florida are very dark reddish-brown, some being nearly black. On the basis of insufficient collections, this melanistic phase was first considered a separate species (*Bishopella marianna* Goodnight and Goodnight).

*Color pattern variation.* The members of the family Cosmetidae (suborder Laniatores) ordinarily have elaborate yellow or white patterns on the dorsum. These patterns stand out vividly against the reddish background, and have frequently been used to separate species. While it is true that the general form of the pattern is a valid specific character, great variation must be allowed. Previous workers have

not recognized this, and have separated many species on the basis of such minor differences as the presence or absence of white fleckings. When sufficiently large numbers of individuals are studied, great variability is discovered.

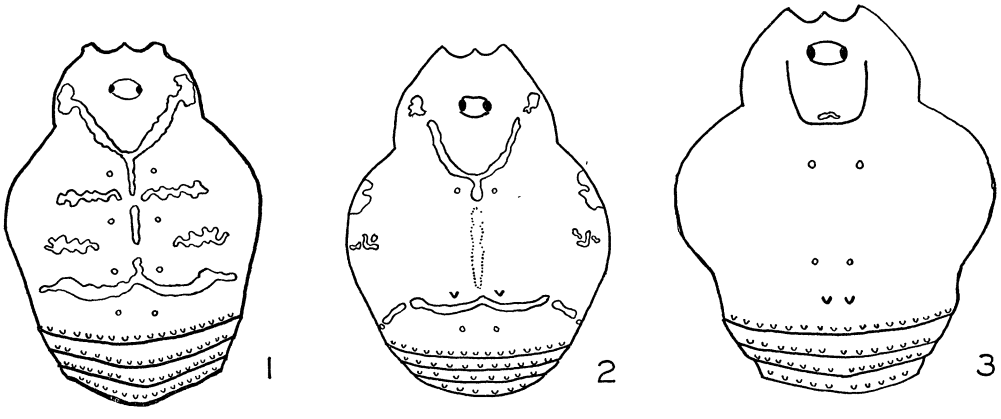
A good example of this variability is found in the cosmetid *Libitiodes ornata* (Wood) (Figs. 1–3). This species ranges from Florida into Texas, and from the Gulf States northward to southern Illinois, Indiana, and Ohio. The Florida specimens have an elaborate white color pattern, while those from Texas often lack all vestiges of white markings. These have been recognized as different species, but the error of this conclusion is shown by a study of specimens from Mississippi or other intermediate regions. Many of these animals have a color pattern vaguely similar to the Florida specimens, but very much reduced. In short, this represents only a cline with different populations and, at the most, geographical subspecies.

In the high mountains near Las Casas, Chiapas, Mexico, the most abundant cosmetid is *Cynorta casa* Goodnight and Goodnight. Most specimens have fine broken white lines which vaguely outline the first three areas of the dorsum and indicate the median line. Some specimens, however, have more white than others, and a few lack white markings entirely. This range of variation can be found in a single collection from a single area.

Many similar examples could be cited. In species with more elaborate patterns, the amount of variation may be even greater, though the general form of the pattern will hold for nearly all specimens.

*Dorsal spination.* Most members of the suborder Laniatores have a variety of combinations of spines and tubercles on the areas of the dorsum, the free tergites, and on the anal operculum. The arrangement of the armature has been used to define not only species but also genera. While again it is true that the pattern of the spines and tubercles is a valid character to use for the designation of species, much variation must be admitted. So great are the variations that only in rare instances can they be used for generic characters.

In a long series of the cosmetid *Vonones incrassatus* (Cambridge) from Chiapas, Mexico, dorsal spination was found to be exceptionally variable. One specimen from southeastern Chiapas had paired spines on both the third and fourth areas, while most others had spines only on the third. On some individuals even these spines were reduced to tubercles, and a few specimens lacked spines even on the third area. This is not a population dif-




FIGS. 1–3. Color pattern variation of dorsum among males of *Libitiodes ornata* (Wood). 1. Male from Hatchet Creek, Coosa County, Alabama. 2. Male from Hattiesburg, Mississippi. 3. Male from Austin, Texas.

ference, but only an individual variation, since all variants may be found in a single large series.

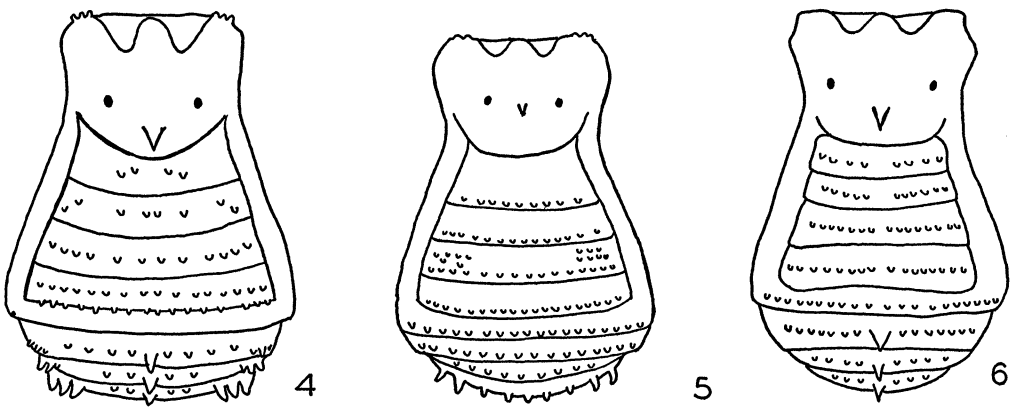
*Cynortina acanthotibialis* Goodnight and Goodnight, a member of the subfamily Phalangodinae of the Phalangodidae showed similar variation. From one collection in the mountains of southeastern Chiapas, most of the specimens had comparatively small spines on the free tergites and anal operculum, although one large male had the median spine of the anal operculum extremely elongated. By contrast, the males from a collection along the coast, which was just a few miles away, had heavy spinose tubercles on the free tergites and anal operculum.

Another phalangodid, *Stygnomma spinifera* (Packard) occurs in eastern Yucatan, Cuba, and southern Florida; the different populations may be divided into subspecies on the basis of dorsal spination (Figs. 4–6). The males of *S. spinifera spinifera* from Florida typically have median and lateral spines on each free tergite. *S. spinifera tancahensis* Goodnight and Goodnight from Quintano Roo, Mexico, lacks these spines but has small tubercles. *S. spinifera bolivari* (Goodnight and Goodnight) from Cuba has median spines on the free tergites, but lacks the lateral ones. Some overlap and variations between these geographical subspecies may be demonstrated from intermediate areas.

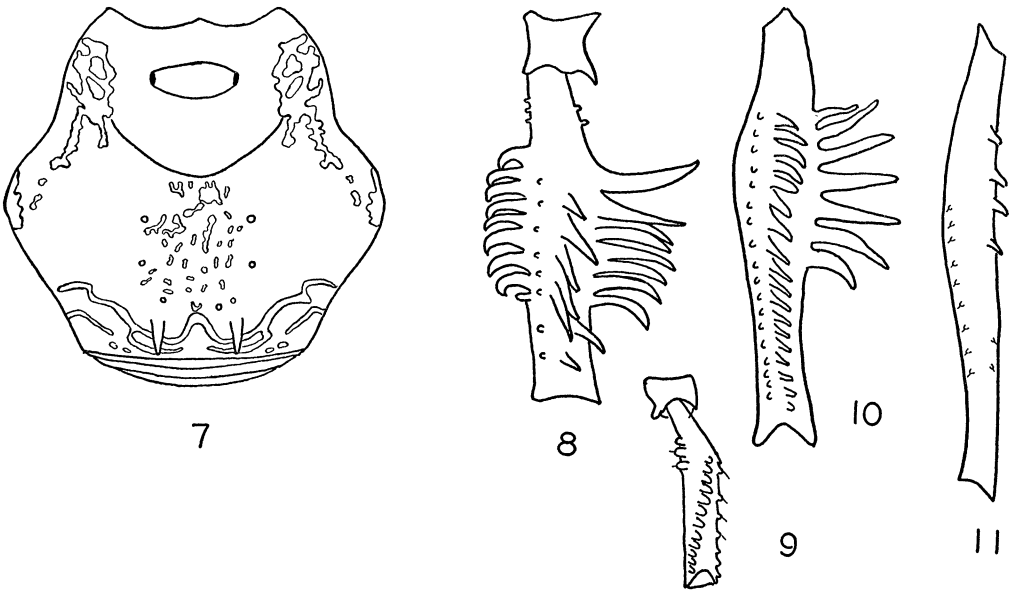
Another cosmetid, *Metacynortoides obscura* (Banks) from the West Indies presents a comparable situation. All the specimens studied had a row of tubercles across the fifth dorsal area; in some, however, the median pair of this row was enlarged into tubercles. In other individuals, the median tubercles were so slightly enlarged as not to suggest median armature.

*Leg spination.* The degree of incrassation of the third and fourth legs of the male has been used as a generic character. This character, however, is subject to great variation, and should not be used for distinguishing between genera. In those forms that have legs armed with spines, the details of these spines and their arrangement are of specific importance. Here again, much variation must be recognized.

*Cynorta subserialis* (Cambridge) (Figs. 7–11) ranges through southeastern Chiapas along the Pacific coast and up into the high mountains. Over the entire range, the dorsum as well as the general appearance of the animals is very similar; however, the leg spination is so variable that it is possible to recognize three subspecies. The fact that these populations are subspecies rather than distinct



FIGS. 4–6. Variation of dorsal spination among males of *Stygnomma spinifera* (Packard). 4. *S. spinifera spinifera* (Packard) from Royal Palm Hammock State Park, Florida. 5. *S. spinifera tancahensis* Goodnight and Goodnight from Touloum, Territory of Quintano Roo, Mexico. 6. *S. spinifera bolivari* (Goodnight and Goodnight) from Cueva del Cura, near Havana, Cuba.




FIGS. 7–11. Variation in leg spination of males of *Cynorta subserialis* (Cambridge). 7. Dorsal view of male. 8. *C. subserialis tricristatus* (Cambridge) from Cacaohuatan, Chiapas, Mexico. Ventral view of trochanter and femur of fourth leg of male. 9. *C. subserialis subserialis* (Cambridge) from Huehuetán, Chiapas, Mexico. Ventral view of trochanter and femur of fourth leg of male. 10. *C. subserialis gertschi* (Goodnight and Goodnight) from El Virgel, Chiapas, Mexico. Ventral view of femur of fourth leg of male. 11. *C. subserialis gertschi* from Tonalá, Chiapas, Mexico. Ventral view of femur of fourth leg of male.

species is clearly indicated by the presence of intermediate forms.

Great variation may also be found among animals from a single locality. In a study of a single collection of *Cynorta clavipes* (Cambridge) from Pichucalco, Chiapas, one male had extremely heavy spines, while others had no spines on the fourth femur but had a peculiar swelling on the distal portion of the fourth tibia.

*Cynorta clavotibialis* (Cambridge) had such extreme variation in its leg spination that it was described as two species by Cambridge (*Erginus clavotibialis* and *E. serratotibialis*). Studies of a single collection of animals from Jesus Carranza, Veracruz, Mexico, showed not only the spination described by Cambridge for his two species, but also intermediate forms.

Many similar situations could be cited, but these few will suffice to illustrate the problem. Leg spination is a valid character if studied sufficiently to establish the extent of possible variations. The definition of species based on minor differences of this character can only result in synonyms.

*Tarsal segments.* Among the laniatores, variation in tarsal segments has until recently been considered a valid generic character. A study of numerous specimens of many species reveals that only the first tarsus consistently has a certain number of segments. This, then, has value as a generic character. The combination of other tarsal segments is of specific value only if reasonable variation is allowed.

In some species, the number of tarsal segments is virtually constant, while in others it varies regularly. In some 200 specimens of the phalangodid *Pachylicus acutus* (Goodnight and Goodnight) which were carefully examined, only one single variation from the normal 3–7–5–5 count was encountered. The variation was minor; one specimen had eight segments in the second tarsus rather than seven. Yet this abundant species ranges throughout much of Chiapas, Tabasco, Veracruz,

Campeche, Oaxaca, Yucatan, and even into British Honduras. On the other hand, *Paramitraceras granulatus* Cambridge with a much more restricted range (the high mountains of Guatemala and Chiapas) had either three or four segments in the taxonomically important first tarsus.

The cosmetid *Vonones compressus* (Cambridge) is very abundant in Yucatan, Tabasco, Campeche, and Chiapas. The tarsal count of this species varies so widely that, with the older generic concepts, this form had been described under several different genera. In a single collection from Ocosingo, Chiapas, the tarsal count was found to be extremely variable. A few examples are as follows: 5–8–6–7, 5–10–7–7, 5–7–6–6, and 5–9–6–6. The only consistent feature was the presence of five segments in the first tarsus.

In a long series of *Vonones incrassatus* (Cambridge) from the Rio San Gregorio, Chiapas, three males had the following tarsal count: 5–9–6–7, 5–10–6–6, and 5–10–6–7. This last specimen even had six segments on one first tarsus and five on the other. Females from the same locality showed the same variation.

Among some gonyleptids, sexual variation in tarsal count has been found. According to the older generic concepts, this would place the males in one genus and the females in another.

*Eye tubercle.* The shape and armature of the eye tubercle of the phalangodids and gonyleptids are fairly constant and may be used as a specific character. Here again, variation is observable. In some species, paired spines may be present on the eye tubercle; in other individuals of the same species, these may be reduced to tubercles, and in others may be entirely lacking. There is also considerable sexual variation in this armature.

## *Summary*

Numerous observations had indicated a need for a critical evaluation of the characters at present used for the definition of opilionid genera and species. Among the characters which have been used are color pattern, dorsal spination, leg spination, number of tarsal segments, and shape of eye tubercle. This study has shown that all of these are subject to considerable variation. Since the degree of variation has not been previously recognized, many genera and species have been incorrectly defined and the number of names enormously multiplied.

Each species must be studied individually, for each has its own range of variation for each of its characters. For such a study, it is necessary to have large collections from many different localities. Only in this way can a species be properly defined. Many areas must be adequately sampled, and this sampling must be correlated with the particular environmental conditions. This emphasizes the importance of the investigator's doing as much of his own field work as possible.

When all the facts concerning variation of characters are incorporated into a revised taxonomy of the opilionids, a classification is assured which is much more in line with modern concepts of genetics and evolution. This results in a drastic reduction of the number of genera, with those that remain showing more relationships and hence being more significant. Similarly, many described species are reduced to subspecies or synonyms. Many species are also demonstrated to be more wide-ranging than had previously been believed, and many are found to be developing into distinct subspecies.

While the present study has been confined to only one order of the arachnids, perhaps it indicates a need for similar studies among other groups of animals.

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(*Concluded on p. 192*)